Geophysical Research Abstracts
Vol. 15, EGU2013-10149, 2013
EGU General Assembly 2013
© Author(s) 2013. CC Attribution 3.0 License.

Solar absorption estimated from surface radiation measurements and collocated satellite products over Europe

Maria Zyta Hakuba, Doris Folini, Martin Wild, and Arturo Sanchez-Lorenzo
ETH Zurich, Institute for Atmospheric and Climate Science, Zurich, Switzerland (maria.hakuba@env.ethz.ch)

Anthropogenic climate change is physically speaking a perturbation of the atmospheric energy budget through the insertion of constituents such as greenhouse gases or aerosols. Changes in the atmospheric energy budget largely affect the global climate and hydrological cycle, but the quantification of the different energy balance components is still afflicted with large uncertainties. The overall aim of the present study is the assessment of the mean state and the spatio-temporal variations in the solar energy disposition, in which we focus on obtaining an accurate partitioning of absorbed solar radiation between the surface and the atmosphere. Surface based measurements of solar radiation (GEBA, BSRN) are combined with collocated satellite-retrieved surface albedo (MODIS, CERES FSW, or CM SAF GAC-SAL) and top-of-atmosphere net incoming solar radiation (CERES EBAF) to quantify the absorbed solar radiation (ASR) at the surface and within the atmosphere over Europe for the period 2001-2005. In a first step, we examine the quality and temporal homogeneity of the monthly time series beyond 2000 provided by GEBA in order to identify a subset of sufficient quality. We find the vast majority of monthly time series to be suitable for our purposes. Using the satellite-derived CM SAF surface solar radiation product at 0.03° spatial resolution, we assess the spatial representativeness of the GEBA and BSRN sites for their collocated 1° grid cells as we intend to combine the point measurements with the coarser resolved CERES EBAF products (1° resolution), and we find spatial sampling errors of on average 3 Wm-2 or 2% (normalized by point values). Based on the combination of 134 GEBA surface solar radiation (SSR) time series with MODIS white-sky albedo and CERES EBAF top-of-atmosphere net radiation (TOAnet), we obtain a European mean partitioning (2001-2005) of absorbed solar radiation (relative to total incoming radiation) of: ASRsurf= 41% and ASRatm= 25%, together equaling TOAnet=66%. Based on 4 BSRN sites in combination with CERES FSW surface albedo and CERES EBAF TOAnet radiation, the partitioning is: ASRsurf=42% and ASRatm= 24%, equaling TOAnet=66%. During 2001-2005, we find a significant brightening in SSR and ASRsurf over Europe (GEBA) of around 1.3 Wm-2yr-1, and a decrease in ASRatm of -1 Wm-2yr-1. The mean-state of the energy balance components is thus largely determined by the period of consideration and varies by up to 5 Wm-2 from year to year. We apply the spatial interpolation technique kriging to the annual mean SSR (based on CM SAF) within 1° grid cells as collocated to the 134 GEBA sites and find the gridded data to be in very good agreement with the original satellite-derived SSR (aggregated onto 1° grid). This result suggests good spatial coverage of the GEBA data, and the possibility of generating a gridded data set based on the in-situ measurements. The possibility of expanding these analyses to the global scale and the application of the obtained data for the validation of global and regional climate models are discussed as well.