**NASA DEVELOP National Program**

Langley Research Center

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**Coastal Mid-Atlantic Water Resources**

*Using the METRIC Model to Estimate Evapotranspiration in the Coastal Mid-Atlantic Region*

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Coastal Mid-Atlantic Water Resources Team Summer 2014

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**Applied Sciences National Applications Addressed:**

Water Resources

**Study Area:** Coastal Plain of Maryland and Virginia

**Study Period:** April 2013 - June 2014

**Partners/Collaborators**

Virginia Secretary of Natural Resources: Molly Ward, Secretary

Virginia Secretary of Technology: Karen Jackson, Secretary

Virginia Secretary of Agriculture & Forestry: Todd Haymore, Secretary

Virginia Department of Environmental Quality: David Paylor, Director

Digital Harvest: Young Kim, General Manager; Ed Hassell, Agronomist

**80-100 Word Blurb**

Crop irrigation accounts for the 80-90% of US water consumption, making it crucial to maximize agricultural water-use efficiency. Irrigation is a massive expense for farmers and accounts for 70% of agricultural productivity. In this study, Landsat 8 and Automated Weather Observing System (AWOS) observations were used as input in the Measuring Evapotranspiration at High Resolution with Internalized Calibration (METRIC) model to contribute toward a more accurate ET estimation. METRIC will allow farmers to make decisions regarding irrigation that are more cost efficient. This model can also provide state policy makers with a means of assessing drought conditions.

**Community Concerns**

* Current regulations of water resources are not monetarily efficient. Improvements are needed for determining when irrigation is necessary based on ET rates.
* Irrigated agriculture accounts for 80-90% of water consumption nationwide and at least half of U.S. irrigated cropland relies on traditional, less efficient irrigation systems, despite technological advances.
* State officials need more accurate models for analyzing drought conditions in order to make more informed decisions regarding water-usage policies.
* Global demand has stressed the agricultural industry, making efficiency and productivity of upmost importance.

**Current Management Practices & Policies**

Currently, crop irrigation needs are monitored through identifying areas of heat stress. When heat stress becomes apparent, irrigation is deemed necessary. Using METRIC-derived ET rates to assess crop conditions would allow farmers to irrigate before heat stress occurs. Current water-allocation decisions for each state are based on weather station precipitation measurements. State officials would benefit from having broad ET estimates for drought monitoring and making water-allocation decisions rather than relying on sparsely distributed weather stations.

**Abstract**

Crop irrigation accounts for a considerable amount of water use in the Coastal Mid-Atlantic region. A better understanding of how often farmers need to irrigate their fields could decrease water waste and lower economic costs. The METRIC model is a powerful tool that calculates evapotranspiration (ET) based on localized data. Executable in ESRI ArcGIS software from a Python script, the model was used as a decision support tool that can provide farmers with information regarding ET rates, allowing them to make more informed irrigation decisions. METRIC was used to calculate ET through a series of equations where local input variables were acquired from Landsat 8 sensors, a United States Geological Survey (USGS) survey based Digital Elevation Model (DEM) from GTOPO30, and local AWOS stations. While METRIC-derived ET estimates are beneficial for irrigation purposes, it also provides state officials with a useful proxy for drought monitoring. Utilizing data from NASA Earth observations in the Coastal Mid-Atlantic region contributes to a large-scale, more-complete, understanding of water consumption behavior in an area.

**Decision Support Tools**

* Python script in ArcGIS that calculates ET using the METRIC model
* Maps of ET rates based on METRIC model output

**Benefit to End-User:**

* Digital Harvest: Mapping ET using Landsat 8 will enable end-users to take measurements of agricultural fields when weather conditions prevent them from flying UAVs to collect data.
* Maryland and Virginia state agencies: ET mapping will provide a more accurate depiction of the water demand for farmers.
* An improved understanding of the water budget will benefit state officials making policy decisions concerning water rights and conservation efforts.
* METRIC software will be developed to make the code open-source and operational for agricultural businesses and policy makers.

**Earth Observations & Parameters**

Landsat 8, OLI/TIRS – Evapotranspiration, Land Cover

Aqua, MODIS – Evapotranspiration

TRMM, PR - Precipitation

Terra, ASTER - Evapotranspiration, Land Cover, DEM

**Future Applicable NASA Missions**

Soil Moisture Active Passive (SMAP) – Soil moisture, terrestrial water cycle

**Models Utilized**

Mapping Evapotranspiration with high Resolution and Internalized Calibration (METRIC) (POC: Dr. Richard Allen, University of Idaho)

**Ancillary Datasets Utilized**

USDA National Cropland Data Layer – Land cover

USGS National Land Cover Dataset – Land cover

USGS GTOPO30- Digital Elevation Model

NOAA/AgriMet- Weather Data

**Software Utilized**

ArcGIS:

* ArcMap – Processes METRIC output for map creation, enhancement, and analysis
* Python – Processes Landsat 8 and AWOS data to develop a raster layer of ET