ABSTRACT BOOK

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL

27th November to 3rd December 2022

National Institute for Space Research – INPE

São José dos Campos, Brazil

C76 Conferência Latino-Americana de Geofísica Espacial (13.: 2022: São José dos Campos, SP)

Abstracts of the 13ª COLAGE: Conferência Latino-Americana de Geofísica Espacial, São José dos Campos, SP, 27th November to 2nd December, 2022 / edited by Clezio Marcos De Nardin, Juliano Moro. – São José dos Campos: INPE, 2022.

43p.
ISBN: 978-65-89159-03-2.

1. Space geophysics. 2. Space weather. 3. Ionospheric research. 4. Neutral atmosphere dynamics. 5. Solar physics. 6. Magnetic field. 7. Non-linear process. I. De Nardin, C. M. II. Moro, J.

CDU: 550.3(048.3)

Preface

The ALAGE precursor according to Juan Roederer was the CLARC (Consejo Latinoamericano de Radiación Cósmica), with the initial name of Curso Latinoamericano de Radiación Cósmica, in Bariloche, Argentina in January 1959 (see paper by Korff y Chasson, Physics Today, July 1959). There was also a CLARC meeting in Mexico City organized by Dr. Ruth Gall and Prof. Manuel Sandoval Vallarta in 1961.

In 1964 there was a course in Tucumán, Argentina, not under the CLARC acronym but with the same sense of activity. The next CLARC meeting that Juan remembers of was in INPE, Brazil, promoted by Prof. Giann Carlo Giambiagi and the support of CLAF, presided by him at that time. There, the words "Radiación Cósmica" were changed by "Geofísica Espacial".

The Asociación Latinoamericana de Geofísica Espacial (ALAGE) was created in 1993. It is an autonomous scientific society that attempts to motivate the development of research in Space Geophysics, taking advantage of the human resources and the cultural unity, as well as the similar economic conditions of Latin America. ALAGE seeks to complement the activities of the existing regional geophysical organisms.

One of the main activities of ALAGE is the periodical organization of meetings that are attended by most of the scientists working in the ALAGE areas of interest: the middle and upper atmosphere, the ionosphere, the magnetosphere, the interplanetary medium, the cosmic rays, the planets, satellites, minor planets and small bodies, the Sun and the Solar-terrestrial environment. These meetings are called Conferencia Latinoamericana de Geofísica Espacial (COLAGE). Up to now, we have organized twelve of them in different Latinamerican countries. The COLAGE meetings have been attended each time by nearly a hundred scientists and graduate students not only working in Latin America but also from all over the world.

The XIII COLAGE occurred at the Fernando de Mendonça Auditorium, in the Integration and Testing Laboratory - LIT, of the National Institute for Space Research – INPE, in São José dos Campos, São Paulo, Brazil, from 27th November to 2nd December 2022. The focus of the XIII COLAGE includes the following scientific fields:

- Space Weather
- Ionospheric Research
- Neutral Atmosphere Dynamics
- Solar Physics
- Earth Magnetic Field, including Ground Magnetism
- Interplanetary Magnetic Field, including Magnetospheric Physics
- Non-Linear Processes

Clezio Marcos De Nardin
President of ALAGE 2021-2022

Official Group Picture of the XIII COLAGE. at the Fernando de Mendonça Auditorium, in the Integration and Testing Laboratory - LIT, of the National Institute for Space Research – INPE, in São José dos Campos, São Paulo, Brazil.

Local Organizing Committee (LOC)

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Scientific Organizing Committee (SOC)

The LOC have invited a list of distinguished scientists to assist with the definition of the scientific fields for the XIII COLAGE, which includes but are not limited to: Space Weather (SWx); Ionospheric Research (ION); Neutral Atmosphere Dynamics (ATM); Solar Physics (SOL); Earth Magnetic Field (EMF), including Ground Magnetism; Interplanetary Magnetic Field (IMF) including Magnetospheric Physics; and Non-Linear Processes (NLP). The names, affiliation and e-mail addresses are listed below (in alphabetical order within the scientific fields).

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* Independent Contractor

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Summary of Initial COLAGE and the Complete List of Meetings

Every three years the ALAGE organizes the Latin American Conference on Space Geophysics (COLAGE), which brings together researchers and students from all Latinoamerica. The objective is the exchange of knowledge and the promotion of multinational projects. The last XII COLAGE was held online in Puerto Varas, Chile, from 22-26 of November 2021. In order to illustrate the history of the COLAGE meeting, we present in the following a brief summary of the previous meetings.

The First COLAGE was organized from the 21st to the 25th of November of 1988, in Águas de Lindóia, São Paulo, Brazil. During this meeting, representatives from the most significant research groups in Space Science from Latin America gathered for the first time to present the latest results of their research and promote scientific discussions. It was hosted by the Instituto Nacional de Pesquisas Espaciais (INPE). It was attended by 125 participants, who presented 85 contributions in the different areas of interest of the ALAGE. There were 25 invited speakers from Asia, Europe, Latin America, and USA.

The Second COLAGE was organized from the 7th to the 11th of June of 1991 in Cuernavaca, Mexico. Was sponsored by the Instituto de Geofisica of the Universidad Nacional Autónoma de Mexico (UNAM). The meeting coincided with the solar total eclipse of the 11th of June observed in the central part of Mexico. It was attended by 110 participants who presented 80 contributions. Nearly 80 works were published in a special issue of Geofísica Internacional, a journal belonging to the SCI. There were 12 invited speakers from Asia, Europe, Latin America, and USA.

The Third COLAGE was organized from the 1st to the 5th of November of 1993 in La Havana, Cuba. It was hosted by the Academia de Ciencias and the Centro de Convenciones Pedagógicas of the Ministerio de Educación de Cuba. There were 68 contributions that were published in the cuban journal "Ciencias de la Tierra y del Espacio" of international circulation. There were 9 invited speakers from Europe, Latin America, and USA. During this COLAGE, all the participants decided to create the Asociación Latinoamericana de Geofísica Espacial (ALAGE), as a way of collaboration among all Space Physics researchers working in Latin America. The document with the objectives and statutes is found in the ALAGE web page under the title RESOLUTION OF THE PARTICIPANTS IN THE III LATINAMERICAN CONFERENCE ON SPACE GEOPHYSICS.

The Fourth COLAGE was organized from the 22th to the 26th of April of 1996 in San Miguel de Tucumán, Argentina. It was sponsored by the Laboratorio de Ionosfera of the Instituto de Física de la Facultad de Ciencias y Tecnología of the Universidad Nacional de Tucumán. There were 75 contributions, also, there were 21 invited speakers from Asia, Europe, Latin America, and USA.

The Fifth COLAGE, was organized from the 3rd to the 7th of November of 1998 in San José de Costa Rica, Costa Rica. It was sponsored by the University of Costa Rica. There were 127 contributions, as well as 14 invited speakers from Europe, Latin America, and USA.

The Sixth COLAGE was organized from the 1st to the 5th of October of 2001 in Puerto Tomé, Concepción, Chile. It was sponsored by the Academia Chilena de Ciencias, Universidad del Bío-Bío, Universidad de Concepción, Universidad de Chile, and Universidad de Santiago de Chile. There were 135 contributions and 80 participants. Many of these works were published in Geofísica Internacional, which belongs to the SCI. There were two plenary conferences: Dynamic trapping of electrons in

collisionless space plasmas (C.G. Fälthammar, from Sweden) and Ulysses Mission (B. Tsurutani, USA) and two invited speakers: Present status of magnetometers and Digisonde observations in Peru (Oscar Veliz, Peru) and Upper atmosphere research at INPE (B. Clemesha, Brazil).

The meetings that followed these first meeting ruled over the same subjects are listed below:

Edition	Year	City	Country
I COLAGE	1988	Águas de Lindóia	Brazil
II COLAGE	1991	Cuernavaca	Mexico
III COLAGE	1993	La Habana	Cuba
IV COLAGE	1996	San Miguel de Tucumán	Argentina
V COLAGE	1998	San José	Costa Rica
VI COLAGE	2001	Tomé	Chile
VII COLAGE	2004	Atibaia	Brazil
VIII COLAGE	2007	Mérida	Mexico
IX COLAGE	2011	Puntarenas	Costa Rica
X COLAGE	2014	Cusco	Peru
XI COLAGE	2018	Buenos Aires	Argentina
XII COLAGE	2021	Pucón	Chile (online)

Sessions

The study of space geophysics involves the study of the effect of the sun on the interplanetary medium, the planets, and comets. It considers the solar variability and its impact on Earth, and how it affects the reliable operation of space systems and the understanding of the processes involved in Global Climate Change. Several research groups in Latin America have made significant contributions to space geophysics, complementing theoretical and experimental efforts, as well as collaborating in scientific campaigns as part of international programs. The list of scientific sessions is presented in the following sub-sessions.

1. SWx – Space Weather

MSO: Américo Gonzalez Esparsa, UNAM, Mexico
Co-SO: Sergio Dasso, UBA, Argentina
Co-SO: Clezio De Nardin, INPE, Brazil

Sun-planets interaction and space weather: This section is mainly devoted to all contributions related to the Sun-Planets interaction and Space Weather. Among the covered topics (but not limited to) are monitoring, analysis and modelling, understanding and forecasting the state of the Sun, the interplanetary and planetary environments, the radiation at ground level, the solar and non-solar driven perturbations that affect them, and forecasting and now-casting the possible impacts on biological and technological systems, among other assets. Additionally, we strongly encourage new contributions regarding instrumentation and instrument networks (especially in Latin-America) as well as the development of new methods and procedures in the field of Data Science applied to Space Weather.

Invited Speakers:

Mamoru ISHII – Japan

Joaquim E. R. Costa – Brazil

2. ION – The Ionosphere and Upper Atmosphere

MSO: Marco Milla, PUCP, Peru
Co-SO: Ana Paulino, UEPB, Brazil
Co-SO: Christiano Brum, Arecibo, EUA
Co-SO: Láysa Resende, INPE - CBJLSW, Brazil
Co-SO: Maria Graciela Molina, UNT, Argentina

The phenomena occurring in the ionosphere and upper atmosphere can affect the propagation of radio waves in these media. Thus, plasma irregularities and atmospheric perturbations at different altitudes have an impact on the performance of satellite communication, navigation, and other technological systems. In this session, we accept contributions related to the study of the mesosphere, thermosphere, and ionosphere at different latitudes in the American sector including observational (ground-based and space-borne), theoretical, simulation, and modeling studies. Contributions related to the coupling between the lower atmosphere and the ionosphere, machine learning applications, long-term trend studies, and instrumentation development or deployment are especially welcomed.

Invited Speakers:

Fabiano Rodrigues – USA

Federico Conte – Argentina

Angela Santos – Brazil

3. SOL – Solar Physics, Heliosphere, Cosmic Rays

MSO: Jean Carlo Santos, UTFPR, Brazil
Co-SO: Alessandra Pacini, CU-CIRES/NOAA-NCEI, USA

This session welcomes contributions on theoretical, numerical, and observational studies of solar-helio and cosmic rays physics. The focus of the session is to enable discussions related to new results and techniques, as well promote scientific collaborations among the community. Therefore, this session is also a place to raise awareness and concerns with data, models and current interpretation of the related physical processes. Additionally, we strongly encourage new contributions regarding the application of AI/ML and data science methods and procedures in the field of solar-helio and Cosmic Rays physics.

Invited Speakers:

SOLAR PHYSICS

Maria Cristina de Assis Rabello Soares – Brazil

Paulo José de Aguiar Simões – Brasil

HELIOSPHERE/COSMIC-RAYS

Fadil Inceoglu – USA

4. MAG – Solar Wind, Magnetosphere and Geomagnetism

MSO: Marcos Vinicius Dias Silveira, Independent Contractor, Brazil
Co-SO: Ramón Caraballo, UNAM, Mexico

The Earth's Magnetic field varies in a temporal scale of almost seven orders of magnitude, from its secular variation ranging in scales of thousands to million years up to seconds in the case of geomagnetic pulsations. The study of the Earth's magnetic field caught the interest of the scientific community since the early XVI century. The continuous observation of the secular evolution can provide clues to understand the dynamics of the Earth's dynamo process in the outer core. On the other hand, their rapid time variations constitute one of the main inputs for Space Weather studies and magnetospheric-ionospheric coupling phenomena. The interplanetary magnetic field (IMF) acts as the main external driver for magnetospheric disturbances. Important energy transfer and transport occur during the interaction of solar wind features with the magnetosphere system. Solar energy in various forms can propagate into the magnetosphere and ionosphere. This section is devoted to contributions in the area of geomagnetism and all phenomena related to the evolution and interactions between the Sun and Earth's magnetic fields.

Including magnetic dynamo physics, the temporal evolution of the internal and external magnetic field, crustal field prospecting, and modeling at all scales. Solar dynamo, Helioseismology, interplanetary magnetic field, magnetic reconnection, transient events, magnetopause and bow shock phenomena, etc. All contributions related to these research fields are welcome. Additionally, we strongly encourage new contributions in the field of geomagnetic instrumentation as well as the development of new methods and procedures in the field of Data Science disciplines applied to geomagnetism and Forecasting.

Invited Speakers:

David Sibeck – USA

Gelvam Hartmann – Brazil

5. PLA – Space Plasma and Nonlinear Processes in Space Geophysics

MSO: Juan Alejandro Valdivia, UCHILE, Chile
Co-SO: Abraham Chian, Un. Adelaide, Australia
Co-SO: Daniel Gomez, UBA, Argentina

We welcome contributed poster papers on theoretical, numerical, and observational studies of fundamental nonlinear processes in space plasmas and space geophysics. Emphasis will be given to new ideas, new formulations, new techniques for simulation and data analysis, and for revising old problems with new strategies.

Invited Speakers:

Breno Raphaldini – USA

Sponsors

Supports

XIII COLAGE PROGRAM

Begin	End	27th Nov.	28th Nov.	29th Nov.	30th Nov.	1st Dec	2nd Dec.	3th Dec.
		Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
07:30	08:30		Transportation to INPE					Field Trip
08:30	09:00		REGISTRATION & OPEN CEREMONY	Ionosphere and Upper Atmosphere	Solar Physics, Heliosphere, Cosmic Rays	Ionosphere and Upper Atmosphere	Space Weather	
09:00	09:30							
09:30	10:00		Sol. Physics, Helios., Cosmic Rays					
10:00	10:30							
10:30	11:00		Coffee Break					
11:00	11:30		Poster Sessions 1,3	Plenary & Award Mario Acuña	Poster Session 2	Plenary & Award Ruth Gall	Poster Sessions 4,5	
11:30	12:00							
12:00	12:30							
12:30	14:00		Lunch Time					
14:00	14:30		Space Weather	Solar Physics, Heliosphere, Cosmic Rays	Solar Wind, Magnetosphere and Geomagnetism	Space Weather	Award Roberto Manzano COLAGE Assembly	
14:30	15:00							
15:00	15:30	Ice Breaker & Registration (Ema Palace Hotel)						
15:30	16:00		Coffee Break					
16:00	16:30		Solar Wind, Magnetosphere and Geomagnetism	Space Plasma Physics and Nonlinear Processes in Space Geophysics	Ionosphere and Upper Atmosphere	Latinxs in Space Geophysics: Discussing Gender Bias in ALAGE/COLAGE	COLAGE Assembly COLAGE Closing	
16:30	17:00							
17:00	17:30							
17:30	18:00							
18:00	18:30		Transportation to Hotel	Transportation to Hotel	Session Break	Transportation to Hotel	Transportation to Hotel	
18:30	19:00				CONFERENCE CONCERT			
19:00	19:30							
19:30	20:00				Transportation to Dinner			
20:00	20:30							
20:30	21:00				CONFERENCE DINNER			
21:00	21:30							
21:30	22:00							
22:00	22:30							

Monday, 28th November 2022

Begin	End	Activity
07:30	08:30	**Transportation to INPE**
08:30	08:45	**REGISTRATION & OPEN CEREMONY**
08:45	09:00	
09:00	09:15	
09:15	09:30	
SESSION 3: SOLAR PHYSICS, HELIOSPHERE, AND COSMIC RAYS		
09:30	09:45	Invited: **Fadil Inceoglu**, *Unveiling The Interplay Of Convection, Drift, And Diffusion On GCR Modulation In The Inner Heliosphere Using Light Gradients Boosting Machines* (Virtual Presentation)
09:45	10:00	
10:00	10:15	**Rockenback et al.**, *What Cosmic Rays Daily Variations Can Tell Us About The Solar-Terrestrial Environment?*
10:15	10:30	**Gutierrez and Dasso**, *Galactic Cosmic Ray Shielding By ICMEs And SIR: Superposed Epoch Analysis*
10:30	10:45	**Coffee Break**
10:45	11:00	
11:00	11:15	**POSTER PRESENTATION - SESSIONS 1 & 3 -**
11:15	11:30	
11:30	11:45	
11:45	12:00	
12:00	12:15	
12:15	12:30	
12:30	14:00	**Lunch Time**
SESSION 1: SPACE WEATHER		
14:00	14:15	Invited: **Mamoru Ishii**, *The Present And Future In Operational Space Weather International Cooperation* (Virtual Presentation)
14:15	14:30	
14:30	14:45	**Collado-Vega et al.**, *The Moon To Mars Space Weather Analysis Office; Mission, Goals And Concept Of Operations*
14:45	15:00	**Molina et al.**, *Machine Learning Based Ionospheric Forecasting: Towards Operative Implementation*
15:00	15:15	**Yupanqui et al.**, *Ensemble Forecasts Of Geomagnetic Indexes*
15:15	15:30	**Valdés-Galicia et al.**, *Solar Neutron Event Recorded By The Muon Telescope In Mexico City On November 4, 2003*
15:30	15:45	**Coffee Break**
15:45	16:00	
SESSION 4: SOLAR WIND, MAGNETOSPHERE, AND GEOMAGNETISM		
16:00	16:15	Invited: **David G. Sibeck and the Storm Team**, STORM: A Magnetospheric Imaging Mission
16:15	16:30	
16:30	16:45	**Cutait et al.**, *Study Of The Solar Wind Energy Transfer To The Earth's Magnetosphere*
16:45	17:00	**López and Gonzalez**, *Magnetic Storm Intensity And The Dst Index*
17:00	17:15	**Silveira et al.**, *Continuously Tracking The Bow Shock And Magnetopause: Observations*
17:15	17:30	**Valdivia et al.**, *The Universality Of The Kinetic Regulation Of Plasma Turbulence And Thermally Induced Electromagnetic Fluctuations*
17:30	17:45	**Ferreira et al.**, *The ULF Waves' Activity In The Inner Magnetosphere Under The Influence Of Low-Beta Supercritical Interplanetary Shock Waves*
17:45	18:00	**Da Silva et al.**, *The Role Of The Inner Radiation Belt Dynamic In The Generation Of Auroral-type Sporadic E-layers Over South American Magnetic Anomaly (SAMA)*
18:00	19:00	**Transportation to Hotel**

Tuesday, 29th November 2022

Begin	End	Activity
07:30	08:30	**Transportation to INPE**
SESSION 2: IONOSPHERE AND UPPER ATMOSPHERE		
08:30	08:45	Invited: **Ângela M. Santos et al.**, *An Overview Of The Intriguing Descending Layers Over The Brazilian Sector Based On Recent Finds*
08:45	09:00	
09:00	09:15	**Brians et al.**, *Simulating The Influence Of Upward Propagating Waves On Vertical Plasma Drift Based On The Whole Atmosphere Community Climate Model-Extended*
09:15	09:30	**Aricoché et al.**, *Modeling Ionograms With Deep Neural Networks And Electron Densities Forecasting: Recent Advances And Comparisons*
09:30	09:45	**Klipp et al.**, *Modeling Ionosphere Topside Density Profile In SUPIM-DAVS*
09:45	10:00	**Rohr et al.**, *TEC Forecasting Based On Seasonal Machine Learning Model*
10:00	10:15	**Carmo et al.**, *Evaluation Of Different Methods For Calculating The ROTI Index Over The Brazilian Sector*
10:15	10:30	**Mesquita et al.**, *Observing System Simulation Experiment And The EZIE mission*
10:30	10:45	**Coffee Break**
10:45	11:00	
11:00	11:15	Plenary: **R. Mesquita et al.**, *The Electrojet Zeeman Imaging Explorer (EZIE) Mission: Science, Data Products, And Opportunities* **AWARD Mario Acuña**
11:15	11:30	
11:30	11:45	
11:45	12:00	
12:00	12:15	
12:15	12:30	
12:30	14:00	**Lunch Time**
SESSION 3: SOLAR PHYSICS, HELIOSPHERE, AND COSMIC RAYS		
14:00	14:15	Invited: **Maria C. de A. R. Soares**, *Analysis Of Sunspots And Flares Using Solar Acoustic Models Which Propagate In The Solar Interior* (Virtual Presentation)
14:15	14:30	
14:30	14:45	**Jafarzadeg et al.**, *Wave Studies In The Lower Solar Atmosphere With Solar Orbiter*
14:45	15:00	**Dasso et al.**, *Analysis Of The Magnetic Twist Inside Magnetic Clouds*
15:00	15:15	***Barroso et al.***, *Sunspot Waves At High Resolution*
15:15	15:30	***Da Silva et al.***, *Statistical Analysis of the Onsets of Solar Flares in Xray Soft*
15:30	15:45	**Coffee Break**
15:45	16:00	
SESSION 5: SPACE PLASMA PHYSICS AND NONLINEAR PROCESSES IN SPACE GEOPHYSICS		
16:00	16:15	Invited: **Breno Raphaldini**, *Rossby Waves As An Organizing Mechanism For The Magnetic Activity Of The Sun* (Virtual Presentation)
16:15	16:30	
16:30	16:45	**A. Chian**, *Observation Of Coherent Structures In Solar Supergranular Turbulence*
16:45	17:00	**Clark et al.**, *Discharges In A Non-Local System: The Waiting Time Behavior*
17:00	17:15	**Miranda et al.**, *The Role Of Coherent Structures In Intermittent Magnetic Field Turbulence*
17:15	17:30	**Eyelade et al.**, *The Response Of The Ion And Electron Kappa Distribution Functions In The Inner Magnetosphere To Solar Wind Conditions*
17:30	17:45	**Mendes et al.**, *Comparison Of High And Low Latitude Magnetic Effects Related To HILDCAAs: Cases Studied*
17:45	18:00	**P. Dmitruk**, *Test Particle Energization Of Protons And Heavy Ions In Magnetohydrodynamic Turbulent Environments In Space Physics*
18:00	19:00	**Transportation to Hotel**

Wednesday, 30th November 2022

Begin	End	Activity
07:30	08:30	**Transportation to INPE**
SESSION 3: SOLAR PHYSICS, HELIOSPHERE, AND COSMIC RAYS		
08:30	08:45	Invited: **Paulo Simões,** *Exploring The TeraHertz Sun* (Virtual Presentation)
08:45	09:00	
09:00	09:15	**Amaro et al.**, *Study On The Role Of The Gyroresonance Emission Mechanism In The Brightness Intensification At 17 GHz Of Solar Active Regions*
09:15	09:30	**Santos and Castanheira**, *Investigation of the motion of sunspots associated with the active region NOAA 12673 during its passage close to the solar disk center*
09:30	09:45	**Oseni et al.**, *Observation Of Magnetic Flux Ropes In The Interplanetary Medium*
09:45	10:00	**Jeunon et al.**, *Investigating The Effects Of Erosion In Magnetic Flux Ropes*
10:00	10:15	**Silva et al.**, *A Genetic Algorithm To Model Solar Radio Active Regions From 3D Magnetic Field Extrapolations*
10:15	10:30	**Justino et al.**, *Sunspots Detection And Analysis Using Artificial Intelligence And Big Data*
10:30	10:45	**Coffee Break**
10:45	11:00	
11:00	11:15	**POSTER PRESENTATION - SESSION 2 -**
11:15	11:30	
11:30	11:45	
11:45	12:00	
12:00	12:15	
12:15	12:30	
12:30	14:00	**Lunch Time**
SESSION 4: SOLAR WIND, MAGNETOSPHERE, AND GEOMAGNETISM		
14:00	14:15	Invited: **Gelvam A. Hartmann**, *Geomagnetic Field Fluctuations In South America For The Last Millennia* (Virtual Presentation)
14:15	14:30	
14:30	14:45	**Espinosa et al.**, *GICs Modeling In The 525 kV Power Network Of North-Northeast Brazil Using A 3-D Earth Resistivity Model*
14:45	15:00	**Jácome et al.,** *Jovian Decametric Radio Emissions Induced By Europa*
15:00	15:15	**Echer et al.**, *ULF Waves At Venus: Venus Express Observations*
15:15	15:30	**Franco et al.**, *A Statistical Study Of Wave Penetration Into The Martian Ionopause*
15:30	15:45	**Coffee Break**
15:45	16:00	
SESSION 2: IONOSPHERE AND UPPER ATMOSPHERE		
16:00	16:15	Invited: **Fabiano Rodrigues et al.**, *On Ionospheric Scintillation And Total Electron Content Observations Made By Low-Cost GNSS-Based Radio Sensors*
16:15	16:30	
16:30	16:45	**Scipion et al.**, *New Jicamarca Unattended Low Investigations Of The Atmosphere (JULIA) Using The New Mid-Power Solid-State Transmitters*
16:45	17:00	**Adebayo and Pimenta**, *Airglow Imaging Observations Of Some Evolutionary Aspects Of Plasma Blobs During Solar Minimum Over The Tropical Region*
17:00	17:15	**Barros et al.**, *Effects Of Transequatorial Thermospheric Meridional Winds On The Equatorial Plasma Bubbles Development*
17:15	17:30	**Das and Paul**, *Occurrences Of Summer Night-time E-region FAIs Observed By CU-Radar*
17:30	17:45	**Milla et al.**, *Incoherent Scatter Spectral Measurements With AMISR-14 At Jicamarca*
17:45	18:00	**Tunde et al.**, *Long-Term Variation of Gravity Wave Parameters Over 60° and 30°W - 90°W Derived From the TIMED/SABER Measurements*
18:00	19:00	**Transportation to Conference Dinner**
19:00	22:00	**Conference Dinner – Steakhouse "Boigalê"**

Thursday, 1st December 2022

Begin	End	Activity
07:30	08:30	**Transportation to INPE**
SESSION 2: IONOSPHERE AND UPPER ATMOSPHERE		
08:30	08:45	Invited: **Frederico Conte et al.**, *MLT Studies Along The Andes Mountain Range Using Multistatic Meteor Radar Configurations* (Virtual Presentation)
08:45	09:00	
09:00	09:15	**Andrioli et al.**, *Fast Metallic Neutral Sporadic Layer A Case Study On 27/08/2019*
09:15	09:30	**Suclupe et al.**, *Climatology Of Tides And Quasi-Two-Days PWs In The MLT Region Over The Central Coast Of Peru (11.95°S, 76.87°W) And Comparison With WACCM-X Model*
09:30	09:45	**Wrasse et al.**, *Generation And Propagation Of Quasi-Monochromatic Gravity Waves Observed Over Southern Brazil From April 2017 To April 2022*
09:45	10:00	**Afolabi et al.**, *Study And Modelling Of The Brazilian Low Latitude Ionosphere Response To The Occurrence Of 22-23 2015 Geomagnetic Storm*
10:00	10:15	**Sergeeva et al.**, *Observation Of Solar Flare Effects Over Mexico*
10:15	10:30	**Takahashi et al.**, *Tonga Volcanic Eruption: What We Observed In The Ionosphere Over The South American Continent* (presented by Cristiano M. Wrasse)
10:30	10:45	**Coffee Break**
10:45	11:00	
11:00	11:15	Plenary: **Madhulika Guhathakurta**, *Catalyzing Academic And Private Partnerships In The Use Of Big Data For Space Exploration And Human Benefit* **AWARD Ruth Gall**
11:15	11:30	
11:30	11:45	
11:45	12:00	
12:00	12:15	
12:15	12:30	
12:30	14:00	**Lunch Time**
SESSION 1: SPACE WEATHER		
14:00	14:15	Invited: **Joaquim E. R. Costa and Embrace Team**, *The Research And Service Plans Of EMBRACE Program*
14:15	14:30	
14:30	14:45	**Santos et al.**, *Space Weather R202R Activities Developed By LAMP*
14:45	15:00	**Klipp et al.**, *Evaluation Of Ionosphere Simulation Results Using EUVAC And SOLAR2000*
15:00	15:15	**Gonzalez-Esparza et al.**, *Monitoring Space Weather In Mexico During The Declining Phase And Minimum Of Solar Cycle 24*
15:15	15:30	**Hsieh and Sibeck**, *Ground-Based All-Sky Auroral Imaging For Space Weather Research*
15:30	15:45	**Coffee Break**
15:45	16:00	
16:00	16:15	Panel: *Latinxs in Space Geophysics: Discussing Gender Bias in ALAGE/COLAGE* **Chair:** Laysa Cristina Araújo Resende **Panelist #1:** Alessandra Abe Pacini **Panelist #2:** Vânia Fátima Andrioli **Panelist #3:** Maria Graciela Molina
16:15	16:30	
16:30	16:45	
16:45	17:00	
17:00	17:15	
17:15	17:30	
17:30	17:45	
17:45	18:00	
18:00	19:00	**Transportation to Hotel**

Friday, 2nd December 2022

Begin	End	Activity
07:30	08:30	**Transportation to INPE**
SESSION 1: SPACE WEATHER		
08:30	08:45	**A. Dal Lago**, *ICME High Intensity Sheath Magnetic Fields And Their Geoeffectiveness*
08:45	09:00	**Romero-Corona et al.**, *A Semi-Empirical Approach To The Dynamic Coupling Of CMEs And Solar Wind*
09:00	09:15	**Nascimento et al.**, *Convolutional Neural Network Applied In The Identification And Classification Of Shock Waves*
09:15	09:30	**C. Bertucci,** *Plasma Boundaries In Induced Magnetospheres*
09:30	09:45	**Stepanova et al.**, *The Influence Of The Solar Wind On The Inner Magnetosphere Plasma Pressure And The Geomagnetic Field Configuration*
09:45	10:00	**Bolzan et al.**, *Multifractality Observed In HILDCAAS Events*
10:00	10:15	**Pinto et al.**, *Forecasting Ground Magnetic Perturbations Using Deep Learning And Near Real-Time Data*
10:15	10:30	**Stalder et al.**, *Type III Solar Radio Bursts Observations By Paraguay CALLISTO Spectrometer: First Results*
10:30	10:45	**Coffee Break**
10:45	11:00	
11:00	11:15	**POSTER PRESENTATION - SESSIONS 4 & 5 -**
11:15	11:30	
11:30	11:45	
11:45	12:00	
12:00	12:15	
12:15	12:30	
12:30	14:00	**Lunch Time**
14:00	14:15	**COLAGE Assembly**
14:15	14:30	
14:30	14:45	
14:45	15:00	
15:00	15:15	
15:15	15:30	
15:30	15:45	**Coffee Break**
15:45	16:00	
16:00	16:15	**AWARD Roberto Manzano**
16:15	16:30	
16:30	16:45	
16:45	17:00	**COLAGE Assembly**
17:00	17:15	
17:15	17:30	**COLAGE Closing**
17:30	17:45	
17:45	18:00	
18:00	19:00	**Transportation to Hotel**

Poster List

SESSION 1: SPACE WEATHER ---------- **MSO:** Americo Gonzalez Esparsa, UNAM, Mexico **Co-SO:** Sergio Dasso, UBA, Argentina **Co-SO:** Clezio Marcos De Nardin, INPE, Brazil		
Serial Number	**Authors**	**Title**
S01_N01	P. K. Purohit and R. Ahmad	Investigation Of Annual And Semi-Annual Variation Of F2 Layer In The Two Hemispheres And Its Comparison With IRI Model
S01_N03	C. M. Denardini; G. A. S. Picanço; C. S. Carmo; S. S. Chen; J. Moro; L. C. A. Resende; R. P. Silva; P. F. Barbosa Neto; P. A. B. Nogueira; E. Romero-Hernández; J. F. B. Campelo; G. Stefani	On The Studies Of Magnetic Storms And Equatorial Plasma Bubbles Over The American Sector Based On Ionospheric And Magnetic Indices
S01_N05 WITHDRAWN	D. Perez-Bello; M.P. Natali; A. Meza; L.P.O. Mendoza	Multi-Stec VTEC Forecasting With Neural Networks Over South America
S01_N06 WITHDRAWN	D. Perez-Bello; M. P. Natali; A. Meza; L. P. O. Mendoza; J. M. Castaño	Applying Geostatistics And Depp Learning In Space Weather
S01_N07	V. H. De La Luz and S. Tinoco	The Interdisciplinary Laboratory Of Scientific Computing (LINCC)
S01_N08	E. L. B. C. Barros; M. J. A. Bolzan; P. F. Gomes	Fourier Analysis Of The One Decade Of H-Component Geomagnetic Field Observed At Jatai, Brazil
S01_N10	J. C. Mejia-Ambriz; E. Aguilar-Rodríguez; J. A. Gonzalez-Esparza; P.Villanueva Hernández; E. Andrade Mascote; G. Baron-Martínez; A. R. Espinosa Jiménez	Quasi Real-Time Remote Sensing Of Solar Wind Using The New Digital Back-End Of MEXART
S01_N11	R. L. C. Madeira; J. R. De Souza; C. R. De Aguiar; A. M. Dos Santos	TEC Map Generation Over The South American Sector Using Combined GNSS And Ionosonde Data
S01_N12	G. A. Mansilla and M. M. Zossi	Sub-Auroral Ionospheric Effects Of The April 14, 2022 Magnetic Storm
S01_N13	T. O. Osanyin; C. M. N. Candido; F. Becker-Guedes; Y. Migoya-Orue; S. F. Chingarandi	Study Of Ionospheric Response To Geomagnetic Disturbances Using TEC Regional Maps And The NeQuick 2 Model
S01_N14	M. M. Zossi and G. A. Mansilla	Changes On The Ozone With The Entry Of Energetic Protons In South Atlantic Anomaly Zone During Severe Geomagnetic Storms. Influence Of The QBO Sign
S01_N15	J. M. Castaño and A. M. Meza	Analysis Of Ionospheric Disturbances Produced By Solar Wind Variations Using Different Ionospheric Parameters

S01_N16	E. Huipe Domratcheva and V. De La Luz Rodriguez	Estimating D Region Absorption Radio Blackouts In The HF Range Over Mexico
S01_N17	G. González-González and V. M. Velasco-Herrera	Influence Of Space Weather Phenomena Periodicity (~1.7 Years) On Epilepsy Incidence
S01_N21	N. Romanova; A. M. Inostroza; M. Stepanova; V. Pinto; E. E. Antonova	Behavior Of The Energetic Electron Fluxes And The Auroral Oval During 1 June 2013 Geomagnetic Storm
S01_N22 WITHDRAWN	E. F. M. T. São Sabbas; Y. Y. Yair; J. M. Velarde; C. L. T. F. Oliveira; R. G. Negri; D.M. Uba; M. S. Custódio	2022 TLE Campaign With The Ground-Based South American Network LEONA And The Spaceborne Israeli Mission ILAN-ES
S01_N23	Oliveira, C. L. T. F; São Sabbas, E. F. M. T.; Custodio, M. S.	Life Cycle Of TLE-Producing Storms Detected By The LEONA Collaborative Network
S01_N24	J. R. Souza; R. L. Sá; R. L. C. Madeira; I. S. Batista; J. Riccobono; M. A. Migliozzi; S. Kapali; B. Kerr; P. Dandenault; J. Noto; A. M. Santos	Thermospheric Neutral Winds Impact On The Ionosphere Over Cachoeira Paulista
S01_N25	R. Gutierrez-Zalapa; M. Rodriguez-Martinez; E. Aguilar-Rodriguez; J. Estevez-Delgado; J. A. Gonzalez-Esparza	Study Of The Dynamics Of An Asteroid When It Travels Through Earth's Atmosphere
S01_N26	J. Newton Bosch; L. X. González; S. Perea; J. F. Valdés; F. Monterde; Y. Muraki; Y. Matsubara; T. Sako; K. Watanabe; O. Musalem; A. Hurtado	Signatures Of Space Weather Events During Solar Cycle 24's Descending Phase On The Solar Neutron Telescope At Sierra Negra, Mexico
S01_N27 WITHDRAWN	A. M. Vasquez; D. G. Lloveras; F.A. Nuevo; R.A. Frazin; N. Sachdeva; W.B. Manchester; B. Van Der Holst; P. Lamy; H. Gilardy	EUV And Visible Light Tomography As Validation Tool For 3D-MHD Coronal Models
S01_N28	Molina, M. G.; Bravo, M. A.; Ovalle, E.; J. Lopez; B. Urra; M. Nacud; J. Namour; S. Tarulli; M. Martinez-Ledesma; L. Pascuale	The Argentinian-Chilean Validated Ionospheric Database (ACVID)
S01_N30	A. R. Piassi; C. M. Denardini; S. S. Chen	Preliminary Analysis Of Sudden Commencement Morphology Of 4 November 2021 Geomagnetic Storm In The SAMA Region
S01_N32 WITHDRAWN	R. Caraballo; J. A. González-Esparza; C. Ramírez Pacheco; P. Corona-Romero	New GIC Measurements And Estimates In The Mexican Power Grid
S01_N35	J. A. González-Esparza	Cataloging Space Weather Hazards. Defining Extreme Events
S01_N36	J. A. Gonzalez-Esparza; E. Aguilar-Rodriguez; M. A. Sergeeva; P. Corona-Romero; L.X. Gonzalez; J.C. Mejia-Ambriz; J.J. González-Aviles; E. Romero-Hernández; E. Perez-Tijerina; E. Sánchez-Garcia; R. Caraballo; M. Rodriguez; O. Chang-Martínez; J.C. Villagrán-Orihuela; V. Ontiveros-Hernandez	Monitoring Space Weather In Mexico During The Declining Phase And Minimum Of Solar Cycle 24
S01_N39	A. M. Inostroza; M. Stepanova; M. Martínez-Ledesma; N. Higashio; S.	Radiation Belt's Adiabatic Acceleration Of Electrons During Geomagnetic Storms

	Kasahara; T. Mitani; V. Pinto; E. E. Antonova	
S01_N42 WITHDRAWN	D. R. De La Torre; S. A. Sosa; S. E. Romero; S. R. Silva; S. Y. Vela; J. A. Marin; N. A. Rojas; C. J. Solano	Nanosatellite Proposal For Monitoring The South Atlantic Magnetic Anomaly And Plasmaspheric Hiss In Interplanetary Shocks
S01_N43 WITHDRAWN	D. R. de La Torre; S. A. Sosa; S. E. Romero; S. R. Silva; S. Y. Vela; J. A. Marin; N. A. Rojas; C. J. Solano	Computational Tools for Modeling the Chasqui A and Chasqui B Nanosatellite Missions in Space Weather Study
S01_N45	H. X. Alvarez-Bolom	Propagation Of Interplanetary Coronal Mass Ejections And Their Interaction With The Solar Wind
S01_N46	M. O. Fakomiti; O. E. Abe; W. N. Igboama; O. O. Akinola; O. Ogunmodiumu; Y. O. Migoya-Orué	Statistical Analysis Of The Occurrences Rate Of Geomagnetic Storms During Solar Cycles 20-24
S01_N47	J. S. Hincapie Tarquino; B. Calvo Mozo; J. C. Martínez Oliveiros; J. L. Araque Quijano	Development Of A Multi-Element Phased Array Solar Radio Interferometer At 1.42 GHz
S01_N48 WITHDRAWN	T. Young; V. Ledvina; E. MacDonald; L. Brandt; M. McCormack; S. Collins; W. Barkhouse	The North Dakota Dual Aurora Camera Version 2.0 (NoDDAC2.0), A Platform For Citizen Science And A Testbed For Implementing Best Practices In Open Data And Collaboration
S01_N49	P. C. Pesántez-Cabrera	The Strongest Solar Storms In Recorded History And Their Effects
S01_N52	C. I. Castellanos-Velazco; P. Corona-Romero; J. A. Gonzáles-Esparza; A. L. Caccavari-Garza; et al., M. Seergeva	Regional Effects Of Strong Geomagnetic Storms During The Solar Cycle 23 And 24

SESSION 2: IONOSPHERE AND UPPER ATMOSPHERE

MSO: Marco Milla, PUCP, Peru
Co-SO: Ana Paulino, UEPB, Brazil
Co-SO: Christiano Brum, Arecibo, USA
Co-SO: Láysa Cristina Araújo Resende, INPE - CBJLSW, Brazil
Co-SO: Maria Graciela Molina, UNT, Argentina

Serial Number	Authors	Title
S02_N01	R. De Jesus; I. S. Batista; C. M. Denardin; E. A. Kherani; A. M. Santos; C. A. O. B. Figueiredo; K. Venkatesh; L. C. A. Resende; A. J. De Abreu; D. Barros; O. F. Jonah; P. R. Fagundes; S. S. Chen	Ionospheric Response To The Patrick's 2013 And 2015 Events Over The South American Sector
S02_N02	G. A. S. Picanço; C. M. Denardini; A. M. Meza; L. P. O. Mendoza; M. P. Natali; P. A. B. Nogueira; L. C. A. Resende; C. S. Carmo; S. S. Chen	Assessment Of The DIX Responses To Equatorial Plasma Bubbles Using Multi-GNSS Data Over South America
S02_N03	J. Moro; J. Xu; C. M. Denardini; G. Stefani; L. C. A. Resende; R. P. Silva; L. A. Da Silva; C. S. Carmo; S. S. Chen; G. A. S. Picanço; J. A. Carrasco; H. Li; Z. Liu; C. Wang; N. J. Schuch	Occurrences Of Es_b Layers Over Santa Maria, A Transition Station From Low To Middle Latitude In Brazil
S02_N04	A. J. De Abreu; E. Correia; R. De Jesus; K. Venkatesh; E. P. Macho; M. Roberto; P. R. Fagundes	Statistical Response Of The High- And Mid-Latitudes Ionosphere In The Southern Hemisphere During 70 Geomagnetic Storms Occurred In The Period Of Two Decades
S02_N07 WITHDRAWN	M. Merino; A. Palacios; B. F. De Haro; A. G. Elias; E. Rojas	Long-term Trends At The Geomagnetic Equator Over Jicamarca
S02_N08	Y. S. Carvalho; R. C. De Araújo; Â. M. Dos Santos; I. S. Batista; Y. M. Briglia	Study Of Intermediate Descending Layers Over Boa Vista - Roraima During Periods Of Maximum And Minimum Solar Activity
S02_N09	F. S. Chingarandi; C. M. N. Candido; F. Becker-Guedes; O. F. Jonah; O. O. Taiwo; S. P. Moraes-Santos	Influence Of A Moderate Geomagnetic Storm On The Post-Sunset Ionosphere Over South America
S02_N10	M. V. M. Cabrera; W. J. Marais; E. W. Eloranta; I. I. Razenkov; J. P. Garcia; R. E. Holz	Quantifying Stratospheric Aerosol Optical Properties Over South-East Asia Via High Spectral Resolution Lidar Measurements
S02_N12	R. P. Silva; C. M. Denardini; M. S. Marques; L. C. A. Resende; J. Moro; G. A. A.	HILDCAA Disturbances Effects In The Total Electron Content

	Picanço; G. L. Borba; M. A. F. Santos	
S02_N13	A. M. Casanova and J. S. G. Rodríguez	Advances In The Repair And Maintenance Of The Habana Station, International Code CD923
S02_N16 WITHDRAWN	D. E. Scipion; A. C. Castro; K. Kuyeng	Estimation Of MLT Winds From Non-Specular Meteors: Operational Mode At Jicamarca
S02_N17 WITHDRAWN	K. Luyo; M. Milla; E. Rojas	Estimating Electron Densities In The Valley Region: 20 Years Of 150 km JULIA Data
S02_N18	Da Silva, K.S.; Franco, A. M. De S.; Bolzan, M. J. A.	Multifractality Observed In The Virtual Hight Layer Ionosphere Over Brazil
S02_N19	Y. M. Briglia; Y. S. Carvalho; R. C. De Araújo; Â. M. Dos Santos; I. S. Batista	Occurrence Of Spread F Over Boa Vista Roraima - BR
S02_N20	J. F. B. Campelo; C. M. Denardini; R. P. Silva; L. C. A. Resende; J. Moro; S. S. Chen; G. A. S. Picanço; P. F. Barbosa Neto	TEC Responses To Geomagnetic Storm And HILDCAA Disturbances During The Descending Phase Of 24th Solar Cycle Over The Brazilian Region
S02_N23	E. Romero-Hernandez; F. Salinas-Samaniego; A. Salas-Navarro; J. Gamezcastro; C. M. Wrasse; G. A. S. Picanço; L.C.A. Resende; P. F. Barbosa Neto; S. S. Chen; R. P. Silva; C. S. Carmo; J. C. Mejia-Ambriz; J. Moro; C.M. Denardini; E. Aguilar-Rodriguez; E. Pérez-Tijerina; J. A. González-Esparza	Analysis Of Plasma Irregularities In The Ionosphere Using The Instruments Of LANCE In Mexico
S02_N24	S. A. Sanchez; E. A. Kherani; E. Astafyeva; E. R. De Paula	Rapid Development Of Co-Seismic TEC Ionospheric Disturbances During Earthquakes In South America
S02_N25	S. L. Palacios and M. A. Milla	Automatic Classification Of Range-Time-Intensity Maps Of Equatorial Spread-F
S02_N26	P. H. Gomes; J. V. Bageston; J. Moro	Nighttime Sky Conditions For Observation Of Airglow And Types Of Atmospheric Gravity Waves Observed At The Southern Space Observatory Between 2017 And 2020
S02_N27	M. A. L. Dias; P. R. Fagundes; K. Venkatesh; B. A. G. Ribeiro; V. G. Pillat	Variations Of Equatorial Ionization Anomaly (EIA) Over The Brazilian Sector Using GPS-TEC Network And IRI Model
S02_N30	A. R. Paulino; W. B. Lima; I. Paulino; P. P. Batista; R. A. Buriti	Determination Of The Lunar Semidiurnal Tide In The Concentration Of Meteors
S02_N31	I. Paulino; E. B. Carvalho; C. M. Wrasse	Statistical Study On Mesospheric Fronts Over The Brazilian Equatorial Region
S02_N32	B. H. La Rosa; E. Rojas; M. Milla	Revisiting Langevin Modeling For ISR Spectra: Final Results For A Higher-Order Stochastic Algorithm Approach
S02_N34	L. C. A. Resende; Y. Zhu; C. Arras; C. Denardini; J. Moro; S. S. Chen; R. A. J. Chagas;	Analysis Of The Sporadic-E Layer Behavior In Different Latitude Stations During The Space Weather Events

	L. A. Da Silva; V. F. Andrioli; J. P. Marchezi; A. J. Carrasco; C. Wang; H. Li; Z. Liu	
S02_N35	Honda. R. H.; Takahashi, H.; Figueiredo, C. A. O. B.; Barros, D.; Wrasse, C. M.; Giongo, G. A.; Vital, L. F. R.; Resende, L. C. A.; Nyassor, P. K.; Ayorind, T. T.; Carmo, C. S.; Padua, M. B.	Atmospheric Lamb Wave Propagation Over South America Generated By Tonga Volcanic Eruption
S02_N38	C. A. Castillo Rivera; M. A. Bravo; E. Ovalle	Traveling Ionospheric Disturbances In The Near And Far Field Induced By Earthquakes/Tsunamis
S02_N39	B. Urra; M. Bravo; E. Ovalle; M. Martinez-Ledesma; J. Marín; L. Tamblay; P. Veja-Jorquera; P. R. Muñoz; et al.	Characterization Of Ionospheric Disturbed Currents During Two Geomagnetic Storms In South America
S02_N40	C. U. Villalobos; M. A. Bravo; C. A. Castillo Rivera; A. J. Foppiano; G. Concha; E. M. Ovalle	Seasonal Evolution Of The Ionospheric Summer Evening And Weddell Anomalies: Antarctic Peninsula Area
S02_N41 WITHDRAWN	M. A. Bravo; J. R. De Souza; M. Martinez-Ledesma	SUPIM-INPE Prediction Of Ionospheric Impacts By The Annular Solar Eclipse On October 14, 2023
S02_N45 WITHDRAWN	G. De L. González	Storm-Time Variability Of Ionospheric Irregularities Over South America
S02_N48	Vieira F.; Fagundes P. R.; Pillat V. G.; Agyei-Yeboah E.; Arcanjo M. O.	Ionospheric Disturbances Over The American And African Sectors Due To Two Major Sudden Stratospheric Warming Under Low Solar Activity Conditions
S02_N51	J. J. D'aquino; V. De La Luz; M. Chavez-Dagostino; J. A. Gonzales-Esparza	AzTEC: TEC Maps Near To Real-Time On México
S02_N52	C. Mauricio; J. Suclupe; M. Milla; K. Kuyeng; J. L. Chau; R. Rodríguez; D. Scipión	Predictability Of The Winds In The MLT Region Over The Central Coast Of Peru Using Machine Learning Algorithms - Preliminary Results
S02_N56	L. M. Lima; A. R. Paulino; L. R. de Araújo; P. P. Batista	Tropical Mesospheric Dynamics Response To Antarctic Stratospheric Warming Of 2019
S02_N57	G. A. Giongo; J. V. Bageston; C. M. Wrasse; C. A. O. B. Figueiredo; H. Kam; Y. H. Kim	A Case Study Of Gravity Waves Observed By An All-Sky Imager Over The Antarctic Peninsula
S02_N58	C. S. Yamashita; M. P. S. Echer; E. Echer; C. G. M. Brum	Long-Term Trends Of F2 Peak's Parameters For The South American Sector Equatorial-And-Low-Latitudes
S02_N59	R. L. Sa; J. R. Souza; I. S. Batista	The Ionospheric Vertical Drift And Its Effects On TEC Variability Over The South American Sector
S02_N60	P. Terra; C. G. M. Brum; F. Vargas	A Qualitative Analysis Of MSTIDs Observed Over Puerto Rico During The Minimum Solar Activity Using Multi-Instruments
S02_N61	Vital, L. F. R.; Barros, D. S.; Takahashi, H.; Wrasse, C. M.; Figueiredo, C. A. O. B.	Ionospheric F-Layer Pre-Reversal Enhancement And The Occurrence Of Equatorial Plasma Bubbles
S02_N62	P. A. Fontes; M. T. A. H. Muella; L. C. A. Resende	Es Layers Modulated By The Terdiurnal Tide In The Brazilian Sector

S02_N63 WITHDRAWN	D. R. De La Torre; E. Rojas	Ionosphere Plasma Density Estimation By Ray Tracing Optimization
S02_N64 WITHDRAWN	E. E. Pacheco; J. P. Velasquez; G. Fajardo; L. Condori; R. Flores; K. Kuyeng; D. Scipion; M. Milla; R. Rojas; C. De La Jara; J. Suclupe; P. Condor; I. Manay	Ionospheric Effects Of The Tonga Volcanic Eruption Over The Peruvian Sector
S02_N65	L. Otiniano; A. Arriola; J. Vega; J. Samanes; M. Milla	Development Of A VLF Receiver Based On RedPitaya Board For Space Weather Studies
S02_N66	O. R. Idolor; A. O. Akala; O. S. Bolaji	African And American Equatorial Ionization Anomaly (EIA) Responses To 2013 SSW Event
S02_N67	J. Sánchez. G.; S. Vargas. D.; C. Triana.; R. Joya.; D. Bonaccini. C.	Implementation Of A Portable Site-Testing Instrument For Solar Observations
S02_N68	Araújo, P. S and Bolzan, M. J. A.	Air Emission Variances Observed In Meteor Spectrometry In Relation To Metallic Density
S02_N69	Araújo, P. S; Da Silva, K. S.; Honório, D. C.; Da Silva, D. M.; Martins, A.; Bolzan, M. J. A.	Results From The Launch Of An Atmospheric Prob Developed In Brazil
S02_N70	A. G. F. M. Paines; J. V. Bageston; et al.	Review Of Upper Atmosphere Dynamics And Airglow Observations At Southern Space Observatory - SSO (29.4º S, 53.8º W) In São Martinho Da Serra, RS, Brazil

SESSION 3: SOLAR PHYSICS, HELIOSPHERE, COSMIC RAYS --- **MSO:** Jean Carlo Santos, UTFPR, Brazil **Co-SO:** Alessandra Abe Pacini, CU-CIRES/NOAA-NCEI, USA		
Serial Number	**Authors**	**Title**
S03_N01 WITHDRAWN	K. R. Moya Castillo; V. M. Velasco Herrera; G. Velasco Herrera	Analysis and reconstruction of Total Solar Irradiance (TSI) data from the year 2003 to the year 2020. TSI forecast for mid-2023
S03_N02 WITHDRAWN	V. I. Angeles Romero and V. M. Velasco Herrera	Wildfires In Mexico
S03_N03	F. M. López and C. G. Giménez De Castro	Study Of The 30 THz Atmospheric Optical Depth At El Leoncito
S03_N08	W. Portugal; E. Echer; M. P. D. S. Echer; A. A. Pacini	A Statistical Study On The Latitudinal Effects Of Forbush Decrease Events On Surface Temperature
S03_N09	N. A. Santos; S. Dasso; A. M. Gulisano; O. Areso; M. Pereira; L. Rubinstein; for the LAGO Collaboration	Atmospheric Effects And Solar Anisotropies Of The Cosmic Ray Flux Observed With A Water Cherenkov Detector In The Antarctic Peninsula
S03_N10	E. Flández and V. Muñoz	Complexity in Solar Cycles
S03_N11	F. Monterde-Andrade; L. X. González; J. F. Valdés-Galicia; O. G. Morales-Olivares; Y. Muraki; Y. Matsubara; T. Sako; K. Watanabe; S. Shibata; M.A. Sergeeva; A. Hurtado; O. Musalem; J. Newton Bosch; S. Perea-Contreras	Simulation Of Solar Neutron Flux In The Earth's Atmosphere For Three Selected Flares
S03_N12	A. J. R. S. Diogo	Estimates Of The Solar Magnetic Field In Region AR11967 Using Inversion Methods
S03_N14	M. S. Echer; M. Domingues; C. Yamashita; E. Echer; C. Brum; O. Mendes; et al.	Multiscale Aspects Of The Solar Indices MgII, F10.7 And Sunspot Number
S03_N15	M. A. Kychenthal and L. F. Morales	Build Up And Release Of Energy In An Avalanche Model For Solar Flares
S03_N16 WITHDRAWN	Manini F.; Cremades H.; López F. M.	Tracking Of An Earth Earth-Directed Coronal Mass Ejection Through The Inner Heliosphere
S03_N17 WITHDRAWN	Manini F.; Cremades H.; López F. M.	A Comprehensive List Of Kilometric Type II Emissions Detected By Wind/WAVES TNR
S03_N19	T. Zurita-Valencia and V. Muñoz	Analyzing The Solar Activity Using The Horizontal Visibility Graph Method
S03_N22	F. O. Tavares; L. E. A. Vieira; I. De Oliveira; F. L. Guarnieri	Characterization Of Narrow Band Filter For Solar Spectropolarimetry Based On

		Volume Holographic Gratings - Angular Selectivity Analysis
S03_N23	I. R. Winkelmann; E. F. M. T. São Sabbas; X. Bertou	Energetic Terrestrial Gamma-Ray Flashes (TGFs) And/Or Other Lightning Created Emissions Possibly Detected By The Pierre Auger Observatory Tanks
S03_N24	F. Carlesso; A. R. Barbosa; A. K. R. Souza; E. A. De Almeida; A. M. E. Santo; L. E. A. Vieira	TSI Scientific Requirements For Future Missions And Technical Challenges Of The Instruments
S03_N28	B. Mamani and M. A. Subieta Vasquez	Study Of The Stability Of A CHERENKOV Water Detector Within The Framework Of The LAGO Collaboration
S03_N29 WITHDRAWN	T. R. C. Stekel	Inversion of Solar Spectropolarimetric Data With Convolutional Neural Network
S03_N30	G. Baron; E. Aguilar-Rodriguez; J. Mejia-Ambriz; O. Chang; J. A. Gonzalez-Esparza	An Updated Catalog Of IPS Radio Sources Observed By MEXART
S03_N31 WITHDRAWN	A. M. Vasquez; F. A. Nuevo; F. Frassati; A. Bemporad; R. A. Frazin; N. Sachdeva; W. B. Manchester IV; B. Van der Holst; M. Romoli	Tomographic Reconstruction Of The 3D Solar Wind Speed With Solar Orbiter/Metis: Simulations
S03_N32	M.A. Rojas-Quesada; N. Labrosse; C. Osborne	Filament Cloud-Modeling For SST Observations In The Ca II (8542 Å) Line
S03_N34	J. J. González-Avilés; P. Riley; M. Ben-Hun; J. A. González-Esparza; Et Al.	Study Of The Propagation Of The Solar Wind And Coronal Mass Ejections: Numerical MHD Simulations And The Comparison With Observations
S03_N36	A. R. Barbosa; F. Carlesso; L. E. A. Vieira	sCMOs Commercial Camera Feasibility For GSST Proof-Of-Concept Spectropolarimeter
S03_N37	F. Da Silva; L. Da Silva; R. A. R. Oliveira; M. W. S. Oliveira	Characterization Of Magnetic Clouds Through Machine Learning
S03_N40	L. Di Lorenzo; H. Cremades; L. A. Balmaceda	Evolution Of A Coronal Mass Ejection Of The Streamer Blowout Type
S03_N41	B. O. Felício and G. C. C. Lopes	Cosmic Rays: Do We Need To Be Afraid?

SESSION 4: SOLAR WIND, MAGNETOSPHERE AND GEOMAGNETISM --- **MSO:** Marcos Vinicius Dias Silveira, Independent Contractor, Brazil **Co-SO:** Ramón Caraballo, UNAM, Mexico		
Serial Number	**Authors**	**Title**
S04_N01	F. C. M. Hermes; G. S. Souza; L. C. C. Benyosef	Seasonality in daily variation on oceanic islands around the South American continent
S04_N02	D. G. Sibeck and the STORM Team	Science Applications For Soft X-Ray Imaging Missions
S04_N03	L. M. Guizelli; C. M. Denardini; S. S. Chen; L. C. A. Resende; J. Moro	Similarities And Differences Observed Evolution Of The Kp And Ksa Indices During Selected Geomagnetic Storms
S04_N08	L. V. Zanfolim; F. R. Cardoso; M. V. D. Silveira; V. M. C. S. Souza; A. C. G. Ilha; R. G. Cutait	Study Of Earth's Magnetopause
S04_N10	J. C. M. Castro Neto; E. Echer; A. M. S. Franco	Identification Of Venus Plasma Boundaries
S04_N11	C. Paniagua; G. Menesse; J. Molina; T. Rolon; D. Stalder	A Low-Cost Geomagnetic Field Station
S04_N13	A. C. G. Ilha; F. R. Cardoso; L. V. Zanfolim; M. V. D. Silveira; R. G. Cutait	Study Of Earth's Bow Shock
S04_N15	E. F. F. Doca; M. A. R. Vasconcelos; J. Da C. Batista; A. C. L. Santos-Matos	Geoelectric Characterization Of Impact Structure: Santa Marta - Piauí, Brazil
S04_N16	S. De La Maza and V. Muñoz	Community Structure Of Satellite Measurements Of The Earth's Magnetic Field
S04_N17	D. M. Schaefer; L. R. Alves; L. A. Da Silva	Monitoring ULF Waves In Radiation Belts During TheHILDCAAs Events
S04_N18	Jauer, P. R.; Wang, C.; Echer, E.; Souza, V. M.; Loesch, C.; Alves, M. V.; Alves, L. R.; Marchezi, J. P.; Liu, Z.; Hui, L.; Da Silva, L. A.; Vieira, L. E. A.; Rockenback, M.; Gonzalez, W. D.; Denardini, C. M.; Medeiros, C.; Costa, J. E. R.	Study Of The Response Of The Inner And Global Magnetosphere Due To The Interaction Of 3 Types Of Alfvénic Solar Wind Fluctuations Using Global MHD Modeling
S04_N19	V. Deggeroni; L. A. Da Silva; M. Rockenbach; J. P. Marchezi	The Role Of The Whistler-Mode Chorus Waves In The Relativistic Electron Flux Variability Of The Outer Radiation Belt Under The Influence Of High-Speed Stream: A Case Study
S04_N20	D. S. F. Medeiros; L. E. A. Vieira; V. M. C. S. Souza	Magnetic Reconnection At The Dayside Magnetopause
S04_N22	C. Medeiros; V. M. Souza; L. A. Da Silva; L. R. Alves; G. B. D. Silva; P. R. Jauer; M. Rockenbach; R. Bhanu; A. Halford; D. G. Sibeck	Electromagnetic Ion Cyclotron Waves (EMIC) - A Review

S04_N24	J. M. Espinoza. A.; M. Stepanova; R. López; E. Antonova	Self-Consistent Solution Of Geomagnetic Field Disturbances And Plasma Pressure Distribution For Strong Geomagnetic Storms
S04_N26	S. S. Chen; L. C. A. Resende; C. M. Denardini; R. A. J. Chagas; L. A. Da Silva; J. P. Marchezi; J. Moro; P. A. B. Nogueira; A. M. Santos; P. R. Jauer; C. S. Carmo; G. A. S. Picanço; R. P. Silva	The 14 December 2020 Total Solar Eclipse Effects On Geomagnetic Field Variations Over South America
S04_N27 WITHDRAWN	C. Barbosa; R. Caraballo; G.A. Hartmann; J. A. Gonzalez-Esparza	Application Of The Tsallis Statistics To Assess Extreme GIC Events In The Mexican Power Network
S04_N28	G. B. D. Silva; L. R. Alves; A. L. Padilha; J. E. R. Costa	Evaluation Of db/dt Amplitudes And Sources Over Brazil During Geomagnetic Storms Of The 2021-2022 Biennium
S04_N29	E. Camacho; L. Benyosef; O. Mendes; M. Domingues	Pc5-Pulsations In Conjugate Stations To Investigate The South Atlantic Magnetic Anomaly Effects: Case Study
S04_N31	W. Kabata; A. L. Padilha; M. J. Barbosa	Measuring Temperature Effects In Fluxgates Magnetometers To Generate Compensation Parameters
S04_N32	Y.-S. Castillo-Rosales; M.-A. Pais; J. Fernandes; F. Pinheiro; A. Morozova; P. Ribeiro	Temporal Variability Of 27 Day-Averaged Space Weather Related Parameters: Connecting Solar, Interplanetary Medium And Geomagnetic Activity Indices
S04_N33 WITHDRAWN	Y.-S. Castillo-Rosales; N. I. P. Cruz; M. Rodríguez; J. Mejuto	Progress To Build The First Magnetic Observatory Of Honduras
S04_N34 WITHDRAWN	P. Hosseini; I. J. Cohen; D. L. Turner; K. Sorathia; S. Ukhorskiy	Energetic Electron Injections Associated With Substrom Dipolarization
S04_N35 WITHDRAWN	Ashna. V. M.; Ankush Bhaskar; G. Manju; Sini. R.	Solar Cycle Dependence Of The Solar Wind-Magnetosphere-Ionosphere Coupling During Geomagnetic Storms Of 23-24 Solar Cycles
S04_N36	J. L. R. Vanegas and V. H. D. la L. Rodriguesz	Distributed System For Near Real-Time Recording Of The Electromagnetic Spectrum Over Mexico

SESSION 5: SPACE PLASMA PHYSICS AND NONLINEAR PROCESSES IN SPACE GEOPHYSICS --- **MSO:** Juan Alejandro Valdivia, UCHILE, Chile **Co-SO:** Abraham Chian, Un. Adelaide, Australia **Co-SO:** Daniel Gomez, UBA, Argentina		
Serial Number	**Authors**	**Title**
S05_N03	V. Fernández; V. Muñoz; G. Nigro; V. Carbone	Statistical Study Of A Magnetized Plasma Under Fractal Forcing
S05_N05	V. Muñoz and A. Zamorano	2D Sandpiles In Networks With Variable Topology As A Model For Geomagnetic Activity
S05_N06	A. L. Piragibe; R. A. Miranda; A. B. Schelin; J. L. Ferreira	Lagrangian Chaotic Mixing In Numerical Simulations Of Resistive Drift-Wave Turbulence In Plasmas
S05_N07	L. S. Cassara; M. M. Lopes; O. Mendes; R. Deiterding; M. O. Domingues	Effects Of Magnetic Divergence Control In Numerical MHD Modeling Of Instabilities
S05_N08 WITHDRAWN	H. A. Carril; J. A. Gidi; R. E. Navarro; J. A. Araneda	Formation Of Multiple BGK-Like Structures In The Time-Asymptotic State Of Collisionless Vlasov-Poisson Plasmas
S05_N09	S. G. S. P. Costa; R. A. Miranda; A. B. Schelin	Spectral Entropy Of Numerical Simulations Of Resistive Drift-Wave Turbulence In Plasmas During A Transition To Zonal Flows
S05_N10	E. F. D. Evangelista; O. Mendes; M. O. Domingues	Simulating The Interactions Of A Rigid Body And Of A Source Of Ions With A Flow Of Plasma Using AMROC
S05_N14	P. K. Nyassor; C. M. Wrasse; I. Paulino; E. F. M. T. São Sabbas; J. V. Bageston; D. Gobbi; P. K. Naccarato; T. T. Ayorinde; H. Takahashi; C. A. O. B. Figueiredo; D. Barros	Sources Of Concentric Gravity Waves Generated By A Moving Mesoscale Convective System In São Martinho Da Serra
S05_N15	M. Kychenthal; L. Morales; V. Muñoz; A. Zamorano	Solar Flare Analysis Using Complex Networks

Plenaries

The Electrojet Zeeman Imaging Explorer (EZIE) mission: Science, data products, and opportunities

Authors

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Affiliation

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Abstract

The Electrojet Zeeman Imaging Explorer (EZIE) is a NASA three-satellite mission with the overarching goal of characterizing the structure and dynamics of the auroral electrojets flowing at altitudes around 100 km in the auroral regions. Studying these currents provide insight into the Earth-Space electrical current circuit and provide strong observational constrains on the underlying magnetospheric processes. The two science objectives is determining which of the proposed substorm current wedge configurations is right and determining to what extent the auroral electrojet consist of wedgelet currents. We will present an overview of the mission, describe the Zeeman technique used to infer the vector magnetic field, the observation strategies, and how we will ensure closure to the science objectives. We will also present the supplemental science objective of characterizing the equatorial electrojet and focus on collaboration opportunities.

Catalyzing Academic and Private Partnerships in the Use of Big Data for Space Exploration and Human Benefit

Authors

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Affiliation

Senior Advisor for New Initiatives, NASA/GSFC/HQ

Abstract

The recent advances in Artificial Intelligence (AI) capabilities are particularly relevant to NASA science and exploration goals because there is growing evidence that AI techniques can improve our ability to model, understand and predict our environment using the petabytes of data already within NASA archives. In particular this represents a strategic opportunity in Heliophysics, since the need to improve our understanding of space weather is not only mandated by directives such as the National Space Weather Action Plan and the Presidential Executive Order for Coordinating Efforts to Prepare the Nation for Space Weather Events, but also because space weather is a critical consideration for astronaut safety as NASA moves forward leave LEO and return to the Moon. I will also talk about the Frontier Development Lab (FDL) which is an AI research accelerator that was established in 2016 to apply emerging AI technologies to space science challenges which are central to NASA's mission priorities and provide some examples. FDL is a partnership between NASA Ames Research Center and the SETI Institute, with corporate sponsors that include IBM, Intel, NVidia, Google, Lockheed, Autodesk, Xprize, Space Resources Luxembourg, as well as USC and other organizations. The goal of FDL is to apply leading edge Artificial Intelligence and Machine Learning (AI/ML) tools to space challenges that impact space exploration and development, and even humanity. Six prior FDL sessions have demonstrated that meaningful progress could be industrialized by bringing together individuals at the PhD and Post Doc level as well as members from industry together to work on connected, but adjacent problems in a shared space mentored by senior scientists with a deep knowledge of the problems. FDL uses sprint methodologies for faster results, uses interdisciplinary teams for better results, and public-private partnerships to lower costs. FDL results will be shared that demonstrate the power of bridging research disciplines and the potential that AI/ML has for supporting research goals, improving on current methodologies, enabling new discovery and doing so in accelerated timeframes.

Latinxs in Space Geophysics: discussing gender bias in ALAGE/COLAGE

Authors

A. A. PACINI

Affiliation

CU-CIRES / NOAA-NCEI

Abstract

The main goal of this plenary session is to discuss gender representation in our Latin American scientific association during the last three decades and to address the issue of implicit bias in our community. The gender "leaking pipeline" is a persistent problem in the space sector around the globe, creating the underrepresentation of women and non-binary people in STEM education and Space Science careers still visible in both developed and developing countries. Nowadays, many civil and scientific organizations like United Nations (UN), American Geophysical Union (AGU), Brazilian and American Physical Societies (SBF and APS) and Brazilian Society of Space Geophysics and Aeronomy (SBGEA), are actively addressing the gender inequality within their communities by promoting workshops, establishing networks and creating commissions to identify and mitigate the gender bias. This plenary session demonstrates ALAGE's commitment in building an inclusive environment for the development of Space Geophysics in Latin America, ensuring equal access to education and career opportunities to all, in accordance with the UN Sustainable Development Goals (SDGs) #4 (Quality Education) and #5 (Gender Equality). The plenary opening presentation will be followed by an inclusive and open discussion with the COLAGE participants, which main goals are: To define strategies to identify and mitigate gender bias in our community. To raise awareness about the participation of Latinxs in the ALAGE and understand the obstacles in their career's progression. To design initiatives to increase opportunities and enhance the participation of Latinxs in ALAGE leadership positions. The plenary session will be led by Drs. Alessandra Abe Pacini (CU-CIRES/NOAA-NCEI), Maria Graciela Molina (Tucumán Space Weather Center - FACET/UNT) and Vânia Fátima Andrioli (CBJLSW-INPE), who are also responsible for preparing a document to be delivered to the ALAGE leadership, compiling concrete ideas and actions to promote gender equality in our science community.

Abstracts

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 1 - SWx
Serial Number:

Investigation of Annual and Semi-Annual Variation of F2 layer in the Two Hemispheres and its comparison with IRI model

Authors

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Affiliation

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Abstract

We used the ionospheric foF2 and hmF2 parameters to investigate the annual and semi-annual variability of the ionospheric F2 layer. The data used from the mid-latitude station of Hermanus, South Africa (Geog. Lat. -34.420 S, Geog. Long. 19.220 E) and Rome, Italy (Geog. Lat. 41.900 N, Geog. Long. 12.500 E) from 2004 to 2019. It is found that the foF2 is maximum at noon-time 1200 UT (1400LT), about 12 MHz, and lowest at night-time 0000 UT (~ 0200 LT) ~ 4 MHz. In both stations, hmF2 values reached their highest value ~ 370 km around night-time 0000 UT (0200 LT), and their lowest value between 170-250 km at 0800 UT during the day was observed. From the analysis of foF2 and hmF2 data, the presence of an annual anomaly throughout the year 2014-2019 in the northern hemisphere mid-latitude was found, while the annual anomaly was absent in the southern hemisphere mid-latitudes. On the other hand, the average means of equinox months were higher than those of solstice months for each of the years 2014-2019, indicating the presence of a semi-annual anomaly at mid-latitude across both hemispheres. We also determined the correlation between the monthly observed data and the IRI-2016 model by using the Consultative Committee on International Radio (CCIR) option for foF2 and the SHU-2015 option for hmF2; we found that the regression factor for both hemispheres was greater than 0.90 in mid-latitude.
Key words: ionosphere, fof2, hmh2, anomaly, IRI model,

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XIII COLAGE
27th November to 2nd December 2022
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Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

The Research and Service Plans of EMBRACE Program

Authors

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Affiliation

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Abstract

In line with global coordination efforts for space weather activities in accordance with the UNOOSA Guidelines for the Long-Term Sustainability of Outer Space Activities, INPE/EMBRACE is working through space weather cooperations, fostering initiatives to facilitate the development of new products and exchange of data to protect the technological infrastructure of the countries. EMBRACE is the Brazilian Regional Space Weather Alert Center that runs a set of network of instruments such solar telescopes, Ionosondes, radars, all-sky imagers, Fabry-Perot imager, magnetometers, GNSS receivers for TEC and scintillation. Regionally, INPE through EMBRACE is promoting cooperation with Latin American
countries in a partnership within a recent space weather league called All4Space, created in late 2021 with Argentina, Chile and Mexico. For EMBRACE, two important anomalies, the Equatorial Ionization Anomaly and the South Atlantic Magnetic Anomaly over Brazil are subjects of studies and monitoring. The program has a strong focus on the dynamics of the ionosphere and particle precipitation. EMBRACE
is participating in the missions COSMIC 2, SPORT, and EQUARS to monitor and research such irregularities. We will show the research plans of EMBRACE with ground instruments to complement the
SPORT mission to observe the ionospheric plasma bubbles. Some results of TEC maps with multi constellations is under test to be delivered on our home page. For the GIC over Brazil, a set of instruments was acquired that will be installed to measure the grounding currents in the Brazilian electrical grid to validate our 3D models of electrical conductivity of the Earth's interior. To attend the aviation sector EMBRACE has signed a cooperation agreement with the aviation authorities to train the staff of the Integrated Aeronautical Meteorology Center (CIMAER) in the provision of aeronautical space meteorology service, provided for by the ICAO (International Civil Aviation Organization);

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27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

On the studies of magnetic storms and equatorial plasma bubbles over the American sector based on ionospheric and magnetic indices

Authors

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Abstract

In order to improve our knowledge of the effects of Magnetic Storm and Equatorial Plasma Bubbles (EPB) over the ionosphere at equatorial and low latitude regions in the American sector, several efforts have been made recently to develop new tools based on ionospheric indices derived from the Global Navigation Satellite System (GNSS) data. Concurrently, local geomagnetic indices have been developed to overcome the lack of observatories in the South American sector providing data for binding the Kp index, widely used as a global response to space weather disturbances. In the present work, we present and discuss results from studies recently published and under preparation related to the use of these indices. Concerning the ionospheric indices, we primarily have been focusing on studies about the detection (or detectability), and measurement of parameters related to EPBs (latitudinal extension and velocity). Finally, we compare differences in the time evolution of the regional versus the global magnetic indices.

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27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 1 - SWx
Serial Number:

A semi-empirical approach to the dynamic coupling of CMEs and solar wind

Authors

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Affiliation

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[3] Predictive Science, United States.

Abstract

Coronal mass ejections (CMEs) are one of the most relevant phenomena for space weather. Moreover, CMEs can negatively affect essential services and facilities. Therefore, to protect society, we require well-grounded knowledge of physics that governs the propagation of CMEs from near the Sun to the orbit of Earth. In this work, we deduce expressions to approximate the main forces that affect the dynamic coupling between CMEs and the surrounding solar wind. Therefore, we explore the CME-solar wind dynamic coupling from a magnetohydrodynamic perspective, which, combined with a few reasonable assumptions, allows us to obtain expressions for the thermal and magnetic pressure forces, viscous and dynamic drag, and gravity. We simultaneously use our expressions to compute the trajectories of 34 Earth-directed CMEs. Our results, which are compared with in situ data, show significant quantitative consistency; our synthetic transits closely mimic their in situ observed counterparts. We conclude from our results that magnetic, thermal, and dynamic drag significantly surpass the other forces such as dynamic agents of CMEs in the interplanetary medium. In addition, we find that the initial relative speed of CMEs and solar wind is a determinant factor for the dynamic behavior of CMEs- In other words, subsonic CMEs are initially mostly affected by magnetic and thermal pressure forces, whereas initially, inertial drag governs super-magnetosonic CMEs.

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27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type:
Session ID:
Serial Number:

The Interdisciplinary Laboratory of Scientific Computing (LINCC)

Authors

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Affiliation

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Abstract

In this work, we introduce the new Interdisciplinary Laboratory of Scientific Computing (LINCC) at the National University of Mexico (UNAM). The LINCC is focused in the area of Earth Sciences, mainly in the development of models of the solar atmosphere at millimeter and sub-millimeter emission. The infraestructure of LINCC allow us to development, deploy, and test numerical models in a distributed mode using parallel computing and deep learnning. We use the GIT protocol to stablish a team software process that includes three steps: development, testing, and production. Additionaly, the LINCC developments software to implements backends of digital data processing in real time in distributive mode

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27th November to 2nd December 2022
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Presentation Type: POSTER
Session ID: 1 - SWx
Serial Number:

Fourier Analysis of the One Decade of H-Component Geomagnetic Field Observed at Jatai, Brazil

Authors

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Affiliation

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Abstract

The study of the geomagnetic field is very important due the several human activities that depend of the satellite communications, global positioning satellite. One decade of the measurement of H-component geomagnetic field obtained at Jataí (GO) were analysed through of the Fourier Analysis. Results show periodicities already knew, but another periodicities shown important energetic variability. Discussions in terms of the nonlinear phenomena underlying are done in order to explain some peculiar periodicities.

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27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

Space Weather R2O2R activities developed by LAMP

Authors

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Abstract

The Argentine Space Weather (SW) laboratory LAMP (in Spanish: Laboratorio Argentino de Meteorología del esPacio) has been developing space weather research-to-operations and operations-to-research (R2O2R) activities since 2016. LAMP became the Argentina's regional warning center of the international consortium of space weather centers (ISES) in January 2020.
Regarding the activities of LAMP on fundamental research, one of the main developed scientific lines involves the solar wind near Earth, such as transient disturbances (e.g., interplanetary coronal mass ejections ICMEs, magnetic clouds MCs, stream interaction regions SIRs) and how these structures affect the transport of galactic cosmic ray (GCR) in the interplanetary medium. LAMP has a laboratory for studies of SW in the Antarctic Peninsula. Among the instrumentation, the main highlight is the cosmic ray detector based on water Cherenkov radiation, developed completely inhouse. This instrument observed its first Forbush decrease in 2021.
The use of real-time SW data in a quasi-operational setting leads to improved scientific understanding of SW. This is one of the reasons why the line between research and operations is becoming increasingly blurred. In this sense, the group developed various prototype products and services, all available on http://spaceweather.at.fcen.uba.ar/2/. LAMP operative products include observations covering the whole chain of events and processes that connect the Sun to the Earth. Many of these products are generated using instruments located in our region and all of them are enhanced with original added value.
In this work we will present a general overview of LAMP ' s development, highlighting the latest offered products (e.g.,relativistic electron fluence) and those related to the conditions of the interplanetary medium, which include real time characterization of the state of alfvenicity in the solar wind near Earth, and the expected and observed solar wind proton temperature (useful for identifying ICMEs). In addition, an alert system is offered by subscription via email, which informs the user in the case of occurrences of geomagnetic storm, radio blackout, radiation storm or particle storm. Finally, a historical database of events of interest in SW is in the final stage of implementing.
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27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

SQuasi Real-Time Remote Sensing of Solar Wind using the New Digital Back-End of MEXART

Authors

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Abstract

The Mexican Array Radio Telescope (MEXART) observes the sky at 140 MHz. Its back-end was updated during 2019-2020, increasing bandwidth (from 2 to 12.5 MHz) and improving its sensitivity. The instrument has an antenna of 900 m^2 and is mostly dedicated to observe compact radio sources which exhibit interplanetary scintillation (IPS). The IPS analyzes can be used as remote sensing technique to infer physical solar wind parameters along the line of sight, like speed, density and small-scale turbulence. This remote sensing technique is also used to track the evolution of coronal mass ejections. With IPS observations of MEXART and by implementing an automation analysis, it is possible to obtain speed and density of solar wind seconds after an observation of a radio source. Here we show the implementation of an automatic operation for analyses of IPS of MEXART to get quasi real-time solar wind speeds and densities. The resulting solar wind values obtained by the automation can supply inputs to solar wind models, which can contribute to the study and prediction of space weather. We report the first quasi real-time results and we show how the results are used to figure out the current state of the solar wind. We print the obtained values of solar wind and conditions of observation in a standard format agreed by the Worldwide IPS Stations (WIPSS) network.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

TEC Map Generation over the South American Sector Using Combined GNSS and Ionosonde Data

Authors

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Affiliation

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[2] Federal University of Technology - Paraná, Paraná - Brazil.

Abstract

With the emergence of a high-tech society added to the civilian operations of satellite technologies, one space weather area worth studying is the ionized region of the upper Earth's atmosphere called the " ionosphere " . As such a region acts upon the radio wave propagation as a magnetoionic medium, signals of Global Navigation Satellite Systems (GNSS) undergo changes in their properties that is proportional to the quantity known as Total Electron Content (TEC). In this work, we combined ionosonde data from Brazil and Global Positioning System (GPS) data from GNSS stations over the South American sector to compose a TEC database to be used as input to an interpolation function, which uses the minimum curvature solution to generate TEC maps in the function of the latitude and longitude. We have applied our method for three consecutive days, March 21-23, 2021 - which corresponds to a transition period between moderate to geomagnetically quiet days - to generate the TEC maps over the Brazilian sector and its neighborhoods. Also, the maps were compared to the ones produced by the Laboratorio de Meteorología Espacial, Atmósfera Terrestre, Geodesia, Geodinámica, diseño de Instrumental y Astrometría (MAGGIA laboratory). It was noticed that just the maps generated with our method were able to detect properly Equatorial Plasma Bubble (EPB) signatures, which were also identified by All-Sky imager pictures and scintilation index (S4) data.

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DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

Sub-auroral ionospheric effects of the April 14, 2022 magnetic storm

Authors

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Abstract

The response of the ionospheric F2 layer to a geomagnetic storm has been widely studied mainly at middle and low latitudes. Instead, there are comparatively fewer studies of the ionospheric behavior during storms at high or polar latitudes.
In order to increase knowledge of the ionospheric effects at subauroral latitudes during a geomagnetic storm, we studied the behavior of the F2 layer at subauroral latitudes during the geomagnetic storm occurred on 14 April 2022 in two longitudinal sectors: Sector 1 (19 E – 33 E), stations: Tromso (70 N; 19 E) and Murmansk (68 N; 33 E) and Sector 2 (80 E – 90 E), stations: Dixon (74 N; 80 E) and Tunguska (62 N; 90 E). For that, we used the critical frequency of the F2-layer foF2 and their corresponding height hmF2.
We observed nearly simultaneous decreases in hmF2 initially both in Sector 1 and Sector 2 that occurred during the beginning of the main phase of the storm. Possibly, an electric field penetrating to the nightside ionosphere produced a convection of ionospheric plasma downward to lower altitudes. In sector 1, the decreases in hmF2 had associated a negative effect (density depletion). Chemical recombination that occurs at lower altitudes caused the reduction of foF2. Because the decreases in hmF2 and foF2 were observed for several hours during the main phase, that possibly evidenced a long-duration penetration of the interplanetary electric field. In sector 2, an electric field in opposite direction to Sector 1 drive the height of the maximum electron density to lower heights that in quiet conditions. However, as in this sector the main phase began at local dawn, possibly photoionization contributed to increase the electron density to values close to those of quiet conditions.
Thus, the different electron density behavior observed in sectors 1 and 2 could be consequence of the different Electric Fields (DDEFs) which played an important role during the recovery phase (~ 18 UT – 23 UT on 15 April). DDEFs are in opposite direction to the quiet time ionospheric electric field during both day and night sides, that is, DDEFs are westward (eastward) during the dayside (nightside). This mechanism could explain the increases in hmF2 and the subsequent positive effects observed in some stations during the recovery phase of the storm.

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XIII COLAGE
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São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

Study of Ionospheric Response to Geomagnetic Disturbances Using TEC Regional Maps and the NeQuick 2 Model.

Authors

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Abstract

In this study, we present the results of validation of modeled foF2 (F2 layer critical frequency) and TEC (Total Electron Content) during the solstice on the 21-24 June 2015 geomagnetic storm. The solstice storm was the second strongest geomagnetic storm of cycle 24 with minimum Dst value of -197 nT (G4 class). Both TEC and foF2 changes and percentage changes were considered in comparison with the quiet time background. Also, comparison was made between the modeled quantities and the ground-based observations of the vertical Global Navigation Satellite System TEC at the four locations selected in the low-latittude South American sector. The model's performance was quantitatively evaluated using the root mean sqaure error (RMSE) and percentage changes. An average RMSEs of TEC were calculated between ~ 5 and ~10 TECu (1 TEC Unit =10^16 el/m^2) whereas an average RMSEs of foF2 range from about 1 MHz to 2.5 MHz. Our results showed a dependence on geomagnetic activity with RMS errors increasing with increasing geomagnetic activity.

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27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 1 - SWx
Serial Number:

Changes on the ozone with the entry of energetic protons in South Atlantic Anomaly zone during severe geomagnetic storms. Influence of the QBO sign

Authors

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Abstract

The loss events of protons in the inner belt occur during great geomagnetic storms. Proton losses at the outer boundary of the inner radiation belt could be explained by the field line curvature scattering mechanism, while the decrease of the proton flux near the center of South Atlantic Anomaly (SAA) is probably caused by the enhanced neutral atmospheric density during geomagnetic storms. A great part of the energy transported by the protons could affect the middle atmosphere leading to atmospheric interactions that would result in the production of NOx constituents, which can lead to ozone content variation. The quasi-biennial oscillation, QBO, with a period varying from about 26 to 30 months, is the main variation of the mean zonal wind in the equatorial stratosphere and also a feature of many processes in the Earth ' s atmosphere. In this work, we analyze the effects of the entry of energetic protons in the SAA region during and after the occurrence of six intense geomagnetic storms occurred in 2001, 2003, 2004 and 2015; three of them during QBO westerly phase, and the other three during QBO easterly phase. Furthermore we consider three stations (Bauru, Sao Paulo and Cachoeira Paulista) located in the SAA area (5 - 40 degrees South and between -45 and -60 degrees East). Data of total column ozone (TCO) and ozone profiles registered by SBUV Merged Ozone Data are used. The effects on the stations during and after the occurrence of geomagnetic storms in QBO easterly phase, first show increases (values between 2.0 % and 4.0 %) in TCO between day one and day five after the minimum value of Dst geomagnetic index; and the following days the effects show significant decreases in TCO with values between -3.4% and -6.0 %, 7 to 10 days after the day of the minimum value of the Dst index, depending on the intensity of each storm. In the case of geomagnetic storms during QBO westerly phase, the TCO on stations located in SAA zone shows increases, in some cases statistically significant, between the day one and 6 to 10 days after the minimum value of the Dst index. The next days show no significant decreases in TCO that reaches -4.0% in the case of November 6, 2001 storm for Sao Paulo station. In the case of ozone profiles, between 0.639 hPa (~53.3 km) and 101.3 hPa (~15.8 km), a significant increase at middle stratospheric heights, with values between 2.0 % and 4.0 %, are detected in the day of the minimum value of the Dst index for the six analyzed storms. For the storms occurred during QBO easterly phase, the days following the day of the minimum value of the Dst index, the ozone presents decreases of the order of - 4.0% at lower height

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São José dos Campos, Brazil

Presentation Type:
Session ID:
Serial Number:

Analysis of Ionospheric Disturbances Produced by Solar Wind Variations Using Different Ionospheric Parameters

Authors

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Abstract

The solar wind has an important influence on magnetospheric convection, where variations in IMF and solar wind dynamic pressures (PSW) can change the magnetospheric electric field and affect the mid and low-latitude ionosphere through the penetration process. Some authors studied quasi-periodic ionospheric perturbations by Millstone Hill radar observations and they associated those perturbations with the penetration of magnetospheric electric fields.
In our work, we analyze the variability of the ionosphere during different transient and oscillatory events in the IMF and solar wind dynamic pressure behaviors, using vertical total electron content (VTEC) obtained from GNSS measurements. We analyze the degree of electromagnetic field penetration at different longitudes and latitudes, taking advantage of GNSS receivers varied geographical distribution. Our preliminary results show quasi-periodic variations in VTEC at permanent stations near Millstone Hill. The ionospheric perturbations obtained are very similar to those obtained by radar measurements, Therefore, we can assume that the oscillatory changes of VTEC show the oscillatory effects caused by the penetration of the electromagnetic field.
Furthermore, we will implement different numerical methods to analyze the power spectrum behavior of the studied parameters, and the correlation between the oscillations present in the ionosphere with those observed in the solar wind pressure and the IMF.

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XIII COLAGE
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São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

Estimating D Region Absorption Radio Blackouts in the HF Range Over Mexico

Authors

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Abstract

Space weather is defined as the physical phenomena in the solar system which can affect technology. One of the eruptive events that constitute the space weather is the solar flare. These flares are generated in the upper solar atmosphere and are identified as strong and sudden brightenings in metric, millimetric, visible light, UV, X rays and gamma wavelengths. The Earth ' s ionosphere can absorb the energy released by a flare and thus, the radio communications can be affected in ranges of minutes or hours. To study the impact of the solar flares in the HF (3-30 MHz) band, a D region affectation prediction model was implemented, developed initially by the National Oceanic and Atmospheric Administration (NOAA) from the US. In this work, the model was replicated to study the historical events which affected the Mexican territory since 1975, the year when the NOAA satellites started to register solar flares. This analysis led to preliminary estimation of the country ' s susceptibility in the face of solar flares, this work describes the highest frequency affected (HAF) by 1 decibel. The analysis indicates the return levels for the Mexican territory for the subsequent 11 years since the year 2017. The return values with 95 % confidence interval are: 283 (288,277) events will occur with 16 MHz as MFA, 88 (89.47 ,85.72) events of 20 MHz, 20 (20.7,19.7) events of 25 MHz 4.6 (4.8,4.56) of 30 MHz, 1.94(2,1.89) events of 33 MHz and 1.08 (1.11,1.05) events of 35 MHz. This study works as a first approach to the risks in radio communications which will allow to increase the resilience in Mexico facing space weather phenomena.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 1 - SWx
Serial Number:

Influence of Space Weather Phenomena Periodicity (≈1.7 years) on Epilepsy Incidence

Authors

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Affiliation

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Abstract

For thousands of years, human beings have adapted to different terrestrial climate variations to survive. Also, these variations have been and are modified by interplanetary space phenomena which constitute Space Weather. Therefore, human beings are biologically adapted to both terrestrial and space conditions. There is under representation of research focused on knowing the effects of Space Weather phenomena on human physiology, even though there are reports surrounding the effects caused by variations in the geomagnetic field on the functioning of the Central Nervous System (CNS), such as cellular and neurohormonal alterations and effects on electrophysiological patterns of brain activity. The justification for these alterations focuses on the consideration of the brain as a highly susceptible electromagnetic organ, on which certain levels of geomagnetic field, above or below the values to which it is adapted, cause instabilities. To evaluate possible effects of Space Weather phenomena on human physiology, in this research different phenomena were studied by wavelet analysis as possible external factors that influence on Epilepsy, a CNS disorder in which normal brain activity is disturbed. To do this, quarterly data from 2002 to 2014 of thirteen Space Weather phenomena were used: sunspot number, solar flares index, disturbed days due to the collision of an Interplanetary Coronal Mass Ejection (ICME) with the Earth, total ICMEs registered, number of ICMEs associated with magnetic clouds, number of ICMEs with rotations in their magnetic field, number of ICMEs not associated with magnetic clouds and without rotations in their magnetic field, cosmic ray counting rates, number of Ground Level Enhancements, Dst, aa and Kp indices, and solar irradiance; and data from Epilepsy incidence. The findings found showed common periodicities between the Epilepsy incidence and the solar flares index, some of the ICMEs markers, and the Dst, aa and Kp indices. Interestingly, it was observed that the common periodicity of ≈1.7 years was the most representative in the results, therefore, Pearson's correlation coefficients were made between the oscillations of this periodicity. The correlations showed values above 50% only in the total ICMEs registered, the number of ICMEs with rotations in their magnetic field, and in the Dst, aa and Kp geomagnetic indices. Finally, the results showed by the Wavelet analysis in addition to the percentage of influence of the periodicity of ≈1.7 years on the Epilpesy incidence, identified that one in four people with Epilepsy is influenced by this periodicity in specific phases of the oscillation, causing increases and/or abnormal synchronous discharges of neuronal electrical activity in people considered as susceptible.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

Convolutional neural network applied in the identification and classification of shock waves

Authors

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Abstract

The interplanetary space is dominated by several magnetic field topologies that control the confinement and particle flux of the solar wind. Disturbances in space weather can damage communication systems, power distribution, equipment, and satellite reliability.
In the interplanetary medium, some magnetic structures derived from solar activity, such as coronal mass ejections, regions of co-rotating interaction, solar flares, etc., travel at speeds above the speed of the solar wind, resulting in the formation of a shock wave in the interplanetary medium.
In this work, artificial neural networks are applied as a method for detecting and classifying interplanetary shocks (IP). A new approach is proposed, which uses graphs as input, generated from time series data sets referring to some parameters of the solar wind and the interplanetary magnetic field.

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XIII COLAGE
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São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **3 - SOL**
Serial Number:

Forecasting Ground Magnetic Perturbations Using Deep Learning and Near Real-Time Data

Authors

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Abstract

Prediction of ground magnetic fluctuations is a first step towards risk assessment and forecasting of geomagnetically induced currents (GICs), which can pose a substantial risk to power lines and other conductors mostly at high and mid-latitudes. Direct GIC measurements are rarely available or heavily restricted, and when available, they tend to be are very limited in their spatial coverage. The MAGICIAN (Machine Learning Algorithms for Geomagnetically Induced Currents in Alaska and New Hampshire) team has developed over the past years a series of machine-learning based models to predict the occurrence of strong geomagnetic fluctuations using mostly solar wind data as input, as the continuous measurements of solar wind parameters by monitors located at the L1 point provide a near-real time data stream that anticipates the arrival of the solar wind by approximately 20-40 minutes to the Earth, making it ideal for early warning tools. In this work, using different deep learning techniques we show our results in predicting near-real time ground magnetic fluctuations 30 minutes into the future for different magnetometer stations located between 40-60° magnetic latitude. We will discuss our choices regarding the selection of parameters to use when forecasting as well as the model tuning, when using measurements provided by the SuperMag initiative to compare against. Additionally, we will discuss the merits of using additional data from ground or low altitude observatories to improve our current predictions and our recent advances in finding metrics and evaluation tools that are appropriate in the context of GICs.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type:**ORAL**
Session ID:**1 - SWx**
Serial Number:

The Moon to Mars Space Weather Analysis Office; Mission, Goals and Concept of Operations

Authors

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Abstract

Future exploration missions to deep space will no longer have the Earth's protective magnetic field shielding them from radiation in space. Improvements in space weather analysis, modeling prediction techniques, and communication of radiation risks to the crew are essential for mission success. The Moon to Mars (M2M) Space Weather Analysis Office located at Goddard Space Flight Center was established to support NASA's Space Radiation Analysis Group (SRAG) with human space exploration activities by providing novel capabilities to characterize the space radiation environment. M2M will work as the proving grounds and testbed for the capabilities that will eventually transition to operational agencies. M2M also supports NASA robotic missions with space weather notifications and anomaly assessments. We will present the M2M Office's goals, infrastructure, and activities to support SRAG and NASA missions in collaboration with CCMC and other government agencies.

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27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **ORAL**
Session ID: **1 - SWx**
Serial Number:

Behavior of the energetic electron fluxes and the auroral oval during 1 June 2013 geomagnetic storm.

Authors

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Abstract

Among the multiple current unknowns of magnetospheric physics, a key research question is the relation between the auroral physics and the dynamics of energetic electrons in the outer radiation belt during geomagnetic storms. It is well known that during storms the equatorial border of the auroral oval moves towards the equator. At the same time the plasma pressure in the inner magnetosphere increases, and the location of the pressure maximum displaces fowards the Earth. The analysis of the electron fluxes using the Van Allen Probes satellites indicates a strong depletion occurred during the main phase of the storm and a subsequent enhancement of relativistic electrons during the recovery phase. Moreover, as described by the Tverskaya relation, the maximum electron flux is found at the L-shell nearly to 3.73. The maximum of the plasma pressure is located at the same L-shell. In order to establish the relation between the auroral phenomena and the geomagnetic storm we used the data of the POES satellites and established that the maximum of energetic electron fluxes is located inside the auroral oval, indicating the role of the substorm injections as seed populations of electrons to be accelerated adiabatically during the recovery phase of storm.

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27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

Life Cycle of TLE-Producing Storms Detected by the LEONA Collaborative Network.

Authors

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Abstract

The layers of the atmosphere are coupled to each other by various physical processes. The EFfects SignAlIng the ElectRodynamic CouplIng between the AtmospherE and Space (FAIRIES) carry electrical properties between the layers. Within the FAIRIES we have the Transient Luminous Events (TLEs) that are transient plasmas in the upper atmosphere generated by quasi-static electric fields from thunderstorms lightning discharges, such as Sprites, Elves, Halos, and Blue Jets. The type of clouds that produce lightning are the cumulonimbus and their associations, such as the Mesoscale Convective Systems (MCSs), thus these clouds are major generators of FARIES. The life cycle of the FAIRIES generating storms is still not well understood and this work sought to improve this understanding. To do this, we analyzed infrared (IR) maps of the cloud tops of three storms, recorded by the GOES 16 satellite. We selected convective systems that produced TLEs that were captured by the LEONA network. We estimated the location and type of each TLE using the software StarStereo, which uses the star field present in the images, the geolocation of the observation site, the camera field of view and the observation time to calculate the star field that should be visible, and by matching that with one present in the image, it is possible to estimate the latitude and longitude of the events, assuming the altitude of their top (88 km for Sprites). Then we plotted these and the lightning locations on top of the IR cloud top temperature maps to study the evolution of general and convective areas, delineated by brightness temperature thresholds, to better understand the temporal evolution of the storm, and also to understand which storm stages produced the most ELTs. The results found agree with the scientific literature: (1) TLEs were predominantly produced in the stratiform region of the systems, (3) TLEs were mainly associated with +CG lightning, (3) and the maximum TLE production recorded occurred during the maximum extent of the convective region.

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XIII COLAGE
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São José dos Campos, Brazil

Presentation Type: **ORAL**
Session ID: **1 - SWx**
Serial Number:

Thermospheric Neutral Winds Impact on the Ionosphere over Cachoeira Paulista

Authors

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Abstract

The dynamics of the equatorial and low-latitude ionosphere is mainly controlled by the equatorial electric field and thermospheric neutral wind. In this work, we investigate the role of wind in ionospheric plasma dynamics over a low latitude Brazilian station, Cachoeira Paulista (CP), during a three-day sequence, March 21 to 23, 2021. This period is a geomagnetically moderate transition to quiet condition. The study involves physical modeling and experimental data of ionospheric peak parameters hmF2 and foF2, Total Electron Content (TEC), thermospheric neutral winds and ExB vertical drift velocities in the equatorial F region. Such ExB drifts are obtained by terrestrial magnetometers, one at the magnetic equator and the other offset. The full-day variations of the ExB drift are formed by combining the values from an empirical model (Utah State University model) and the drifts inferred from the magnetometer data. Wind measurements over CP were recorded by a modern Fabry-Perot interferometer. The Sheffield University Plasmasphere Ionosphere Model at the National Institute for Space Research (SUPIM-INPE) is used to quantify the response of the local ionosphere to effective winds, i.e. the wind along the magnetic field. In general, the SUPIM-INPE model has already presented coherent results for the electron density of the ionosphere over equatorial and low latitude sectors. The model's ability to predict TEC, when local measurements of both ExB drift and neutral wind are assimilated, is evaluated.

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São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

Study of the Dynamics of an Asteroid When it Travels Through Earth's Atmosphere

Authors

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Abstract

When describing the dynamics of an asteroid as it passes through Earth's atmosphere, a system of four differential equations is regularly used that relates the rate of velocity, mass, angle and height of flight of the object. In this work, a new model is presented that provides a solution to the aforementioned system of equations, which has as characteristics, assuming that there is a variation in the angle of flight of the object during its journey through Earth's atmosphere, dispensing with an explicit equation to calculate said angle of flight. Knowing the velocity and mass of the object before it fragments and admitting an atmospheric density profile, not necessarily flat-parallel, for allows introducing a drag force with a more realistic scenario. In addition, an implementation of this model is presented for the hypothetical case 99942 Apophis asteroid's impact, obtaining results related to the impact energy that this phenomenon would cause. These results are consistent with what would be physically expected to happen.

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Presentation Type: POSTER
Session ID: 1 - SWx
Serial Number:

Signatures of Space Weather Events during Solar Cycle 24's Descending Phase on the Solar Neutron Telescope at Sierra Negra, Mexico

Authors

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Abstract

The effects of space weather events on cosmic rays detected by the Solar Neutron Telescope (SNT) at Sierra Negra, Mexico, were studied. The SNT is part of the Sierra Negra Cosmic Ray Observatory (SN-CRO), located at 4580 m a.s.l. We analyzed the data recorded by six SNT channels (S2, S3, S4, S2withAnti, S3withAnti and S4withAnti) during geomagnetic storms on the descending phase of Solar Cycle 24. Using the Dst and Kp indices, 21 moderate (Dst < -50 nT, Kp > 5) and intense (Dst < -100 nT, Kp > 7) geomagnetic storms were selected. The S2, S3, S4, S2withAnti, S3withAnti and S4withAnti channels detect charged and neutral particles with energy deposition thresholds of E > 60, 90 and 120 MeV, respectively. The counting rates of these channels present diurnal variation, which was removed with the seasonal trend decomposition using Loess method. After data treatment, either significant decreases or enhancements were observed in the trend of at least one SNT channel for 18 of the 21 analyzed events. Two Forbush decreases were also identified.

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Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

The Argentinian-Chilean Validated Ionospheric Database (Acvid)

Authors

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Abstract

The ionosphere of the Southeast region of Latin America has a large variability due to its multiple local and global interconnections (such as the EIA, SAMA, etc.). Nevertheless, this area is known to be highly undersampled and requires a large observational effort to fully understand its global dynamics and internal teleconnections. Nowadays, thanks to the ubiquity of GNSS receivers, there exist different national GNSS networks that allow TEC measurements along the Southamerican continent. Even so, up to date, very few studies have considered the vertical distribution of the ionosphere of such a geographic region, and the information about the layers' distribution and dynamics is key to solving its multiple unknowns and improving the accuracy of current ionospheric models.

To solve this constraint, this new project aims to create and maintain the first validated ionospheric database for ionosonde measurements of the southern region of Latin America (i.e., the Argentinian-Chilean validated ionospheric database, ACVID). In this presentation, we will show the first results of the collaboration (i.e., the first years of solar cycle 25) and introduce the new database to the community.

This is an international and multi-institutional effort to provide open access and validated data (manually corrected) to the scientific community. Although automatic scaling is essential for space weather studies, the algorithms used usually fail to scale some features of ionograms or may have considerable estimation errors. Thus, manual correction is required to add reliability to the data (crucial for climatological studies). Moreover, such validated data is required to generate reference curves and trends that help to understand the dynamics and morphology of possible irregularities, and also can be used to issue space weather alerts when significant changes from the reference occurred. Therefore, this new project focuses on the manual scale of raw data obtained from the ionosondes of their respective institutions and the integration of all the measurements from both countries into a centralized database that will be available in the Tucumán Space Weather Center TSWC portal (https://spaceweather.facet.unt.edu.ar/).

Within this project framework, currently, in Argentina, there are two AIS-INGV (Tucumán and Bahía Blanca) deployed in collaboration with INGV, both providing continuous autoscaled data in real-time. While in Chile, there is a single IPS-42 ionosonde providing ionospheric measurements but its

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Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

Machine Learning Based Ionospheric Forecasting: Towards Operative Implementation

Authors

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Abstract

We propose different deep learning (DL) methodologies to perform a 24 hs TEC forecasting using external inputs such as space weather forcing. We used a long data series of TEC for different stations located in high, mid and low latitude regions and under different geographic conditions (e.g. oceanic stations). In the first stage, we trained the DL models using Kp index as the geomagnetic proxy for external forcing (due to solar wind-magnetosphere coupling). We also discuss the role of other proxies according to the geomagnetic regions (e.g. Dst, AE, AU, etc), IMF and solar wind parameters, and solar activity proxies, for feature selection.
In this work, we analyse the robustness of each DL model, and the approaches needed to implement them as a pre-operative prototype .
We discuss different strategies and analyze the computational requirements and the methodologies required to implement a ML-assisted forecaster tool, including previous data pre-processing steps. We show comparative results and future works.

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Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

Preliminary Analysis of Sudden Commencement morphology of 4 November 2021 geomagnetic storm in the SAMA region

Authors

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Abstract

A geomagnetic Sudden Commencement (SC) is comprehended as a signature of disturbances in the magnetosphere caused by a density pulse from the solar wind. It occurs on a large scale and almost simultaneously around the whole globe. The morphological characteristics of these signals may vary according to the internal processes between the local magnetosphere and ionosphere coupling. In this study, we analyzed the SC of the geomagnetic storm that occurred on November 4, 2021, using ground-based magnetometer data from Embrace MagNet and INTERMAGNET. The SC morphology was evaluated for sites inside and outside the South American Magnetic Anomaly (SAMA). The preliminary results show discrepancies in the magnetometer signals inside and outside the SAMA.

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Presentation Type: **ORAL**
Session ID: **1 - SWx**
Serial Number:

Evaluation of Ionosphere Simulation Results Using EUVAC and SOLAR2000

Authors

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Abstract

Extreme ultraviolet (EUV) solar radiation is the main source of ionization in the Earth thermosphere region, producing the ionosphere and impacting its behavior among several physical and chemical processes. Thus, it is an important input variable to most physical-based ionospheric models. Substantial efforts have been employed to measure the EUV radiation by spacecraft and satellite missions. EUV reference spectra and more recently EUV proxy models were created to fill the EUV data gaps and provide inputs to ionospheric models, even in the lack of measurements. Nevertheless, EUV models estimatives and measured observations have differences from each other which can lead ionospheric models to present distinct results, considering the source of EUV adopted. The aim of this work is to evaluate the Sheffield University Plasmasphere Ionosphere Model using the Data Assimilation and Visualization System (SUPIM-DAVS) response to two well known EUV solar models: the EUV flux model for aeronomic calculations (EUVAC) and the SOLAR2000 empirical solar irradiance model. The EUV flux information is the most important input of SUPIM-DAVS, driving its behavior and directly impacting its outputs. The daily integration of EUV flux spectrum from EUVAC and SOLAR2000 showed a significant difference in mean value, although when considering the broad spectrum from 5 to 105nm wavelength, some bandwidth intervals seem to contribute more to this divergence. Thus, we have compared SUPIM-DAVS total electron content (TEC) produced using EUVAC and SOLAR2000 models. The International GNSS Service (IGS) vertical TEC (vTEC) data was used as reference. The experiments considered daily global simulations every five days in the time period between 2011 to 2021, aiming at covering a full solar cycle, which includes periods of high, moderate and low solar activity. As expected, daily averaged TEC values showed considerable differences when using different EUV models. Considering the entire period evaluated, while TEC estimation using EUVAC frequently provides values much lower than IGS vTEC, the estimatives using SOLAR2000 often overestimates them. Despite the differences observed, EUVAC and SOLAR2000 EUV models show good agreement in solar flux variation for the period. Also, TEC values produced using both EUV models maintain a similar variation trend in relation to IGS vTEC. Hence, we propose a new EUV flux model which combines EUVAC and SOLAR2000 outputs to better approximate SUPIM-DAVS TEC values to IGS vTEC observations. The weighted combination of EUV may be balanced by solar activity and the bandwidth considered, since EUVAC and SOLAR2000 spectra have different impacts on the ionization of Earth's atmosphere using SUPIM-DAVS numerical estimations.

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Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

Ensemble forecasts of geomagnetic indexes

Authors

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Abstract

Solar activity can affect the dynamics of the Earth's magnetosphere and ionosphere, in what is called " the sun - solar wind – magnetosphere – ionosphere interaction [1]. In particular, during a geomagnetic storm the ring current of the Earth's magnetosphere can produce large perturbations of the horizontal component of the magnetic field observed at the ground at low latitudes. These variations are usually quantified using the storm weather disturbance index (Dst) that estimates the intensity of the ring current and is used to monitor the severity of the storm.

In this work we propose and study an ensemble of linear evolution models of Dst, properly weighted through a " skill measure ", driven by solar wind variables [2] as a convenient and flexible strategy to model and forecast the behavior of Dst and its uncertainty over time. In order to improve the forecast it is neccesary to know if this " skill measure " is an indicator of the behavior of a particular storm, that is why we propose a genetic algorithm method that allows to predict Dst in a short time. The data is taken from the OMNI dataset.

Acknowledgment: We thank the support of ANID/Fondecyt Project 1190703. Additionally, the professors Jose Rogan and Max Ramirez thank the support of ANID/Fondecyt Project 1190662

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Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

ICME High Intensity Sheath Magnetic Fields and Their Geoeffectiveness

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Abstract

In this work we study high intensity magnetic fields in ICME sheath regions. These high intensity fields are short duration when compared to the total duration extent of the ICMEs but they often drive intense geomagnetic disturbances. The selection of the events is via visual inspection of interplanetary data observed by L1 interplanetary monitors. We sort these events by their magnetic field profile: a very high intensity B within the sheath, followed by a smooth region, which could be interpreted as the ICME. We look at their solar counterparts and study their dynamics from the Sun to the Earth. As expected, our findings show that high speed coronal mass ejections (CMEs) are related to the occurrence of these high intensity sheath magnetic fields. However, we find important exceptions which deserve more careful study. To evaluate the geomagnetic impacts we use the Disturbance Storm-time Dst index. In the context of Space Weather, it is known that shock sheath fields are a very important origins of energy injection in the Earth ' s magnetosphere.

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Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

Cataloging Space Weather Hazards. Defining Extremme Events

Authors

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Abstract

The Sendai Framework for Disaster Risk Reduction 2015 – 2030 (' the Sendai Framework ') was one of three landmark agreements adopted by the United Nations in 2015. In 2020, the United Nations Office for Disaster Risk Reduction (UNDRR) published a list of hazard definitions for monitoring and reviewing implementation. The UNDRR hazard list includes 302 events: 60 meteorological and hydrological, nine extraterrestrials (including four space weather events), 35 Geohazard, 24 environmental, 25 chemicals, 88 biologicals, 53 technological, and eight societal. The four space weather events are geomagnetic storms, ionospheric storms, solar corpuscular radiation storms, and radio blackouts. An expert team in cataloging hazard events (ET-CHE) at the World Meteorological Organization (WMO) is developing the terminology so that users and stakeholders (e.g., disaster risk managers) can understand hazards that may impact them. In addition, this terminology would be integrated into national early warning systems. Therefore, it is crucial that the space weather community reviews and discusses the specific hazard list. On the other hand, the recent operation of four global centers providing 24/7 space weather warnings for the International Civil Aviation Organization (ICAO), has given them experience in reporting and measuring space weather events for users. Therefore, reviewing and incorporating this information into the WMO system is essential. I will present a report on the status of reviewing the space weather hazard definitions.

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São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

Monitoring space weather in Mexico during the declining phase and minimum of solar cycle 24

Authors

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Abstract

The Mexican Space Weather Service (SCIESMEX) was established in 2014, and in 2016 the National Space Weather Laboratory (LANCE). One of the main objectives is the observation, monitoring, and warning of space events at low latitudes that can significantly affect the Mexican territory. SCIESMEX publishes a weekly report of space weather events, distributed on social networks, and operates an early warning system for the National Civil Protection System. This early warning system is specific for events that might significantly affect the Mexican territory. On the other hand, LANCE is developing new instrumental networks to provide data on different space weather phenomena: ionospheric disturbances, geomagnetic variations, cosmic rays fluxes, interplanetary disturbances, solar radio bursts, and geomagnetic induced currents in the national electricity grid. Based on this regional data and international data sources, such as NASA and NOAA satellites' observations, we monitor the space weather phenomena affecting low latitudes. Based on the observations obtained during the minimum phase of solar cycle 24, we present a summary of the region's quiet values. These initial minimum values are essential to understanding the behavior in this region located at low latitudes.

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Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

Plasma boundaries in induced magnetospheres

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Abstract

An induced magnetosphere forms when a magnetized plasma flow encounters the ionized atmosphere of an unmagnetized or weakly magnetized object. This is the case of the plasma interactions at planets Mars and Venus, active comets and moons such as Titan. In these environments, energy and momentum is transferred from the external flow to the local plasma that eventually escapes from these bodies. In the collisionless regime, plasma boundaries are the places where this transfer is more efficient. In situ observations have revealed three main boundaries 1) the bow shock in the case of a supersonic external flow; 2) the induced magnetosphere boundary that separates local from external ions and 3) the induced magnetotail current sheet, where the draped field reverses direction. In this work we revisit their properties as revealed by spacecraft Cassini, MAVEN and others and discuss the importance of scales for future multi-spacecraft missions.

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Presentation Type: **ORAL**
Session ID: **1 - SWx**
Serial Number:

The influence of the solar wing on the inner magnetosphere plasma pressure and the geomagnetic field configuration

Authors

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Abstract

It is well known that the solar wind dynamic pressure and IMF Bz component are the key input parameters for the majority of geomagnetic field models and their influence on the inner magnetosphere dynamics is well studied. Nonetheless, due to a statistical study using the data from THEMIS mission we reached to establish some new important features of how the variation of the solar wind dynamic pressure and the IMF Bz component affect the geomagnetic field and the plasma pressure in the inner magnetosphere. In particular, we could obtain a combination of the input parameters for which a minimum of the geomagnetic field located nearly 12 Earth Radii can be clearly observed for the dawn, night, and dusk MLT. We also found how the inner magnetosphere pressure grows with the solar wind dynamic pressure for different values of Bz. These statistical studies were compared with the radial pressure profiles, obtained using DMSP mission satellites. The results obtained contribute to the further development of geomagnetic field models and give new insights about the physics of geomagnetic substorms.

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Presentation Type: **ORAL**
Session ID: **1 - SWx**
Serial Number:

Radiation belt's adiabatic acceleration of electrons during geomagnetic storms.

Authors

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Abstract

Among the multiple current unknowns of magnetospheric physics, a key research question is the formation mechanism of the outer radiation belts during geomagnetic storms. To study this phenomena, the adiabatic and non-adiabatic behavior of relativistic electrons in the outer radiation belt is studied during strong geomagnetic storms using data from multiple platforms: the Van Allen Probes, ARASE, and THEMIS satellites. The analysis of the electron fluxes indicates a strong depletion occurred during the main phase of the storm and a subsequent enhancement of relativistic electrons during the recovery phase. Moreover, as described by the Tverskaya relation, the maximum electron flux is found at the Lshell.
To verify if the adiabatic mechanisms are relevant to explain the behavior of relativistic electrons, we first analyzed the electron spectra and found that they fit well to a power-law function. In the majority of the cases studied for a fixed L-shell, the power-law index is conserved during the pre-storm time, increases during the main phase, and decreases during the recovery phase. This long time conservation of the slope of the electron spectra can be considered as evidence of a dominant contribution of adiabatic processes, as it is difficult to explain this effect by other processes such as acceleration and losses of relativistic electrons. Hence, this result present a strong evidence that the adiabatic acceleration of electrons population can make a significant contribution to the formation of energetic electron fluxes during the recovery phase. Nonetheless, strong changes are also observed in the electron spectra slope during the different storm phases, which can be related to other processes that may lead to electron loss or acceleration, such as the interaction with ULF waves.

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Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

Multifractality Observed in HILDCAAS Events

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Abstract

Multifractal aspects had been observed in several physical systems since 80 ' s years and given us a deep knowledgment about the nature. In this work we applied the multifractal subject in geomagnetic H-component time series with high-intensity long-duration continuous AE activity (HILDCAAS) signatures in order to check the multifractality on these time series. Results shown that the geomagnetic system is in a multifractal state permanently

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São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

Ground-Based All-Sky Auroral Imaging for Space Weather Research

Authors

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Abstract

Ground-based all-sky imaging techniques have been used in many research and science applications to study the magnetosphere, upper atmosphere, and space weather. Rapid advances in sensor technology in recent years have greatly improved sensor performance, allowing ground-based imagers to capture very weak nightglow and auroral emissions at high spatial and temporal resolution. Ground-based auroral imaging provides a wealth of observations concerning key magnetospheric and ionospheric phenomena and is an essential partner for many space-based missions. Magnetospheric and ionospheric physicists seek to understand geospace phenomena from micro- to global-scales. Geomagnetic storms and substorms represent two of the most important scientific topics. Studies of these two topics often deal with the processes that control the flow of solar wind mass, energy, momentum through the magnetospheric system. We will discuss how ground-based all-sky imaging techniques complement space-based missions and together answer fundamental science questions. We will introduce the GoIono multispectral all-sky imaging array of the Johns Hopkins University/Applied Physics Laboratory (JHU/APL) installed at the Poker Flat Research Range and the High-Frequency Active Auroral Research Facility (HAARP) in Alaska that have been operating since October 2018.

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São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **3 - SOL**
Serial Number:

Type III Solar radio bursts observations by Paraguay CALLISTO spectrometer: First results

Authors

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Abstract

Solar flares are energetic bursts that can damage our technology (satellites, communication, power grids, hydroelectric, navigation systems (GPS)). They can be accompanied by coronal mass emission, X-rays, and SRB (Solar Radio Bursts). An SRB sufficiently intense can generate serious problems in the propagation of radio waves, interfering with our communications systems. This work presents the process of antenna construction, integration, and installation of a radio spectrometer that will allow us to observe SRB. To receive the radio waves, a log-periodic antenna measuring 5.3 m long and approximately 2.7 m wide at the base was built. The monitoring station integrated us into the International Solar Radio Spectrometer Network, e-Callisto, which allows us to monitor solar activity 24 hours a day. From May 2022, this new station detected at least three, type III solar radio bursts. We analyzed the signals in order to implement and develop an automatic algorithm to detect future events

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 1 - SWx
Serial Number:

Propagation of Interplanetary Coronal Mass Ejections and Their Interaction With the Solar Wind

Authors

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Abstract

The Sun-Earth interaction represents a complex system in which the mutual connections between the vast regions that compose it and the mechanisms through which energy is transferred in the system are complex and require an adequate development of models and techniques in order to be adequately described.

An Inerplanetary Coronal Mass Ejection (ICME) heading towards the Earth represents a potential danger to the stability of terrestrial space weather as its perturbations can disrupt, damage or disable terrestrial technological systems and infrastructure.

A better understanding of the mechanisms involved in the propagation through the interplanetary medium of an ICME and its coupling with the Solar Wind (SW) has as a direct application the improvement of forecasts in the time it takes to arrive in the terrestrial space environment.

In order to better understand the propagation of ICMEs through the interplanetary medium, a review of analytical models is carried out in this work. The work focuses on the physical principles of some of the analytical models that describe the propagation of ICME, mainly those based on a viscous drag force from a linear, quadratic and turbulent regime as well as those based on interchage of linear momentum (inertial models) where for both a hydrodynamic type interaction between the SW and the ICME along its propagation is assumed.

The analysis suggests that models involving inertial or viscous drag forces with quadratic regime are likely mechanisms for dynamic ICME-SW coupling.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **3 - SOL**
Serial Number:

Statistical Analysys of the Occurrences rate of Geomagnetic Storms During Solar Cycles 20-24

Authors

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Abstract

This study examines the occurrences of geomagnetic storms during the solar cycles 20-24. It investigates also the solar sources at cycles 23 and 24. The Disturbed storm time (Dst) and Sunspot Number (SSN) data were used in the study. The study establishes that the magnitude of the rate of occurrences of geomagnetic storms is higher (lower) at the descending phases (minimum phases) of solar cycle. It as well reveals that severe and extreme geomagnetic storms Dst <-250 seldom occur at low solar activity but at very high solar activity and are mostly associated with coronal mass ejections (CMEs) when occurred. The majority of moderate storms at solar minimum are associated with coronal hole-high speed solar wind CH-HSSW and CMEs at other phases. Storms caused by CME are more prominent during the descending phase than any other phase of the solar cycle. Solar minimum features more CH-HSSW-associated storms than any other phase. It was also revealed that all high intensity geomagnetic storms (strong, severe and extreme) are mostly associated with CMEs. However, CH-HSSW can occasionally generate strong storms during solar minimum. The results have proven that CMEs are the leading cause of geomagnetic storms at the ascending, maximum and the descending phases of the cycles 23 and 24 followed by CME.
KEYWORDS: Geomagnetic storms, solar cycle phases, sunspot number, Dst, CME, CH

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **ORAL**
Session ID: **1 - SWx**
Serial Number:

Development of a Multi-element Phased Array Solar Radio Interferometer at 1.42 GHz

Authors

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Abstract

Solar radio emissions account for different emission processes and the medium in which these are generated in the Solar Atmosphere. Radio Astronomy is a field that is gradually growing in Colombia thanks to several projects aiming to a more viable way of performing astronomical studies in a country whose climate conditions are predominantly cloudy, as well as the contribution it presumes to the scientific and technological development that can have an impact on future generations of Colombian astronomers, scientists and engineers.

This work presents the development and implementation stages of a Solar Radio Interferometer with a novel antenna design, previously tested, located in the focus of a collector dish, on a fully-steerable mount and the proposed configuration for a 3-element interferometric array. We also discuss the implemented time correlation system implemented using the Reconfigurable Open Architecture Computing Hardware (ROACH-1) electronic system. The radio interferometer will to study solar radio emissions at the frequency of 1.42 GHz, corresponding to the 21cm emission line, generated by gyro-resonance mechanisms.

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XIII COLAGE
27th November to 2nd December 2022
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Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

The Strongest Solar Storms in Recorded History and their effects

Authors

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Abstract

Solar storms are one of the most exciting celestial occurrences to see. When they are directed towards Earth, though, the results might be terrible for our technologically dependent civilisation.

While we haven't seen a large solar storm since the mid-1800s, many experts fear the next "big one" would be catastrophic for our modern society. Keeping this in mind, below are some of the most noteworthy solar storms in recorded history.

Every day, solar storms erupt from the Sun into space, including solar flares, sunspots, and coronal mass ejections (CMEs). If these disturbances travel the 94-million-mile journey to Earth, their charged particles can force their way into our upper atmosphere, generating a buffet of hazards (broken electrical systems, communications failures, and radiation exposure) and delights (auroral displays).

In this poster we will discuss some of the most powerful solar storms known to mankind, both before and after the Space Age (1957) and their effects, and emphasize the importance of space weather monitoring.

A modern-day solar storm as intense as the one seen in 1921 (Love, Jeffrey J., et al., 2019) would cause a blackout affecting 150 million people across North America with no warning. Insidious magnetic storm currents would destroy transformers with no replacements available, forcing them to be constructed elsewhere due to a lack of domestic sources. According to some estimates, the daily cost of a superstorm event might surpass $30 billion in missed wages, damaged food, factory closures, and other collateral impacts - and this situation could last for a week or more (Odenwald, S. F., 2008).

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XIII COLAGE
27th November to 2nd December 2022
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Presentation Type:**ORAL**
Session ID:**1 - SWx**
Serial Number:

The present and future in Operational Space Weather international Cooperation

Authors

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Abstract

It is essential to have international cooperation for operational space weather forecast, warning and alert services. We need huge observation areas, local to global, the Sun to the Earth. and ground- to satellite-based, which is impossible to be covered by few countries. It is ideal to share all observational data and model results in the world.
As an international organization, the International Space Environment Service (ISES) has been active since 1962 under the International Council of Science Union. As of January 2020, 20 countries and the European Space Agency were members of the ISES, which is a federation of organizations that regularly disseminate space weather information.
In 2010, the World Meteorology Organization (WMO) established the Interprogramme Coordination Team on Space Weather (ICTSW) as a temporary organization focusing on the distribution of space weather information in the WMO Information System. In 2015, the Interprogramme Team on Space Weather Information, Systems, and Services (IPT-SWeISS) was established as a regular organization. This group is now reconstructed and start the activity as Expert Team on Space Weather (ET-SWx) in 2022.
The International Civil Aviation Organization (ICAO) has been considering the incorporation of space weather information as weather information for use in aviation operations. Its aim is to avoid the risk of degradation of high-frequency (HF) communication and satellite positioning and increase in human exposure by space weather events, owing to the increase in the use of polar routes since the beginning of 21th century. The ICAO Space Weather service started in November 2019, and in the present status four global centers are working (United States, PECASUS (Finland, Austria, Belgium, Cyprus, Germany, Italy, Netherlands, Poland, and United Kingdom), ACFJ (Australia, Canada, France, and Japan), and CRC (China and Russian Federation)).
I will show the present status of international cooperation in the operational space weather services and discuss the future aspects.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

Solar Neutron Event Recorded by the Muon Telescope in Mexico City on November 4, 2003

Authors

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Abstract

In association with the X28 flare on november 4, 2003, the muon telescope in Mexico City observed an 8 sigma enhancement of the counting rate between 19:50 and 20:05 UT. Based on numerical simulations done for the neutron flux entering the terrestrial atmosphere, we found that the entry of these particles in the energy range from 0.2 to 20 GeV is capable of producing a muon flux that can reach the atmospheric depth of Mexico City. Furthermore, we also found that the expected excess based on the simulation is of the same order of the counts registered in the telescope.

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Presentation Type: **POSTER**
Session ID: **1 - SWx**
Serial Number:

Regional Effects of Strong Geomagnetic Storms During the Solar Cycle 23 and 24

Authors

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Abstract

The purpose of this project is to identify and characterize geomagnetic regional effects on the center of Mexico during geomagnetic storms periods for the last two solar cycles. To identify such effects, we compare the planetary geomagnetic response (Dst index) and regional geomagnetic response (DH index) for the selected study cases. It was found out that a regional geomagnetic response is presented with Dst <-50 nT. It is important to consider that such regional effects where sistematically associated to local ionospheric disturbances.

From the analysis of the data we conclude that the influence of the ionospheric disturbances Ddyn and DP2 are consistent with the sharper regional geomagnetic effects observed on the center of Mexico. These mecanisms are also consistent with the local ionospheric disturbances associated with the study cases.

The deadline for abstract submission and travel support requests is July 1st, 2022.
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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 2 - ION
Serial Number:

IONOSPHERIC RESPONSE TO THE PATRICK'S 2013 AND 2015 EVENTS OVER THE SOUTH AMERICAN SECTOR

Authors

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Abstract

The main purpose of this investigation is to study the response of the upper atmosphere to two intense geomagnetic storms in March 2013 and 2015 using the ionosondes, all-sky images, GNSS-TEC, and magnetometers measurements over the South American sector. The first geomagnetic storm reached a minimum Dst of -132 nT at 20 UT on 17 March 2013 and the second storm reached a minimum Dst value of -223 nT at 22 UT on 17 March 2015. We use the continuous wavelet transform to check the periodicities of the equatorial electrojet (EEJ) and the height of the F-layer peak density (hmF2) during these events. Also, the nonlinear numerical simulation of the ionospheric irregularities (plasma bubbles) will be adopted for the present study. The ionospheric F-region and sporadic E (Es) layer over the equatorial and low latitudes of the South American sector shows significant ionospheric change during the storms. The following anomalous ionospheric behavior were also observed at the South American sector: (a) traveling ionospheric disturbances (TIDs); (b) positive and negative ionospheric storms; and (c) strongly enhanced EEJ. Finally, using all-sky images, we report the suppression of plasma bubbles over the eastern part of the South American sector during the March 2013 and 2015 storms. However, using the rate of change of the TEC index (ROTI) derived from GNSS measurements, we observed weak phase fluctuations (0.2 < ROTI < 0.6) in the central South American sector on 18 March 2013. On the other hand, moderate phase fluctuations (0.4 < ROTI < 2) were observed around the eastern, central, and western sectors on 17-18 March 2015.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 2 - ION
Serial Number:

Assessment of the DIX responses to Equatorial Plasma Bubbles using multi-GNSS data over South America

Authors

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Abstract

In this work, we evaluate the Disturbance Ionosphere indeX (DIX) responses to Equatorial Plasma Bubbles (EPBs) over South America. In this context, we use data from different Global Navigation Satellite Systems (GNSS: GLONASS, Galileo, GPS, and BeiDou) to obtain the Total Electron Content (TEC) values used in the DIX calculation. Specifically, we selected ten EPB events over South America and calculated DIX for equatorial- and low-latitude GNSS stations. Then, we compare the multi-GNSS DIX responses with the Rate Of TEC Index (ROTI) values calculated from the same data during the same EPB events. Therefore, our preliminary results show that DIX can be a more reliable proxy for the ionospheric disturbances related to plasma bubbles when using multi-GNSS data. Finally, we present an analysis of the characteristics of the EPB events, aiming to understand better the ionospheric responses to these phenomena using a new index, the DIX.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **2 - ION**
Serial Number:

Occurrences of Esb layers Over Santa Maria, a Transition Station From Low to Middle Latitude in Brazil

Authors

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Abstract

In this work, we present a study of the sporadic E layers (Es) of blanketing type (Esb) over Santa Maria (29.7° S, 53.8° W), Brazil, irrespective of the geomagnetic activity. We considered ionograms with a 5 min temporal resolution obtained from July 2019 to June 2020 by a Digisonde. We first calculated the Esb percentages of occurrences for each month and season of the year. We also classified the Esb layers into their different types according to the URSI Handbook of Ionogram Interpretation and Reduction – flat (Esf), low (Esl), high (Esh), and cusp (Esc) – to obtain their percentage of occurrences for each season. The results show that the occurrences of Esb vary in different months and seasons being maximum in summer, followed by spring, autumn, and winter. Except during the winter, the Esf is the predominant type of Esb. We also analyzed the Esb maximum reflected frequency (ftEs), the blanketing frequency (fbEs), and the virtual height (h'Es) to obtain the frequencies of their occurrence. The results show that the Esb present ftEs and fbEs parameters most often ranging from 3 to 4 MHz in the 100-105 km altitude. The difference between the ftEs and fbEs was used to calculate the ΔfEs to give the plasma density gradient variations during the year. Finally, the E-Region Ionospheric Model (MIRE) is also used to simulate the Es layers to study the roles of the neutral winds in the Esb formation according to the seasons of the year.

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XIII COLAGE
21st November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **2 - ION**
Serial Number:

Statistical response of the high- and mid-latitudes ionosphere in the Southern hemisphere during 70 geomagnetic storms occurred in the period of two decades

Authors

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Abstract

The first time statistical response of the positive and negative ionospheric storms phases using Vertical Total Electron Content (VTEC) measurements during 70 geomagnetic storms at high- and mid-latitudes regions in the Antarctic and Argentine/Chilean sectors in the Southern hemisphere are investigated. The study covers the years between 1999 and 2018 of solar cycles 23 and 24, using the Dst <= -100 nT as a criterion for all 70 storms selected. Significant features of solar cycle, seasonal and local time of ionospheric storms are showed. Our results indicate that the occurrence of geomagnetic storms follows a pattern of solar activity dependence, and also indicate a predominance of positive and positive-negative phases during autumn, winter, and spring at mid-latitudes and winter at high-latitudes. Negative and negative-positive phases occur during all seasons and mid- and high-latitudes. In addition, positive phases occur more frequently during the daytime than during nighttime and negative phases occur predominantly in nighttime. There is also a predominance of positive and positive-negative phases simultaneously at mid- and high-latitudes latitudes, indicating a coupling between the Antarctic and Argentine/Chilean sectors. The percentages of total occurrence of positive phase are around 50% at mid- and 60% at high-latitudes and positive-negative phase is around 19% at mid- and 22% at high-latitudes. Negative and negative-positive phases are below 9% at both latitudes.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 2 - ION
Serial Number:

Airglow Imaging Observations of Some Evolutionary Aspects of Plasma Blobs During Solar Minimum Over the Tropical Region

Authors

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Abstract

Plasma blobs have been reported as one of the notable consequences of ionospheric plasma instabilities. Oftentimes, they are found in conjunction with plasma bubbles which are large-scale plasma irregularities. However, cases of plasma blobs without plasma bubbles have also been reported. The key outstanding research question on this phenomenon has been: are plasma blobs causally related to plasma bubbles or independent? One of the approaches to answering this question could be knowing their generation mechanism. But their generation mechanism is still under intensive investigation. This seems to be a result of inadequate information about the morphology and dynamical features of this phenomenon. In this work, we report, for the first time, some evolutionary features of plasma blobs that could enlighten us further and probably also reveal the mechanism responsible for the generation of plasma blobs in the tropical region of Brazil. We have studied the OI 630.0 nm emission data during the March and October of solar minimum (2019 and 2020) using the ground-based all-sky imager at ZF-2 (2.58oS, 60.22oW) in the Amazona region of Brazil, and we have observed plasma blobs detachment and plasma blobs merging (also known as ionospheric electrostatic reconnection). Plasma blobs detach as a result of a growing midnight plasma bubble which splits and eventually detaches a blob from the main blob. We have associated the plasma blobs merging to the activities of the polarized electric field inside blobs whereby the electric field in one blob reconnects with another in the adjacent blob. Also, we propose that a big plasma blob along the magnetic field lines would merge with another succeeding smaller blob when its scale size (E-W extension) is above a certain threshold value and the decrease in zonal neutral wind velocity with time and gravitational force could be responsible for this feature of plasma blob. Using the linearization technique presented by Garcia et al., (1997), we investigated the scale size (E-W extension) of the blobs during these processes: we discovered that during merging, as one of the blobs losses its scale size the other gains; while during detachment the main blob increased rapidly in its scale-size (before detachment) as the bubble (observed to be responsible for the detachment) grows. Simulataneous observations of plasma blobs and plasma bubbles on all-sky imager and satellite data are also presented.
Keywords: plasma blobs; all-sky imager; solar minimum; detachment; merging

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **2 - ION**
Serial Number:

MLT Studies Along the Andes Mountain Range Using Multistatic Meteor Radar Configurations

Authors

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Abstract

Specular meteor radars (SMRs) are powerful and reliable tools to explore mesosphere and lower thermosphere (MLT) dynamics. Particularly, multistatic SMRs can go one step further, allowing the investigation of MLT dynamics down to horizontal scales of a few tens of kilometres. In recent years, the Leibniz Institute of Atmospheric Physics (IAP) has led the deployment of several multistatic SMRs along the Andes mountain range, a region known to harbour the world ' s strongest hot spots of gravity wave activity. In this talk, we will explore planetary and mesoscale dynamics at MLT altitudes using data from five multistatic SMR networks: SIMONe Piura (5°S), SIMONe Jicamarca (12°S), CONDOR (30°S), SIMONe Argentina (49°S) and MMARIA-SAAMER (54°S). Results on mean winds, tides, wind residuals and momentum fluxes, among others, will be presented and compared among these five locations. Possible coupling effects between the MLT and the ionosphere/thermosphere region will be also discussed.
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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **2 - ION**
Serial Number:

Study of Intermediate Descending Layers Over Boa Vista - Roraima During Periods of Maximum and Minimum Solar Activity

Authors

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Abstract

This work aims to study the intermediate descending layers (CI's) on the region of Boa Vista, Roraima – Brazil (BV, 2.8°N, 60.7°O). For that, data collected by Digisonde DPS-4 during periods representative of high (2014) and low (2020) solar activity are being evaluated. From the analysis of the ionograms, the parameters of top frequency and height of the CI's were processed using the software SAO-Explorer. Preliminary results indicate that the intermediate layers present a well-defined downward movement and occur predominantly during the day. The average behavior of height and frequency of CI's is being analyzed, as well as the monthly percentage occurrence of this layer for both periods studied. In 2014, for example, it was found a maximum occurrence in June (81%) and a minimum occurrence in February (28%). As for 2020, a representative period of minimum solar activity, the data processed so far indicate an occurrence of 90% and 61% for these same months, respectively. A comparative study between the analyzed periods will be carried out and the peculiar characteristics found in the formation/dynamics of the intermediate layers for both periods will be discussed.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **2 - ION**
Serial Number:

Influence of a Moderate Geomagnetic Storm on the Post-sunset Ionosphere over South America

Authors

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Abstract

The current solar cycle, Solar Cycle 25, has sparked a lot of debate about whether it is going to be the next Maunder Minimum which was a period of unusually low solar activity from 1650 to 1715. We investigate the impact on the ionosphere of a geomagnetic storm on 24 October, 2019 that just before the beginning of this cycle. The storm was driven by a High-Speed Solar Wind Stream/ Co-rotating interaction region (HSSWS/CIR) emanating from a large coronal hole. We used a combination of ground-based GPS data as well as satellite observations to probe the ionosphere during this disturbed period. Two-dimensional maps of OI 135.6 nm obtained from the GOLD Far-Ultraviolet imager were used to study the equatorial ionization anomaly. A large positive ionospheric storm occurred over the low latitude during the main phase driven by positive Interplanetary Eastward Electric Field. Equatorward propagating wavelike structures were observed for several days lasting into the recovery phase. Enhancement of the zonal electric field in the presence of prompt-penetration electric fields led to poleward expansion of the Equatorial Ionization Anomaly. After sunset the storm-related dynamics perturbed the diurnal variation in ionospheric irregularities and Equatorial Plasma Bubbles. Simultaneous observations from GPS TEC and135.6nm maps irradiance revealed large diurnal variability in the morphology and occurrence of ionospheric irregularities.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 2 - ION
Serial Number:

Quantifying Stratospheric Aerosol Optical Properties Over South-East Asia via High Spectral Resolution Lidar Measurements

Authors

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Abstract

There has been an observed increase in stratospheric aerosol since 2000 (Kremser, 2016). Both stratospheric aerosol and tenuous cirrus clouds are considered key features in the terrestrial energy balance, therefore relevant in general circulation models such as weather-forecasting climate models. The radiative transfer properties of aerosols and cirrus clouds can be quantified by their optical properties (Solomon, 2011; Stephen 1990). Consequently, various remote sensing instruments study stratospheric aerosol and cirrus clouds' optical properties, such as ground-based, space and air-borne lidars. Although the space-borne Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) instrument has been providing invaluable aerosol and cloud optical property measurements, CALIOP measurements can have uncertain biases for a couple of reasons. First, standard backscatter lidars like CALIOP are incapable of measuring both extinction and backscatter cross sections independently, and so these instruments make assumptions about the two measurements' highly variable relationship, dependent on the size distributions of the scattering crystals (Heymsfield, 1984), which induce biases. These instruments also have calibration parameter sensitivities that are time dependent. Therefore, CALIOP struggles to detect tenuous aerosol layers, or assume cirrus clouds are not accompanied by an aerosol layer above or below it. The implication of the latter is that CALIOP's tenuous cirrus cloud optical depths measurements have uncertain biases. Therefore, researching the optical properties of stratospheric aerosol and their geographical distribution with lidars capable of measuring aerosol extinction and backscattering coefficients independently is relevant not only towards climate studies, but also to help quantify the error induced by CALIOP's measurement methodology. The University of Wisconsin in Madison High Spectral Resolution Lidar (HSRL) provides the unique capability to measure extinction and backscatter independently with high signal to noise ratio, and can be robustly calibrated. This work aims to present accurate preliminary stratospheric aerosol optical depth measurements at different geographical regions, when the UW HSRL was part of the NASA CAMP2EX, KORUS-AQ and ONR PISTON campaigns. As a long term goal, characterizing stratospheric aerosol optical properties and geographic distributions with an HSRL lidar will help in further estimating the inaccuracy with which CALIOP measures tenuous cirrus clouds and aerosol layers' optical depths.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 2 - ION
Serial Number:

Incoherent Scatter Spectral Measurements with AMISR-14 at Jicamarca

Authors

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Abstract

Incoherent scatter radar observations with antenna beams pointing perpendicular and off-perpendicular to the geomagnetic field (B) were recently conducted with the AMISR-14 radar at the Jicamarca Radio Observatory. The AMISR-14 system operates at 445 MHz and can deliver pulses at a nominal peak power of 224 kW. Applying a standard long pulse configuration, F-region spectral measurements were obtained. When pointing perpendicular to B, the spectrum shows a relatively narrow shape with a spectral width in the order of a few kHz. More interesting, spectral peaks at frequencies close to the lower hybrid oscillation were also detected. When pointing offperpendicular to B, the spectrum was wider, as expected, resembling standard ISR measurements. We have modeled the measured spectra applying the Coulomb collision incoherent scatter spectral approach developed by Milla & Kudeki [2011]. The modeled spectrum shows similar features as the ones obtained with the measurements. In this presentation, we will describe the different experiments conducted to obtain the incoherent scatter observations, as well as the efforts to model the spectral measurements. The results show that spectral fitting might
be possible to extract physical ionospheric parameters from the measurements.

References

M. A. Milla and E. Kudeki, " Incoherent scatter spectral theories – Part II: Modeling the spectrum for modes propagating perpendicular to B, " IEEE Transactions on Geoscience and Remote Sensing, vol. 49, pp. 329 – 345, January 2011

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
21th november to 2nd december 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **2 - ION**
Serial Number:

HILDCAA Disturbances Effects in The Total Electron Content

Authors

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Abstract

The High-Intensity Long-Duration and Continuous AE Activities (HILDCAA) intervals are capable of causing a global disturbance in the terrestrial ionosphere. Concerning ionospheric storms, the effects of these intervals are still not widely understood. In this work, we seek to comprise the HILDCAA disturbance time effects in the total electron content (TEC) values with respect to the quiet days' pattern by analyzing seasonal and local time dependences, for two Brazilian GNSS stations, São Luís (2.59 S; 44.21 W) and Cachoeira Paulista (22.68 S; 44.98 W), on a sample of 10 intervals that occurred in the years 2015 and 2016. The main results showed that the hourly distribution of the disturbance TEC may vary substantially between one HILDCAA interval and another, for both GNSS stations. Regarding to seasonal dependence analysis, an equinoctial anomaly was found since the equinoxes represent more ionospheric TEC responses than the solstices.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 2 - ION
Serial Number:

Advances in the repair and maintenance of the Habana station, international code CD923 and de la Estación Habana, código internacional CD92

Authors

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Abstract

The investigations of the ionosphere in Cuba began in August 1964. Three fundamental stages stand out:
-(19642003) Research began the country with the soviet made analog ionosonde type AIS, on 35mm film;
- (2003-2010) technological renovation of the AIS ionosonde with incorporation of processing in digital format;
- (2010-2015) the monitoring of the ionosphere at the Havana Station is reestablished, using a new ionosonde type IPS-42, from the firm KEL Aerospace of Australia. The processed data is used in the different investigations that are carried out of the ionosphere over
Cuba, in the Forecast Service of the State of the Ionosphere, its sending to the World data Center (WDC) and deliver them to any national or foreign user who requests it. Since 2015, due to technological obsolecence and scientific descapitalization of the instition, these activities related to research in this field of study haven't been carried out. As part of the work policies of the Institute of Geophysics and Astronomy (IGA), they are currently working on the maintenance and repair of IPS.42. The next projection is the expansion to a second monitoring point of the ionosphere in Cuba. The objective of this work is to show the tasks that are carried out in order to restart the investigations, a task in wich the IGA is a national leader

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **ORAL**
Session ID: **2 - ION**
Serial Number:

Fast Metallic Neutral Sporadic Layer a Case Study on 27/08/2019

Authors

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Abstract

Mesopause Sodium (Na) and Potassium (K) concentrations are observed simultaneously by a dual-beam Na-K LIDAR deployed at São José Dos Campos (23.1°S, 45.9°W) owing to the Cooperative Agreement between NSSC and INPE. We also used an ionosonde and an all-sky interferometric meteor wind radar data to investigate, respectively, the Es layers and wind behavior, the two equipment are located at Cachoeira Paulista (22.7° S, 45° W). The Sporadic enhancement of neutral metal layers (Ns) concentration within thin layers has been investigated by several authors since its first report by Clemesha et al. (1978). These layers are much thinner than the background layer, their concentrations are at least two times larger than the background layer at that altitude and they last between a few minutes and many hours. On August 27th 2019, a special case of the Sporadic layer was observed, it lasted about 12 min, and the K peak density reached more than two times larger than the background peak concentration. Moreover, the downward phase speed reached 9 km/h which is much faster than the downward movement associated with atmospheric tides (~2 km/h). There was a good correspondence with the Ionospheric Sporadic E layer. And Ion Neutralization mechanism is the most probable source of this Ns layer. However, the speed phase velocity is much larger than the diurnal tide, usually believe to drive the wind shear mechanism which generates the Es layer. This study suggests other dynamical contributions, perhaps gravity waves being the main responsible for this wind shear. Additionally, the meteor rate during the event was larger than the hourly mean rate. This case study helps a better understanding of the formation mechanism involved in the fast sporadic layers.

CONFERÊNCIA LATINO-AMERICANA
DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 2 - ION
Serial Number:

New Jicamarca Unattended Low Investigations of the Atmosphere (JULIA) using the new mid-power solid-state transmitters

Authors

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Abstract

The Jicamarca Unattended Low Investigations of the Atmosphere (JULIA) mode has been used at the Jicamarca Radio Observatory (JRO) for more than 30 years to study the upper atmosphere by monitoring the coherent equatorial echoes like the Equatorial ElectroJet (EEJ), the Equatorial Spread-F (ESF), and the 150-km echoes. Horizontal and vertical drifts from 150-km echoes has been used as a proxy to characterize the ionosphere in the valley region.

In the past years, there had been many attempts to obtain Incoherent Scatter echoes at Jicamarca using less transmitter power. In 2018, IS drifts up to 400 km were obtained by using two 100 kW (mid-power) tube-transmitters, but they requiere continuous monitoring.

As part of the improvements to the Jicamarca radar, two new 96 kW solid-state transmitters were installed and added to the JULIA unattended mode. The goal for this addition is to obtain continuous horizontal and vertical IS drifts all year long (during ISR modes and JULIA mode). These measurements will contribute to the investigations of the upper-atmosphere, and they will also lead us to statistically investigate the correlation between the IS drifts and the 150-km echoes drifts, as well as other phenomenon detected from the continuous ISR measurements.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 2 - ION
Serial Number:

Multifractality Observed In The Virtual Hight Layer Ionosphere Over Brazil

Authors

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Abstract

A digital ionosonde of the type known as Canadian Advanced Digital Ionosonde (CADI) is operational at Jatai (17.2oS, 51.9oW), Brazil. This ionospheric sounding station is located under the equatorial ionospheric anomaly crest. The F-layer electron density profile present considerable day-to-day variability, even during the undisturbed conditions, and is still one of the less understood aspects of the physics of the ionosphere. The propagation of waves into the ionosphere may be playing an important role in this day-to-day ionospheric variability. In this paper we used the multifractal approach in order to understand the physical process underlying to raise to plasma bubbles. Wavelet techniques also used to investigate the action of these plasma bubbles over the planetary waves.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 2 - ION
Serial Number:

Occurrence of Spread F over Boa Vista Roraima - BR

Authors

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Abstract

In this work, a statistical survey of the ionospheric F layer scattering (spread F) was carried out from the analysis of ionograms generated by a DPS4D Digisond installed in Boa Vista, Roraima, Brazil 2° 49 ' 12 ' ' N 60° 40 ' 19 ' ' W. We analyzed range and frequency spread F for the months of January and July between 2014 and 2020 , comprising the descending phase of the solar cycle 24 . In the years 2014 and 2020 , a complete analysis of the spread F was carried out for all months of the year. The range type spread F is predominant in the months of October, November, December, February and March, while the frequency type has a peak in the months of June and July, noting that, in 2014, there are occurrences of another peak in January, after midnight local time. In January, it is observed that range spread F occurred in all years analyzed, however, the spread F duration was longer in the years of high solar activity, decreasing the duration from the year 2017 to 2020. In January, the spread F duration was longer in the years of high solar activity. Frequency type has peaks in the years 2014 to 2016 , with a long duration, which decreases from 2017 to 2020 . For the month of July, we observed that frequency type spread F occurs mainly in the period of low solar activity (2019-2020), while range spread F shows peaks in 2015 and 2018.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **2 - ION**
Serial Number:

TEC Responses To Geomagnetic Storm And HILDCAA Disturbances During The Descending Phase Of 24th Solar Cycle Over the Brazilian Region

Authors

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Abstract

Geomagnetic storms and HILDCAAs (High Intensity, Long Duration, Continuous AE Activity) are geomagnetic disturbances that can cause changes in the satellite signals such as Global Navigation Satellite Systems (GNSS). The disturbance levels caused by these events can be quantified through the Total Electron Content (TEC) of the ionosphere. Thus, this work aims to understand the behavior of TEC during the descending phase of solar cycle 24. For this proposal, two GNSS station receivers, one in the equatorial region, in São Luís - MA (2.59° S; 44.21° W), and another in low latitude, Cachoeira Paulista - SP (22.68° S; 44.98° W), were chosen. In addition, it was developed a catalog of magnetic storms and HILDCAAs that occurred during the descending phase of the solar cycle 24 whence a total of eight disturbed events were chosen for study, half of the events at the beginning and the other half at the end of the descending phase of the solar cycle. The main results show significant variations in the behavior of the TEC during those geomagnetic disturbances across the whole descending phase of the solar cycle, as well as a higher occurrence of positive phases of the disturbed TEC in both GNSS stations.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 2 - ION
Serial Number:

Evaluation of Different Methods for Calculating the ROTI Index Over the Brazilian Sector

Authors

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Abstract

Ionospheric irregularities as plasma bubbles occur in the ionosphere, and generally, they are characterized by the low plasma density regions. The Rate Of TEC Index (ROTI) was defined in terms of the Total Electron Content (TEC) variation and is used to characterize these plasma bubbles. It is essential to evaluate the ROTI behavior since the ionospheric irregularities can cause fluctuations in the radio signal, interfering in the ionospheric data analysis. Therefore, we performed in this work a comparative study of five different methods available to calculate the ROTI to evaluate the most suitable over the Brazilian region. The ROTI was calculated over three GNSS stations at different latitudes: São Luís (SALU, 2°31 ′ S, 44°16 ′ W; dip: 3.8°), Cachoeira Paulista (CHPI, 22°40'S, 44°59'W; dip: 36.4°), and Santa Maria (SMAR, 29°41 ′ S, 53°48 ′ W, dip: 37°). The results show that the most viable method for calculating ROTI in the Brazilian region is based on the Slant TEC equation as defined by Cherniak et al. (2018), https://doi.org/10.1007/s10291-018-0730-1. Our results are supported by the comparison between the ROTI with TEC maps, ionograms collected at Fortaleza (FZA0M, 3°43'S, 38°32'W, dip: 15.8°), SALU, and CHPI and All-Sky imagers collected at the São João do Cariri (SJCA, 7°23'S, 36°31'W, dip: 11°) and CHPI. Additionally, we observe Equatorial Plasma Bubbles (EPBs) in the Brazilian region using the ROTI index map.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 2 - ION
Serial Number:

Analysis of plasma irregularities in the ionosphere using the instruments of LANCE in Mexico

Authors

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Abstract

We present a comprehensive study of the plasma irregularities in the ionosphere over Mexico, using the instrumental network of the National Laboratory of Space Weather (Laboratorio Nacional de Clima Espacial: LANCE). The analysis includes data from Global Navigation Satellite System (GNSS) receivers, MEXART's radio telescope, and an all-sky imager between 2018 and 2022. The intention is to report the plasma irregularities' main parameters (occurrence, velocity, periodicity, and extension) that help us to understand the physical processes involved in their generation under different solar activity conditions.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 2 - ION
Serial Number:

Rapid development of co-seismic TEC ionospheric disturbances during earthquakes in South America

Authors

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Abstract

The great Earthquakes are known to generate disturbances in the ionosphere due to the Lithosphere-Atmosphere-Ionosphere coupling in which seismic energy is transferred in the atmosphere and ionosphere in the form of Acoustic-Gravity Waves (AGWs). Such disturbances are known as co-seismic ionospheric disturbances (CIDs). The CIDs occurred as Traveling Ionospheric Disturbances in total electron content (TEC) data. This study reports the rapid development of co-seismic TEC disturbances within 7 minutes from the onset of earthquakes, in South America. The spectral and propagation characteristics reveal that they are high frequency acoustic oscillations near 3.7 mHz and 5.5 mHz that propagate with the acoustic speed in the range of 0.8-1.5 km/s. These characteristics suggest their origin altitude to be in the upper thermosphere above 200 km. Numerical simulation based on the Seismic-Atmosphere-Ionosphere coupling mechanism and AGWs energy confirms the rapid arrival of AGWs at ionospheric heights and the development of CIDs as early as 7 minutes after the onset of the main shock.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 2 - ION
Serial Number:

Automatic classification of Range-Time-Intensity maps of Equatorial Spread-F

Authors

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Abstract

The equatorial spread F (ESF) is an ionospheric phenomenon related to the occurrence of plasma density irregularities at F-region heights. In Peru, the Jicamarca radar operating in the JULIA (Jicamarca Unattended Long-term Investigations of the Ionosphere and Atmosphere) mode has been used to measure the coherent backscatter signals generated by the ESF for many years. The measured power is plotted in range-time-intensity (RTI) maps. In these plots, four different patterns related to ESF echoes can be identified (bottom-type, bottom-side, radar plumes, and post-midnight irregularities). This study aims to automatically identify and classify the ESF patterns in the RTI power maps measured with JULIA. The database of these observations is available in Madrigal. The classification is based on machine learning algorithms. In particular, we are testing the following techniques, Random Forest (RF), Extreme Gradient Boosting (XGBoost), and Neural Networks. In order to increment the number of features to be used in the classification, statistical pattern information and upper atmospheric physical
parameters are used.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 2 - ION
Serial Number:

Nighttime Sky Conditions for Observation of Airglow and Types of Atmospheric Gravity Waves Observed at the Southern Space Observatory Between 2017 and 2020

Authors

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Abstract

The observation of airglow with all-sky imagers makes it possible to observe atmospheric gravity waves (AGWs). The all-sky imager installed at the Southern Space Observatory (SSO/COESU/INPE-MCTI), located in São Martinho da Serra-RS, Brazil (29°26' S, 53° 48 ' W), has a single filter for the hydroxyl emission bands in the near infrared (OH NIR) and obtain approximately two images per minute. Based on a preliminary visual analysis of 272.880 nighttime airglow images obtained between 2017 and 2020 , the observational data were classified according to their validity into useful and useless according to preestablished criteria, such as sky visibility, light contamination and duration of observations. This resulted in a total of 1.063 observed nights, of which 410 were classified as useful (38,57%) and 653 as useless (61,42 %). Considering the observations classified as useless, 389 were due to the low visibility of the sky (59,57 %), 44 due to light contamination (6,73 %), 137 due to the short duration of the observation (20,98 %) and 83 due to technical failure (12,71 %). The AGWs events found in the useful nights were quantified, and the statistics about their different types, such as bands, ripples, ladder or mesospheric fronts, will be presented and discussed

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 2 - ION
Serial Number:

Variations of Equatorial Ionization Anomaly (EIA) over the Brazilian sector using GPS - TEC network and IRI model

Authors

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Abstract

The equatorial and low-latitude ionospheric regions show solar cycle, seasonal and day-to-day space-time variations, due to strong electrodynamics and thermosphere-ionosphere coupling. Consequently, the Equatorial Ionospheric Anomaly (EIA) morphology and its space-time evolution show a strong variability. In this study, the EIA seasonal morphology and space-time variations are investigated using the observations from a network of 35 GPS-TEC receivers over the Brazilian sector during the low solar activity period from January 2016 to December 2016 (F10.7 = 89 10-22 W/m2 Hz). Since the distances between the geographic and magnetic equators vary from 3o to 10o (~350 to ~1200 km) in the Brazilian sector, the EIA characteristics are investigated in 3 different longitudinal sectors. These longitudinal sectors are separated from each other by about 6o longitude (~700 km). It is noticed that the EIA is formed during daytime from 11:00 to 24:00 UT for the whole year. However, the EIA is much more intense from January to April and less intense from May to August. In addition, the pre-reversal electric field follows similar behavior. In general, the EIA in all 3 chosen sectors are quite similar. However, some differences are noted during the months of September and October. Also, a comparison between the GPS-TEC data and IRI model output was done, and its results are discussed here.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **ORAL**
Session ID: **2 - ION**
Serial Number:

An overview of the intriguing descending layers over the Brazilian sector based on recent finds

Authors

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Affiliation

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Abstract

In this talk, we will present a compilation of the recent studies that have been developed about the intermediate layers located in the ionospheric valley region that extends from ~ 130 to 180 km over the equatorial and the low latitude sectors of Brazil. We have used Digisonde data from São Luis (SL, 2°S; 44°W, I: −3.8°) and Cachoeria Paulista (CP, 22.42°S; 45°W, I: −34.4°) for the periods of low and high solar activity of 2009 and 2003, respectively. The characteristics of ILs such as the rate of occurrence; height, frequency, and velocity variability; duration; seasonality; and; magnetic and solar activity dependence were analyzed. Possible impacts of electric fields and gravity waves in the formation/development of this layer will also be discussed. Furthermore, examples of the effects of pre-reversal enhancement of the zonal electric field in the anomalous upward movement of ILs during quiet and disturbed periods over the equatorial region of SL, as well as the formation of ILs associated with gravity wave activities in the ionosphere will be shown.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 2 - ION
Serial Number:

Effects of Transequatorial Thermospheric Meridional Winds on the Equatorial Plasma Bubbles Development

Authors

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Affiliation

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[5] Other authors' affiliation are placed in the end of the abstract.

Abstract

Equatorial plasma bubbles (EPBs) development were studied using both detrended total electron content (dTEC) data and a numerical model. The EPBs characteristics were estimated using dTEC data for the period from January 2012 to February 2016. In several cases the EPBs presented an inter hemispheric asymmetry. Simulations conducted considering the effect of a trans-equatorial meridional winds suggested that a transequatorial meridional wind could decrease the EPBs growth rate, forcing them to become " fossil ". During the " fossil " stage, the EPBs may drift under the influence of background
neutral winds and then present an asymmetric meridional development with respect to the geomagnetic equator. Monthly averaged meridional wind and F-layer virtual height measurements were also analyzed and presented a good agreement with the simulated results.

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São José dos Campos, Brazil

Presentation Type:POSTER
Session ID:2 - ION
Serial Number:

Determination of the Lunar Semidiurnal Tide in the Concentration of Meteors

Authors

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Abstract

Using two meteor radars deployed at Cachoeira Paulista (22.7° S, 45.0°W) and São João do Cariri (7.4° S, 36.5° W), the lunar semidiurnal tide was investigation in the altitude of the concentration peak of meteors in the mesosphere and lower thermosphere region from 2000 to 2020. The altitude of the concentration peak of meteors was determined using a Gaussian fit to the altitude range of the detected echoes within a window of three hours running every hour. The influence of the solar components were removed and the time was converted to the lunar tide in order to estimate the amplitude and phase of the lunar semidiurnal tide. The results suggested that the lunar semidiurnal tide acts in altitude of the meteor concentration peak reaching amplitudes of ~100 m. In general, the amplitudes were larger in São João do Cariri than Cachoeira Paulista. A semiannual oscillation in the amplitude of the lunar tide was observed in both locations as well.

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Presentation Type:POSTER
Session ID:2 - ION
Serial Number:

Statistical Study on Mesospheric Fronts over the Brazilian Equatorial Region

Authors

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Abstract

Mesospheric fronts were observed over São João do Cariri (7.4°S, 36.5°W) from September 2011 to June 2021 using an all sky airglow imager. The long period of observations revealed interesting aspects on the seasonality of the occurrence of the fronts. Over 59 events were observed during this period and more than 10 fronts were observed every year indicating that this phenomenon is not as rare as formerly thought. The occurrence of the fronts increased from the summer to spring (southern hemisphere). A clear anisotropy in the propagation direction of the fronts was observed with the preferential propagation to the northeast, southeast and south, changing with the seasons. It suggests that either the sources or the filtering process by the wind system could be the reason for the temporal changes in the anisotropy.

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Presentation Type: ORAL
Session ID: 2 - ION
Serial Number:

Revisiting Langevin Modeling for ISR Spectra: Final Results For A Higher-Order Stochastic Algorithm Approach

Authors

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Affiliation

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[2] Cornell University, Ithaca – United States

Abstract

An incoherent scatter spectral model for collisional and magnetized F-region plasma was developed by Milla and Kudeki (2011), based on single-particle statistics and a nonlinear Langevin equation that captures the physics of Coulomb collision at small aspect angles. The stochastic differential equation (SDE) resulting from this model was solved using a first-order approximation known as Euler-Maruyama. Furthermore, the statistics needed to perform the autocorrelation function (ACF) were estimated by Monte Carlo experiments. The numerical stiffness and particle dynamics complexity of the system requires the use of adaptive time-stepping to avoid unstable regions.
In this work we propose a higher-order stochastic Runge-Kutta (SRK) numerical algorithm to solve this nonlinear Langevin equation. We can reproduce previous estimates, like parallel displacement distribution deviation from Gaussian and ACF differences for small aspect angles considering collisional phenomena. In addition, we avoid adaptive time-stepping that leads to small time discretization, reducing computational efficiency. Final benchmarks between numerical schemes, like computational execution time and weak convergence analysis, are described.

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São José dos Campos, Brazil

Presentation Type: **ORAL**
Session ID: **2 - ION**
Serial Number:

Observation of Solar Flare Effects Over Mexico

Authors

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Abstract

It is known that at the time of an intense solar flare, the electron concentration in the ionospheric D region grows drastically which results in the increased absorption of radio waves and sometimes in HF blackout events. This study is focused on two flares that occurred recently: X1.3-class flare on March 30, 2022 and M9.6-class flare on March 31, 2022. Both flares originated from the same active region, had similar duration and occurred in the close UT hours under quiet geomagnetic conditions. We studied the changes of HF radio propagation conditions over the low-latitude North-American region. This region was of particular interest due to the fact that the flares occurred near midday local hour of the region (12:21 LT and 13:17 LT local hour of central Mexican time). We report the flare observations by local ionosonde and GNSS data. A full blackout of the reflected vertical sounding signal was observed in one case.

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Presentation Type: POSTER
Session ID: 2 - ION
Serial Number:

Analysis of the Sporadic-E Layer Behavior in Different Latitude Stations during the Space Weather Events

Authors

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Abstract

The sporadic-E (Es) layer formation is analyzed over Digisonde stations located in equatorial, lowmiddle latitudes and an auroral region during the geomagnetic storms. The main purpose of this work is to investigate the physical dynamics in the Es layer formation, which is still open in the literature. We analyzed the winds, electric fields, and particle precipitation to help understand the space weather event influence in these Es layers. Therefore, a numerical model (MIRE, Portuguese acronym for E Region Ionospheric Model), magnetometer data, and radio occultation (RO) technique are also considered to observe the E layer dynamics around these times. The results show that the wind pattern does not change during the disturbed periods. Also, it is confirmed that the electric field only influenced the Es layer dynamics in equatorial regions. Chorus and hiss waves activities detected by the Van Allen Probes A-B data showed that energetic particle precipitations acted in auroral and South American Magnetic Anomaly (SAMA) stations, respectively. Additionally, during the solar flare occurrences (class M or X), the blackout occurred in all stations almost instantly. Finally, this analysis brings new answers to different formation mechanisms in the Es layers globally concerning the disturbed periods.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 2 - ION
Serial Number:

Atmospheric Lamb Wave Propagation Over South America Generated By Tonga Volcanic Eruption

Authors

[1] , R. H HONDA; [1] H, TAKAHASHI; [1] C. A. O. B FIGUEIREDO; [1]D. BARROS; [1] C. WRASSE; [1] G. A. GIONGO; [1] L. F. R., VITAL ; [1] L. C. A RESENDE; [1] , P. K NYASSOR; [1] T. T AYORINDE; [1] ; C. S CARMO; [1] M. B. PADUA

Affiliation

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Abstract

On January 15, 2022, at 04:15 UT (Universal Time), a huge volcanic eruption occurred at Hunga Tonga – Hunga Ha'apai (20.55S, 175.39W). The eruption caused several kinds of atmospheric disturbances. Among them, a disturbance in the atmospheric pressure was observed in the form of a Lamb wave. The Lamb wave was observed by barometers installed at GNSS (global navigation satellite system) receiving stations spread in Brazil and Chile. The data was collected with a frequency of 1 min. The Lamb-wave arrived in Chile at Futaleufu station: SCFT(71.9W, 43.2S) at 12:29 UT, and had an amplitude of approximately 1.0 hPa and took about 5 hours to cross the continent, propagating from the southwest to northeast, by the phase velocity of 305±11.86 m. The present work discusses on the movement of the phase front and the related other wave phenomena in the upper atmosphere and ionosphere.

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São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **2 - ION**
Serial Number:

Simulating The Influence Of Upward Propagating Waves On Vertical Plasma Drift Based On The Whole Atmosphere Community Climate Model-Extended

Authors

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Affiliation

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Abstract

The initial and recovery phases of the geomagnetic storm of November 3-4 2021 coincide with prereversal enhancement (PRE) on November 3 and 4 respectively, providing an ample opportunity to study the influence of different phases of a geomagnetic storm on PRE. Using NCAR ' s Whole Atmosphere Community Climate Model-Extended (WACCMX) with Weimer and Heelis high latitude input, we show that enhancement of PRE on November 3 is due to storm-time perturbations while the weakening of PRE on November was associated with an antagonizing storm-time perturbation in E x B drift. We also show that this mechanism is clearly responsible for the enhanced equatorial plasma bubbles (EPBs) observed on November 3 from NASA's GOLD satellite measurement.

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27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 2 - ION
Serial Number:

Study and Modelling of the Brazilian low Latitude Ionosphere Response to the Occurrence of 22-23 June 2015 Geomagnetic Storm

Authors

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Abstract

In this research article, we study the response of the Brazilian low latitude ionosphere to the geomagnetic storm that occurred on 22-23 June 2015.
To understand the state of the interplanetary medium during the storm period, we analyzed interplanetary parameters such as interplanetary magnetic Bz component, Interplanetary electric field (IEF), and solar wind speed obtained from the National Aeronautics and Space Administration (https://omniweb.gsfc.nasa.gov) website. GPS Rinex File was downloaded at (https://www.ibge.gov.br/) and processed by using GPS-TEC analysis software by Gopi Seemala, and magnetometer data from Brazilian Study and Monitoring of Space Weather, and SAMBA-AMBER Magnetometers Data Center (Embrace:
http://www2.inpe.br/climaespacial/portal/en/ and http://magnetometers.bc.edu) for equatorial and low latitude stations (Belem: dip latitude (-0.47, Alta Floresta: dip latitude (- 3.76), Cachoeira Paulista: dip latitude (-19.71)) were analyzed to examine the ionosphere response to the geomagnetic disturbance.
We also used a first principle physics base model (SAMI2) to simulate the ionospheric response to the geomagnetic storm during this period. We observed that there is no formation of the distinct crest and trough during the June month due to the suppression of the fountain effect.
On the dayside, Vertical Total Electron Content (VTEC) enhancement is due to the eastward prompt penetration of the magnetospheric convection electric field (PPEF). The nighttime VTEC enhancement in the Brazilian low latitude ionosphere is attributed to the effect of the eastward disturbance dynamo electric field (DDEF). DP2 current presents a large amplitude during the main phase on the dayside, but the eastward disturbance dynamo electric field dominates the nightside main phase of the geomagnetic storm. The counter electrojet current corresponds with the VTEC depletion that we observed during the recovery phase of the geomagnetic storm on the 23 of June 2015. Vertical drift velocity that we calculated from a ground-based magnetometer is used as one of the input parameters for the SAMI2 model to reproduce the effect of the 22-23 June geomagnetic storm on the Brazilian low latitude ionosphere and also to examine the role played by the zonal wind and the magnetic meridional wind in inhibition of the fountain effect as seen on the observation data.

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São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **2 - ION**
Serial Number:

Traveling ionospheric disturbances in the near and far field induced by earthquakes/tsunamis

Authors

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[3] Centro Interuniversitario de Física de la Alta Atmósfera, Chile;

Abstract

In recent decades, large earthquakes and tsunamis have affected the countries surrounding the Pacific Ocean, in which Traveling Ionospheric Disturbances (TIDs) can originate. Sometimes (depending on seismic source features), TIDs can be observed near the epicenter of the earthquake due to the shock-acoustic wave generated. On the other hand, TIDs can also be generated by tsunamis and detected several thousand kilometers away from the source thanks to the gravity waves that the tsunami originates in its path. TIDs can be detected by analyzing Total Electron Content (TEC), which is calculated, indirectly, using signals from Global Navigation Satellite System (GNSS) receivers. This procedure allows studying the ionosphere with good spatial and temporal resolution. This work aims to identify TIDs several thousand kilometers away from the source and also in the vicinity of the event, mainly in Chile and New Zealand for some tsunamis between 2010 and 2021 in the South Pacific. A possible association between the parameters of these TIDs and transpacific tsunamis would contribute to understanding the mechanisms involved and could help develop near real-time early warning systems.
https://www.gov.br/inpe/en/events/colage/2022

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27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **2 - ION**
Serial Number:

Characterization of Ionospheric Disturbed Currents During Two Geomagnetic Storms in South America.

Authors

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Abstract

The Earth's ionosphere acts as a conductive layer, creating a current system which is observed by magnetic sensors every day. During geomagnetic storms, this currents are disturbed by penetration electric fields and disturbed dynamo effects due to equatorward thermospheric winds. Studies of ionospheric currents using ground magnetometers are mainly done in the northern hemisphere due the lack of instrumentation in the southern. In South America, new magnetometer chains has been operative last decade, allowing the observation of disturbed currents during space weather events in the region. However, these has been rarely used combined, losing the opportunity of a wider spatial coverage and its implications. In this study, magnetometers from multiple networks (LISN, EMBRACE, SAMBA, INTERMAGNET) were used to obtain equivalent ionospheric currents during two major events of Solar Cycle 24 (September 2017 and August 2018), identifying the source of the observed disturbances.

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Presentation Type: **POSTER**
Session ID: **2 - ION**
Serial Number:

Seasonal Evolution of the Ionospheric Summer Evening and Weddell Anomalies: Antarctic Peninsula Area

Authors

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Abstract

Anomalies in the maximum electron concentration of the ionosphere (NmF2) have been studied even before the World War II. According to Chapman's theory, the maximum electron concentration ex-pressed in terms of the critical frequency of the ionospheric F2 region, foF2, should increase as the Sun's zenith angle decreases due to being dependent on solar radiation, resulting in diurnal maximum values close to noon and seasonal maximum in the summer hemisphere. However, phase inversions in the expected diurnal and seasonal behavior of foF2 have been reported in some geographical re-gions. In particular, the so-called Weddell Sea, Bearing Sea and Summer Evening anomalies occur preferably in the local summer and at the equinoxes in three different regions: East Asia, North At-lantic and South Pacific. Here, we re-analyze in greater detail than elsewhere the diurnal behavior of foF2 observed on the King George (62.2° S, 58.8° W) and Argentine Islands (65.3° S, 64.3° W), Antarc-tic Peninsula, and compare this behavior with that reported for other regions. We use the available diurnal variations of foF2 for every day between 1986 and 1989 (years of low and high solar activity, respectively) derived from HF vertical-incidence radar records (ionograms). The diurnal variation phases are initially analyzed by determining the foF2 time series spectra between 64 days and 6 hours (Morlet-type Ondelette). The diurnal variations are then modeled using three Fourier components (periods of 24h, 12h and 8h). It is found that the phase of maximum, the amplitude and the explained variance of each component change systematically with time between the equinoxes, a result not reported so far. Furthermore, the found diurnal behavior of the foF2 is compared with results from a first principles and a semi-empirical model in order to contribute to the understanding of the role of neutral thermospheric winds in the Antarctic Peninsula. Preliminary results show that there are signifi-cant differences and similarities with those reported by other authors.

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São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 2 - ION
Serial Number:

Modeling ionograms with deep neural networks and electron densities forecasting: recent advances and comparisons

Authors

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Abstract

In this work, we will describe recent progress on two models based on deep neural networks (DNN) to predict ionograms and electron densities. Both models were trained using around 20 years of ionogram data from Jicamarca Radio Observatory Digisonde and geophysical input parameters. The first model predicts virtual heights and foF2. The second model estimates electron densities using physics-informed neural networks based on the first model. The accuracy of their estimates was compared to a based model, IRI, and Sami2 models. Our results show that our models can often produce estimates better than those obtained by the empirical and numerical models when trained using the most recent data.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 2 - ION
Serial Number:

Occurrences of Summer Night-time E-region FAIs observed by CU-Radar

Authors

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Abstract

A VHF phased-array radar operated at 53 MHz is being operational by University of Calcutta at Ionosphere Field Station (22.93°N, 88.50°E geographic; magnetic dip: 36.2°N), Haringhata situated about 50km north-east of Kolkata in the Indian longitude sector. There is no such facility at this frequency in the eastern and north-eastern parts of India as well as in the south-east Asian longitude sector. This region around the northern crest of the Equatorial Ionization Anomaly (EIA) is also the seat of some of the most intense ionospheric irregularities. Coupled with the long tradition of upper atmospheric research and seminal contribution made by University of Calcutta in this field makes this an important location for studying ionospheric dynamics and coupling processes. Ionospheric E region irregularities are normally observed from Kolkata during summer daytime and winter night-time. Ionospheric backscatter signatures have been observed using the University of Calcutta Stratosphere Troposphere Radar in the range of 110 – 145 km during early evening hours to midnight of the summer months of 2019 and 2020, which are quite prominent. The observed Doppler velocities were in the range of -90-120 m/sec with spectral width limited to 110 m/s. The observed E region Field Align Irregularities (FAI) signatures at Haringhata are very much similar to signatures observed generally at off-equatorial low and mid-latitudes. Most of the occurred signatures are descending and continuous in nature with patchiness. This paper presents results of occurrences of E region night-time FAIs during the summer months of 2019 and 2020 using pilot version of CU-ST Radar operated from Ionosphere Field Station.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 2 - ION
Serial Number:

Climatology of Tides and Quasi-Two-Days PWs in the MLT Region Over the Central Coast of Peru (11.95°S, 76.87°W) and Comparison With WACCM-X Model

Authors

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Abstract

The Mesosphere and Lower Thermosphere (MLT) is the region which connects the atmosphere with the geospace. The understanding and characterization of the dynamics of this MLT region can allow to improve the simulations and prediction of atmospheric models. This work will show results of the climatology of background winds, tides (8, 12 and 24 hours) and quasi-two-day (Q2D) planetary waves obtained from the analysis of zonal and meridional mean winds that have been estimated at heights between 80-100 km over the central coast of Peru. We are considering in this analysis two years and half of wind data (2020-2022) measured with the multistatic specular meteor radar deployed around the Jicamarca Radio Observatory (11.95°S, 76.87°W) (SIMONe Jicamarca). Furthermore, this observational climatology is compared to a climatology obtained with the WACCM-X model. Based on the observations, we can conclude that, in general, the diurnal tide is more intense than the semidiurnal tide, and that the meridional components are more intense than the zonal ones. The observations show that the Q2D PW has the maximum module in local summer months (mainly January) while the model shows maximum amplitudes in local summer months (January) and also in local winter months (June and July). Observations show that the 24h tide has the main maximum intensity between August and September, and a second peak in April, but the model shows two similar maximum peaks, the first one between August and September and the second one between February and April. The methodology used was least square fitting and wavelet analysis. Further details about short-term variability, the monthly and seasonal variations of the MLT climatology and their comparison to the WACCM-X model will be described in this work.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 2 - ION
Serial Number:

Tonga Volcanic Eruption: What we observed in the ionospher over the South American Continen

Authors

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Abstract

A huge volcanic eruption occurred at Hunga Tonga Hunga Ha''apai (175.4°W; 20.6°S) in the Tonga archipelago on January 15, 2022, at 4:15 UT, and disturbed the earth ' s atmosphere in a global scale. Volcanic ashes were injected in the troposphere to stratosphere up to the lower mesosphere. The thermal energy exploded in the troposphere producing atmospheric pressure waves (Lamb wave), propagating horizontally and upwards, reached the South of Chile after 8 hours. Since the eruption provoked the earthquake, Tsunami was also generated and propagated through the Pacific Ocean, reached along the Chile coast after 13 hours. Space weather division of INPE detected signatures of Traveling Ionospheric Disturbances (TIDs) propagating from the south of Chile to the Brazilian sector during 10 hours from 11 to 21 UT. This is the first time to detect ionospheric response against the Lamb wave and Tsunamis over the South America. We present a variety of the TID events observed over Chile, Argentine and Brazil.

CONFERÊNCIA LATINO-AMERICANA
DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **ORAL**
Session ID: **2 - ION**
Serial Number:

Modeling Ionosphere Topside Density Profile in SUPIM-DAVS

Authors

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Abstract

It is well known that ionosphere F2 layer peak electron density height (hmF2) can vary from around 200 up to 400Km of altitude. In fact, different ionosphere topside models to exponential decay were proposed, including adapted alpha-Chapman and more recently NeQuick topside analytical formulation, based on electron density measurements made by Swarm satellite constellation. It is expected that contribution of topside profile above ~800Km to electron density integration, considering these models, does not significantly impact TEC values. However, when IGS vTEC data is used as reference, an underestimation of TEC values in ionosonde data was observed. The extension of electron density profile integration up to satellite orbits, and the variation of plasmaspheric basis density proportionality coefficient (K) can reduce these differences. Recent efforts are being applied to improve ionosphere topside estimations. This work evaluates ionosphere simulations using Sheffield University Plasmasphere Ionosphere Model (SUPIM) in the Data Assimilation and Visualization System (SUPIM-DAVS), considering low, moderated, and high solar activity. The 3D simulation outputs are first used to estimate, using the inverse distance weighting (IDW) method, the electron concentrations in a geographic coordination homogeneous grid, which are then integrated in height. The comparison to IGS vTEC data shows significant differences when different integration heights are considered. Even above 3,000Km of height, where contribution of electron density profile is expected to be almost irrelevant to total TEC estimation, an important increment of over >3TECU was observed when integration height is increased to 10,000Km. Considering SUPIM follows a limited number of geomagnetic field lines, these discrepancies can be assigned to both the low simulation points density at high altitudes, mainly outside the mid-latitudes regions, and over-estimation of electron density in the plasmasphere. The approach to improve the ionospheric model output, reaching closer results to IGS vTEC data, was to model the topside exponential decay, above hmF2, using alpha-Chapman or NeQuick topside analytical formulation, instead of SUPIM data.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 2 - ION
Serial Number:

Ionospheric disturbances over the American and African sectors due to two major Sudden Stratospheric Warming under low solar activity conditions.

Authors

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Abstract

Sudden Stratospheric Warming (SSW) is one of the most spectacular large-scale atmospheric phenomena, which takes place at high latitudes during the winter months. It is more frequent in the Arctic region than in the Antarctic region. SSWs can change the vertical, latitudinal, and longitudinal distributions of the neutral atmosphere and its dynamics, which in turn affects the ionospheric electrodynamic processes. This study investigates the VTEC and EIA daily and day-to-day ionospheric responses in the American and African sectors during the 2017-2018 SSW (SSW1) and 2018-2019 SSW 2018-2019 (SSW2) events. In this context, we also investigated the ionospheric parameters (foF2 and h'F) and the occurrence of ionospheric irregularities such as Spread-F (RSF and FSF) in the American sector and for the African sector the ionospheric irregularities of the ROT phase fluctuation. The data used in the investigation on GPS-TEC and ionosonde refer to the following days of the year (DOY) from 335 to 365 (December 2017 and 2018) and from 01 to 90 (January to March 2018 and 2019). It is noted that the VTEC increased during SSW1 and decreased during SSW2 in most of the disturbed days and several latitude regions, particularly during the SSW temperature peak. The EIA exhibits significant changes in its shape, intensity, and symmetry during the SSW. Therefore, EIA and VTEC are disturbed during SSWs over the American and African sectors and the EIA trough and crests change their shape, intensity, and symmetry during events.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 2 - ION
Serial Number:

Long-term variation of gravity wave parameters over 60° N-60°S and 30° W-90°W derived from the TIMED/SABER measurements

Authors

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Abstract

The annual, latitudinal, and height dependencies of gravity waves (GWs) parameters (horizontal wavelength and the intrinsic velocity) from the stratosphere to lower thermosphere (20-100 km) over 60°N-60°S and 30°W and 90°W have been studied from 2002 to 2021 . The latitudinal distributions of the parameters were grouped into latitudinal distributions between 60°N-60°S at interval of 20° and height distribution between 20 to 100 km at interval of 10~km. Each of the latitudinal distribution and height distribution were represented by histogram analysis. The mean and standard deviation (σ) of each distribution of the GW parameters were found to have a consistent trend over the 21-years of study at each latitudinal distribution. We found a similar difference of the mean and σ of the GW parameters between the latitudinal distribution at the Southern and the Northern hemisphere. For example, at 20-30 km the mean horizontal wavelength at 0°-20°N and 0°-20°S are 1250.5 km and 1234.43 km, respectively. The rate of change (ROT) of mean of the GW parameters in the Southern and the Northern hemisphere are also similar. Our result showed an evidence of Coriolis force control on the GW parameters. The gap between each of the latitudinal distribution of the GW parameters were found to reduce as the altitude increases. The annual variation of these GW parameters will also be presented.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 2 - ION
Serial Number:

TEC Forecasting Based on Seasonal Machine Learning Model

Authors

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Abstract

The analytical description of models for the ionospheric Total Electron Content (TEC) shows high complexity and computational cost. Therefore, with the large amount of data already available, an interesting approach is the application of machine learning and data science methods to forecast the ionospheric TEC using solar activity proxies. In that way, it was developed a dynamical modeling of ionosphere for long-term periods using spectral analysis by means of the Discrete Cosine Transform (DCT). The variables evaluated as the model ' s features were the Relative Sunspot Number (RSN), the F10.7 index and 39 bandwidths of Photon Fluxes (PF) in the Extreme Ultra-Violet (EUV) spectrum, all of those obtained from the empirical model SOLAR2000. Aiming at grouping information from the 39 bandwidths into one combined PF variable, it was derived a new feature based on the weighted average, where the weights are the Pearson correlation coefficient with respect to the TEC for each bandwidth. The machine learning model considered different regression approaches to map the variables to the TEC frequency response in a day, evaluating each geographic coordination independently. The experiments presented in this work considered linear regression and Support Vector Machine (SVM). The database covered 19 years (2003-2021) of TEC and solar data, for which the performance over different periods of training and testing were evaluated. Seasonal divergence was handled by subdividing training data and applying into models which end up tuned for solstices. Root mean squared error was calculated using the International GNSS Service (IGS) vTEC as the reference. It was observed that using F10.7 e different bands of PF the errors were consistently larger than those trained only with RSN and/or combined PF, who reached mean global errors down to 2.8 TECU. When seasonal variation is considered, the errors remain in the range of ~2 TECUs for the whole test period.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **2 - ION**
Serial Number:

AzTEC: TEC Maps Near to Real-Time on México

Authors

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Abstract

The Total Electron Content (TEC) is one of the most important parameters for the analysis of the Ionosphere, one of the regions of the Earth's atmosphere through which the electromagnetic waves used by telecommunications systems in the Earth's surface as in space. Telecommunications are sensitive to changes in electronic density in the Ionosphere. Currently, there are tools that use a model based on the development of maps for the analysis and monitoring of the Ionosphere, which is modified by the earth's climate and by the conditions of space weather. The space weather in Mexico is a topic of recent presence, the development of protocols and tools for its study and monitoring, is an advance that has accelerated in recent times, given that studies have been carried out that demonstrate the effects of space weather on our country, especially in radiocommunications. Currently in Mexico, there are 4 institutions involved in the development of projects that study and monitor the space weather on our territory, these are: the Research Center of Geospatial Information Sciences (CentroGeo, in spanish), the National Institute of Astrophysics, Optics and Electronics (INAOE, in spanish), the National Autonomous University of Mexico (UNAM, in spanish) and the Autonomous University of Nuevo León (UANL, in spanish). AzTEC is the first product that creates maps with the ionospheric conditions near to real-time on the mexican territory, as Mexico has a privileged latitudinal position, due to its proximity to the Cancer Subtropical zone, for that reason, in the current thesis project, the development of a methodology that characterizes and validates the TEC maps obtained during two years of observational data in real-time is described, coming from the network of GPS stations of the National Seismological Service (SSN, in spanish) and TLALOCNet. Analyzing the behavior of the TEC in the more than 40,600 maps and obtaining their statistical values to determine the impact of the TEC values, due to changes in the spatial resolution of the vertex mesh of the MAGIC model, a powerful computational model that uses the filter of Kalman and the empirical model of the Ionosphere to create every 15 minutes, a TEC map with the current conditions of the Ionosphere over Mexico.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **2 - ION**
Serial Number:

Predictability of the winds in the MLT region over the central coast of Peru using Machine Learning Algorithms - Preliminary results

Authors

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Abstract

The mesosphere and lower thermosphere (MLT) is the region of the atmosphere between 70 and 110 km altitude. The dynamics of this region is influenced by atmospheric waves, solar and lunar tides. This dynamic also reflects the behavior of the troposphere, and its study can contribute to the development of atmospheric models. One way to study this region is through wind analysis. In Peru, the SIMONe radar, located at Jicamarca, estimates zonal and meridional mean winds at heights between 80-100 km over Peru's central coast. This work will show predictions of the zonal and meridional component of the mean wind at a height of 90 km over Jicamarca, in the period from July 2021 to June 2022. A training and testing process is carried out with data recorded from September 2019 to June 2021. The predictors are global physical indices and estimated parameters of the Mesosphere, which are obtained from NASA repositories. The dependent variables are the winds measured by the SIMONe Jicamarca radar. In the training process, an analysis of principal components and selection of important predictor variables is carried out. Then, wind models are built using the Random Forest algorithm. In the testing process, the precision of the models is evaluated through the mean square error and the coefficient of determination. Finally, the predicted and real winds (zonal and meridional component) in the period from July 2021 to June 2022, are compared. For this purpose, the climatologies of the tides (8, 12, and 24 hours) and planetary waves quasi-two days (Q2D) are compared.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 2 - ION
Serial Number:

Generation and Propagation of Quasi-Monochromatic Gravity Waves Observed over Southern Brazil from April 2017 to April 2022

Authors

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Abstract

Two hundred and fifty (250) events of quasi-monochromatic atmospheric gravity waves (QMGWs) were acquired from five (5) years of Gravity Waves observation in Southern Brazil. The observations were made using OH all-sky imagers hosted by the Southern Space Observatory (SSO) coordinated by the National Institute for Space Research at São Martinho da Serra (RS) (29,44°S; 53,82°W). A two (2) dimensional Fast Fourier Transform-based spectral analysis show that the QMGWs have horizontal wavelengths of 10 – 55 km and periods of 5 – 74 minutes. The waves exhibited clear seasonal dependence on the propagation direction with anisotropic behaviour; propagating mainly toward the southeast during the summer and autumn seasons and mainly toward the northwest during the winter season. On the other hand, the propagation directions in the spring season exhibited a wide range from northwest to south. A complementary backward ray-tracing simulation revealed that the major factors contributing to the propagation direction of the QMGWs are their source locations and the dynamics of the background winds per season.

CONFERÊNCIA LATINO-AMERICANA
DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **ORAL**
Session ID: **2 - ION**
Serial Number:

Observing System Simulation Experiment and the EZIE mission

Authors

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Abstract

We will present the Observing System Simulation Experiment (OSSE) technique and its use in the Electrojet Zeeman Imaging Explorer (EZIE). We will discuss the use of OSSEs to ensure science closure but also how it allows a mission to optimize design, operations, establish system requirements, test and ready retrieval algorithms, demonstrate measurement capabilities, etc. We will also describe EZIE data products (e.g. derived vector magnetic fields, 2D equivalent current maps, neutral winds, temperature profiles).

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 2 - ION
Serial Number:

Tropical Mesospheric Dynamics Response to Antarctic Stratospheric Warming of 2019

Authors

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Abstract

From late August to mid-September 2019, an exceptional Antarctic Sudden Stratospheric Warming (SSW) event had been observed. To investigated the tropical mesospheric dynamics response to this SSW, we have used winds obtained by meteor radar at São João do Cariri (7.4°S, 36.5°W), and Cachoeira Paulista (22.7°S, 45.0°W), Brazil. The vertical structures of zonal winds in the upper mesosphere and lower thermosphere (MLT) region exhibits a sequence of westward and eastward shifts, that are amplified during September. The wavelet spectra of the MLT zonal winds shown distinct oscillations from August to October 2019, with spectral energy for periods of quasi 16, 10 and 5-6 days, at both sites. The ~10-day wave amplitude observed in MLT region at 7°S is twice as large as at 23°S, indicating that it is not the antisymmetric normal mode. The 5-6 day wave amplifies in the second half of September, just after SH polar anomalous warming. During the SSW event were also observed modulation of the tidal amplitudes by 10-day and 6-day periodicities, suggesting nonlinear interactions between tides and planetary waves.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 2 - ION
Serial Number:

A Case Study of Gravity Waves Observed by an All-Sky Imager Over the Antarctic Peninsula

Authors

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Abstract

Atmospheric gravity waves contribute to the transport of energy and momentum over the atmosphere because of their large horizontal and vertical motion. Understanding the propagation conditions of gravity waves is an important issue to correctly parameterize their influence on the atmosphere. Airglow observations were made during winter nights, in 2017, over the Comandante Ferraz Antarctic Station (62.1°S, 58.4°W), located on King George Island, about 130 km to the north of the Antarctic Peninsula, but on the night of July 20, it was observed eight small-scale waves and one medium-scale gravity wave (MSGW) which will be studied in this work because of its good observation conditions (full night of clear sky) and waves characteristics. Then, it was analyzed the gravity wave parameters and propagation characteristics concerning the filtering conditions by the horizontal wind at all altitudes from the troposphere to the mesosphere. In addition, a ray-tracing model was used to estimate the possible source region of the observed gravity waves. The blocking diagrams showed the same wind filtering anisotropy observed in seasonally averaged diagrams, with the majority of the waves propagating to different directions with respect to the winds, but two out of the eight small-scale waves were propagating in the same direction as the stratospheric wind, suggesting that the behavior of filtering existed on that night and these waves should be originated above this layer or came from a distant region in some kind of duct. The ray-tracing paths stopped near the airglow layer for most of the waves (5 of 9), indicating they should be generated near the observation altitude (~87 km) or are a consequence of the breaking of a primary wave. Two other waves could be propagated from the troposphere, and two of the waves were probably generated above the stratospheric jet, as indicated by the blocking diagrams. The results showed some influence of the wind on the propagation conditions of the waves and demonstrated that the ray-tracing results agree with the interpretation of the blocking diagrams.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 2 - ION
Serial Number:

LONG-TERM TRENDS OF F2 PEAK'S PARAMETERS FOR THE SOUTH AMERICAN SECTOR EQUATORIAL-AND-LOW LATITUDES.

Authors

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Abstract

The long-term variability of the F2 peak of the ionosphere at equatorial-and-low-latitude of the South American sector is studied based on foF2, hpF2, and hmF2 parameters obtained through the ionospheric sounding records of Cachoeira Paulista (22.67o S; 44.99 o W) and Fortaleza (3.71o S; 38.54o W) sites for local noon-time under geomagnetically quiet times for 30 years. For such, an empirical model was created based on the main forcings that modulate the ion pairs production, i.e., variation in the incidence of solar radiation over the years, and compared with the data by the computation of the F2 parameters residuals (data minus model). It was found that the electron density at the F2 peak above Cachoeira Paulista decreased approximately ~ -20% during the southern hemisphere winter and increased by around ~ 15% during the summer. Such behavior indicates the range of possible variation in the scale height of the atomic oxygen over the years, and that this variability is also strongly modulated by the period of the year. For Fortaleza, it was found that the parameter foF2 showed a positive trend between 13-24% for most of the year. The parameters hpf2 and hmF2 showed a negative trend of ~ -11-14% in July and a positive trend of ~ 10-18% in summer and equinoxes.

CONFERÊNCIA LATINO-AMERICANA
DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **2 - ION**
Serial Number:

The Ionospheric Vertical Drift and its Effects on TEC Variability over the South American Sector

Authors

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Abstract

Several studies have shown that vertical plasma drift plays an important role in the formation of the equatorial ionization anomaly (EIA). Preliminary observations have revealed that these drifts present peculiarities even during magnetically calm quiet conditions. To In order to investigate it's the vertical drift characteristics, in this work, the horizontal components of the magnetic field over an equatorial and a low latitude station are used. We selected two sectors in South America, formed by the pairs Jicamarca-Piura and Tatuoca-Kourou or Tatuoca-Eusébio. The difference between the horizontal component (H) of the magnetic field at each station (Delta H) is correlated to the electric field of the equatorial electrojet. With Using the Delta H values, the vertical drifts in each sector were obtained. In order to estimate the influence of the vertical drifts in the development of the equatorial ionization anomaly EIA, we used the values of the total electronic content (TEC) measured over the same regions. The analysis will be done initially for some periods of the year 2014, which is considered as a period of high solar activity. The preliminary analysis shows large vertical drifts variations and its effect on TEC values. We will also investigate the vertical plasma drifts effect on TEC during a magnetic disturbance disturbed period.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 2 - ION
Serial Number:

LONG-TEA Qualitative Analysis of MSTIDs Observed Over Puerto Rico During the Minimum Solar activity Using Multi-Instruments

Authors

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Affiliation

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Abstract

The Medium Scale Traveling Ionospheric disturbances (MSTIDs) are one of the most observed perturbations in the nighttime ionosphere in mid latitudes. Arguably, many aspects of their nature are still poorly understood. The MSTIDs are attributed to gravity graves propagating into the thermosphere and affecting the ionosphere through collisions or recombination/production rate changes. The MSTIDs contribute to the energy and momentum flux transfer between the troposphere and thermosphere and can lead to a better understanding of the coupling between these regions. This work focuses on a qualitative analysis of the MSTIDs observed at the Arecibo Observatory Remote Optical Facility (ROF) in Culebra, Puerto Rico, during the descending phase of solar cycle #24, from November 2015 to August 2019. We present detailed features of the MSTIDs as horizontal wavelength, orientation, and observed phase velocities. Besides, background neutral winds acquired by a Fabry-Perot interferometer (FPI) are also used to estimate the vertical wavelength of the MSTIDs

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 2 - ION
Serial Number:

Ionospheric F-layer Pre-reversal Enhancement and the Occurrence of Equatorial Plasma Bubbles

Authors

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Abstract

Two Digisonde Portable Sounder-4 (DPS-4) and Ground-based global navigation satellite systems (GNSS) receivers have been used to estimate the probability of equatorial plasma bubbles (EPBs) occurrence over northern-west part of Brazil for the year of 2014. The probability of EPBs occurrence were estimated studying the relationship between F2 vertical drift velocity (Vz) and the EPBs occurrence. The two DPS-4 are localized at Fortaleza (3.9°S, 38.45°W; dip angle: 9°S) and São Luis (2.33°S, 44.2°W; dip angle: 0.5°S), and were used to calculate Vz. The EPBs occurrence were confirmed by using the total electron content (TEC) maps obtained from GNSS receivers. The relationship between the Vz and the EPBs occurrence is characterized by a probability distribution function. When the Vz greater than 45 m/s, the probability of EPBs occurrence is greater than 95%. On the other hand, the probability of EPBs occurrence was practically null for Vz lower than 15 m/s. From the interval of 15 to 45 m/s, the probability changes gradually indicating some other parameters which control the EPB generation.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **2 - ION**
Serial Number:

Es Layers Modulated by the Terdiurnal Tide in the Brazilian Sector

Authors

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Affiliation

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Abstract

The sporadic-E layers (Es) are thin and dense regions observed at heights between around 100-140 km. Their formation at low latitudes are mainly associated with the diurnal and semidiurnal components of the tidal winds through ion convergence driven by the wind shear mechanism. However, some recent studies have shown the influence of other tidal modes, such as the terdiurnal tide. Therefore, this study presents an analysis of the effect of terdiurnal tidal oscillations on the occurrences of the Es layers observed over Palmas (10.17° S; 48.33° W; dip lat. -8.3), a low-latitude station located in Brazil. We used data collected from a CADI (Canadian Advanced Digital Ionosonde) ionosonde to analyze the Es layer types and parameters observed from December/2008 to November/2009. The E Region Ionospheric Model (MIRE) was used to simulate the terdiurnal tidal component in the Es layer development. The results show that modulations of the terdiurnal tide on the occurrence rates of the Es layers are observed during all seasonal periods. In summer and autumn, we see three well-defined peaks in the rate of occurrence of the Es layer types. We also observed that the modulation of the terdiurnal tide on the Es occurrence rates minimizes in December, the beginning of the summer season. The results from simulations have shown that the inclusion of the terdiurnal tide caused an increase in the electron density of the Es layers for all seasonal periods. Finally, the results of this analysis allowed us to observe the influence of the terdiurnal tide on the Es layer for the first time in the Brazilian sector.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **2 - ION**
Serial Number:

Development of a VLF receiver based on RedPitaya board for space weather studies

Authors

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Affiliation

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[2] Pontificia Universidad Católica del Perú (PUCP), Lima, Perú.

Abstract

A new VLF (Very low Frequency) receiver is under development at Peruvian Space Agency - CONIDA. VLF radio waves are efficiently reflected by the lower ionosphere and their propagation parameters provide information related to the electrical properties of this ionospheric region. Therefore, VLF remote sensing is widely used for sounding the lower ionosphere and to study ionospheric disturbances related to terrestrial, solar and extrasolar phenomena. The receiver continuously tracks VLF signals of the NAA transmitter (f = 24 kHz) from USA. The receiver consists of a vertical antenna, a preamplifier to filter and amplify the recorded signals and a Red Pitaya board which performs an SDR (Software Defined Radio) to digitalize, process and store data. The whole receiver can cover a bandwidth from 1 up to 50 kHz. The receiver has been designed to be low-cost and autonomous, solar powered, so that it can be placed in multiple locations under different environmental conditions. We show the performance of the receiver during july 2022. The typical daily behavior of the lower ionosphere for the NAA VLF signal and the first solar flare detected are reported. Our observations are compared with data recorded by the SAVNET (South American VLF Network) installed in Peru.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 2 - ION
Serial Number:

African and American Equatorial Ionization Anomaly (EIA) Responses to 2013 SSW Event

Authors

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Affiliation

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[3] Department of Mathematics and Physics, University of Tasmania, Australia.

Abstract

This study investigates the responses of the African and American Equatorial Ionization Anomaly (EIA) regions to 2013 Sudden Stratospheric Warming (SSW) event. The Total Electron Content (TEC) data obtained from chains of Global Positioning System (GPS) receivers within ±40° geomagnetic latitudes in the African and American sectors were used to construct the EIA structures for both longitudinal sectors. The responses of the EIA structures, constructed from the TEC, ΔTEC, and ionospheric irregularities data to the 2013 SSW event were investigated. During the SSW peak phase, EIA structures in both longitudinal sectors responded significantly, with the pole-ward flow of plasma from the equator to higher crests ' locations (strengthening of the EIA). Furthermore, a clear asymmetry in plasma distribution in the northern and southern crests of the EIA was observed. Generally, for the entire data span, TEC enhancements and ionospheric irregularities occurrences during SSW were more in the American sector than the African sector. The geomagnetic activity of 17th January 2013 caused negative TEC response in the African sector and positive TEC response in the American sector. Moderate storminduced TEC enhancements were generally lower than SSW-induced TEC enhancements. Furthermore, solar flux-induced TEC of 10th January 2013 was lesser than the SSW-induced TEC of 15-16th January 2013.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brasil

Presentation Type: ORAL
Session ID: 2 - ION
Serial Number:

Implementation of a portable site-testing instrument for solar observations

Authors

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Affiliation

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Abstract

One of the factors that most affect ground-based astronomical observations is the seeing caused by atmospheric turbulence. To counteract this effect, adaptive optics elements are used in modern telescopes. In order to quantify this phenomenon, an instrument called scintillator can interpret thermodynamic fluctuations within an atmospheric cell (Seykora, 1993). With a series of photodetectors, which respond to the twinkling of moonlight, the scintillator probes the turbulence structure along the line of sight through the atmosphere (Hickson, 2002) . The measured quantities are time series of intensity fluctuations received by the individual detectors in the array, from which the turbulence profile can be inferred. This work describes the implementation of a site-testing instrument that measures solar scintillation, therefore used to examine the quality of the sky in order to find favorable places for installing a ground-based facility for observing and monitoring the Sun from Colombia.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 2 - ION
Serial Number:

Air Emission Variances Observed in Meteor Spectrometry in Relation To Metallic Density

Authors

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Affiliation

[1] Universidade Federal de Jataí - Brazil;

Abstract

The meteors are a luminous phenomenon where the atmospheric gases and the meteoroid are excited due the shock of these external bodies in terrestrial atmosphere. Thus the light from the reentry of the meteors give us the the opportunity of to use the spectroscopy in order to investigate the chemistry signature of the meteors and atmosphere as well. Thus, in this present work we presented different chemistry compositions from five meteor ' s reentry obtained in Brazil. The analyses shown the presence of different metallic quantities and also different atmospheric emissions. Through of the spectroscopy also we conjecture that the different quantities of the hydrogen (H2), nitrogen (N2) and oxygen (O2) gases are related with the distinct variations of the metal quantities of the meteors

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 2 - ION
Serial Number:

Results from the Launch of an Atmospheric Prob Developed in Brazil

Authors

[1] P. S. ARAÚJO; [1] K. S DA SILVA; [1] D. C HONÓRIO; [1] D. M D. M DA SILVA; [1] A.MARTINS; [1] M. J. A. BOLZAN.

Affiliation

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Abstract

Atmospheric probes are widely used for the acquisition of various atmospheric variables with purposes from Łweather forecasting to aeronautical safety. These, however, have a high acquisition cost because they are Łimported. Therefore, in this work, the result of a launching of a probe developed using low-cost materials with Łvery interesting results will be exposed. The telemetry technology used allowed for longdistance communiŁcation in a way. In addition, this project aimed to get students involved in the various stages of the project, Łfrom planning, construction, launch, recovery and analysis of Łmeteorological data obtained.

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XIII COLAGE
21st November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **2 - ION**
Serial Number:

Review of upper atmosphere dynamics and Airglow observations at Southern Space Observatory – SSO (29.4°S, 53.8°W) in São Martinho da Serra, RS, Brazil

Authors

[1] A. G. F. M. PAINES; [2] J. V. BAGESTON; et al.

Affiliation

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Abstract

This work will present a review of the Airglow phenomenon and the upper neutral atmosphere and ionospheric dynamics studies using the airglow image analysis technique. By using the Airglow, which is a tenue and continuous radiation emission from atoms and molecules of the upper atmospheric layers, that is, the Mesosphere and Lower Thermosphere - MLT (~80-100 km), and the Ionosphere (~ 80 to > 500 km) regions. The theoretical study was conducted from traditional books, Master's and Ph.D. Thesis and scientific articles. Based on the acquired knowledge in the review stage, the progression of the study will be focused on the analysis of gravity waves seen in the airglow images of the MLT region, their impacts on the winds in that region, and also its potential relation with ionospheric disturbances in the base of the ionosphere. Also, it is essential to obtain basic knowledges on computer programs, such as the IDL language and other programming techniques, in order to perform the needed image processing and the consequent extraction of the gravity wave parameters. This work also presents examples of airglow images, showing events of gravity waves, obtained from the Southern Space Observatory - SSO/INPE-MCTI (29.4°S, 53.8°W), located in São Martinho da Serra-RS, and the pre-processing and spectral image analyses review to obtain the wave events characterization. The previously published results obtained from airglow observations at the SSO, such as traveling ionospheric disturbances and concentric gravity waves, will be presented and revised.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 2 - ION
Serial Number:

On ionospheric scintillation and total electron content observations made by low-cost GNSS-based radio sensors

Authors

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Affiliation

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Abstract

We have dedicated efforts to designing and testing low cost radio sensors for fundamental and applied studies of the Earth ' s ionosphere. As a result, we developed a series of low-cost, easy-to-deploy and easy-to-operate monitors of ionospheric scintillation and total electron content (TEC). These monitors are based on off-the-shelf GNSS receivers controlled by single-board computers (Raspberry Pi) and are referred to as ScintPi monitors. Three versions of ScintPi were developed and tested: ScintPi 1.0 is a GPS-based, single-frequency scintillation monitor. ScintPi 2.0 is a multi-constellation, single-frequency scintillation monitor. Finally, ScintPi 3.0 is a multi-constellation, dual-frequency scintillation and TEC monitor. In this talk we will present results of measurements made by ScintPi 3.0 at low and mid-latitudes. We will discuss the ability of ScintPi 3.0 to detect ionospheric irregularities and scintillation. The discussion will include a comparison with collocated measurements made by commercial scintillation monitors. We will show that despite its low cost, ScintPi 3.0 can provide accurate measurements S4 values associated with scintillation events, and phase as well as code TEC.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brasil

Presentation Type: **POSTER**
Session ID: **3 - SOL**
Serial Number:

Study of the 30 THz atmospheric optical depth at El Leoncito

Authors

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[3] Instituto de Astronomía y Física del Espacio, UBA-CONICET, Buenos Aires, Argentina

Abstract

Mid-infrared solar observations were recently started with the ARgentine 30 THZ Telescope (AR30T) which has a spectral window centered at 30 THz (10 μm), between 7.5 μm and 14 μm. The knowledge of the atmospheric extinction is key to understanding how the solar radiation is absorbed by the terrestrial atmosphere, a fundamental aspect to interpret data obtained by ground-based telescopes. In this work we present the first results of the atmospheric absorption in the mid-infrared using data taken with AR30T. The instrument is located at an altitude of 2500 meters at the Estación de Altura Carlos U. Cesco (OAFA-UNSJ) in the National Park "El Leoncito" (San Juan, Argentina). The atmospheric optical depth (τ_{30}) at 30 THz is determined by the solar extinction observed at different elevation angles, and a Levenberg-Marquardt least-squares technique is used to fit the atmospheric radiative transfer equation to the observations. Our findings indicate that "El Leoncito" would present low opacity at 30 THz, with values of τ_{30} of 0.04, 0.06 and 0.16 for the 50th, 75th and 90th percentiles respectively. Our analysis indicates very favorable conditions for mid-infrared observations from the observatory.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 3 - SOL
Serial Number:

Analysis of sunspots and flares using solar acoustic modes which propagate in the solar interior

Authors

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Affiliation

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Abstract

Solar acoustic waves are generated by turbulent convection near the solar surface and propagate in the solar interior. Waves below a certain frequency are trapped in the solar interior and those with a certain frequency and wavelength interfere constructively to form standing waves. Several million normal modes are excited with very small individual amplitudes and periods around five minutes. Changes in the wave properties as they propagate through the Sun can reveal spatial and temporal variations in the interior thermal structure and dynamics. In particular, the modes characteristics are modified as they propagate through a sunspot. Changes in the mode characteristics and flows in active regions have since been extensively studied using different techniques of local helioseismology, with the goals of studying the effects of magnetic fields on wave propagation, generation, and absorption, and also of inferring the subsurface structure of sunspots. However, both the physical mechanisms in play and the interpretation of the measurements are still subject to controversy.
I will present results on the effect of a sunspot in its quiet surroundings by applying a helioseismic technique on Helioseismic and Magnetic Imager (HMI) observations to further study the sunspot structure below the solar surface. Several attempts have been made to observe whether solar flares excite acoustic modes since Charles Wolff suggested this possibility almost fifty years ago. We look for the impact of flares on the amplitude of solar acoustic modes and other effects that are also affecting the mode amplitude. I will present our results after analyzing the largest flare in the space age (the ‘ Halloween Flare ’ , SOL2003-10-28T11:00), using MDI data. Then, using HMI data, I will present the analysis of thousands of flares observed during the high activity phase of cycle 24 based on the Heliophysics Event Knowledgebase (HEK).

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 3 - SOL
Serial Number:

Exploring the TeraHertz Sun

Authors

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Affiliation

[1] CRAAM - Mackenzie

Abstract

Solar observations in the sub-millimeter range over the past twenty years have revealed new and intriguing aspects about thermal and non-thermal processes in active regions and during solar eruptions. The discovery of a new spectral component showing the sub-mm flux increasing with frequency, spectrally distinct from a well-known microwave component,
still challenges our theoretical understanding of the radiation processes in solar flares. Towards the THz/infrared range, recent observations, supported by modelling efforts, have been able to probe the evolution of the flaring chromosphere. THz observations provide a new way to directly investigate the evolution of the heating and ionization of
the plasma, and also cast a new light into the origin of white-light flares – an ongoing debate since the first detection of a flare 160 years ago. We will review these sub-mm and THz observations, the discoveries and implications for our understanding of flare physics in relation with observations in other spectral bands, as well as the instruments
that made them possible, while discussing the prospects and challenges for the future exploration of the solar activity in the THz range

CONFERÊNCIA LATINO-AMERICANA
DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **3 - SOL**
Serial Number:

Observation of Magnetic Flux Ropes in the Interplanetary Medium

Authors

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Affiliation

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Abstract

Interplanetary coronal mass ejections (ICMEs) are ejections of plasma and magnetic field from the Sun observed in-situ, in the interplanetary medium. Embedded in these ejections are helical magnetic field structures called magnetic flux ropes (MFRs) which are characterised by (i) enhanced magnetic field, (ii) smooth rotation of the magnetic field, and (iii) decreased temperature and plasma beta. It is commonly known that the interaction of the southward configuration of MFRs with Earth's magnetospheric magnetic field is the cause of magnetic reconnection leading to geomagnetic storms on Earth. We seek to understand the magnetic configuration of these structures in the interplanetary medium using the Minimum Variance Analysis (MVA) technique; and study their evolution as they move towards the earth using multispacecraft observations.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 3 - SOL
Serial Number:

A Statistical Study on the Latitudinal Effects of Forbush Decrease Events on Surface Temperatur

Authors

WILLIAMARY PORTUGAL, [1] EZEQUIEL ECHER, MARIZA PEREIRA DE SOUZA ECHER AND [2] ALESSANDRA ABE PACINI.

Affiliation

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[2] CU-CIRES/ NOAA-NCEI, US

Abstract

We present in this work a statistical study of the Forbush Decrease (FD) effects on the surface air temperatures in different latitude ranges of the Northern and Southern Hemispheres (20 - 30, 40 - 50, 60 - 70), considering the possible influence of the cosmogenic atmospheric ionization on the water vapor condensation patterns (link Galactic Cosmic Rays – cloud condensation nuclei) as the main hypothesis to be tested. In order to conduct this analysis, we have used superposed epoch analysis and other statistical methods around the ten strongest FD events that occurred between 1987 and 2015 observed by neutron monitors at Oulu - Finland. The variation of the daily average of the surface air temperature data during FDs, the comparison between the surface air temperature daily averages during FD event periods and equivalent periods without FDs (during solar minima years of 1987, 1996 and 2008) and between the average of this temperature variation for intervals of five days before and five days after the 0 day were here performed. It was possible to note the anticorrelation between the surface air temperature average and the Galactic Cosmic Rays (GCR) flux, increasing from low to high latitudes, suggesting a latitudinal dependence of the induced ionization by GCR on the atmospheric parameters. For the Southern Hemisphere, the anticorrelation between these data was only found for the high and middle latitudes, also with a poleward increase. However, a statistically significant relationship between GCR and temperature was found only for the latitudinal ranges of the Southern Hemisphere.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **3 - SOL**
Serial Number:

Atmospheric Effects and Solar Anisotropies of the Cosmic Ray Flux Observed with a Water Cherenkov Detector in the Antarctic Peninsula

Authors

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Affiliation

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[4] IAA, DNA, Buenos Aires - Argentina.

Abstract

A new water Cherenkov radiation detector has been monitoring the variability of galactic cosmic rays (GCRs) flux at the Argentine Marambio Antarctic Base. One of the main aims of this detector is to study interplanetary transport of GCRs, in particular during transient solar wind conditions. We present the detector and analyze observations made during one full year. The atmospheric corrections gave us an estimated barometric coefficient of (0.19 ±0.02) % hPa1 and an atmospheric expansion temperature coefficient of (3.89 ± 0.02) % km1 . After correcting data for both effects, we can significantly observe a period of 1 day, associated with the Earth rotation combined with the spatial anisotropy of the GCRs flux. The mean anisotropy amplitude is 0.08% in the 15 hr LT direction in the interplanetary space. In such way, we determine the capability of Neurus to observe solar modulations on the GCRs flux arriving Earth.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **3 - SOL**
Serial Number:

Complexity in Solar Cycle

Authors

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Affiliation

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Abstract

We study solar magnetic activity by means a complex system aprroach. A complex network is built based on information on the space and time evolution of active regions, as given by image recognition algorithms on solar magnetograms taken during the complete 23rd solar cycle [1]. Directed networks are built, and we calculated degree distributions, Thus, we show that complex network analyses may yield both useful information on the evolution of solar activity, as well as reveling universal features valid at any stage of the solar cycle. Then, we calculate the box counting fractal dimension of each magnetogram, for solar cycles 24 and 25, as an additional way to measure the complexity of magnetic field time series and spatial patterns.We find that the fractal dimension follows the shape of the magnetic field throughout the solar cycle. These results are in agreement with the work of the Ref. [2] for SC 23. We then performed a time series analysis of solar parameters. The fractal dimension (D) is directly related to the Hurst exponent for a statistically self-similar data set as H=E+1 - D. For a one-dimensional signal H = 2 - D, so from the above equation we can say that a small H has a larger fractal dimension and a rougher surface. A larger H has a smaller fractal dimension and a smoother surface. There are several ways to calculate the Hurst exponent, the most popular being based on rescaled rank (R/S) analysis. We examined data for years 1976--2022, following a procedure similar to Ref.[3]. We obtain similar Hurst Exponent values. Since we found that the most persistent series were the magnetic field series, we decided to repeat this analysis for the
magnetic field at the north and south poles of the Sun, because solar physicists have identified that one of the precursors that is linked to solar activity is the strength of the magnetic field at the Sun's poles.

Acknowledgements:
V. M. acknowledges support of ANID through Fondecyt Grant 1201967.
E. F. acknowledges support from doctoral fellowship from ANID and FONDECYT grant no. 1201967.

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São José dos Campos, Brazil

Presentation Type:
Session ID: 3 - SOL
Serial Number:

Simulation of Solar Neutron Flux in the Earth's Atmosphere for Three Selected Flares

Authors

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Abstract

We performed simulations of the solar neutron (ns) flux in the Earth's atmosphere associated with three significant flares (X17 of September 07, 2005, X1.3 of September 07, 2017 and M2.9 of September 08, 2017). The input of the simulations was calculated on the basis of ns signals detected at ground level by the Solar Neutron Telescope of Sierra Negra (SNT-SN), in Mexico, and by the FIB scintillator of the Space Environment Data Acquisition-Attached Payload on board of the International Space Station. Since ns can produce Extensive Air Showers (EAS) in the Earth's atmosphere, we used the CORSIKA code and FLUKA subroutines to simulate the particle fluxes associated with the X17, X1.3 and M2.9 flares. We studied the average longitudinal variations of particle flux and energy loss through the atmosphere to estimate the ns flux impinging on the SNT-SN. The results of the simulated interactions and multiplicities of the particles, as a function of their energy, showed that 11-13% of the ns, released by the X17 flare, could overcome the atmospheric attenuation and propagate from the top of the atmosphere to the SNT-SN (4580 m a.s.l.) without producing EAS. This result is a theoretical confirmation of the detection of ns by the SNT-SN on September 7, 2005. On the other hand, ns associated with the X1.3 and M2.9 flares were lost due to atmospheric attenuation and the production of new particles; therefore, they were not detected at ground level by the SNT-SN.

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CONFERÊNCIA LATINO-AMERICANA
DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **3 - SOL**
Serial Number:

Estimates of the Solar Magnetic Field in Region AR11967 Using Inversion Methods

Authors

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Abstract

Determine the magnetic field in the solar photosphere of the active region AR11967 using Stokes parameters and using tools such as Inverse Problem Theory and Spectropolarimetry. Furthermore, we present the Radiative Transfer Equation (RTE) and obtain its solutions (Stokes spectra) to obtain diagnoses of the active region studied. We chose data from the Hinode mission on AR11967 on 02/04/2014.

We chose the spectral line Fe I to study the properties and behaviors of the active region studied, which is AR11967. For this, we will use the pyMilne inversion code and we will compare what was obtained with the results of the MERLIN inversion code from the SpectroPolarimeter (SP) of the Hinode mission. In addition, a Milne-Eddington atmospheric model was adopted.

With the inversion code in hand, it was possible to compare with the SP/Hinode results where the maps obtained will be subtracted from the SP/Hinode maps.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 3 - SOL
Serial Number:

Analysis of the Magnetic Twist Inside Magnetic Clouds

Authors

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Abstract

Interplanetary Coronal Mass Ejections (ICMEs) are large-scale interplanetary transient structures in the solar wind traveling from the Sun toward the outer-heliosphere in the interplanetary medium. Magnetic clouds (MCs) are a sub-set of ICMEs, forming a flux rope (FR). The distribution of the magnetic twist in MCs (i.e., the number of turns of field lines per unit length rounding the FR axis) is determined by its initial solar configuration, by the processes involved during its eruption from the Sun, and by the dynamical evolution during its interaction with the ambient solar wind. The internal distribution of twist
in MCs is under debate. One of the main problems to deduce it from in-situ observations is that from a single event, the magnetic fluctuations increase the noise of the observed magnetic fiel time series, which
is necessary to deduce the twist. In this work, we present results of the typical twist distribution inside MCs using a superposed epoch analysis applied to a large set of events, combined with detailed information of MCs taken from the Lepping's catalogue. This technique, permits us to extract the common features, removing the peculiarity of individual cases. We find that the twist is nearly uniform in the FR core (central half part), and it increases moderately, up to a factor two, towards the MC boundaries. This profile is close to the Lundquist field model limited to the FR core where the axial field component is above about one-third of its central value.

CONFERÊNCIA LATINO-AMERICANA
DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **3 - SOL**
Serial Number:

Multiscale aspects of the solar indices MgII, F10.7 and Sunspot Number

Authors

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Abstract

The Sun is the primary source of energy for the planetary systems. However, its output is not constant as it shows variations on time scales of a few years, the 11-year solar cycle, and longer timescales. This variability occurs in its magnetic field, particle flux, and electromagnetic radiation. Several indexes have been used as solar activity proxies, such as the sunspot number and the Mg II index (a proxy for the extreme ultraviolet irradiance). Further direct measurements in radio at centimeter wavelengths have been conducted since 1947 (F10.7 index). This work studies the relations between these solar indices and their long-term variation through multiscale techniques. Monthly averages of those indices in the 1947-2020 period are analyzed with wavelet scalogram, global wavelet spectrum, wavelet cross-correlation, and wavelet entropy. We identify some non-linear multiscale aspects in the long-term variation of these solar indexes.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 3 - SOL
Serial Number:

Build up and release of energy in an avalanche model for solar flares

Authors

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Abstract

Solar flares are the most powerful events in the solar atmosphere, releasing a huge amount of energy in tenths of minutes.
In the last 4 decades avalanche models for solar flares have been used to model the release of energy in the solar corona vía magnetic reconnection with simple and computationally inexpensive schemes. They successfully reproduced most of the main statistical features observed in solar flares flares (e.g., probability density function of flares energy, duration, etc.). In the last years interest in solar flares avalanche models have renewed mainly because they can provided a reliable tool to explore the wide parameter space leading to the prediction of extreme flaring events.
In this work, perform simulations using the well known model for flares developed by Lu and Hamilton in the nineties. With them we study if the build up of energy in the simulated corona can be related to the inter-burst times and if the spatial distribution of the lattice energy can be used as a proxy of extreme-flaring (avalanching) events.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type:
Session ID: 3 - SOL
Serial Number:

Galactic Cosmic Ray Shielding by ICMEs and SIR: Superposed Epoch Analysis

Authors

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Abstract

Interplanetary Coronal Mass Ejections (ICMEs) and Stream Interaction Regions (SIRs) are both transient structures that cause instabilities in the medium they propagate. One of their consequence are the so called Forbush Decreases (Fds), which consist in an abrupt decrease on the Galactic Cosmic Ray (GCR) flux measured at the Earth surface by different detectors. In this work we studied all ICMEs and SIRs occurred in the period 1998-2017 and their consequences in the GCR flux measured by neutron monitors at MC Murdo, located at the Antarctica. The main objective of this study in to find the main differences between FDs produced by ICMEs and SIRs. To do so we utilize the mathematical technique called Superposed Epoch Analysis (SEA) to obtain typical FD profiles produced by both structures. This method is applied to different groups of ICMEs and SIRs, in case of ICMEs we differentiate between the distinct substructures of them. Analyzing the FD profiles we found that ICMEs are associated to the most intense FDs in spite of analyzing events with similar magnetic fields intensity. We also described and analyzed the different shapes of the FDs profiles.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **3 - SOL**
Serial Number:

Analyzing the solar activiy using the horizontal visibility graph method

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Abstract

Various measures of complexity can provide relevant ways to study the complexity in the dynamics of magnetized plasma. In this case, the sun and its behavior will be studied through the use of complex networks. We take two time series associated with solar activity, namely total sunspot and global mean magnetic field, taken from 1975 to 2015. Both time series will be analyzed through the Horizontal Visibility Graph (VG) technique [1]. Formally, given a series of data Y_N , it is said that each value of the time series correspond to a node, and two arbitrary nodes y_a and y_b "see" each other if for every node yc the relation y_a , y_b > y_c is satisfied. Then, once the HVG criterion is established, the method leads to a complex network, where the nodes correspond to the values of each time series. The HVG allows to study statistical properties of time series such as reversibility [2], and it has been successfully used to study a variety of physical systems [3,4]. Using this analysis, we observed a specific metric of the complex networks that is sensitive to the solar cycle, Betweenness Centrality (BC), which quantifies the frequency at which a node acts as a connecting bridge along the shortest path between any other two nodes. Furthermore, from the connections established within the networks, we also observed that they follow an exponential topology for their degree distribution, which is the fraction of nodes with k connections over the total amount of nodes, P(k) = n_k/n.

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[4] Muñoz, V. & Garcés, N. E. (2021). Analysis of pulsating variable stars using the visibility graph algorithm. Plos One, 16(11):e0259735.

CONFERÊNCIA LATINO-AMERICANA
DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 3 - SOL
Serial Number:

What Cosmic Rays daily variations can tell us about the Solar-Terrestrial environment?

Authors

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Abstract

Cosmic Rays are mostly protons that come from outside the Heliosphere, and reach Earth with a large range of energy. The minimum energy required to be detected in the ground is called cutoff energy and depends on the Earth's magnetic field intensity, and the inclination of the trajectory in relation to the zenithal line. These particles are modulated by the Interplanetary Magnetic Field, and expresses a diurnal variation due to the Earth rotation. This diurnal variation have a maximum value around the 18h local time, due to the anisotropy, that is composed by the contributions of the convection of the cosmic rays in the solar wind, the diffusion of particles along the interplanetary magnetic field, and the orbital motion of the Earth, which causes the Compton-Getting effect. We expect that the different condition of the interplanetary medium caused by different solar structure (ICMEs or CIRs), can move the maximum value of the diurnal variation toward the 12h local time if the cosmic ray convection is bigger than the diffusion, and the maximum of the diurnal variation moves toward the 20h local time if the diffusion is bigger than the convection. In these analises, the Compton-Getting effect can be neglected, because this anisotropy is much smaller than the others. We will use the GMDN data to perform the analysis of the diurnal variation, and ACE, WIND or DSCOVR satellites to identify the solar structures.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **ORAL**
Session ID: **3 - SOL**
Serial Number:

Sunspot Waves at High Resolution

Authors

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Abstract

Waves and oscillatory phenomena have been observed in the solar atmosphere as mechanisms that transfer energy through its different heights, from the photosphere to outer layers. Hence, they are considered as one of the main processes responsible for heating the upper solar atmosphere. This study aims to detect and characterize various MHD wave modes in a sunspot atmosphere (i.e., active region AR12533), based on high-resolution observations with the Swedish 1-m Solar Telescope (SST). The SST observations sample various atmospheric heights in the lower atmosphere, taken in multiple wavelength positions of the Ca II 852.2 nm (in full Stokes) and Hα 656.3 nm spectral line. The MHD waves are traced throughout the solar atmosphere by analysing temporal evolution in intensities and Doppler velocities and shifts in wave frequency. The preliminary results and the next steps of the waves propagation analysis are presented.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **3 - SOL**
Serial Number:

Characterization of Narrow Band Filter for Solar Spectropolarimetry Based on Volume Holographic Gratings - Angular Selectivity Analysis

Authors

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Abstract

The volumetric diffraction grating (VHG) appears with the modulation of the refractive index by an interference pattern imposed by two coherent beams incident to a photorefractive crystal, configuring the recording step. With the grating recorded, a diffracted beam appears in the absence of one of the two beams (reading process), by the interaction of the grating with the existing beam. The diffracted beam is shown just on very restricted conditions of the reading beam, in terms of wavelength and angle of incidence (Bragg condition). Photons outside this range are not selected. This characteristic is interesting to compose ultra-narrow wavelength filters. Depending on the network configuration, the beam with a specific wavelength can be diffracted by transmission or reflection. This work is part of the effort to evaluate a conceptual solution for an optical filter based on VHG (Volume Holographic Gratings) with the primary objective of selecting, with a high spectral resolution, different spectrum lines necessary to estimate the magnetic field on the solar surface, based on a holographic volumetric diffraction grating. The prototype to be developed is named V2HSI (Volume Holographic Hyperspectral Solar Imager) etched in photorefractive material (LiNbO3:Fe), iron-doped lithium niobate crystal. The initial hypothesis is that the V2HSI can improve solar spectropolarimeter instruments, due to its characteristics of high spectral resolution and low complexity compared to traditional solutions. This work aims at recording a high-efficiency VHG and evaluates the angular selectivity and polarization of a lithium niobate crystal sample recorded by a 633 nm beam. The recording setup is described in detail, with an emphasis on the hologram stabilization strategies used. Angular selectivity is analyzed in terms of diffraction efficiency by the angular position of the sample. Finally, the preliminary analysis of VHG polarization effects is conducted by a classical measurement setup of the Stokes polarization parameters changes induced by the sample.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **ORAL**
Session ID: **3 - SOL**
Serial Number:

Energetic Terrestrial Gamma-Ray Flashes (TGFs) and/or Other Lightning Created Emissions Possibly Detected by the Pierre Auger Observatory Tanks

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Abstract

Theorized in the 1920s, the emission of particles and energetic photons by thunderclouds and lightning has been the subject of intense study within the last couple of decades. Other energetic phenomena produced lightning and thunderstorm electric fields are X-rays, electrons, positrons and neutrons, collectively they are called High Energy Emissions from Thunderstorms (HEETs). In this work, the data of the Lightning Imaging Sensor (LIS), onboard the Tropical Rainfall Measurement Mission (TRMM) satellite, was explored for the first time in combination with the high-energy particle/photon data of the tank detectors of the Pierre Auger Observatory, located in Argentina, in seeking of such emissions. Using five years of data, a preliminary analysis was performed looking for emissions detected by the Auger with a maximum time interval of +/-100 ms from the lighting detected by LIS. We investigate a total of 11,455 ,273 Auger T3 events (a category of detected emissions of several tanks), and 64,378 lightning discharges classified as groups, for which we found 1,109 lightning groups coinciding with 209 Auger T3 events, which represents 1.72 % of the lightning data set. Based on that we reduced the data set to 209 Flashes for 209 T3 events. At this point, we worked with the data category of Flashes and individual Auger tank records. Then we analyzed the type of trace (shape of the data recorded in each tank in an interval of 25 ns), classifying them into traces produced by particles/photons (73.9%) and traces made by VHF emissions (26.1%). A total of 210 VHF emission traces, corresponding to 96%, and 81 particle/photons traces, a 13%, were recorded at a distance less than 32+/-4 km from the location of the first Group of the Flash. The main candidates to be energetic particles/photons produced by lightning or lightning Electromagnetic Pulses (EMPs) are indeed the particle/photon traces. Five tanks recorded this kind of traces within 0 and 4 km. These five tanks represent a detection rate of particles/photons per group of 7.8*10^-5. The duration of the records varied between 0.27 and 0.50 microseconds and their energy varied between 489.4 MeV and 2493.2 MeV. The time difference between the beginning of the records and the associated Flashes ranged from -31+/-26 and 11+/-26 microseconds. In one of the cases, it was possible to establish that the Group happened before the recording of the tank trace. These events may form a completely new class of HEETs, since they are in an energy range that is much higher than the highest particle/photons ever detected reported in the literature, which are Terrestrial Gamma-Ray Flashes of ~100 MeV detected by the AGILE satellite.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **3 - SOL**
Serial Number:

TSI Scientific Requirements for Future Missions and Technical Challenges of the Instruments

Authors

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Abstract

The solar radiation at the top of the atmosphere is the main energy source of the Earth's coupled atmosphere–land–ocean system. Total Solar Irradiance is one of the parameters of the Earth's energy balance. Minor fluctuations of TSI in long timescales could impact the energy balance due to nonlinear effects. TSI monitoring supports the understanding and international response to climate change. Despite the improvement of accurate measurements provided by the instruments, at the time, long-term TSI variability and its effects have not been established. The magnetic features on the solar surface and their dynamics are accepted to describe most of the TSI variability. However, these measurements have been restricted to regions near the ecliptic plane. We will present an overview of irradiance observations, highlighting the variability's importance. This overview drives the GSST mission requirements for stellar physics research and its impact on the Earth. The requirements will drive the likely instruments that would be an evolution of the classical electrical substitution radiometers.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **3 - SOL**
Serial Number:

Investigation of the Motion of Sunspots Associated With the Active Region NOAA 12673 During its Passage Close to the Solar Disk Center

Authors

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Abstract

Active region NOAA 12673 was responsible for many flares and a couple of CMEs during its passage through the solar disk. In this work we determine the velocity field responsible for the dynamics of a sunspot group associated with this active region, during its passage close to the disk center, and investigate its properties. The obtained velocity field shows that this region consists of a main spot structure, located practically at the same position during the investigated period, and of fragments of spots that move around the main structure like a fluid around an obstacle. During their evolution the fragments coalesce forming larger structures. The velocity field shows the presence of a large number of critical points, which increases during the analysed period indicating that the it becomes more and more complex. We also identify the presence of attracting and repelling vortexes associated to critical points of the type focus. An analysis of the rotation sense of the vortexes indicated that there is no preference for clockwise or counter-clockwise rotation. This complex velocity field may have a significant contribution to the activity of NOAA 12673, one of the most flare producing active region of the solar cycle 24.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **ORAL**
Session ID: **3 - SOL**
Serial Number:

Statistical Analysis of the Onsets of Solar Flares in Xray Soft.

Authors

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Abstract

Solar Flare radiation, energetic particles, and associated coronal mass ejections drive the Space Weather near Earth. To help forecast Space Weather and mitigate its effects on our technological infrastructure is need to understand the physical processes that trigger solar flares. We present the investigation of solar flares that occurred between 2011 and 2012 of a recently identified and yet understood phenomena in solar flares: the presence of hot (10–15 MK), low-lying and compact sources at the onset of these events. This statistical analysis aims to study the onset of solar flares using the temperature and emission measure the soft x-ray data. The sample of flares used in this study has been extracted from the GOES event list. For the statistical analysis of the onset, we applied the method the subtraction of the preflare background X-ray flux is done manually. We analyzed 749 events for which the onset temperature and emission measure values at the onset were reliably obtained, and the flare location was provided in the list. Our statistical analysis shows that 564 (~75%) flares exhibit an onset with a temperature higher than 10 MK.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type:
Session ID: 3 - SOL
Serial Number:

STUDY ON THE ROLE OF THE GYRORESONANCE EMISSION MECHANISM IN THE BRIGHTNESS INTENSIFICATION AT 17 GHZ OF SOLAR ACTIVE REGIONS

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Abstract

Associated with magnetic fields between the chromosphere and the corona, specifically in active regions, gyroresonance emission plays an important role in revealing the magnetic dynamics in such layers. Given this association, this work hypothesized the possible relationship of the gyroresonance mechanism with brightness bumps at radio frequencies. Such hypothesis was based on the control played by the magnetic field on the radio emission when such field reaches conditions conducive to gyroresonant radiation at given frequency and harmonic. To test such a hypothesis, we selected and observed 8 active regions from the ascending phase of the 24th solar cycle. In this analysis, the data for these regions were HMI magnetograms from the Solar Dynamics Observatory (SDO) and images at 17 GHz from the Nobeyama Radioheliograph (NoRH). We then analyzed both the magnetic field and brightness temperature through the magnetograms and the radio map respectively corresponding to the same time. We then observed that the magnetic field conducive to the gyroresonance mechanism is partially or completely enveloped by the brightness bumps at 17 GHz. Furthermore, we also observed that most of these bumps had circular polarization modulus (|r_{c}|) above 30% and that, in most of the cases, the brightness temperature and its gradient of the selected active regions were strongly correlated with |r_{c}| e 30% while it was weakly or moderately correlated with |r_{c}| < 30%. Without observing magnetograms and polarization maps, we still need a method to identify the bumps caused by the gyroresonance mechanism. Solving this problem is the next step to map the magnetic field associated with this type of emission under given boundary conditions. However, the results of this work corroborate the proposed hypothesis in order to show that such radio emission mechanism usually performs the brightness control at 17 GHz coming from active regions.

CONFERÊNCIA LATINO-AMERICANA
DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **3 - SOL**
Serial Number:

Study of the stability of a CHERENKOV water detector within the framework of the LAGO collaboration.

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Abstract

The LAGO project (Latin American Giant Observatory) mainly focused to studying Gamma Ray Bursts (GRBs), also is addressed to study high energy astroparticles, space weather and atmospheric radiations on ground level. The techinque used in LAGO are ground-based Water Cherenkov Detectors (WCD), by using ” individual particle ” detection. The present work shows the performance and stability of (WCD) prototype at the Cosmic Ray Laboratory of the Universidad Mayor de San Andres (UMSA) in Cota Cota La Paz city at 3400 m.a.s.l. The detector was studied taking into account four parameters; first, independence of the data by testing goodness-of-fit to Poisson distribution, second, the behaviour of the signals Area-Peak ratio, thirt, the behaviour of the charge histogram and fourth, the muon half-life time was experimentally measured obtaining a value of about 2.2 ± 0.2 μs. The last one study was carried out over four months of data taking.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 3 - SOL
Serial Number:

An Updated Catalog of IPS Radio Sources Observed by MEXART

Authors

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Abstract

Interplanetary scintillation (IPS) is a phenomenon that occurs when radio waves, coming from a compact radio source (<1 arcsec) pass through the inhomogeneous solar wind and undergo a random variation in their flux intensity. These variations can be detected by ground based radio telescopes. Since its discovery in 1964, IPS observations has been analyzed to estimate solar wind properties such as speed and density, among others. The Mexican Array Radio Telescope (MEXART) is an IPS-dedicated instrument operating at a central frequency of 139.65 MHz. Originally, the instrument operated with 2 MHz bandwidth in an analog fashion, but calibrating was difficult, leading to a loss in its sensitivity. So the instrument recently had an update, a 12.5 MHz bandwidth state-of-the art digital backend was implemented with the aim of increasing the number of IPS sources and expanding the type of studies that can be carried out with. In this work we present preliminary results on the updated catalog of radio sources with IPS signal that MEXART is detecting with these new technical capabilities.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **3 - SOL**
Serial Number:

Filament Cloud-Modeling for SST Observations in the Ca II (8542 Å) line.

Authors

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Abstract

Stability and evolution studies of filaments require accurate diagnostics of the conditions of the confined material. We study the conditions of a filament and its surrounding region using the high-resolution observations from the Swedish Solar Telescope (SST) based in the Canary Islands. The studied region was observed by SST on 19 May 2018 in the Ca II 8542 Å spectral line.

Spectral inversion techniques built on cloud models are useful for the determination of the properties and dynamics of the filaments. We build a cloud model for the filament to compute the theoretical contrast profile for the outgoing radiation and used spectral inversion techniques to estimate four physical parameters of the structure (line-of-sight velocity, source function, optical depth, and Doppler width) which allowed us to build maps of the parameters in the filament.

Additionally, complementary observations of the Helioseismic and Magnetic Imager (HMI) and the Atmospheric Imaging Assembly (AIA) on board the Solar Dynamics Observatory (SDO), are used to describe the conditions and evolution of the filament and its surroundings.

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XIII COLAGE
27th November to 2nd December 2022
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Presentation Type: ORAL
Session ID: 3 - SOL
Serial Number:

Investigating the Effects of Erosion in Magnetic Flux Ropes

Authors

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Abstract

Interplanetary Coronal Mass Ejections (ICMEs) entrain mass and magnetic energy from the Sun to the Heliosphere. A subset of these ICMEs are Magnetic Clouds (MCs), also known as Magnetic Flux Ropes (MFRs), are characterized by an enhanced magnetic field strength, a smooth rotation of the magnetic field vector, and a low proton temperature. These MRFs contain twisted flux tubes, which provide an organized magnetic structure entraining confined plasma. That way, the magnetic helicity coming from the Sun into the heliosphere is transported. As these ICMES travel through the interplanetary space, they can interact with the solar wind and suffer magnetic reconnection. This reconnection leads to a change in the internal structures of the MCs, a process we call erosion. By looking into the azimuthal magnetic flux and signatures of reconnection, we can further study the process of erosion. In this work, we will explore the effects of such erosion in the magnetic field configuration of the heliospheric flux ropes.

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27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 3 - SOL
Serial Number:

Study of the propagation of the solar wind and coronal mass ejections: numerical MHD simulations and the comparison with observations

Authors

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Abstract

In this work, we present a study of the dynamics of the propagation of solar wind currents (SW) and coronal mass ejections (CMEs) in the interplanetary medium using numerical MHD simulations in three spherical dimensions. Additionally, we show results for the SW's speed, density, and the magnetic field near the terrestrial environment (~1 AU). Finally, we compare the results of the numerical simulations with the in situ measurements obtained by ACE, WIND, STEREO-A, Parker Solar Probe, and Solar Orbiter.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type:
Session ID: 3 - SOL
Serial Number:

Unveiling the interplay of convection, drift, and diffusion on GCR modulation in the inner heliosphere using Light Gradient Boosting Machines

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Abstract

Galactic Cosmic Rays (GCRs) are charged particles, originating from galactic and/or extra-galactic Supernova Remnants (SNR), that continuously permeate the Heliosphere. The GCRs are modulated in the heliosphere by convection by solar wind (SW), drift via gradients and curvatures in the Heliospheric Magnetic Field (HMF), diffusion from fluctuations in the HMF, and adiabatic cooling in the expanding SW. An improved understanding of their modulation is imperative as studies on the variations in solar activity levels and solar eruptions in the past rely heavily on the relationship between their modulation and formation of the secondary particles in the Earth's atmosphere. Here, for the first time, we utilize an AI method, Light Gradient Boosting Machines (LightGBM), to investigate the interplay among the modulation processes in different timescales for the past 4 solar cycles. Results show that diffusion, in all time scales, is a leading factor in GCR modulation. The drift plays a major role, when the diffusion is suppressed, in general, and convection becomes important for timescales shorter than 4.5 years.

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27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **3 - SOL**
Serial Number:

sCMOs Commercial Camera Feasibility for GSST Proof-of-Concept Spectropolarimeter

Authors

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Abstract

Spectropolarimetry is the primary method for measuring the solar magnetic field, the main driver of diverse phenomena. In general, polarization modulators, wavelength discriminators, and cameras are the main components of a spectropolarimeter. Cameras are essential, as it is the element that quantifies the modulated signal. Consequently, characterization of cameras is vital, as it might introduce various measurement errors in the data. In this work, we characterize the camera used in the spectropolarimeter proof of concept for the Galileo Solar Space Telescope (GSST) mission, a Zyla 5.5 sCMOS. Investigations were made into the shutter and cooling mechanisms of the camera. Examinations were also conducted into other critical factors like gain, linearity, and the polarization effect in the pixel. The study demonstrated the impact of cooling on reducing camera noise, as well as the impact of the shutters. The camera proved successful in getting the Stokes parameters correctly and promptly, despite the considerable non-linearity.

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27th November to 2nd December 2022
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Presentation Type: POSTER
Session ID: 3 - SOL
Serial Number:

Characterization of Magnetic Clouds through Machine Learning

Authors

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Abstract

This study is a literature review regarding machine learning (ML) and space weather, focusing on applications using Python (ROSSUM, 2009). The libraries studied were scikit-learn (PEDREGOSA, 2011), Keras (CHOLLET, 2015) and Pytorch (PASZKE, 2019) based on neural networks (NN) an convolutional neural networks (CNN). In addition, the research has as object the characterization of magnetic clouds (MCs); that is, subset of interplanetary coronal mass ejections (ICMEs), large quantities of cooled plasma released by the disruption of the solar field (OLIVEIRA, 2020). Here, the MC is analysed using minimum variance method (MVA) (OLIVEIRA, 2020) and force free model (BURLAGA, 1988).

The area of space weather has all the ingredients for the application of machine learning: large amounts of accessible data, sophisticated physical models, and an understanding of the process behing most spatial events (CAMPOREALE, 2019). For the scikit-learn library we studied the Multi-layer Perception (MLP) methods, in which the input data becomes the features we want to analyze and each feature is associated with a weight value in a layer followed by a linear activation function that can form multiple layer, and Restricted Boltzmann Machines (RBM), in this method the input variables go through an analysis similar to the MLP, however the RBM has only two layers, presented by sklearn functions.neural network.MPLCassifier function for MLP sklearn.neural network.BernoulliRBM functions for RBM. The method analysed using the Keras library is the Long short-term memory network (LSTM) which focuses on the analysis of univariate and multivariable time series represented by the function tf.keras.layers.LSTM. The method analyzed applying the Pytorch library involves using the images of the graphs representing the coordinates of the magnetic field with the function nn.Sequential, which allows us to assemble a sequence of other functions to form the layers of a convolutional network. nn.ReLU or nn.Linear are examples of functions that can be applied through nn.Sequential. In this review we studied too a recent work that identifies flux rope signatures using a deep neural network (SANTOS, 2020).

Thus, the study aims to present machine learning techniques and libraries that can be applied in magnetic clouds characterization and its potentialities.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type:ORAL
Session ID:3 - SOL
Serial Number:

A Genetic Algorithm to model Solar Radio Active Regions from 3D Magnetic Field Extrapolations

Authors

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Abstract

In recent decades our understanding of solar active regions (ARs) has improved substantially due to observations made with better angular resolution and wider spectral coverage. While prior AR observations have shown that these structures were always brighter than the quiet Sun at centimeter wavelengths, recent observations at millimeter and submillimeter wavelengths have shown ARs with well defined dark umbrae. Given this new information, it is now necessary to update our understanding and models of the solar atmosphere in active regions. In this work, we present a data-constrained model of the AR solar atmosphere, in which we use brightness temperature measurements of NOAA 12470 at three radio frequencies: 17, 100 and 230~GHz. The observations at 17~GHz were made by the Nobeyama Radioheliograph (NoRH), while the observations at 100 and 230~GHz were obtained by the Atacama Large Millimeter/submillimeter Array (ALMA). Based on our model, which assumes that the radio emission originates from thermal free-free and gyroresonance processes, we calculate radio brightness temperature maps that can be compared with the observations. The magnetic field at distinct atmospheric heights was determined in our modelling process by force-free field extrapolation using photospheric magnetograms taken by the Helioseismic and Magnetic Imager (HMI) on board the Solar Dynamics Observatory (SDO). In order to determine the best plasma temperature and density height profiles necessary to match the observations, the model uses a genetic algorithm that modifies a standard quiet Sun atmospheric model. Our results show that the height of the transition region (TR) of the modelled atmosphere varies with the type of region being modelled: for umbrae the TR is located at 1080 ± 20 km above the solar surface; for penumbrae, the TR is located at 1800 ± 50 km; and for bright regions outside sunspots, the TR is located at 2000 ± 100 km. With these results, we find good agreement with the observed AR brightness temperature maps. Our modeled AR can be used to estimate the emission at frequencies without observational coverage.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type:ORAL
Session ID:3 - SOL
Serial Number:

Sunspots Detection and Analysis Using Artificial Intelligence and Big Data

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Abstract

In operation since February 2010, the "Solar Dynamics Observatory" (SDO) obtains solar white light images and magnetograms through the "Helioseismic and Magnetic Imager" (HMI) equipment. That provides a very important database to study sunspot behavior. Sunspots can present two main structures, umbra and penumbra. The umbra and penumbra tonality is directly related to the temperature, in which the darker regions present lower temperatures. This work presents a statistical analysis of the structures of the sunspots. The analysis uses Artificial Intelligence and Big Data computing techniques to be able to identify and calculate the physical characteristics of the umbras and penumbras, such as: area, temperature, magnetic field and location. This work covers a 11-year period of daily HMI/SDO maps, between May 1, 2010 and May 10, 2021. Analyzing a total of 6961 images, 12562 umbras were detected and 16169 penumbras, with longitude between -40° and 40°. As a final result, the correlations between the characteristics of the umbras and penumbras showed the different behaviors of umbra and the penumbra.

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São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 3 - SOL
Serial Number:

Evolution of a Coronal Mass Ejection of the Streamer Blowout Type

Authors

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Abstract

In this work, we study the eruptive event that occurred on January 29, 2011, which presents characteristics of streamer blowout (SBO). SBOs, once developed in the field of view of a coronagraph, appear as coronal mass ejections. However, this type of event is characterized by initially showing a gradual increase in the width of the lower part of the streamer, to later give rise to a coronal mass ejection (CME), generally leading to the streamer disappearance. The entire process is slow compared to the eruption of other CMEs, and can take several hours to more than a day. Despite being quite frequent, these events have been scarcely studied, so there are several pending questions about the conditions of their generation, their characteristics and their relationship with structures of the solar atmosphere. On the other hand, the source regions of SBO are difficult to detect, so when these events are directed towards the Earth, they result in stealth CMEs. In this work, we describe in detail the evolution of the event from approximately 2 to 15 solar radii, determining its three-dimensional position, velocity and acceleration. To do this we use observations made by LASCO-C3 aboard the Solar and Heliospheric Observatory (SOHO), SECCHI-COR2 and COR1 aboard the Solar-Terrestrial Relations Observatory Ahead and Behind (STEREO), and instruments aboard the Solar Dynamics Observatory (SDO).). Likewise, we study the magnetic fields configuration in the region where the event occurs using a PFSS (Potential Field Source Surface) model. Based on the obtained results, we enumerate the considerations that must be taken into account to identify this type of events.

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27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **3 - SOL**
Serial Number:

Cosmic Rays: Do we need to be afraid?

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Abstract

This paper has the function of explaining what the cosmic rays are, qhat compose them and what is their role and action in the universe. Every secong the Earth is bombarded by these particles, which have energy in the millions of electrons volts. We will see if the cosmic rays do any harm to the earth and to human beings, whether they are on the planet or not. This study will aim to explain whether cosmic rays bring any negative consequences to Earth and human beings, whether they are on the planet or not. Thus, we can address possible positive aspects that energy coming from these particles can provide and demystufy some false news.

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XIII COLAGE
27th November to 2nd December 2022
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Presentation Type:**POSTER**
Session ID: **4 - MAG**
Serial Number:

Seasonality in daily variation on oceanic islands around the South American continent

Authors

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Abstract

In this work it used data from six magnetic observatories (TDC, PIL, KEP, ASC, IPM and VSS). All of them are located in magnetic southern hemisphere below the DIP Equator and one (PIL) is located near the center of the South America Magnetic Anomaly (SAMA). The VSS observatory is on the SAMA's northeast border. ASC, TDC and KEP are islands located in the South Atlantic Ocean and IPM in the South Pacific Ocean. These results are from a study of the influence of the geology at the locations and the SAMA on diurnal variation in oceanic islands and in mainland stations at low and medium latitudes. The analysis of the influence of the SAMA on the diurnal variation of the horizontal components (H) and (Z) of the geomagnetic field south of the equatorial dip occurs in the period of the year 2015. The results obtained are associated with the presence of the EEJ and solar activity considering that changes in the amplitude and phase of the diurnal variation occur due to solar activity. In this study we are also including the increasing influence of this anomaly in regions of the Pacific Ocean considering its relative fast displacement of 0.3° per year. Thus, we analyze the regions formed by islands around the South American continent including the southern parts of the Atlantic and South Pacific Oceans as being of special scientific interest especially as they are under the influence of the most extensive magnetic anomaly of the Earth's magnetic field (CMT), the SAMA, which has its lowest intensities compared to any other region in the world.

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Presentation Type: **POSTER**
Session ID: **4 - MAG**
Serial Number:

Science Applications for Soft X-ray Imaging Missions

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Abstract

STORM, the Solar Terrestrial Observer for the Response of the Magnetosphere, is a proposed Medium Class Explorer mission. STORM would be a self-standing mission in a high-inclination circular orbit with a radius of 30 Earth radii that takes its own solar wind measurements and ground-based observations of the aurora whilst remotely imaging the dayside magnetosheath and magnetopause in soft X-rays, the auroral ovals in far ultraviolet, the ring current in energetic neutral atoms, and the exosphere in Lyman-α. STORM's central goal is to quantify the flow of solar wind mass, energy, and momentum through the magnetosphere from start to end, helping us to understand and predict space weather. Sub-objectives include: (1) quantifying the contributions of proposed magnetopause reconnection modes, (2) quantifying the significance of proposed magnetotail response modes, (3) quantifying the importance of source, transport, and loss mechanisms for the ring current, and (4) quantifying the role played by the ring current in determining magnetopause location and substorm onset. STORM provides global context for all in situ geospace projects, both ground- and space-based. In exchange, these projects can verify and validate the inferences drawn from STORM's remote imaging. This presentation provides details of STORM and other (e. g. SMILE, LEXI) soft X-ray imaging mission capabilities and suggestions for the wide variety of partnerships that would be possible with researchers outside the mission.
See http://www.stormmission.com.

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27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **4 - MAG**
Serial Number:

Similarities and differences observed evolution of the the Kp and Ksa indices during selected geomagnetic storms

Authors

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Abstract

Geomagnetic activity is often described in terms of magnetic indices evolution, which are used to examine space weather disturbances in several environments besides the magnetosphere. Specially, the geomagnetic index Kp is widely used as a global response to these disturbances. However, it is well known that there is a lack of observatories in the South American sector. Therefore, in order to consider and study the regional geomagnetic peculiarities found as the South America Magnetic Anomaly (SAMA), the Embrace group from the National Institute for Space Research (INPE) developed the index Ksa based on the Embrace Magnetometer Network (MagNet). Thus, in this work we used ground-based magnetometer data from the Embrace MagNet and the International Real-Time Magnetic Observatory Network (INTERMAGNET) to evaluate the similarities and differences observed evolution of between the Kp and Ksa indices during intense, moderate, and weak selected geomagnetic storms. The preliminary results show some discrepancies between them, pointing to the importance of considering the measurements over the South American, especially in the SAMA region.

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27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **ORAL**
Session ID: **4 - MAG**
Serial Number:

ULF WAVES AT VENUS : VENUS EXPRESS OBSERVATIONS

Authors

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Abstract

Plasma waves in the Ultra Low Frequency (ULF) range (below 30 Hz) are very important in the solar wind planetary magnetosphere interactions. For induced magnetospheres such as Mars and Venus they can have important role on planetary atmospheric evolution, through ion-particle interaction mechanisms leading to extraction of atmospheric ions along the planet history. In this work we presented results from statistical studies of ULF wave activity around Venus space environmnt. Plasma and magnetic field data from Venus Express entire mission are used. A few selected examples of wave occurrence during VEX orbits are shown. Using both plasma and magnetic field data, the wave modes are identified. The distribution of their occurrence - alfvenic, mirror mode, fast and slow modes around Venus environment are shown. This distribution is further studied for different solar cycle and solar wind pressure conditions. Further the correlation lenghts of ULF waves for different solar wind pressure and solar cycle conditions were computed and are presented.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 4 - MAG
Serial Number:

Jovian Decametric Radio Emissions Induced by Europa

Authors

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Abstract

The partial control of Jovian auroral emissions by the Galilean satellite Io is known and studied since the 1960s. This control results of the electrodynamic interaction between the satellite and the Jovian magnetic field, which generates Alfvén waves that couple the equatorial magnetosphere to the Jovian poles and accelerate electrons, generating electromagnetic emissions through collisions and excitation in the Jovian polar atmosphere and through wave-particle resonance at higher altitudes. Evidence of the satellite-magnetic field interaction is the occurrence of emissions in UV and IR wavelengths at the satellites' footprint, which were already observed for the Galilean satellites Io, Ganymede and Europa. However, evidence of the satellite control at the radio decametric wavelength had been detected only for Io and Ganymede. In this work, we have searched the Nançay Decameter Array's extensive digital catalog of Jovian Decametric emissions for evidence of control by Europa. We have found evidence of this control in the Jovian decametric emissions and we present some general characteristics of the Europa-induced emissions.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 4 - MAG
Serial Number:

STORM: A Magnetospheric Imaging Mission

Authors

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Abstract

STORM, the Solar Terrestrial Observer for the Response of the Magnetosphere, is a proposed Medium Class Explorer mission. STORM would be a self-standing mission in a high-inclination circular orbit with a radius of 30 Earth radii that takes its own solar wind measurements and ground-based observations of the aurora whilst remotely imaging the dayside magnetosheath and magnetopause in soft X-rays, the auroral ovals in far ultraviolet, the ring current in energetic neutral atoms, and the exosphere in Lyman-a. STORM ' s central goal is to quantify the flow of solar wind mass, energy, and momentum through the magnetosphere from start to end, helping us to understand and predict space weather. Sub-objectives include: (1) quantifying the contributions of proposed magnetopause reconnection modes, (2) quantifying the significance of proposed magnetotail response modes, (3) quantifying the importance of source, transport, and loss mechanisms for the ring current, and (4) quantifying the role played by the ring current in determining magnetopause location and substorm onset. STORM provides global context for all in situ geospace projects, both ground- and space-based. In exchange, these projects can verify and validate the inferences drawn from STORM ' s remote imaging. This presentation provides details of STORM ' s capabilities and suggestions for the wide variety of partnerships that would be possible with researchers outside the mission.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 4 - MAG
Serial Number:

Geomagnetic field fluctuations in South America for the last few millennia

Authors

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Abstract

Geomagnetic field of internal origin operates on several timescales, from years to, virtually, the age of the Earth. Analysis from data and geomagnetic field models indicate that the most important field feature is presently on South America. The South Atlantic Magnetic Anomaly (SAA) is the most outstanding and intriguing anomaly, reaching from the core to the space. It is characterized by the lowest total field intensities and occupying an area from the South Atlantic Ocean to South America. However, its origin, geometry and longevity are poorly known, specially through long- time periods. In this talk, we will address some questions regarding SAA from years to the last few millennia, by comparing the available data and field models.

CONFERÊNCIA LATINO-AMERICANA
DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **ORAL**
Session ID: **4 – MAG**
Serial Number:

Study of Earth's Magnetopause

Authors

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Abstract

The Earth's magnetopause is a boundary region between the Earth's magnetic field domain, called magnetosphere, and the solar wind, which consists of charged particles continuously released from the Sun. The location of the magnetopause is determined by the balance between kinetic pressure of the solar wind and the magnetic pressure exerted by the Earth's field. This equilibrium region is extremely sensitive to changes in both solar wind conditions and magnetospheric plasma dynamics. It is in the magnetopause that the phenomenon of magnetic reconnection occurs, which allows the transfer of plasma, energy, and momentum between the interplanetary medium and the magnetosphere. During extreme solar wind conditions, the magnetopause may change its typical position of approximately 10 R_E (Earth's radius) from the Earth's surface and be compressed to distances smaller than 6 R_E (shorter than the geostationary orbit at 6.6 R_E). The position of the magnetopause is an important topic in space physics, as it is fundamental for monitoring the space weather and therefore for planning space missions. In this project we study the position of the diurnal magnetopause as a function of the solar wind conditions, using THEMIS and MMS data.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 4 - MAG
Serial Number:

A statistical study of wave penetration into the Martian ionopause

Authors

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Abstract

Due to the absence of a global magnetic field, the Martian magnetosphere is induced, and the low energy ion escape is related to the EUV solar radiation and to the solar wind pressure variations. The ion reflection at the bow shock is a permanent source of Ultra-Low frequency (ULF) waves, which are an essential factor in magnetospheric physics, since they may transfer energy and momentum from the solar wind to the inner magnetosphere. These are convected through the magnetosheath and can penetrate into the upper ionosphere. This can cause additional turbulence at the ionopause which can then cause an enhanced erosion of the ionosphere. Knowing the important role of waves produced in the magnetosheath in the loss processes of the Martian atmosphere, searching for evidences and conditions that ULF waves can penetrate in the ionosphere is of great value. The present study has the aim of making a statistical study of 70 potential cases of wave propagation into the ionosphere of Mars using 14 years of MEX observations. Our results show that the most energetic frequencies in the ionosphere are in the same range of the main frequencies observed in the magnetosheath. Further, It seems that wave penetration at Mars tends to occur mainly in the descending/maximum solar cycle phase and on the dayside. It was also seen that these events are more frequent in the northern hemisphere Autumn Equinox and during conditions of moderate solar wind pressure.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **4 - MAG**
Serial Number:

Identification of Venus Plasma Boundaries

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Abstract

In this work we present an updated list of Venus plasma boundaries determined by plasma and magnetic field instruments onboard the European Space Agency Venus Express (VEX) probe (2006-2014). Venus' space environment was first explored by the Venera and Mariners space probes in the 1960s and 1970. Those first data indicated that Venus did not have an intrinsic magnetic field. However, the interaction of the solar wind with its ionized atmosphere produced and induced a magnetosphere. Detailed studies were conducted in Venus with the NASA Pioneer Venus Orbiters (1978-1992). More recently the VEX explored the Venus plasma environment and its interaction with the solar wind. We have analysed the VEX ASPERA-4 plasma and MAG magnetic field data to update the plasma Venus induced magnetospheric plasma boundaries catalog. Using ion and electron energy spectra and magnetic field vector components, we visually determined the time of the bow shock, magnetic pileup boundary and photospheric electron boundary crossings. This list of crossing will be used in future works to make detailed analysis of regions in Venus induced magnetosphere, such as the fluctuations in the magnetosheath.

CONFERÊNCIA LATINO-AMERICANA
DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **4 - MAG**
Serial Number:

A LOW-COST GEOMAGNETIC FIELD STATION

Authors

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Abstract

The geomagnetic field is the earth's natural defense that protects us from the cosmic rays coming in the solar wind. These energetic particles can damage our technology such as communication satellites, electric networks, hydroelectric and GPS navigation systems, especially in the South Atlantic Anomaly (SAMA). This work presents the design and implementation of a low-cost geomagnetic station to monitor the variations of the earth's magnetic field and their correlations with space weather. The station uses Commercial Off-The-Shelf electronic devices such as a Raspberry pi, high-precision analog-digital converters, and triaxial fluxgate sensors. The hardware system is integrated, and the software allows to record data automatically. Preliminary results allowed us to measure variations that are correlated temporally with the geomagnetic storm caused by the solar flare and a minor earthquake registered in the city of Villa Hayes, Paraguay.

Key words: Earth's magnetic field, magnetometer, FLUXGATE sensors, Space weather.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **ORAL**

Session ID: **4 - MAG**

Serial Number:

Study of the Solar Wind Energy Transfer to the Earth's Magnetosphere

Authors

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Abstract

The Earth ' s magnetic field, also known as magnetosphere, works as a shield to protect the planet from solar wind charged particles. However, under certain conditions of the interplanetary magnetic field, this protection is not so efficient. This "failure" allows the entrance of those particles, energy, and momentum of the solar wind to the magnetosphere. The main mechanism of that transfer is called magnetic reconnection. The flux transfer events (FTEs) are one of the byproducts of transient magnetic reconnection. The central problem addressed in this project is the study of the FTEs and the energy transferred from the solar wind to the Earth ' s magnetosphere through magnetic reconnection. In particular, we calculated the magnetic flux for FTEs identified in NASA's Magnetospheric Multi Scale (MMS) mission data and also analyzed size, motion and other important parameters for the set of 229 FTE events.

CONFERÊNCIA LATINO-AMERICANA
DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **ORAL**
Session ID: **4 - MAG**
Serial Number:

Study of Earth's Bow Shock

Authors

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Abstract

The solar wind is a continuous flux of high velocity charged particles from de Sun's corona that permeates through interplanetary space. At the moment the solar wind collides with the Earth's magnetic field, there is a sudden decrease to subsonic speed. Thus a schock wave is created in front of the Earth's magnetosphere, known as bow shock. After the shock, the solar wind is divided into the upstream region, where the flux is not disturbed, and the downstream region, also known as the magnetosheath, where the flux is disturbed. The bow shock is a region that has been studied over the years. Observational studies have shown that the parameters of the solar wind can vary by a factor of order 4 through the bow shock. The location of the bow shock can be determined by the shape of the magnetosphere, the Mach number of solar wind, and the orientation of the interplanetary magnetic field. The objective of this project is to study the bow shock location as a function of the solar wind using in situ observation.

CONFERÊNCIA LATINO-AMERICANA
DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation type: Oral

Session ID: 4- MAG

Serial Number:

GICs Modeling in the $525\ kV$ Power Network of North-Northeast Brazil Using a 3-D Earth Resistivity Model

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This work presents a case study for the north-northeast Brazilian sector under the influence of the equatorial electrojet. The main goal is to analyze the impact of the equatorial electrojet current system on the induced geoelectric field amplitudes that could contribute to GIC amplifications. Here is presented a regional study of geomagnetically induced currents for a synthetic situation using one-minute geomagnetic field data from a temporary array settled up in the equatorial region mainly covering the Parnaiba Basin from November 22 1990, until March 25 1991, the 3-D conductivity structure in the subsurface, and the $525\ kV$ current power transmission line. Geomagnetic data were convolved with 3-D MT impedances derived from forward calculation of an Earth conductivity model obtained from a combined GDS-MT inversion to obtain geoelectric surface fields. Finally, a simplified model of the current 525 kV transmission grid was integrated with the calculated geoelectric fields, and GICs were computed at grid nodes using the Lehtinen-Pirjola method. Isolating the influence of the EEJ, geoelectric field results suggest that the EEJ current system can induce important variations in the N-S component of the geoelectric field, affecting transmission lines with different directions, however, the largest amplitudes in the Ey component confirm that the EEJ current system drives the largest induced E amplitudes along the E-W direction. The estimated geoelectric field suggests a joined effect derived from the resistive structure in the subsurface and the contribution of the no static electrojet current system. The most exposed regions were identified in the central branch of the electrical network, where the transmission lines are oriented mainly east-west, and a higher concentration of substations is observed.

CONFERÊNCIA LATINO-AMERICANA
DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **4 - MAG**
Serial Number:

Geoelectric Characterization of Impact Structure: Santa Marta - Piauí, Brazil

Authors

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Abstract

A meteoritical impact event can disturb the Earth's climate and cause significant changes to the crustal structure, depending on the size of the projectile. The Santa Marta impact structure is a complex impact crater located in the southeastern part of the Piauí State, Brazil. It has a diameter of approximately 10 km and was formed in a complex scenery of Mesozoic rocks, where the Sanfranciscan Basin overlap sediments of the Paleozoic. Large meteoritical impacts can release enough energy to modify the physical properties of the rocks, which favors the use of electromagnetic methods to understand the deformation printed on the target rocks. In this way, we used broadband magnetotelluric data to image the electrical resistivity structure up to ~ 3 km depth in this study. The results show rocks of the western annular basin with intermediate resistivity values between 50 - 1000 m, probably related to the strata of the Sanfranciscan Basin and impact breccias. We also may interpret that the units of the Parnaíba Basin are placed underneath those rocks and present lower resistivity between 100 - 800 m. The central uplift is marked by two basement discontinuities, which define a distinctive block ~4 km-wide. Finally, its eastern annular basin is characterized by low resistivity between 1 - 100 m, identified as rocks of the Parnaíba Basin sequence. These results show that Santa Marta has a more distinctive electrical signature than expected once they usually show a circular pattern surrounding the central uplift. Therefore, our results make us understand that Santa Marta seems to be a very complex impact structure in terms of electrical resistivity, which reflects the structure's geological asymmetry.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 4 - MAG
Serial Number:

Community Structure of Satellite Measurements of the Earth ' s Magnetic Field

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Abstract

The Earth's magnetic field has dependence both in the time and spatial domains. Also, due to the underlying physical processes involved, the change of the magnetic field at a given point or at a given instant may induce variations at other points and/or subsequent times. We propose to study this complex dynamics of spatiotemporal correlations by means of tools derived from graph theory and complex networks, which have shown to be useful to describe the behavior of various systems of geophysical interest [1, 2, 3]. In particular, we intend to study the evolution of the measurements of the magnetic field on the Eart's surface throughout solar cycle 23. In a first study, we carried out this study with records from 59 magnetometers during solar cycle 23 (taken from the World Data Center for Geomagnetism, Kyoto, http://wdc.kugi.kyotou.ac.jp/hyplt/index.html). A problem that we found in this first work is that the stations are not evenly distributed. To complement the conclusions of this first work, we are now going to consider data from 1999 to 2005 from the Oersted satellite (taken from the National Space Institute of the Technical University of Denmark, https://www.space.dtu.dk/english/research/scientific data and models/magnetic satellites), and data from 2000 to 2008 from the Champ satellite (taken from the German Research Center for Geosciences, https://isdc.gfz-potsdam.de/champ-isdc/access-to-the- champ-data/). For both cases we consider a network of 63 uniformly distributed points with a separation of 22,5° in latitude and 40° in longitude. Each of these points represents the average of data within an area around this point with a height of 22,5° in latitude and a width of 40° in longitude, and averaged in time over a five-days windows. We define a complex network where the nodes are the averaged data points, and their connection is determined by the correlation between their respective magnetic field time series [4]. Therefore, the complex lattice structure is expected to be a representation of the spatio-temporal patterns of the Earth's magnetic field.
For this work, the network is defined using only one similarity method between time series, the Pearson correlation [4, 5]. Complex networks are built for each available year. Then, the community structure of eachnetwork is analyzed, and some of its basic features are studied over the available years, for example, usingmetrics such as the number of communities, and the average area covered by the communities.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **4 - MAG**
Serial Number:

Monitoring ULF Waves in Radiation Belts During the HILDCAAs Events

Authors

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Abstract

The interaction of solar wind with the magnetosphere can cause a lot of geomagnetic events that could create consequences for technological systems and economic activities. Because of that, monitoring and seeking to understand the mechanisms around this dynamic are relevant research subjects. Events with high auroral intensity, where the AE-index value never is below 200 nT for more than two hours, which persists for at least two days, are named HILDCAA (name of the acronym: High Intensity, Long duration, Continuous Auroral Activity) events. During the HILDCAAs event, the disturbances of Earth ' s geomagnetic are observed, followed by fluctuations everywhere inside the geomagnetic field, reaching the inner magnetosphere, such as the radiation belts region. The Ultra Low-Frequency (ULF) fluctuations can be measured through magnetometers in the ground-based network and onboard satellites. This work aims to study the ULF waves in the outer radiation belt region during HILDCAAs events. Therefore, we analyze the Interplanetary Magnetic Field (IMF), the solar wind speed, and the proton density measured at the L1 Lagrangian point. Additionally, we analyze the AE and SYM-H index and the frequency of ULF waves during the periods chosen for the study. Two HILDCAAs events were selected, March and July 2015, and one event without HILDCAA, July 2016. In the HILDCAAs events, the ULF waves presented higher values for both frequency and power spectral compared with the event without HILDCAA. Thereby, we will calculate the correlation between the ULF wave activities and the HILDCAAs events and their impacts on the high-energy electron flux variability in the outer radiation belt.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 4 - MAG
Serial Number:

Study of the response of the inner and global magnetosphere due to the interaction of 3 types of Alfvénic solar wind fluctuations using global MHD modeling

Authors

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Abstract

The fast solar wind stream from open magnetic field line regions on the solar surface play a key role in the dynamics of the global and inner terrestrial magnetosphere during the minimum of solar activity. These fast solar wind stream carry mass, momentum, energy, magnetic flux and waves in the plasma. Many physical questions still remain without a clear understanding of how these fast solar wind stream interact with the Earth's magnetosphere and can cause storms, substorms, increase or decrease in the flow of particles that orbit the inner magnetosphere. It is generally believed that the Alfven waves contained in these fast stream of the solar wind are precursors or triggers for magnetosphere activity, but the exact mechanisms of how such waves act are not yet known. In this work we will perform a set of controlled numerical experiments that mimic these structures of the fast solar wind using an global MHD model to try to identify the triggers and the way these waves interfere in the conversion of thermal, magnetic and kinetic energy in the internal and global magnetosphere and its correlation with the dynamics of storms, substorms and the population of particles orbiting the inner magnetosphere.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 4 - MAG
Serial Number:

The role of the whistler-mode chorus waves in the relativistic electron flux variability of the outer radiation belt under the influence of High-Speed Stream: a case study

Authors

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Abstract

The dynamic of Earth's magnetosphere can be disturbed by solar wind structures, such as High-Speed Stream - HSS, and change the dynamic of the outer and inner magnetosphere. Those perturbations can generate waves in a wide frequency range, such as whistler-mode chorus waves (from hundreds of Hz up to tens kHz), which can be observed almost simultaneously with the arrival of solar wind structures in the magnetosphere. It means that the trapped particles' dynamic in the outer radiation belt can be violated, causing a direct impact on the population of the outer radiation belt, which is formed primarily by electrons. This impact may occur from different dynamic mechanisms, such as radial diffusion, pitch-angle scattering, magnetopause shadowing, and others. The main goal of this case study, which occurred on July 7, 2016, focuses on identifying the pitch-angle scattering mechanism from the resonance between chorus and relativistic electrons using the Van Allen probes and DSCOVR satellite data. The outer radiation belt's electron flux enhancement (flux increase) and dropout (flux decrease) are analyzed from the characterization of the wave packets (sub-elements) and the calculation of the Wave Normal Angle (WNA) during the influence of an HSS. Generally, the chorus wave activities under the influences of the HSS are observed during several days, associated with the Alfvenic fluctuations. Therefore, this work will characterize the wave's sub-elements during the dropout and enhancement of the outer radiation belt to identify the main differences in the physical processes responsible for the high-energy electron flux variability in the outer radiation belt.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **4 - MAG**
Serial Number:

Magnetic Reconnection at the Dayside Magnetopause

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Abstract

The Sun is the main source of structures that contribute to the occurrence of magnetospheric phenomena. The solar wind is a constant supersonic flow of plasma permeated by the interplanetary magnetic field (IMF) and is the result of the expansion of atmospheric solar energy. When structures such as Interplanetary Coronal Mass Ejections (ICMEs) and High-Speed Streams (HSSs) reach the Earth, they interact with the Earth's magnetosphere, and from this interaction, magnetic reconnection can occur, responsible for geomagnetic storms. In order to study the ions outflow during the magnetic reconnections in the dayside magnetopause, we will analyze the data of the parameters of the solar wind obtained by the THEMIS's satellites and, from these data reconstruct the X-line of reconnection using the model of Gonzalez and Mozer (1974) to verify the performance of the model in predicting the direction of reconnection jets.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
21th november to 2nd december 2022
São José dos Campos, Brazil

Presentation Type: **ORAL**
Session ID: **4 - MAG**
Serial Number:

The ULF Waves' Activity in the Inner Magnetosphere Under the Influence of Low-beta Supercritical Interplanetary Shock Waves

Authors

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Abstract

One of the main open questions concerning interplanetary shocks is the physical processes related to particle acceleration to relativistic and ultra-relativistic levels in the inner magnetosphere during the shock arrival at the magnetosphere. In an attempt to answer this question, this work analyzes the ULF waves' activity after supercritical shock waves interaction with the magnetosphere and how they probably affect the variation of relativistic electron flux in the outer radiation belt throughout the Van Allen Probes era. The Earth's magnetosphere can be hit by interplanetary shock waves originating from different solar wind structures. The Solar wind-magnetosphere coupling can trigger the physical processes responsible for generating magnetospheric waves. The interactions between waves and particles significantly contribute to the enhancement or decrease in the population of trapped electrons and ions and cause impacts on the space environment. Thus, to verify the implications that a supercritical shock wave may cause in the ULF wave activity and consequently in the relativistic electron flux variability in the outer radiation belt, this work analyzes the magnetosphere and solar wind conditions during the occurrence of interplanetary supercritical shock waves. First of all, to classify it as a supercritical shock, we adopted the following criteria: fast Mach number upper the critical Mach number ($M_f>2,5$), and low beta ($\beta<1$). Adopting this classification, we were able to work with all the range of θBn ($90°>\theta Bn>0°$). Also, we verified the solar wind parameters and the magnetopause location using ACE satellite data for the supercritical shocks. To ensure that the ULF wave spectra wasn't due to magnetotail convection but possibly to the shock, we inspected graphics of the interplanetary magnetic field Bz component and compared the periods where the Bz was north orientated with the electron flux and the ULF wave spectra. A further step would be analyzing the ULF wave modes of polarization under the influence of interplanetary supercritical shock waves. From October/2012 to June/2019, 118 interplanetary shock waves were registered, most of them (79,66%) quasi-perpendicular and low beta (84,74%). Among these shocks, we identified 25 supercritical shocks, being 76% quasi-perpendicular. In 20 of the supercritical shocks, using Van Allen Probes data, it was observed changes in the outer radiation belt relativistic electron flux and in the ULF wave activity. We present a case study for shocks with the Bz component predominantly north-oriented a few hours after the shock hit the Earth's magnetosphere.

CONFERÊNCIA LATINO-AMERICANA
DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **ORAL**
Session ID: **4 - MAG**
Serial Number:

Electromagnetic Ion Cyclotron Waves (EMIC) - a review

Authors

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Abstract

The Earth' s magnetosphere involves the Van Allen Radiation belts which is formed by trapped charged particles. During geomagnetically quiet times these particle motion respect the invariant adiabatic motions meaning gyromotion, bounce and drift motion. However, several disturbances in the magnetosphere can promote magnetospheric waves which can violate these invariants. One of these waves is the Electromagnetic Ion Cyclotron (EMIC) wave. The EMIC waves usually appears after plasma thermal instabilities. Their major effect is to promote outer belt electron precipitation at relativistic and ultrarelativistic energies. This presentation mean to update our understanding about EMIC waves with the news about what has been done on this topic.

CONFERÊNCIA LATINO-AMERICANA
DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 4 - MAG
Serial Number:

Magnetic storm intensity and the Dst index

Authors

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Abstract

Magnetic storms are an important component of space weather because the disturbances that they produce in the magnetosphere and ionosphere can have significant effects on our technology. The traditional measure of magnetic storm intensity is Dst, which is generally taken as a measure of ring current intensity. However, many of the most important space weather effects involve the ionosphere and are driven by variations in ionospheric currents. In this talk I will discuss how for many storms the ionospheric currents are correlated with Dst, but for storms where the solar wind magnetosonic Mach number is low these quantities become uncorrelated. Therefore, for these storms, which tend to be the most intense storms, Dst is a much less useful measure of storm intensity.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **4 - MAG**
Serial Number:

Self-Consistent Solution of Geomagnetic Field Disturbances and Plasma Pressure Distribution for Strong Geomagnetic Storms.

Authors

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Abstract

The maintenance of magnetostatic equilibrium is the first problem that should be solved while we are analyzing any plasma configuration. It is not yet fully understood how the magneto-sphere reaches magnetostatic equilibrium and what specific conditions are necessary to maintain it. Unraveling these processes requires knowledge about the 2-D distribution of plasma pressure for different geomagnetic conditions. In this work, we have obtained a self-consistent numerical solution for the dipole magnetic field disturbances caused by plasma pressure in the case of an azimuthally symmetric plasma distribution specified in the near Earth's magnetosphere.
These results are complemented with the use of actual data measured by high-orbit satellite missions, such as THEMIS, RBSP or MMS. The main result is that we can recover the Earth's magnetic field depression due to a 2-D pressure profile in the presence of strong geomagnetic storms

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 4 - MAG
Serial Number:

The universality of the kinetic regulation of plasma turbulence and thermally induced electromagnetic fluctuations

Authors

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Abstract

In magnetized non-collisional plasmas, there are strong indications that the kinetic physics regulate the turbulent behavior in a universal manner. This phenomena is associated with relevant levels of thermally induced electromagnetic fluctuations; particularly in the laboratory, space, and astrophysical setting where the plasma reaches a state of relaxation in the absence of instabilities. This is the so-called quasi-equilibrium state to which non-collisional plasmas seems to stay for a long time when not driven. Under these conditions, the thermal motion of charged particles naturally produces fluctuations that the system tries to dissipate, reaching a state with a finite level of fluctuations that are balanced by the dissipation. In these systems; such as the solar wind [1], the Earth's magnetosphere[2], or the magnetosphere of pulsars[3]; it is possible to study the production of these electromagnetic fluctuations in the so called -A diagram; with as the ratio between the thermal parallel energy and the magnetic energy, and A as the thermal anisotropy. The universality is characterized by the shape of the particle velocity (or energy) distribution function. Although, there has been a number of proposed explanations about the existence of these electromagnetic fluctuations under quasi-stable conditions, we advocate that a relevant component of these fluctuations can be explained by the random motion of particles in the plasma so that their understanding requires a kinetic treatment that relies on an extension of the fluctuation-dissipation theorem for anisotropic plasmas . We have found that this processes is quite general and that appears in a number of plasma settings, suggesting the universality of the processes,

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **4 - MAG**
Serial Number:

The 14 December 2020 Total Solar Eclipse Effects on Geomagnetic Field Variations Over South America

Authors

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Abstract

We discuss the effects in the geomagnetic field variations caused by the Total Solar Eclipse (TSE) that occurred on 14 December 2020 over the South American sector. We used ground-based magnetometer data to evaluate the modification in the Equatorial Electrojet (EEJ) strength and Total Electron Content (TEC) maps derived from the Global Navigation Satellite System (GNSS) to study the electron density variations during the eclipse. The results show that the geomagnetic field daily variation weakens between the first and last solar eclipse penumbra contact. Additionally, we observed a significant reduction of about 52.33 nT of the EEJ strength at Jicamarca (11.95° S, 76.88° W), where the solar obscuration reached 16.67% approximately. This behavior indicates that the solar eclipse in the equatorial region has possibly affected electric conductivities, altering the E region dynamo electric field. Consequently, it weakens the equatorial plasma fountain, affecting the Equatorial Ionization Anomaly (EIA) development. The solar eclipse also caused some modifications in the q-type sporadic E (Es) layer and F region dynamics at Jicamarca. The results found here provide a better understanding of how the solar eclipse passage in the equatorial region affects the electron density in the low-latitude regions.

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DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **4 - MAG**
Serial Number:

Evaluation of dB/dt amplitudes and sources over Brazil during geomagnetic storms of the 2021-2022 biennium

Authors

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Abstract

The present work aims to study the typical amplitude range and main sources of the rate of change in the geomagnetic field (dB/dt) associated with geomagnetic storms, as recorded over low to mid magnetic latitudes of Brazil. It is well known that intense dB/dt rates of a few nT/s may generate geomagnetically induced currents underground, which oftentimes cause damage of components of the power grid system in higher latitude regions. As such, the characteristics of storm-time dB/dt signals is mainly understood for the high latitudes. Another motivation to develop this study is that the 2021-2022 biennium is a suitable period for evaluating dB/dt, especially at low latitude region, as geomagnetic storms have become more frequent due to the ascending phase of the solar cycle 25. Therefore, we inspect the dB/dt amplitudes observed by the Brazilian Embrace magnetometer array during several geomagnetic storms in 2021-2022, with respect to local time and magnetic latitude, and the frequency response of these signals. As a result, we expect to characterize the dB/dt occurrence over different sites in Brazil and potentially elucidate its sources and means of amplification mostly considering the external and crustal origins of the geomagnetic field variations recorded on the ground.

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DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 4 - MAG
Serial Number:

Pc5-Pulsations in conjugate stations to investigate the South Atlantic Magnetic Anomaly effects: case study

Authors

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Abstract

In this work, Pc5 magnetic pulsations are studied using data from geomagnetically conjugate stations as a case study. The effort proposes a nonlinear-multiscale methodology to investigate the Pc5 to aid in a comprehensive low latitude investigation, mainly involving the South Atlantic Magnetic Anomaly (SAMA). The data refer to the horizontal magnetic component collected during a peculiar geomagnetic storm at San Juan, Porto Rico, and Sao Martinho da Serra, Brazil. The former is in the northern hemisphere, and the latter is the other hemisphere in a region affected by the SAMA. The approach to evaluating the dynamical phenomena characteristics are based on spectral techniques, obtaining signal characterizations and coherence analysis to highlight the Pc5 process dynamics. The case study results support complete research involving the low latitude stations and comparisons with the Pc5 development in the SAMA.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 4 - MAG
Serial Number:

The role of the inner radiation belt dynamic in the generation of auroral-type sporadic E-layers over South American Magnetic Anomaly (SAMA)

Authors

[1,2] L. A. DA SILVA; [1] J. SHI; [1,2] L. C. A. RESENDE; [3] O. V. AGAPITOV; [2] L. R. ALVES; [2] I. S. BATISTA; [4] C. ARRAS; [2] L. E. VIEIRA; [2] V. DEGGERONI; [1,2] J. P. MARCHEZI; [1] C. WANG; [1,2] J. MORO; [2] A. INOSTROZA; [1] H. LI; [2] C. MEDEIROS; [5] F. R. CARDOSO; [1,2] P. JAUER; [2] M. V. [2] M. V. ALVES; [2] S. S. CHEN; [1] Z. LIU; [2] C. DENARDINI

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Abstract

The dynamics of the electron population in the Earth ' s radiation belts affect the upper atmosphere's ionization level through the low-energy Electron Precipitation (EP). The impact of low-energy EP on the high-latitude ionosphere has been well explained since the 1960's decade. Conversely, it is still not well understood for the region of the South American Magnetic Anomaly (SAMA). In this study, we present the results of analysis of the strong geomagnetic storm associated with the Interplanetary Coronal Mass Ejection (May 27-28, 2017). The atypical auroral sporadic E layers (Esa) over SAMA are observed in concomitance with the hiss and magnetosonic wave activities in the inner radiation belt. The wave-particle interaction effects have been estimated, and the dynamic mechanisms that caused the low-energy EP over SAMA were investigated. We suggested that the enhancement in pitch angle scattering driven by hiss waves result in the low-energy EP (10 keV) into the atmosphere over SAMA. The impact of these precipitations on the ionization rate at the altitude range from 100 km to 120 km can generate the Esa layer in this peculiar region. In contrast, we suggested that the low-energy EP (1 keV) causes the maximum ionization rate close to 150 km altitude, contributing to the Esa layer occurrence in these altitudes.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **4 - MAG**
Serial Number:

Measuring Temperature Effects in Fluxgates Magnetometers to Generate Compensation Parameters

Authors

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Abstract

In fluxgate magnetometers we have some imprecisions in the measurements due to the temperature changes. We have problems with the size of the coil, the resistance of the copper wire and the electronics drifts. We have to compensate all changes, but should be better if we know the changes of each one particularly. The main change we found is due to the copper wire resistivity in the detection coil and now we present a magnetometer circuit that correct the variation of resistivity acting as a negative impedance circuit. Also we collect the data of magnetic field, feedback current and temperature precisely to compare them with the calibrations data and generate parameters to future corrections. In addition to we present a methodology to make the calibration of magnetometers in order to find better parameters to correct the gain and the offset voltage changes. To get this we apply a positive and negative pre-determined value of magnetic field in the detection coil to verify how much the detection coil has changed. As we already have calibrated the variations of the magnetic coil response with the temperature changes, so, we can compare them and correct all the measurements data with these new parameters.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **4 - MAG**
Serial Number:

Temporal variability of 27 day-averaged space weather related parameters: connecting solar, interplanetary medium and geomagnetic activity indices

Authors

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Abstract

We analyzed correlations between solar, interplanetary medium parameters, and geomagnetic-activity proxies in 27-day averages (a Bartels rotation) for the 2009 – 2016 time interval. We considered two new proxies: i) Bzs GSM (Geocentric Solar Magnetic), calculated as the daily percentage of the IMF southward component along the GSM z-axis and then averaged every 27 days; ii) four magnetospheric indices (T-indices) derived from the individual contributions of the main magnetospheric components of the semi-empirical Tsyganenko and Sitnov model (J. Geophys.Res. 110, A03208, 2005: TS05), towards the local north – south (X) component of magnetic field. These are the cross-tail (TAIL), symmetric ring (SRC), partial ring (PRC) and Birkeland (FAC) currents. Our results suggest, among the parameters tested here, solar facular areas, interplanetary-magnetic field intensity and new proxies derived here could be taken into account in an empirical model, with a 27-day resolution, to explain geomagnetic activity felt on the Earth's surface in terms of solar surface features and the IMF condition. We further retrieve a clear annual oscillation in series of 27-day-mean values of toward/away asymmetries of geomagnetic-activity indices, which can be interpreted in the light of the Russell – McPherron hypothesis for the semiannual variation of geomagnetic activity (Russell, C. T., and R. L. McPherron (1973), J. Geophys. Res., 78, 92 – 108).

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **4 - MAG**
Serial Number:

Distributed System for Near Real-Time Recording of the Electromagnetic Spectrum over Mexico.

Authors

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Abstract

Development of a prototype for the acquisition, storage, processing, and analysis of the electromagnetic spectrum in near real-time, distributed in Mexico to monitor the stability of radio communication signals between 30 MHz and 150 MHz and the relationship of stability with solar storms.

We use Software Defined Radio devices connected to Raspberry Pi 4 for real-time signal processing, obtaining the electromagnetic spectrum from the recorded signals by applying the Fast Fourier Transform, which has free implementations for parallel processing, making the prototype cheap and easy to replicate.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **4 - MAG**
Serial Number:

Continuously Tracking the Bow Shock and Magnetopause: Observations

Authors

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Abstract

On plasma physics, boundaries play a very important role separating two adjacent plasma regimes. The Earth ' s magnetosphere is the outermost boundary of the magnetospheric magnetic field, it is defined (first approximation) by the pressure equilibrium between the magnetosheath plasma and the magnetic field confined in the magnetosphere. The bow shock is the result of the interaction of the supersonic solar wind and the Earth ' s magnetosphere. It is through these boundaries that energy can be transfer from one regime to the other. Even though there are satellite missions able to measure location and other magnetopause/bow shock properties in-situ, the most of the time they are somewhere else. MHD models predict that after cross the bow shock in the subsolar region the Vx component of the solar wind velocity decrease linearly until zero where it encounters the subsolar magnetopause. In this case it is possible to determine the boundaries location using radial gradient measurements of the magnetosheath plasma velocity. We will present cases where the bow shock and magnetopause stand-off locations can be determined using Themis magnetosheath velocity data. The results are consistent with observation made by the same spacecraft during the same period.

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27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 5 - PLA
Serial Number:

Observation of coherent structures in solar supergranular turbulence

Authors

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Abstract

The quiet Sun exhibits a wealth of magnetic activities that are fundamental for our understanding of solar magnetism. The magnetic fields in the quiet Sun are observed to evolve coherently, interacting with each other to form prominent structures as they are advected by photospheric flows. We study the supergranular turbulence by detecting Lagrangian coherent structures (LCS) based on the horizontal velocity fields derived from Hinode intensity images at disc centre of the quiet Sun on 2010 November 2. LCS act as transport barriers and are responsible for attracting/repelling the fluid elements and swirling motions in a finite time. Repelling/attracting LCS are found by computing the forward/backward finite-time Lyapunov exponent (FTLE), and vortices are found by the Lagrangian-averaged vorticity deviation method. We show that the Lagrangian centres and boundaries of supergranular cells are given by the local maximum of the forward and backward FTLE, respectively. The attracting LCS expose the location of the sinks of photospheric flows at supergranular junctions, whereas the repelling LCS interconnect the Lagrangian centres of neighbouring supergranular cells. Lagrangian transport barriers are found within a supergranular cell and from one cell to other cells, which play a key role in the dynamics of internetwork and network magnetic elements. Such barriers favour the formation of vortices in supergranular junctions. We show that the magnetic field distribution in the quiet Sun is determined by the combined action of attracting/repelling LCS and vortices. Moreover, we report observational evidence of Lagrangian chaotic saddles in plasmas, given by the intersections of finite-time unstable and stable manifolds, using an 22 h sequence of spacecraft images of the horizontal velocity field of solar photosphere. A set of 29 persistent objective vortices with lifetimes varying from 28.5 to 298.3 min are detected by computing the Lagrangian averaged vorticity deviation. The unstable manifold of the Lagrangian chaotic saddles computed for 11 h exhibits twisted folding motions indicative of recurring vortices in a magnetic mixed-polarity region. We show that the persistent objective vortices are formed in the gap regions of Lagrangian chaotic saddles at supergranular junctions.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 5 - PLA
Serial Number:

Rossby waves as an organizing mechanism for the magnetic activity of the Sun

Authors

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Abstract

Rossby waves are one of the most fundamental mechanisms to govern the dynamics of Earth's atmosphere and oceans, being associated with weather and climate patterns. Rossby waves were also recently detected on the Sun, there is a growing basis of evidenc pointing out to the role of these waves in spatio-temporal organization of the solar magnetic activity, including the determination of the location and intensity of solar flares and coronal mass ejection events. In the present talk, we will introduce the theory of magnetohydrodynamic waves in the Sun and proide the evidence of their signature on observational records of the solar magnetic activity.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 5 - PLA
Serial Number:

Statistical Study of a Magnetized Plasma Under Fractal Forcing

Authors

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Abstract

Shannon entropy of a probability distribution can be estimated directly by knowing the probabilities associated with each state [1]. In the case of real time series, this probability can be derived from a binning of the possible values, a strategy that can give a bad estimate of the entropy if the number of intervals is not properly chosen. To overcome this issue, Di Crescenzo et al. proposed an entropy based on the cumulative probability distribution (CDF) [2]. Recently, the fractality of a magnetohydrodynamic turbulence shell model has been studied [3,4]. In order to represent the evolution of the Earth's magnetosphere with the GOY-type shell model, the forcing terms for the velocity and the magnetic field were obtained from fractional Brownian motion time series with various Hurst exponents, thus generating different levels of intermittency in the plasma simulations. In this study, we investigate the possible correlations between the cumulative entropy of the dissipated magnetic energy time series and the fractal dimension of the forcing time series. In addition, the sensitivity to fractal forcing induced by time series with different Hurst parameters is analyzed.

We thank the support of ANID, Chile, through FONDECYT Grant No. 1201967 (VM).

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type:
Session ID: **5 - PLA**
Serial Number:

Discharges in a Non-local System: The Waiting Time Behavior

Authors

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Abstract

Using a model of electrical discharges consisting on a self-organization process induced by a nonlocal critical field, in analogy with the electric field that is derived from the global spatial profile of electric charge density during a discharge. In this nontrivial extension of standard sandpile like models of intermittent dissipation, the charges move in a similar manner to grains of sand when the threshold condition on the field is achieved. We have previously studied the long-term statistics of events. For the simulated avalanches we have analyze four characteristic quantities: current, charge discharged, energy discharged, and duration of the discharge. Waiting times statistics can provide crucial information enabling the prediction of electric discharges (or at least the most extreme ones). We have used three different definitions of waiting time thus advancing our understanding of systems with avalanches or discharges, when the criticality is controlled by nonlocality.

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 5 - PLA
Serial Number:

2D Sandpiles in Networks with Variable Topology as a Model For Geomagnetic Activity

Authors

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Abstract

Various studies have pointed out that the Earth ' s magnetosphere exhibits self-organized critical (SOC) features, such us the power-law behavior of auroral indices and in-situ observations of the magnetic field in the Earth ' s geotail. [1] Indeed, the dynamics of the magnetosphere has the basic components expected in a SOC model: an external driver (the solar wind), slow accumulation of energy, and energy release in much shorter timescales (geogmagnetic events such as substorms). Sandpile models [2] are a paradigmatic model for SOC behavior, and studies like Ref. [1] have used them to describe magnetopheric dynamics. Usually, sandpile models consider a grid of cells, and when load on a cell reaches a given threshold, it is redistributed on neighboring cells, until all loads are below the threshold, thus completing an energy release event (avalanche). However, several studies [3,4] have considered the generalized case of sandpiles on a complex network, whose nodes are loaded, and avalanches redistribute the load on their connections. Network topology modifies the SOC features, and thus it is interesting to study this in the context of magnetospheric physics, where magnetic field distortion and reconnection may modify the direction and intensity of energy release events. In this work we study a simple sand pile model as in [5,6] but now on a complex network that reconnects without breaking itself, as a first step for its application to magnetospheric dynamics.

Acknowledgment: We thank the support of CONICYT through Fondecyt Grant 1201967 (VM).

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DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **5 - PLA**
Serial Number:

Lagrangian chaotic mixing in numerical simulations of resistive drift-wave turbulence in plasmas.

Authors

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Abstract

We analyze the Lagrangian chaotic mixing properties of numerical simulations of a simplified model for electrostatic resistive drift-wave turbulence in plasmas, given by the modified Hasegawa-Wakatani equations. We focus on two different regimes, namely, a regime dominated by turbulent patterns, and a regime dominated by zonal flows. Lagrangian coherent structures are detected by computing the finite-time Lyapunov exponent of the velocity field derived from the electrostatic potential, and the statistics of the chaotic mixing of the two regimes are compared. These results can contribute to the understanding of turbulent transport processes due to drift-wave turbulence in space and fusion plasmas.

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XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **5 - PLA**
Serial Number:

Effects of Magnetic Divergence Control in Numerical MHD Modeling of Instabilities

Authors

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Abstract

Kelvin-Helmholtz (K-H) instability is a typical process in many heliophysics environments, including the magnetopause of the Earth. This instability is characterized by energy and momentum transport across many scales, involving dissipative processes, and occurring as a turbulent flow. The present study analyzes K-H instability simulations using an ideal magnetohydrodynamic (MHD) numerical model, developed in the finite-volume, time explicit, wavelet adaptive mesh, MPI parallel AMROC framework. To numerically satisfy Gauss law for magnetism, usually called divergence-free condition, we implemented two Generalized Lagrange Multiplier (GLM) approaches, namely: GLM-MHD, completely homogeneous, and its recent inhomogeneous development, IGLM-MHD. For comparative analysis we use key metrics, such as overall magnetic curvature, dimensions of the flow and magnetic Taylor microscales, magnetic intermittency, and kinetic and magnetic energies. The impact of each GLM approach on these metrics is discussed. Varying the magnetic field to typical heliospheric values, we aim to investigate the existence of physical and/or numerical regimes in which different GLM approaches might be more appropriate, and also highlight the implications of magnetic divergence errors on the evolution of non-linear MHD systems.

CONFERÊNCIA LATINO-AMERICANA
DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **5 - PLA**
Serial Number:

Spectral entropy of numerical simulations of resistive drift-wave turbulence in plasmas during a transition to zonal flows.

Authors

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Abstract

We analyze two-dimensional numerical simulations of the modified Hasegawa-Wakatani equations, which provide a simplified nonlinear model of electrostatic resistive drift-wave turbulence in plasmas. We construct a bifurcation diagram of a transition from a turbulent regime to a regime dominated by zonal flows, in which turbulence is suppressed. The degree of order/disorder during this transition is then characterized by computing the normalized spectral entropy of the electrostatic potential. Our results show that the turbulent regime displays a high degree of entropy, and the regime dominated by zonal flows is characterized by lower values of entropy. These results can be relevant for the understanding of the nonlinear processes in drift-wave turbulence in space and fusion plasmas.

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27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **5 - PLA**
Serial Number:

Simulating the interactions of a rigid body and of a source of ions with a flow of plasma using AMROC

Authors

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Abstract

The study of the interaction of solid objects and sources of ions with magnetohydrodynamic (MHD) fluids is of great importance in Space Plasma Physics once from such scenarios we can simulate planets and comets interacting with stellar winds. In order to do so, we use AMROC, which is a computational code that provides a generic object-oriented implementation in C++ of the adaptive mesh refinement algorithm described in M. Berger and J. Oliger, J. Comput. Phys. 53:484 (1984). Our aim here is to implement the simulations of the interaction of a moving fluid with two particular types of object: a solid body and a source of ions, both spherical. The case of the solid object is interesting once it yields the possibility of creation of realistic scenarios such as, e.g., the Sun-Earth and Sun-Moon systems. Concerning the source of ions, the scheme is the basis for simulating the behavior of comets; with effect, we are currently working on the implementation in AMROC of the computational model of a comet detailed in A. Ekenbäck et al., Geophys. Res. Lett. 35:L05103 (2008).

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27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **5 - PLA**
Serial Number:

The Role of Coherent Structures in Intermittent Magnetic Field Turbulence

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Abstract

The solar wind is a natural laboratory for the study of turbulence in plasmas. The power spectrum of magnetic field fluctuations in the interplanetary solar wind displays an inertial subrange with power-law scaling and spectral index of -5/3, which is indicative of a turbulent state. The magnetic field turbulence displays intermittency evidenced by non-Gaussian probability distribution functions, departure from self-similarity, multifractality, and amplitude-phase synchronization among scales.

Intermittency within the inertial subrange is due to the presence of coherent structures which dominate the statistics of fluctuations at small scales. Here we demonstrate that coherent structures are responsible for the decrease of disorder in turbulent plasmas. We apply the normalized Shannon entropy to the spatiotemporal patterns of the magnetic field obtained from numerical simulations of a three-dimensional incompressible MHD model of a Keplerian shear flow. We also compute the normalized entropy of magnetic field data within reconnection exhausts detected in the solar wind at 1 AU. Our results show that coherent structures are responsible for decreasing the degree of entropy in turbulent plasmas.

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27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: **POSTER**
Session ID: **5 - PLA**
Serial Number:

The Response of the Ion and Electron Kappa Distribution Functions in the Inner Magnetosphere to Solar Wind Conditions

Authors

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Abstract

The Earth's magnetosphere is filled with a collisionless plasma having non-Maxwellian particle distributions, which are often fitted by a Kappa distribution function. In contrast to the Maxwellian distribution function, the Kappa distribution contains not only density and temperature but also the kappa index that allows us to characterize the energetic tails. In this study, we analyze the response of the ion and electron Kappa distributions obtained by fitting ion and electron fluxes measured by the five THEMIS satellites to the changes of the solar wind dynamic pressure and the Bz component of the interplanetary magnetic field (IMF). It was found that both quantities strongly affect the values of kappa index, and their impact depends on the MLT sector. The results obtained reflect the global reconfiguration of the magnetosphere by solar wind dynamic pressure and IMF.

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27th November to 2nd December 2022
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Presentation Type: ORAL
Session ID: 5 - PLA
Serial Number:

Comparison of High and Low Latitude Magnetic Effects Related to HILDCAAs: cases studied.

Authors

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Abstract

There is an apparent interrelationship between specific geomagnetic effects at low (given by the index Asy-H) and high (AE) latitudes measured during High-Intensity Long-Duration Continuous Auroral Electroject Activity (HILDCAA) occurrences. This work investigates those geomagnetic indices to enrich our understanding of involved electrodynamical process developments. We use datasets of different HILDCAA conditions, together a control data concerning a geomagnetically quiet interval. The study methodology consists of wavelet scalogram analysis to characterize the similarities among the HILDCAA processes, signal-normalized equivalent-energy comparison to evaluate the interrelationship coupling condition, and dynamical time distortion analysis to assess an energy-transfer influence regime. In conclusion, we verify a complex electrodynamical response characterized in the HILDCAAs, and a nonlinear interrelationship in the effects during the cases investigated.

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XIII COLAGE
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São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 5 - PLA
Serial Number:

Sources of Concentric Gravity Waves Generated by a Moving Mesoscale Convective System in São Martinho da Serra

Authors

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Abstract

Studies on the vertical interaction between the lower and upper atmosphere were conducted using two concentric gravity waves (CGWs) generated by a moving Mesoscale Convective System (MCS) on the night of October 1 - 2, 2019. The observations were made using OH all-sky imagers hosted by the Southern Space Observatory (SSO) coordinated by the National Institute for Space Research at São Martinho da Serra - RS (29.44°S; 53.82°W). Three distinct CGW events were observed at three different times and regions of the images. 2D spectral analysis showed that the CGWs have horizontal wavelength H 50.30, 54.90, and 30.50 km, horizontal speed cH 73.90, 91.00, and 72.90 m/s, and period 11.40, 10.00, and 07.00 minutes, respectively. A reverse ray-tracing model revealed that the two of the waves were excited by an overshooting in convective cores within the MCS which is indicated by the proximity of the ray-traced tropopause positions coldest regions of the MCS. To determine whether or not the overshooting is the source of the CGWs, the vertical extent of the overshooting is estimated. On this night, we observed that the cold-point tropopause (CPT) was -80°C, which was 10°C cooler than CPT on the days preceding and after the MCS, and also colder than usually observed. Since the tropopause height and temperature are fundamental parameters underlying the overshooting extent analysis, a new approach was developed to establish a reference tropopause that would enable a quantitative estimate of these parameters.
Keywords: Concentric Gravity Waves, Mesoscale Convective System, Ray-tracing model

CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
XIII COLAGE
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: POSTER
Session ID: 5 - PLA
Serial Number:

Solar flare analysis using complex networks

Authors

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Abstract

Solar flares are sudden and powerful events that occur in the solar corona. Flaring activity is related to the rapid release of huge amounts and energy.
One of the theoretical/computational approach to the flaring corona has been studied assuming that magnetic reconnection is the main mechanism behind the fenomena that can be collectively modeled using a cellular automata simulation [1].
This models successfully reproduced most of the main statistical features observed in solar flares.
Because of their inherent simplicity, this models can be also use as a tool to search for possible proxies that could account for flare predictivity (for at least the most intense flares).
In this work we perform simulations using the well known model for solar flares proposed by Lu and Hamilton in 1991 [2] and analyse the simulations results using a graph theory to build the complex network, as has been done in works such as [3].
Some characteristics (e.g., degree distribution, clustering coefficient, characteristic path length, and diameter) in the network are obtained to determine the type of network according to [4].
With this results we discuss the forecasting each of them enables.

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CONFERÊNCIA LATINO-AMERICANA DE GEOFÍSICA ESPACIAL
27th November to 2nd December 2022
São José dos Campos, Brazil

Presentation Type: ORAL
Session ID: 5 - PLA
Serial Number:

Test Particle Energization of Protons and Heavy Ions in Magnetohydrodynamic Turbulent Environments in Space Physics

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Abstract

In this talk I will present a study of the energization and displacement of test particles (protons and heavy ions) interacting with the electromagnetic fields in a regime of magnetohydrodynamic (MHD) turbulence, using direct numerical simulations. The results show the particle's energization to be predominantly perpendicular to the main magnetic field, and the ratio of perpendicular to parallel energization to increase with lower charge-to-mass ratio (heavy ions). The displacement and preferential concentration of particles is analyzed using a Voronoi tessellation technique. Also, a study is performed comparing the energization of test particles in a turbulent regime versus a purely wave (linear) behavior in MHD. Different mechanisms for the particleâ s energization will be discussed. The results have application in the general behavior of charged particles in space physics, and in particular in turbulent environments.

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