Metrological Issues with the Space Weather Indices Derived Using GNSS Phase Observables
URSI Extended Abstract Template

P. T. Jayachandran, A. McCaffrey, K. Song, N. Labuschagne, K. Meziane, A. Kashcheyev,
C. Watson, and D. R. Themens
Physics Department,
University of New Brunswick, Fredericton, NB, Canada

Recently there has been an explosion in the number of space weather indices based on phase observable of the Global Navigation Satellite System (GNSS) signals. These include rate of change of TEC (ROT), rate of change of TEC index (ROTI), gradient index (GIX), sudden Ionospheric index (SIDX), delta phase rate (DPR), and the classical phase scintillation index (σ_Φ) to name a few. It is already established that the use of σ_Φ to quantify scintillation in the polar region is questionable. It is also known that some of these indices are dependent on the type of receivers used in the measurement, the time interval used to derive the index, and the sampling rate used by the receiver. Here we introduce another underlying issue with the metrology of TEC using the GNSS phase observable itself. Ionospheric TEC measurements, using GNNS, requires the underlying signal observables used in the estimation of TEC (carrier phase or pseudo-range) to follow an assumed $1/f^2$ dependence where f is the carrier frequency. If this dependence is violated TEC cannot be calculated. Therefore, the resulting TEC measurement and the derived indices using TEC measurements do not represent physical variations of the ionosphere. This talk will present the conditions under which it is violated and will show a new way to approach the issue by applying basic physics.