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The global energy balance from a surface perspective

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In the framework of the global energy balance, the radiative energy exchanges between Sun, Earth and space are now accurately quantified from new satellite missions. Much less is known about the magnitude of the energy flows within the climate system and at the Earth surface, which cannot be directly measured by satellites. In addition to satellite observations, here we 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 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. Combined with an estimated global mean surface absorbed solar radiation and thermal emission of 161 Wm-2 and 397 Wm-2, respectively, this leaves 106 Wm-2 of surface net radiation available globally for distribution amongst the non-radiative surface energy balance components. The climate models overestimate the downward solar and underestimate the downward thermal radiation, thereby simulating nevertheless an adequate global mean surface net radiation by error compensation. 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, which may be able to reconcile currently disputed inconsistencies between energy and water cycle estimates.
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References:
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