Variability of the tropopause inversion layer in baroclinic lifecycles based on ECMWF IFS analysis data

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The tropopause inversion layer (TIL) as a region of enhanced static stability above the thermal tropopause is in theory generated and/or influenced by several atmospheric processes, ranging from dynamic phenomena such as baroclinic wave breaking , the generation of inertia gravity waves and the large-scale stratospheric circulation to radiative processes concerning primarily the radiative forcing of water vapor and icewater as well as ozone. However these findings are results of idealized model simulations, and the contribution of each process leading up to the observed TIL-variability, as well as the synergy of these processes is not finally understood.

Here we focus on the evolution of the TIL over the North Atlantic using analysis fields.
In preparation for the HALO-mission WISE (Wave driven ISentropic Exchange) and extending recent results of Kunkel et al. [1] on the contribution of diabatic processes on the TIL formation, we study the variability of the TIL relative to the developing cyclones. For this we use a five year high-resolution dataset of ECMWF IFS (Integrated Forecast System) operational analysis fields, with a special focus on baroclinic lifecycles. By tracking the individual cyclones in the stages of genesis, maximum intensity and lysis, we can derive statistically based statements concerning a mean TIL evolution and variability during cyclone events. We found that the mean TIL evolution during the intensification of the individual cyclones appears to be linked to regions of strong updraft and cloud formation, such as warm conveyor belts.

[1] D. Kunkel, P. Hoor, and V. Wirth, Atmospheric Chemistry and Physics, Volume 16, (2016).