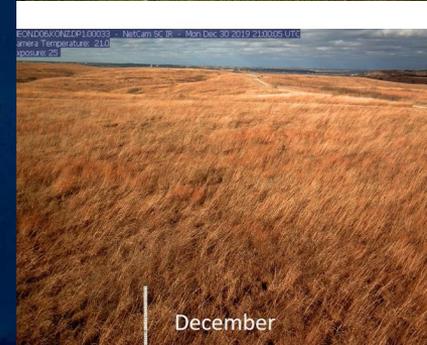
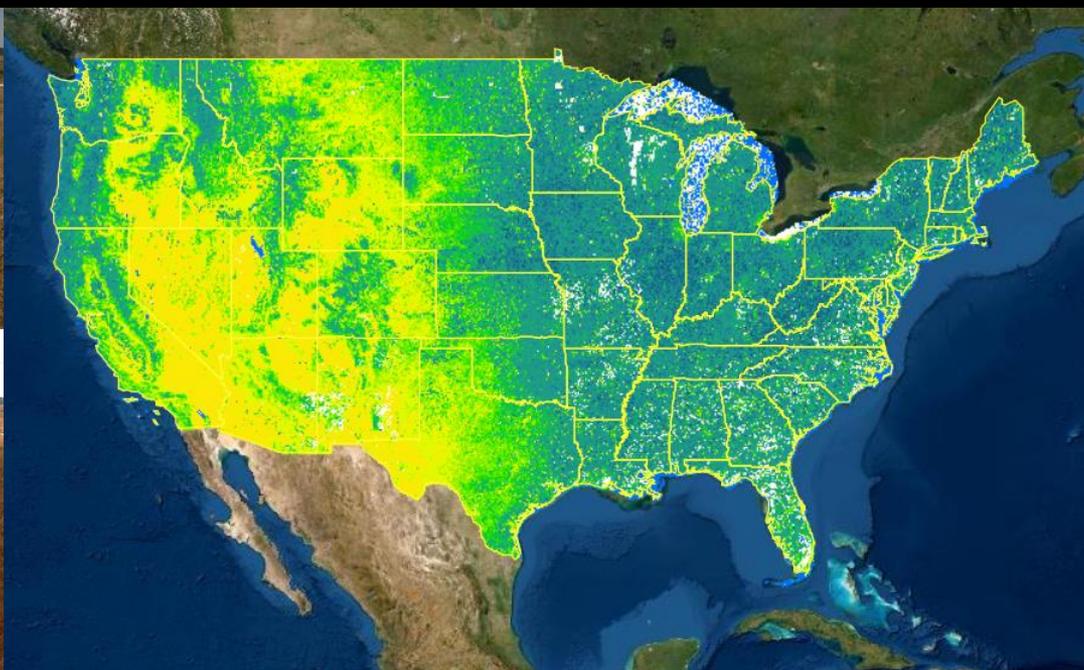
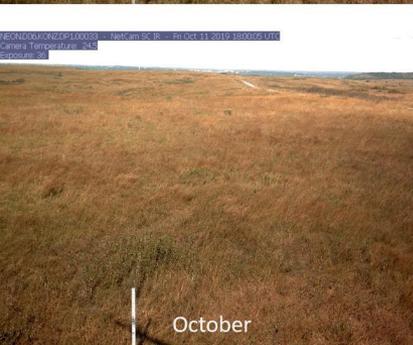


# PhenoMap: Providing weekly vegetation development monitoring for effective management

Jacqueline Ott<sup>1</sup>, Charlie Schrader-Patton<sup>2</sup>, and Nancy Grulke<sup>3</sup>



1- Rocky Mountain Research Station; 2- RedCastle Resources Inc., Western Wildlands Environmental Threat Assessment Center; 3-Pacific Northwest Research Station

# Presenters



Jackie Ott is a Research Ecologist with the Rocky Mountain Research Station based in Rapid City, SD.



Charlie Schrader-Patton is a Geospatial Analyst and Developer for RedCastle Resources Inc. and the USFS Western Wildlands Environmental Threat Assessment Center.



Nancy Grulke is a Research Ecologist with the Pacific Northwest Research Station.

# Outline

## I. PhenoMap: Background

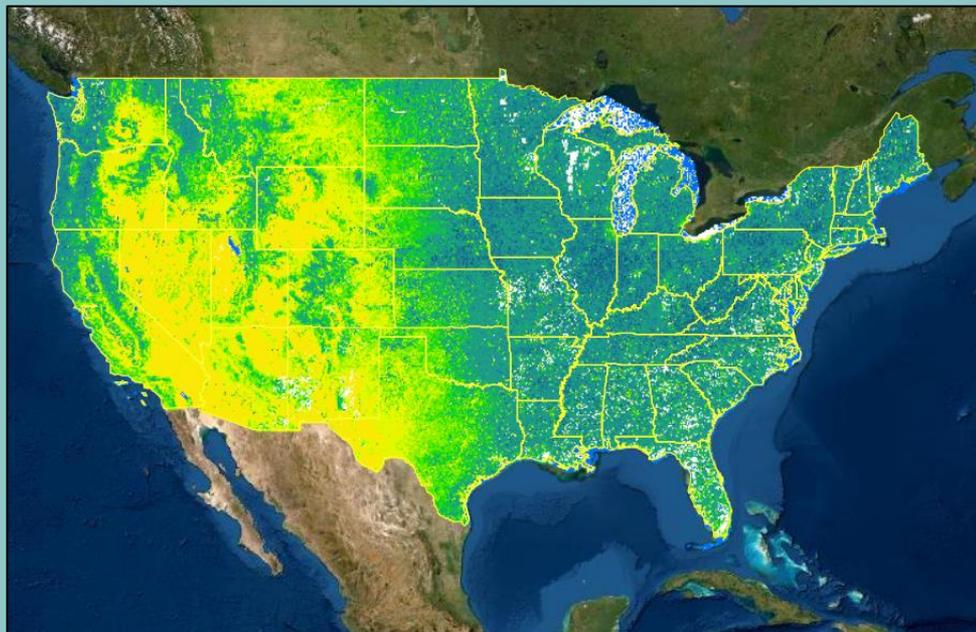
## II. Scenarios: What can I use PhenoMap for?

## III. PhenoMap Basics: How do I use PhenoMap?



# What is PhenoMap?

PhenoMap is a web-based mapping tool that **provides a weekly assessment of vegetation phenology** across the United States that can be used for vegetation condition assessments throughout the year.

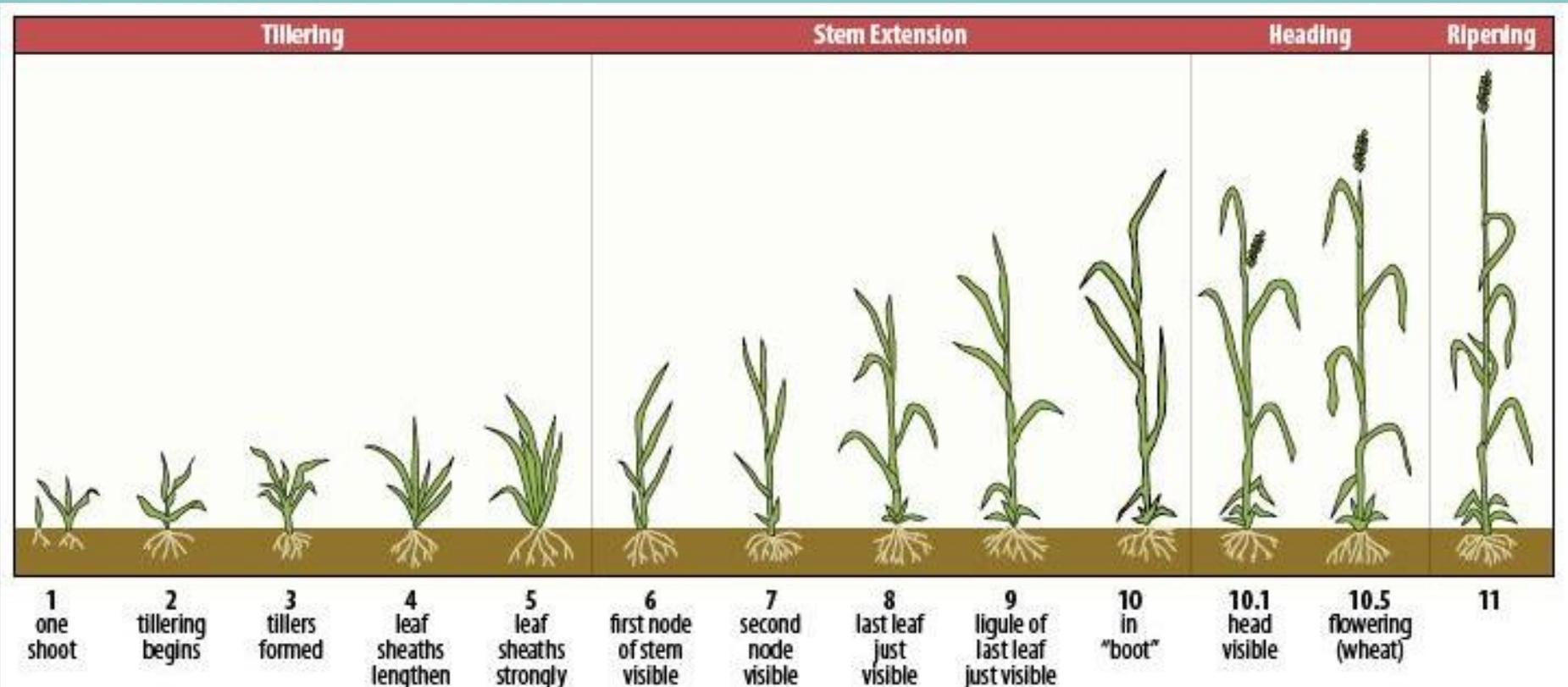


What is phenology?

# Phenology

What is phenology?

- The timing of life history events



<http://www.uky.edu/Ag/GrainCrops/>

# Phenology

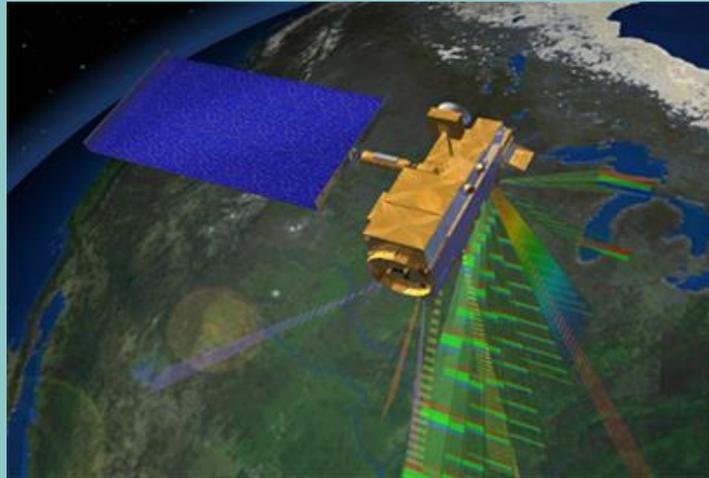
- The study of cyclic and seasonal natural phenomena, especially in relation to climate and plant and animal life



# Phenology

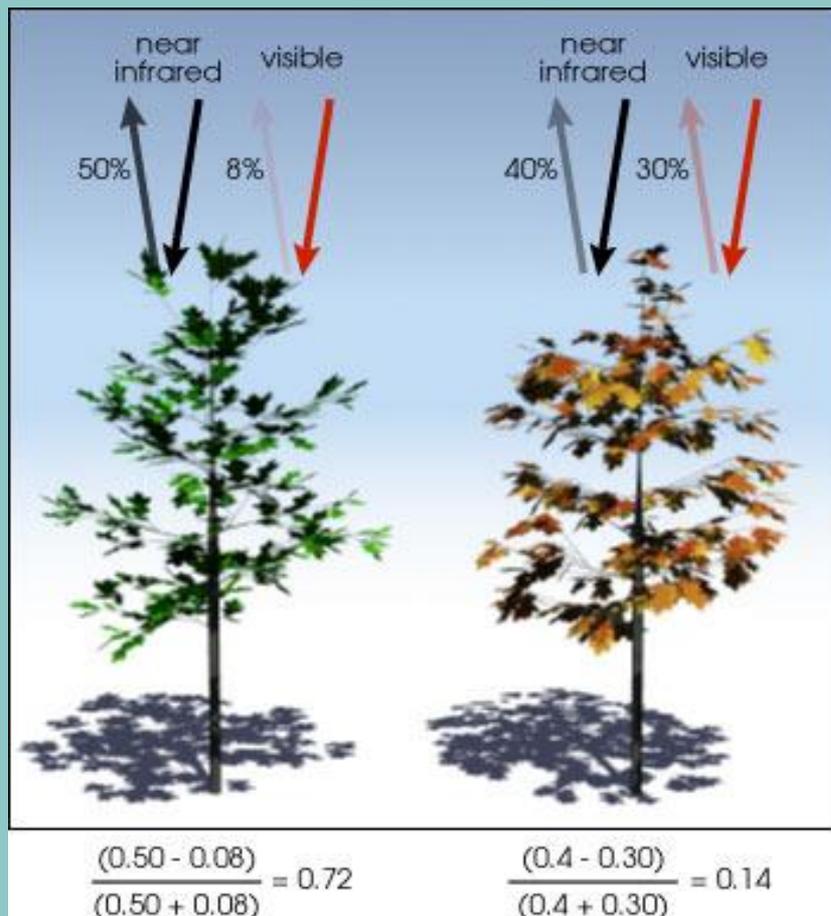
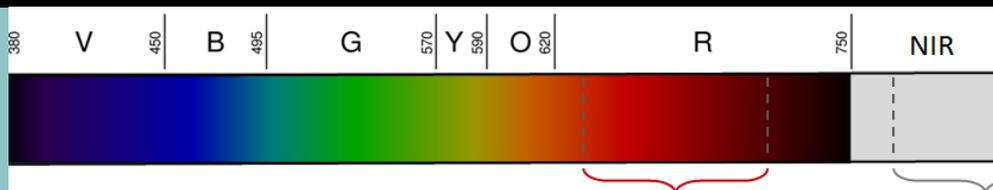
How can we measure phenology?

- Plant phenology is really a measure of “greenness”
- Use satellite data to monitor vegetation over large areas



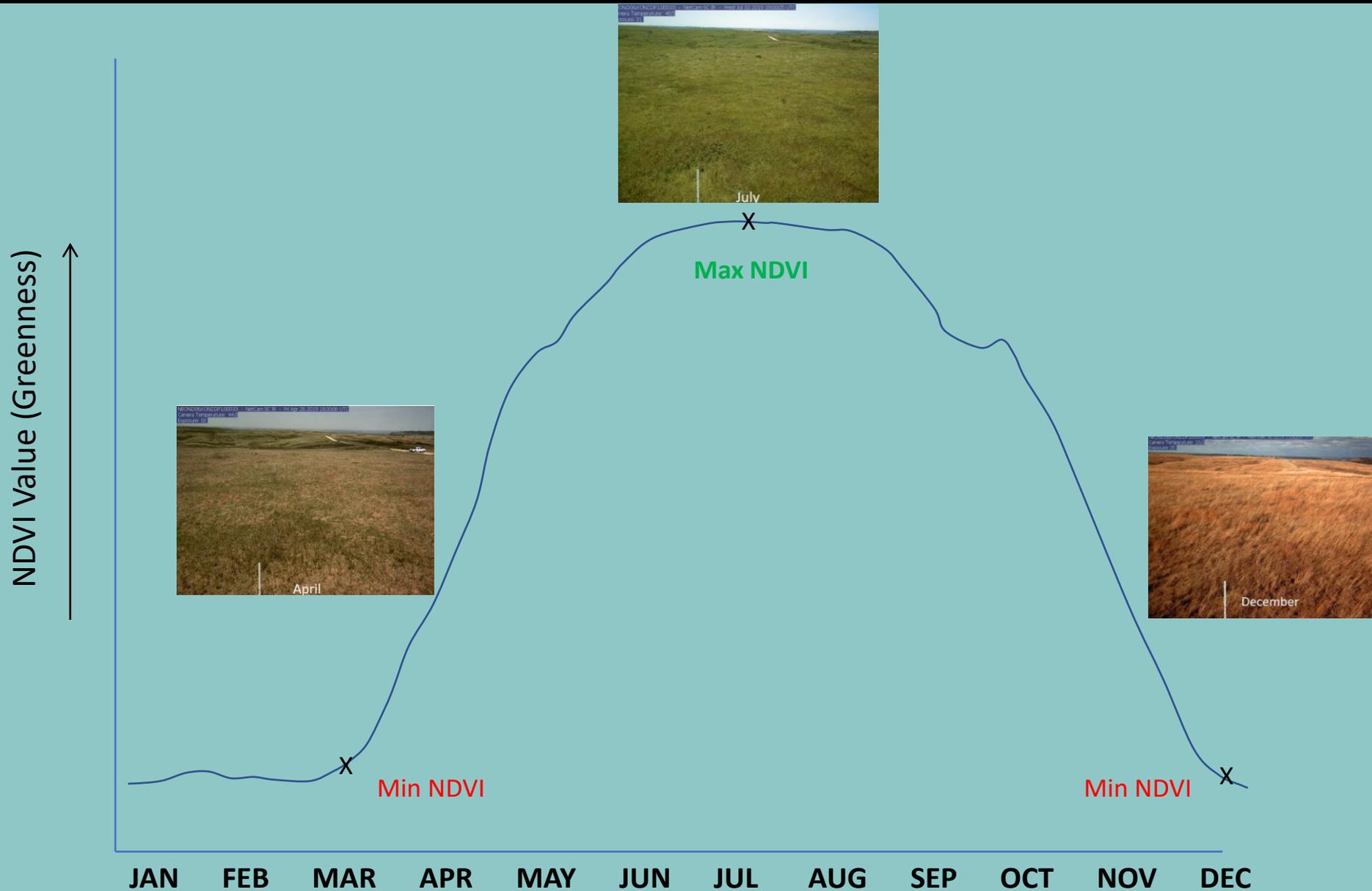
NASA Earth Observation System  
MODIS – Moderate Resolution Spectroradiometer

# Normalized Difference Vegetation Index (NDVI)



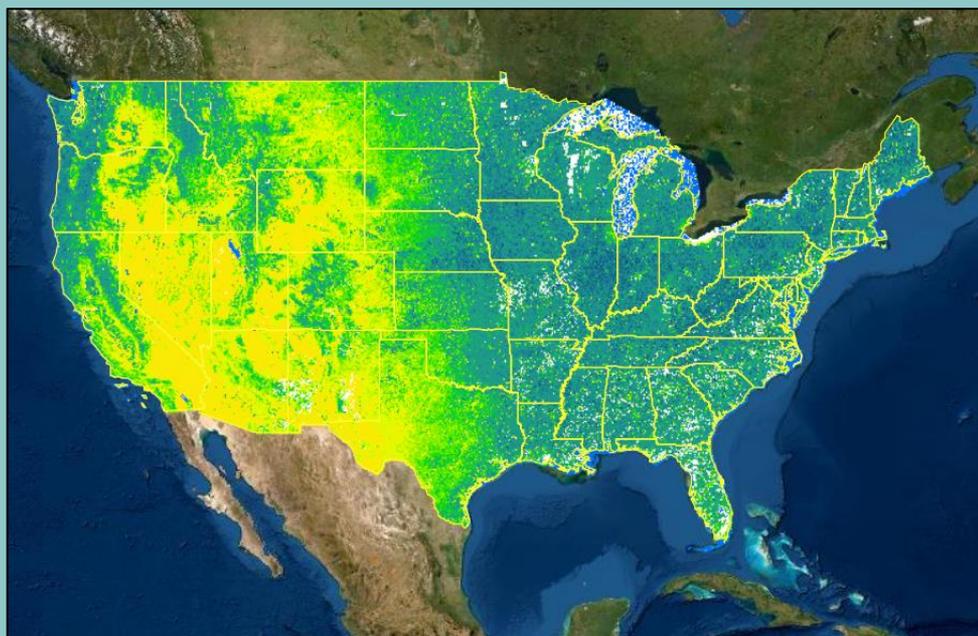
$$NDVI = \frac{(NIR - Red)}{(NIR + Red)}$$

# NDVI (Greenness) through the year

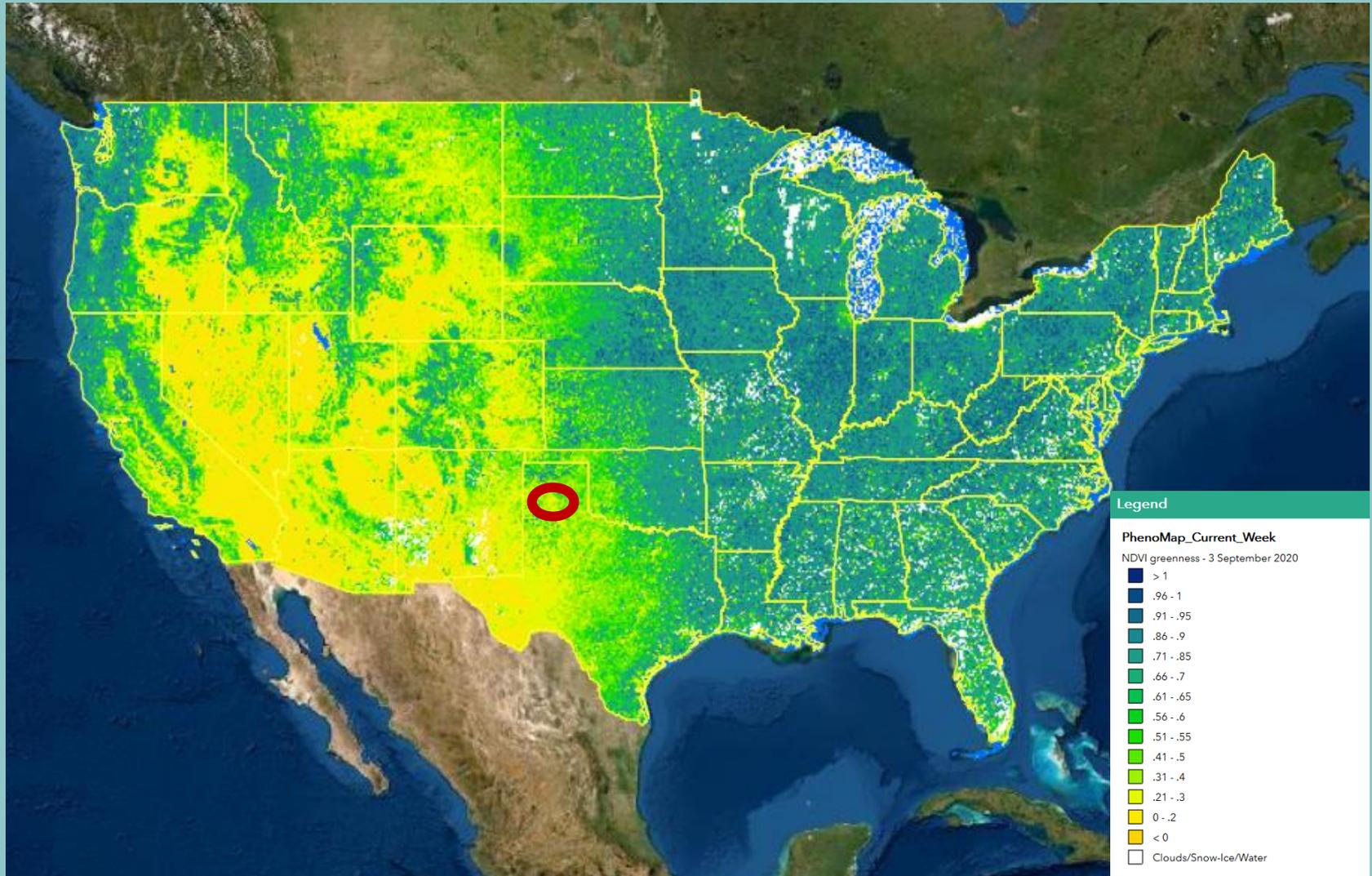


# Purpose of PhenoMap

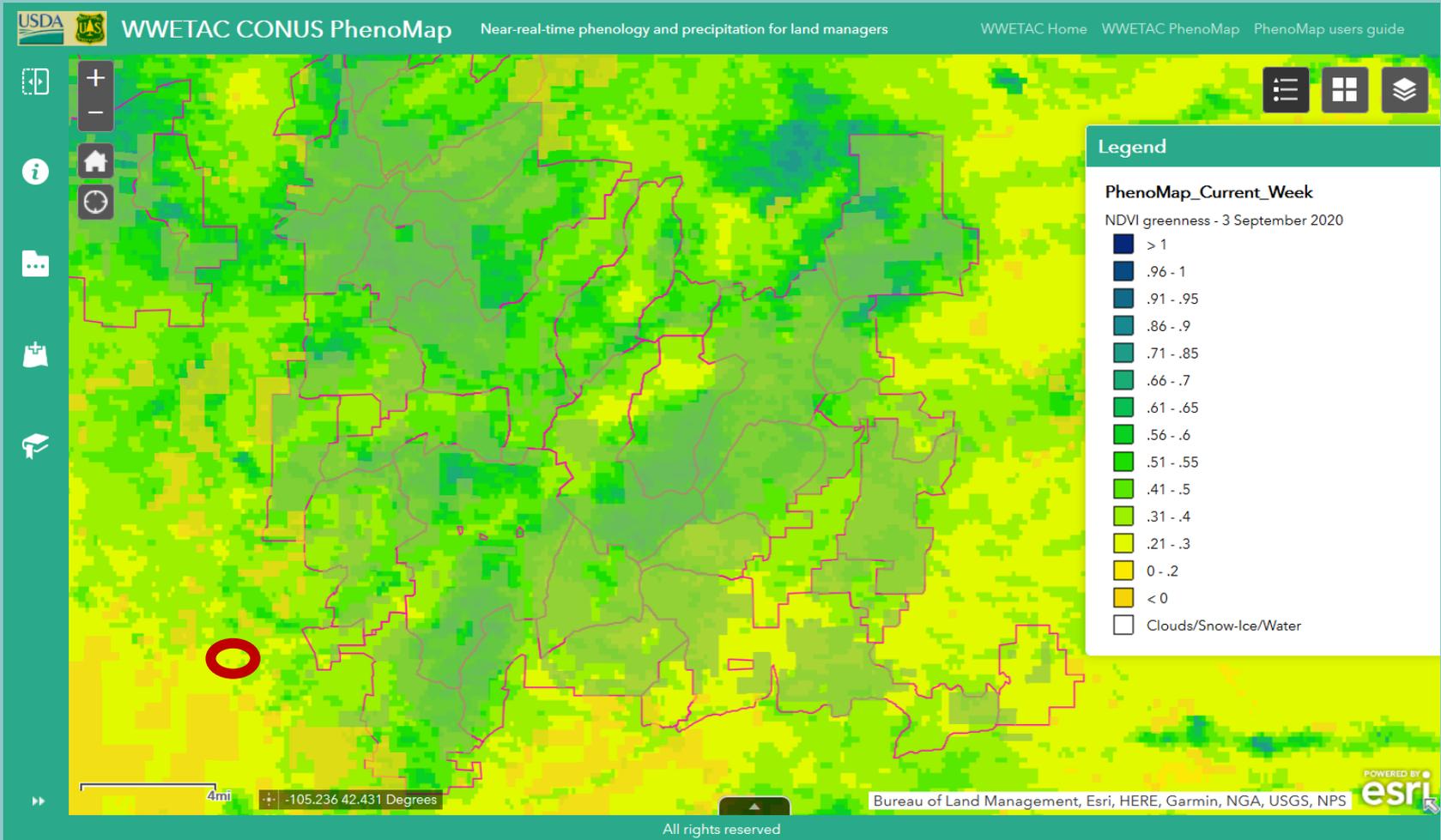
PhenoMap is a web-based mapping tool that provides a **weekly assessment of vegetation phenology across the United States** that can be used for vegetation condition assessments throughout the year.



# National Scale

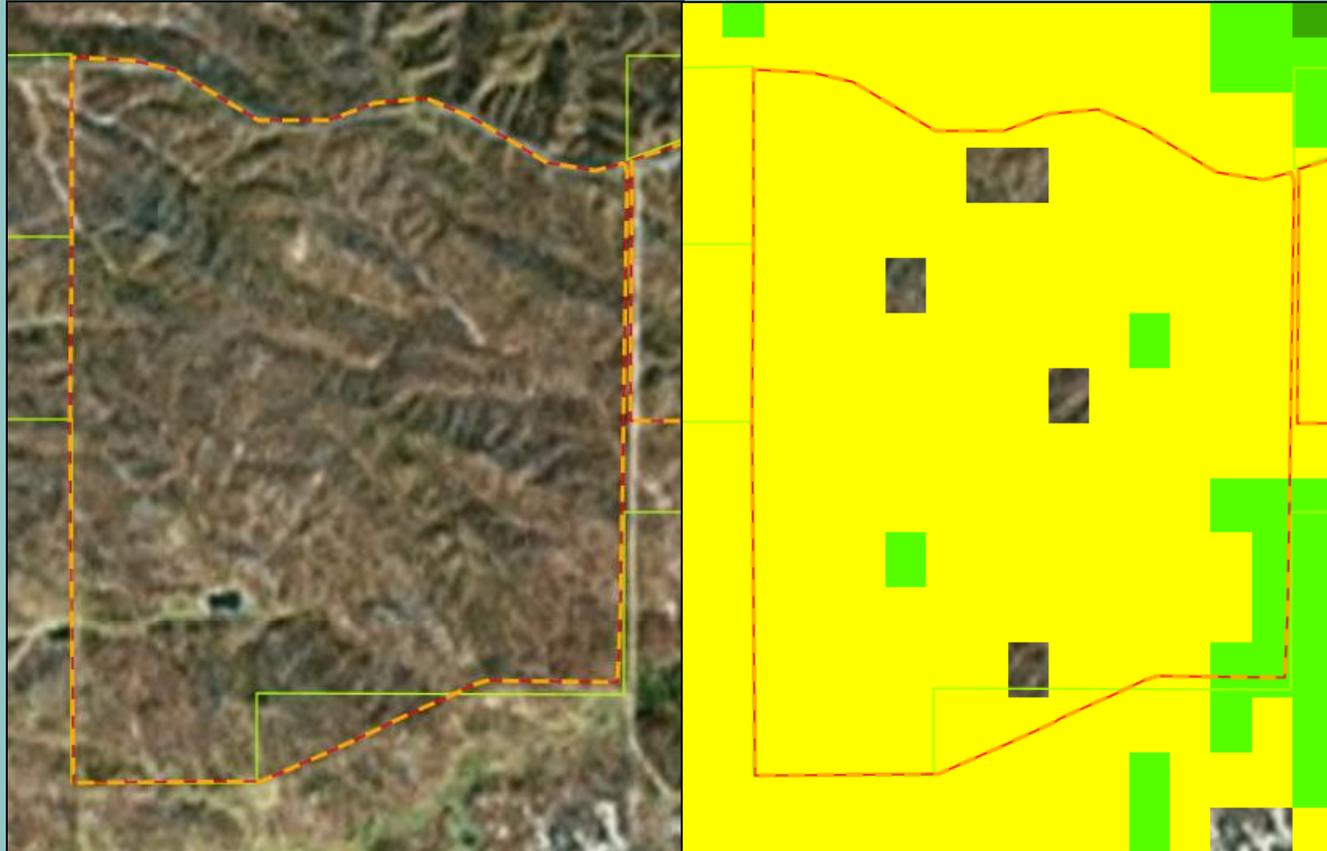


# Regional Scale



# Pasture Scale

Each Pixel = 15 acres



# PhenoMap

PhenoMap is a web-based mapping tool that **provides a weekly assessment of vegetation phenology across the United States** that can be used for vegetation condition assessments throughout the year.

- How does NDVI from satellites compare to what I see on the ground?
- Does satellite data correlate to anything managers measure on the ground?

# Scaling Greenness in Near-Real Time

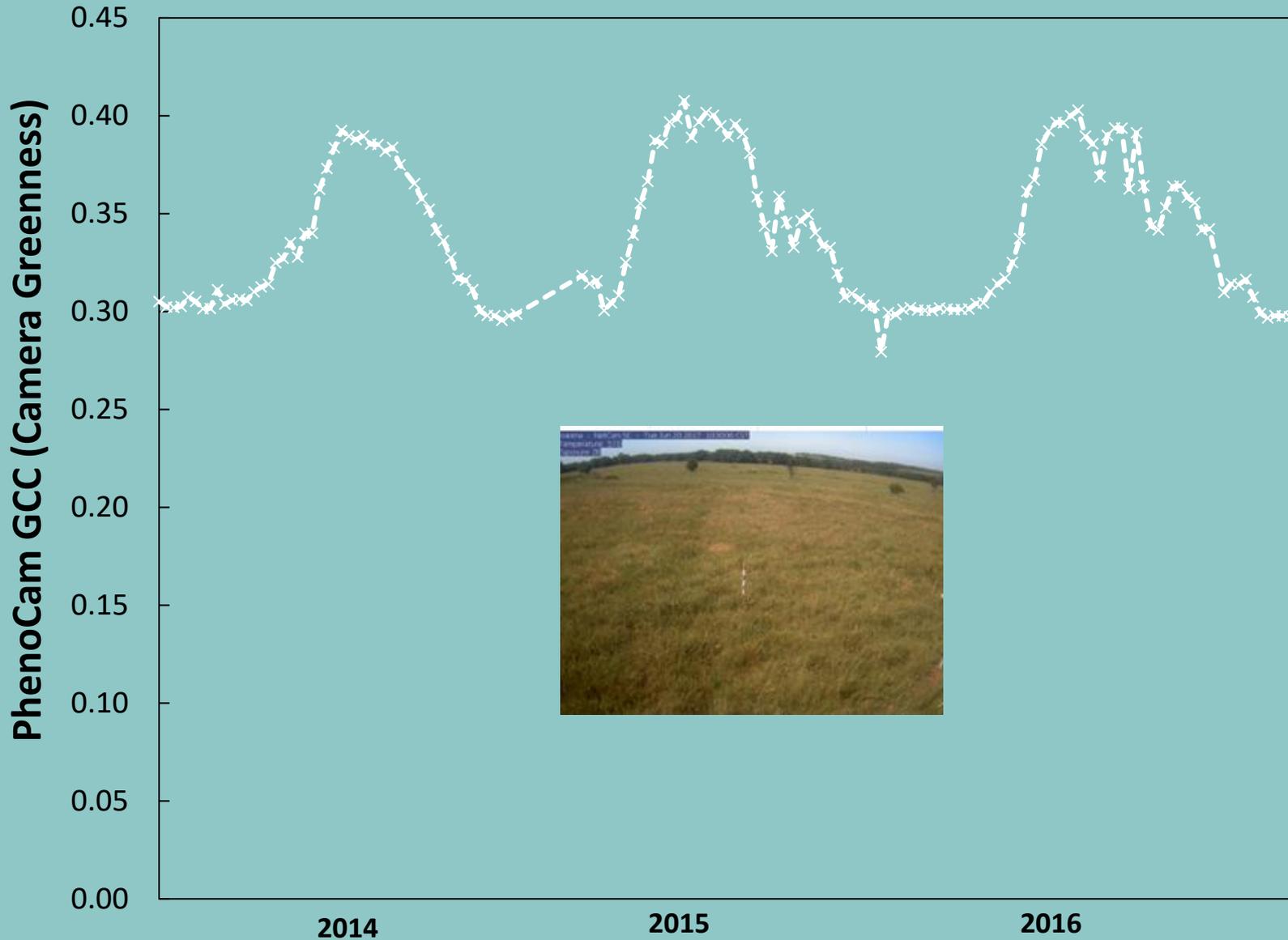




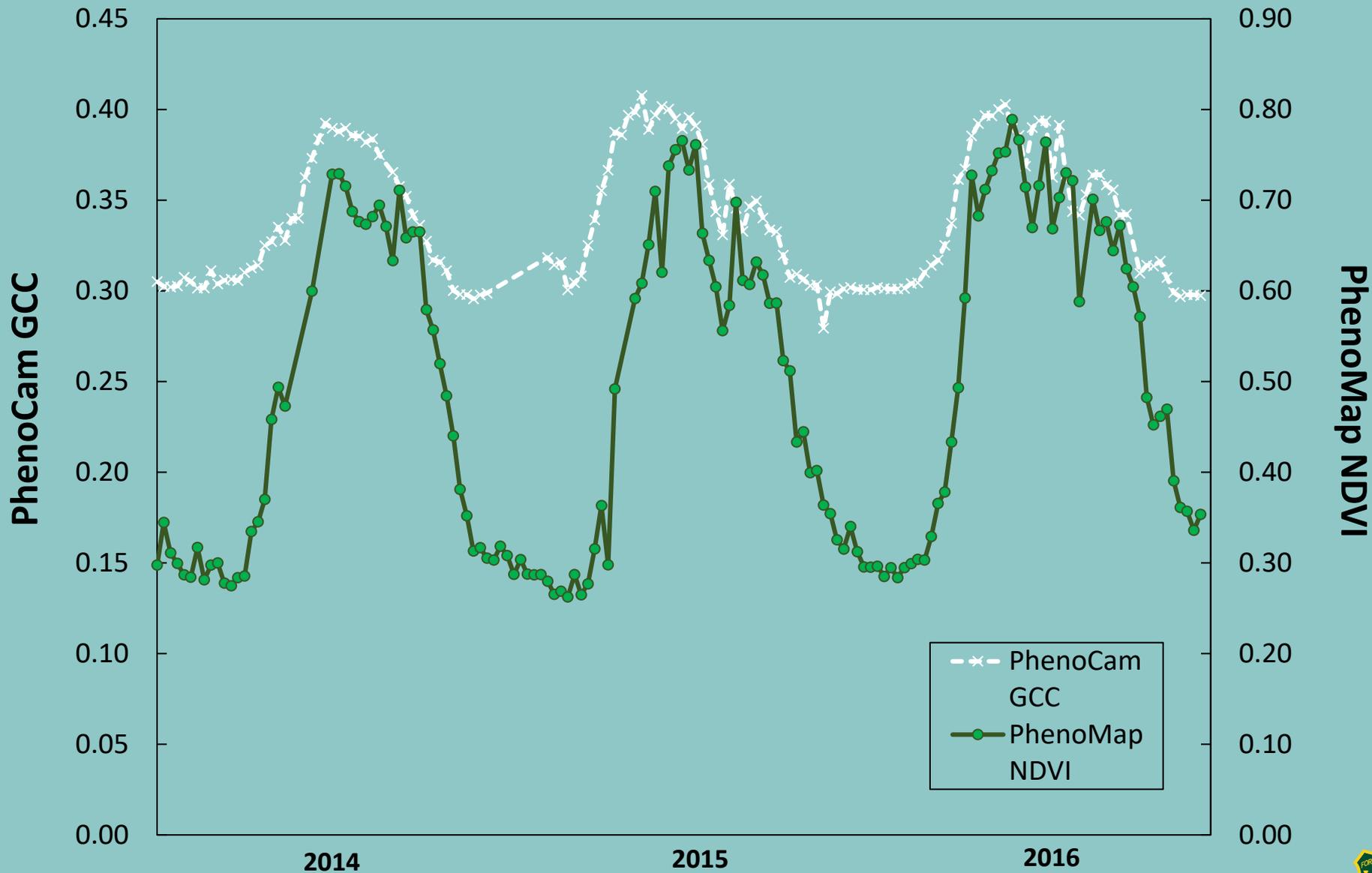
# Validation of PhenoMap: PhenoCams



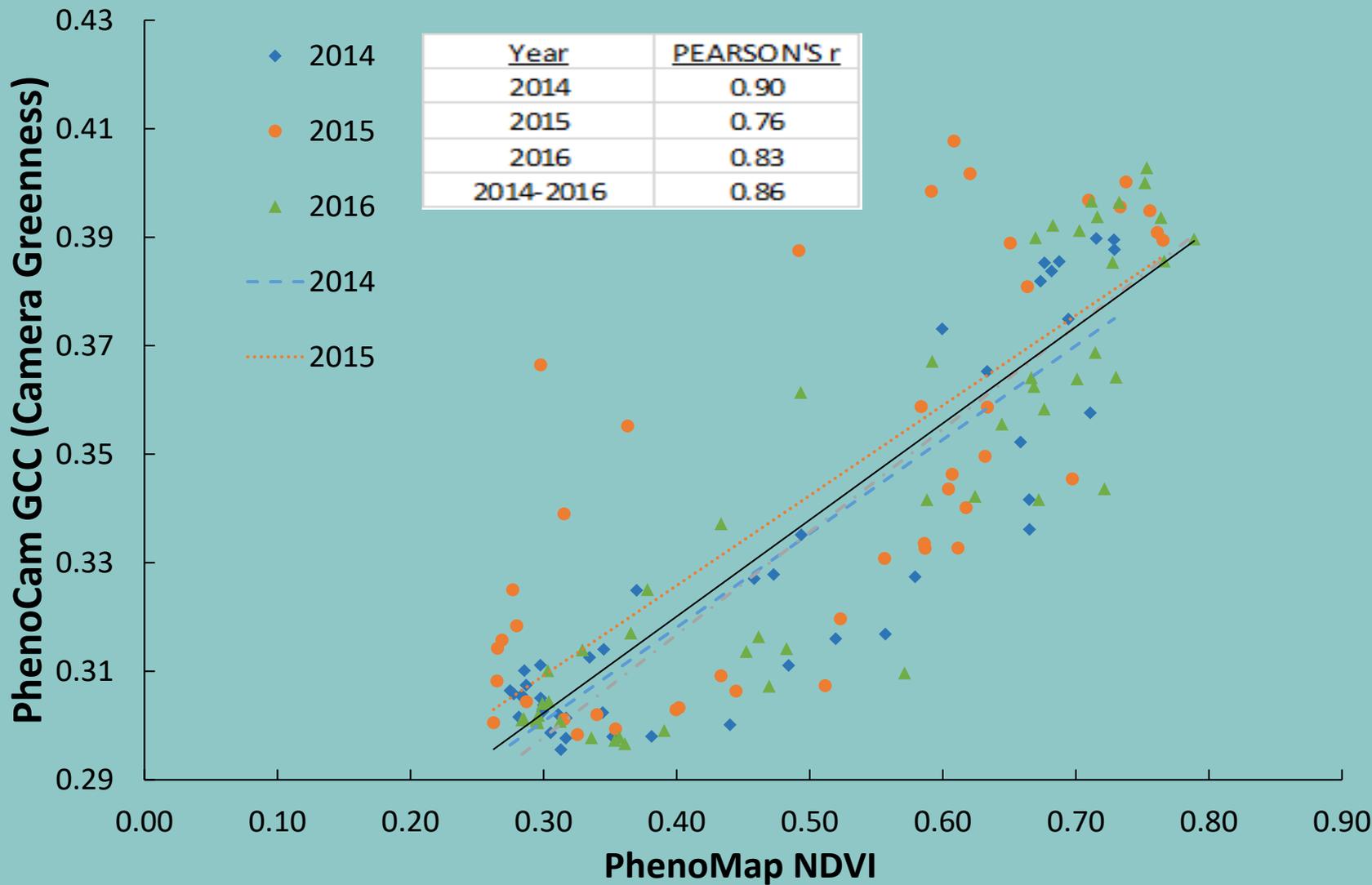
# Validation of PhenoMap: PhenoCams



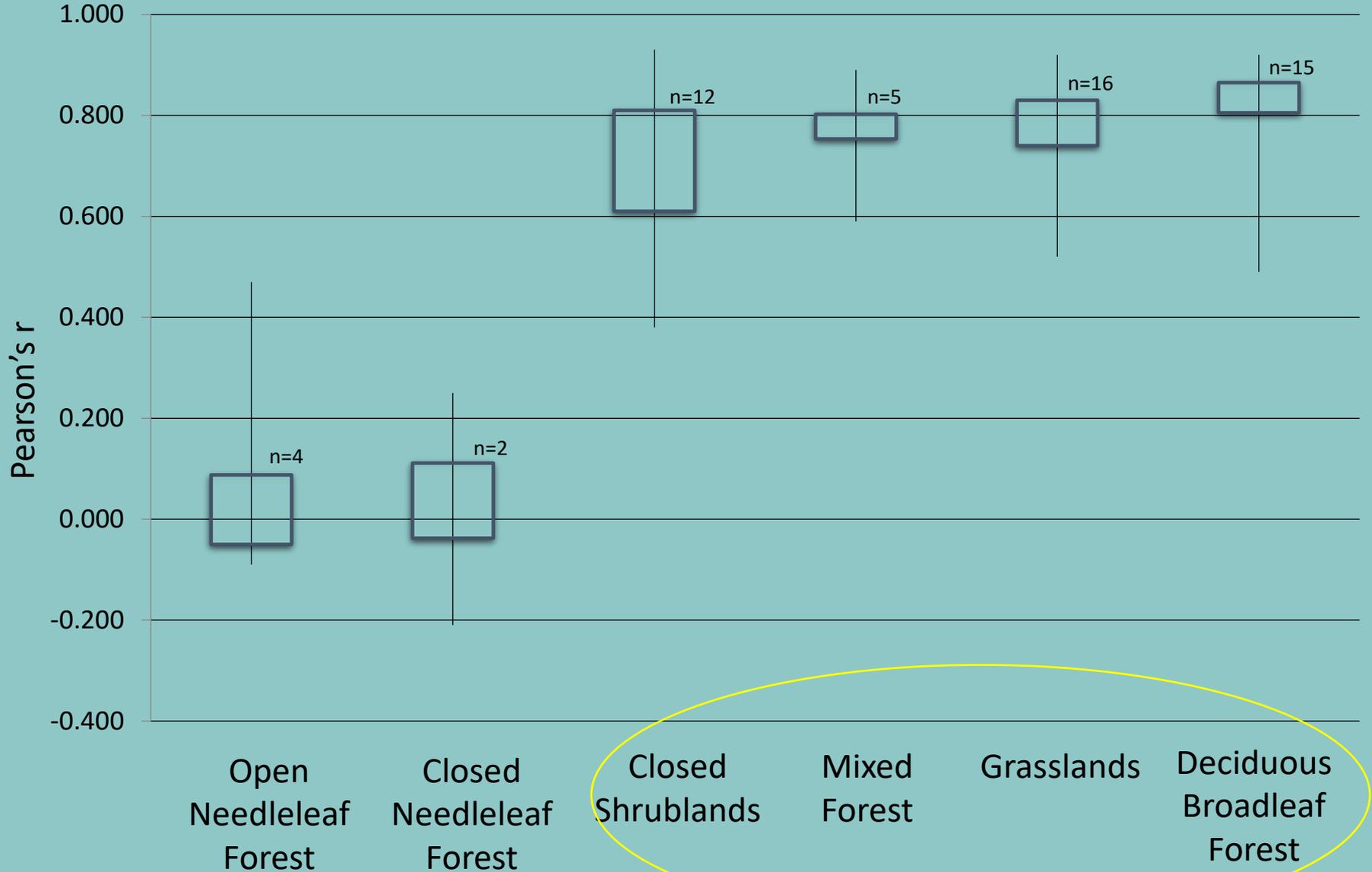
# Validation of PhenoMap: PhenoCams



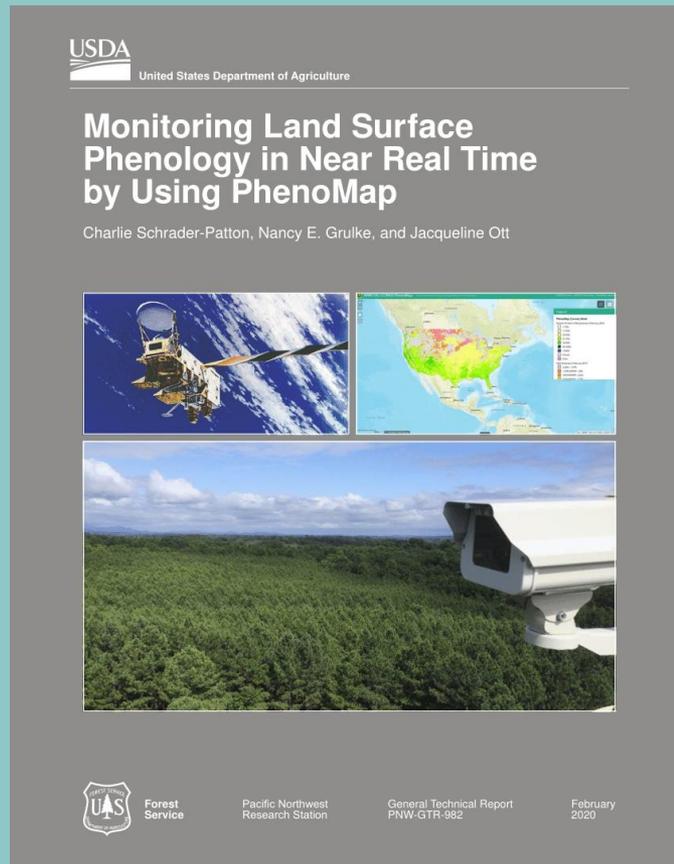
# PhenoCams are well-correlated with Satellite NDVI



# PhenoCams Correlated Across Ecosystems



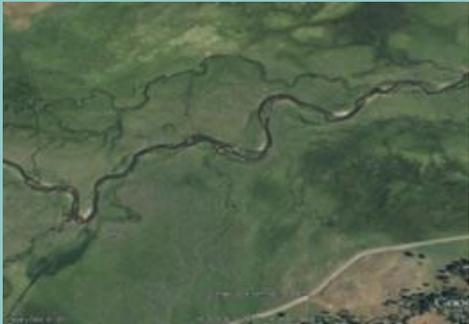
# Validation of PhenoMap: PhenoCams



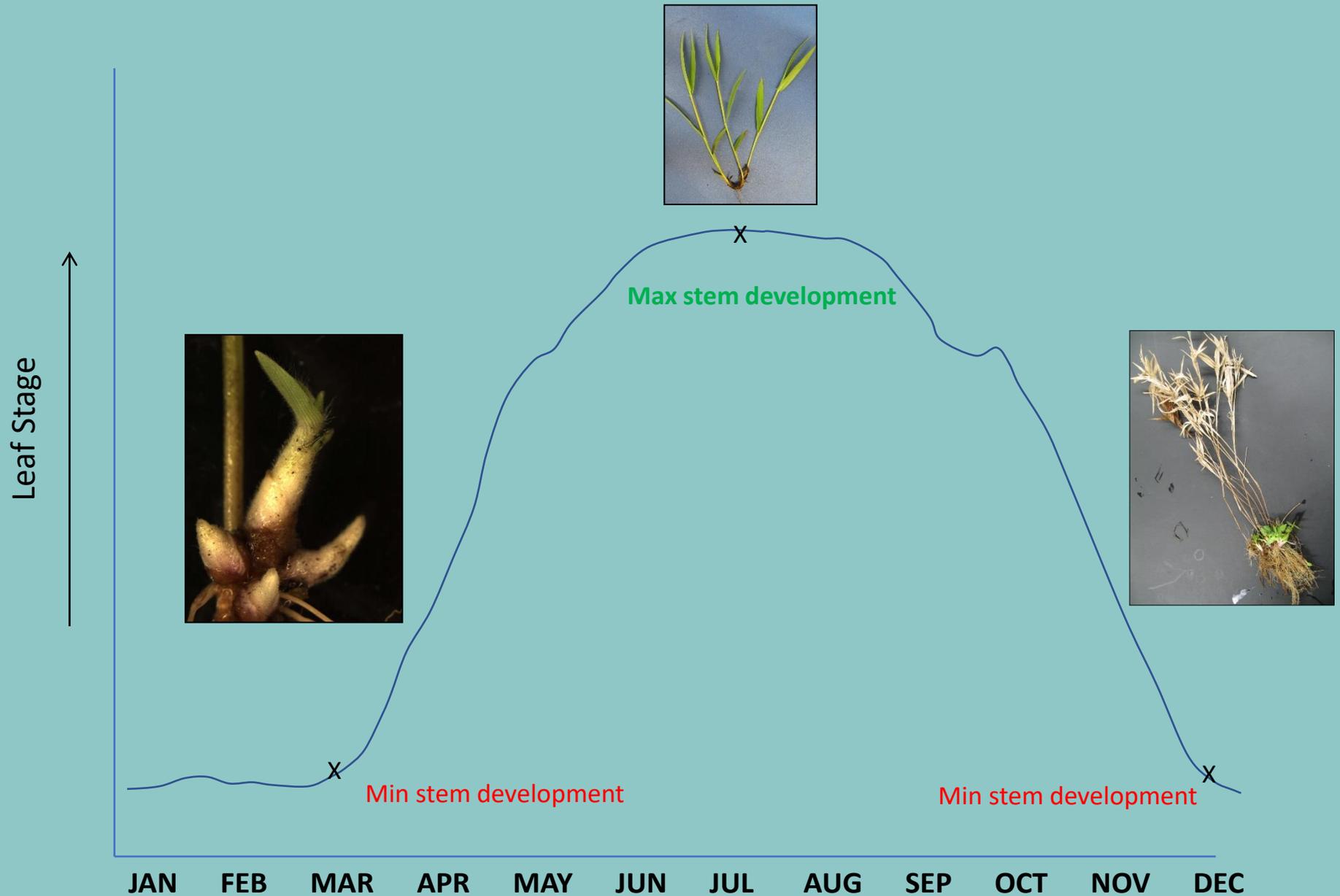
Schrader-Patton, Charlie; Grulke, Nancy E.; Ott, Jacqueline. 2020. Monitoring land surface phenology in near real time by using PhenoMap. Gen. Tech. Rep. PNW-GTR-982. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 98 p.



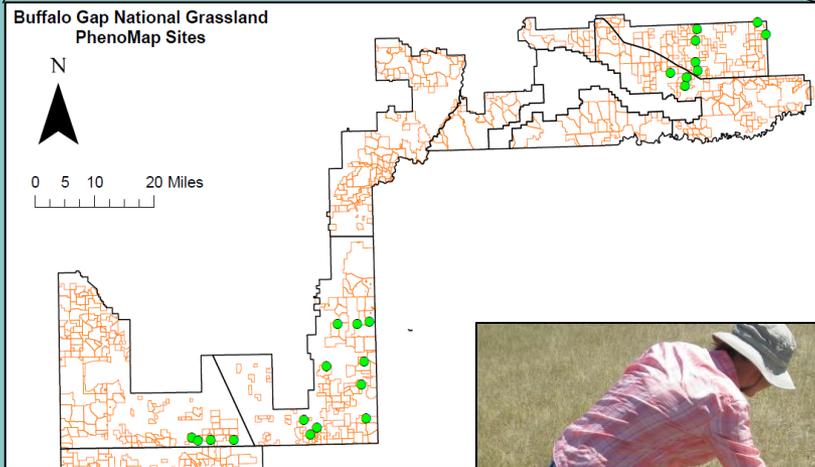
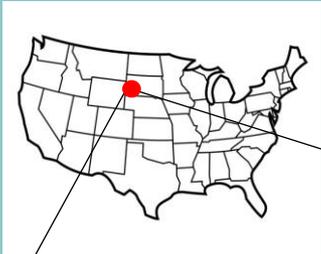
# Validation of PhenoMap



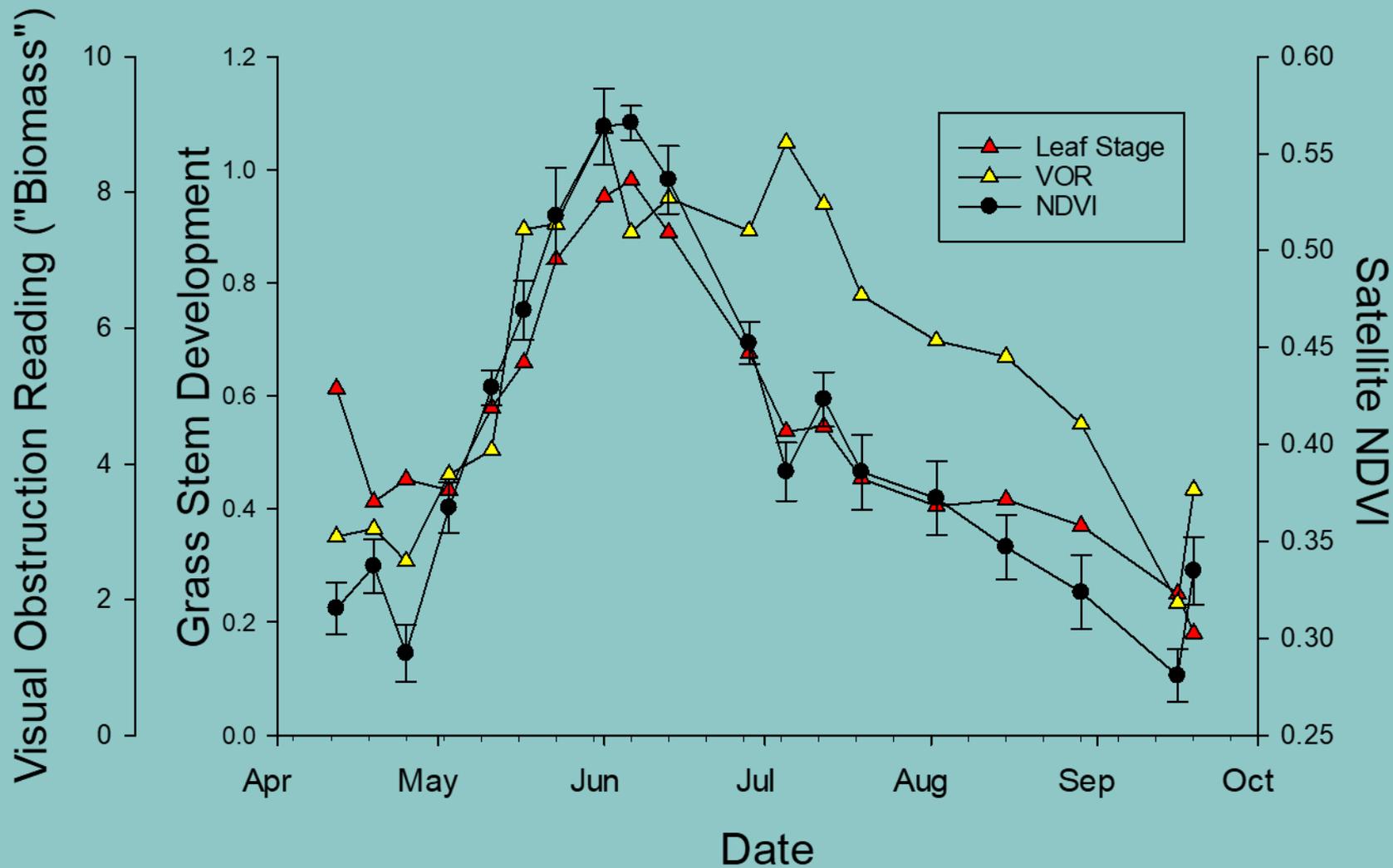
# Validation of PhenoMap



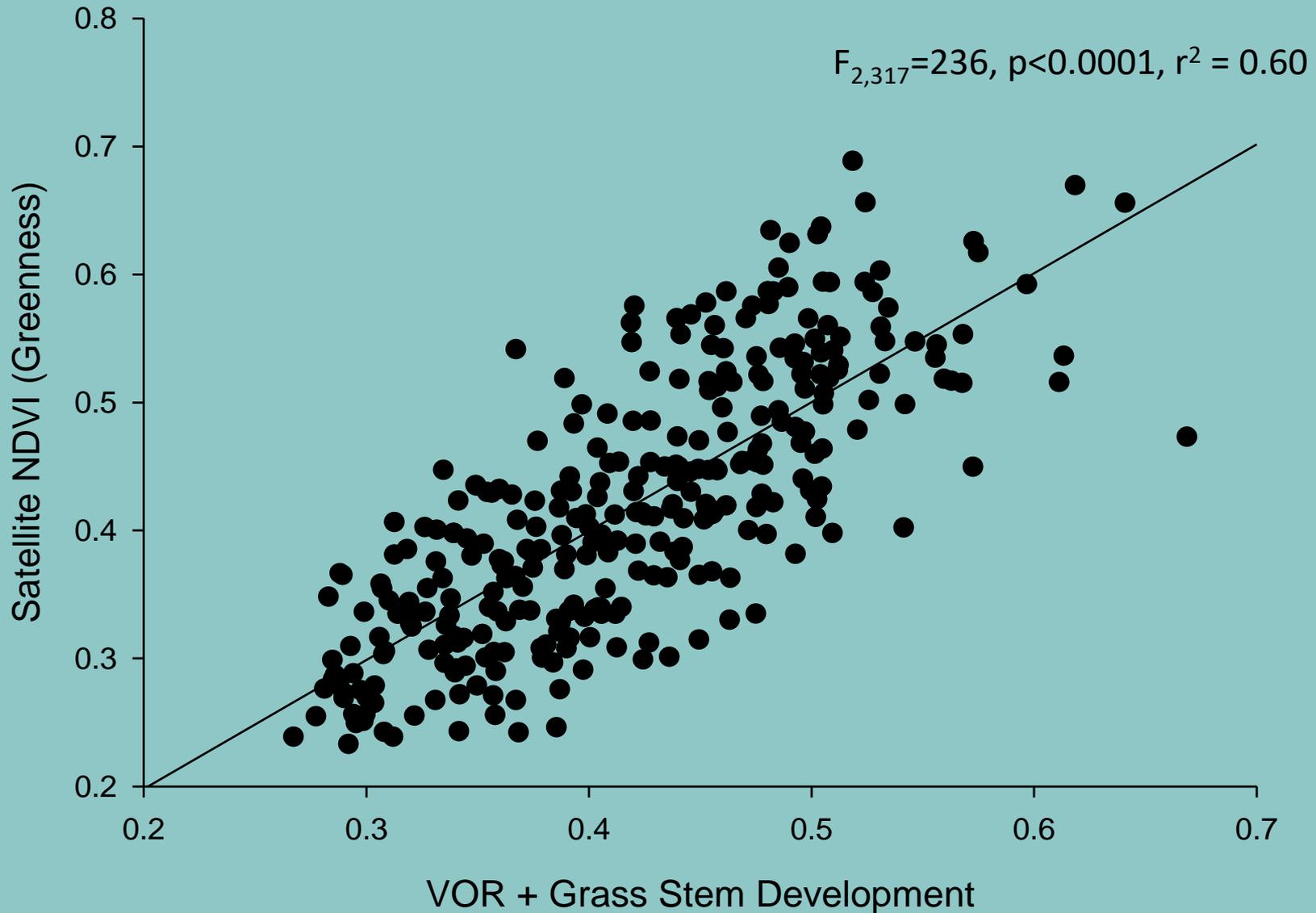
# Validation of PhenoMap: Grasslands



# Satellite NDVI (Greenness) tracks Grass Stem Development



# VOR and Leaf Stage are strongly correlated with NDVI



# Validation of PhenoMap

## Two major efforts

- Phenology Cameras (PhenoCams) across multiple ecosystems
- Grassland Validation in western South Dakota



# Outline

I. PhenoMap: Background

**II. Scenarios: What can I use PhenoMap for?**

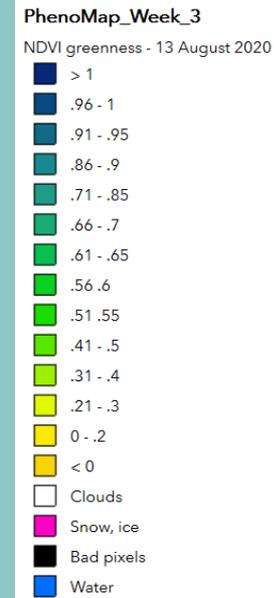
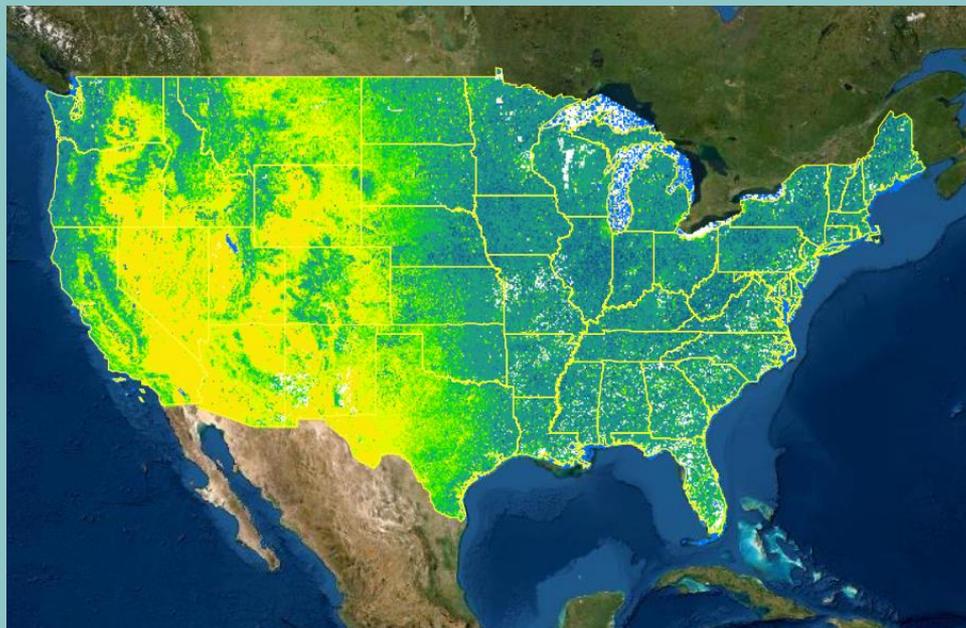
III. PhenoMap Basics: How do I use PhenoMap?



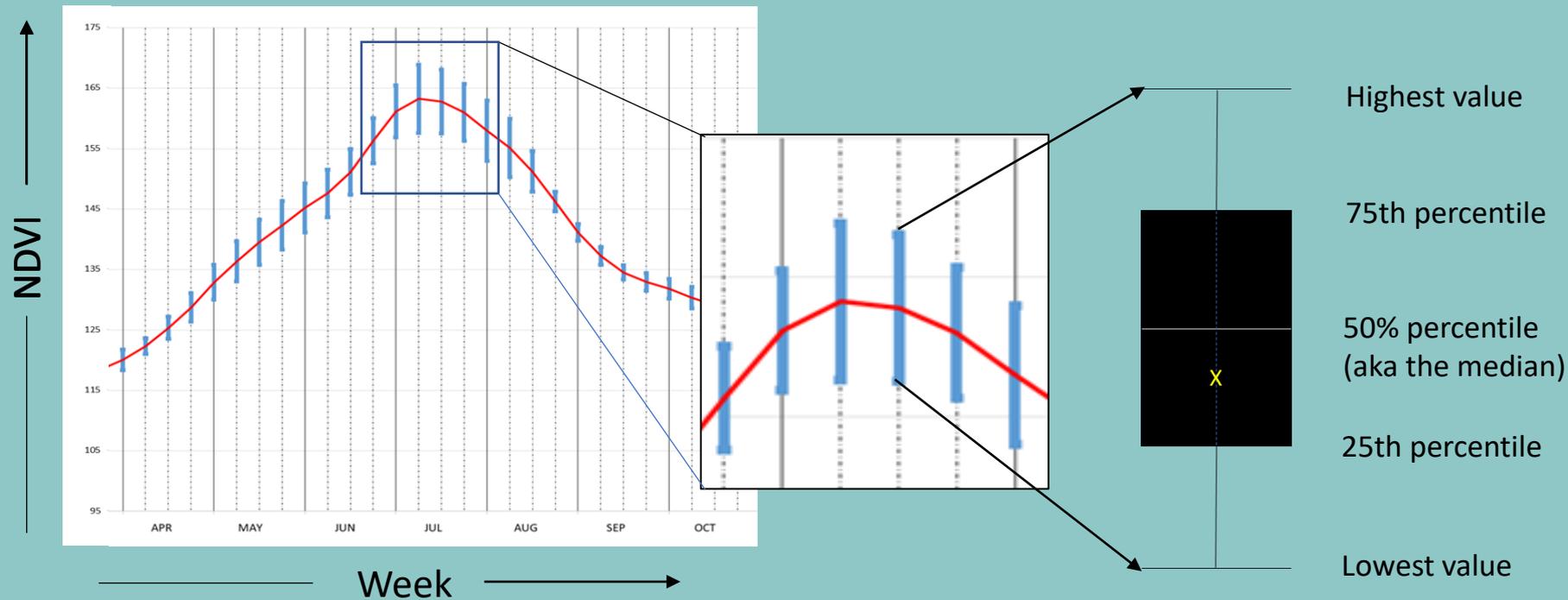
# Putting NDVI in context

There are two ways *PhenoMap* places the current week's greenness in context historically using all the data collected from 2003-2019. We can compare the current week's greenness to:

- 1) - The same week in previous years (*Percentile week*).
- 2) - All weekly values for previous years. (*Percentile annual*).



# Putting NDVI in context, cont.



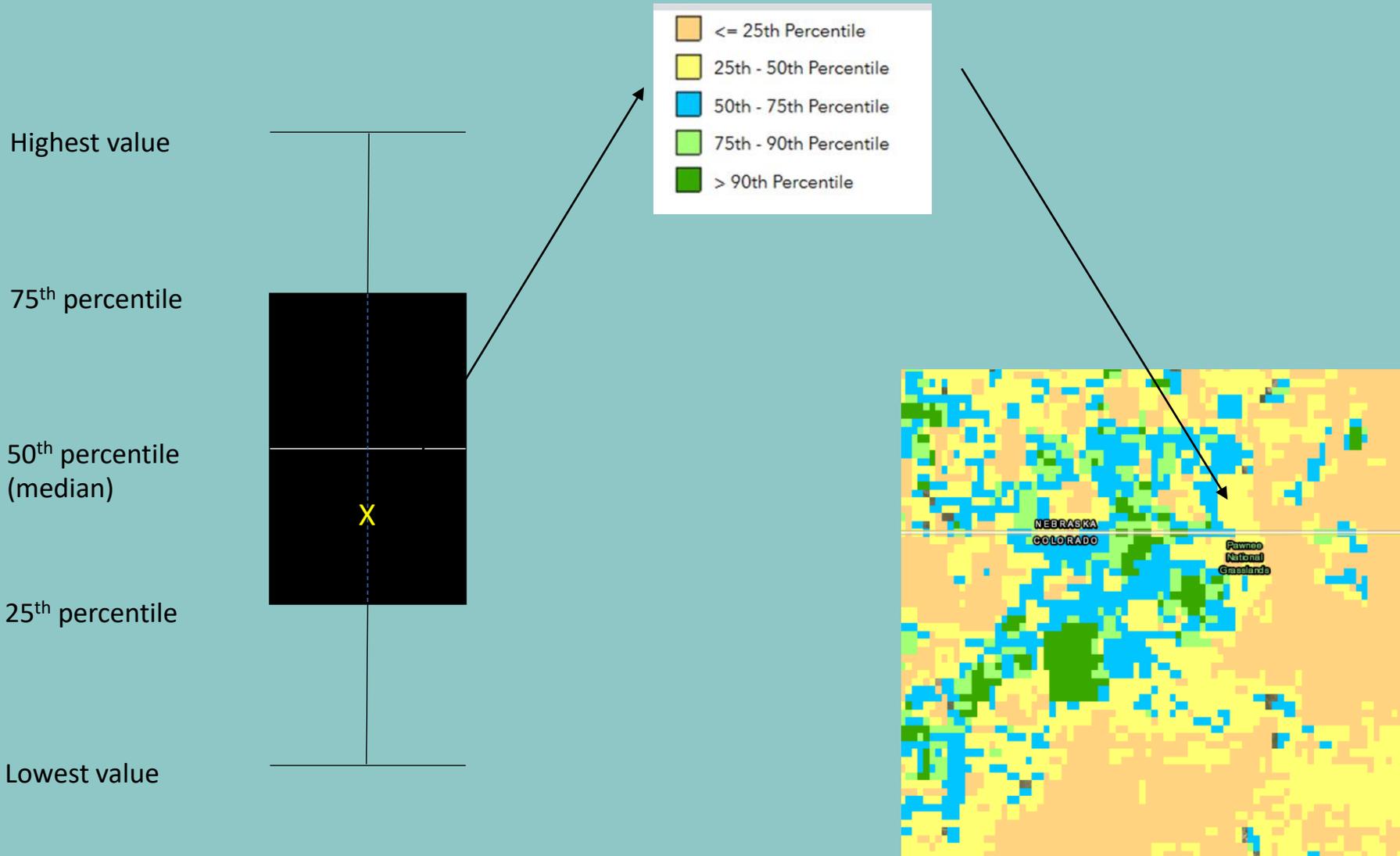
Red line – 2003-2019 median NDVI value for each week of the year.

The blue bars show the range of the 2003-2019 value...

..and this Box and Whisker graphic shows the distribution of those values

The yellow **X** is the NDVI value for the current week.

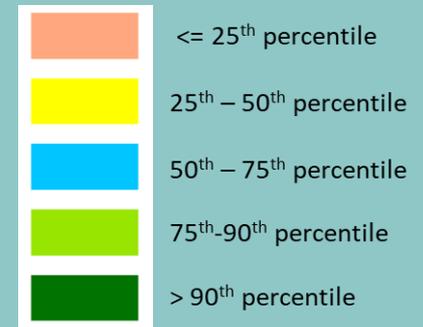
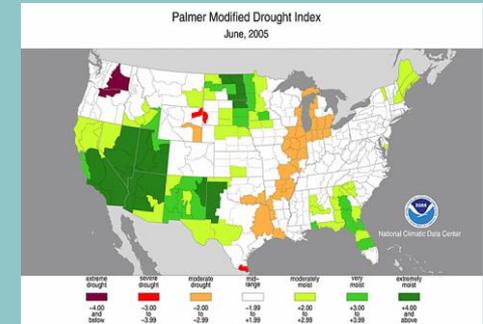
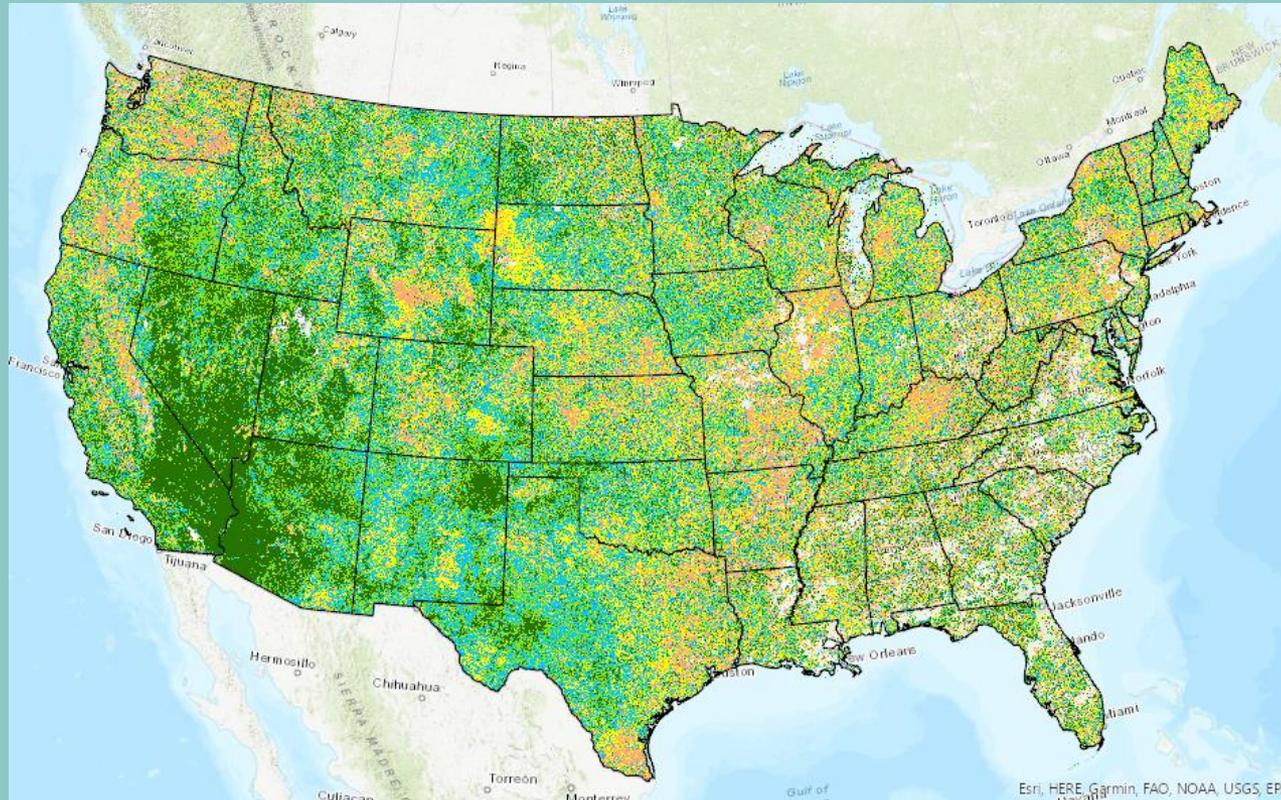
# Putting NDVI in context, cont.





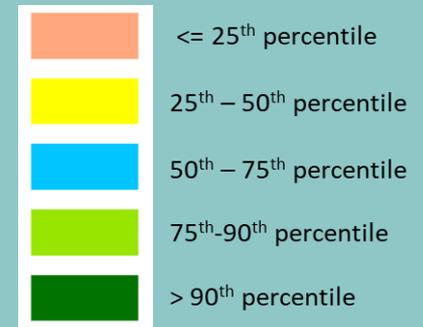
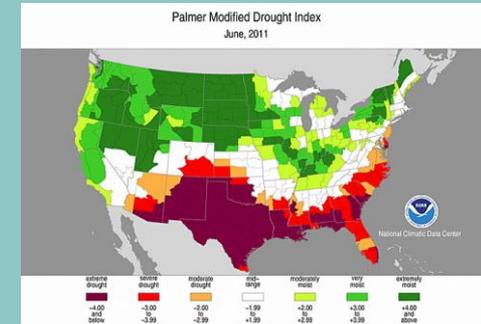
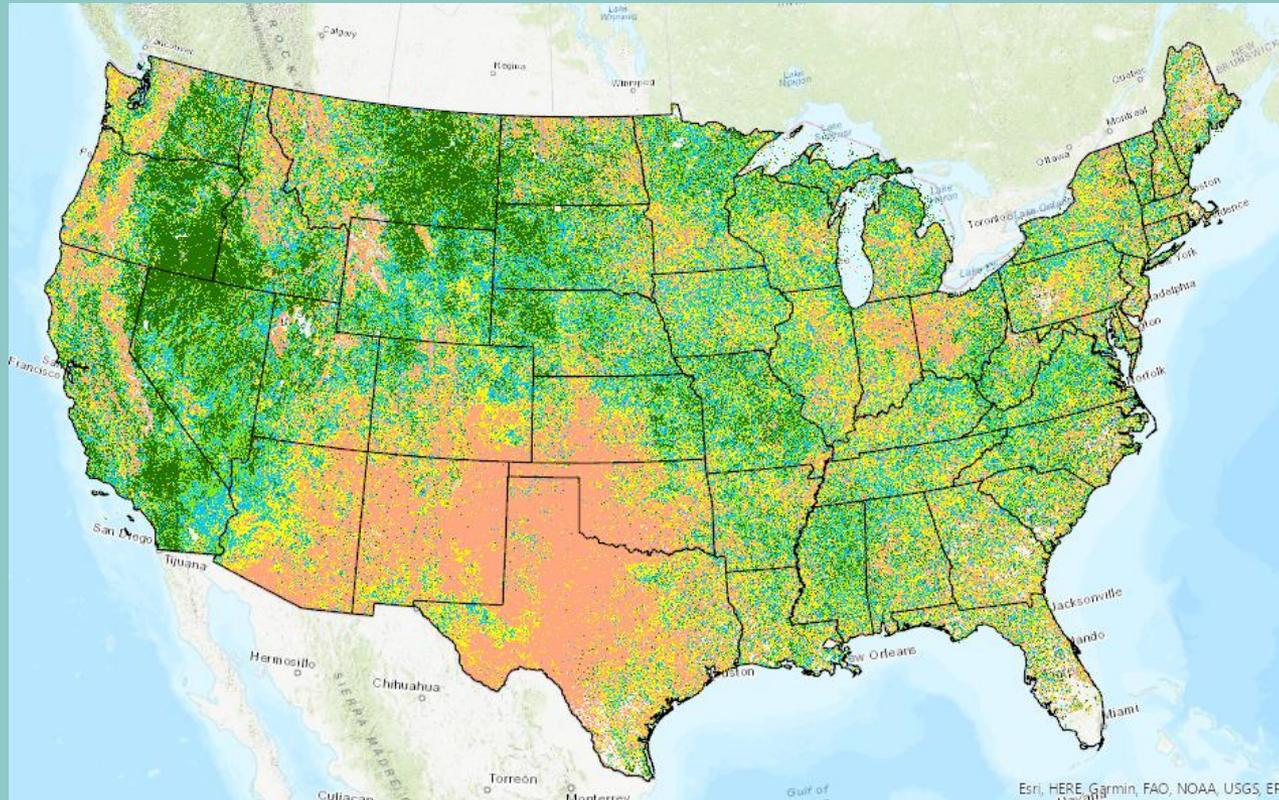
# CONUS PhenoMap

Weekly median NDVI percentile for the end of June 2005



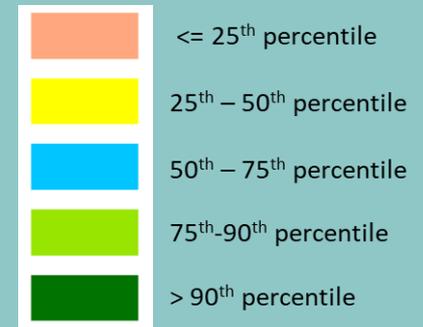
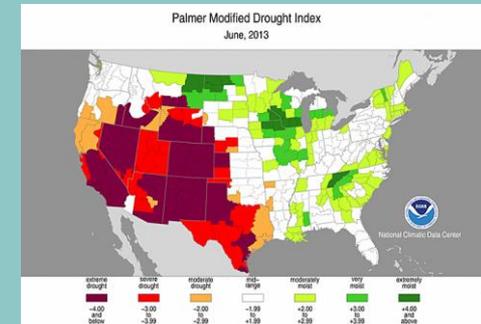
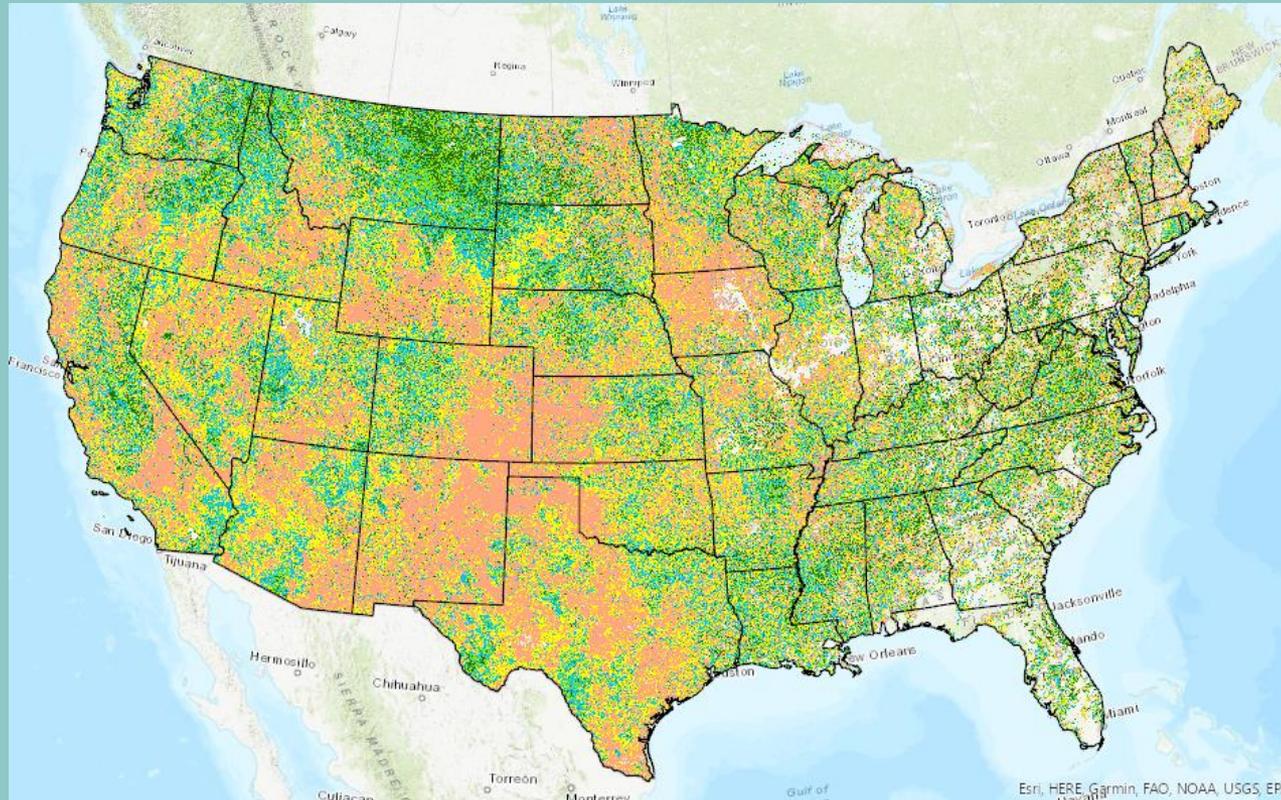
# CONUS PhenoMap

Weekly median NDVI percentile for the end of June 2011



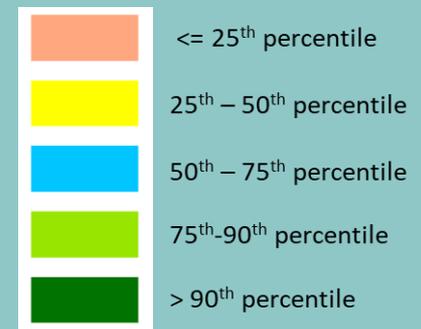
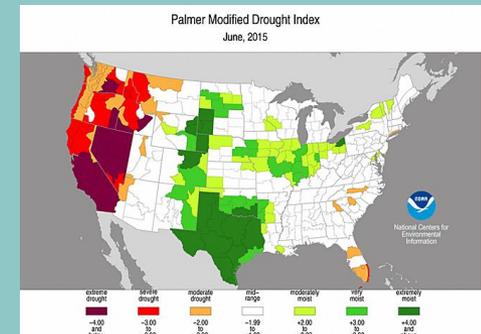
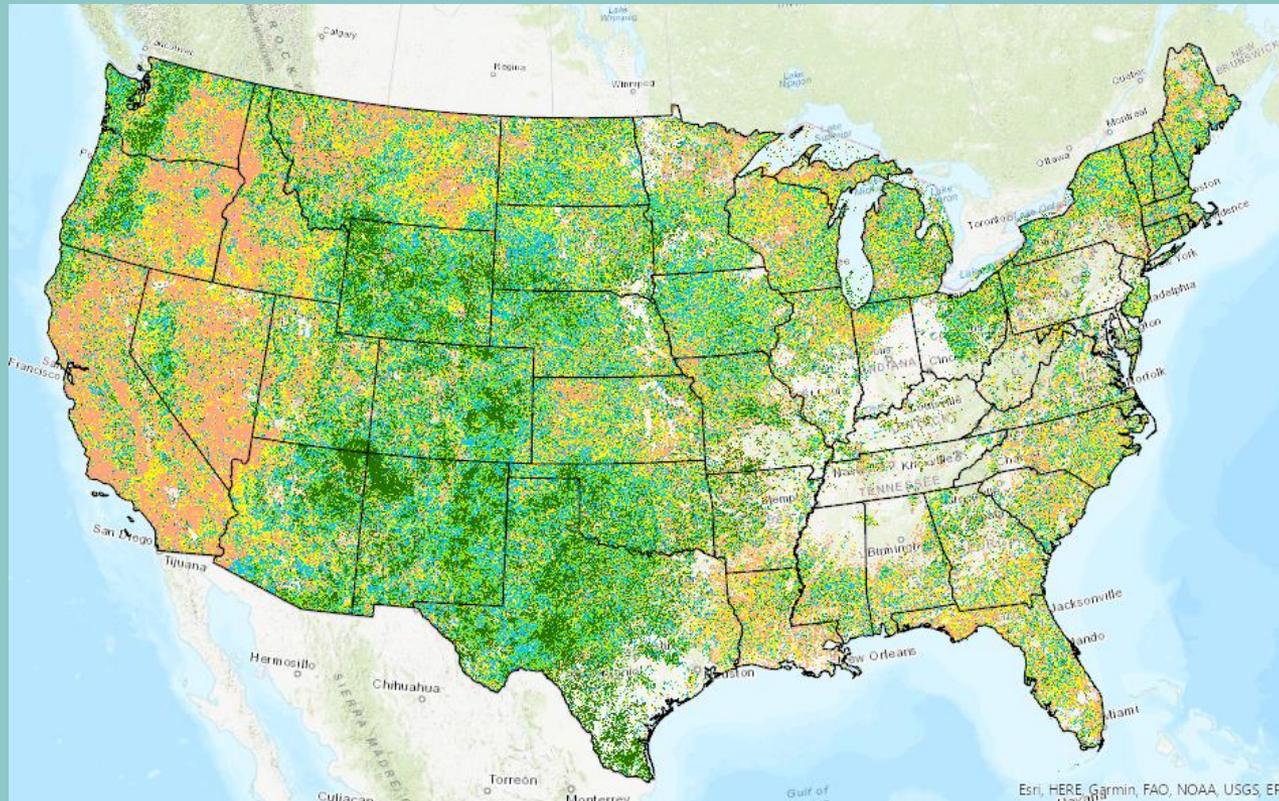
# CONUS PhenoMap

Weekly median NDVI percentile for the end of June 2013



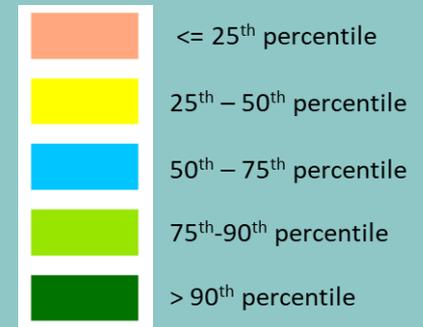
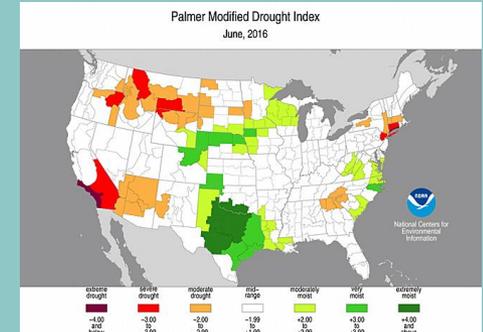
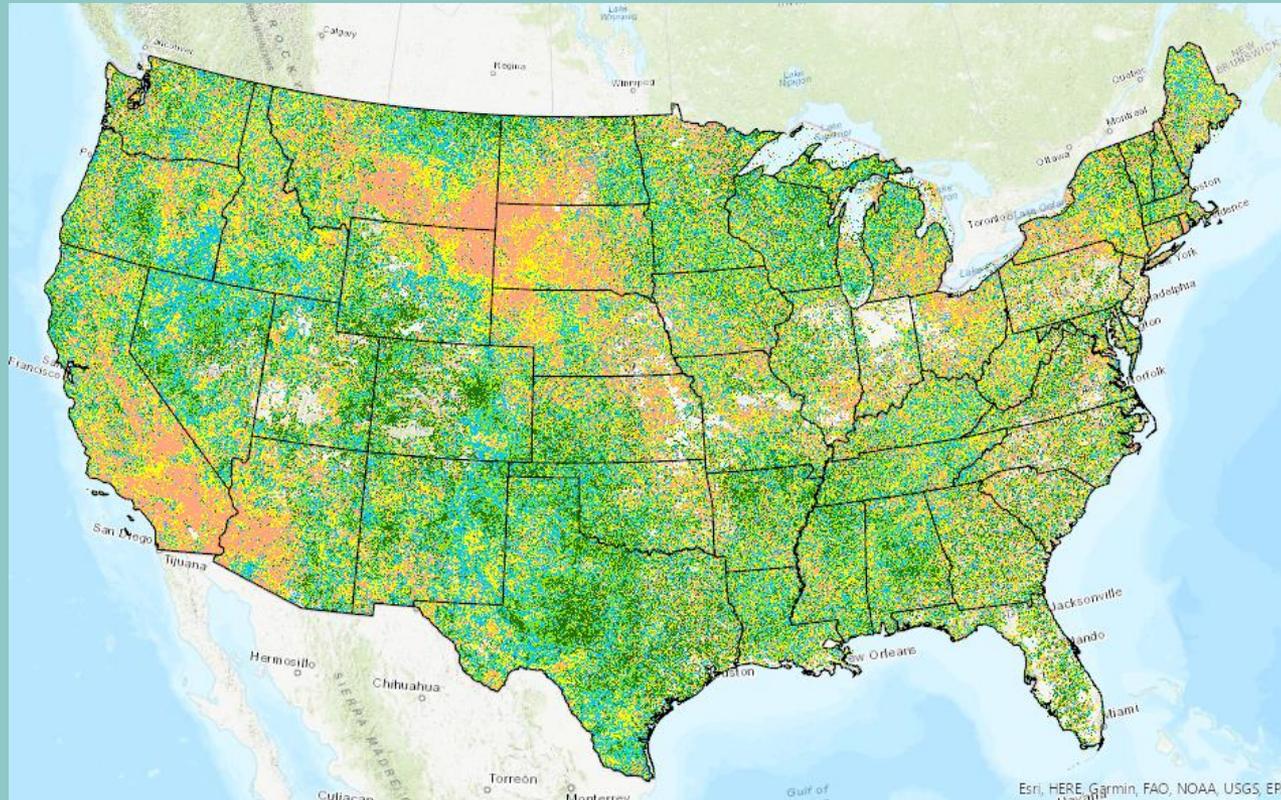
# CONUS PhenoMap

Weekly median NDVI percentile for the end of June 2015



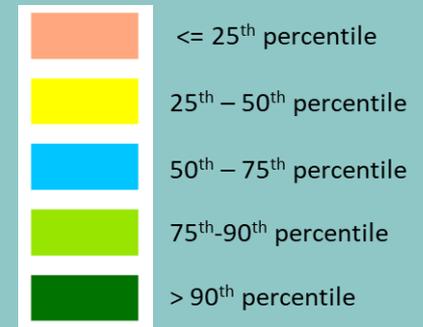
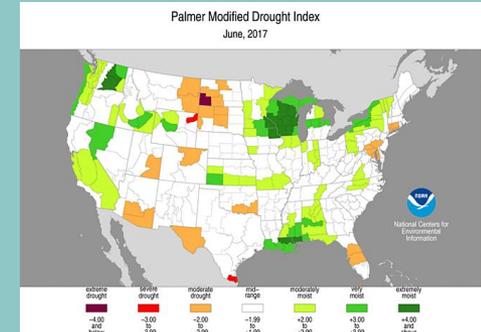
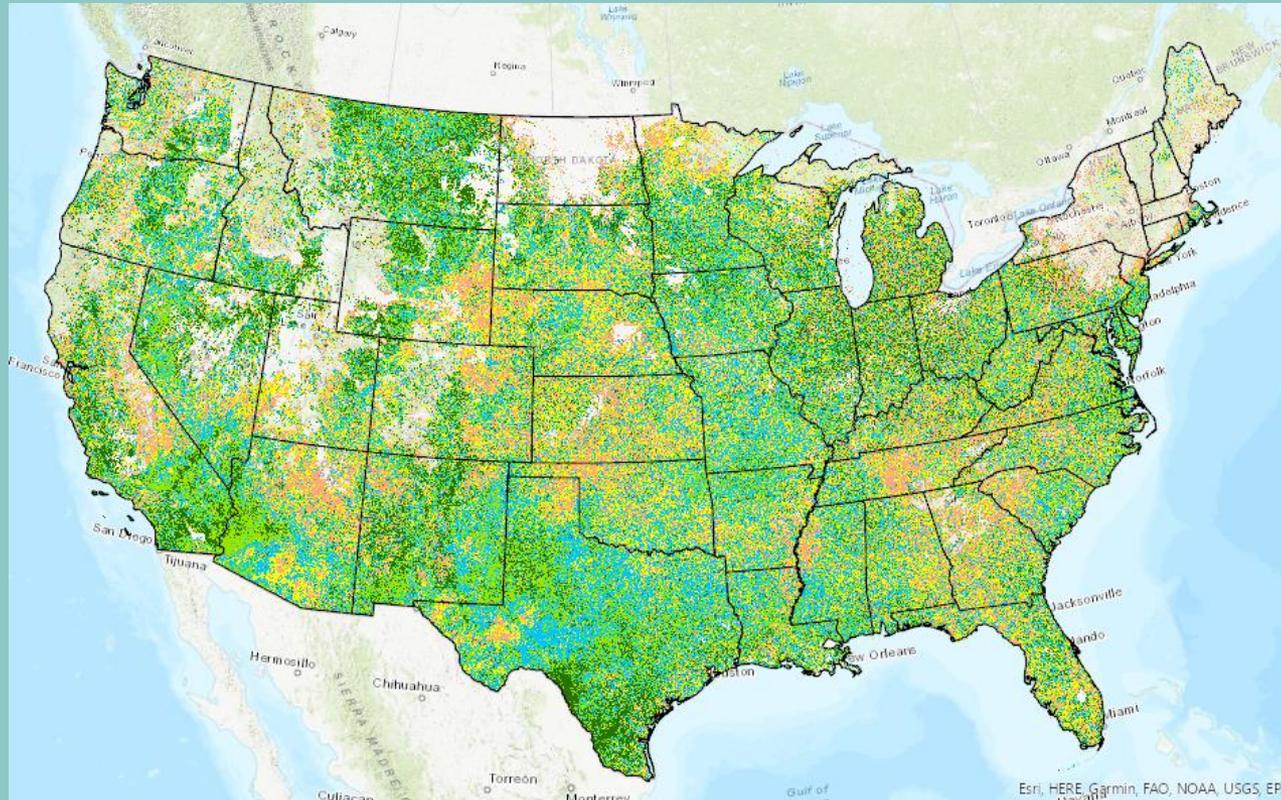
# CONUS PhenoMap

Weekly median NDVI percentile for the end of June 2016



# CONUS PhenoMap

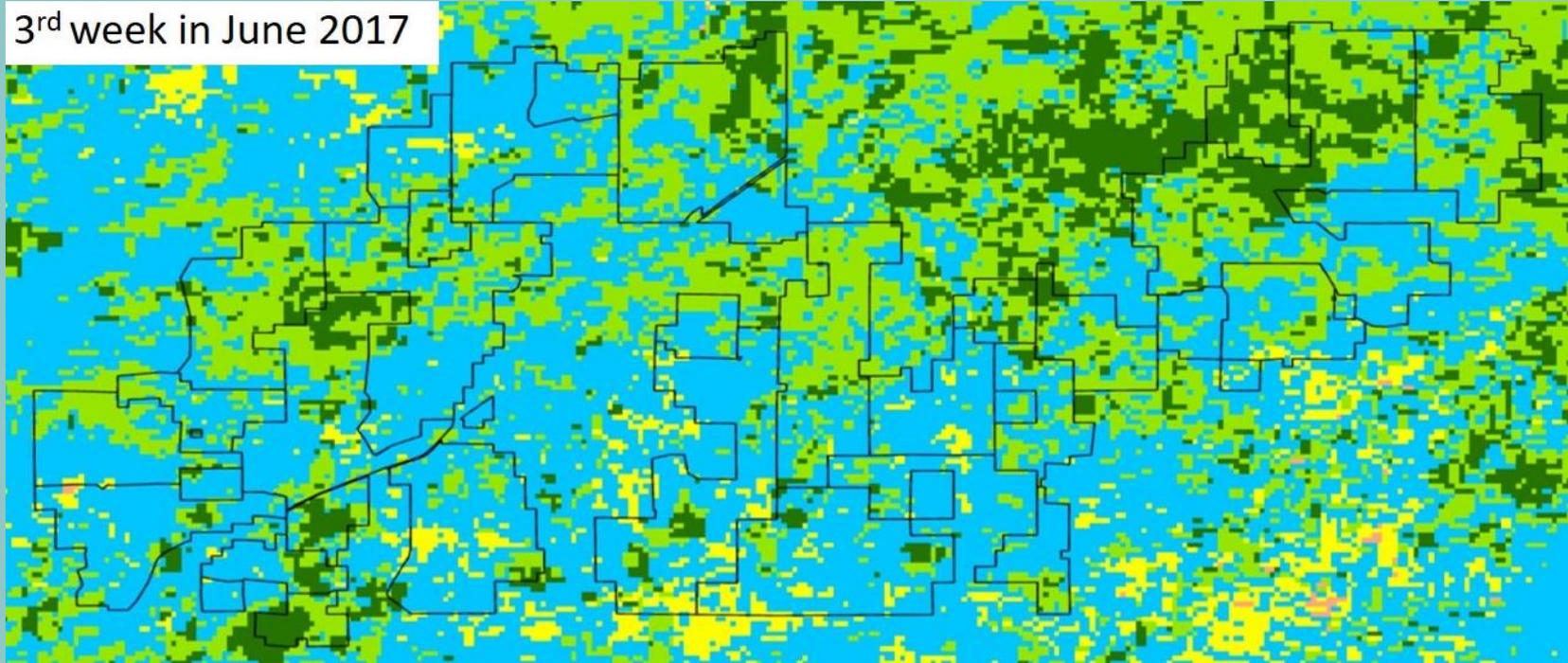
Weekly median NDVI percentile for the end of June 2017



# Use scenario: Drought!

Comanche NG (SE Colorado) 2011

3<sup>rd</sup> week in June 2017

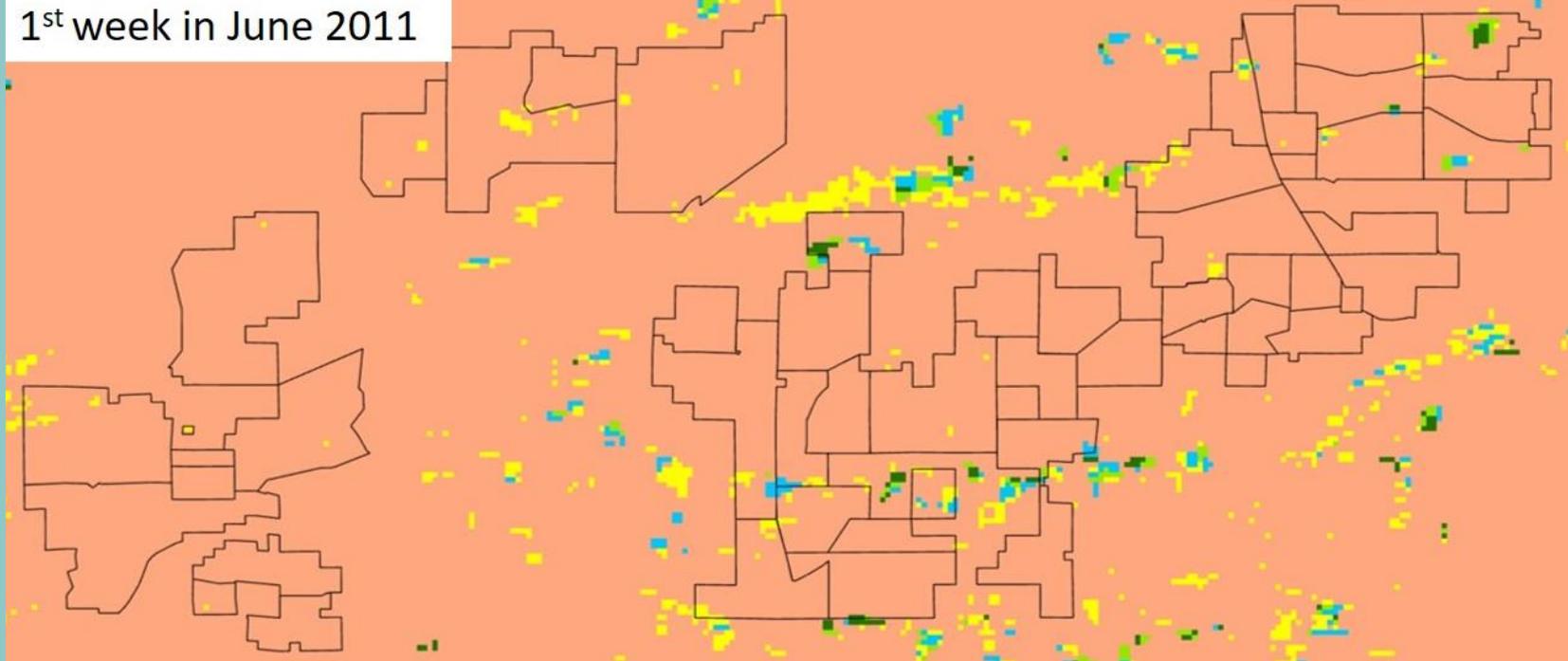


Weekly percentile data - Current greenness compared to the distribution of historic values for that week.



# Use scenario: Drought!

Comanche NG (SE Colorado) 2011

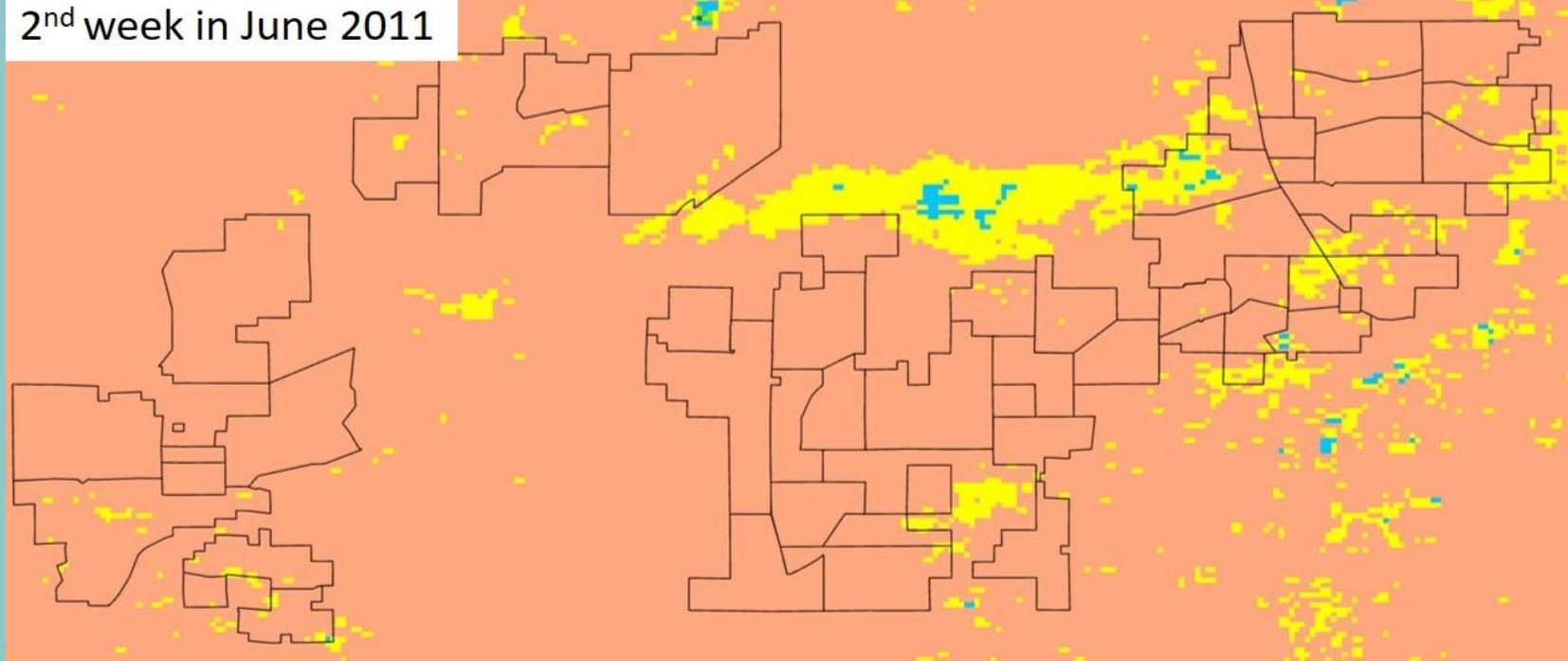


Weekly percentile data - Current greenness compared to the distribution of historic values for that week.



# Use scenario: Drought!

Comanche NG (SE Colorado) 2011



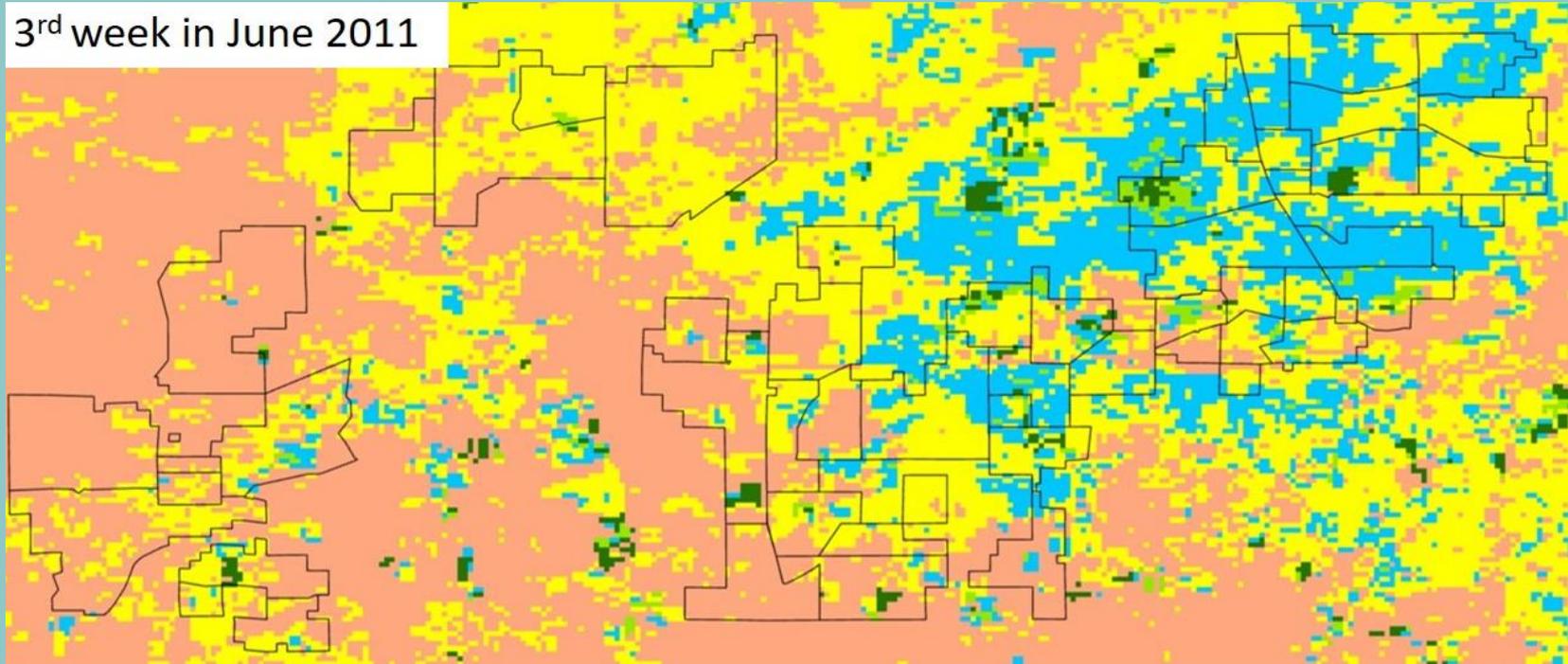
Weekly percentile data - Current greenness compared to the distribution of historic values for that week.



# Use scenario: Drought!

Comanche NG (SE Colorado) 2011

3<sup>rd</sup> week in June 2011



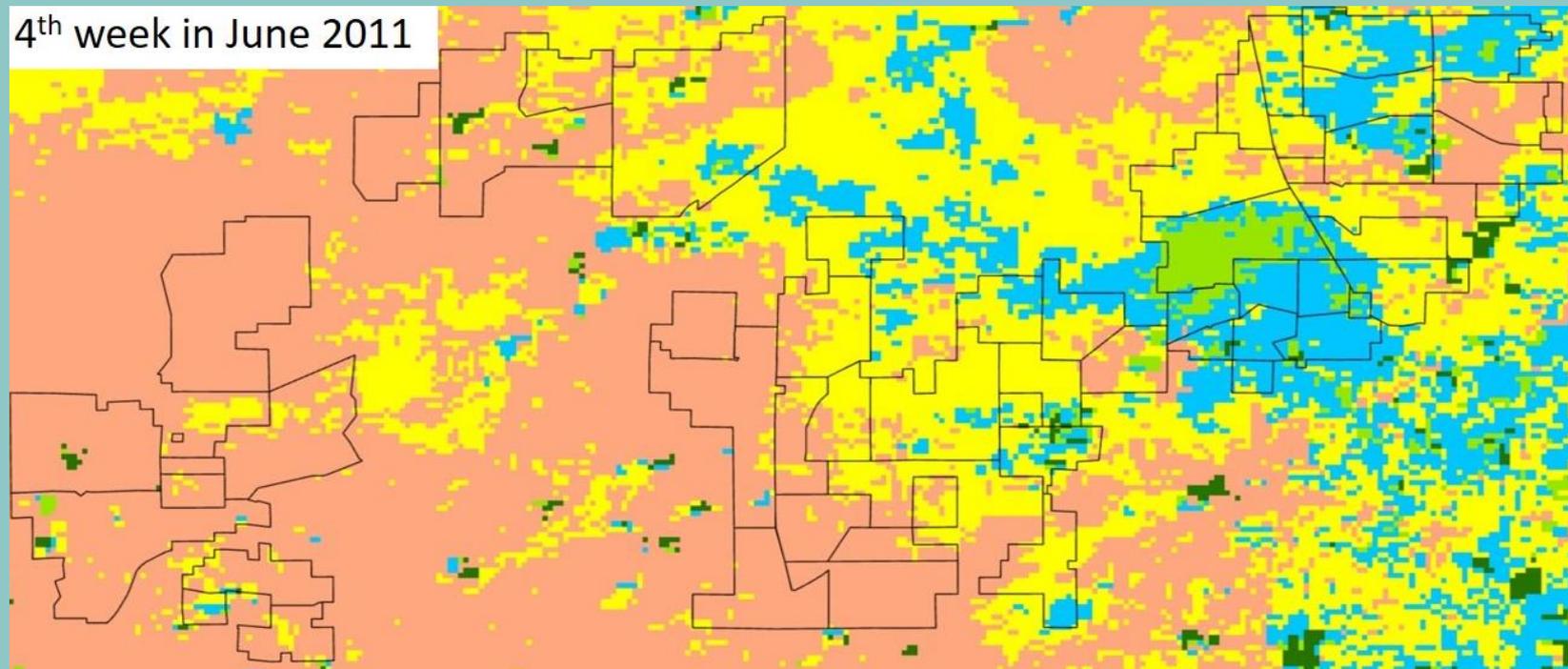
Weekly percentile data - Current greenness compared to the distribution of historic values for that week.



# Use scenario: Drought!

Comanche NG (SE Colorado) 2011

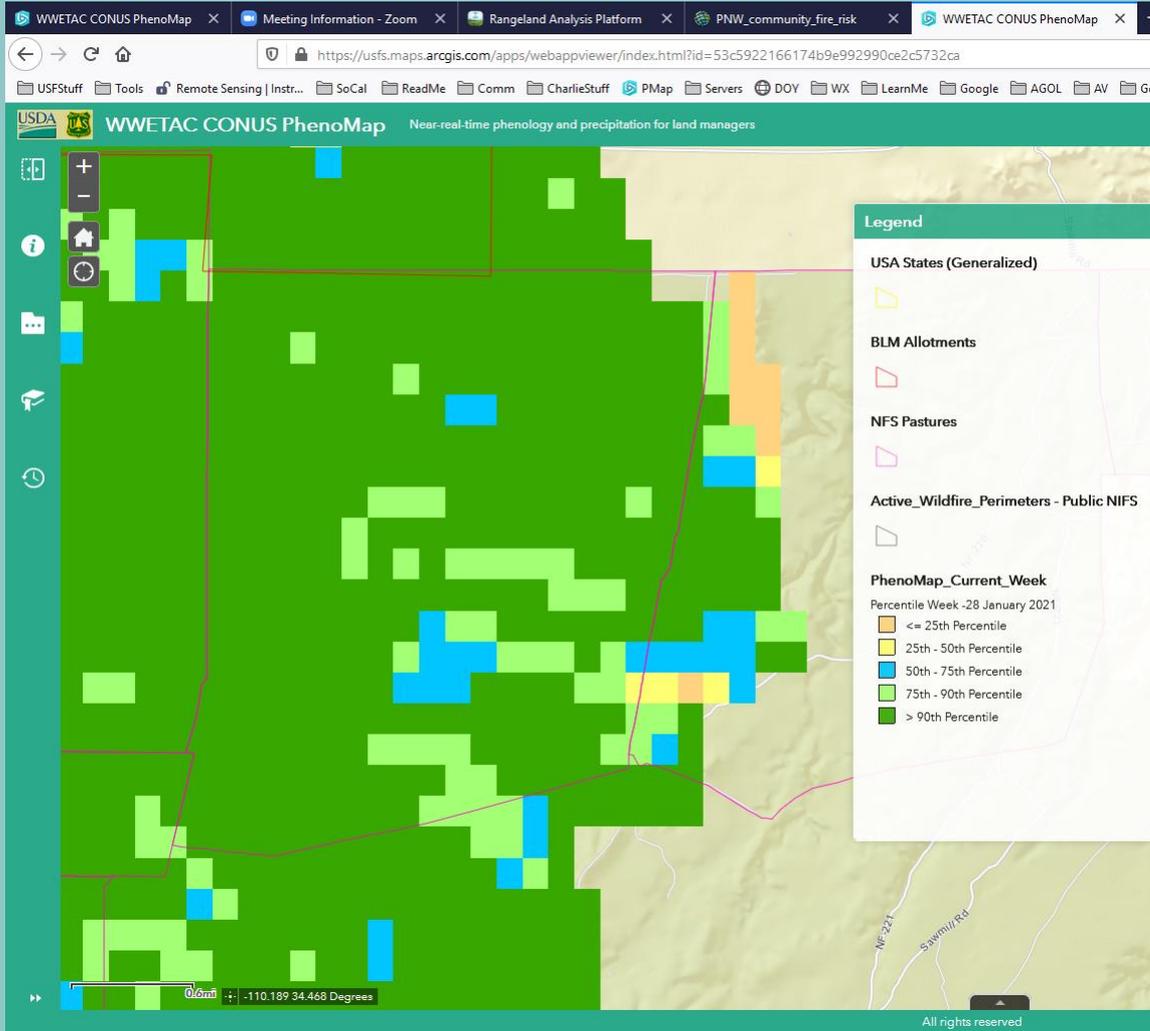
4<sup>th</sup> week in June 2011



Weekly percentile data - Current greenness compared to the distribution of historic values for that week.



# Use scenario: Wildlife habitat



allaboutbirds.org



daily-journal.com



# More scenario ideas...

*Green-up on Black Mesa is sometimes two weeks behind the lower meadows. What's going on up there?*



britannica.com

*PhenoMap shows that spring is late and this has delayed movement of wild sheep to the high country, To avoid contact with domestic sheep, the stocking of this allotment should be delayed.*



publicdomainpictures.net

*Last August a wildfire burned the NW allotments. Are they ready for stocking?*



doi.gov

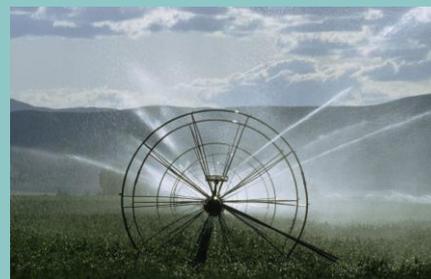
# PhenoMap... use in all lands

Invasive species and pest control...



forestryimages.org

Who is irrigating?



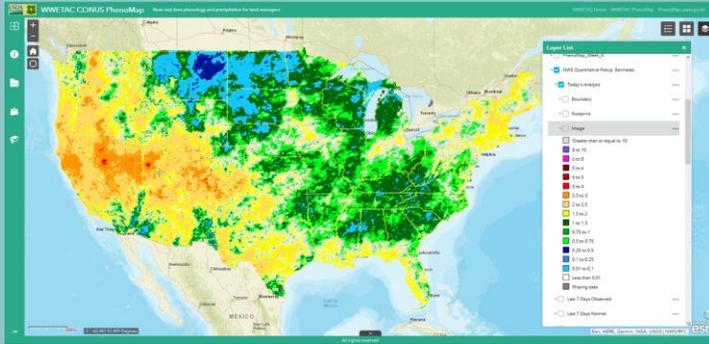
pinterest.com

Leaf peeping



peakvisor.com

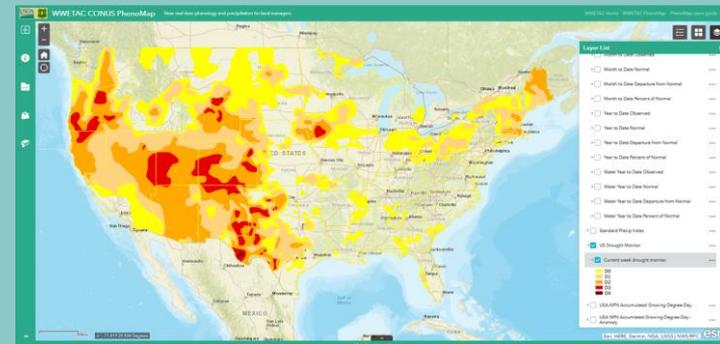
# Other phenology data in PhenoMap



National Weather Service precipitation estimates  
<https://water.weather.gov/precip/>

US Drought Monitor

<https://droughtmonitor.unl.edu/>



National Phenology Network growing degree-day

<https://www.usanpn.org/home>

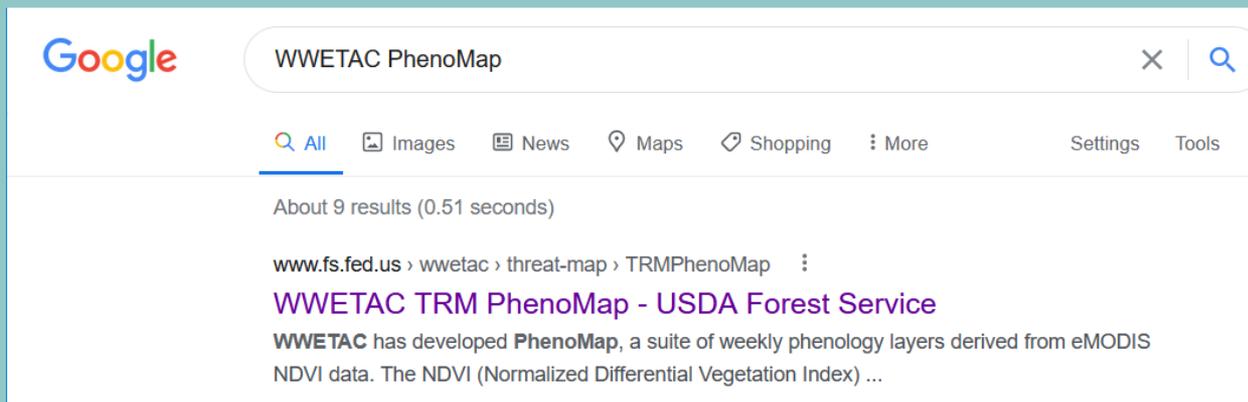


# Outline

## I. PhenoMap: Background

## II. Scenarios: What can I use PhenoMap for?

## III. PhenoMap Basics: How do I use PhenoMap?



# PhenoMap tools and features:

Swipe between layers



Add your local data



Change basemaps



Layers on/off



Bookmarks



Measure tool, print



Map legend



For a more details on using PhenoMap, click [here](#).

*Pheno-Map Users Guide*  
Updated 22 August 2020

Welcome to PhenoMap, the weekly vegetation greenness and precipitation tracking web map developed by the USDA Forest Service Western Wildlands Environmental Threat Assessment Center (WWETAC). This is a guide to the features and data in PhenoMap.

PhenoMap is a web map, meaning that it functions inside a web browser (no software to install) and all the map layers are delivered with services over the web. This allows us to update the map weekly and you always see the latest data.

The first step is to load the map. It's linked on this web page:  
<https://www.fs.fed.us/wwetac/threat-map/TRMPhenoMap.php>

Here is the link:  
[TRM - CONUS PhenoMap](#)

Here is what the map looks like when it initially loads in your browser:



1 | 22--August-20

USDA US Forest Service Western Wildlands Environmental Threat Assessment Center



# Acknowledgements

## Funding

Western Wildland Environmental Threat Assessment Center (WWETAC)  
Rocky Mountain Research Station  
Pacific Northwest Research Station

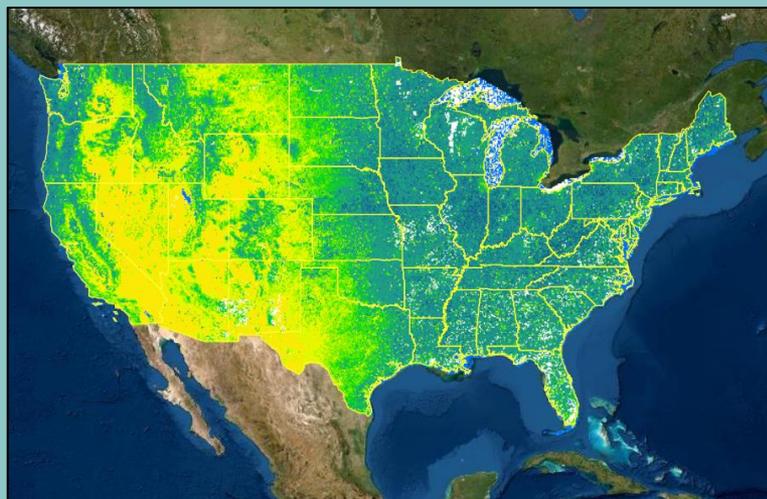
## Contact

Jackie Ott ([jacqueline.ott@usda.gov](mailto:jacqueline.ott@usda.gov))

Charlie Schrader-Patton ([charlie.schrader-patton@usda.gov](mailto:charlie.schrader-patton@usda.gov))

Nancy Grulke ([nancy.grulke@usda.gov](mailto:nancy.grulke@usda.gov))

Click here to try  
out [PhenoMap!](#)



Many thanks to the  
USGS EROS Data  
Center in Sioux Falls  
SD eMODIS team for  
providing satellite  
data!