Geophysical Research Abstracts,
Vol. 11, EGU2009-3205, 2009
EGU General Assembly 2009

Use of BSRN data to analyze the bias in the clear-sky downward shortwave surface flux in the coupled GFDL General Circulation Model

S. Freidenreich
GFDL/NOAA, Princeton NJ, United States (stuart.freidenreich@noaa.gov, 609-987-5063)

A state-of-the-art coupled GCM developed at the Geophysical Fluid Dynamics Laboratory (GFDL) is used to examine the difference with the Baseline Surface Radiation Network (BSRN) inferred "clear-sky" downward shortwave surface fluxes. The model includes a prescribed aerosol climatology and the focus here is to assess the GCM flux biases that arise considering this development. A monthly-mean climatology of BSRN flux values for the direct, diffuse and total beam components have been obtained. The availability of reliable estimates of the clear-sky downward surface flux, in particular the individual direct and diffuse components, make it possible to analyze both the role of the computed aerosol optical depth and, in some instances, the prescribed surface albedo, in the bias seen. When aerosols are excluded, the GCM overestimates the direct flux values for all the site locations considered, with maximum differences > 30 W/m2 over North American and European locations. The magnitude of these overestimates serve as an indicator of the magnitude of the aerosol optical depth needed to get good agreement with the BSRN flux values. With the inclusion of aerosols, the differences are generally < 10 W/m2. The most notable exceptions occur at Payerne (Switzerland), Lindenberg (Germany), and Tateno (Japan) where similar or larger underestimates occur. Based on observations from AERONET over these regions, the optical depth is overestimated in the GCM by > 50%, which explains the corresponding direct flux underestimates by the GCM in these locations. When aerosols are excluded, the GCM correspondingly underestimates the diffuse monthly-mean surface flux values for all the site locations, by up to 30 W/m2. With the inclusion of the aerosols, the magnitude of these maximum differences are mostly < 10 W/m2. Again, notable exceptions occur for Payerne, Lindenberg and Tateno where there are comparable overestimates (> 20 W/m2) due to the atmosphere reflecting too much flux back to the surface in response to the aerosol optical depths also being too large. Also, for the coastal Antarctic locations of Syowa and Neumayer a significant diffuse flux underestimate remains due to an underestimation of the surface albedo. Because of spatial averaging, the albedo is mostly weighted towards the smaller ocean values. The resultant bias in the total clear-sky flux is generally < 20 W/m2. Thus, the BSRN dataset has been useful in providing a firmer basis for deciphering improvements needed in modeling aerosol absorption in the GCM.