TRMM/Terra CRS Results and Status
CERES Science Team Meeting
Norfolk, Virginia    May 6, 2002

Surface and Atmosphere Radiation Budget (SARB) group:
T. P. Charlock (NASA LaRC)
Fred G. Rose (AS&M)
David A. Rutan (AS&M) – validation and “CAVE” URL
Zhonghai Jin (AS&M) - coupled radiative transfer
Lisa H. Coleman (SAIC) - Data Management Team
Thomas E. Caldwell (SAIC) - Data Management Team

Seiji Kato (H.U.) – second part of this presentation with Rose

Access to CAVE on line surface and CERES validation, point and click Fu-Liou and COART calculations:
www-cave.larc.nasa.gov/cave/ or goggle “CERES CAVE”
Wenying Su
Foam albedo at COVE with Ken Rutledge
Ultra Long Duration Balloon (ULDB) mishap
Icebreaker proposal

Bill Smith, Jr.
CLAMS manuscripts due this summer for JAS issue

TRMM CRS Edition 2B released last fall
TRMM CRS Edition 2C corrected our reporting of SSF file
Both have two errors:
  Organic carbon aerosols neglected (~10% forcing)
  Cloudy "cosSZA" as 0.5 rather than 0.6, boosting albedo

Land bug Terra Beta run – but test over COVE will be shown

Qiang Fu, Dave Kratz, and Fred Rose – continuum update in progress

Planned changes to SARB in recompetition
  All-sky direct aerosol forcing (CRS)
  Spectral output at surface (CRS)
  More vertical levels & Surface Albedo Forcing in SYN?
Aerosol direct forcing to SW TOA at cosSZA=0.33.

External mixture of continental AOT=0.25 and soot AOT=0.05.
Aerosol scale height 2km.

<table>
<thead>
<tr>
<th>Cloud</th>
<th>Aerosol forcing</th>
<th>Surface type</th>
</tr>
</thead>
<tbody>
<tr>
<td>top (km)</td>
<td>τ</td>
<td>SW TOA (Wm⁻²)</td>
</tr>
<tr>
<td>clear</td>
<td>0</td>
<td>16 water</td>
</tr>
<tr>
<td>1</td>
<td>20</td>
<td>-21 water</td>
</tr>
<tr>
<td>5</td>
<td>20</td>
<td>-2 water</td>
</tr>
<tr>
<td>clear</td>
<td>0</td>
<td>-47 snow</td>
</tr>
<tr>
<td>1</td>
<td>20</td>
<td>-37 snow</td>
</tr>
<tr>
<td>5</td>
<td>20</td>
<td>-20 snow</td>
</tr>
</tbody>
</table>

We already produce cloud forcing and clear-sky direct aerosol forcing; here add all-sky forcing.

May need surface albedo forcing, too.
Future CERES: SPECTRAL output at surface (bio-medical applications)

Transmission to Surface in Near UV  \( \cos(SZA) = 0.33 \)

- Blue: Ozone = 247 DU
- Thick dashes: Snow Albedo
- All others: Water Albedo

- Ozone = 397 DU
- AOT=0.30 (soot AOT=0.05)
- Low Cloud Optical Depth = 20

UV MFRSR already deployed at COVE for validation
<table>
<thead>
<tr>
<th>ALL SKY</th>
<th>Observed mean</th>
<th>N</th>
<th>Obs. - SARB</th>
</tr>
</thead>
<tbody>
<tr>
<td>LW Down Surface</td>
<td>349</td>
<td>455</td>
<td>-3</td>
</tr>
<tr>
<td>LW Up Surface</td>
<td>416</td>
<td>430</td>
<td>-3</td>
</tr>
<tr>
<td>SW Down Surface</td>
<td>428</td>
<td>260</td>
<td>-21</td>
</tr>
<tr>
<td>SW Up Surface</td>
<td>87</td>
<td>260</td>
<td>11</td>
</tr>
<tr>
<td>LW Up TOA</td>
<td>247</td>
<td>457</td>
<td>0</td>
</tr>
<tr>
<td>SW Up TOA</td>
<td>225</td>
<td>260</td>
<td>2</td>
</tr>
<tr>
<td>CLEAR SKY sat. + sfc.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SW Down Surface</td>
<td>324</td>
<td>17</td>
<td>-14</td>
</tr>
<tr>
<td>SW Up TOA</td>
<td>109</td>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td>OVERCAST sat. + sfc</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SW Down Surface</td>
<td>156</td>
<td>30</td>
<td>-32</td>
</tr>
<tr>
<td>SW Up TOA</td>
<td>461</td>
<td>30</td>
<td>3</td>
</tr>
</tbody>
</table>

Excuses for errors in SW Down at Surface:

- Input AOT is small (60% of Cimel observed)
- Surface albedo for cloudy sky is not spatially representative
Terra Beta CRS run for Jan-Apr-Jul 2001

Mistake in aerosol interpolation zaps land footprints

The NOAA/ECMWF SST that we picked for SARB

The Cloud WG SST that we ignored

"COVE SST" = in situ measurement

But gliches should have minimal effect on SW over COVE, where Surface albedo is known
MODIS aerosol retrievals should be okay
Beware of sunglint: Tuned SARB results in clear skies (Terra Beta at COVE)

“Glint Angle” = difference of CERES viewing angle and specular reflection from mirror sea

For 23% of sample

Tuned insolation exceeds observations by ~30 Wm-2 (as if tuned AOT is too low)

Tuned reflection to TOA is much greater than CERES (as if tuned AOT is too high)
CERES Terra Beta CRS SW SARB over COVE (Jan, Apr, Jul 2001)

PAPS greatly enhanced coverage during CLAMS (July 2001).

Tuned in regular font.  
*Untuned in parentheses using italic font.*

<table>
<thead>
<tr>
<th></th>
<th>Observed mean</th>
<th>N</th>
<th>Bias Obs-Sarb</th>
<th>RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ALL SKY</strong></td>
<td>Wm-2</td>
<td>Wm-2</td>
<td>Wm-2</td>
<td>Wm-2</td>
</tr>
<tr>
<td>SW Down Sfc.</td>
<td>701</td>
<td>633</td>
<td>-8 (-8)</td>
<td>90 (84)</td>
</tr>
<tr>
<td>SW Up at TOA</td>
<td>209</td>
<td>633</td>
<td>-3 (7)</td>
<td>15 (32)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>OVERCAST Sat. + Sfc.</strong></th>
<th>Wm-2</th>
<th>Wm-2</th>
<th>Wm-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW Down Sfc.</td>
<td>281</td>
<td>109</td>
<td>-28 (17)</td>
</tr>
<tr>
<td>SW Up at TOA</td>
<td>533</td>
<td>109</td>
<td>4 (-40)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>CLEAR Sat. + Sfc.</strong></th>
<th>Wm-2</th>
<th>Wm-2</th>
<th>Wm-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW Down Sfc.</td>
<td>816</td>
<td>78</td>
<td>-13 (7)</td>
</tr>
<tr>
<td>SW Up at TOA</td>
<td>73</td>
<td>78</td>
<td>-11 (-21)</td>
</tr>
</tbody>
</table>

Why such odd results for overcast?  
(Wish we had Su’s ULDB to answer)
Suppose this is the real footprint, but then we use a Point Spread Function (PSF) that's too small.

What happens?
By assuming a PSF that’s too small (the red oval), we would label the footprint as overcast when it’s really partly cloudy.

And because the clouds are random, we would greatly underestimate cloud fraction in some partly cloudy cases.
Observations - Untuned Calculations

SW Partly Cloudy

SW Overcast
Computed cloud forcing is too large.

SW Overcast:

Computed cloud forcing is too small.

Observations - Untuned Calculations:

- SW Partly Cloudy
- SW Overcast
Cloud forcing in SW and LW have opposite signs, so window signal here may be consistent.

Signal seen for broadband LW radiance, but not for OLR (flux)
Computed cloud forcing is too large

Computed cloud forcing is too small

What else can do this?

Possibilities include:

3-D effects in ADM but not in 2 stream

“Gamma distribution” effect [i.e., need pdf of tau, not just ln(tau)]