EOS MLS Status Report

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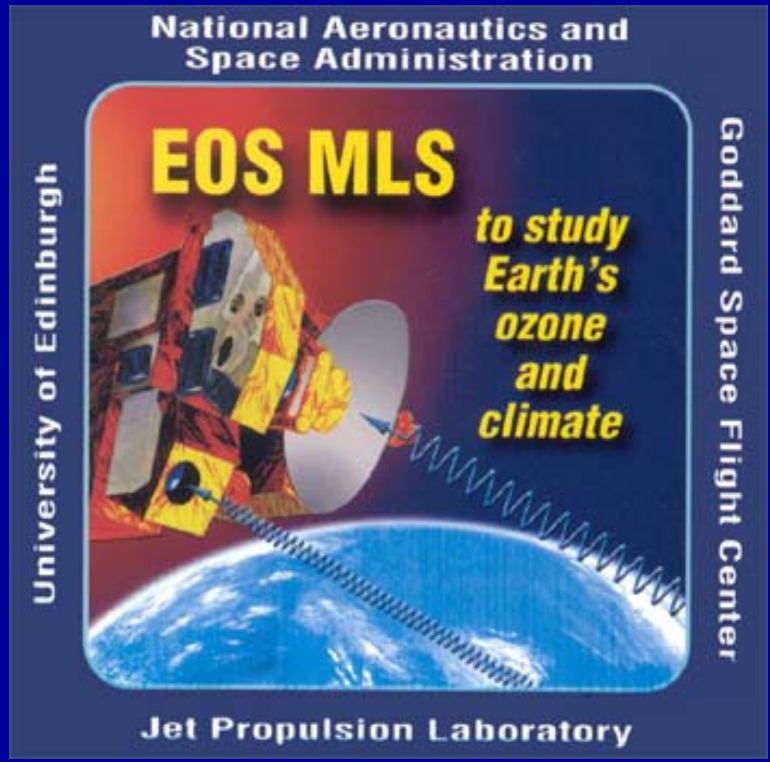
Aura Science Team Meeting

Pasadena, California
2 March 2005



MLS Status Summary

- **Instrument and data systems are performing excellently**
  - Have been in full-up science mode since 13 August 2004
  - No significant problems have been encountered
- **All key measurements have been demonstrated**
- **Now producing data (Version 1.5) for public release**
  - Uses algorithm updates based on inspection of results from the first few months of operation
- **Data are available on AVDC and DAAC**
  - MLS 'data quality document' is required reading for data users
    - document is distributed with the data, and available from MLS team
    - describes quality and known artifacts for each data product
  - Users of these initial data should work closely with MLS team
- **Validation activities are well underway**
  - and some science

Milestones since 15 July 04 launch

- Start MLS instrument activation ..... 18 Jul 04
- Instrument 'first light' ..... 24 Jul 04
- Begin L1 radiance processing at SCF and SIPS ..... 25 Jul 04
- Begin Level 2 (retrievals) processing at SCF ..... 27 Jul 04
- First full day of instrument operation in orbit ..... 3 Aug 04
- Begin full-up science mode with instrument ..... 13 Aug 04
- Begin Level 2 production processing at SIPS ..... 30 Aug 04
- Begin processing with updated (V1.50) algorithms .. 8 Jan 05
- Fix error in V1.50 software, start using V1.51 ..... 28 Jan 05
- Begin putting data on AVDC and DAAC ..... 15 Feb 05

‘First Light’ Spectra Examples

individual 1/6 s measurement example from each MLS radiometer (120 such measurements, and calibration, on each limb scan)

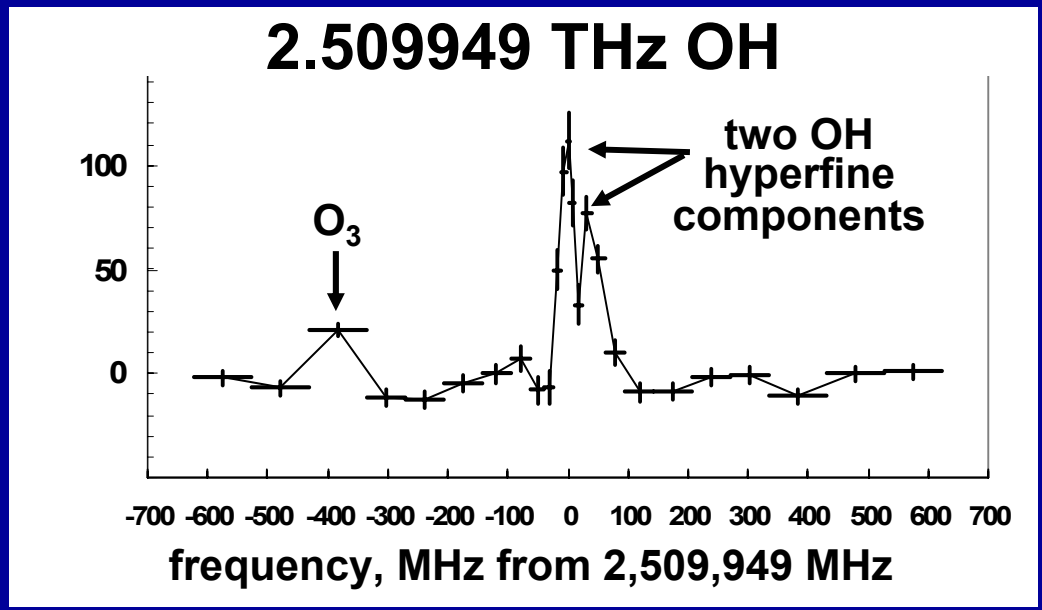
vertical axis is radiance in Kelvin; horizontal is delta frequency in MHz
vertical extents of bars give ±1σ noise, horizontal give channel resolution

2.5 THz OH spectra

(one of four 2.5 THz OH lines measured by MLS)

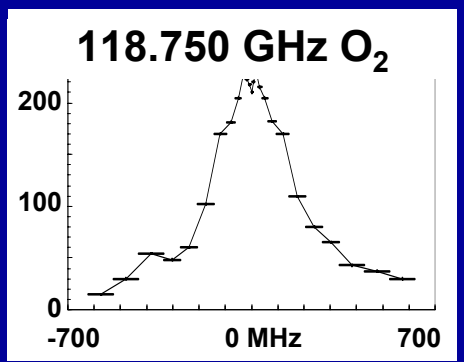
24 July 2004 data

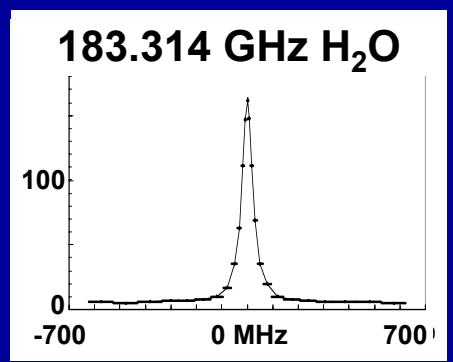
Calibration and spectra by Herb Pickett

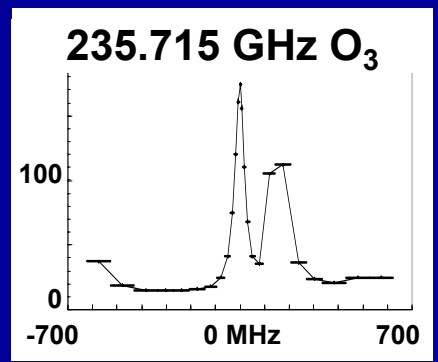


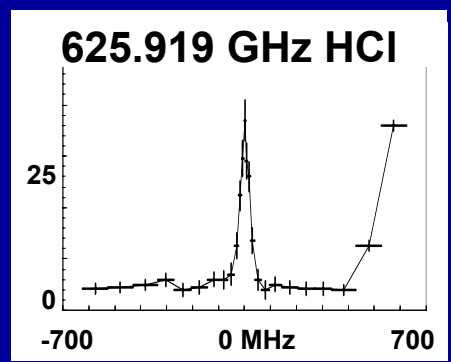
GHz spectra

27 July 2004 data: Calibration and spectra by Robert Jarnot









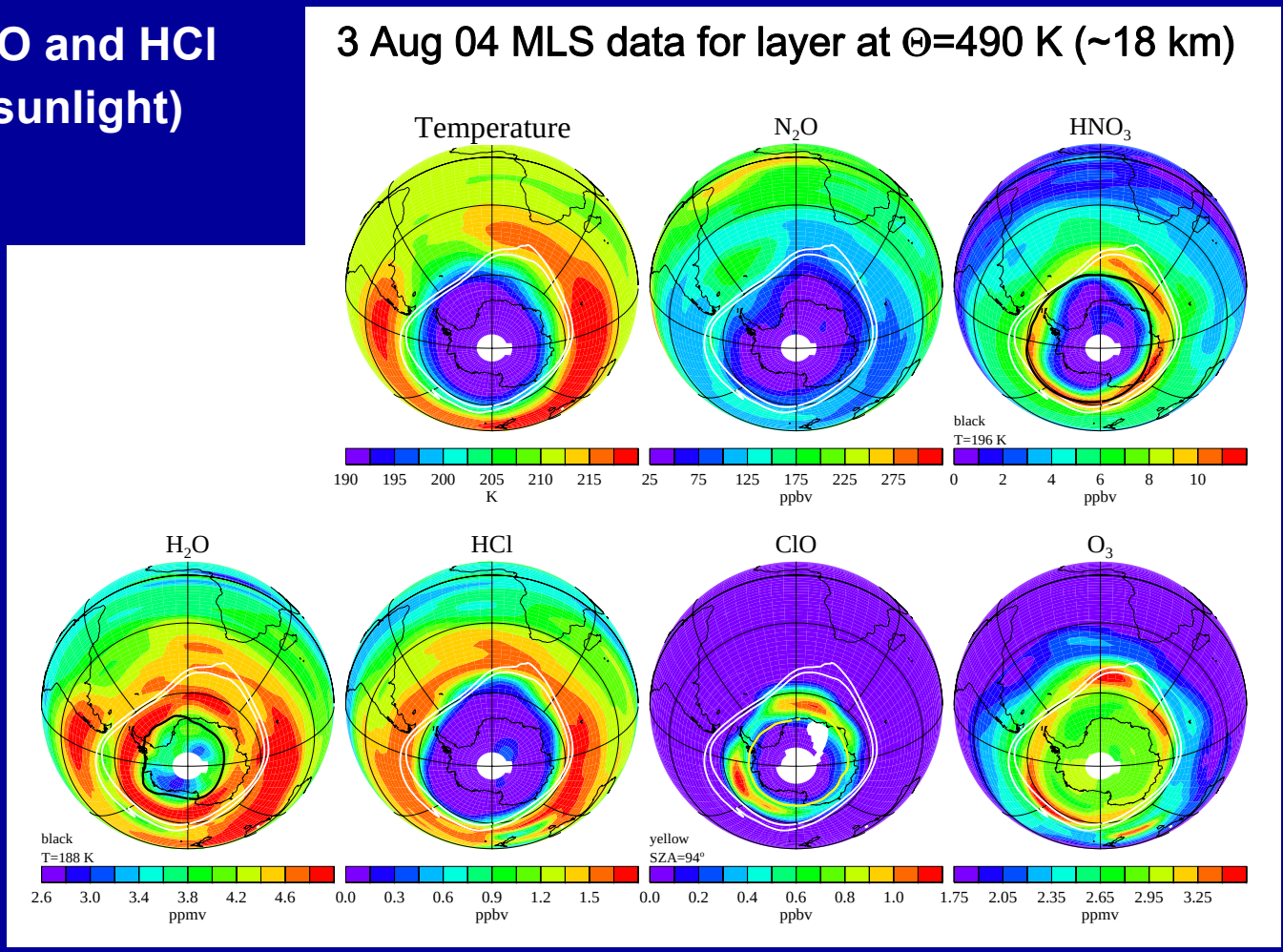
First full day of MLS operation in orbit

(3 August 2004, retrievals using pre-launch algorithms)

- **We see features expected in Antarctic vortex at this time of year**
  - low temperatures
  - descent (N_2O)
  - depleted HNO_3, H_2O and HCl
  - enhanced ClO (in sunlight)
  - start of O_3 loss

- **For polar processing studies really nice to get temperature, N_2O and HCl that we didn't have on UARS MLS**

- **Also, really nice <u>not</u> to have 'yaw gaps' that were present on UARS**



MLS Instrument Operation Status Summary

Atmospheric data production metric

100%
99% to < 100%
90% to < 99%
< 90% (due to plan or S/C issue)
< 90% (due to MLS ops issue)

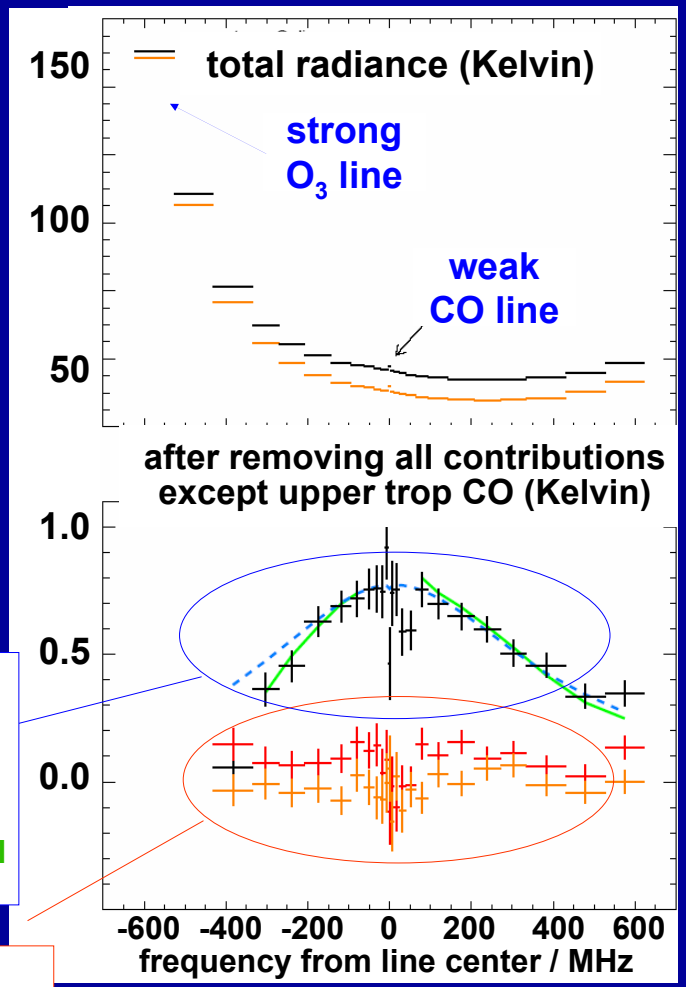
(fraction of all possible data for each 24-hour period that is useful for atmospheric measurements)

	S	M	T	W	T	F	S
Jul 04	4	5	6	7	8	9	10
	11	12	13	14			
Aug 04	Aura launch and MLS instrument activation						
						13	14
	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
Sep 04	29	30	31	1	2	3	4
	5	6	7	8	9	10	11
	12	13	14	15	16	17	18
	19	20	21	22	23	24	25
Oct 04	26	27	28	29	30	1	2
	3	4	5	6	7	8	9
	10	11	12	13	14	15	16
	17	18	19	20	21	22	23
	24	25	26	27	28	29	30

	S	M	T	W	T	F	S
Nov 04	31	1	2	3	4	5	6
	7	8	9	10	11	12	13
	14	15	16	17	18	19	20
	21	22	23	24	25	26	27
Dec 04	28	29	30	1	2	3	4
	5	6	7	8	9	10	11
	12	13	14	15	16	17	18
	19	20	21	22	23	24	25
Jan 05	26	27	28	29	30	31	1
	2	3	4	5	6	7	8
	9	10	11	12	13	14	15
	16	17	18	19	20	21	22
Feb 05	23	24	25	26	27	28	29
	30	31	1	2	3	4	5
	6	7	8	9	10	11	12
	13	14	15	16	17	18	19
	20	21	22	23	24	25	26

MLS Instrument Performance Summary

- **Instrument performance in orbit has been excellent**
  - sensitivity requirements are well met
  - radiometer system noise stability of 0.2% or better demonstrated
  - moon scans have confirmed pre-launch FOV boresight pointing accuracy of 0.003° (corresponds to 150 meters at limb)
  - indications are that pre-launch absolute calibration accuracy of few % achieved
- **Calibration and performance are documented in MLS IEEE papers**
- **Stringent performance test is shown at right**
  - Weak upper trop CO signature measured in presence of nearby strong O_3 lines



region of enhanced CO over south Asia (blue and green are calculated signatures for upper trop CO: green for retrieved geophysical parameters)

'clean' Pacific regions

from Filipiak et al., GRL, submitted 2005

MLS Level 1 Data Processing Status

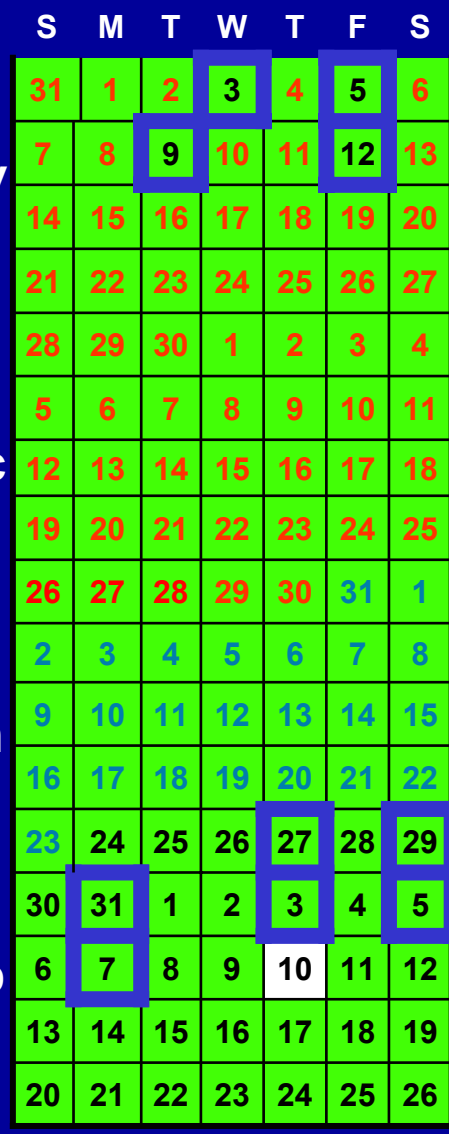
L0 data processed to L1

latest version

100% (by SIPS)	prel.	V1.50	V1.51

data versions to date

- 'prel.' is 'preliminary' version from first processing following instrument activation
- V1.50 is improvement over 'preliminary', but error was found in high-resolution spectrometer radiance uncertainties
- 'V1.51' corrects error in 'V1.50' and is the MLS data version first being made publicly available



Blue borders indicate 'validation days' given processing priority

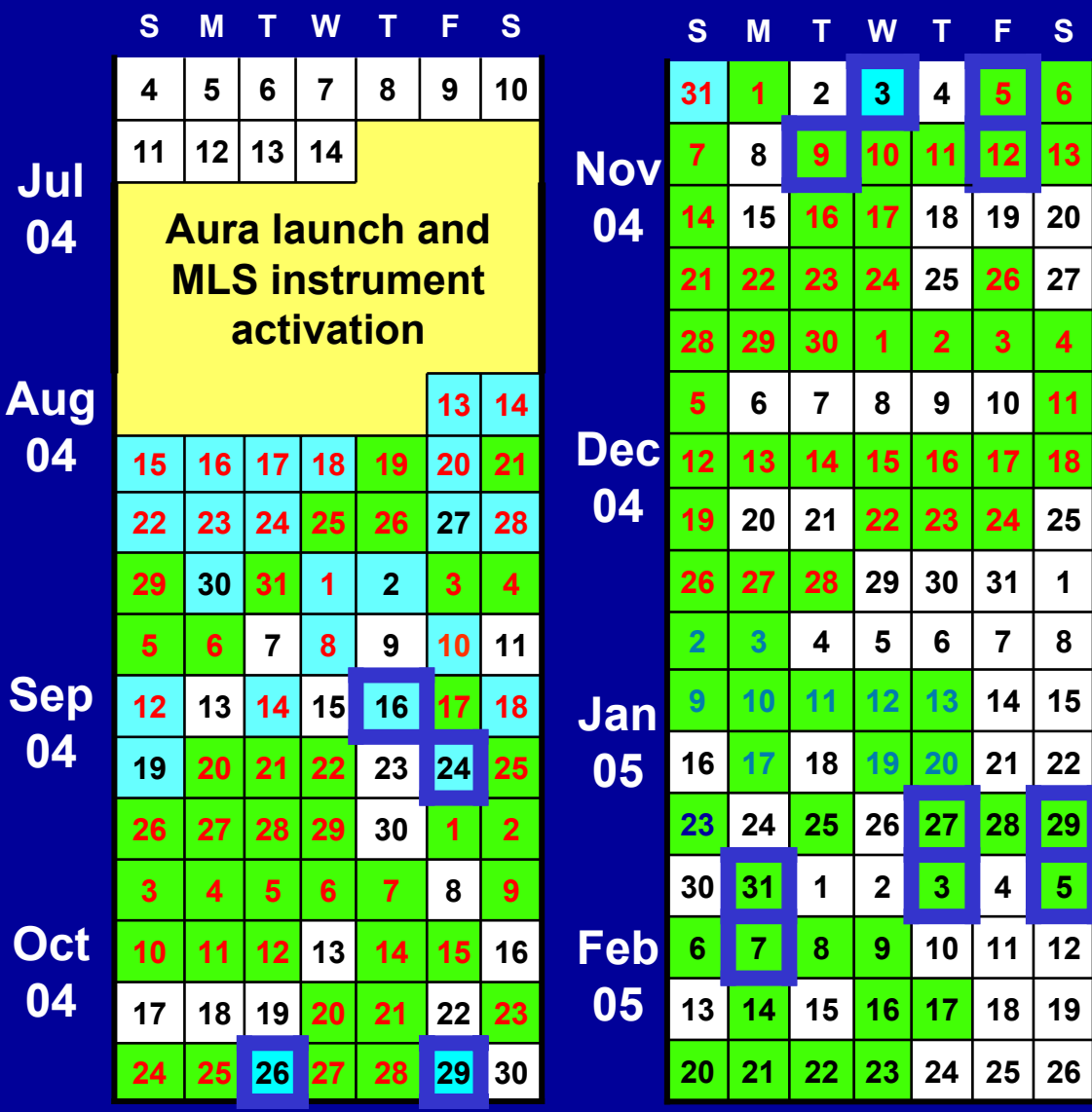
MLS Level 2 Data Processing Status

L1 data processed to L2 (latest version)

100% (by SIPS)	prel.	V1.50	V1.51
100% (by SCF)	prel.	V1.50	V1.51

notes

- V1.50 and V1.51 use same L2 algorithms, but V1.50 has metadata error and must be reprocessed
- V1.51 being made publicly available
- MLS SIPS sized & funded to process 60% of L1 data to L2 for first year of ops
  - achieved 62% to date
- MLS SIPS is now being upgraded to process 100% of new data to L2 and to do reprocessing



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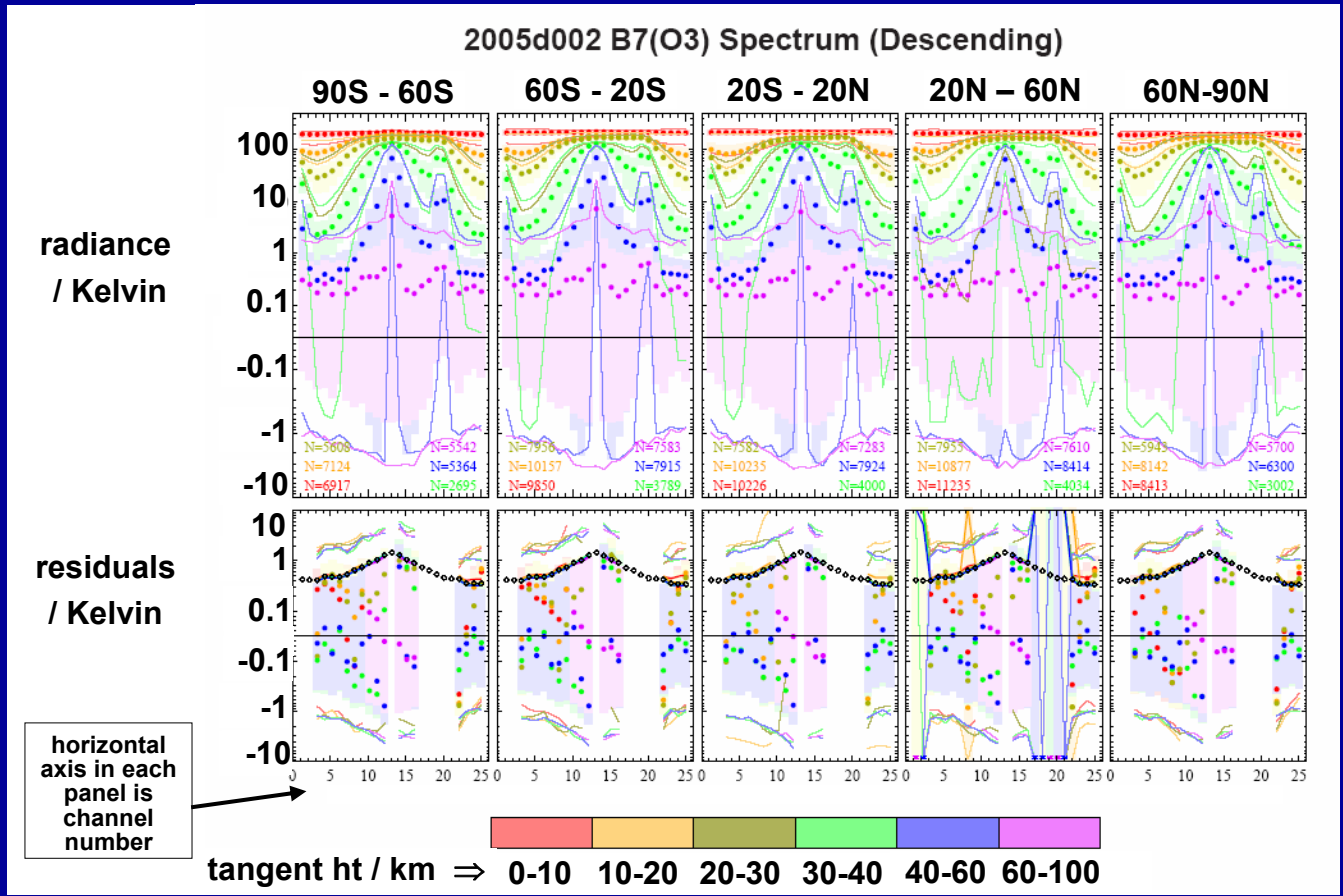
MLS Data Validation (1)

- First steps in MLS data validation are routine inspections of daily radiances and residuals for each spectral band
  - and (when possible) comparison of data products with 'climatology'
- Example here of radiance/residual inspection for one band & one day

in plots at right:

- dots are averages
- thin lines are extrema
- shading is ±1σ
- diamonds are estimated precision

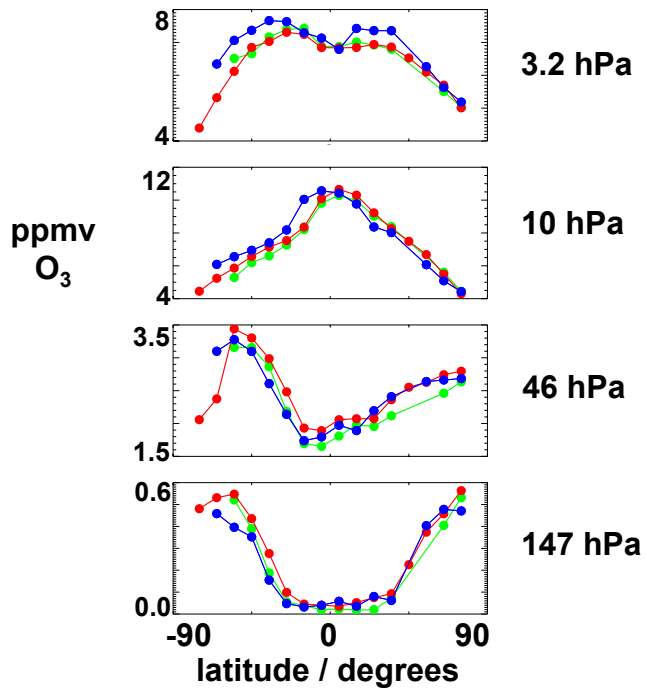


MLS Data Validation (2)

- Now comparing MLS data with <u>many</u> other measurements
- O_3 (Lucien Froidevaux) and OH (Herb Pickett) examples here

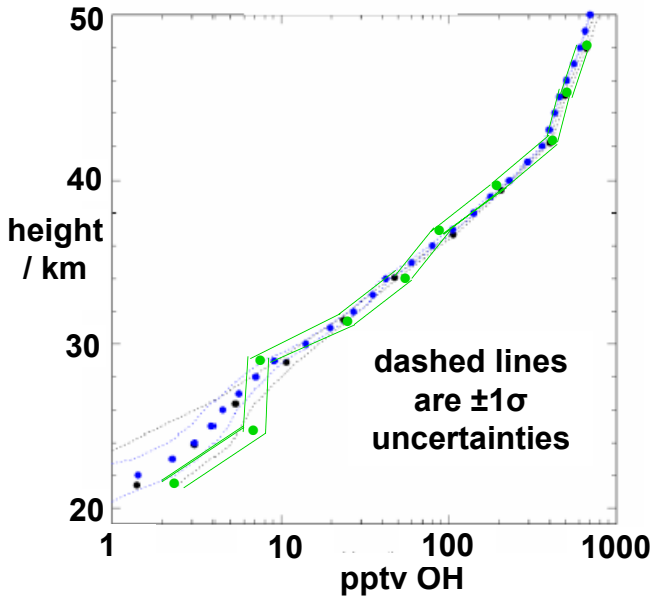
O_3 vs latitude at 4 heights

red: MLS, 29 Aug 04
green: HALOE, month of Aug 04
blue: SAGE II, Aug-Sep 04



OH vs height at 34° N

black: MLS 5° ascending zonal mean centered at 34° N on 23 Sep 04
blue: Harvard SAO FIRS, and
green: JPL balloon OH
from Ft. Sumner (34° N) on 23 Sep 04



MLS Data Validation (3)

- Several MLS data validation talks yesterday
- Additional posters this afternoon
- MLS scientists responsible for geophysical data products

Mark Filipiak ..... CO, upper tropospheric O_3

Lucien Froidevaux ..... stratospheric O_3, HCl, HOCl

Nathaniel Livesey ..... N_2O, BrO, CH_3CN

Gloria Manney ..... dynamical consistency of data

Herb Pickett ..... OH, HO_2

Hugh Pumphrey ..... stratospheric H_2O, HCN

Bill Read ..... upper tropospheric H_2O, volcanic SO_2

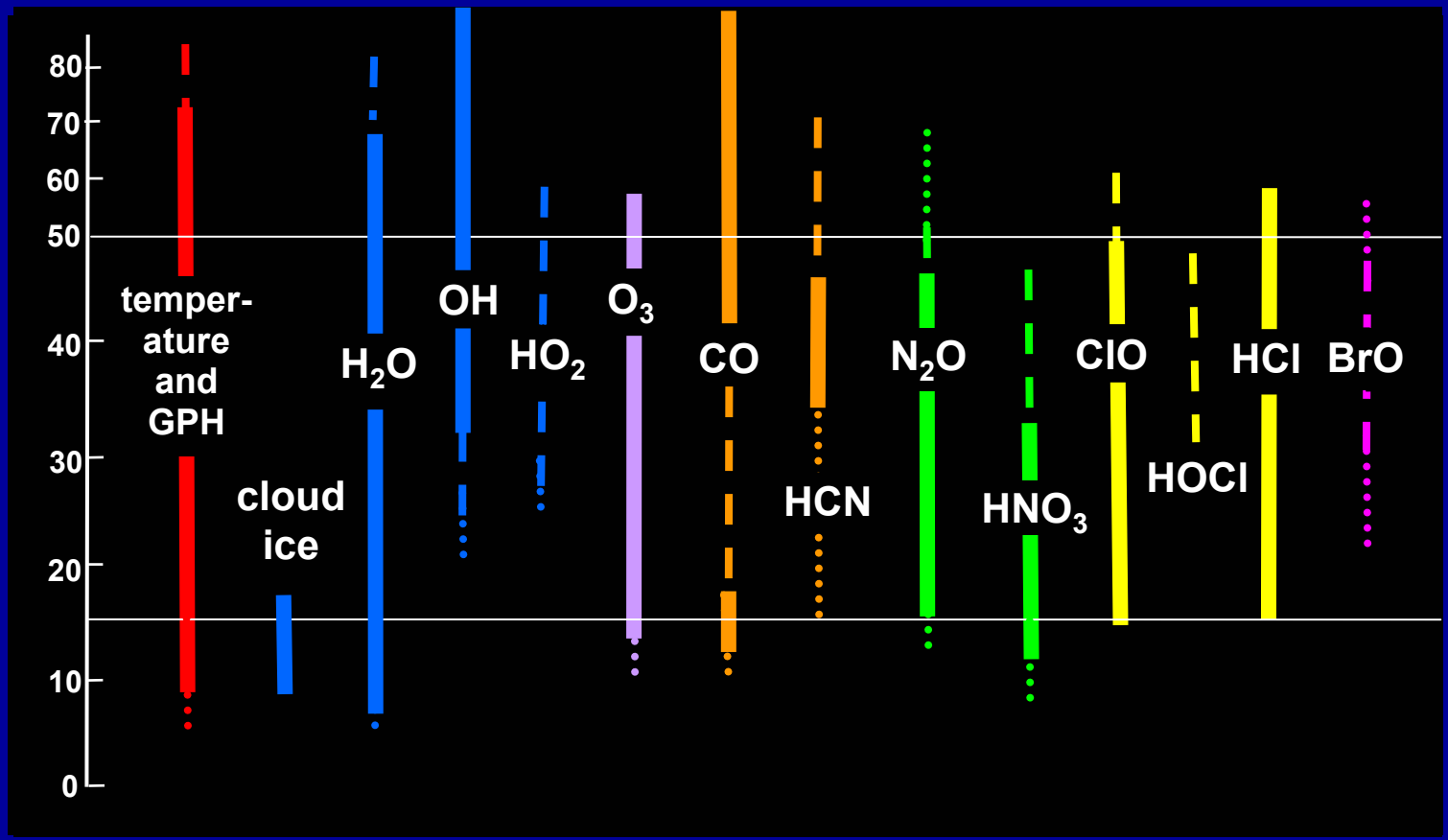
Michelle Santee ..... HNO_3, ClO

Michael Schwartz ..... T, geopotential height, (tangent pressure)

Dong Wu ..... cloud ice

Approximate Useful Vertical Range Expected for MLS V1.5 Data Products

reminder: be familiar with 'data quality document' before using data



Dashes indicate that averages are generally needed for useful precision

Dots indicate goals that may be demonstrated in V1.5 with further work
(will have some yet wider ranges in V2 (e.g., mesosphere O_3), planned for ~1 year from now)

Day-night differences currently required for BrO, HO_2, and OH below ~30 km

Some MLS Science Results

- **Papers submitted to GRL** (preprints at http://mls.jpl.nasa.gov)

  Michelle Santee, et al., 'Polar processing and development of the 2004 Antarctic ozone hole: First results from Aura MLS'
  (write-up of Michelle's paper given at Dec 04 AGU)

  Gloria Manney, et al., 'EOS Microwave Limb Sounder Observations of the Antarctic Polar Vortex Breakup in 2004'
  (Gloria's talk on this at 11:15 am tomorrow)

  Mark Filipiak, et al., 'Carbon Monoxide Measured by the EOS Microwave Limb Sounder on Aura: First Results'
  (includes validation of enhanced upper trop O_3 feature observed by MLS)

  Qinbin Li, et al., 'Trapping of Asian pollution by the Tibetan anticyclone: A global CTM simulation compared with EOS MLS observations'
  (Qinbin's talk on this at 2:30 pm tomorrow)

  Cory Davis, et al., 'Cirrus Induced Polarization in MLS Radiances'
  (measurement of preferred alignment of cirrus particles)

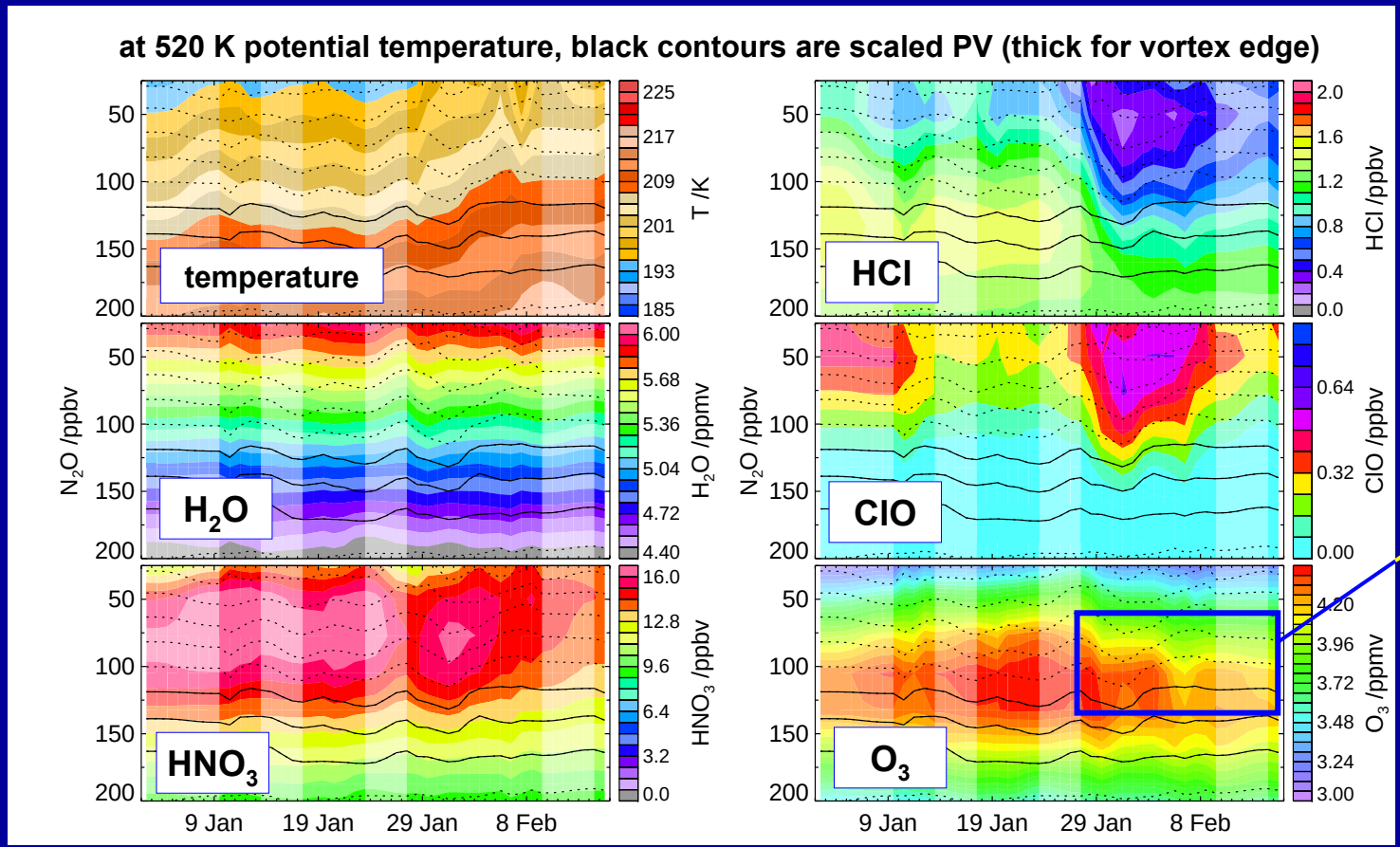
- **Additional talks and posters at this meeting**

- **Detected SO_2 and HCl injected into lower stratosphere from 27 January 2005 New Guinea Manam Volcano (Bill Read)**

MLS is closely watching the Arctic

time-series of measurements on N_2O surfaces, averaged over equivalent latitude bands poleward of ~50º, are shown here

see poster by Gloria Manney, Michelle Santee, et al.
(with more data in late February than shown here)



decreases here indicate O_3 loss of 0.3-0.5 ppmv, depending upon surface