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Contents

2.2 Seminars (10:30 – 12:30)

2.2.1 Session 04 (10:30 – 11:00): Operational Ionospheric Dynamics Prediction For South America

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This work shows the development and preliminary results of operational ionosphere dynamics prediction system for South America region, based on an enhanced version of Sheffield University Plasmasphere-Ionosphere Model (SUPIM), a physics-based model computer code describing the distribution of ionization within the Earth mid to equatorial latitude ionosphere and plasmasphere. The model outputs are given in a 2-dimensional plane aligned with Earth magnetic field lines, with fixed magnetic longitude coordinate. The code was adapted to improve output stability, and to run in parallel using high performance computing (HPC) hardware. The outputs are geographical coordinates, using the Earth's magnetic field model as an eccentric dipole, based on the International Geomagnetic Reference Field (IGRF-11) approximation. During the system operation, several simulation runs are performed at different longitudes. A parallel version for the code was developed for enhancing the performance. After preliminary tests, it was frequently observed code instability, mainly for periods of low ionization, when negative ion temperatures or concentrations are found. After a detailed analysis, it was verified that most of these problems occurred due to concentration estimation of simulation points located at high altitudes, typically over 4000 Km of altitude. In order to force convergence, an artificial exponential decay for ion-neutral collisional frequency was used above mentioned altitudes. This approach shown no significant difference from original code output, but improved substantially the code stability. In order to make operational system even more stable, the initial altitude and initial ion concentration values used on exponential decay equation are automatically changed when convergence is not achieved, within pre-defined values. When all code runs end, an approximate neighbor searching technique was developed to obtain the ion concentration values in a regularly spaced grid, using inverse distance weighting (IDW) interpolation. A 3D grid containing ion and electron concentrations is generated for every hour of simulated day. Its spatial resolution is 1 degree of latitude per 1 degree of longitude per 10 Km of altitude. The vertical total electron content (VTEC) is calculated from the grid, and plotted in a geographic map. The whole process runs every day and predicts the VTEC values for South America region with up to 24 hours ahead. The maps are available at www.inpe.br/climaespacial/. Recently, data from ionosondes can be assimilated in the system to improve its accuracy.