Evaluation of multispectral remote sensing derived vegetation indices to estimate reflectance-based crop coefficients and seasonal evapotranspiration rates for grass pastures in western Colorado

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Abstract. Knowledge of crop evapotranspiration (ETc) is important for effective irrigation water management. Among the various methods used to estimate ETc, the standardized FAO56 Penman-Monteith approach, using tabulated generalized Kc values, has been widely adopted to estimate crop evapotranspiration. This research project aims to develop quantitative relationships and to improve the estimation of actual crop coefficients from remotely sensed data for and grass pastures in the western slope of Colorado. Remote sensing techniques are growing rapidly as a way to monitor actual crop water use. Remotely sensed data are used in algorithms to measure the spectral reflectance of the crop canopies. The differences in reflectance values, at different bandwidths from typical multispectral signatures, help determine the current or actual canopy properties like crop fractional cover, water stress, nutrient level, etc. The actual crop coefficients (Kca) values were calculated using ETc and alfalfa based reference crop evapotranspiration (ETr). The soil water balance approach was used to estimate the ETc for grass during the 2016 and 2017 growing seasons. A handheld multispectral radiometer was used to collect surface/canopy reflectance data. Vegetation indices (VI) were calculated using those surface reflectance data. Vegetation indices are the mathematical combination or transformation of surface reflectance in different spectral bands. These VI were then related to actual crop coefficients to develop the VI-Kca models. Among the 11 different vegetation indices evaluated, the soil adjusted vegetation index (SAVI) model performed better. The difference between estimated ETc and actual ETc for one cutting cycle (7/11/1017 to 9/3/2017 for days free from irrigation event) were under 20% for most indices evaluated. This approach can be a promising tool to estimate the seasonal as well as near real-time ETc rates for grass pastures. The following will be discussed: the vegetation indices used in this study, the models developed, results, and the performance evaluation of the models.