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A Bayesian approach to improve remote sensing of sensible and latent heat fluxes

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To estimate fluxes of energy, water and carbon dioxide at the earth surface is relevant for agriculture and weather prediction. Remote sensing is a promising tool to yield spatially distributed estimates of these fluxes. The fluxes cannot be measured directly from space. Instead, they are calculated from other variables using models. Most of these models, including SEBS, use surface temperature, the most important state variable, as input. Another important variable, surface or stomatal resistance, is treated as an unknown. Because the models require remotely sensed surface temperature as input, interpolation between satellite overpasses is not possible. Uncertainty in the estimate is usually not quantified, but it can be high, because sensible heat flux is proportional to the difference between air and surface temperature: a relatively small difference between two measured variables.

In this study we propose to use, besides surface temperature, also a-priori information about surface resistance as input. The problem is then over-defined. A Bayesian approach is used to find the most likely solution, taking the uncertainty of both parameters and measurements into account. This approach makes it possible to calculate fluxes in absence of surface temperature measurements, and thus to interpolate between satellite overpasses. Besides, the uncertainty in the model output is quantified, and unrealistic model output as a result of erroneous measurements is prevented.

A consistent or periodic difference between calculated parameter values and a-priori values could reveal inaccuracies in model or a-priori values. The algorithm was tested for a field data set collected during the EAGLE campaign in the summer of 2006 in The Netherlands.