# Estimation and Preliminary analysis of Ionospheric delay due to IRNSS L5 and IRI -2016 model for various Seasons

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**Abstract:** Ionospheric layer is the upper part of the atmosphere which consists of electrons and ions. It extends from about 50 Km to 1500 Km from the surface of the earth. The ionospheric delay is the most predominant error in Global and Regional Navigation Satellite Systems,, which is proportional to ionospheric Total Electron Content (TEC) along the signal path. The IRNSS (Indian Regional Navigation Satellite System) provides navigation services for India and up to the range of 1500 Km boundary area. The paper discusses about the analysis for two cases. In case (i) the result of vertical ionospheric delay due to IRNSS L5 signals from a dual frequency IRNSS receiver are discussed, which is installed at (Lat:$17.39^0$N ; Lon:$78.31^0$ E ) Hyderabad station. The analysis is carried out for a typical quiet day in the month of May 2017. It is observed that there is not much difference between vertical ionospheric delays due to all IRNSS satellites. As expected the value of ionospheric delay is low during night time (16 UT – 24 UT) whereas during day time (10 UT- 11 UT) the observed value of ionospheric delay is increased to a large value. It is observed that for 1B and 1G satellites, the peak ionospheric delay difference is 1.94m and the corresponding IPP latitudes $17.28^0$ and $15.56^0$ (Ionospheric Pierce Point), and directions (1B: SW; 1G: SE) of arrival of the satellite signals are not same. Even though the peak delay occurrence time is same, peak ionospheric delays are not same for 1B, 1C and 1F satellites due to different directions of the incoming signals and different IPP latitudes due to satellites. Case (ii) discusses the estimated vertical ionospheric delays due to IRNSS L5 signal for different seasons (Winter, Summer, Rainy) during selected days of 2017 year. For each season one quiet day (16/01/2017, 16/04/2017, 05/07/2017) and one disturbed day (31/01/2017, 22/04/217, 16/07/2017) are considered. These days are selected based upon the $K_p$ (Geomagnetic Index) value. The obtained results due to experimental IRNSS data are compared with that of ionospheric delay due to (International Reference Ionospheric) IRI-2016 model. The IRI model is a global ionospheric model and is developed by the Committee on Space Research (COSPAR) and the International Union of Radio Science (URSI). The IRI

model is an empirical and data based model to predict the variations in ionospheric layer. The maximum peak ionospheric delays are observed in the month of April (Summer) for quiet day 13.83m, 12.04m and for disturbed day 13.98m, 15.82m due to model and IRNSS L5 data respectively. The minimum peak ionospheric delays are found in the month of July (Rainy season) for quiet day 8.35m, 7.26m and for disturbed day 8.32m, 9.01m. It is found that from the obtained results, IRI model can reflect the seasonal variations over low latitude Hyderabad station but not able to estimate the ionospheric delay appropriately. The obtained results will be helpful to validate the IRI-2016 model over low latitude region using IRNSS data.

**Keywords: TEC, Ionospheric delay, IRNSS, IRI, IPP**