Gottfried
Kirchengast
Wegener Center for Climate and Global Change (WEGC), University of Graz, Austria
Jakob Schwarz, Wegener Center, University of Graz, Austria
Marc Schwaerz, Wegener Center, University of Graz, Austria
Veronika Proschek, Wegener Center, University of Graz, Austria
Ying Li, Institute of Geodesy and Geophysics/CAS, Wuhan, China
Poster
Global Navigation Satellite System (GNSS) radio occultation (RO) observations are highly accurate and long-term stable. Essential climate variables (ECVs) for the thermodynamic state of the free atmosphere such as temperature and tropospheric water vapor profiles can be derived from these data, which thus have the potential to serve as climate benchmark data.

In order to exploit this potential, atmospheric profile retrievals need to be very accurate and the remaining uncertainties need to be quantified and traced throughout the processing chain. The new Reference Occultation Processing System (rOPS) at the Wegener Center aims to deliver such an accurate retrieval chain with integrated uncertainty propagation.

Here we introduce and demonstrate the algorithms implemented in the rOPS for uncertainty propagation from RO excess phase profiles via bending angle and refractivity to dry-air atmospheric profiles, and further through a moist-air retrieval to the ECVs temperature and specific humidity. We separately propagate estimated random and estimated systematic uncertainties, and as needed also estimate observation-to-background weighting ratio profiles. We implemented the random uncertainty estimation by a covariance propagation approach that we validated by Monte-Carlo ensemble methods. For the estimated systematic uncertainty profiles, which represent highly correlated errors either or both over the RO profile itself and across ensembles of RO profiles, we implemented an efficient incremental state propagation approach avoiding full covariance propagation.

We also present validation results and demonstrate how the algorithms perform for individual simulated RO events as well as ensembles of real RO events. We find that the new uncertainty estimation chain shows robust performance and is in good agreement with previous results from statistical error estimation. The key advantage of the integrated uncertainty estimation is its capability to run concurrently with the state retrieval serving in this way as a seamless part of the RO processing that delivers traceable co-estimates of uncertainties for the benefit in particular of climate monitoring and research as well as calibration/validation applications.
OSTS session
Regional and Global CAL/VAL for Assembling a Climate Data Record