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Estimating evapotranspiration in the Doode Bemde wetland from AHS data

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Abstract: Estimation of evapotranspiration in natural landscapes with conventional procedures is often hindered by the fact that these landscapes are too heterogeneous. Remote sensing applications are therefore being developed that specialize in estimating water and energy fluxes of heterogeneous earth surfaces. For the estimation of remotely sensed evapotranspiration, the most popular approach is to use surface temperature and vegetation indices at small scale and low resolution satellite imagery to estimate regional fluxes. New developments in thermal and hyperspectral airborne imagery (e.g. the Airborne Hyperspectral Scanner (AHS)) allow deriving hydrological relevant observations at a resolution of 1-10 m. In this research it is proposed to estimate the energy and water fluxes at the surface on basis of this thermal and hyperspectral imagery on a scale, which allows discriminating local wetness and vegetation heterogeneity in relation to differences in soil and vegetation conditions. The evapotranspiration was estimated for the Doode Bemde Wetland in Belgium using remote sensing data from AHS. The evapotranspiration in the study area was first simulated with the Surface Energy Balance Algorithm for Land (SEBAL). In a further step of the research, the recently developed “Triangle Method” was used to estimate daily evapotranspiration from the same dataset and the results were compared to those of the SEBAL method.

The daily total evapotranspiration is calculated for the complete study area, but most of the attention is spent on the wetland part of the region and its grasslands, for which detailed soil moisture conditions have been measured. The values range between 2 and 4 mm/day for all grassland types for both estimation methods used. The estimated evapotranspiration values can be related to other hydrological and vegetation conditions, resulting in an increased understanding of the ecohydrological functioning of the study area. To get an idea of the accuracy of the final results, a comparison is made with the evapotranspiration calculated with the standard FAO method for a small homogenous meadow. Also, the results are compared to the results of a previous study that dealt with the estimation of shallow groundwater tables in the study area. As can be expected, the studied vegetation types occurring under shallow groundwater table conditions show higher evapotranspiration rates than vegetation types that grow on area’s which have a deeper groundwater table. Comparing the two methods that were used revealed that the SEBAL model gives a more precise estimation as well as a better absolute value, whereas the results from the triangle method give a better idea of the relative differences between the vegetation types that were considered in the study. Hence, the method to be selected in future studies is in other words dependent on the information one wishes to derive from the spectral information. As a final conclusion it can be stated that the AHS remote sensing data and the methods used are appropriate to monitor temporal and spatial differences in water and energy fluxes on a local scale. Limitations in precision and accuracy for different scales and methods should however always be taken into account.