JPSS 2015 Annual Science Meeting

Operational Monitoring and Forecasting of Land Surface Phenology from JPSS VIIRS Observations and its Applications

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August 25, 2015

Objectives

- Goal(s):
  - To establish a system for monitoring in real-time and forecasting in short term temporal development of vegetation growth in North America and across the globe from JPSS VIIRS.

- Targeted users:
  - Numerical Weather Prediction Systems at NOAA Environmental Modeling Center
  - Agriculture and forest management
  - Climate monitoring

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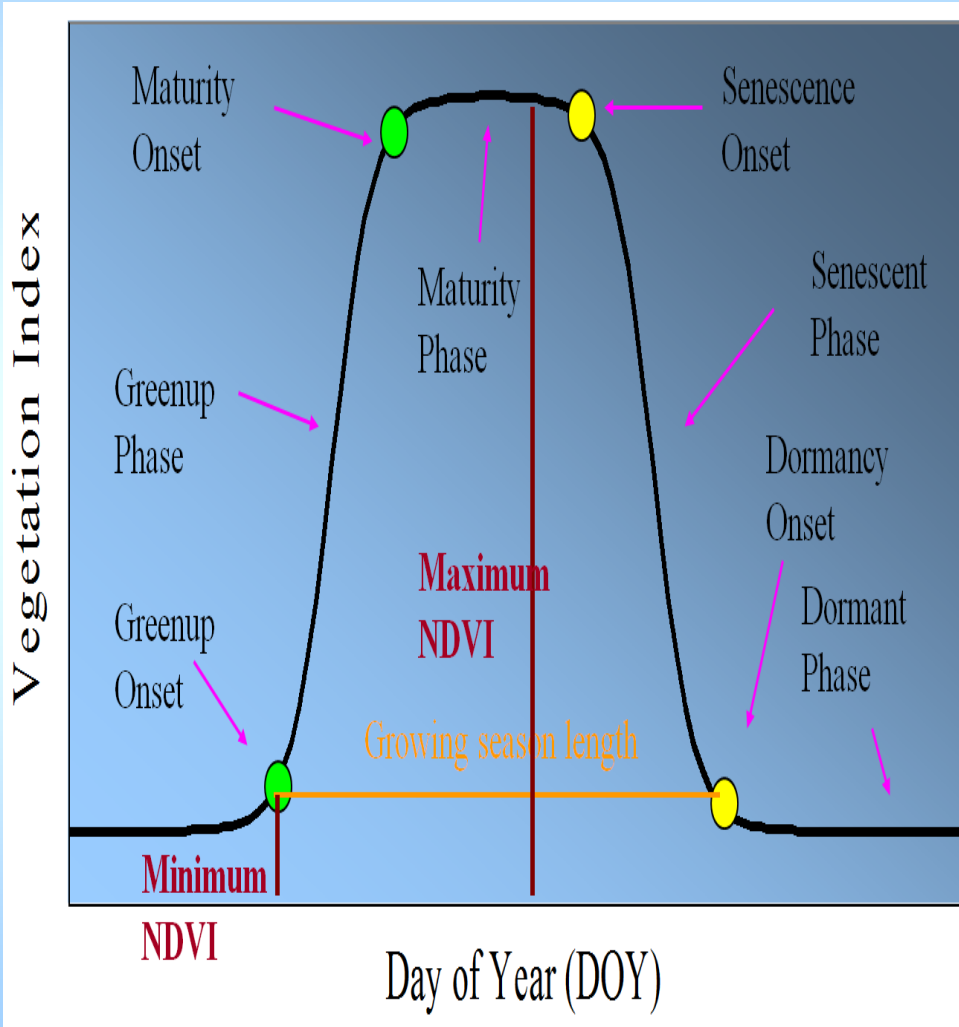
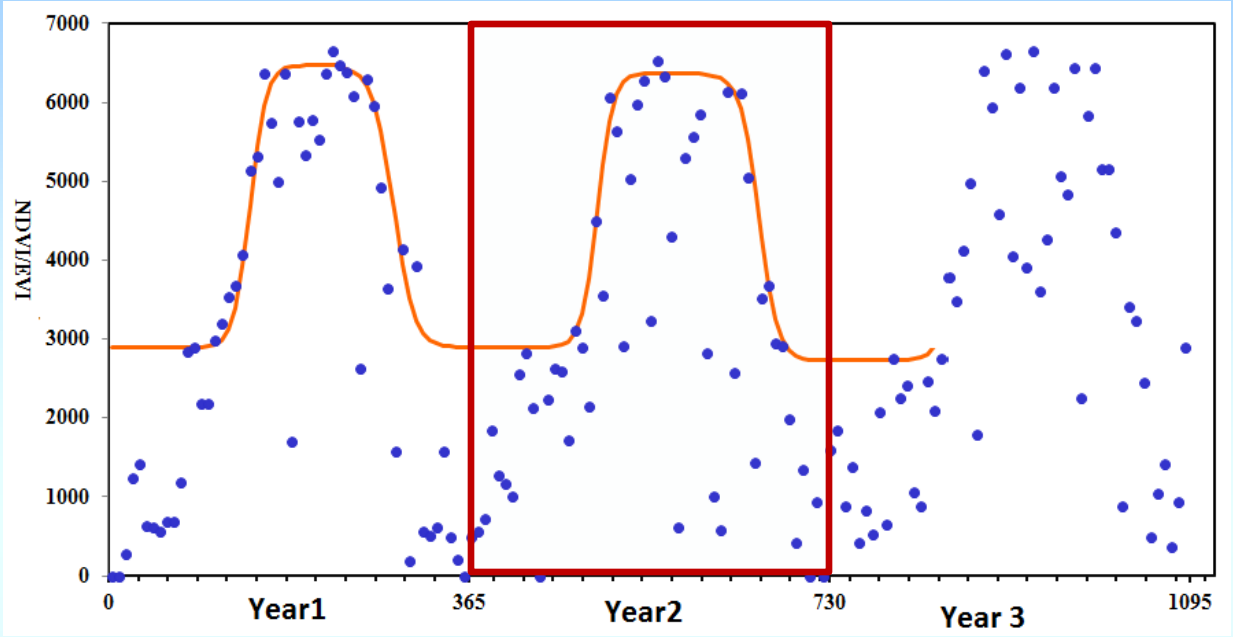
Metrics of Land Surface Phenology/Dynamics

1. Onset of greenness increase
2. Onset of greenness maximum
3. Onset of greenness decrease
4. Onset of greenness minimum
5. Growing season VI minimum
6. Growing season VI maximum
7. Summation of VI for growing season length
8. Rate of change in greenness increase;
9. Rate of change in greenness decrease
10. Onset of fall foliage low coloration
11. Onset of fall foliage moderate coloration
12. Onset of fall foliage near peak coloration
13. Onset of fall foliage peak coloration
14. Onset of fall foliage post peak coloration

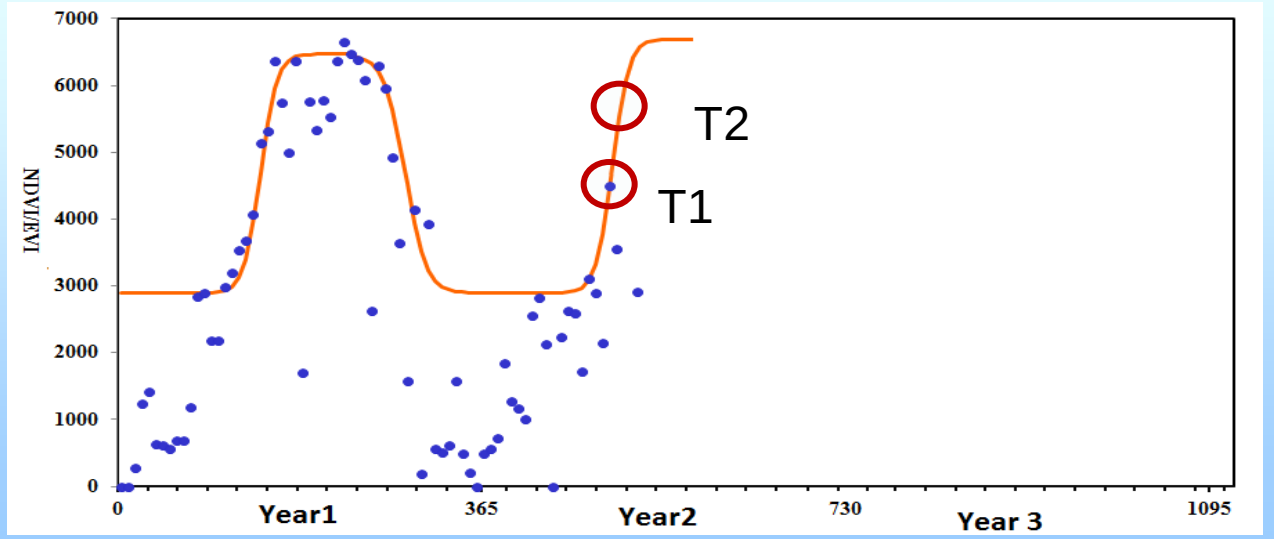


Establishment of Phenology Climate Data Record and Detection of Real Time Phenology

Climate data record of phenology is detected from annual time series of satellite data with a latency longer than half year

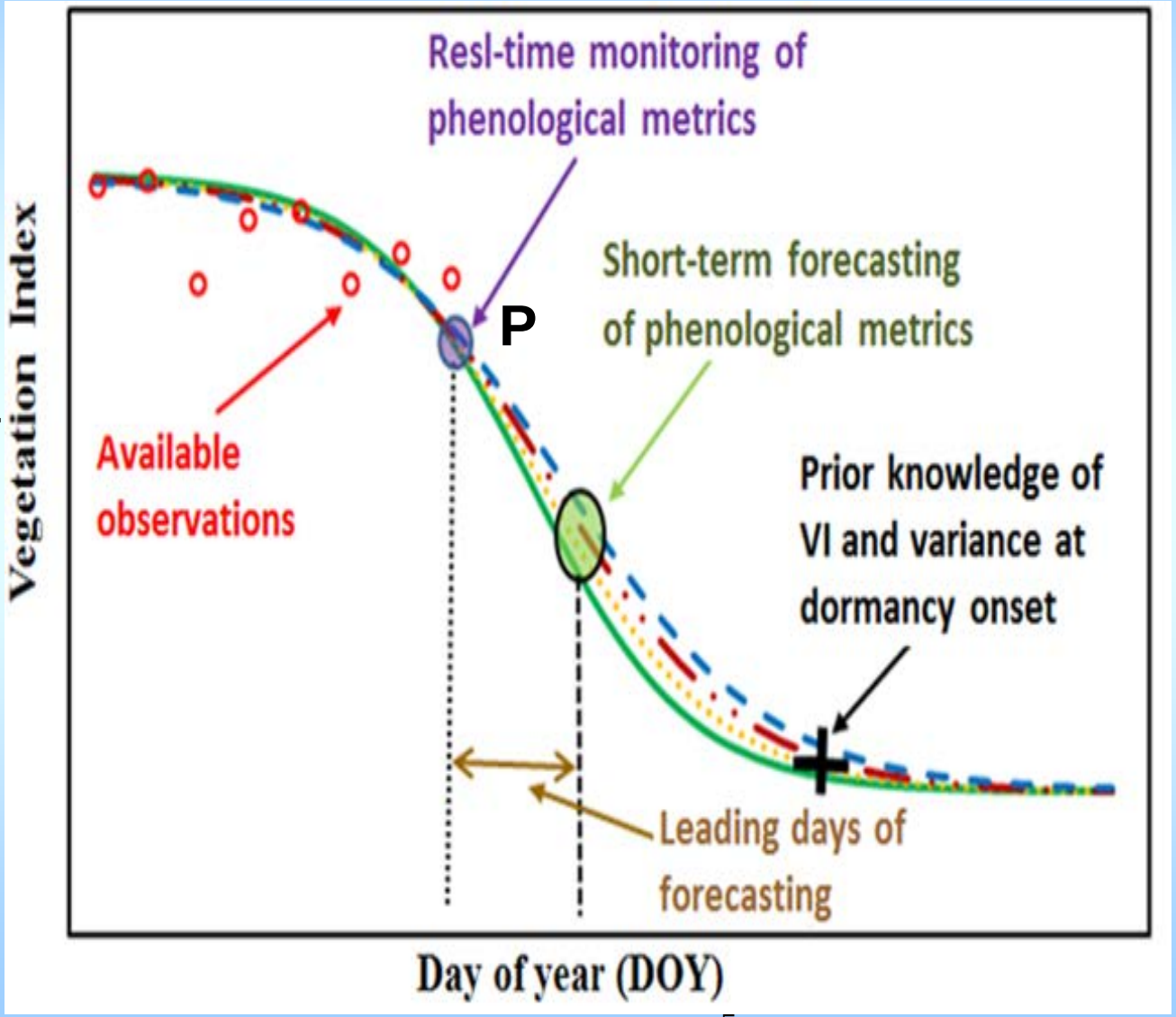


Real Time phenology is detected from currently available time series of satellite data without any latency



Prediction of Temporal Greenness Trajectory in Autumn

A set of potential VI trajectories in a senescent phase are modeled in near-real time for a pixel from the available observations (dots) and climatology.



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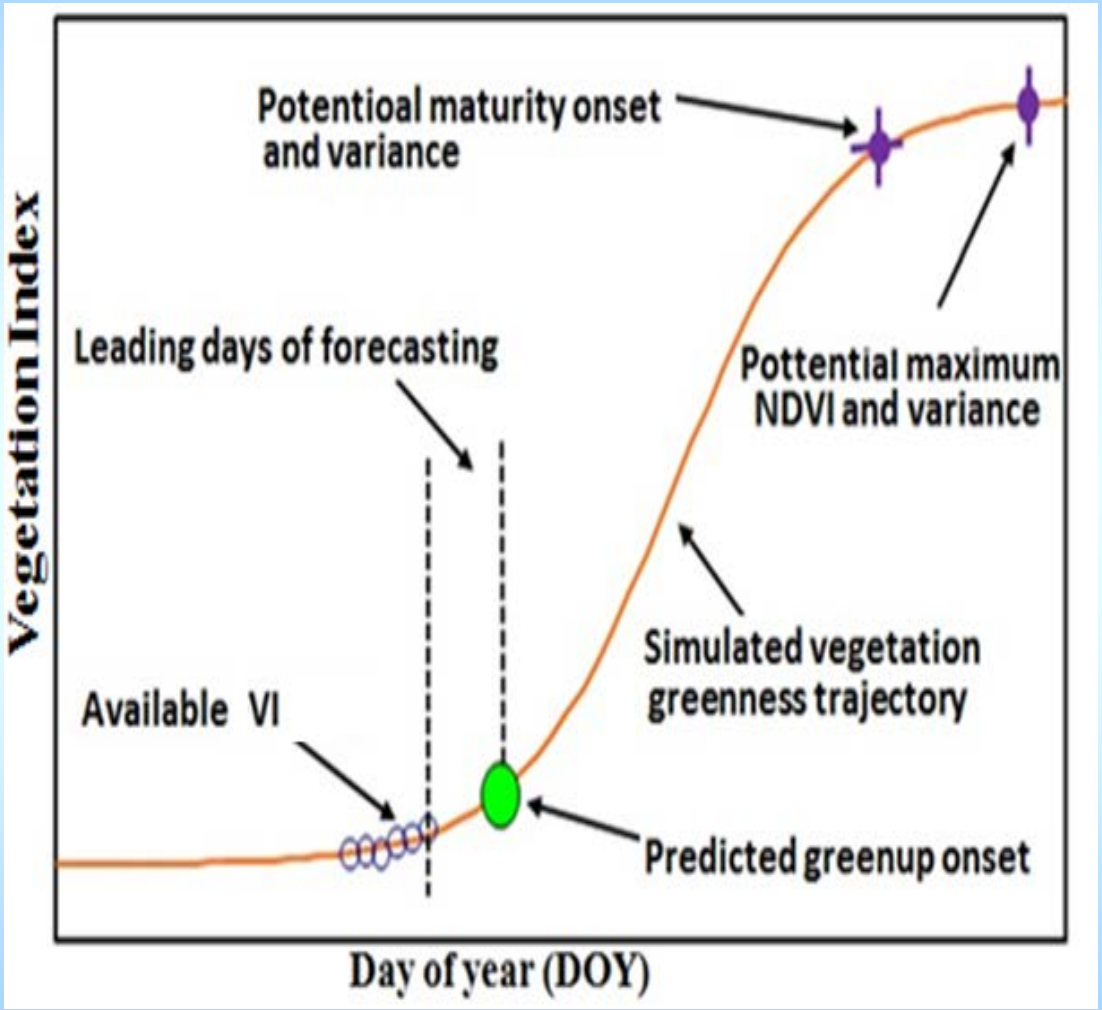
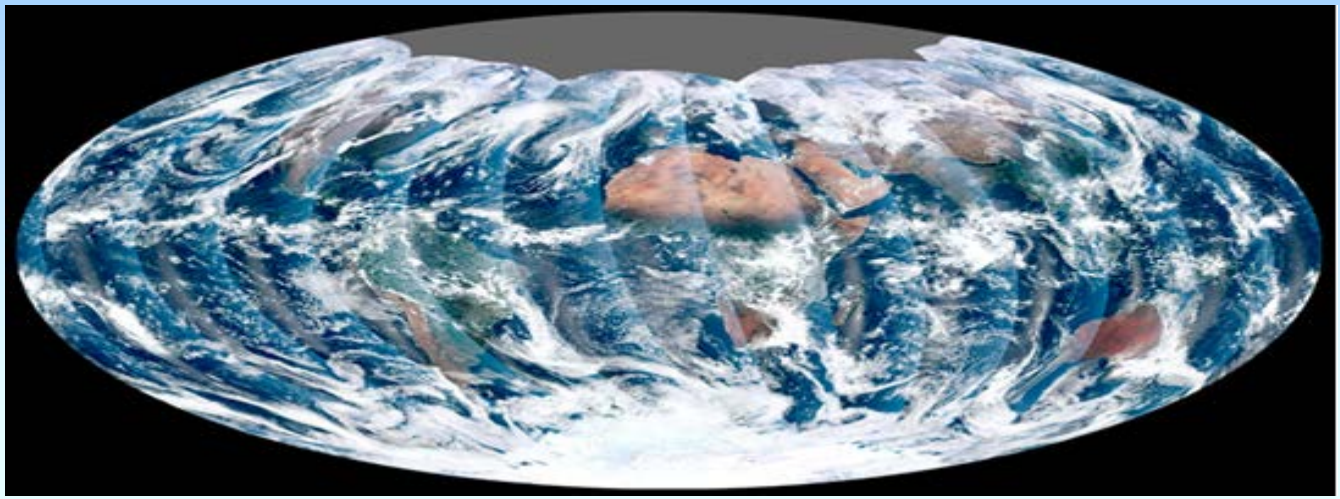
Prediction of Temporal Greenness Trajectory in Spring

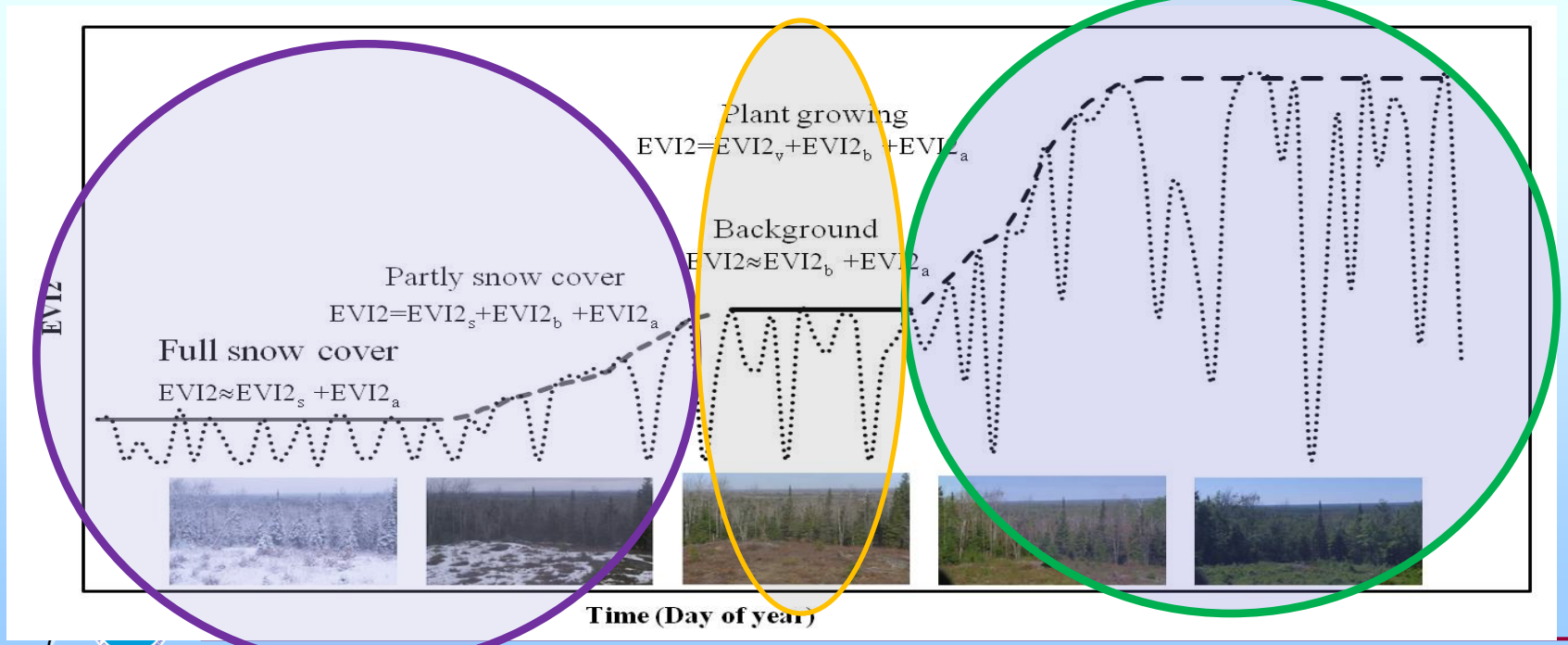


Simulating the potential temporal trajectory from available daily VI data (circles) and monitoring and forecasting phenological events in spring green-up phase.

6

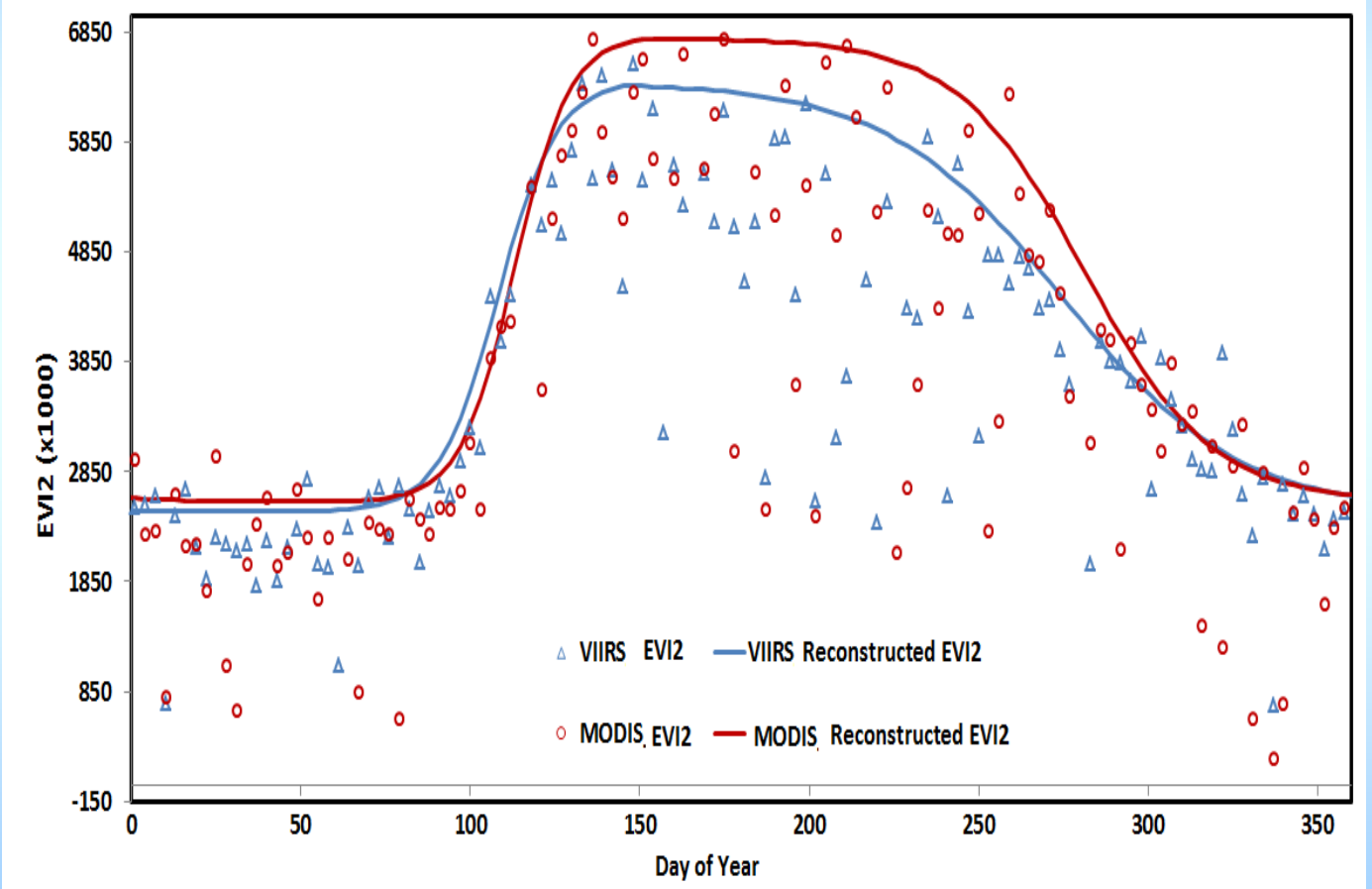
Biophysically Understanding Temporal Trajectory of Satellite Vegetation Index (VI)





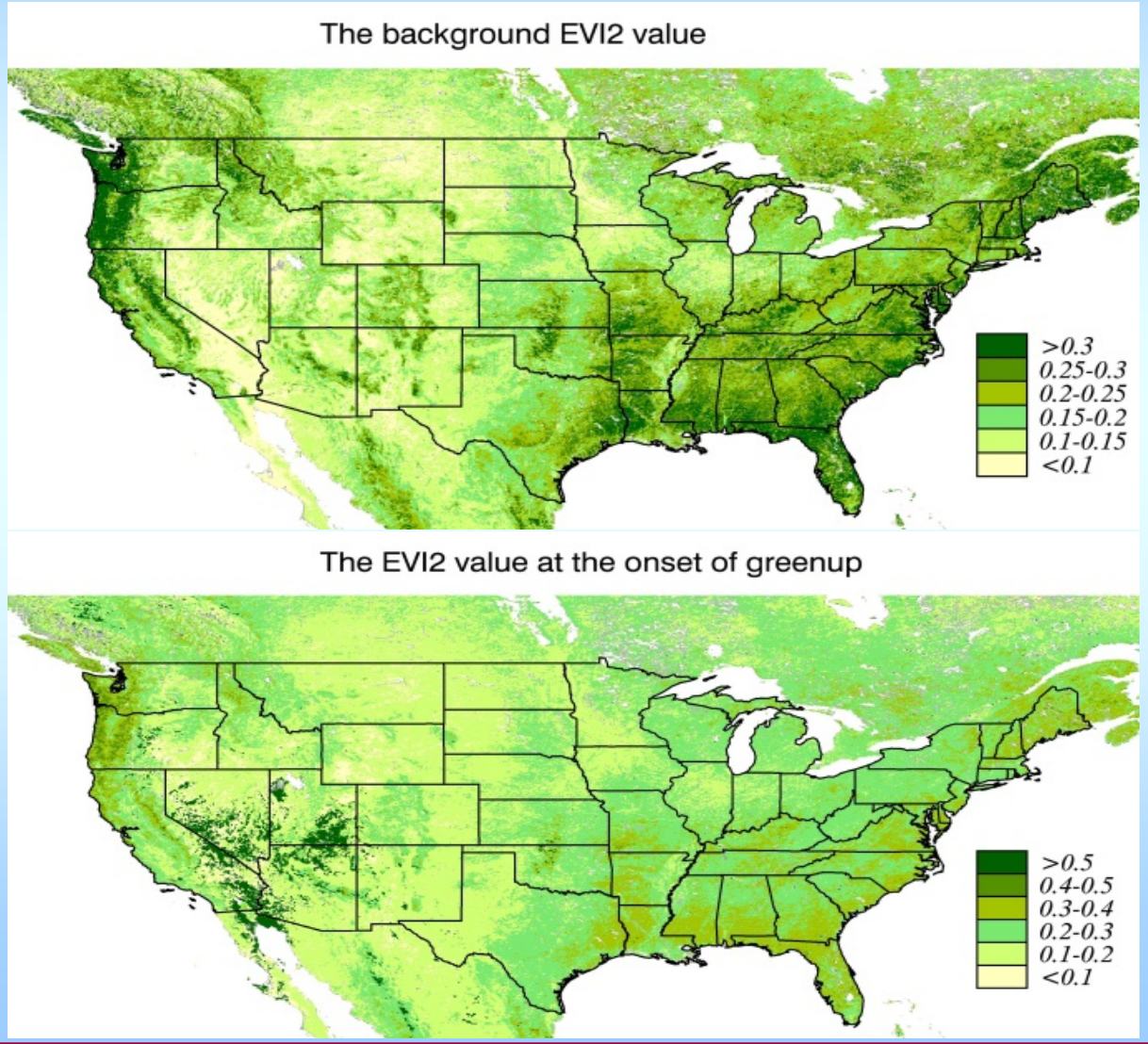
Calibration of Climatological Phenology Trajectory (from MODIS) to be comparable with VIIRS Data

- MODIS EVI and VIIRS EVI are not exactly the same
- Climatological EVI from MODIS needs to be calibrated to be comparable to VIIRS EVI



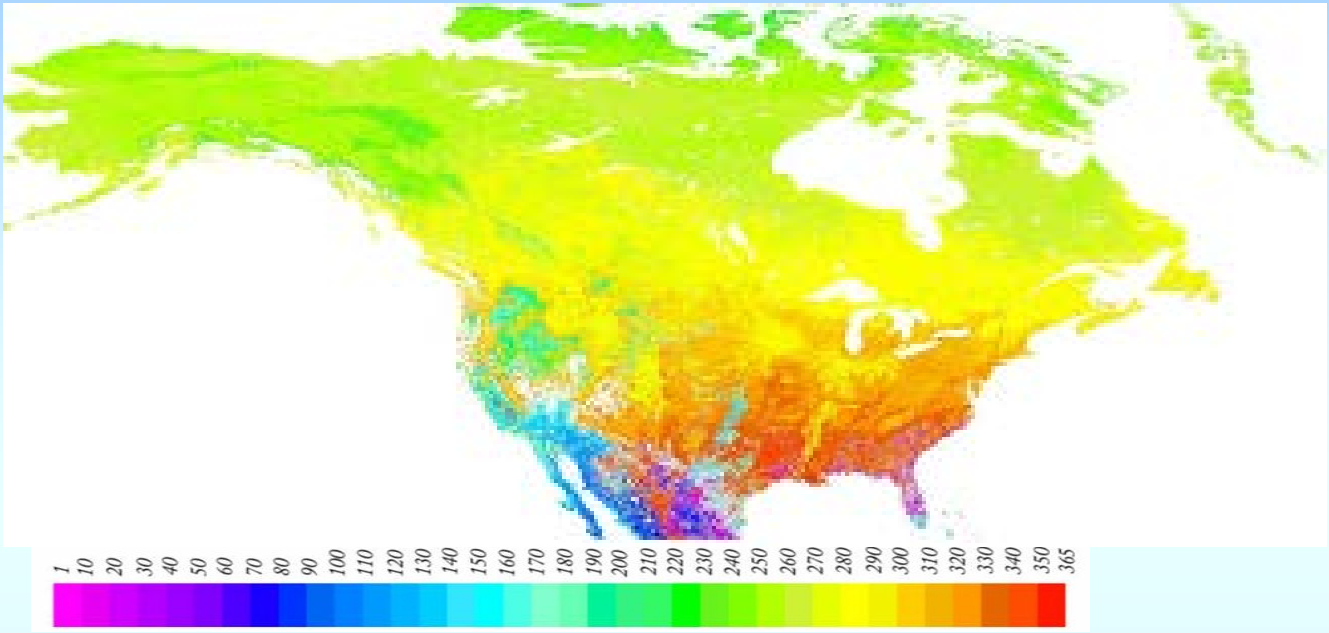
Climatological MODIS Vegetation Index for Real-time Monitoring from VIIRS data

Climatology MODIS vegetation index (2001-2012) calibrated using annual time series of MODIS and VIIRS data in 2013.

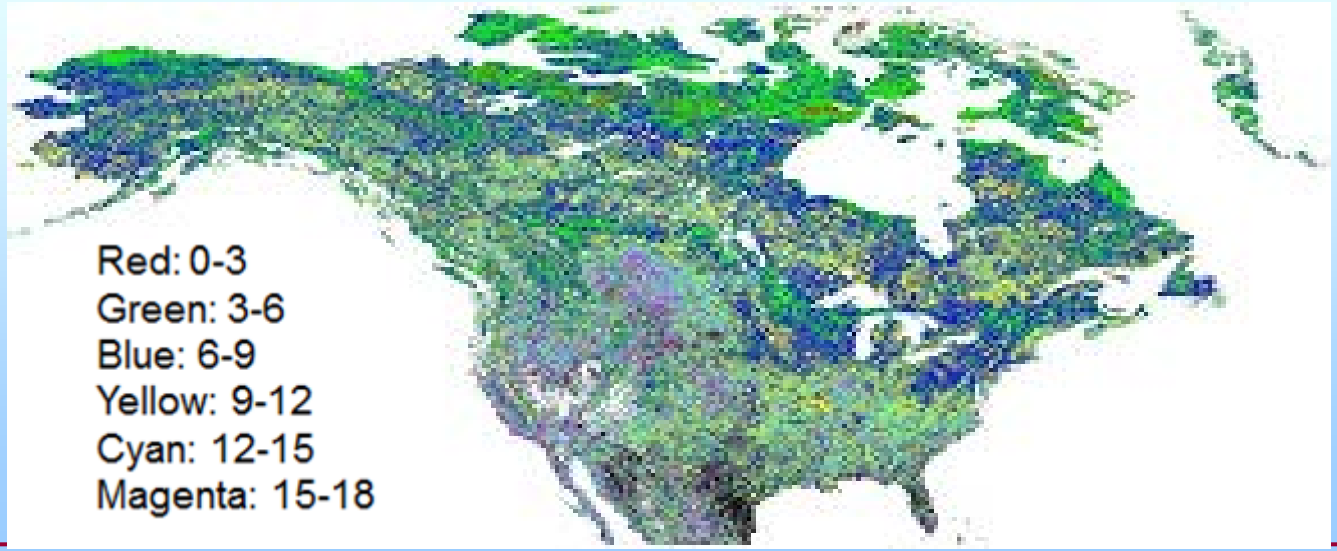


Climatology of Dormancy Onset and Standard Variation

Climatology from MODIS data from 2001-2012



Standard variation of dormancy onset (2001-2012)



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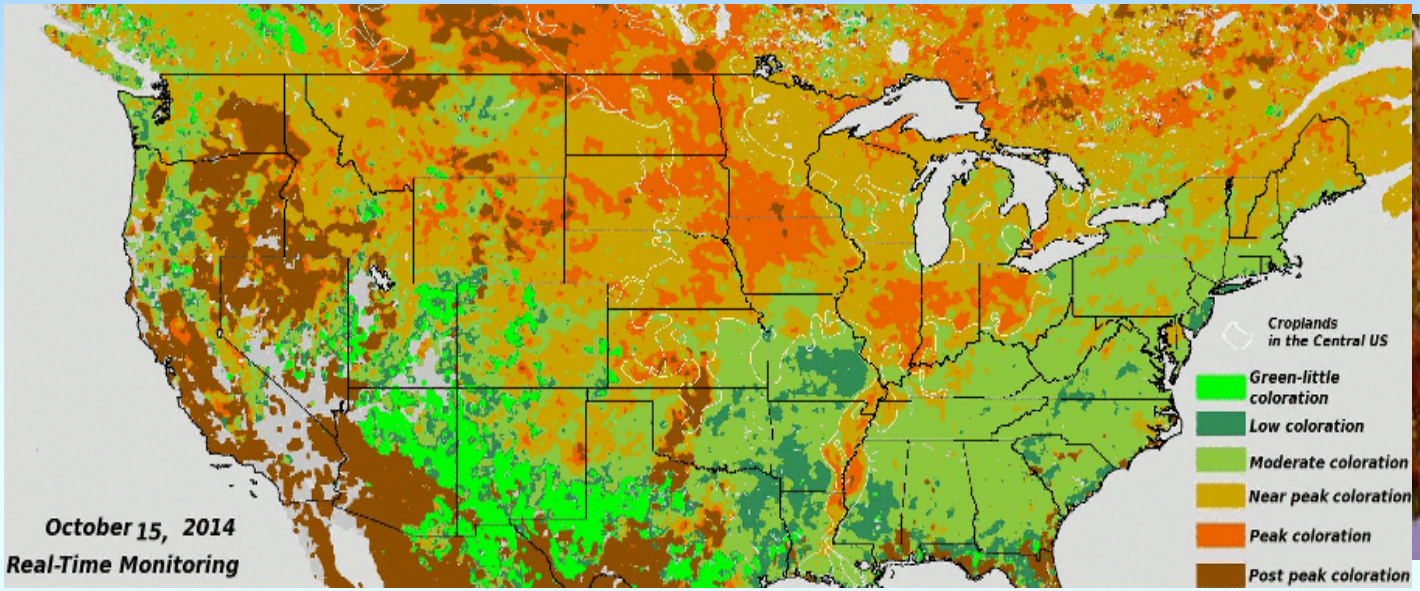
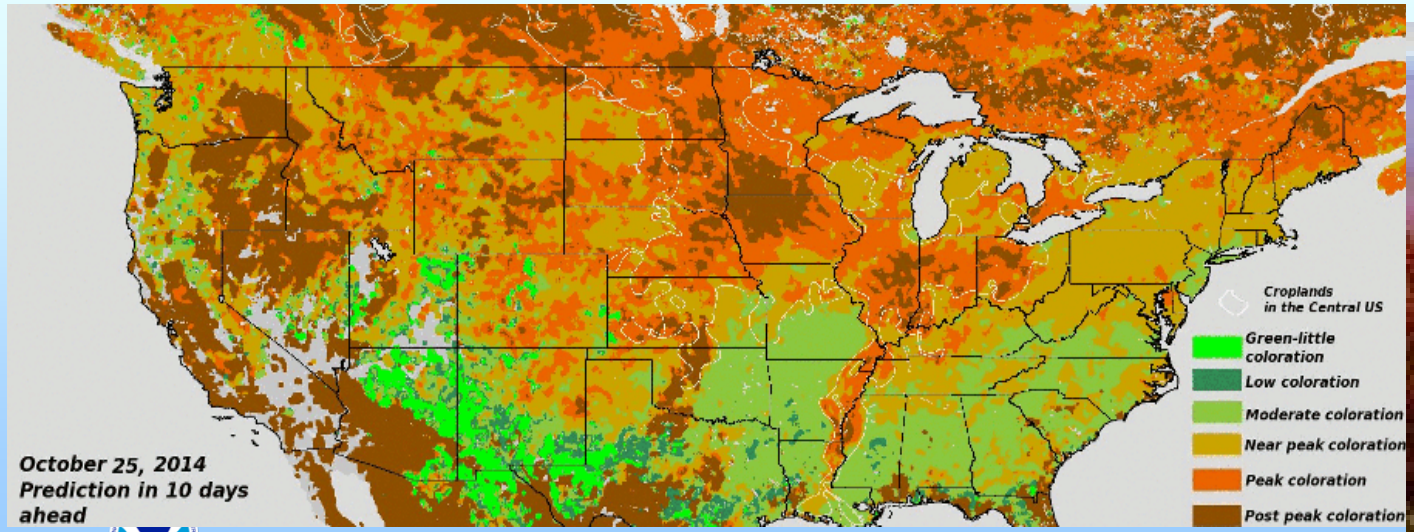
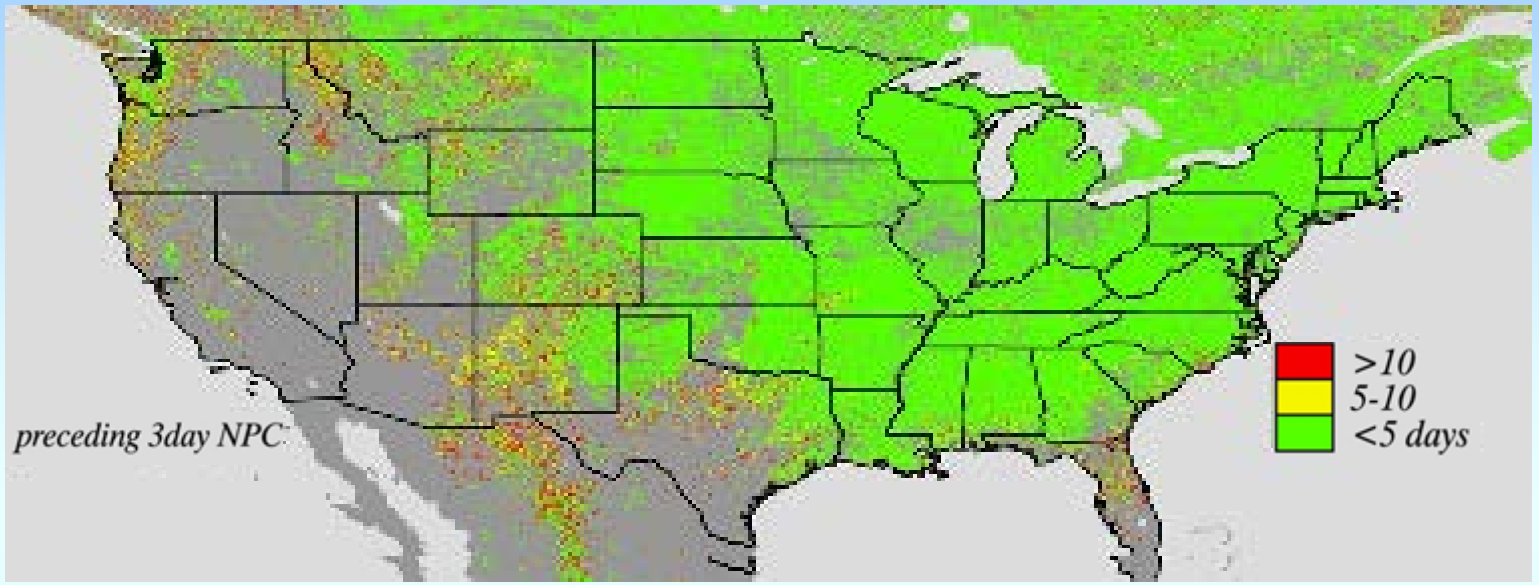
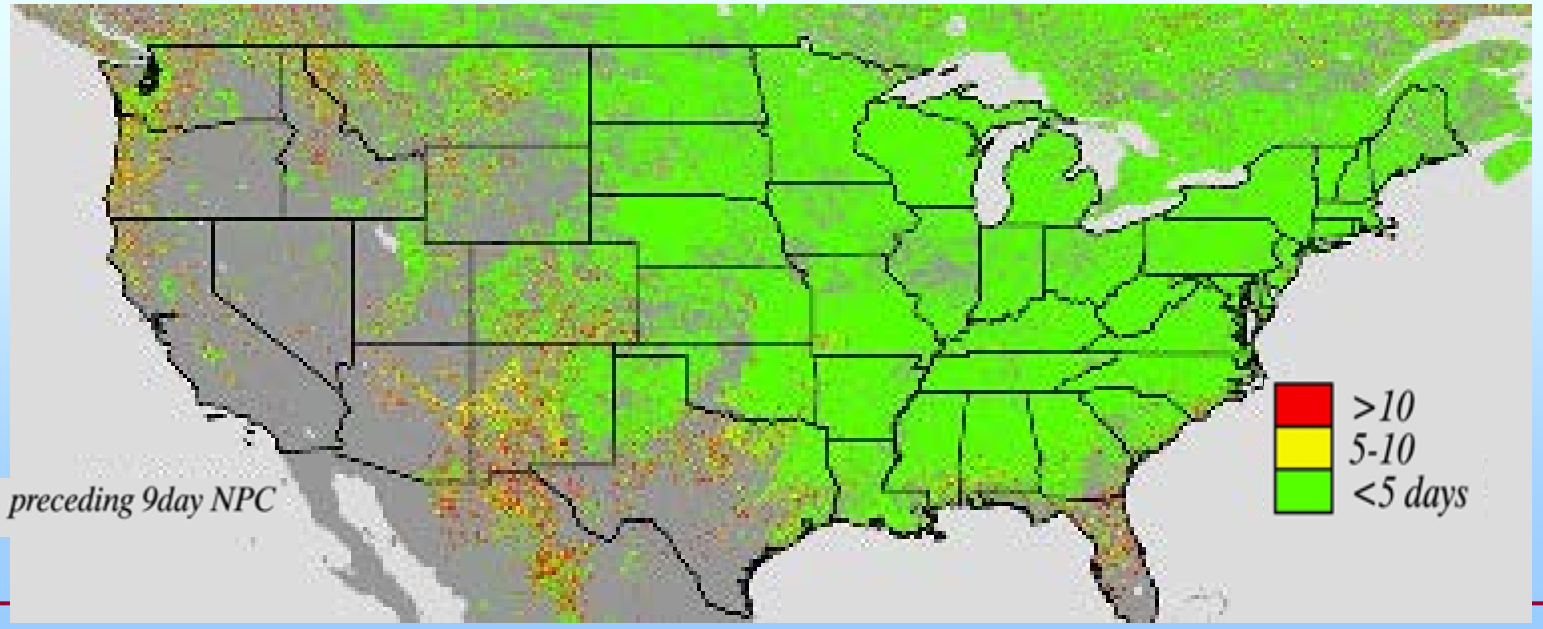
Real-time Monitoring and Short-term Forecasting of Fall Foliage from JPSS VIIRS





Uncertainty of Color Foliage Monitoring





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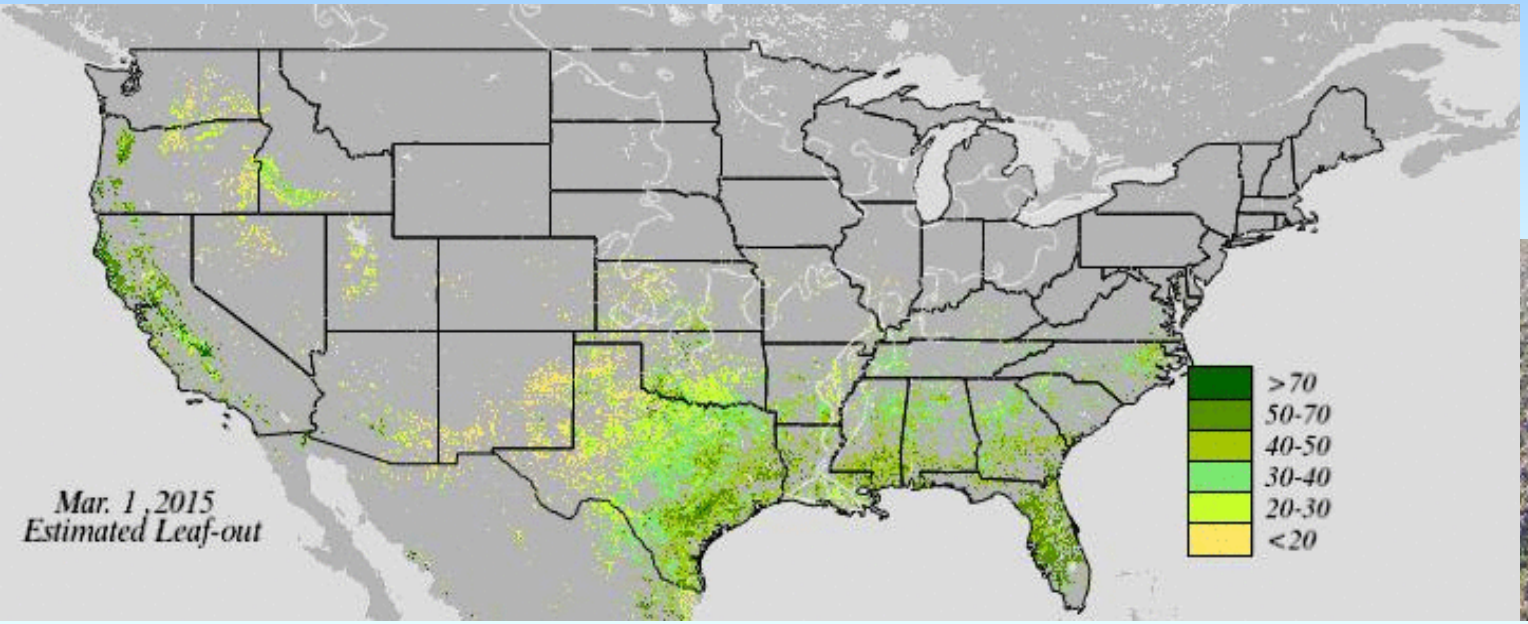
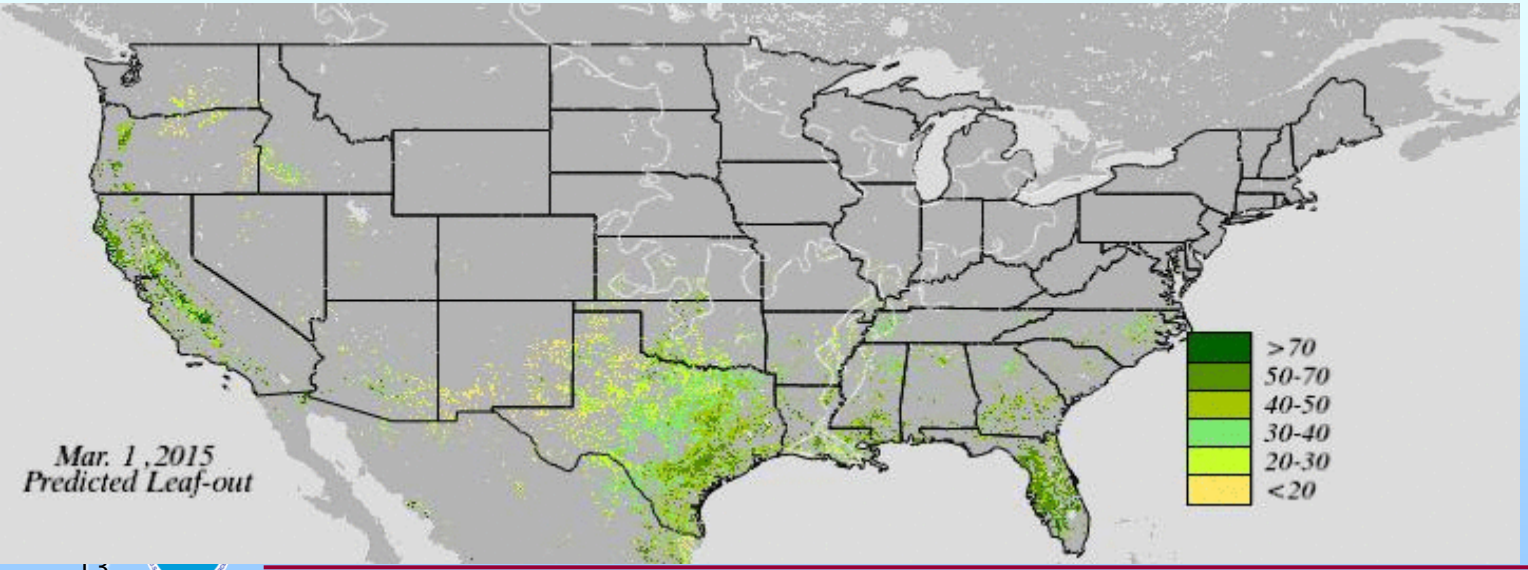
Monitoring and Forecasting of Spring Vegetation Progress





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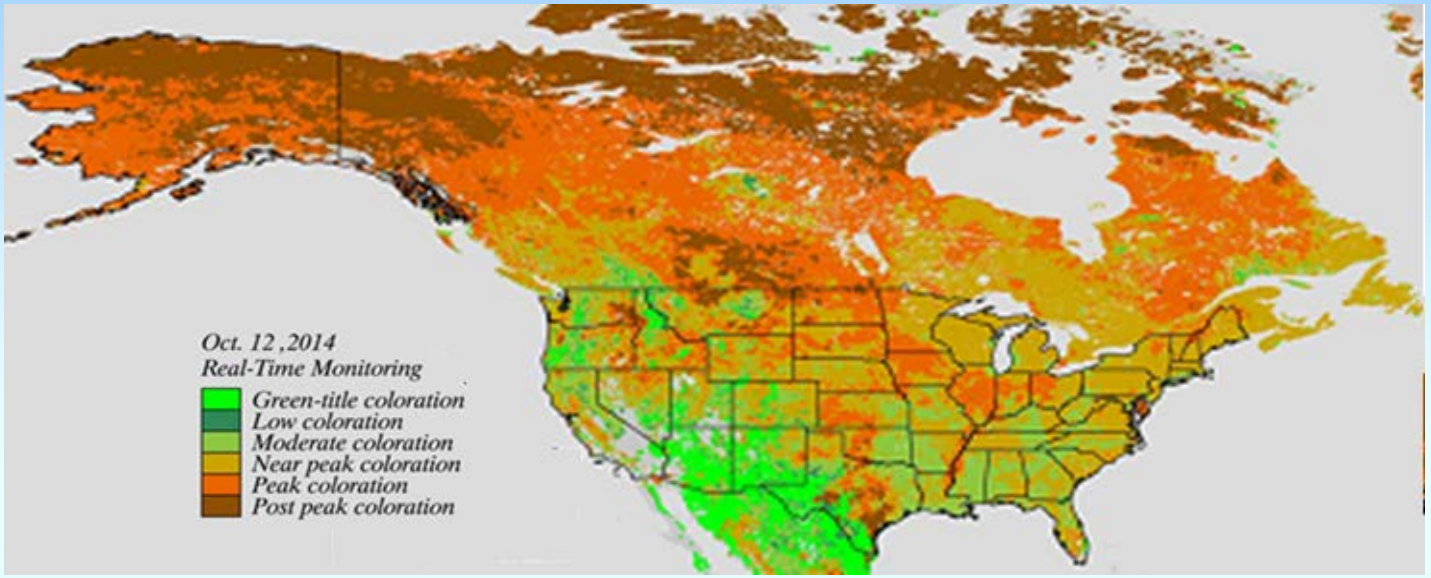
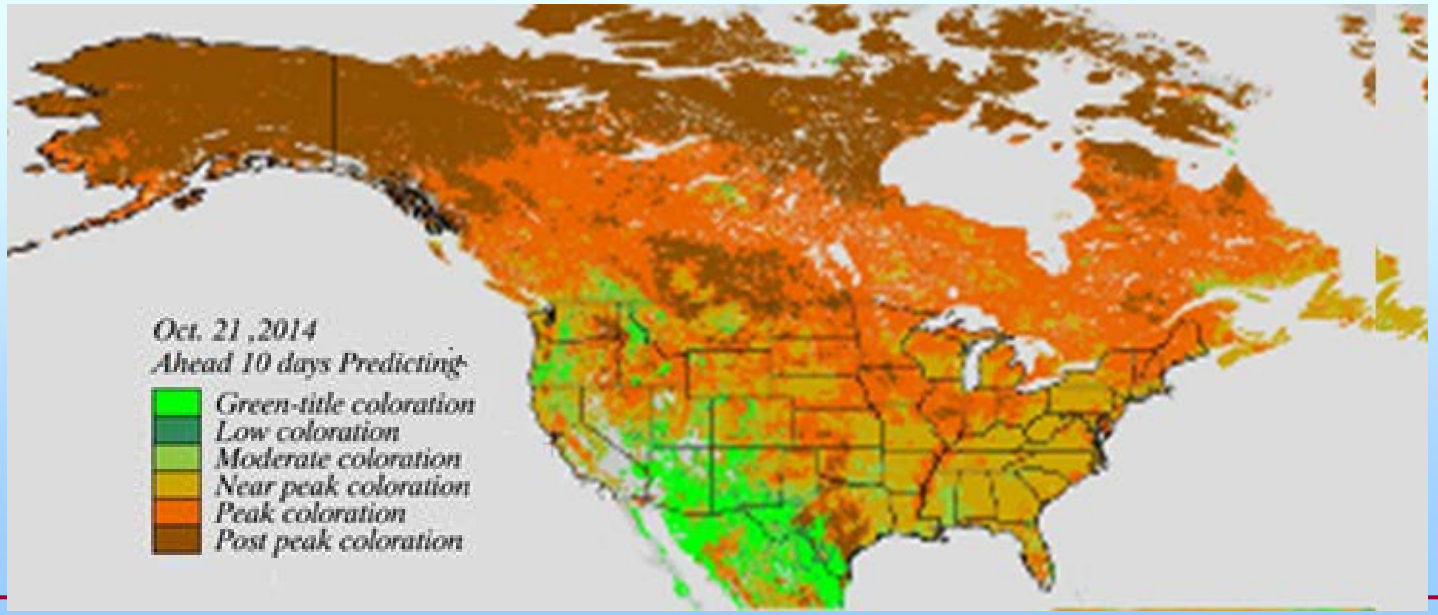
VIIRS Monitoring Across North America





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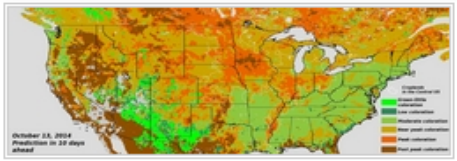
STAR developed new Foliage Phase Prediction system



Foliage Phase Prediction Derived from VIIRS NDVI

Image: NOAA

Two scientists of the Center for satellite Applications and Research (STAR), the scientific arm of the NOAA Satellite and Information Service (NESDIS), have elaborated a new method to observe and forecast short-term fall foliage coloration.

The latest STAR system was created with the support of the JPSS Proving Ground and Risk Reduction Program and it employs the VIIRS daily vegetation index to monitor foliage indicators across the United States with a time-pace of 3 days and to generate predictions of 10 days.

The STAR product represents the first instrument that can evaluate and forecast the fall foliage coloration phenomenon from a satellite data time series. The information will be useful for a wide variety of purposes, such as monitoring drought and crops germination, individuating hurricane destruction, forest pests, disease outbreaks, and species invasion.

Read full story: NOAA

Processed on Nov 6th 2014

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changes in visible light and in infrared. The forecast is updated every three days.

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Fall Foliage Monitoring from NOAA National Weather Service Weather Forecast Office

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Autumn officially
September 22nd
at 8:49 AM MDT.

Have you e
wondered
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color durin
Autumn?

It's all caused by
earth's orbit arou
sun and its effect
weather. During t
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The Autumn Color Show

- Wisconsin fall color report
- Minnesota fall color report
- Iowa fall color report

Many people think that cold weather is solely responsible for the color change in leaves, but not so. Leaves begin to turn before we have any frosts. Change in coloring is the result of chemical processes which take place in the tree as the seasons change.

During the spring and summer a food-making process takes place in the leaves, within cells containing the pigment chlorophyll. This gives the leaf its green color. The chlorophyll absorbs energy from sunlight and uses it in transforming carbon dioxide and water to carbohydrates, such as sugars and starch.

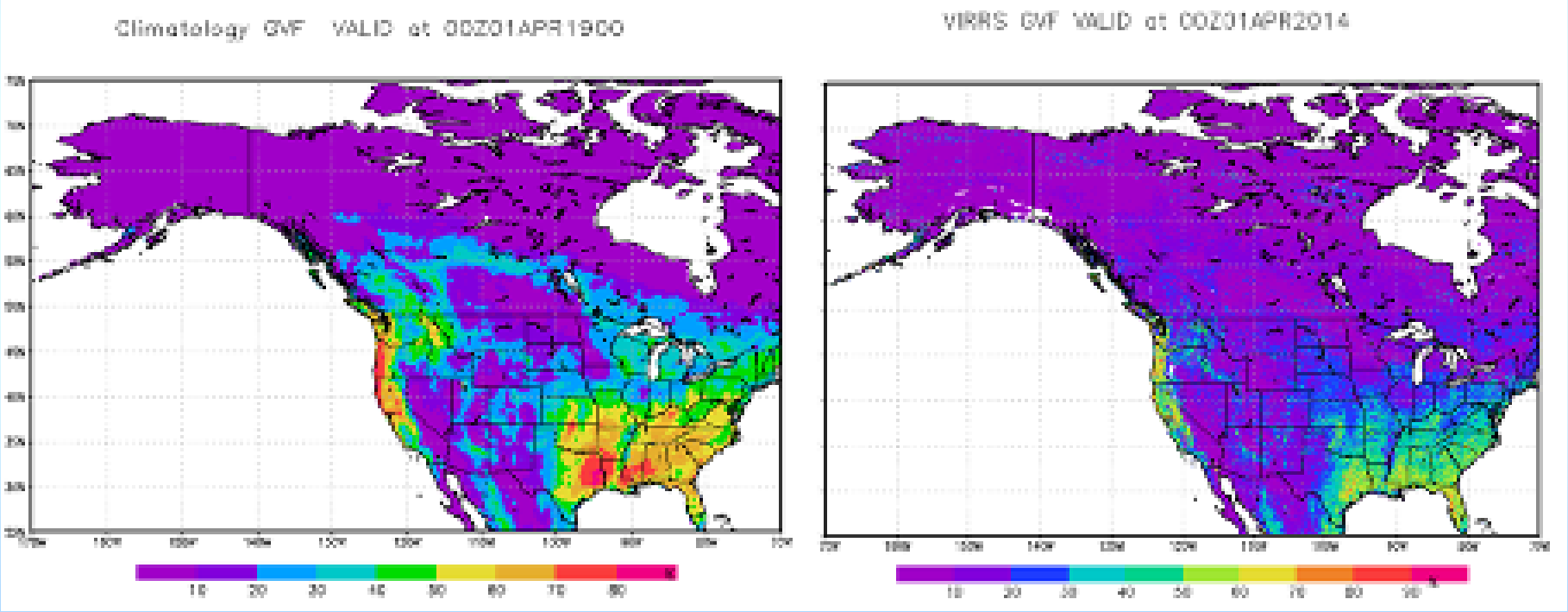
In the fall the decrease in intensity and duration of sunlight, and the cooler temperatures cause the leaves to stop their food- making process. The chlorophyll breaks down, the green color disappears and the yellowish colors or other pigments already in the leaf become visible.

VIIRS real time monitoring of fall foliage coloration can serve the prediction from weather data in NOAA National Weather Service.

Real Time Phenology for Land Modeling (in NOAA EMC)

Metrics of phenology – the seasonal vegetation dynamics

- Estimate surface energy balance,
- Determine the partition of surface sensible and latent heat fluxes
- Predict boundary layer structures in the global and regional numerical weather prediction models



Climatology greenness currently used in Land Model in EMC

Real Time VIIRS data from phenological detection

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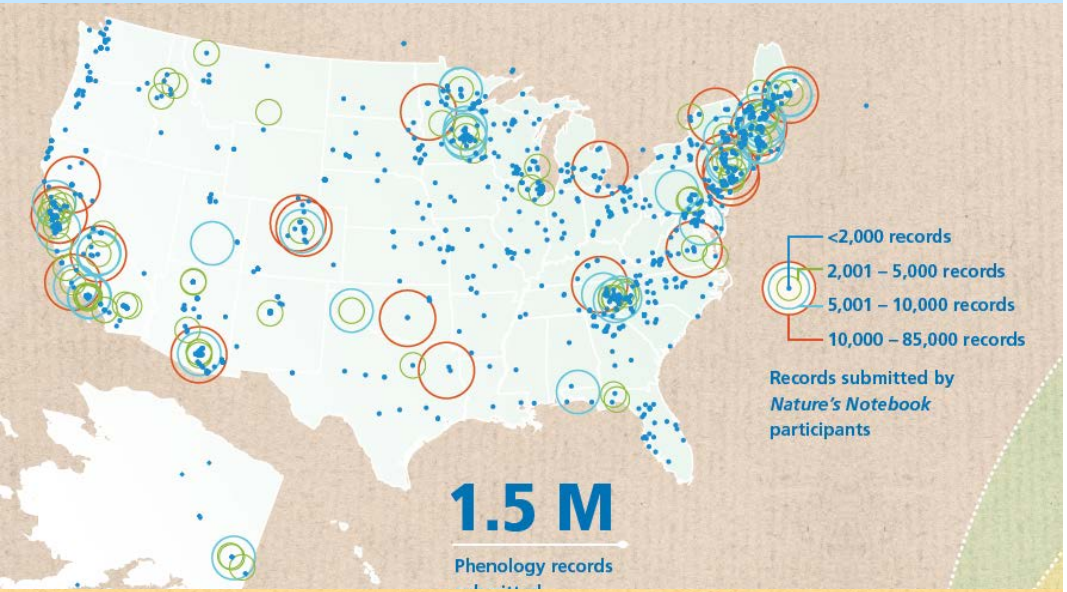
Assistance in USA National Phenology Network

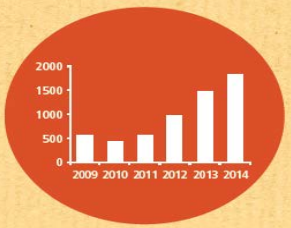


People and Partners

141 Active partner organizations

4,451 Total active participants since 2009

41% Proportion of participants registered since 2009 that submitted observations in 2014



3,975 Participants registered in 2014

23% Increase in active participants over 2013

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Of Special Interest: Maples, Oaks, and Poplars

nature's notebook
A project of the USA-NPN

Track the "Green Wave" across the country as trees progress through seasonal changes

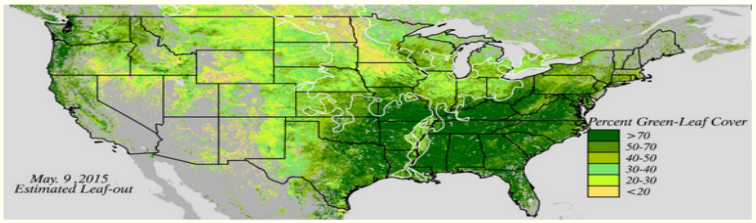

Oak leaves, © Ellen Denny

Spring has finally sprung! Across the country, trees are responding. Are the trees in your yard putting on their leaves?

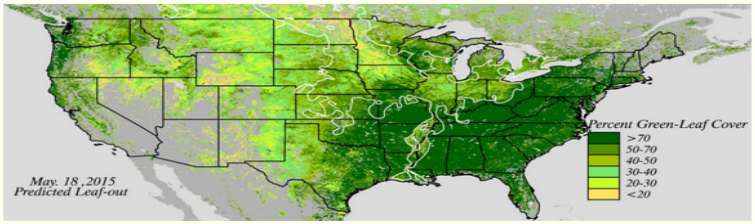
Since our last email, more of you have submitted observations for the **Great Plains North Green Wave Campaign** - thank you!

This spring, we have a new way for you to know when to expect leaves on your maples, oaks and poplars. A team of scientists including Drs Xiaoyang Zhang and Lingling Liu (South Dakota State University) and Dr Yunyue Yu (NOAA/NESDIS/STAR/SMCD/EMB) have created predictions of green-up across the country, based on historical and current satellite information and temperature. Click the links below to see a larger version of these maps.

Does the **Estimated Leaf-out map** match what you see on your trees?



If you are not yet seeing leaf-out on your trees, the **Predicted Leaf-out map** will show you if you can expect to see leaves on your trees in the next week. Don't forget to log your observations in *Nature's Notebook* to help verify whether these models are correct!



Thank you *for helping out on this important project! Through this effort, you are contributing directly to scientific discovery and your participation is truly appreciated.*

Forward to a Friend

Erin Posthumus
Outreach Associate
erin@usanpn.org / p 520.622.0363
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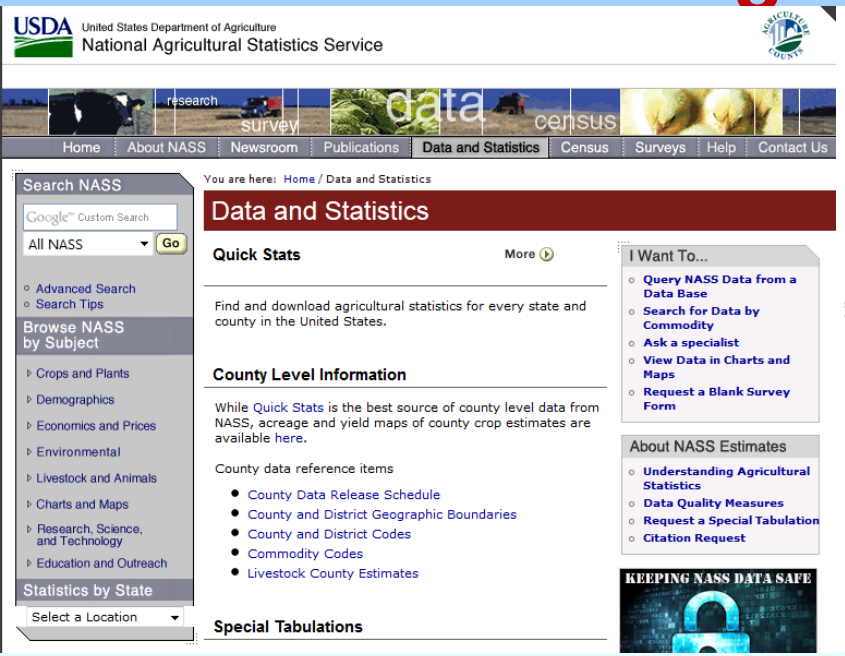
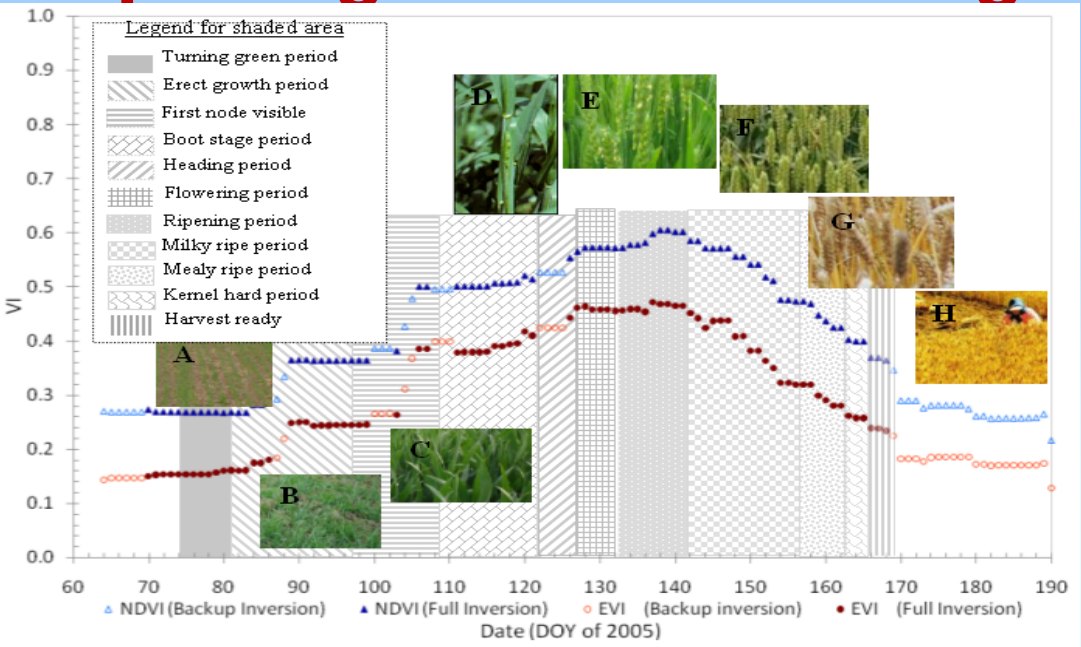
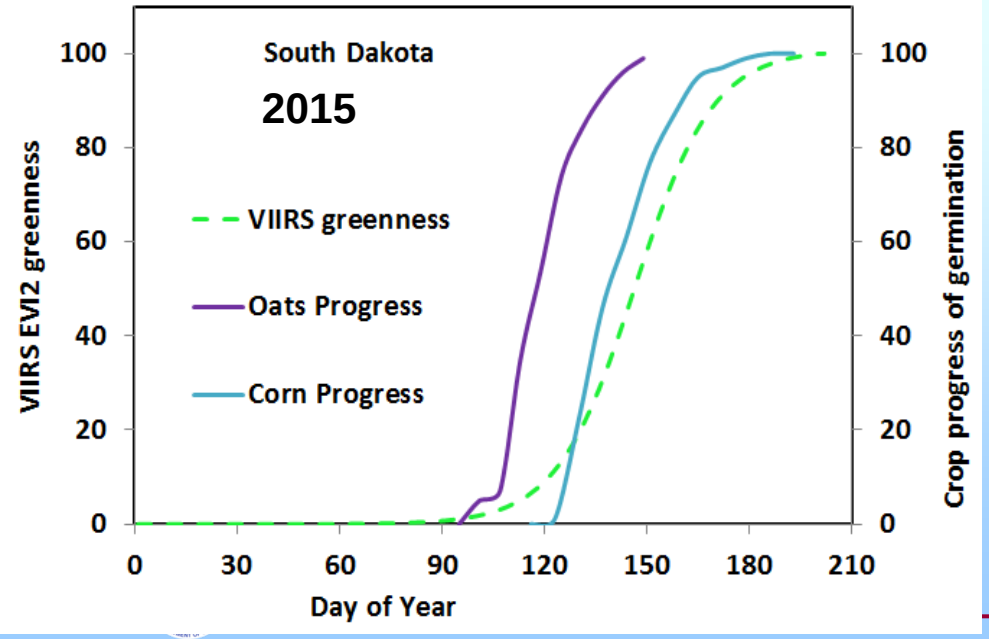
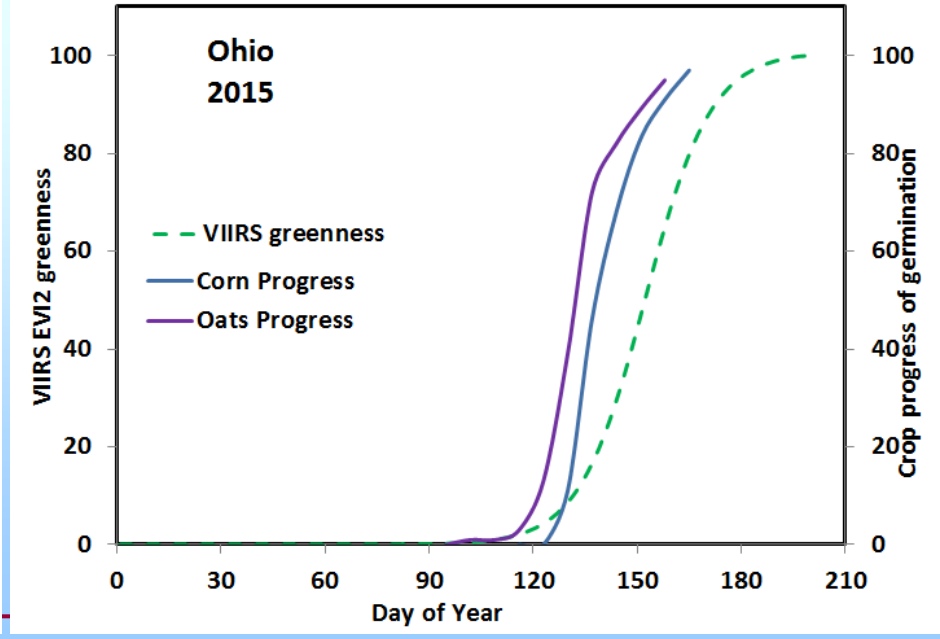
Serving Crop Progress Monitoring



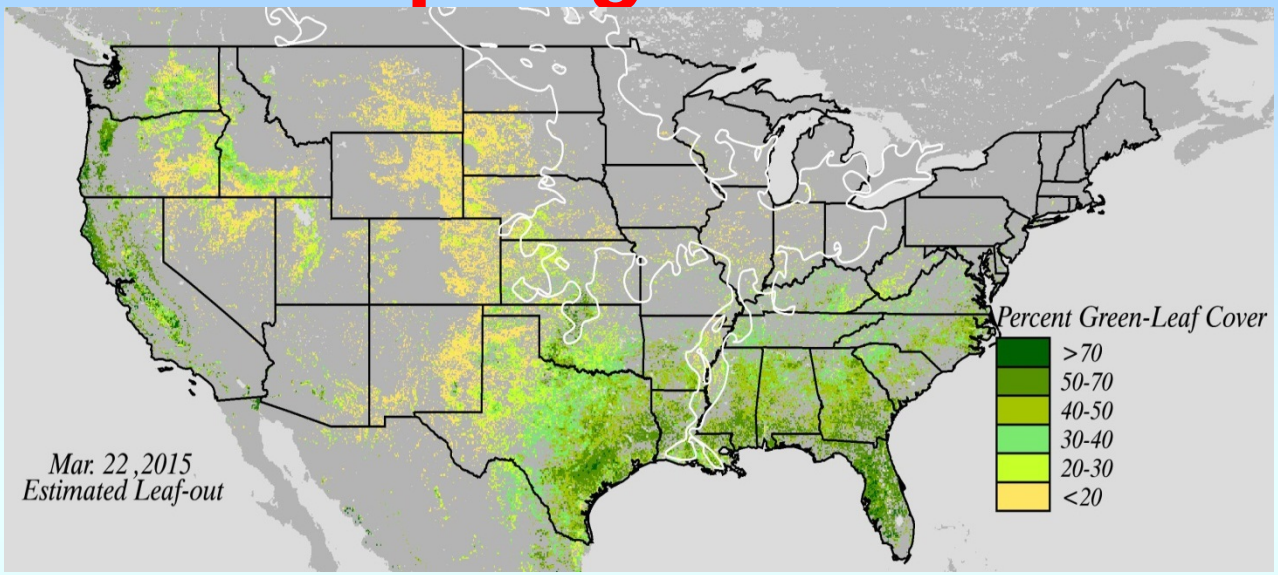




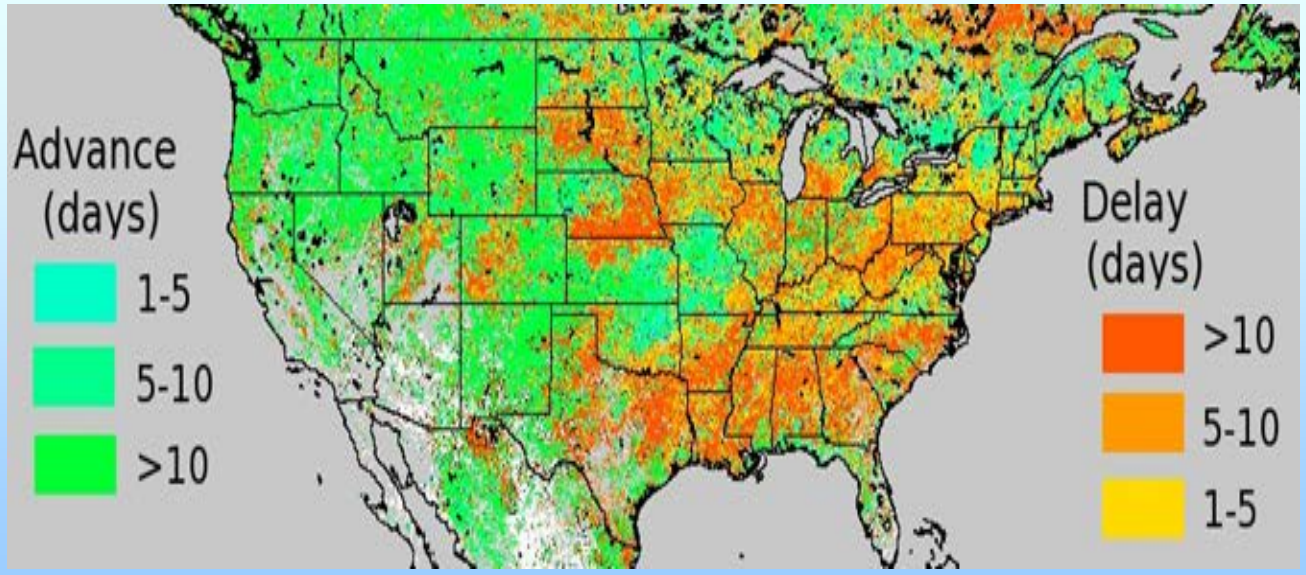


Climate Indicator – Spring 2015

Real time monitoring shows a earlier spring in the western region than eastern area in 2015



Comparison of the spring event in 2015 with climatology (2000-2011) shows the spring was advanced in western region while it was delayed in eastern area.



Summary and Issues

1. Near real time VIIRS observations make it possible to reconstruct the potential trajectories of daily vegetation dynamics timely.
2. The preliminary results indicate VIIRS real-time monitoring of phenology has wide applications.

3. This project has been very successful with the support from JPSS Risk Reduction during the past two years.
4. How to continue this effort is a major issue because the funding support will end before next summer.