Acrobatics to Squeeze Aerosols and Their Direct Forcing from the CERES CRS Product


Co-I Report to CERES STM (Newport News, 1-3 May 2001)

Essential starting points:

Clear sky screen (Minnis Cloud WG)

“VIRS200+” TOA SW fluxes (Loeb ADM WG)

VIRS aerosol optical thickness AOT (Stowe-Ignatov)

Fu-Liou code

Collins-Rasch assimilation
Aerosol Forcing at TOA

Reflected in Wm$^{-2}$

<table>
<thead>
<tr>
<th>cosSZA=0.5</th>
<th>1 micron dust</th>
</tr>
</thead>
<tbody>
<tr>
<td>cosSZA=0.5</td>
<td>4 micron dust</td>
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</tbody>
</table>

* We retrieve 0.06 for optical depth
* Gosh, we calculate forcing as only 2.4 Wm$^{-2}$
SARB output for clear-sky footprint on CRS includes:

Pu = pristeen flux, untuned (Fu-Liou calculation with no aerosols)
Cu = clear flux, untuned (Fu-Liou with aerosol)
Ct = clear flux, tuned (constrained Fu-Liou)
Co = clear flux observed by CERES

AOTu = input aerosol optical thickness (Collins-Rasch or Stowe-Ignatov)
AOTt = tuned AOT from constrainment

Three estimates of direct forcing at TOA:

F1 = Cu-Pu a raw calculation
F2 = Ct-Pu constrained estimate
F3 = Co-Pu another estimate (okay if the ocean optics are good)

AOTo = “observed” AOT that fits CERES, Fu-Liou, and assumed optical properties

\[ AOT_o = \frac{(Co-Pu)}{(dTOA/dAOT)} = \frac{(Co-Pu)}{[(Cu-Pu)/AOT_u]} \]
Results for 1 May 2001 with “VIRS200+” ADM module

Pu = pristeen flux, untuned
Cu = clear flux, untuned with aerosol
Ct = clear flux, tuned
Co = clear flux observed by CERES

AOTu = input aerosol optical thickness (some Collins, some Stowe)
AOTt = tuned AOT from constrainment

Forcings for clear footprints with NO FORWARD SCATTERING:

<table>
<thead>
<tr>
<th>mean</th>
<th>insolation</th>
<th>type of forcing</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.14 Wm-2</td>
<td>7.81 Wm-2</td>
<td>F1 = Cu-Pu</td>
</tr>
<tr>
<td>6.38 Wm-2</td>
<td>5.50 Wm-2</td>
<td>F2 = Ct-Pu</td>
</tr>
<tr>
<td>7.14 Wm-2</td>
<td>5.29 Wm-2</td>
<td>F3 = Co-Pu</td>
</tr>
</tbody>
</table>

AOTo = “observed” AOT that fits CERES, Fu-Liou, and assumed optical properties

AOTo = (Co-Pu)/(dTOA/dAOT) = (Co-Pu)/[(Cu-Pu)/AOTu]