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Tropospheric water vapor retrieval with GPS radio occultation aboard CHAMP

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Global Positioning System (GPS) radio occultation (RO) observations aboard Low Earth Orbiting (LEO) satellites provide a powerful tool for atmospheric sounding which requires no calibration, is not affected by clouds, aerosols or precipitation, and provides an almost uniform global coverage. Considering future LEO satellite missions (e.g. COSMIC or METOP), GPS RO data will form a valuable data base for climatological investigations and improvement of global weather forecasts in the future. The CHAMP (CHAllenging Minisatellite Payload) GPS RO experiment is activated continuously since mid 2001. With a predicted lifetime till end of 2007 CHAMP is collecting the first long-term GPS RO data set.

Basic RO observable is the atmospheric excess phase of the occultation satellite link which is used to retrieve vertical profiles of refractivity and subsequently meteorological quantities like pressure, temperature and water vapor. Whereas RO refractivity shows in general a good agreement with meteorological data (e.g. radiosondes) in the upper troposphere and lower stratosphere, a pronounced negative bias is observed in the lower troposphere. This bias could be reduced by application of advanced retrieval techniques, such as the Full Spectrum Inversion method (FSI) which is implemented in the GFZ analysis software version (005). Nevertheless, the remaining bias still leads to a noticeable humidity underestimation of RO retrievals especially in the tropical lower troposphere.

Since dry air and water vapor both contribute to atmospheric refractivity, vertical profiles of the tropospheric temperature and humidity can only be derived using ancillary atmospheric information from e.g. meteorological analyses (either temperature or water vapor). At GFZ a 1Dvar algorithm and a new direct method is used to retrieve

vertical humidity profiles from RO refractivity and ancillary ECMWF analysis data. In this paper we briefly review both methods, compare retrieval results with global radiosonde data and discuss the potential of RO retrievals for water vapor monitoring on a global scale.