Ionospheric scintillations studies using Spire and COSMIC-2 radio occultation and GOLD satellite data

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Low-earth orbits (LEO) satellites have been harnessing the concept of GNSS radio occultation (RO) for several atmospheric applications. With the advent of CubeSat technology, many space companies are now extending the GNSS-RO for ionospheric and space weather studies. This study demonstrates the capabilities of Spire's constellation of CubeSats in detecting ionospheric scintillations. High rate 50 Hz GNSS measurements received by the STRATOS receivers onboard Spires's CubeSats are used to detect scintillations over low latitude African sector. Spire's GNSS-RO atmPhs files are accessed from University Corporation for Atmospheric Research (UCAR) data repository along with COSMIC-2 conPhs files.

The amplitude scintillation index (S4) is computed for each COSMIC-2 and Spire RO profiles. While COSMIC-2 conPhs files are restricted to tangent point altitudes up to ~130 km, the scintillation detection algorithm onboard Spire receivers enable to downlink the associated 50 Hz phase and pseudorange data of the extended RO profiles (up to zenith). Spire's extended RO profiles enable to detect F-layer amplitude scintillations often occurring in post-sunset hours. The occurrences of scintillations are corroborated by equatorial plasma bubble (EPB) structures observed from NASA's Global-scale Observations of the Limb and Disk (GOLD) satellite.

This study indicates the potential of Spire GNSS-RO data in augmenting and complementing ionospheric scintillation studies available from COSMIC-2 and other similar RO missions. This capability can provide an important contribution to scintillation monitoring and can further be extended to space weather nowcasts and forecasts.