BENEFITS FROM TYING SATELLITE-BASED ENERGY BALANCE TO GROUND-BASED REFERENCE EVAPOTRANSPIRATION

Dr. Richard G. Allen, Dr. Masahiro Tasumi

1. University of Idaho, Research and Extension Center, 3793 N. 3600 E., Kimberly, Idaho 83341, fax 1 208 423 6699, RALLEN@kimberly.uidaho.edu

Key-words: METRIC, evapotranspiration, remote sensing

Objective of the study
Applications of satellite-driven surface energy balances by the University of Idaho have used calculated hourly reference evapotranspiration for the alfalfa reference crop (ETr) as a source of calibration of the ET surface generated from the energy balance and for extrapolation of ET images to 24-hour and longer periods. The ETr used is alfalfa reference ET calculated using the ASCE-EWRI standardized Penman-Monteith equation (ASCE-EWRI, 2004). Experience and field verification with the ASCE standardized PM method has created confidence in using this procedure for ET image calibration rather than using net radiation (available energy) only.

Materials and Methods
The energy balance procedure that we use is METRICTM (Mapping Evapotranspiration at high Resolution and with Internalized Calibration). METRIC calculates evapotranspiration (ET) as a residual of the surface energy balance and is a variant of SEBAL, an energy balance process developed in the Netherlands by Bastiaanssen. METRIC was extended by the University of Idaho for application to mountainous terrain and to provide tighter integration with ground-based reference evapotranspiration. METRIC is auto-calibrated for each image using ground-based calculations of ETr (made using hourly weather data) where accuracy of the ETr estimate has been established by lysimetric and other studies in which we have high confidence.

The use of ETr during calibration and extrapolation to 24-h ET provides equivalency and congruency with ET as estimated using the traditional crop coefficient (Kc) and reference ET approach. This congruency is valuable for using ET maps generated by energy balance in water rights management where water rights are based on previous Kc ETr calculations. The ETr used is alfalfa reference ET calculated using the ASCE-EWRI standardized Penman-Monteith equation (ASCE-EWRI, 2004). With Landsat images, fields of alfalfa or other high leaf area vegetation can generally be identified that are close to or at full cover, so that the ET from these fields can be expected to be near the value of ETr as computed for the alfalfa reference. ETr is typically 20 to 30 percent greater than grass reference ET (ETo).

Results
Comparisons between ET by METRIC, ET measured by lysimeter and ET predicted using traditional methods have been made on a daily and monthly basis for a variety of crop types and land-uses. The results suggest that METRIC or similar methods hold substantial promise as efficient, accurate, and inexpensive procedures to predict the actual evaporation fluxes from irrigated lands throughout a growing season.