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# Rossby wave breaking and Lagrangian structures inside the Antarctic stratospheric polar vortex during Vorcore and Concordiasi campaigns

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The trajectories in the lower stratosphere of isopycnic balloons released from Antarctica by international field campaigns during the southern springs of 2005 and 2010 showed events of latitudinal transport inside the stratospheric polar vortex, both away and towards the poleward flank of the polar night jet. The present work applies trajectory-based diagnostic techniques to examine mechanisms at work during such events. Reverse domain filling calculations of potential vorticity (PV) fields from ECMWF ERA-Interim data set during the events show irreversible filamentation of the PV fields in the inner side of the polar night jet, which is a signature of planetary (Rossby) wave breaking. Balloons motions during the events are fairly consistent with the PV filaments. Events of both large ($\sim$15º of arch length) and small ($\sim$5º of arch length) balloon displacements from the vortex edge are associated to deep and shallow penetration into the core of the elongated PV contours. The function M is applied to study the configuration of Lagrangian coherent structures during the events. A close association is found between hyperbolic points and breaking waves inside the vortex. The geometric configuration of the invariant manifolds associated with the hyperbolic points helps to understand the apparent chaotic behavior of balloons motions, and to identify and analyze balloon transport events not captured by the Reverse Domain Filling calculations.
The Antarctic polar vortex edge is an effective barrier to air parcel crossings. Rossby wave breaking inside the vortex, however, can contribute to tracer mixing inside the vortex and to occasional air crossings of the edge.