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# Composite analysis of the tropopause inversion layer in extratropical baroclinic waves over the North Atlantic

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The tropopause inversion layer (TIL) as a region of enhanced static stability above the thermal tropopause is generally thought to be influenced by a variety of atmospheric processes related to dynamics on different scales as well as to radiative effects of water vapor and clouds. In particular, at mid latitudes a variety of studies of idealized numerical experiments suggest the importance of baroclinic wave dynamics. In particular in regions of anticyclonic flow in the lower stratosphere the cross frontal circulation and thus vertical advection of potential vorticity from higher levels leads to a local enhancement of static stability, along with the advection of large values of static stability from lower latitudes. Diabatic processes related to moist dynamics and cloud formation are further known to enhance the variability and the magnitude of maximum values of static stability in the extratropical lower stratosphere.
In the extratropics, the TIL is co-located to the region of strong trace gas gradients between the troposphere and the stratosphere, the extratropical transition layer or mixing layer. This co-location points toward an inhibiting function of the TIL concerning cross-tropopause transport, however, this is still subject of scientific discussion and the processes at work are not finally understood. Moreover, the TIL is essential for the vertical propagation of waves on different scales as it represents a maximum of the so called refractive index for these waves.

We present a study that focuses on the synopsis of the findings concerning possible TIL formation mechanisms which were derived mostly from idealised simulations. Our study aims at the analysis of the coherent formation and evolution of the TIL in baroclinic waves using a five year high resolution operational analysis data set from the ECMWF. We focus on baroclinic life cycles over the North Atlantic which are associated with surface cyclones and anticyclones. We use the surface information to track the evolution of these systems and to analyse the associated flow in the upper troposphere and lower stratosphere. This provides the possibility to analyse comparable stages of the TIL evolution during baroclinic life cycles, in one case in individual life cycles, as well as in composites of subsets of the baroclinic waves.
We will present the TIL evolution and associated flow patterns for individual baroclinic waves, resembling the well known classifications LC1 and LC2. Furthermore, we will present results from composite analyses of various baroclinic life cycles over the North Atlantic. We will also put our results in perspective to the results from the idealized simulations. A second major focus is the analysis of the stability regarding turbulent motion and possible stratosphere-troposphere exchange in these regions.