Geophysical Research Abstracts
Vol. 15, EGU2013-1286-1, 2013
EGU General Assembly 2013

The Earth's radiation balance and its representation in CMIP5 models

Martin Wild (1), Doris Folini (1), Christoph Schär (1), Norman Loeb (2), Ellsworth Dutton (3), and Gert König-Langlo (4)

(1) ETH Zurich, Institute for Atmospheric and Climate Science, Zurich, Switzerland (martin.wild@env.ethz.ch), (2) NASA Langley Research Center, 21 Langley Boulevard, Hampton, VA 23681-2199 USA, (3) NOAA/ESRL, R/GMD, 325 Broadway Boulder, Colorado 80305 USA, (4) Alfred Wegener Institute, Bussestrasse 24, D-27570 Bremerhaven, Germany

The genesis and evolution of Earth's climate is largely regulated by the global energy balance. Despite the central importance of the global energy balance for the climate system and climate change, substantial uncertainties still exist in the quantification of its different components, and its representation in climate models. While the net radiative energy flow in and out of the climate system at the top of atmosphere is known with considerable accuracy from new satellite programs such as CERES, much less is known about the energy distribution within the climate system and at the Earth surface. Accordingly, the quantification of the global energy balance has been controversially disputed in the past.
Here we review this discussion and make an attempt to put additional constraints on the components with largest uncertainties. In addition to satellite observations, we thereby make extensive use of the growing number of surface observations to constrain the global energy balance not only from space, but also from the surface. We combine these observations with the latest modeling efforts performed for the 5th IPCC assessment report (CMIP5) to infer best estimates for the global mean surface radiative components. Our analyses favor global mean downward surface solar and thermal radiation values near 185 and 342 Wm-2, respectively, which are most compatible with surface observations. These estimates are lower and higher, respectively, than in many previous assessments, including those presented in previous IPCC reports. It is encouraging that our estimates, which make full use of the information contained in the surface networks, coincide within 2 Wm-2 with the latest satellite-derived estimates (Stephens et al. 2012, Kato et al. submitted to J. Climate), which are completely independently determined.
Combining our above estimates with an estimated global mean surface absorbed solar radiation and thermal emission of 161 Wm-2 and 397 Wm-2, respectively, results in 106 Wm-2 of surface net radiation globally available for distribution amongst the non-radiative surface energy balance components.
The 23 CMIP5 models investigated in this study overestimate the downward solar and underestimate the downward thermal radiation, both by 5-10 Wm-2 on average. Thus, the CMIP5 models nevertheless simulate an adequate global mean surface net radiation, by error compensation in their downward solar and thermal components. This also suggests that, globally, the simulated surface sensible and latent heat fluxes, around 20 and 85 Wm-2 on average, state realistic values. The findings of this study are compiled into a new global energy balance diagram, and may be able to reconcile currently disputed inconsistencies between global mean energy and water cycle estimates.
The study is published online in Climate Dynamics.

Related references:

Wild, M., 2012: New Directions: A facelift for the picture of the global energy balance. Atmospheric Environment, 55, 366-367.

Wild, M., Folini, D., Schär, C., Loeb, N., Dutton, E.G., and König-Langlo, G., 2013: The global energy balance from a surface perspective, Clim. Dyn., published online. Doi:10.1007/s00382-012-1569-8.

Stephens, G.L., Li, J.-L., Wild, M., Clayson, C.A., Loeb, N., Kato, S., L'Ecuyer, T., Stackhouse, P.W., and Andrews, T., 2012b: An update on Earth's energy balance in light of the latest global observations, Nature Geoscience, 5, 691-696, doi:10.1038/ngeo1580.