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Characterization of transport and mixing across the tropopause

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The transport processes between the upper troposphere and the lower stratosphere control a range of important phenomena at both small and large scales like weather patterns, the spreading of pollutants, greenhouse gases distribution, and ozone depletion. From sounding data one may look at the tropopause as a sharply defined layer, and thus expect the tropopuse to play the role of a well defined transport barrier. However, simulated and measured tracer data point to a very different picture, much closer to an interface region with some properties of a transport barrier and some properties of a mixing layer.For this reason, typical measures used for characterizing transport barriers (like Lyapunov exponents or effective diffusivity calculation) provide sometimes conflicting answers. Here we approach this problem, proposing a different method for quantifying mixing. The method is based on the correlation decay inside a packet at a given lengthscale and is applied to two cases: an artificial system (simulating tropospheric convection and stratoshperic jet interaction) and to real data corresponding to the wintertime polar vortex.