MLS-Related Scientific Publication

Scientific Theme: Atmospheric Dynamics and Transport

EOS Microwave Limb Sounder observations of "frozen-in" anticyclonic air in Arctic summer, G. L. Manney, N. J. Livesey, C. J. Jimenez, H. C. Pumphrey, M. L. Santee, I. A. MacKenzie, and J. W. Waters, *Geophys. Res. Lett.*, **34**, L06810, doi:10.1029/2005GL025418, 23 March 2006.

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Summary

A previously unreported phenomenon in the polar stratosphere after the breakup of the winter polar vortex has been discovered in measurements from the Microwave Limb Sounder (MLS) on NASA's Earth Observing System (EOS) Aura satellite. Previous studies have shown remnants of the polar vortex persisting well into the summer. In this case, the vortex broke up in a very dramatic way, with large tongues of low-latitude material pulled into the polar regions. One such tongue formed a small, closed anticyclone (a vortex rotating in the opposite direction to the winter polar vortex) near the pole, and this anticyclone persisted throughout the summer; we refer to this as a "frozen-in anticyclone" (FrIAC). This feature moved westward with the summertime winds, and gradually tilted in the vertical and weakened at levels in the upper and lower stratosphere. When winds reversed to their fall/winter direction in late August, the feature dissipated. The FrIAC does not appear in O_3 because photochemical processes rapidly dilute the signature. Transport models did not successfully reproduce this feature, and analysis suggests that the winds used to drive the transport models are responsible for this failure. A localized, fast-moving feature such as this would not have been detectable without daily, global measurements of long-lived trace gases such as N_2O and H_2O from MLS.

This work benefits society by improving our understanding of the circulation of the stratosphere and by providing new ways to test the accuracy of our transport models and the winds used to drive them. Transport modeling of the stratosphere is critical to many studies, including those related to ozone loss and climate change.

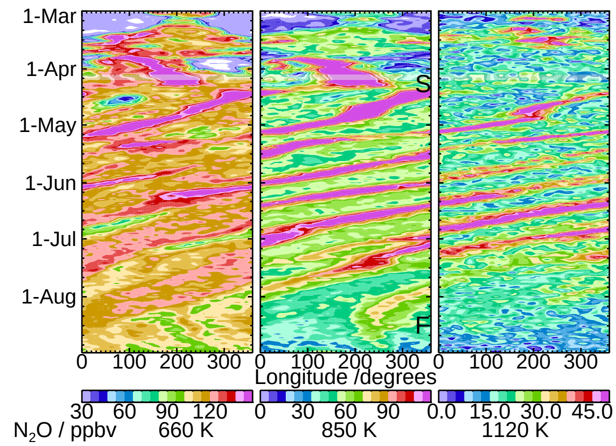

Figure 3. Time-longitude (Hovmöller) plots from March through August 2005 of MLS N_2O at 78°N and (left to right) 660, 850, and 1120 K (near 25, 30, and 40 km altitude, respectively). S and F show times of spring and fall background wind reversals at 850 K. The figures show an high-N_2O anomaly moving westward with the summertime winds, and persisting throughout the 2005 Arctic summer.

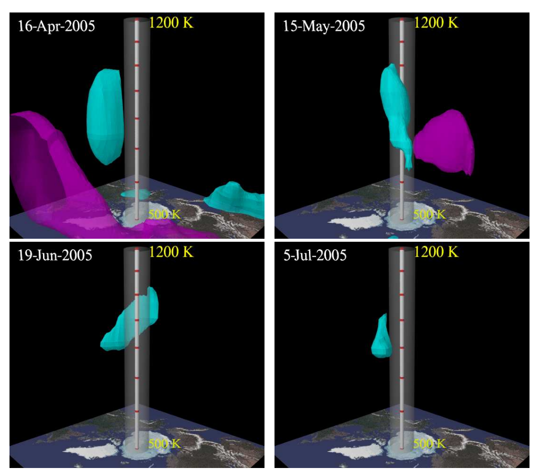

Figure 4. Isosurface plots of N_2O showing the FrIAC (cyan surface) shortly after formation, and at intervals throughout its lifetime. The magenta surface shows the remains of the winter polar vortex. Surfaces are a value of the departure of N_2O from a hemispheric mean.