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Scientific Theme: Atmospheric Chemistry and Transport

2002-2003 Arctic Ozone Loss Deduced from POAM III Satellite Observations and the SLIMCAT Chemical Transport Model, C. S. Singleton, C. E. Randall, M. P. Chipperfield, S. Davies, W. Feng, R. M. Bevilacqua, K. W. Hoppel, M. D. Fromm, G. L. Manney, and V. L. Harvey, *Atmos. Chem. Phys.*, **5**, 597–609, February 2005.

MLS contact: Gloria Manney, manney@mls.jpl.nasa.gov, 505-454-3364.

Summary

Inferring chemical ozone loss from satellite data requires quantifying ozone changes due to dynamical processes, so that these can be separated from chemical effects. A state-of-the-art three-dimensional chemical transport model (CTM) called SLIMCAT, driven by winds based on observations, was used to model how ozone would behave in absence of an chemical processes ("passive" ozone), and how it would behave in the absence of the heterogeneous processes that destroy ozone in the winter lower stratosphere ("pseudo-passive" ozone). These estimates were substracted from ozone observed by the Polar Ozone and Aerosol Measurement (POAM) III instrument to quantify the amount of Arctic ozone loss in the 2002-2003 winter. Although strong stratospheric warmings starting in January halted ozone loss early in the winter, the unusual cold in early winter still led to a moderate amount of ozone loss over the winter. Results based on observations are also compared with the chemical loss calculated in the SLIMCAT model, with overall good agreement.

This research benefits society by improving our ability to quantify Arctic ozone loss. Because Arctic ozone loss, and the meteorological conditions that determine its extent, varies so much from year-to-year, and because future cooling of the stratosphere could lead to much more extensive Arctic ozone loss, quantifying and predicting this loss is critical to understanding the health of our planet.

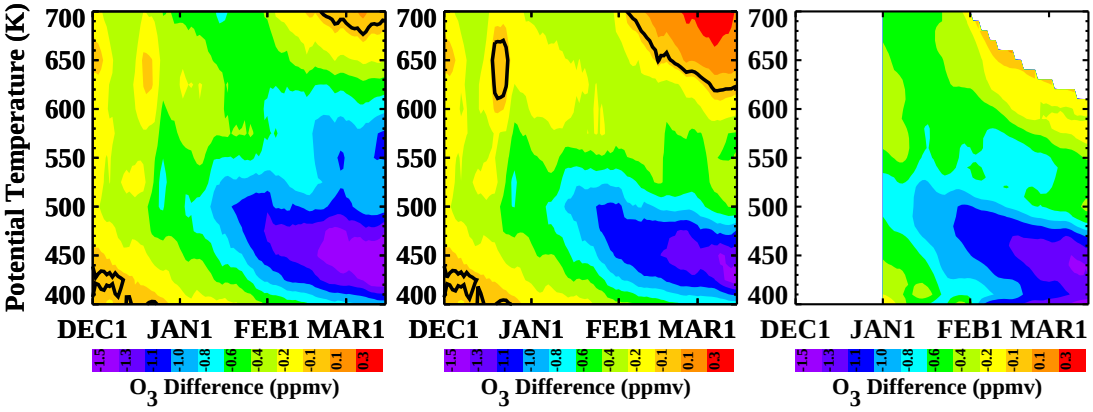

Figure 9. Inferred ozone loss using three different methods: On the left, ozone loss is inferred from the difference between ozone observed by POAM and ozone that is passively transported in the SLIMCAT model. The center panel shows ozone loss inferred from POAM/SLIMCAT differences, but in this case, only the heterogeneous reactions on polar stratospheric clouds have been removed from the ozone chemistry in the model. On the right, ozone loss was inferred by modifying an initial POAM-observed vortex-average ozone profile on the basis of calculated vortex-average descent rates. All calculations show significant ozone loss maximizing at a level near 450 K (about 18 km).