



Spatial distribution of water stress and evapotranspiration estimates using an unmanned aerial vehicle (UAV)

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The estimation of spatial distribution of evapotranspiration poses a particular challenge in quantitative hydrology. Conventional methods provide punctual measurements of evapotranspiration rates which may be transformed into aggregated mean values by extrapolation or the application of empirical models. The influence of spatial structures (heterogeneity of the landscape) in relevant small spatial scales is captured insufficiently by these methods.

Modern optical remote sensors aboard an unmanned aerial vehicle (UAV) provide the basis for the generation of high spatial resolution data. Spectral data in the optical, near infrared and thermal infrared domain will be used as input into a surface energy balance (SEB) model to produce evapotranspiration maps. The spectral properties of vegetation are of particular importance for the calculation, since plants are the link between soil and atmosphere and thus have major impact on evapotranspiration rates of land surfaces. First estimates of plant status and indicators of transpiration behavior will be obtained by applying and combining water stress parameters of different wavelengths. As opposed to satellite data, time-series of self-determined spatial and temporal resolution may be created by varying flight altitude and turnaround times. Thus it is possible to analyze the influence of landscape structures, as well as the chronological development of the observed parameters.

Located at the interface between hydrology and remote sensing this work utilizes an innovative remote sensing platform to gain distributed spectral information. This information will be used to visualize evapotranspiration patterns in hydrological heterogeneous areas. Particular attention will be paid to the analysis of transition zones of varying water supply and under the influence of selected environmental parameters (e.g. soil moisture, depth of GW-table). To reach that goal it is essential to generate a robust processing chain, involving all necessary processing steps. These include camera calibration, geometric and radiometric correction of the image data, as well as automatic image stitching at different scales. Effects of atmospheric aerosols on the spectral information of the surface have to be considered and, if necessary, corrected for the application of a SEB model. Data collection is conducted at several ZALF research sites in NE-Germany.