

Descent and Anomalous Mixing in the 1999-2000 Northern Vortex

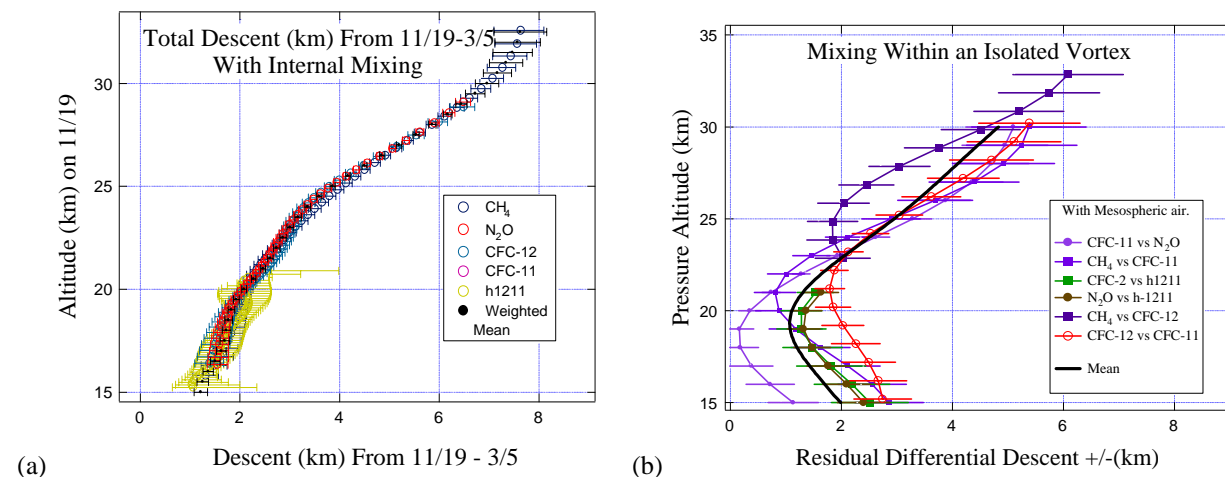
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In situ measurements from the Lightweight Airborne Chromatograph Experiment (LACE) and Airborne Chromatograph for Atmospheric Trace Species (ACATS-IV) instruments taken during the SOLVE campaign are used to examine the descent and mixing in the 1999-2000 northern vortex. LACE was flown twice on the in situ balloon platform: in November just after the vortex formed and in March near the end of the vortex lifetime. Descent within the vortex can be estimated by comparing long-lived tracer profiles from the two flights. The magnitude of descent is a strong function of height: from 6-7 km in the middle-stratosphere near 30 km to 1-2 km in the lower stratosphere near 16 km over the nearly 4-month period between flights (figure a).

Mixing within the vortex can be examined through changes in inner vortex tracer-tracer correlations from those in the midlatitudes. Several types of mixing may have occurred which could cause the changes in the LACE tracer-tracer correlation curves. Two simple models of vortex transport will be used to show the potential of different types of mixing to cause the changes. One model is of a vortex completely isolated from the midlatitudes, but containing asymmetrically descended air remnant from the vortex formation, followed by relatively efficient mixing within the vortex. A second model allows a small amount of mixing of midlatitude air into the vortex and relatively efficient mixing within the vortex. The first model is found to reproduce the observed correlations for all tracer combinations measured (figure b), whereas the second model does not.



Shown in (a) is the total calculated descent between the two LACE flights which span the four month time frame of the northern 1999-2000 vortex, and in (b) is the calculated residual altitude spread for a given tracer value in the early vortex that has mixed by the second LACE flight. Both calculations show agreement across all tracers measured by LACE and indicate a high degree of isolation from the midlatitudes in the vortex for this particular year.