Demonstration of a Daily High-Resolution (375-m) ALEXI Evapotranspiration Product for the NENA Region

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Demonstration of a Daily High-Resolution (375-m) ALEXI Evapotranspiration Product for the NENA Region

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Atmosphere-Land-Exchange-Inversion Model (ALEXI)

ALEXI is a two-source energy balance model which was initially developed to address issues dealing with the monitoring of surface fluxes, including actual evapotranspiration (ET), from a satellite-based platform (Anderson et al., 1997; Fig. 1). Flux partitioning within ALEXI is driven by time changes in land surface temperature (LST); the amplitude of the diurnal surface temperature wave has been found to be a good indicator of surface flux partitioning, and using a time-differential measurement significantly reduces model sensitivity to errors in LT retrieval. Model evaluation through disaggregation over flux sites in the US and other regions indicate accuracy on the order of 19% of daily time steps (e.g., Commerell et al., 2013, Fig. 2).

The LST inputs to ALEXI are a valuable diagnostic of biophysical stress resulting from soil moisture deficiencies. Soil surface temperature increases with decreasing water content, while moisture depletion in the plant root zone leads to stomatal closure, reduced transpiration, and elevated canopy temperatures that can be effectively detected from space.

Training a Regression Model to Estimate Mid-morning LST rise from Day/Night MODIS/VIIRS Observations

While the current constellation of geostationary sensors provides near-global coverage (60 km to 100 km) - it requires merging data from 7 satellites (resolving time differences, new single atmospheric correction) - Passive optical sensors such as MODIS and VIIRS provide daily global coverage of LST at higher resolutions than GEO sensors but of only two times per day.

A technique has been developed and evaluated using GOES data to train a regression model to use day-night LST differences from MODIS to predict the morning LST (ETRAD) rise needed by ALEXI (Fig. 3). The regression model can provide reasonable estimates of the mid-morning rise in LST (RAGE - 5 to 8°C, Fig. 4) from the twice daily MODIS or VIIRS LST observations.

Prototype VIIRS ET Results – Spatial Resolution Improvements with VIIRS

Project Overview

Food and water security over the MENA (Middle East / North Africa) region is of increased importance as diminishing water supplies and a growing population continues to put strain on countries to provide adequate agriculture production. Satellite remote sensing of consumptive water use provides a mechanism to observe how efficiently, or in many cases inefficiently, local farmers are using water.

In this project, we aim to produce near-real-time (on average less than 5 days) daily 375-m evapotranspiration from VIIRS towards improvement monitoring of agricultural water use and as the primary input into Landsat-based DisALEXI simulations (~30-m resolution) over several targeted agricultural regions in the study domain.