Geophysical Research Abstracts
Vol. 19, EGU2017-6756, 2017
EGU General Assembly 2017

Joint modeling and behavior of the water- and energy fluxes between the atmosphere and the land surface in the TERENO pre-alpine region

Mohsen Soltani (1), Harald Kunstmann (1,2), Patrick Laux (1), and Matthias Mauder (1)

(1) Institute of Meteorology and Climate Research, Karlsruhe Institute of Technology, Campus Alpin (IMK-IFU/KIT), 82467 Garmisch-Partenkirchen, Germany (mohsen.soltani@kit.edu) , (2) Institute of Geography, University of Augsburg, Germany

Abstract

In mountainous and pre-alpine regions, eco-hydrological processes exhibit rapid changes within short distances due to the complex orography and strong elevation gradients. Water- and energy fluxes between the land surface and the atmosphere are crucial drivers for nearly all ecosystem processes. The aim of this research is to analyze the variability of surface water- and energy fluxes as well as their joint probability distribution. For this reason, we conducted process-based modeling using the hydrological model GEOtop and analyzed the simulated bivariate density distribution in the rank space, i.e. the empirical copula functions. The understanding of the impact of the terrain slope and soil- as well as land-use types on the spatiotemporal variability of surface water- and energy fluxes is our main focus. Our study area consists of two catchments: the Rott (55 km2) and the upper-Ammer (300 km2) catchments, as part of the TERENO pre-alpine observatory in Bavaria, southern Germany. The GEOtop model is calibrated using a “trial and error” approach for the summer 2013, and validated using observed discharge, heat fluxes and soil moisture by visual inspection and statistical performance measures for the summer 2015. Overall, good performance statistics are found for water- and energy fluxes. The simulated energy and water balances for the entire Rott (and upper-Ammer) catchment indicate that 78% (65%) of net radiation leaves the catchment as latent heat flux, 17% (31%) as sensible heat, and 5% (4%) enters the soil in the form of soil heat flux. 45% (35%) of the catchment aggregated precipitation leaves the catchment as discharge and 55% (65%) as evaporation. It is also found that GEOtop is able to reproduce the joint distribution functions of most variables, indicating a robust calibration of the model. The empirical copula between soil moisture and discharge exhibit bivariate dependence functions with increased densities in both, the lower and the upper tails. A similar dependence structure is found between the latent (LE) and sensible (H) heat fluxes. Further results of the GEOtop model are presented and discussed in conjunction with the terrain slope and different land use types.