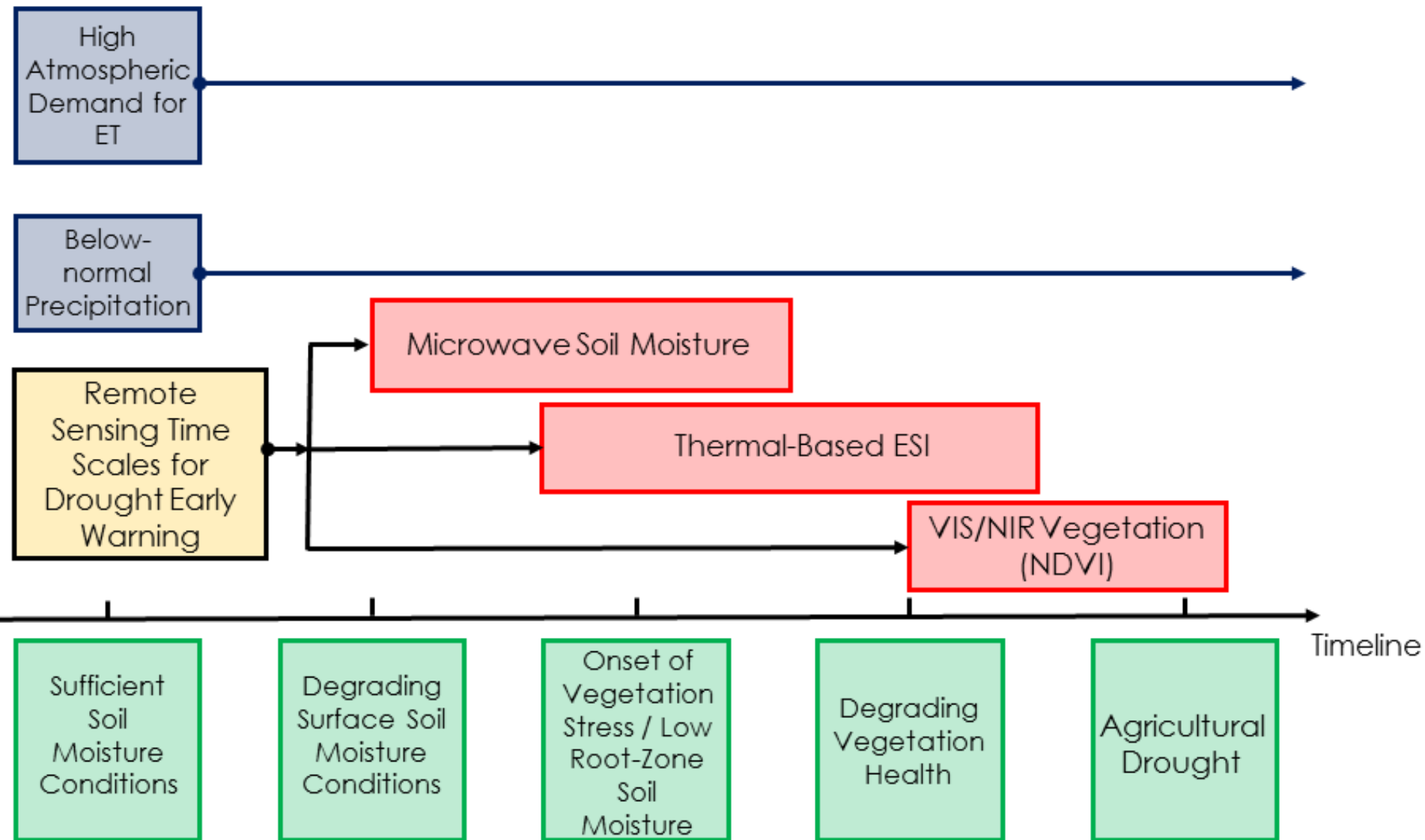
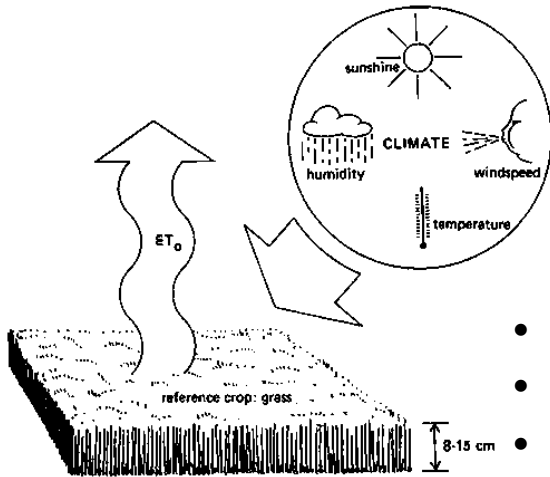


Example of the Evolution of Agricultural Drought



Atmospheric Demand: Evaporative Demand Drought Index

“Atmospheric Thirst”

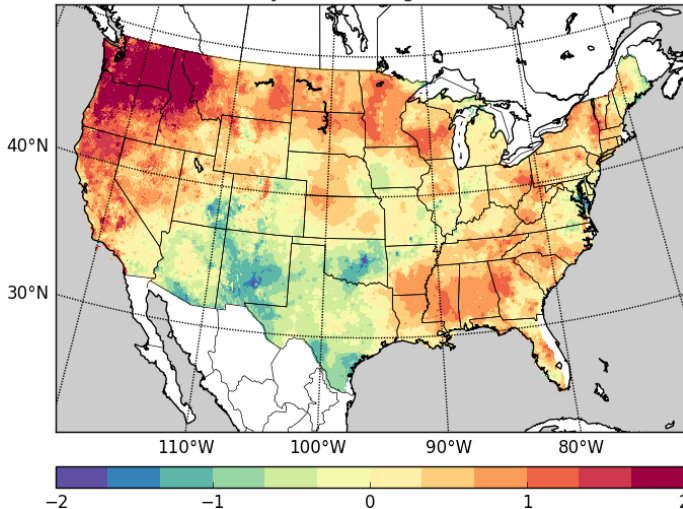


Drought early warning in Midwest during 2012 using 1-month EDDI.

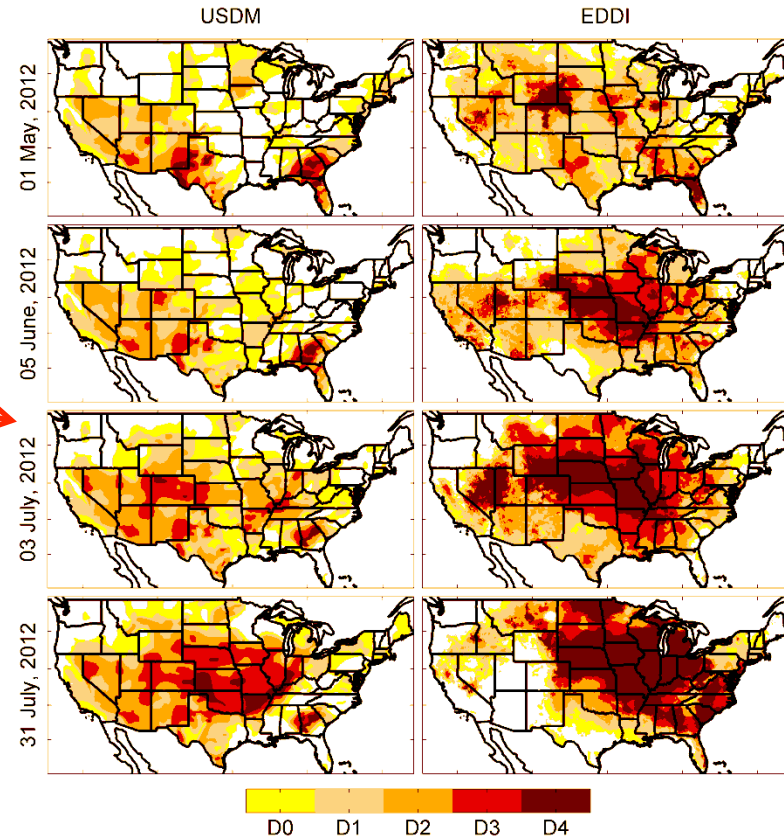
- 4-km spatial resolution
- U of Idaho gridMET data
- 1979-present

- ASCE Standardized Reference Evapotranspiration

365 day EDDI ending 2015-09-30



September 12-month EDDI (western water year) captures CA drought, Pacific Northwest snow drought, and record spring rains in OK are also reflected.



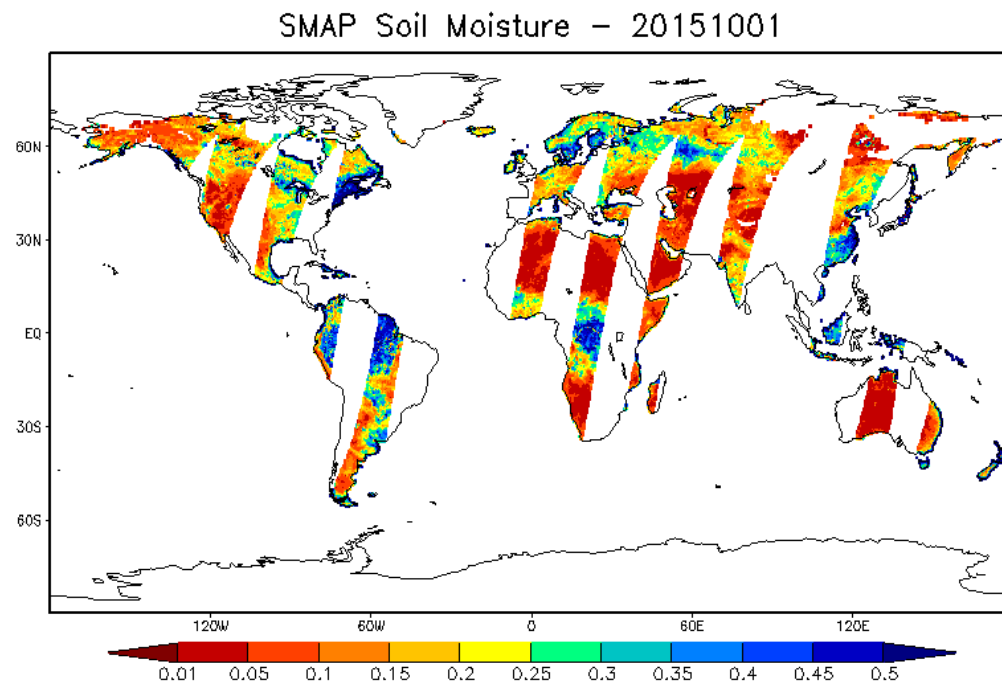
+ EDDI = dry,
above normal ET_0

- EDDI = wet,
below normal ET_0

Early Warning Metrics for Surface Soil Moisture Changes

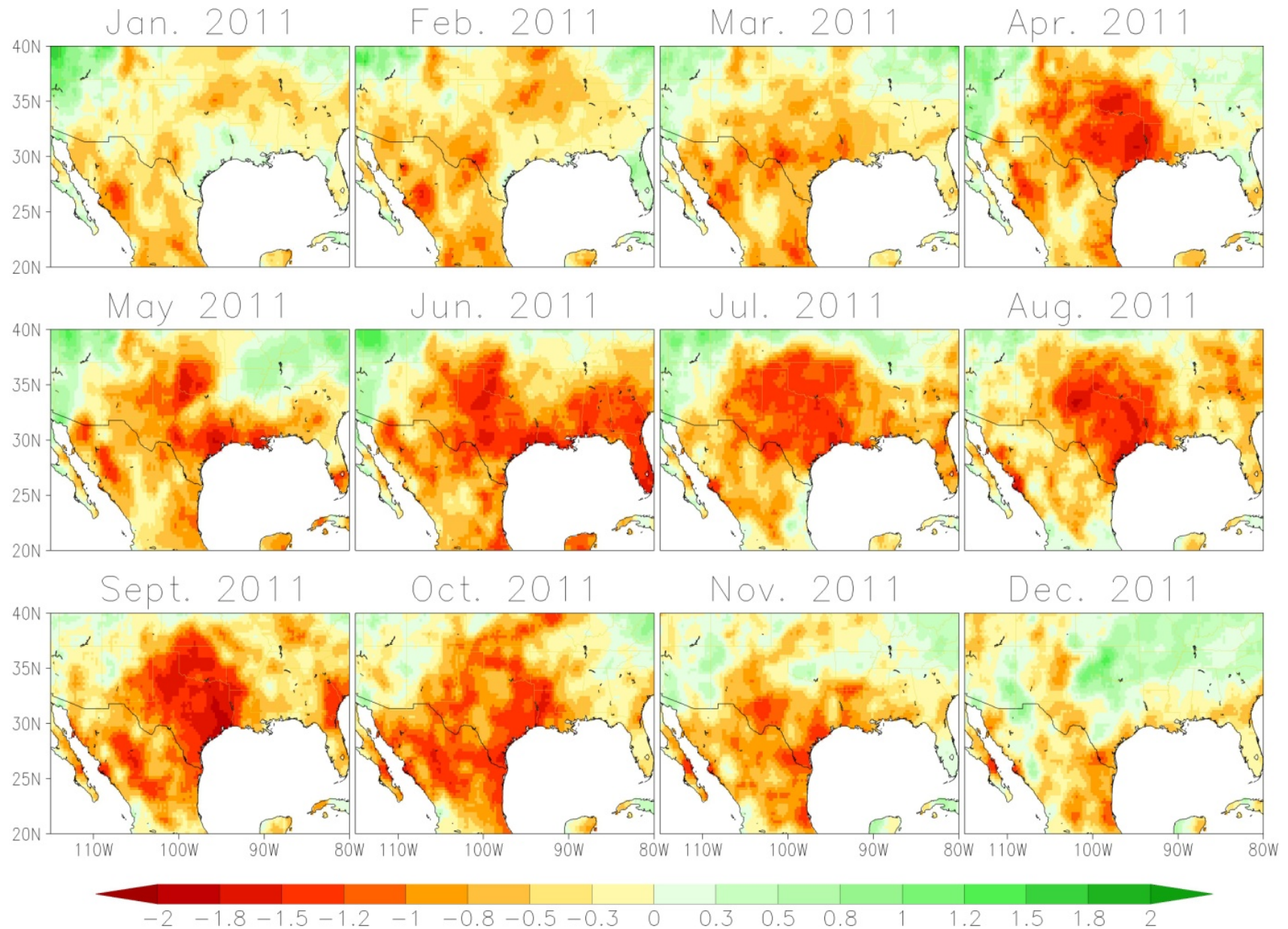
Remote sensing of soil moisture based on microwave wavelengths:

- Relatively-coarse scale resolution (15 to 30 km)
- High temporal sampling (MW signals are not affected by clouds)
- Accuracy is strongly tied to density of vegetation (accuracy decreases as vegetation density increases)
- NOAA provides operational microwave soil moisture products (SMOPS; Soil Moisture Operational Product System)



Early Warning Metrics for Surface Soil Moisture Changes

NOAA MW-Composite Drought Index (GLDAS+MW SM) – “Research Mode”



Early Warning Metrics for Onset of Vegetation Stress

Evaporative Stress Index (ESI):

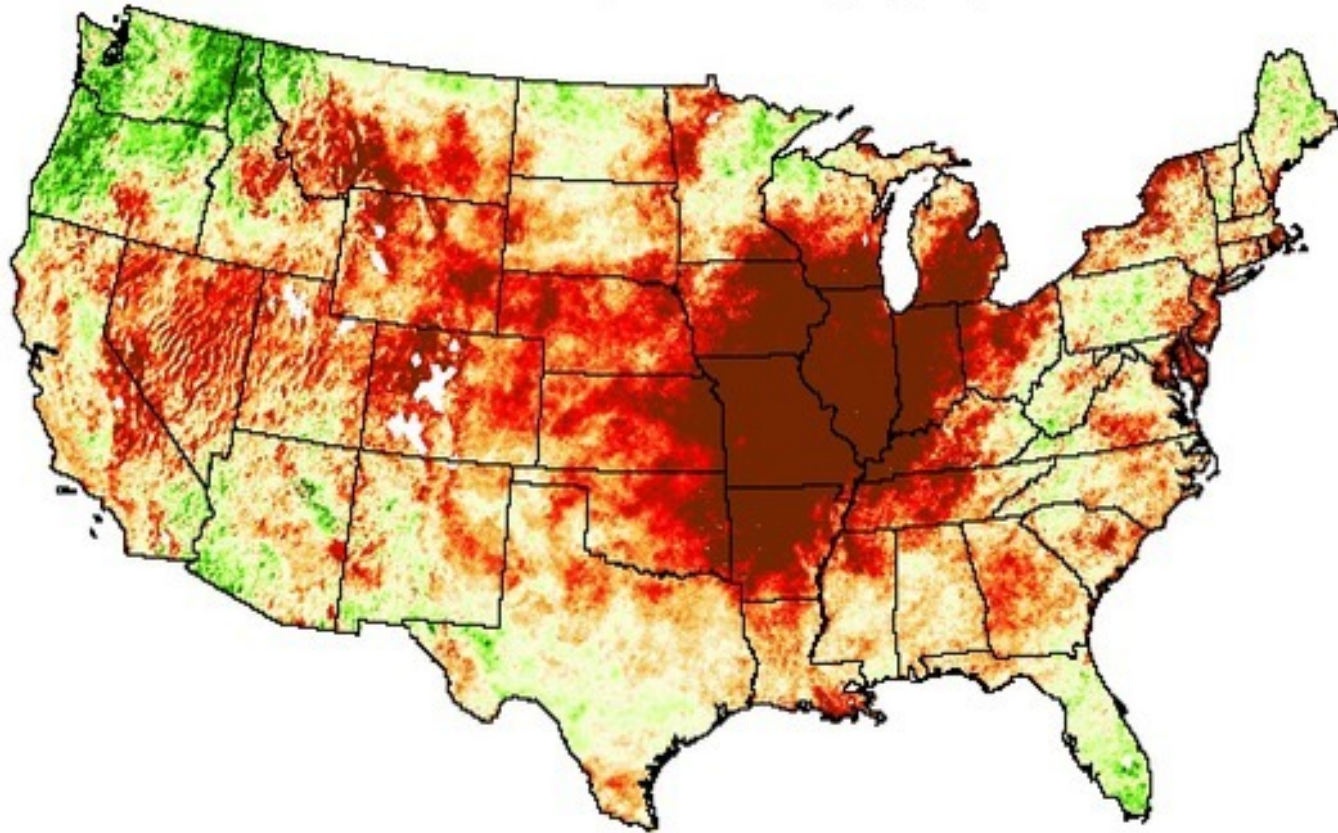
Remote sensing of soil moisture/vegetation stress based on thermal-infrared wavelengths:

- High spatial resolution (1 – 8 km [and getting better....])
- Lower temporal sampling due to cloud cover
- Accuracy is less related to vegetation density and more related to how well we can determine if a cloud is contaminating the signal
- ESI will be operational at NOAA over North America at 8-km starting this spring
- Hi-Res ESI will be available over CONUS at 4-km (currently run in “research-mode”)

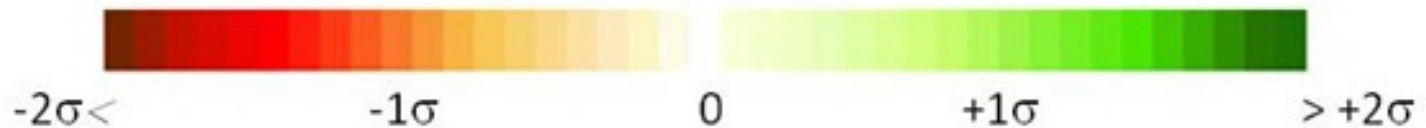
Early Warning Metrics for Onset of Vegetation Stress

Evaporative Stress Index 4km

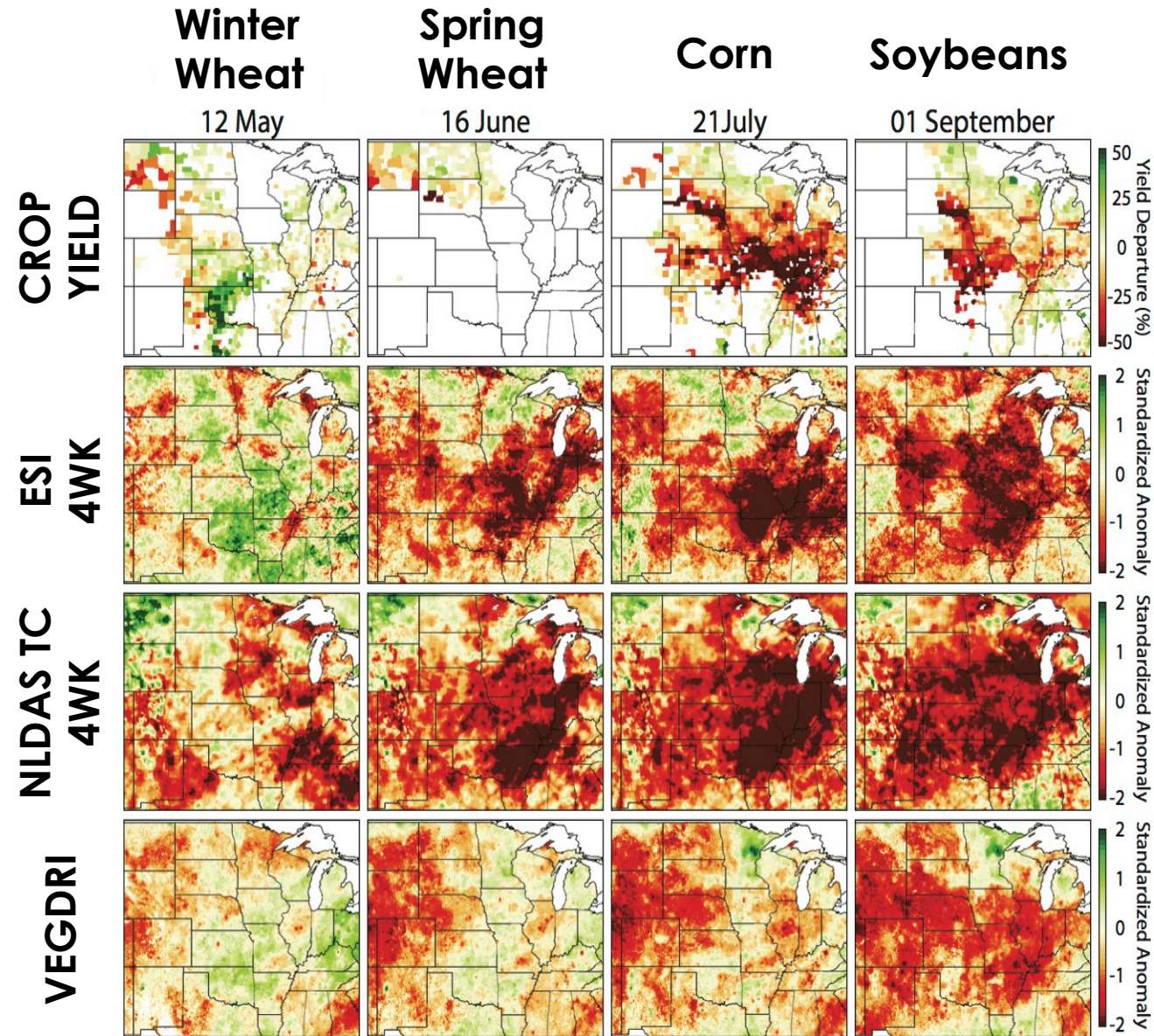
3 month composite ending July 28, 2012



Standardized ET/PET anomalies



Early Warning Metrics for Onset of Vegetation Stress



- Examine drought conditions during critical crop stages
- Strong relationship between wheat yield and the ESI and VegDRI during critical crop stages
- NLDAS has strong (weak) relationship to corn/soybeans (wheat) yield
- ESI had strongest correlation to the wheat, corn, and soybean yield departures

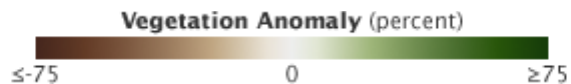
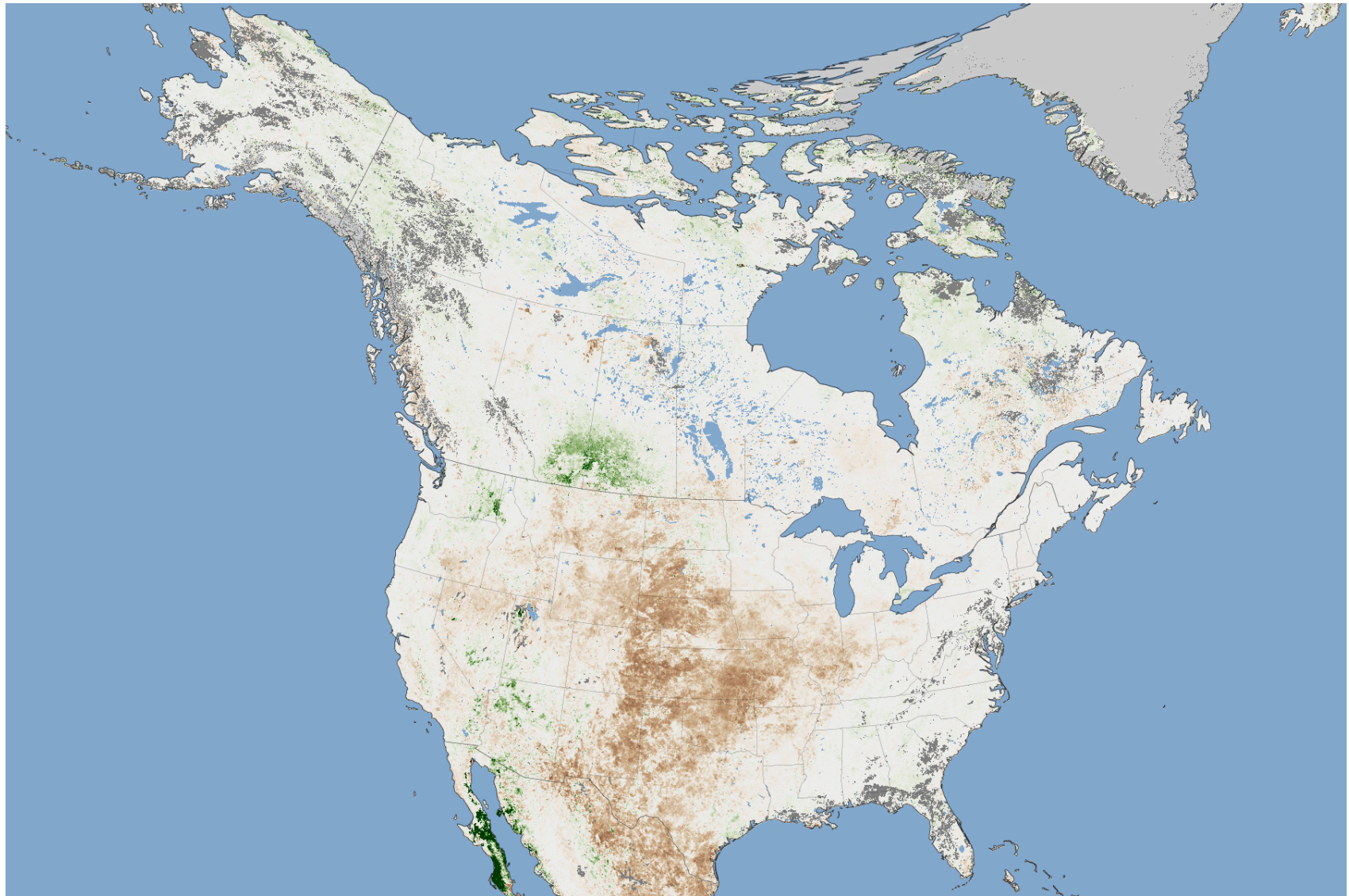
Remote Sensing of Vegetation – Onset of Degradation in Vegetation Health

Normalized Difference Vegetation Index (NDVI)

Remote sensing of vegetation based on visible / near-IR wavelengths:

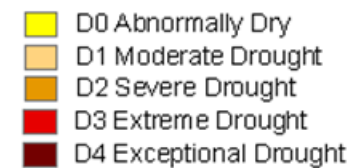
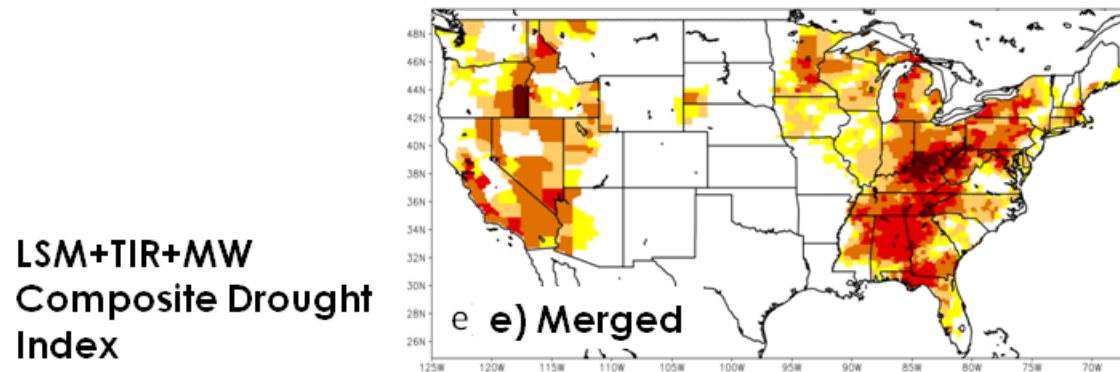
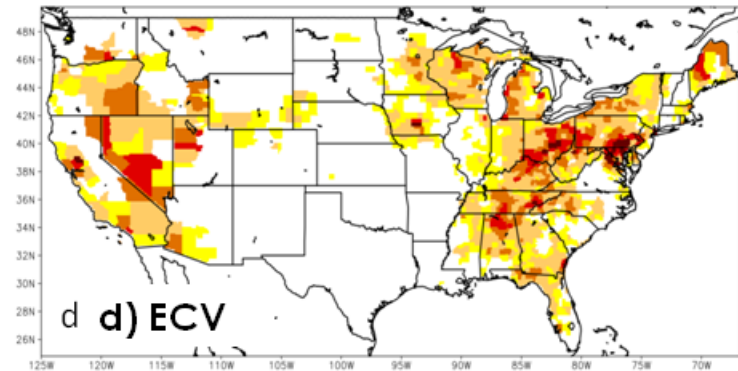
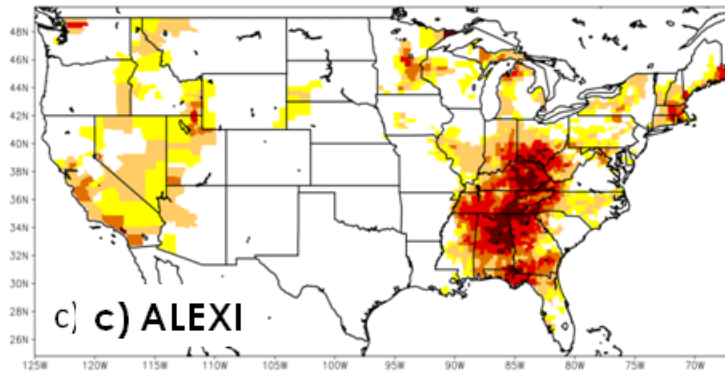
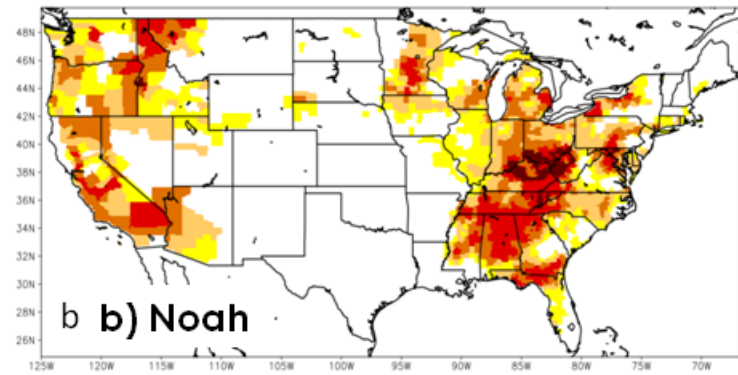
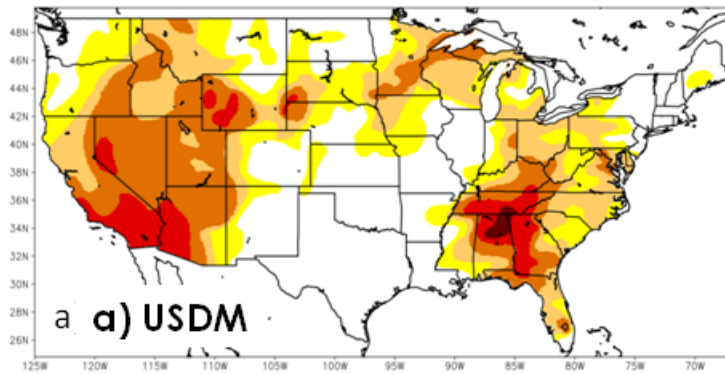
- High spatial resolution (375 m – 8 km [and getting better....])
- Temporal sampling related to cloud cover
- Most commonly used remote sensing-based drought indicator
- Shows drought impacts only after damage to vegetation starts to occur through an observation of decreased “greenness”

Remote Sensing of Vegetation – Onset of Degradation in Vegetation Health



*** MODIS NDVI Anomaly September 2012**

Composite Drought Index based on Remote Sensing Drought Indicators



LSM+TIR+MW
Composite Drought
Index

How do I get these datasets:

Evaporative Drought Demand Index (EDDI):

Contact: Dan McEvoy (dan.mcevoy@dri.edu)
Justin Huntington (justin.huntington@dri.edu)

Data access: <ftp://pubfiles.dri.edu/pub/mcevoy/EDDI/>

NOAA Soil Moisture Operational Product System (SMOPS):

Contact: Xiwu Zhan (xiwu.zhan@noaa.gov)
Christopher Hain (chris.hain@noaa.gov)

Data access: <http://www.ospo.noaa.gov/Products/land/smops/>

Evaporative Stress Index (ESI):

Contact: Christopher Hain (chris.hain@noaa.gov)
Martha Anderson (martha.anderson@ars.usda.gov)

Data access: <http://hrsl.ba.ars.usda.gov/drought/> (warm season only)
NOAA Operational Website TBD (Available March/April 2016)