Tropopause Altitude and Temperature Characteristics from GPS Radio Occultation: Climatologies and Trends

Therese Rieckh, Barbara Scherllin-Pirscher, Florian Ladstädter, and Ulrich Foelsche

Wegener Center for Climate and Global Change (WEGC) and Institute for Geophysics, Astrophysics, and Meteorology/Institute of Physics (IGAM/IP), University of Graz, Graz, Austria

The tropopause is one of the key regions of the atmosphere as it acts as a transport barrier between troposphere and stratosphere and thus influences exchange and trace gas concentrations. For the last decades, radiosonde data have been the most important data source to study tropopause parameters and their characteristics. Radiosondes measure with high vertical resolution, but coverage above the southern hemisphere and oceans is poor. The Radio Occultation (RO) technique, on the other hand, provides profiles of various atmospheric parameters with high vertical resolution and global coverage. Measuring the phase delay of GPS signals, its characteristics include high precision and long-term stability.

In this work, RO temperature data are used to globally determine and analyze the thermal lapse rate and cold point tropopause. Data from CHAMP, SAC-C, GRACE, and the six COSMIC satellites are used for this study.

Climatologies on monthly basis give an overview of the spatiotemporal characteristics of tropopause altitude and temperature, such as the annual cycle for different latitudes or the occurrence of multiple tropopauses.

We investigate trends in tropopause altitude and temperature by applying multiple regression analysis to RO data from 2001 to 2010. Global coverage allows to compute latitude dependent trends. We find negative (positive) altitude (temperature) trends in the tropics and positive (negative) altitude (temperature) trends at mid latitudes. At higher latitudes, insufficient spatiotemporal RO sampling and high atmospheric variability lead to large sampling errors of the climatologies. Due to this reason, and the rather short time series, only data within 50°N and 50°S are considered here.