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Radiative fluxes over the oceans and their representation in CMIP5 models

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Radiative fluxes at the ocean surfaces play a key role in the atmosphere-ocean energy exchanges. Radiative fluxes also state the dominant energy sources for the turbulent fluxes of sensible and latent heat, the latter being the energy equivalent of surface evaporation. Since 85% of the global precipitation stems from evaporation over oceans, the amount of radiative energy at the ocean surfaces critically determines the magnitude of the global water cycle. To better constrain the latent heat flux and with it the intensity of the global water cycle, knowledge of surface radiation over oceans is therefore particularly relevant. This even more so, as the link between radiation and latent heat fluxes/evaporation is more tight over oceans than over land, due to the unlimited availability of water. However, the magnitudes of these fluxes, which cannot be directly measured from space, are only known with considerable uncertainties. Surface radiative fluxes over oceans inferred from satellite products therefore require careful validation. Similarly, state-of-the-art climate models from the Coupled Model Intercomparison Project Phase 5 (CMIP5) used in the last IPCC report (AR5), still show large spreads in their surface radiative fluxes, even when averaged over the entire oceans.

This calls for an urgent expansion of surface radiation networks to include more anchor sites over the notoriously underrepresented ocean areas. An extension of well-calibrated measurement sites on small islands, ocean platforms or buoys with a careful quality assessment is required. Due to the spatially comparatively homogeneous maritime environments already a limited number of sites of adequate quality can be most valuable to effectively constrain the fluxes of satellite-derived and modeling products. We demonstrate how direct radiation observations in combination with modeling approaches can be used to quantify the energy budget averaged over the global oceans.

Related references:

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