

A pythonic implementation of the ALEXI/DisALEXI modeling suite

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Overview

- Background
- Two-Source Energy Balance (TSEB)
- ALEXI
- DisALEXI
- PyDisALEXI
- Future Directions/Conclusions

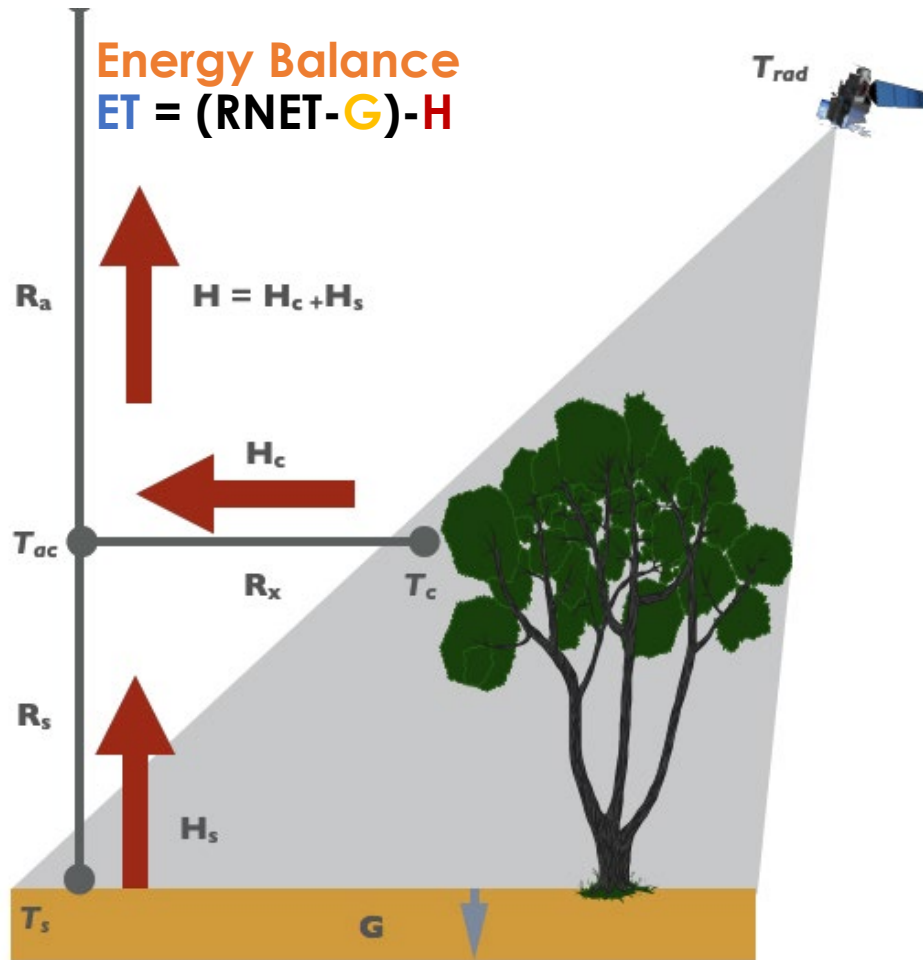
Background

- Middle East North Africa (MENA) stakeholders are interested in knowing about their water consumption and water use efficiency.

Goals

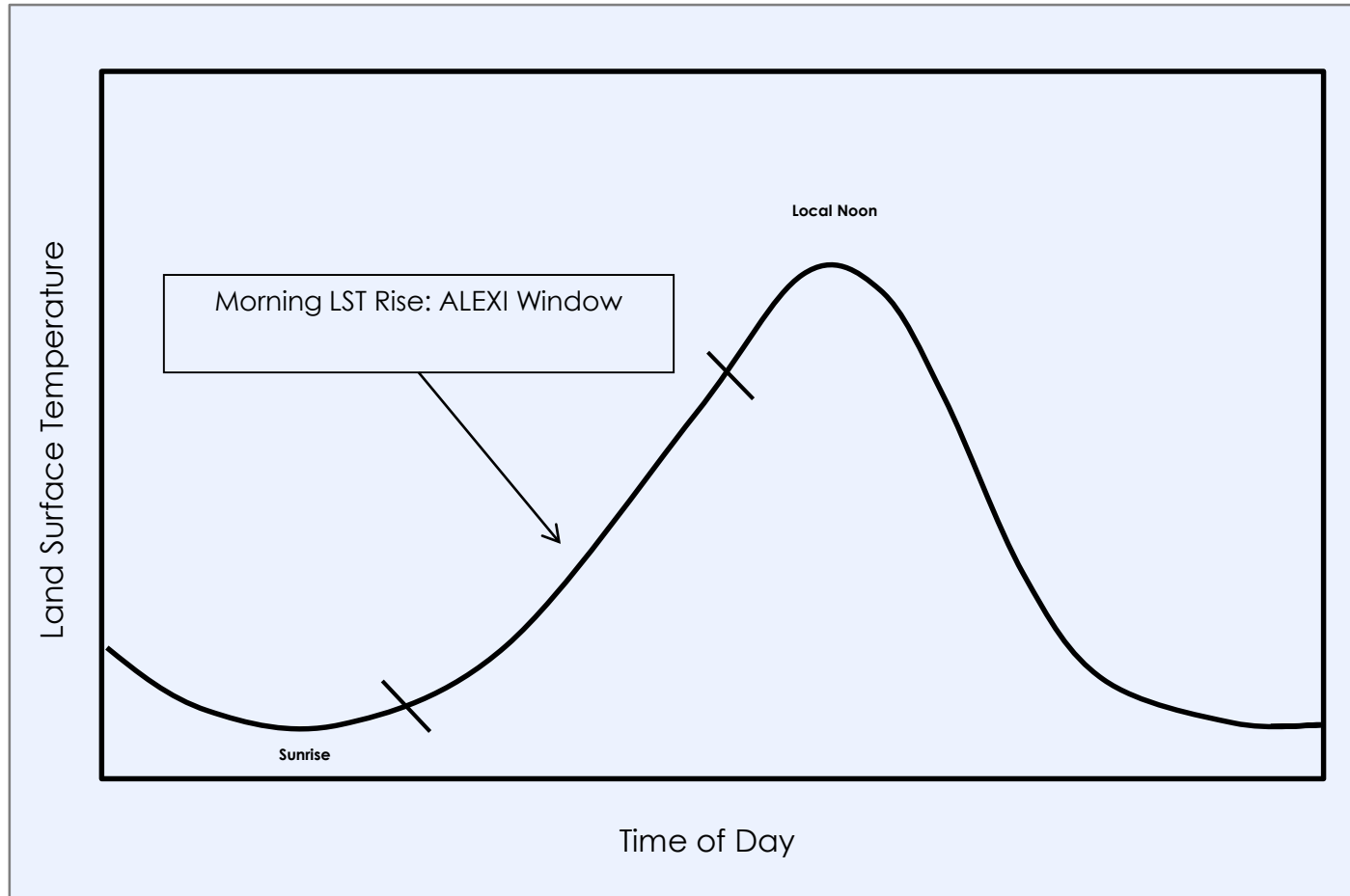
- Develop regional and field-scale capability for water use mapping.
- Develop an easy to use freely available open-source tool for local stakeholders to use.

Two Source Energy Balance (TSEB)



- Treats soil/plant-atmosphere coupling differences explicitly.
- Uses land surface temperature (LST) as a surrogate to soil-moisture content.
- Accommodates off-nadir thermal sensor view angles.
- Provides information on soil/plant fluxes and stress.

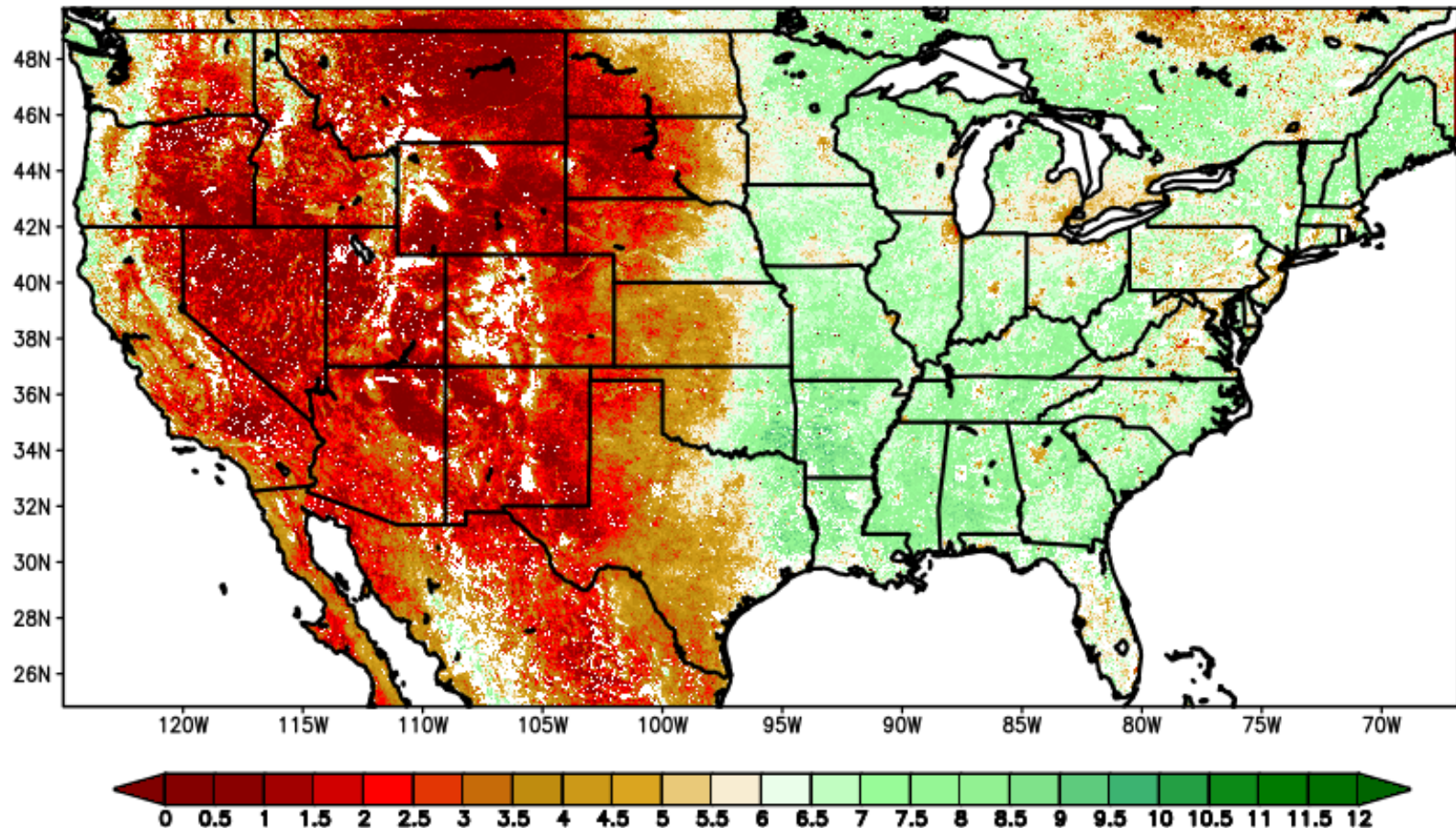
Atmosphere Land Exchange Inverse (ALEXI)



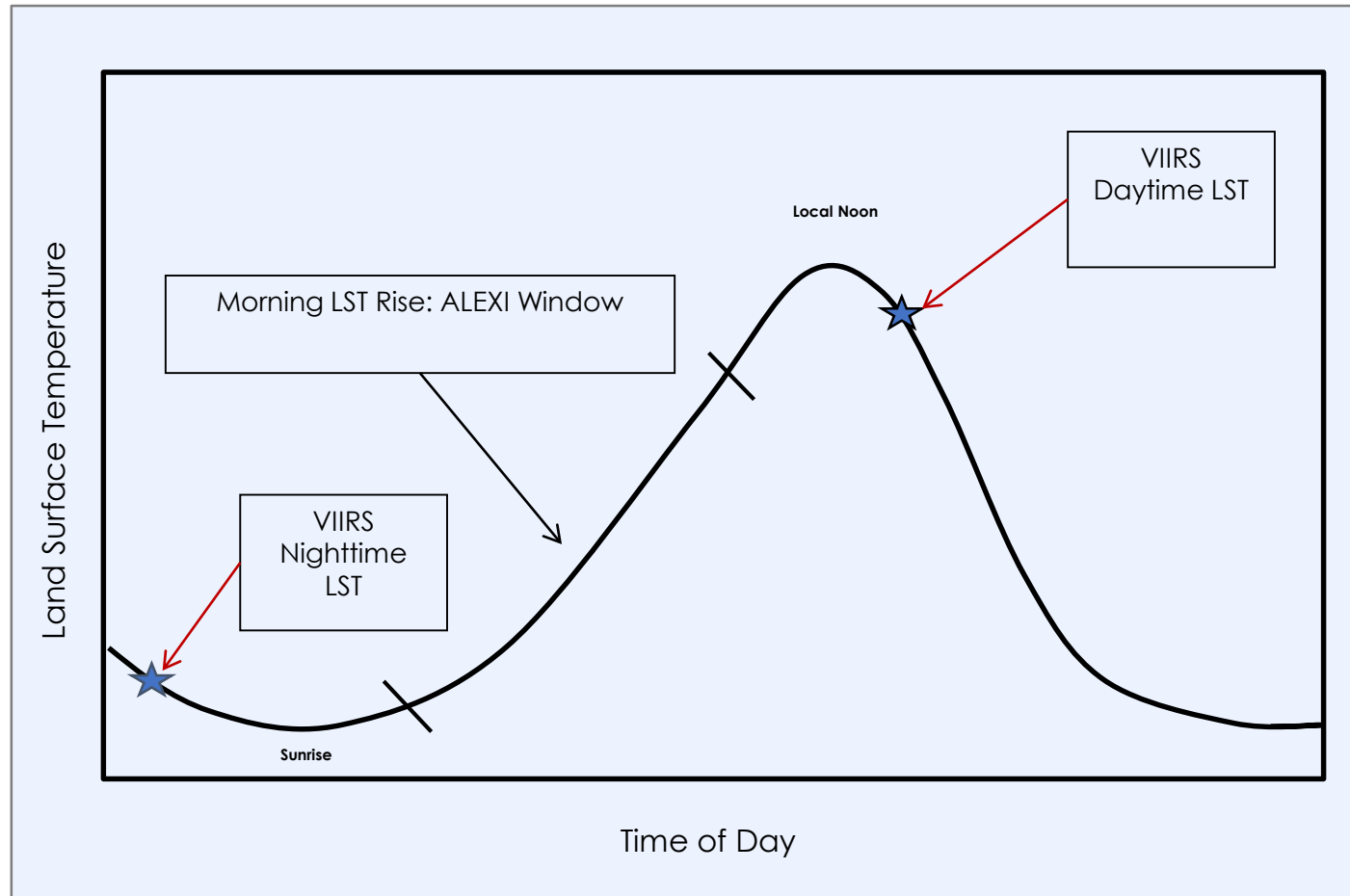
ALEXI: GOES Evapotranspiration and Drought (GET-D)

Daily Evapotranspiration from GOES

Spatial distribution of daily ET on July 10-24, 2017
produced by the ALEXI model at ~2 km resolution



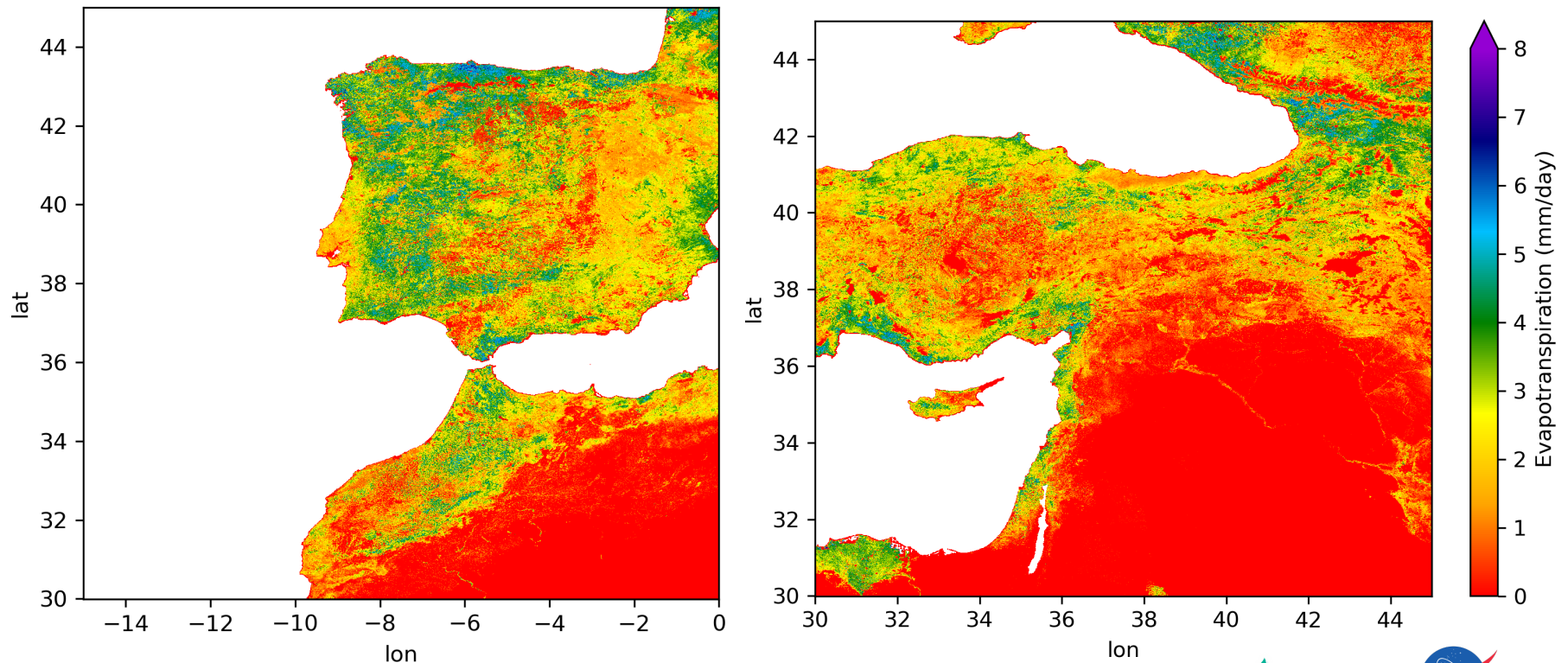
Atmosphere Land Exchange Inverse (ALEXI)



ALEXI: VIIRS 375-m MENA

Daily Evapotranspiration from VIIRS

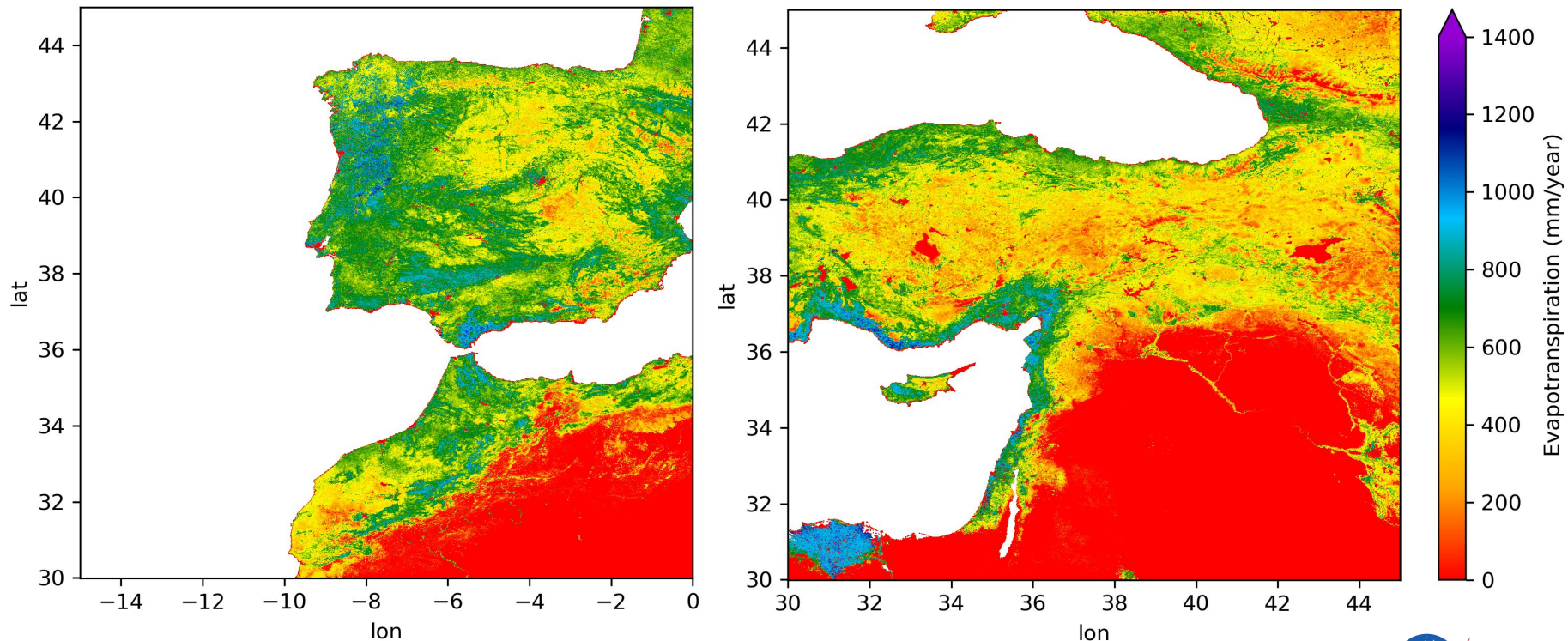
Spatial distribution of daily ET on July 1, 2018
produced by the ALEXI model at ~400 m resolution



ALEXI: VIIRS 375-m MENA

Development of a High-Resolution (375-m) VIIRS ET Product

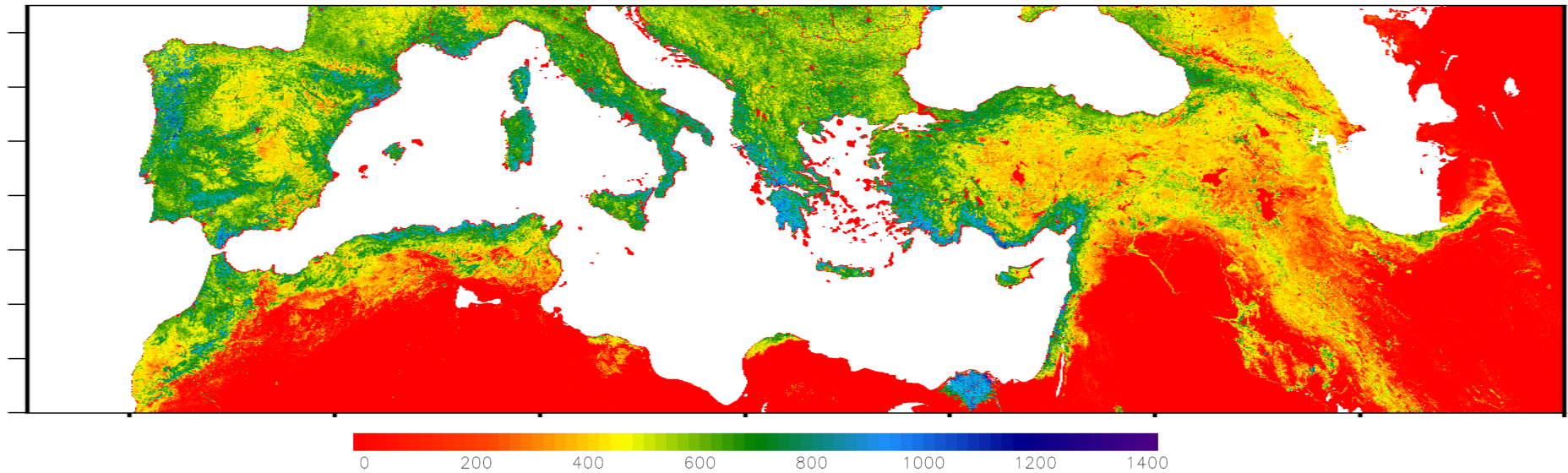
VIIRS 375 m Annual ET (mm)



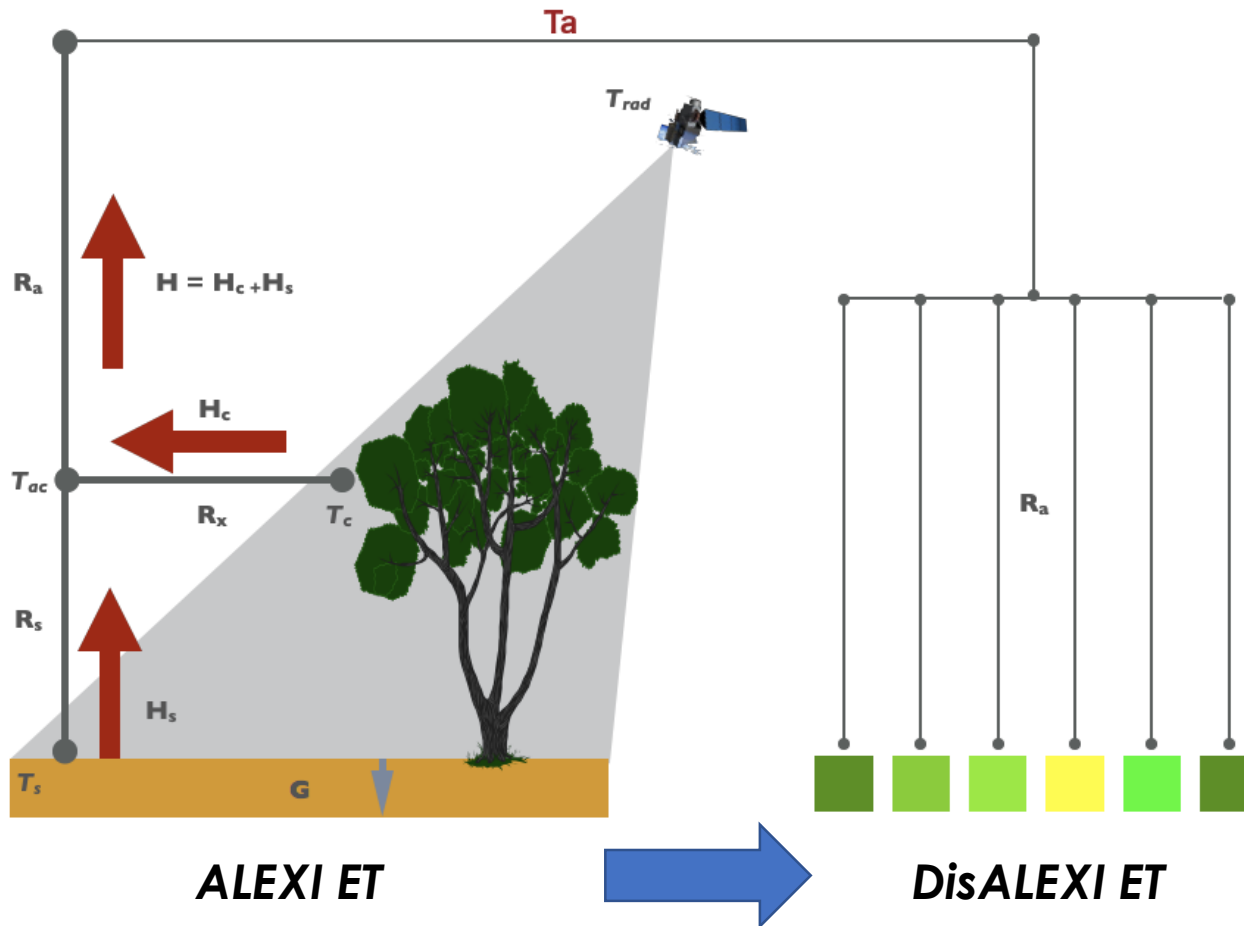
ALEXI: VIIRS 375-m MENA

Development of a High-Resolution (375-m) VIIRS ET Product

Annual ET estimated from integrating daily values for 2018



Disaggregated ALEXI (DisALEXI)



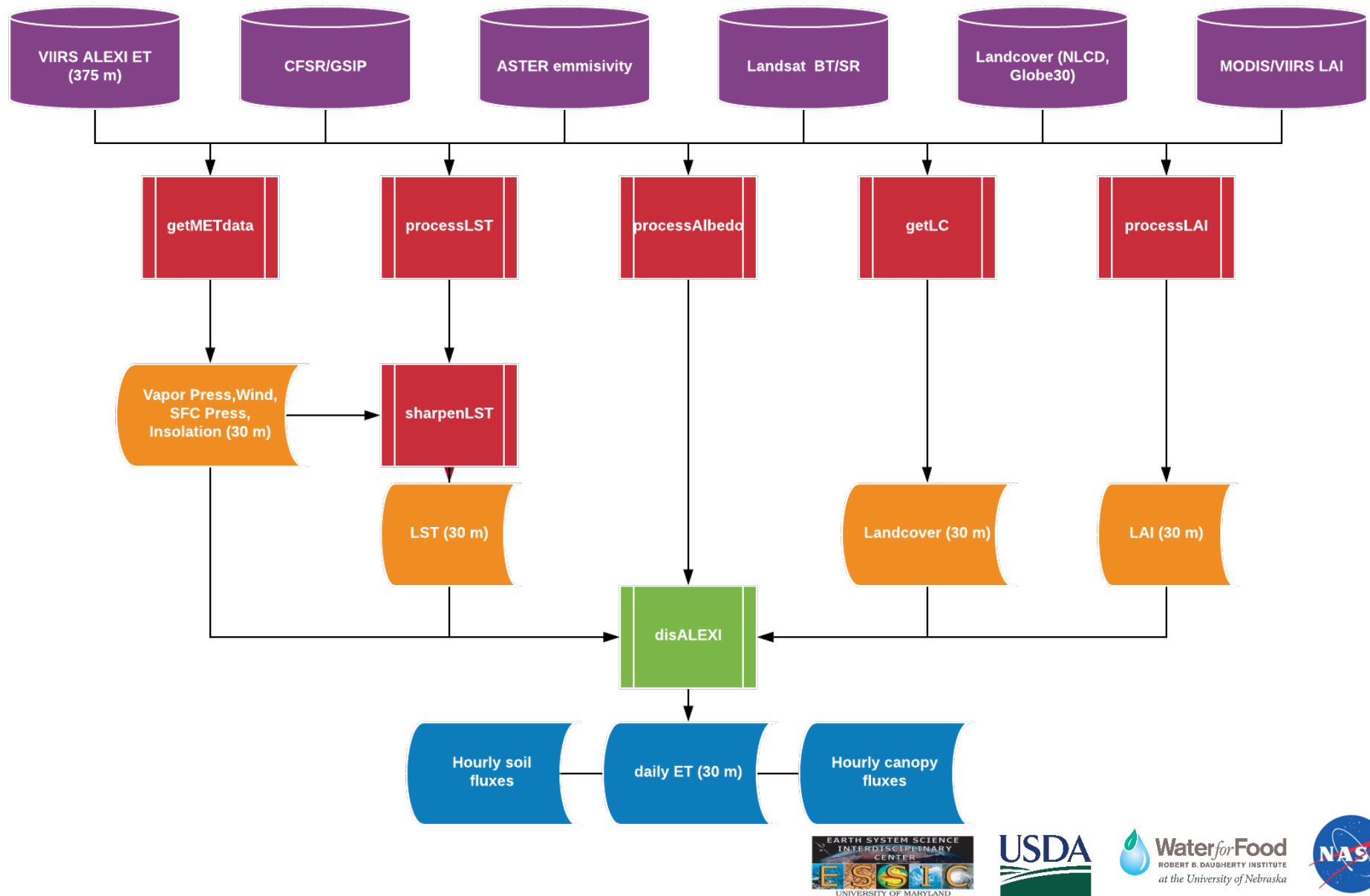
An initial guess air temperature map is iteratively altered until the aggregated daytime fluxes retrieved by DisALEXI match the ALEXI fluxes at the scale of the ALEXI grid.

PyDisALEXI

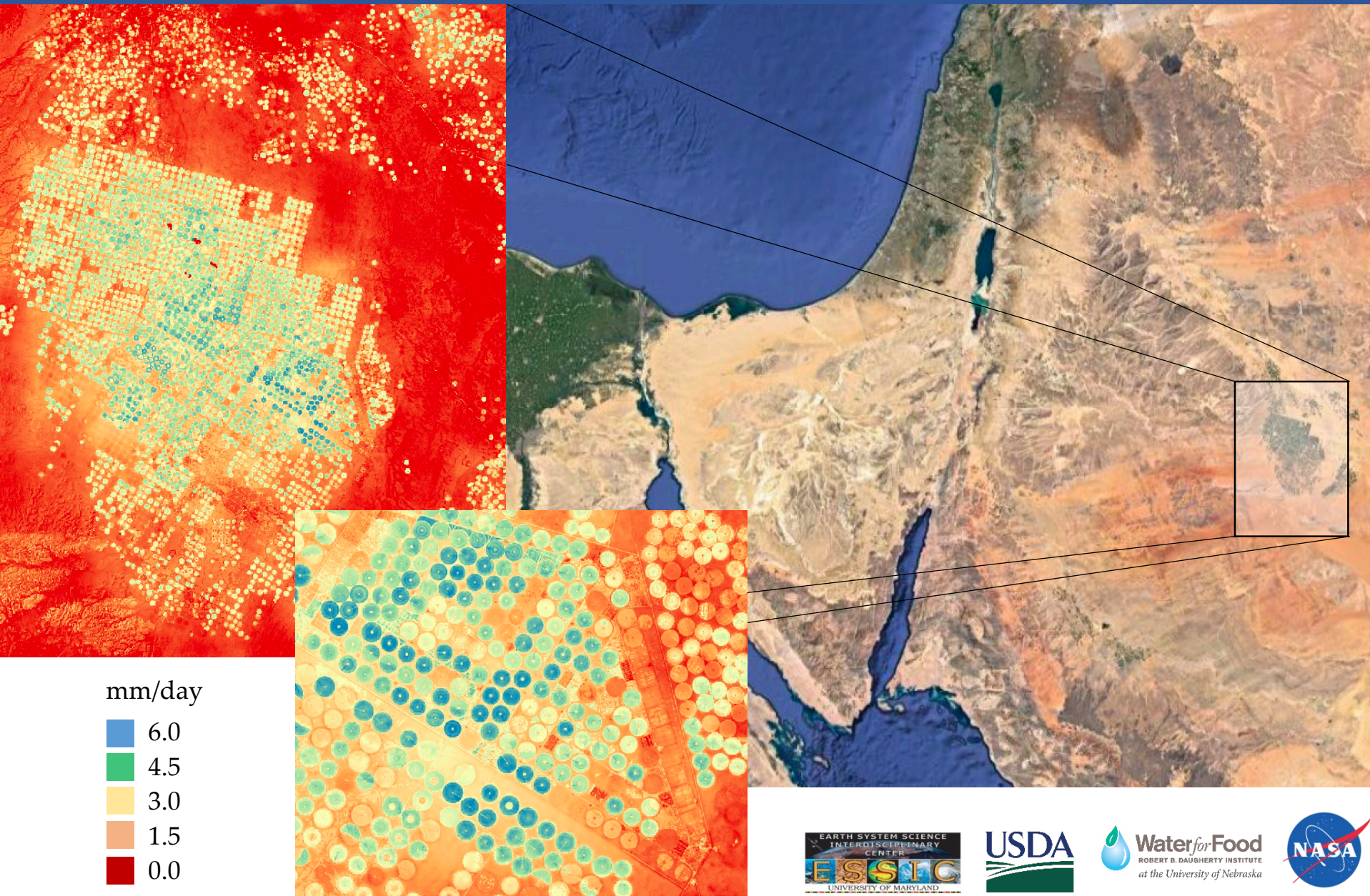
PyDisALEXI is an open source implementation of the DisALEXI fusion suite. It is primarily composed of the following freely available python modules.

- Continuum's Anaconda python distribution is used:
 - NumPy
 - SciPy
 - Pandas
 - Xarray
- Other important modules
 - rasterio
 - Pythonic implementation of RTTOV, pyrttov
 - pyModis
 - USGS's Landsat-api
 - joblib

PyDisALEXI: flowchart



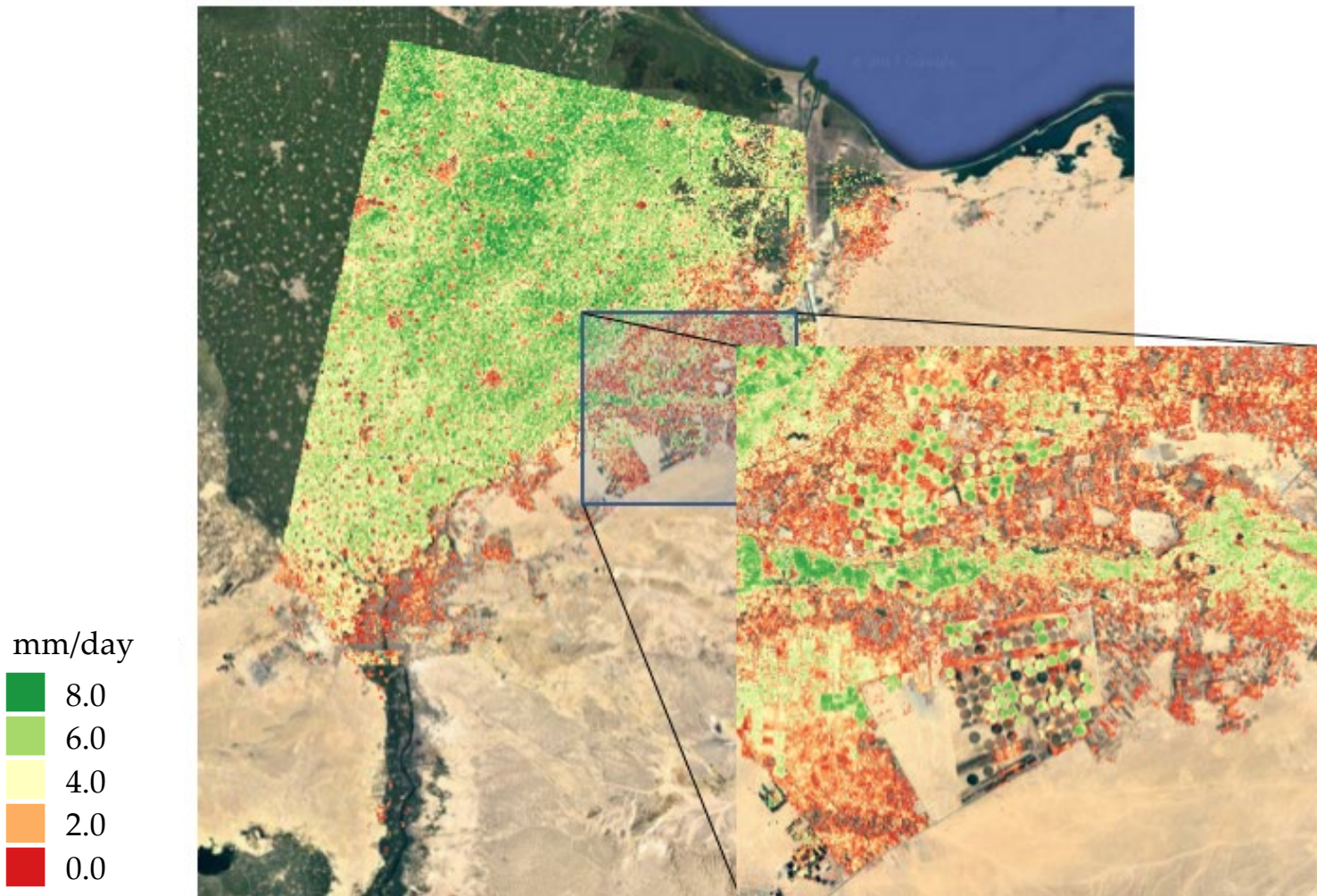
PyDisALEXI: Saudi Arabia, irrigation



PyDisALEXI: Example

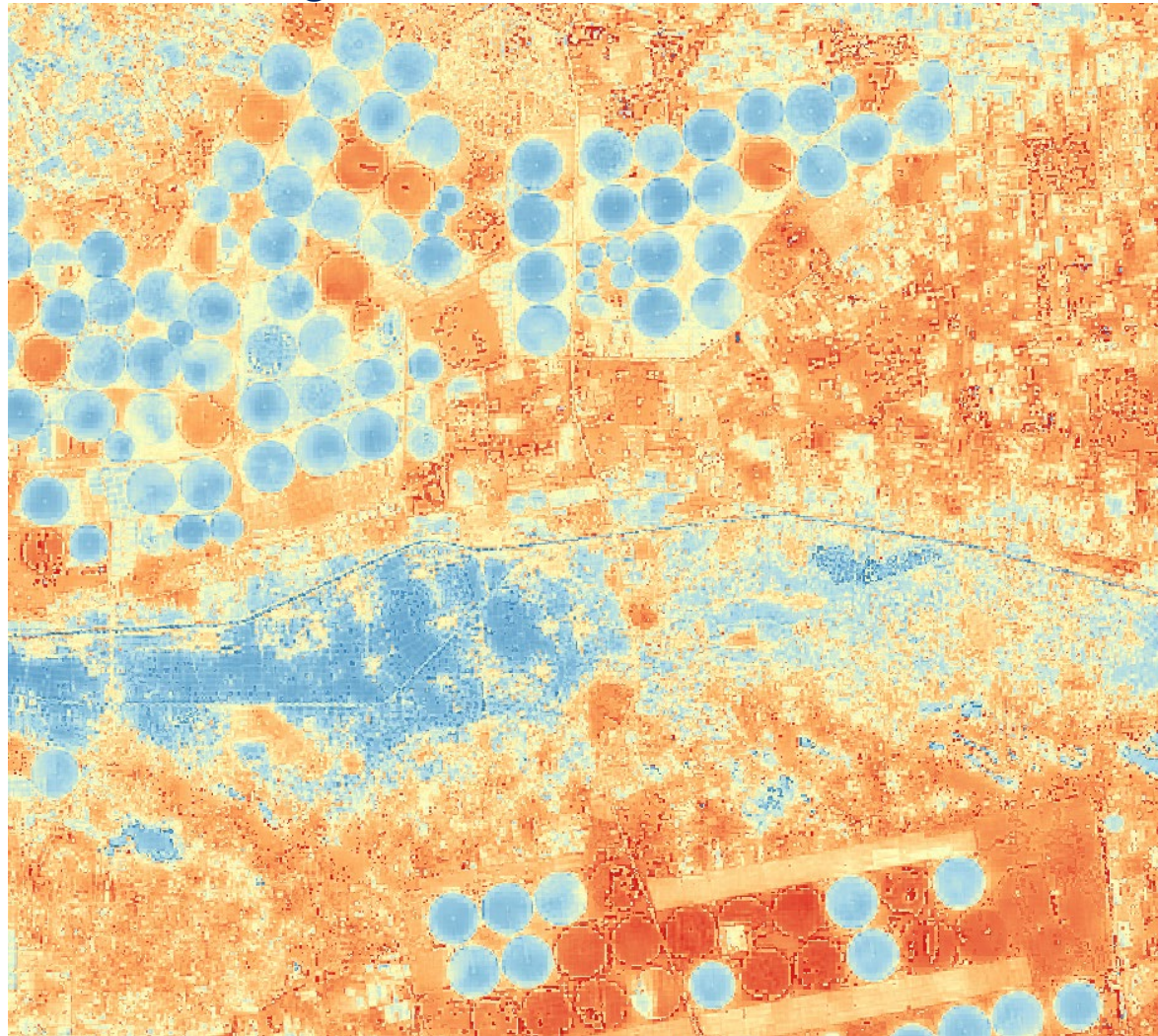
Nile Delta Irrigation Aug. 9, 2015

Landsat ET



Input data: Land Surface Temperature (LST)

Nile Delta Irrigation

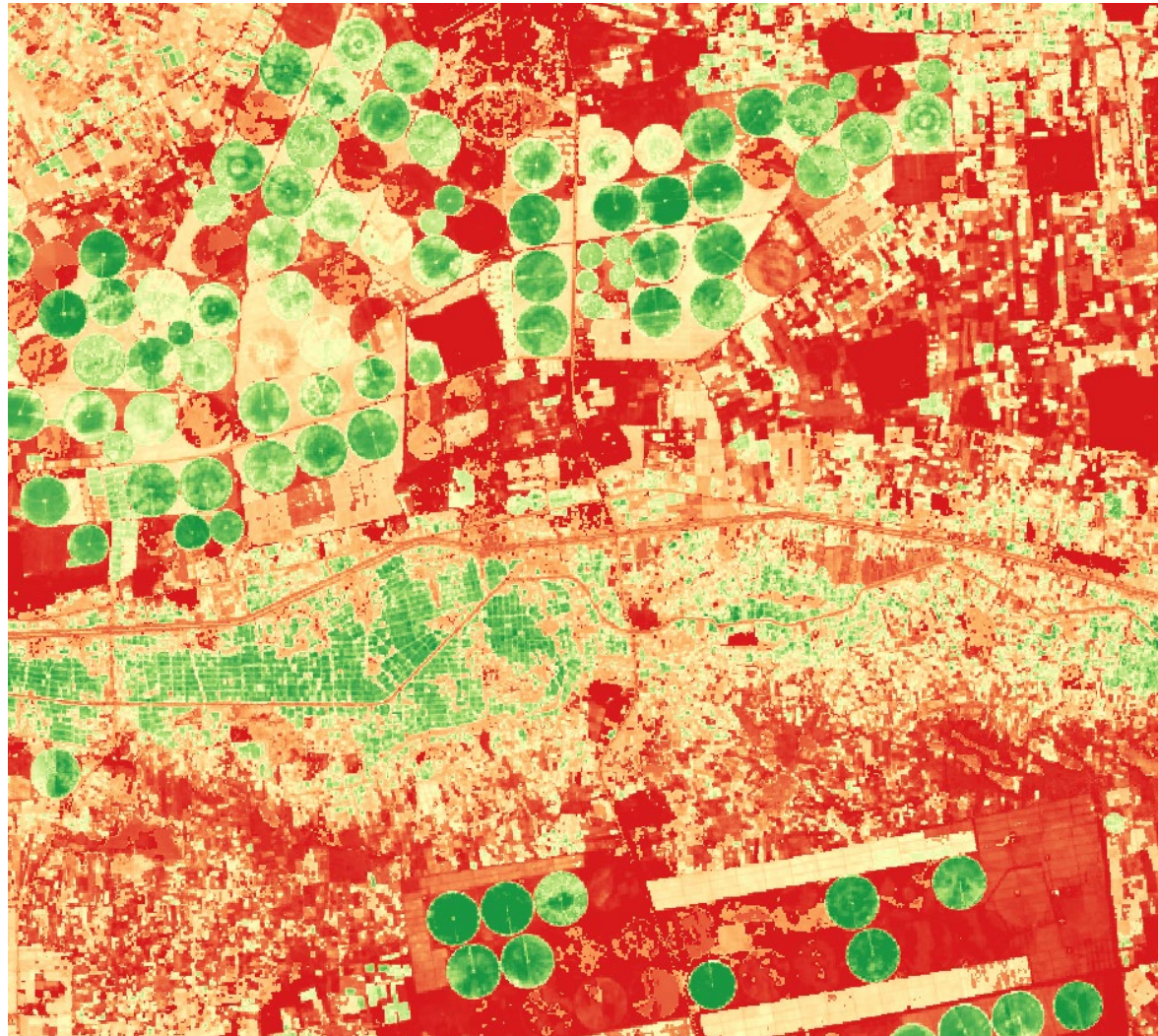


Sharpened LST (K)

- LST calculated using the RTTOV atmospheric radiative transfer model to convert Brightness Temperature to LST.
- Landsat 8 TIRS product has a native resolution of 100 m.
- Sharpened to 30 m by the Data Mining Sharpening (DMS) tool using visible (30 m) and TIRS (100 m) data.

Input data: Leaf Area Index (LAI)

Nile Delta Irrigation

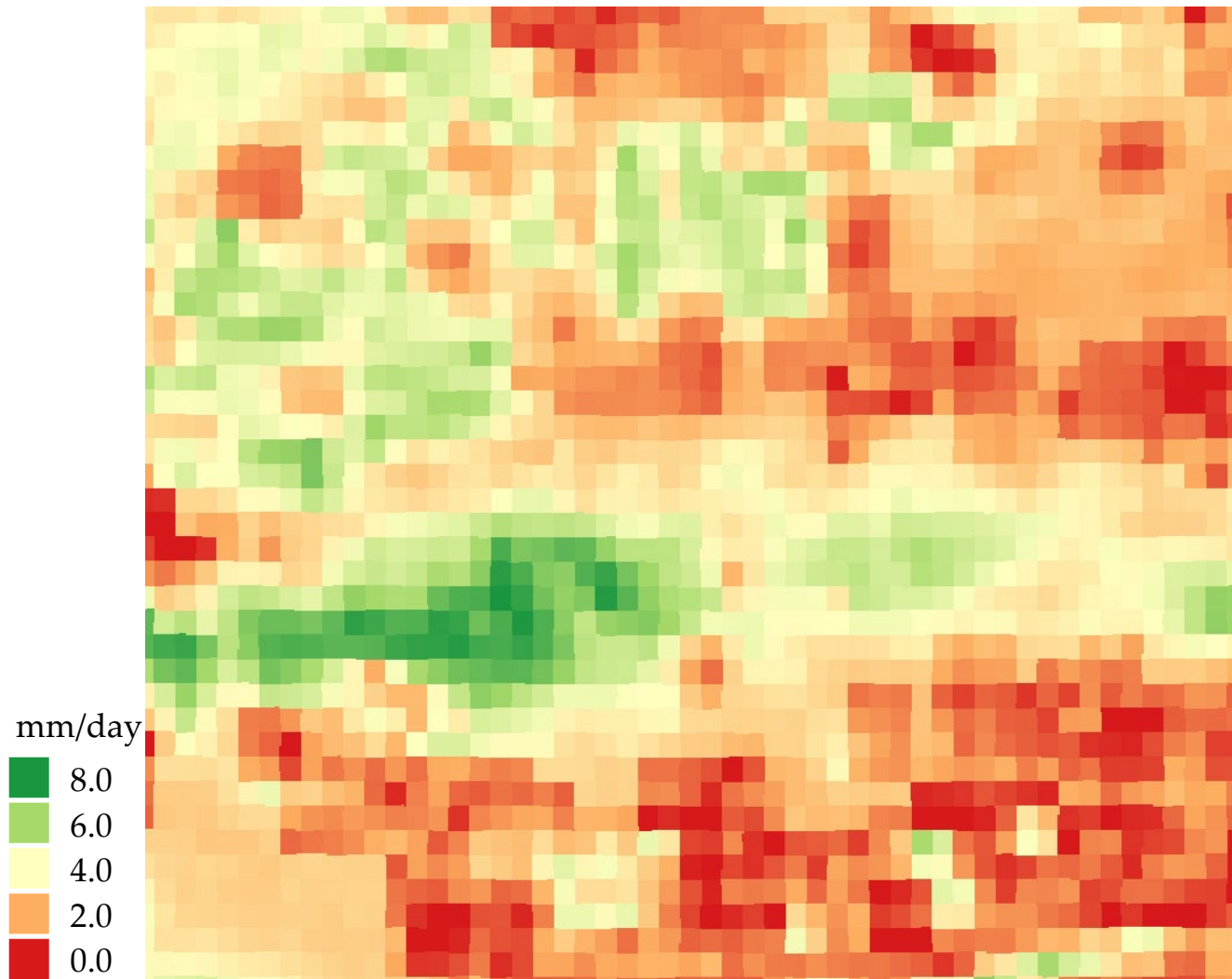


Landsat LAI

- 30 m LAI product
downscaled LAI from
lower resolution
instruments (i.e.
MODIS 1 km , VIIRS
375 m)
- LAI is downscaled to
30 m by the Data
Mining Sharpening
(DMS) tool using
visible (30 m) and LAI
at coarser scales
data.

Input data: ALEXI daily ET

Nile Delta Irrigation

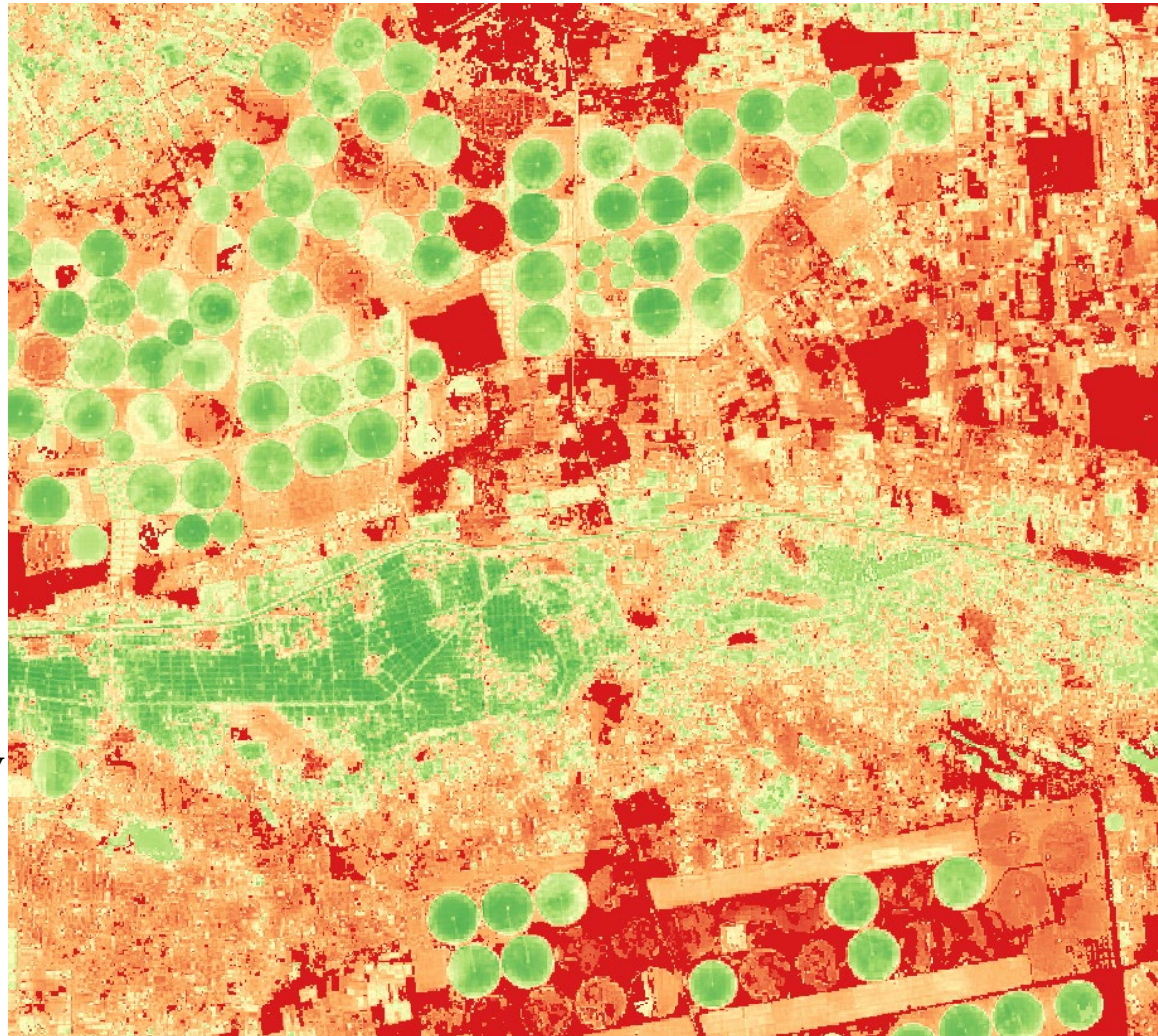


VIIRS daily ET mm/d

- Daily ET calculated at VIIRS 375 m data using the ALEXI model.

Initial results: Landsat daily ET

Nile Delta Irrigation



Landsat daily ET mm/d

- Landsat Daily ET downscaled from ALEXI using the PyDisALEXI model.

Future Direction

- PyDisALEXI is being tested and validated against fluxes over well characterized flux towers in the MENA region and in the US.
- Building a front-end using Dash to make a modern GUI for users to more easily use PyDisALEXI.
- PyDisALEXI will be distributed to our stakeholders in the MENA region for use on the ground.
- The PyDisALEXI framework is currently be ported to the Google Engine as part of the OpenET project.

Conclusions

- Developed a regional daily ET product for the MENA region.
- Created an open-source tool, PyDisALEXI, that will allow for us to easily and freely distribute DisALEXI to our stakeholders to use.
- The higher resolution ET will allow for:
 - improved accounting of current water use and crop water productivity.
 - Monitoring changes in water use with a changing climate and land-use.

Questions

PyDisALEXI: Example

Tunisian Agriculture, July 17th, 2015

