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Estimating Evapotranspiration Irrigated Maize in Brazil Using a Hybrid Modelling Approach and Satellite Image Inputs

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Abstract : Multispectral and thermal infrared imagery from satellite sensors coupled with climate and soil datasets were used to estimate evapotranspiration and biomass in center pivots planted to maize in Brazil during the 2016 season. The hybrid remote sensing based model named Spatial EvapoTranspiration Modelling Interface (SETMI) was applied using multispectral and thermal infrared imagery from the Landsat Thematic Mapper instrument. Field data collected by the IRRIGER center pivot management company included daily weather information such as maximum and minimum temperature, precipitation, relative humidity for estimating reference evapotranspiration. In addition, soil water content data were obtained every 0.20 m in the soil profile down to 0.60 m depth throughout the season. Early season soil samples were used to obtain water-holding capacity, wilting point, saturated hydraulic conductivity, initial volumetric soil water content, layer thickness, and saturated volumetric water content. Crop canopy development parameters and irrigation application depths were also inputs of the model. The modeling approach is based on the reflectance-based crop coefficient approach contained within the SETMI hybrid ET model using relationships developed in Nebraska. The model was applied to several fields located in Minas Gerais State in Brazil with approximate latitude: -16.630434 and longitude: -47.192876. The model provides estimates of real crop evapotranspiration (ET), crop irrigation requirements and all soil water balance outputs, including biomass estimation using multi-temporal satellite image inputs. An interpolation scheme based on the growing degree-day concept was used to model the periods between satellite inputs, filling the gaps between image dates and obtaining daily data. Actual and accumulated ET, accumulated cold temperature and water stress and crop water requirements estimated by the model were compared with data measured at the experimental fields. Results indicate that the SETMI modeling approach using data assimilation, showed reliable daily ET and crop water requirements for maize, interpolated between remote sensing observations, confirming the applicability of the SETMI model using new relationships developed in Nebraska for estimating mainly ET and water requirements in Brazil under tropical conditions.

Keywords : basal crop coefficient, irrigation, remote sensing, SETMI
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