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Lyapunov diffusion, tropical pipe and the QBO

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Using a new diagnostic tool, the transverse Lyapunov exponent and Lyapunov diffusion, which is akin to effective diffusivity but allows to resolve structures in longitude, we study transport and mixing properties of isentropic motion in the stratosphere.

The study is performed over a five year dataset of the ERA-40 that spans two periods of the QBO. We use wind fields from the ERA-40 and from reprocessings based on balancing corrected heating rates.

We discuss the modulation of the tropical pipe, which often divides in two, with the annual cycle and the QBO. We show the role of the region located near 400K in the mixing between tropical and extratropical atmosphere. We compare the mixing diagnostic with transport and age of air calculations and discuss the validity of modified and non-modified ERA-40 winds for stratospheric transport studies.