Surface Atmosphere Radiation Budget (SARB) working group update

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CERES Science team meeting
May 16-18, 2017
Hampton, VA
Work done after the last CERES meeting

• Evaluation of Ed4 SYN (with ship, buoy, and land sites data)
• Start revising C3M
• Production of Ed2.8 EBAF-surface (currently available through August 2016)
• Development of the algorithm of Ed4 EBAF-surface
• Start evaluating GMAO products, MERRA2 and FP (Ham’s presentation)
• Evaluation of the effect of multi-layer cloud on surface radiation
• Evaluation of permanent snow BRDF observations and model derived from the observations (Radkevich’s presentation)
Evaluation of Ed4 SYN

- GEO cloud retrieval used more than 2 channels
  - 1 hourly retrieval compared to 3 hourly
  - Nighttime longwave flux improvements
- Southern ocean
Improvements of nighttime surface longwave irradiance (Eastern Pacific)
Western Pacific

Nighttime Surface LW Down Hourly (MTSAT W Pac Ocean Buoy Group, 08 Sites)

Sfc LW Down Ed3

y-Mean: 388
x-Mean: 391
Bias(y-x): -3
RMS: 14
N: 46968

Sfc LW Down Ed4

y-Mean: 392
x-Mean: 391
Bias(y-x): 1
RMS: 14
N: 46968

Observations vs. Synop: Annual Time Series

Obs LW (Wm$^{-2}$) vs. SYN LW (Wm$^{-2}$)

Legend:

- Blue: 0.0
- Red: 6.0
- Ln(Count)
Atlantic ocean

Nighttime Surface LW Down Hourly (MeteoSat Atl Ocean Buoy Group, 11 Sites)

MET-10 algorithm changed beginning of 2013
North Polar Environmental Observatory (Ice buoys)
http://psc.apl.washington.edu/northpole/Buoys.html

Bias (RMS) Wm^{-2} | 2002  | 2003  | 2004  | 2005  | 2006  | 2007  | 2008  |
-----------------|------|-------|-------|-------|-------|-------|-------|
LW down (day)    | -10  (23) | -7 (21) | -2 (23) | -65 (77) | -11 (27) | -1 (20) | -13 (23) |
LW down (night)  | 4 (24)    |       |       |       |       |       | -22 (30) |
SW down          | 15 (43)   | 59 (85) | 53 (69) | 24 (54) | 49 (69) | 13 (47) | 22 (45) |
N hours, day (night) | 2211 (3757) | 3284 | 1879 | 2391 | 2439 | 2206 | 3664 |

Surface air temperature

Ice Buoy ΔT (G541 - N Polar Ice Buoys)

SYN1deg – NPEO buoy observations
Southern ocean ship data
Downward longwave irradiance
Evaluation of multi-layer clouds

Separation of between cloud base and cloud top needs to be greater than 1 km

For average, footprints contains these multi-layers with the cloud fraction of 100% are 5.3% of all footprints

Multi-layer effect on surface downward longwave irradiance

<table>
<thead>
<tr>
<th>Pressure (hPa)</th>
<th>Occurrence (%)</th>
<th>CRS-C3M (Wm⁻²)</th>
<th>LW flux mean (Wm⁻²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HH</td>
<td>12.1</td>
<td>-0.8</td>
<td>322</td>
</tr>
<tr>
<td>HM</td>
<td>22.3</td>
<td>-7.5</td>
<td>304</td>
</tr>
<tr>
<td>HL</td>
<td>56.1</td>
<td>-7.7</td>
<td>320</td>
</tr>
<tr>
<td>MM</td>
<td>0.8</td>
<td>-7.3</td>
<td>242</td>
</tr>
<tr>
<td>ML</td>
<td>8.7</td>
<td>-8.2</td>
<td>269</td>
</tr>
<tr>
<td>LL</td>
<td>0.1</td>
<td>-4.9</td>
<td>282</td>
</tr>
</tbody>
</table>

CRS: Multi-layer is treated as a single layer

C3M: Multi-layer is derived from CALIPSO and CloudSat
MATCH Status

• Switch from MODIS Collection 5 to MODIS Collection 6
• 6 month C5/C6 overlap Oct 2016 – Mar 2017
• Decrease data latency to ~ 1 month (April 2017 shown below)
• Continued comparisons to MERRA2 aerosol
Ice particles size conversion

\[ \text{mass(D)} = aD^b \]
\[ \text{area(D)} = rD^d \]

Where

- \( D \): Diameter in cm
- \( a = 0.146 \text{ (g cm)}^{-b} \)
- \( b = 2.80 \)
- \( r = (\text{g cm}^2)^{-d} \)
- \( d = 1.97 \)

Ham et al. 2017 JGR
Publications

