Observing the upper troposphere and lower stratosphere with GPS radio occultation data: Results from CHAMP, GRACE, TerraSAR-X, and FORMOSAT-3/COSMIC

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The radio occultation (RO) technique uses GPS signals received aboard low Earth orbiting satellites for atmospheric limb sounding. Temperature profiles are derived with high vertical resolution. Due to its long-term stability, all-weather capability and global coverage the GPS RO technique offers the possibility for global monitoring of the tropopause and temperature structure in the upper troposphere and lower stratosphere (UTLS) region. The German CHAMP (2001-2008), the US/German GRACE (since 2006), the Taiwan/US FORMOSAT-3/COSMIC (since 2006), and the German TerraSAR-X (since 2007) missions provide together about 2500 occultation measurements daily.

An overview of recent results from RO missions and data is given with respect to

(1) the status of the CHAMP, GRACE, TerraSAR-X and Tandem-X RO experiments at GFZ: data delivery, near-real-time and post-processing, future plans.

(2) tropopause and temperature trends in the UTLS region: A global increase of the tropopause height is observed combined with a global upper tropospheric warming of about 0.1 K/year and a cooling of 0.1–0.2 K/year above the tropopause for the time interval 2001-2009.

(3) global gravity wave (GW) activity in the UTLS: The specific potential energy as a measure of GW activity is deduced from the temperature profile for each occultation event up to 35-40 km. To separate the GWs from the background a band-pass filter associated to different vertical wave lengths is applied to the measured temperature profiles. Seasonal changes of GW activity will be discussed and results from COSMIC with the higher spatial density compared with the other single RO missions will be highlighted.