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Evaluation of satellite and reanalysis-based global net surface energy flux and uncertainty estimates

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The net surface energy flux is central to the climate system yet observational limitations lead to substantial uncertainty (Trenberth and Fasullo, 2013; Roberts et al., 2016). A combination of satellite-derived radiative fluxes at the top of atmosphere (TOA) adjusted using the latest estimation of the net heat uptake of the Earth system, and the atmospheric energy tendencies and transports from the ERA-Interim reanalysis are used to estimate surface energy flux globally (Liu et al., 2015). Land surface fluxes are adjusted through a simple energy balance approach using relations at each grid point with the consideration of snowmelt to improve regional realism. The energy adjustment is redistributed over the oceans using a weighting function to avoid meridional discontinuities. Uncertainties in surface fluxes are investigated using a variety of approaches including comparison with a range of atmospheric reanalysis input data and products. Zonal multiannual mean surface flux uncertainty is estimated to be less than
5 Wm-2 but much larger uncertainty is likely for regional monthly values.

The meridional energy transport is calculated using the net surface heat fluxes estimated in this study and the result shows better agreement with observations in Atlantic than before. The derived turbulent fluxes (difference between the net heat flux and the CERES EBAF radiative flux at surface) also have good agreement with those from OAFLUX dataset and buoy observations. Decadal changes in the global energy budget and the hemisphere energy imbalances are quantified and present day cross-equator heat transports is re-evaluated as 0.22 ± 0.15 PW southward by the atmosphere and 0.32 ± 0.16 PW northward by the ocean considering the observed ocean heat sinks (Roemmich et al., 2006) .

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