

Executive Summary

Mapping Evapotranspiration from Satellites

Accurate evapotranspiration data are needed to help deal with present and future water supply problems in Idaho and other areas of the western US. The need for accurate evapotranspiration data is critical throughout the western United States where increasing demands for water have outpaced limited supplies. The US Department of the Interior has identified areas that are at risk for substantial conflict over water supply during the next 20 years and parts of Idaho are among those areas. Evapotranspiration data are crucial for water conservation, planning, and administration, because evapotranspiration data represent the amount of water consumed by irrigated agriculture and other land uses.

The Idaho Department of Water Resources (IDWR) is the state agency responsible for water administration in Idaho. IDWR's responsibilities include measurement and accounting of consumptive and non-consumptive uses of water. Idaho has 3.3 million acres of irrigated agriculture and irrigated agriculture accounts for about 99% of the consumptive use in the state. Evapotranspiration is the water evaporated from soil and transpired by vegetation and is synonymous with consumptive use.

IDWR and the University of Idaho worked from 2000 to 2005 under a NASA grant to develop the procedures to map evapotranspiration from satellite images and to apply the evapotranspiration data to water resource problems. The Mapping EvapoTranspiration using high Resolution and Internalized Calibration (METRIC) model was developed to compute and map evapotranspiration using Landsat satellite images and weather data. Landsat is used because it is the only operational satellite that collects thermal data and has a pixel size small enough to map individual agricultural fields. IDWR uses Landsat-based evapotranspiration data in hydrology, water resources planning, and water administration.

The Mapping Evapotranspiration from Satellites program is innovative in that it computes and maps evapotranspiration using Landsat satellite images. IDWR has used this program to compute and map evapotranspiration for much of Idaho and is the first state to implement this program. Evapotranspiration data are critical for settling water-resource conflicts and are especially important for agricultural water-management.

Our program uses Landsat satellite images to compute and map evapotranspiration for all 10,000 square miles covered by an image. We use Landsat because it collects an image over the same area every 16 days, it has a large data archive for historical analysis, and evapotranspiration can be computed on a daily, monthly, or seasonal basis. Landsat's 30-by-30 meter pixels provide enough detail to map evapotranspiration within individual fields. Our program, using Landsat satellite images, is from 75% to 96% accurate for a full growing season compared to ground measurements of evapotranspiration.

A cost benefit analysis for using evapotranspiration data from Landsat satellites, for a well monitoring program, compared to the current method shows the potential to reduce costs from \$119 to \$32 per well. But the well monitoring has not converted to using Landsat-based evapotranspiration data due to the uncertainty of a thermal band in future Landsat satellites.