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Retrieve electron density profiles from truncated Radio Occultation GNSS data

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GNSS ionospheric radio occultation (IRO) data provide globally rich information to study the vertical electron density structure of the ionosphere. In the near future, at least 20000 occultations per day, with better coverage in low and high latitudes, will be reached under the recommendation and promotion of International Radio Occultation Working Group (IROWG), in cooperation with worldwide space agencies and commercial entities. This will boost the research in the field of numerical weather prediction, climate and space weather, and help further speed up the application of new results at an operational level. Among different low earth orbit (LEO) satellite missions, EUMETSAT Polar System - Second Generation (EPS-SG) will play an important role in providing global observation. The new RO instrument on board EPS-SG satellites, flying at a height of 820 km, focuses on neutral atmospheric profiling. It provides truncated ionospheric RO data, only below impact heights of 500 km, in order to guarantee a full data gathering of the neutral part. The key problem in electron density profile inversion from truncated IRO data in EPS-SG, is rank deficiency of the normal matrix in the least square estimation by means of Abel inversion. Therefore, realistic external constraints need to be added to the observation equations to solve the unknowns. One option is to take advantage of the Vary-Chap model based on physical property [1, 2]. For instance, SEEIRO and AVHIRO methods [3], targeted at solving the aforementioned problem, were proposed recently. Specifically, SEEIRO uses a two-step processing strategy, i.e. estimating the electron density profile below 500 km and extrapolating upwards with the Vary-Chap model separately, and needs less computation time. While, AVHIRO estimates the full electron density profile simultaneously and achieves more accurate results, yet at higher computational cost. We will present as well the on-going AVHIRO update in order to reduce the computation time to achieve the goal of near real-time service. In addition, the first results of another approach based on the climatic model - NeQuick [4] will be presented as well.

References

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