Geophysical Research Abstracts
Vol. 18, EGU2016-15675, 2016
EGU General Assembly 2016

Towards SI-traceable radio occultation excess phase processing with integrated uncertainty estimation for climate applications

Josef Innerkofler (1), Christian Pock (1,2), Gottfried Kirchengast (1), Marc Schwaerz (1), Adrian Jaeggi (3), and Jakob Schwarz (1)

(1) Wegener Center for Climate and Global Change (WEGC) and Institute for Geophysics, Astrophysics and Meteorology/Institute of Physics (IGAM/IP), University of Graz, Graz, Austria (josef.innerkofler@uni-graz.at), (2) Institute of Geodesy, Graz University of Technology, Graz, Austria, (3) Astronomical Institute, University of Bern, Bern, Switzerland

The GNSS Radio Occultation (RO) measurement technique is highly valuable for climate monitoring of the atmosphere as it provides accurate and precise measurements in the troposphere and stratosphere regions with global coverage, long-term stability, and virtually all-weather capability. The novel Reference Occultation Processing System (rOPS), currently under development at the WEGC at University of Graz aims to process raw RO measurements into essential climate variables, such as temperature, pressure, and tropospheric water vapor, in a way which is SI-traceable to the universal time standard and which includes rigorous uncertainty propagation.

As part of this rOPS climate-quality processing system, accurate atmospheric excess phase profiles with new approaches integrating uncertainty propagation are derived from the raw occultation tracking data and orbit data. Regarding the latter, highly accurate orbit positions and velocities of the GNSS transmitter satellites and the RO receiver satellites in low Earth orbit (LEO) need to be determined, in order to enable high accuracy of the excess phase profiles.

Using several representative test days of GPS orbit data from the CODE and IGS archives, which are available at accuracies of about 3 cm (position) / 0.03 mm/s (velocity), and employing Bernese 5.2 and Napeos 3.3.1 software packages for the LEO orbit determination of the CHAMP, GRACE, and MetOp RO satellites, we achieved robust SI-traced LEO orbit uncertainty estimates of about 5 cm (position) / 0.05 mm/s (velocity) for the daily orbits, including estimates of systematic uncertainty bounds and of propagated random uncertainties. For COSMIC RO satellites, we found decreased accuracy estimates near 10-15 cm (position) / 0.1-0.15 mm/s (velocity), since the characteristics of the small COSMIC satellite platforms and antennas provide somewhat less favorable orbit determination conditions. We present the setup of how we (I) used the Bernese and Napeos package in mutual cross-check for this purpose, (II) integrated satellite laser-ranging validation of the estimated systematic uncertainty bounds, (III) expanded the Bernese 5.2 software for propagating random uncertainties from the GPS orbit data and LEO navigation tracking data input to the LEO data output.

Preliminary excess phase results including propagated uncertainty estimates will also be shown. Except for disturbed space weather conditions, we expect a robust performance at millimeter level for the derived excess phases, which after large-scale processing of the RO data of many years can provide a new SI-traced fundamental climate data record.