



## HyspIRI TQ3: Water Use and Availability

**M.C. Anderson**

*USDA-ARS, Hydrology and Remote Sensing  
Laboratory*

**R.G. Allen**

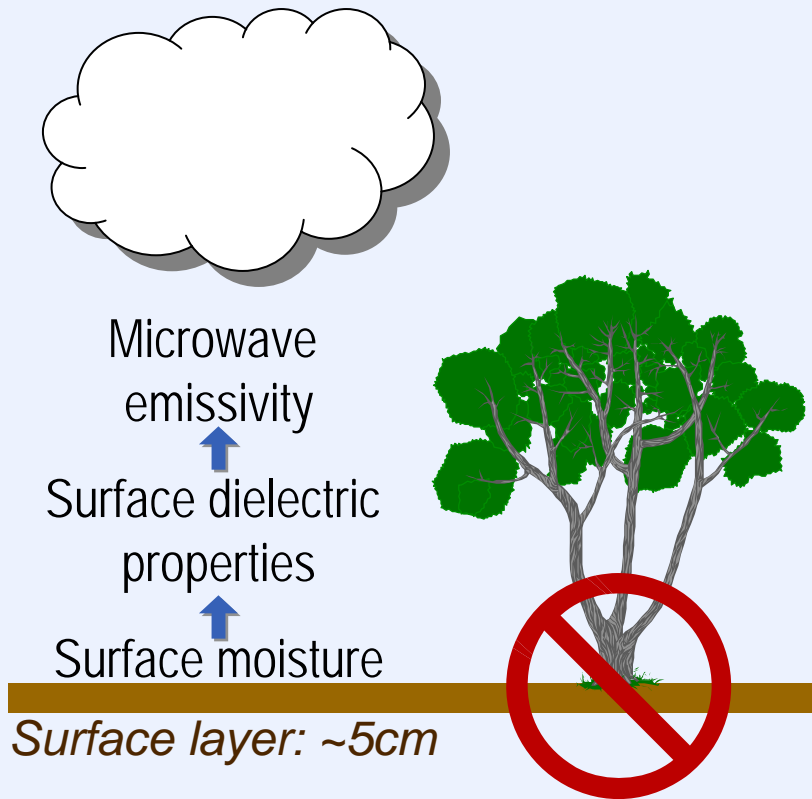
*University of Idaho - Kimberly*

## TQ3: Water Use and Availability

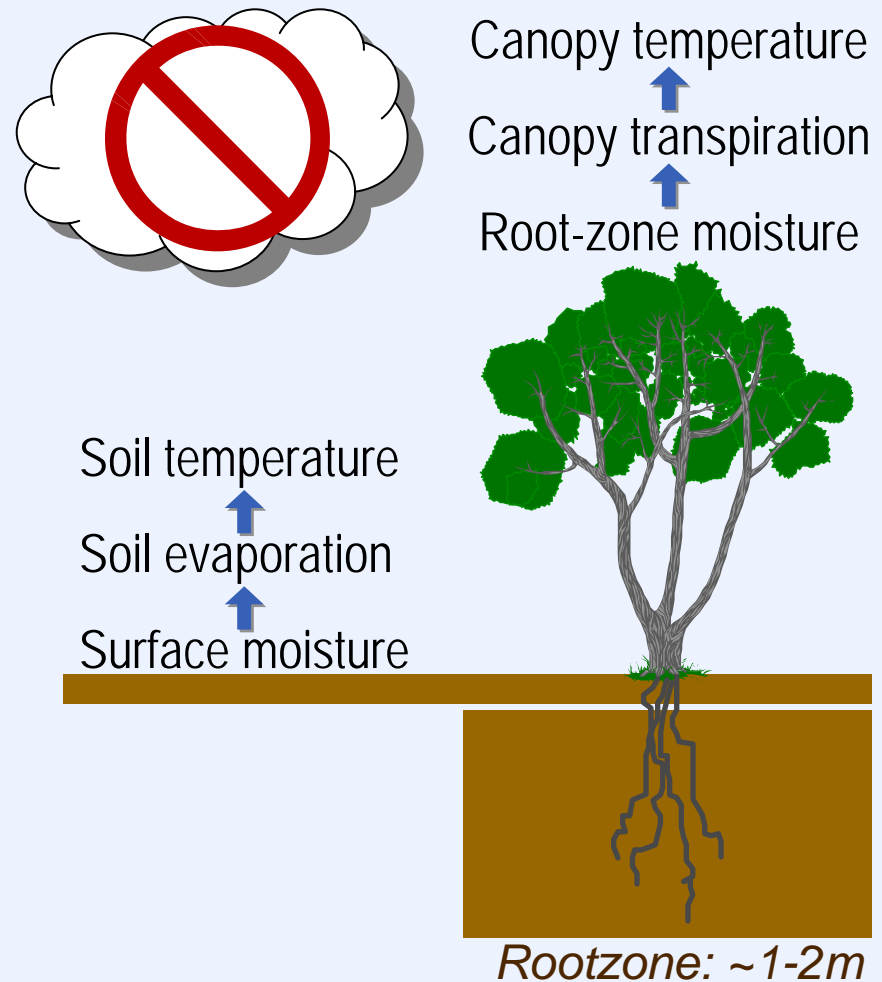
- *Response to climate change:*  
How is climate change impacting the evaporative component of the global water cycle over natural and managed landscapes?
- *Water management:*  
How can information about evapotranspiration and its relationship to land-use/landcover be used to facilitate better water management?
- *Drought:*  
How can we improve early detection, mitigation, and impact assessment of droughts at local to global scales?
- *Irrigated area:*  
What is the current global irrigated acreage, how is it changing with time, and are these changes in a sustainable balance with regional water availability?
- *Water use in food production:*  
Can we increase food production in water-scarce agricultural regions while improving or sustaining environmental access to water?

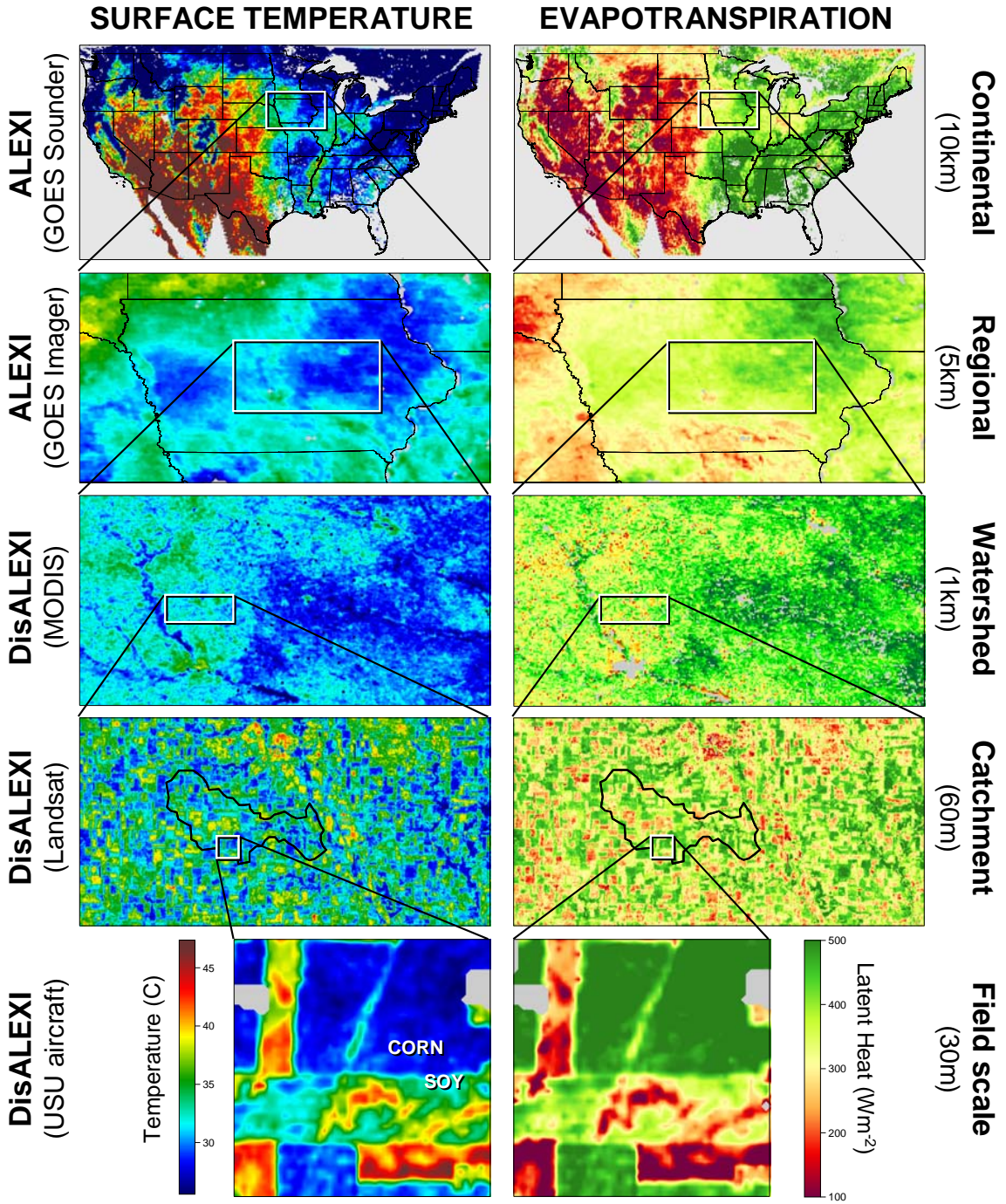
# Remote Sensing of Surface Moisture

## *MICROWAVE* (10-50 km resolution)



## *THERMAL* (60m - 10km resolution)





1 July 2002 – 10:30AM CST

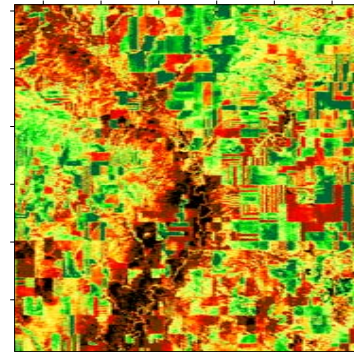
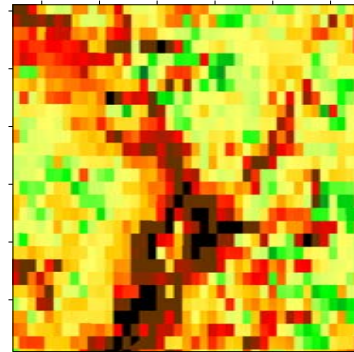
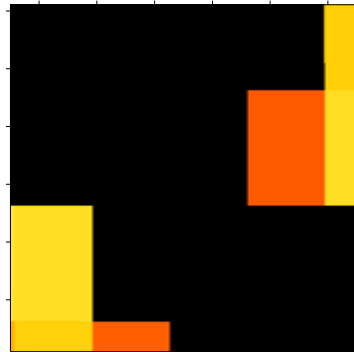
## TQ3: Water Use and Availability

- *Response to climate change:*  
How is climate change impacting the evaporative component of the global water cycle over natural and managed landscapes?
- *Water management:*  
How can information about evapotranspiration and its relationship to land-use/landcover be used to facilitate better water management?
- *Drought:*  
How can we improve early detection, mitigation, and impact assessment of droughts at local to global scales?
- *Irrigated area:*  
What is the current global irrigated acreage, how is it changing with time, and are these changes in a sustainable balance with regional water availability?
- *Water use in food production:*  
Can we increase food production in water-scarce agricultural regions while improving or sustaining environmental access to water?

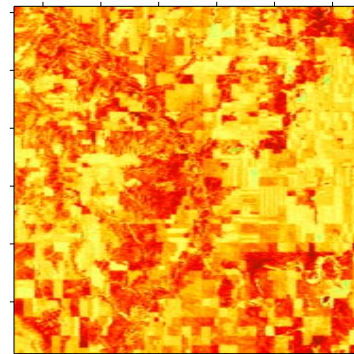
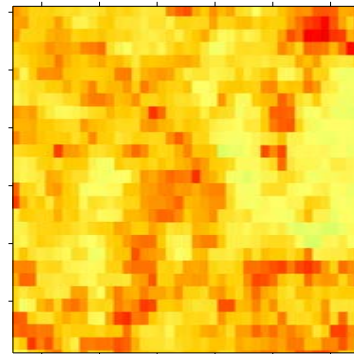
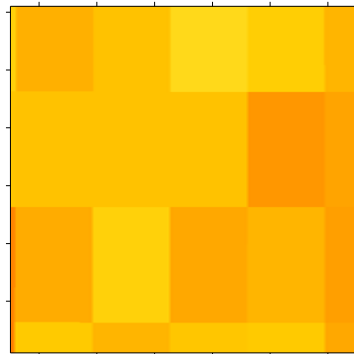
# FORT PECK, MONTANA

GOES (10km)    MODIS (1km)    Landsat (~100m)

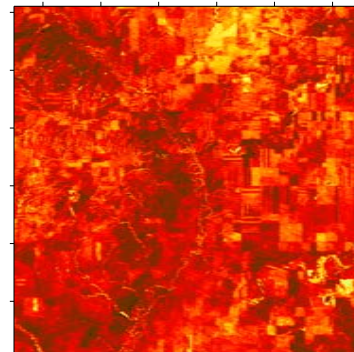
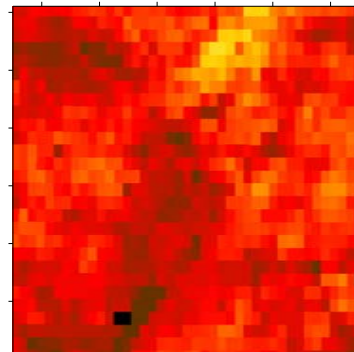
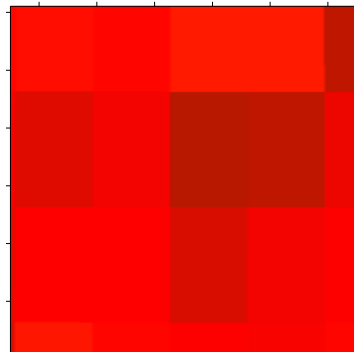
30 Jun 2002



18 Aug 2002



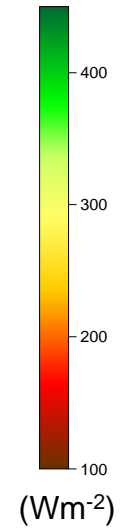
2 Sep 2002



(hourly)

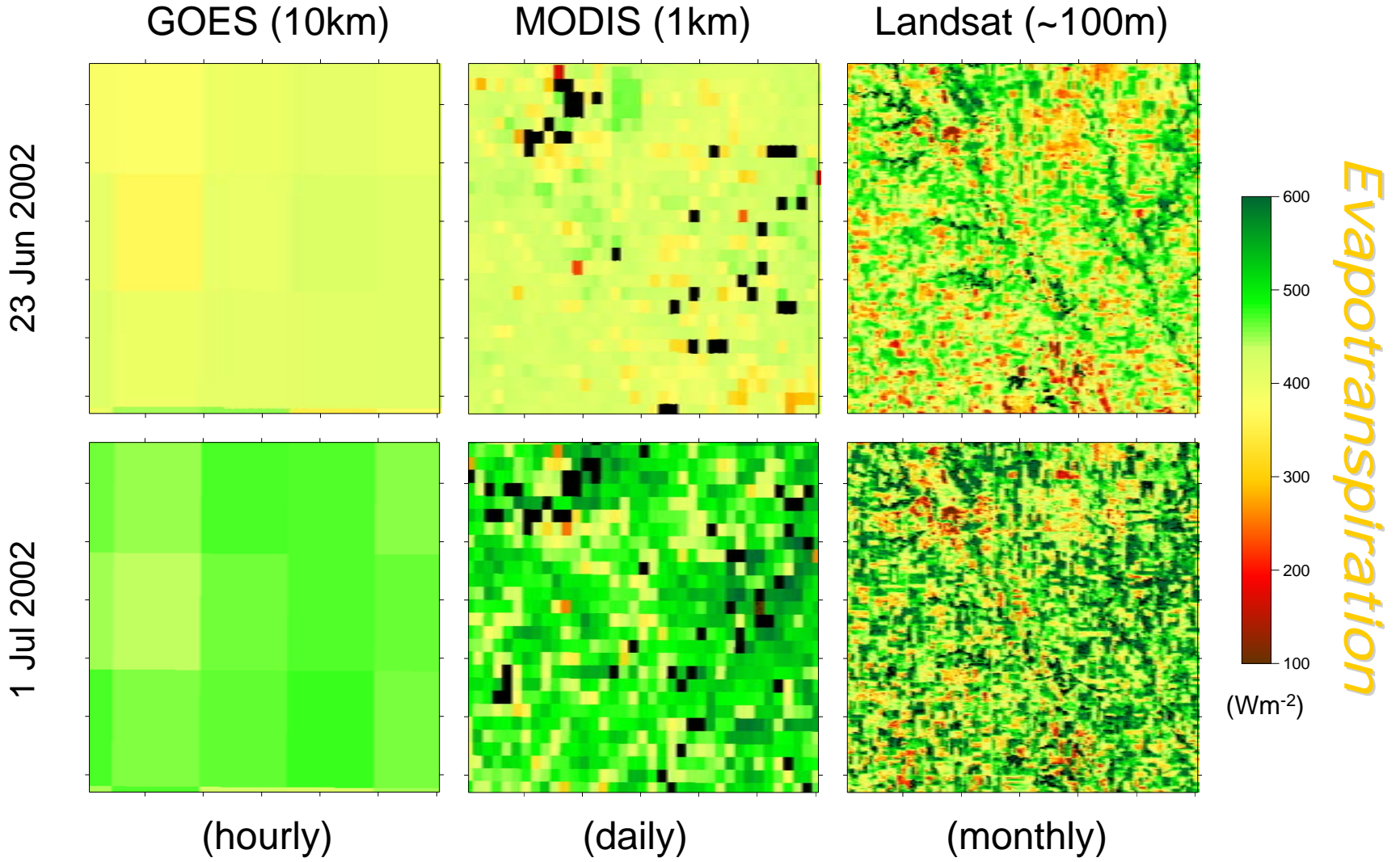
(daily)

(monthly)

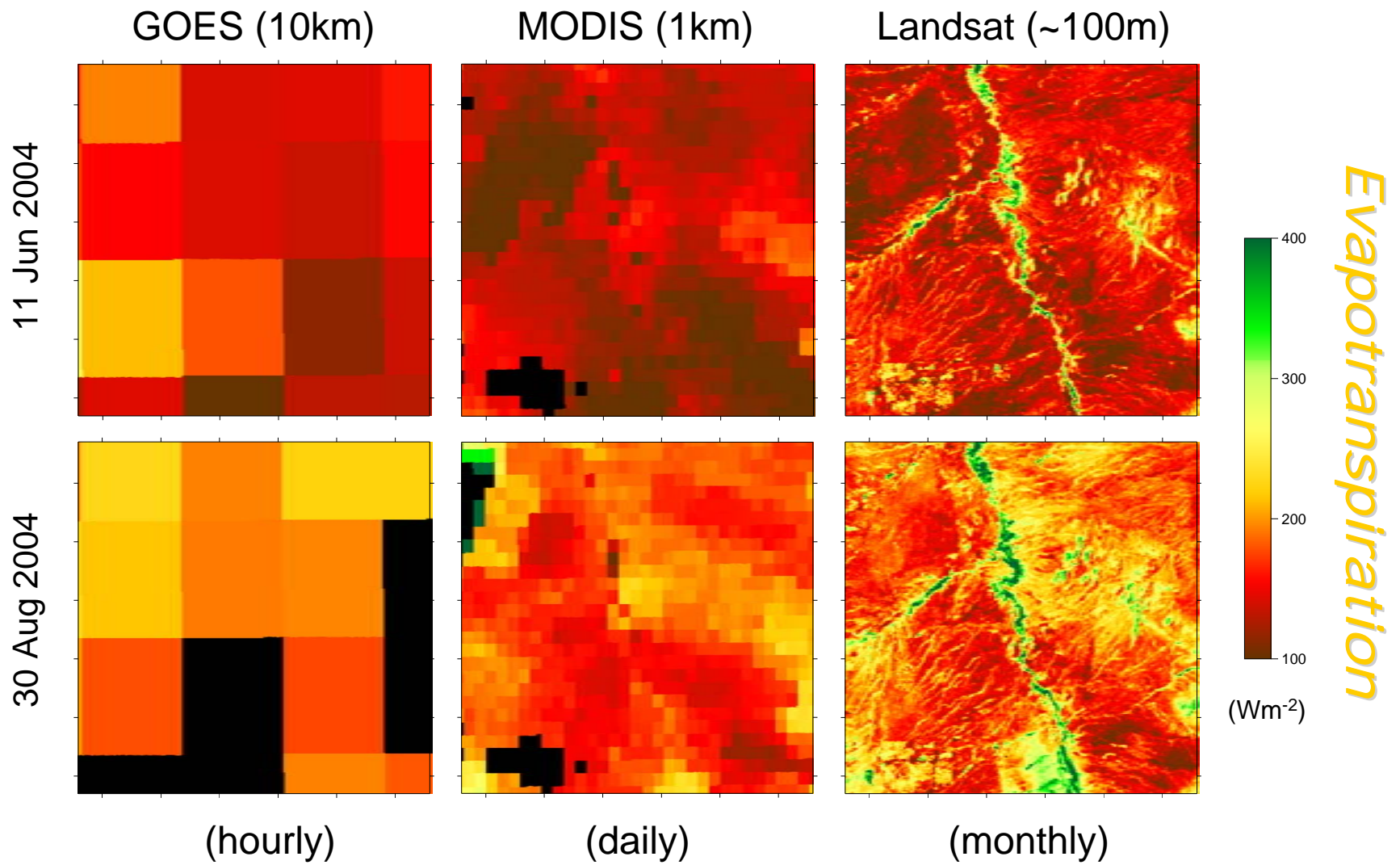


Evapotranspiration

# AMES, IOWA



# *SAN PEDRO RIVER, ARIZONA*



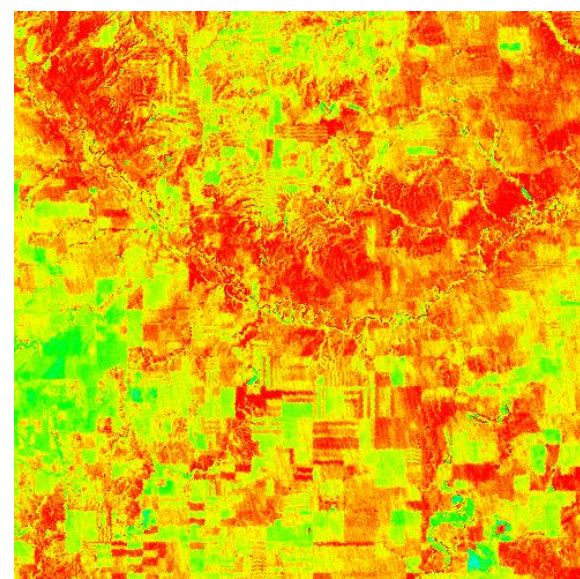
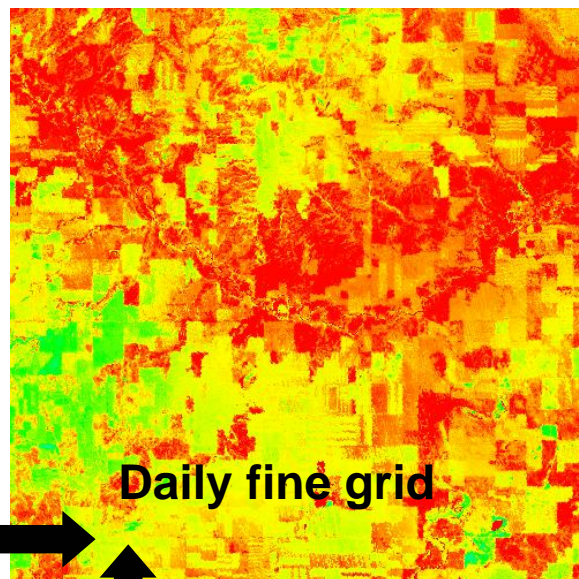
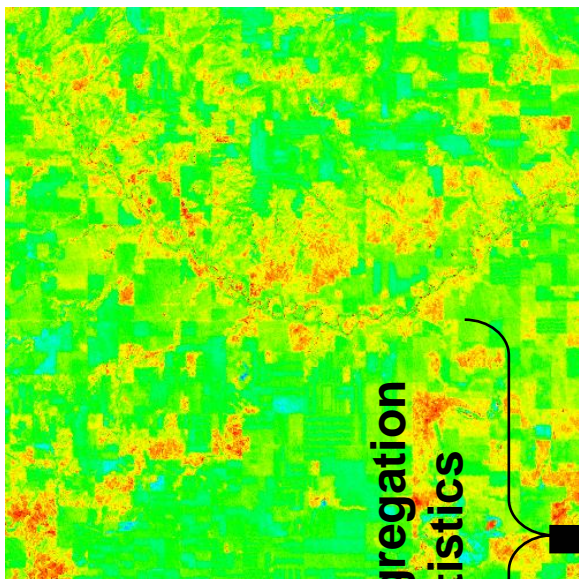


**Landsat**

observed 2002-229

predicted 2002-245

observed 2002-245

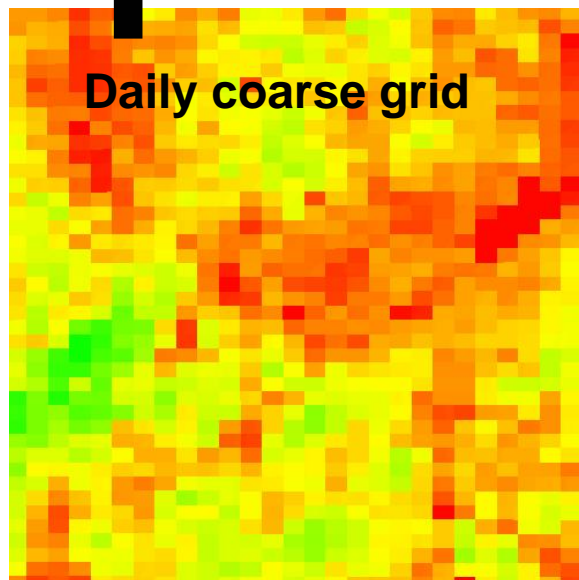
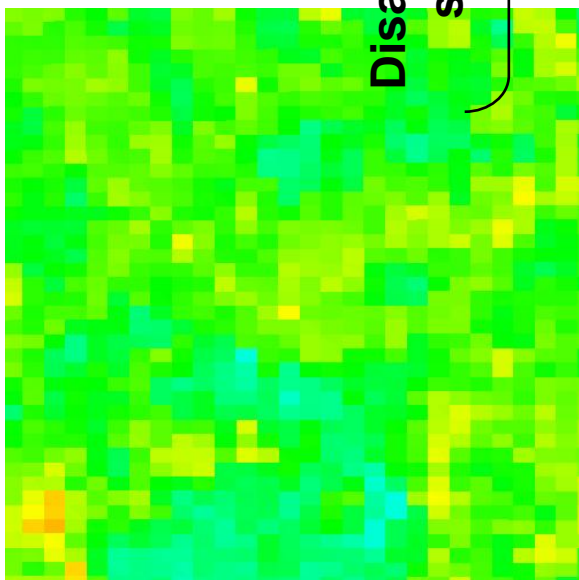


Disaggregation statistics

Daily fine grid

Daily coarse grid

**MODIS**



observed 2002-229

observed 2002-245

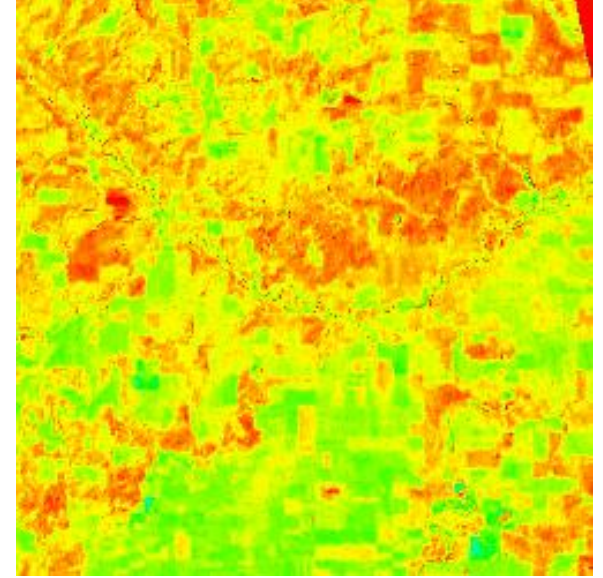
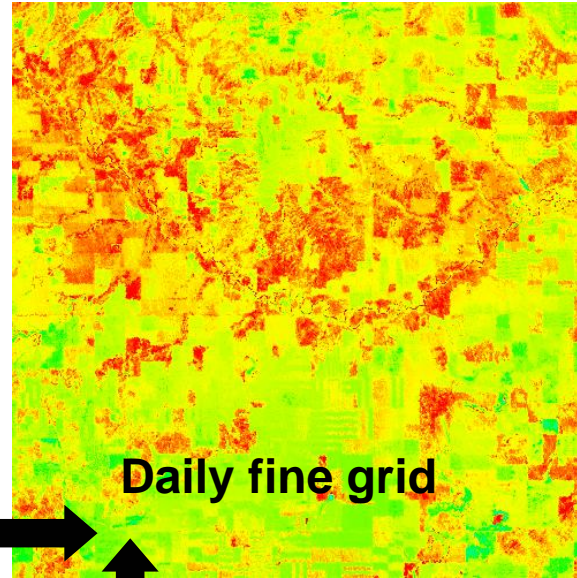
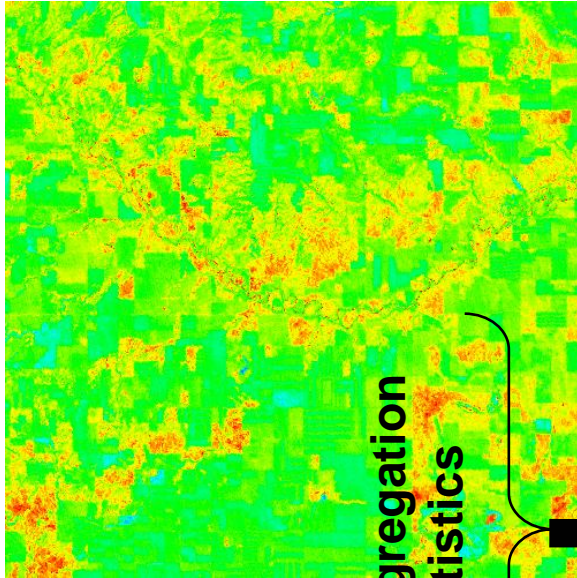
*STAR-FM  
Data fusion  
(F. Gao, GSFC)*

**Landsat**

observed 2002-229

predicted 2002-253

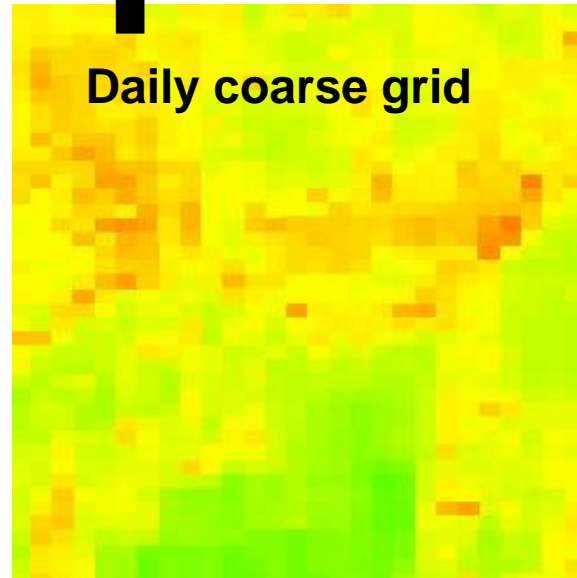
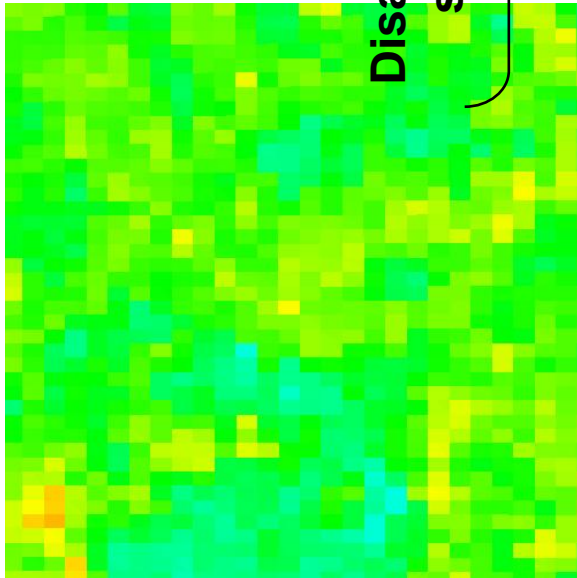
observed 2002-253



Disaggregation statistics

Daily fine grid

**MODIS**

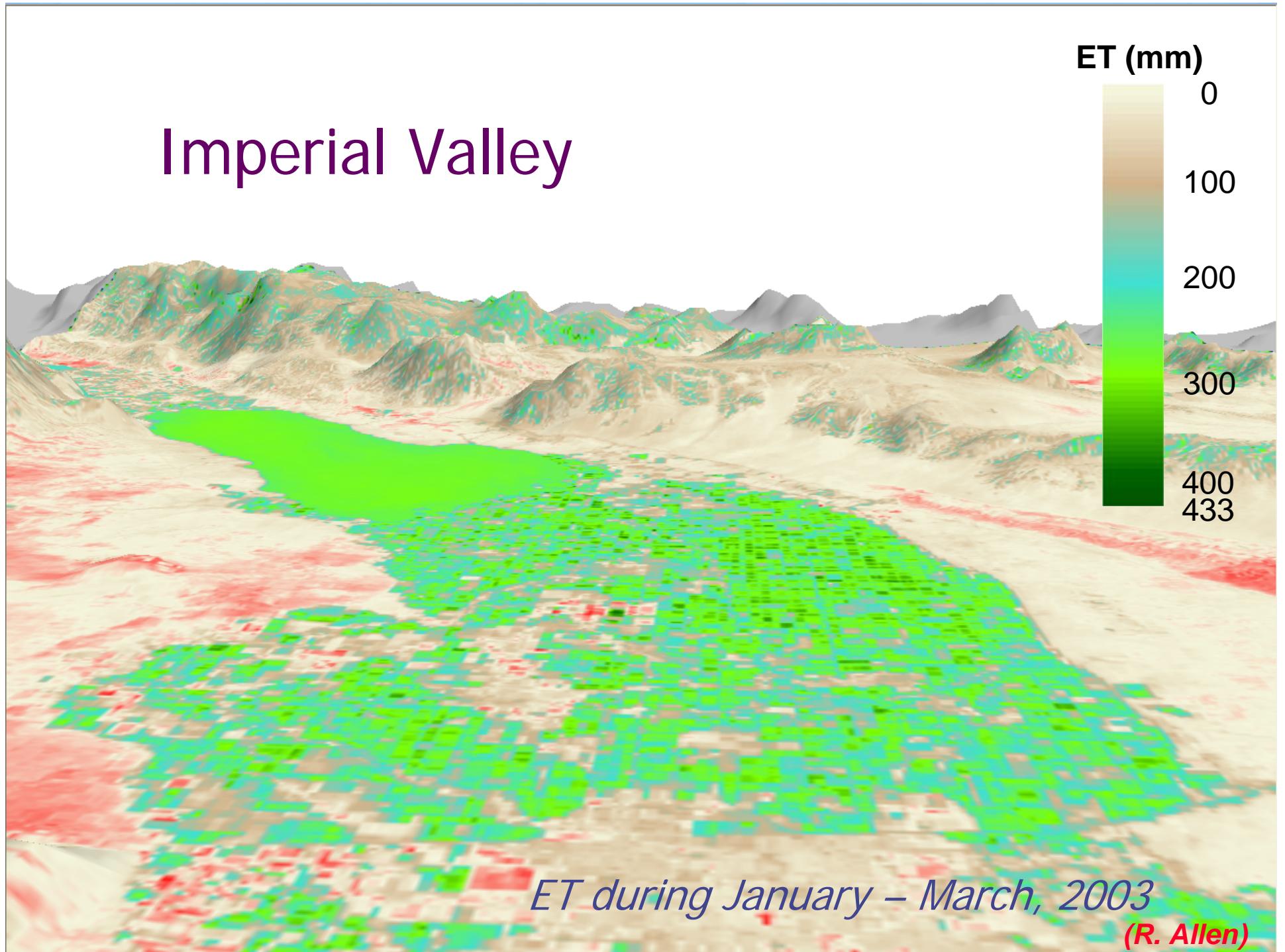


observed 2002-229

observed 2002-253

*STAR-FM  
Data fusion  
(F. Gao, GSFC)*

# Imperial Valley

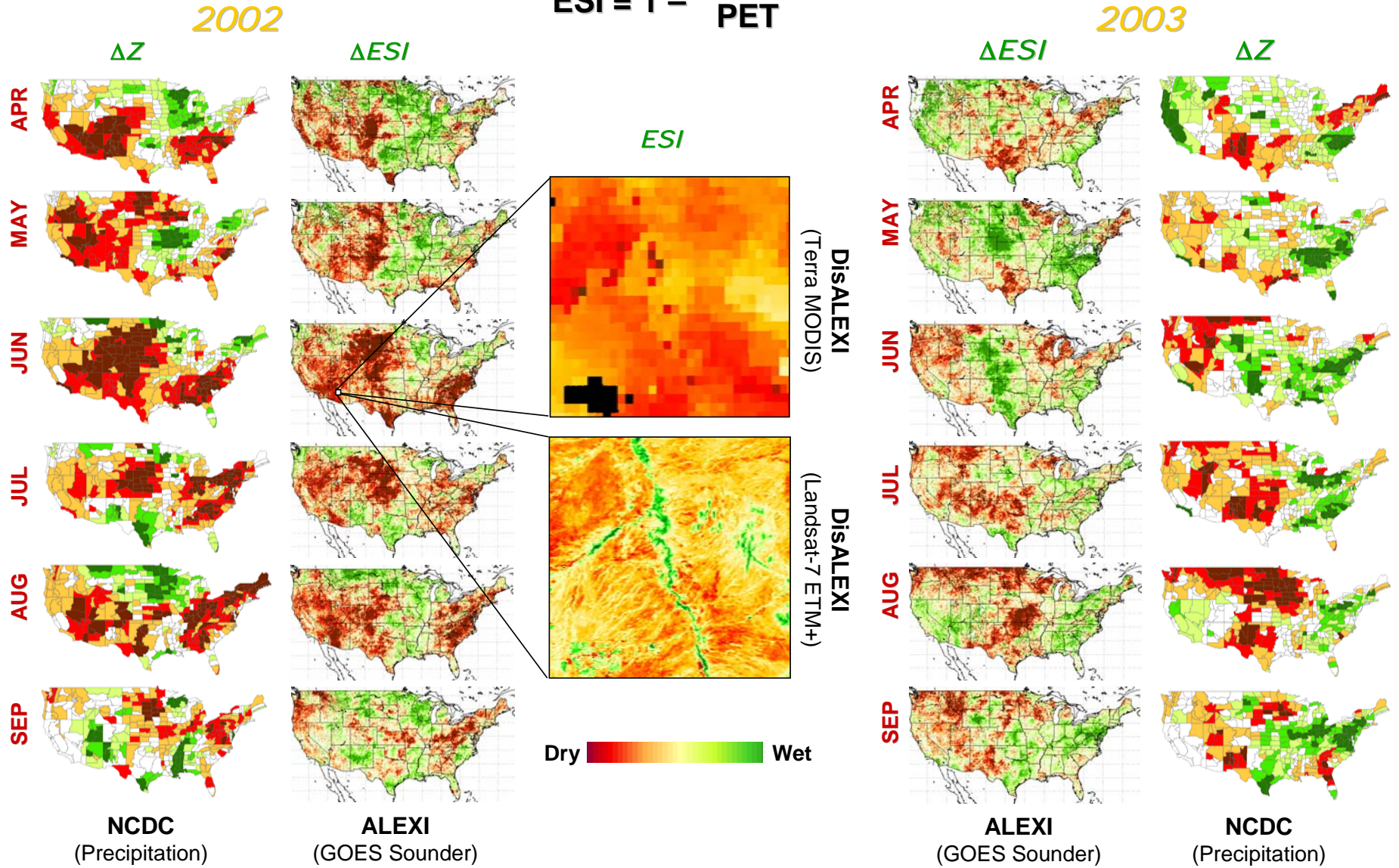


## TQ3: Water Use and Availability

- *Response to climate change:*  
How is climate change impacting the evaporative component of the global water cycle over natural and managed landscapes?
- *Water management:*  
How can information about evapotranspiration and its relationship to land-use/landcover be used to facilitate better water management?
- *Drought:*  
How can we improve early detection, mitigation, and impact assessment of droughts at local to global scales?
- *Irrigated area:*  
What is the current global irrigated acreage, how is it changing with time, and are these changes in a sustainable balance with regional water availability?
- *Water use in food production:*  
Can we increase food production in water-scarce agricultural regions while improving or sustaining environmental access to water?

# EVAPORATIVE STRESS INDEX

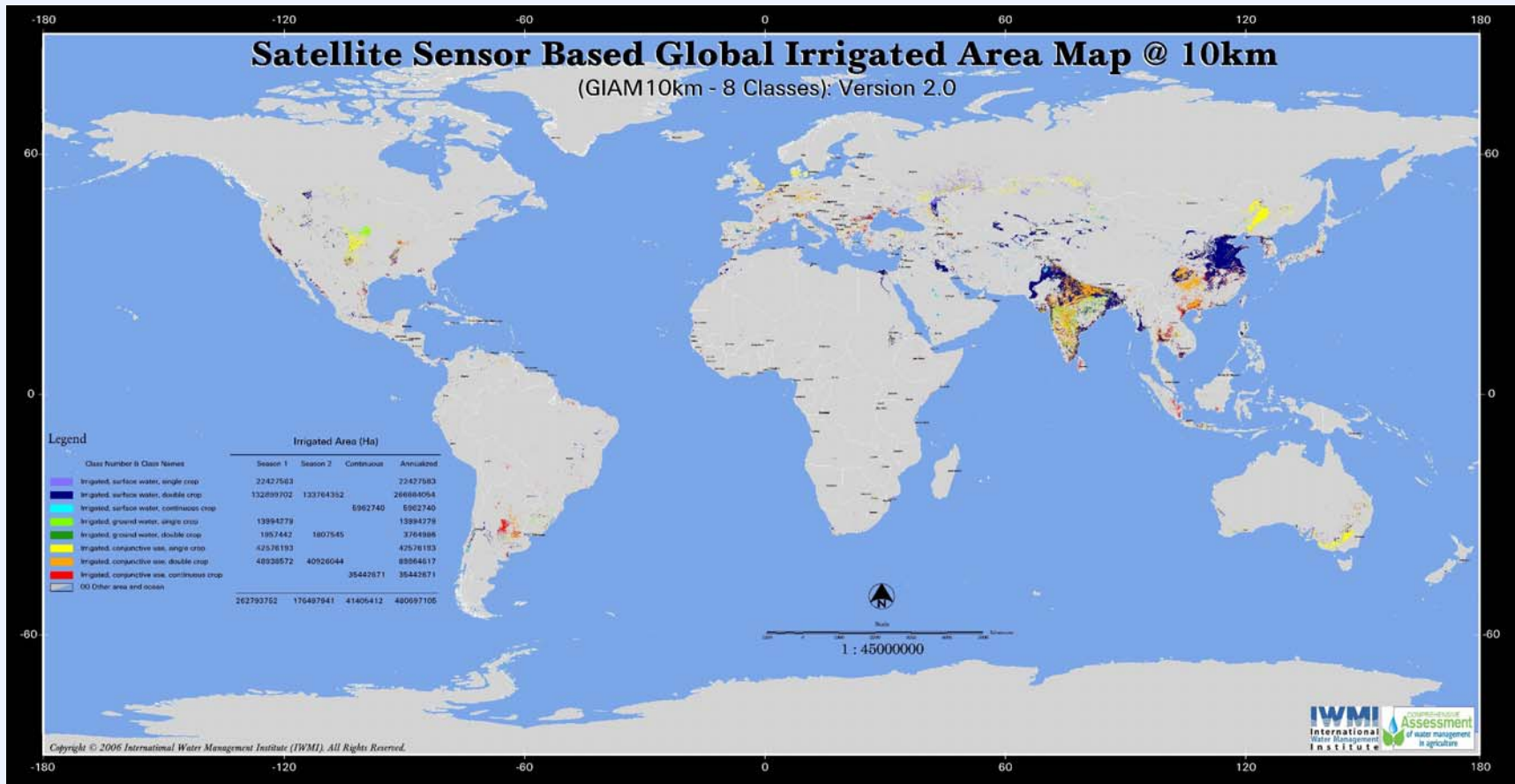
$$ESI = 1 - \frac{AET}{PET}$$



(Anderson et al., 2007)

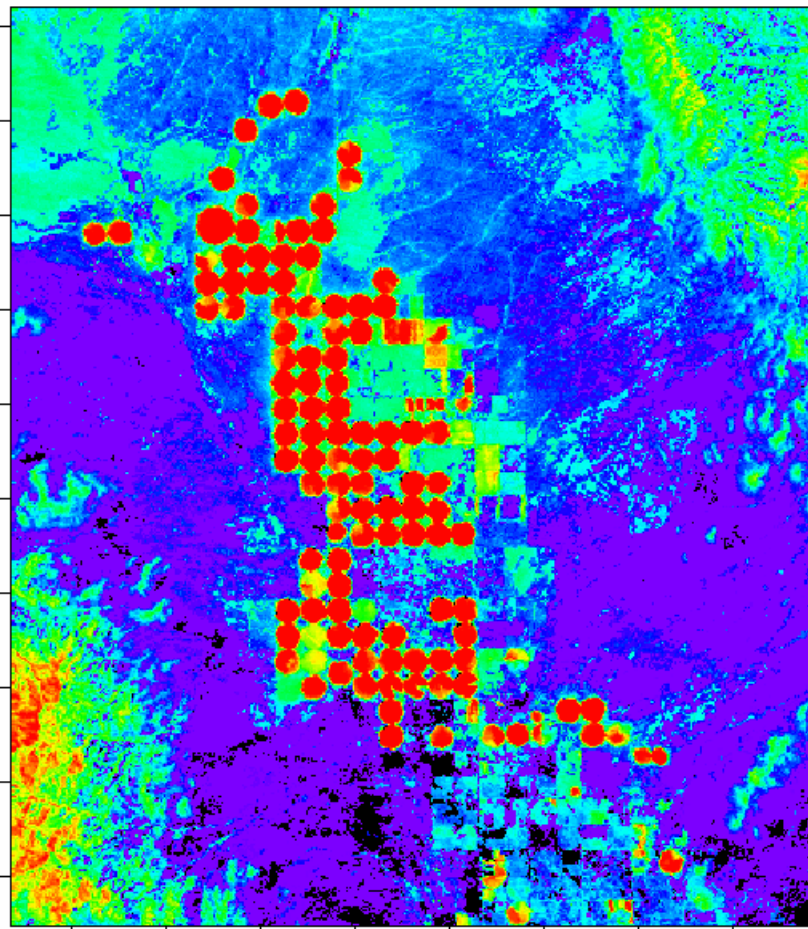
## TQ3: Water Use and Availability

- *Response to climate change:*  
How is climate change impacting the evaporative component of the global water cycle over natural and managed landscapes?
- *Water management:*  
How can information about evapotranspiration and its relationship to land-use/landcover be used to facilitate better water management?
- *Drought:*  
How can we improve early detection, mitigation, and impact assessment of droughts at local to global scales?
- *Irrigated area:*  
What is the current global irrigated acreage, how is it changing with time, and are these changes in a sustainable balance with regional water availability?
- *Water use in food production:*  
Can we increase food production in water-scarce agricultural regions while improving or sustaining environmental access to water?

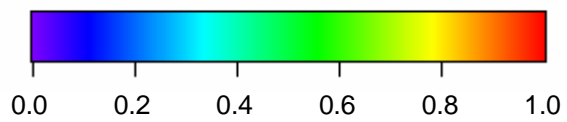
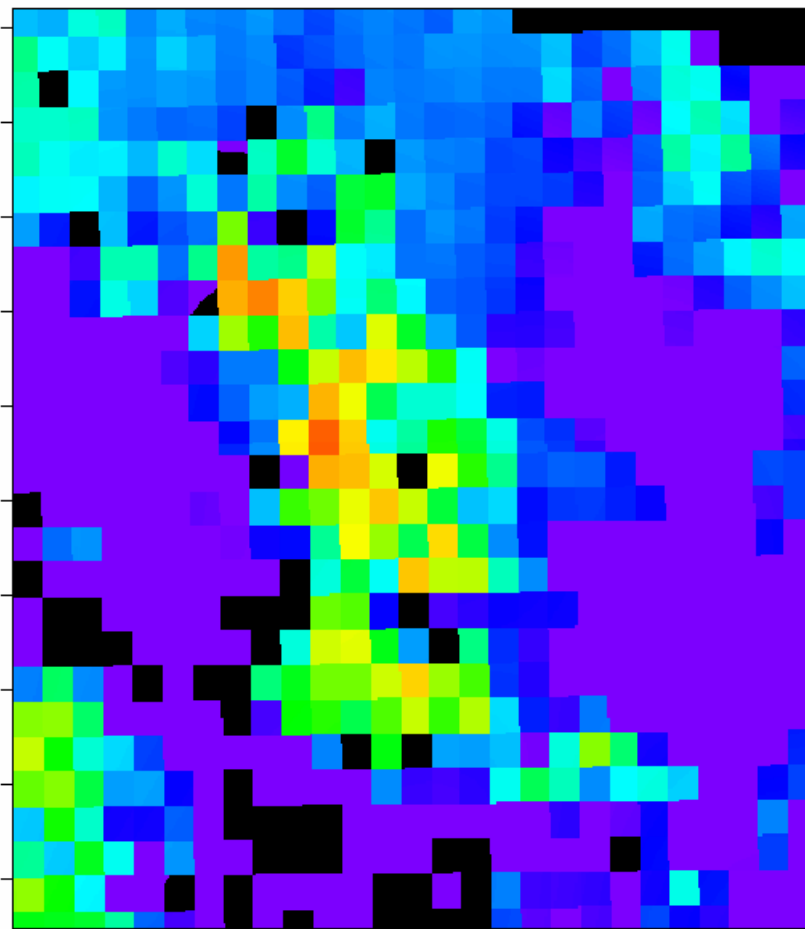


**Current maps are based on radiation, precipitation, landcover class, and shortwave reflectances**

Landsat 7 – 60m



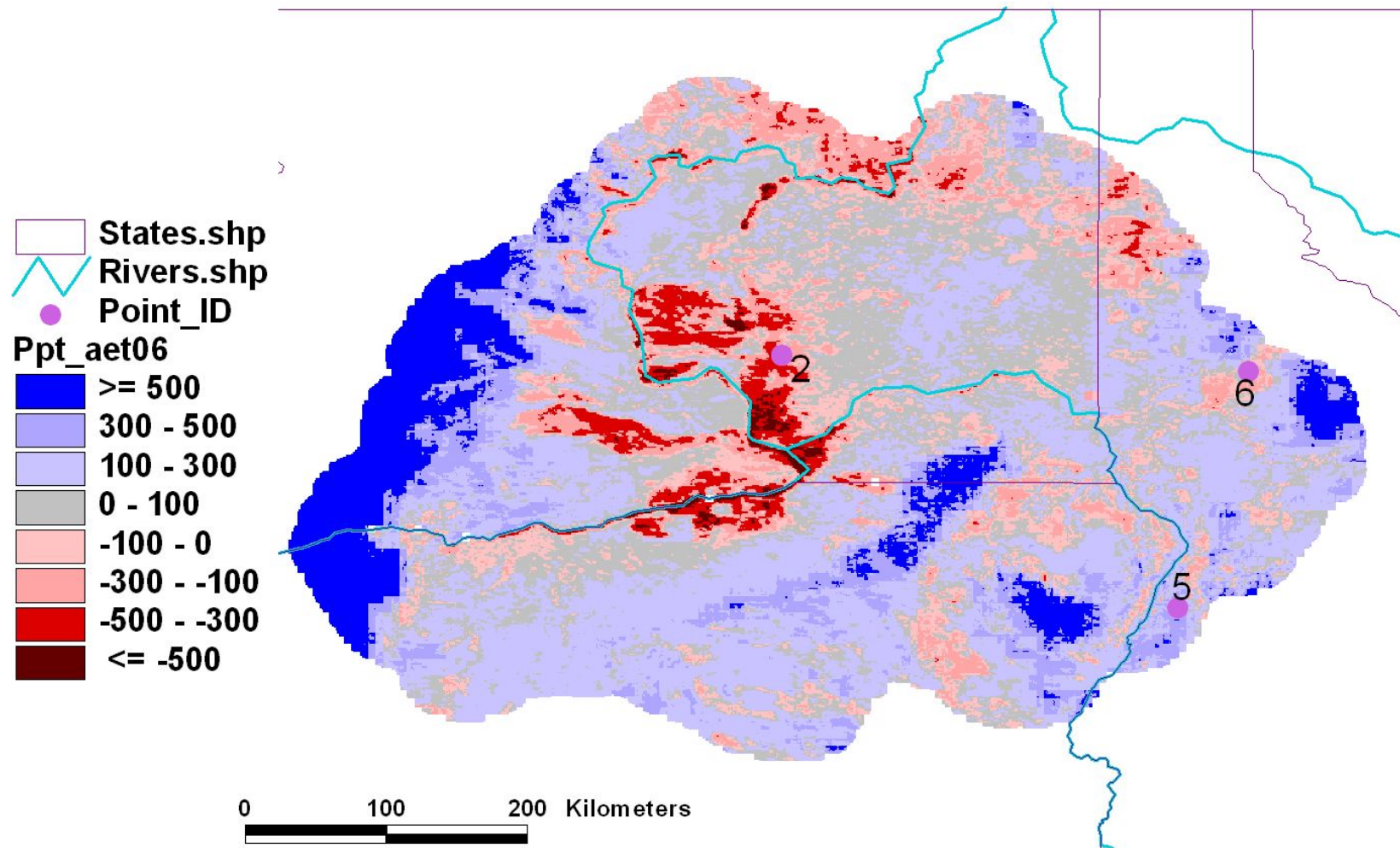
MODIS – 1km



$$\frac{ET}{PET}$$



# 2006 Annual Water Balance (PPT - ETa) (mm) Columbia Plateau: NOAA/NEXRAD Precip minus SSEB ETa)

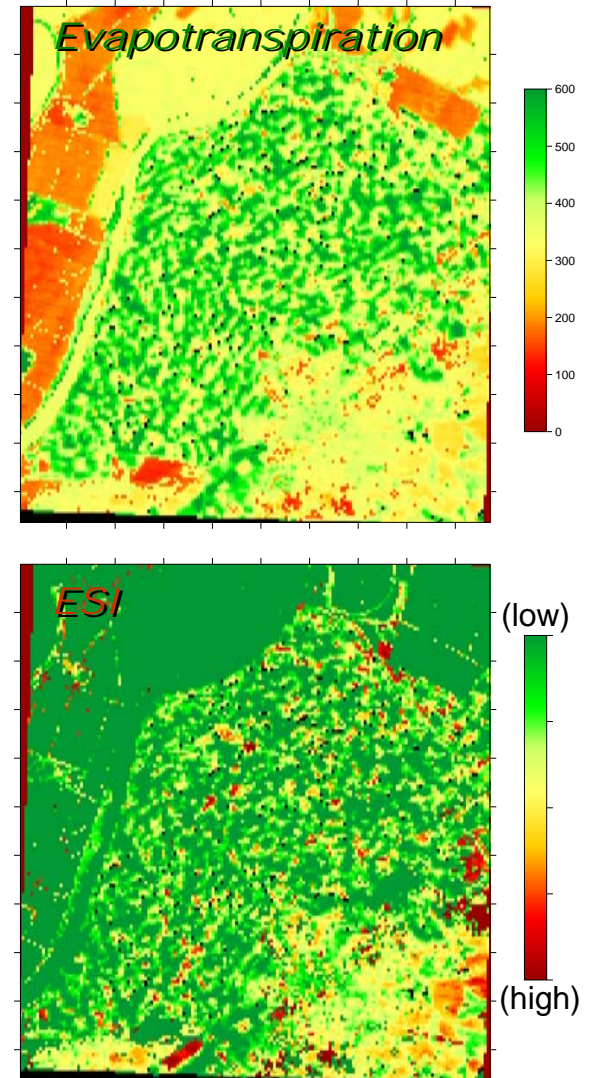


(G. Senay; EROS)

## TQ3: Water Use and Availability

- *Response to climate change:*  
How is climate change impacting the evaporative component of the global water cycle over natural and managed landscapes?
- *Water management:*  
How can information about evapotranspiration and its relationship to land-use/landcover be used to facilitate better water management?
- *Drought:*  
How can we improve early detection, mitigation, and impact assessment of droughts at local to global scales?
- *Irrigated area:*  
What is the current global irrigated acreage, how is it changing with time, and are these changes in a sustainable balance with regional water availability?
- *Water use in food production:*  
Can we increase food production in water-scarce agricultural regions while improving or sustaining environmental access to water?

# Irrigation district in Lebrija, Spain



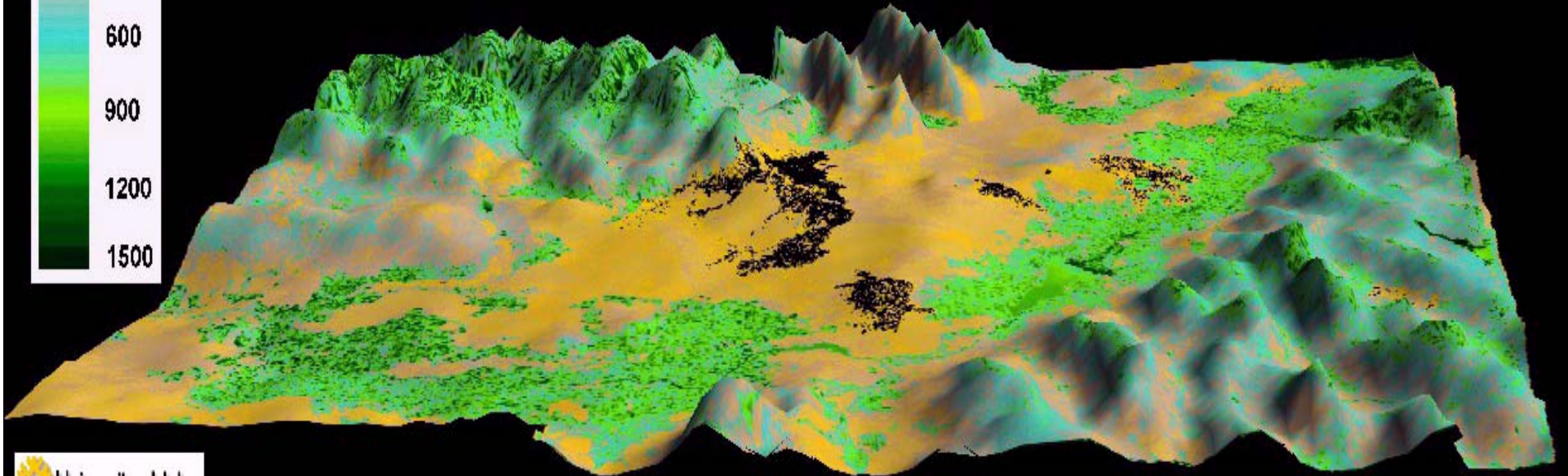
Landsat 5 (120m)

## TQ3: Water Use and Availability

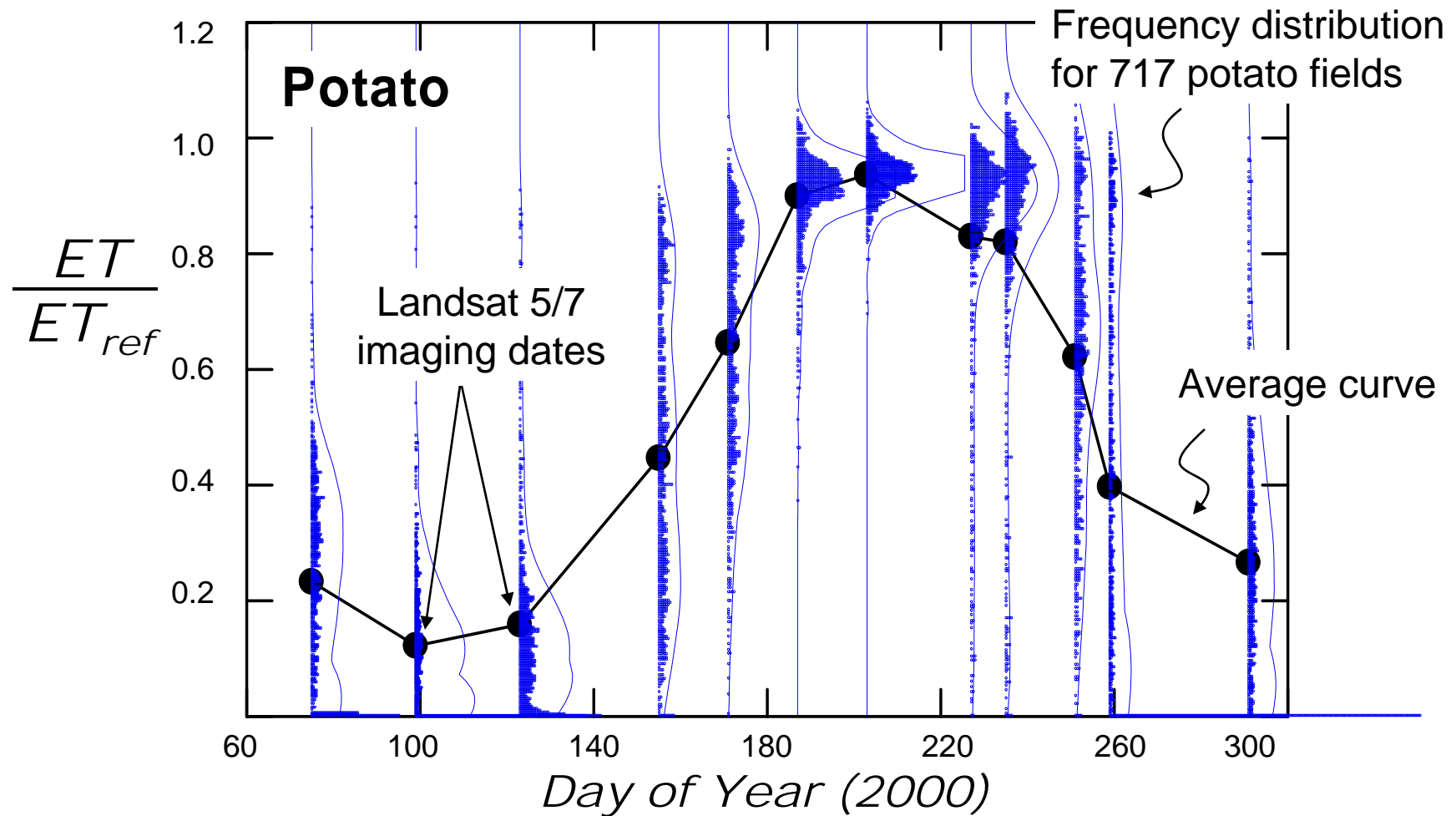
- *Response to climate change:*  
How is climate change impacting the evaporative component of the global water cycle over natural and managed landscapes?
- *Water management:*  
How can information about evapotranspiration and its relationship to land-use/landcover be used to facilitate better water management?
- *Drought:*  
How can we improve early detection, mitigation, and impact assessment of droughts at local to global scales?
- *Irrigated area:*  
What is the current global irrigated acreage, how is it changing with time, and are these changes in a sustainable balance with regional water availability?
- *Water use in food production:*  
Can we increase food production in water-scarce agricultural regions while improving or sustaining environmental access to water?



*Seasonal Evapotranspiration during 2000  
Eastern Snake River Plain, Idaho*

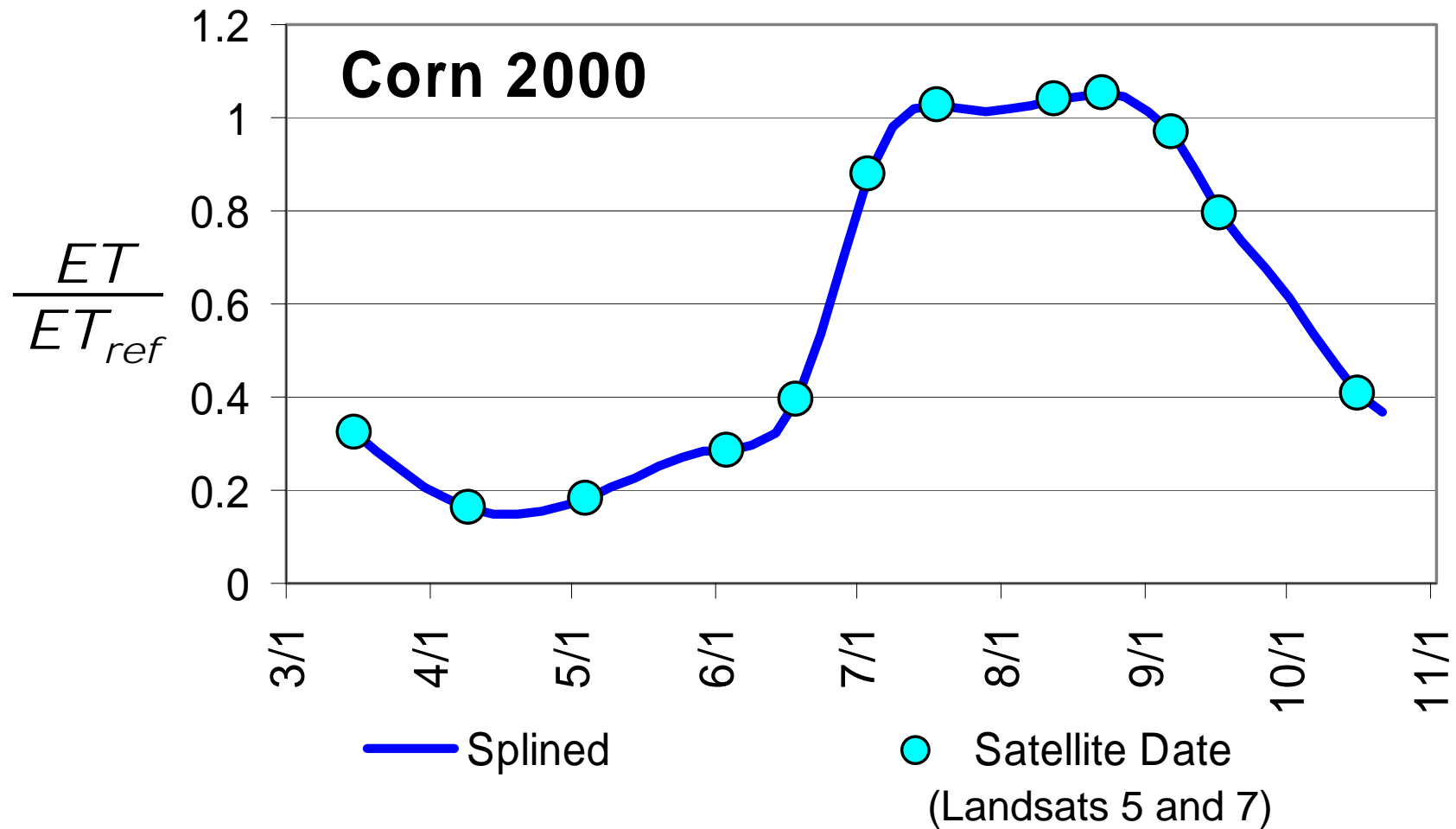


# Seasonal ET



- <100m TIR imaging allows sampling of individual fields
- weekly revisit will improve seasonal integration

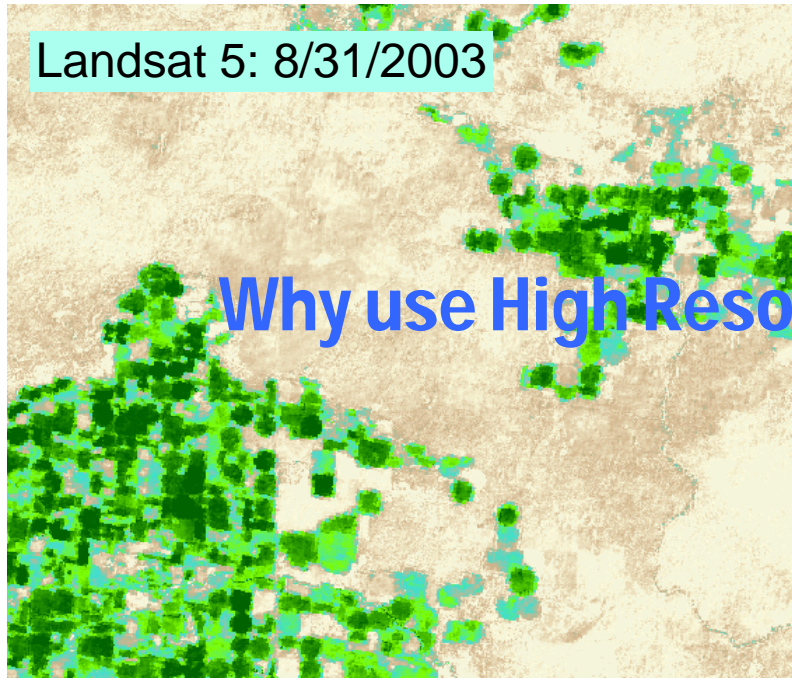
# Seasonal ET



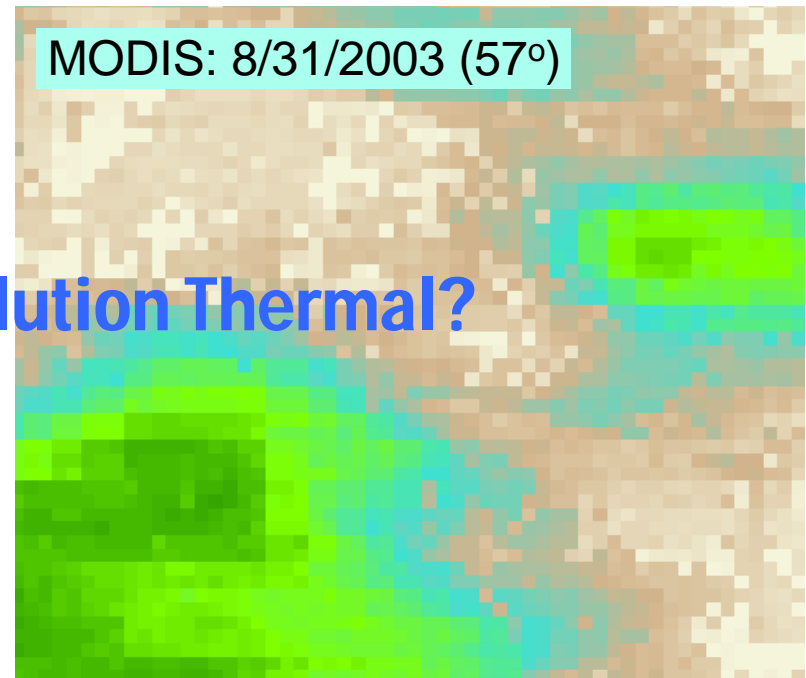
Interpolate fraction of reference ET between satellite imaging dates



Landsat 5: 8/31/2003

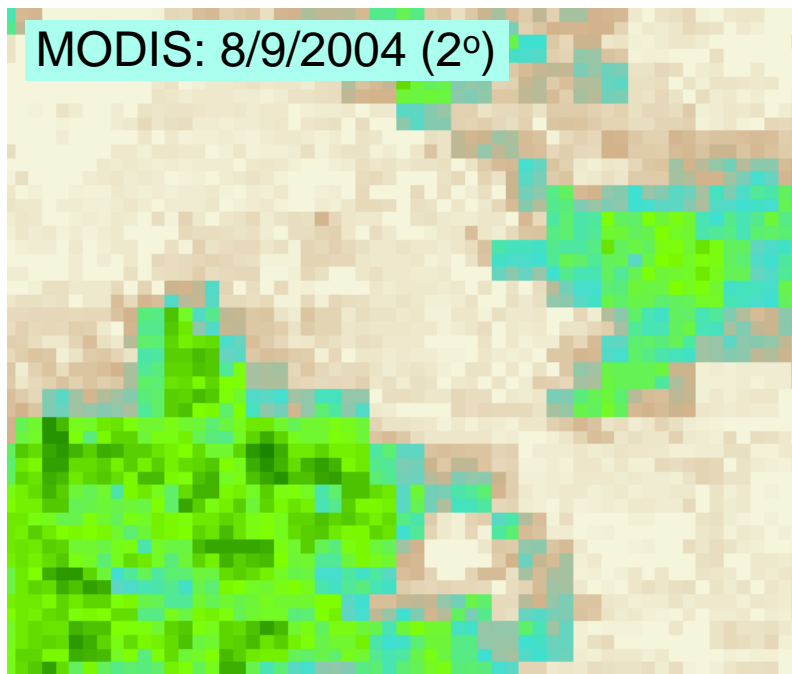


MODIS: 8/31/2003 (57°)



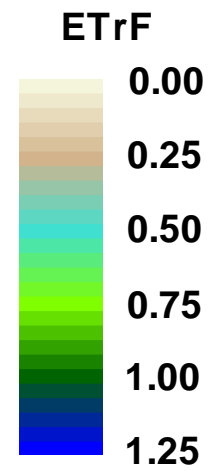
Why use High Resolution Thermal?

MODIS: 8/9/2004 (2°)



ET by METRIC  
Minidoka, Idaho

$$ET_{rF} = \frac{ET}{ET_{reference}}$$



# Satellite Thermal Imaging Systems

<i>Pixel Scale</i>	<i>Spatial Resolution</i>	<i>Temporal Resolution</i>	<i>Current Sources</i>	<i>Future Sources</i>
<i>Coarse</i>	5-20 km	15 min	AIRS GOES MSG	CrIS GOES MSG
<i>Moderate</i>	1 km	2-4 times daily	MODIS AVHRR ATSR	VIIRS AVHRR ATSR
<i>Fine</i>	90–120 m	Once every 8-16 days	ASTER <i>Landsat</i>	

*Table from S. Hook*