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What controlls CO and H2O in the UTLS?

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The upper troposphere/lower stratosphere (UTLS) of the extratropics is affected by frequent mixing events across the extratropical tropopause, in the region of the subtropical jet as well as air originating from the 'tropical controlled' transition layer above Θ=380K. The distributions of CO and H_2O have been extensively used to investigate transport and mixing across the extratropical tropopause and define the structure of the lowermost stratosphere – particularly the extratropical transition region (ExTL). Here, we investigate the distributions of CO and H_2O in the extratropical UTLS and their relation to transport time and Lagrangian cold point temperature, respectively, using a statistical data set of 90-day backward trajectories driven by ERA interim windfields.

We show that the upper boundary of H_2O in the lowermost stratosphere is under non-local controll and driven by the annual temperature cycle at the (sub-)tropical tropopause. Using H_2O ozone scatter plots from observations we show that the location of the ExTL upper boundary deduced from water vapour is controlled by the Brewer Dobson circulation, rather than transport across the tropopause in the extratropics. In contrast, CO isopleths tend to follow the local tropopause mirroring the transit time of airparcels having crossed the tropopause in the extratropics and subtropics. Thus, CO and H_2O mirror complementary properties of transport and we discuss possible consequences for the definitions of transport regimes deduced from CO and H_2O in the UTLS.