First Comparisons of Equatorial Irregularities Measurements of TEC and Scintillations using CERTO and CITRIS with In-Situ Plasma Density Measurements on C/NOFS

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Ionospheric measurements of TEC (Total Electron Content) and radio scintillations can provide direct inputs for space-weather models and for tracking of ionospheric disturbances such as Spread-F. These measurements require propagation from a transmitter to a receiver through the F-region plasma. The C/NOFS (Communication/Navigations Outages Forecasting System) satellite, which is dedicated to the study of Spread-F was launched in April of 2008 in an elliptical (400 km x 850 km), 13 degree inclination orbit. C/NOFS carries a Naval Research Laboratory (NRL) three-frequency 150/400/1067 MHz CERTO (Coherent Electromagnetic Radio TOmography) beacon transmitter. In addition, the NRL CITRIS (Scintillation and TEC Receiver in Space) instrument is currently in orbit at 560 km altitude with 35 degree inclination on the STPSat1 satellite. The orbit periods of the two satellites are relatively close, so that the CERTO beacon stays in view of the CITRIS receiver for several days. In addition, the C/NOFS CERTO beacon and ground receivers can simultaneously measure TEC and scintillations on different paths. Thus, when C/NOFS is not in view, CITRIS makes measurements from the global network of French DORIS beacons and from other satellites in low earth orbit (e.g. Taiwan ROCSAT3, DMSP/F15, RADCAL, GFO, etc.). Because of the approximately 95 minute orbital periods, CITRIS will always make measurements at the same longitude as C/NOFS within 48 min. The ability to look at multiple paths is unique and useful for studying the spatial extent and time duration of Spread-F events. The first several months of joint measurements with the CERTO beacon on C/NOFS and the CITRIS receiver have provided unique and exciting data on geophysical plasma structures at low latitudes. We will report on these measurements and compare to C/NOFS in-situ plasma measurements from the Planar Langmuir Probe (PLP).

With the new CERTO and CITRIS satellite-to-satellite measurement capability it is possible to retrieve absolute TEC. Another new capability for CITRIS is the ability to use three frequencies (150, 400, and 1067 MHz) for TEC measurements, which can resolve two-pi phase ambiguities. When absolute TEC is available it is possible to cross-calibrate the C/NOFS PLP measurements.