

An update on CIRC

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Historical perspective (1)

- ICRCCM (InterComparison of Radiation Codes for Climate Models)

- ICRCCM-I (1984 - 1991)***

- LW: Ellingson and Fouquart (1991)

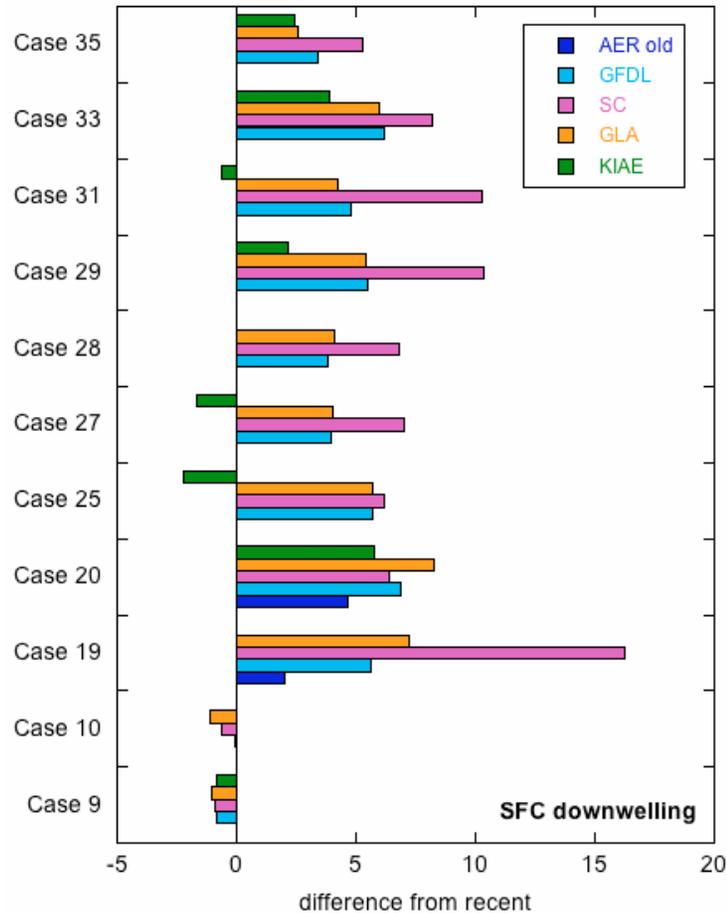
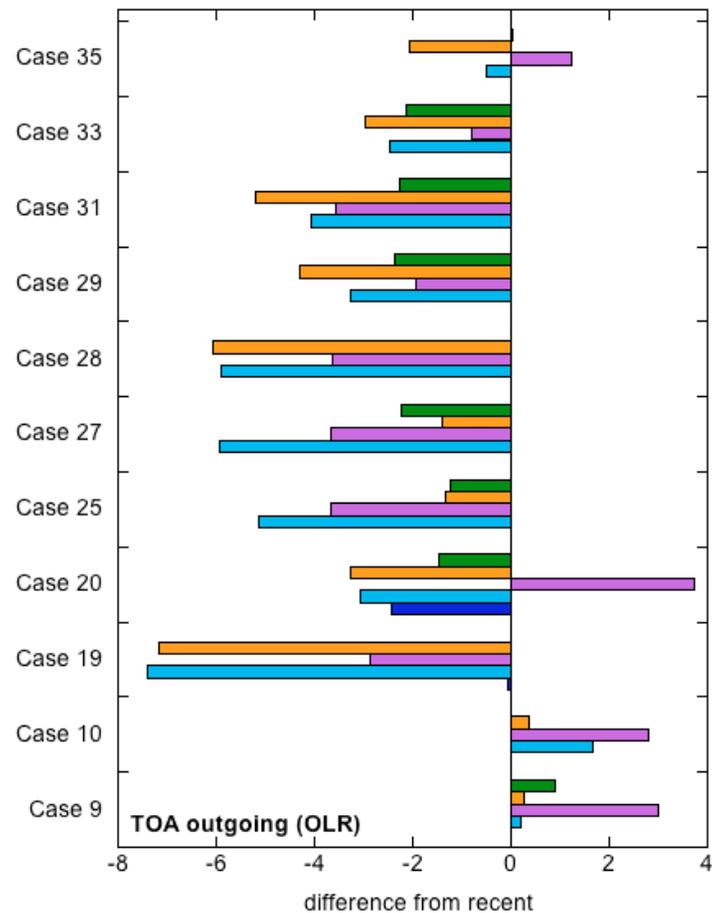
- ~60 idealized cases (mostly cloudless)

- SW: Fouquart et al. (1991)

- ~60 idealized cases (again, mostly cloudless)

Overall message : for cloudless skies, errors can be alarmingly large

ICRCCM, historical, from ARM archive and Ellingson



- 9 CO₂ only 300 ppmv, mid-latitude summer
- 10 CO₂ only 600 ppmv, mid-latitude summer
- 11 CO₂ only 300 ppmv, mid-latitude winter
- 12 CO₂ only 600 ppmv, mid-latitude winter
- 13 CO₂ only 300 ppmv, subarctic summer
- 14 CO₂ only 600 ppmv, subarctic summer
- 15 CO₂ only 300 ppmv, subarctic winter
- 16 CO₂ only 600 ppmv, subarctic winter
- 17 H₂O only, 0.75 * H₂O concentration with continuum, mid-latitude summer
- 18 H₂O only, 0.75 * H₂O concentration without continuum, mid-latitude summer
- 19 H₂O only, 1.00 * H₂O concentration with continuum, mid-latitude summer
- 20 H₂O only, 1.00 * H₂O concentration without continuum, mid-latitude summer

- 25 All constituents (CO₂, H₂O, O₃), 300 ppmv CO₂, tropical
- 26 All constituents (CO₂, H₂O, O₃), 600 ppmv CO₂, tropical
- 27 All constituents (CO₂, H₂O, O₃), 300 ppmv CO₂, mid-latitude summer
- 28 All constituents (CO₂, H₂O, O₃), 600 ppmv CO₂, mid-latitude summer
- 29 All constituents (CO₂, H₂O, O₃), 300 ppmv CO₂, mid-latitude winter
- 30 All constituents (CO₂, H₂O, O₃), 600 ppmv CO₂, mid-latitude winter
- 31 All constituents (CO₂, H₂O, O₃), 300 ppmv CO₂, subarctic summer
- 32 All constituents (CO₂, H₂O, O₃), 600 ppmv CO₂, subarctic summer
- 33 All constituents (CO₂, H₂O, O₃), 300 ppmv CO₂, subarctic winter
- 34 All constituents (CO₂, H₂O, O₃), 600 ppmv CO₂, subarctic winter
- 35 All constituents, 300 ppmv CO₂, without H₂O continuum, mid-latitude summer

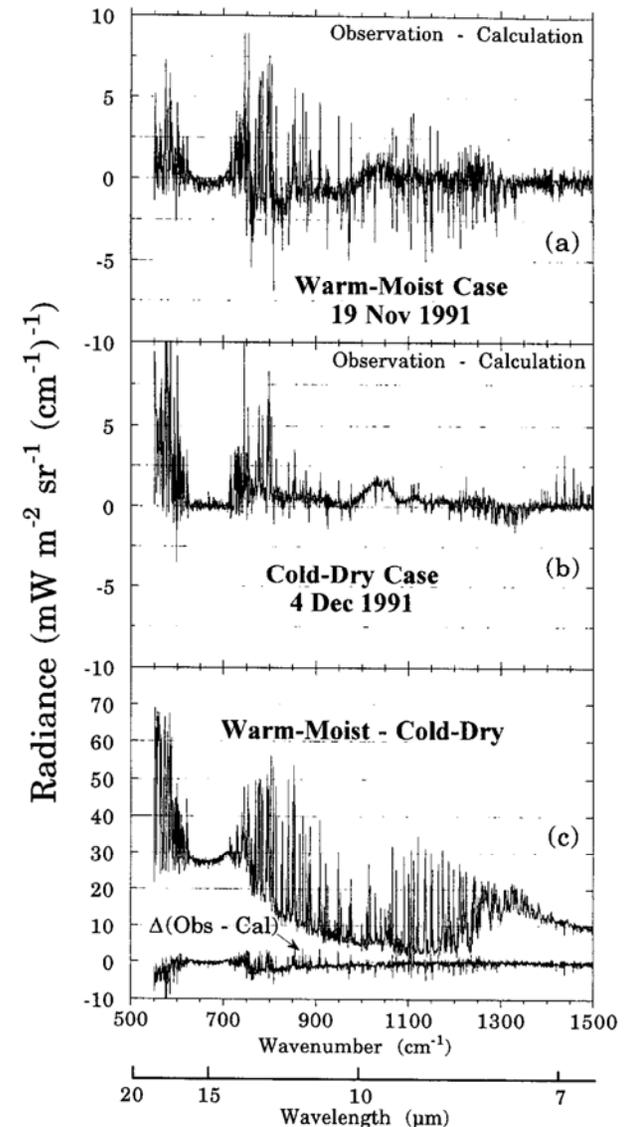
Historical perspective (2)

- **ICRCCM-II (1991): SPECTRE (FIRE II)**

- ✓ Emphasis on LW and cloudless skies

- ✓ Ellingson + Wiscombe (BAMS, 1996)

Overall message : using observations to assess models can be fruitful, but it is HARD ... ARM program.

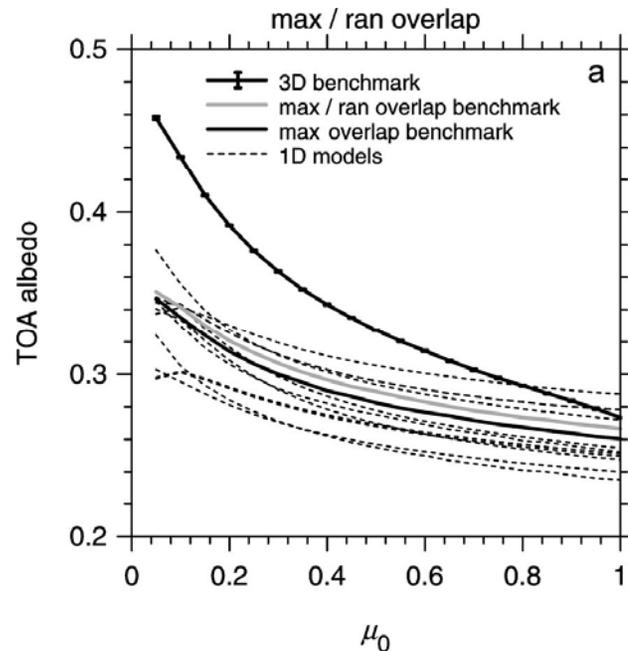


Historical perspective (3)

ICRCCM-III: (GRP; Barker et al. 2003)

- SW only (LW coming up: Ellingson and Takara)
- Interpretation and handling of unresolved clouds
- CSRMs domains; benchmarks set by 3D MC codes
- cloudless and cloudy (PPH and 3D)

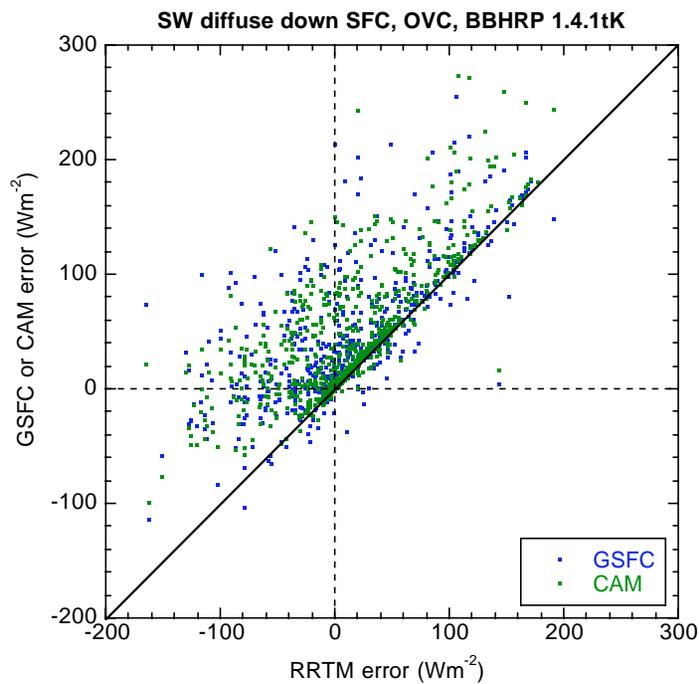
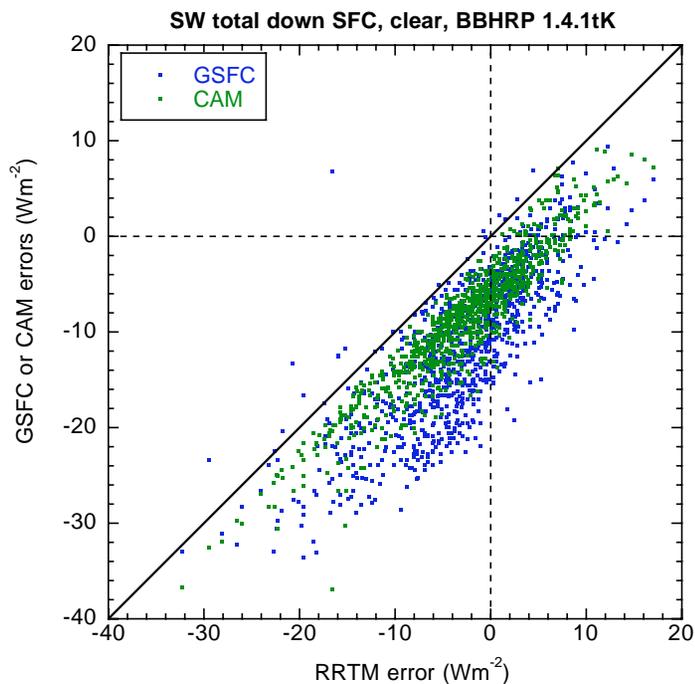
Overall message : standard assumptions are often inadequate *and* no 1D single method is adequate for all.



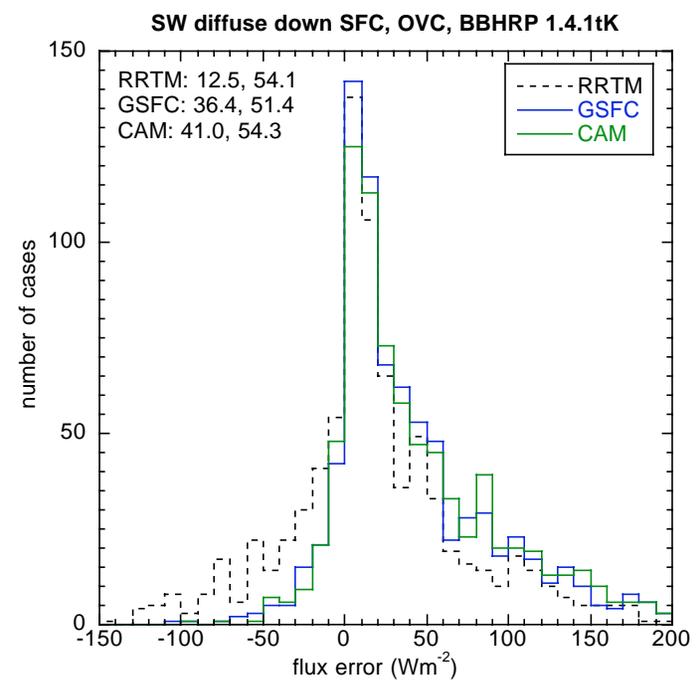
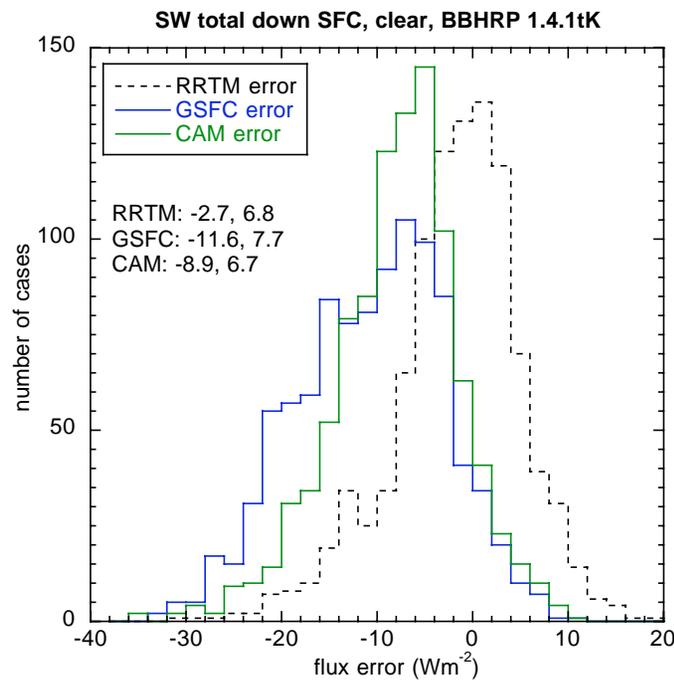
So, what is CIRC?

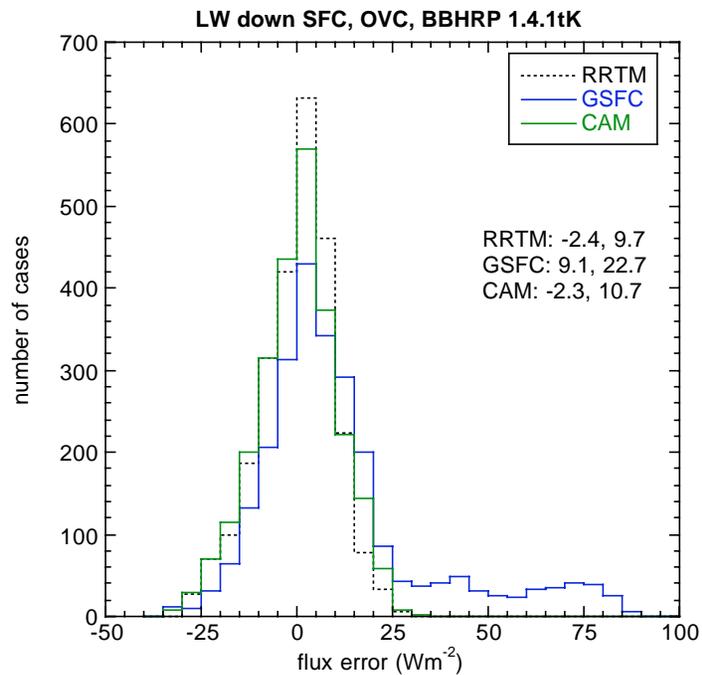
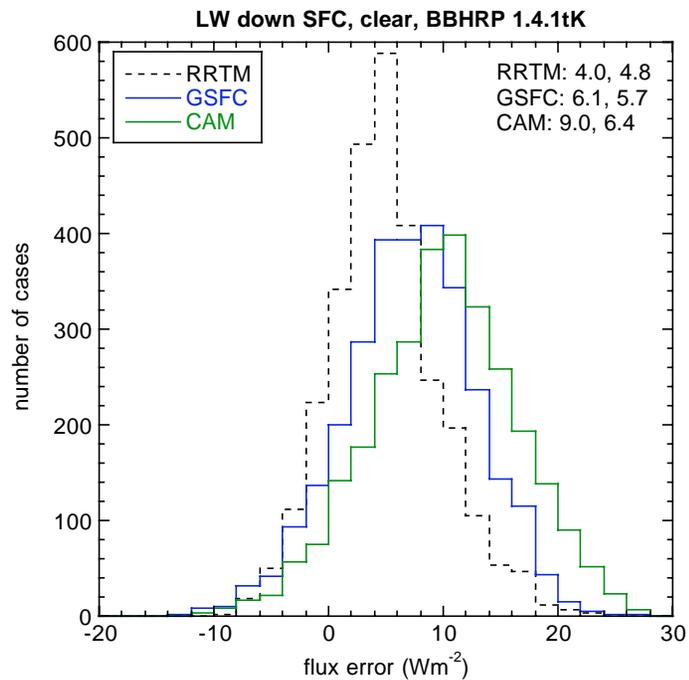
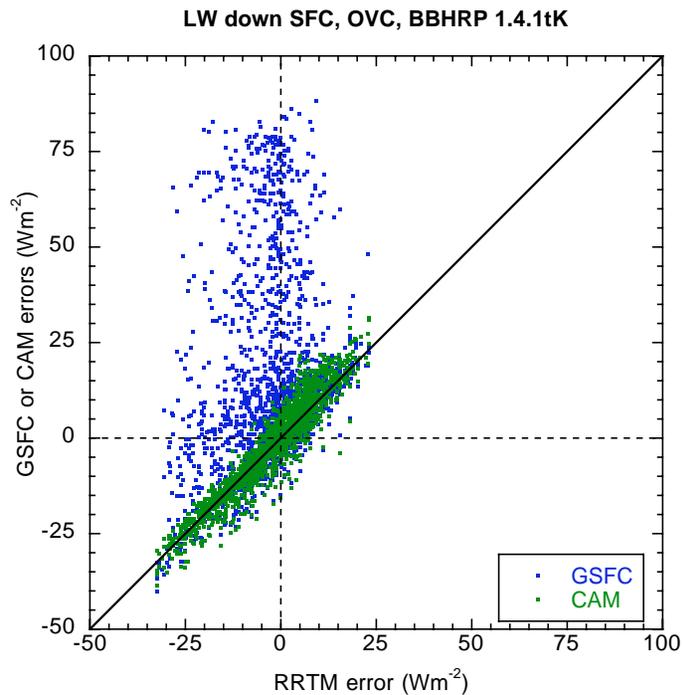
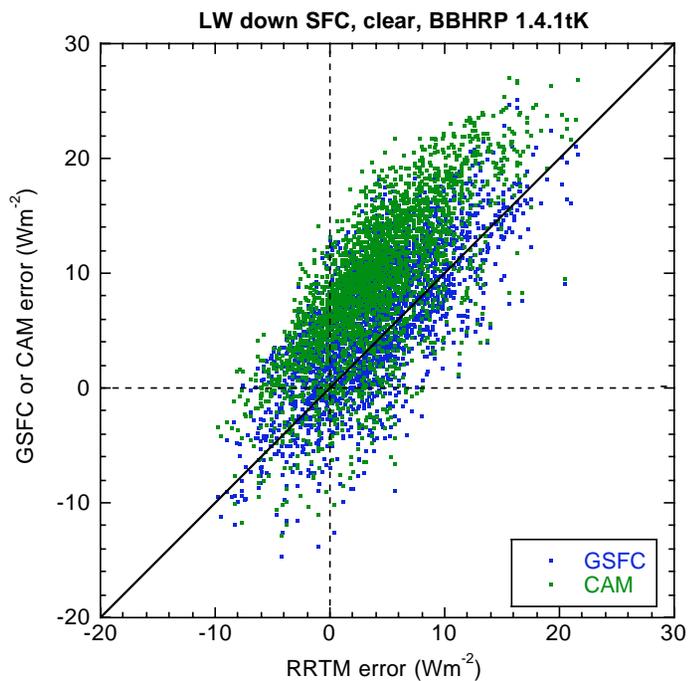
- Continuous Intercomparison of Radiation Codes
- Proposed at the October 2003 GRP meeting in Victoria, BC
- Hopefully, the new standard for assessing the performance of GCM-style SW and LW RT codes
- Sponsored by ARM and endorsed by GRP

- Observations to be used as radiative benchmarks
- ARM provides input and radiative benchmarks (mainly select BBHRP cases)
- Reference calculations (incl. HRs) are based on both LBL and LBL-tuned c-k models
- More flexible structure and longer lifespan
- Greater emphasis on cloudy atmospheres
- Greater attention to surface radiative fluxes



GSFC and CAM radiation codes running in BBHRP mode (SW, SFC)





**GSFC and CAM
radiation codes
running in BBHRP
mode (LW, SFC)**

Challenges

- For reference calculations to be credible, a reasonable level of agreement with observations is desirable
- BBHRP dataset is small; very few BBHRP cases satisfy our criteria: homogeneous* (1D), consistency (closure) between SW & LW observed and reference calculations at TOA and SFC
- To enhance usefulness of dataset high spectral resolution benchmarks should also be provided => moving us further away from BBHRP and existing products

* See also Ellingson and Wiscombe (1996)

CIRC's main data source: BBHRP at SGP March 2000-February 2001

daytime datapoints with TOA and SFC fluxes:

375

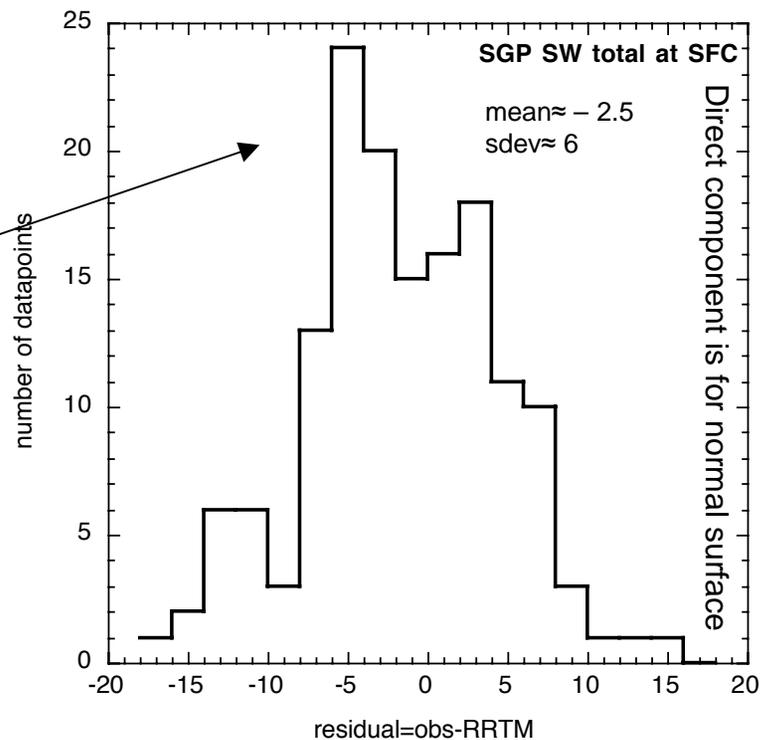
overcast liquid clouds:

8

appropriate for CIRC
(homogeneous, closure)

1

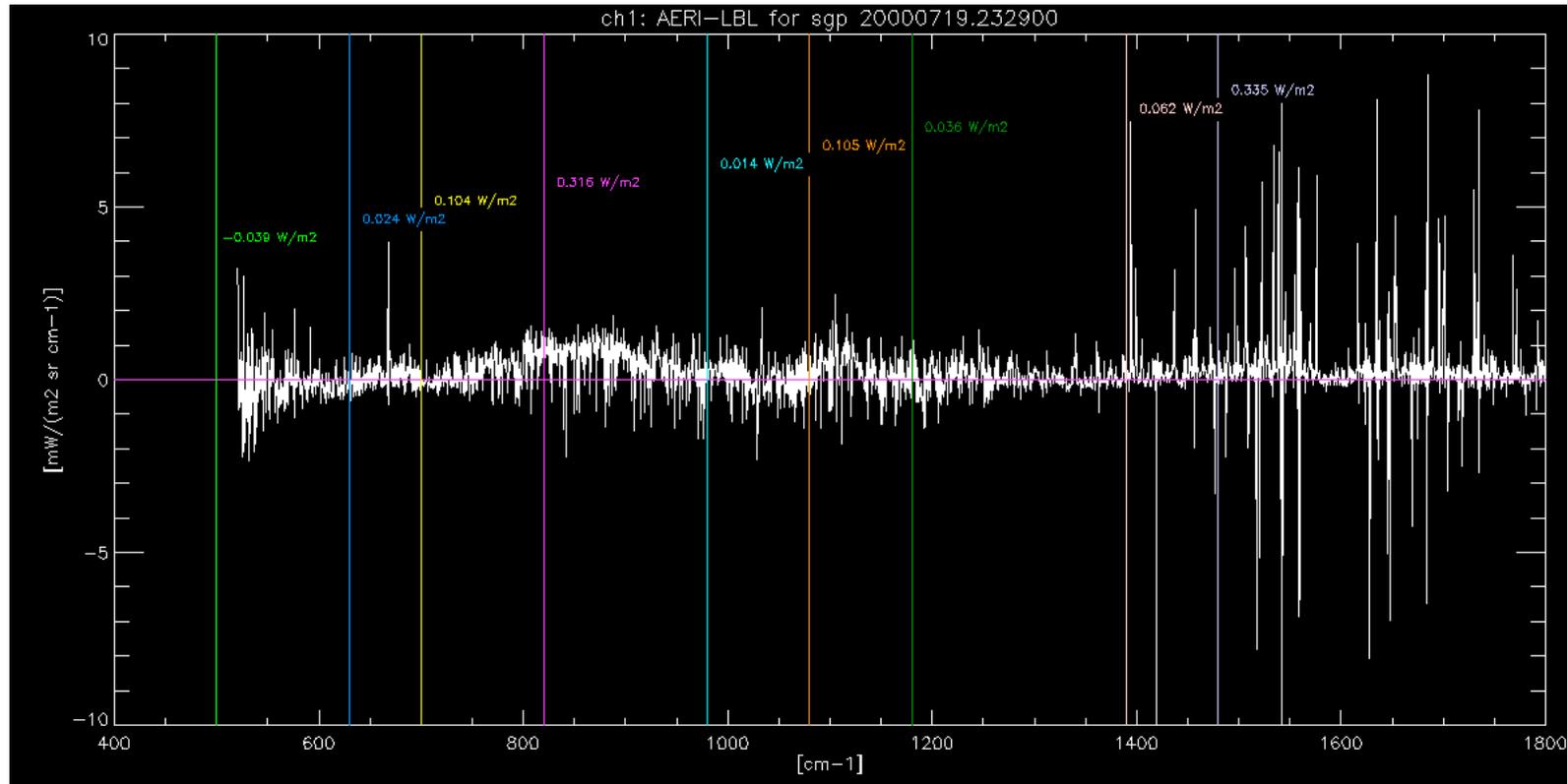
Clear-sky cases: 150
(~60 % have SZA > 60°)



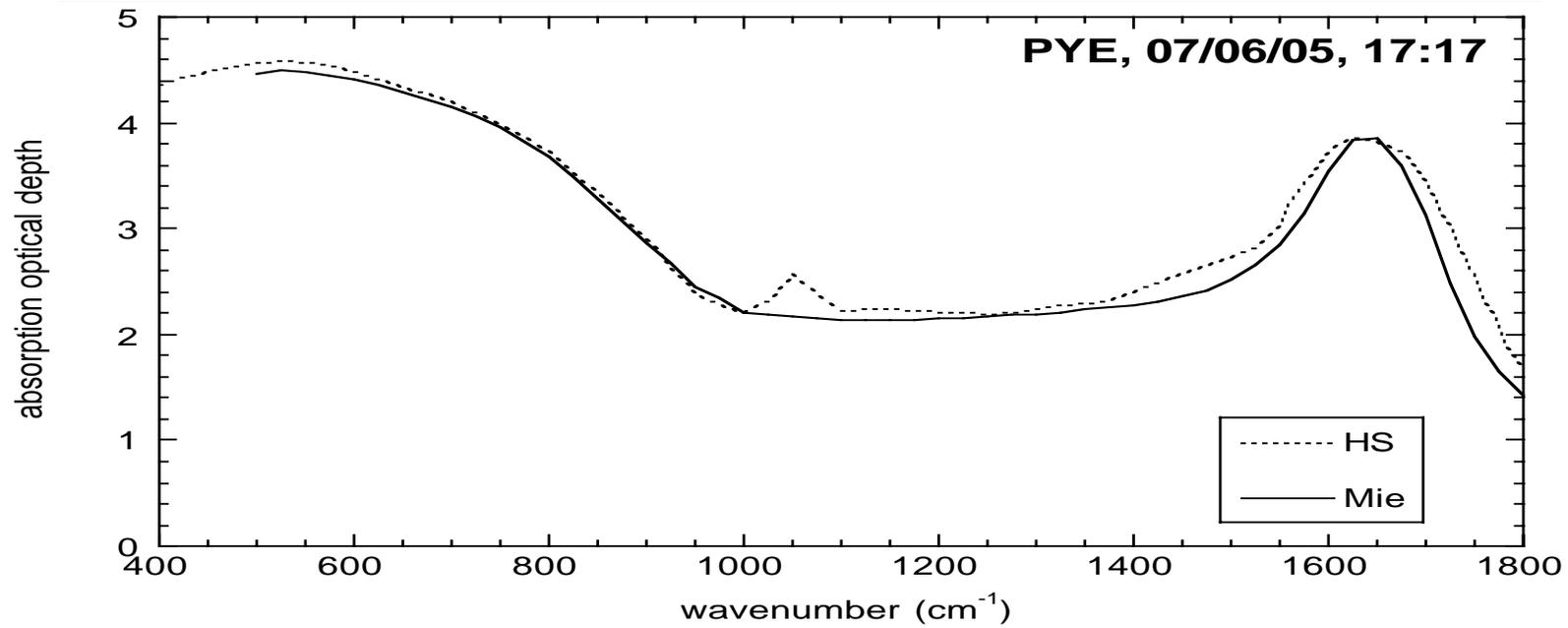
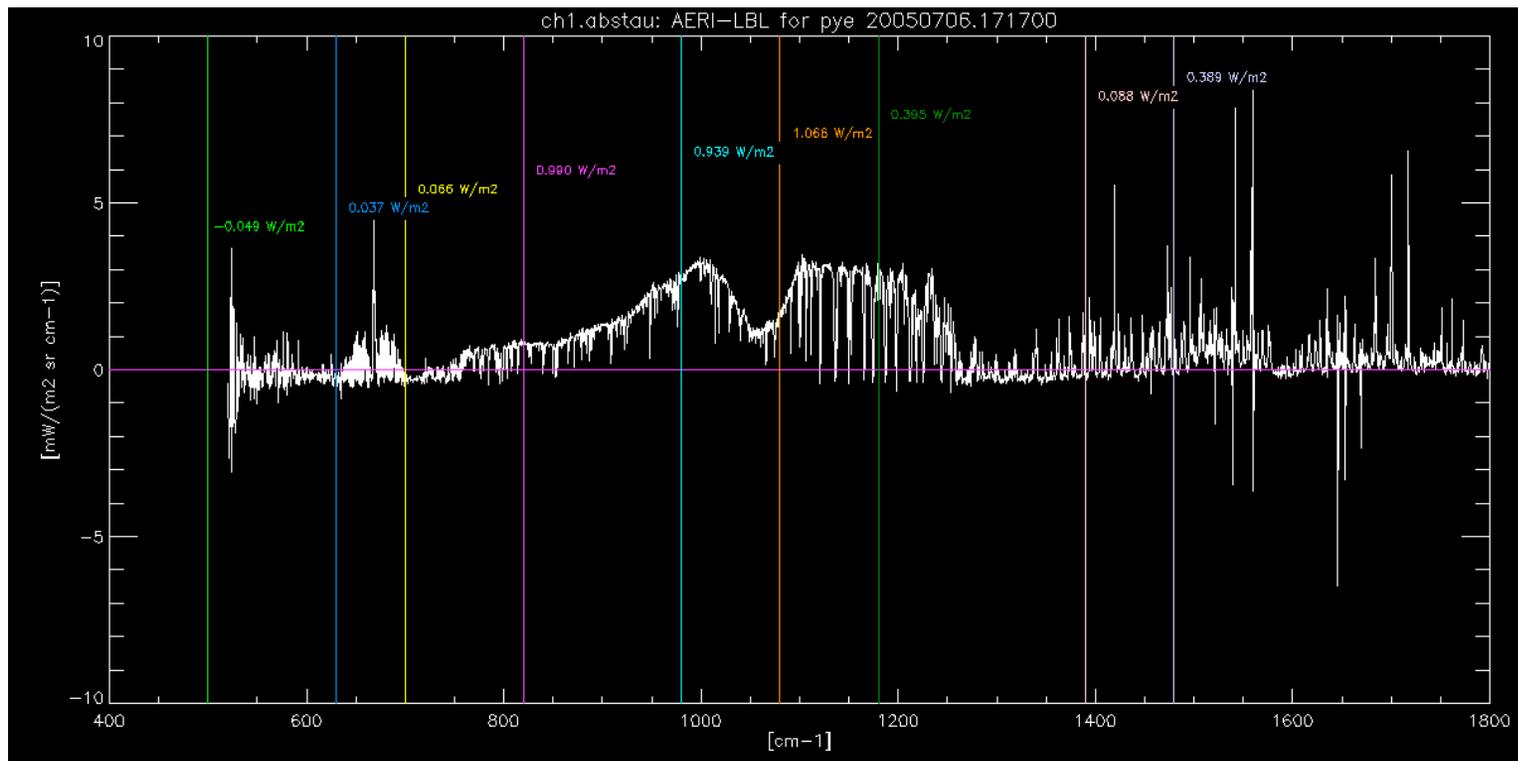
CIRC Phase I cases: obs-RRTM

Case	SZA	PWV (cm)	τ_{aer}	LWP (gm^{-2})	LW _{SFC}	LW _{TOA}	SW _{SFC}	SW _{TOA}
SGP 3/17/00	45.5°	1.90		263.4	1.1%	-2.1%	2.3%	1.9%
SGP 5/4/00*	40.6°	2.31	0.09		1.1%	1.5%	-0.3%	-3.6%
SGP 7/19/00	64.6°	4.85	0.18		0.2%	0.8%	-1.2%	9.6%
SGP 9/25/00	47.9°	1.23	0.04		0.7%	-0.4%	0.3%	0.5%
NSA 5/3/04 (also 2xCO ₂)	55.1°	0.29	0.13		1.7%	-1.1%	-1.1%	2.2%
PYE 7/6/05	41.2°	2.42		39.1	-0.2%	1.5%	-1.0%	-1.7%

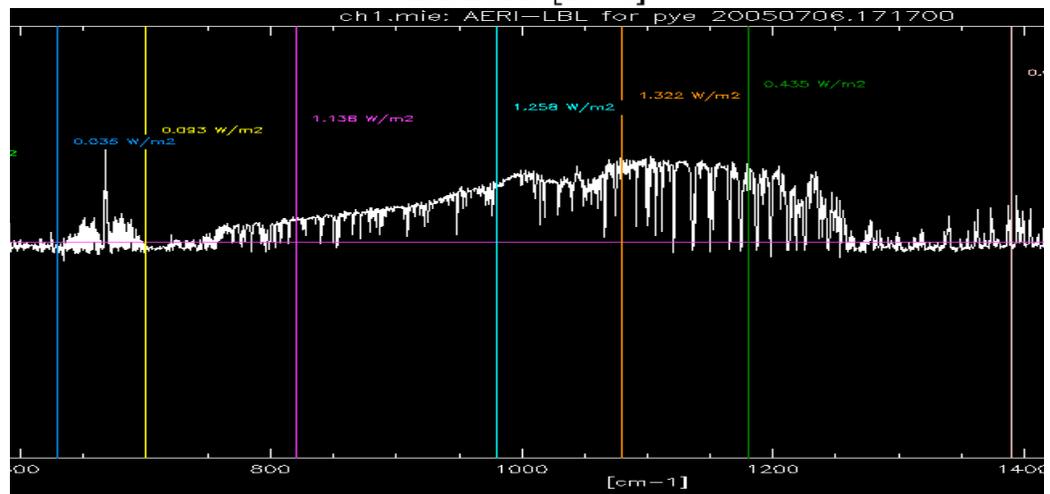
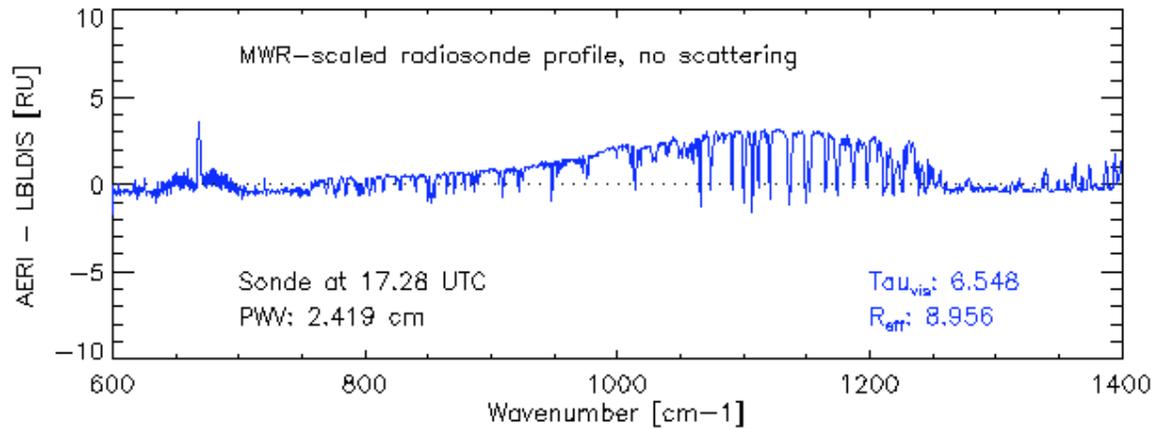
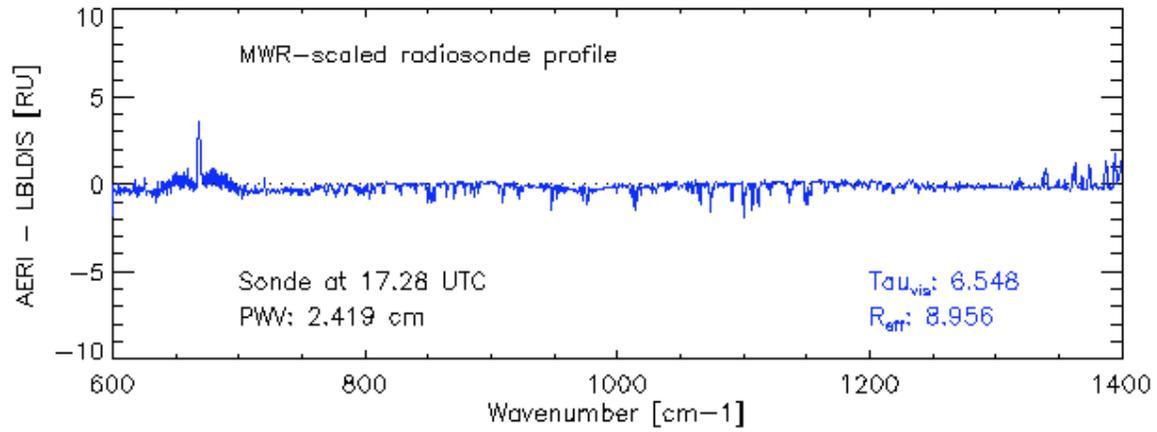
7/19/2000, SGP: The warm, moist case



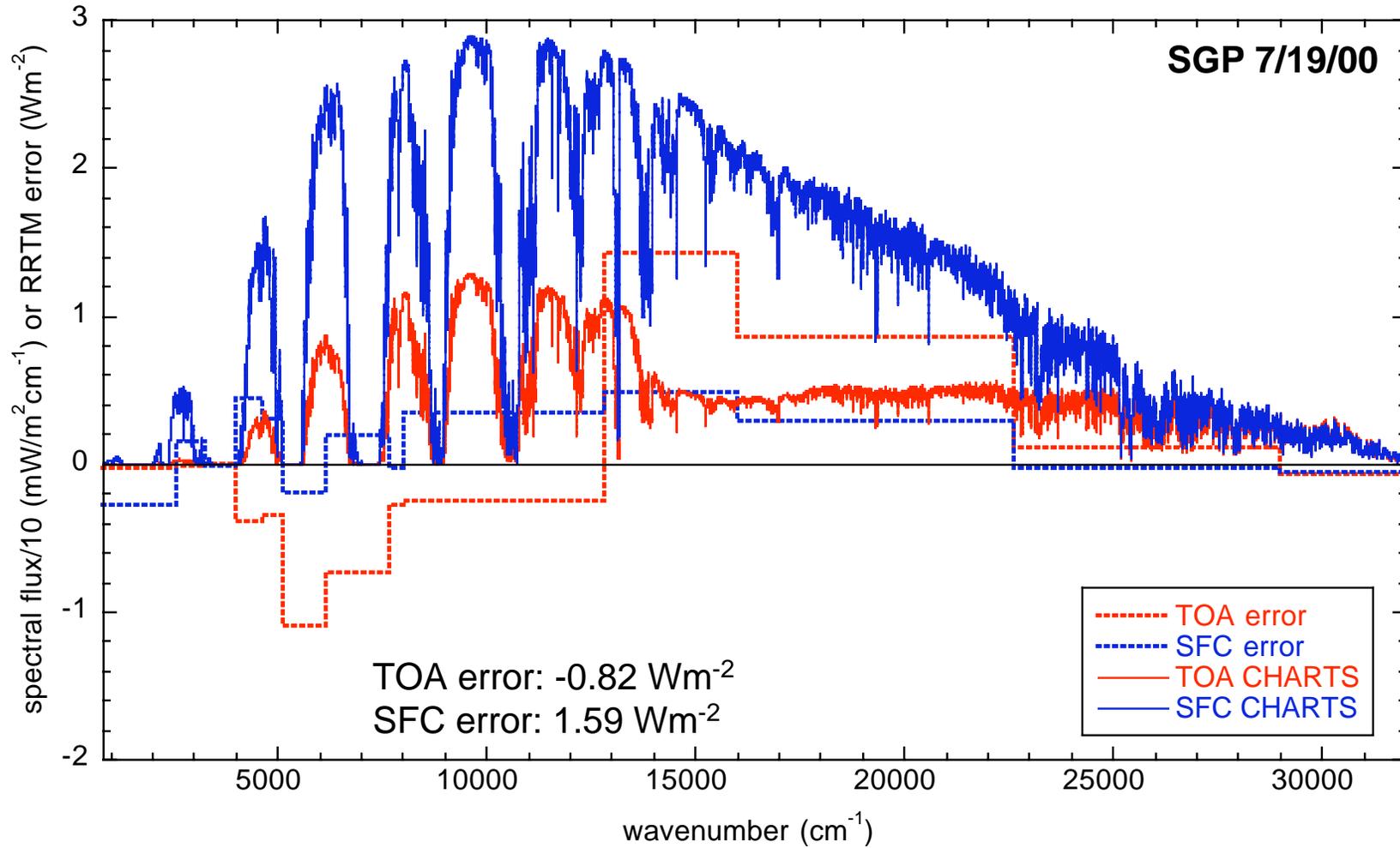
$LW_{TOA} = 292.6$ (LBLRTM), 293.1 (RRTM)
 $LW_{SFC} = 439.3$ (LBLRTM), 440.8 (RRTM)



PYE 20050706 at 17.22 UTC



CHARTS calculations require a surface spectral albedo product





Continuous Intercomparison of Radiation Codes

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What is CIRC? CIRC aspires to be the successor to ICRCCM (Intercomparison of Radiation Codes in Climate Models). It is envisioned as an evolving and regularly updated reference source for GCM-type radiative transfer (RT) code evaluation with the principle goal to contribute in the improvement of RT parameterizations. CIRC is jointly endorsed by DOE's Atmospheric Radiation Measurement (ARM) program and the GEWEX Radiation Panel (GRP).

How does CIRC differ from previous intercomparisons? CIRC's goal is to provide test cases for which GCM RT algorithms should be performing at their best, i.e., well-characterized clear-sky and homogeneous, overcast cloudy cases. What distinguishes CIRC from previous intercomparisons is that its pool of cases is based on observed datasets. The bulk of atmospheric and surface input as well as radiative fluxes are from ARM observations as documented in the Broadband Heating Rate Profile (BBHRP). The BBHRP also provides reference calculations from AER's RRTM RT algorithms giving us a rough estimate of our ability to achieve radiative flux closure given the limitations in our knowledge of the atmospheric state.

How will CIRC be run? All input and some output will be available to everybody (like in "open" intercomparisons); but only registered users (as formal participants as in "closed" intercomparisons) will have access to additional output (spectral results) and e-mail notifications about changes, updates, and corrections to the CIRC dataset. They will also be invited to participate in workshops and co-author publications about CIRC. Registered users are expected to submit results from their RT runs within predetermined deadlines.

CIRC modus operandi (Phase I)

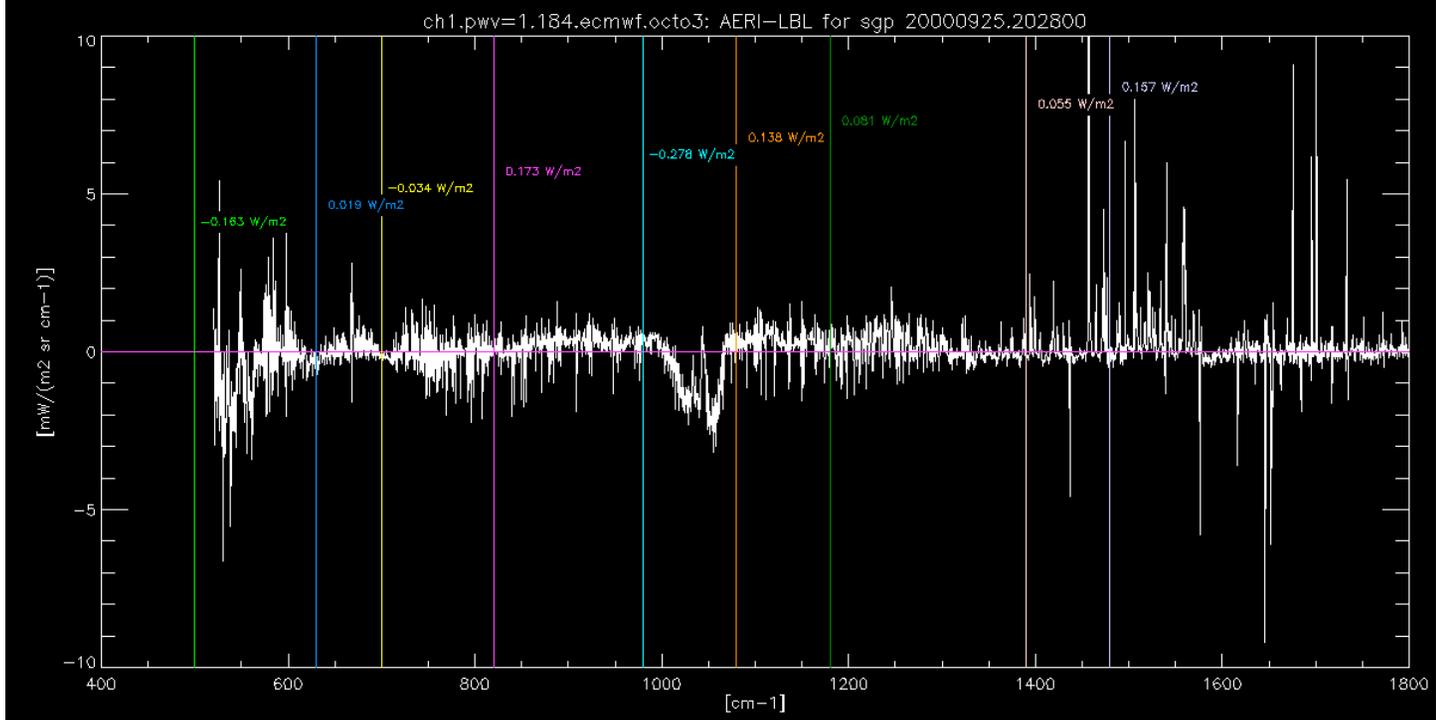
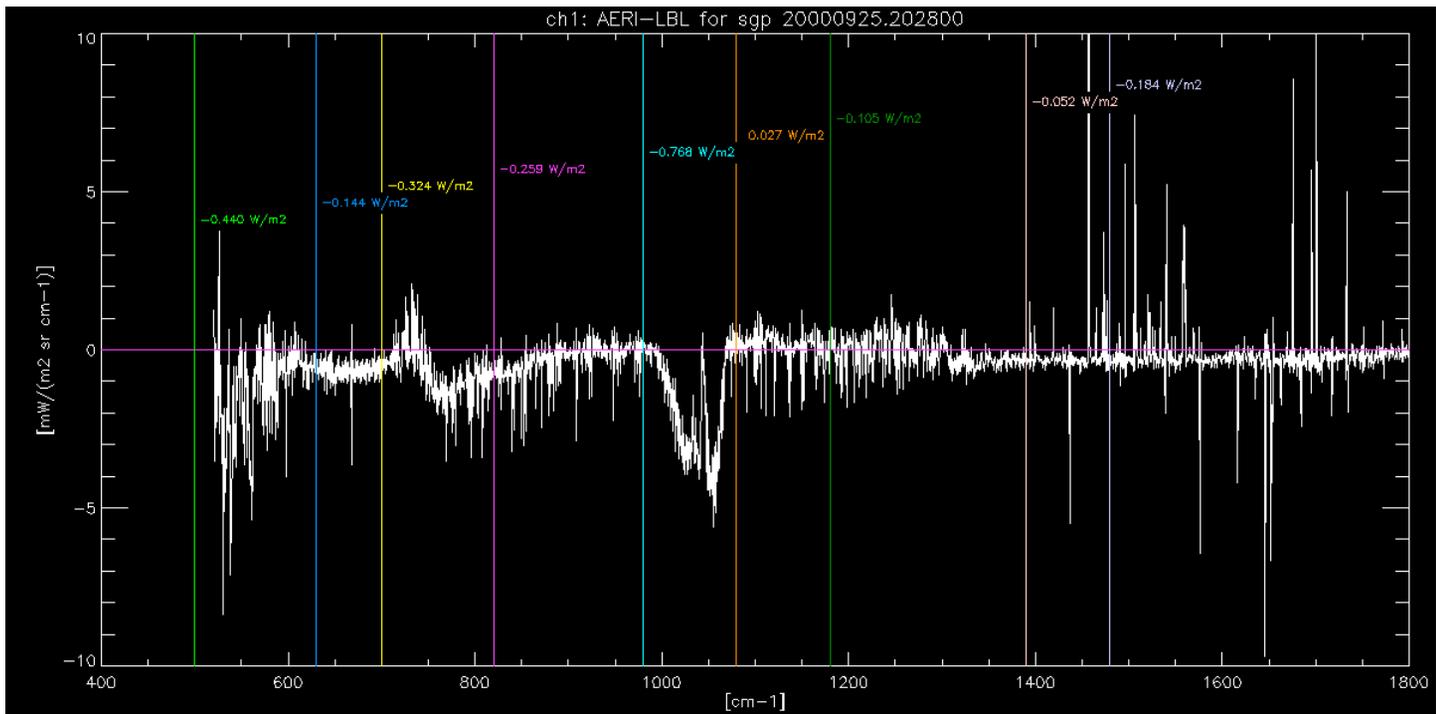
- All input and some output will be available to everybody via website
- Only registered users (considered as formal participants) will have certain privileges:
 - ✓ access to additional output (e.g., spectral results)
 - ✓ posting permissions on the CIRC weblog (under construction)
 - ✓ e-mail notifications about changes, updates, and corrections to the CIRC dataset.
 - ✓ priority to participate in workshops and publications

Registered users are expected to submit results from their RT runs within predetermined deadlines.

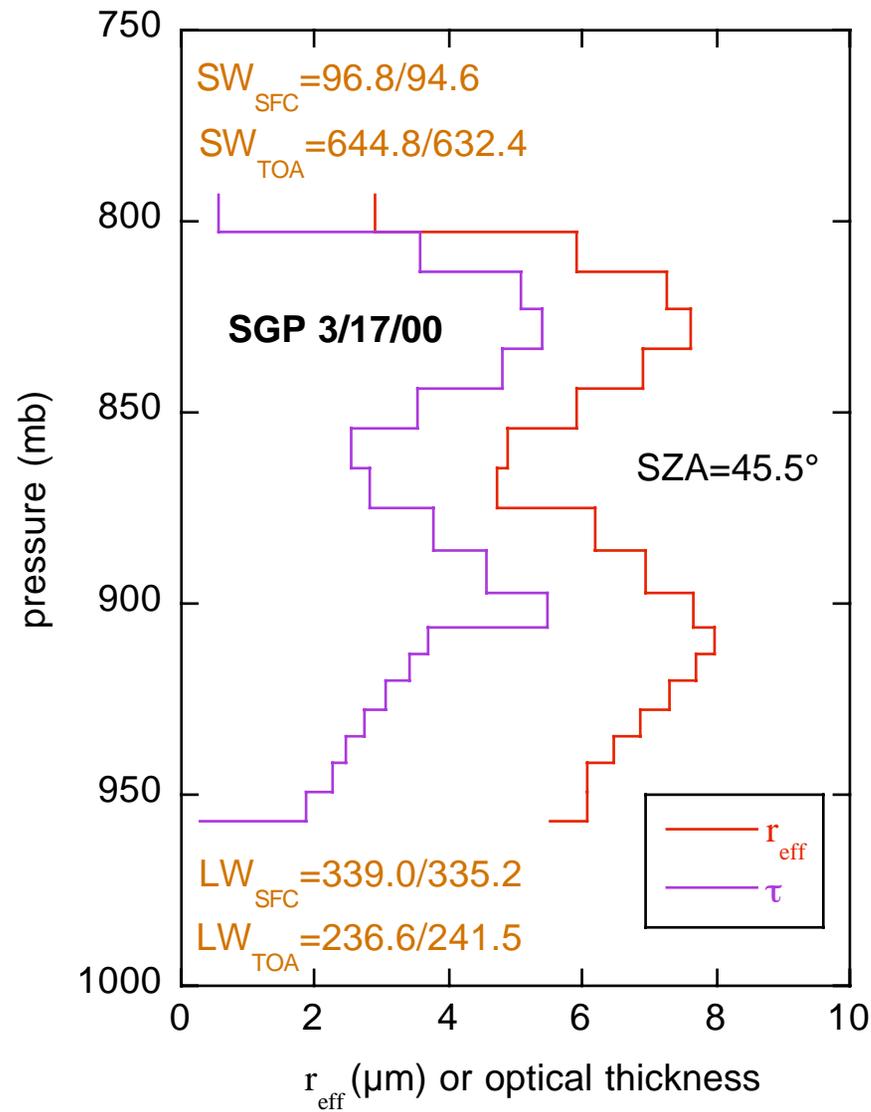
What would make for a successful CIRC?

- CIRC draws the attention of the GCM RT modeling community, ties to IPCC
- Majority of BB RT code developers participate
- CIRC becomes the de-facto standard to assess performance of RT code
- Published RT code evaluations refer to level of agreement with CIRC cases
- Momentum can be sustained for future Phases (ice clouds, aerosols, tropics)

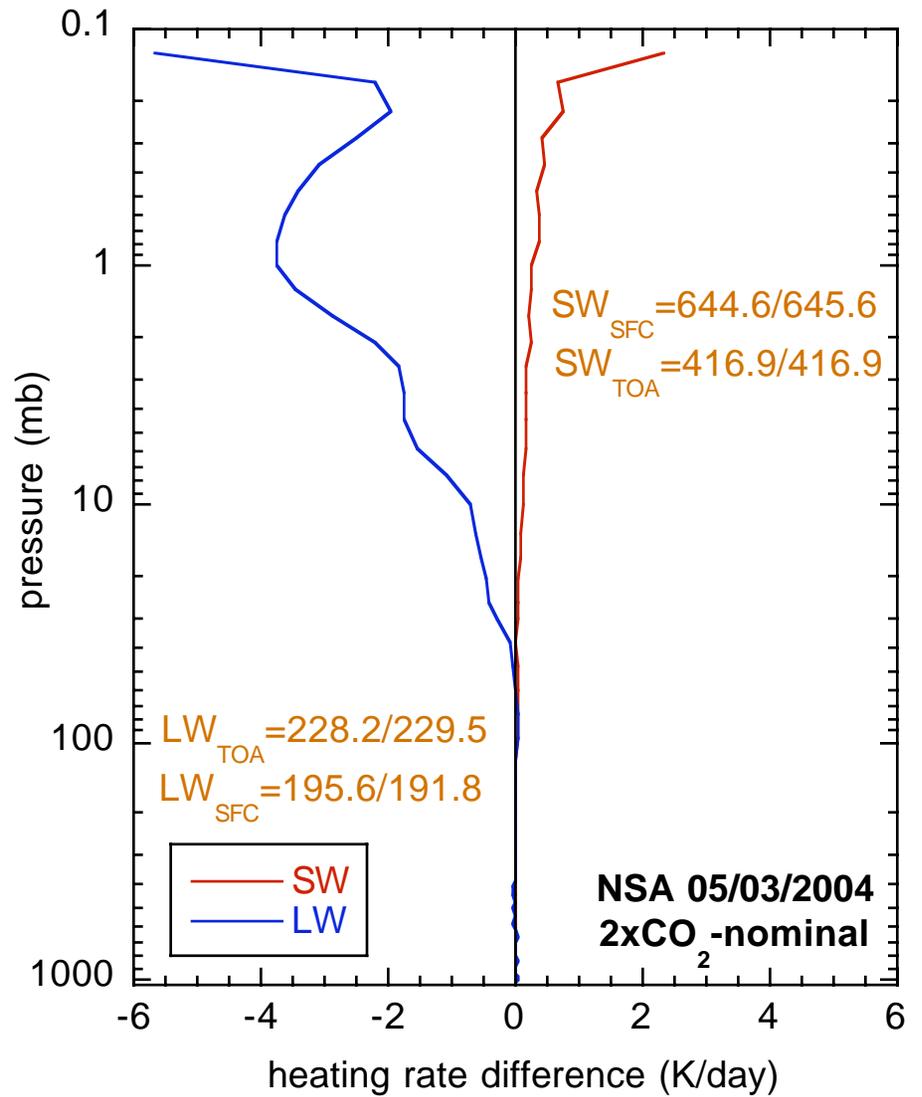
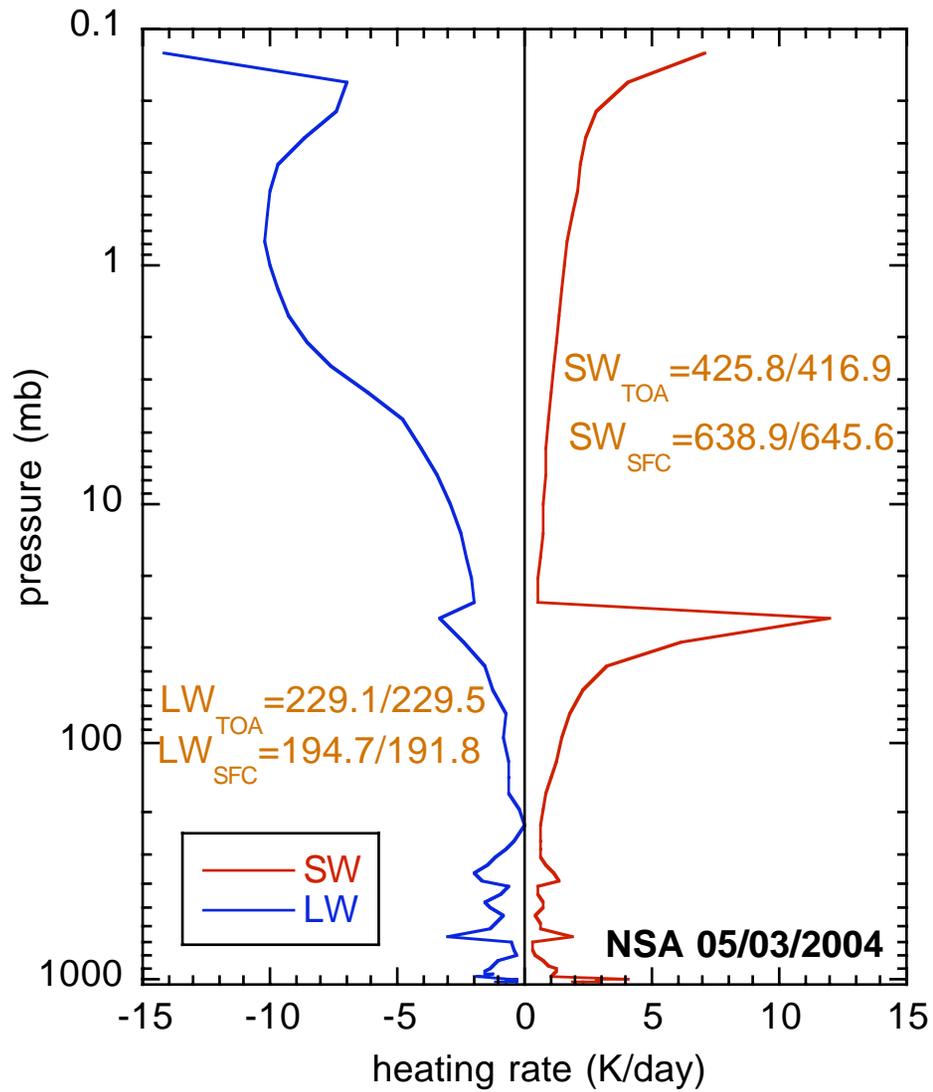
Additional slides

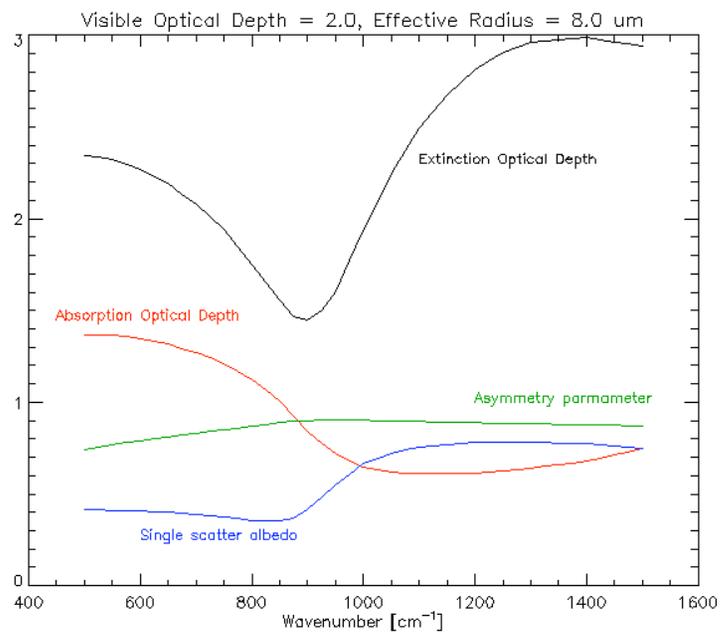
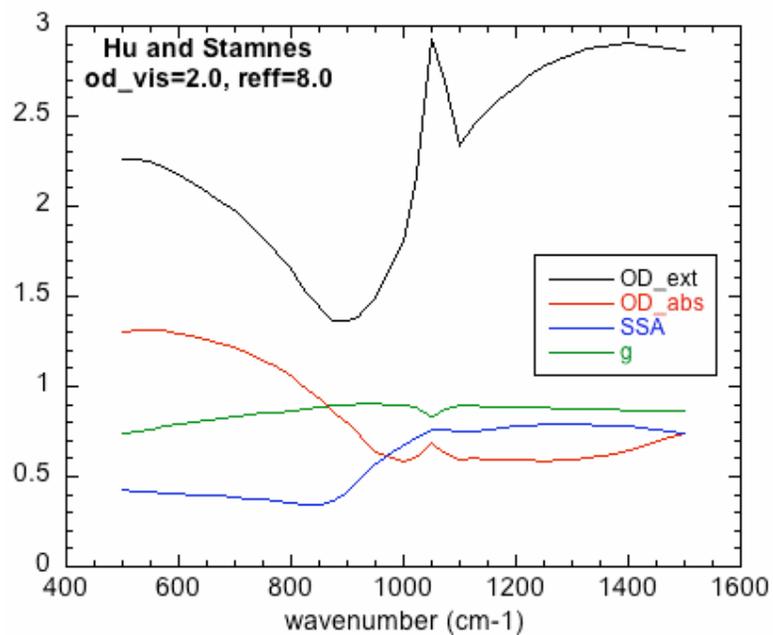
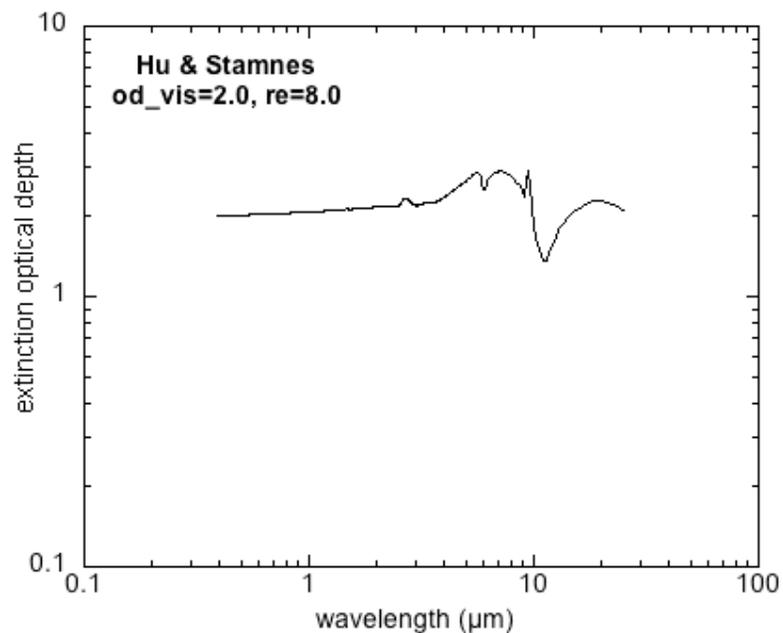
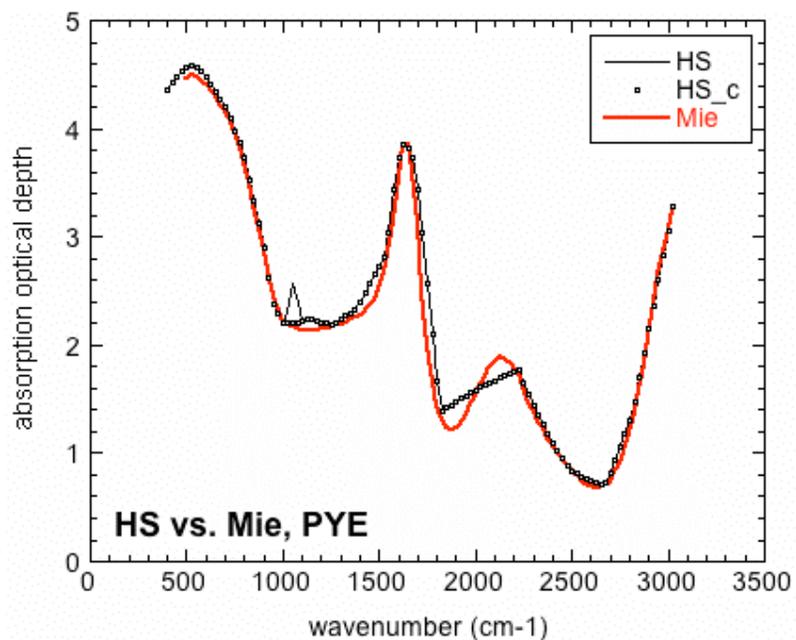


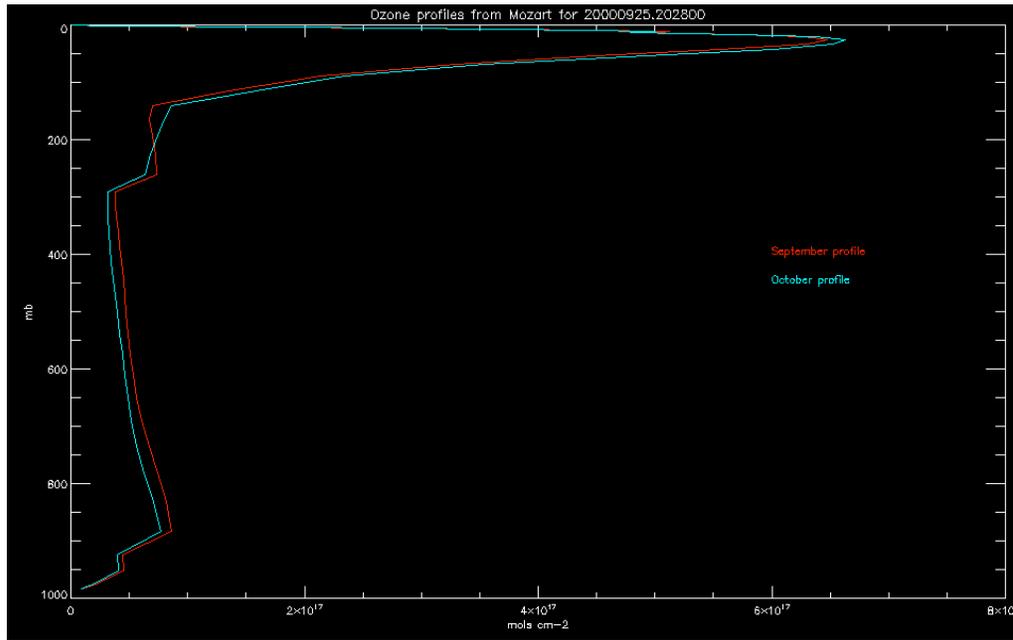
Profile of τ and r_{eff} for SGP 3/17/00



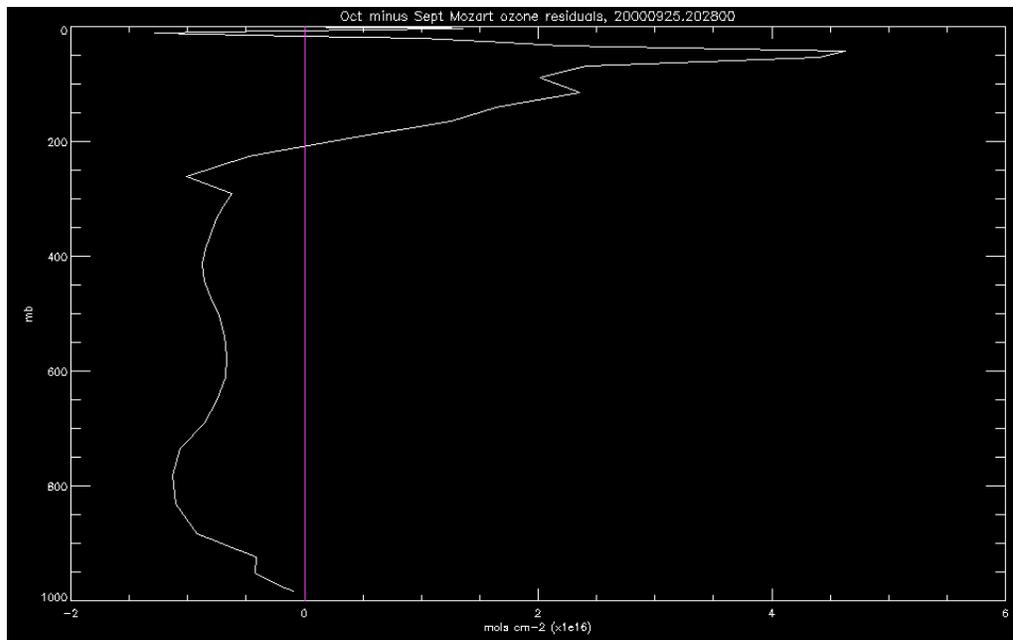
NSA heating rates



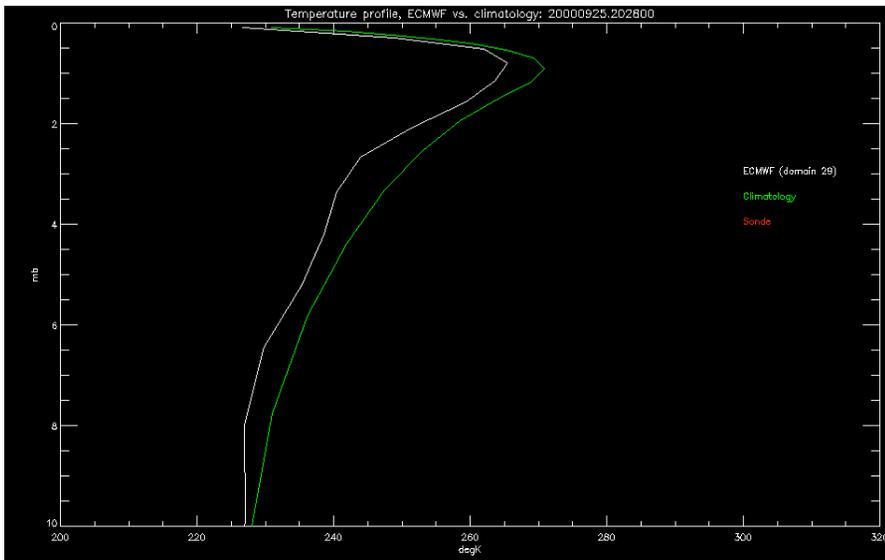
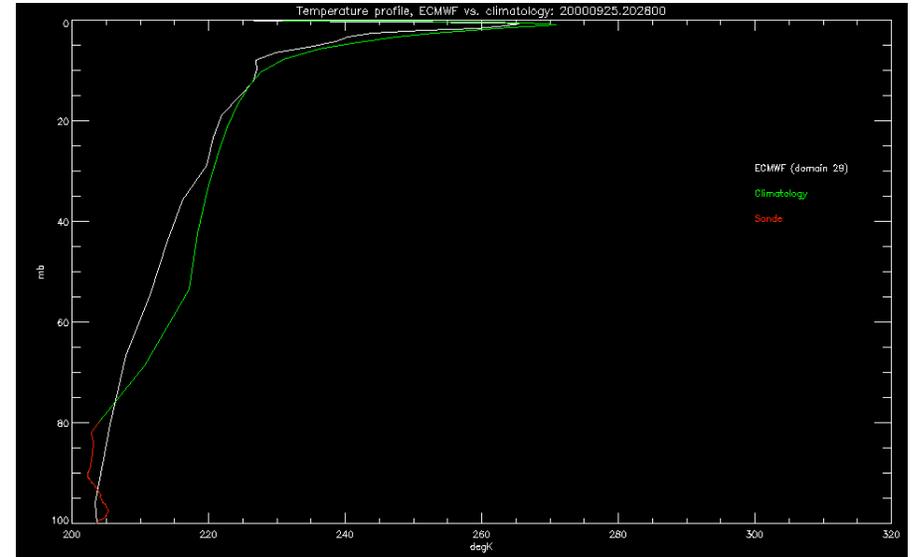
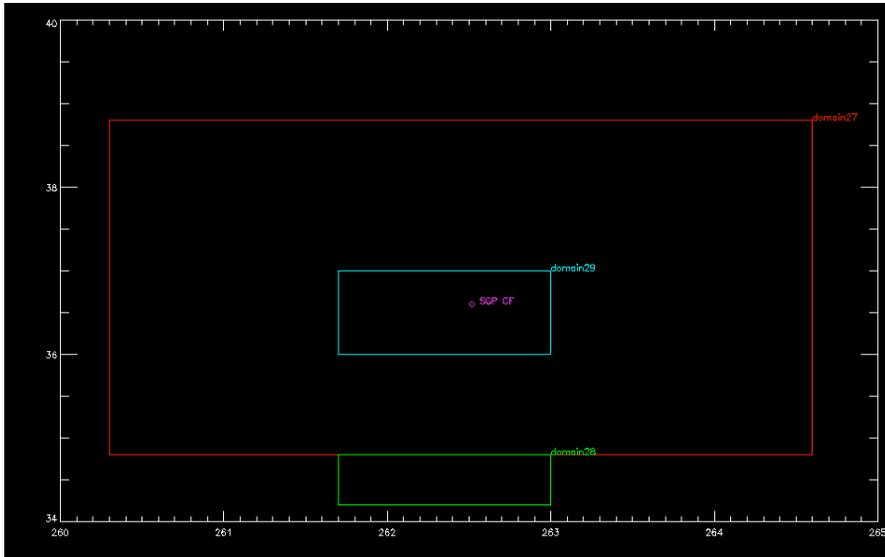




9/25/00 SGP case
ozone profiles



SGP 9/25/00, temperature profiles



Sfcalb: 20000719.232900

