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# The global land and ocean mean energy balance

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The energy balance over land and oceans governs a diversity of terrestrial and maritime processes and is the key determinant of climatic conditions in these areas. Despite its crucial role, climate models show significant differences in the individual components of the energy balance over both land and oceans, particularly at the surface. Here we combine a comprehensive set of radiation observations from GEBA and BSRN with 43 state-of-the-art climate models to infer best estimates for present day annual mean downward solar and thermal radiation averaged over land and ocean surfaces, together with their uncertainty ranges. Over land (including the polar ice sheets), where most direct observations are available to constrain the surface fluxes, we obtain 184 and 306 Wm-2 for solar and thermal downward radiation, respectively. Over oceans, with weaker observational constraints, corresponding estimates are around 185 and 356 Wm-2. These values closely agree, mostly within 3 Wm-2, with the respective quantities independently derived by a state-of-the-art reanalysis (ERA-Interim) and satellite-derived product (surface CERES EBAF). This remarkable consistency enhances confidence in the determined flux magnitudes, which so far stated large uncertainty sources in the energy budgets. The estimated downward solar radiation averaged over land and ocean surfaces is almost identical despite differences in the incoming solar flux at the Top-of-Atmosphere (TOA) around 20 Wm-2, indicative of an overall less transparent atmosphere over oceans than land. Considering additionally surface albedo and emissivity, we infer a surface absorbed solar and net thermal radiation of 136 and -66 Wm-2 over land, and 170 and -53 Wm-2 over oceans, respectively. The surface net radiation is thus estimated at 70 Wm-2 over land and 117 Wm-2 over oceans, which may impose additional constraints on the poorly known sensible and latent heat flux magnitudes. These are estimated here near 32 and 38 Wm-2 over land, and 16 and 100 Wm-2 over oceans, for sensible and latent heat fluxes, respectively. Estimated uncertainties are on the order of 10 and 5 Wm-2 for most surface and TOA fluxes, respectively. Combining these surface budgets with satellite-determined TOA budgets (CERES-EBAF) results in an atmospheric solar absorption of 77 and 82 Wm-2 and a net atmospheric thermal emission of -165 and -190 Wm-2 over land and oceans, respectively. We further revisit the global mean energy balance by combining the area weighed land and ocean mean budgets.

This study is published in:

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