Summaries of GPS RO Inversion Procedures in the Upper Troposphere and Middle Stratosphere among Operational Centers and Structural Uncertainties in the Multiple Center Comparisons

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Accurate Global Positioning System (GPS) Radio Occultation (RO) retrievals of atmospheric variable profiles depend on the adequate calculation of the GPS excess atmospheric phase data of two L band frequencies due to signal delay and bending in the Earth's atmosphere and ionosphere. While the fundamental phase delay observed from the GPS RO technique is synchronized to the ultra-stable atomic clocks on the ground, the derived RO variables (e.g., bending angle, refractivity, temperature, geo-potential height, and temperature profiles) are not. The retrieved results may vary when different processing algorithms and implementations are used. Currently, multi-year GPS RO data can be obtained from GeoForschungsZentrum Potsdam (GFZ), Germany, the Jet Propulsion Laboratory (JPL), Pasadena, CA, USA, University Corporation for Atmospheric Research (UCAR), Boulder, CO, USA, and the Wegener Center of the University of Graz (WegC), Graz, Austria, European Organisation for the Exploitation of Meteorological Satellites (EUM), Darmstadt, Germany, and Danish Meteorological Institute (DMI), Copenhagen, Denmark. Common RO inversion approaches but different implementations are used by each individual centers. To use RO data for climate monitoring, it is critically important to quantify the structural uncertainties of the retrieved profiles due to different assumptions and inversion methods and how those uncertainties are propagated from bending angle profiles to temperature and pressure profiles. In this study, we detail the GPS RO inversion procedures in the middle stratosphere and upper troposphere, implemented by the six RO operational centers, and quantify the structural uncertainty of the derived variables among centers. Profile-to-profile CHAMP variables from January 2002 to September 2008 retrieved by the six centers are compared.