Daily Tropospheric Ozone Residual from OMI-MLS

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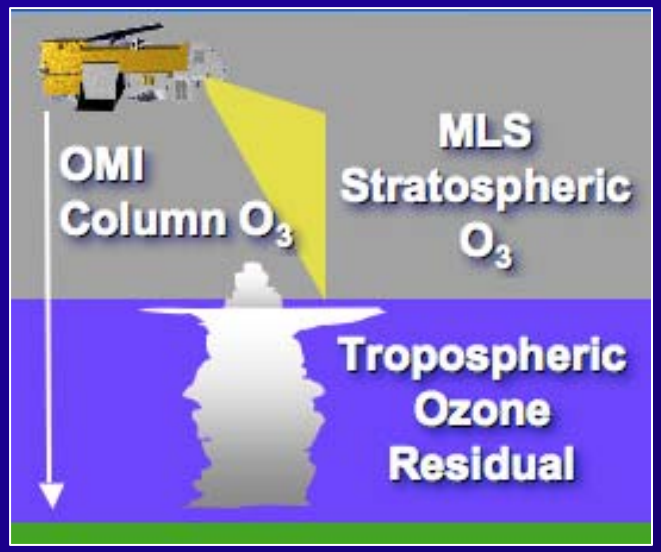
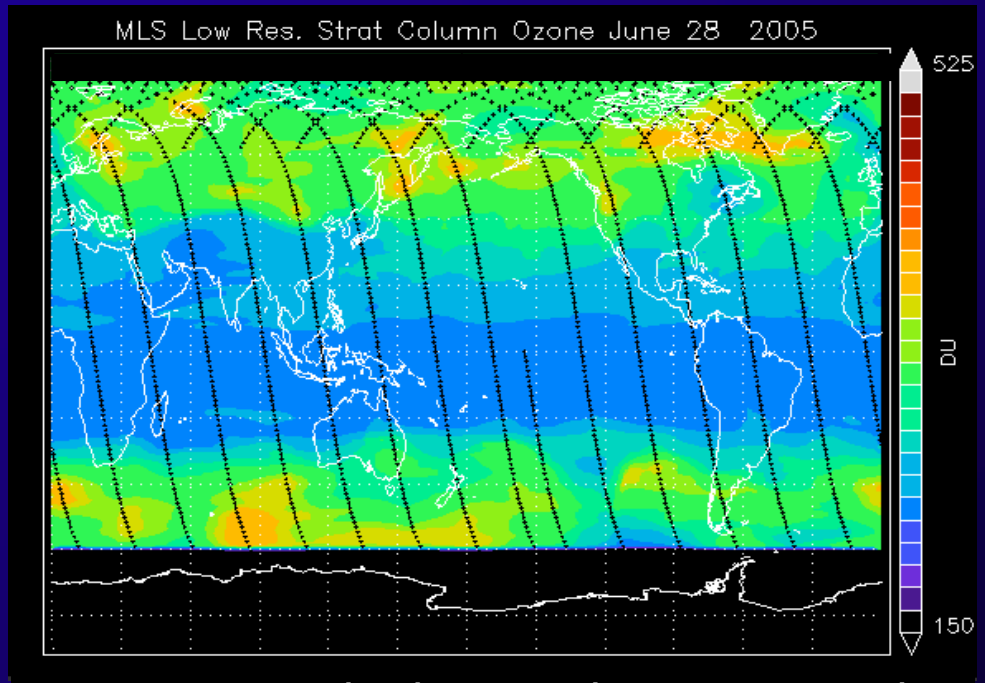
Tropospheric Ozone Residual (TOR)





MLS Stratospheric O_3 Column Map made from MLS measurement points shown

How hard can it be to subtract two numbers?

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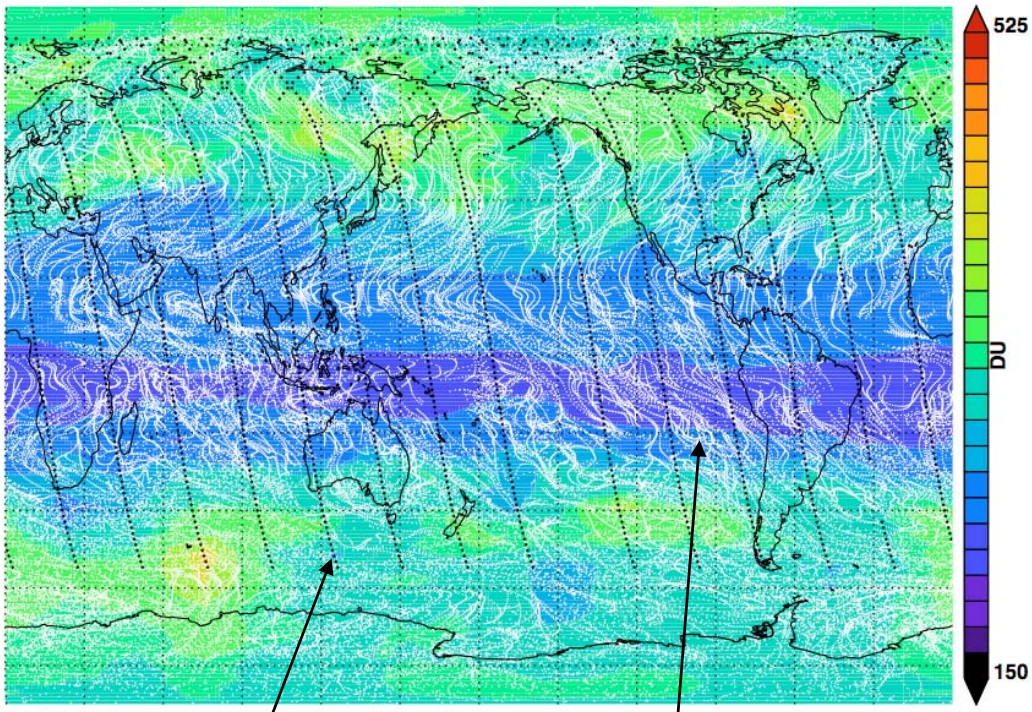
Increasing the Resolution of the Stratospheric Column with

- Forward trajectories from six previous days of MLS V1.5 data are used to increase the stratospheric column resolution
- OMI L2G with measurement time stamps are used to correct for asynoptic affects
  - Forward trajectories are grouped in time for target day (1/10th day resolution)
- Tropopause is time interpolated from 6 hour DAS fields

- Product has same zonal mean as asynoptic TOR
- Fold TOR anomalies are better handled

June 24 2005



MLS Ascending node measurements

Forward Trajectory Points

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Validation

1. Sonde Comparisons
2. TES Comparisons
3. GMI - sonde Comparisons

Most comparisons are made using the surface-200hPa product from ozonesondes and TES - this avoids issues with different definitions of the tropopause.

Dates: October 2004 to December 31, 2006
GMI Dates: Jan 1, 2005-Dec 31,2005

Data is interpolated to location of sonde or TES measurement.

Sonde data base >6000 comparisons from Envisat, Shadoz, Canadian, IONS,etc.

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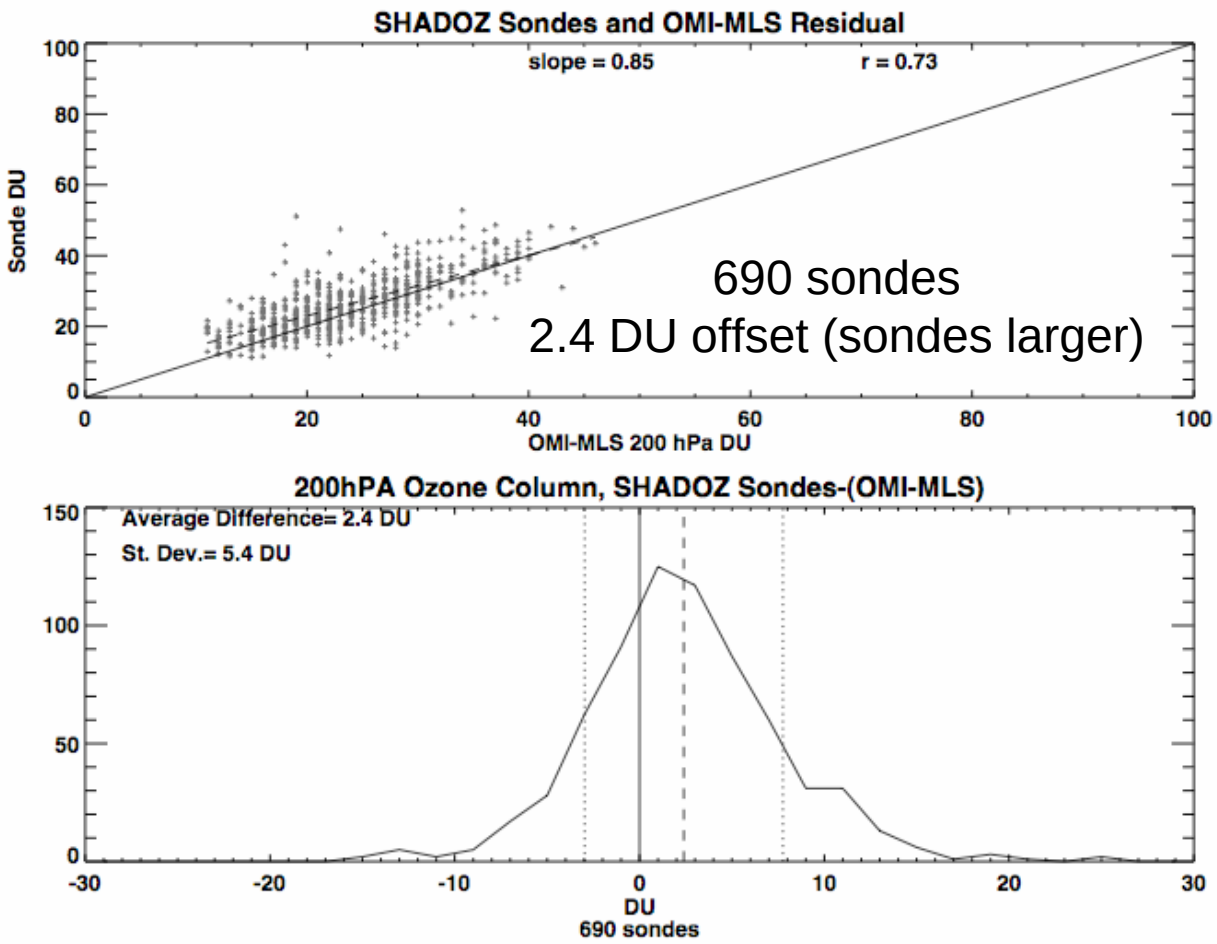
Tropical Sondes



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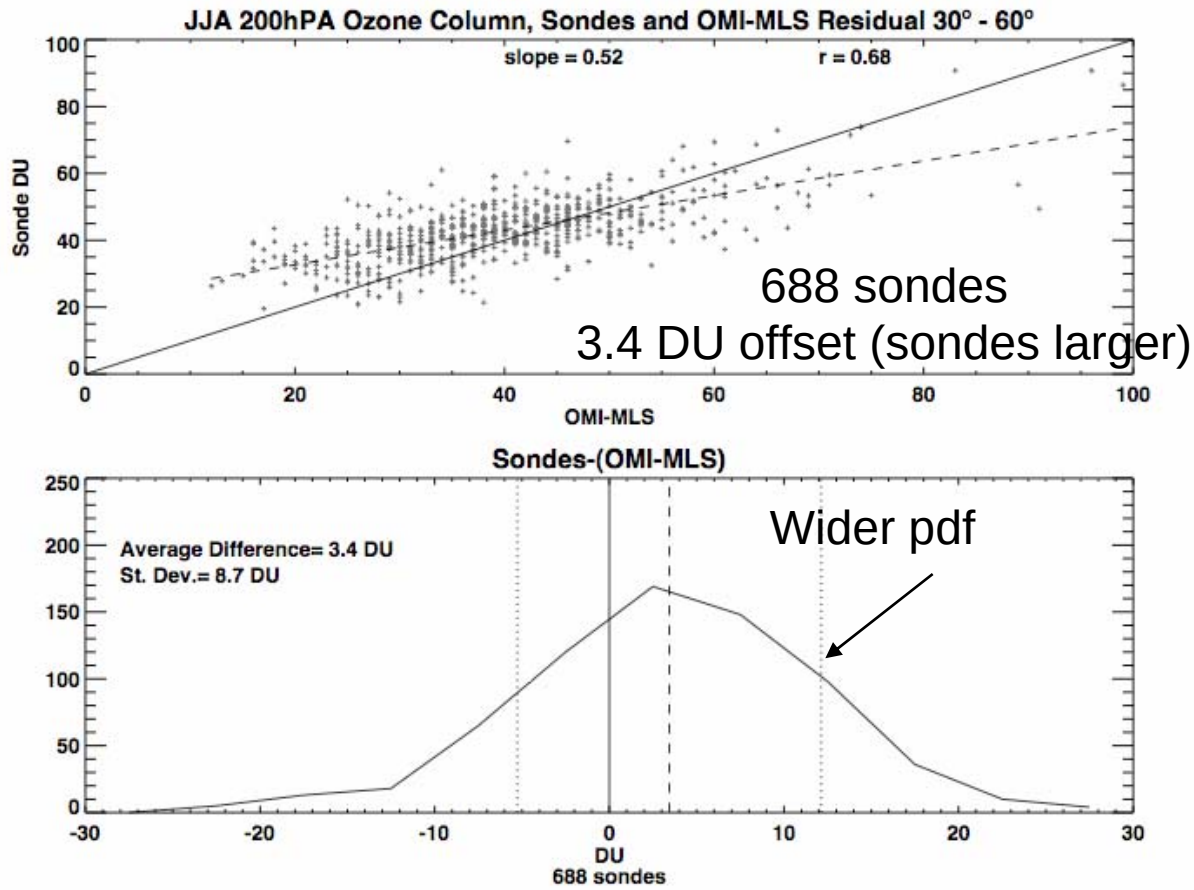
Mid-latitude Sondes

June -July- August



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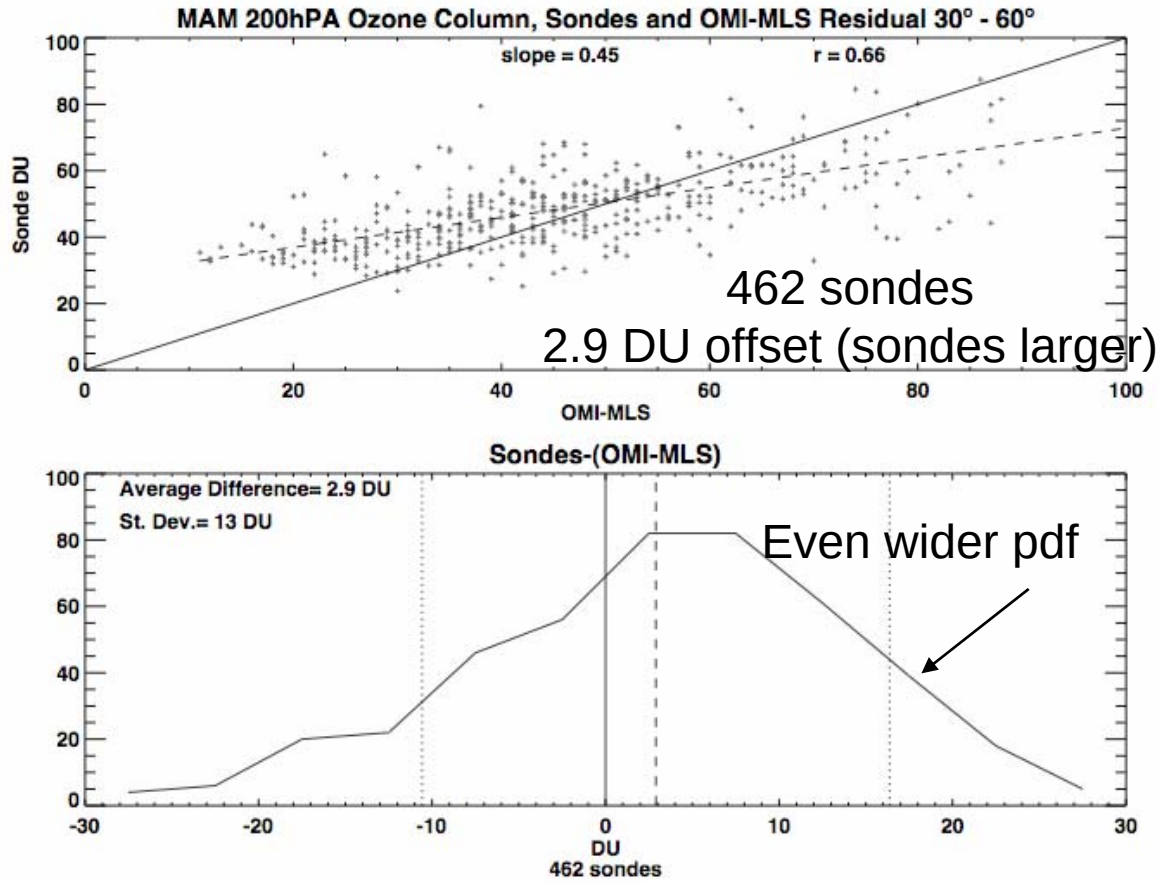
Mid-latitude Sondes

March-April-May



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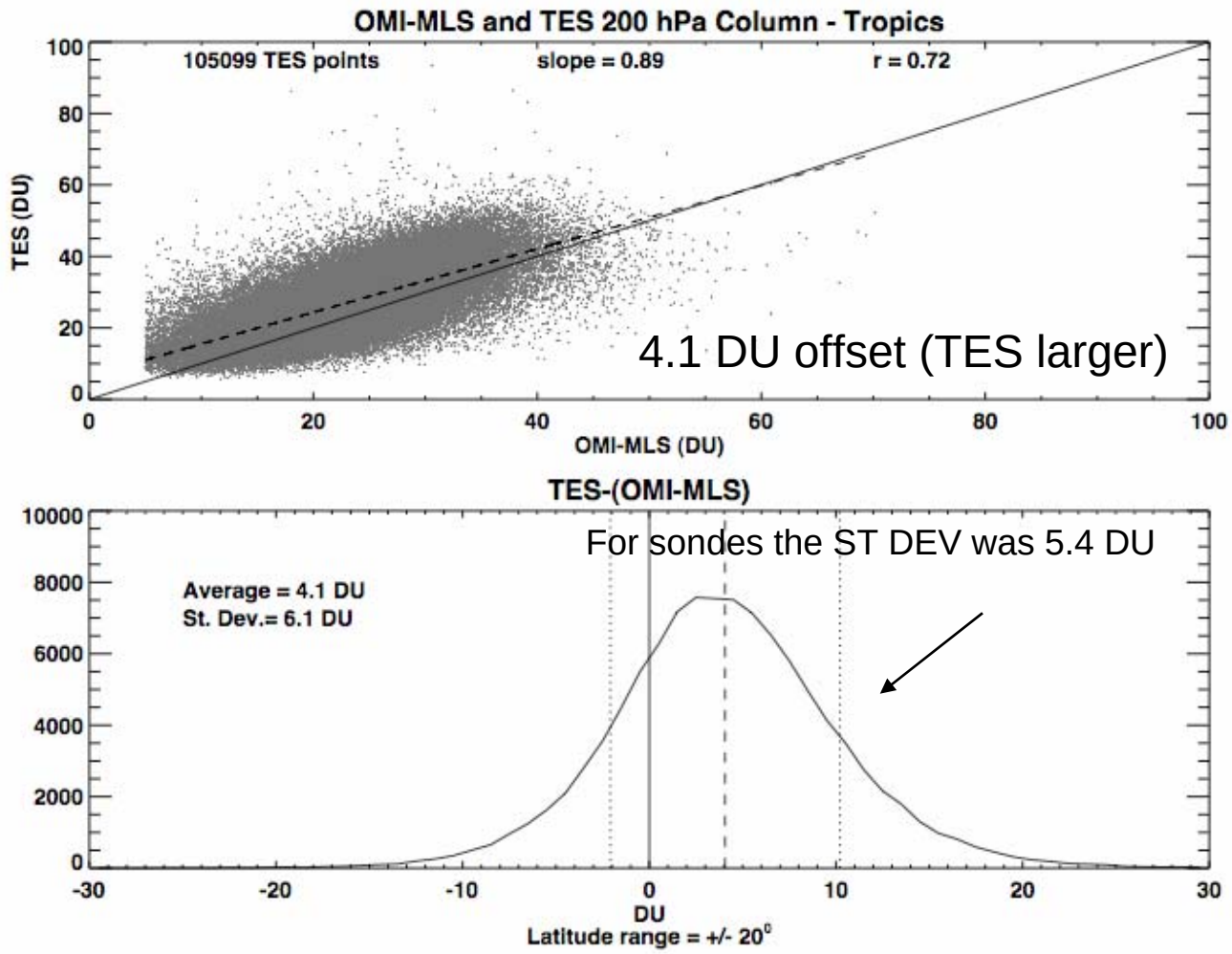
TES Comparison Tropics



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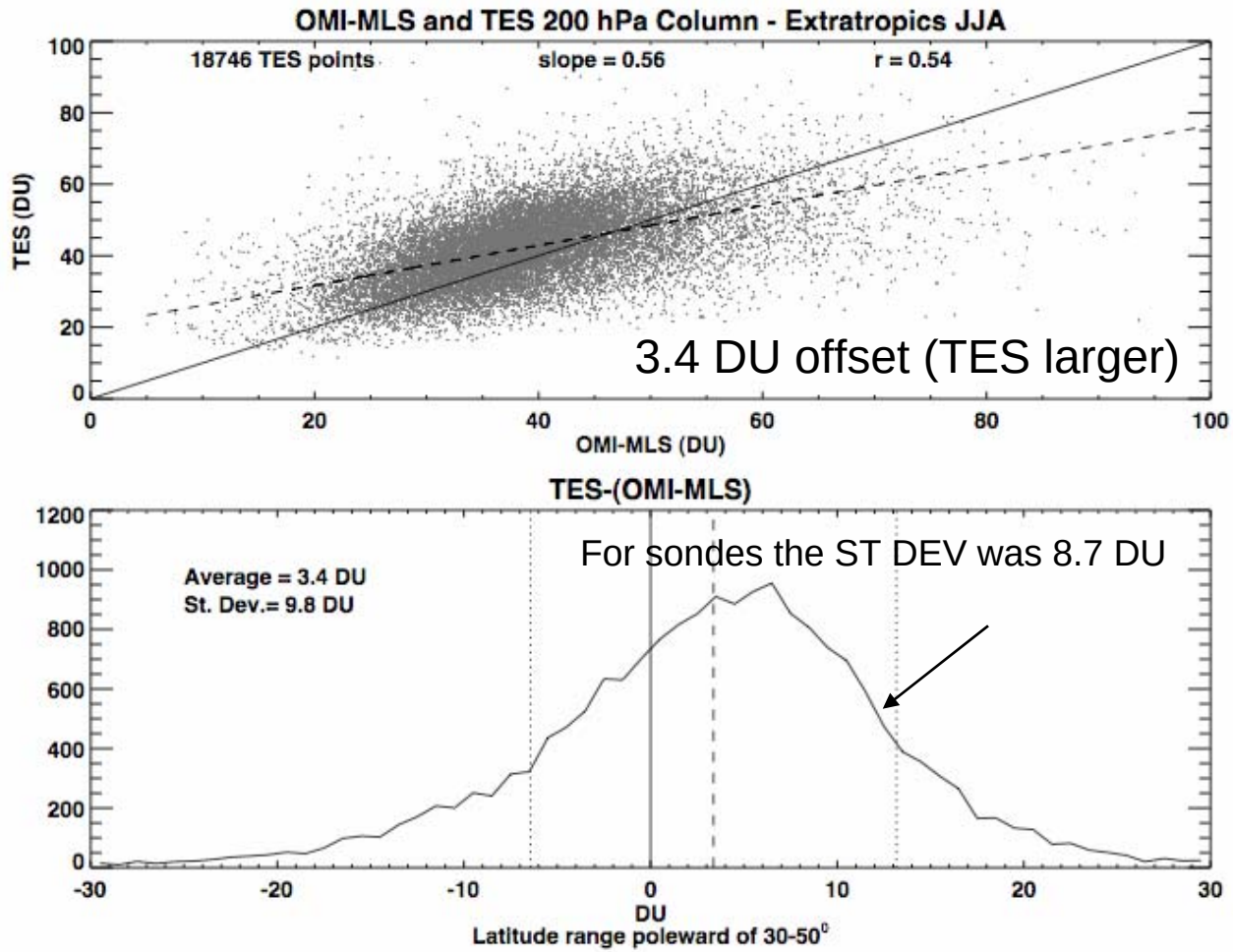
TES Comparison at Mid-Latitudes



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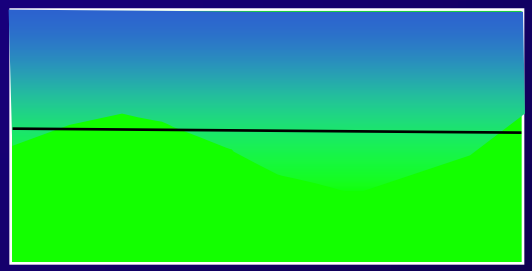
Validation Summary

Comparison		Tropics	NH Extratropics			
			DJF	MAM	JJA	SON
Ozonesonde	Biases (DU)	2.4	3.9	2.9	3.4	5.4
	Standard Deviation	5.4	12	13	8.7	8.7
	Correlation Coef.	0.73	0.45	0.66	0.68	0.48
TES	Biases	4.1	2.6	0.85	3.4	7.5
	Standard Deviation	6.1	8.2	15	9.8	8.6
	Correlation Coef.	0.72	0.6	0.48	0.54	0.43

Questions

- Why is there more variability in the TOR than in the GMI or sondes or TES?
  - Clue: variability is associated with folds - or strong vertical changes
  - Clue: both enhancements and depletions are larger
  - Clue: not a function of tropopause definition
  - Clue: TOR is systematically low - this bias is larger at mid-latitudes
- One explanation that fits all these data is that the MLS ozone amount at 215 hPa is too large or too variable - stratospheric ozone variability is mis-assigned to the troposphere
  - Consistent with data presented by Froidevaux et al. [2006], Livesey et al. [2007]

Less variation in TOR



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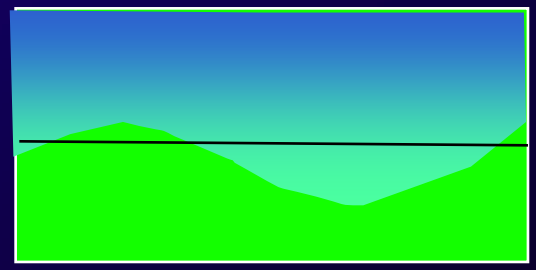
More variation in TOR



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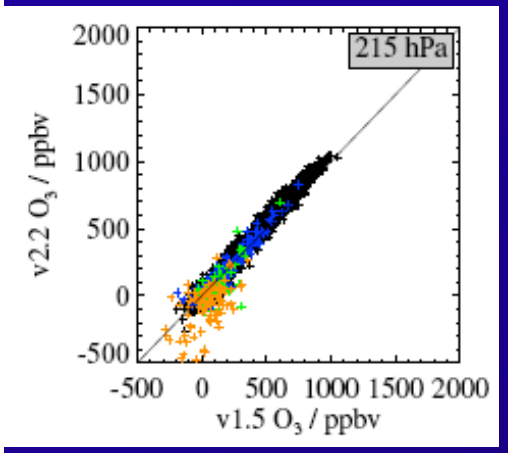
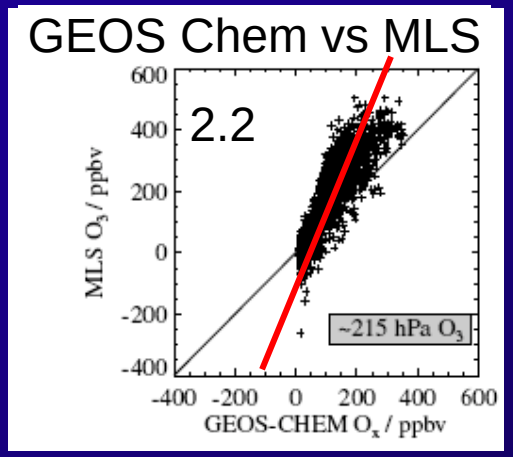
Evidence from MLS validation

V2.2 vs V1.5

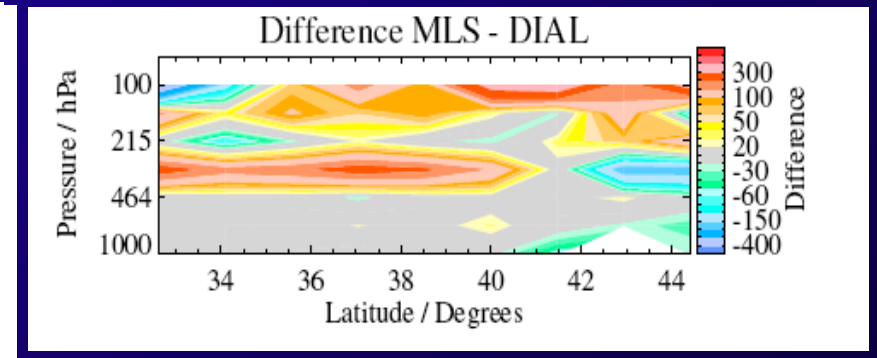


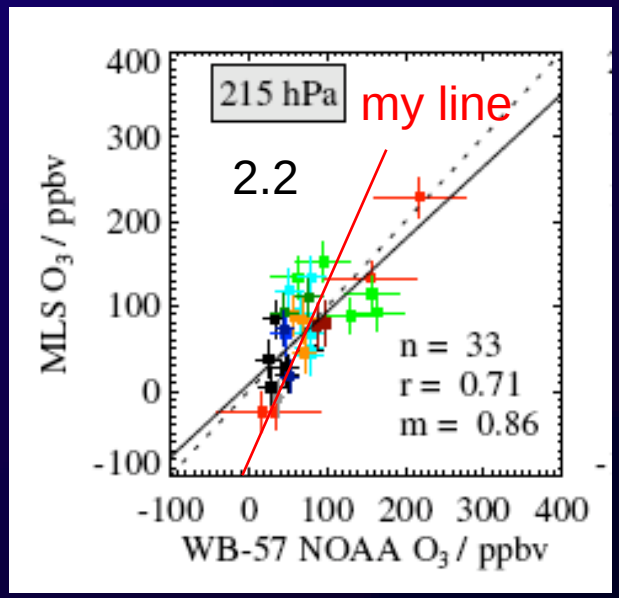
MLS 2.2 has lower values at 215 but "variability" is about the same

Comparison with GEOS Chem shows higher MLS variability



Validation data shows more variability as well





Livesey et al. [2007]

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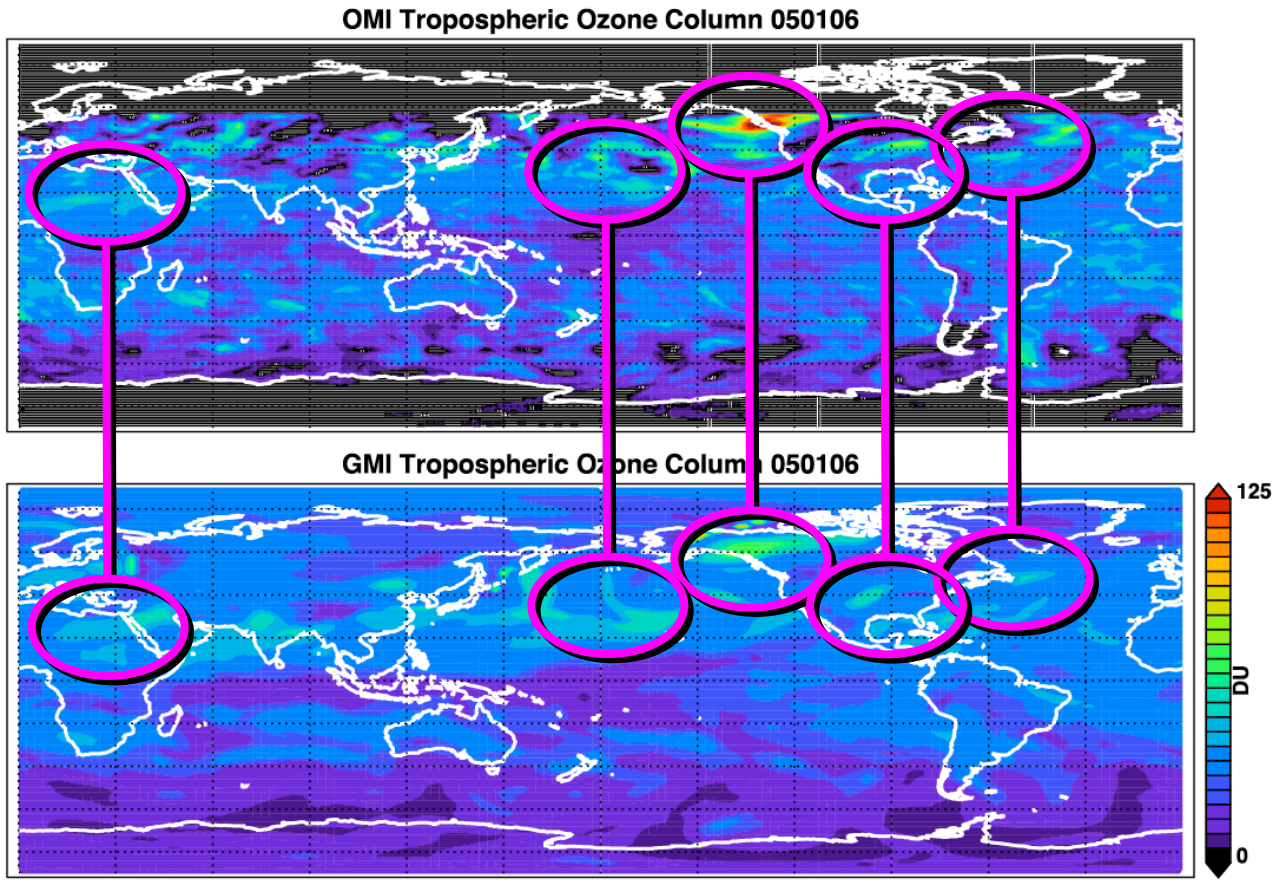
Comparison to GMI Combo Jan 6, 2005



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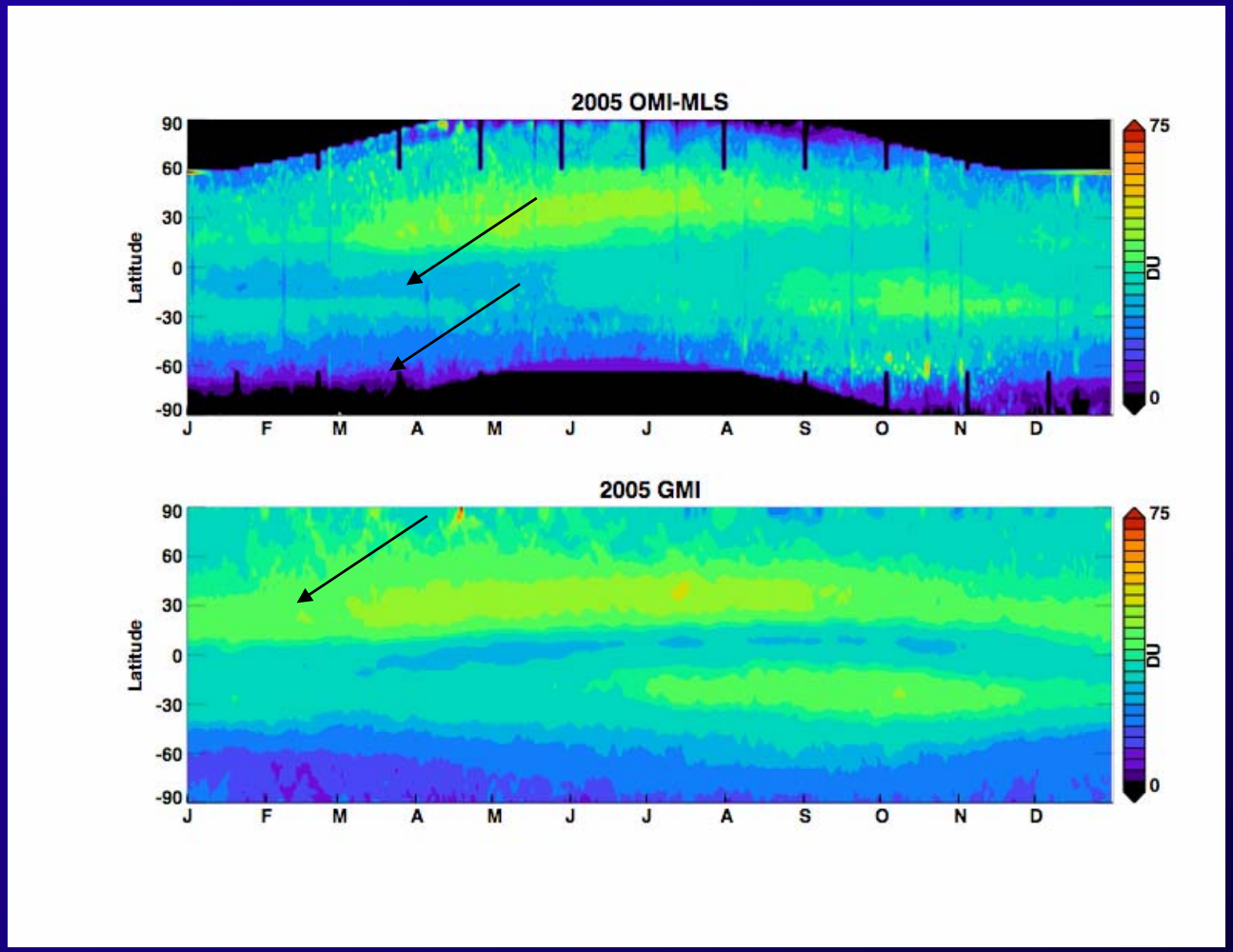
Zonal Mean Comparison with GMI



Overall good agreement

Arrows indicate some differences:

- GMI SH and NH mid-latitude maxima starts sooner
- OMI-MLS values too low at high latitudes
- Winter tropical values are lower than GMI

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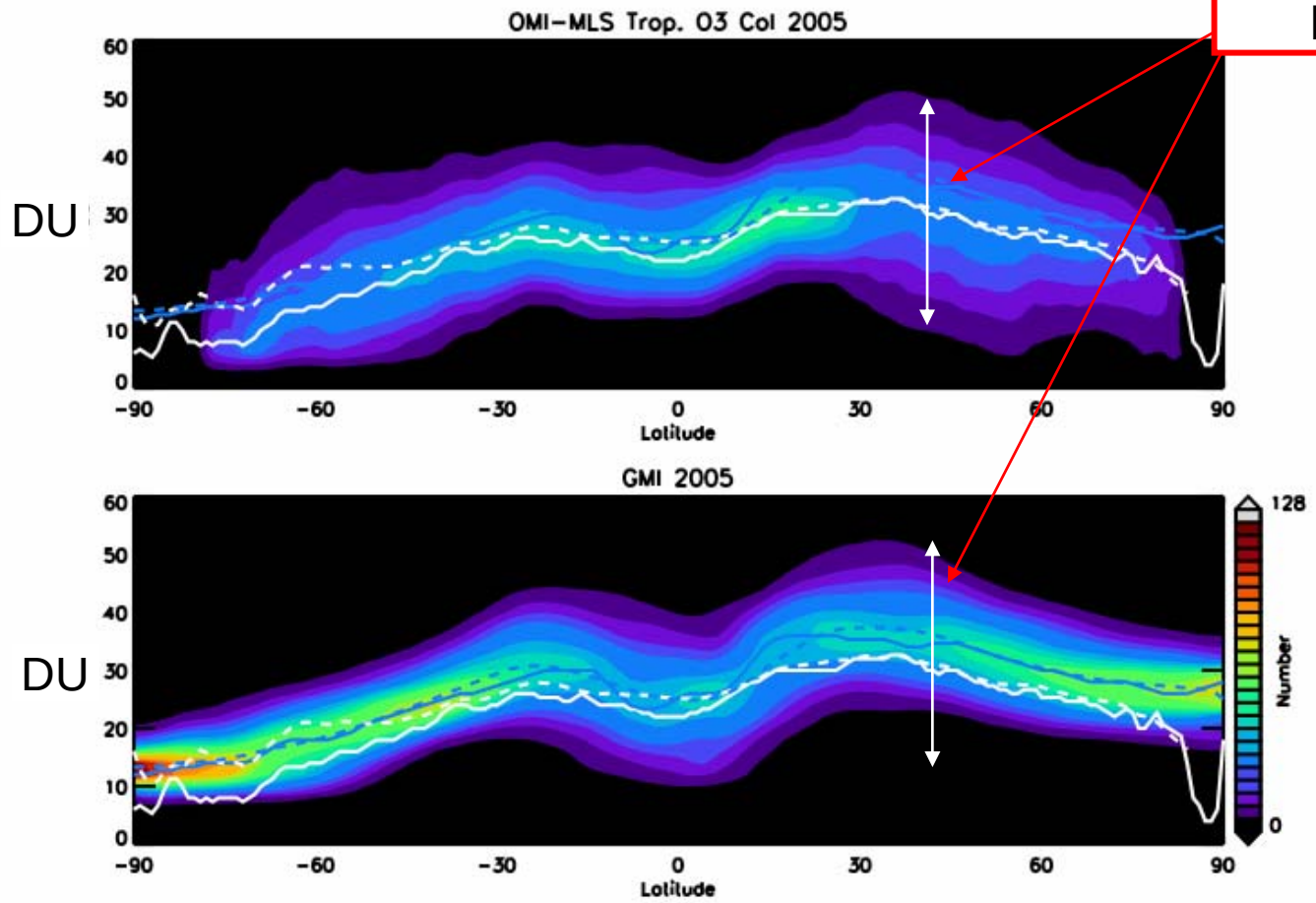
PDF Comparison with GMI

Tropopause Column hPa column

These lines are the same length



GMI

Solid = mean Dashed = mode

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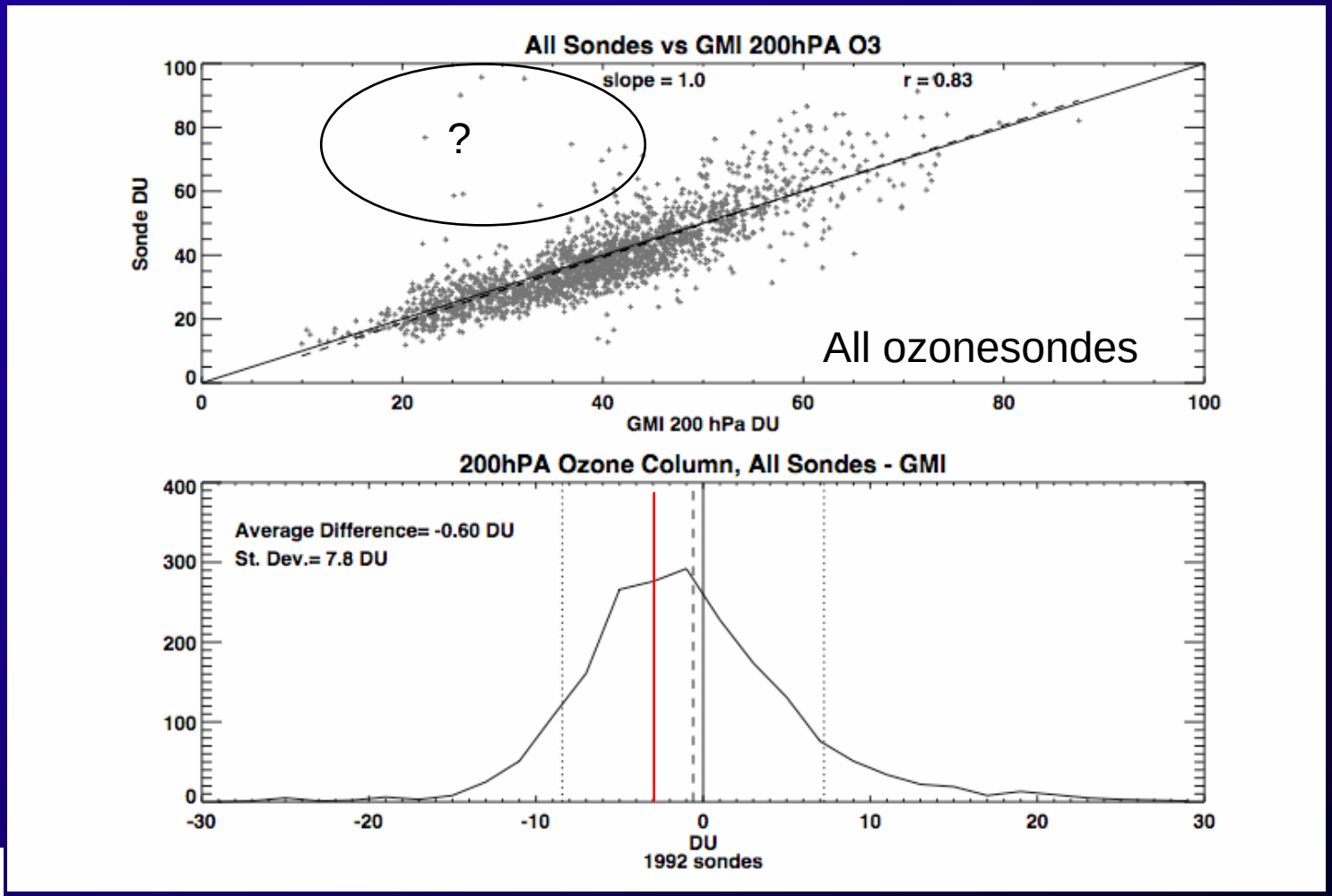
GMI-Sonde Comparisons

- 1,992 '05 sondes
- Comparisons between surf-200 hpa Product



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Summary of GMI-sonde comparison

	Avg Dif (S-G)	St. Dev	R	Slope
Tropics	-0.55	5	0.73	0.9
30-60N DJF	-3.2	8.4	0.74	1.1
30-60N MAM	-1.4	7.4	0.82	1.3
30-60N JJA	-0.5	7.8	0.58	1.1
30-60N SON	-3.7	8.4	0.42	0.85

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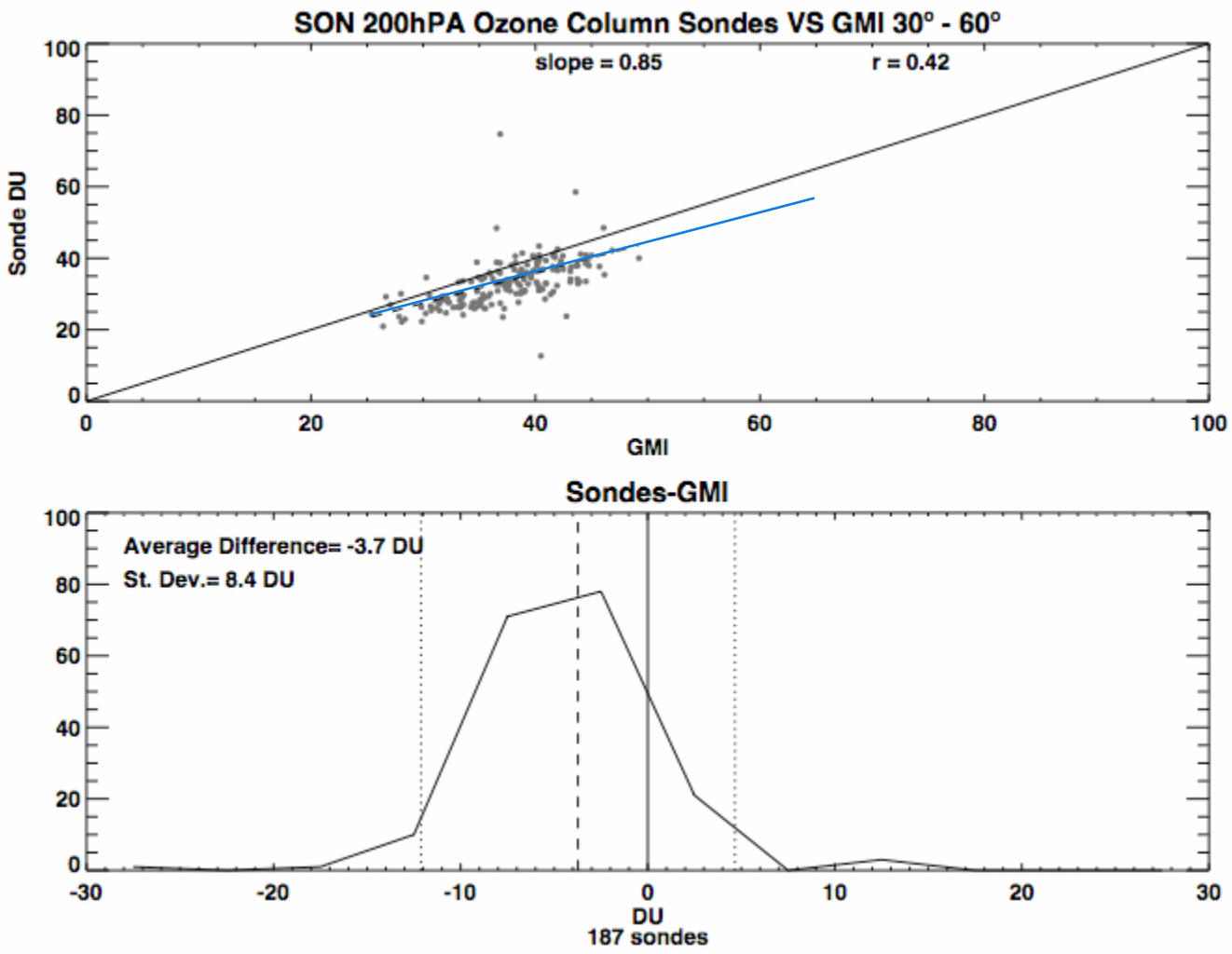
SON 30-60N



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Summary

- Forward Trajectory transport of MLS data is used to create a high horizontal resolution stratospheric ozone column which is then used to produce the tropospheric ozone residual (TOR).
- Validation with ozonesondes shows good tropical comparisons, but more variability in TOR at mid-latitudes than ozonesondes
- TES comparisons show similar results
- Both TES and ozonesondes show a systematic offset with OMI-MLS being a few DU low
- Comparisons of total tropospheric ozone amount to GMI Combo model show overall good agreement
- Comparisons of GMI and sondes show good agreement
  - GMI does not show the high variability - slopes are closer to 1
  - GMI is slightly high biased - especially in Fall and Winter
  - Agreement is worse in Fall and Winter, best in Spring and Summer

The End