Effects of Ionospheric Asymmetry on Electron Density Standard Inversion Algorithm Applicable to Radio Occultation (RO) Data Using Best-suited Ionospheric Model

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ABSTRACT

The "Onion-peeling" algorithm is a very common technique used to invert Radio Occultation (RO) data in the ionosphere. Because of the implicit assumption of spherical symmetry for the electron density (Ne) distribution in the ionosphere, the standard Onion-peeling algorithm could give erroneous concentration values in the retrieved electron density vertical profile Ne(h). In particular, this happens when strong horizontal ionospheric electron density gradients are present, like for example in the Equatorial Ionization Anomaly (EIA) region during high solar activity periods.

The NeQuick2 and the International Reference Ionosphere (IRI) are ionospheric electron density models widely used in positioning, imaging and assimilation algorithms. In this work, for each identified case study considering low and high solar activity conditions, we attempted to analyze the best-suited ionospheric model out of the two. Using simulated RO Total Electron Content (TEC) data computed by means of the best-suited ionospheric model and ideal RO geometries, we then tried to formulate and evaluate an asymmetry level index for quasi-horizontal TEC observations. This asymmetry index is based on the Ne variations that a signal may experience along its ray-path (satellite to satellite link) during a RO event. This index is strictly dependent on RO geometry and azimuth of the occultation plane and is able to provide us indication of the errors (in particular those concerning the peak electron density NmF2 and the vertical TEC) expected in the retrieval of Ne(h) using standard Onion-peeling algorithm.

On the basis of the outcomes of our work, for a given geometry of a real occultation event and using best-suited ionospheric model, we will try to investigate the possibility to predict the ionospheric asymmetry expected for the particular RO geometry considered. We could also try to evaluate, in advance, its impact on the inverted electron density profile, providing an indication of the product quality.