

Ed 4 EBAF-surface

Seiji Kato¹ and Fred G. Rose²

¹NASA Langley Research Center

²Science System & Applications Inc.

EBAF-surface (Ed4) plan

- Use LW spectral irradiances to better constrain downward and upward LW irradiance.
 - Testing the impact on LW spectral is in progress
- Revise the bias correction of downward longwave because Ed 4 SYN accounts for cloud overlap
 - Bias correction is based on cloud overlap comparison using Ed4 SYN and CALIPSO and CloudSat (C3M). Next version of C3M (with Ed4 algorithms) will be used to assess downward longwave bias correction.
- Revise the bias correction of OLR with AIRS v006 because reanalysis is switched to GEOS-5.4.1
 - Bias error estimate is based on upper tropospheric relative humidity comparison with AIRS, MERRA2, and ERA-Interim
- Test a possible use of spectral radiance for T and Q bias corrections
 - Use AIRS radiances and forward spectral radiance computations
- Revise the uncertainty estimate used for Lagrange multiplier algorithm.
- Estimate uncertainty in surface radiative fluxes
 - Comparison with surface observations
 - Evaluation of surface radiative flux variability
 - Surface and atmospheric energy balance check

Ed 4 EBAF-surface adjustment process simulation

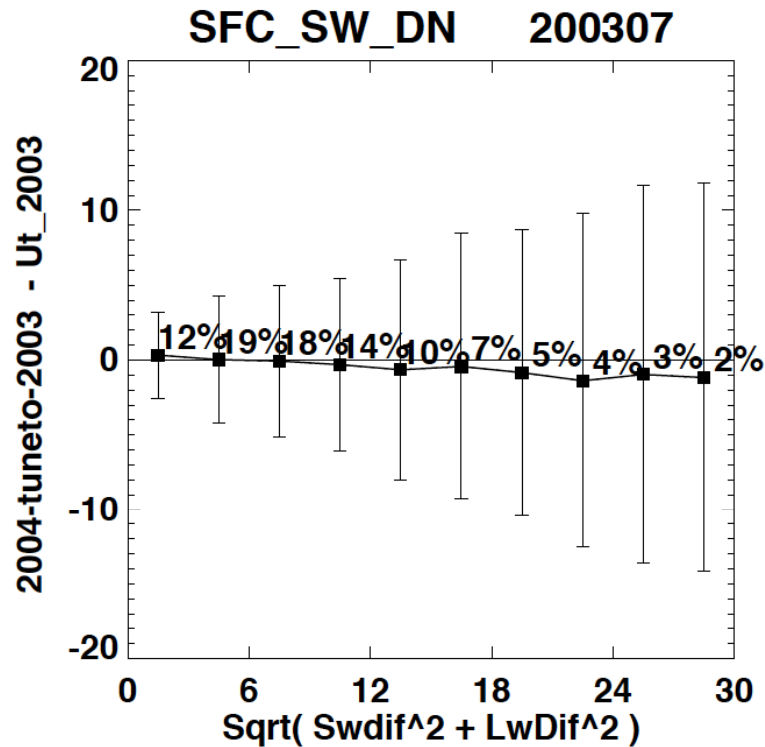
- To evaluate current process indeed reduces the error in surface irradiances
 - Computed SYN 200307 (200407) SW and LW irradiances are tuned to computed SYN 200407 (200307) TOA SW and LW irradiances.
 - Surface SW and LW irradiances are evaluated using 200407 (200307) computed surface irradiances.
- Sensitivity of tuned surface irradiance to initial TOA computed irradiance
 - Use two different months from SYN 200307 and 200407 or and tuned to 200307 or 200407 EBAF-TOA
- To test whether or not spectral information improve surface irradiances, EBAF-surface process
 - Add spectral irradiances and evaluate whether or not surface up and downward irradiances improve.

Evaluation of current process

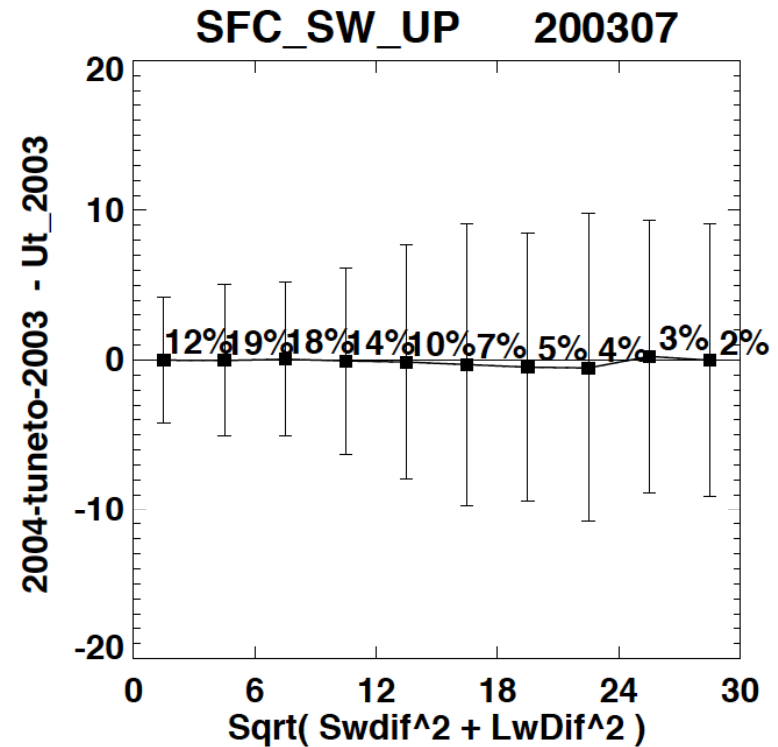
	SYN - SYN-TOA		Tuned surface irradiance difference Different month – correct month (RMS)			
	SW	LW	SW down	SW up	LW down	LW up
Tuned to 200307 SYN						
200307 (EBAF)	-0.462 (5.86)	-2.36 (4.59)				
200407	-0.231 (14.38)	-0.498 (11.51)	-0.521 (9.38)	-0.07 (6.41)	-0.075 (8.92)	-0.465 (9.87)
Tuned to 200407 SYN						
200407 (EBAF)	-0.650 (5.56)	-2.09 (4.30)				
200307	0.231 (14.38)	0.498 (11.51)	-0.676 (8.95)	0.321 (6.13)	4.68 (10.17)	-0.618 (10.23)

Simulated process needs to correct larger regional differences (larger RMS) than the actual EBAF process

Surface SW

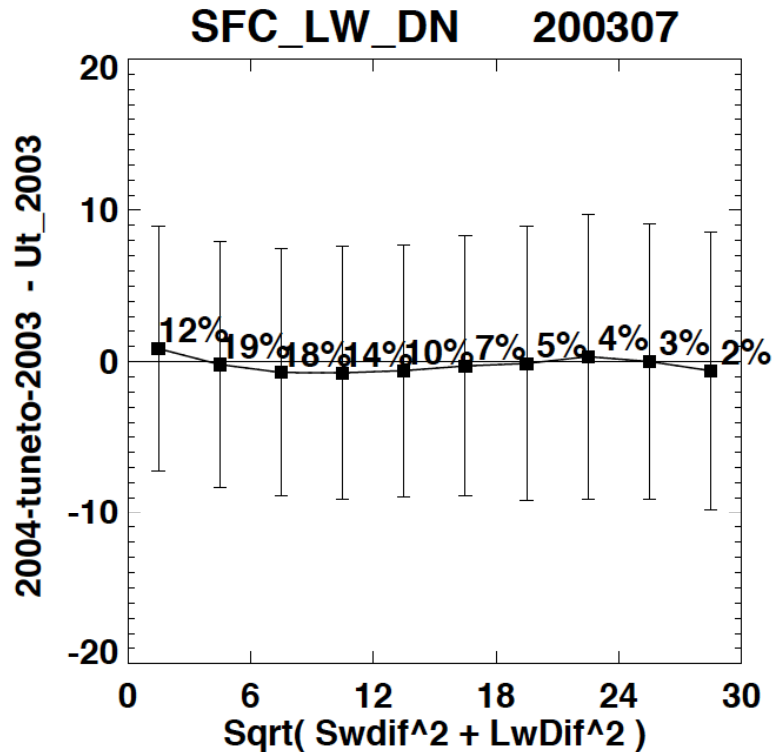


N= 39818. Mean (StdDev)
 Sqrt(Swdif^2 + LwDif^2) 10.46(7.13)
 2004-tuneto-2003 - Ut_2003 -0.284(6.87)

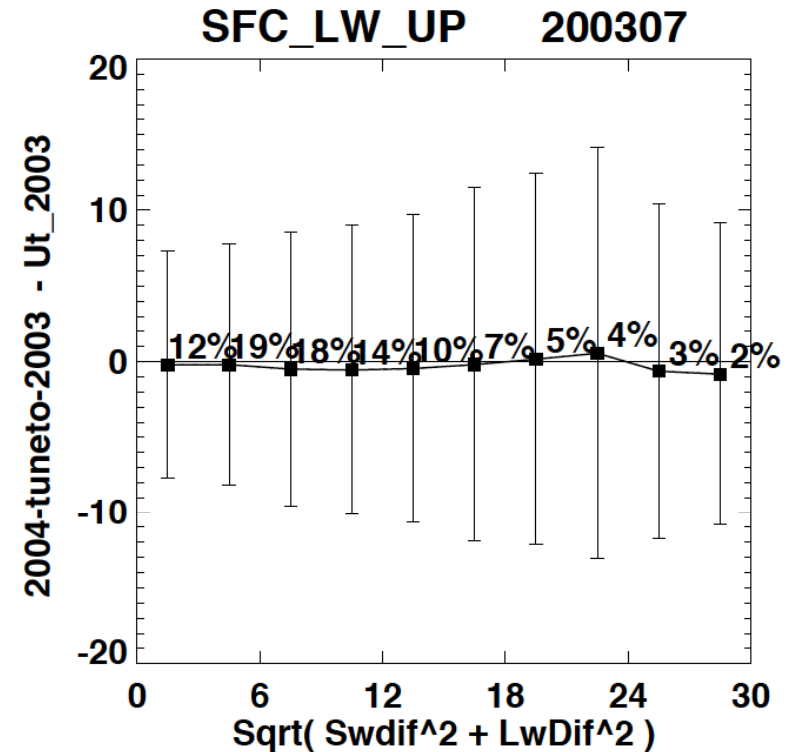


N= 39818. Mean (StdDev)
 Sqrt(Swdif^2 + LwDif^2) 10.46(7.13)
 2004-tuneto-2003 - Ut_2003 -0.084(6.74)

Surface LW



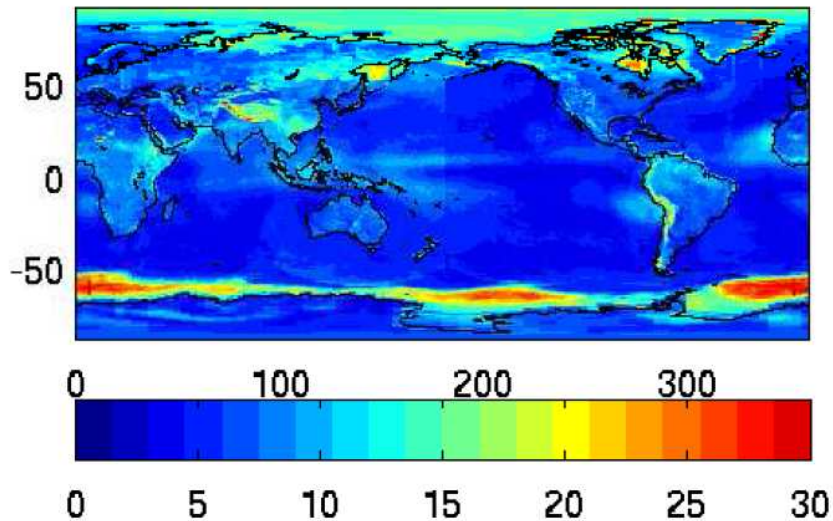
N= 39818. Mean (StdDev)
 Sqrt(Swdif^2 + LwDif^2) 10.46(7.13)
 2004-tuneto-2003 - Ut_2003 -0.258(8.42)



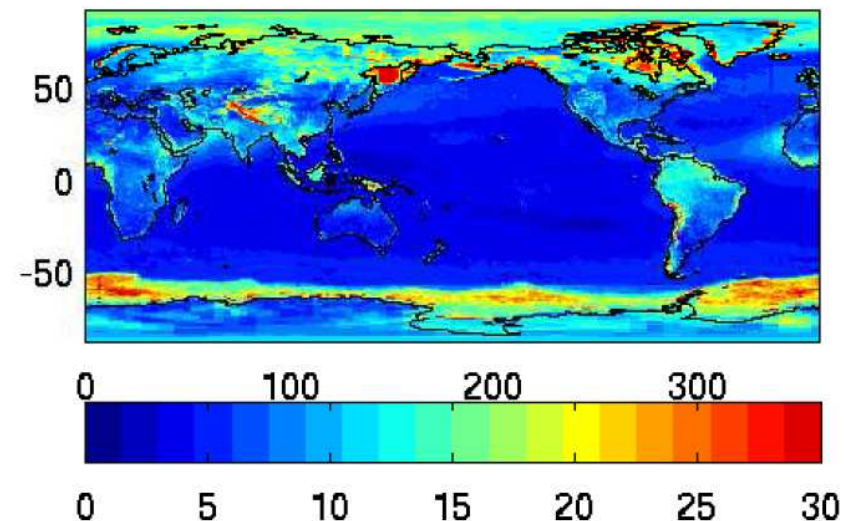
N= 39818. Mean (StdDev)
 Sqrt(Swdif^2 + LwDif^2) 10.46(7.13)
 2004-tuneto-2003 - Ut_2003 -0.310(9.66)

Regions with larger surface irradiance uncertainty

All-sky $\text{SQRT}[(\text{SW RMS})^2 + (\text{LW RMS})^2]$



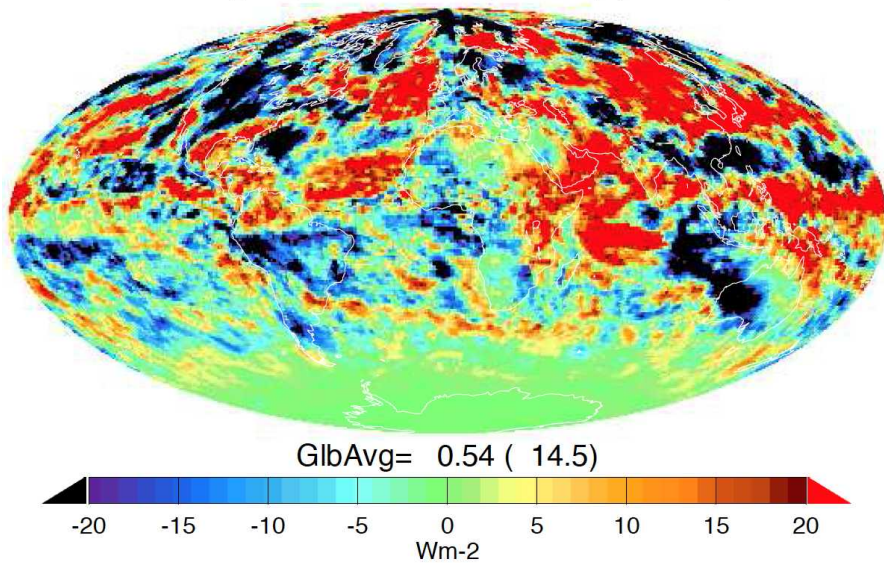
Clear-sky $\text{SQRT}[(\text{SW RMS})^2 + (\text{LW RMS})^2]$



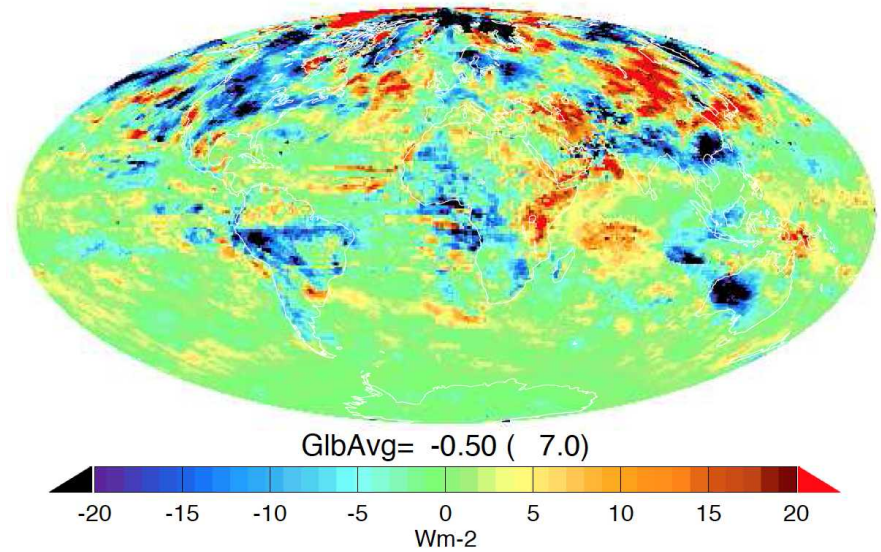
Regions with a larger RMS difference of modeled and observed TOA irradiances often coincide with regions with a larger uncertainty of surface irradiance

Surface SW down

SFC_SW_DN Untuned (200407)-(200307)

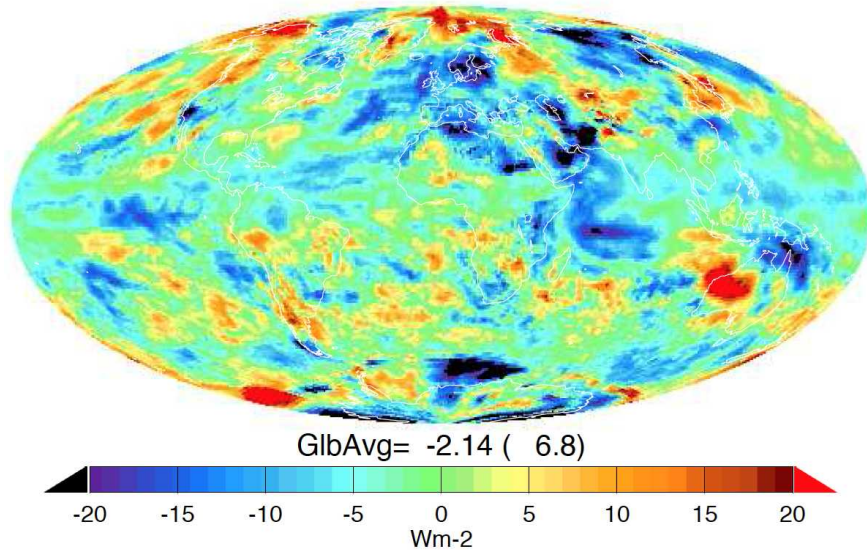


SFC_SW_DN TU 200407 to SYN^{WV1-2}_TOA 200307 - Untuned(200307)

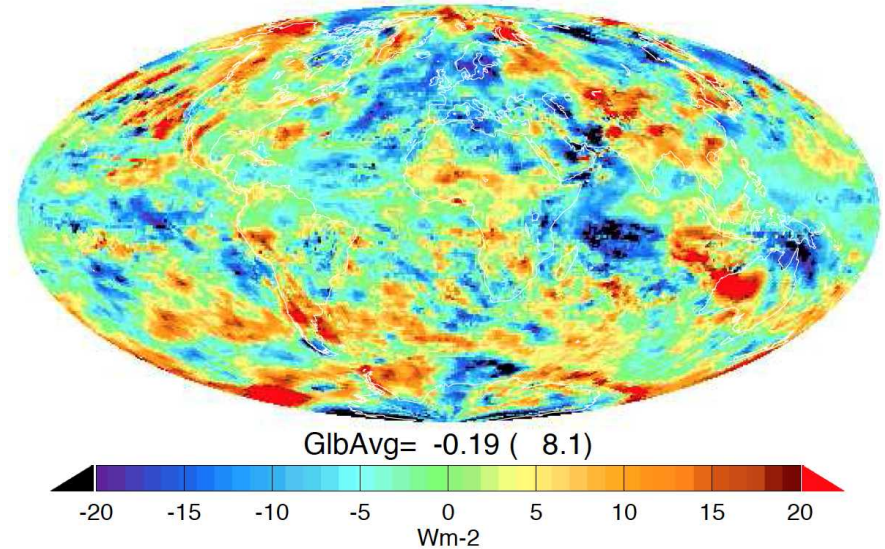


Surface LW down

SFC_LW_DN Untuned (200407)-(200307)



SFC_LW_DN TU 200407 to SYN_TOA 200307 - Untuned(200307)

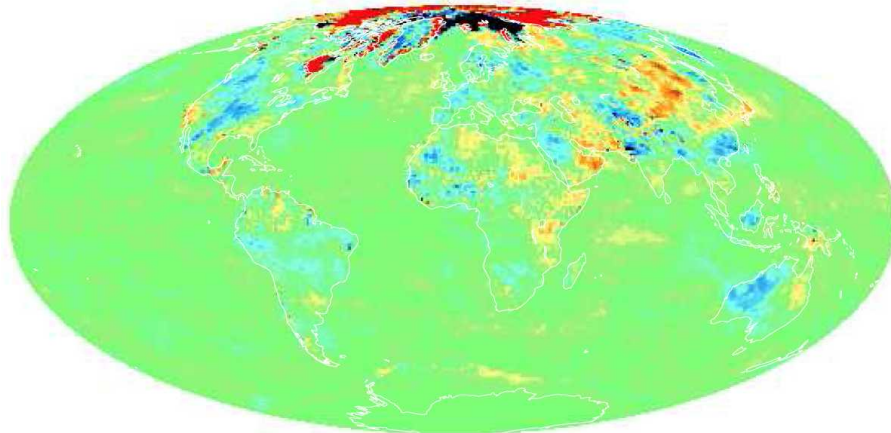


Summary of current process

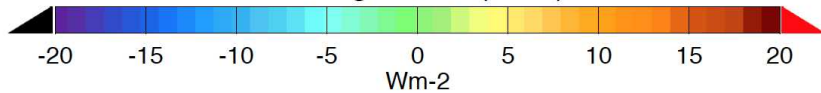
- Surface SW (especially downward) irradiance is constrained by TOA irradiance better than LW.
- When one of computed SW and LW TOA irradiances cannot match TOA observations, it affects both SW and LW surface irradiances.
- When the difference between modeled and computed TOA irradiance is smaller, the uncertainty in the surface irradiance is also smaller (except for LW down).

SW up

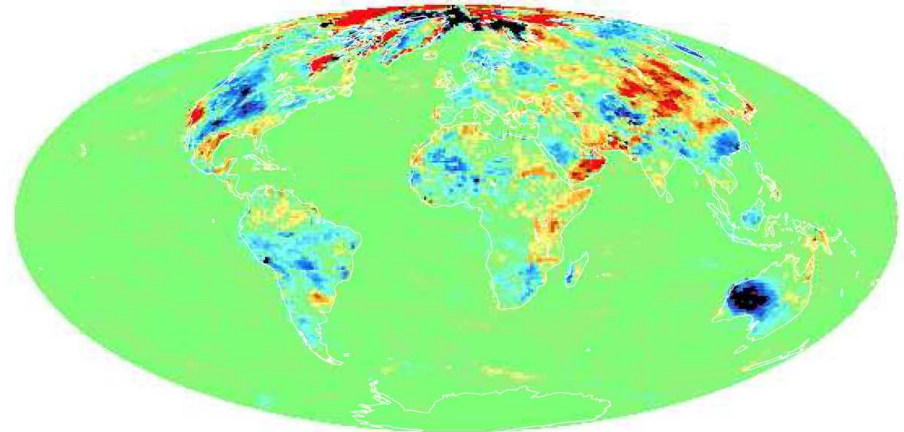
SFC_SW_UP Untuned (200407)-(200307)



GlbAvg= 0.06 (3.2)



SFC_SW_UP TU 200407 to SYN_TOA 200307 - Untuned(200307)

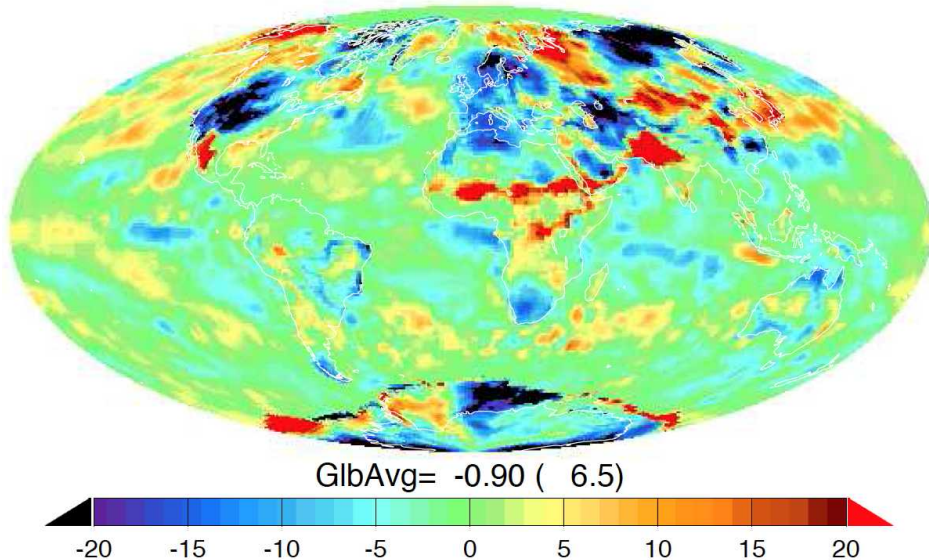


GlbAvg= -0.08 (3.9)

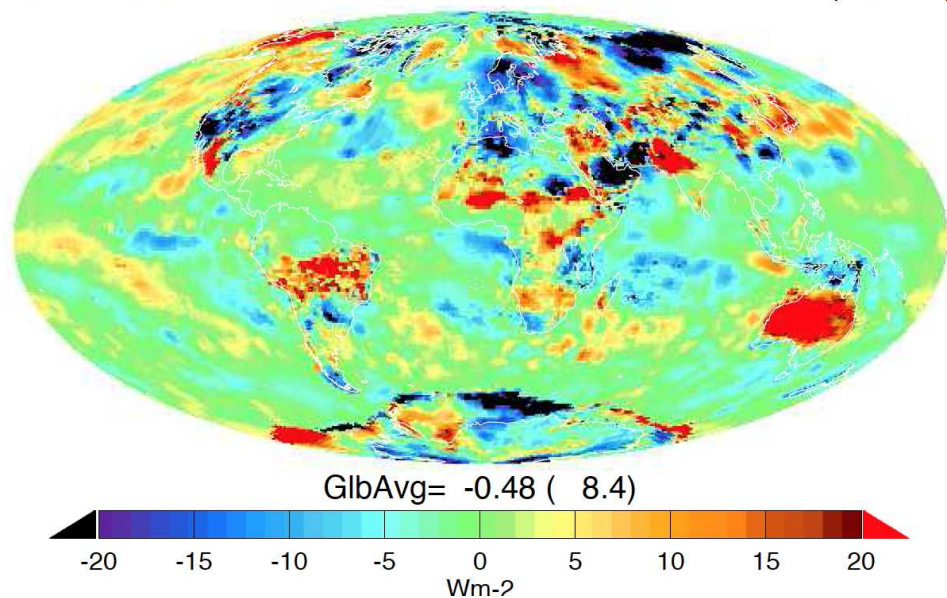


LW up

SFC_LW_UP Untuned (200407)-(200307)



SFC_LW_UP TU 200407 to SYN_TOA 200307 - Untuned(200307)



Large tuned error over Australia is due to a large error in SW down
Perhaps, tuning needs to be too large to match TOA SW.

Sensitivity to initial conditions

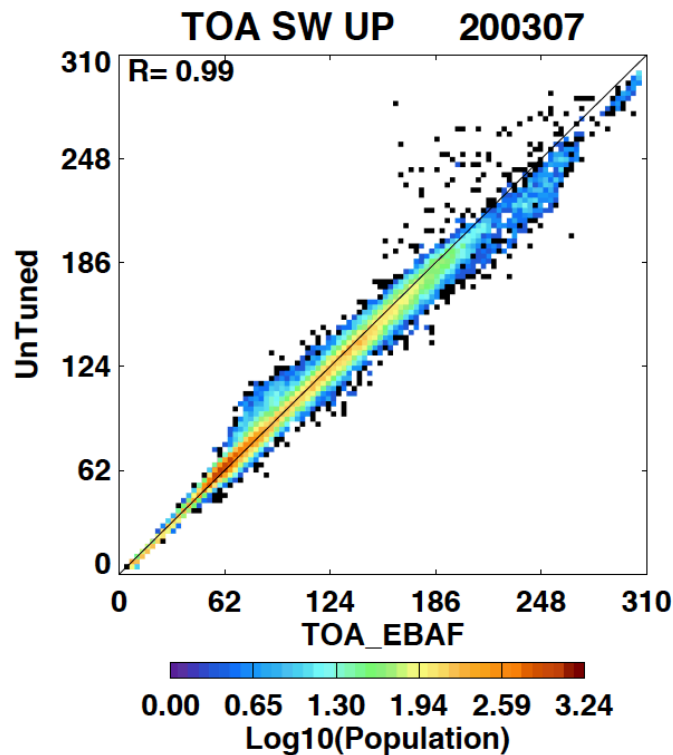
- Sensitivity of tuned surface irradiances to initial TOA computed irradiances
 - Use two different months from SYN 200307 and 200407 or and tuned to 200307 or 200407 EBAF-TOA

Dependence to the initial condition

	SYN - EBAF-TOA		Tuned surface irradiance difference Different month – correct month (RMS)			
	SW	LW	SW down	SW up	LW down	LW up
Tuned to 200307 EBAF-TOA			(untune 200407 – untune 200307)			
200307	-0.462 (5.86)	-2.36 (4.59)	0.414 (16.94)	0.102 (6.73)	-2.02 (7.91)	-0.903 (8.13)
200407	-0.691 (15.10)	-2.86 (12.17)	-0.293 (9.78)	-0.106 (6.66)	-2.14 (9.05)	-0.555 (10.09)
Tuned to 200407 EBAF-TOA						
200407	-0.650 (5.56)	-2.09 (4.30)				
200307	-0.420 (15.79)	-1.59 (11.83)	-0.590 (9.56)	0.321 (6.49)	2.67 (9.18)	-0.504 (10.44)

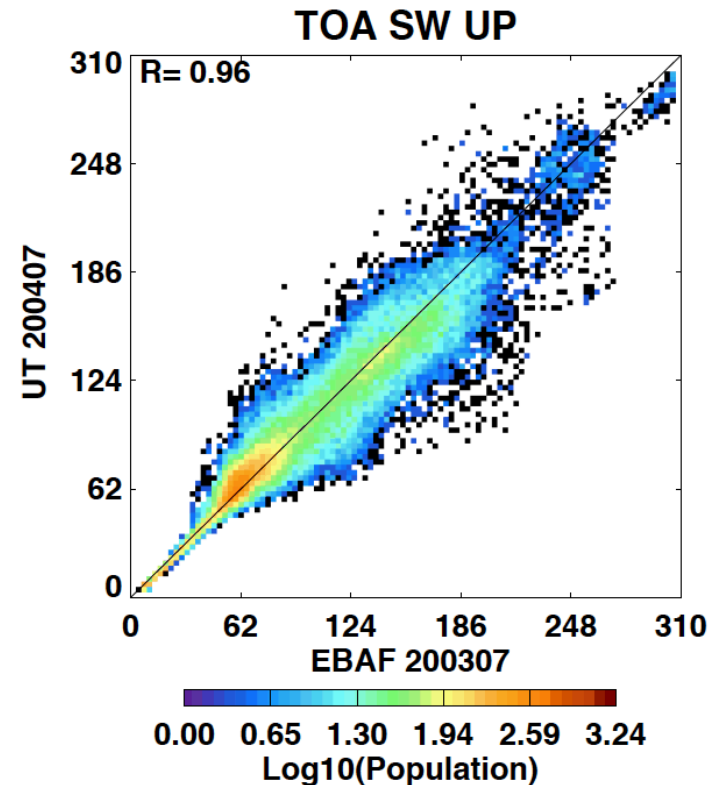
SW down is least sensitive and LW down is most sensitive

200307 or 200407 tuned to 200307 SW



N= 44012.

	Mean (StdDev)
TOA_EBAF	93.35(53.29)
UnTuned	92.89(51.36)
Y-X	-0.462(5.84)
RMS(	5.86).....



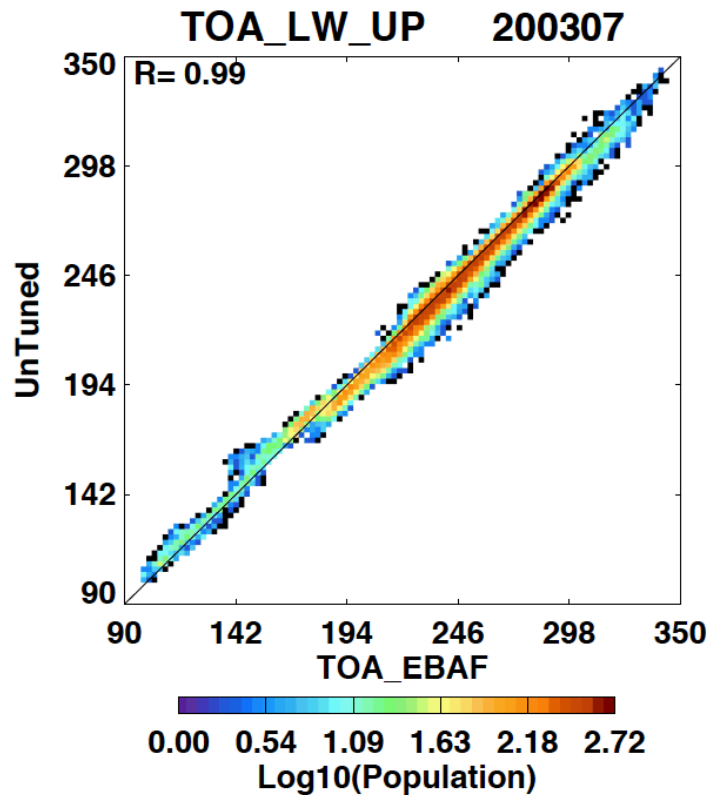
N= 44012.

	Mean (StdDev)
EBAF 200307	93.35(53.29)
UT 200407	92.66(50.37)
Y-X	-0.691(15.08)
RMS(	15.10).....

Tuning is larger when different month is used

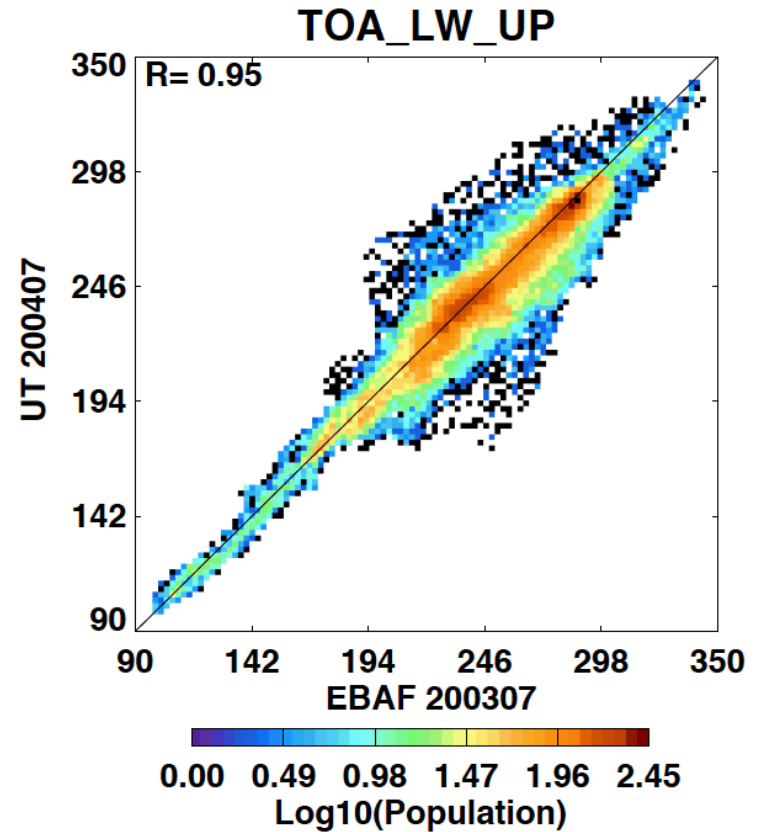
200307 or 200407 tuned to 200307

LW



N= 44012.

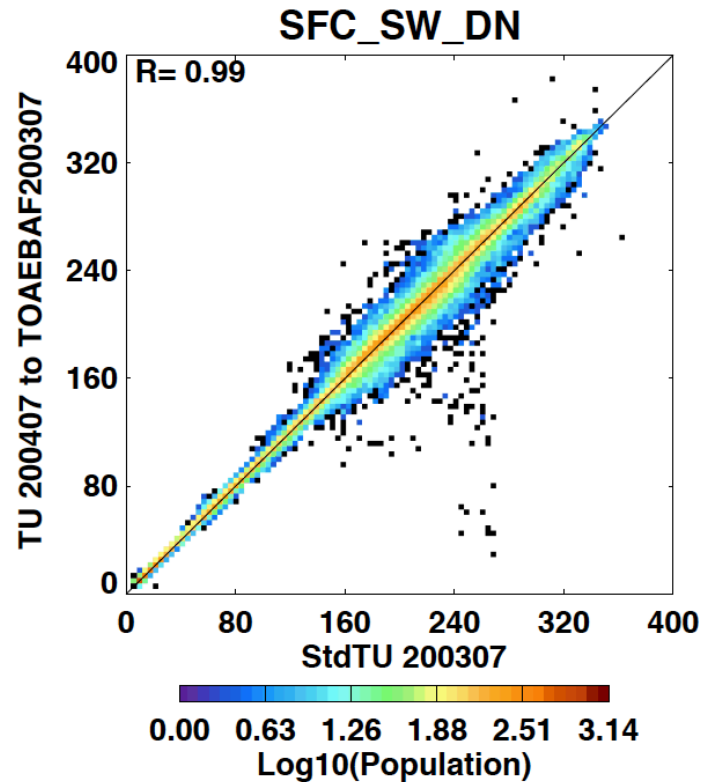
	Mean (StdDev)
TOA_EBAF	244.4(37.72)
UnTuned	242.1(37.35)
Y-X	-2.36(3.93)
RMS(	4.59).....



N= 44012.

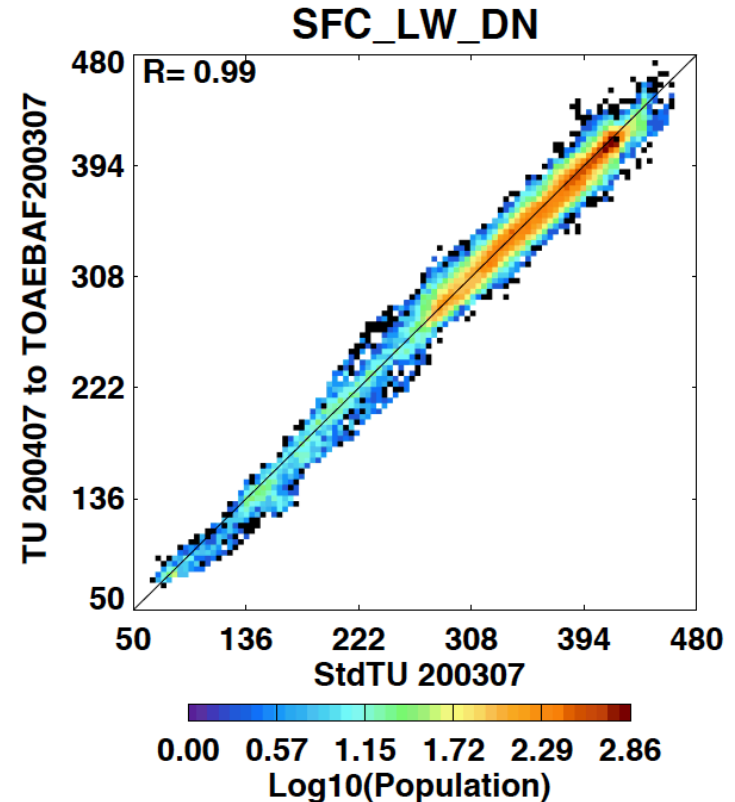
	Mean (StdDev)
EBAF 200307	244.4(37.72)
UT 200407	241.6(36.97)
Y-X	-2.86(11.83)
RMS(	12.17).....

Tuned surface SW and LW down



N= 44012.

	Mean (StdDev)
StdTU 200307	177.9(89.54)
TU 200407 to TOAEBAF200307	177.6(89.23)
Y-X	-0.293(9.77)
RMS(	9.78).....



N= 44012.

	Mean (StdDev)
StdTU 200307	353.3(65.46)
TU 200407 to TOAEBAF200307	351.1(65.23)
Y-X	-2.14(8.80)
RMS(	9.05).....