Evaluation of Water Stress Coefficient Methods to Estimate Actual Corn Evapotranspiration in Colorado

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Abstract. Increased competition for water resources is placing pressure on the agricultural sector to remain profitable while reducing water use. Remote sensing techniques have been developed to monitor crop water stress and produce information for evapotranspiration (ET) based irrigation scheduling decisions. Use of stress detection methods allows producers to avoid exceeding set crop water stress levels and keep operations profitable under limited irrigation despite some yield reduction. Remote sensing data such as spectral reflectance and infrared canopy temperature can be used to quantify crop water stress, often through the use of temperature indices calculated from the thermal wavelength and vegetation indices calculated from the near-infrared and red bands. Reference crop ET methods estimate water use based on crop characteristics and climactic parameters assuming optimum soil water conditions. Stress index techniques that are sensitive to crop development and stress are necessary in order to adjust crop ET for water limited conditions such as drought or water allocation restrictions. The performance of seven remote sensing techniques to estimate corn ET in Northern Colorado under drought conditions were evaluated: Crop Water Stress Index method, three methods based strictly on canopy temperature, and three methods based on multispectral vegetation indices. Data were collected during 2010 through 2013 growing seasons at the USDA-ARS Limited Irrigation Research Farm near Greeley, CO. Varying water deficit levels were imposed on corn (Zea mays L.) under pressurized drip irrigation. ET estimates from the seven remote sensing techniques were compared to soil water balance (via neutron probe) and energy balance ET calculations. Results will provide producers with an indication of which remote sensing methods are appropriate to use given certain data availability and irrigation level, in addition to providing an estimation of the associated error. Using the most appropriate stress coefficient method has the potential to improve irrigation scheduling and therefore allow crops to reach the maximum possible yield given the level of deficit irrigation.