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Investigating the Tropopause Structure in GPS-Radiooccultation Data and High-Resolution Coupled Chemistry Climate Model Simulations

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The upper troposphere and lower stratosphere (UTLS) is a key region for troposphere-stratosphere interactions and reacts particularly sensitive to climate change. The Tropopause Inversion Layer (TIL), an important characteristic of the UTLS, is presently not well investigated and understood for its characteristics, variability and mechanism(s). As reported by the recent SPARC CCMVal report, the CCMVal-2 models may not be able to reproduce the quantitative structure of the observed TIL due to the coarse vertical resolution in the CCMs. The Global Positioning System-Radio Occultation (GPS-RO) data (CHAMP, GRACE and TerraSAR-X), with long-term stability since 2001 to present, self-calibration and very high vertical resolution, will be used here together with reanalysis data (ERA-INTERIM, MERRA), as well as simulations from CCMs especially by NCAR's WACCM model with finer vertical resolution (WACCM-highres, with 103 vertical layers and about 300 m resolution in the UTLS) to investigate the tropopause structure.
A slight global increase of the tropopause height and a significant tropical increase of tropopause temperature can be seen from the GPS-RO data, while the CCMs perform inconsistent with each other from 2001 to 2011. We find a significant decrease of the TIL strength in the past decade from the GPS-RO initial profiles data (CHAMP and GRACE). Comparing the characteristics and strengths of the TIL in GPS-RO data with CCMs and standard vertical resolution (about 1 km in the UTLS) with WACCM-highres model runs (Three ensemble runs have done, using observed solar parameters and SSTs but following the RCP45 scenario for the GHGs, ODSs and aerosols for the period 2001-2010.) shows that the latter represents a more realistic latitude distribution as well as a more realistic sharpness of the tropopause. An analysis of the possible mechanisms for the strength variability of the TIL will be performed for the WACCM-highres simulations in order to shed more light on the underlying UTLS processes.