Tropical Ocean Water Budgets and Model Diagnostics as Derived from Satellite Data

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with Help from GEWEX Data and Assessments Panel
Global Water and Energy Budgets
(from Trenberth, Fasullo and Kiehl, 2009, BAMS)
# Multi-Year Average Radiation

<table>
<thead>
<tr>
<th>Source</th>
<th>LW↑</th>
<th>LW↓</th>
<th>LW$_{net}$</th>
<th>SW↑</th>
<th>SW↓</th>
<th>SW$_{net}$</th>
<th>Sfc$_{net}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trenberth et al., 2009</td>
<td>396.0</td>
<td>333.0</td>
<td>-63.0</td>
<td>23.0</td>
<td>184.0</td>
<td>161.0</td>
<td>98.0</td>
</tr>
<tr>
<td>GEWEX SRB (1/84 – 12/07)</td>
<td>396.5</td>
<td>343.9</td>
<td>-52.6</td>
<td>22.0</td>
<td>188.6</td>
<td>166.6</td>
<td>114.0</td>
</tr>
<tr>
<td>ISCCP FD (1985 – 2004)</td>
<td>395.6</td>
<td>344.7</td>
<td>-50.9</td>
<td>23.2</td>
<td>188.9</td>
<td>165.7</td>
<td>114.9</td>
</tr>
<tr>
<td>CERES (Ed 2 Avg) (2000 – 2005)</td>
<td>398.0</td>
<td>342.0</td>
<td>-56.0</td>
<td>23.1</td>
<td>188.9</td>
<td>165.8</td>
<td>109.8</td>
</tr>
<tr>
<td><strong>A-Train</strong> (2006 – 2009)</td>
<td>398.0</td>
<td>347.2</td>
<td>-50.8</td>
<td>20.8</td>
<td>189.0</td>
<td>168.2</td>
<td>117.4</td>
</tr>
</tbody>
</table>
Global Energy Budget Closure

Global Precipitation Climatology Project (GPCP)
Robert Adler, U. of Maryland-College Park, USA

GPCP mean is 2.64 mm/day corresponding to 76 W/m² ± 7 W/m²
• **Near-surface air temperature and humidity**
  – Roberts et al. (2010) neural net technique
  – SSM/I only from CSU brightness temperatures (thus only covers 1997 - 2006 in Version 1.0)
  – Gap-filling methodology -- use of MERRA variability – 3 hour

• **Winds**
  – Uses CCMP winds (cross-calibrated SSM/I, AMSR-E, TMI, QuikSCAT, SeaWinds)
  – Gap-filling methodology -- use of MERRA variability – 3 hour

• **SST**
  – Pre-dawn based on Reynolds OISST
  – Diurnal curve from new parameterization
  – Needs peak solar radiation, precipitation

• **Uses neural net version of COARE**

• **Available at [http://seaflux.org](http://seaflux.org)**
Open Ocean Domains

Tropical Indian (TI)
Tropical West Pacific (TWP)
Tropical Central Pacific (TCP)
Tropical East Pacific (TEP)
Tropical Atlantic (TA)
E, P and Div(Q) for Tropical Indian Ocean
E, P and Div(Q) for Tropical Atlantic
E, P and Div(Q) for Tropical East Pacific
E, P and Div(Q) for Tropical Central Pacific
E, P and Div(Q) for Tropical West Pacific
Water budgets from Reanalysis
The Bulk Parameterization

\[ E = a C_q u_x (q_0 - q_a) \]
The Bulk Parameterization

\[ E = \alpha C_q u_x (q_0 - q_a) \]
Summary

- Water is in balance over tropical oceans

- A trend is evident in West Pacific that is not seen in other basins. Therefore not a satellite trend but a natural change.

- Global models require too much evaporation and therefore precipitation to balance water. Extra precipitation is in the form of excess drizzle.