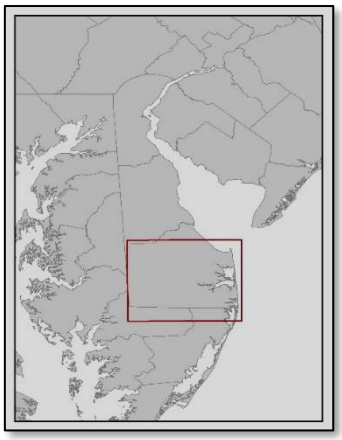
DelawareView Remote Sensing Activities 2015 - 2016

Estimating Evapotranspiration using Landsat Data

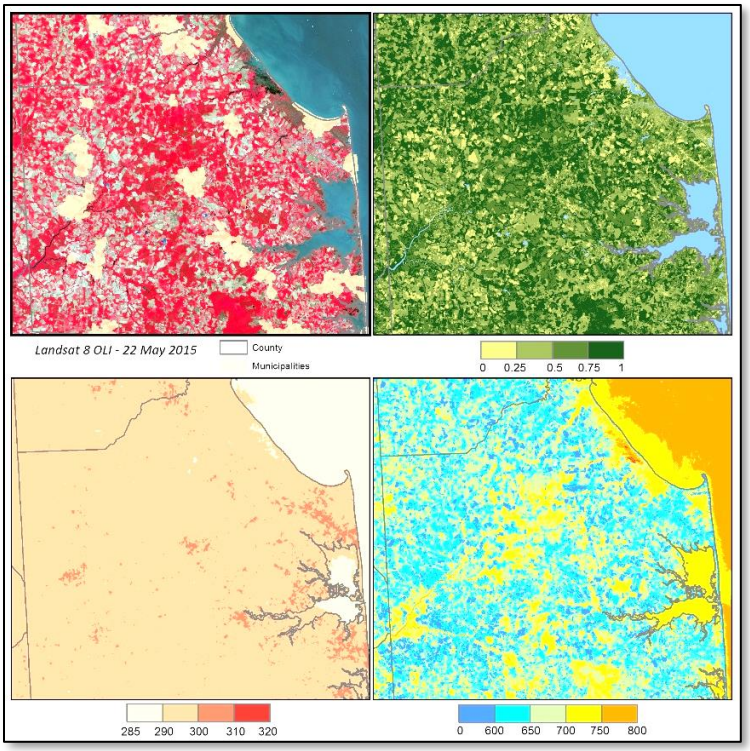
DelawareView is completing a study to develop and test a method to estimate the seasonal evapotranspiration distribution in Delaware using Landsat data. Evapotranspiration (ET) is the sum of evaporation from the soil and transpiration water loss from plants. ET is a main component of the water cycle. In Delaware, ET may account for approximately two-thirds of the annual average water budget. Estimates of ET at the monthly and seasonal scale along with regional spatial scales are valuable to agricultural planners, water resource managers, and hydrologists.

The method involves the use of the Surface Energy Balance Algorithm for Land (SEBAL) to compute actual evapotranspiration from visible, near infrared and thermal infrared bands of Landsat imagery along with weather data. Given the access to and availability of the free Landsat collections, this method has been widely applied and validated under various conditions around the world.

The SEBAL procedure computes the net surface radiation flux using the surface radiation balance equation. The computation begins with estimating the surface albedo, incoming shortwave radiation, incoming and outgoing longwave radiation and then solving for net surface radiation flux.



Study area includes the State of Delaware with red box defining the zoomed-in view of Sussex County (graphic on lower left) where reference ET data exists.



False color Landsat 8 Operational Land Imager collection of Sussex County from 5/22/2015 (upper left) with derived NDVI (upper right), surface temperature (K) (lower left), and surface net radiation (Wm^{-2}) (lower right).

The four panel figure to the left displays a false color composite image (upper left) used as input to the model, and computed vegetation index (upper right), surface temperature (lower left), and net surface radiation (lower right). The result is the estimation of evapotranspiration on a seasonal basis.

The weather data are obtained from the Delaware Environmental Observation System (DEOS). DEOS is housed at the University of Delaware, and provides real-time environmental conditions for Delaware and the surrounding region. The weather data collected for estimating ET include wind speed, precipitation, humidity, solar radiation and air temperature.

The Principal Investigator and two undergraduate students completed the project. Both students are in the Environmental Science program in their junior year.

The tools used to compute ET include Python scripting and Desktop ArcGIS.

DelawareView is a member of the AmericaView Consortium, a nationally coordinated network of academic, agency, non-profit, and industry partners and cooperators that share the vision of promoting and supporting the use of remote sensing data and technology within each state.

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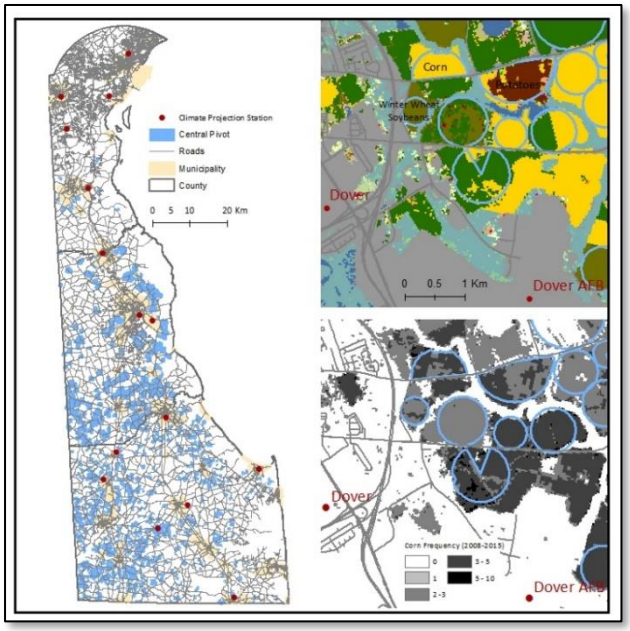
Benefits to Delaware

The benefits of this project are to provide a method to estimate ET on a seasonal temporal scale and across the state of Delaware from readily available Landsat imagery. Since ET accounts for almost two-thirds of the annual average water budget, providing estimates of ET is valuable for water resource management and hydrologic studies.

As irrigation rapidly expands in Delaware and climate change continues to stress water resources, a method of computing ET across larger spatial and temporal scales will be extremely valuable to farmers, as well as to local and state water resources officials.



Central pivot irrigation systems across the state of Delaware (left) and a zoomed in view of an area east of Dover (right) showing irrigation areas enclosed in blue circles along with main crop information (upper right) and corn frequency information (lower right).

DelawareView Consortium Membership

The members of DelawareView include Tracy DeLiberty, John Callahan, Tina Callahan and Matthew Shatley. Tracy DeLiberty is an Associate Professor in the Department of Geography at the University of Delaware. Her research interests are in the areas of hydroclimatology, GIS, and remote sensing, focusing on land surface interactions with climate by investigating regional and global observations and remotely sensed datasets. John Callahan is an Associate Scientist with the Delaware Geological Survey (DGS). The DGS is a science-based, public-service-driven Delaware State Agency at the University of Delaware that conducts geologic and hydrologic research, service, and explorations for the benefit of the citizens of the First State. Tina Callahan works with the Delaware Environmental Monitoring and Analysis Center to promote and coordinate environmental monitoring efforts in Delaware and surrounding areas. Matthew Shatley provides programming support and is the coordinator of the university's satellite receiving station.

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Major funding for the AmericaView Consortium is provided by the U.S. Geological Survey through Grant Number G14AP00002.