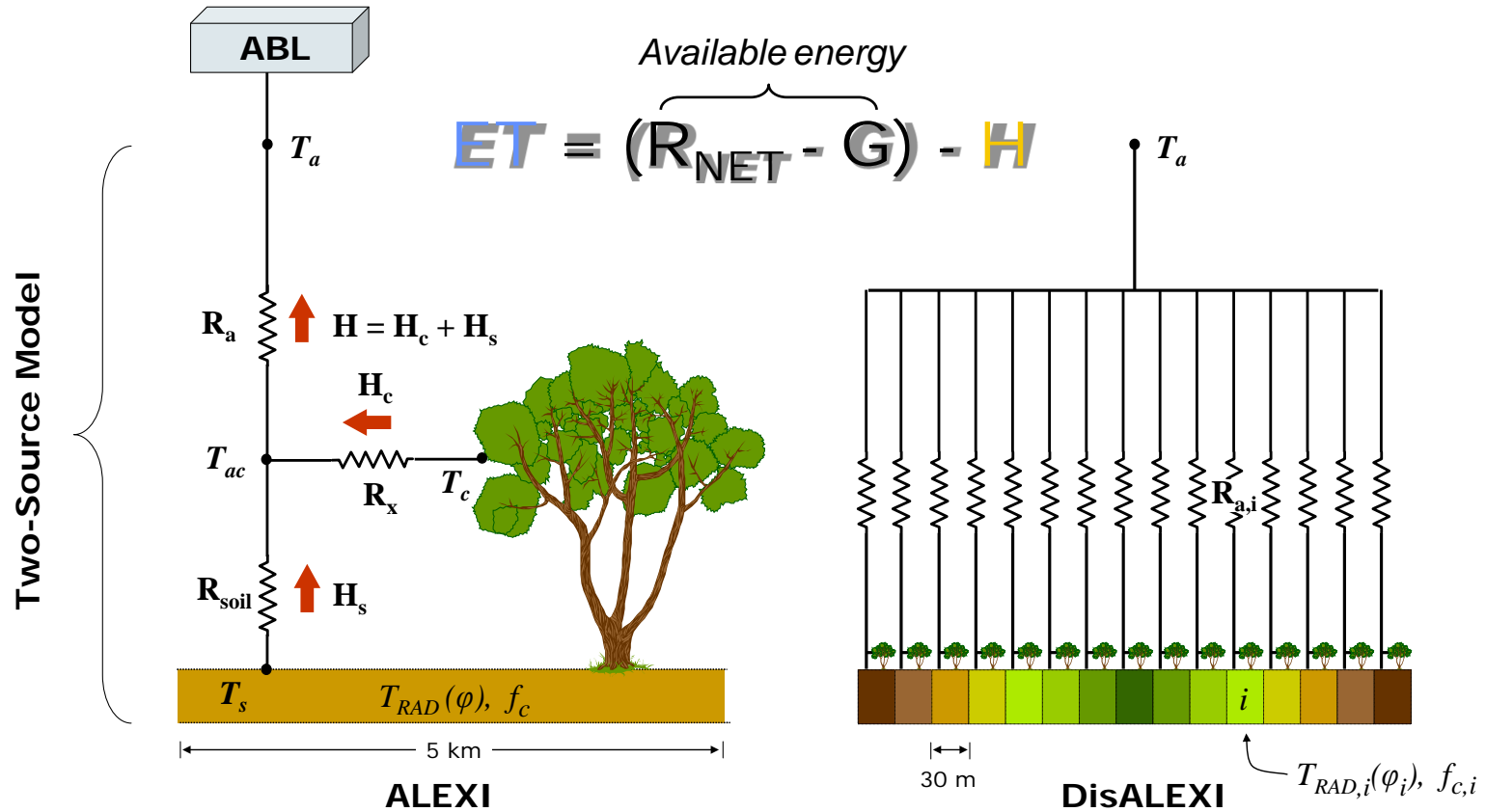




# High Spatiotemporal Resolution Maps of Evapotranspiration and Surface Moisture Availability

**M.C. Anderson, W.P. Kustas**  
*USDA-ARS, Hydrology and Remote Sensing Laboratory*

# Atmosphere-Land Exchange Inverse (ALEXI)



Regional scale

Surface temp:  $\Delta T_{RAD}$  - GOES  
 Air temp:  $T_a$  - ABL model

Landscape scale

$T_{RAD}$  - TM, MODIS, HypsIRI  
 $T_a$  - ALEXI

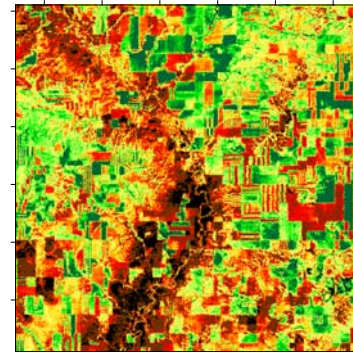
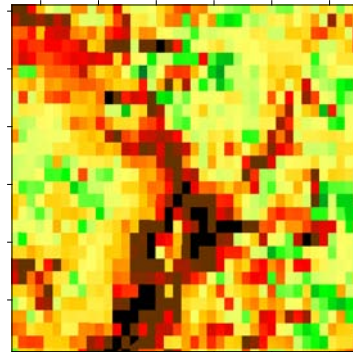
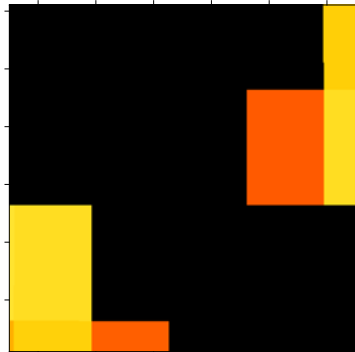
# FORT PECK, MONTANA

GOES (10km)

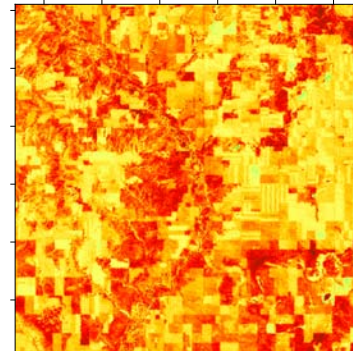
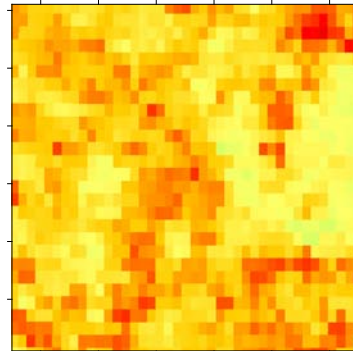
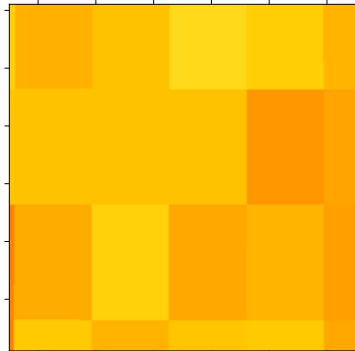
MODIS (1km)

Landsat (~100m)

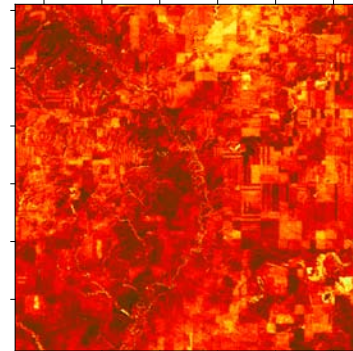
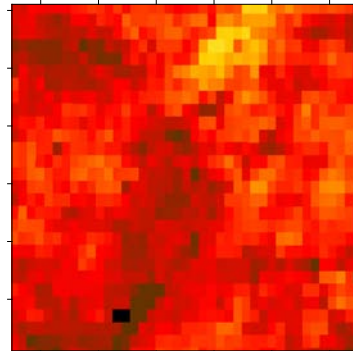
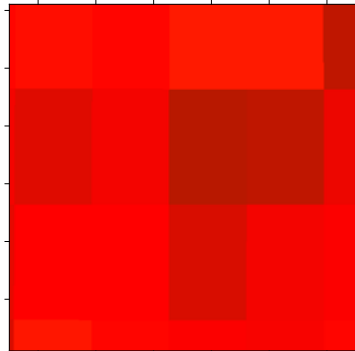
30 Jun 2002



18 Aug 2002



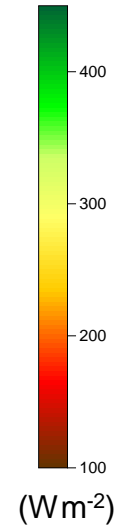
2 Sep 2002



(hourly)

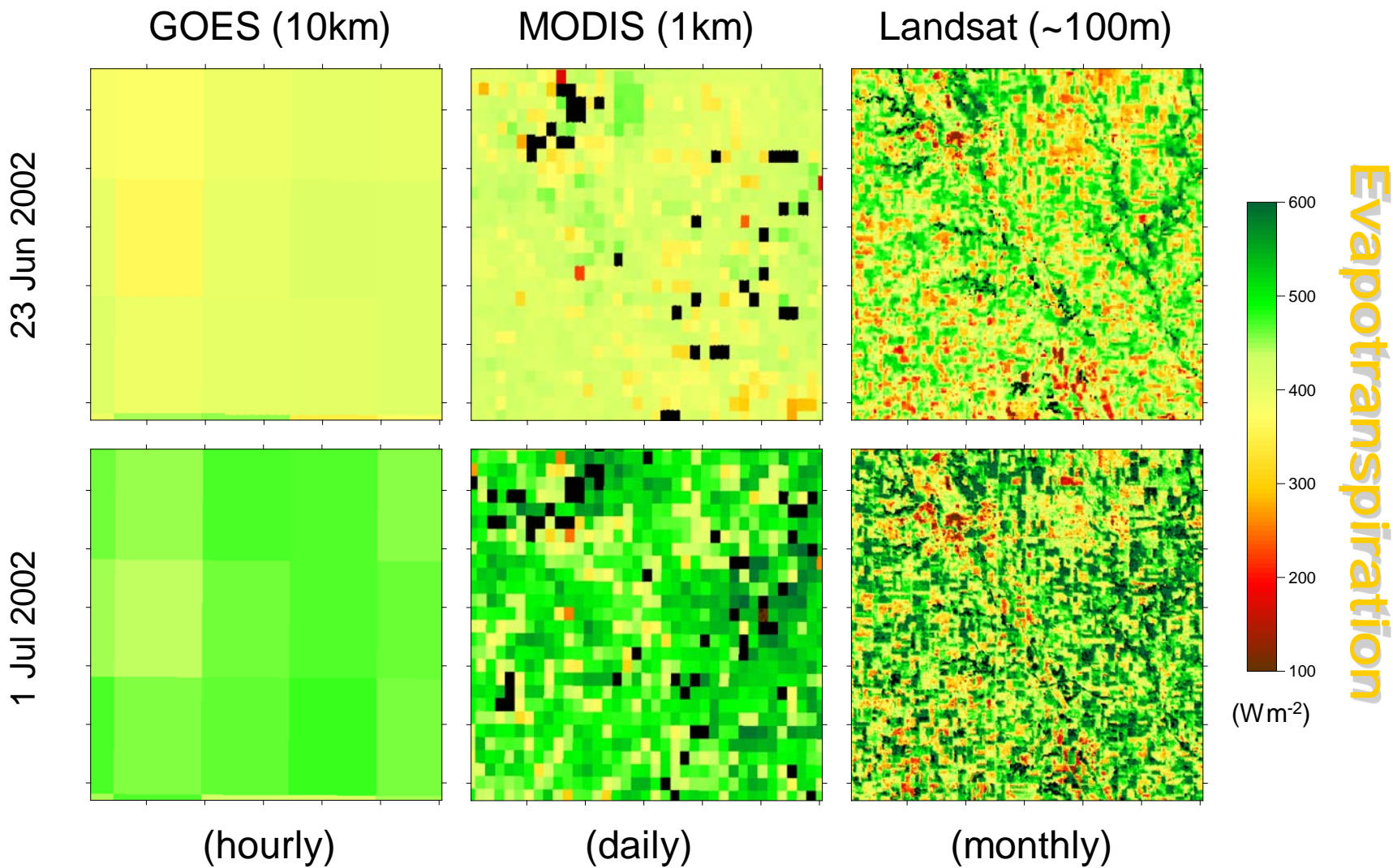
(daily)

(monthly)

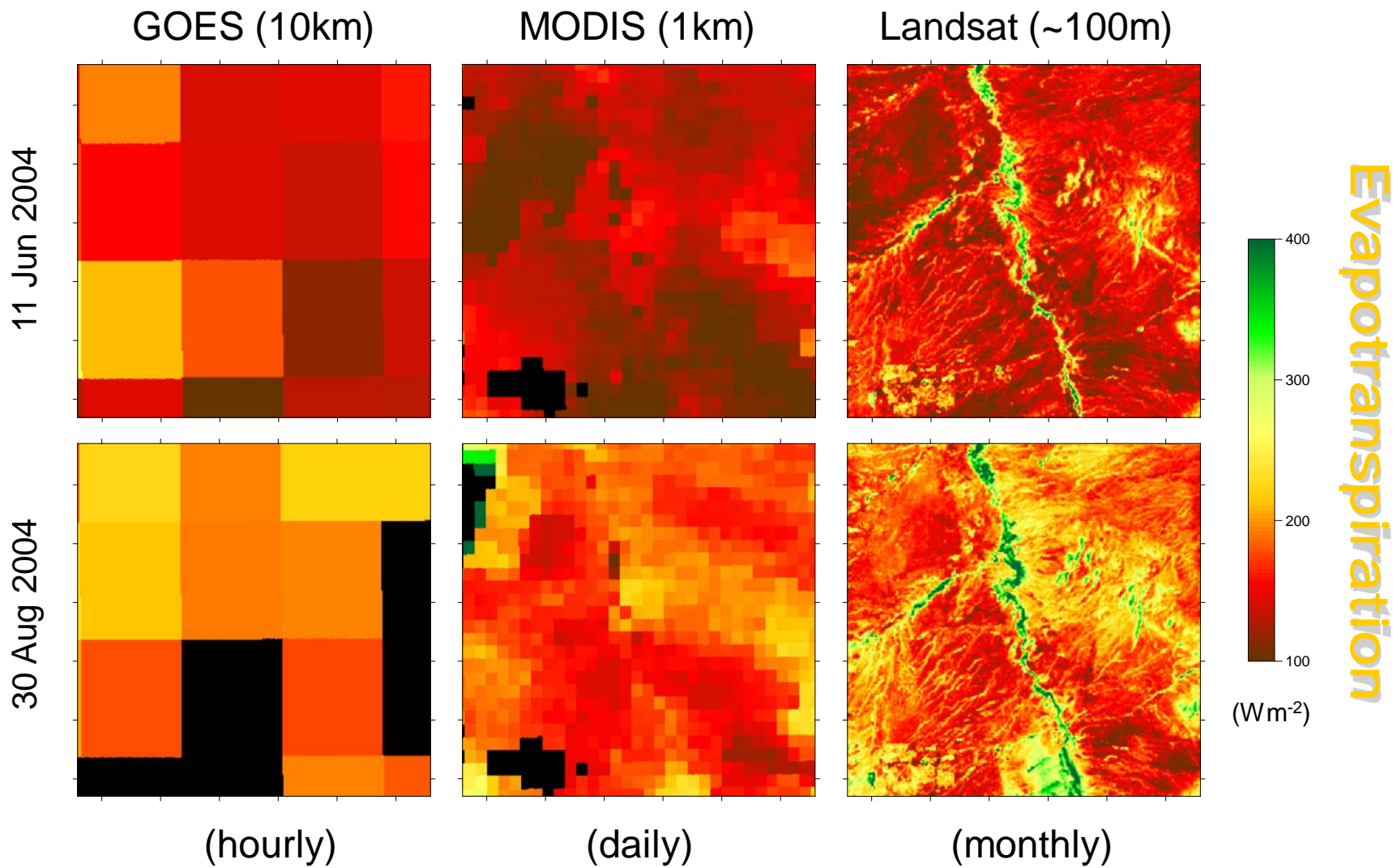


Evapotranspiration

# AMES, IOWA

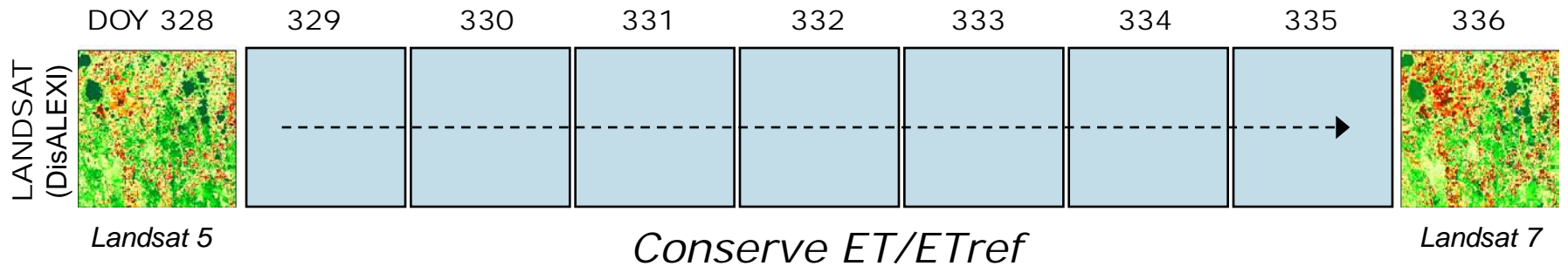


# SAN PEDRO RIVER, ARIZONA



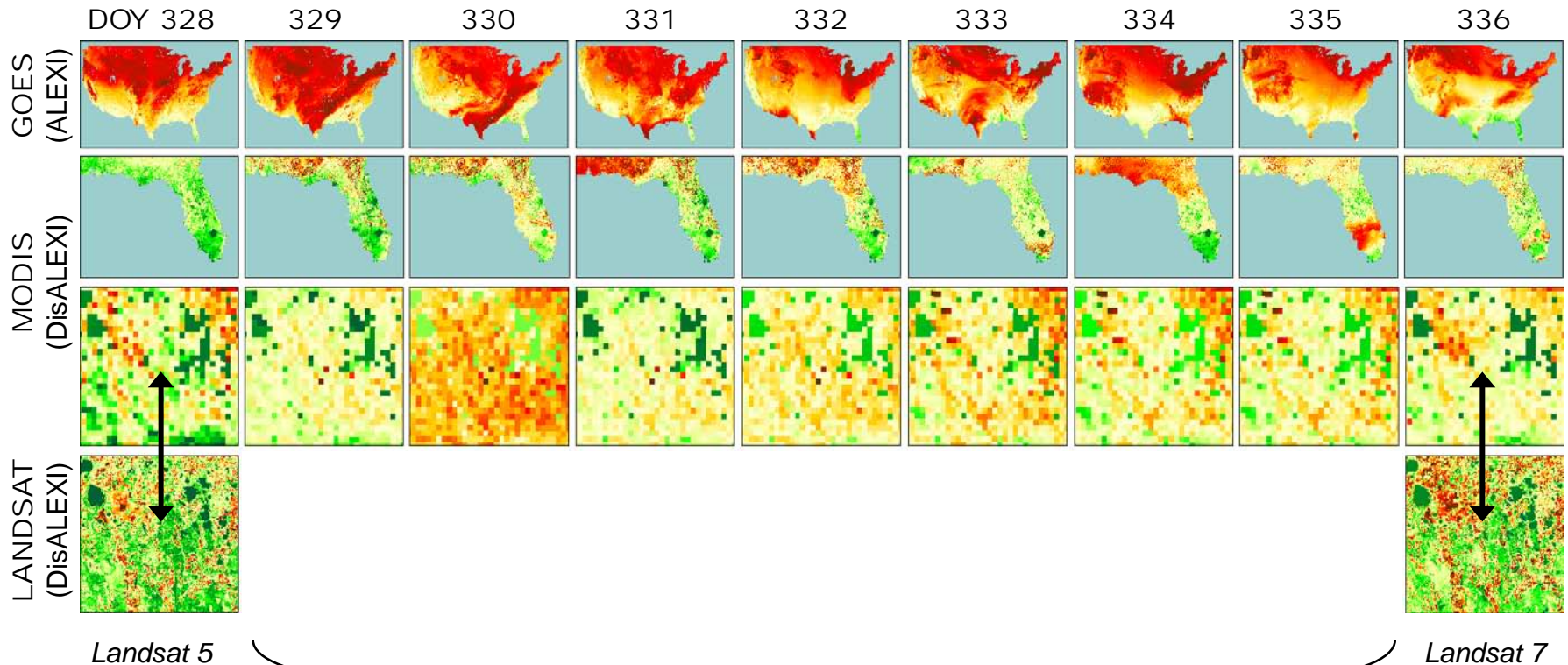
# HIGH-RESOLUTION INTERPOLATION

Daily Evapotranspiration - Reedy Lake, FL, 2002



# GOES/MODIS/Landsat FUSION

Daily Evapotranspiration - Reedy Lake, FL, 2002



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

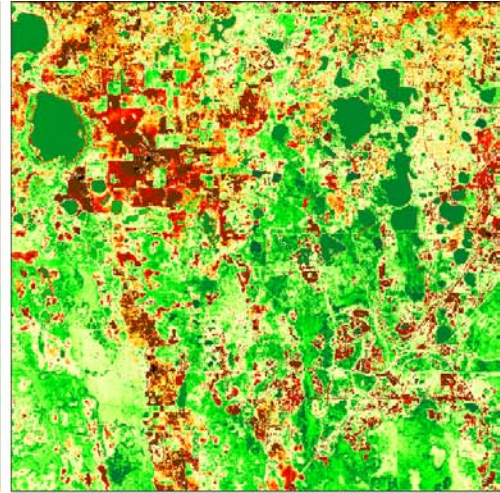
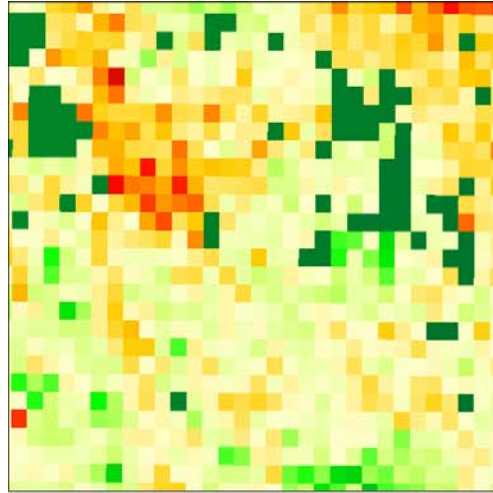
# EVALUATION OF PREDICTED FIELDS

MODIS  
(DisALEXI)

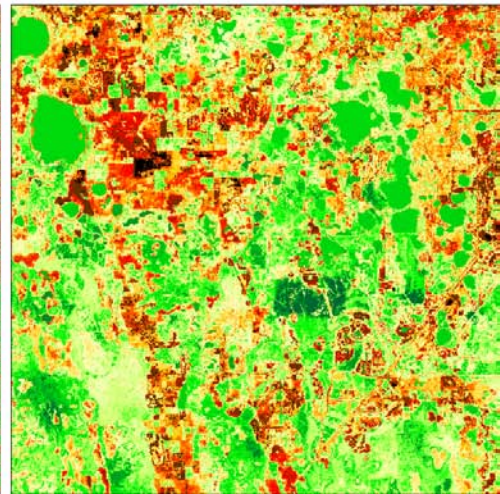
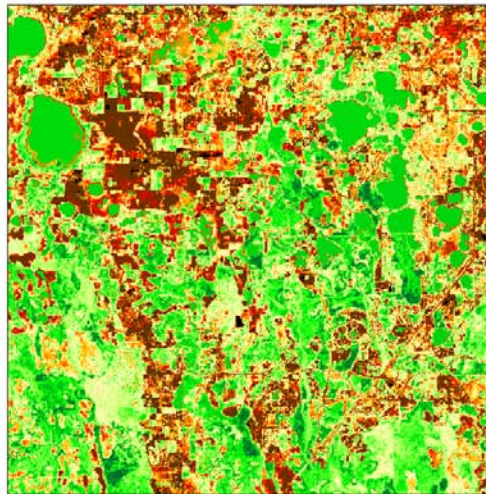
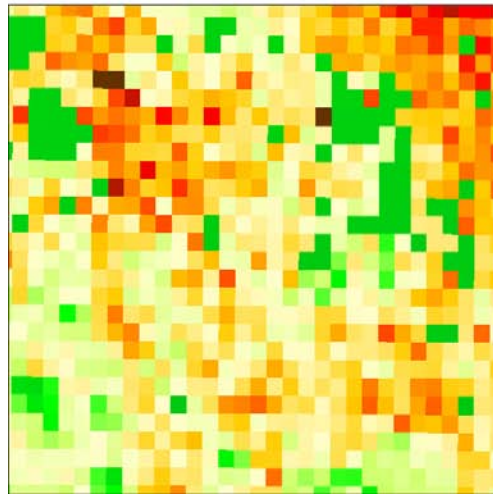
Landsat  
(DisALEXI)

Landsat  
(STARFM)

DOY 2002328



DOY 2003019



*Observed*

*Predicted*



# APPLICATIONS

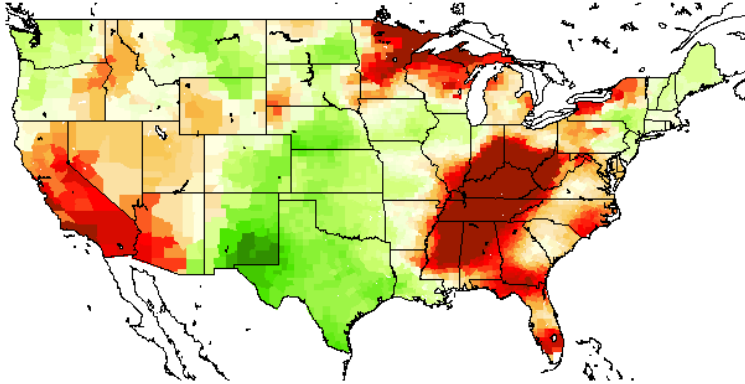
... monitoring ecosystem health

**Anomalies in  $\frac{AET}{PET}$**

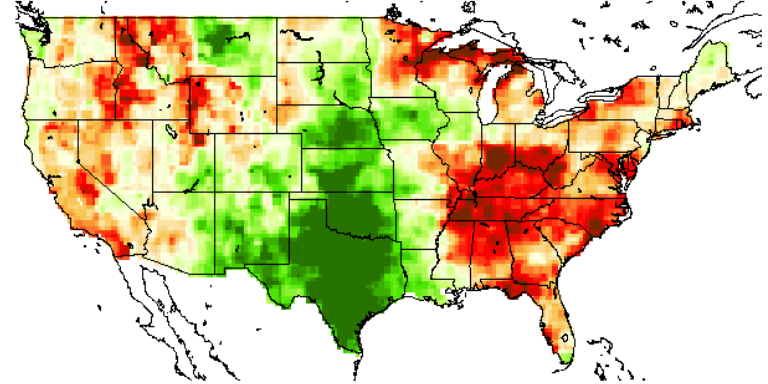
**Evaporative Stress Index**

# 2007 GROWING SEASON ANOMALIES

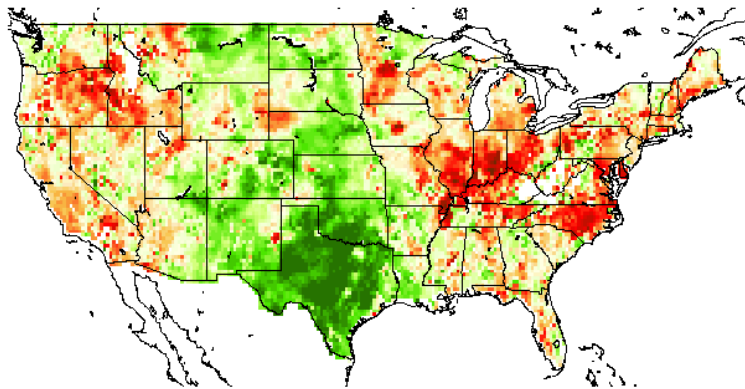
US DROUGHT MONITOR



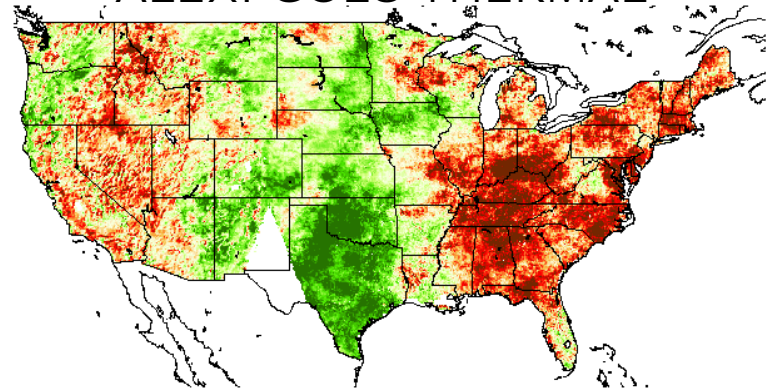
LIS - NOAH



USDA AMSR-E MICROWAVE



ALEXI GOES THERMAL



- samples 5cm layer
- 50km pixels (AMSR)
- ~2-day coverage
- light vegetation cover

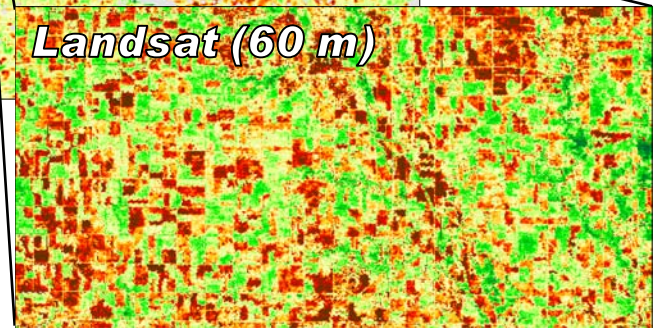
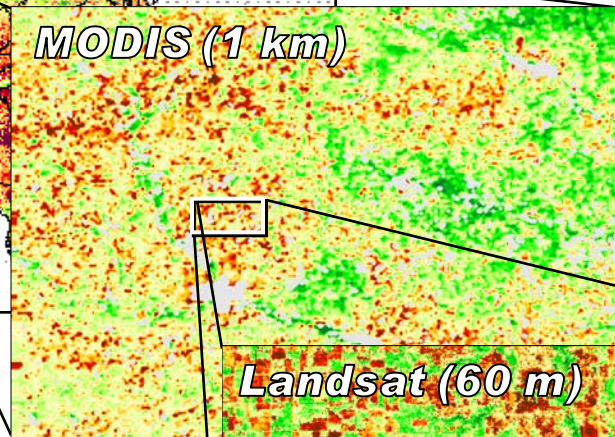
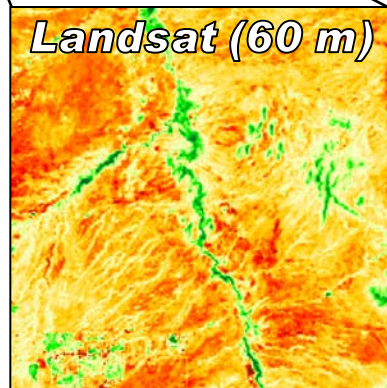
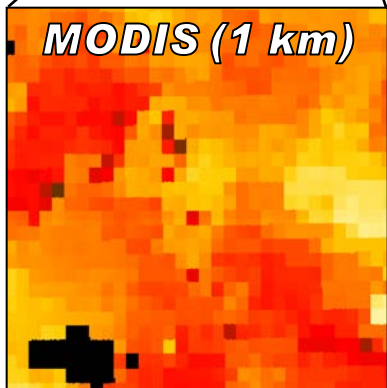
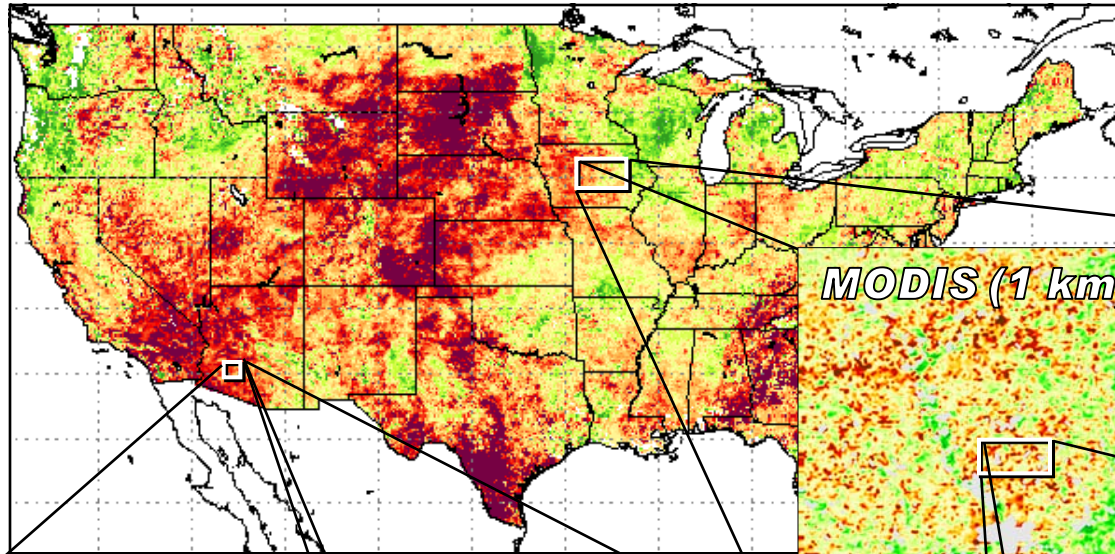
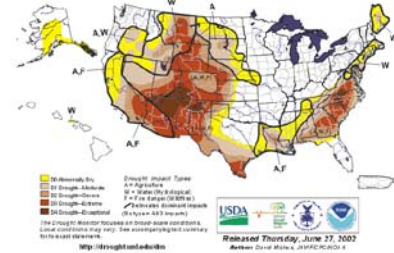
- samples ~1-2m layer
- 60m - 5km pixels (L7, GOES)
- ~15-day coverage (90%)
- low to high vegetation cover

# Multi-scale Drought Monitoring

**GOES Evaporative Stress Index**

**JUNE 2002**

U.S. Drought Monitor June 25, 2002



A satellite-style map of North America, showing the United States, Canada, and Mexico. The map is overlaid with a grid of green lines representing state or provincial boundaries. A red rectangular box is drawn over the central part of the United States, specifically covering the Great Plains and Great Lakes regions. The text is overlaid on this map.

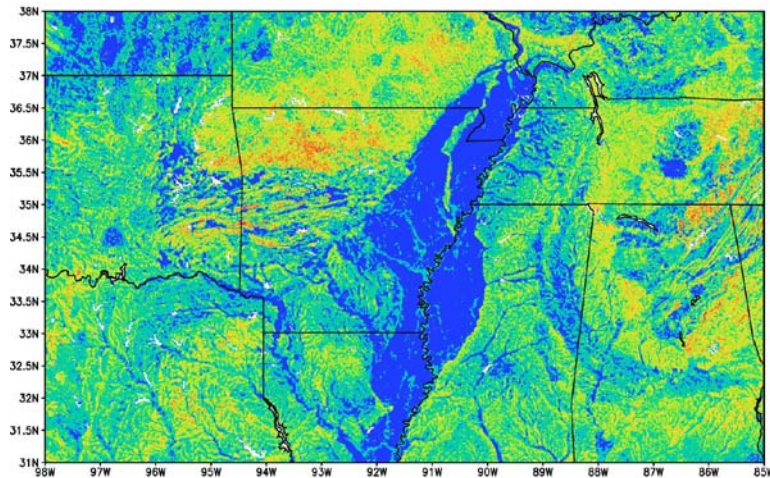
## APPLICATIONS

... monitoring moisture availability

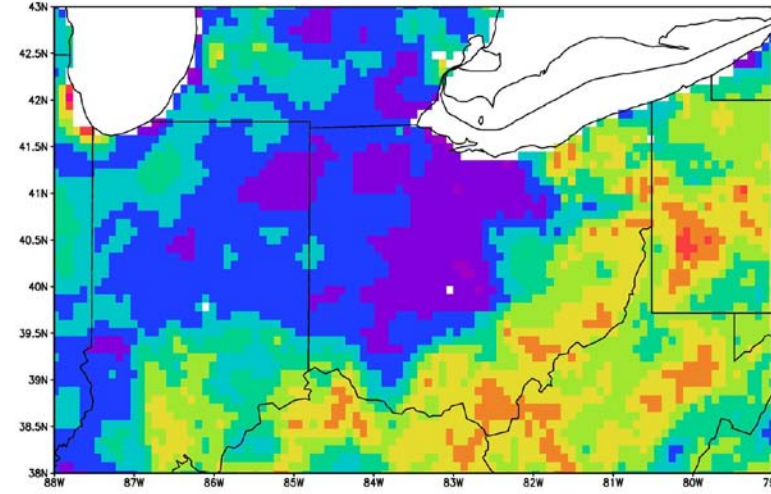
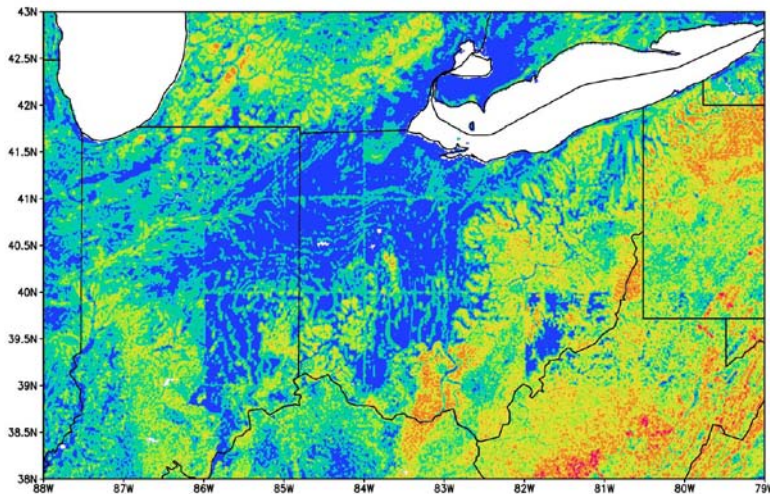
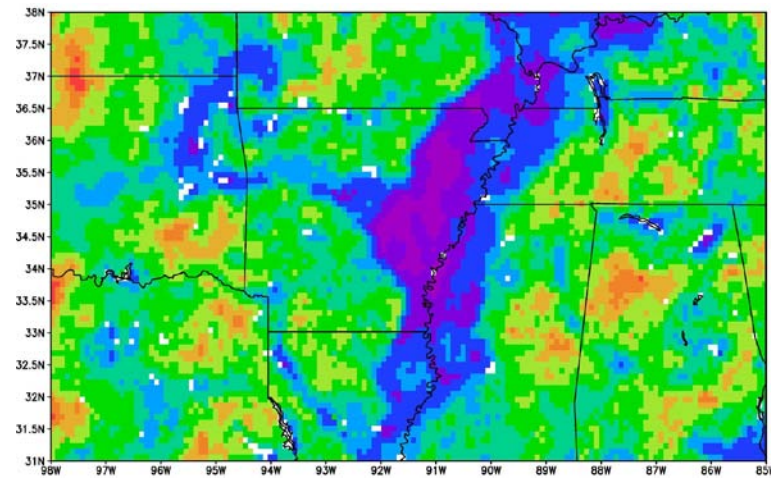
**Variability in  $\frac{AET}{PET}$**

# Sensitivity to shallow water tables

Simulated climatological water table\*



Temporal variability in ET/PET



shallow  deep

low  high

\* Miguez-Macho et al, BAMS, 90, 663-672

# Groundwater Dependent Ecosystems (GDE)

## Services:

- Rich in biodiversity, especially in semiarid climates
- Habitat for birds, amphibians, endemic fish

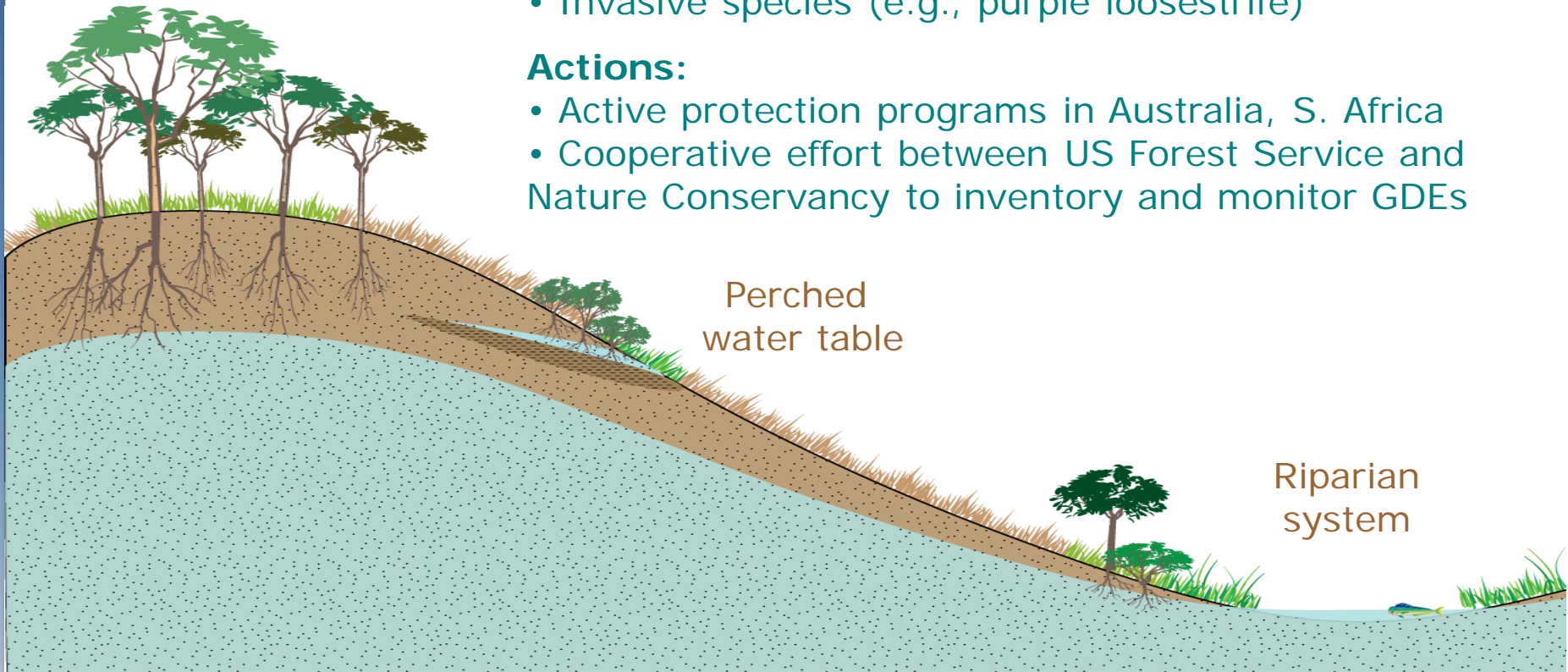
## Threats:

- Declining water tables due to over-extraction and climate change
- Invasive species (e.g., purple loosestrife)

## Actions:

- Active protection programs in Australia, S. Africa
- Cooperative effort between US Forest Service and Nature Conservancy to inventory and monitor GDEs

Phreatophytic  
community

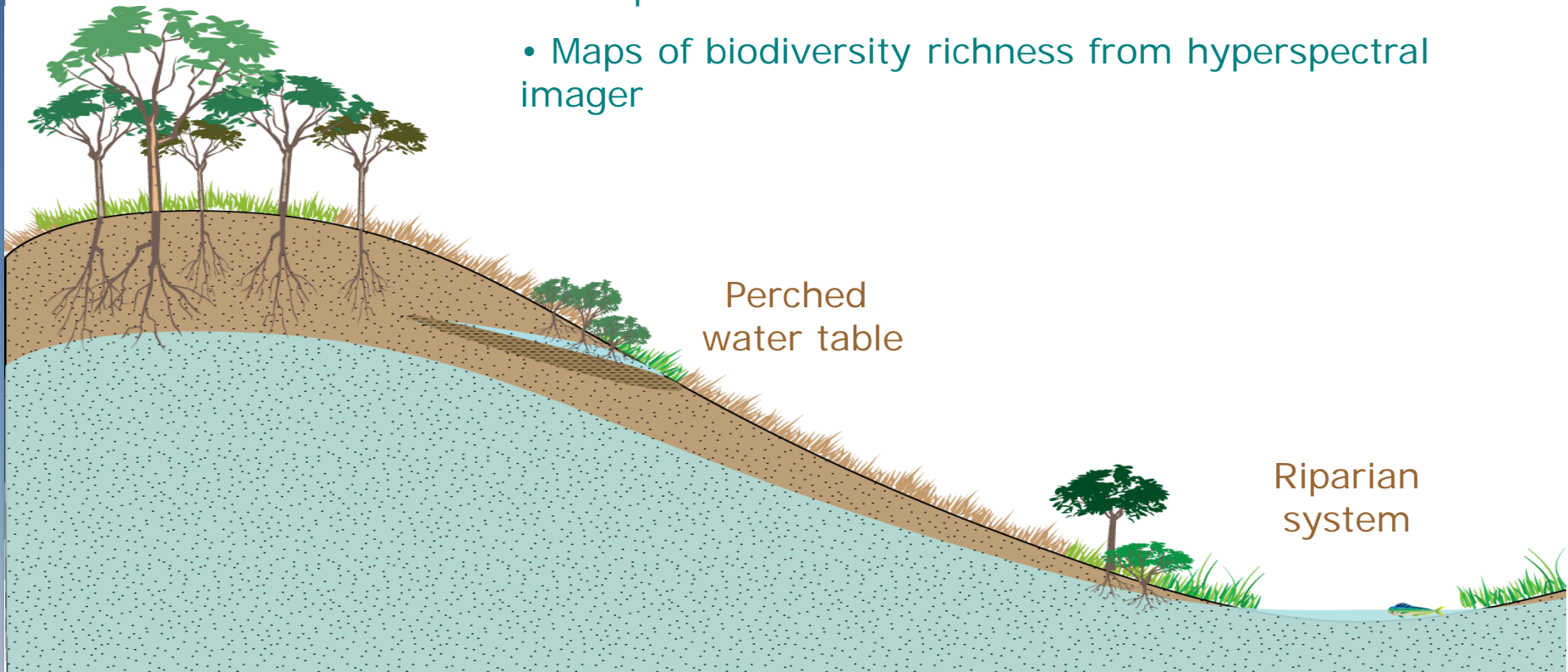


# Groundwater Dependent Ecosystems (GDE)

## HyspIRI data layers for GDE identification:

- High resolution maps of temporal variability in ET/PET from TIR imager
  - indicator of non-precipitation related moisture inputs
- Maps of biodiversity richness from hyperspectral imager

Phreatophytic  
community



# PRODUCTS

- *60m maps of daily ET*  
... *monitoring water use*
- *60m maps of daily ET/PET*  
... *monitoring moisture availability*

**HYSPIRI WILL ADD VALUE  
TO EXISTING TIR PRODUCTS**

Martha.Anderson@ars.usda.gov