Lagrangian Studies of the Southern Stratosphere

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Unique datasets have been collected by field campaigns that released from Antarctica super-pressure balloons capable of drifting for months in the lower southern stratosphere during the springs of 2005 and 2010. The existence of these datasets provided a major motivation for Lagrangian studies of this region of the atmosphere wherein the "Antarctic Ozone Hole" forms. In this presentation we review the results of our analyses that used this data complemented by modeling studies to examine the transport inside the strong circumpolar vortex that characterizes the region during spring and the kinematics of the large-scale (Rossby) waves that perturb the vortex.

The data analysis applied by the first time to the stratospheric flow the Lagrangian descriptor known as the function M (e. g. Madrid and Mancho 2009). The modeling approach was based on the simulation by a conceptual numerical model of the flow both inside the vortex from realistic initial conditions.

The results obtained have demonstrated that the function M provides a sharp depiction of key Lagrangian features of a highly transient flow, presented plausible routes of large-scale horizontal transport across the vortex edge, highlighted the importance of lobe dynamics as a transport mechanism across the Antarctic polar vortex, and identified episodes of planetary (Rossby) wave breaking both inside and outside the vortex. The modeling studies showed how hyperbolic trajectories can be used to detect kinematic structures associated Rossby wave breaking. Current research focuses on the interannual variability of the winter-to-summer transition in the southern stratosphere.