ADVANCEMENT OF GNSS RADIO OCCULTATION RETRIEVAL IN THE UPPER STRATOSPHERE

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Current Global Navigation Satellite System (GNSS) radio occultation (RO) retrieval techniques generally yield excellent results in the upper troposphere and lower stratosphere (i.e., below 30 - 35 km). Above 35 km the errors of retrieved atmospheric parameters increase significantly, however. Two processes are commonly applied to improve upper-stratospheric retrievals: ionospheric correction to minimize ionosphere-induced errors and high-altitude initialization ('statistical optimization') to control and smooth noisy observed data by less noisy background data. In this presentation we focus on results of a RO retrieval advancement study aiming at minimizing upper-stratospheric errors, especially biases, in order to maximize the climate monitoring utility of the data up to the stratopause.

In the first part of the study we analyzed the sensitivity of simulated RO retrieval products to ionospheric residual errors and high-altitude initialization errors in order to explore the importance of, and interaction between, these two error sources, to evaluate different methods presently in use, and to find most promising advancement pathways. This was done by using a systematic case study design based on a small set of simulated occultation events. The main tool of the study was a modified version of the End-to-end GNSS Occultation Performance Simulator (EGOPS) software. The results discussed in the presentation show that the usually applied ionospheric correction of bending angles is remarkably robust against extreme ionospheric conditions if combined with advanced statistical optimization, that the retrieval can be significantly improved, both in terms of standard deviation and bias, by sensible high-altitude initialization, and that further improvements are possible by refinement of statistical optimization algorithms and by paying more attention to the quality of the background data and their error characteristics.

In the second part of the study, presently on-going, we implement improved statistical optimization techniques to our most advanced current algorithm. First results of the enhanced algorithm will be presented in form of climatological retrieval errors (i.e. residual biases) for large ensembles of occultation events at different latitudes. In a subsequent study we will switch from simulated to real GNSS-RO data (from CHAMP) and validate the enhanced algorithm against correlative data (ECMWF analysis fields, LIDAR data). The validated algorithm will then be used in the CHAMP-RO based global climate monitoring system currently under preparation at IGAM.