

ERROR CHARACTERISTICS OF GPS RO ATMOSPHERIC PROFILES

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At the WEGC, University of Graz, Austria, a radio occultation (RO) retrieval scheme has been established, which uses phase delay profiles and precise orbit information (level 1 data) provided by other data centers. The WEGC retrieval OPSv5.4 mainly uses level 1 data provided by UCAR/CDAAC, Boulder, CO, USA, for different satellites; a selected set of MetOp/GRAS data was provided by EUMETSAT, Darmstadt, Germany.

We present an estimation of the data quality and observational errors of WEGC OPSv5.4 atmospheric profiles of bending angle, refractivity, dry pressure, dry geopotential height, and dry temperature. Furthermore, we present simple global models for the observational error based on the statistical analysis of individual profiles. We compare data characteristics of GPS/MET, SAC-C, CHAMP, GRACE-A, FORMOSAT-3/COSMIC, and MetOp/GRAS.

We investigated bending angle bias (relative to MSIS) and bending angle standard deviation at high altitudes (estimated between 65 km and 80 km impact height) for all multi-year data available at WEGC and analyzed their temporal evolution. The median of the bending angle bias was found to be slightly negative and very similar for all satellites. Regarding standard deviation, MetOp data exhibit smallest bending angle noise (about 1 μ rad). GPS/Met, COSMIC, and GRACE data are about a factor of 2 to 2.5 noisier and CHAMP data noise level is about 4 times as high as that of MetOp. Variable data quality (from worst to good) was found for SAC-C.

For the observational error characterization the retrieved RO profiles were referenced to co-located ECMWF profiles, giving a combined (RO plus ECMWF) error. We restrict our analysis to the years 2007 to 2009 due to known ECMWF deficiencies prior to 2007 (e.g., deficiencies in the representation of the austral polar vortex or the weak representation of tropopause height variability).

The GPS RO observational error was determined by subtracting the estimated ECMWF error from the combined error in terms of variances. We found that the estimated ECMWF error and the GPS RO observational error are approximately of the same order of magnitude. Differences between different satellites are distinctively smaller. The GPS RO observational error features latitudinal and seasonal variations, which are most pronounced at stratospheric altitudes at high latitudes. Global error models were derived from fitting simple analytical functions to relative standard deviation profiles for bending angle, refractivity, and dry pressure and absolute standard deviation profiles for dry geopotential height and dry temperature.