Relative Humidity as a Surrogate for Soil Moisture in the Crop Coefficient Method

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Abstract

Estimation of the crop coefficient (Kc) in the conventional crop coefficient EvapoTranspiration (ET) method requires detailed knowledge of geo/biophysical properties of the coupled land–vegetation system, precipitation, along with monitoring soil moisture gradient. In practice, precise quantification of these parameters is challenging, if not impossible, which reduces the accuracy of the model significantly. This paper addresses these issues by expressing Kc as a 2nd order polynomial function of relative humidity (RH) and reference ET (ETo) calculated over the same crop, where the coefficients of the function are crop–specific. This shapes the framework of the Ambient Regression Evapotranspiration Model (AREM), a real–time, simple actual ET model. Six years 15-min micrometeorological records of six sites (i.e. corn, soybeans, prairie, and forest) in Iowa, New Hampshire, and California of the USA were used to calibrate the model. The Mean Absolute Percentage Error (MAPE) of the regression was 18.2% during the growing season (days of year 140–260), and 28.4% for the entire year. The Root Mean Square Error (RMSE) was 0.69 mm day–1 with coefficient of determination (R2) = 0.73. The results indicate that AREM requires calibration over various soil types. The average MAPE of 30% over the four Iowan sites was obtained based on inputs from weather stations and NLDAS-2 of NASA, which suggests that the model can be widely employed in practical applications requiring real–time ET with reasonable accuracy. AREM was capable of capturing the dynamics of ET irrespective of varying complexities of biophysical and climatological states.

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