Assessing ARM Clear Sky BBHRP with CERES and AIRS

University of Wisconsin - Madison, Space Science and Engineering Center
Leslie Moy, Dave Tobin, Bob Knutson, Lori Borg, Hank Revercomb (PI), Marty Mlynczak1, and Joel Susskind2
1NASA Langley, 2NASA GSFC

Clear Sky Analysis at SGP between September 2002 and February 2005:
For the 2007 STM the BBBHRP clear sky methodology was extended at the SGP site to cover multiple years. TOA flux calculations using RRTM were compared to GOES fluxes (which is based on a regression with CERES). This year we compare directly with CERES SSF FM-3 OLR within 10 km of the SGP site and 10 minutes of the Aqua overpass times, and a 99% clear sky requirement. We used interpolated sondes to Aqua overpass times (Best Estimate profiles, BE), and added RRTM calculations using NASA AIRS level 2 retrievals.

Night time Clear Sky OLR

**NIGHT** OLR differences: Observations minus Calculations
Mean, W/m² Uncertainty in mean Stdv, W/m² Prrs

- **SGP 2002 - 2005**
  - SSA CERES - BE RRTM +0.5 +1 ~1 2.6 ~74
  - SSA CERES - BE profile with AIRS surface RRTM +0.8 +1.2 ~2 2.2 ~74
  - SSA CERES - AIRS RRTM +1.2 +1.5 ~3 1.8 ~74

**NIGHT** OLR differences: Observations minus Calculations
Mean, W/m² Uncertainty in mean Stdv, W/m² Prrs

- **Global 16Nov2002**
  - SSA CERES - AIRS RRTM +0.9 +0.5 ± 0.5 2.6 ~21k

Clear Sky Global Analysis of 16 November 2002
Clear sky OLR RRTM calculations using NASA AIRS L2 retrievals (version 5) were compared to SSA CERES.

Introduction
The overall objective of this research is to assess and improve the ARM Broad Band Heating Rate Profile (BBHRP) measurement-model comparison effort that will couple heating rates based on ARM data more directly into SCM and GCM models. Methods of determining OLR include measurements from broadband radiometers onboard satellites and calculations from radiative transfer models (RTM) requiring atmospheric profile and surface properties as inputs. We assess CERES against AER’s RRTM calculations using ARM data and AIRS retrievals.

Summary of our technique
- SSA CERES is currently a better metric for BBHRP assessment than GOES.
- AIRS spectral radiance analysis allows us to evaluate the atmospheric and surface estimates.
- AIRS spectral flux analysis allows us to interpret uncertainties in the OLR products, and infer uncertainties in the far IR.
- Using AIRS retrievals for global RRTM calculations of OLR and heating rate profiles.

Summary of Results
The RRTM calculations of clear sky OLR agree with CERES observations to ~1 W/m² with an uncertainty of ~1 W/m².
- True at SGP over 2.5 years, true globally (with some understood regional exceptions) for study day.
- True using ARM data as input to RRTM, true using AIRS sounding retrievals as input to RRTM.

All Sky Global Analysis of 16 November 2002
NASA AIRS L2 cloud retrieval product reports the cloud fraction and optical depths for up to two clouds. We calculated OLR with RRTM assuming grey clouds.

**NIGHT**

**CERES - AIRS RRTM**, W/m²

Night CERES clear sky OLR, W/m²
Night CERES - AIRS RRTM, W/m²

Determining uncertainty in the mean
- We attribute the Gaussian component to spatial mismatch between CERES and AIRS footprints. For the Gaussian shown, the statistical uncertainty is very small (0.01 W/m²) and not representative of the true uncertainty of the mean.
- The negative tail of the histogram is consistent with the expected shape of the distribution.
- Estimation of the mean of the full distribution with uncorrected tail.

Acknowledgements
- Dave Rutan, Pat Minnis, Pat Heav, Mandy Khayier, Tony Clough, Eli Mlawer, the AIRS Project, the ARM infrastructure.
- This work supported by DOE grant DE-FG02-00ER861057.