# Mapping Phenology, Water Use and Drought using Landsat Imagery

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Project overview

## TOOLS

| | |
|---|---|
| STARFM | Multi-sensor data fusion |
| DMS | Thermal image sharpening |
| ALEXI | Multi-scale ET modeling |

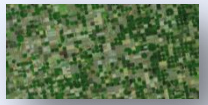
## ASSETS

| | | SW/TIR |
|---|---|---|
| GEO | Hourly | 5km/5km |
| MODIS | Daily | 250m/1km |
| Landsat | 16 day | 30m/100m |
| Lsat-like | | ~20-60m/ -- |

## APPLICATIONS

*(daily/30 m)*

Crop phenology metrics

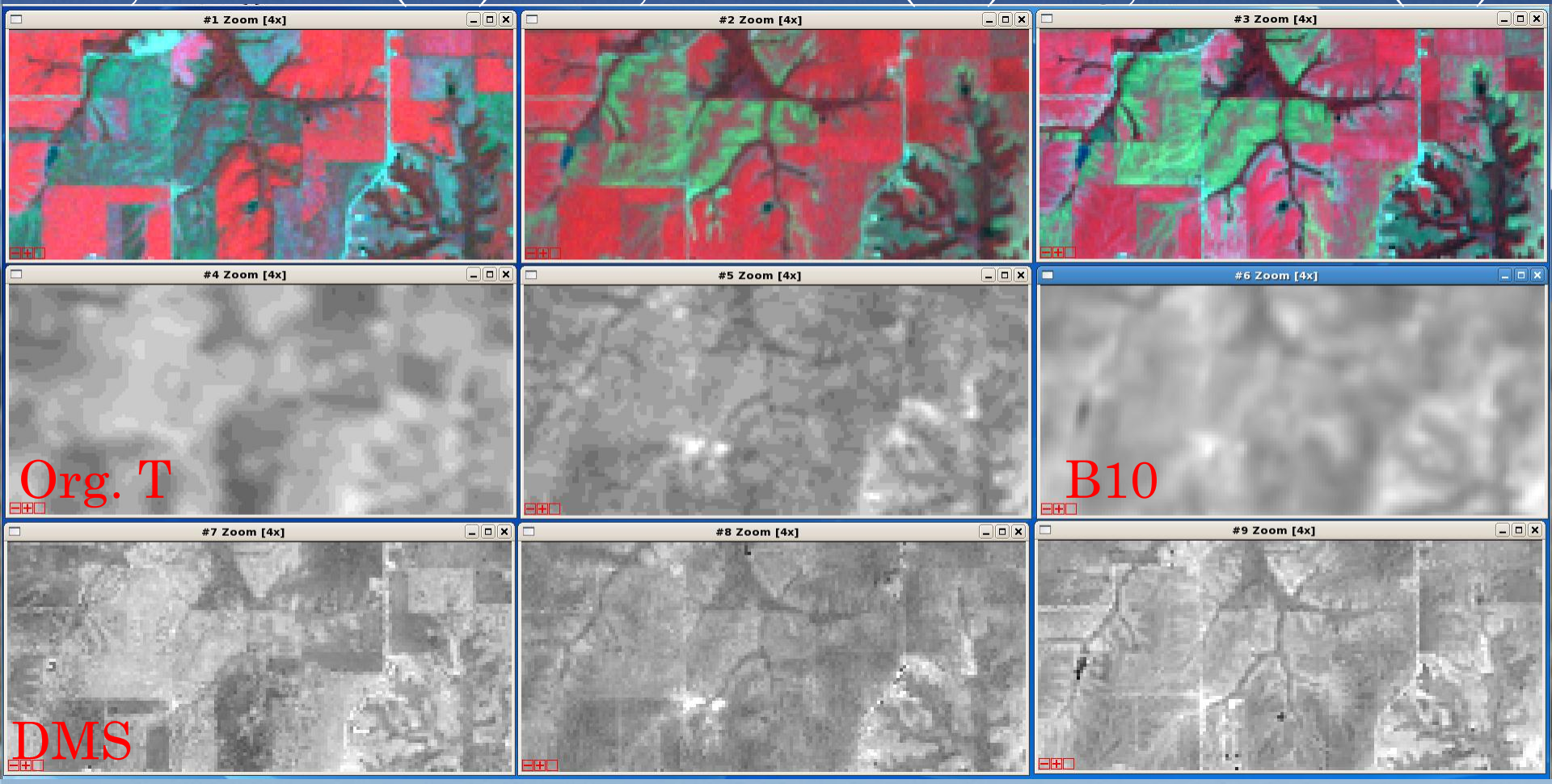


Crop water use (Evapotranspiration)

Crop stress (drought early warning)

# Data Mining Sharpener

L5, 2011-247 (9/4) L7, 2013-244 (9/1) L8, 2013-252 (9/9)




T Range (in K): (287-295) (292-300) (300-308)

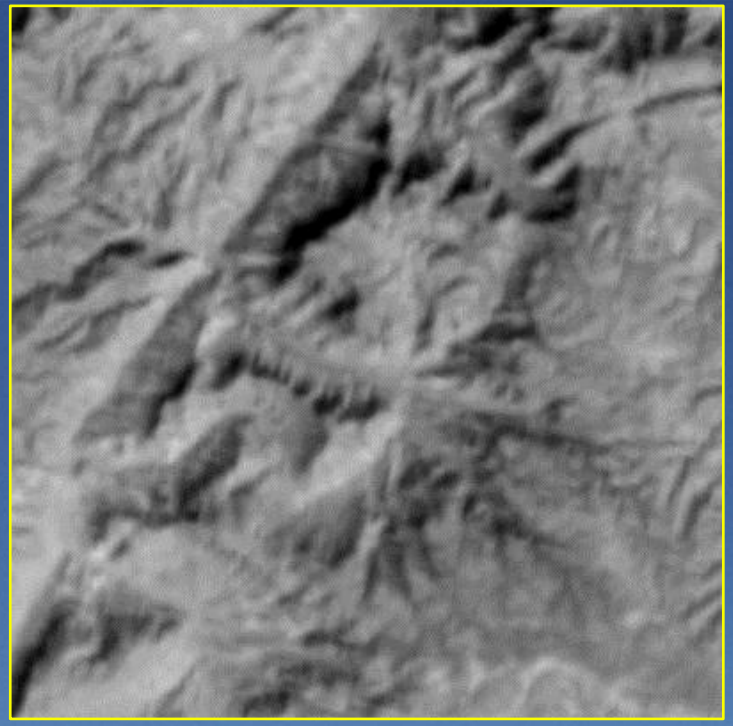
- L8 TIRS captured small variations that were uniform in L5 and L7, also smoother
- L8 VNIR bands show more details -> better sharpening results (e.g. small ponds)

(WRS-2 path 26 and row 31, central Iowa, 41.21554N, 93.0337W)

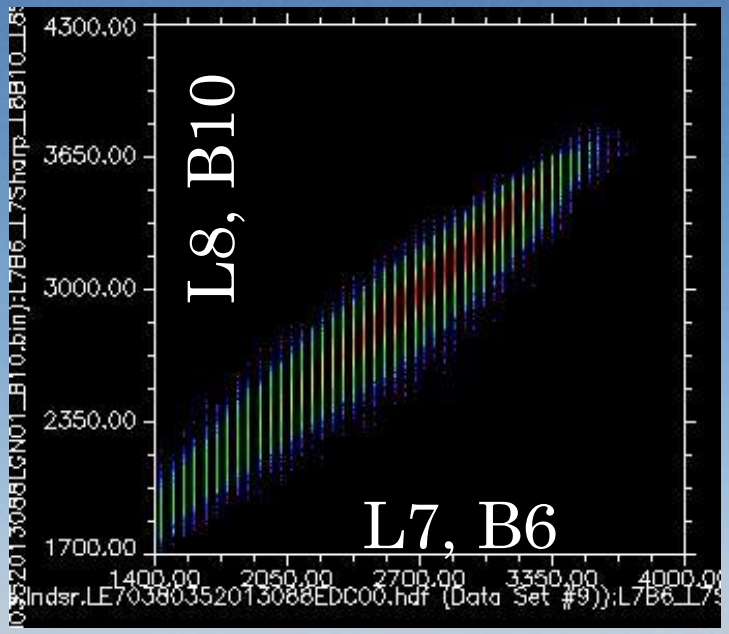
Overfly L7 & L8 (Org.)

p38r35 (NW AZ)

2013-088 (Mar. 29)



Tool: DMS

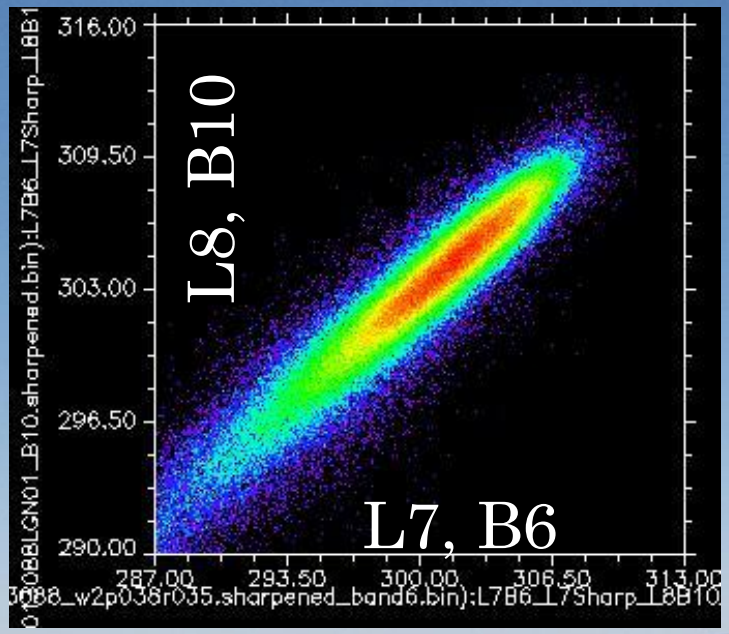


Overfly
L7 & L8
(Sharp)

p38r35
(NW AZ)

2013-088
(Mar. 29)

Tool: DMS



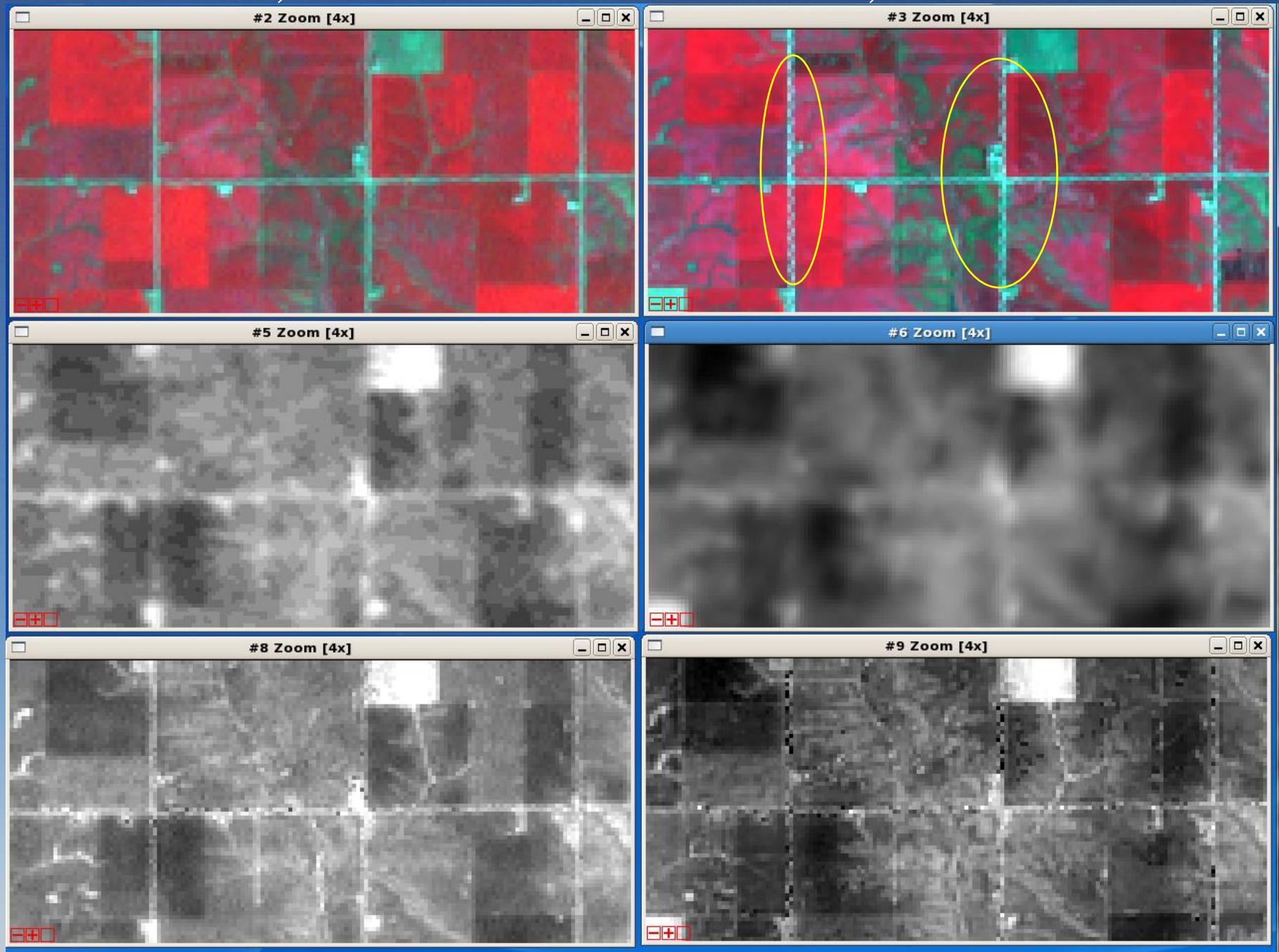
L7, 2013-244

L8, 2013-252

L7(432)/ L8 (543)

Original T

Sharpened T



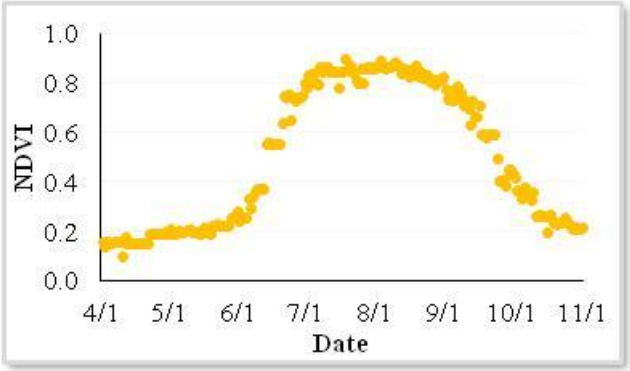
# FIELD-SCALE PHENOLOGIC METRICS

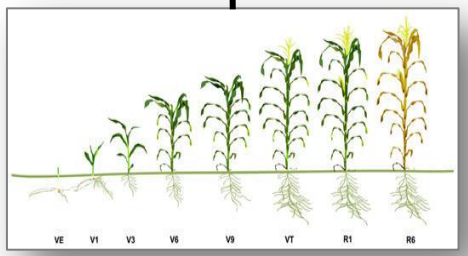
MODIS

Landsat

Lsat-like

STARFM



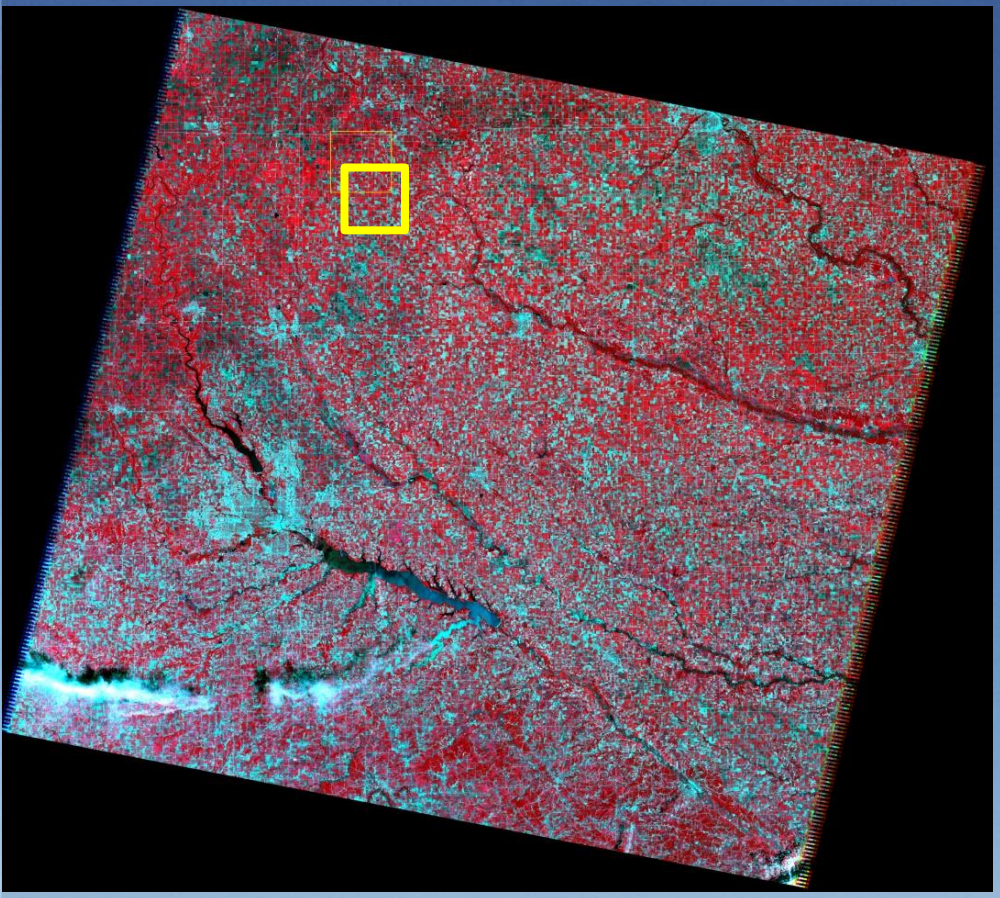



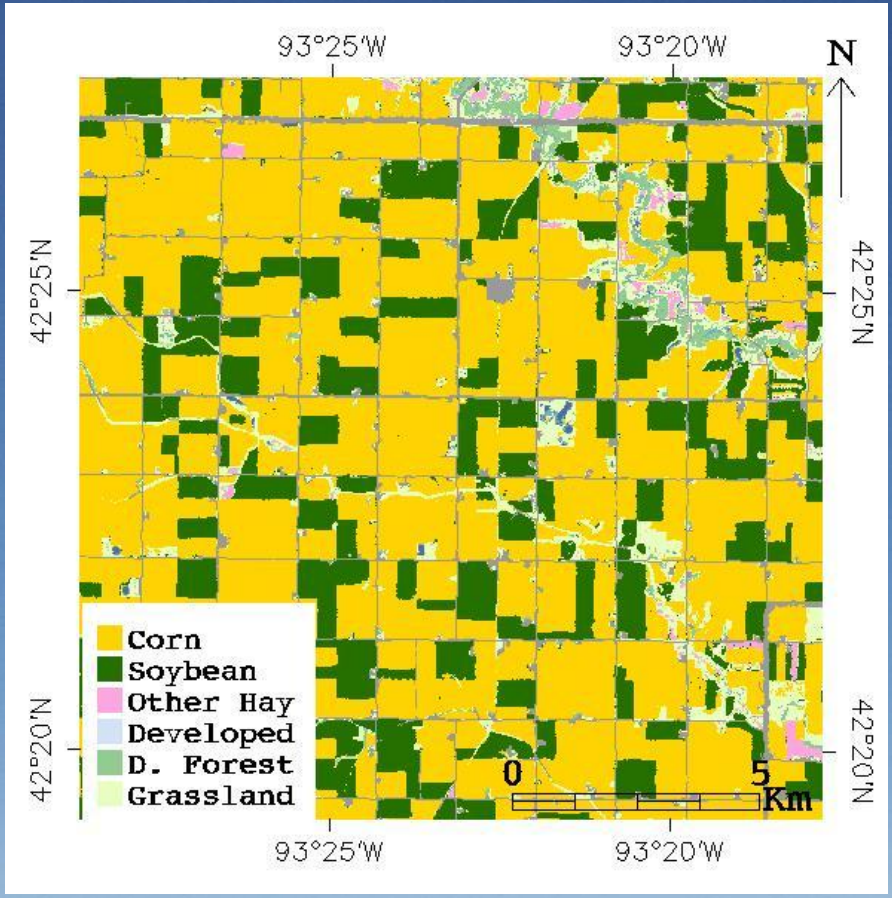
AGRICULTURE COUNTS NASS

## Phenology

- start of season
- end of season
- peak greenness
- start of senescence
- … …

# Study Area: South Fork, Iowa

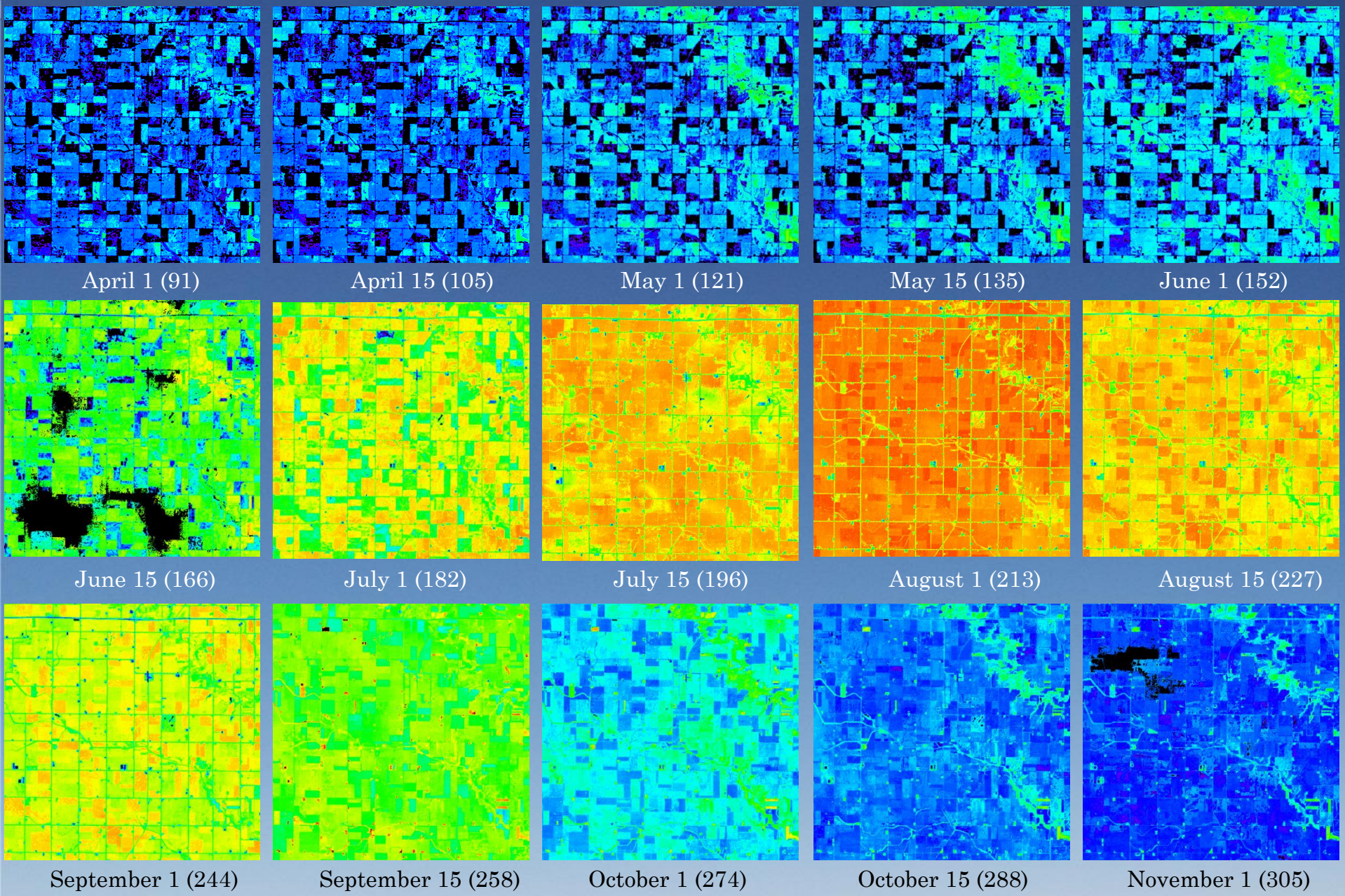





WRS-2 Path 26 Row 31

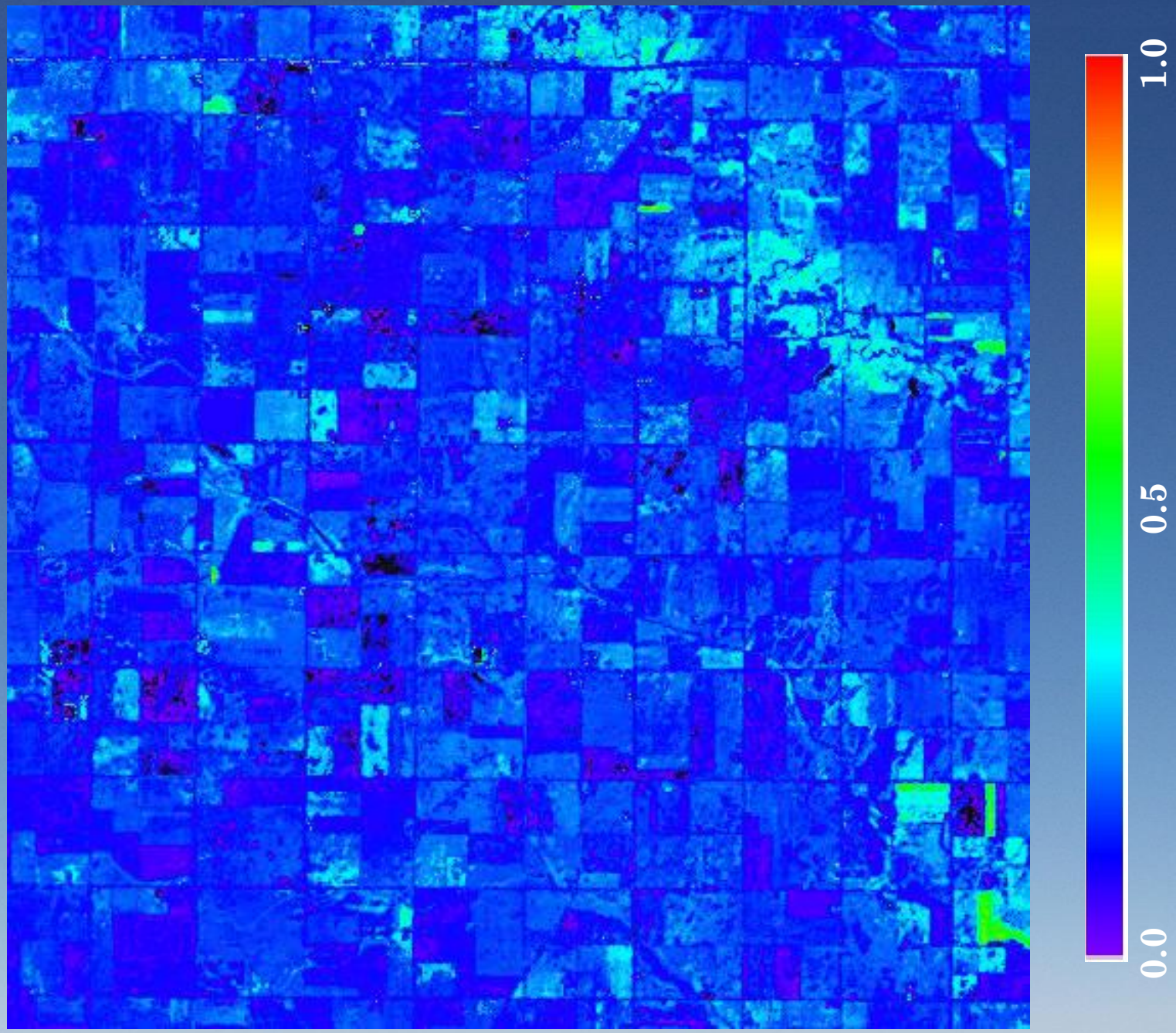
Cropland Data Layer (2011)

(six pairs of Landsat and MODIS images from July 2 to Nov. 7, 2011)



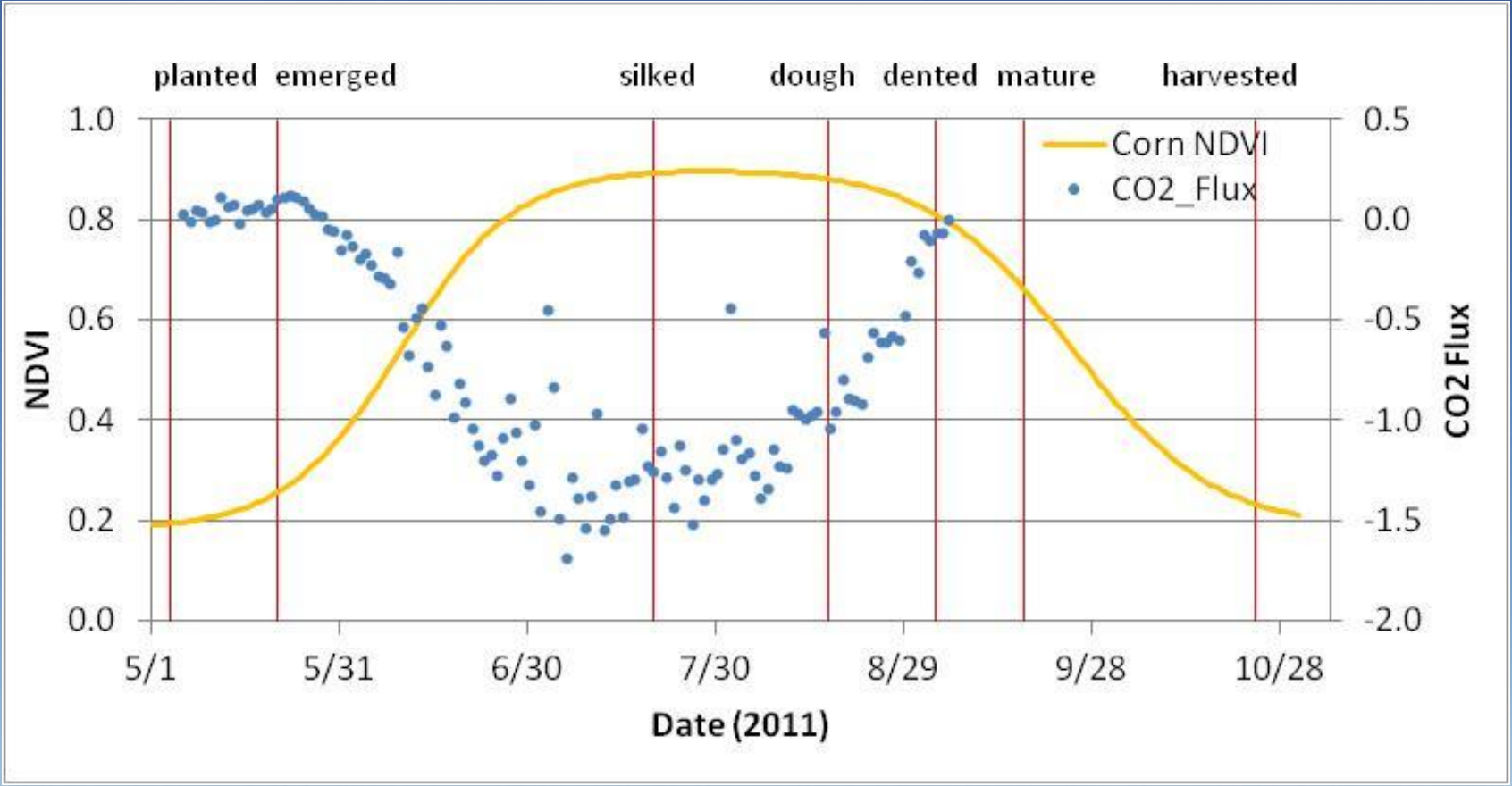

# STARFM NDVI Results

# APP: Crop Phenological Metrics

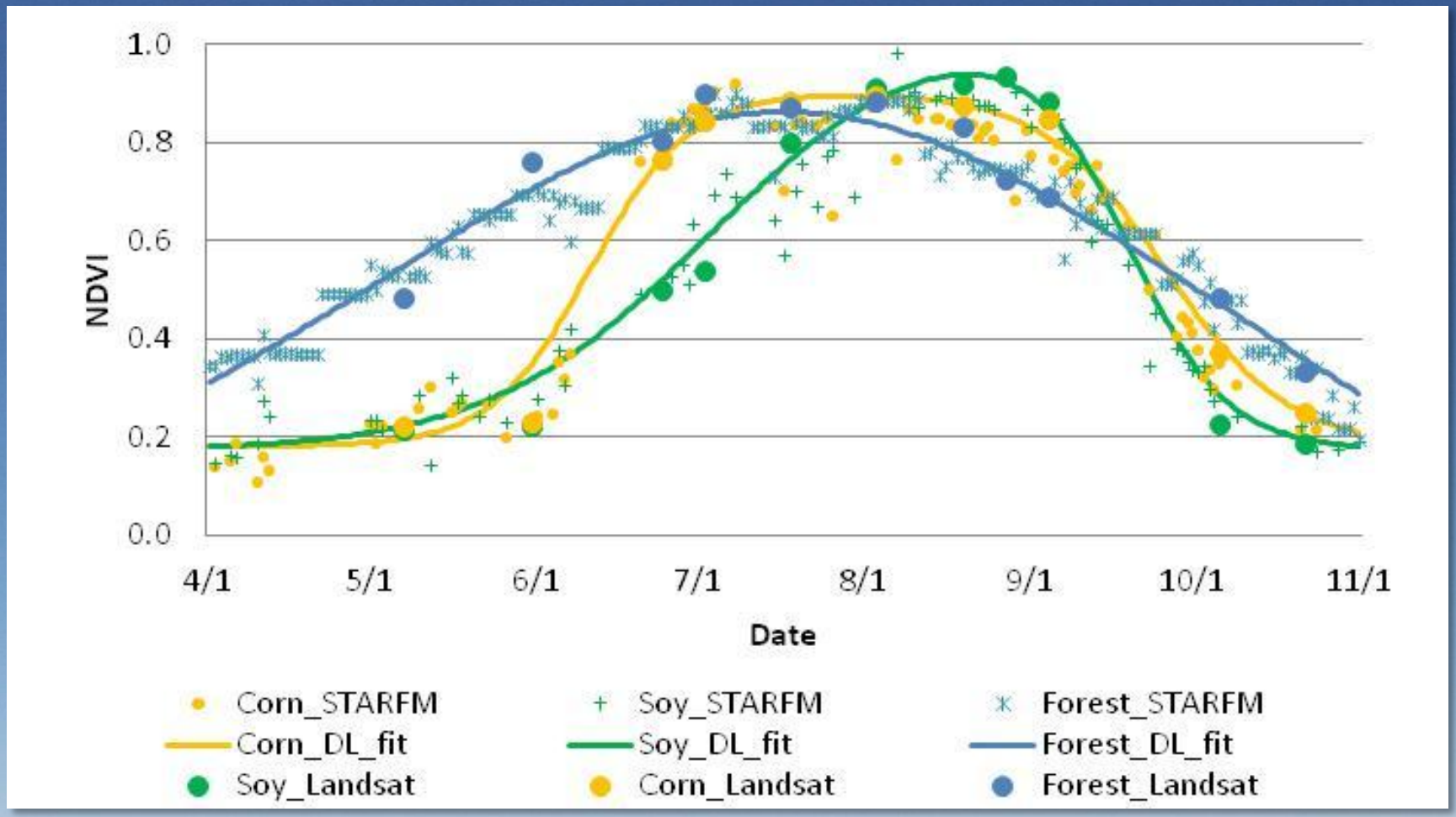



Smoothed Daily NDVI, Apr. 1 – Nov. 1, 2011

# Crop Growth Stages & Remote Sensing Phenology

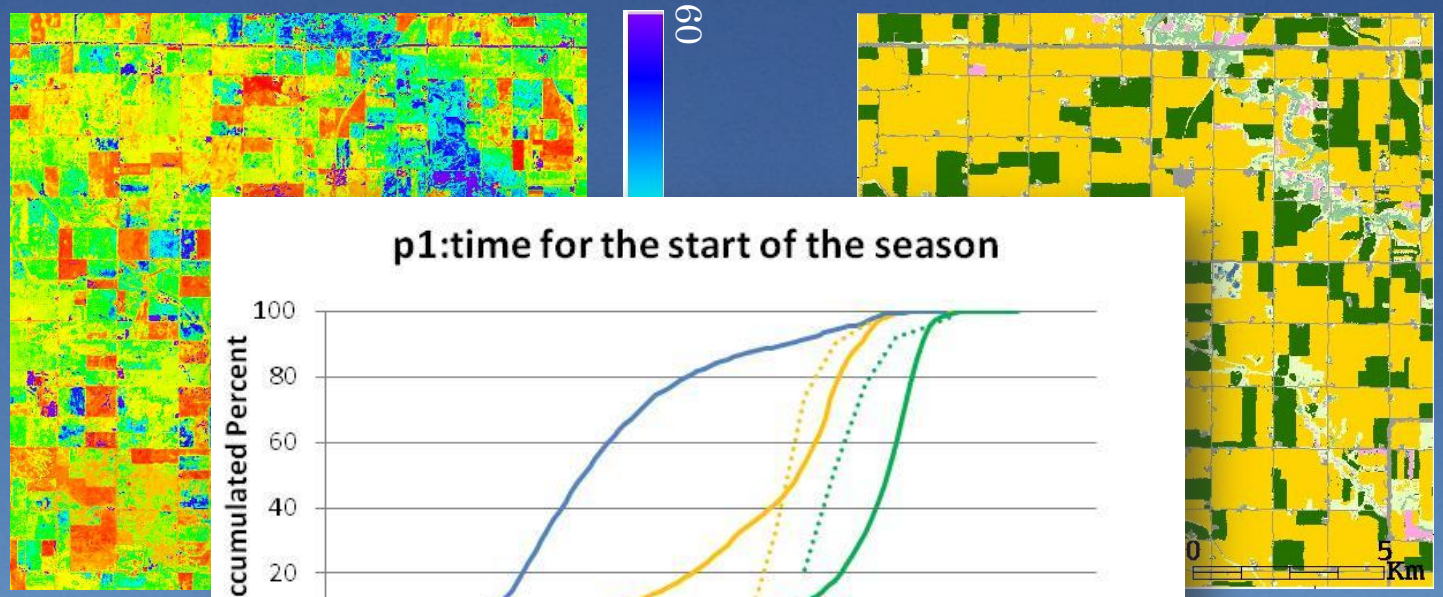


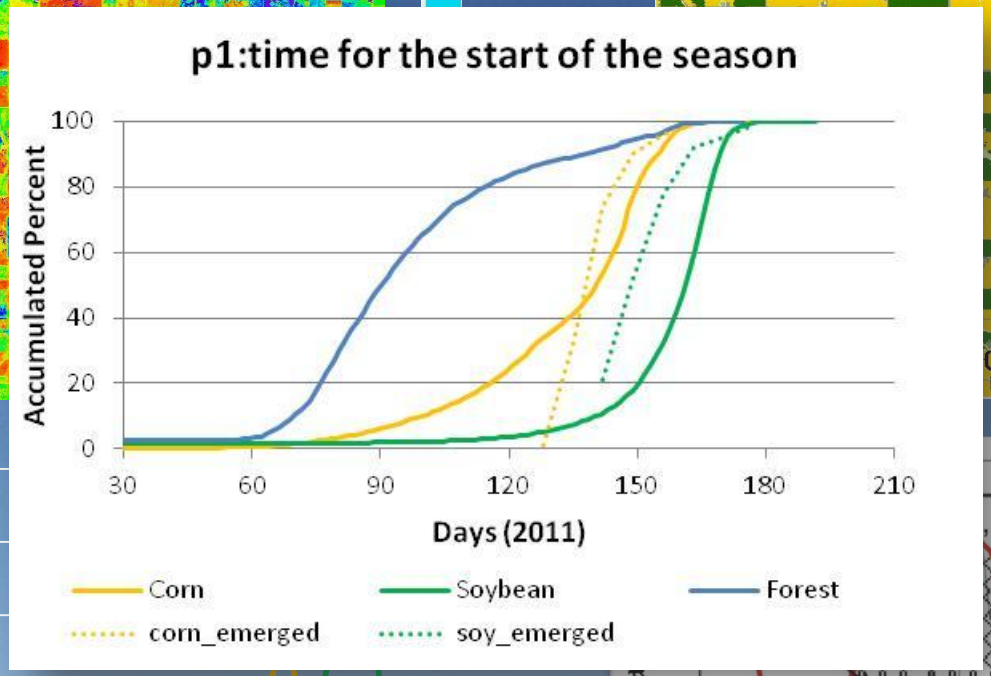
# Typical Cover Types (3 Landsat Pixels)

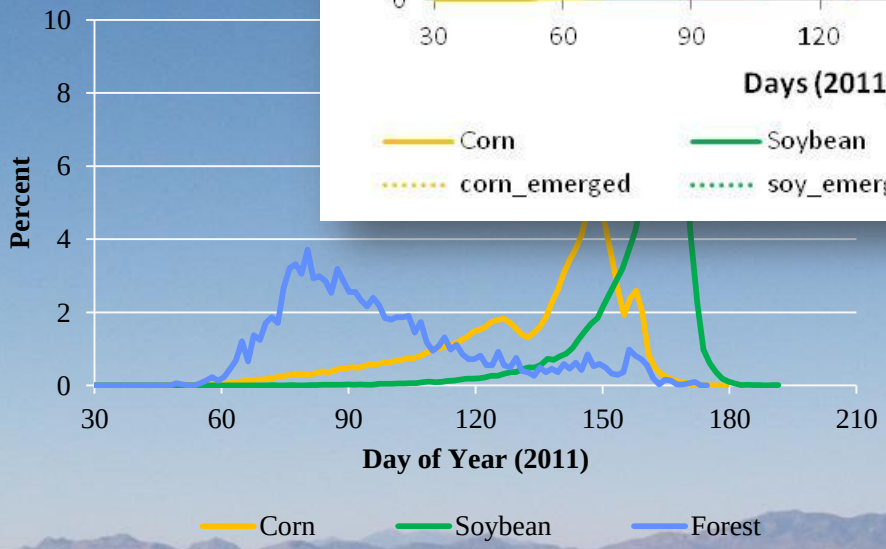


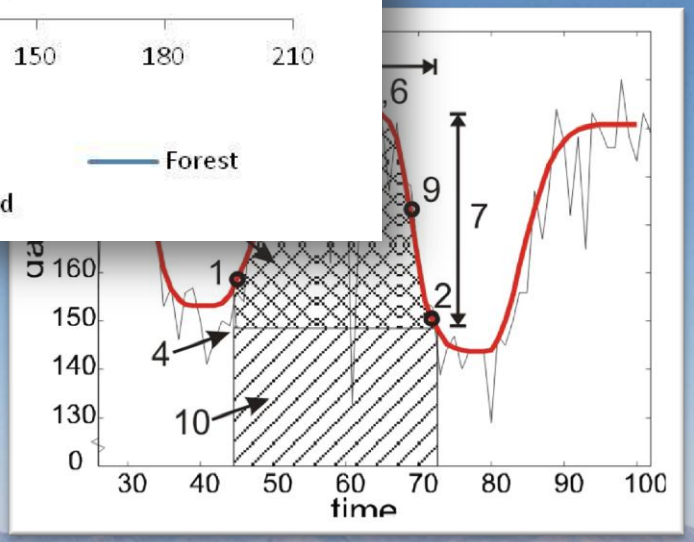
APP: Crop Phenological Metrics

# Time for the Start of the Season (P1)



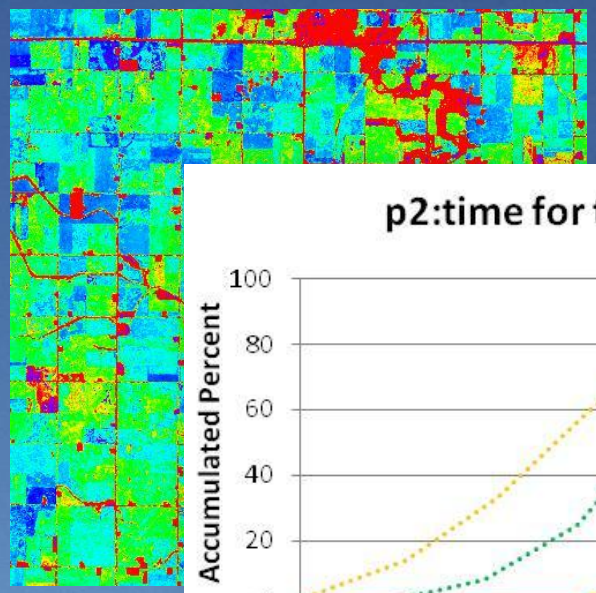



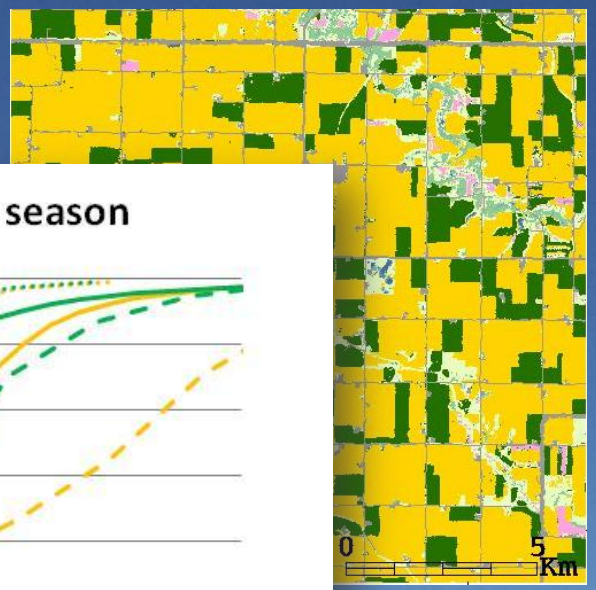



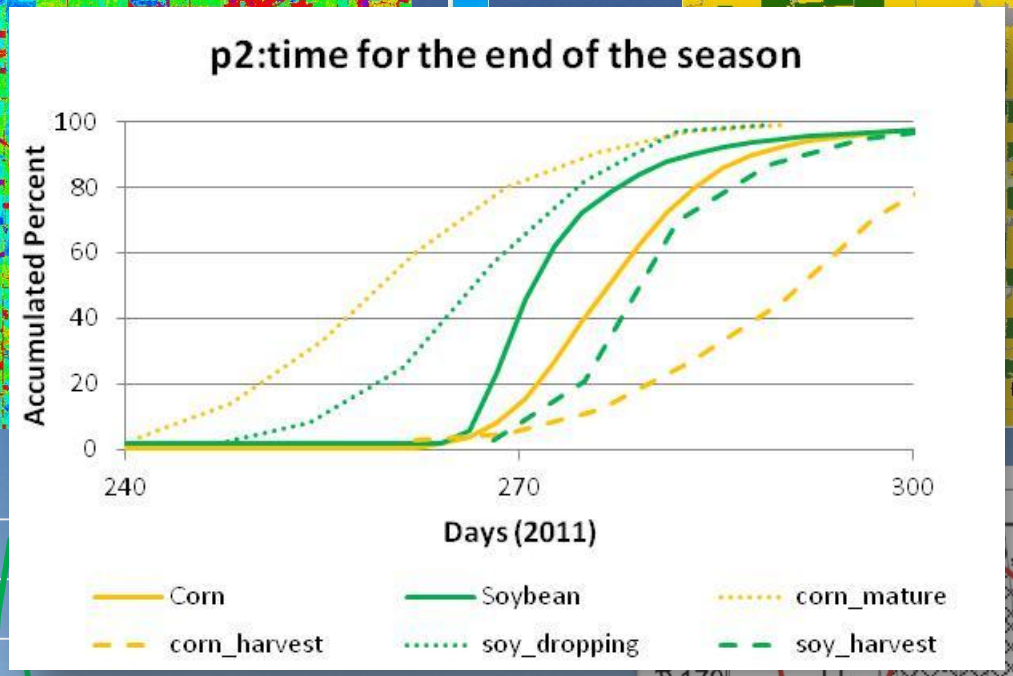



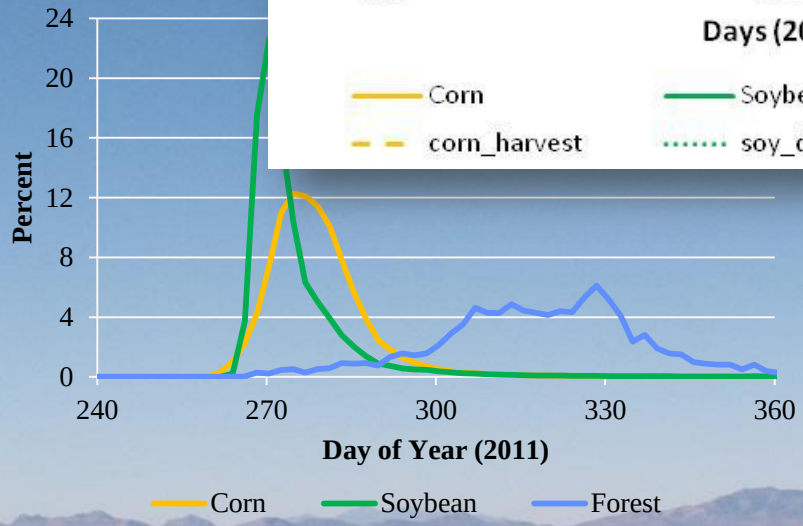
APP: Crop Phenological Metrics

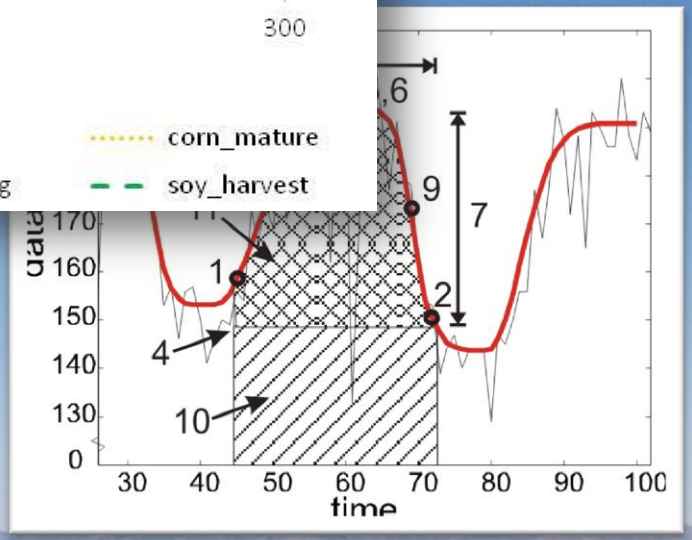
# Time for the End of the Season (P2)



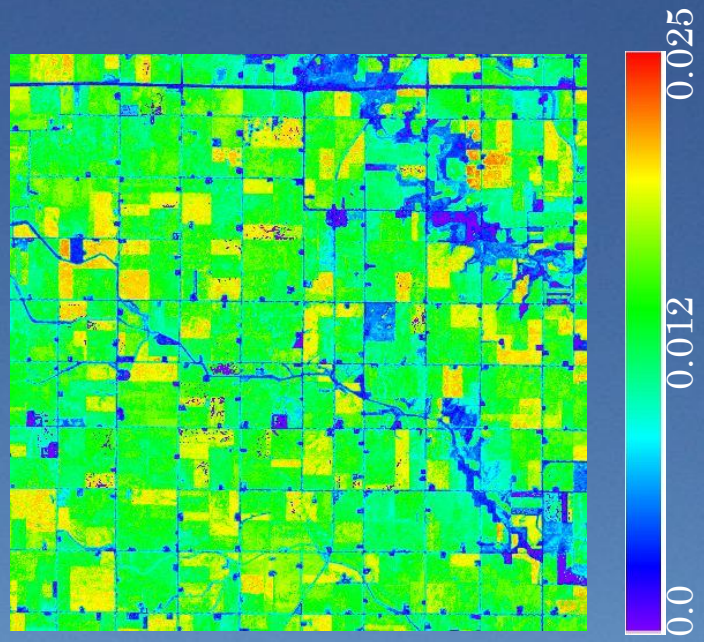



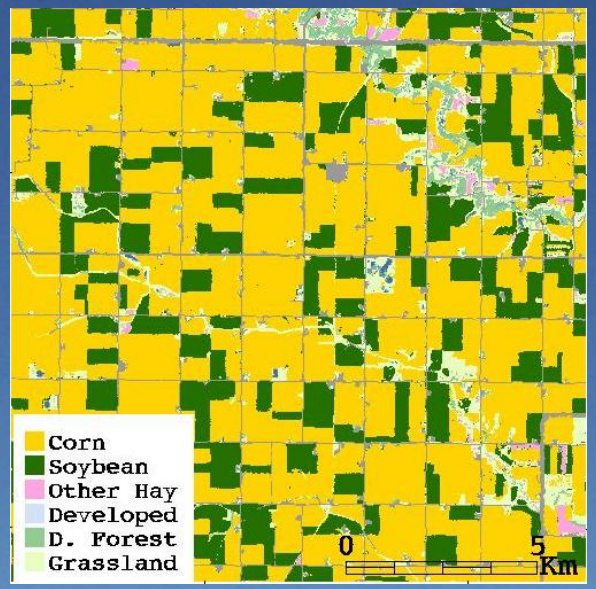



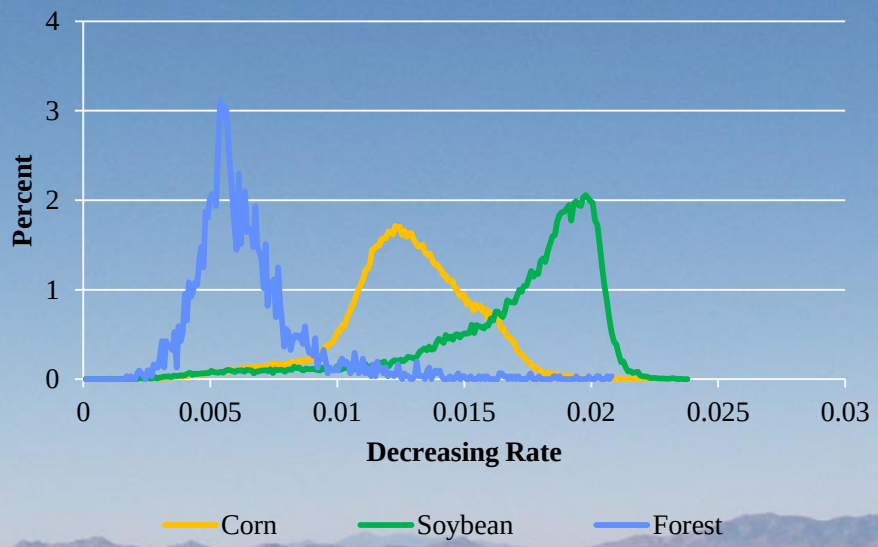



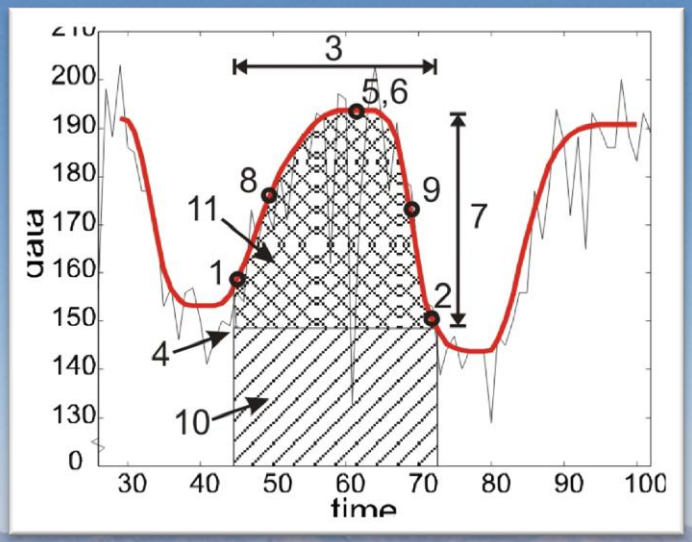



# Rate of Decrease (right slope, P9)



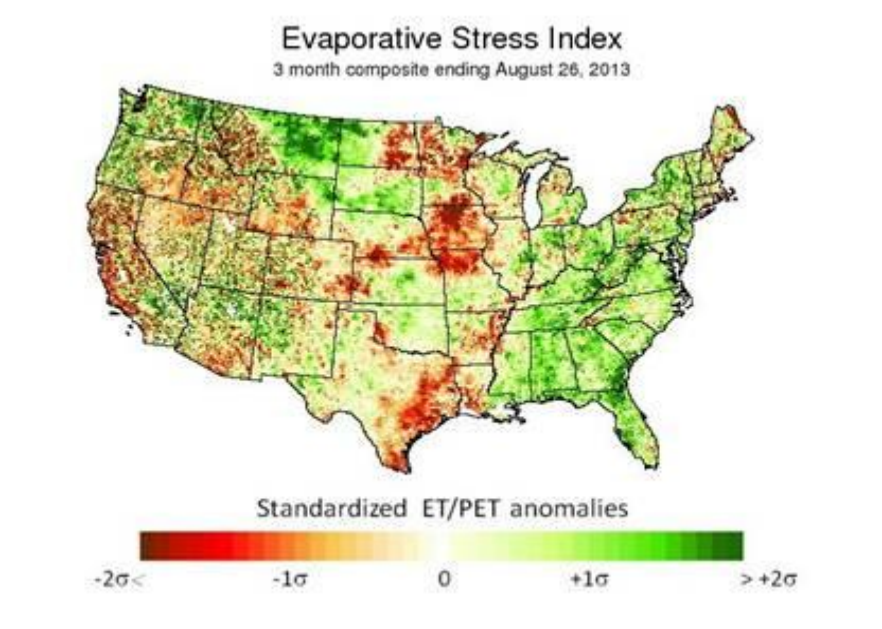
# Summary

- L8 TIRS sharpening results (30m) show comparable spatial details to the results sharpened from L7 ETM+
- Annual crop phenology were extracted using L5, L7 and MODIS. We will test L7 and L8 combination when L8 surface reflectances are available.

# Fusion tools and products = understanding Evaporative Stress signal

Negative ET anomalies:

-phenological shift
(i.e. planted to emerged)
-variable acreage planted
-soil moisture deficit
-variable response reflective of vegetation type
-water management

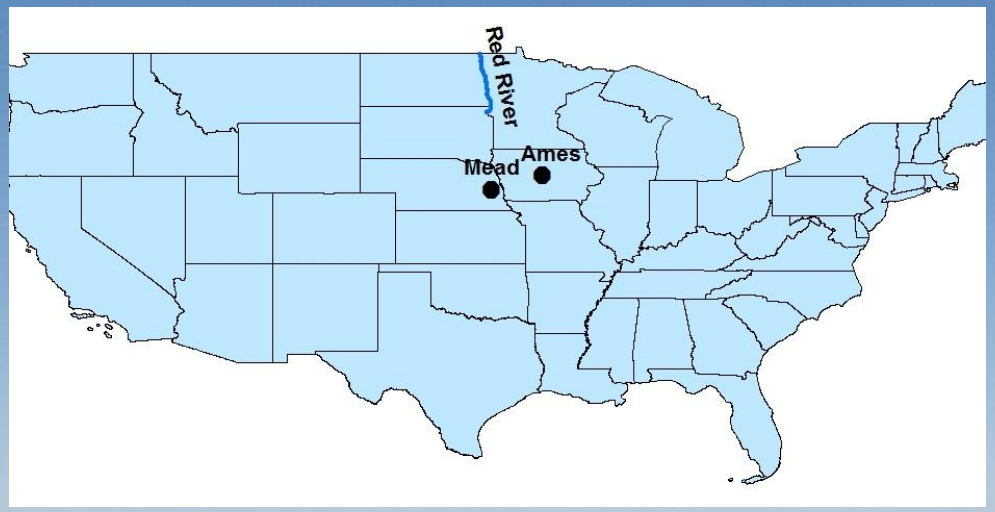



*Can only determine primary cause at field scale through Landsat*

*Cause influences management action*

# Time series (2000-2013) of Fusion data products (Daily ET at Landsat resolution)

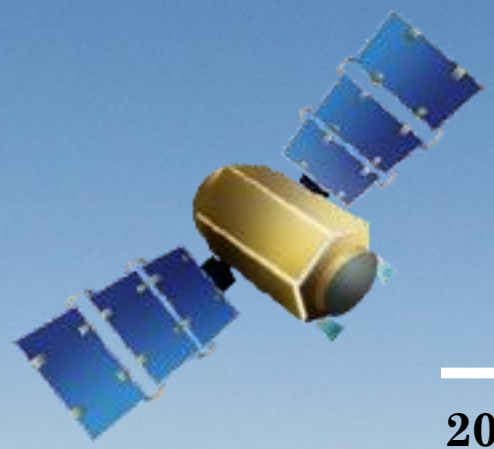
- Mead, Nebraska → middle of cornbelt, auxiliary datasets for validation, hail damage 2004
- Ames, Iowa → effects of phenology and unplanted acreage
- North Dakota (Red River Valley) → effects of changes in land management (tile drainage installation)

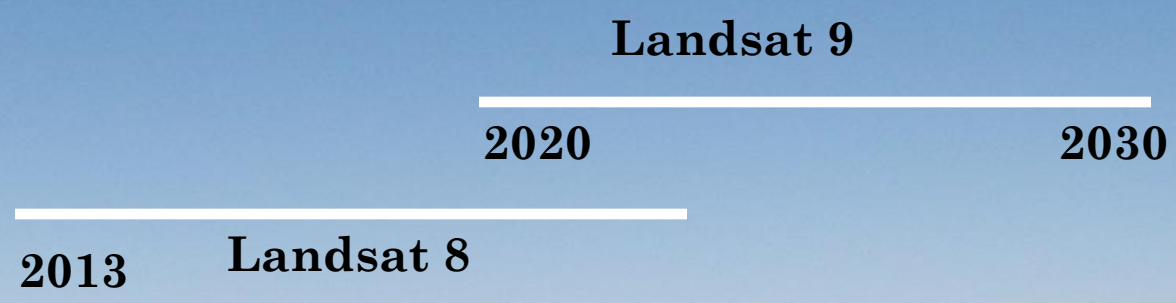
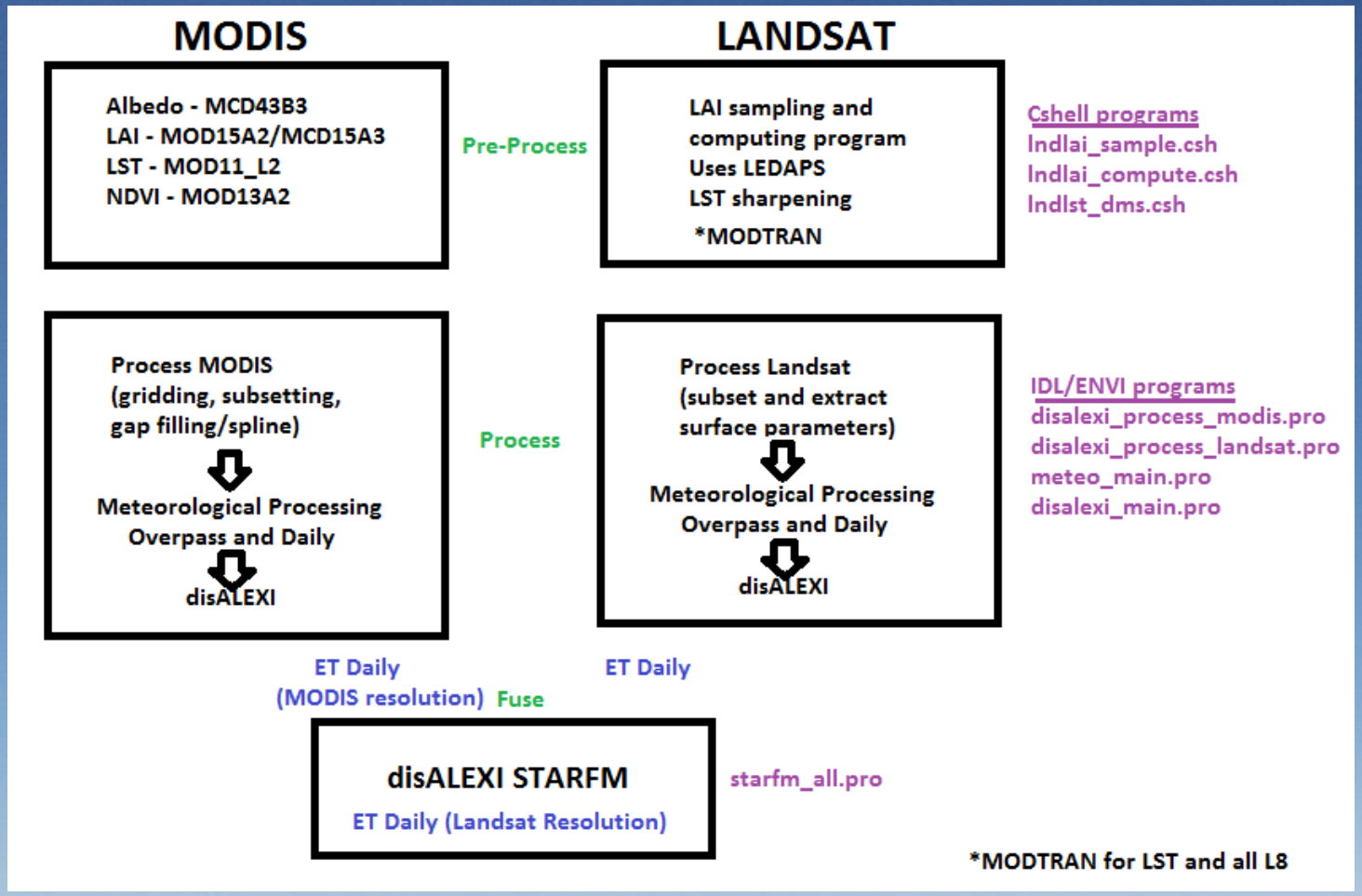



Study Sites

# Consequences of Landsat coverage gap

- Lost opportunities to determine stress causes
- 2012 severe drought year BUT little Landsat data
- Need to be proactive and plan for Landsat 9 now to eliminate gaps





# Extras – Processing Flowchart