MLS-related Scientific Publication

Scientific Theme: Atmospheric Chemistry

Onset, Extent, and Duration of Dehydration in the Southern Hemisphere Polar Vortex, Elizabeth M. Stone, Azadeh Tabazadeh, Eric Jensen, Hugh C. Pumphrey, Michelle L. Santee, and John Mergenthaler, *J. Geophys. Res.*, **106**, 22,979–22,989, Oct. 2001.

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Summary and MLS contribution

This paper examines measurements of stratospheric water vapor from the Microwave Limb Sounder (MLS) and aerosol extinction from the Cryogenic Limb Array Etalon Spectrometer (CLAES), both onboard the Upper Atmosphere Research Satellite. In conjunction with temperature histories obtained from air parcel trajectory calculations, the water vapor mixing ratios and aerosol extinction values are correlated to identify the onset, extent and duration of dehydration in the Antarctic winter polar region in 1992. Substantial areas with enhanced aerosol extinction indicative of polar stratospheric clouds (PSCs) developed by mid-June, but water remained undepleted since temperatures were still above 185 K, the typical ice nucleation temperature (∼3 K below the ice frost point). By mid-July the area of low H_2O abundances coincided roughly with both the area of temperatures below the ice nucleation threshold and the area of high aerosol extinction. This evidence, together with temperature statistics from the trajectory calculations, suggests that the onset of the dehydration process occurs between late June and early July. By mid-August the area of H_2O depletion greatly exceeded that of enhanced extinction or low temperature, indicating that the air over a vast region had been irreversibly dehydrated. The dehydrated area persisted at roughly 30–35% of the total vortex area (equatorward of 80°S) through September and then decreased rapidly after mid-November. Comparison of the aerosol extinction measurements with results from a Mie code calculation suggests an average ice particle number density and size of 10^{-2}–10^{-3} cm^{-3} and 10–30 μm, respectively.

This work benefits society by enhancing our understanding of stratospheric cloud processes and their role in promoting severe dehydration, which is intimately connected to ozone depletion and the possible coupling between climate change and ozone loss.

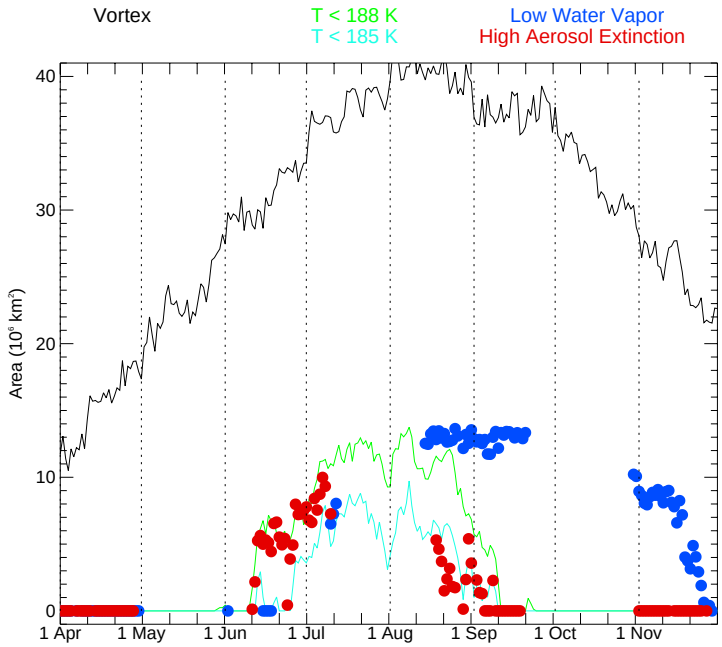

Figure 2. Areas (in km^2) in the southern hemisphere equatorward of 80°S at 465 K encompassing the polar vortex and the regions of low temperatures, MLS H_2O mixing ratios less than 3 ppmv, and CLAES aerosol extinction values greater than 0.001 km^{-1}, from April through November 1992.