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Surface resistance calibration for a hydrological model using actual evapotranspiration retrieved from remote sensing data in Nahe catchment forest area

Weiwei Bie (1), Casper Markus (1), Reiter Philipp (1), and Vohland Michael (2)

(1) Physical Geography, University of Trier, Trier, Germany, (2) Institute for Geography, Geoinformatics and Remote Sensing, University of Leipzig, Leipzig, Germany

For no-rainfall conditions in a forest region, actual evapotranspiration (ET) comes from transpiration from plant leaves and evaporation of bare soil between the plants. In this paper, the WaSiM-ETH hydrological model was used for simulation of plot scale water balance in the Nahe catchment (Rhineland-Palatinate/Germany). The model is physically based: The model concept includes both, the approach after Penman-Monteith for calculation of evaporation and the Richards-equation for water transport in the soil column. Plant transpiration and soil evaporation were calculated respectively for each combination of forest type, soil storage capacity and exposition. It was found that various parameters affected the final simulated ET values.

As reference, daily latent heat flux (LE, another expression of evapotranspiration in the surface energy balance equation) was estimated from remote sensing data. Two days are from Landsat-ETM, three days from Landsat-TM. MODIS products and regional meteorological data have been used to derive a high resolution (30m*30m) LE grid. The results were divided into deciduous forest and pine forest, since there are two primary forest types in the Nahe catchment. Five separate ¬dates are available: Two medium to wet scenes (15/05/2000, 05/ 07/2001) and three successive scenes in the dry year2003 (19th July, 4th August, 21th September).

The simulated ET was compared to remote sensing derived LE. In the aim of finding the most suitable simulated ET, several combinations of canopy resistance and soil surface resistance values from 80 s/m to 1500 s/m have been used. Only by setting the canopy resistance (rsc) at 150s/m and the soil surface resistance (rs_evaporation) at 250 s/m for deciduous forest, rsc as 300 s/m and rs_evaporation as 750 s/m for pine forest region, the simulated ET exhibit similar change trend in time series with remote sensing derived LE, all other combinations showed large differences for a least one scene.