

Updated on the ARM-SGP, MERRA-2 and AIRS comparison

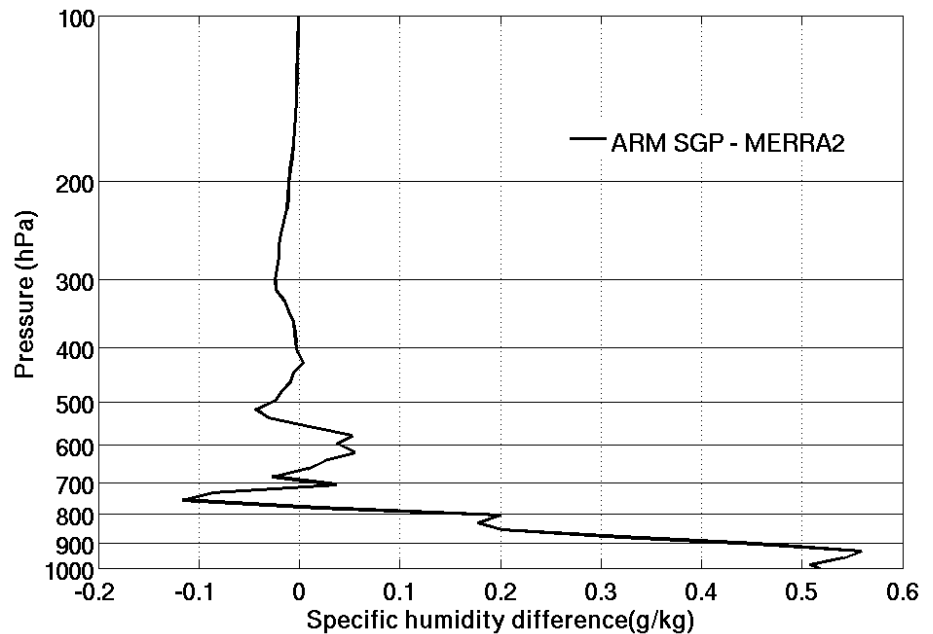
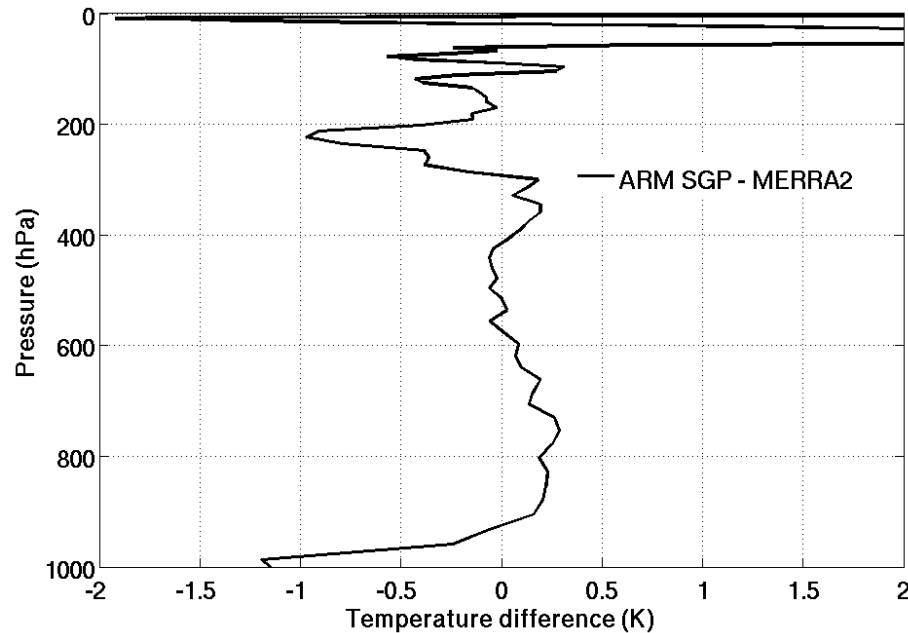
Huang's group (the Univ. of Michigan)

Jan 11, 2017

Updated from the version of December 23,
2016

Profiles difference between ARM SGP and MERRA 2

51-profile mean



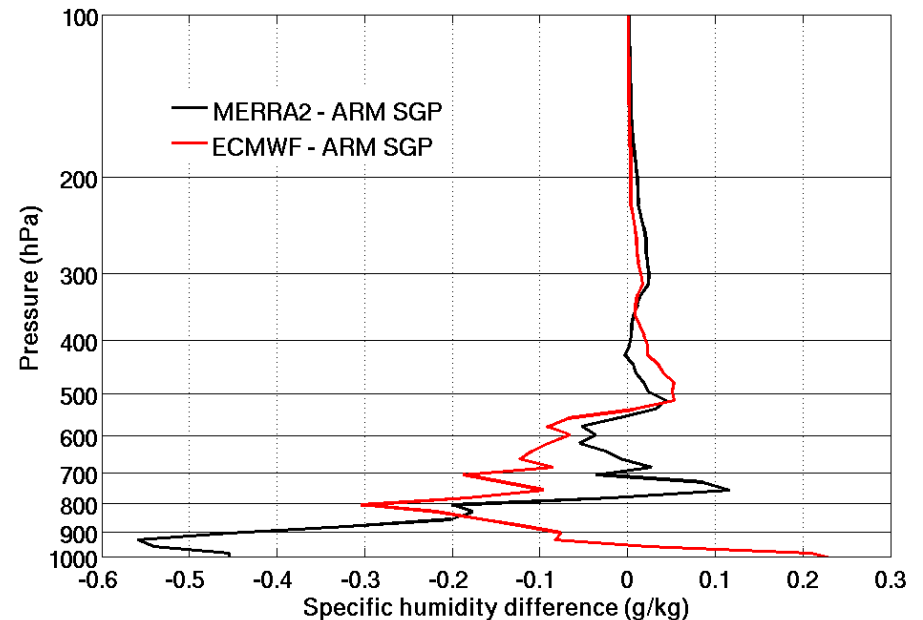
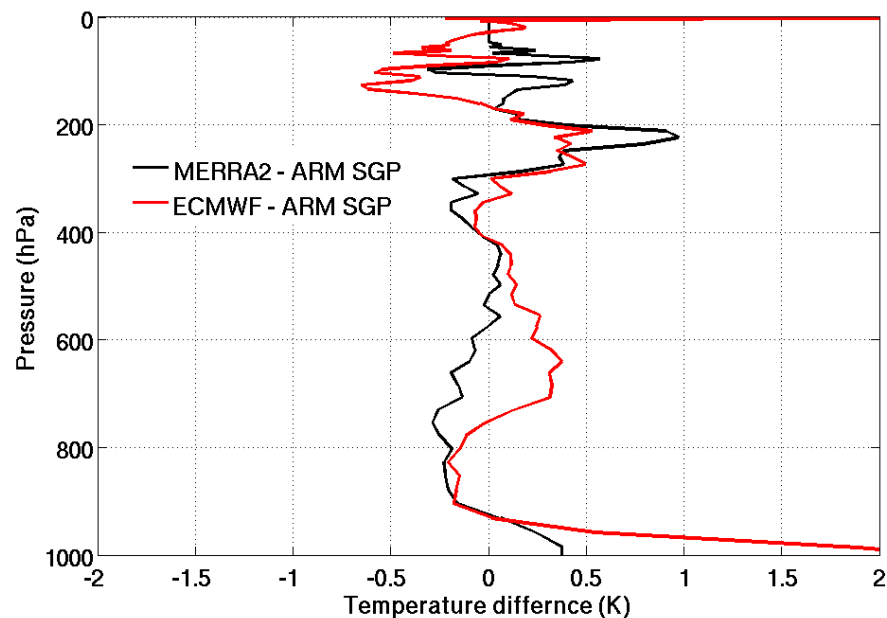
This was the page that I showed on Wednesday. It is ARM_SGP – MERRA2. MERRA2 does have **a wet bias** in 500-200 hPa layer, compared to ARM_SGP.

Update

- Above 50 hPa, ARM SGP use the same profile of MERRA2
- Surface Pressure in ARM simulation is from ECMWF ERA-interim
- Add ECMWF ERA-interim results for cross comparison with MERRA2
- Surface temperature updated from Xiquan's group

Profiles difference between ARM SGP and MERRA 2/ECMWF ERA

51 profiles mean



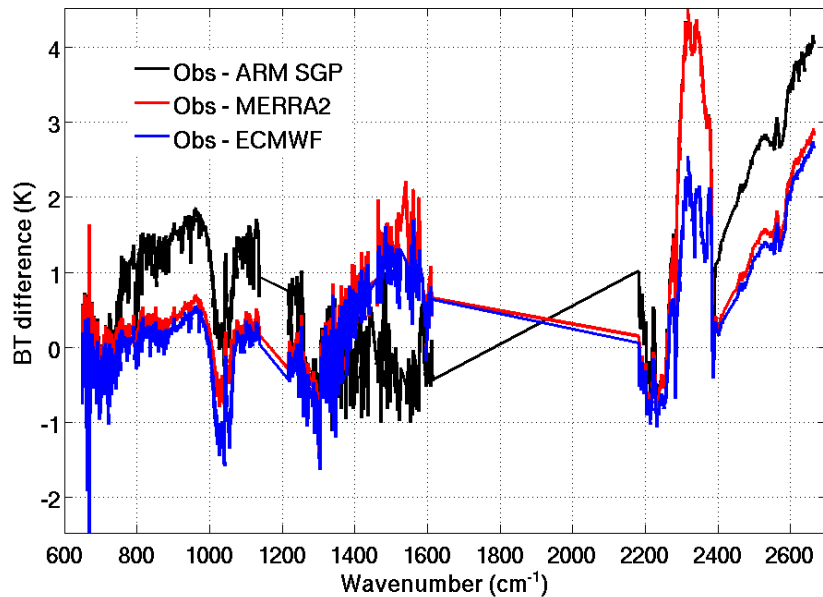
Now the difference is “Reanalysis – ARM”

Positive is wet bias w.r.t. ARM

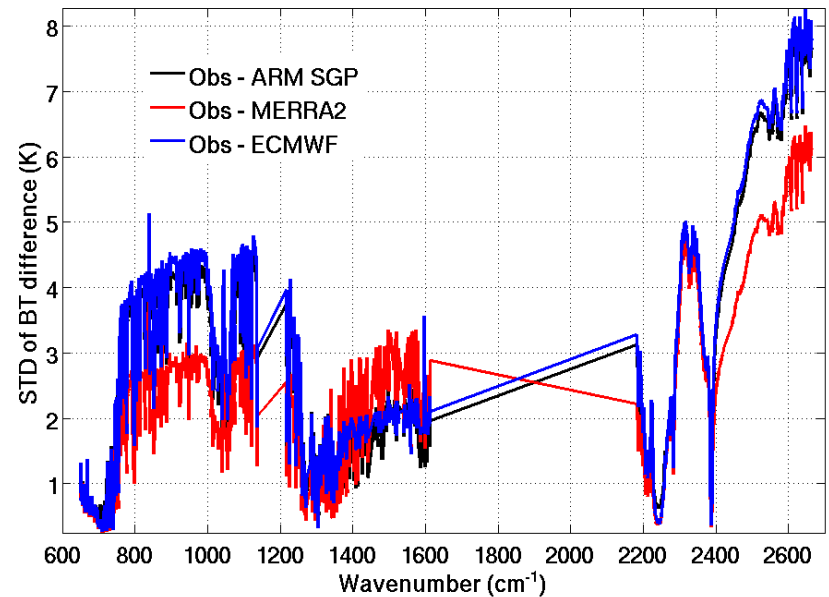
Negative is dry bias w.r.t. ARM

Comparison between AIRS observation and ARM SGP/MERRA2/ECMWF

Mean difference



Standard deviation

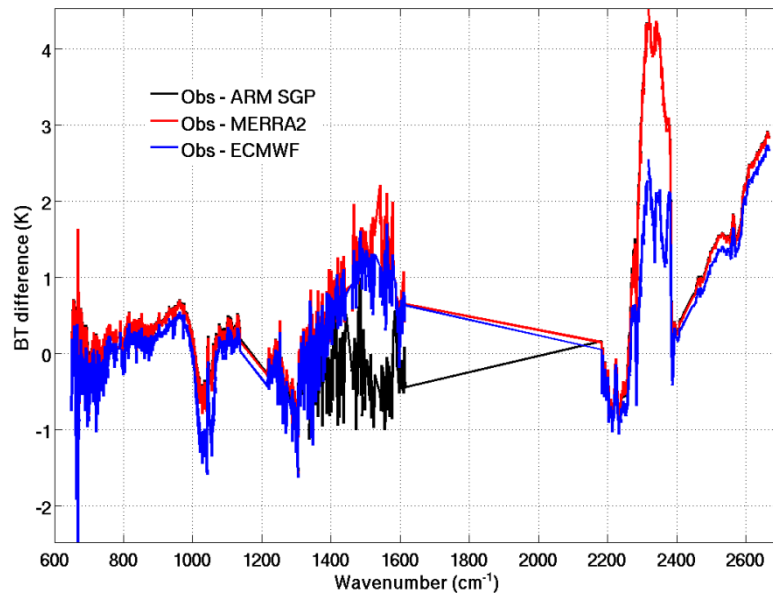


51 footprints in total from Sep. 2004 to Jan. 2013

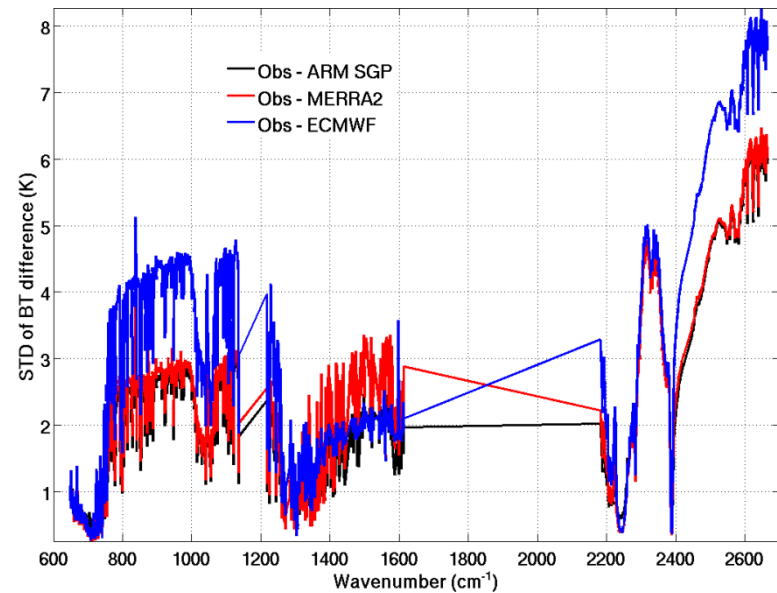
Surface temperature from ARM-SGP data

Comparison between AIRS observation and ARM SGP/MERRA2/ECMWF

Mean difference



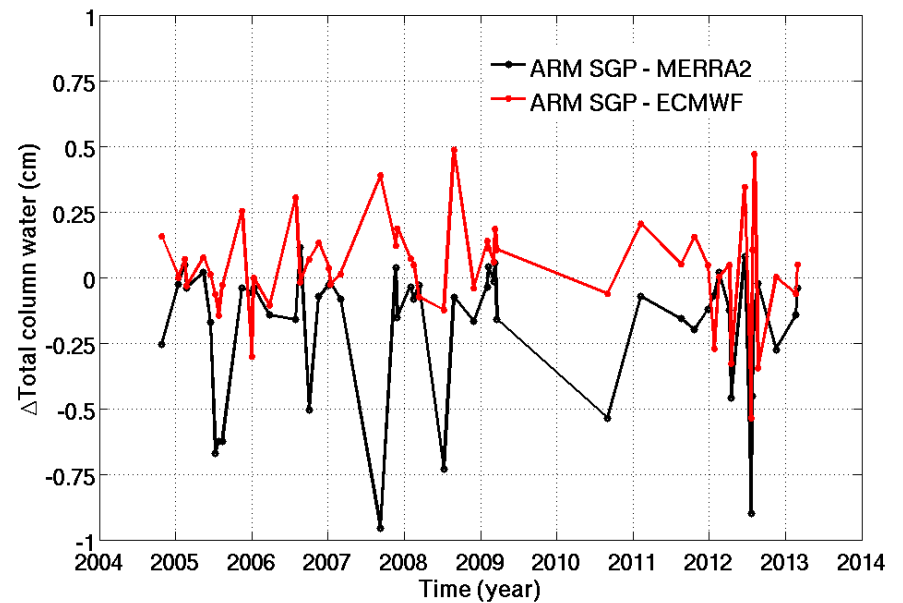
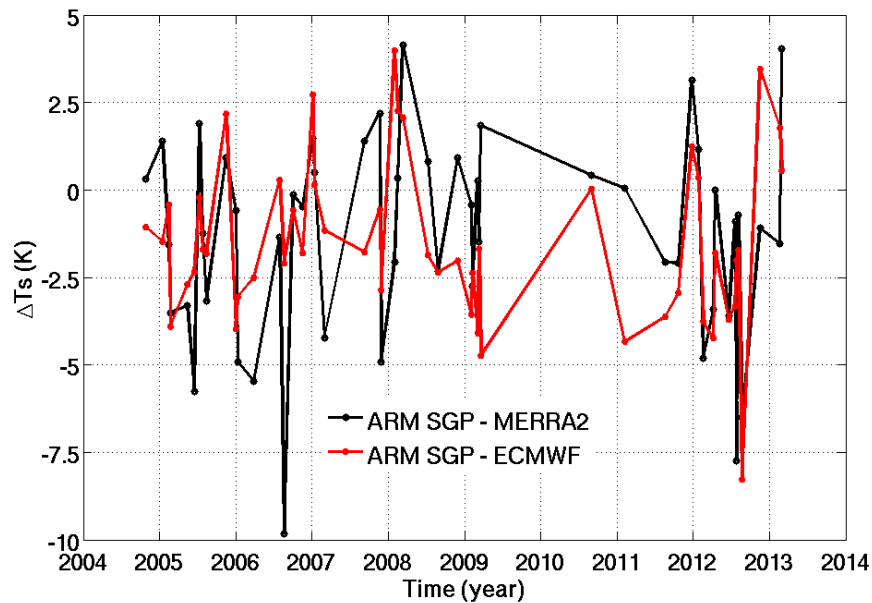
Standard deviation



51 footprints in total from Sep. 2004 to Jan. 2013

Surface temperature MERRA-2

Ts difference and total column water difference



Mean: -1.31 K

Mean: -1.52 K

In average, Ts in ARM SGP lower than those in reanalysis

Mean±SD of BT difference (K)

	CO ₂ band			H ₂ O band		
	Obs – ARM SGP	Obs - MERRA2	MERRA2 – ARM SGP	Obs – ARM SGP	Obs - MERRA2	MERRA2 – ARM SGP
1000-800 hPa	0.76±2.71	0.15±1.86	0.61±1.60	1.44±3.91	0.38±2.67	1.06±2.35
800-600 hPa	0.03±0.95	-0.03±0.73	0.06±0.63	0.68±1.79	0.32±1.28	0.36±1.19
600-400 hPa	-0.15±0.57	-0.14±0.45	-0.01±0.46	0.11±1.52	0.71±2.07	-0.60±2.20
400-200 hPa	-0.39±0.54	-0.43±0.45	0.05±0.38	-0.47±2.05	1.35±2.73	-1.82±2.93
200-70 hPa	-0.22±0.68	-0.31±0.66	0.09±0.24			
70-30 hPa	0.08±0.74	0.04±0.74	0.04±0.11			
30-1 hPa	0.43±0.90	0.42±0.90	0.01±0.03			

MERRA2 – ARM SGP over co2 band is improved after setting T profile above 50 hPa in ARM SGP the same as that in MERRA2.

Mean±SD of BT difference (K)

	CO ₂ band		H ₂ O band	
	ECMWF– ARM SGP	MERRA2 – ARM SGP	ECMWF – ARM SGP	MERRA2 – ARM SGP
1000-800 hPa	0.77±1.52	0.61±1.60	1.21±1.99	1.06±2.35
800-600 hPa	0.26±0.70	0.06±0.63	0.50±1.23	0.36±1.19
600-400 hPa	0.16±0.47	-0.01±0.46	-0.58±1.73	-0.60±2.20
400-200 hPa	0.17±0.38	0.05±0.38	-1.43±1.78	-1.82±2.93
200-70 hPa	0.13±0.30	0.09±0.24		
70-30 hPa	0.39±0.34	0.04±0.11		
30-1 hPa	1.35±1.19	0.01±0.03		

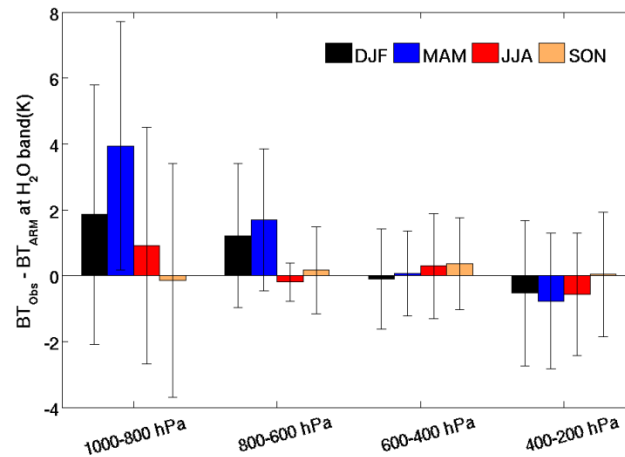
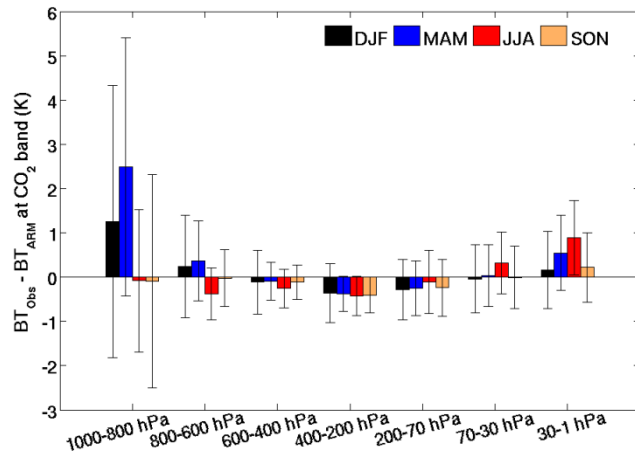
MERRA2 – ARM_SGP in CO2 band is consistently better than ECMWF – ARM_SGP.

$$\Delta R_v \approx \sum_i \frac{\partial R_v}{\partial T_i} \Delta T_i + \sum_i \frac{\partial R_v}{\partial \log q_i} \Delta \log q_i$$

	CO ₂ band			H ₂ O band		
	MERRA2 – ARM_SGP (ΔBT in K)	T_Kernel * (T _{MERRA-ARM}) (ΔBT in K)	q_Kernel * (q _{MERRA-ARM}) (ΔBT in K)	MERRA2 – ARM_SGP (ΔBT in K)	T_Kernel * (T _{MERRA-ARM}) (ΔBT in K)	q_Kernel * (q _{MERRA-ARM}) (ΔBT in K)
600-400 hPa	-0.01	-0.004	-0.02	-0.60	-0.02	-0.61
400-200 hPa	0.05	0.08	-0.01	-1.82	0.06	-1.65

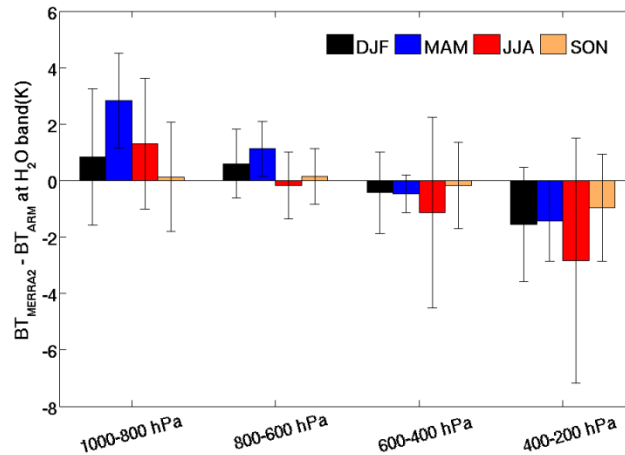
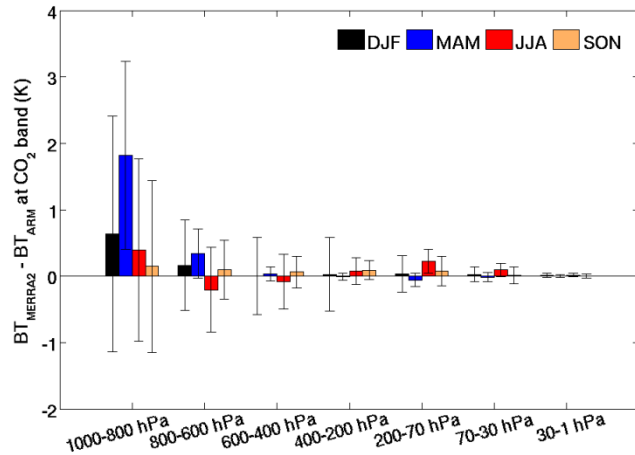
	CO ₂ band			H ₂ O band		
	ECMWF – ARM_SGP (ΔBT in K)	T_Kernel * (T _{ECMWF- ARM}) (ΔBT in K)	q_Kernel * (q _{ECMWF- ARM}) (ΔBT in K)	ECMWF – ARM_SGP (ΔBT in K)	T_Kernel * (T _{ECMWF- ARM}) (ΔBT in K)	q_Kernel * (q _{ECMWF- ARM}) (ΔBT in K)
600-400 hPa	0.16	0.16	-0.01	-0.58	0.13	-0.50
400-200 hPa	0.17	0.16	-0.01	-1.43	0.15	-0.91

Mean difference averaged over 51 clear-sky profiles

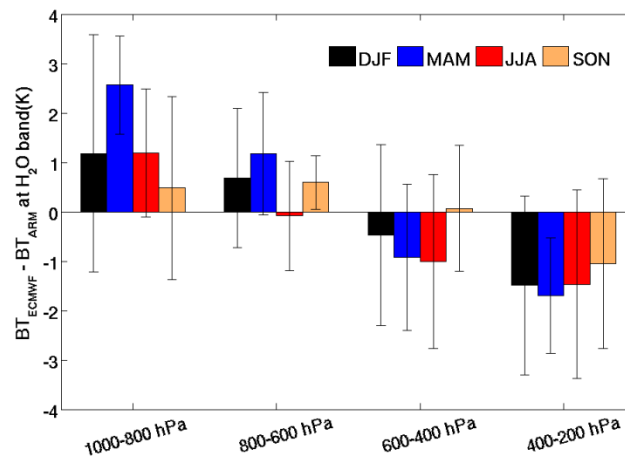
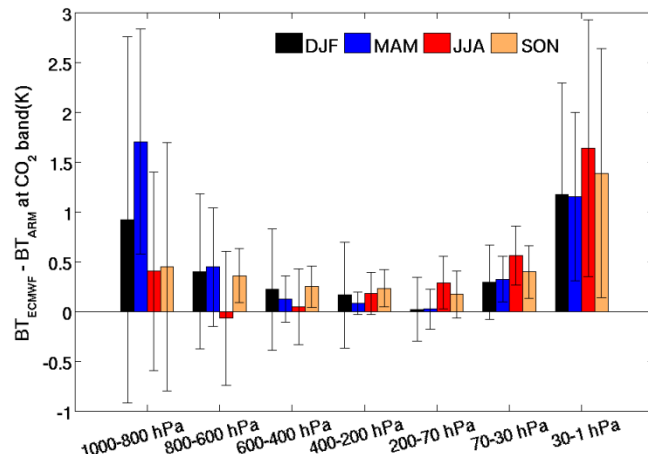


Left CO_2 band
Right H_2O band

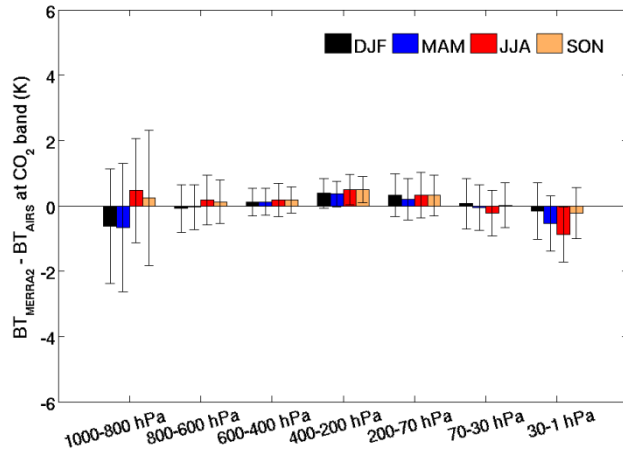
Top Obs – ARM
Mid. MERR2 – ARM
Low ERA – ARM



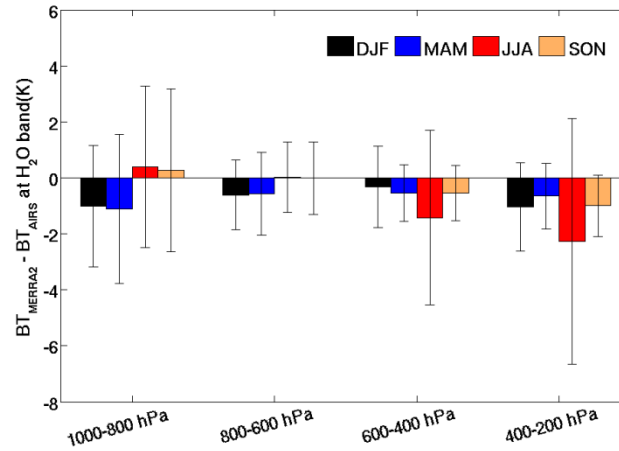
DJF 22 profiles
MAM 5 profiles
JJA 15 profiles
SON 9 profiles



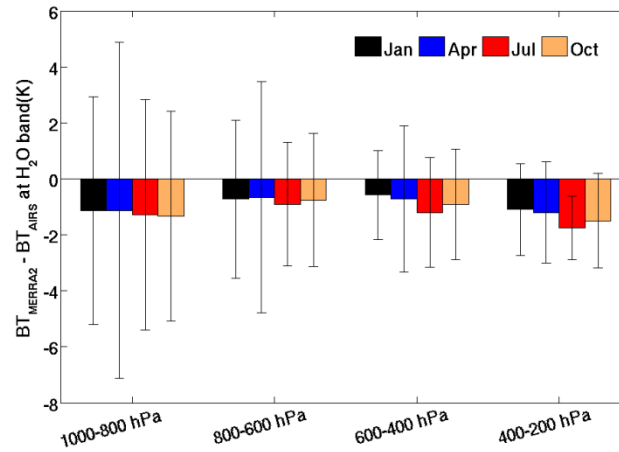
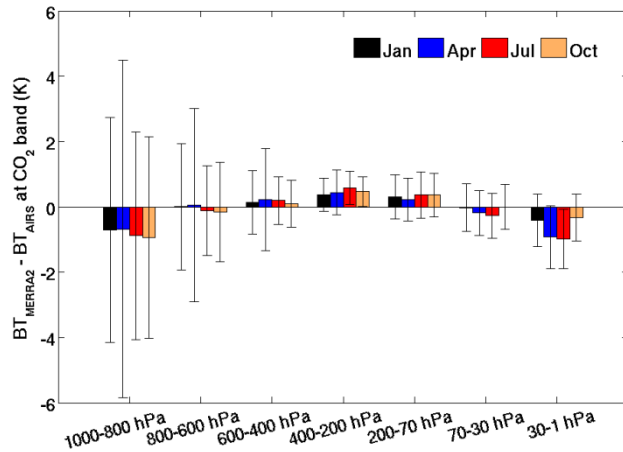
CO₂ band



H₂O band



MERR2 – Obs at ARM SGP site (36.61°N, 97.49°W)



MERR2 – Obs at 30°-40° N latitude band

Left CO₂ band

Right H₂O band

Upper MERR2 – Obs at ARM SGP site (36.61°N, 97.49°W)

Lower MERR2 – Obs at 30°-40° N latitude band