



Use of Land Surface Temperature Observations in a Two-Source Energy Balance Model Towards Improving Monitoring of Evapotranspiration and Drought

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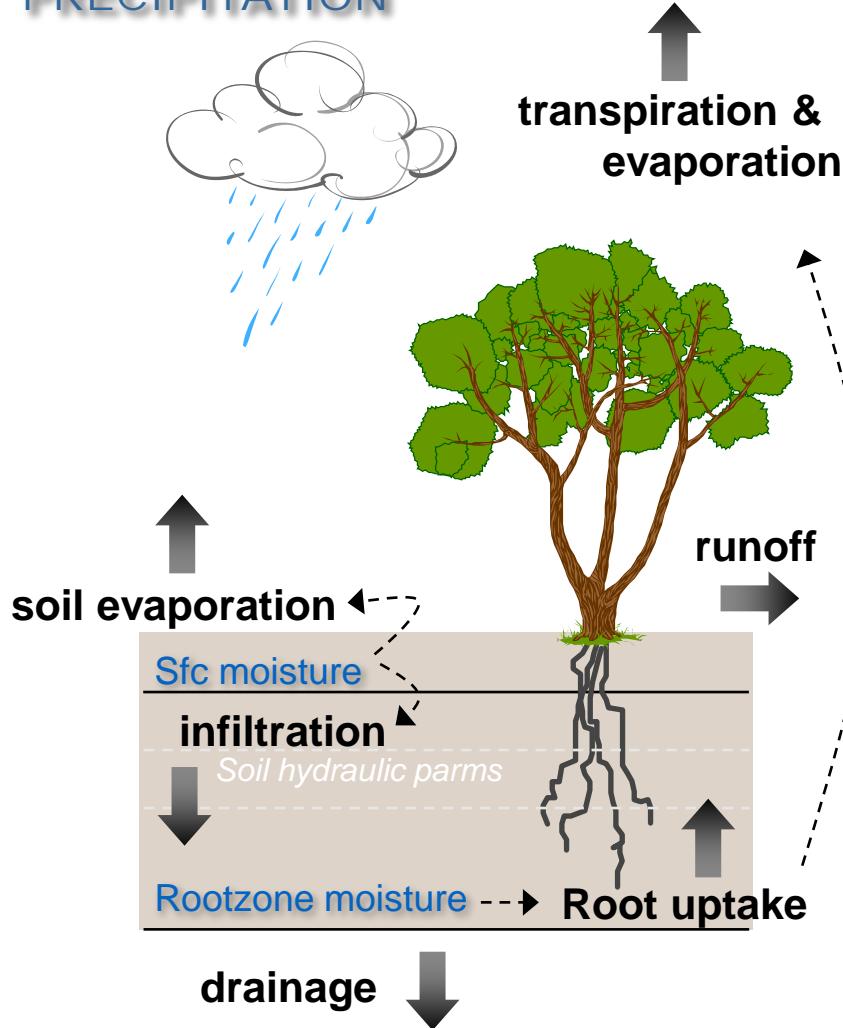
The background of the image is a high-resolution aerial photograph of a rural landscape. The fields are organized into a grid-like pattern, with many circular irrigation systems creating distinct green spots within the fields. The colors range from deep green to yellow and brown, indicating different types of crops or soil health. A thin white diagonal line runs from the bottom-left towards the top-right.

MULTI-SCALE SATELLITE ET RETRIEVAL

... based on land surface temperature

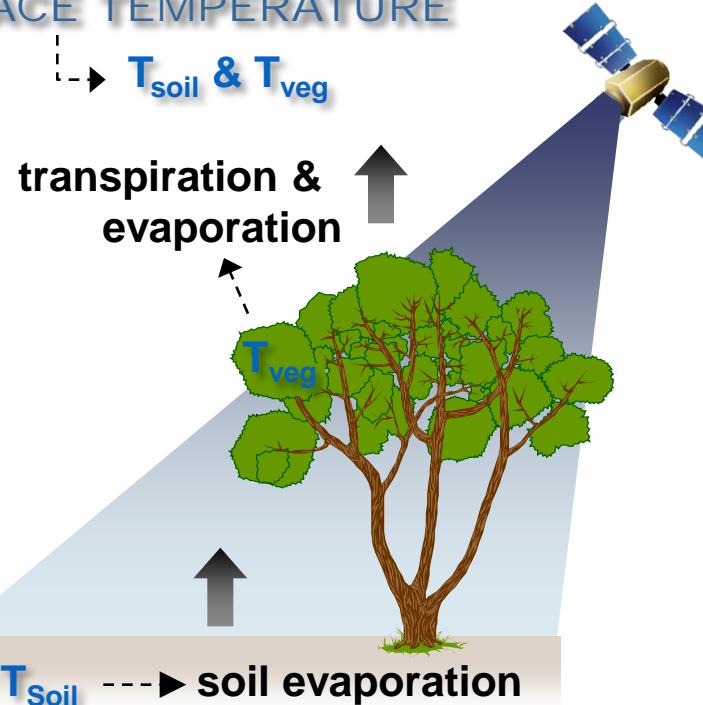
Approaches to mapping ET

PRECIPITATION



WATER BALANCE APPROACH
(prognostic modeling)

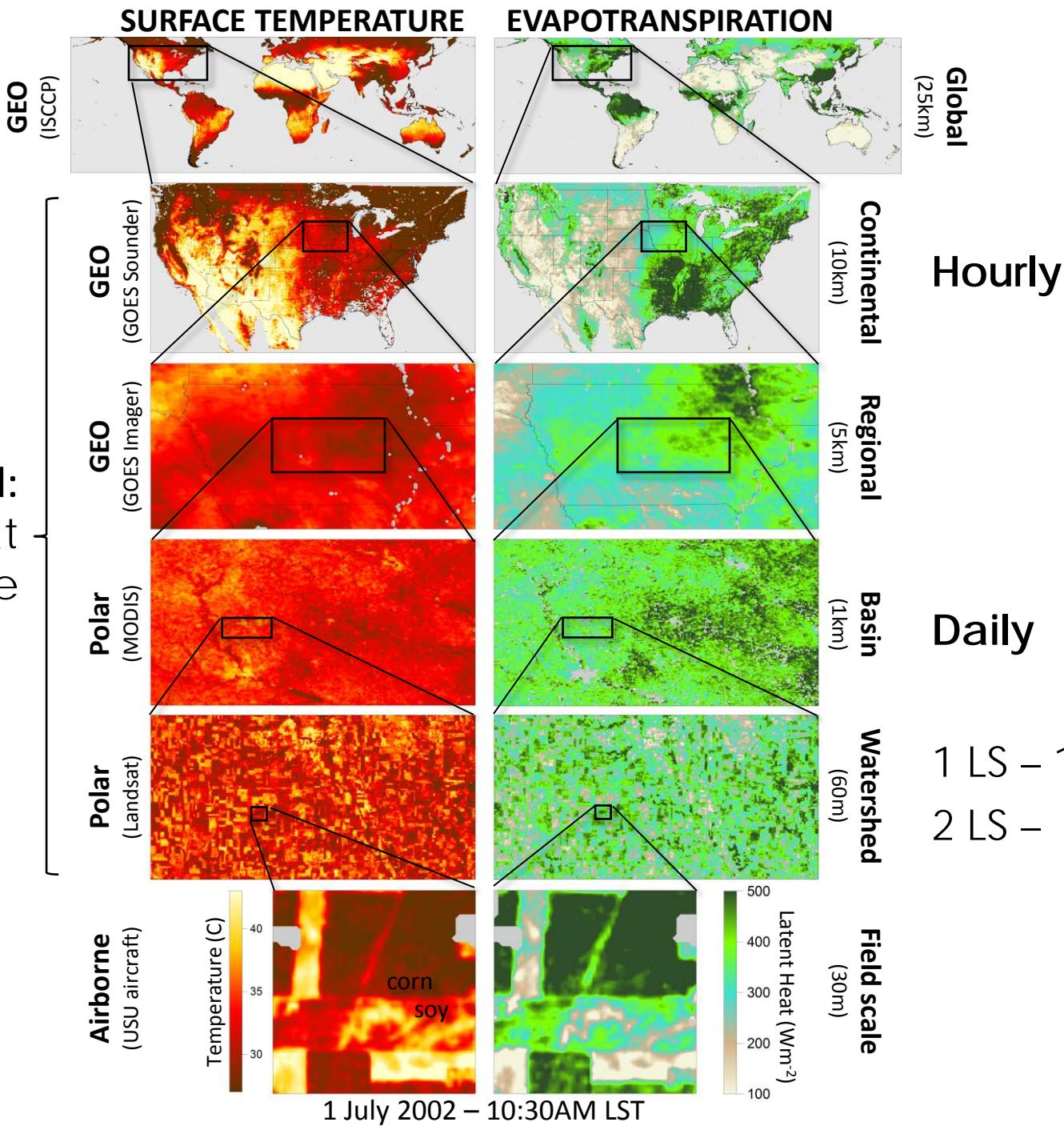
SURFACE TEMPERATURE



Given known radiative energy inputs,
how much water loss is required to keep
the soil and vegetation at the observed
temperatures?

ENERGY BALANCE APPROACH
(diagnostic modeling)

DATA FUSION: daily ET at field scale





WATER
MANAGEMENT



DROUGHT
MONITORING



FOOD AND WATER
SECURITY

MONITORING DROUGHT

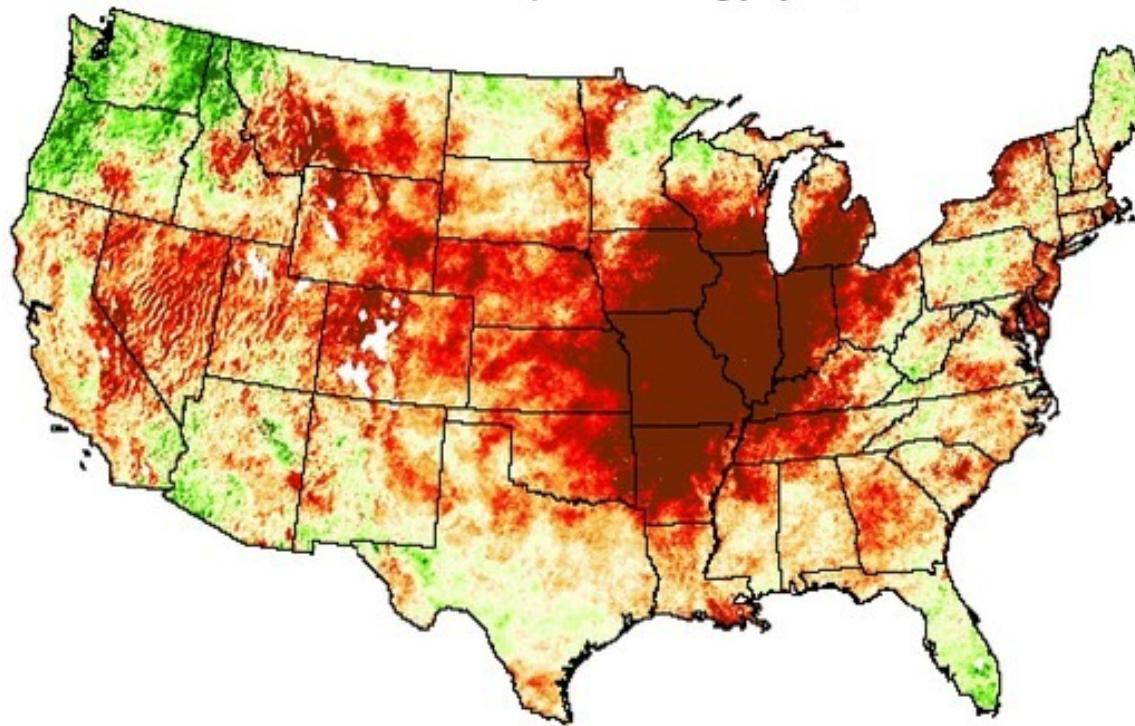
... Crop stress and yield impacts

ESI

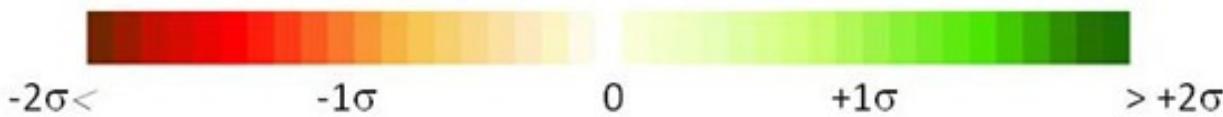


Evaporative Stress Index 4km

3 month composite ending July 28, 2012



Standardized ET/PET anomalies



Atmosphere-Land Exchange Inverse Model (ALEXI)
(Anderson et al., 1997, 2007)

2012 FLASH DROUGHT

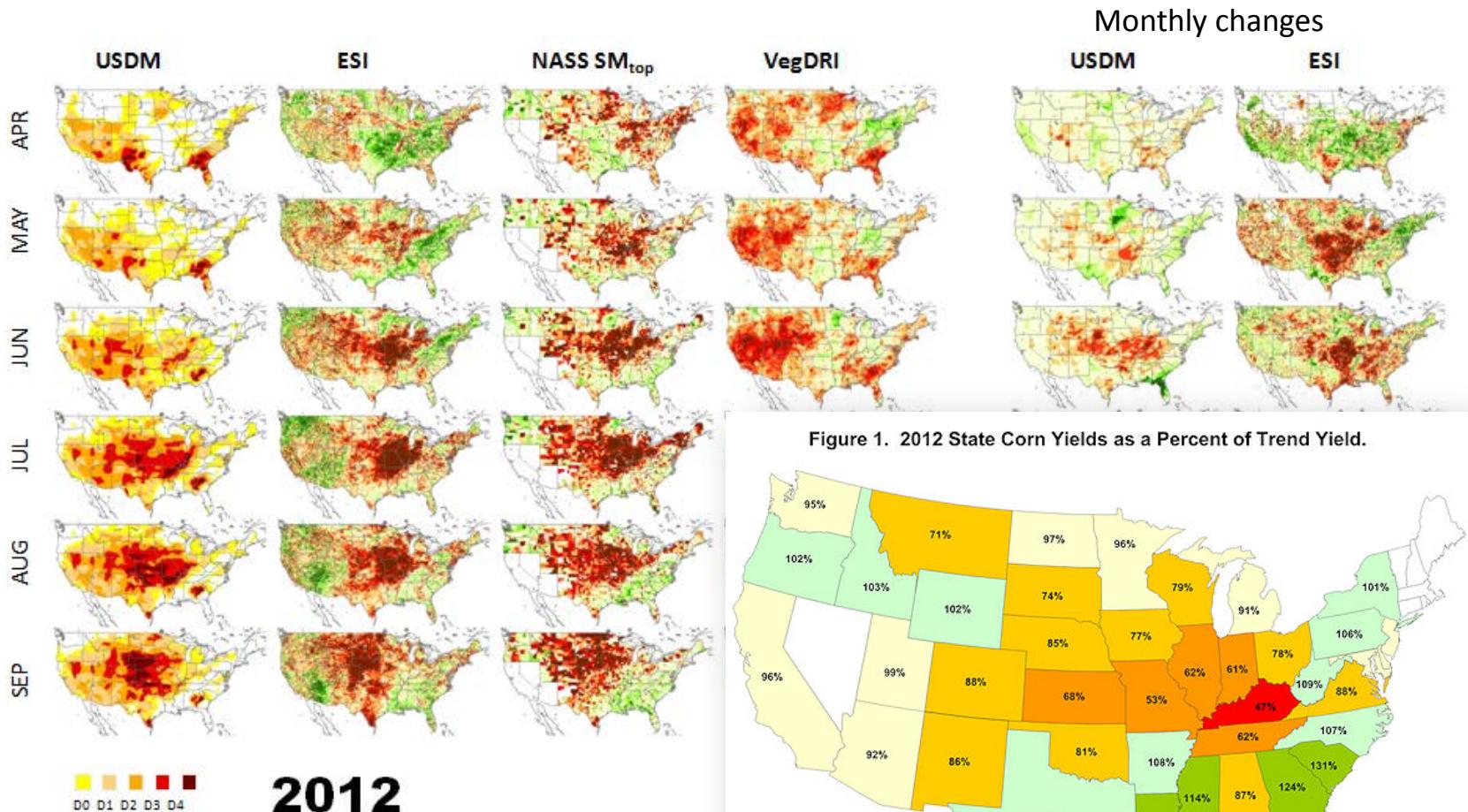


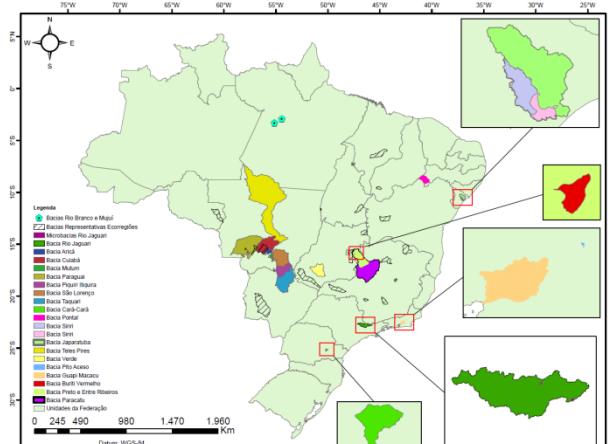
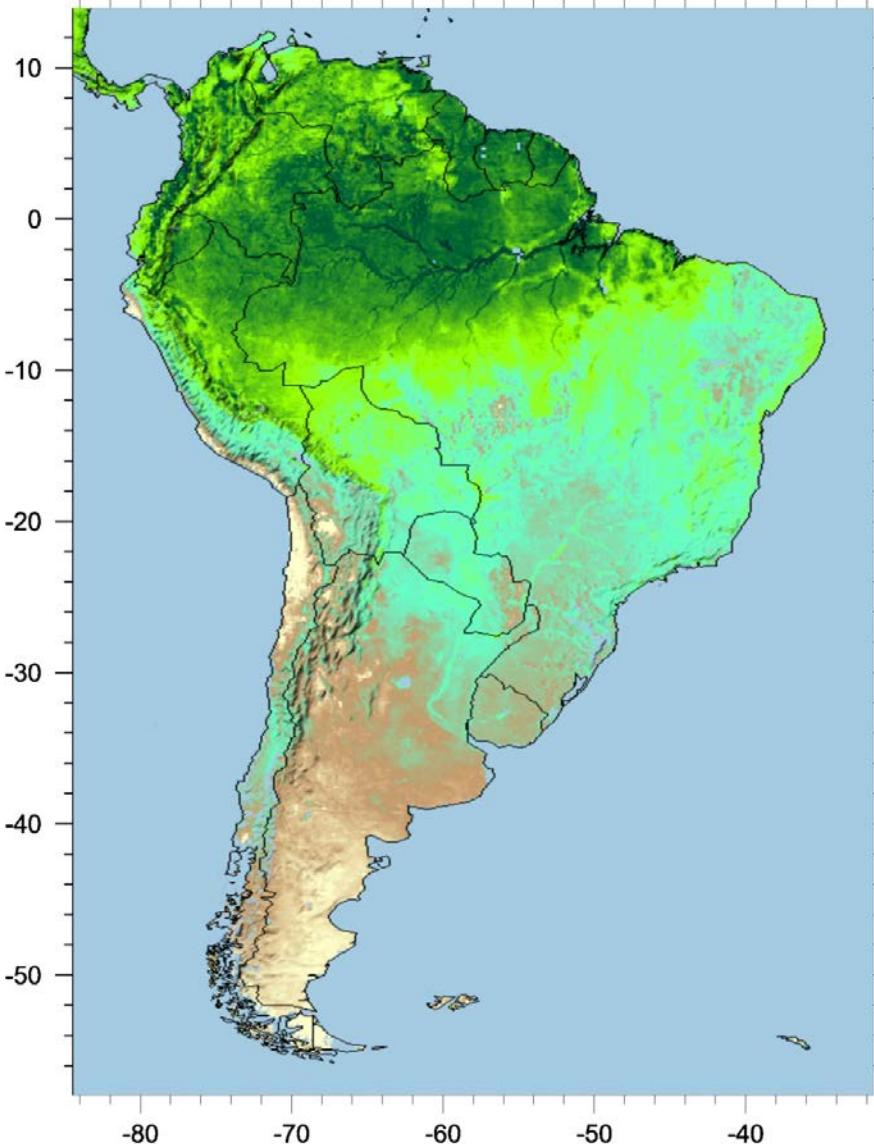
Figure 1. 2012 State Corn Yields as a Percent of Trend Yield.

A high-resolution satellite or aerial photograph showing a landscape with a mix of green agricultural fields and brown, arid land. A large body of water, possibly a lake or reservoir, is visible in the upper left. In the lower right, there's a prominent, dark, winding feature, likely a river or a large irrigation canal. The terrain shows various textures and patterns from different land uses.

APPLICATIONS FOR SATELLITE ET

... Monitoring Food and Water Security

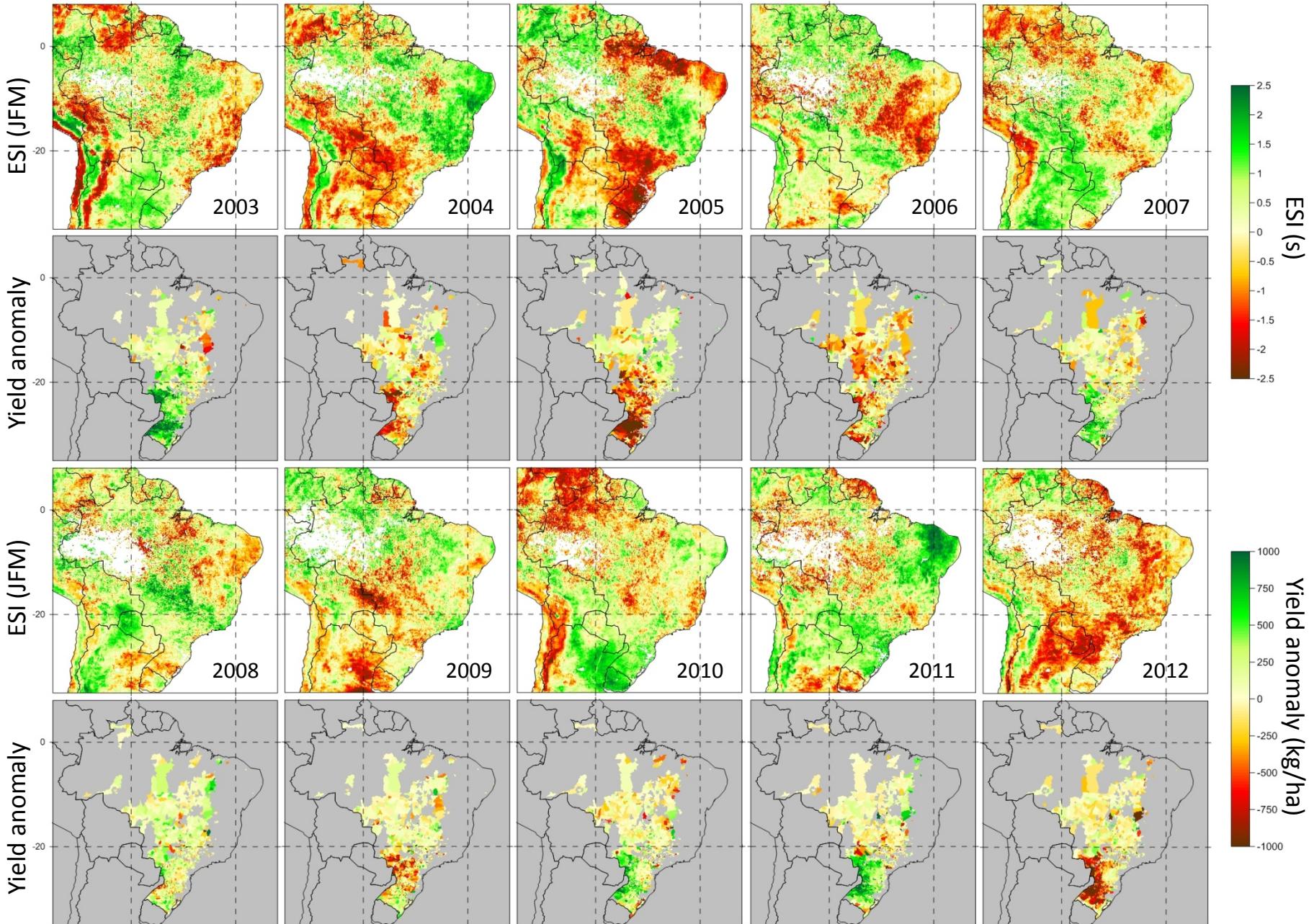
August-October composite of
clear-sky midday latent heat flux for 2013 (10 km)



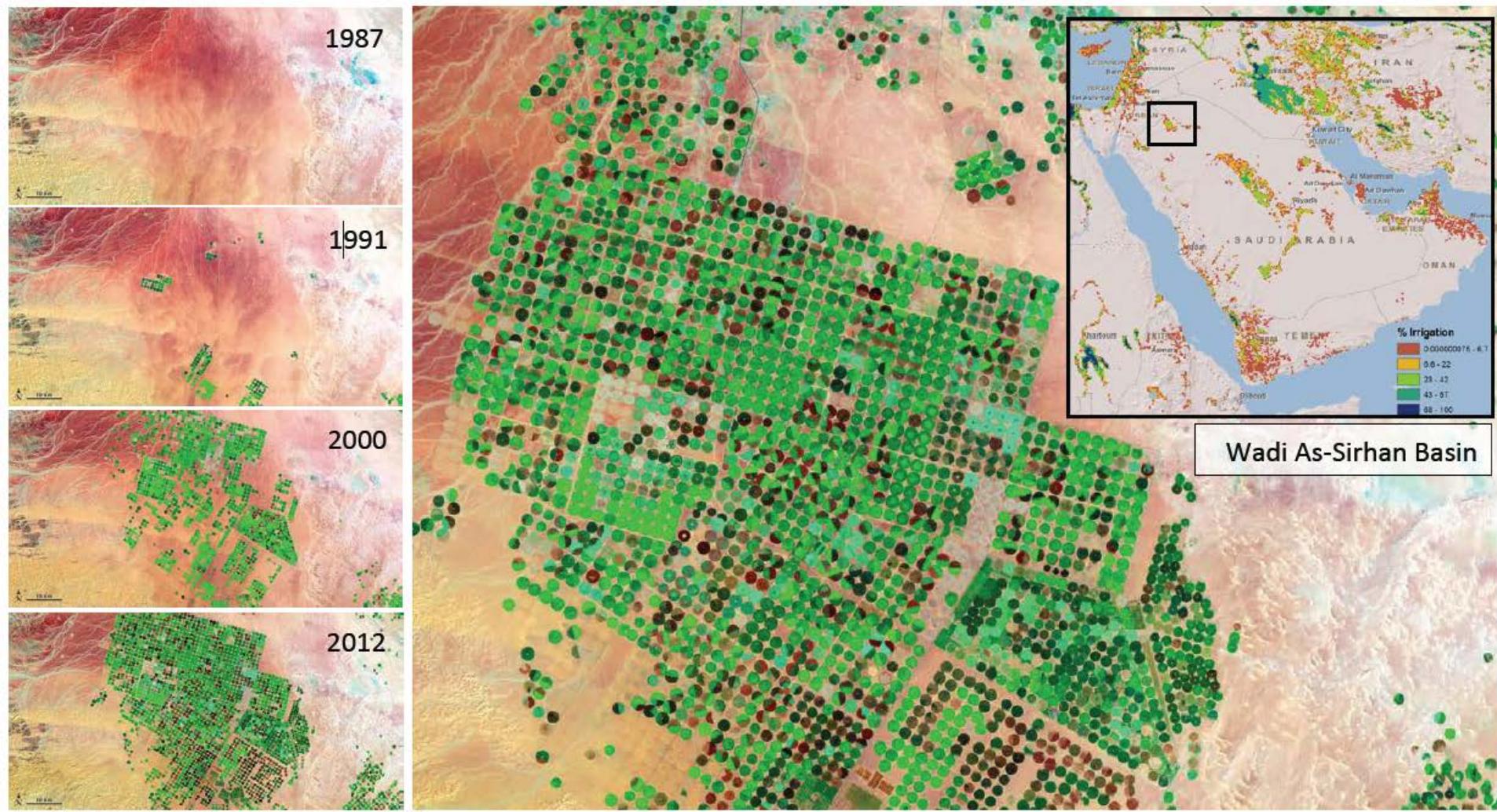
Wm⁻²



ANNUAL MUNICIPAL LEVEL SOYBEAN YIELD ANOMALIES



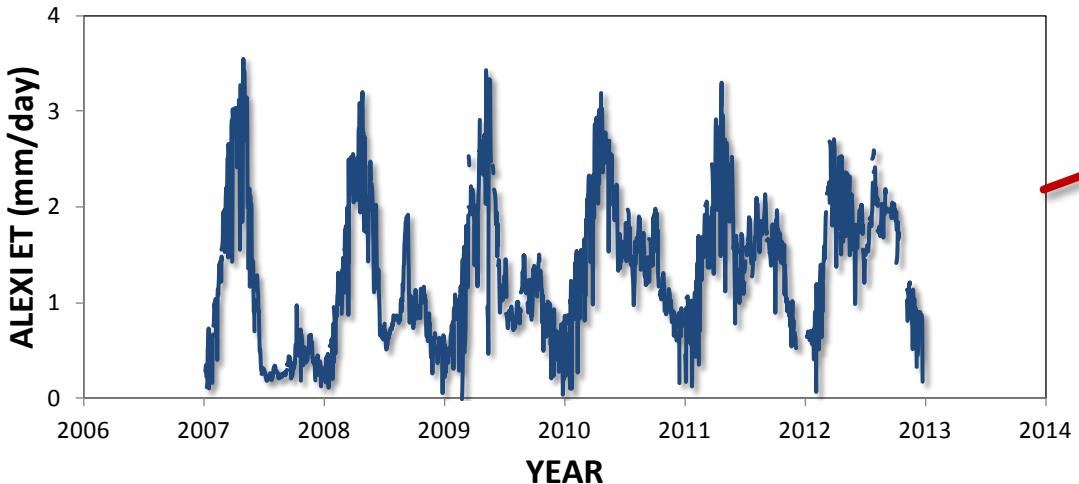
EXPANSION of IRRIGATION



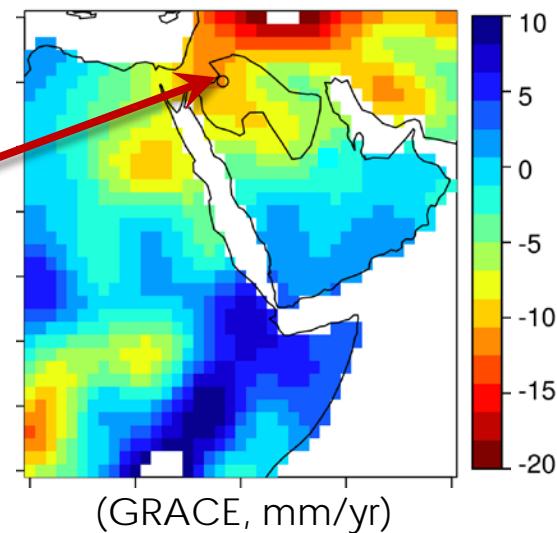
Landsats 4,5,7

Visible, near IR bands: vegetation amount
Thermal band: water use

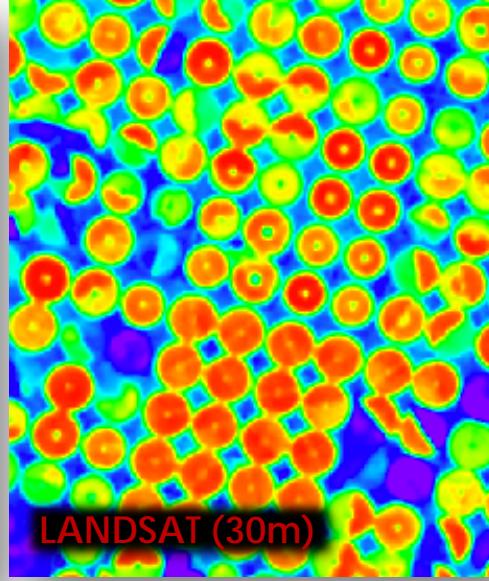
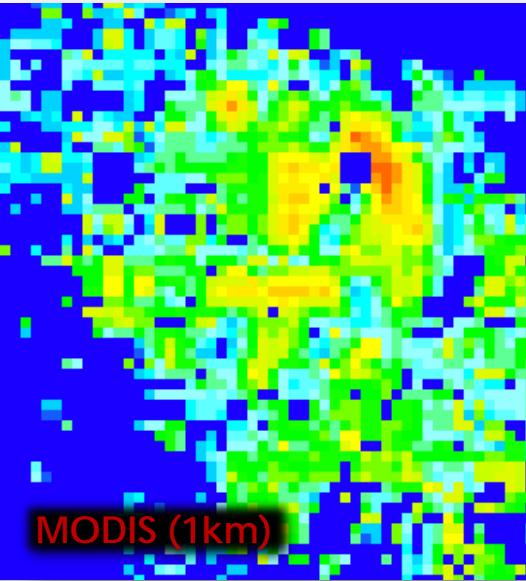
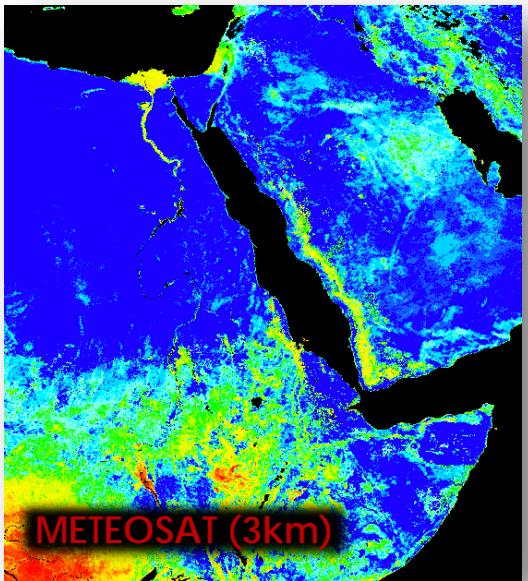
ALEXI ET – AL JOWF IRRIGATION SITE



GROUNDWATER DEPLETION TRENDS



MULTI-SCALE ET MAPPING (mm/day)



Water use by irrigation

"Constraint is often high quality weather information at the village scale – satellite data are the key to scaling up"

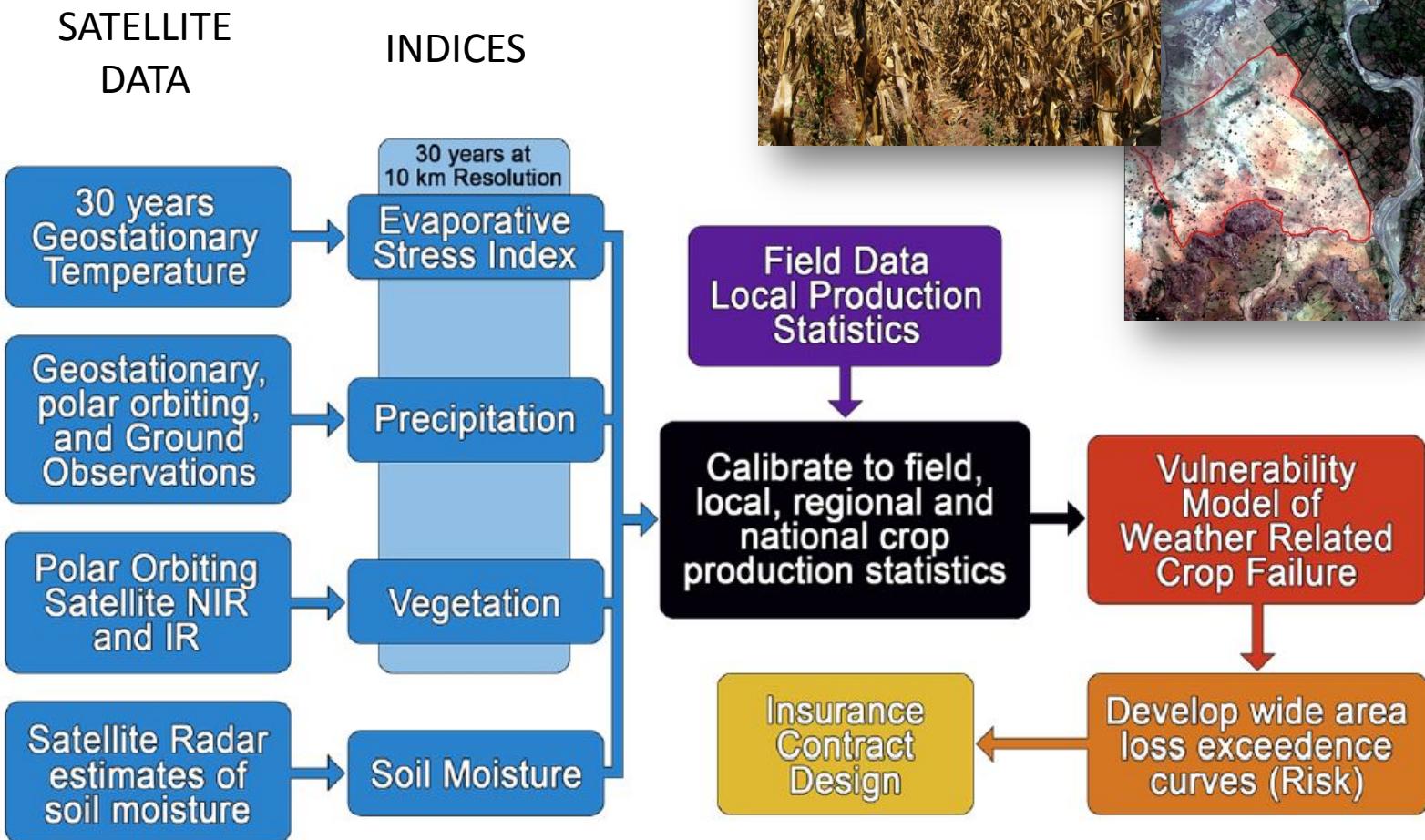
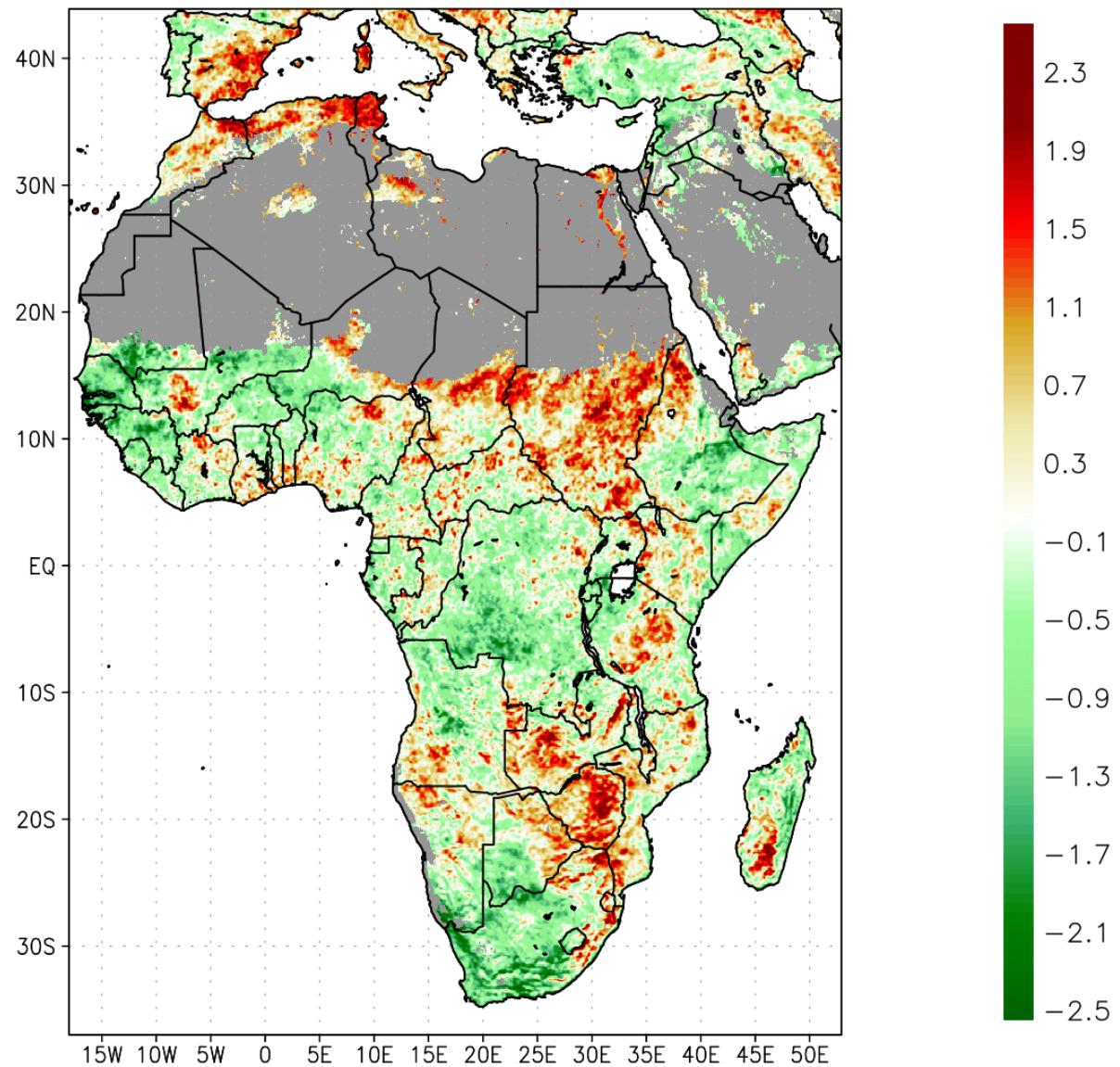


Figure 1. Summary of Data and Analysis for Index Insurance Project

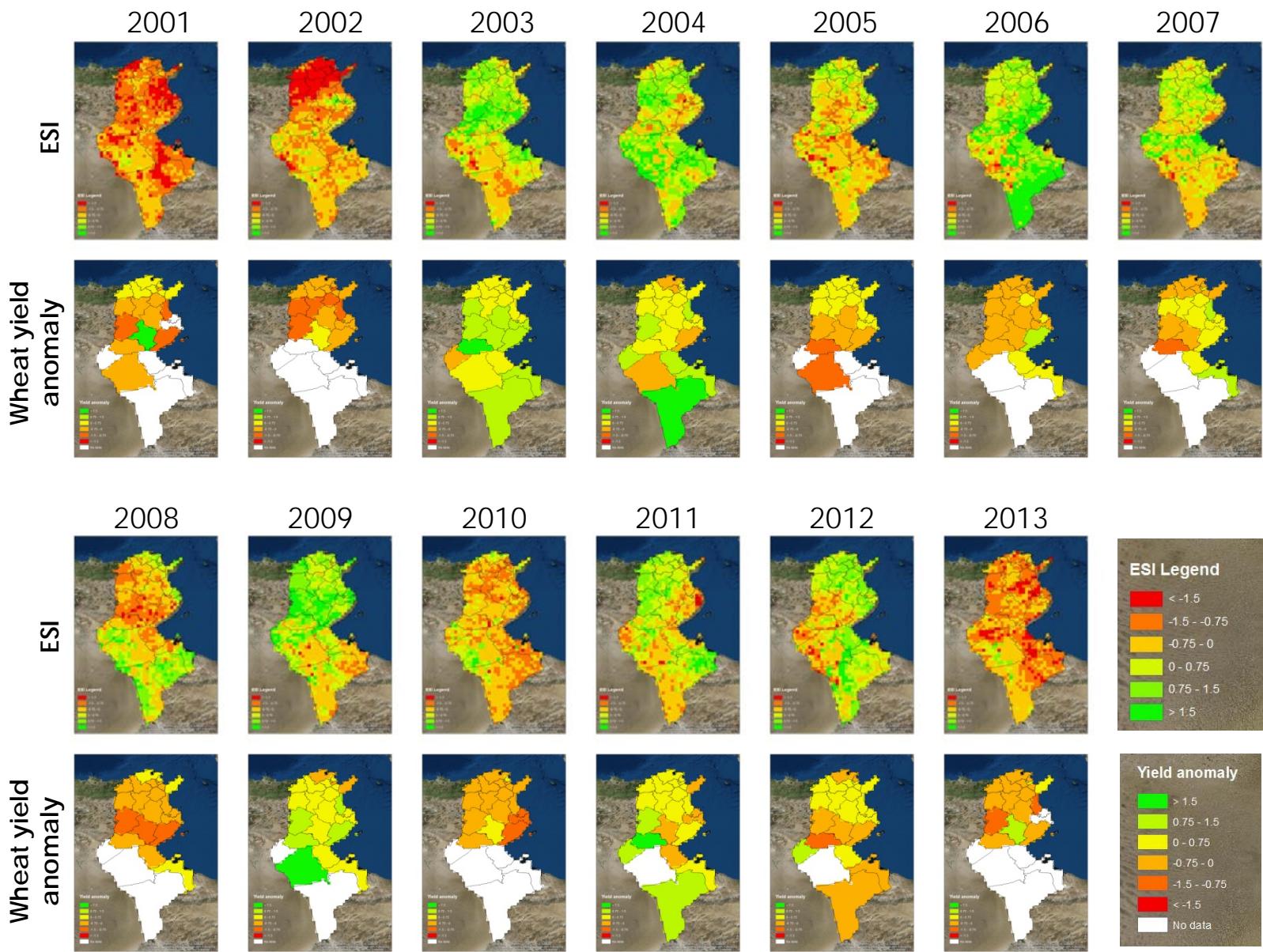
ALEXI DTRAD Anomaly: 12-week Composite 1983218

Index insurance in Sub-Saharan Africa

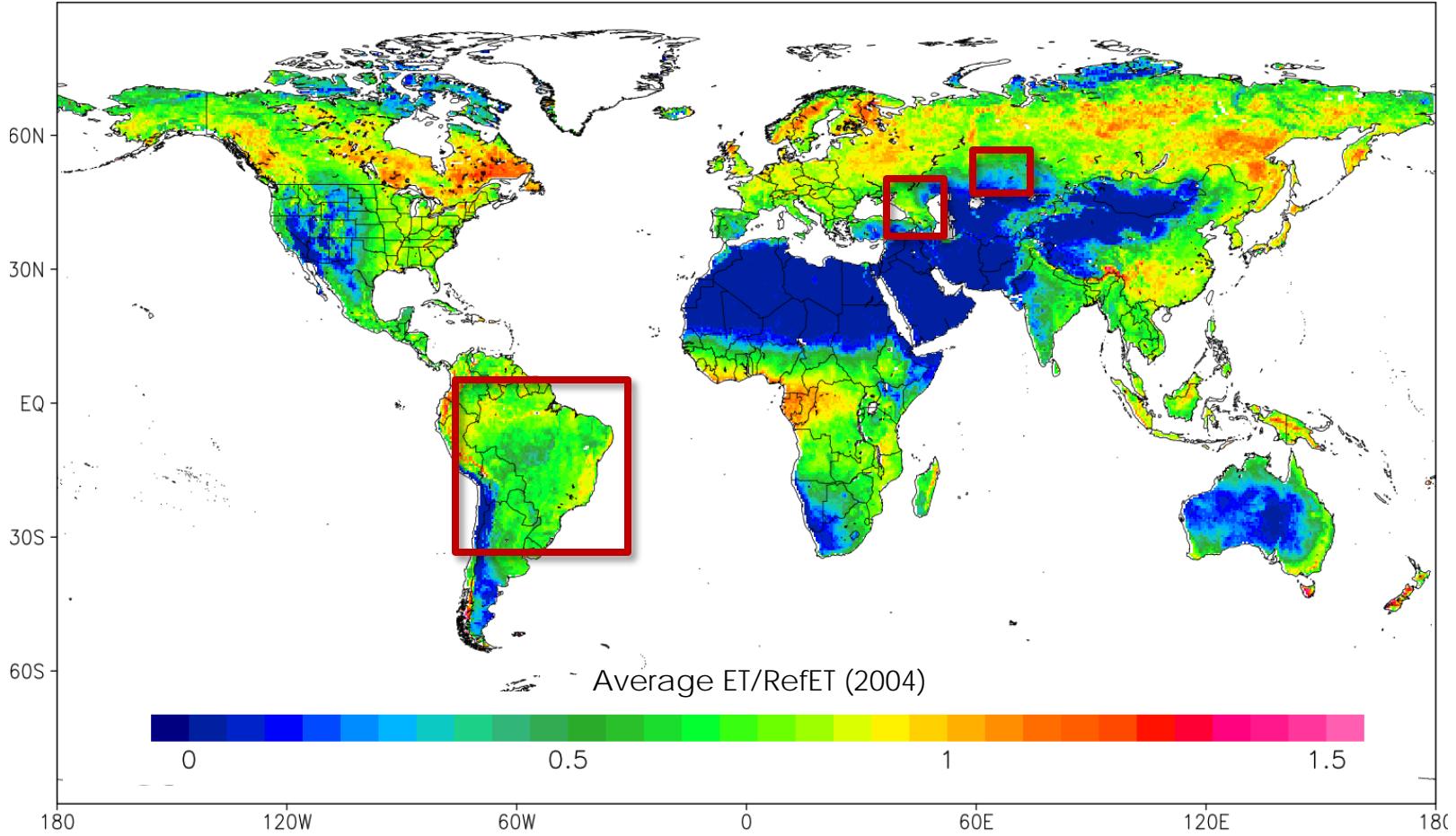


ALEXI 0.1° (~12 km) AFRICA Grid (710x810)

Yield estimation in Tunisia



Global basin water accounting

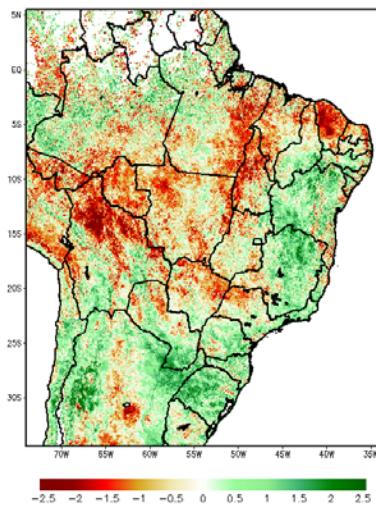


Global ESI Pilot Study Regions for USDA FAS (Brazil, Ukraine, Kazakhstan; 2000-2013)

11 August 2010

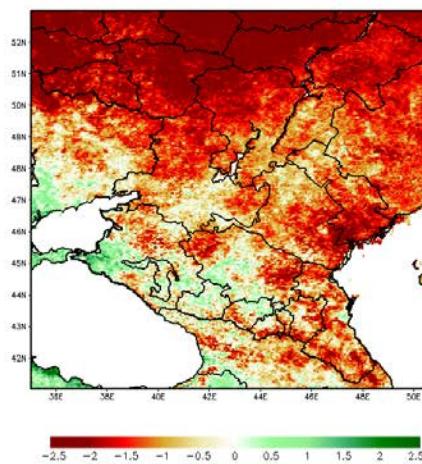
ALEXI Evaporative Stress Index

a) 4-week ESI composite



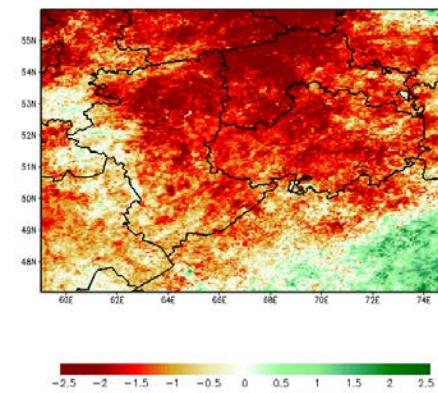
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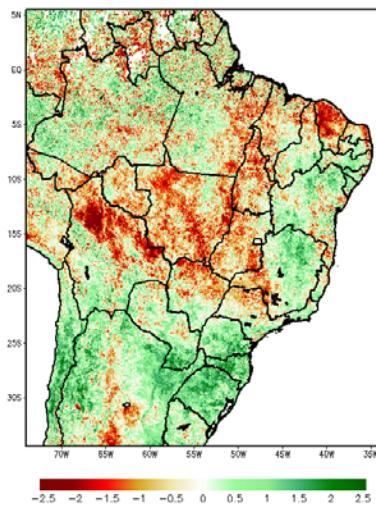


ALEXI Evaporative Stress Index

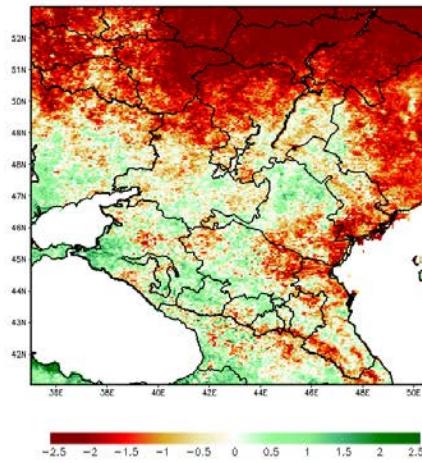
a) 4-week ESI composite



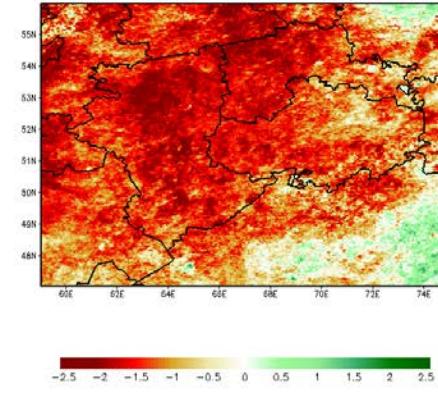
c) 12-week ESI composite



c) 12-week ESI composite



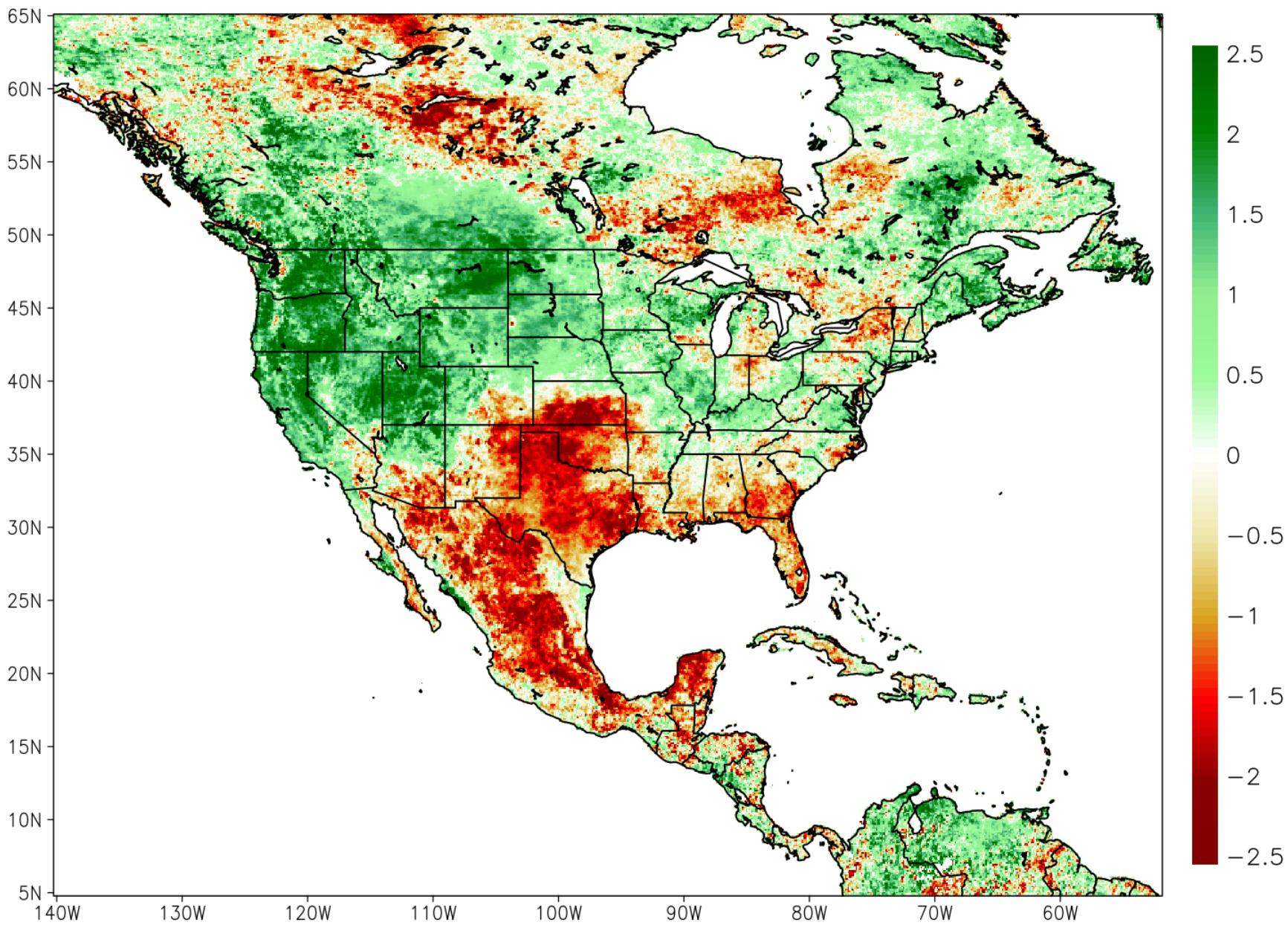
c) 12-week ESI composite



Global ESI Pilot Study Regions for USDA FAS (Brazil, Ukraine, Kazakhstan; 2000-2013)

ALEXI Evaporative Stress Index: 12-week Composite

Initialized : 5 August 2011



Questions ?

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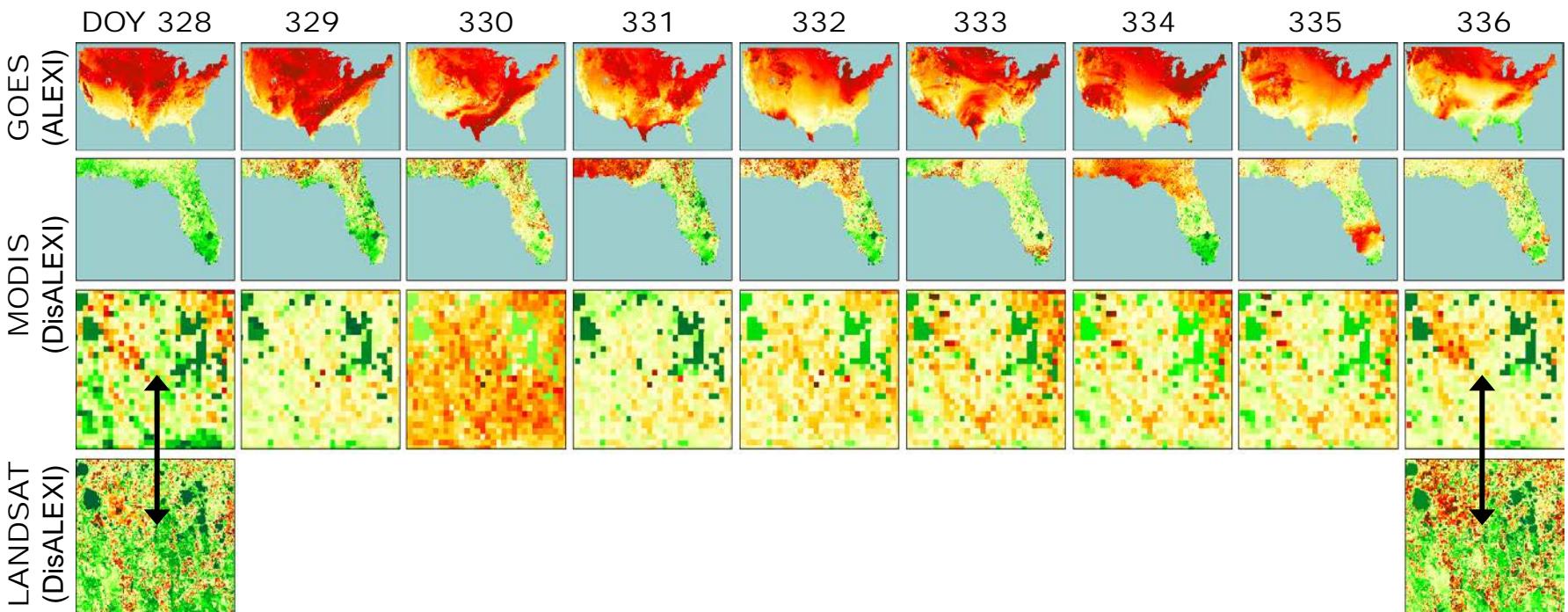
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Hydrology and Remote Sensing Laboratory
Beltsville, MD*

GOES/MODIS/Landsat FUSION

Daily Evapotranspiration – Orlando, FL, 2002



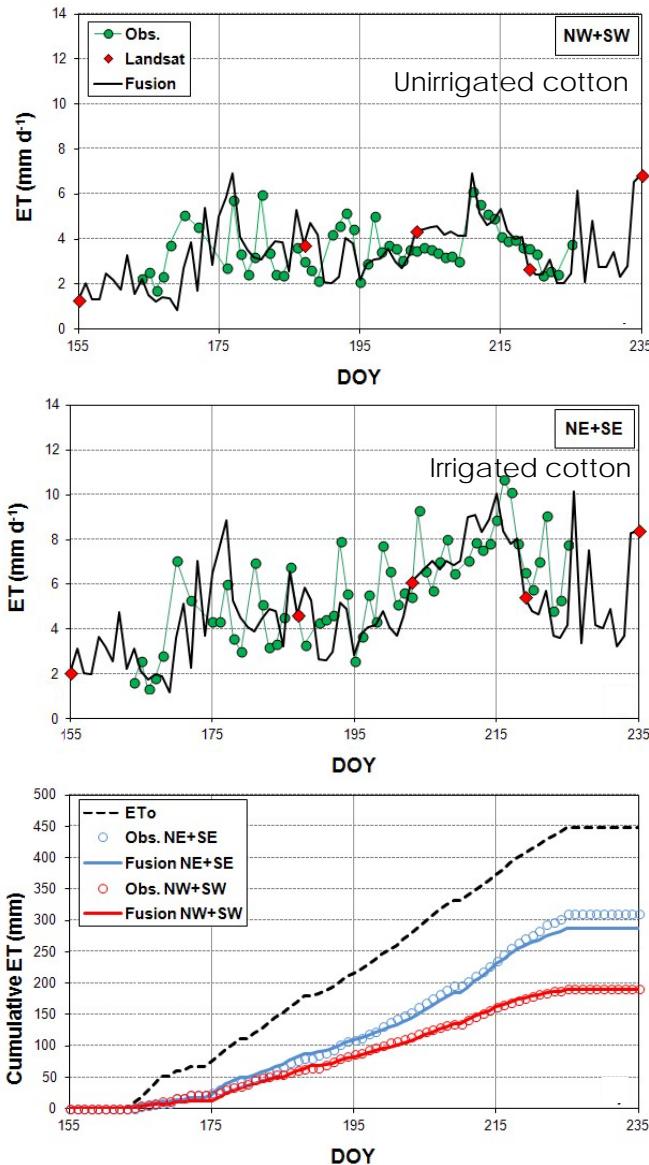
Landsat 5

Landsat 7

**Spatial Temporal Adaptive Reflectance Fusion Model
(STARFM) (Gao et al, 2006)**

Irrigated vs. rainfed crop water use

Bushland, TX



Mead, NE

