JPL (MLS Team) Scientific Publication

Scientific Theme: Atmospheric Chemistry and Transport

Stratospheric Effects of Energetic Particle Precipitation in 2003–2004, C. E. Randall, V L. Harvey, G. L. Manney, Y. Orsolini, M. Codrescu, C. Sioris, S. Brohede, C. S. Haley, L. L. Gordley, J. M. Zawodny, and J. M. Russell III, *Geophys. Res. Lett.*, **32**, L05802, doi:10.1029/2004GL022003, March 2005.

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Summary

Extraordinary solar storms in the fall of 2003 led to production of unusually large amounts of nitrogen oxides (NO_x, composed of NO and NO_2) in the upper atmosphere. In this paper, data in the stratosphere from numerous satellite instruments are combined to show the enhanced nitrogen oxides descending into the stratosphere, and their effects on ozone there. Data were used from the HALOE (Halogen Occultation Experiment), SAGE (Stratospheric Aerosol and Gas Experiement) II and SAGE III, and POAM (Polar Ozone and Aerosol Measurement) II and POAM III occultation instruments, as well as MIPAS (Michelson Interferometer for Passive Atmospheric Sounding) and OSIRIS (Optical Spectrograph and InfraRed Imager System) instruments. An unusually strong stratospheric polar vortex in late January through March 2004 facilitated the downward transport of NO_x. This was accompanied by ozone reductions in the upper stratosphere of up to 60%, caused by chemical reactions involving NO_x.

This research benefits society by improving our understanding of processes affecting ozone throughout the stratosphere. Only by understanding both natural (e.g., solar storms) and anthropogenic effects on ozone variability can we hope to understand ozone changes and their causes.

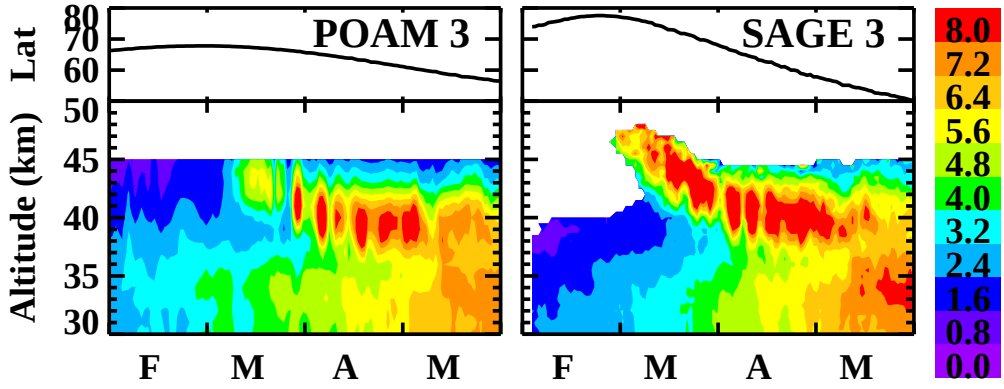

Figure 4. Plots of polar NO_2 from POAM III and SAGE III solar occultation measurements during the 2004 Arctic winter, showing enhanced NO_2 resulting from extraordinary solar storms descending as far down as the mid-stratosphere.