MLS-Related Scientific Publication

Scientific Theme: Atmospheric Chemistry

EOS MLS Observations of ozone loss in the 2004-2005 Arctic winter, G. L. Manney, M. L. Santee, L. Froidevaux, K. Hoppel, N. J. Livesey, and J. W. Waters, *Geophys. Res. Lett.*, **33**, L04892, doi:10.1029/2005GL024494, 16 February 2006.

MLS contact: Gloria Manney, manney@mls.jpl.nasa.gov, 505-425-6777.

Summary

Measurements from the Microwave Limb Sounder (MLS) on NASA's Earth Observing System (EOS) Aura satellite were used along with meteorological analyses to describe the evolution of the polar vortex and chemical ozone (O_3) loss in the 2004-2005 Arctic winter. That winter was unusually cold, but the cold period ended early with a major stratospheric warming in early March that led immediately to the final warming and vortex breakup. EOS MLS measurements of nitrous oxide (N_2O, a measurement not available from the previous MLS instrument), a long-lived tracer gas unaffected by chemical processes, were used to detail transport processes, and to estimate how those processes would have changed O_3. Changes in O_3 that are not consistent with this resulted from chemical loss. Comparisons with O_3 loss estimates for previous cold Arctic winters indicate that peak O_3 loss (which occurred near 18 km) in 2004-2005 was, despite record cold, less than the most previously observed. Less O_3 loss in a colder winter resulted from the combination of an early end to that cold period (so O_3 loss halted sooner) and differences in dynamical/transport processes that affected the O_3 loss. Because of the complexity of the interplay between dynamical and chemical processes, further study and modeling will be required to completely understand and quantify the O_3 loss.

This work benefits society by improving our understanding of Arctic ozone loss, its interplay with dynamical and chemical processes, and interannual variability in these processes. Arctic O_3 loss is of special concern because it occurs over densely populated latitudes, and because climate changes could produce increased loss, possibly comparable to the Antarctic "ozone hole", in the future.

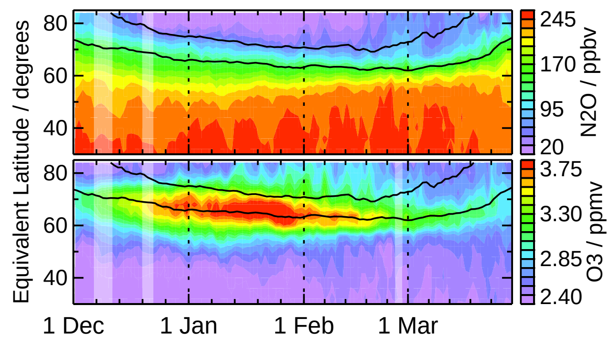

Figure 3. Time series of MLS N_2O (top) and O_3 (bottom) on the 490 K isentropic surface (near 19 km) in the lower stratosphere, as a function of equivalent latitude (a latitude-like coordinate that preserves the distinction between polar vortex and extra-vortex air). N_2O is a long-lived tracer, so changes in it show transport effects. Changes in O_3 that are not consistent with those transport effects – the large decrease starting in late January – are from chemical O_3 destruction.

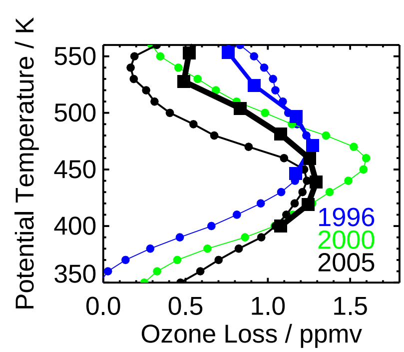

Figure 7. Estimated vortex-averaged Arctic chemical O_3 loss in 2005 from MLS (thick lines with squares, 1996 estimate is from Upper Atmosphere Research Satellite MLS) and POAM (Polar Ozone and Aerosol Measurement, thin lines with dots), compared with earlier years. This estimate showed peak O_3 loss in 2004-2005 to be comparable to that in 1995-1996, but less than that in 1999-2000 (the two previous years on record with most Arctic O_3 loss).