Mapping Evapotranspiration for Water Administration in Idaho

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Introduction

Evapotranspiration (ET) is the sum of evaporation and transpiration from the Earth's surface. It is a critical component of the water cycle and plays a major role in determining the availability of water resources. The estimation of ET is essential for water resource management, especially in arid and semi-arid regions like Idaho, where water resources are limited.

The Idaho Department of Water Resources (IDWR) uses a variety of methods to estimate ET, including remote sensing and field measurements. One of the most widely used methods is the METRIC (Meteorological-EvapoTranspiration) model, which is a semi-empirical model that uses meteorological data to estimate ET.

Developing ET Data

The METRIC model uses a variety of meteorological data, including air temperature, relative humidity, wind speed, and solar radiation. These data are collected at weather stations throughout Idaho, and are used to estimate ET at the field and watershed scales.

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Accurac

The accuracy of ET estimates is crucial for water resource management. The METRIC model has been validated against field measurements and has been shown to provide accurate ET estimates.

Applications in Idaho

ET estimates produced by the METRIC model are used for a variety of applications, including water resource management, hydraulic modeling, and decision-making processes.

Other States

The METRIC model is used in a number of other states, including Nevada, Arizona, California, Kansas, Wyoming, Oregon, Colorado, New Mexico, and Montana.

References


Hydrologic Modeling

The Idaho Department of Water Resources (IDWR) uses a variety of hydrologic models to simulate ground water and surface water systems. These models are used to assess the impact of water resource management decisions on the availability of water resources.

Compliance Assessment

The Idaho Department of Water Resources (IDWR) is responsible for assessing the compliance of water resource management decisions with state and federal laws. This includes assessing the impact of water resource management decisions on the availability of water resources.
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Why is measuring Evapotranspiration (ET) important

- ET is the water consumed by irrigated agriculture
- Important for administration, management and planning of water resources
- Irrigated agriculture in Idaho
  - 3.4 million acres
  - Accounts for over 90% of the water consumed
  - Worth $5 billion per year
- Irrigation in the US
  - 50 million acres agriculture, 32 million acres recreational
  - Accounts for over 80% of the water consumed
  - Crops worth $70 billion per year
Ground-based ET

- Potential ET using crop coefficients
  - Needs crop type acres and stage of growth
  - Produces one ET value per county

Satellite-based ET

- Actual ET from Landsat using METRIC
  - No crop information required
  - ET per pixel can be summed by field
Landsat Thermal Band

- Required for surface temperature
- Landsat is the only operational satellite with a “thermal band” and a pixel size small enough to map ET for individual fields!
METRIC

Mapping EvapoTranspiration at high Resolution with Internalized Calibration

- Satellite-based energy balance model that computes and maps actual ET
- Internalized Calibration ties down ET to weather data
- Over 90% accuracy compared to precision weighing lysimeter
Energy Balance for ET

ET is calculated as a “residual” of the energy balance

\[ ET = R_n - G - H \]

The energy balance includes all major sources (\( R_n \)) and consumers (ET, G, H) of energy.
Energy balance computes “actual” ET

Can „see’ impacts on ET caused by:

- water shortage
- disease
- crop variety
- planting density
- cropping dates
- salinity
- management
- evaporation from bare soil

Idaho and other western states now use METRIC ET data operationally to help manage water resources