Comparisons of COSMIC and C/NOFS GPS Occultation Ionospheric Scintillation Measurements with Ground-based Radar and VHF Measurements

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Ionospheric irregularities are known to cause scintillation of trans-ionospheric radio signals and can affect space-based UHF/VHF communications, causing outages, and degrading GPS accuracy and precision. Current capability for characterizing and predicting ionospheric scintillation utilizes a network of ground-based receivers to detect scintillation and then extrapolate for short-term forecasts. Practical limits on deploying the ground receivers limits the accuracy and spatial coverage one can achieve with this approach. A more global approach is to use a set of space-based satellites equipped with GPS receivers, such as the COSMIC satellite constellation, to measure scintillations observed during so-called occultations with GPS satellites. In this paper the signal-to-noise values of GPS L1 signals received on the COSMIC and C/NOFS satellites for the portions of the occultations that are not affected by the terrestrial atmosphere are examined to help identify areas of ionospheric scintillation. Three years of S4 scintillation index values from COSMIC occultations are compared with near-zenith ground-based VHF S4 scintillation measurements from the AFRL SCIntillation Network Decision Aid (SCINDA) network stations. The data are correlated to ascertain the viability of using space-based scintillation measurements to characterize and predict scintillation to ground-based receivers. Several days of COSMIC and C/NOFS data are compared with each other and the ALTAIR radar located on Kwajalein Atoll, Marshall Islands to examine how occultation geometry affects observed scintillation and also to verify techniques that provide an upper bound on the spatial location of the ionospheric irregularities contributing to scintillations observed in the occultations.