The Continuous Intercomparison of Radiation Codes (CIRC): Phase I Cases

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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 efforts?

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 come from ARM observations as documented in the Broadband Heating Rate Profile (BBHRP) product. BBHRP also provides reference calculations from AER's RRTM RT algorithms that can be used to select the most optimal set of cases and to provide a first-order estimate of our ability to achieve radiative flux closure given the limitations in our knowledge of the atmospheric state.

How where Phase I cases selected?

The common principle criterion for selecting CIRC Phase I cases is achievement of radiative closure at the surface and TOA. For the cloudy cases additional criteria were (1) overcast conditions; (2) the presence of only one water phase (liquid); (3) cloud homogeneity. For the clear sky cases other major criteria were: (1) a wide range of precipitable water loadings; and (2) a significant range of solar geometries. Based on these criteria, four clear sky and two cloudy cases were identified for Phase I of CIRC. All but one of the clear-sky cases come from the SGP ACRF site where BBHRP has been more rigorously tested; the other case is from the NSA ACRF. The cloudy cases are from SGP and the Pt. Reyes AMF deployment in 2005.

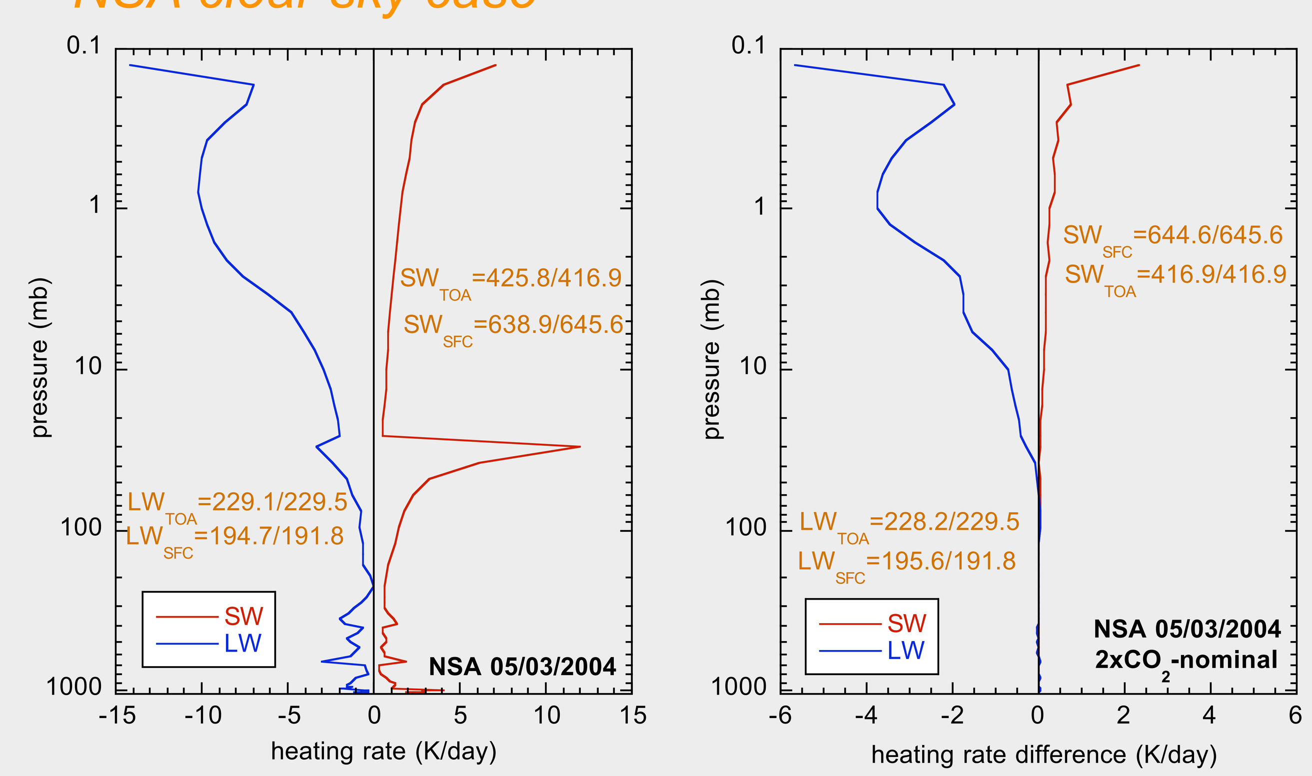
A first look at Phase I cases

SGP clear sky cases

Date	SZA	PWV	τ_{aer}	LW_{SFC}	LW_{TOA}	SW_{SFC}	SW_{TOA}
4/18/00	55.7°	2.61	0.19	336.9 337.6	283.3 284.3	526.7 532.9	152.2 162.4
7/19/00	64.6°	4.85	0.18	441.8 443.8	295.4 291.6	345.4 349.4	133.7 121.2
9/25/00	47.9°	1.23	0.04	289.7 291.8	303.3 305.3	705.9 709.1	175.0 179.5

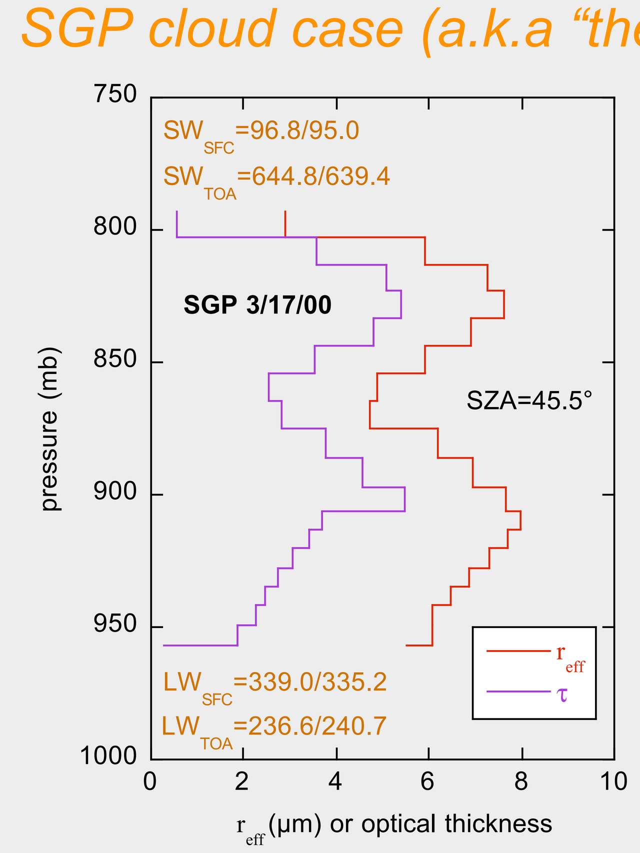
Flux values (upward at TOA, downward at SFC) are in Wm^{-2}, top values from observations and bottom values from RRTM. TOA values are from GOES using NB to BB conversion algorithms. PWV (Precipitable Water Vapor) values are in cm. The aerosol optical thickness refers to 0.55 μm.

NSA clear sky case



SW and LW heating rates (left) and heating rate differences from 2 x CO_2 simulations for CIRC's NSA clear sky case. The baseline CO_2 RRTM fluxes (Wm^{-2}) are listed second while the preceding values come either from observations (left) or the 2 x CO_2 RRTM simulations (right). The TOA fluxes are from the nearest CERES overpass. PWV=0.29 cm, τ_{aer}=0.13, SZA=55.1°.

SGP cloud case (a.k.a "the easy cloud case")



The vertical profile of visible optical thickness and effective radius (from MICROBASE) used in the RRTM calculations. Flux values are in Wm^{-2}, with the first value coming from observations and the second value from RRTM. TOA values are from GOES using NB to BB conversion algorithms.

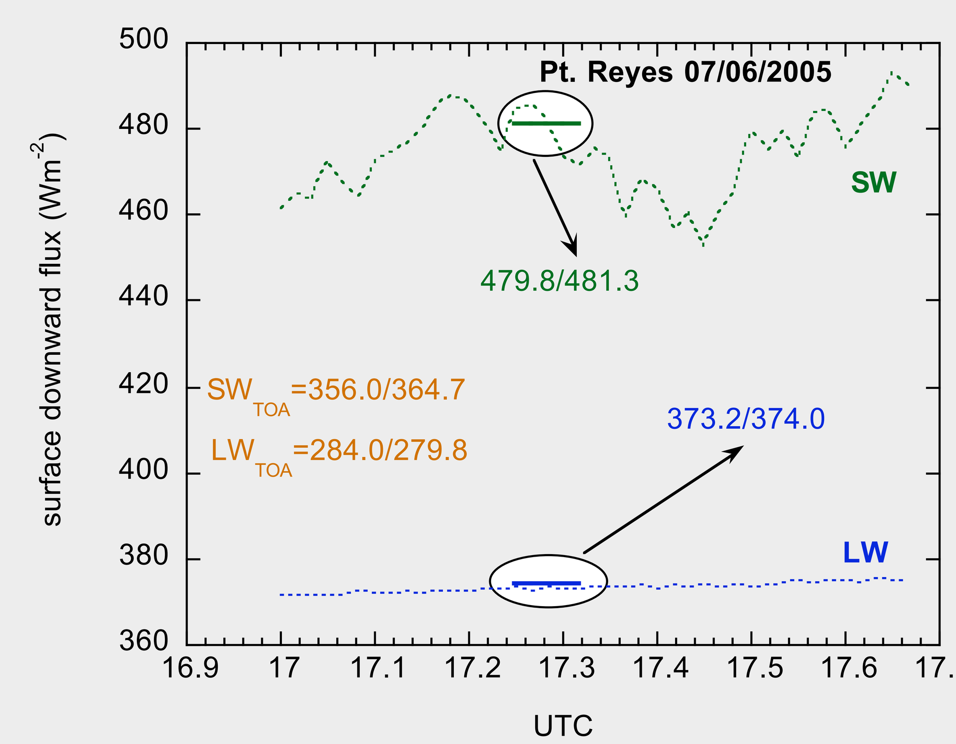
How will CIRC be run?

CIRC will operate as a "hybrid" intercomparison. In practice this means that input and some output will be available to everybody (like in "open" intercomparisons); but only registered users (considered as formal participants as in "closed" intercomparisons) will have access to additional output (e.g., spectral results), posting privileges on the CIRC weblog (under construction), and e-mail notifications about changes, updates, and corrections to the CIRC dataset. They will also be given priority to participate in workshops and publications. Registered users are expected to submit results from their RT runs within predetermined deadlines.

What's next?

In the following weeks we will complete the CIRC reference runs with a full suite of LBL calculations for both clear and cloudy cases and will make final refinements for all runs, as necessary. The input along with selected output data will be posted on the official CIRC website http://www.circ-project.org, as they become available. Participation invitations will be extended to the GCM radiation modeling community, and a timeline will be set for submissions and follow-up activities (workshop, publications, Phase II, etc.)

Pt. Reyes cloud case (a.k.a. "the challenging cloud case")



Left: *Time series of observed downward SW and LW fluxes between 17:00 and 17:40 UTC for the Pt. Reyes AMF deployment on July 6, 2005 (dotted curves). The short solid thick lines are fluxes from RRTM and are based on MIXCRA retrievals of cloud properties (LWP=39.1 gm^{-2}, r_e=8.8 μm) around 17:17 UTC. There are compared with 5-min averages (centered at 17:17 UTC) of downward surface fluxes from ground observations. Corresponding calculated (RRTM) and observed (GOES) TOA upward fluxes are also given. SZA=41.2 °.*
Right: *Sky image from the TSI on 17:17 UTC, July 6, 2005.*