Estimating Water Use through Satellite Remote Sensing

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Project descriptors: remote sensing, water budget, evapotranspiration

PROBLEM AND RESEARCH OBJECTIVES

The project's primary goals are to use the spatial and temporal variation of ET information and rainfall analysis in the following ways:

• Assessing and mapping economic return from agricultural activities. Once ET is determined, then biomass can be calculated and linked to crop yield. This could provide an excellent opportunity to evaluate the impact of various parameters such as crop type, field size, soil, etc. on the economic return from irrigated agriculture.

• Storm Track Analysis. Due to the lack of weather stations and stream gauge stations, significant amounts of water from rainfall could be made available to the irrigation districts that are otherwise unaccounted. Using advanced computing techniques, rainfall can be tracked and, with the aid of storm runoff models, the amount of water entering Elephant Butte Reservoir and regions downstream from the dam may be estimated.

METHODOLOGY

Recent innovations in satellite technology have made it possible to process satellite data to estimate evapotranspiration (ET) with high spatial and temporal resolution. This technology (REEM), utilizes remote sensing parameters, land surface temperature (LST), normalized difference vegetation index (NDVI), and short wave albedo along with climate station data to arrive at an estimate of ET. These ET maps will be processed by overlaying agricultural field boundaries (initially, pecan orchards) to arrive at a field by field estimate of total ET. This is then linked to biomass and crop yield for a determination of economic return. We are now emphasizing the measurement of alfalfa ET and the determination of the crop coefficient for alfalfa.

In addition to the ET work, we will also work on "storm track analysis." Advanced computing techniques allow the tracking of rain events in near real-time as well as for post-event analysis. Such work will allow the estimation of when and where "surplus" water enters the system so that this "new" water may be used in a beneficial way.

PRINCIPAL FINDINGS

An analysis of GIS vector files, ET maps created with two satellite-based remote sensing models, weather data and measured ET was undertaken to study the spatial variation and distribution of ET among the pecan orchards from the Mesilla Valley, New Mexico. A linear model was developed to estimate orchard values of fractional cover (fc) from the normalized vegetation index (NDVI) calculated from remotely sensed data. A pecan model was created for the Valley to estimate the water use of open-canopy orchards that uses midseason NDVI calculated from a single satellite image (as indication of fc) and crop coefficients for unstressed closed-canopy orchards.

The main objective of the study was to evaluate the water use of the population of pecan orchards in the Valley and to relate pecan ET to the fractional vegetation cover (fc) in order to create crop consumptive models for the study area. The results from this study indicated that (a) the annual ET in pecans depicted a high spatial and temporal variation within the orchards of the region, which increased during the midseason to reflect differences in agricultural practices (irrigation, planting arrangements, etc.), size and age of trees, and the fc; and (b) the annual water use in pecans was linearly related to the fc in a field basis. These findings were different than those found for crops with canopies and growth patterns that are different from pecans, but similar to results reported for similar trees.

Maritza Macias-Corral collects ET and climate data at 30-minute intervals using data logger at the Bosque del Apache tower.