The tropical tropopause layer in observations and reanalysis data sets

S. TEGTMEIER[1], J. ANSTEY[2], S. DAVIS[3], I. IVANCIU[1], R. PILCH KEDZIERSKIP[1], K. KRÜGER[4], J. WANG[5], J. WRIGHT[6]

[1] *GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel, Germany*

[2] *Canadian Centre for Climate Modelling and Analysis, Environment and Climate Change Canada, Victoria, Canada*

[3] *Earth System Research Laboratory, National Oceanic and Atmospheric Administration, Boulder, USA*

[4] *Department of Geosciences, University of Oslo, Oslo, Norway*

[5] *Universities Space Research Association, NASA Goddard Space Flight Center, Greenbelt, USA*

[6] *Center for Earth System Science, Tsinghua University, Beijing, China*

The tropical tropopause layer (TTL) is the transition region between the well mixed, convective troposphere and the radiatively controlled stratosphere with air masses showing chemical and dynamical properties of both regions. The complex interactions of circulation, convection, trace gases, clouds and radiation make the TTL a key player in radiative forcing and chemistry-climate coupling. Most importantly, the TTL is the main gateway for air entering the stratosphere with the cold point tropopause setting the boundary conditions for stratospheric composition and chemistry.

In this contribution, we will investigate whether reanalysis data sets reproduce the key characteristics of the TTL including its basic structure as given by the cold point and lapse rate tropopause and the level of zero radiative heating. Based on a multi-linear regression analysis, we will explore the impact of stratospheric and tropospheric key processes on the TTL. Longitudinal variations of the stratospheric and tropospheric signals derived from observational radiosonde and radio occultation data sets will be highlighted in comparison to the reanalysis results. Long term changes of the TTL and particular the cold point temperature will be compared to trend estimates from radiosonde data. In summary, our analysis will demonstrate how well the TTL is represented in the different reanalysis data sets, highlighting advantages and limitations of their use in scientific studies.

We will focus on current reanalyses that assimilate upper-air measurements and have a relatively high resolution (e.g. ERA-Interim, JRA-55, MERRA/-2, and CFSR), but also include older reanalyses (NCEP-R1, ERA-40, and JRA-25), forthcoming reanalyses (e.g. ERA5), and long-term reanalyses that assimilate only surface meteorological observations (e.g. ERA-20C). Our evaluations will take into account the main characteristics of the different reanalysis generations in order to quantify advances in reanalysis data sets due to changes in vertical resolution, assimilated observational data or assimilation scheme.

Key words: tropical tropopause layer, reanalysis, radiosonde and radio occultation data, S-RIP (SPARC Reanalysis Intercomparison Project)