A New View of Polar Processing:

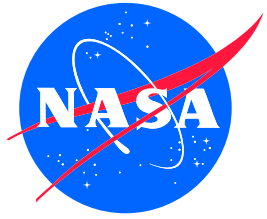
First Results from the Microwave Limb Sounder on Aura

AGU Special Session on Aura

14 December 2004

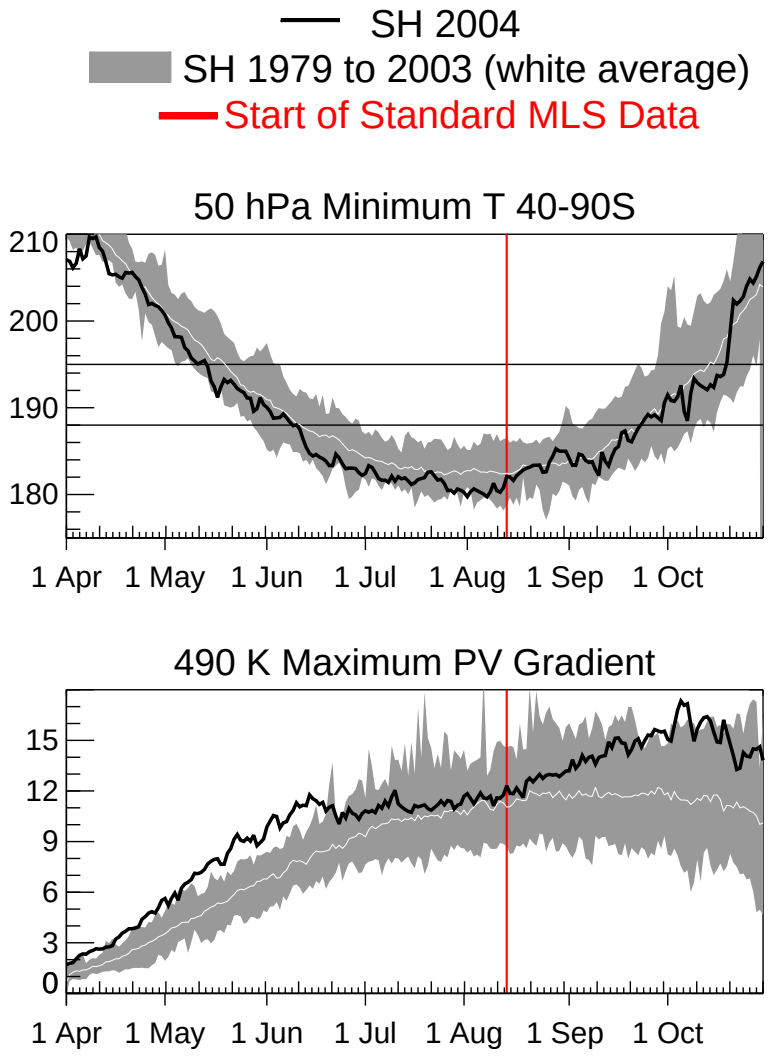
M.L. Santee[†], J.W. Waters[†], G.L. Manney[†,‡], L. Froidevaux[†], N.J. Livesey[†], W.G. Read[†], H.C. Pumphrey[§], M.J. Schwartz[†]

[†]Jet Propulsion Laboratory, Caltech, CA, USA
[‡] New Mexico Highlands University, NM, USA
[§] University of Edinburgh, UK

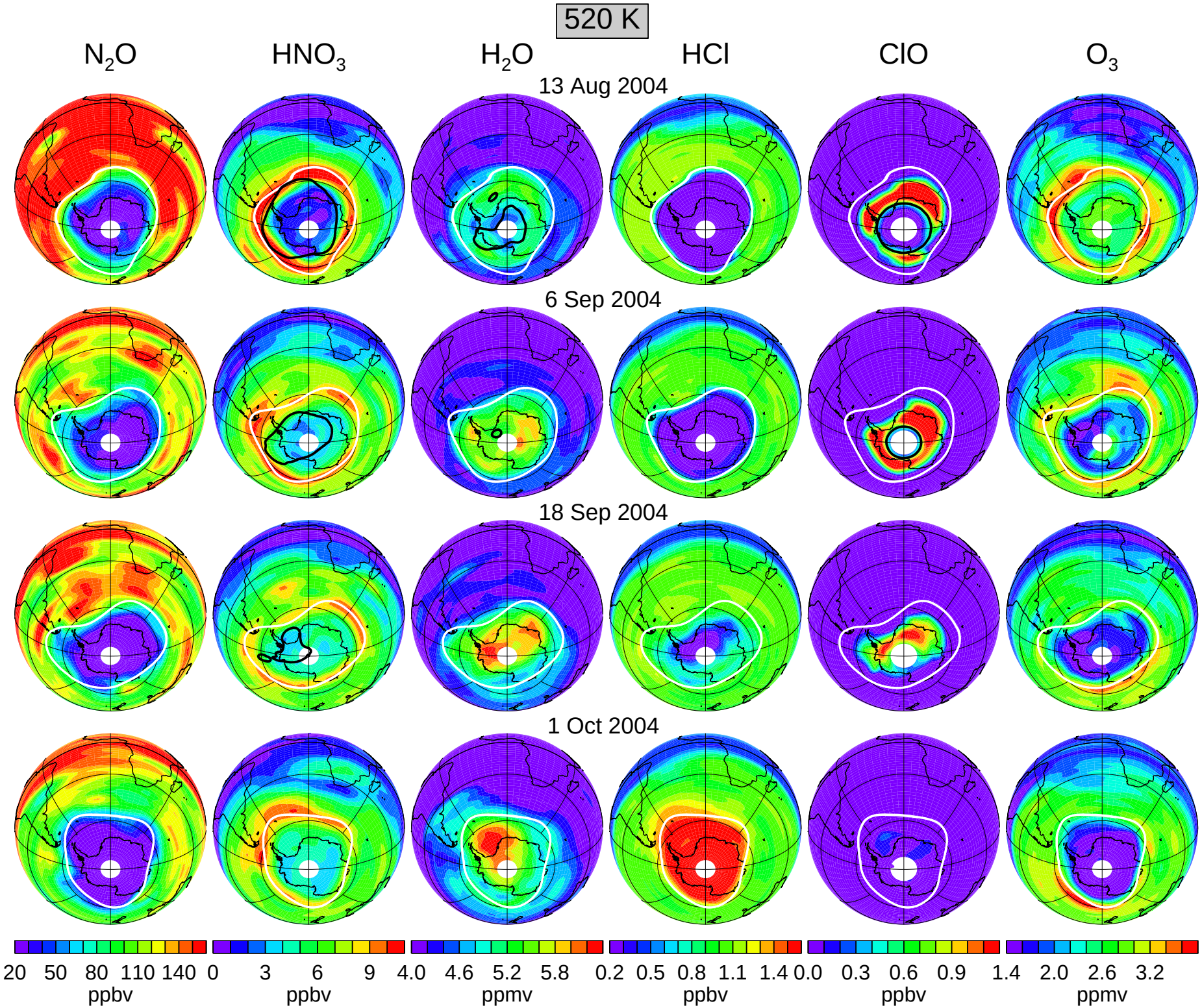


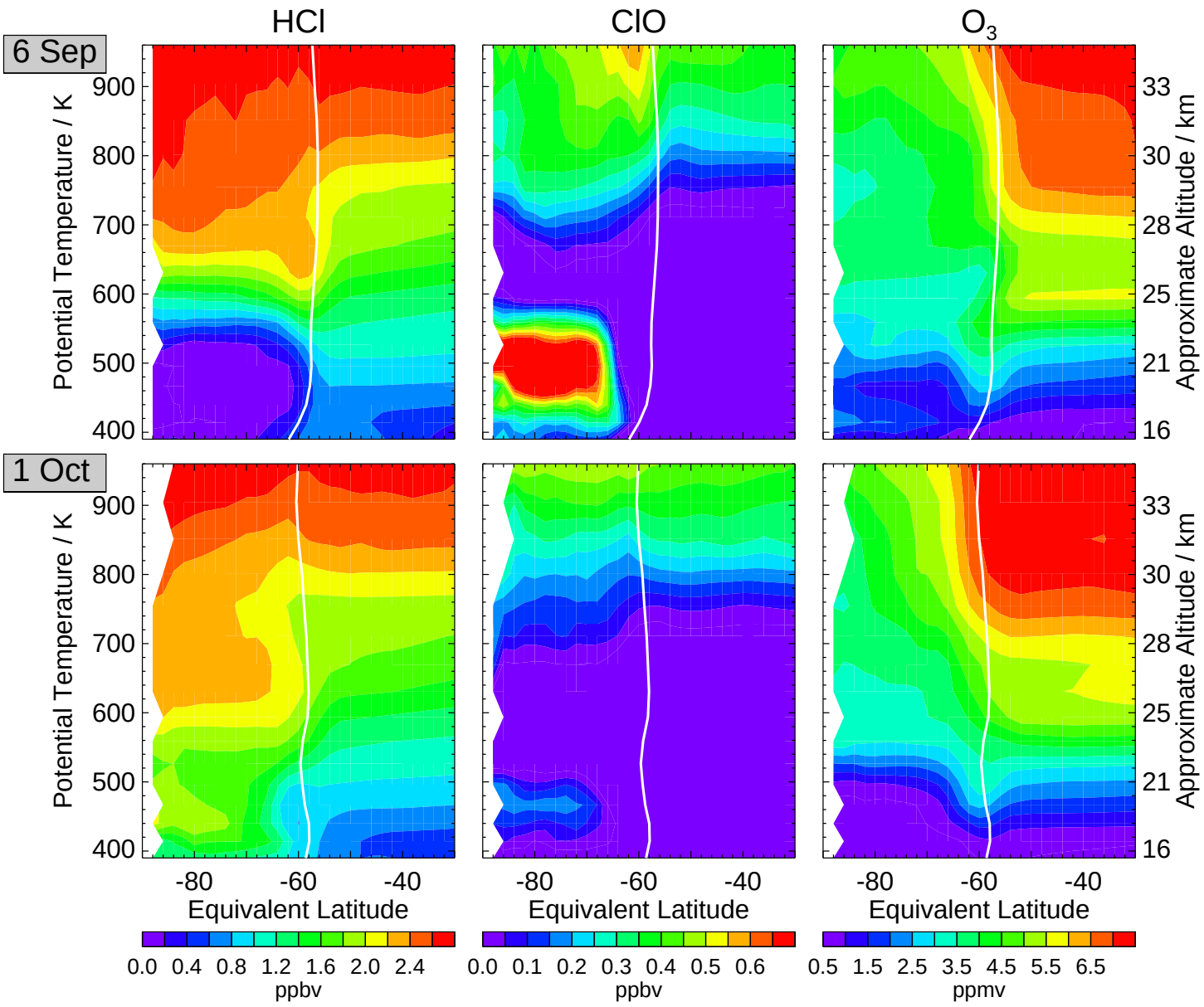
JPL

- EOS MLS is providing an extensive dataset on polar processes affecting stratospheric ozone, including the first simultaneous daily global maps of ClO and HCl, along with N_2O, HNO_3, H_2O, O_3, and temperature.
- We present MLS observations from the 2004 Antarctic late winter/early spring period, with a focus on chlorine and its influence on ozone.
- Results shown here are from preliminary data processing algorithms; refinements to the retrieval code are currently being implemented, and most data products will be improved in the next version, to be released in early 2005.



- Meteorology of the 2004 Antarctic winter:
  - Lower stratospheric minimum temperatures were mostly below the climatological average until MLS entered routine science operations in mid-August, after which they remained near average values.
  - Temperatures in the lower stratosphere rose rapidly starting in mid-September.
  - Maximum potential vorticity (PV) gradients indicate that the lower stratospheric vortex was much stronger than usual throughout the period observed by MLS.


520 K
N_2O
HNO_3
H_2O
HCl
ClO
O_3
13 Aug 2004
6 Sep 2004
18 Sep 2004
1 Oct 2004
20 50 80 110 140
ppbv
0 3 6 9
ppbv
4.0 4.6 5.2 5.8
ppmv
0.2 0.5 0.8 1.1 1.4
ppbv
0.0 0.3 0.6 0.9 1.4
ppbv
2.0 2.6 3.2
ppmv

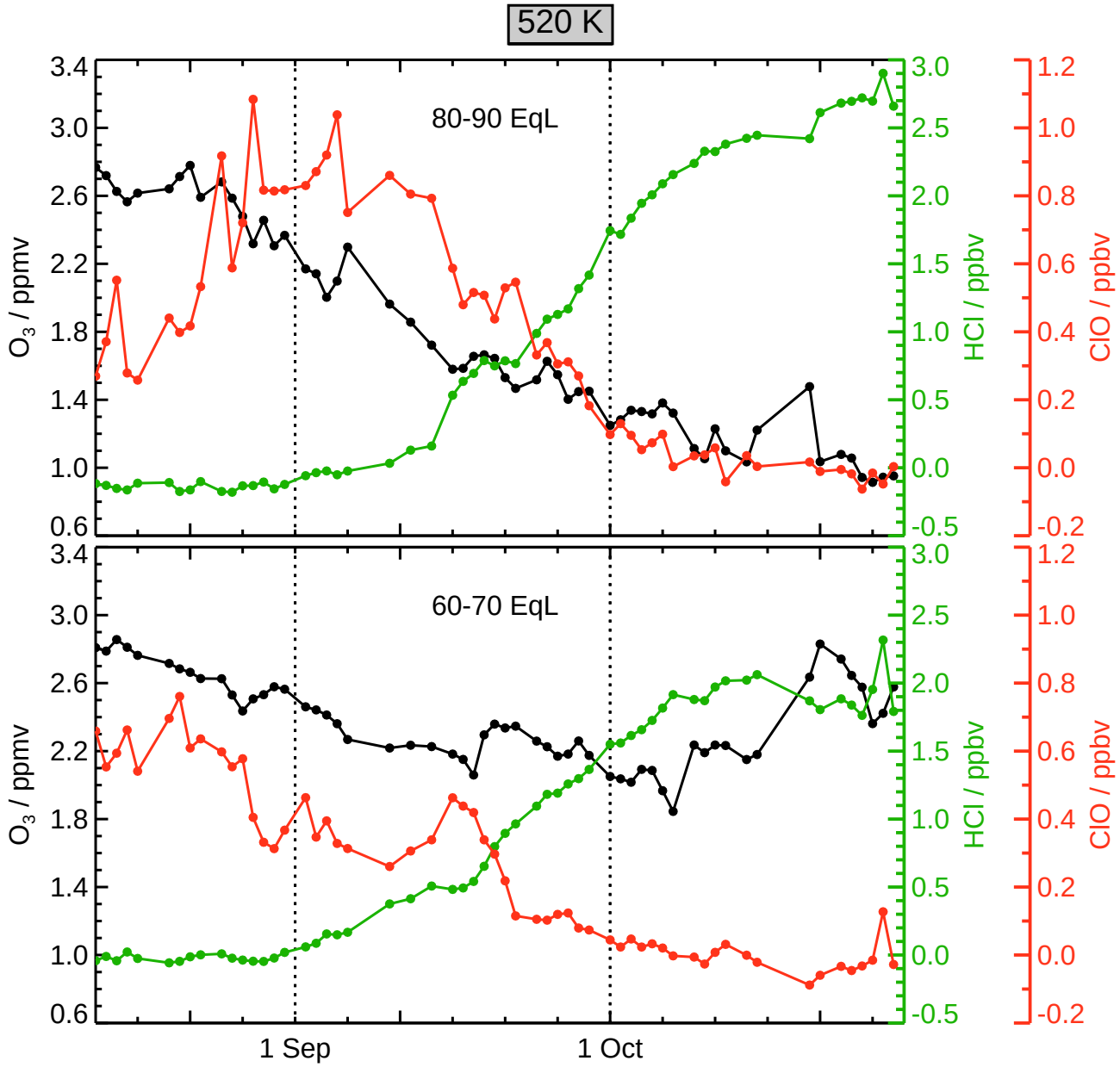


- There is very good correspondence in the vertical extent of depleted HCl and enhanced ClO during the time of peak chlorine activation.
- HCl has recovered and nearly all ClO has disappeared above 500 K by 1 October, although weak enhancement persists at lower altitudes.

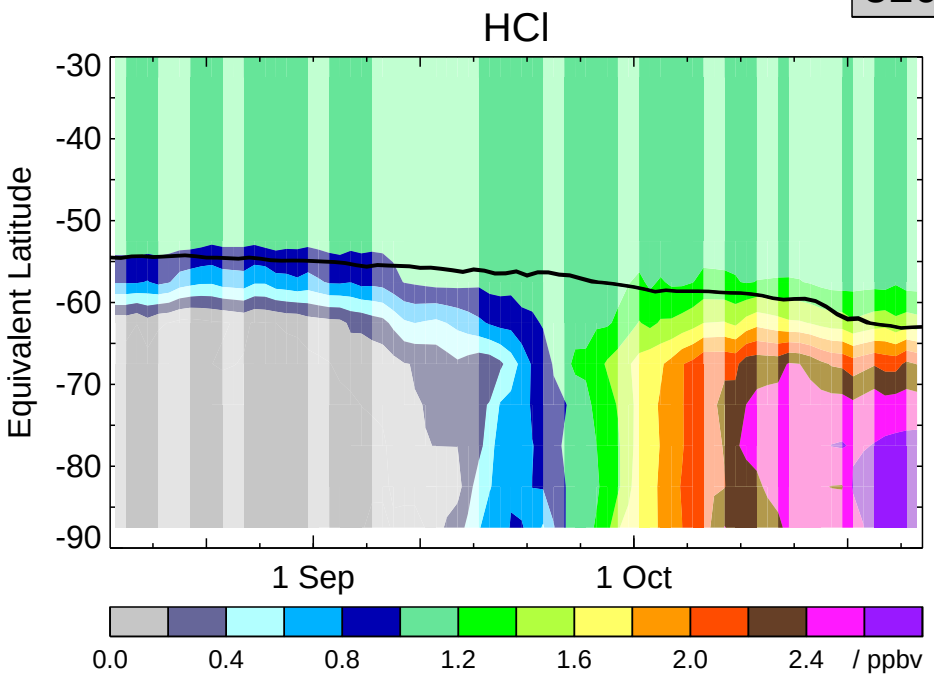
- Contrasting the two O_3 panels illustrates the development of the lower stratospheric ozone hole over the month of September.

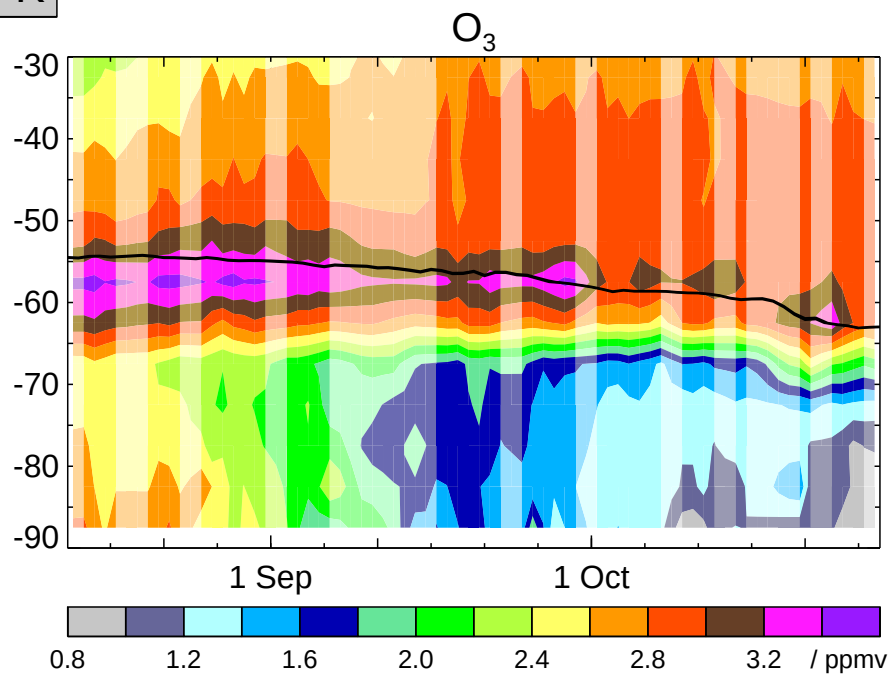
- In the vortex core:
  - ClO values continue to increase until early September, after which they decline rapidly;
  - Rapid HCl recovery begins in mid-September;
  - O_3 loss accelerates in late August and levels off in early October.

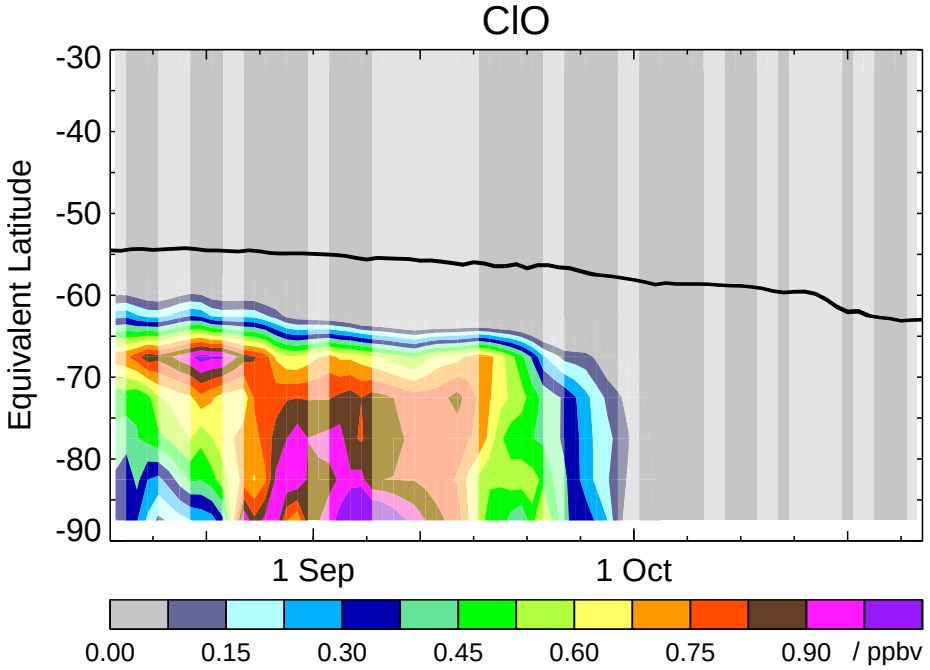
- Closer to the vortex edge:
  - ClO mixing ratios are lower and are relatively constant in mid-August, decreasing thereafter;
  - HCl recovery starts earlier and is more gradual;
  - O_3 loss appears to be less severe.



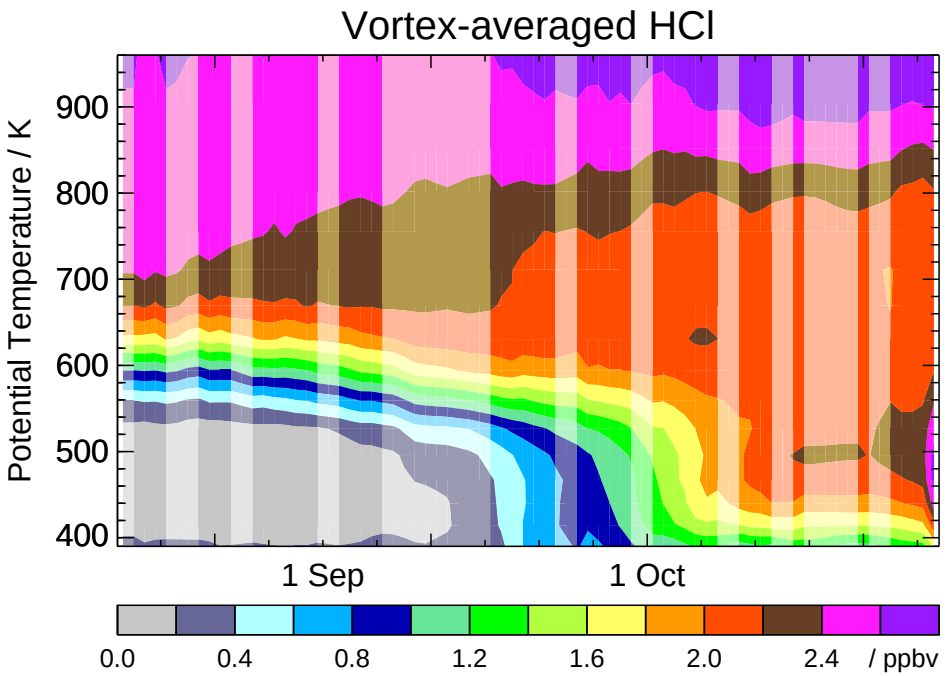
520 K

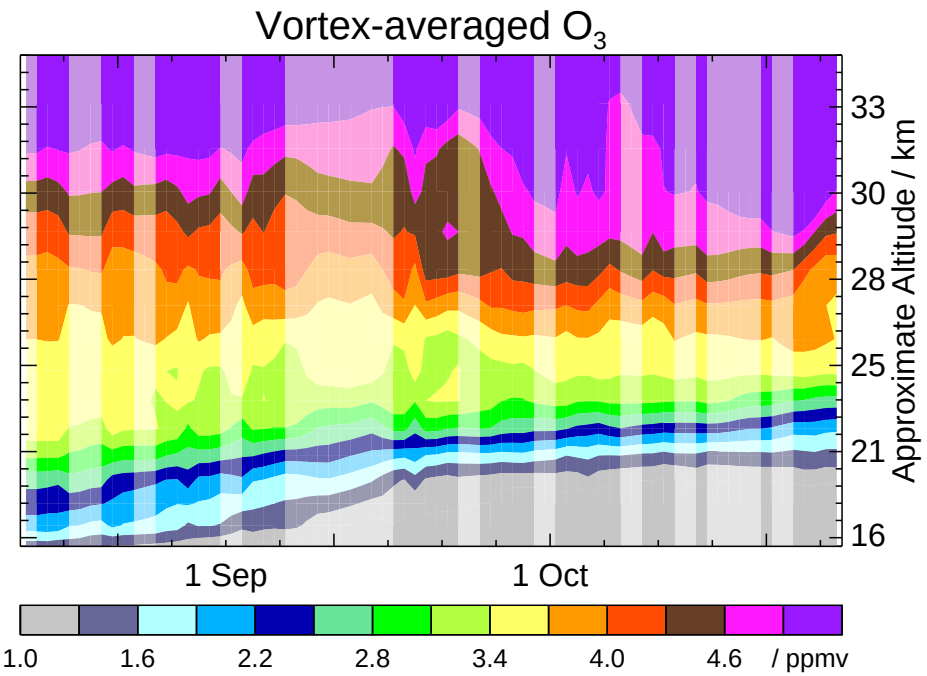


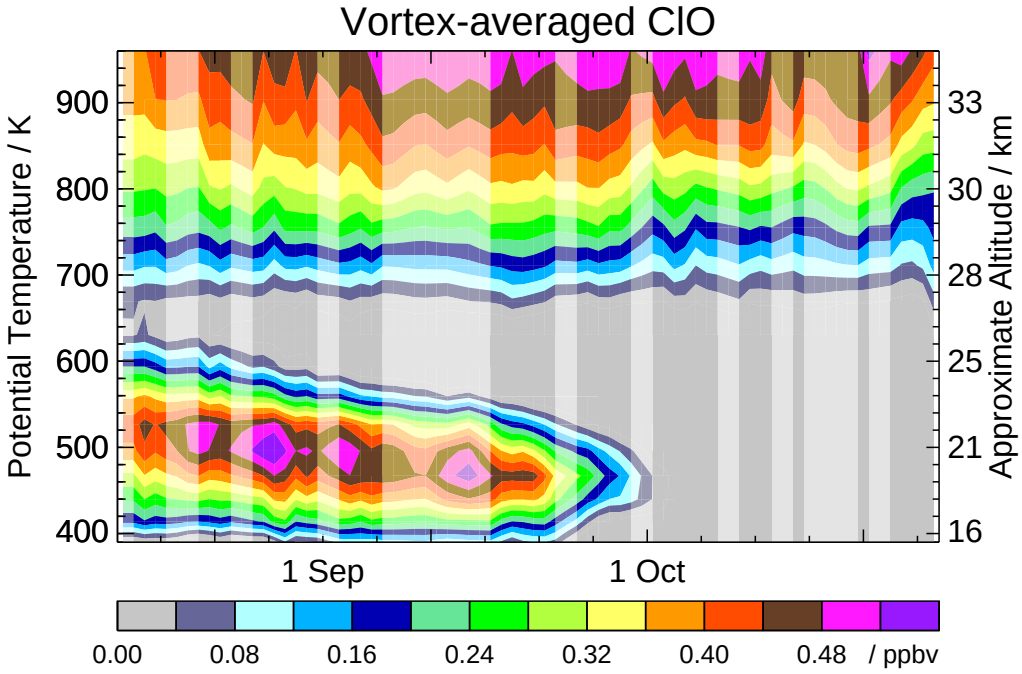




- Short data gaps are filled by running the daily averages through a Kalman smoother; paler colors denote regions where data are sparse or missing.
- The timing and horizontal extent of chlorine activation are consistent in the ClO and HCl fields.
- Inside the vortex, ozone abundances steadily decline until almost all ozone at this level has been chemically destroyed by mid-October.







- The HCl and ClO fields provide a consistent picture of the vertical extent of active chlorine and the timing of chlorine deactivation.
- The downward progression of the peak in the ClO profile in late winter has been observed previously in both UARS MLS and ground-based data.
- Summary: The suite of MLS polar process measurements will be very valuable in detailed process studies in both the Antarctic and the Arctic.