MLS Scientific Publication

Scientific Theme: Atmospheric Chemistry

Variations and climatology of ClO in the polar lower stratosphere from UARS Microwave Limb Sounder measurements, M.L. Santee, G.L. Manney, J.W. Waters, and N.J. Livesey, *J. Geophys. Res.*, **108**(D15), 4454, doi:10.1029/2002JD003335, 2003.

First author: Michelle Santee, mls@mls.jpl.nasa.gov, 818-354-9424.

Summary

The Microwave Limb Sounder (MLS) onboard the Upper Atmosphere Research Satellite (UARS) measured the global distribution of stratospheric ClO over annual cycles for much of the 1990s, albeit with reduced sampling frequency in the latter half of the decade. In this paper, daily maps and equivalent latitude/potential temperature cross sections are used to show interhemispheric and interannual differences in lower stratospheric wintertime ClO abundances, and time series of different slices through the data are examined to develop a comprehensive picture of the mean evolution of enhanced vortex ClO. Climatological fields are derived by averaging together the results for individual years. The main conclusions of this work are: (1) Although ClO enhancement within the Arctic vortex is fairly comparable in both magnitude and spatial extent to that in the Antarctic at 465 K (∼19 km) — the level that most previous studies reporting MLS ClO data focused on — a significant interhemispheric disparity is seen at higher altitudes, where maximum ClO abundances, and their spatial extent, are considerably larger in the Antarctic than in the Arctic. (2) The Arctic exhibits much more interannual variability in the magnitude, timing, and horizontal and vertical extent of ClO enhancement than does the Antarctic. Nevertheless, MLS observed the Arctic vortex to be almost completely filled with enhanced ClO during the atypically cold Arctic winters of the mid-1990s. (3) The peak in the ClO profile is at a higher altitude, and the vertical extent of chlorine activation is larger, in the Antarctic than in the Arctic. (4) The Arctic winter of 1995/1996 stands out as having a much more Antarctic-like ClO distribution, with larger maximum ClO abundances, a higher altitude for the profile peak, and greater horizontal and vertical extent of activation than the other winters observed by MLS. (5) In the Southern Hemisphere, ClO becomes enhanced in the sunlit portions of the vortex by at least late May/early June every year, whereas in the Northern Hemisphere ClO becomes enhanced in mid to late December in some years but not until January in others. In the Arctic, chlorine deactivation is typically completed by mid-March. In contrast, in the Antarctic ClO consistently remains enhanced in mid-September, especially at 465 K. Thus elevated levels of reactive chlorine persist for 4–5 months in the south but only 2–3 months in the north. This work benefits society by improving our understanding of active chlorine, the primary agent for stratospheric ozone destruction.

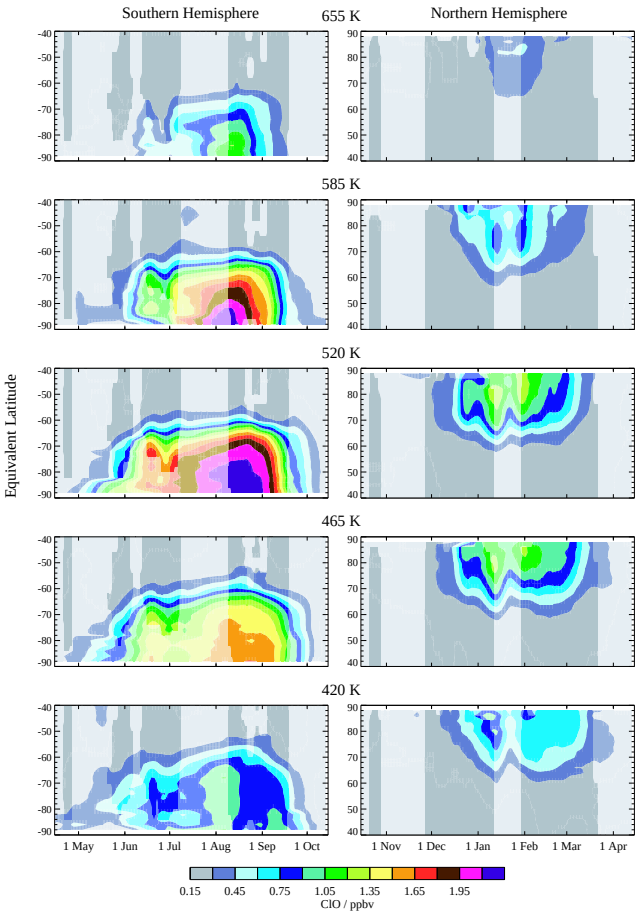

Figure 5. Climatologies of midday (SZA <88°, 11:00<LST<14:00) MLS ClO as a function of EqL and time at five potential temperature levels between 655 K (top panel) and 420 K (bottom panel), derived by averaging together the results for seven individual years at each level. To fill in breaks in the climatological fields arising from data gaps, Kalman smoothing has been applied to the averaged ClO values at each level; paler colors denote regions where the estimated precision of the interpolated values is poor.