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Evidence of small scale quasi-isentropic mixing in extratropical baroclinic waves

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In autumn 2017 the airborne HALO mission WISE (Wave driven ISentropic Exchange) took place over the North Atlantic and Western Europe. Several research flights were performed to study the variability and development of the extratropical tropopause inversion layer during baroclinic life cycles and its impact on the distribution of trace species across the local tropopause.
We present an analysis of one flight number 07 of the WISE campaign which was planned in the ridge of a baroclinic wave. Studies of idealized baroclinic life cycle experiments predicted that these regions might exhibit both a strong enhancement of static stability and the occurrence of dynamic instability in the lower stratosphere.
For our analysis we use a composite of in-situ (trace gases and meteorological state parameters) and remote sensing measurements with GLORIA (Gimballed Limb Observer for Radiance Imaging of the Atmosphere), as well as high resolution operational analysis and forecast products from the European Centre for Medium-Range Weather Forecast (ECMWF). Our initial analysis is further complemented by a five year data set of operational analysis data from the ECMWF and by results from baroclinic life cycle experiments.
The focus of this presentation is to show evidence that cross tropopause transport can occur in a region which has gained little attention with respect to stratosphere-troposphere exchange. Based on trace gas measurements and ECMWF data we will show that air masses crossed the tropopause in the region of co-located occurrence of enhanced static stability, i.e. a well developed TIL, and low values of the the gradient Richardson number during WISE flight number 07. Our unique data set (airborne measurements, high resolution data from the ECMWF and idealized model simulations) allows us further to identify the relevant processes and contributions which lead to the enhancement of static stability and to the transport of tropospheric air into the stratosphere in the ridges of baroclinic waves.