Geophysical Research Abstracts
Vol. 13, EGU2011-3009, 2011
EGU General Assembly 2011

The global energy balance from a surface perspective

Martin Wild
ETH Zurich, Institute for Atmospheric and Climate Science, Switzerland (martin.wild@env.ethz.ch)

The genesis and evolution of Earth's climate is largely regulated by the global energy balance. Despite the central importance of the global energy balance for the climate system and climate change, substantial uncertainties still exist in the quantification of its different components. While the net radiative energy flow in and out of the climate system at the top of atmosphere (TOA) is known with considerable accuracy from new satellite programs such as the Clouds and the Earth's Radiant Energy System (CERES), much less is known about the energy distribution within the climate system. Still not well established are the partitioning of solar energy absorption between the atmosphere and surface, and within the atmosphere between cloudy and cloud-free parts, as well as the determination of the thermal energy exchanges at the surface/atmosphere interface. Uncertainties in the components of the radiation budget at the Earth surface are therefore generally larger and less well quantified than at the TOA. Since the mid-1990s, accurate direct measurements become increasingly available from the networks of surface radiation stations, such as the Baseline Surface Radiation Network, which can serve as reference sites.
The working group "Global Energy Balance" of the International Radiation Commission (IRC) aims at assessing the magnitude and uncertainties of the components of the global energy balance. This study presents current best estimates of the global mean values of the different components of the global energy balance, inferred from surface and satellite observations as well as modeling approaches and reanalyes. Our best estimate for the absorbed solar radiation at the surface is 160 Wm-2 (+-5 Wm-2). Combined with the estimate of total absorbed solar radiation in the climate system (TOA absorption) from CERES EBAF (Loeb et al. 2009) of 240 Wm-2, this leaves a value of 80 Wm-2 for the absorption of solar radiation in the atmosphere. Our corresponding best estimates for clear sky solar absorption are 215 Wm-2, 72 Wm-2, and 287 Wm-2 for surface, atmospheric and total (TOA) absorption, respectively. In the thermal spectral range, our best estimates for surface downwelling and upwelling thermal radiation are 345 Wm-2 (+-5 Wm-2), and -397 Wm-2, resulting in a net thermal energy loss (net thermal balance) at the surface of -52 Wm-2. Combined with the TOA thermal emission to space from CERES EBAF of -240 Wm-2 this results in -188 Wm-2 for the atmospheric thermal cooling. Our best estimates for the clear sky thermal exchanges are 322 Wm-2 for the surface downwelling, -397 Wm-2 for the surface upwelling and -270 Wm-2 (from CERES EBAF) for the clear sky thermal emission to space (TOA). The net radiation available at the surface for the non-radiative components of the Global Energy Balance (predominantly latent and sensible heat) sums therefore up to 108 Wm-2. The atmospheric radiation balance is accordingly negative at -108 Wm-2, and corresponds to the energy demand that has to be balanced by the sensible and latent heat fluxes.