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Variability of the upper troposphere and lower stratosphere observed with GPS radio occultation bending angles and temperatures

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Recently, Lewis (2009) introduced a new method for the identification of tropopause heights (TPHs) from GPS radio occultation (RO) bending angles (α). The method uses a covariance transform to identify transitions in a $ln(\alpha)$ profile. In this study we apply the new method to the RO data sets from CHAMP/GRACE (2001–2009) and FORMOSAT-3/COSMIC (2006–2009). These results are the basis for TPH trend estimations for the time period between May 2001 and August 2009 (100 months) based on zonal monthly mean GPS RO data from CHAMP (2001–2008), GRACE (since 2006) and FORMOSAT-3/COSMIC (since 2006). Further, we compare the α based TPH trends with lapse rate tropopause height trends and discuss the differences, which are largest in the subtropical regions (20°–40°) on both the northern and southern hemisphere. A global increase of the TPH between 5–9 m/yr is found for both methods and different data sets (CHAMP/GRACE alone and CHAMP/GRACE plus FORMOSAT-3/COSMIC). The results for the TPH trends are linked with bending angle and temperature trends in the upper troposphere and lower stratosphere region. Generally, an upper tropospheric warming (bending angle decrease) and a lower stratospheric cooling (bending angle increase) is noted.