Web-Based Dissemination of Surface Energy Balance Evapotranspiration Estimates

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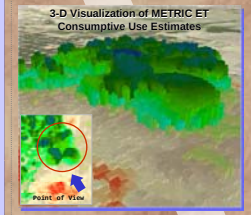
Background

Under a NASA Research Opportunities in Space and Earth Science Grant, Riverside Technology, inc. (Riverside) is leading an effort using remote sensing data to capture actual evapotranspiration over irrigated areas. Using a surface energy balance algorithm for processing satellite imagery, Riverside is developing evapotranspiration prototypes to improve the effectiveness of water decision support systems.

Introduction

Several regions around the world face an increasing threat from drought, and the associated social, economic, and environmental impacts. The combination of diminished water supplies along with increasing demand for urban and other uses is gradually depleting surface and ground water reserves traditionally allocated for agricultural use. Quantification of water consumptive use is increasingly important as water resources are placed under growing tension by increased users and interests. Scarce water supplies can be managed more efficiently through use of comprehensive information and prediction tools, accurate information on irrigation infrastructure, and timely information on the extent of irrigate lands and actual evapotranspiration (ET).

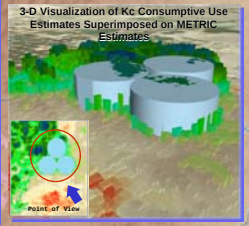


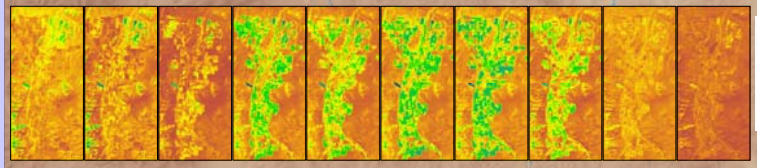
Conventional ET Estimates

ET from agricultural parcels is usually estimated by multiplying the weather-based reference ET by crop coefficients (Kc) determined according to the crop type and the crop growth stage. There is typically some question regarding whether the crops grown compare with the conditions represented by the Kc values, especially in water short areas. In addition, it is difficult to predict the correct crop growth stage dates for large populations of crops and fields.

METRIC ET Estimates

Mapping ET at high Resolution with Internalized Calibration – METRIC (Allen et. al 2007) is a method based on maturing technology for deriving a satellite-driven surface energy balance for estimating ET from the earth's surface. This technology has the potential to become widely adopted and used by water resources communities, providing critical support to a host of water decision support tools. ET maps created using METRIC or similar remote-sensing based processing systems could be routinely used as input to operational and planning models for water demand forecasting, reservoir operations, ground-water management, irrigation water supply planning, water rights regulation, and hydrologic studies.





2009 Monthly METRIC ET Maps, Mason Valley, Nevada

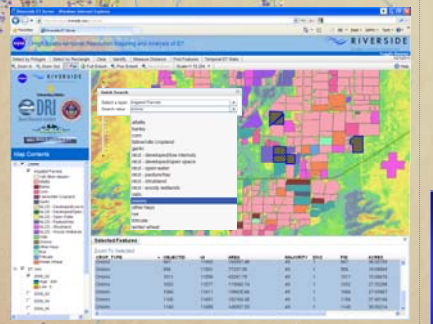
ET Server

Scarce water supplies can be managed more efficiently through the use of information and prediction tools accessible via the Internet. As part of the NASA-ROSES project, Riverside has developed ET Server – a browser-based web mapping application, powered by Esri's ArcGIS Server technology. ET Server provides a vehicle through which METRIC technology can be made more accessible to decision makers. It allows end users to assess the results of the spatially distributed ET modeling and compare with results from conventional ET estimation methods prior to assimilation in surface and groundwater models. In addition, this application provides rapid and transparent access to the data, utilizing GIS-based analytical tools that facilitate ET assessments associated with a spatio-temporal scale of interest. We believe that ET Server and the interaction that it will foster will result in a streamlined flow of consumptive use estimates into hydrologic modeling and water decision support systems. The application is accessible through http://buckeye.riverside.com/etserver.

ET Tool

ET Server provides several tools that include map and layer navigation, feature query and selection, and the ET tool. This tool allows users to summarize ET values for selected AOI and time periods. It was designed to also assess and quantify spatial and temporal variations in ET by comparing conventional estimates to actual estimates produced by METRIC.

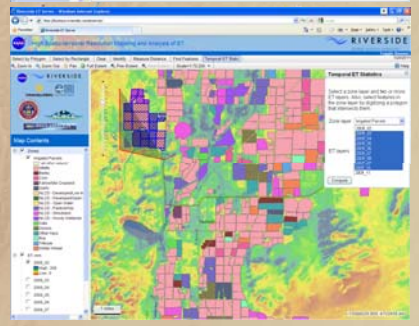
The ET tool has analytical geospatial capabilities that enable the user to query and select irrigated parcels, and then compute total ET for that selection. Similarly, a groundwater modeler can select an area of interest (e.g. return flow contributing area) or an irrigation service area by digitizing on-screen, and compute ET for that area. The ET calculation is based on satellite imagery using the METRIC method.



To use ET tool, first, define your area of interest (AOI).

AOI can be defined by selecting parcels with a specified crop type, as shown on the right, or by digitizing a polygon that intersects the selected parcels or irrigation service areas, as shown on the right below.

The selected area will be highlighted.

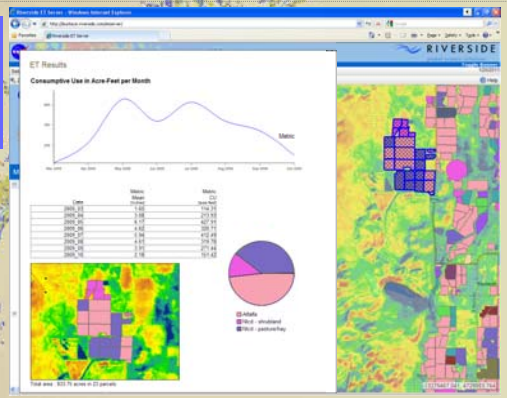


Next, select from the list of available ET layers the time period of interest.

Finally. click the Compute button to submit the task. Task execution can take a few minutes, depending on server performance, size of the selected area, and the number of ET layers included in the calculation.

Example METRIC Output (Mason Valley, Nevada)

Task output is displayed in the Results panel.



The results include:

Map of the selected parcels with the number of parcels and total area indicated below the map.

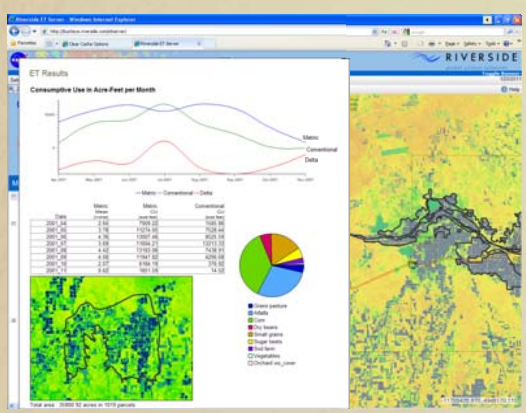
Table of the ET layers (identified by the selected time period), mean ET value in inches, and the total volume of ET, in Acre-Feet, for the selected area. The volume is calculated for the METRIC ET and for conventional ET, if available.

Pie chart of the relative area of each crop type grown in the selected area.

Graph of a spline interpolation between data points for each date. The purple line represents the ET volume calculated by the METRIC method. If conventional ET is available, the green line represents the conventionally calculated ET volume, and the red line shows the difference between the values (METRIC – Conventional).

Example METRIC and Conventional Output (South Platte River Basin, Colorado)

ET results are for parcels in the selected irrigation service area.



Contact and References

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Allen, R. G., Masahiro Tasumi, et al. (2007). "Satellite-Based Energy Balance for Mapping Evapotranspiration with Internalized Calibration (METRIC)—Model." Journal of Irrigation and Drainage Engineering **133**(4).