Assessment of A New System for Generation of Real Time Maps of the Scintillation Index S4 Over Brazil

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A prototype of a new system for real time generation of amplitude scintillation index S4 maps was implemented and tested. It employs S4 data from two ionospheric monitoring networks of GNSS stations covering Brazil, LISN and INCT GNSS-NavAer. The S4 index is calculated for each GNSS satellite-station link from the constellations GPS, GLONASS, GALILEO, BEIDOU, and SBAS. The proposed system requires 5 data processing steps: acquisition, preprocessing, interpolation, image rendering and Internet dissemination. Specific acquisition schemes were developed for the LISN and the INCT stations to send S4 data to the real-time server also implemented in this work, using a NoSQL database that allows exporting data by a data push feature, faster than performing standard queries that would preclude real time operation. After acquisition, data transmission and storage in the database, follow preprocessing, interpolation and image rendering steps. A recent work performed a search for the optimal approach to be employed in this system for generating the maps among 12 preprocessing options and 4 interpolation methods. The evaluation considered the minimization of the interpolation error, smoothness of the resulting map, processing time, and automatic parameterization capability. The best approach was given by a set of preprocessing options coupled with the innovative use of Gaussian Process Regression interpolation with a specific kernel function, being adopted for the proposed system. The quality of the maps was assessed by its smoothness, absence of artifacts, and the error and correlation metrics taking as reference actual S4 values for each available satellite-station link, corresponding to a IPP sample (location and S4 value). The resulting scintillation maps are then made available by a web server application in the real time server in less than 1-minute considering all steps, thus in real-time.