

Interannual Variability in MLS Trace Gas Observations in the Antarctic Polar Vortex: Issues in Detection and Attribution of Trends

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The Microwave Limb Sounder (MLS), launched on NASA's Aura satellite in 2004, measures an extensive suite of atmospheric constituents involved in stratospheric ozone chemistry, including major chlorine and nitrogen reservoir and radical species, long-lived tracers, and ozone itself. We use the 12-year Aura MLS record in conjunction with meteorological analyses to quantify interannual variability and longer-term changes in lower stratospheric trace gas mixing ratio histograms and relate them to dynamical and meteorological variations. We focus on the Antarctic, where unambiguous trends in constituent behavior should be more readily detected than in the more highly dynamically variable Arctic. Even in the Antarctic, however, meteorological variability induces substantial year-to-year variations in trace gas distributions. Although decreases in lower stratospheric ozone loss can be expected in response to declining abundances of ozone-depleting substances, many confounding factors complicate attribution of apparent longer-term changes in ozone and other species to particular processes. Analysis of meteorological fields (including calculated mixing diagnostics) will be combined with histograms of long-lived tracers to provide insight into the possible significance of changes in dynamical and transport processes, including polar vortex characteristics and the location and strength of its "boundary" as well as potential changes in the large-scale transport circulation. This approach will be used to assess the degree to which chemical and dynamical processes controlling the evolution of ozone, as reflected in the frequency distributions of its abundance in the lower stratosphere, can be distinguished from one another.