



Vortex dynamics of stratospheric sudden warming events: a data study using contour integral diagnostics

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The polar vortex is a large scale cyclone located in the upper atmosphere near to the planet's geographic poles. They form during the hemispheric winter and break down in the spring of the following year. During their lifetime they may break down causing a sudden stratospheric warming event (SSW). The vortex is thought to be preconditioned leading up to these warming events, resulting in the breakdown of the vortex. Integral diagnostics are used to investigate the stripping of air from the vortex as part of this preconditioning.

Contour diagnostics of mass and circulation are calculated using ERA-40 reanalysis data for the stratosphere. The edge of the vortex is easily identifiable in these diagnostics as a high gradient of Ertel's potential vorticity (PV), and the warming events are clearly visible. From these the amount of air removed from the vortex is determined from the balance equation of the mass integral. These terms show that there are significant amounts of air removed from the vortex, with several stripping events identifiable in them through the winter, especially in those during which a major sudden warming event occurred. These stripping events can be seen in corresponding PV maps, where tongues of PV can be seen to be stripped from the vortex and mixed into the surrounding surf zone of turbulent air. From the balance equation for circulation integral a frictional term is also calculated. The results from these diagnostics support the fact that the vortex undergoes preconditioning in the lead up to SSW events.