Remote Sensing for Crop and Water Management in Irrigated Agriculture

Doug Hunsaker, Kelly Thorp, Andy French & Tom Clarke
USDA-ARS Arid Land Agricultural Research Center
www.alarc.ars.usda.gov

Remote Sensing & Evapotranspiration

Practical, accurate, & inexpensive methods are needed to estimate crop evapotranspiration (ET) at field to regional scales for irrgated agriculture. For arid environments ET is a dominant water cycle component and an indicator of cropland productivity. Where water scarcity persists, growers and regional management agencies will need to decide where and how much water can be conserved. Remote sensing can help these decision makers by providing water use information unavailable in other ways.

Benefits

Increased on-farm water use efficiency
Improved irrigation scheduling methodologies
Improved spatial monitoring of crop health
Integration of water and nutrient management techniques for precision farming applications

Specific Outcomes

Accurate & transferable crop coefficients for the U.S. Southwest
ET algorithms for extreme weather
Remote sensing indices for crop and water stress
Assimilation techniques for remote sensing & crop models
Decision-support tools for farm-scale application

Project Objectives

Three strategies to improve ET estimation with remote sensing
1. Develop robust & transferable crop coefficients
2. Develop remote sensing techniques to estimate the surface energy balance, and crop water stress
3. Implement remote sensing ET techniques as decision support tools

Study Sites

Fig. 2. Maricopa, Arizona: Ground-based remote sensing.
Fig. 4. Jornada, New Mexico: thermal emissivity from ASTER satellite sensor.
Fig. 3. Bushland, Texas: Aircraft multi-spectral.

Crop Coefficients

Fig. 5. Remote sensing indices help adjust crop coefficients for growth stage and non-standard conditions.

Surface Energy Balance

The most robust ET retrievals are expected from physically-based models, instead of relying on local calibrations. To do this, remote sensing in visible, near infrared, and thermal infrared wavelengths is needed. Our studies require 1 m spatial resolution, which we acquire using an airborne platform illustrated in Fig. 7 below.

Decision Support Tools

Remote sensing data are believed to have the best possible spatially distributed information for irrigation scheduling, but there are many times—e.g. cloudy skies—with no image data. So background crop models are needed to provide continuous water use forecasts. A statistically optimal way to do this is known as “data assimilation”. Fig. 8 illustrates the idea, where a model is updated as new remote sensing data become available.

Conclusions

Remote sensing can be a practical approach to spatially manage crops and their use of water for irrigated lands. Remote sensing provides a way to monitor crop cover, ET, and a way to compensate for crop model uncertainties.

References