A Lagrangian Climatology of Tropical and Extratropical Forcing of the Northern Hemisphere Subtropical Jet

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The subtropical jet, located at the polar edge of the tropical Hadley cell, links tropical and extatropical dynamics. Upper-level outflow of strong tropical convection creates wave disturbances that can propagate downstream along the subtropical jet waveguide and influence the weather in the extratropics.

However, the subtropical jet itself is also affected both by tropical and extratropical dynamical systems. Besides the classical Hadley cell forcing, Rossby waves and Rossby wave breaking in the extratropics and the subtropics can substantially affect the subtropical jet:

- From an angular momentum point of view (breaking) Rossby waves are effective in transporting air from the tropics towards the subtropics, thereby potentially accelerating the subtropical jet. At the same time the zonal pressure gradients associated with the waves affect the conservation of angular momentum
- From a potential vorticity (PV) point of view the subtropical jet is co-located with a zone of strong upper-level baroclinicity, a steep increase in the height of the dynamical tropopause from the north to the south, and a zone of strong PV gradients that demarks the transition from tropical tropospheric low PV air to extratropical stratospheric high PV air. Breaking waves in the subtropics can destabilize the subtropical and tropical atmosphere and trigger convection and thereby influence the upper-level PV distribution. Breaking waves in the extratropics can transport high-PV air equatorward and thereby increase the subtropical PV gradient.

The focus of this presentation is on the forcing mechanisms of the subtropical jet during a five-year "climatological" period addressing both the PV and the angular momentum point of view. This includes i) processes that increase the PV gradient in the vicinity of the jet and ii) the angular momentum budget of air that ends up in the subtropical jet. To this end trajectories were calculated backwards out of the jet starting every 6 hours and tracing diabatic processes and the angular momentum along the pathways of the air parcels and gathering information on the three dimensional motion of these air parcels prior to their arrival in the jet.

A statistical analysis of the relative importance of tropical and extatropcial forcing for different seasons will be presented and the role of extratropical dynamics for angular momentum non-conservation discussed.