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Fusing IRTAM and GIM resources for Real-Time IRI Weather

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Given the high spatial resolution/coverage and near-real-time (nRT) availability of the Global Navigation Satellite System (GNSS) total electron content (TEC) measurements, the opportunity of assimilating GNSS nRT data streams in International Reference Ionosphere (IRI) has always been the attention focus of the IRI Real-Time Task Force [1]. However, up to 50% of the TEC variability must be attributed to the plasmasphere content above the ionosphere [2], which makes the task of directly assimilating TEC in the ionospheric models significantly ill-posed, allowing an infinite number of valid solutions and demanding sophisticated regularization treatments [3]. The data fusion of GNSS TEC with other sensor measurements has therefore been considered helpful in narrowing down the solution pool [4,5], albeit proven complicated in practice [5].

We approach the sensor data fusion task from a different angle by combining the measured peak density NmF2 in the F2 layer, provided by remote high-frequency (HF) sensing from the ground, with the vertical TEC (VTEC) computation using GNSS facilities. This specifies the effective ionospheric slab thickness τ, and its dynamics reveal the vertical restructuring of the plasma. The global NmF2 maps are provided by the IRI-based Real-Time Assimilative Model (IRTAM) driven by the ionosonde measurements from the Global Ionosphere Radio Observatory (GIRO), while the Global Ionosphere Maps (GIM) of VTEC are available from the International GNSS Service (IGS) weather and climate repository at UWM in cooperation with UPC-IonSAT and GIPP CAS IAAC analysis centers. Feasibility of the slab thickness weather maps for modeling the ionosphere is discussed.

References

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