Assessing MOA (GEOS-4 & GEOS5) Humidity and Temperature with ARM Observations

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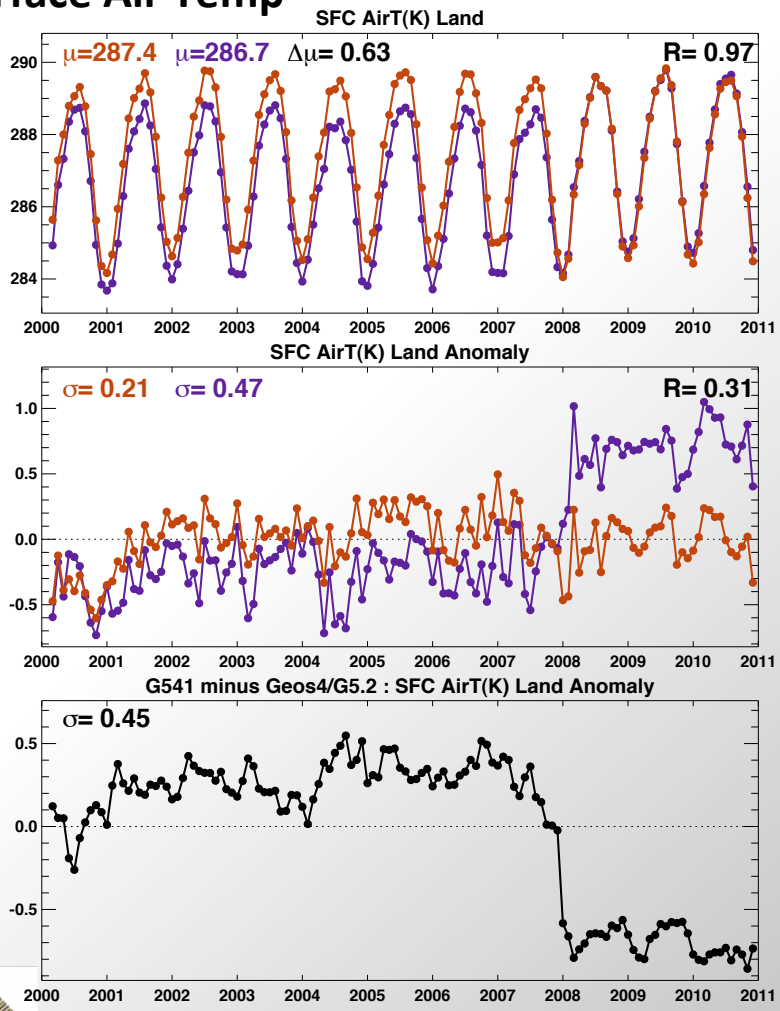
Why?

We know that SYN Edition 2, uses GEOS 4 up through Dec 2007, has a shift in land & ocean temperature & humidity after switch to GEOS 5.2 in Jan 2008.

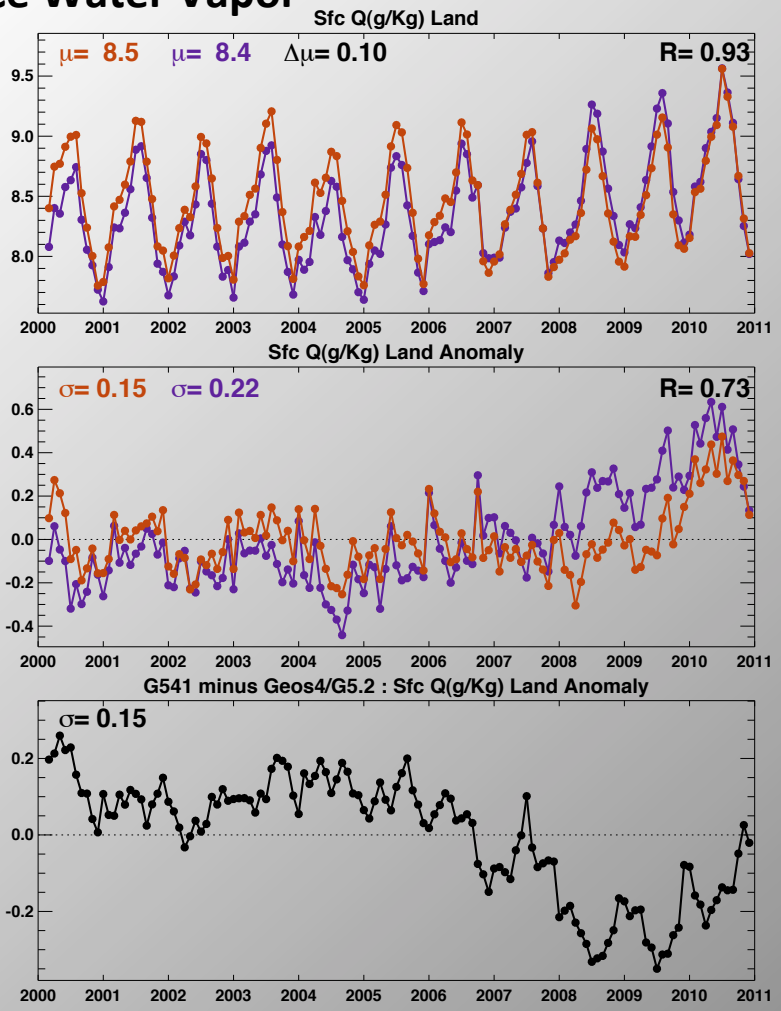
Surface Air Temp

G541
Geos4/G5.2



Surface Water Vapor

G541
Geos4/G5.2



Can we characterize uncertainty on surface and (TOA) flux calculations?

Data Sources & Time

* MOA from GEOS-4 and GEOS-5.2 (used in SYN Edition 2 processing.)

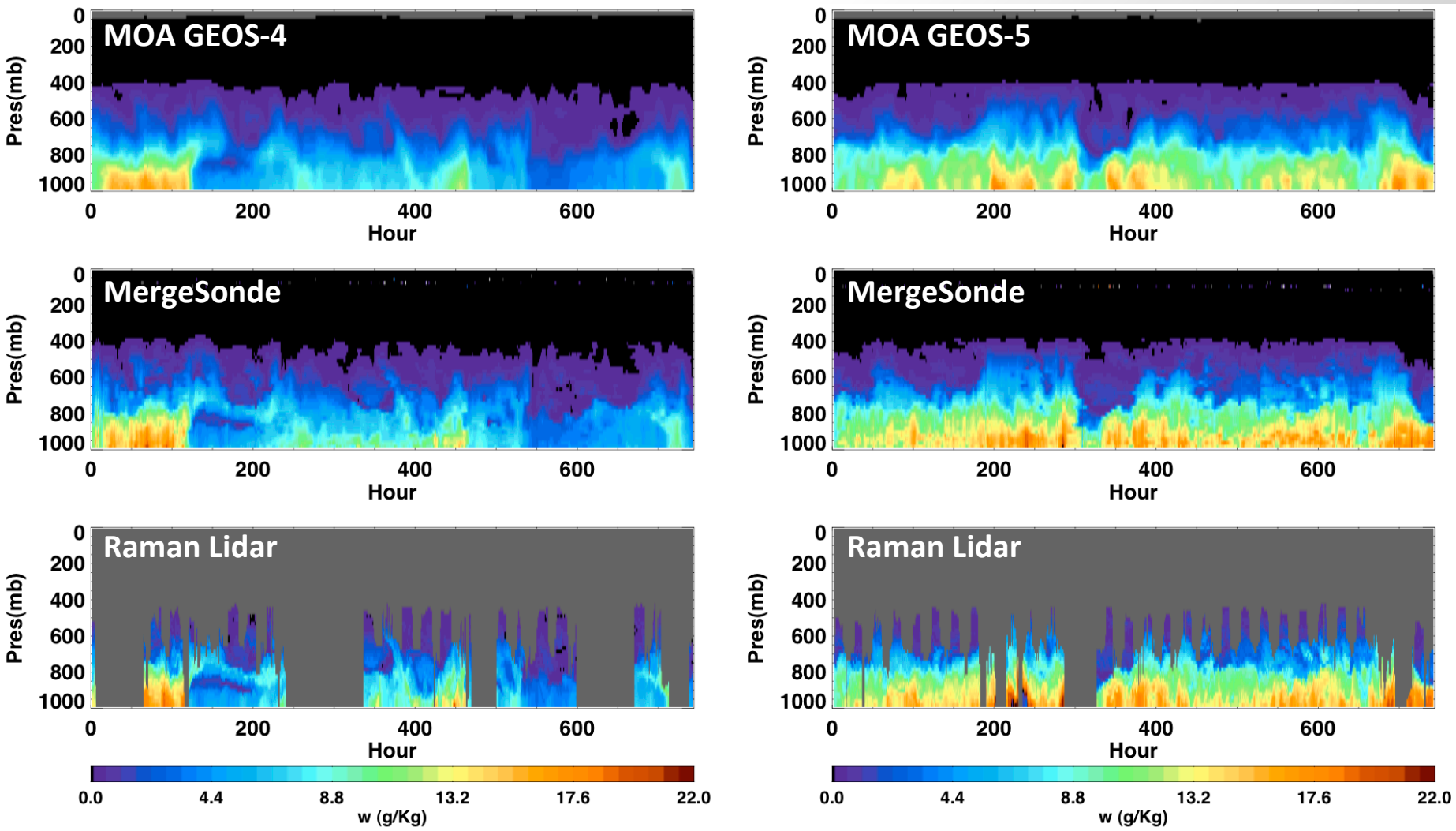
* ARM : MERGESONDE "2" (value added product from Jay Mace)
Raman Lidar "NEWS" (value added product from Dave Turner)

* GEOS-4 Months: 2005 (01,02,03,07,08,10)
2006 (01,02,03,07,08,10,12)
2007 (01,02,03,06,07,09,10)
* GEOS-5.2 months: 2008 (02,03,06,07,08,10,12)
2009 (01,02,03,06,07,10,12)

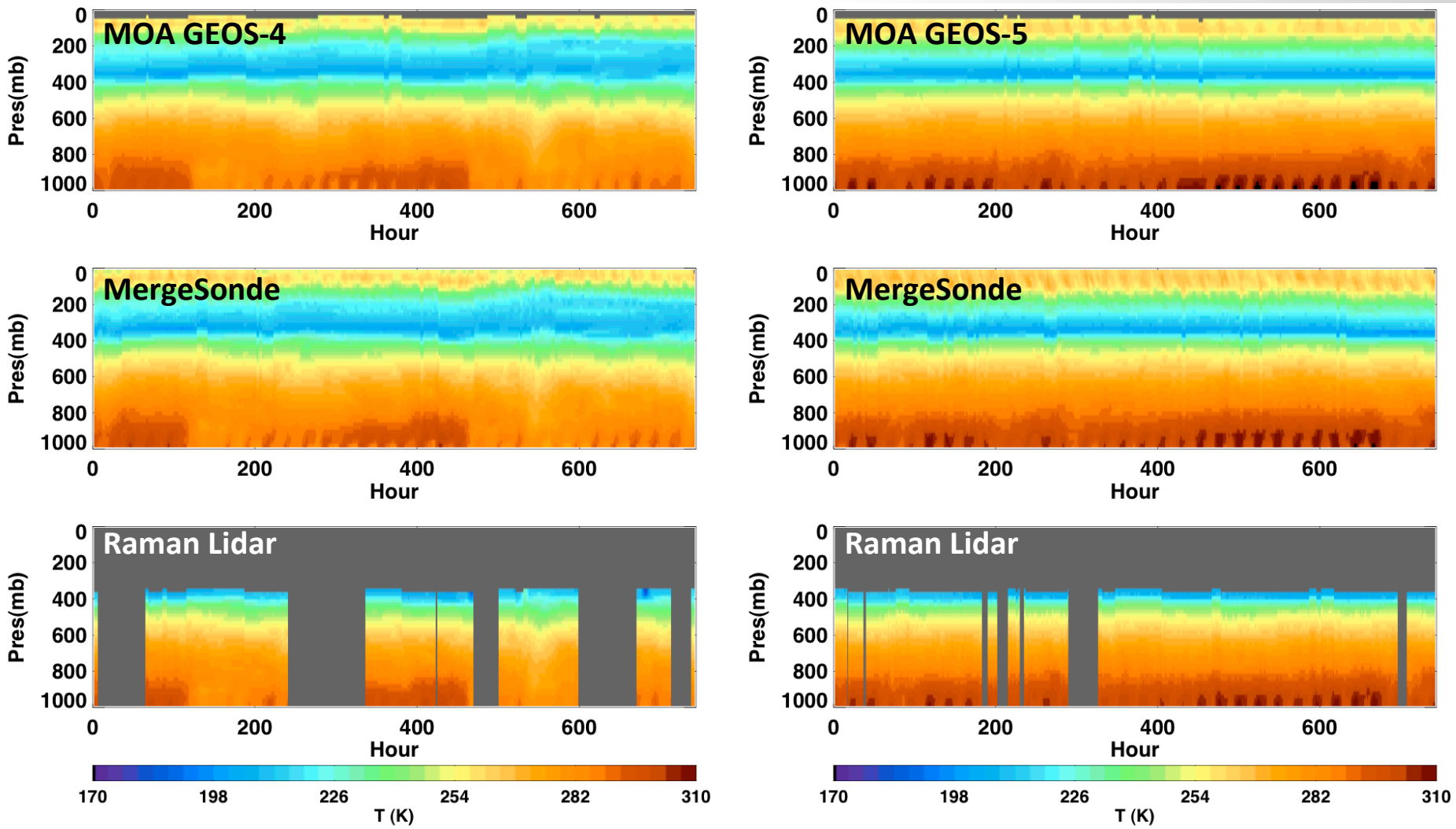
* Comparisons done for 'clear sky' as defined by Raman Lidar.

* Surface Down LW Flux & OLR come from SYN Ed2.

Specific Humidity (g/Kg)



Temperature (°K)

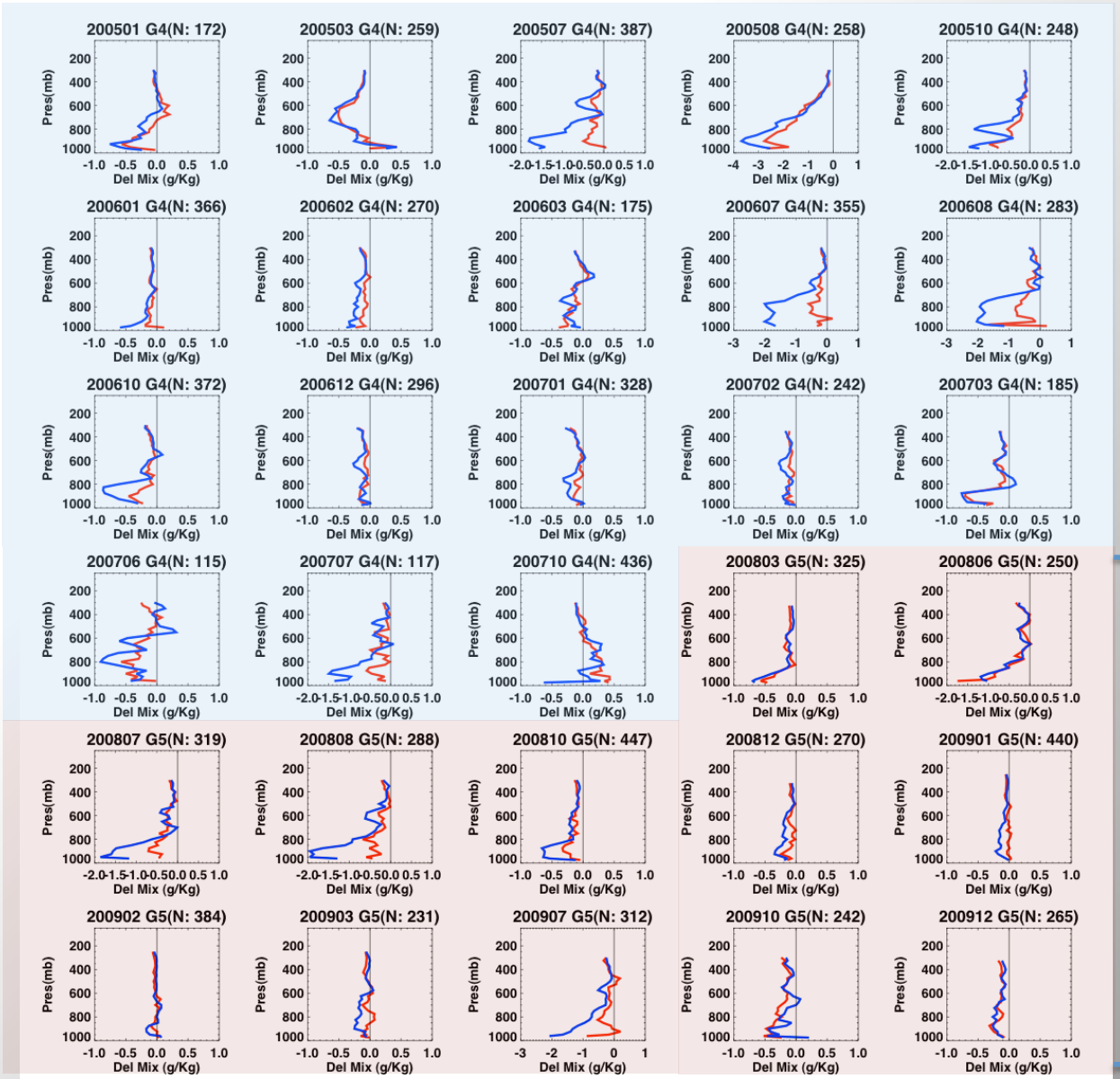


Monthly Specific Humidity Difference (g/Kg)

Mergesonde-RamLid & MOA-RamLid

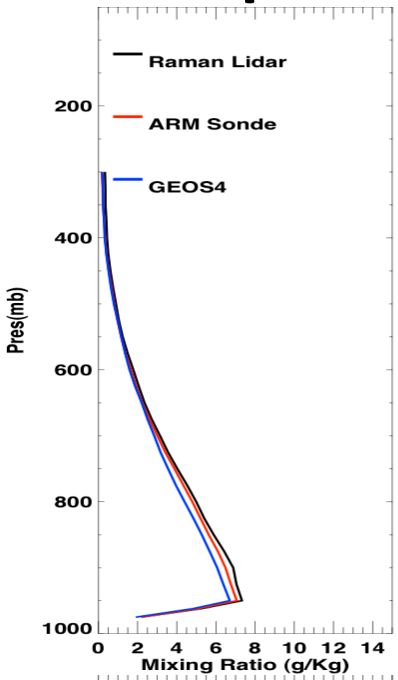
GEOS 4

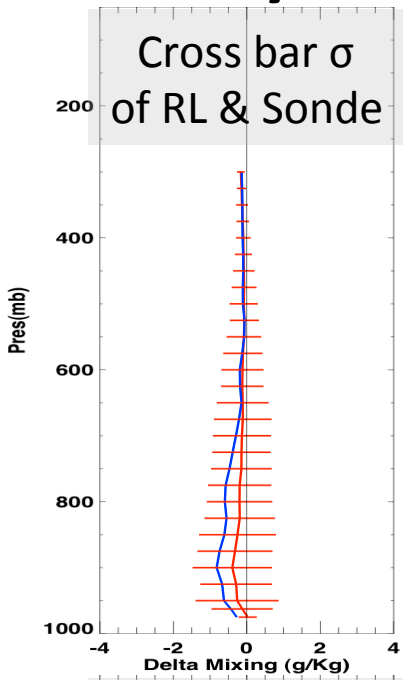
GEOS 5

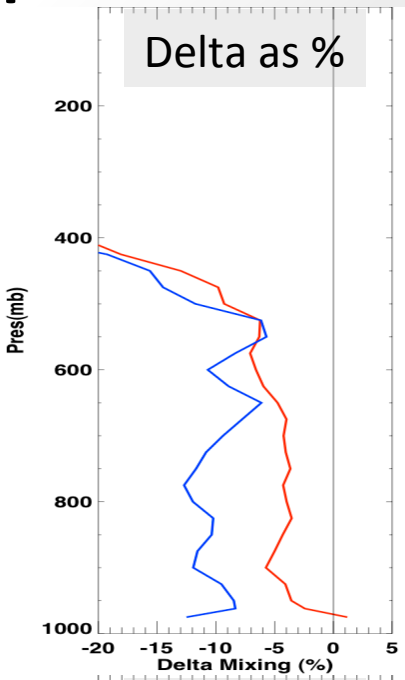


Specific Humidity Comparison

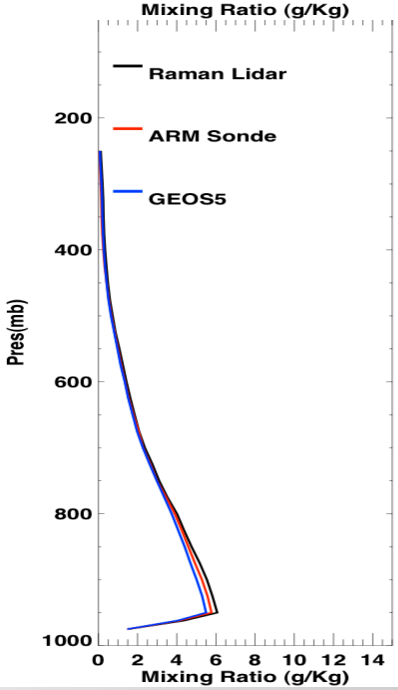
GEOS 4

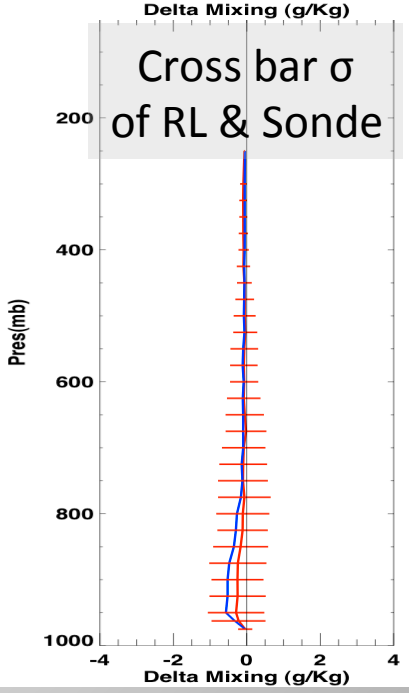


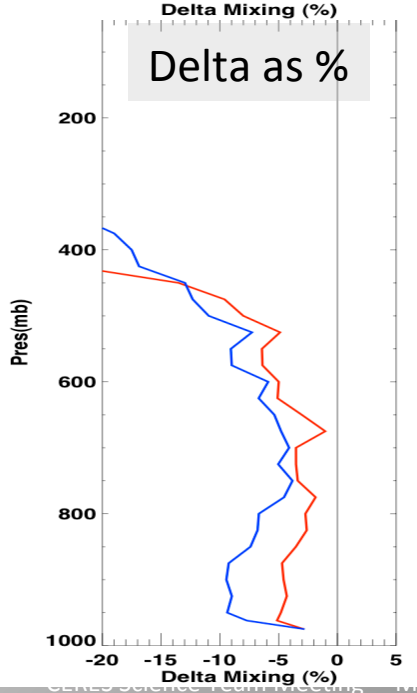




GEOS 5



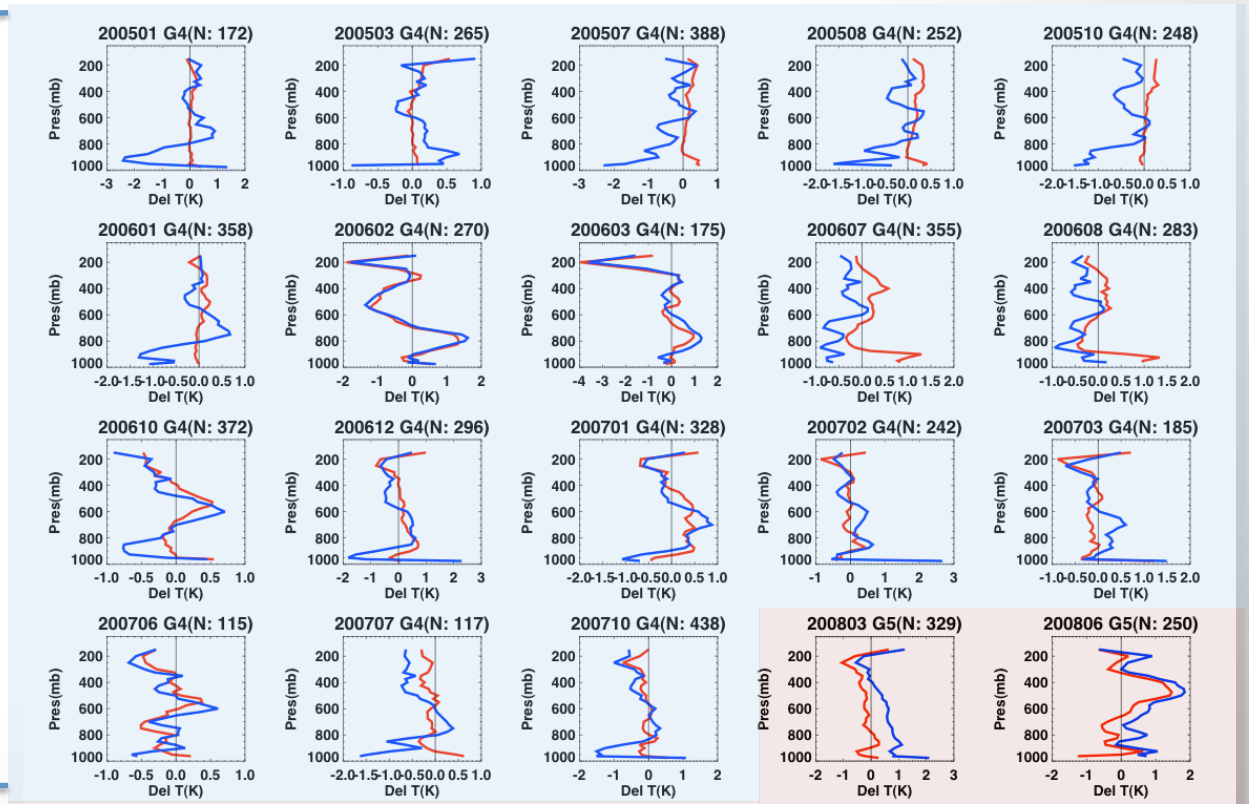




Temperature Difference (°K)

Mergesonde-RamLid & MOA-RamLid

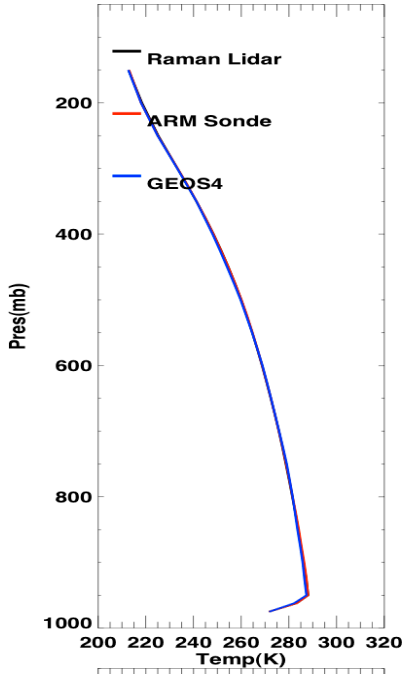
GEOS 4



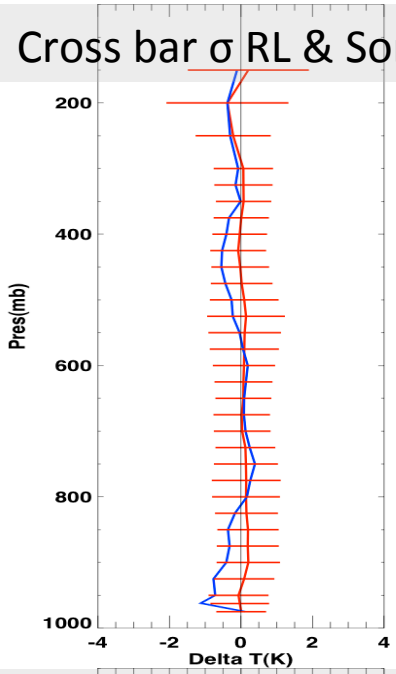
GEOS 5

Temperature Comparison (°K)

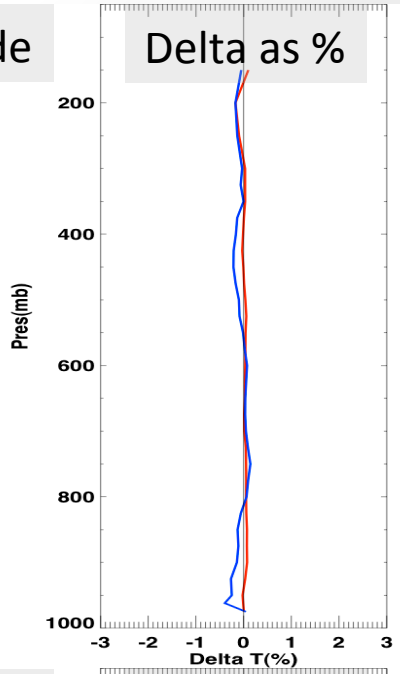
GEOS 4



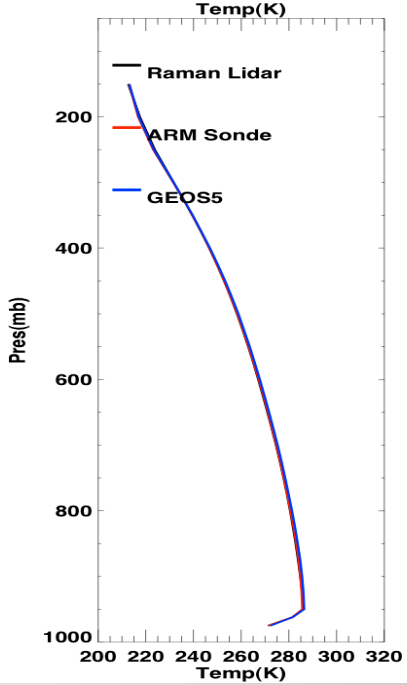
Cross bar σ RL & Sonde



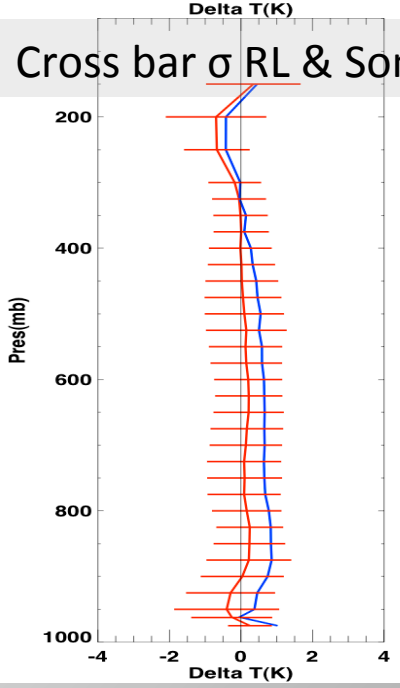
Delta as %



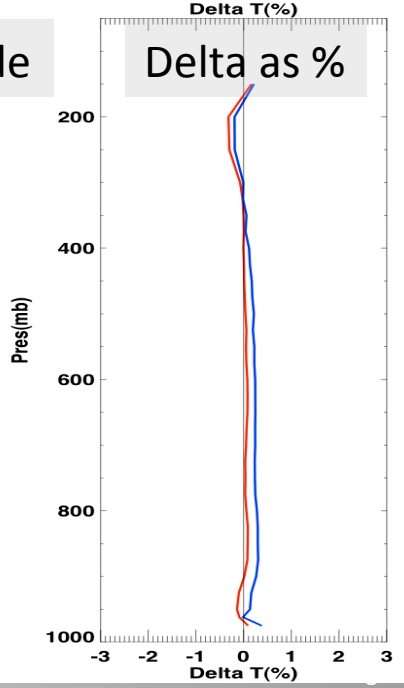
GEOS 5



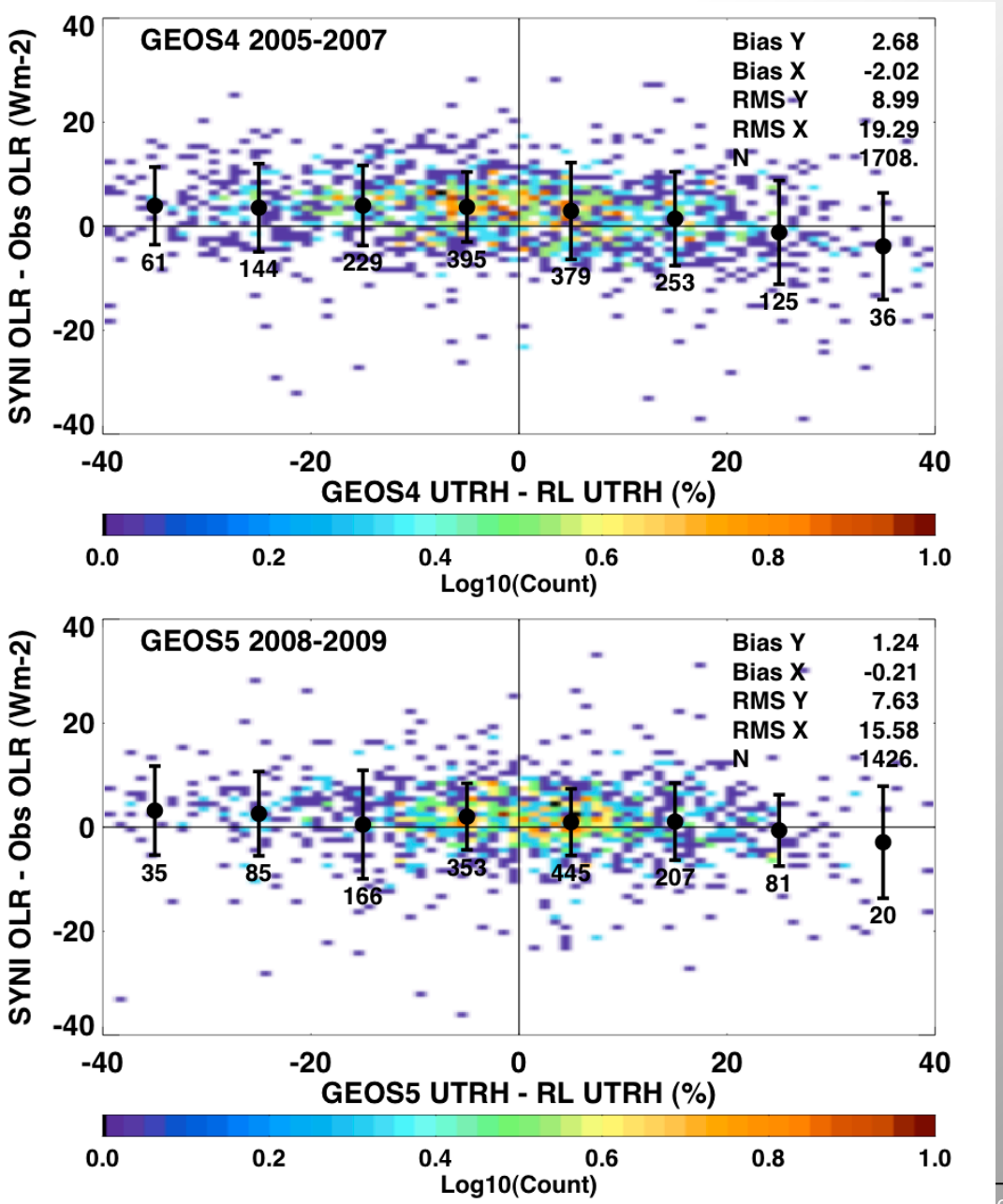
Cross bar σ RL & Sonde



Delta as %



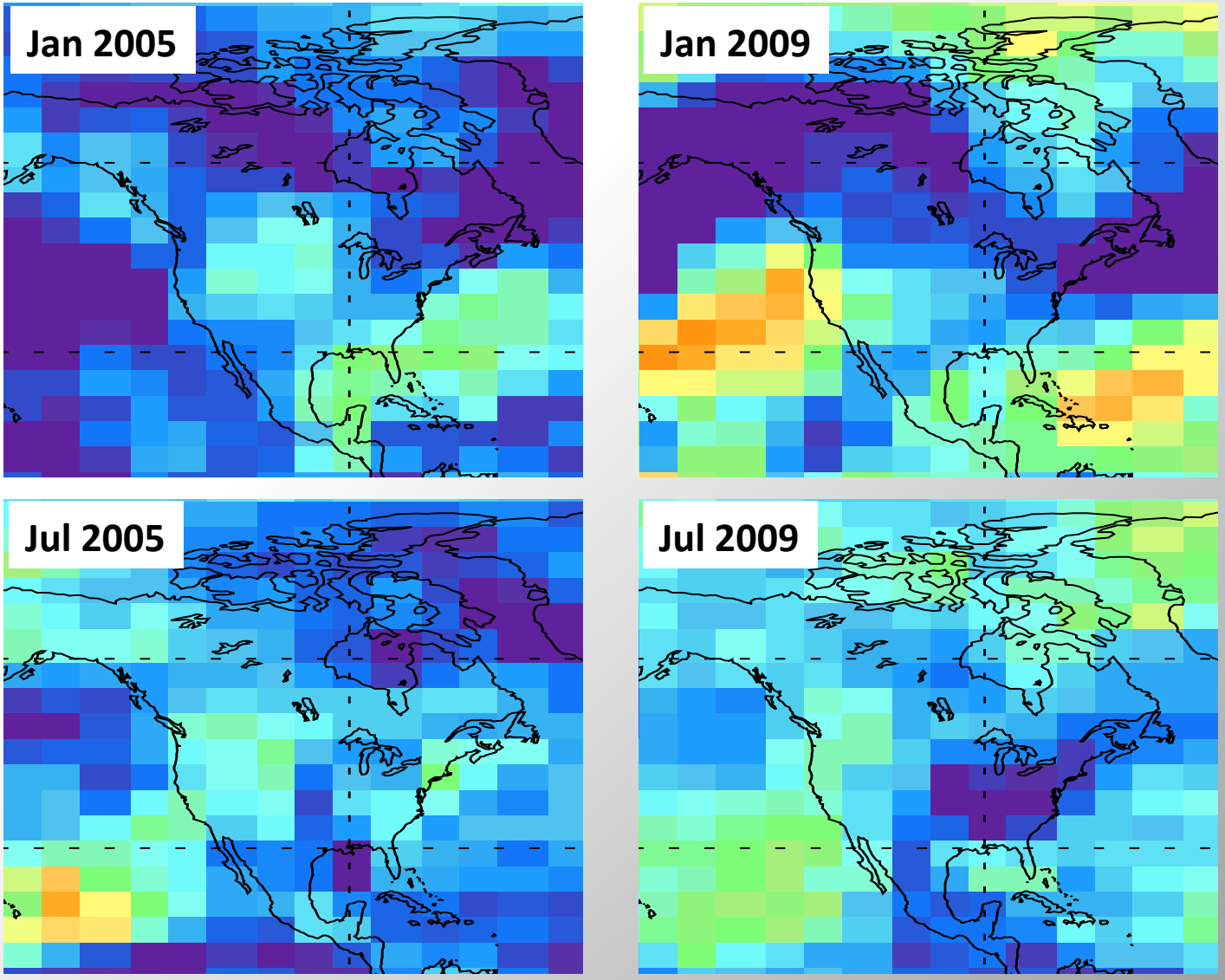
ΔOLR vs ΔUTRH (MOA-Raman Lidar)



UTRH Difference (AIRS-Model)

AIRS – GEOS 4

AIRS - GEOS 5.4.1



Profile Conclusions (at SGP Central Facility):

- GEOS 5.2 generally represents atmospheric humidity better than GEOS 4.

- Mean GEOS 5.2 temperature profile is ~0.2% warm relative to Raman Lidar.

- GEOS 5.2 water vapor and temperature profiles fall within the variability of observation as measured by 1 sigma of variance between two observations.

- Attempt to determine quality of GEOS4/5 UTRH and its effect on OLR, w.r.t the Raman Lidar, is so far inconclusive due to the Lidar's (in)ability to profile above 400mb.

- Comparing MOA to AIRS at SGP using global maps indicates that UTRH in MOA is generally moister than AIRS by 10% to 30%.

Direct Surface Comparisons

Plot: Surface Model – Observed Flux vs.

GOES 4/5 – Observed Surface Temperature & Humidity

Look at 3 years of each model:

GEOS4 Jan 2005 through Dec 2007

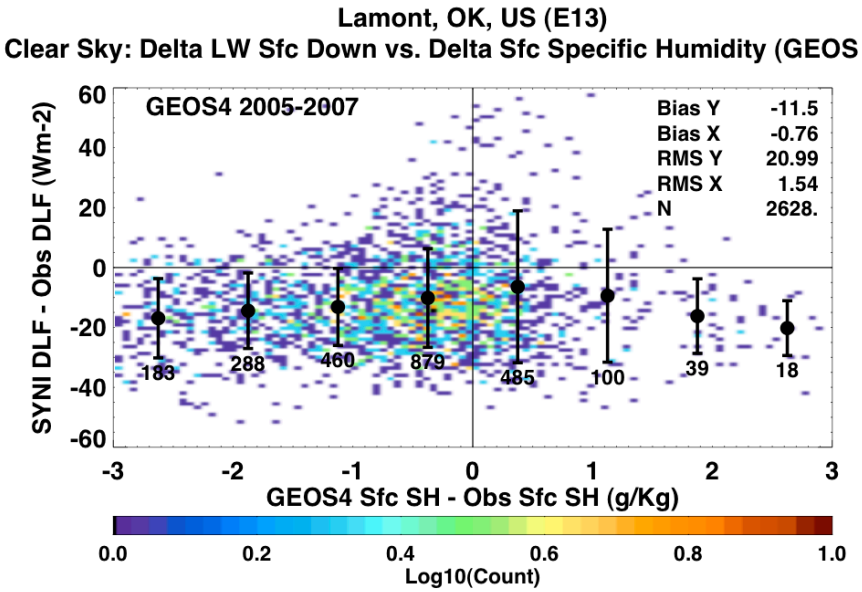
GEOS5 Jan 2008 through Dec 2010

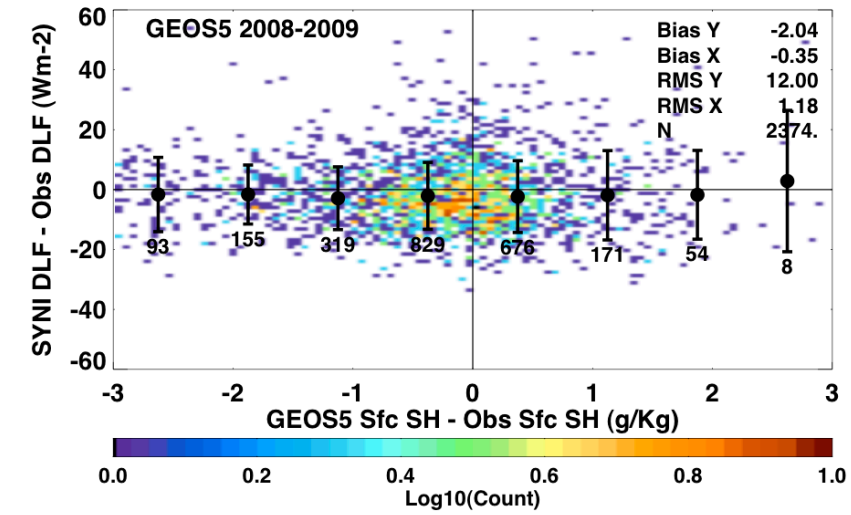
Clear sky defined using Long/Ackerman SWFA (so daytime only for clear sky).

Expand to include TWP sites.

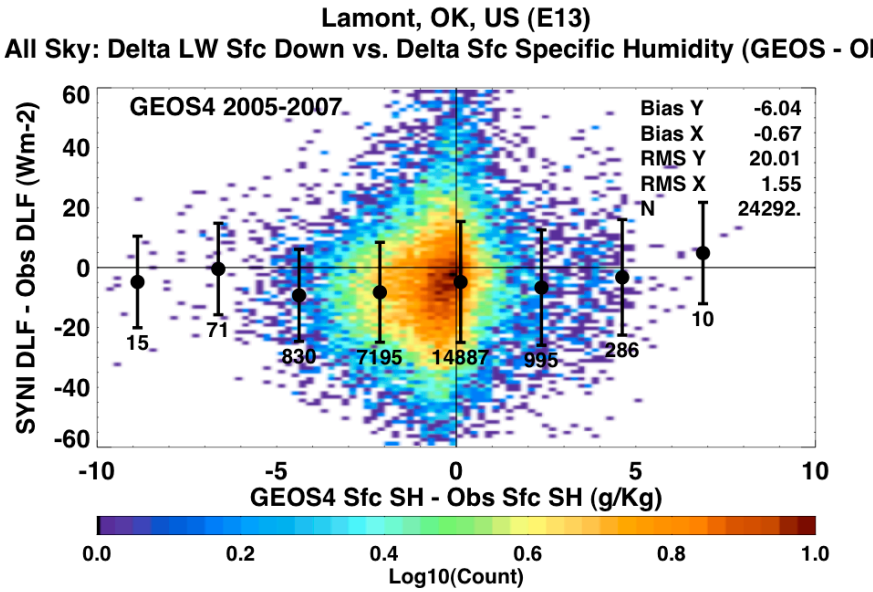
ARM SGP E13 Surface Specific Humidity Comparison (MOA-Obs)

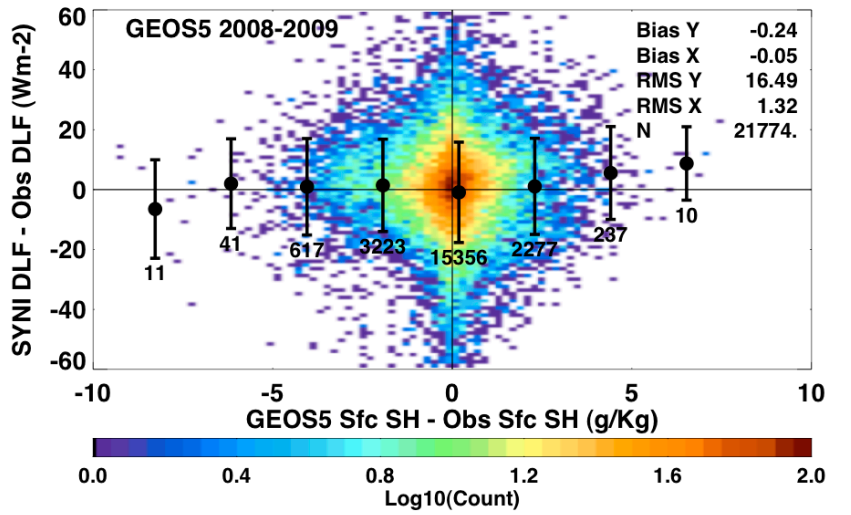
Clear Sky (Daytime SWFA < 0.02)





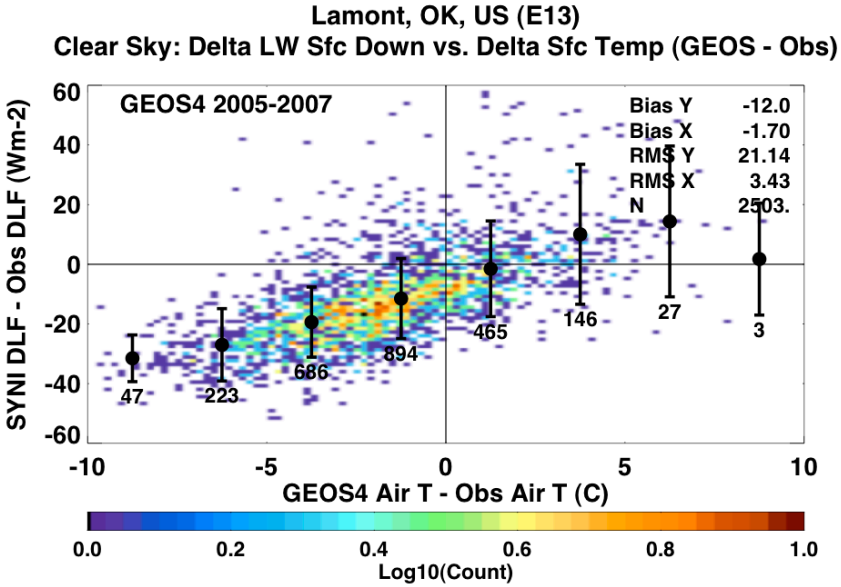
All Sky (Day & Night)

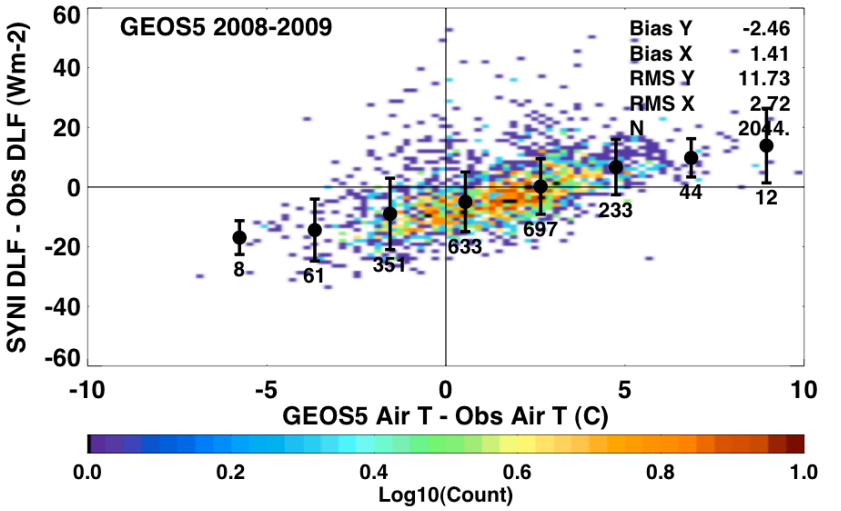




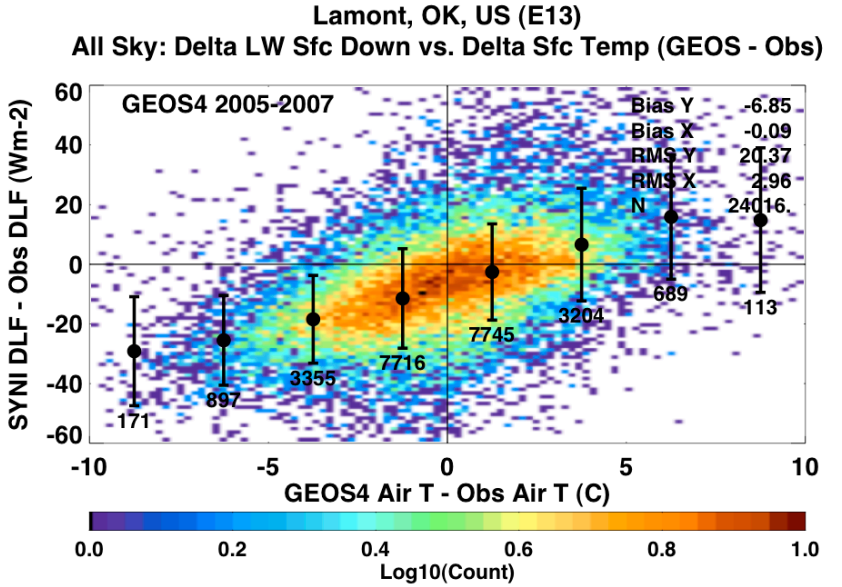
ARM SGP E13 Surface Air Temperature Comparison (MOA-Obs)

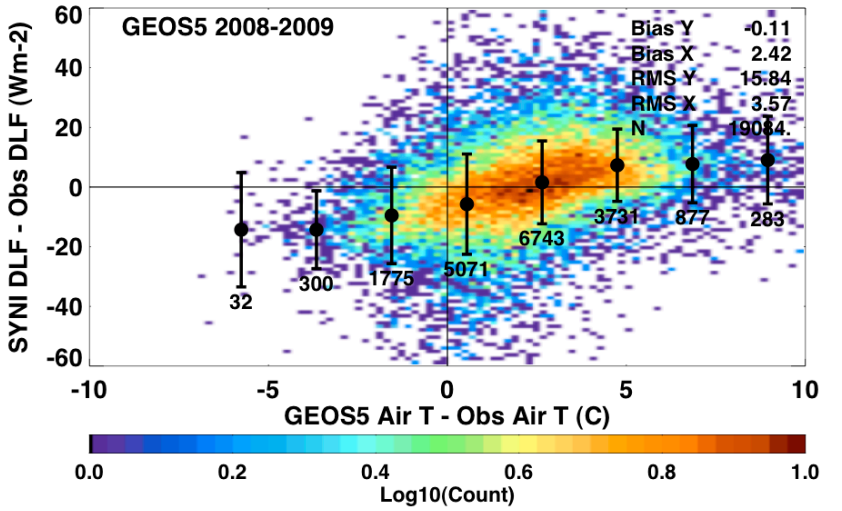
Clear Sky (Daytime SWFA < 0.02)



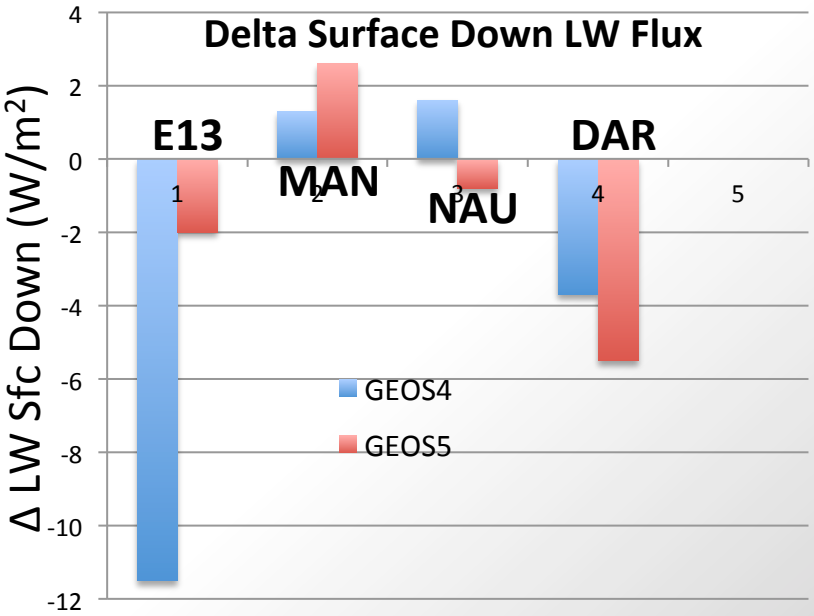


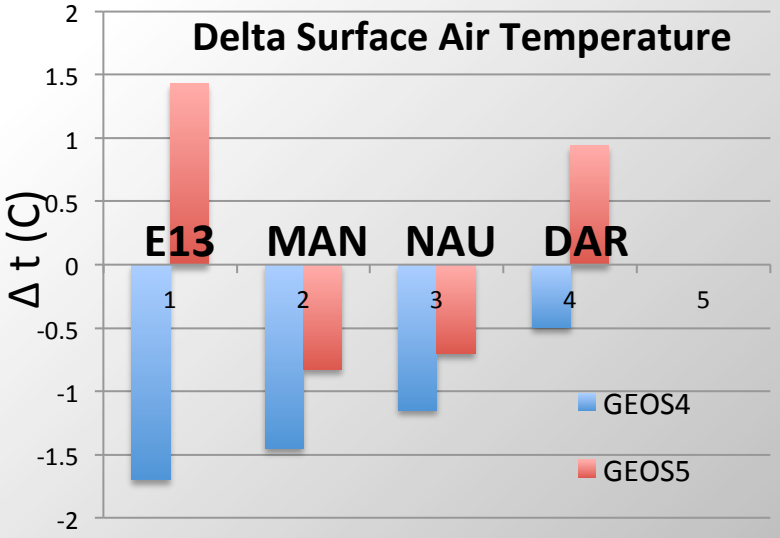
All Sky (Day & Night)

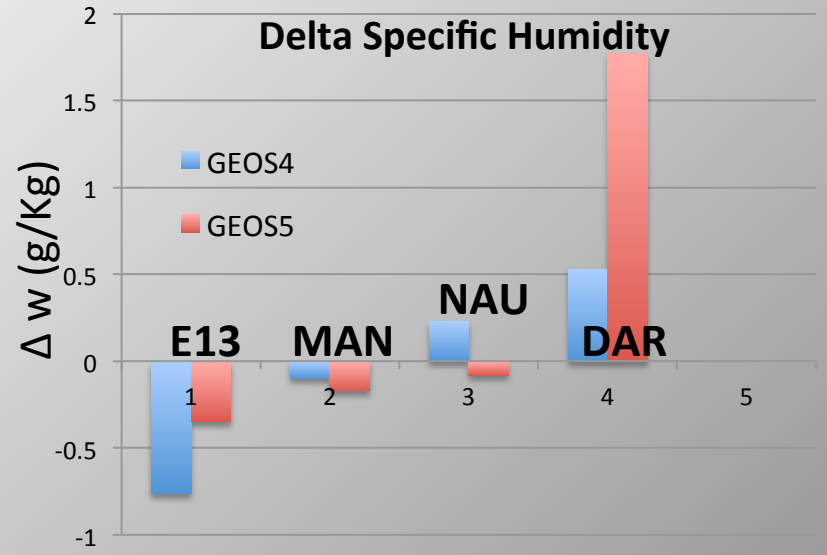




Clear Sky - Mean Difference in Surface Air Temperature, Specific Humidity & Surface Flux (Model-Obs) GEOS 4 & GEOS 5







General Conclusions (at SGP & TWP ARM Sites):

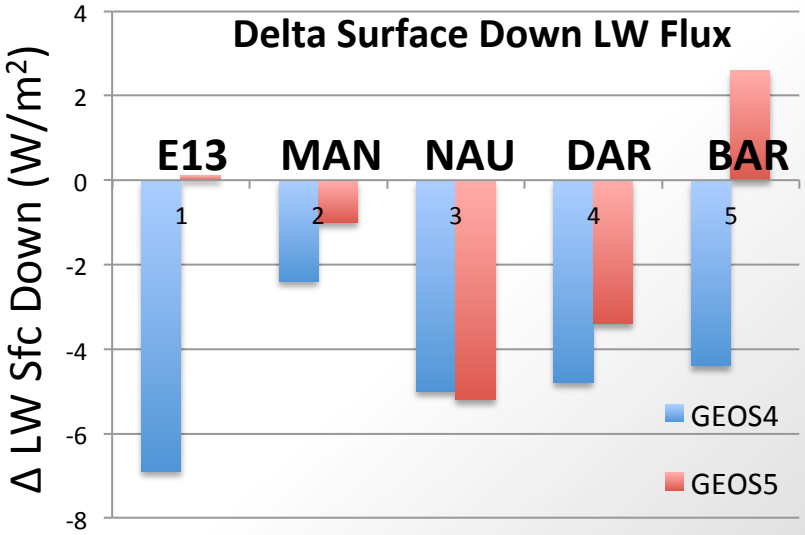
- Directly comparing clear sky and all sky flux differences to surface humidity and temperature differences.

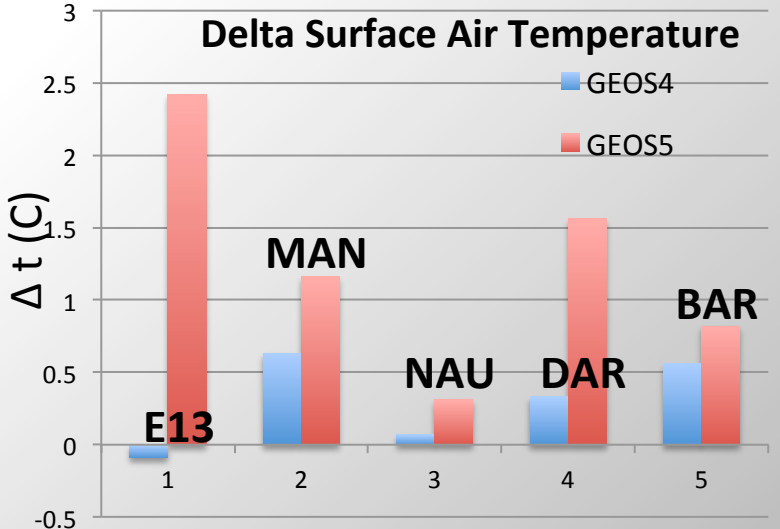
- When there is a large initial discrepancy, as at E13 on DLF, a positive change in MOA results in an improvement in DLF.

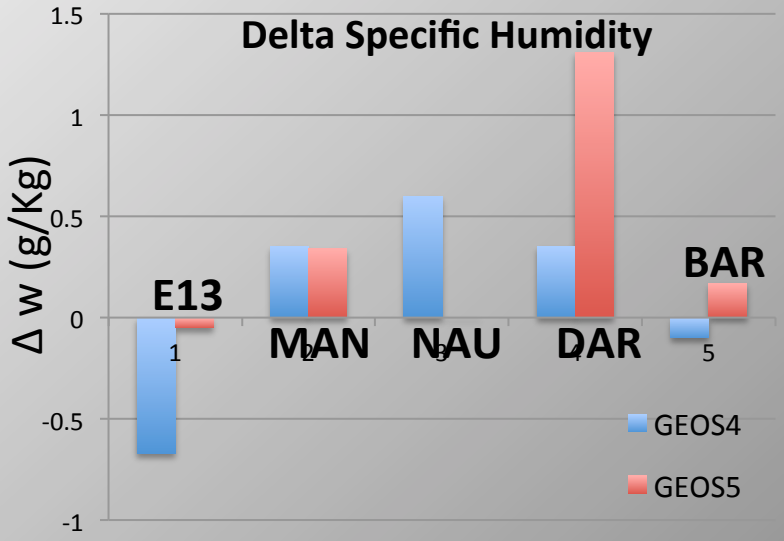
- When initial difference is smaller, attribution of error source and solution becomes more problematic. Near surface air temperature and humidity changes result in a smaller flux errors at E13 and NAU, not MAN & DAR.

To be continued…..
Download AIRS Granules at ARM sites

All Sky - Mean Difference in Surface Air Temperature, Specific Humidity & Surface Flux (Model-Obs) GEOS 4 & GEOS 5







Specific Humidity at Select ARM Sites GEOS4/5 vs. Observations
Bias (Model – Observations)

		All Sky Bias			Clear Sky* Bias (Daytime Only)		
		Flux (Wm^{-2})	SH (g/Kg)	N	Flux (Wm^{-2})	SH (g/Kg)	N
E13	GEOS4	-6.0	-0.67	24292	-11.5	-0.76	2628
	GEOS5	-0.2	-0.05	21774	-2.0	-0.35	2374
MAN	GEOS4	-2.7	0.35	23220	1.3	-0.10	375
	GEOS5	-1.0	0.34	22031	2.6	-0.17	400
NAU	GEOS4	-4.9	0.60	23485	1.6	0.23	488
	GEOS5	-5.2	0.00	21655	-0.8	-0.08	379
DAR	GEOS4	-4.7	0.35	22369	-3.7	0.53	2035
	GEOS5	-3.6	1.31	19600	-5.5	1.77	1221
BAR	GEOS4	-4.9	-0.10	19446	-----	-----	-----
	GEOS5	-0.1	0.17	12610	-----	-----	-----

* Clear Sky defined by Long/Ackerman SWFA algorithm. Cloud fraction = 0 at E13, Cloud fraction <= 0.05 all other sites.

Surface Air Temperature at Select ARM Sites GEOS4/5 vs. Observations (Model – Observations)

		All Sky			Clear Sky* Bias (Daytime Only)		
		Flux (Wm^{-2})	T (C)	N	Flux (Wm^{-2})	T (C)	N
E13	GEOS4	-6.9	-0.09	24016	-12.0	-1.70	2503
	GEOS5	0.11	2.42	19084	-2.7	1.43	2243
MAN	GEOS4	-2.4	0.63	25549	1.7	-1.45	349
	GEOS5	-1.0	1.16	21274	2.5	-0.83	387
NAU	GEOS4	-5.0	0.07	23633	1.5	-1.15	484
	GEOS5	-5.2	0.31	19800	-0.8	-0.70	345
DAR	GEOS4	-4.8	0.33	21812	-3.7	-0.50	2034
	GEOS5	-3.4	1.56	17740	-5.5	0.94	1218
BAR	GEOS4	-4.4	0.56	16209	-----	-----	-----
	GEOS5	2.6	0.82	3429	-----	-----	-----

* Clear Sky defined by Long/Ackerman SWFA algorithm. Cloud fraction = 0 at E13, Cloud fraction <= 0.05 all other sites.