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Comparison of ionospheric scintillation proxies derived from high sampling rate GNSS data.

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Ionospheric scintillation is caused by rapid variations in the electron density of the ionosphere. It manifests as rapid fluctuations in the amplitude and phase of radio signals traversing the ionosphere. In the case of navigation signals transmitted from satellites of the Global Navigation Satellite System (GNSS) ionospheric scintillation can cause a decrease in the accuracy of position estimation. During extreme fluctuations, a loss of lock on the satellites can occur, which can result in data outages. The ability to estimate the likelihood of ionospheric scintillation is of great importance for precision navigation applications such as GNSS assisted aircraft landing systems.

Dedicated GPS scintillation and total electron content monitors (GISTMs) sample the GNSS amplitude and phase at a high rate (20 - 50 samples per second) and then quantify the ionospheric scintillation in terms of the amplitude scintillation index (S₄) and the phase scintillation index (sigma;_{phi;}), which are based on the standard deviation of the amplitude and phase averaged over a period of 1 minute. The aim of this research is to derive proxies for ionospheric scintillation which can be obtained from ordinary dual frequency GNSS receivers, which are much more widely distributed than GISTMs, so as to develop regional maps of the occurrence frequency of ionospheric scintillation.

In this paper we present some preliminary results on the comparison of conventional scintillation indices to a scintillation proxy based on the rate-of-change-of-total-electron-content (ROT) derived from GNSS signals recorded by a receiver installed at Pwani University (Geo. Lon: 39.78deg;E, Geo. Lat: 3.24deg;S) in Kenya which is within the proximity of the southern equatorial ionization anomaly crest, a region of frequently occurring ionospheric scintillations. The ROTI-index, which is a scaled version of the standard deviation of ROT, is shown to correspond well to the S₄-index for moderate scintillations. It also has the ability to detect short-duration high amplitude scintillations that are not detected by the S₄-index.

Summary

The paper presents a comparison of ionospheric scintillation proxies derived from high sampling rate GNSS data. The ROTI-index, which is a scaled version of the standard deviation of ROT, is shown to correspond well to the S₄-index for moderate scintillations. It also has the ability to detect short-duration high amplitude scintillations that are not detected by the S₄-index.

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