Mapping evapotranspiration at high resolutions using the Surface aerodynamic temperature model and airborne multispectral remote sensing data

M. Semin Barlak[1], José L. Chávez[1], Prasanna H. Gowda[2], and Steven R. Evett[2]
[1]Department of Civil and Environmental Engineering, Colorado State University
[2]USDA-ARS, Conservation & Production Research Laboratory, Bushland, Texas

Abstract. The energy balance (EB) based Evapotranspiration (ET) algorithms require the computation of net radiation (R_n), soil heat flux (G) and sensible heat flux (H) to solve for ET as a residual. The EB component can be derived using multispectral remote sensing data. Values of R_n and G can be estimated with an acceptable accuracy. However, estimation of H is not straightforward. This is because, surface aerodynamic temperature (T_o) is difficult to measure or estimate, instead radiometric surface temperature (T_s) is generally used in the estimation of H. However, using T_s may cause overestimation of H, since, in most instances T_s is larger than T_o. For homogeneous surfaces T_o and T_s values are nearly equivalent, but for heterogeneous surfaces there are important differences between T_o and T_s. Therefore, for heterogeneous surface conditions there may be instances of underestimation of ET. To account for those differences between T_o and T_s several remote sensing-based algorithms have been developed for mapping evapotranspiration. The Surface Aerodynamic Temperature (SAT) model is one of those models, and it was used in this study. The SAT model was used to estimate T_o based on T_s, air temperature (T_a), and surface aerodynamic resistance (r_{ah}) for cotton fields. Values of H were computed using the T_o model, and ET was calculated as a residual of the EB for research fields located at the USDA-ARS, Conservation & Production Research Laboratory, near Bushland, Texas, for the 2008 year. The research area comprised four fields, namely, South-East, South-West, North-East and North-West lysimeter fields. The west fields were under a dryland regime while the east fields were fully irrigated with a lateral move sprinkler system. The results obtained from the multispectral airborne remote sensing data, and the ET algorithms were compared with ET measured by mass balance using large weighing lysimeters, one each of which was located in the center of each field.