Microwave Limb Sounder (MLS)

Version 3 data processing improvements and plans

Nathaniel Livesey and the MLS team

Jet Propulsion Laboratory

California Institute of Technology

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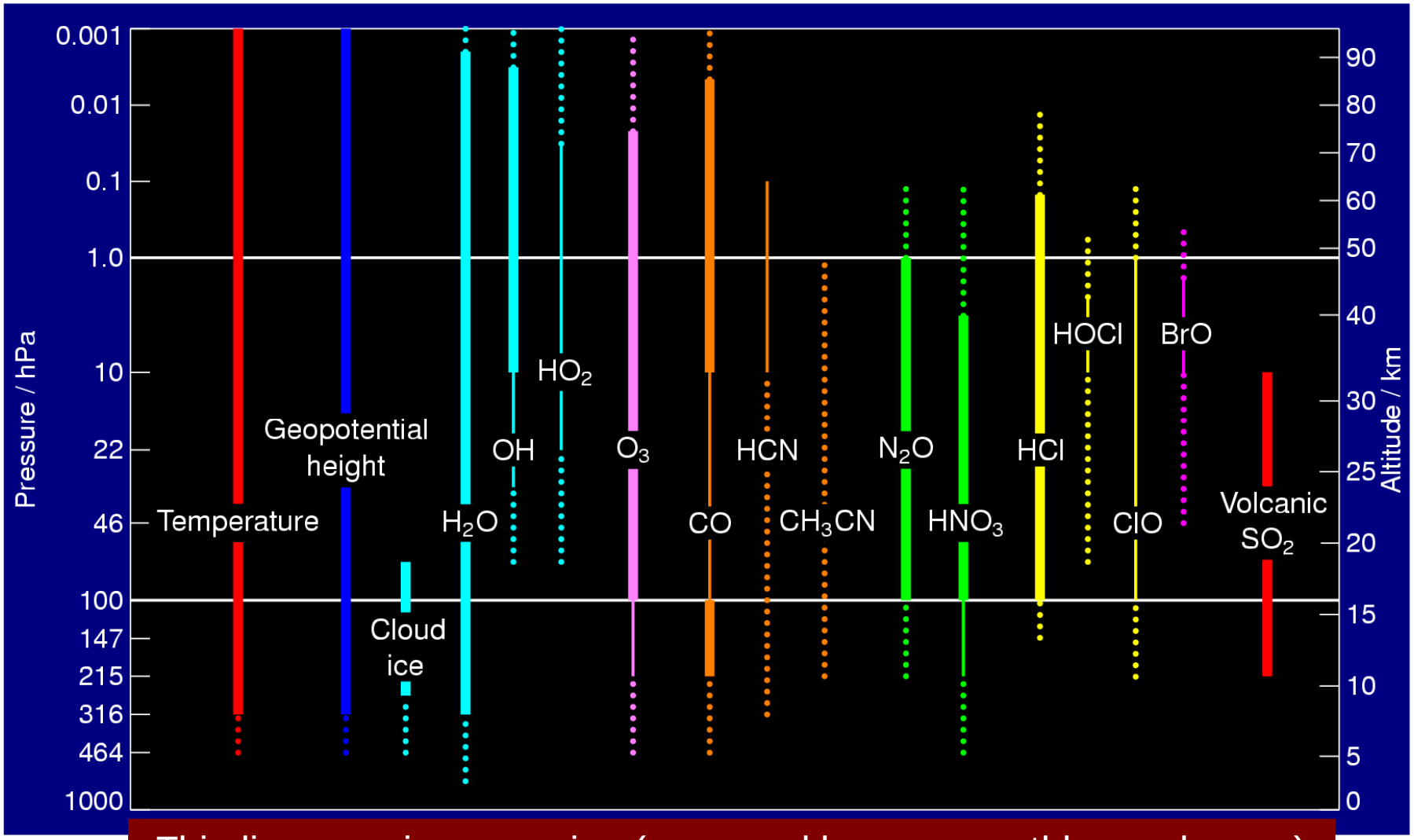
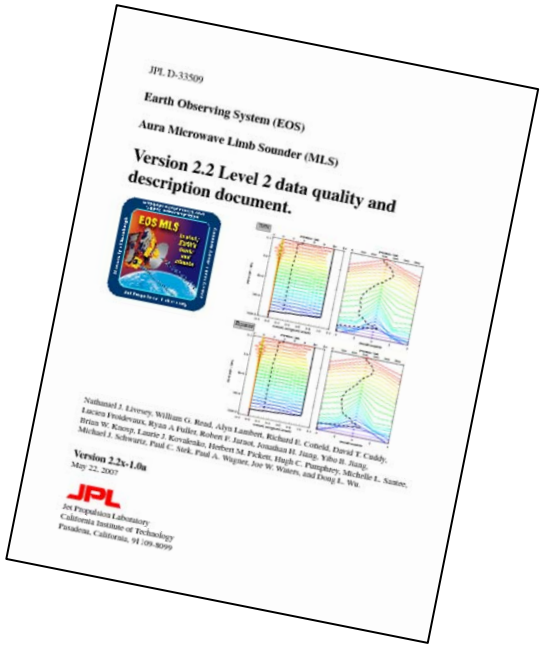
MLS standard data products



Thin lines require averaging (e.g., weekly map, monthly zonal mean)
Dotted lines are goals

Reminder of MLS documents and contacts


JPL D-33509

Earth Observing System (EOS)

Aura Microwave Limb Sounder (MLS)

Version 2.2 Level 2 data quality and description document.

Version 2.2x-1.0a

May 22, 2007

JPL

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California Institute of Technology
Pasadena, California, 91109-8099

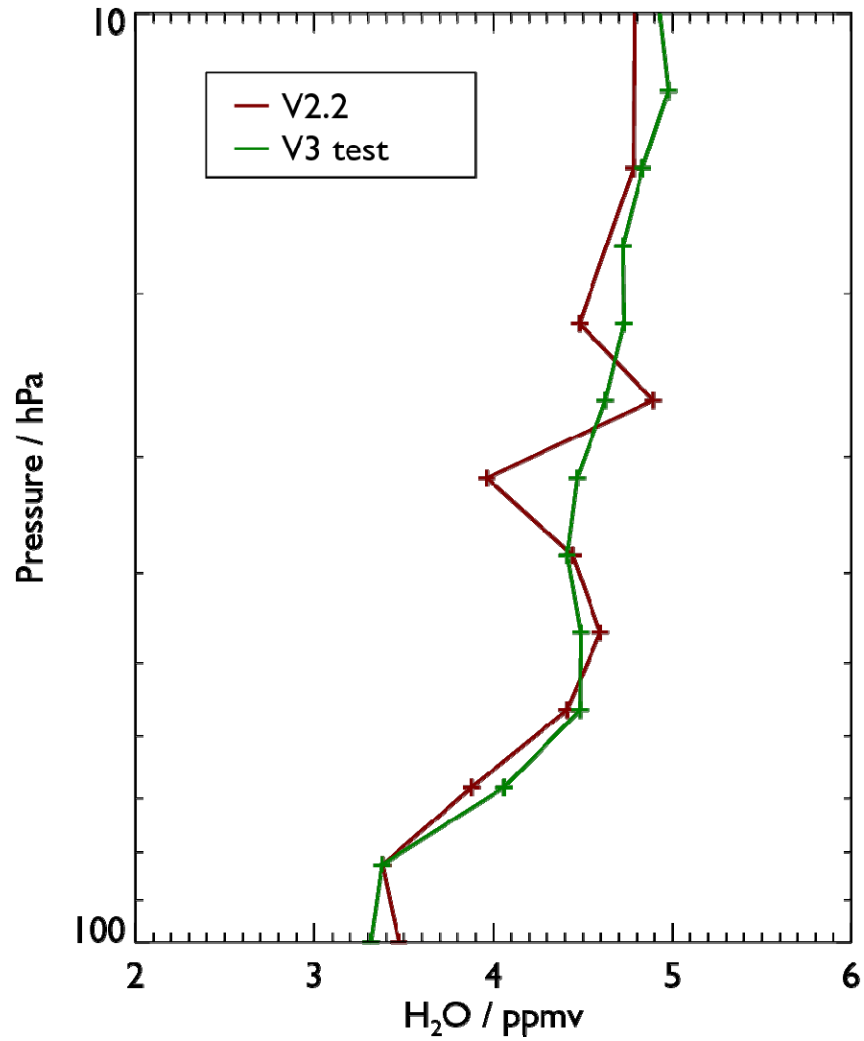
- The MLS validation papers and 'Data quality document' are important resources
- Validation and support of each MLS product is assigned to a member of the MLS science team
- Contact these individuals (or me) with any questions

Product(s)	MLS team member(s)
Temperature / GPH	Michael Schwartz
O_3	Lucien Froidevaux (strat./mes.) Nathaniel Livesey (upper trop.)
H_2O / RHi	Alyn Lambert (strat. / mes.) Bill Read (upper trop.)
CO	Hugh Pumphrey (strat. / mes.) Nathaniel Livesey (upper trop.)
Cloud ice	Alyn Lambert / Dong Wu
HNO_3, ClO, (CH_3Cl, CH_3CN)	Michelle Santee
HCl, HOCl	Lucien Froidevaux
N_2O	Alyn Lambert
OH, HO_2	Shuhui Wang
BrO	Nathaniel Livesey
SO_2	Bill Read
HCN	Hugh Pumphrey

Stratospheric H_2O improvements

- The MLS version 2 H_2O product has a persistent oscillation in the middle stratosphere
- This is in part due to the change in vertical grid in this region in v2
  - 12 surfaces / decade (~1.3 km) from 1000 to 33 hPa
  - 6 surfaces / decade (~2.5 km) from 33 to 0.1 hPa, 3 / decade above
- The version 3 algorithms extend the 12/decade grid throughout the stratosphere, switching to 6/decade at 1 hPa
- Improvements have also resulted from updates to the H_2O spectroscopic data

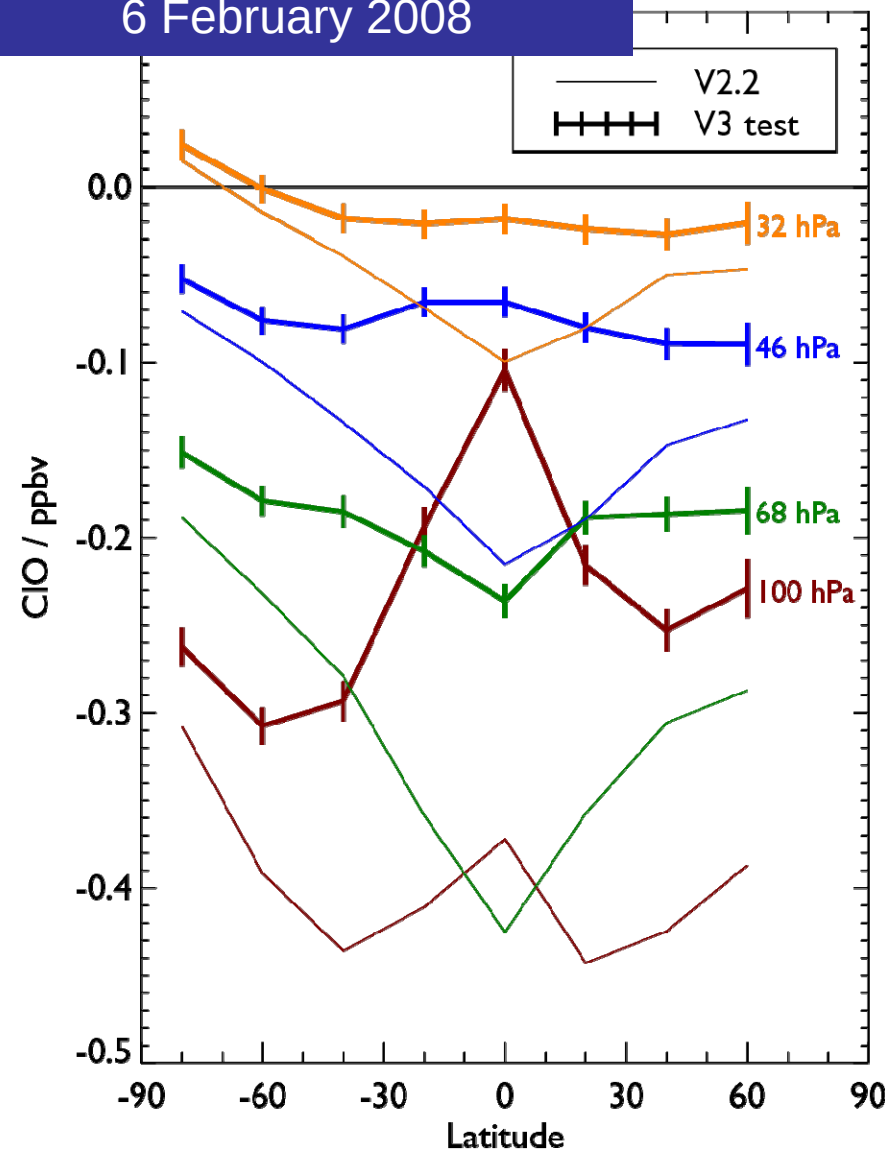
MLS lower stratospheric H_2O for 6 February 2008, 30ºS – 30ºN



Improvements in stratospheric ClO biases

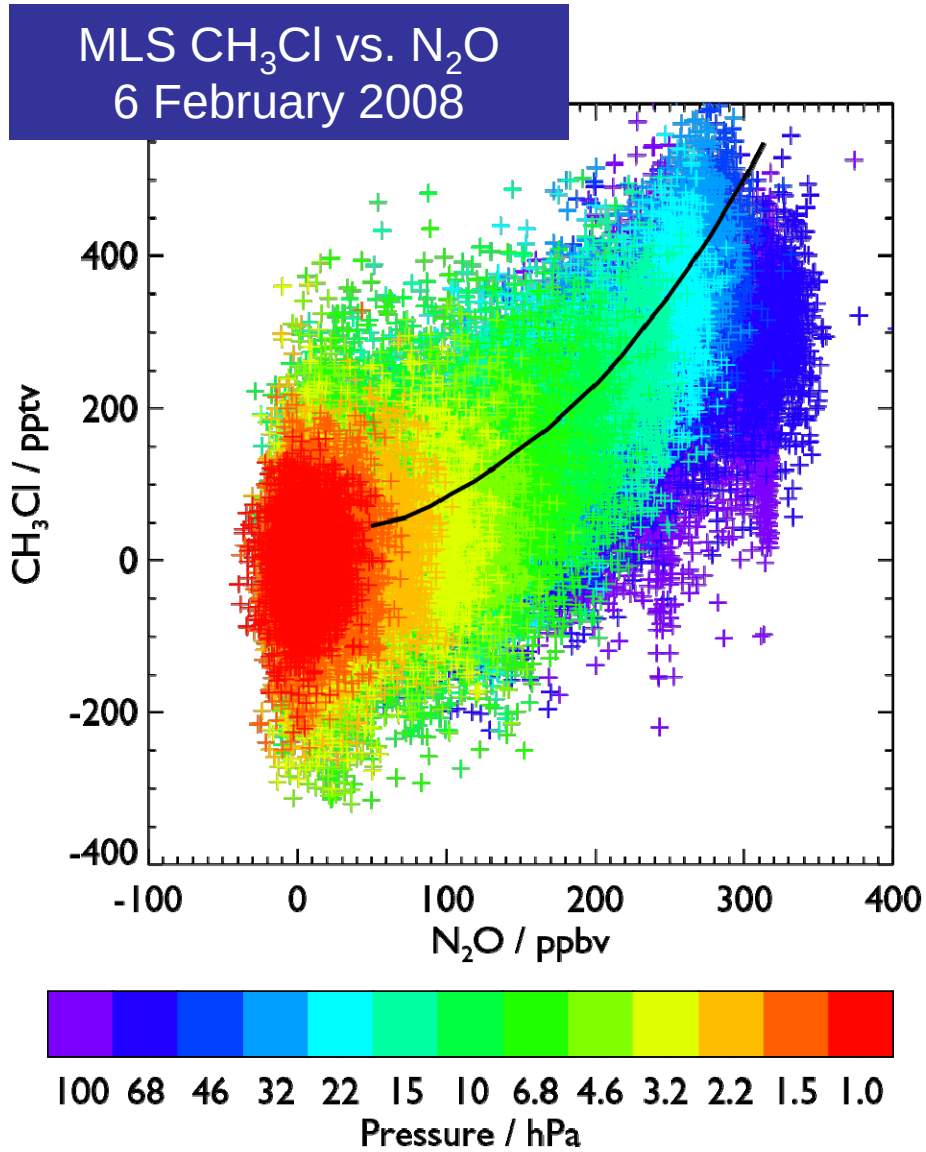
- The MLS v2 ClO product exhibits a negative bias in the lower stratosphere
- This can be ameliorated by taking day/night differences, except in regions where ClO is known to be enhanced at night
  - Plot on right shows night time ClO outside winter vortex
- The version 3 algorithms give a less negative bias that is more constant with latitude (except for 100 hPa)
- This improvement is mainly the result of retrieving CH_3Cl in v3
  - The 640 GHz CH_3Cl spectral signature overlaps that of ClO at the lower altitudes

MLS lower stratospheric ClO
6 February 2008



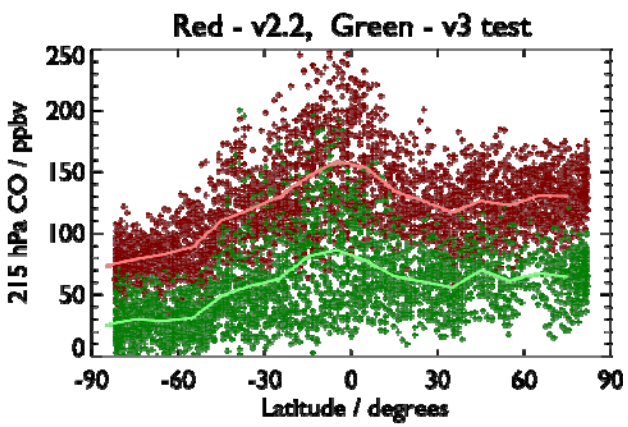
New CH_3Cl product

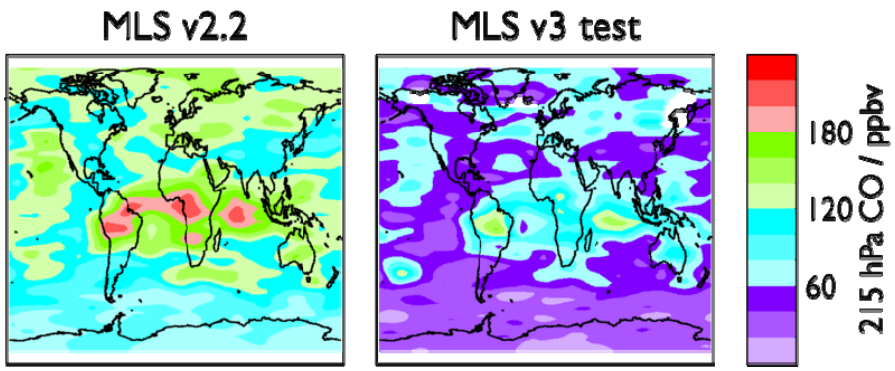
- CH_3Cl is a new product for v3
- It is a long-lived trace gas and the only natural source of stratospheric chlorine
- MLS profiles will be useful from ~100 hPa to ~1 hPa
- Initial results (right) show expected correlations with N_2O
  - Solid line is correlation from SOLVE aircraft measurements
- Individual data points are somewhat noisy
- Weekly maps or daily zonal means (or EqL/Theta means) will have useful signal to noise



Upper tropospheric CO

- The MLS v2.2 data capture the morphology and temporal variations in upper tropospheric CO well
- However, the MLS v2.2 CO exhibit a persistent ~2x high bias at 215 hPa
- The bias has been significantly reduced in v3 by a combination of
  - Changing the manner in which the 'baseline' on which the CO spectral signal sits is accounted for
  - Ignoring certain MLS channels in the retrieval of upper trop. composition
- Although the bias has been reduced, a better understanding of the underlying issues with the MLS radiances is needed

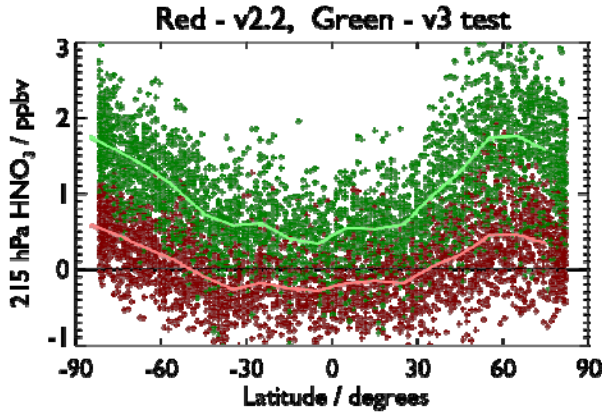


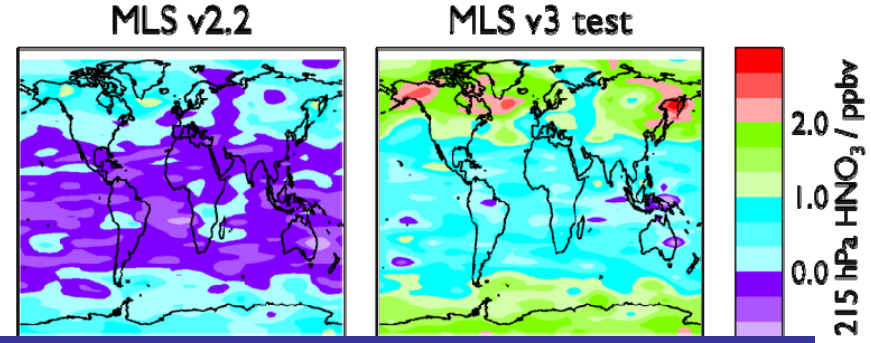


MLS 215 hPa CO, 6 February 2008

Upper tropospheric HNO_3

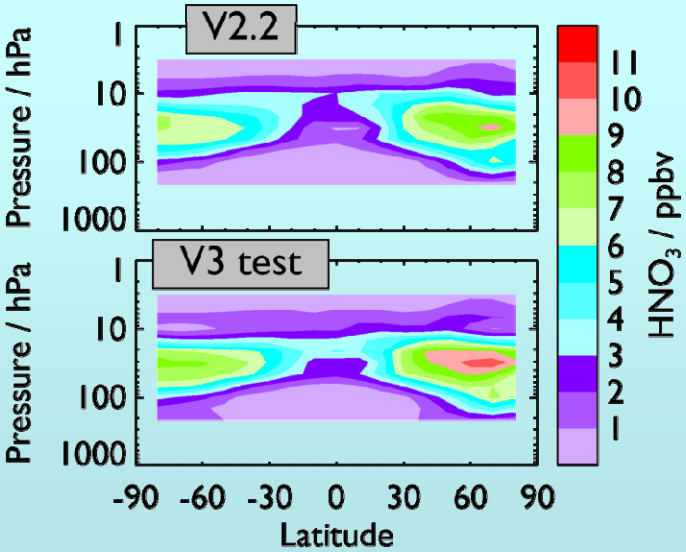
- MLS v2.2 HNO_3 has a significant negative bias at 215 hPa
- The changes that gave the reduction in the CO bias also improve HNO_3





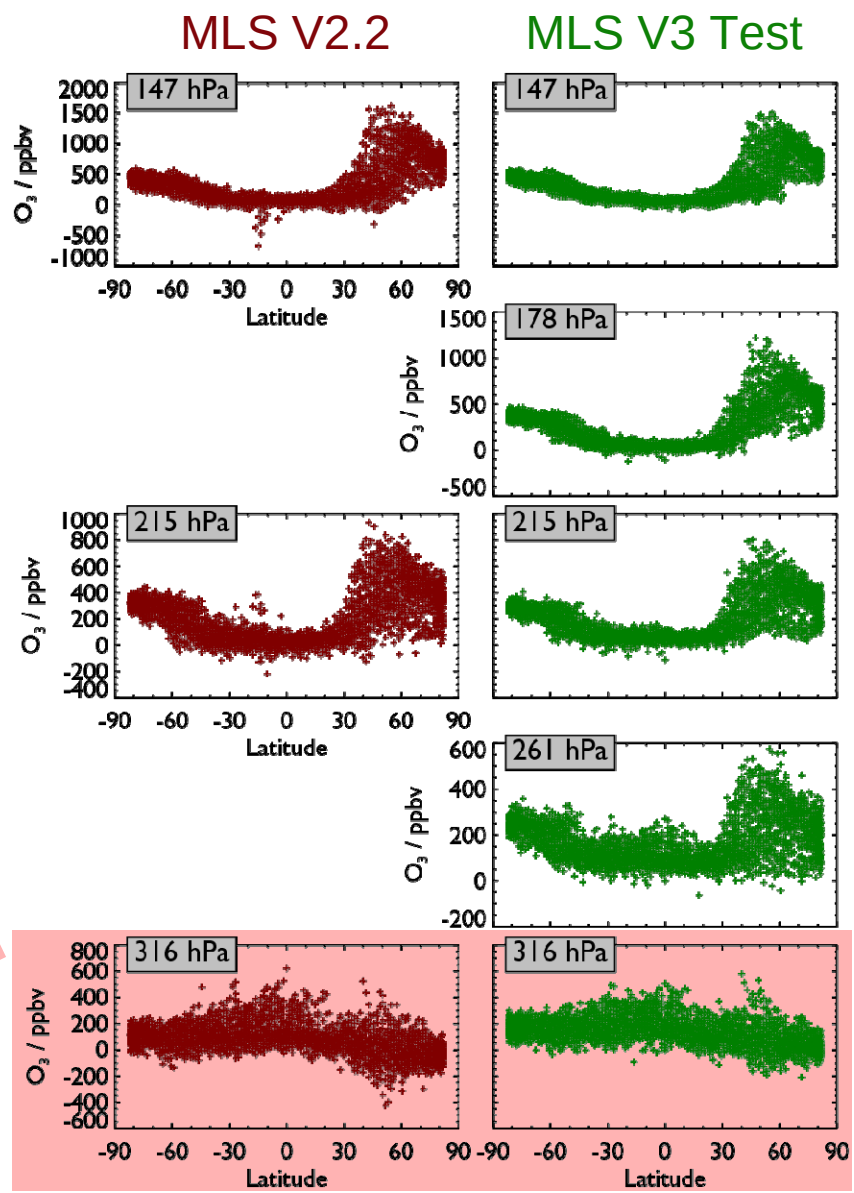
MLS 215 hPa HNO_3, 6 February 2008

- MLS v2 HNO_3 also exhibits a 10–30% low bias in the stratosphere
- Incorporating new lab measurements of ozone line mixing has ameliorated this bias
- Our original hypothesis had been that this line mixing was the cause of the biases in upper tropospheric CO and HNO_3, but this proved not to be the case



Upper tropospheric O_3

- The resolution of the vertical grid for the MLS O_3 product has been increased in the UT/LS in v3
- O_3 is now retrieved on 12 surfaces per decade from 316 hPa to 1 hPa
- The true vertical resolution of the information is closer to ~2 km
- The new 261 hPa O_3 product seems to behave well
- The 316 hPa O_3 product, as in v2, does not show expected behavior



Not recommended for scientific use

MLS O_3, 6 February 2008

Plans for the coming months

- We are currently putting the finishing touches to the software
  - Minor improvements and testing of some days that gave problems before
- Once this is complete, we plan to run several ~1 month periods in 'test mode' and scrutinize the results in detail
- If these are satisfactory, full-scale reprocessing will commence in September
- Recent augmentations in the MLS processing system hardware will enable us to reprocess the entire mission in about 8 months
- Some requests to give priority to particular periods (either for reprocessing or for producing 'preliminary' data) could be accommodated
- An updated data quality document will accompany the release of the v3 data

Plans for MLS ‘version 4’

- The main focus of v4 will be on improving retrievals in cloudy regions
- The impact of clouds on MLS signals depends on the cloud thickness
  1. Thin clouds do not significantly affect MLS radiance observations
  2. Thicker clouds add spectrally-flat features to the MLS radiances
  3. The thickest also distort the spectrally-varying signals from molecules
- Current MLS algorithms (including v2 and v3) ignore radiances in case 3 as the forward model does not represent cloud-scattering processes
- We are nearing completion of a new forward model that includes parameterized cloud scattering processes
- This should enable us to simultaneously retrieve cloud amount and gas-phase composition in all but the cloudiest ~0.1% of cases (~1% in the tropics)
- In addition we will continue improvements in existing products, and explore the extension of some products to lower altitudes