A MULTI-YEAR COMPARISON OF LOWER STRATOSPHERIC TEMPERATURES FROM CHAMP RADIO OCCULTATION DATA WITH MSU/AMSU RECORDS

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Long-term upper air temperature records have been established by different groups with considerable effort from radiosonde data and from satellite based (Advanced) Microwave Sounding Unit (MSU/AMSU) measurements, the latter providing information on layer-average stratospheric and tropospheric brightness temperatures. Comparisons of the temperature series show discrepancies not only with respect to radiosonde data but also between MSU data sets stemming from different retrievals. In this context the Global Navigation Satellite System radio occultation (RO) technique offers new possibilities by providing high quality observations of the atmosphere. RO temperature climatologies have been constructed at the WegCenter/UniGraz based on RO observations of the CHAMP satellite since September 2001, and based on a few months of RO data from other satellite missions (SAC-C, GRACE, COSMIC). Focusing on the MSU lower stratosphere channel (TLS), synthetic TLS temperatures were calculated by applying global weighting functions to zonal-mean monthly-mean RO temperature climatology profiles for Sep 2001-Dec 2006. These synthetic CHAMP TLS temperatures were compared to recent MSU TLS records from the University of Alabama in Huntsville (UAH, USA) and from Remote Sensing Systems (RSS, USA), as well as to synthetic TLS temperatures from HadAT2 radiosonde data (Hadley Centre/MetOffice, UK) and ECMWF (European Centre for Medium-Range Weather Forecasts) analyses. Overall very good agreement of CHAMP temperature anomalies with UAH, RSS, and ECMWF anomalies was found for intra-annual variability (RMS difference of de-trended data < 0.1 K globally, 0.1 K in the tropics, < 0.25 K in the extratropics), whilst HadAT2 anomalies show larger differences (factor of two globally and more in the extratropics). Regarding 2001-2006 trends, UAH and RSS exhibit a statistically significant cooling trend difference to CHAMP globally (-0.30 to -0.36 K/5yrs), stemming mainly from the tropics (-0.40 to -0.42 K/5yrs), whilst in the extratropics the cooling trend differences are not significant. The contribution of known error sources regarding the RO data and the related synthetic-MSU computation procedure is about an order of magnitude smaller than these trend differences. Resolution of the trend discrepancy thus requires either additional, so far overlooked, sources of error in the RO TLS record or the presence of currently unresolved biases in the MSU records. SAC-C, GRACE, and COSMIC TLS temperatures closely match CHAMP temperatures, indicating the consistency and homogeneity of the RO data series.The results underpin the benefit of having multiple independent estimates of the same variable from different instruments for detecting residual weaknesses in otherwise high-quality climate records.Continued inter-comparison, and exploiting the traceability of the RO data to the universal time standard (UTC), then enables us to further reduce the uncertainty in

the climate records in absolute terms.