The Tropopause Inversion Layer in Baroclinic Life Cycle Experiments

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The Tropopause Inversion Layer (TIL) is a region of enhanced static stability just above the thermal tropopause. It is a ubiquitous feature in midlatitudes and is well characterized by observations; however, it still lacks a full theoretical explanation.

The current study uses adiabatic baroclinic life-cycle experiments in order to investigate dynamical mechanisms that lead to the formation of a TIL. Consistent with earlier results, no TIL is found above cyclonic anomalies, while a pronounced TIL is found above anticyclonic anomalies early during the life cycle. Interestingly, regarding tropopause based global mean profiles, a TIL can be seen only much later during the life cycle, at a time when wave breaking starts to occur. There is a significant rise of the thermal tropopause, which is spatially and temporally correlated with TIL formation. In contrast, the dynamical tropopause does not rise significantly and does not exhibit a TIL in the global mean.

The results of these experiments are interpreted using earlier results about the nonlinear dependence of the TIL amplitude on the scale of the tropopause anomaly. The analysis suggests that the TIL (as a global mean feature) is linked to a strongly asymmetric distribution of cyclonic and anticyclonic anomalies, which occurs after the wave breaking event.