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The global surface energy balance in ERA-Interim and satellite derived fluxes

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An accurate estimation of the complete surface total energy and water budget in a global scale is challenging. The surface energy balance is given from the compensation between the storage term, the divergence of the vertically integrated energy transports and the vertical non-advective radiative and turbulent fluxes.
Comprehensive diagnostic comparisons and evaluations have been carried out in this study with the new ERA-Interim reanalysis product from ECMWF, as well as satellite derived fluxes, which comprise the ISCCP data set for the radiative fluxes, HOAPS data for turbulent fluxes over the oceans and GPCP precipitation data.

In the long term the surface energy balance yields consistency conditions for the different data sets. In this framework a diagnostic budget evaluation is presented with model and satellite derived fluxes, estimating local imbalances, that arise from suboptimal model parameterizations.
To achieve this, we compute vertical integrals on hydrid model levels of the field quantities from analysis and 6-h model forecasts, starting from 1989, the first year for the new ECMWF reanalysis product, ending in 2001. A comprehensive diagnostic comparison with the computed fluxes in coupled and uncoupled ECHAM5 control runs, that have been produced for the IPCC-4AR, will help us to assess the physical consistency of the simulated energy and hydrological cycle in a GCM.

Global and zonal annual means help us to identify problematic areas, where imbalances appear. Like in ERA-40 (Trenberth et al. 2001) the model surface fluxes give a spurious vertical divergence, resulting in a global imbalance of 10 W/m^2 for 1990 in

the annual mean.
The hydrological cycle of the new reanalysis product is evaluated, giving better agreement with GPCP compared to ERA-40, the previous ECMWF reanalysis product.

Special emphasis is then given to the temporal evolution of the energy fluxes. Time series of the energy budget for specific regions and global means are shown to assess the atmospheric global response to natural and human-induced forcings, like volcanic eruptions (Pinatubo, 1991), El-Niño events and CO2 rise.