Using METRIC to Estimate Surface Energy Fluxes over an Alfalfa Field in Eastern Colorado

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Abstract. The ability to estimate surface energy fluxes using remote sensing methods has enabled the determination of evapotranspiration over a large area with less cost. Several models that employ the energy balance method have been developed. The model discussed in this paper is the Mapping Evapotranspiration at high Resolution and with Internalized Calibration (METRIC). It estimates the net radiation, soil heat flux, sensible heat flux, and then determines latent heat flux as a residual. Landsat 5 TM images for season 2010 (May – September) for an alfalfa field at Rocky Ford, CO were processed and analyzed using Erdas Imagine 2010 Software. The accurate estimation of the net radiation and soil heat flux is important as these two determine how much energy is available to be partitioned into sensible and latent heat flux, hence the focus on these two fluxes in this study. The results obtained from the processed images were compared with actual fluxes measured by instruments installed in the alfalfa field and performance indicators for each flux determined. For net radiation, the MBE was 18.0 Wm^{-2} (3.3%), RMSE of 22.7 Wm^{-2} (4.2%), and R^2 of 0.88. For soil heat flux, the MBE was -2.96 Wm^{-2} (-5.6%), RMSE of 15.0 Wm^{-2} (28.1%) and R^2 of 0.93. Hourly ET had an MBE of -0.02 mm/h (-2.2%) and RMSE of 0.07 mm/h (10.4%) with an R^2 of 0.95. It was observed that the estimation of soil heat flux had more error for heterogeneous surface conditions (e.g., when the alfalfa had just been harvested and was partly bare and partly vegetated). However, overall the remote sensing model estimated well the heat fluxes and it seems to be suitable for applications at regional scales in hydrology studies.

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