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WIND TURBULENCE CHARACTERISTICS AND SEASONAL COMPARISON AT THE COM. FERRAZ ANTARTIC STATION FROM 2003 TO 2004

Luciana Bassi Marinho Pires, Francisco Eliseu Aquino,
Marcelo Romão, Ana Carolina Vasques and Alberto Setzer

Center for Numerical Weather Forecast and Climate Studies - CPTEC,
National Institute for Space Research – INPE, São José dos Campos, SP, Brazil
E-mail: *lubassi@cptec.inpe.br*

Abstract: This study presents the first characterization and a preliminary seasonal comparison of the wind turbulence at the Com. Ferraz Antarctic Station (EACF) from 2003 to 2004. Turbulence was estimated using the wind gust factor and wind turbulence definitions used in applied engineering studies of meteorology. The EACF (62°05'S; 58°23.5';W) is located on the Keller Peninsula, Admiralty Bay, King George Island, northern Antarctic Peninsula.

Keywords – *wind gust factor, wind turbulence, King George Island, Antarctica.*

1. INTRODUCTION

The low pressure belt around Antarctica, between 60ºS e 65ºS, is the most marked one on the Planet. The predominant westerly winds over the Antarctic Peninsula enhance extratropical cyclone activity. This study presents a first characterization and preliminary results on the structure of the atmospheric turbulence employing the seasonal comparison of the turbulence observed at the Brazilian Antarctic scientific station, *Estação Antártica Comandante Ferraz* (EACF), between 2003 and 2004.

2. MATERIALS AND METHODS

The EACF is located, on the east side of the Keller Peninsula (3.8 km x 2.2 km), a ridge with altitudes in the range of 250 to 360 m, on the northern coastline of Admiralty Bay (Figure 1). Set 794 m from the base of Flagstaff Mt., EACF is within a turbulent recirculation zone, were severe regional meteorological conditions are a constant presence.

Turbulence analysis was made according to the definitions normally employed in applied meteorology studies for engineering problems, e.g. as in Plate (1982), Bergstrom (1987), Kristensen et al., (1991) and Young and Kristensen (1992). The analysis of wind gusts is one of the ways to study the structure of turbulence at any place, and where such events can be defined as the sudden increase/decrease of wind speed at very small and continuous cycles.

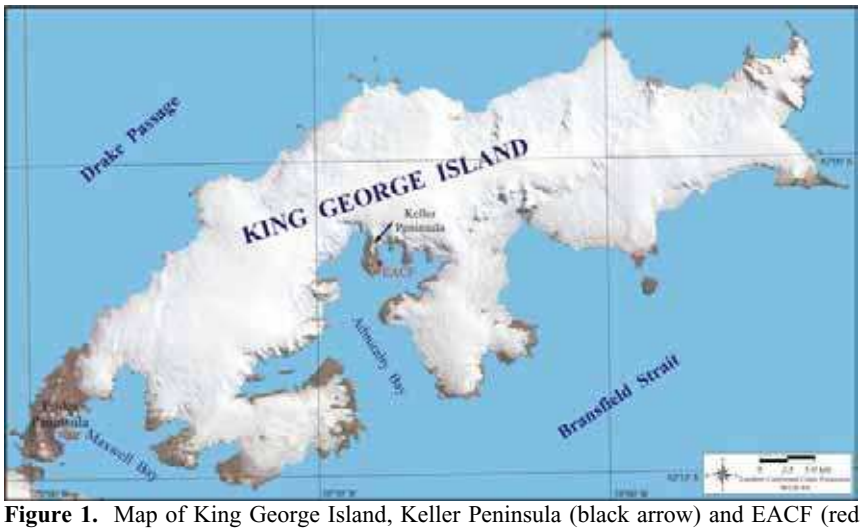

Figure 1. Map of King George Island, Keller Peninsula (black arrow) and EACF (red dot).

To conduct the comparative seasonal study we used the wind data obtained with a Wind Monitor Sensor R.M.Young Model 05103. This equipment is installed on a 10 m anemometric tower adjacent to EACF, at 20 m msl. Wind speed and direction were stored in a Datalogger Campbell 21X, and where the full hour value registered is the average of the last ten minutes interval, sampled at each second – see http://www.cptec.inpe.br/antartica. The data spanned the period from January/2002 to December/2003. The parameters measured were the 10-minutes average scalar speed (ms^{-1}), 10-minutes average direction (degrees), and the daily maximum gust; the calculated variables were the wind gust factor, gust amplitude (ms^{-1}) and turbulence intensity.

3. RESULTS

Table 1 shows the measured values of speed and maximum speed) and the calculated values of the variables: gust factor $G = V_{max} / V_{mean}$, gust amplitude $A = (V_{max} - V_{mean})$, and turbulence intensity $I = \sigma_{speed} / V_{mean}$.

Season	2003					2004				
	V_m	V_{max}	G	A	I	V_m	V_{max}	G	A	I
DJF	5.0	13.9	3.7	8.9	0.8	4.5	13.0	5.3	8.5	0.7
MAM	5.9	16.4	2.3	10.5	0.7	6.1	16.9	5.9	10.8	0.8
JJA	7.5	20.2	5.7	12.8	0.7	7.1	19.6	4.9	12.5	0.7
SON	6.7	18.3	5.1	11.6	0.7	6.7	18.8	4.4	12.1	0.7

Table 1. Mean values for wind characteristics: mean speed (V_m), maximum speed (V_{max}), wind gust factor (G), gust amplitude (A) and turbulence intensity (I).

The most intense winds occurred in winter (JJA) with a seasonal average of 7 ms^{-1}, and the least intense in summer (DJF), averaging 4.5 ms^{-1}. The maximum sustained wind speed of 20 ms^{-1} occurred in winter of 2003, followed by a value of 18 ms^{-1} in spring. The EACF climatology for the winters of 1986 to 2005 presents the mean wind speed of 6.4 ms^{-1} and the maximum wind gusts of 49 ms^{-1}, in agreement with the results of this study. Turbulence intensity did not present seasonal differences, stabilizing around 0.7. The wind gust factor showed a minimum value of 2.3 ms^{-1} in the fall (MAM) of 2003 and a maximum of 5.9 ms^{-1} in the fall of 2004, therefore varying inversely between the two years. Wind gust amplitude was greater in JJA in both years, with approximate mean values of 13 ms^{-1}, followed by SON.

6. CONCLUSION

In this preliminary characterization of the seasonal structure of atmospheric turbulence, it is evident that the summer season (DJF) is the best period for outdoor and fieldwork activities in the EACF region, due to the smaller values in wind speed maxima (13 ms^{-1}) and wind speed averages (5 ms^{-1}). Wind gust amplitude was also weaker in summer, about 8 ms^{-1}, showing values over 10 ms^{-1} at all other periods. Turbulence intensity did not present any differences among the four seasons, probably due to the complex atmospheric circulation in the fjord structure of Admiralty Bay, together with the frequent regional extratropical cyclonic activity and constant local KGI winds.

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