



HIRDLS Overview and Status

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Aura Science Team Meeting
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HIRDLS Overview Topics



The HIRDLS Experiment as Planned

The Problem and Required Corrections

Results

- **Temperature**
- **Ozone**
- **Nitric Acid**
- **Polar Stratospheric Clouds, Cirrus, Cloud Tops**

Future Prospects

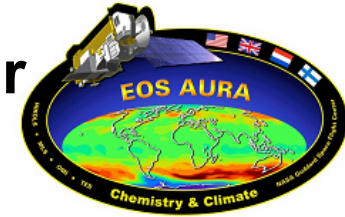
Illustrative Science Results

Schedule

Conclusions

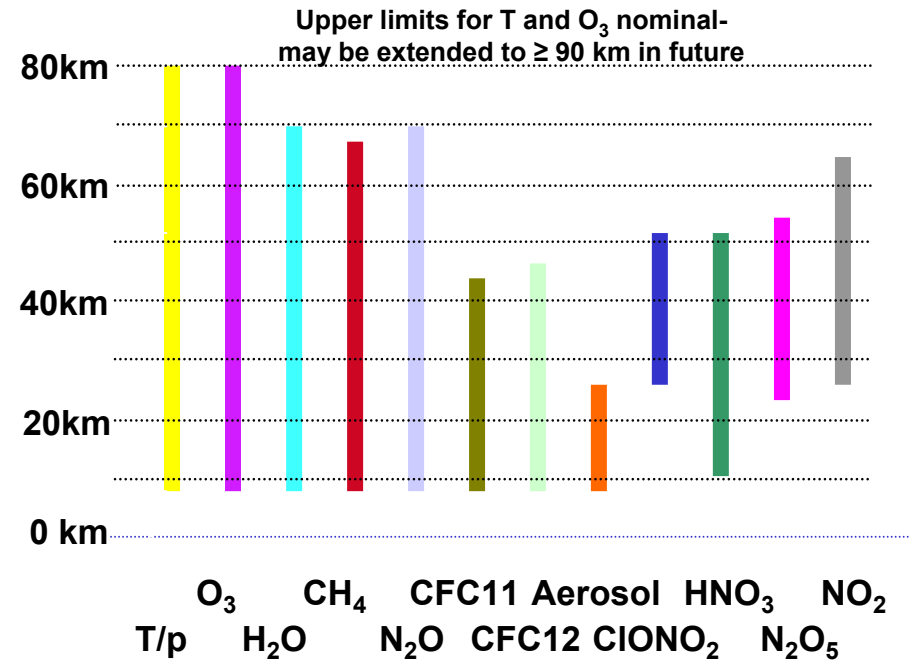


High Resolution Dynamics Limb Sounder (HIRDLS) Experiment



A 21 channel infrared limb scanner, selected for its ability to:

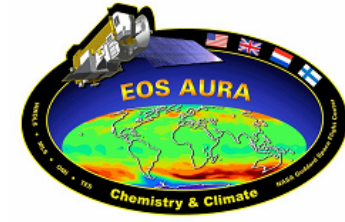
- Sound the tropopause region,
- Measure temperature, 10 trace species,
- Cirrus, PSC's and aerosol heights, amounts and characteristics
- High vertical (≤ 1 km) and horizontal ($\leq 400 \times 500$ km) resolution
- Long life, > 5 years



During launch a piece of Kapton[®] came loose and covered much of the aperture, leaving only a fraction of a beam width clear

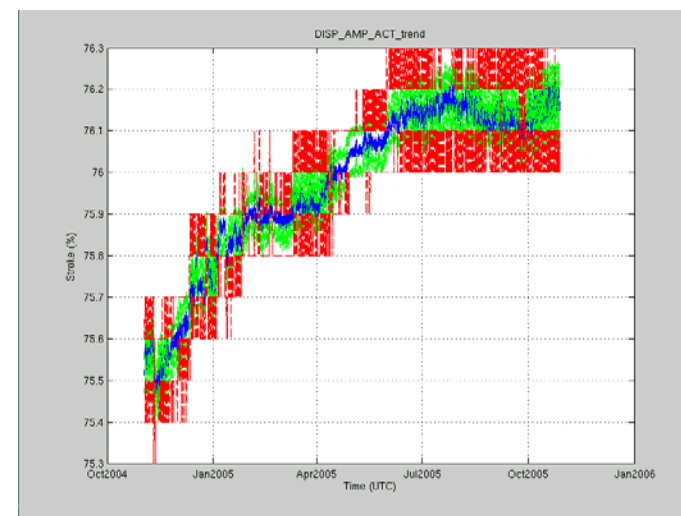
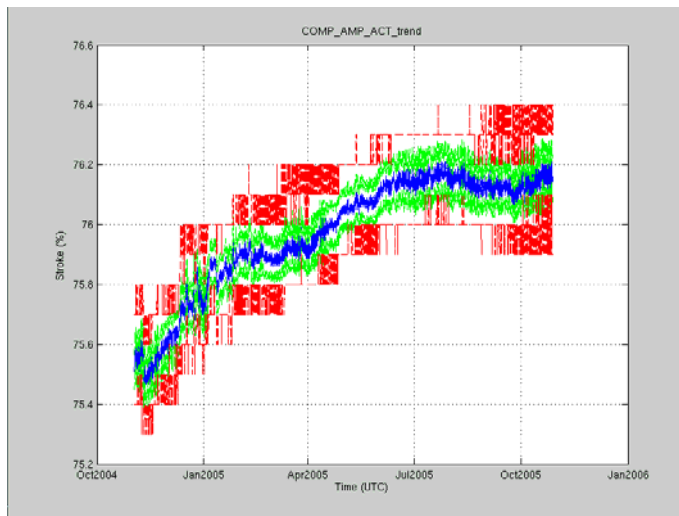
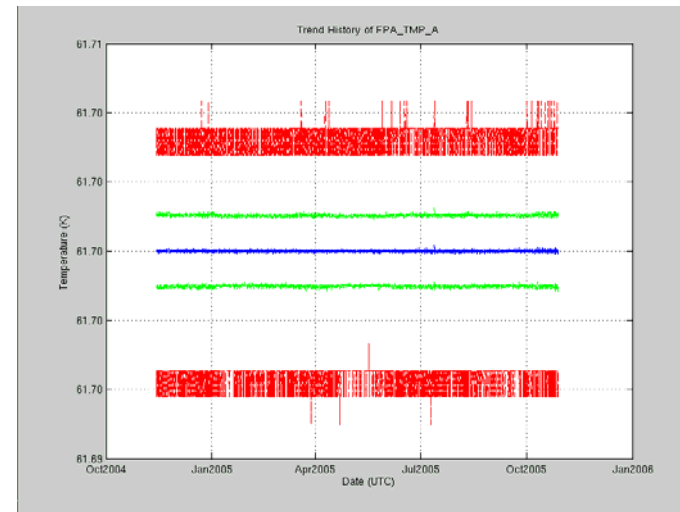


Trending – Focal Plane Temperature & Cooler Compressor and Displacer % Stroke



Focal Plane Temperatures have been maintained at $61.704 \pm .001\text{K}$ since new control algorithm in November 2004.

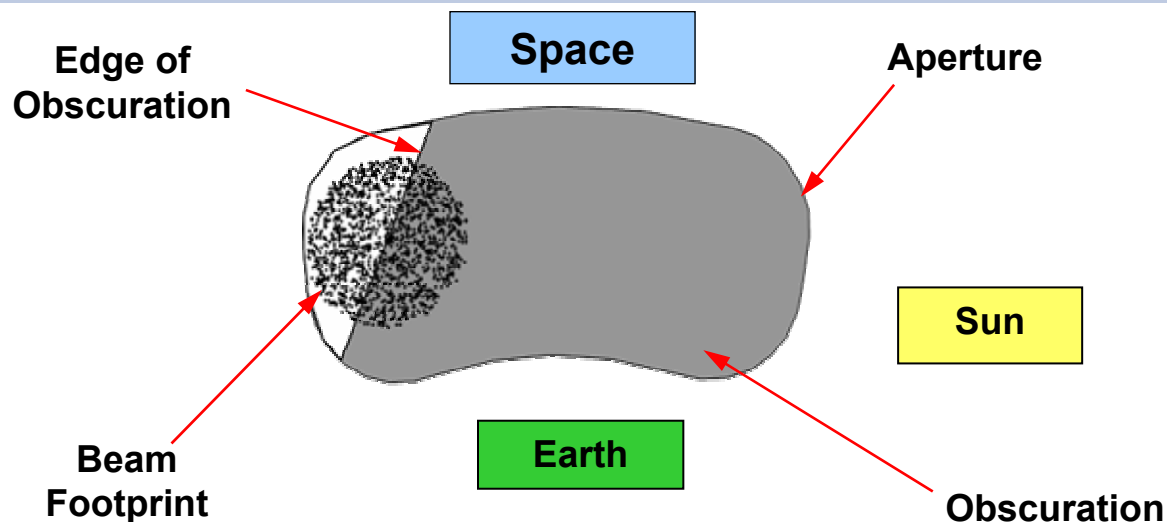
Compressor and displacer strokes have increased from 75.5% ->76.2%, => > 5 years before de-icing needed



More in posters by Craft et al., and Loh et al.



Schematic of HIRDLS Reduced Aperture



During launch we conjecture a piece of Kapton® came loose and covered much of the aperture, leaving only a fraction of a beam width clear

Obscuration covers most of aperture (10-20% clear)

Beam has partial view to atmosphere at azimuth furthest from sun

To use, scan vertically at single azimuth, add new algorithms for:

- Radiometric calibration
- Removal of effect of Kapton® oscillation on radiance
- Removal of Kapton® radiance from signal
- Correction for reduced area

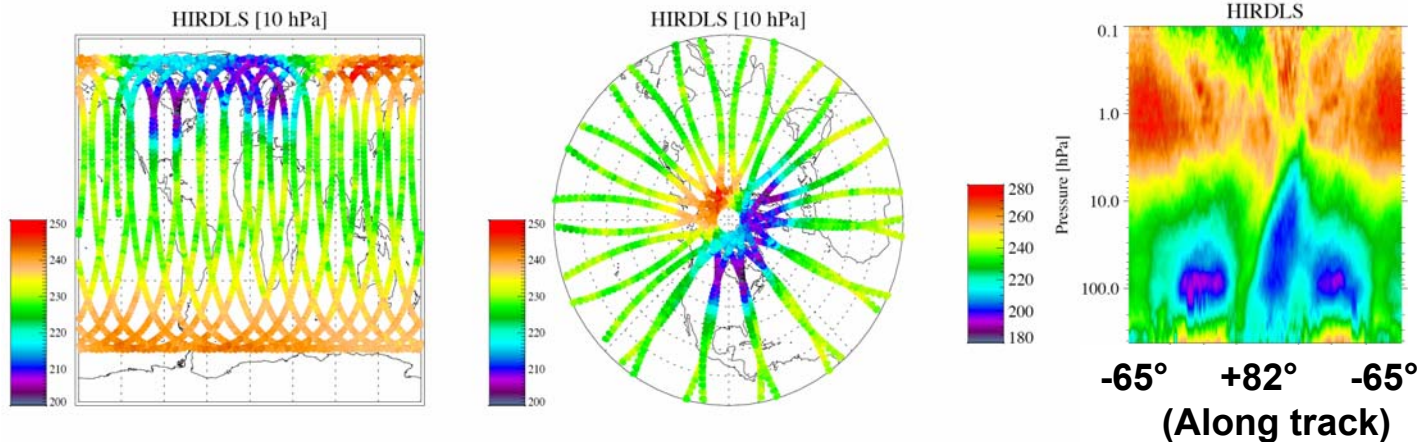
More in posters by Barnett et al., Eden et al, and Francis et al.



HIRDLS Temperatures show good agreement with GMAO

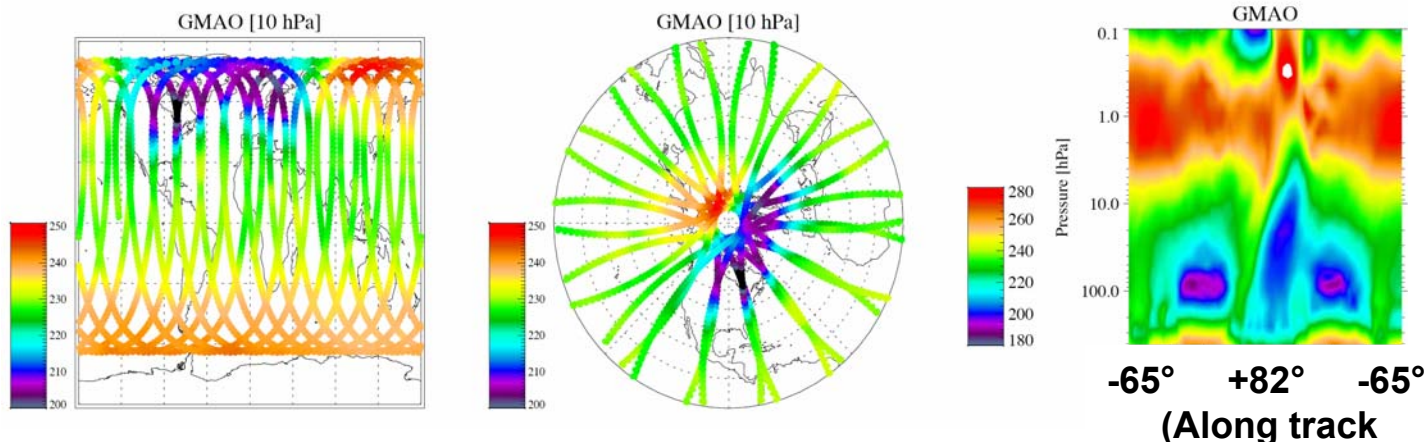


Temperature from the HIRDLS instrument on EOS Aura



- HIRDLS shows good agreement with GMAO T data in the upper troposphere and stratosphere.
- HIRDLS measures temperature in the upper stratosphere and lower mesosphere, where GMAO results are primarily model data

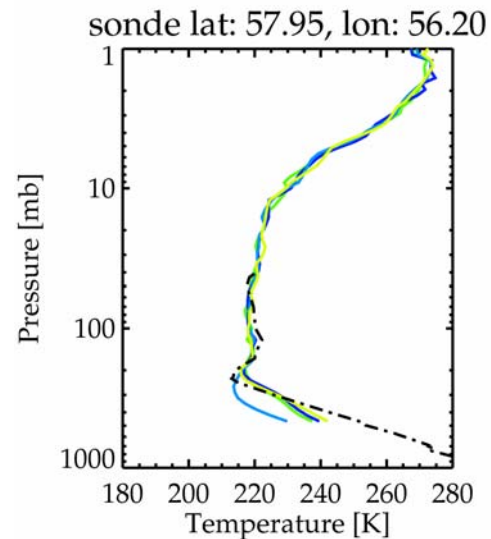
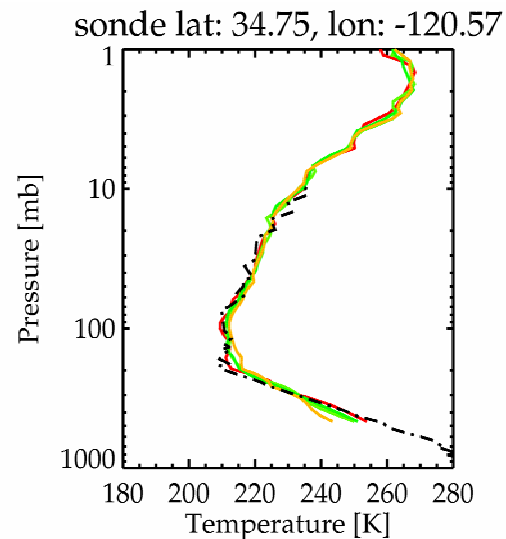
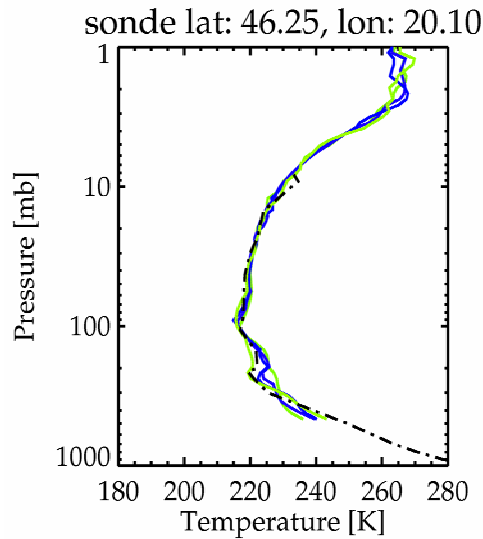
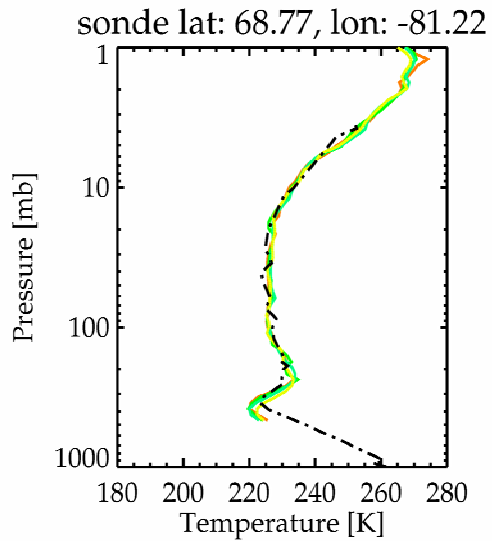
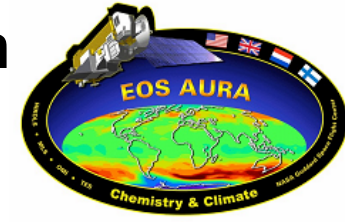
Temperature from the Global Modeling and Assimilation Office (GMAO)



Analyzed temperature precision is $\leq 0.5K$. This matches HIRDLS CDR measurement requirement. 6



HIRDLS Temperature Comparisons with Sonde Data: Accuracy and Vertical Structure is Captured

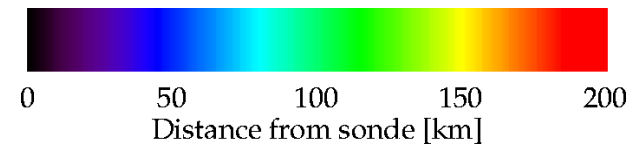


11th May 2005

Radiosonde data
(from UK Met Office
Global Radiosonde
Dataset)

—
HIRDLS
(colors indicate
distance from sonde)

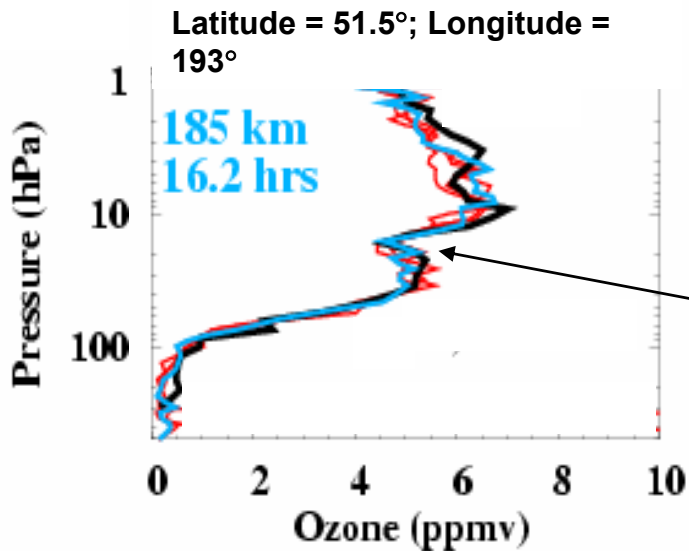
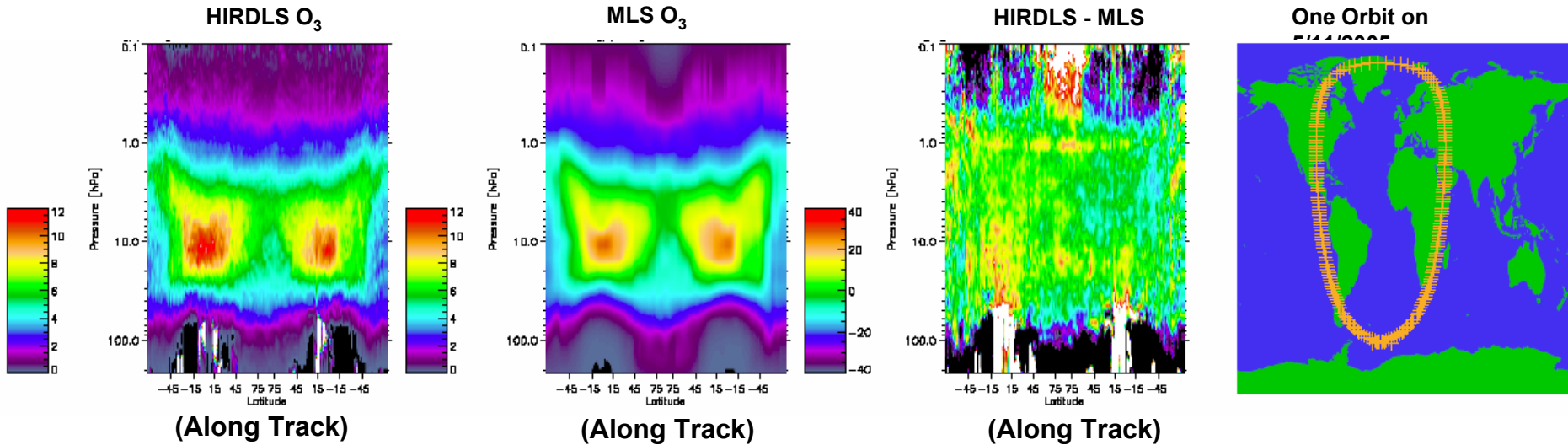
All HIRDLS profiles shown
are within 3 hours and
200km of the sonde data.



More in Gille et al. poster



Comparisons to Aura MLS and SAGE2 Show Very Good Agreement



HIRDLS/Occultation Data Comparison on 2/23/2005

Black is SAGE2

Blue is closest HIRDLS profile.

Red is all other HIRDLS profiles in 500 km.

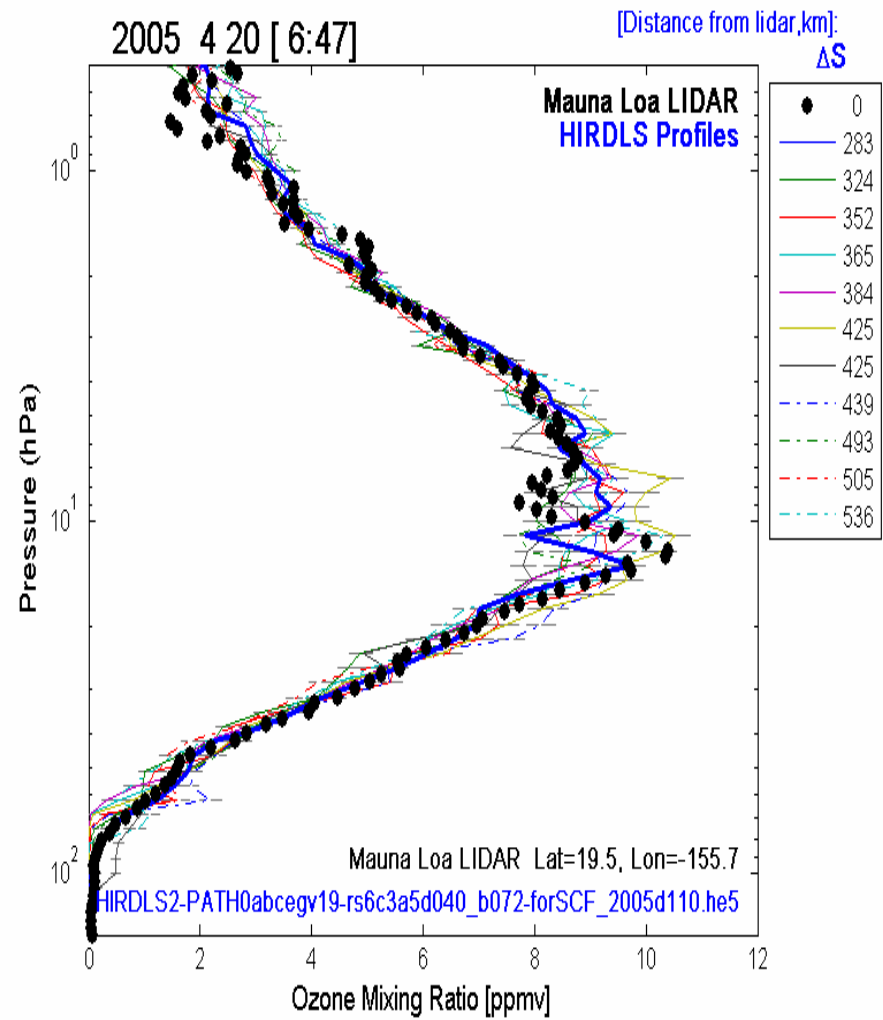
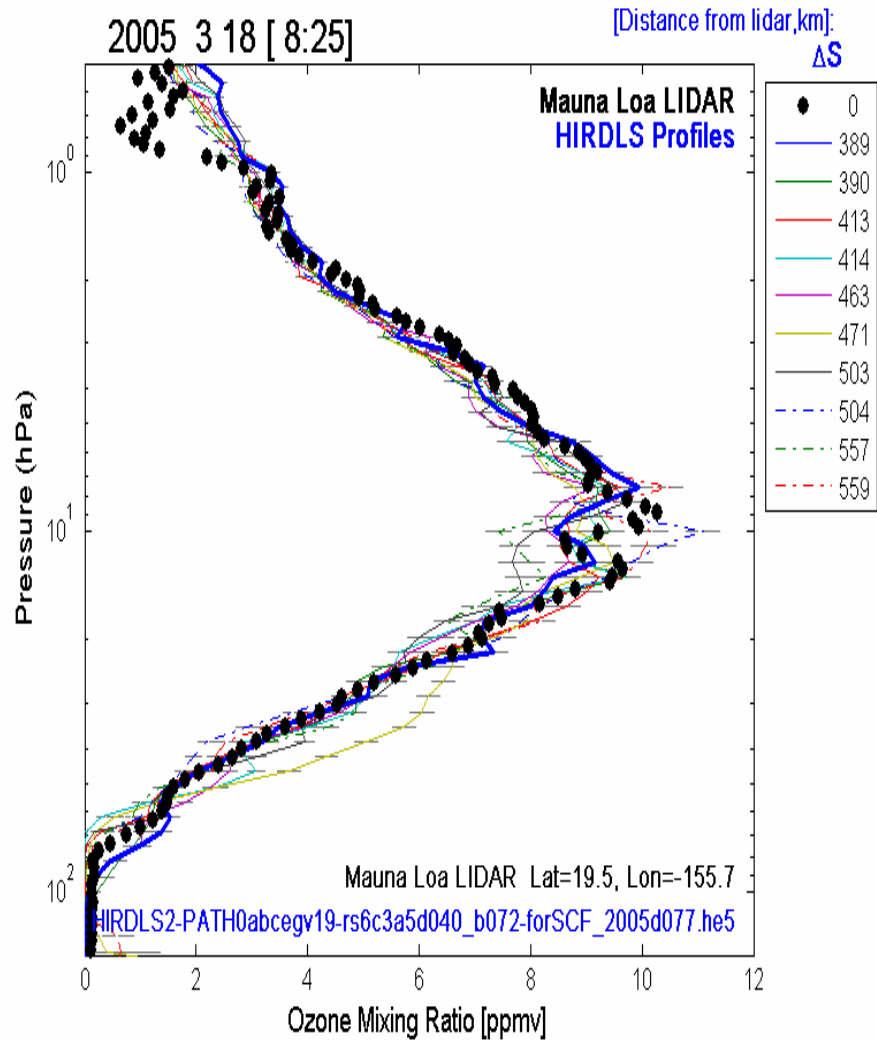
Accuracy and structure is captured by HIRDLS

Analyzed O₃ Precision is $\leq 5\%$, consistent with HIRDLS requirement as presented at CDR

More in Bruno Nardi's talk Thursday AM

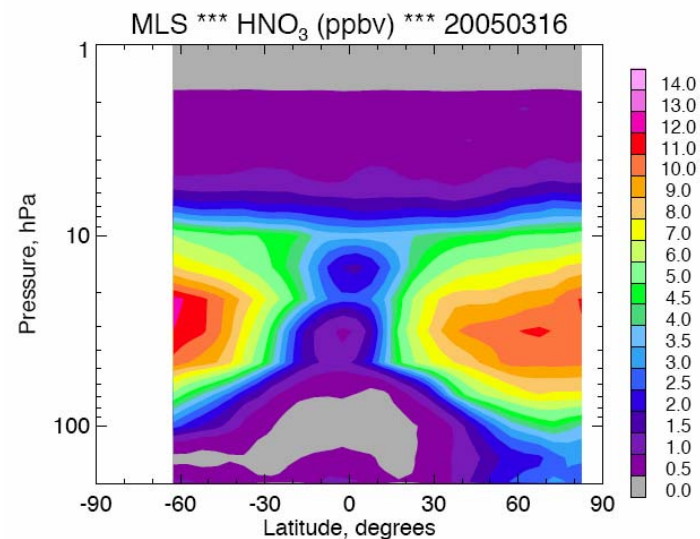
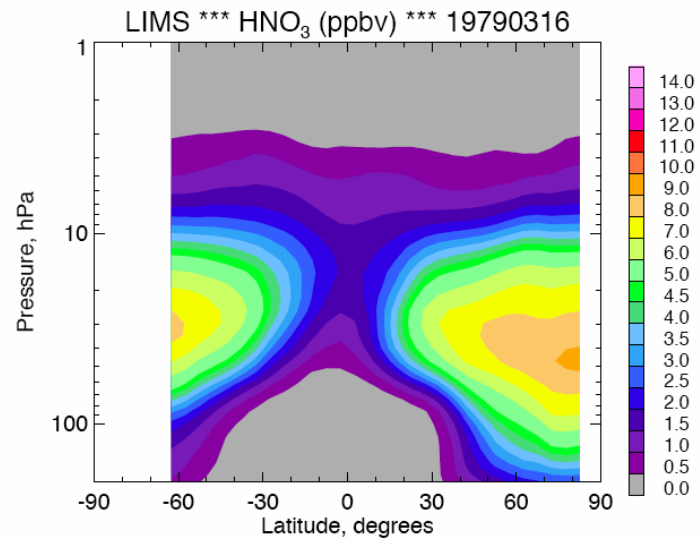
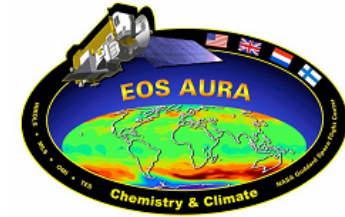


HIRDLS vs Lidar (Mauna Loa)

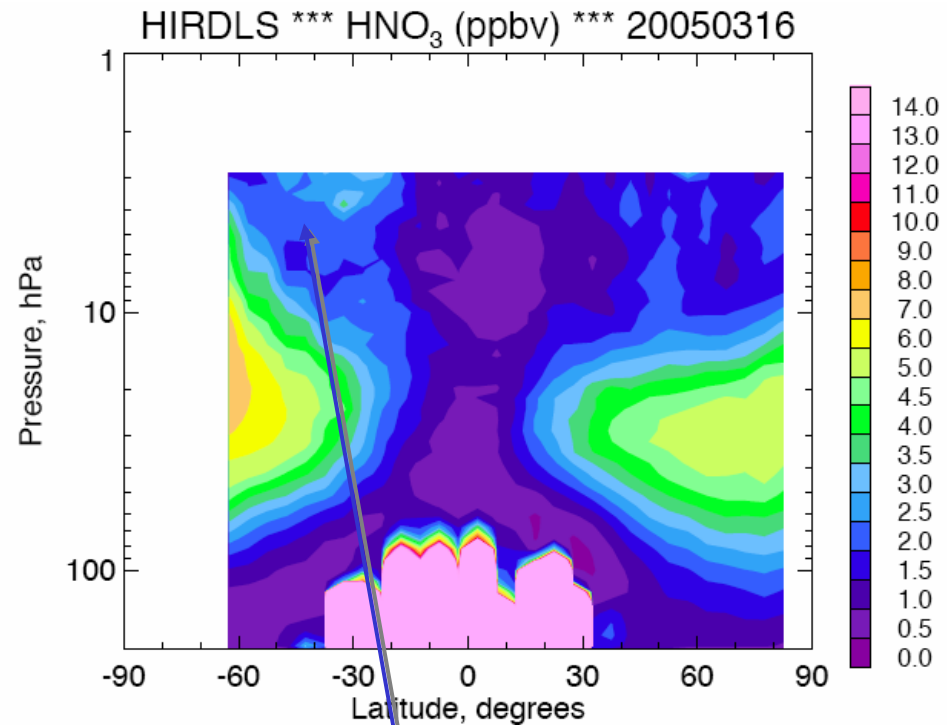




Zonal Mean HNO_3 Comparisons March 16th (1979; 2005)



(Binned: 5° latitude; 20° longitude)



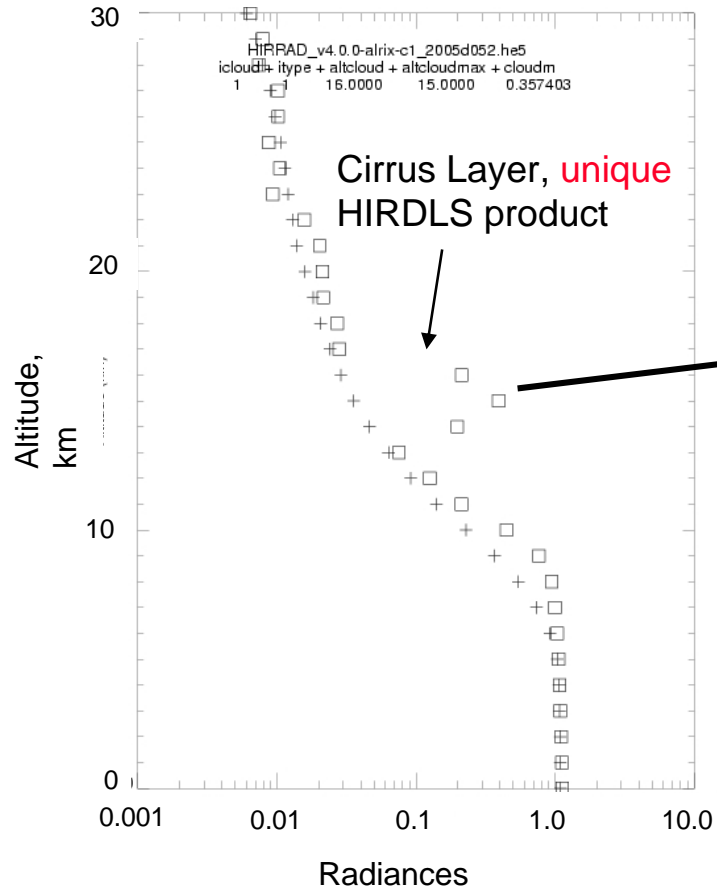
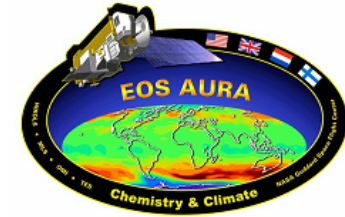
Enhanced HNO_3 not present in MLS

Correct Winter/Summer Asymmetry represented in HIRDLS (approx. equal HNO_3 in NH and SH)

More in Doug Kinnison's talk Thursday AM

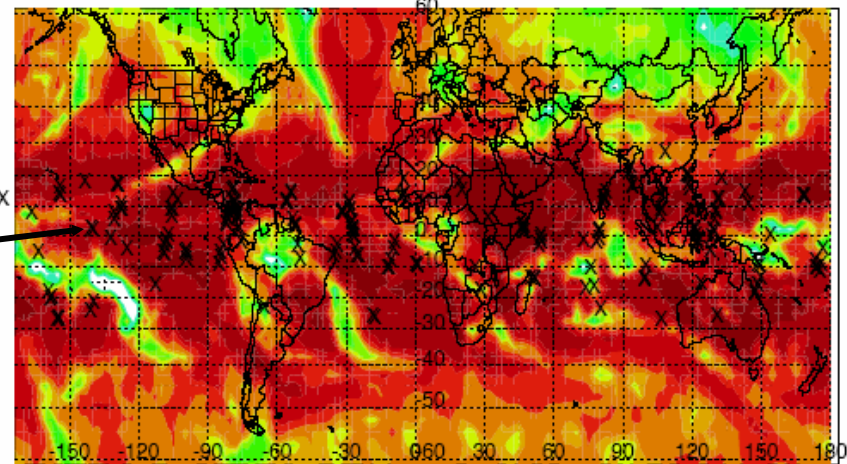


HIRDLS Detection of Cirrus Layers



+’s mark the “no-cloud” reference curve
 squares mark a single radiance profile

Cloud Layer 2/21/05



OLR watts/m2

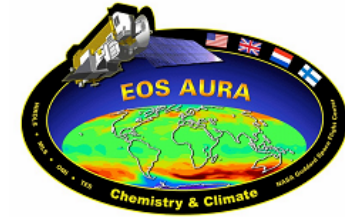
140 150 160 170 180 190 200 220 240 260 280 300

OLR data from CDC Climate Diagnostics Lab

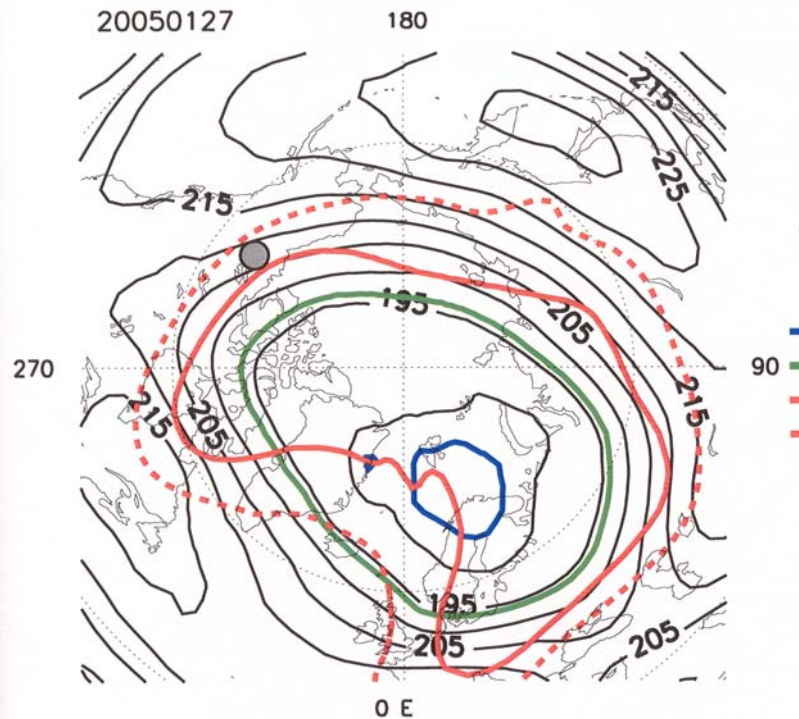
Blue arrow marks location of the radiance profile shown at the right



HIRDLS **Uniquely** Observes PSCs in Cold NH Polar Region

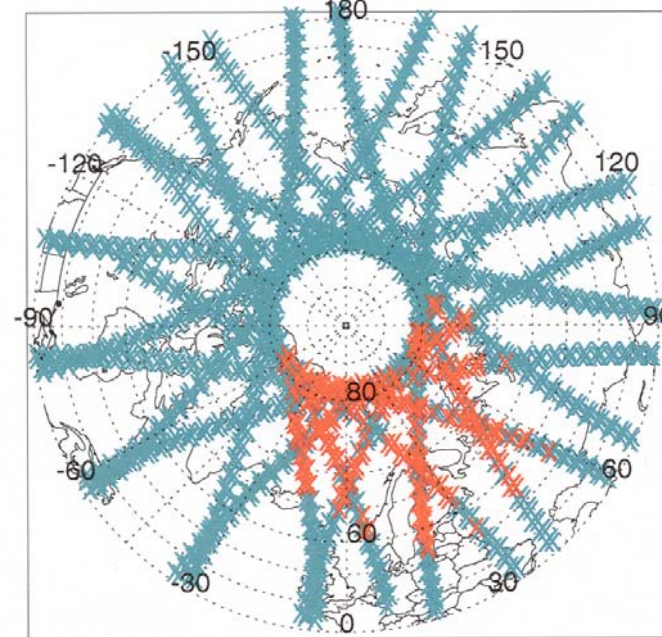


450 K UKMO Temperature (K), Nash Vortex, and POAM



Polar vortex on 27 Jan – courtesy of the POAM group. The green contour marks the region of the 195 K PSC temperature threshold. The blue line marks the ice threshold (for PSC II ice particles). The red lines mark the polar vortex (by the Nash criterion).

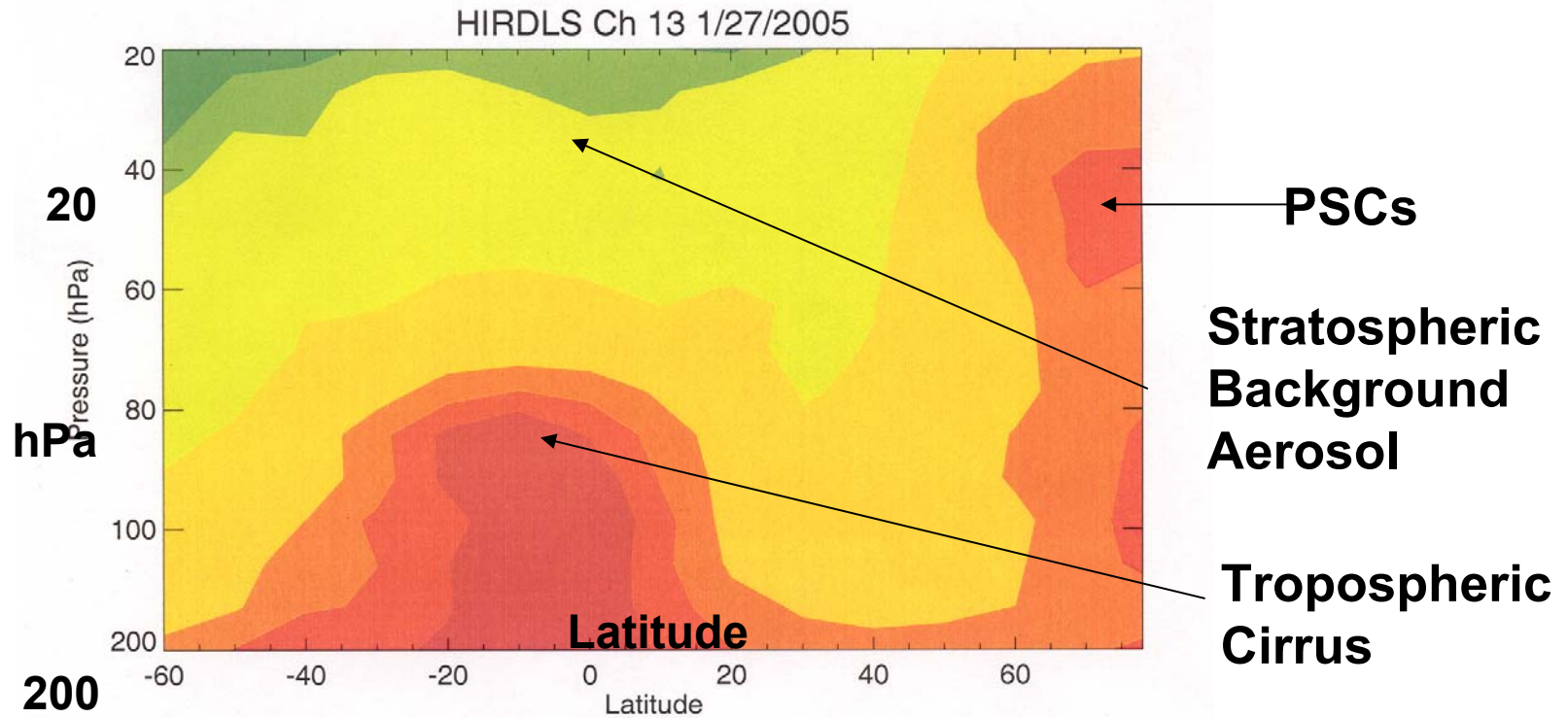
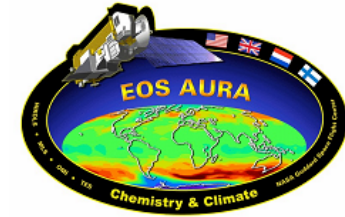
1/27/05



Individual observations of PSCs by HIRDLS 27 Jan 2005. Red crosses are the locations of PSCs (as given by our cloud detection algorithm). Blue crosses are non-cloud observations. By comparing this graph, and the POAM graph, it is apparent that HIRDLS observes many PSC inside the T+195 K temperature contour.



One Day's Retrieval for Clouds and Aerosols- 1/27/05



Extinction (km⁻¹)

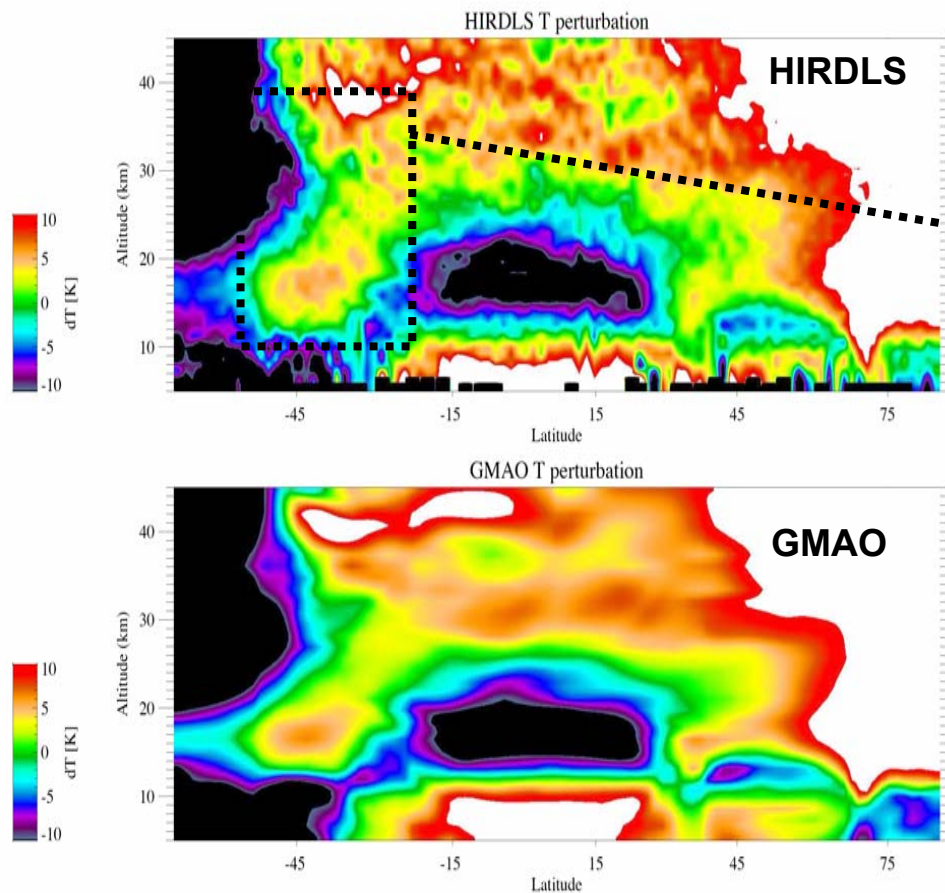
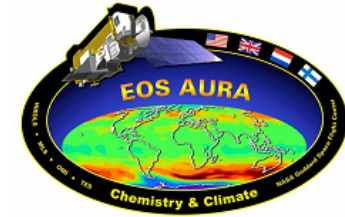


1.0e-5 2.0e-5 3.0e-5 4.0e-5 5.0e-5 6.0e-5 1.0e-4 3.0e-4 6.0e-4 1.0e-3 3.0e-3

More in Steve Massie's talk Thursday PM



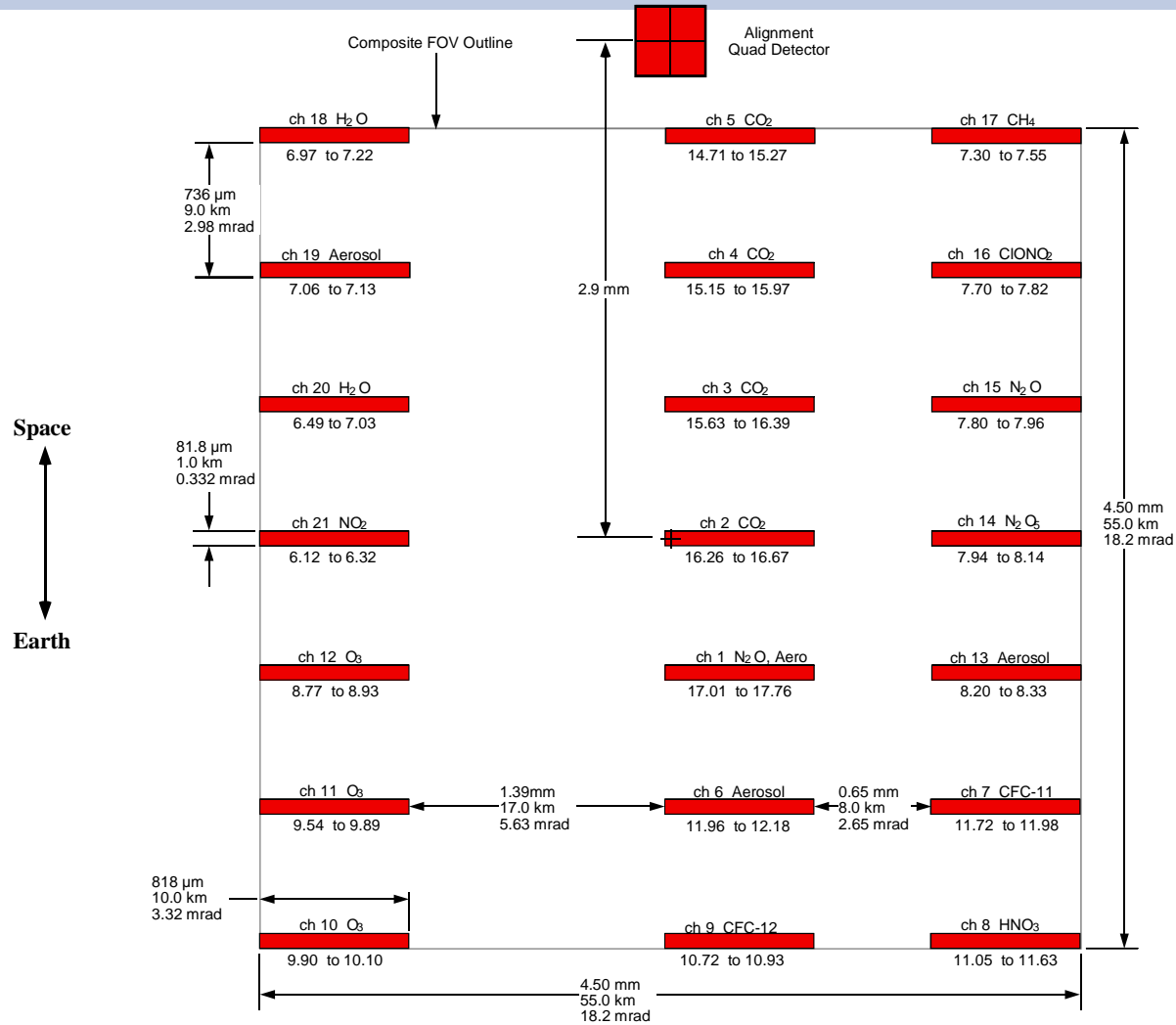
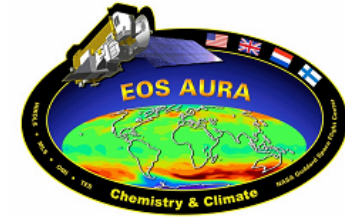
Fine Vertical Scale Wave Activity Observed in HIRDLS Temperature



- The figure shows the upward and equatorward propagating wave near the southern hemisphere polar vortex. Its vertical wavelength is about 3-4 km and its amplitude is 1-2 K.

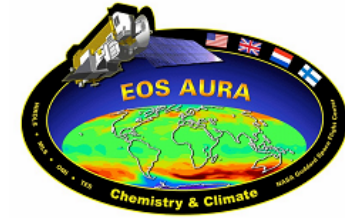
HIRDLS data on June 19, 2005

Field-of-View Map





Accomplishments and Prospects



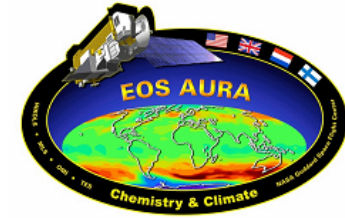
Algorithms Developed, Software Revisions Implemented to Allow Raw Data (L0) to be Processed to Atmospheric Data (L2)

- Retrieved temperature and ozone fields display
 - **HIGH VERTICAL RESOLUTION (1 km)**
 - **High horizontal resolution along track (80 km spacing)**
 - **Atmospheric realism, and agreement with other measurements**
 - **HNO₃ also looking very promising**
- There has been excellent progress to date. Recent results are leading to further improvements in the ability to correct for the Kapton[®] emission, and thus useful radiances in the remaining channels.
- Present efforts are improving these results, and bringing in other species (e.g. H₂O, **CH₄, NO₂, ClONO₂, (HIRDLS unique on Aura), N₂O, F11, F12**)
- With these upgrades, HIRDLS will recover most of its observational capabilities

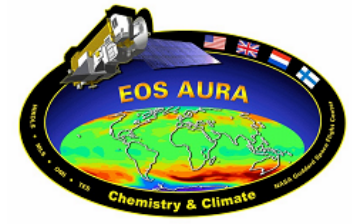
HIRDLS WILL FULFILL ITS SCIENCE OBJECTIVES



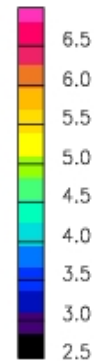
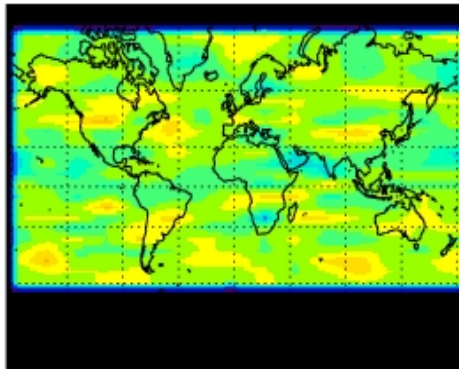
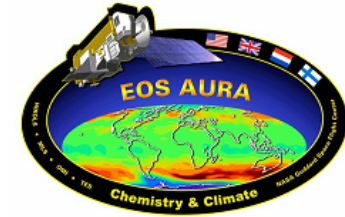
Future Milestones



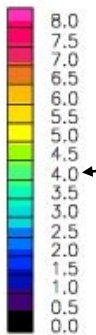
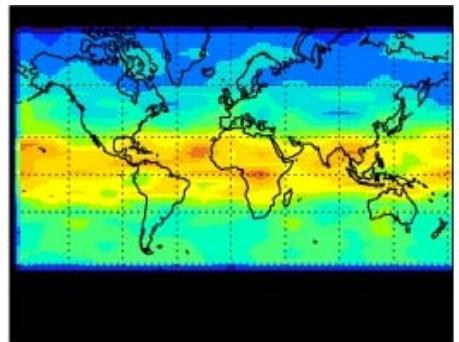
- Oct** Ongoing data processing for review by HIRDLS team
- Nov** Develop improved blockage emission estimation scheme
Improve radiance correction S/W
- Dec** Develop corrections for H₂O, NO₂, CH₄, N₂O channels
Develop corrections for ClONO₂, N₂O₅, F11&12, HNO₃ channels
Optimize retrievals for T, O₃, H₂O
Begin putting “beta” quality data in DAAC for evaluation
- Jan** Optimize retrievals for NO₂, CH₄, N₂O
- Feb** Complete corrections for aerosol channels
Optimize retrievals for ClONO₂, N₂O₅, F11&12, HNO₃
Overall final adjustments
- Mar** Start standard processing, reprocessing of back data
Standard data to HIRDLS team and friendly users for evaluation
- June** **Data released to DAAC**



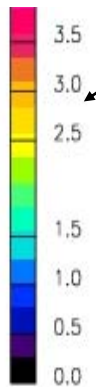
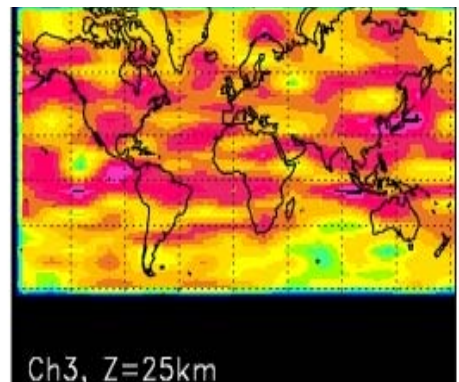
Short Vertical Wavelength Gravity Waves seen by HIRDLS



λ_z (km)



R' / R (%)



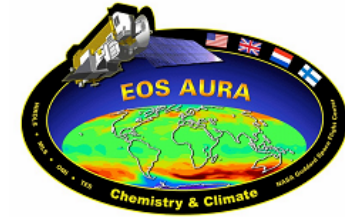
κ_H (10^3 km)⁻¹

Ch3, Z=25km

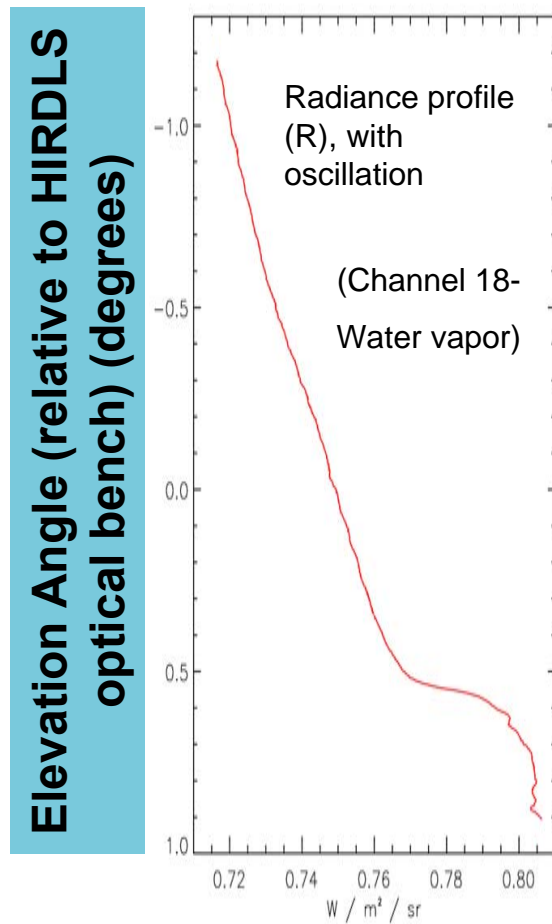
- Day 131: May 11, 2005
- Channel 3
- Z=20-30km average
- Results for short vertical wavelength waves < 8 km
- Global maps:
- Vertical wavelength (4-5 km)
- Wave amplitude
- Horizontal wavenumber
- Amplitudes show equatorial peak and winter > summer asymmetry seen in other data sets at this altitude.
- Models lack a good climatology of gravity waves



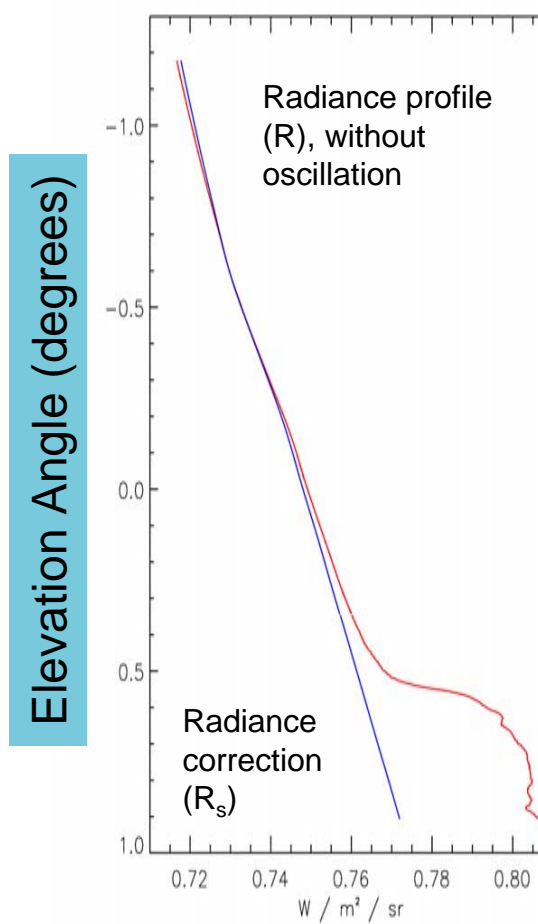
Summary of Major Correction Steps



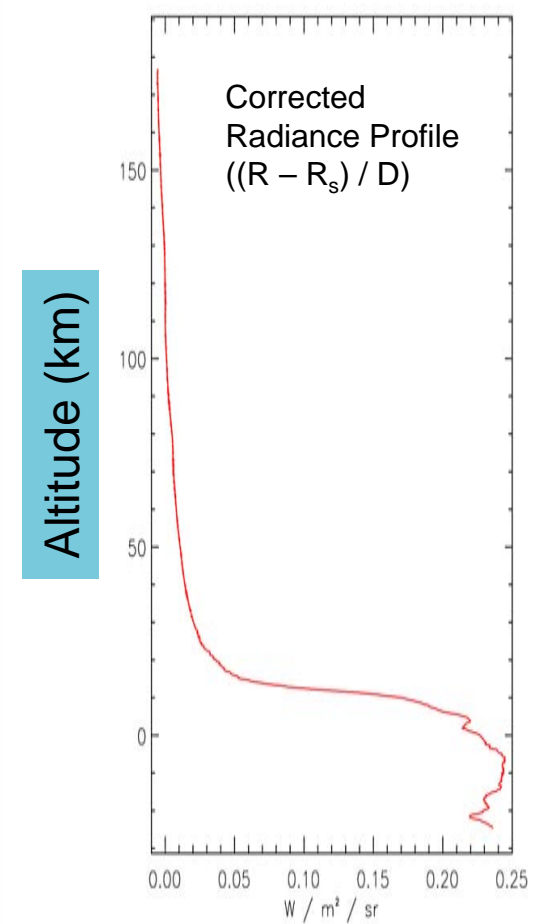
Oscillation Removal



Join to Estimation of Kapton® Signal (R_s)

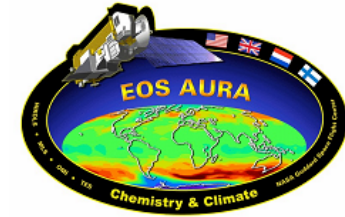


Removal of Kapton® Signal, Correction for Area Fraction





HIRDLS Phase I Review Outline



The HIRDLS Experiment

HIRDLS Phase 1 Achievements

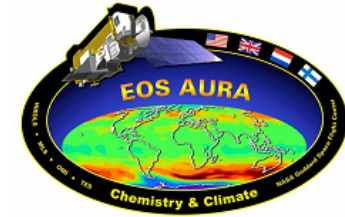
The Problem and Required Corrections

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- **Temperature**
- **Ozone**
- **Polar Stratospheric Clouds, Cirrus, Cloud Tops**
- **Illustrative Science Results**
- **Present Status of Other Species**
- **Summary**
- **Milestones**



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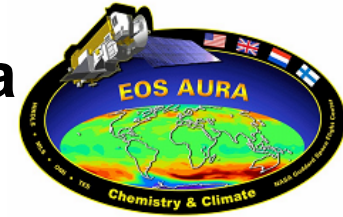
Present Status of Other Species

Summary

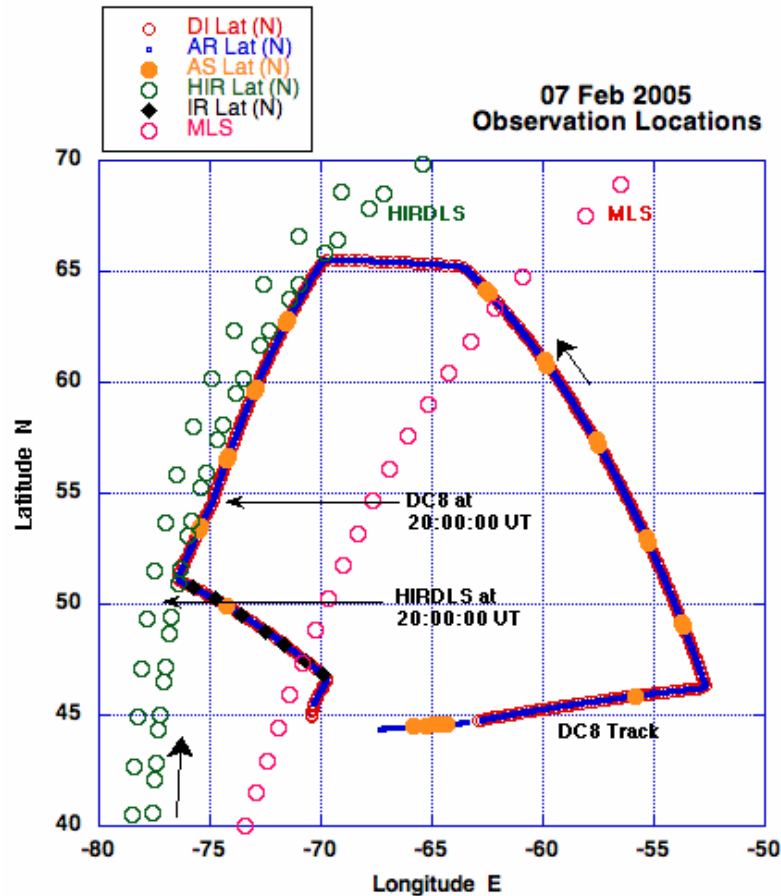
Milestones



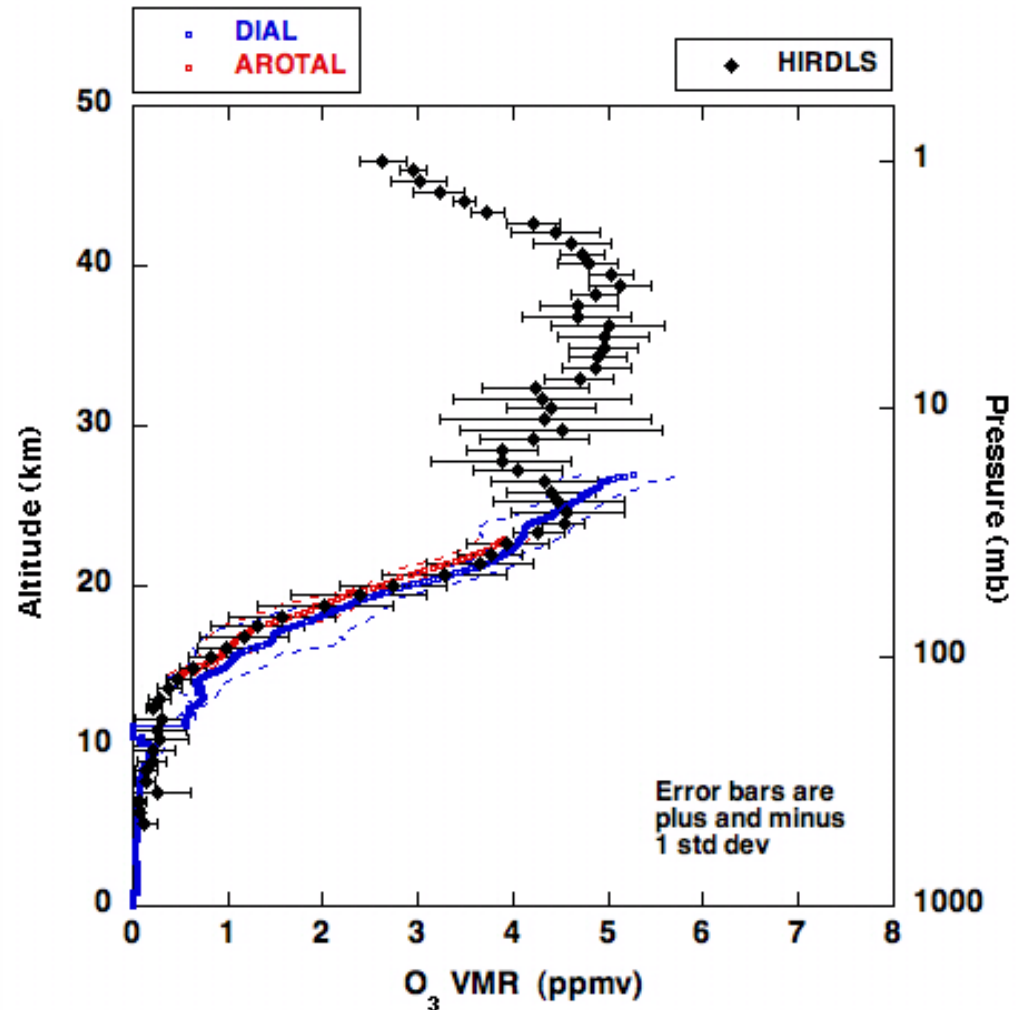
HIRDLS Ozone Validation vs. Polar Aura Validation Experiment (PAVE) Data



- DI- NASA LaRC DIAL LIDAR
- AR-NASA GSFC AROTAL LIDAR
- AS-U. Bremen ASUR μ wave spect.
- IR- NCAR FTIR



HIRDLS - PAVE O₃
50-65 N, 7 Feb 2005





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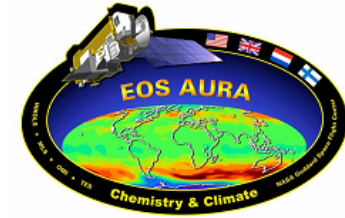


- The HIRDLS instrument exhibits very stable, precise performance
- Recent progress on ozone and temperature has been good, and future effort will focus on improvement of these results, and extension to other species (e.g. H₂O, CH₄, NO₂, ClONO₂, HNO₃, etc.)
- HIRDLS will recover most of its observational capabilities
 - High Vertical resolution
 - Ability to sound the tropopause region
 - Measurement of 10 trace species, aerosols and cirrus
 - With MLS, determine stratospheric ClOx budget

HIRDLS WILL FULFILL ITS SCIENCE OBJECTIVES AS REVISED IN FEB 05



HIRDLS Phase 1 Achievements



Algorithms Developed, Software Revisions Implemented to Allow Raw Data (L0) to be Processed to Atmospheric Data (L2)

- Retrieved temperature and ozone fields display
 - HIGH VERTICAL RESOLUTION (1 km)
 - High horizontal resolution along track (80 km spacing)
 - Atmospheric realism, and agreement with other measurements
- Present efforts are improving these results, and bringing in other species (e.g. H₂O, CH₄, NO₂, ClONO₂, (HIRDLS unique on Aura) HNO₃, etc.)
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