What is the Continual Intercomparison of Radiation Codes (CIRC)?

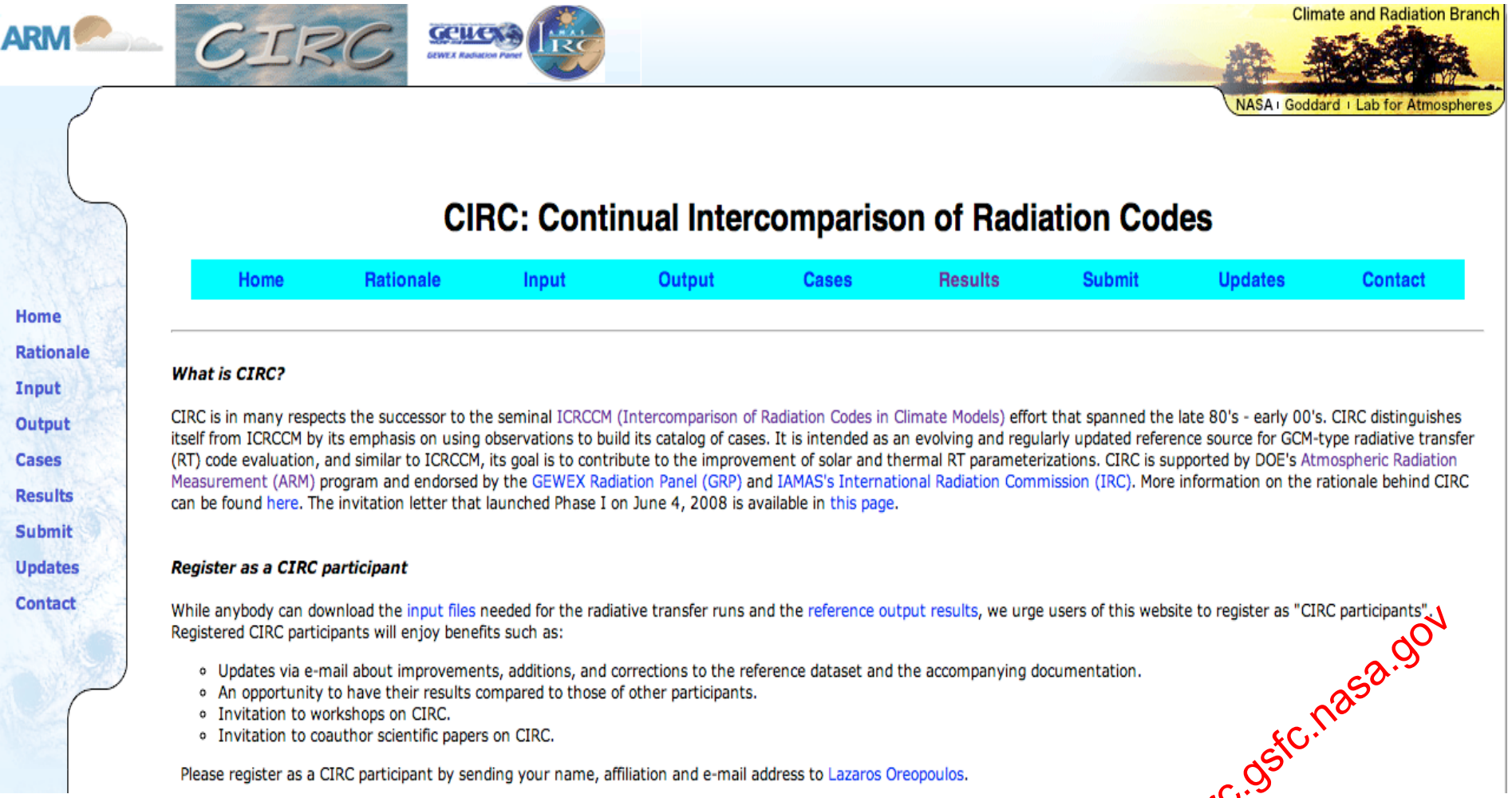
- RT model intercomparison aspiring to become the standard for documenting the performance of RT codes in Large-Scale Models
- Sponsored by ARM and endorsed by GEWEX Radiation Panel and IRC
- Goal is to have RT codes of IPCC models report RT performance against the CIRC cases
- Phase I was launched on June 4, 2008

Differences from previous intercomparisons:

- *Observation-tested* LBL calculations to used as radiative benchmarks
- Benchmark results are publicly available
- ARM observations provide input (from a flux closure dataset named BBHRP)
- Flexible structure and longer lifespan than previous intercomparisons

Core team: Oreopoulos, Mlawer, Delamere, Shippert

CIRC website



http://circ.gsfc.nasa.gov

CIRC Practical Challenges

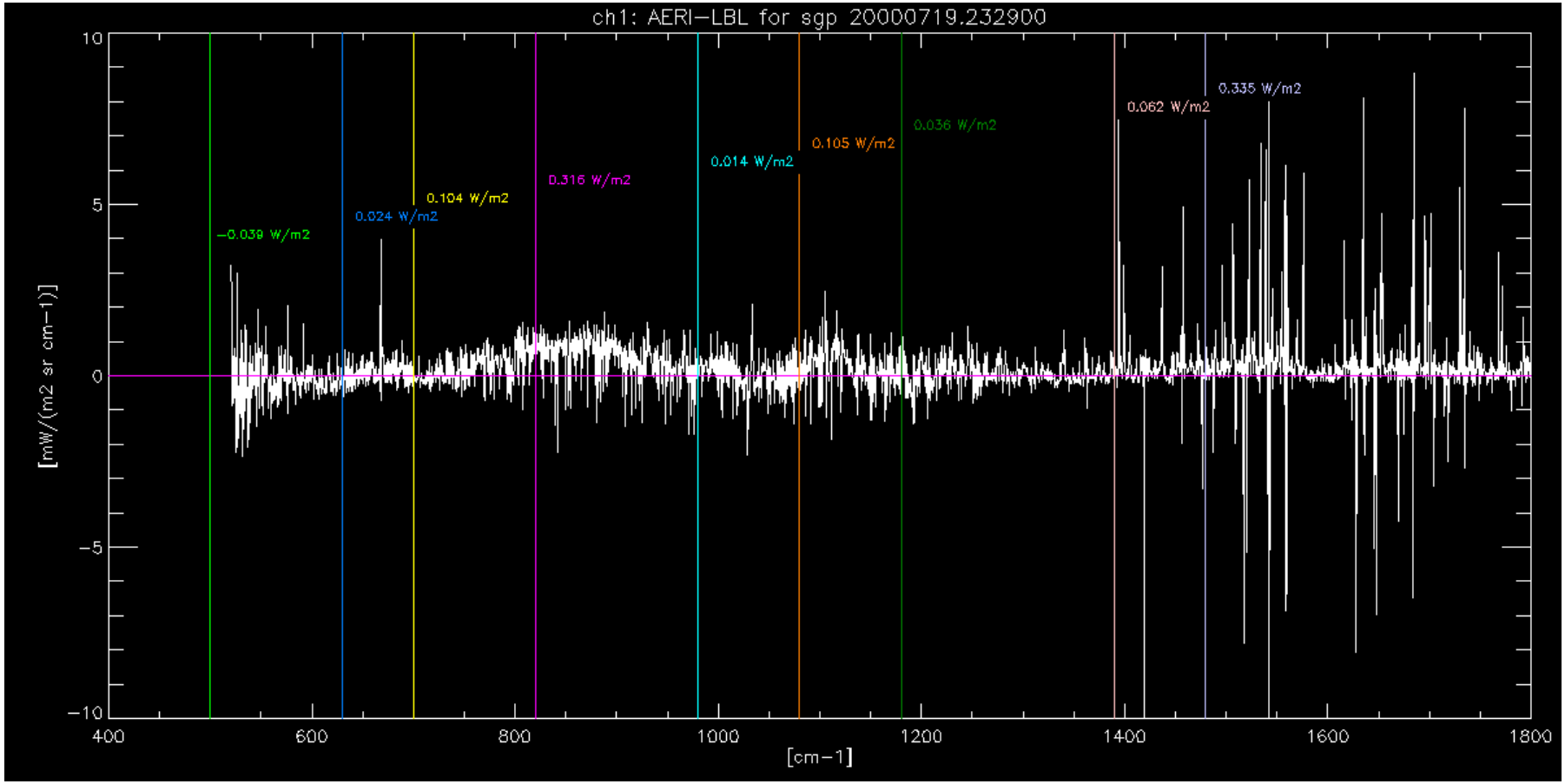
- For input and reference calculations to be credible, a reasonable level of agreement with observations is desirable
- ARM BBHRP dataset (v.1.4.1) is small; very few BBHRP cases satisfy our criteria:
  - ✓ homogeneous* (1D)
  - ✓ closure at TOA and SFC for both SW and LW
- LBL calculations are not standard in BBHRP
- Input for LBL calculations is not necessarily available from BBHRP (e.g., spectral surface albedo)
- Validation of LBL calculations

** See also SPECTRE paper by Ellingson and Wiscombe (BAMS 1996)*

CIRC Phase I cases

Case	SZA	PWV (cm)	τ_{aer}	LWP (gm^{-2})	obs - LBL LW_{SFC}	LW_{TOA}	SW_{SFC}	SW_{TOA}
(1) SGP 9/25/00	47.9°	1.23	0.04		0.4%	-0.5%	0.5%	-3.1%
(2) SGP 7/19/00	64.6°	4.85	0.18		0.6%	-1.4%	-1.1%	8.4%
(3) SGP 5/4/00	40.6°	2.31	0.09		1.0%	-1.2%	-0.1%	-8.7%
(4, 5) NSA 5/3/04 2xCO_2)	55.1°	0.29	0.13		1.2%	-0.6%	-0.8%	0.7%
(6) SGP 3/17/00	45.5°	1.90	0.24	263.4	1.1%	-3.0%	4.9%	-0.9%
(7) PYE 7/6/05	41.2°	2.42		39.1	0.2%	0.6%	-0.4%	-0.1%

LW QC: Spectral comparison with obs



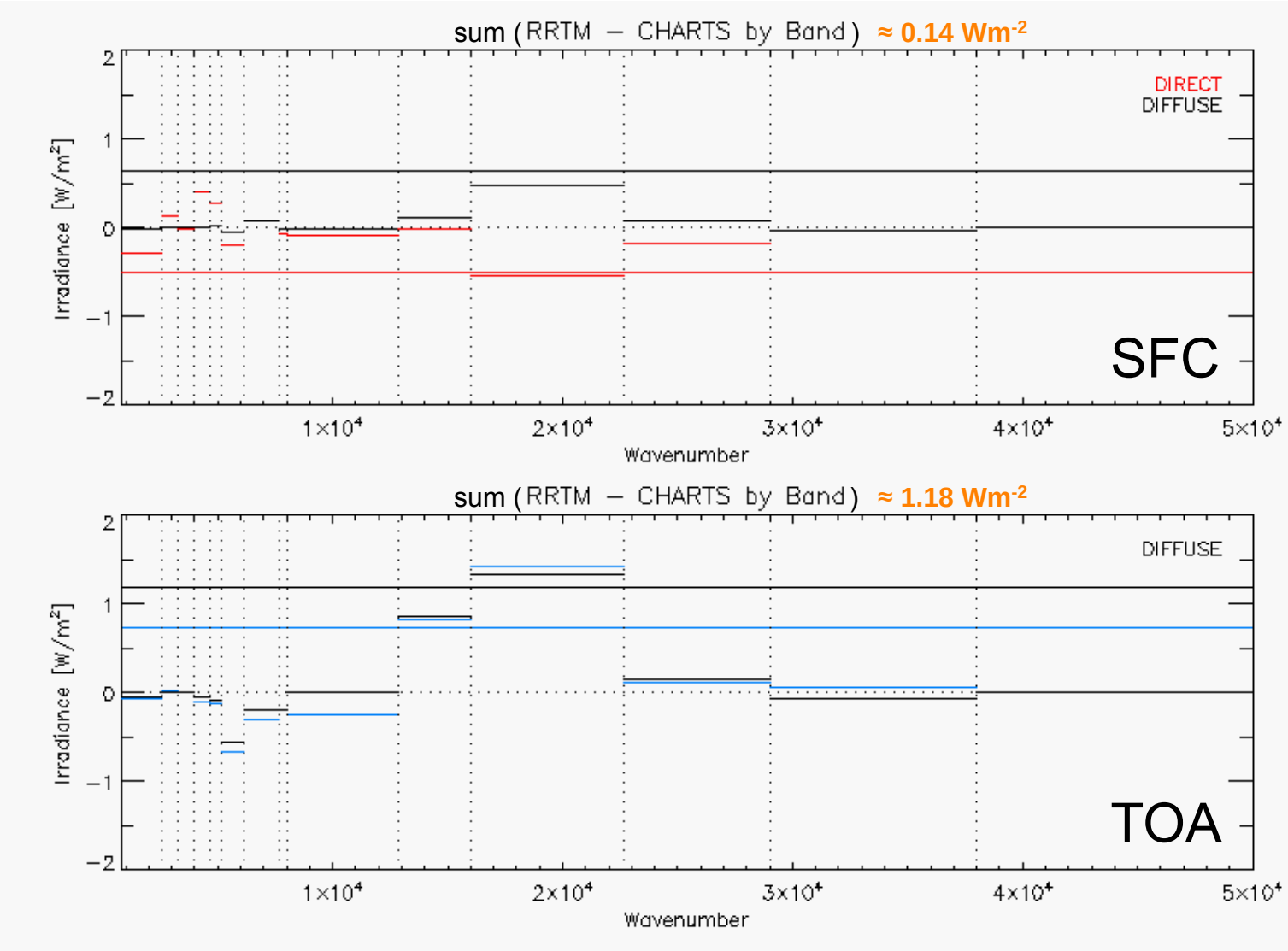
LBLRTM vs AERI

(runs and plot by T. Shippert)

7/19/2000, SGP: Warm and moist

LW_{TOA} = 292.6 (LBLRTM), 288.6 (obs)
LW_{SFC} = 439.3 (LBLRTM), 441.8 (obs)

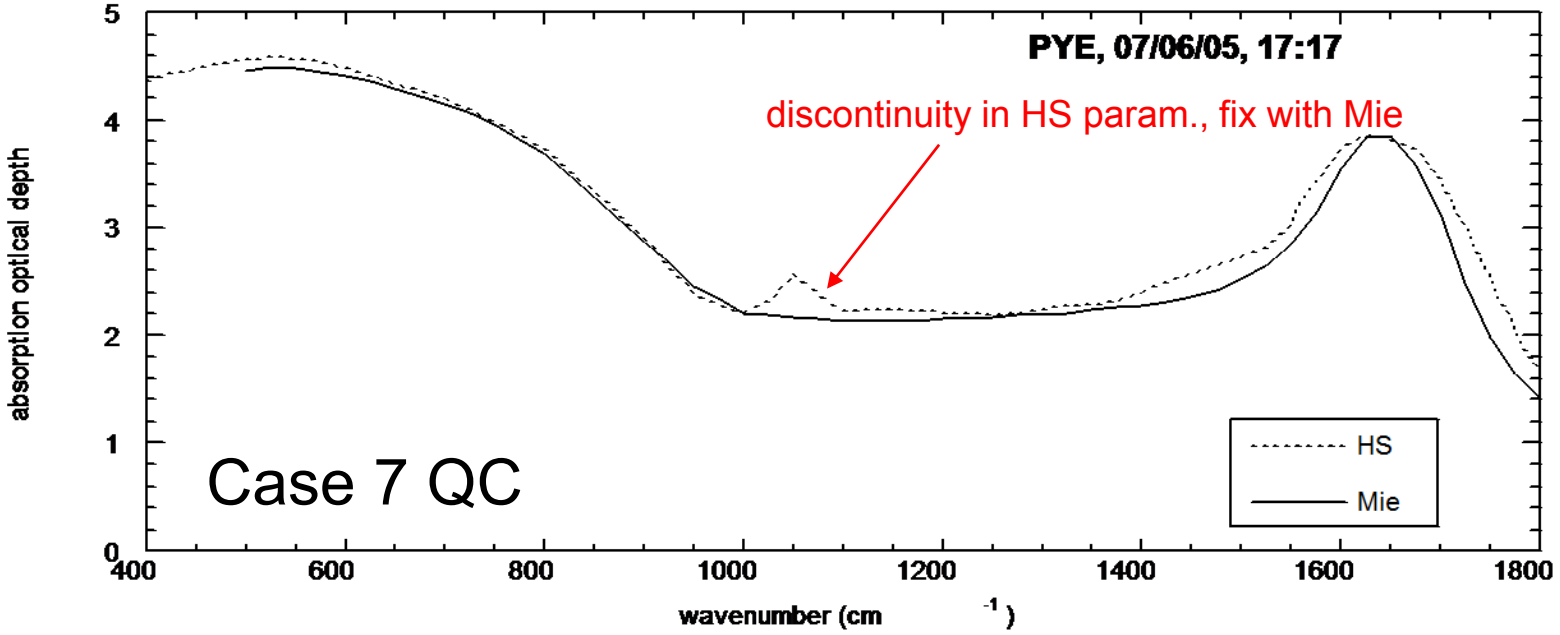
SW QC: Spectral comparison with RRTM

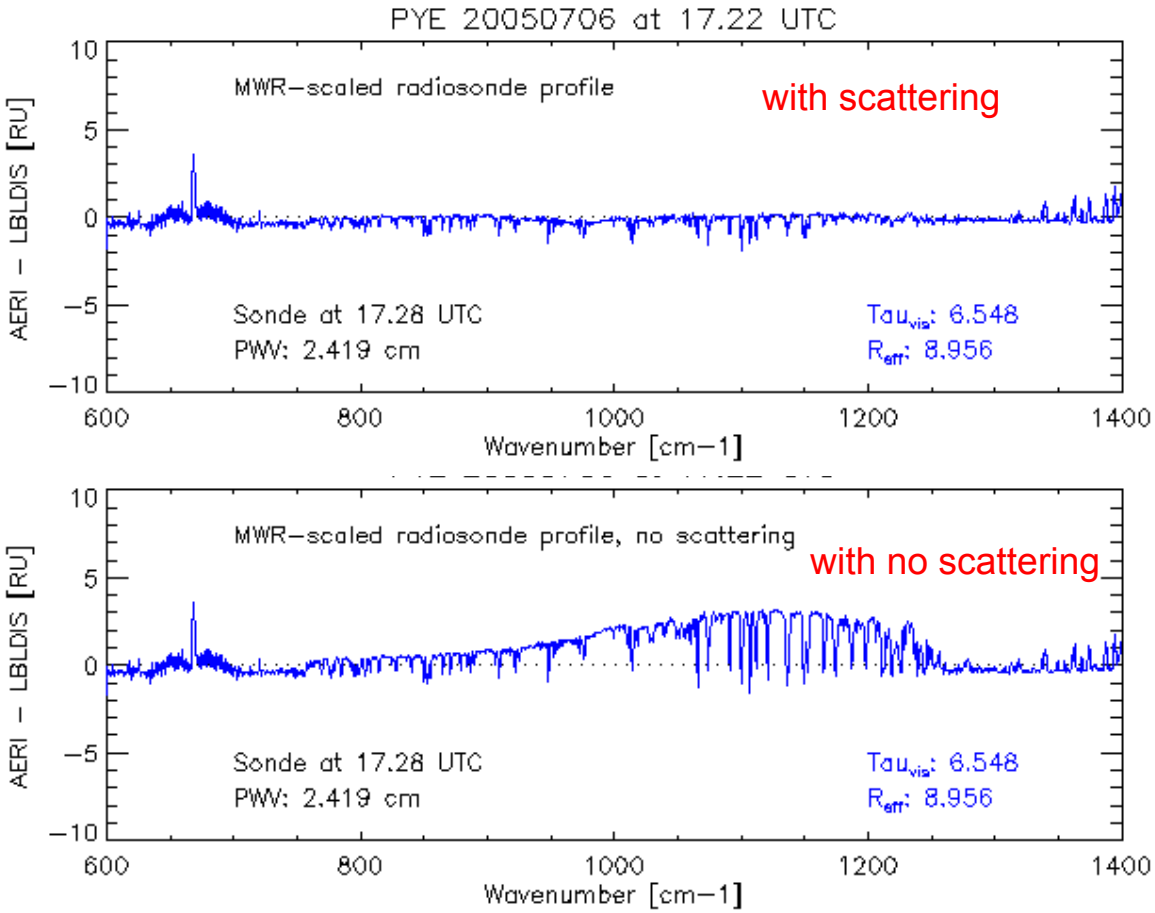


7/19/2000, SGP: Warm and moist

(runs and plots by J. Delamere)

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.





Turner's LBLDIS

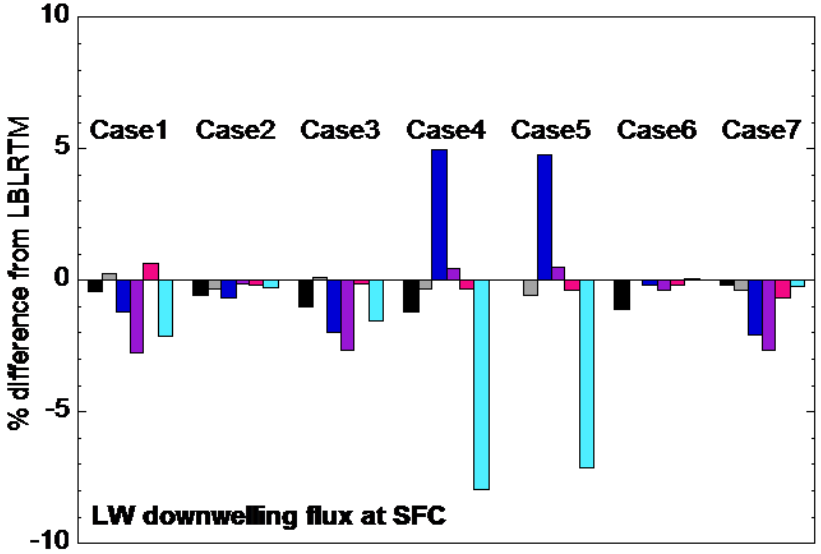
QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

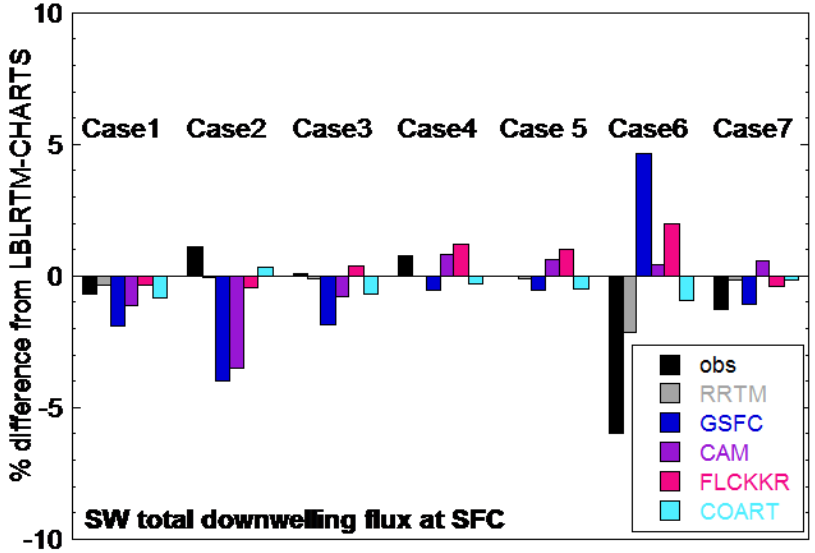
LBLRTM
(no scattering)

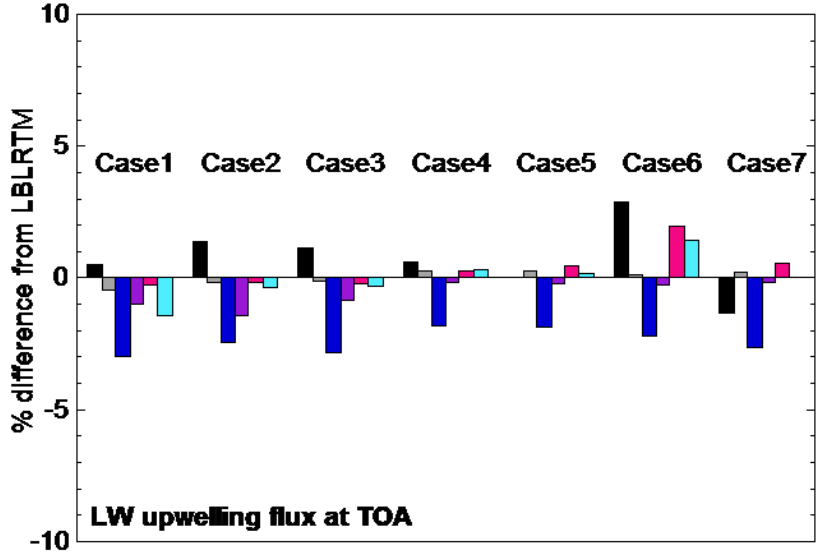
CIRC modus operandi (Phase I)

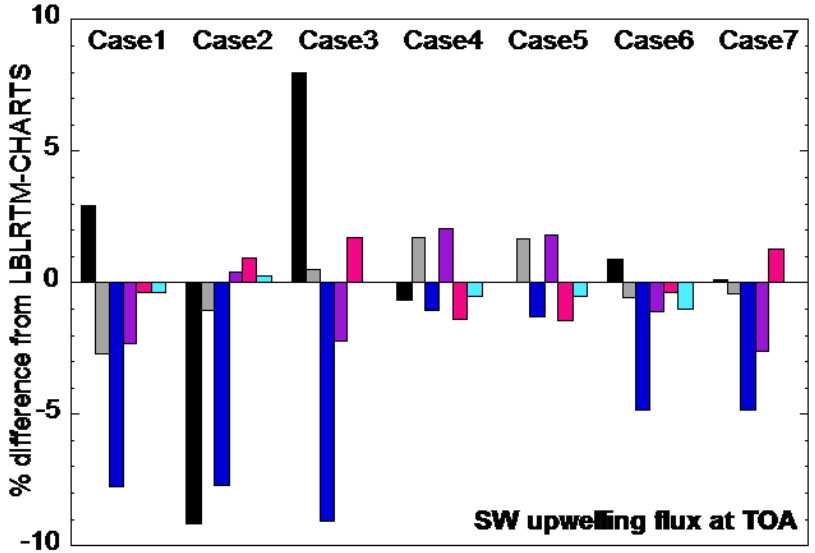
- Input & output (TOA and SFC fluxes at 1 cm^{-1}) and instructions on how to run the cases are openly available at CIRC website
- Only registered users (considered as formal participants) will enjoy certain privileges:
  - ✓ e-mail notifications about changes, updates, and corrections to the CIRC dataset.
  - ✓ priority to participate in workshops and publications
- Registered users may have to submit results within predetermined deadlines.
- Submitted results and intercomparison analysis will be posted on website
- Implementation details and performances of participating codes will be documented and evaluated

Phase I initial results, flux errors









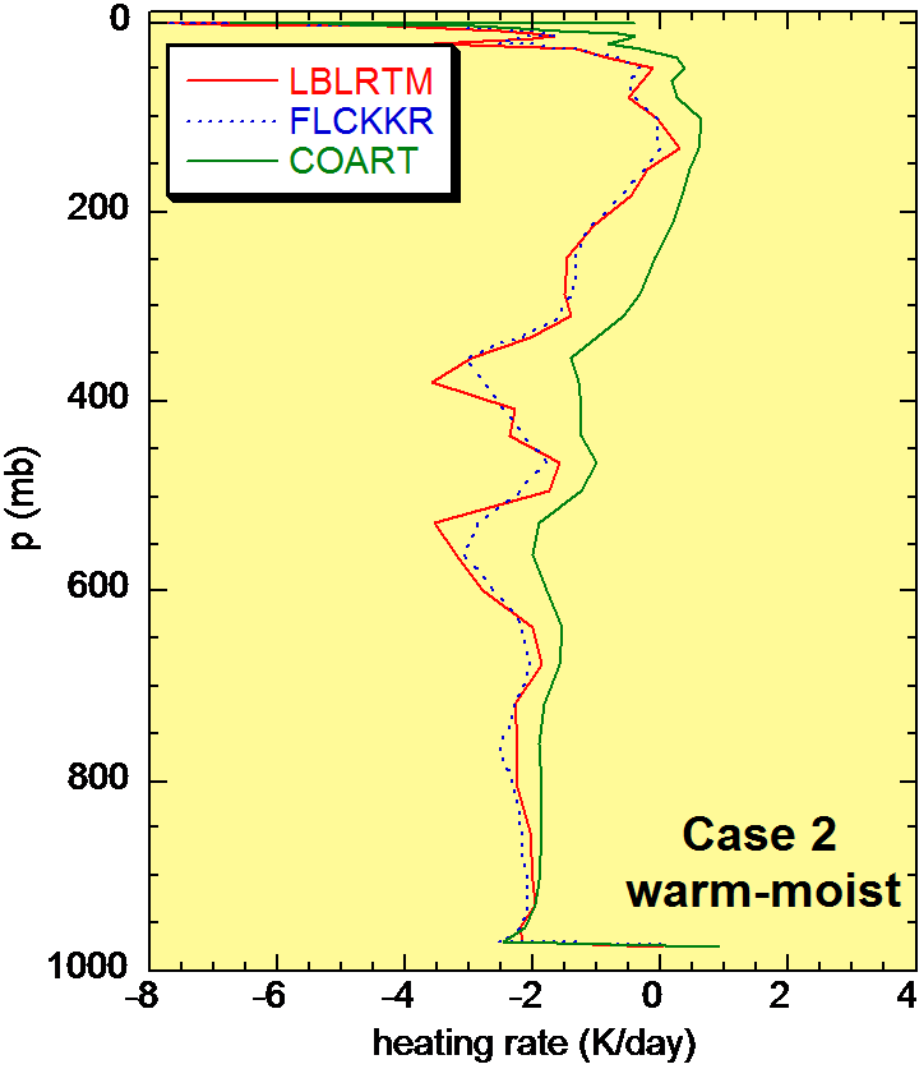
FLCKKR (= Fu, Liou Charlock, Kato, Kratz, Rose), submitted by Rose and Charlock
COART (= Coupled Ocean-Atmosphere Radiative Transfer), submitted by Jin and Charlock

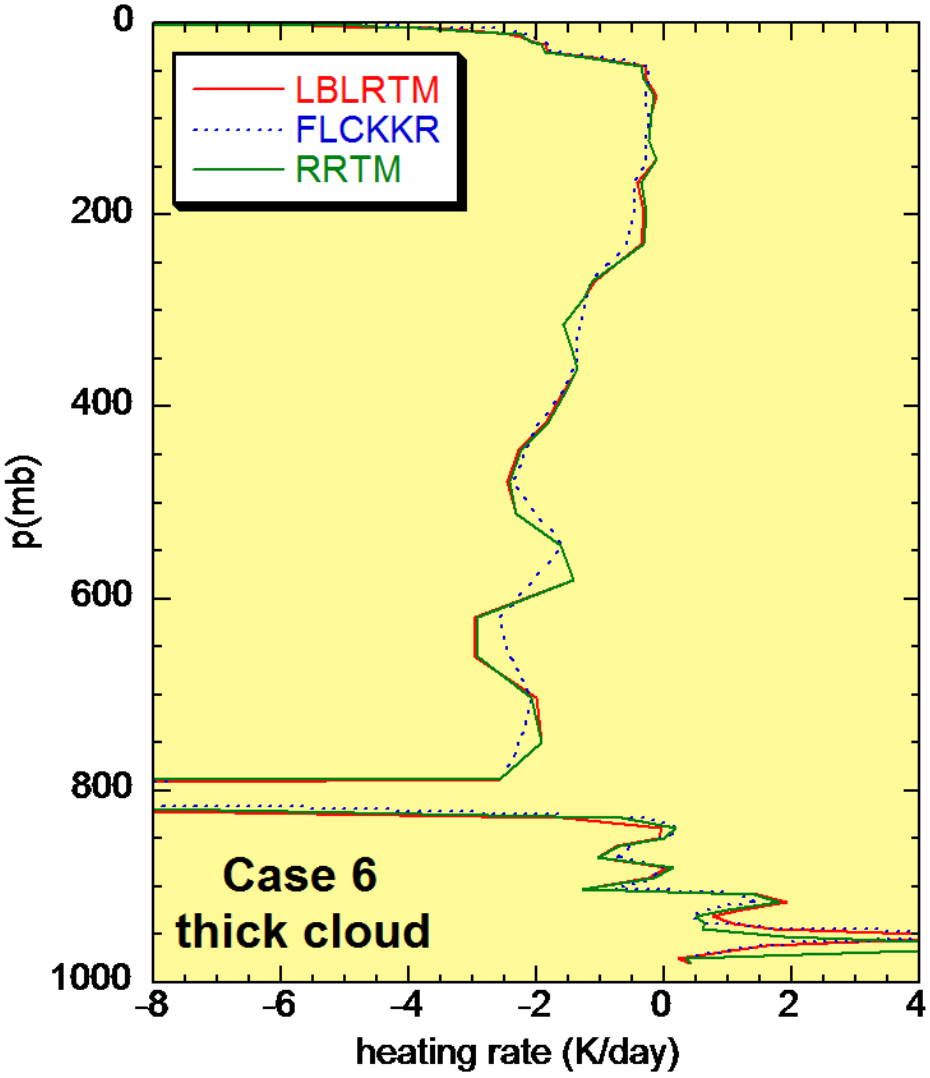
CIRC activities and future

- Poster and extended abstract for IRS 2008
- Greenlighted for short (“Nowcast”) BAMS article
- Submitted ARM proposal seeking funding for Phase II (ice clouds, SW spectral closure)
- “Pristine” and “cloudless” (Cases 6 & 7) versions under consideration
- Advertise via ARM web pages
- Workshop will be planned once there is critical mass
- Standards, certification, IRC support?

Additional slides

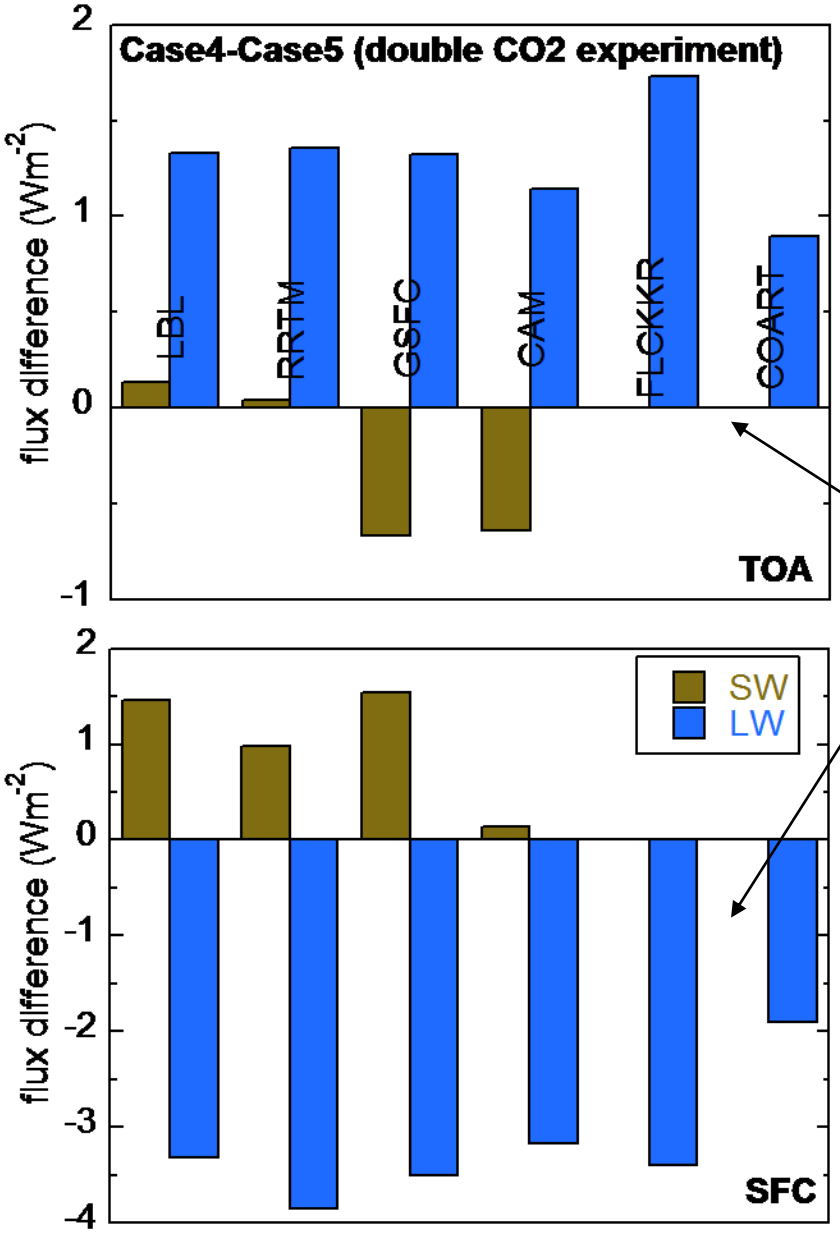
Phase I initial results, LW heating rates





No reference SW HR available from CHARTS

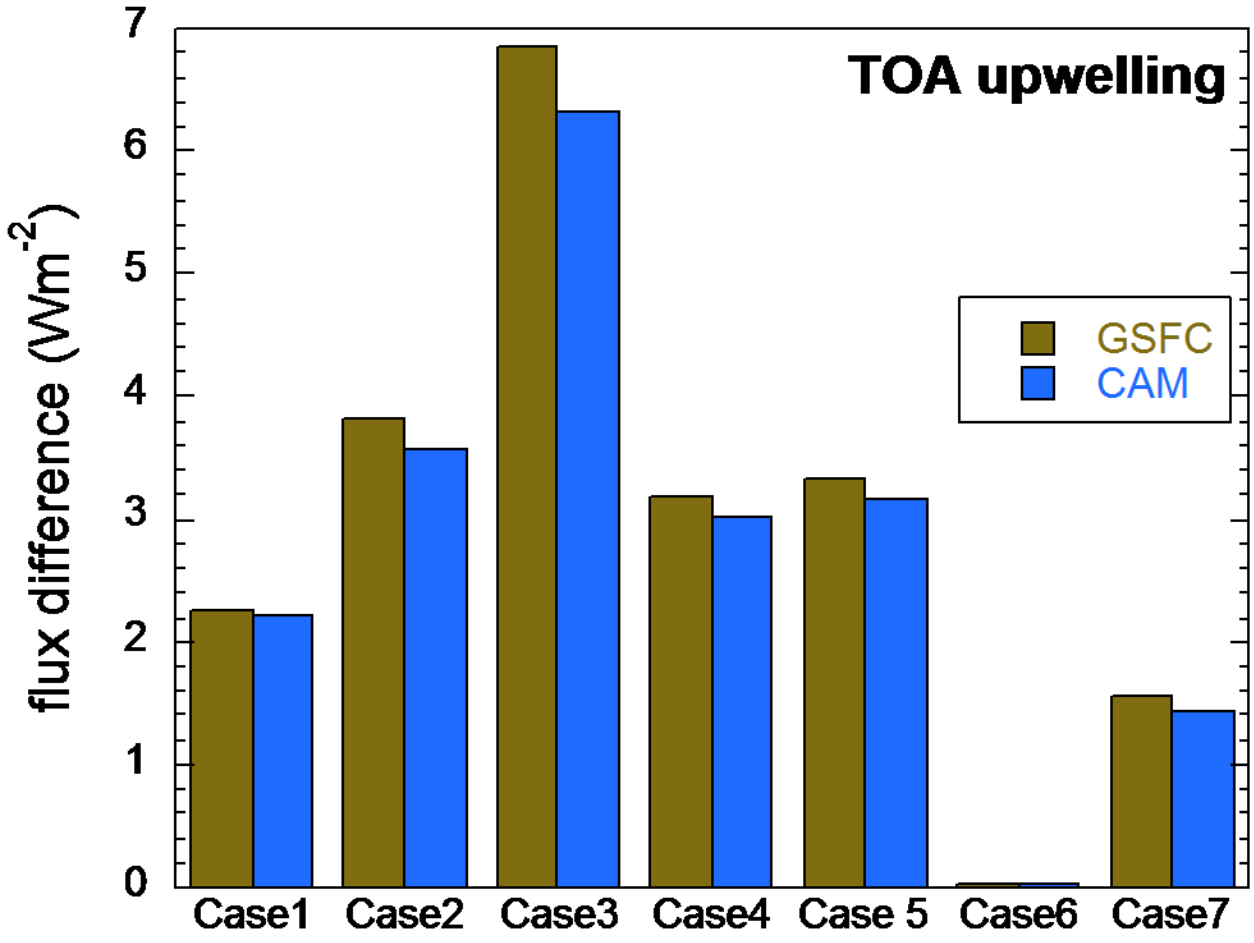
Phase I initial results, CO_2 forcing of dry atmospheres



FLCKKR and COART have fixed CO_2 in SW

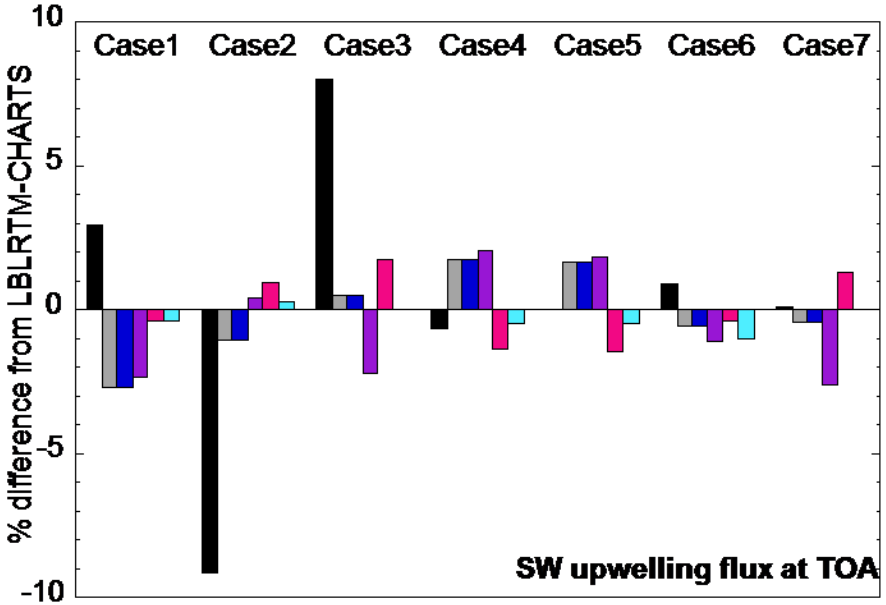
Importance of spectral surface albedo

weighted-unweighted sfc. albedo

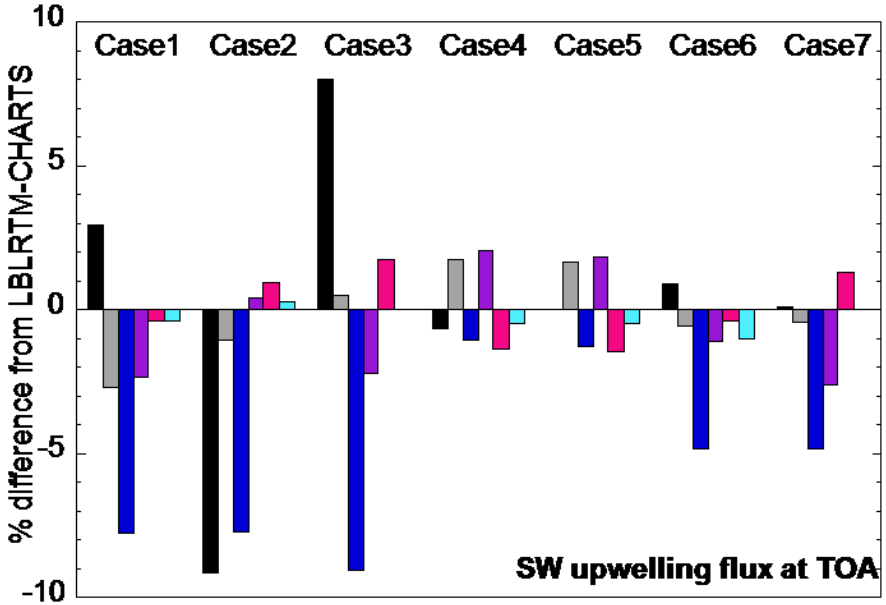


Importance of spectral surface albedo

weighted-unweighted sfc. albedo for GSFC

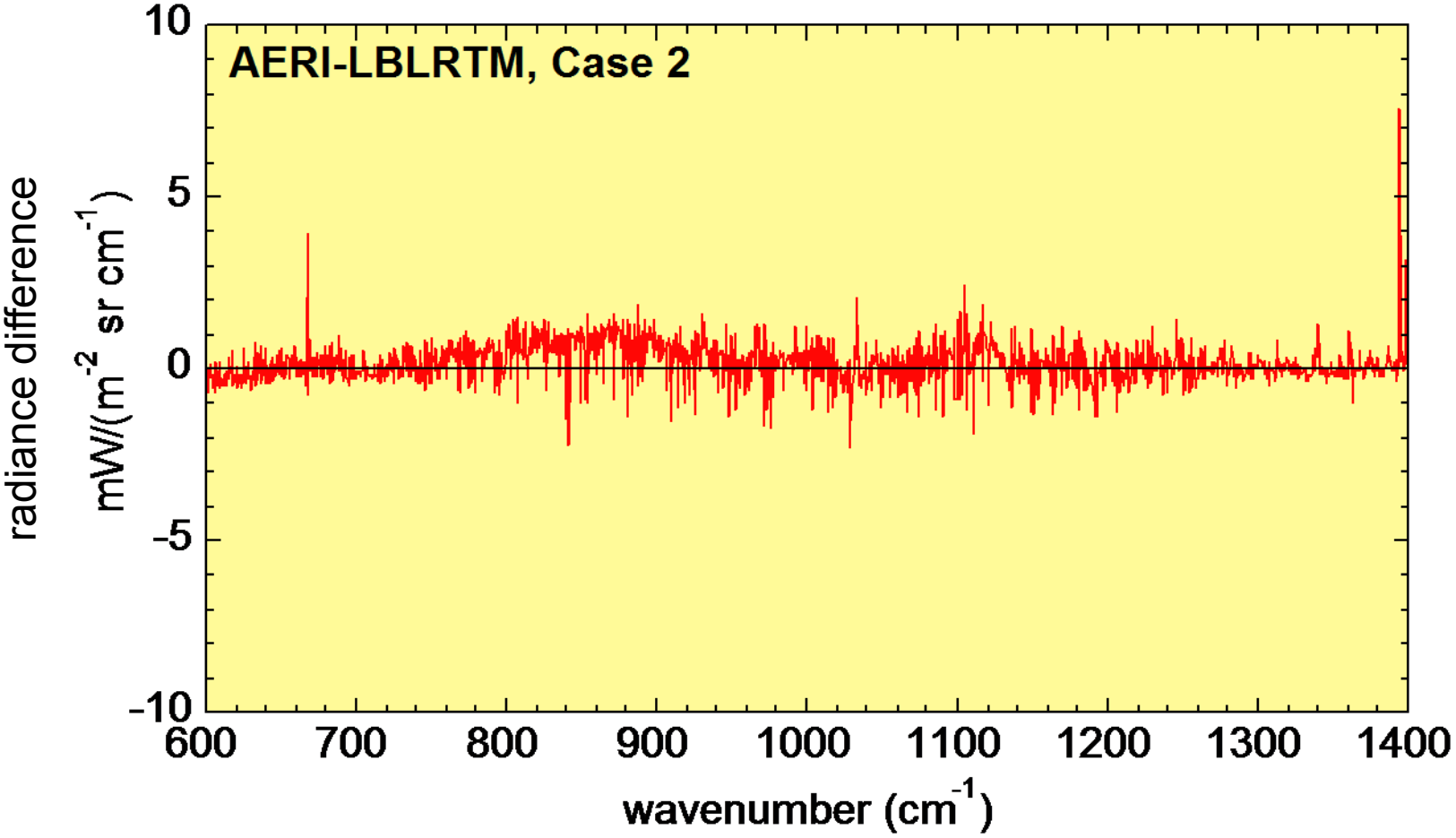


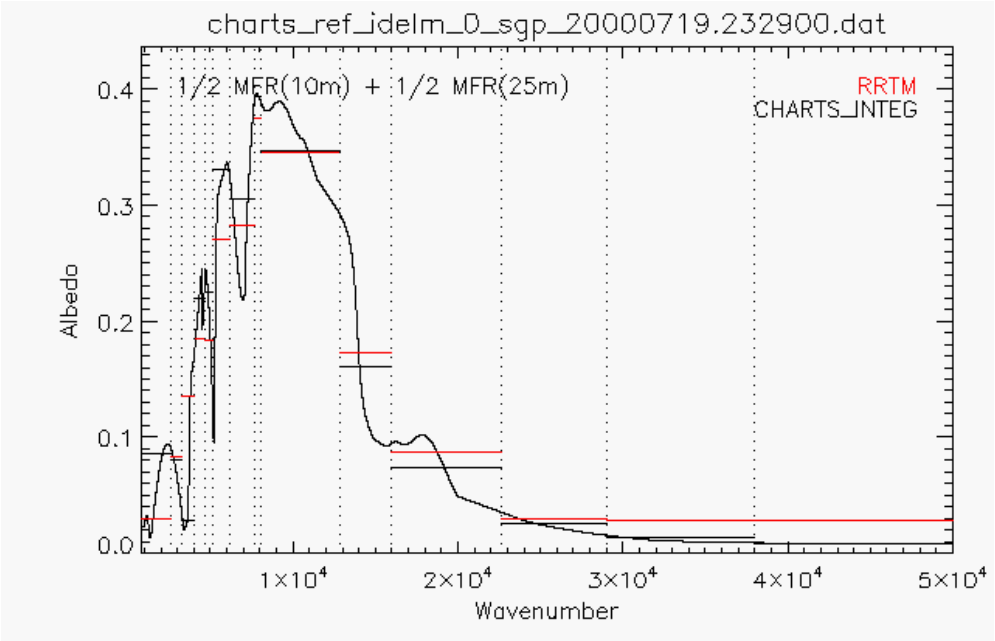
unweighted

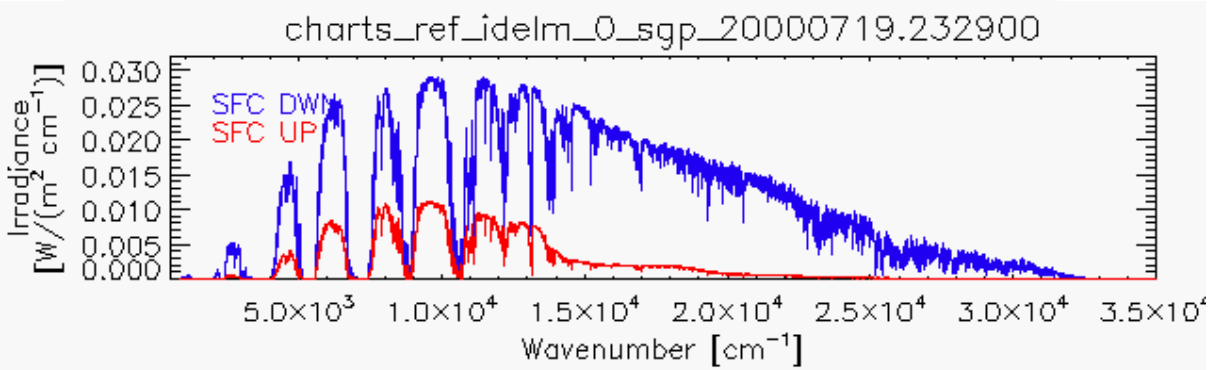


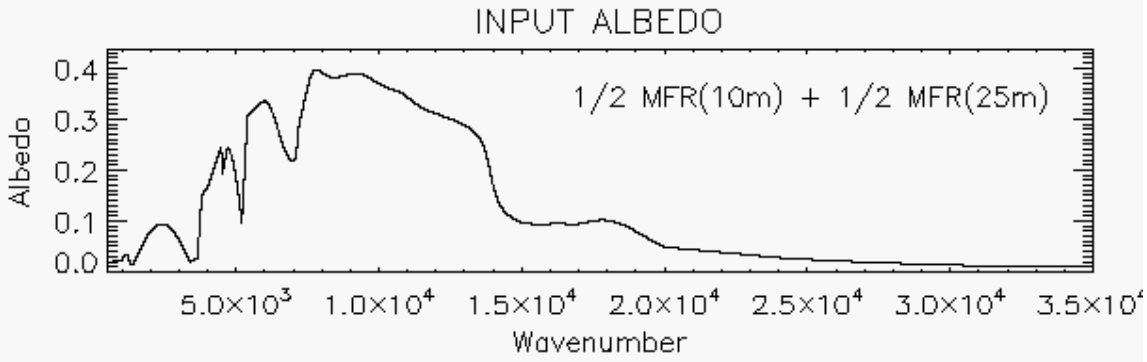
weighted

LW QC: LBLRTM spectral comparisons with AERI




charts_ref_idelm_0_sgp_20000719.232900.dat
1/2 MFR(10m) + 1/2 MFR(25m)
RRTM
CHARTS_INTEG
Albedo
0.0
0.1
0.2
0.3
0.4
1×10^4
2×10^4
3×10^4
4×10^4
5×10^4
Wavenumber


charts_ref_idelm_0_sgp_20000719.232900
Irradiance [W/(m^2 cm^-1)]
SFC DWN
SFC UP
0.000
0.005
0.010
0.015
0.020
0.025
0.030
5.0×10^3
1.0×10^4
1.5×10^4
2.0×10^4
2.5×10^4
3.0×10^4
3.5×10^4
Wavenumber [cm^-1]


INPUT ALBEDO
1/2 MFR(10m) + 1/2 MFR(25m)
Albedo
0.0
0.1
0.2
0.3
0.4
5.0×10^3
1.0×10^4
1.5×10^4
2.0×10^4
2.5×10^4
3.0×10^4
3.5×10^4
Wavenumber