The USA National Phenology Network's National Phenology Database

A Multi-taxa, Continental-scale Dataset for Scientific Inquiry

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and

Staff of the *USA-NPN National Coordinating Office*

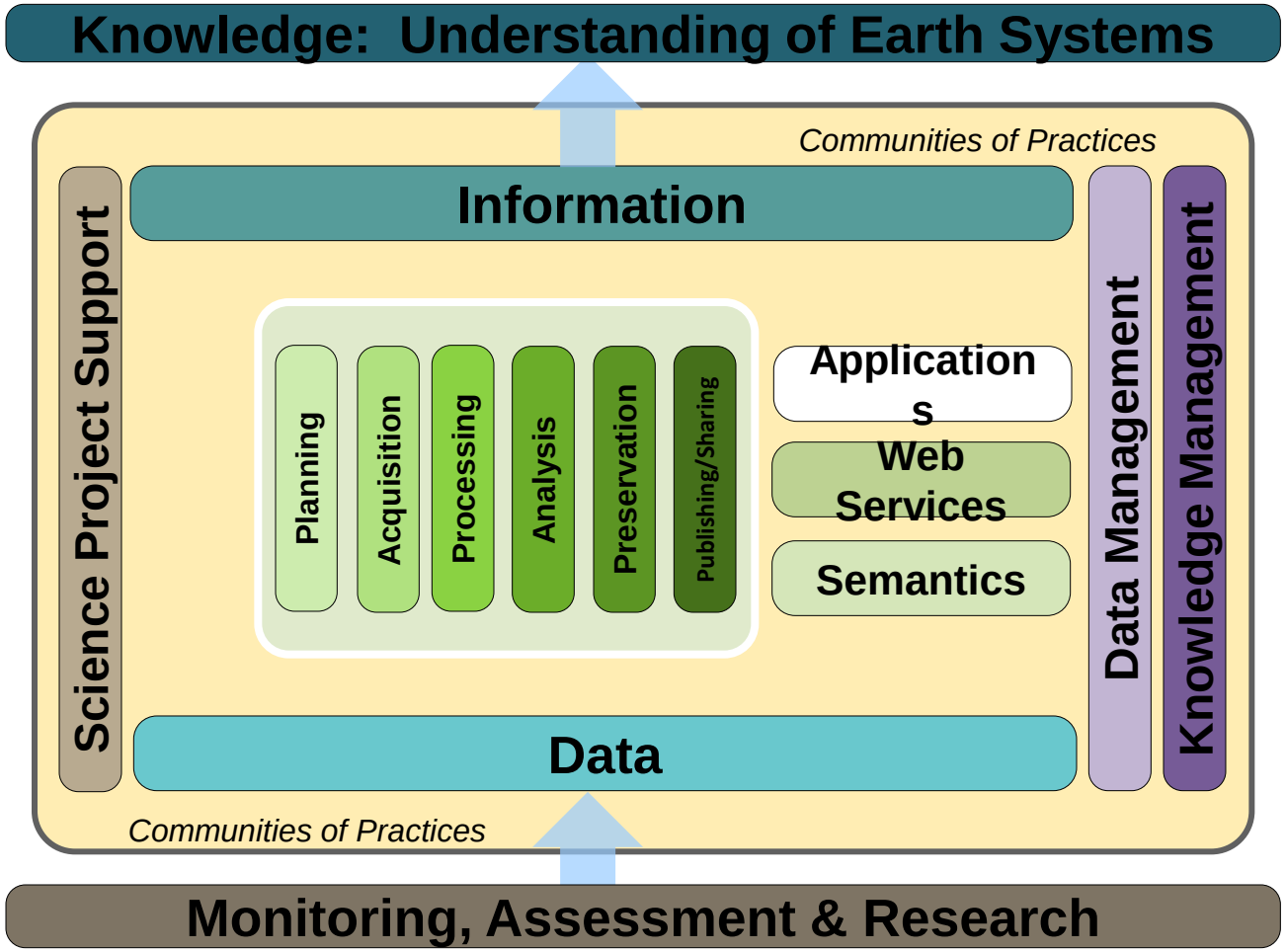
USA npn National Phenology Network

USGS science for a changing world

www.usanpn.org

An operational model for NPN?

CDI Science Support Framework



Goal

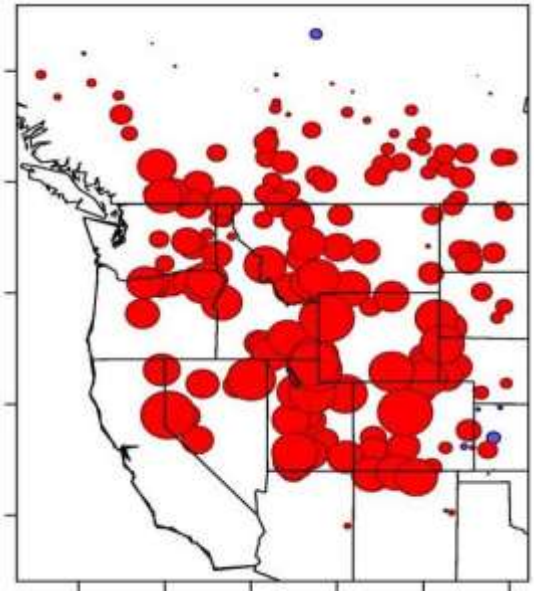
USA npn National Phenology Network

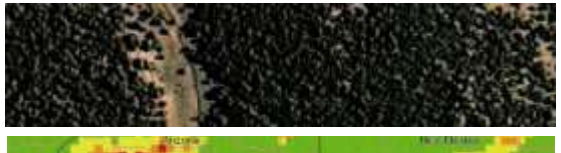
A new data resource—*a national network of integrated phenological observations across space and time*

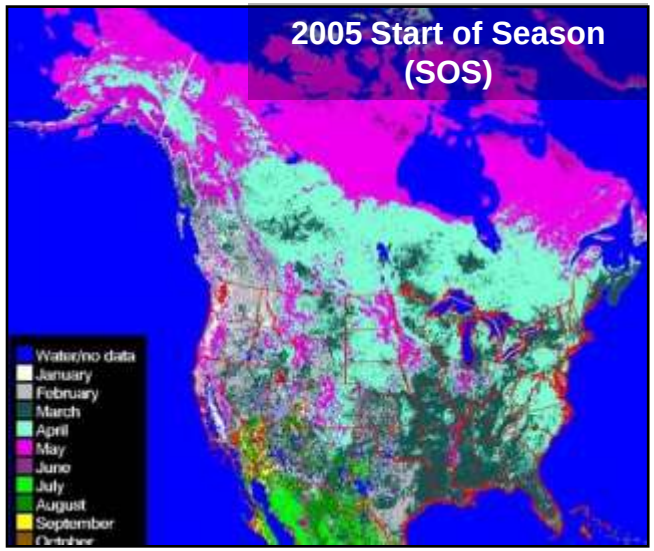
Mission

Make phenology data, models, and related information available to scientists, resource managers, and the public

Fires in western US







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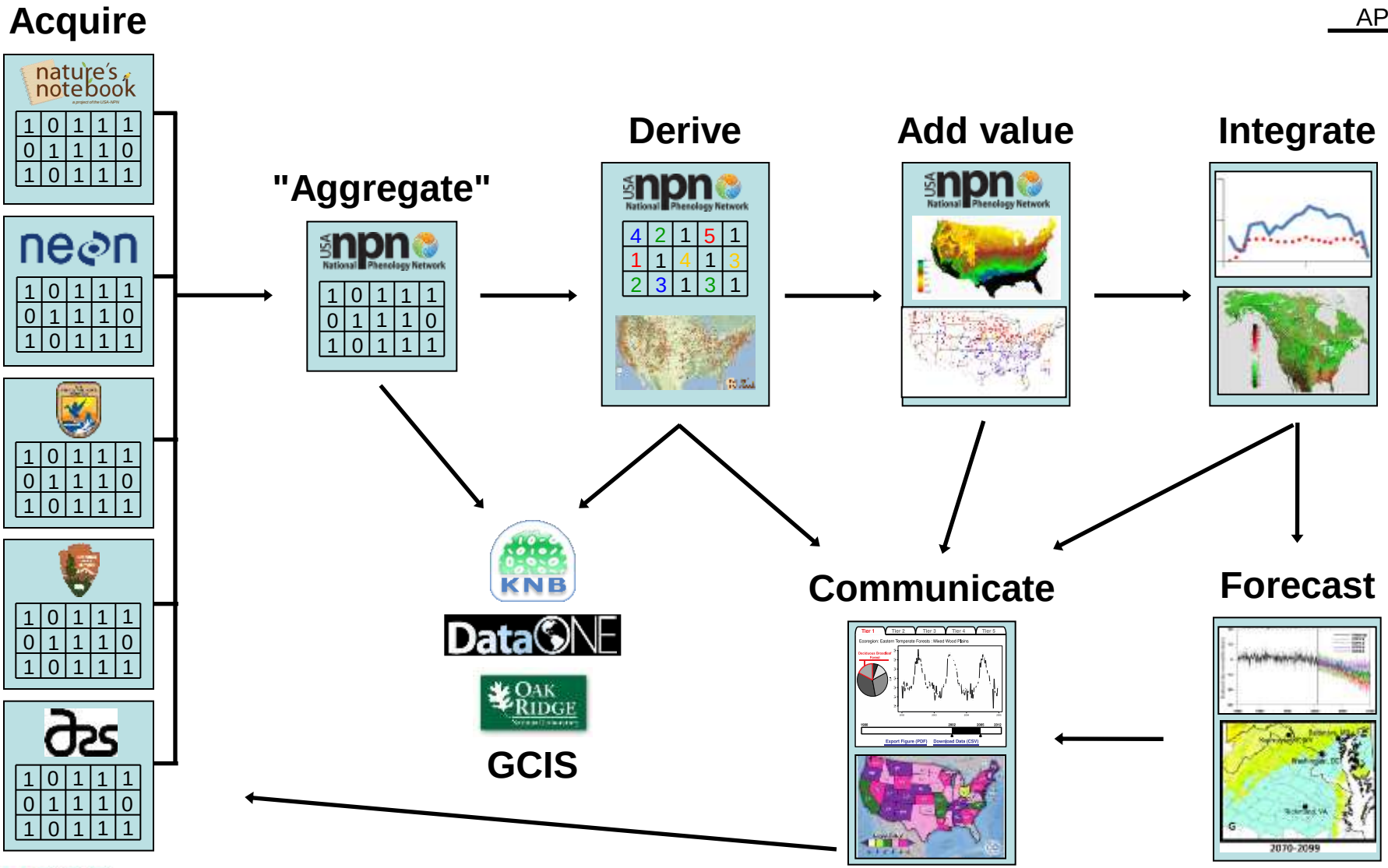
Applied information management

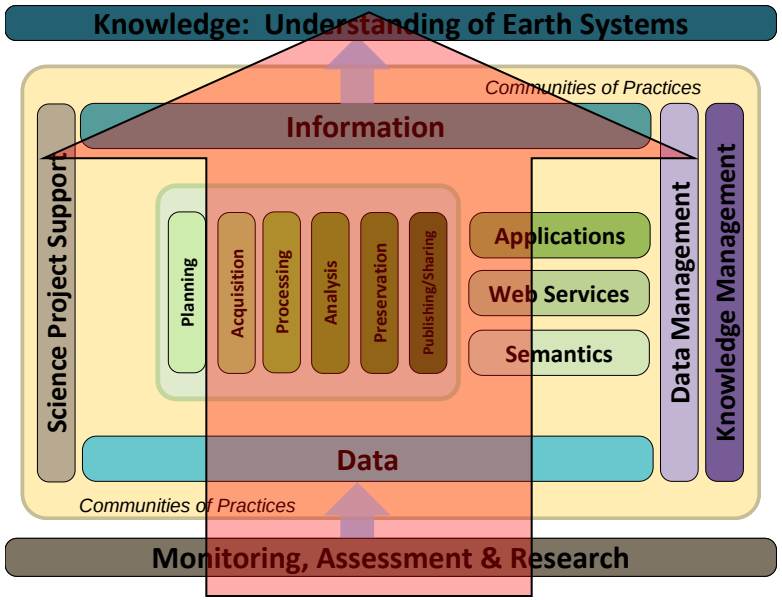


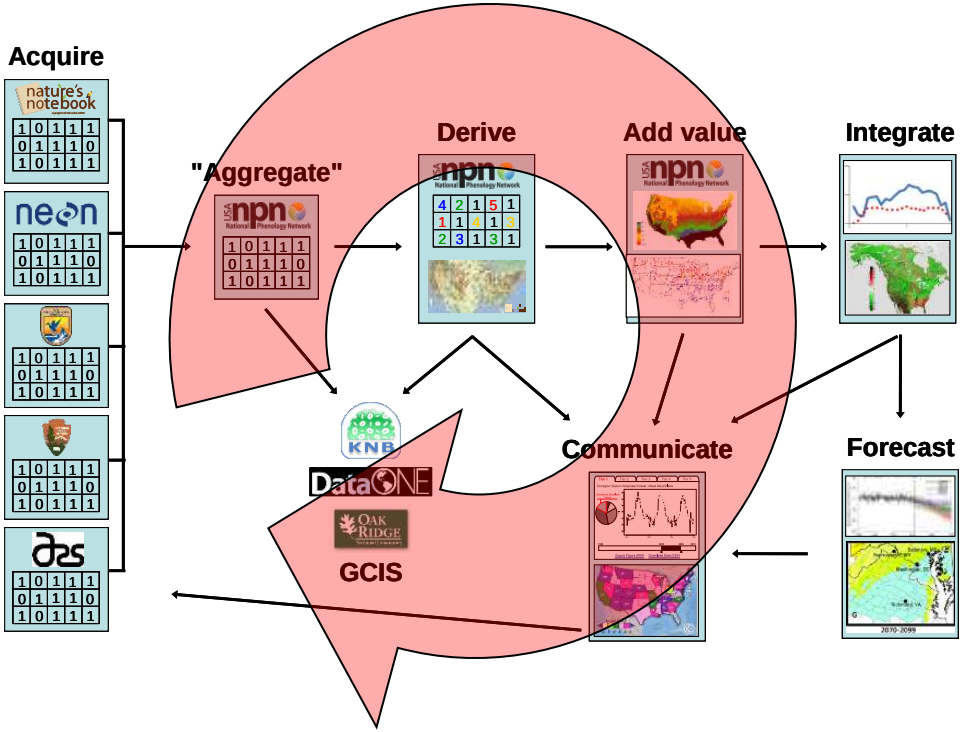
USGS science for a changing world

Applied information management

"Bottom to Top Flow: monitoring, assessment & research → information, products and knowledge"

"Left to Right Flow: projects, processes, data management → information and knowledge management"





The roadmap for this presentation

Acquire

Ground-based, multi-taxa, national-scale observing system

- Standardized protocols
- Status & abundance
- Extensible framework
- 850+ plant/animal spp.
- Web services
- Mobile apps
- Version control
- Fully documented

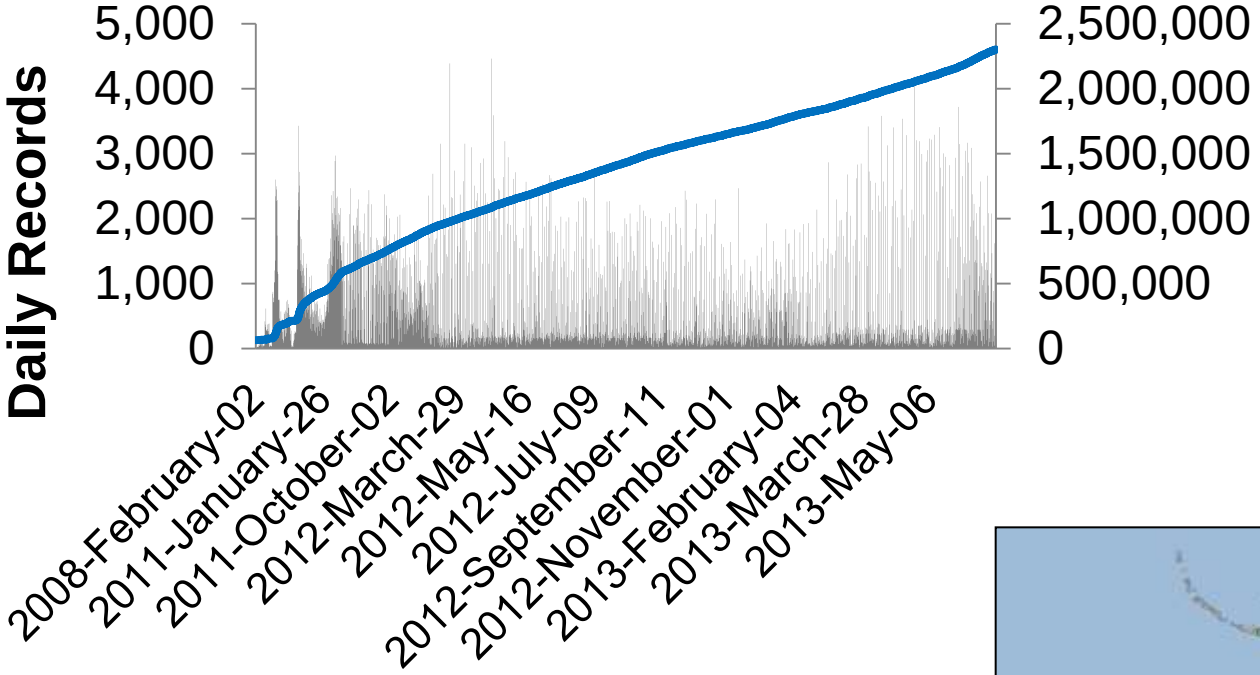
1 Search plants & animals

2 Learn how to observe

3 Register yourself

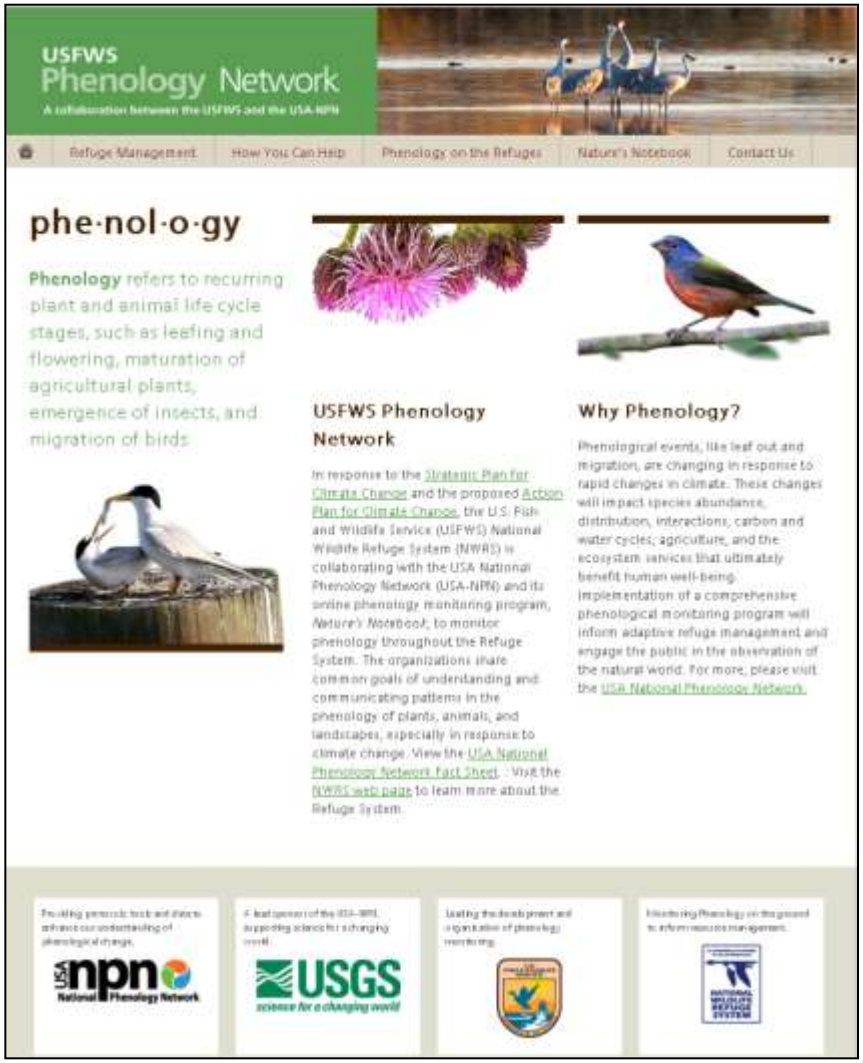
4 Start reporting

Acquire


Daily Records
5,000
4,000
3,000
2,000
1,000
0
Cumulative records
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
2008-February-02
2011-January-26
2011-October-02
2012-March-29
2012-May-16
2012-July-09
2012-September-11
2012-November-01
2013-February-04
2013-March-28
2013-May-06

Acquire

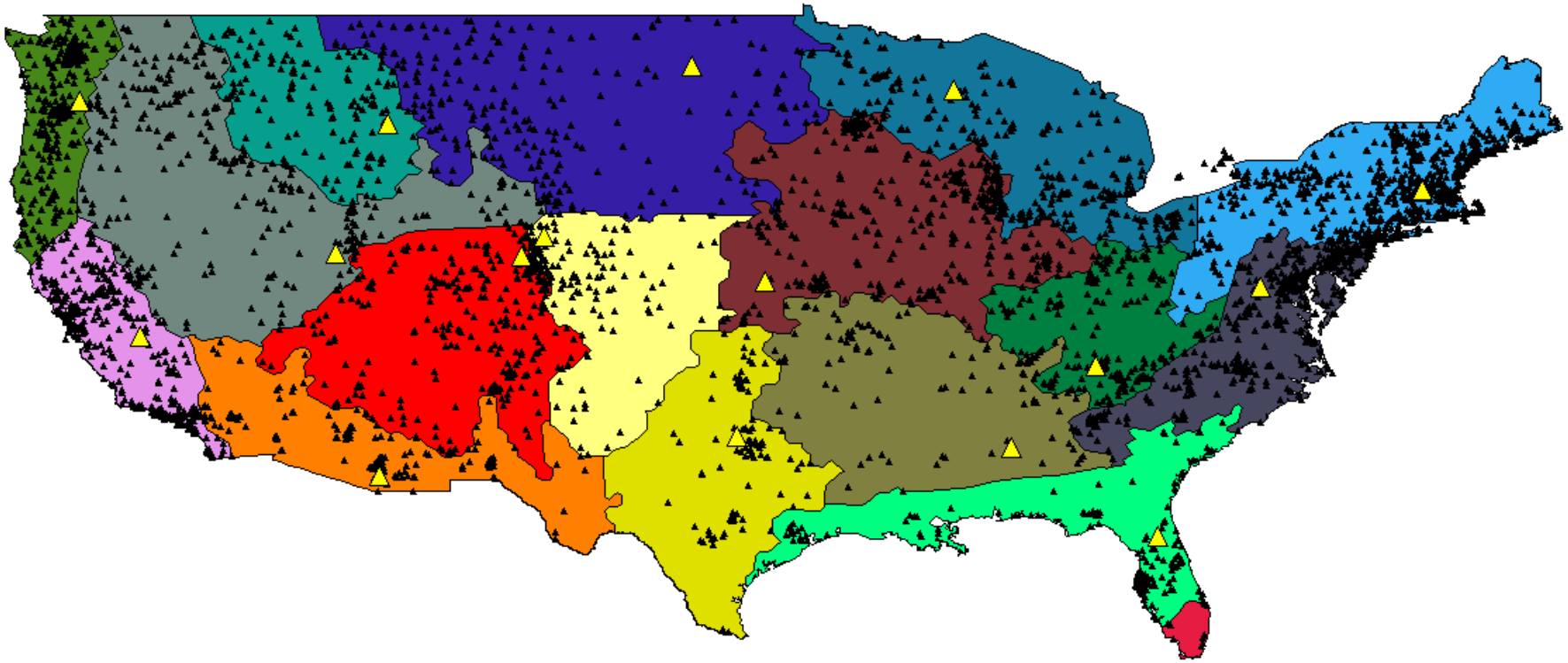
www.usanpn.org/cpp



www.usanpn.org/fws

Acquire

CONUS NEON domains with *Nature's Notebook* observation stations



"Aggregate"

Data, metadata, documentation freely available

DOWNLOAD DATA

Download customized phenology data sets from the USA-NPN's *Nature's Notebook* program. FGDC metadata are available in web page or XML formats. For detailed documentation of *Nature's Notebook* for data end users, read our Nature's Notebook Documentation. For information about quality assurance and quality control measures taken, read our QA/QC Information Sheet.

By downloading these data sets you acknowledge that you have read and agreed to the terms outlined in both the USA-NPN Data Use and Data Attribution policies. To help us track the usage of the data we supply, please register with us.

Optional Fields

- ☐ Observer ID
- ☐ Plant Nickname
- ☐ Site Name
- ☐ Kingdom
- ☐ ITIS Number
- ☐ Protocol ID
- ☐ Phenophase Category
- ☐ Phenophase Definition
- ☐ Secondary Species-Specific Definition
- ☐ Animal Survey Method
- ☐ Animal Search Time
- ☐ Snow On Ground
- ☐ Comments

Default Fields

Observation ID	Genus	Intensity Question
Observation Date	Species	Intensity Value
Observation Time	Common Name	Raw Abundance Value
Day of Year	Species ID	Networks
Site ID	Individual ID	Species Types
Latitude	Phenophase ID	Data Source ID

Get Data

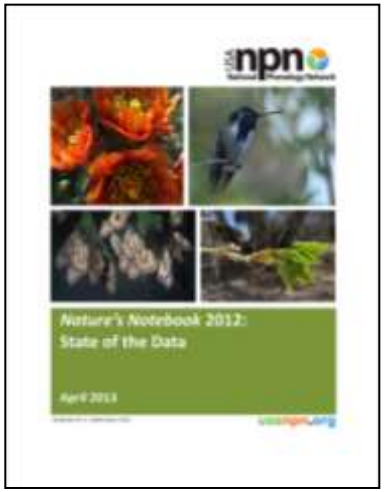
- Phenology Data
- Phenology Visualization Tool
- **Our Data Download Tool**
- Data Search Tools
- Share Existing Data

HOW ARE YOU USING USA-NPN DATA?

Let us know how you've used phenology data for science, management or exploration. Feel free to include feedback on the data, and this download tool.

YOUR EMAIL

We may contact you to highlight your project.



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Derive

nature's notebook
a project of the USA-NPN

www.usanpn.org/nn/connect/visualizations

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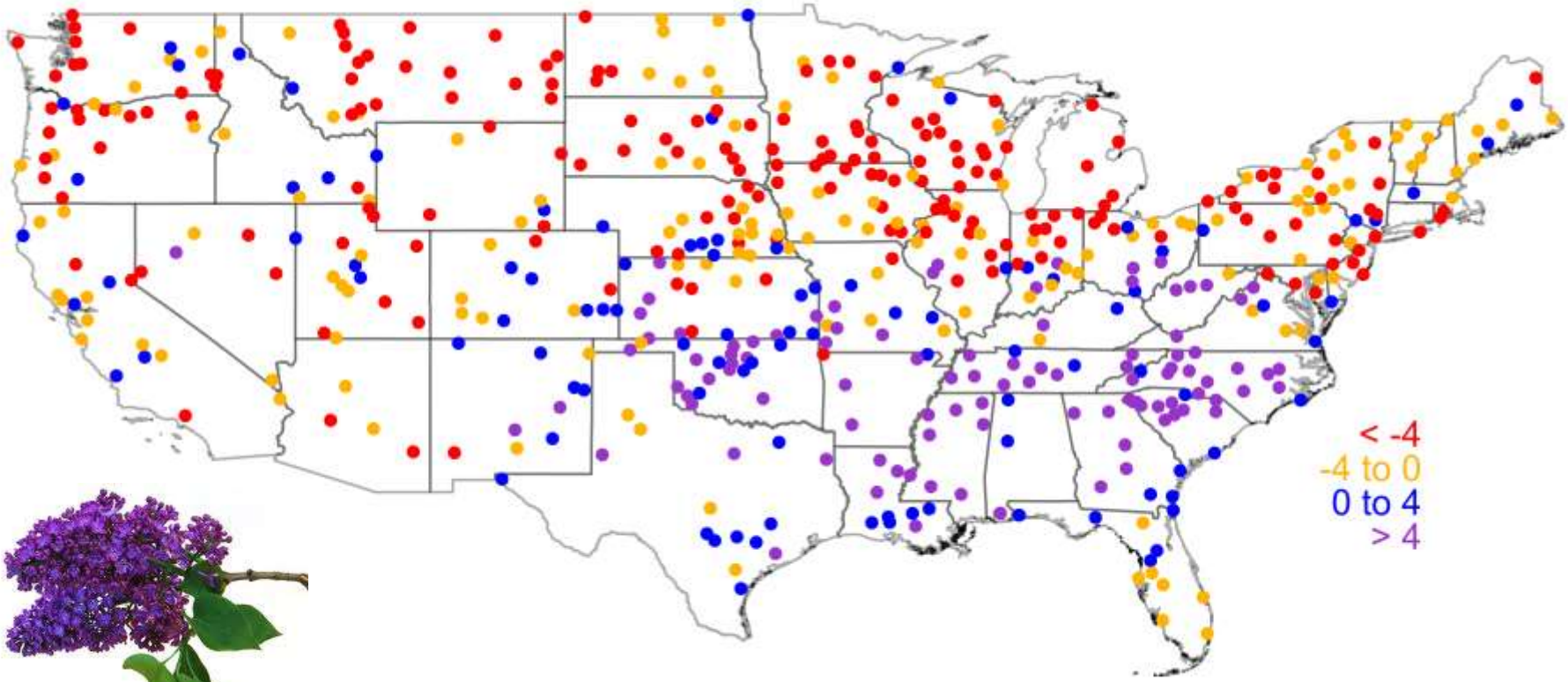
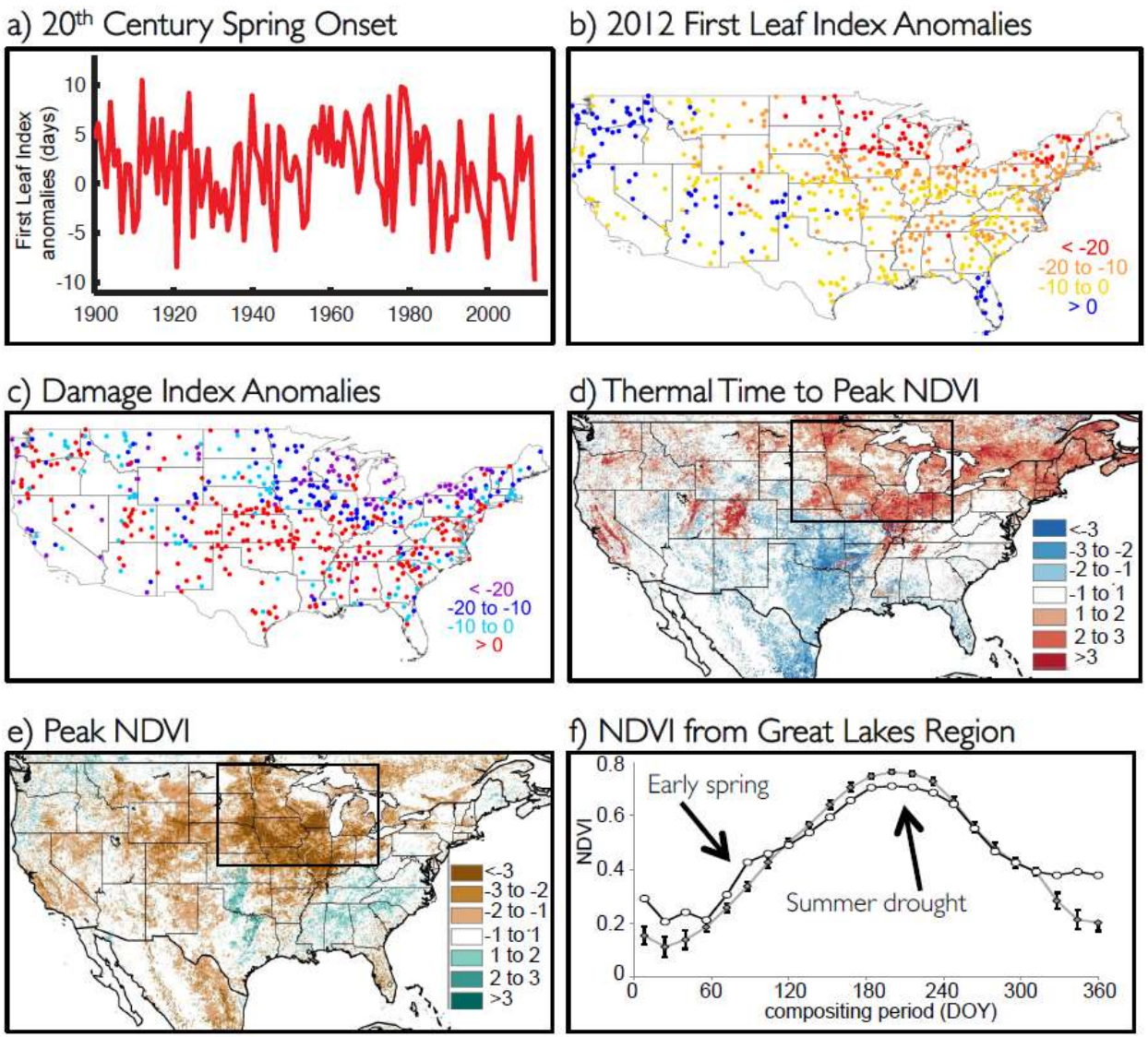
Add value

Change in SI-x first leaf date by station (in days)
between 1951-1960 and 2001-2010



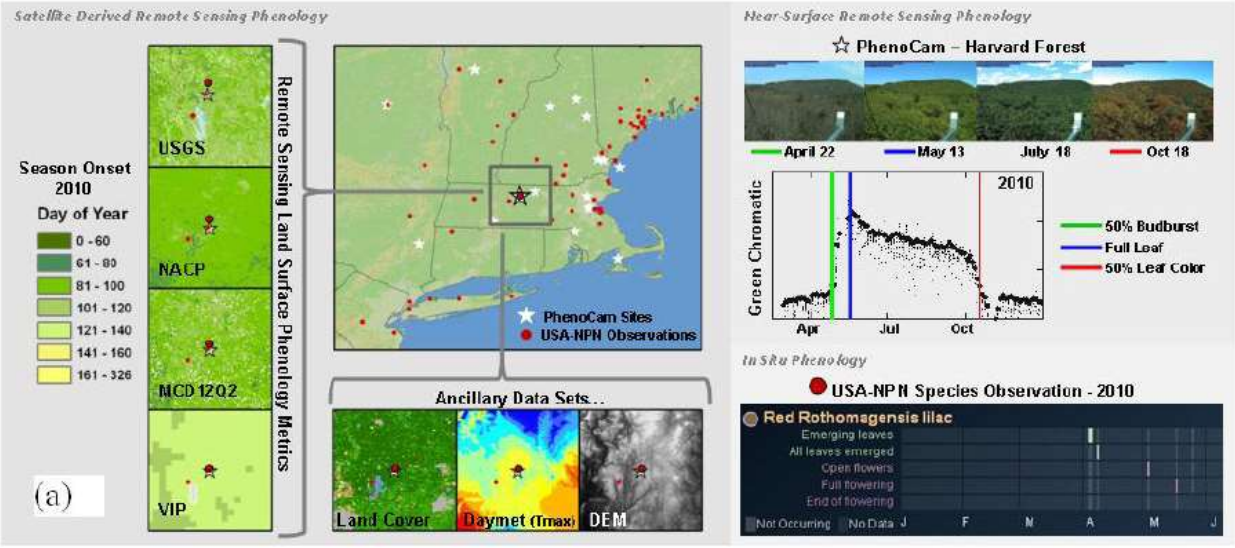
Schwartz, Ault & Betancourt, IJC 2012

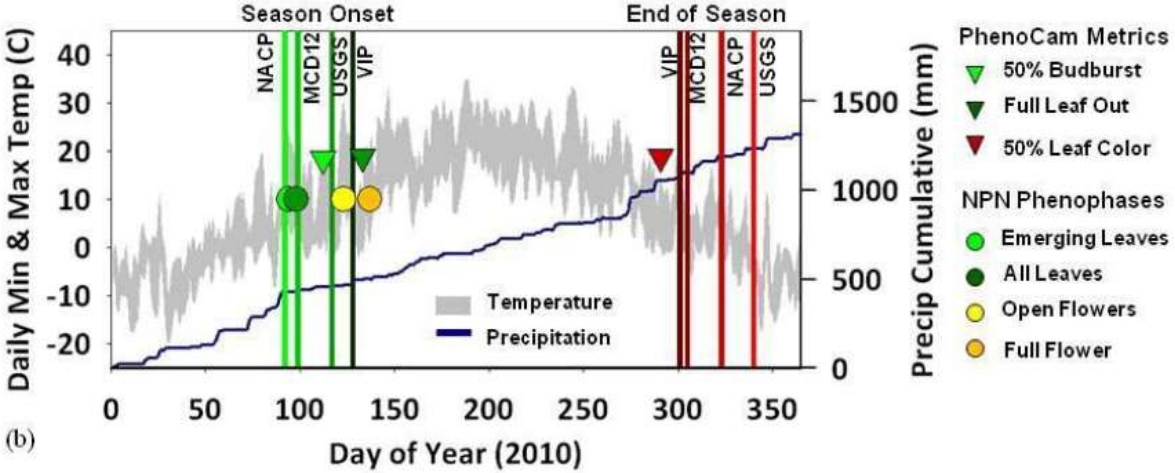
Add value



Ault et al., EOS 2013

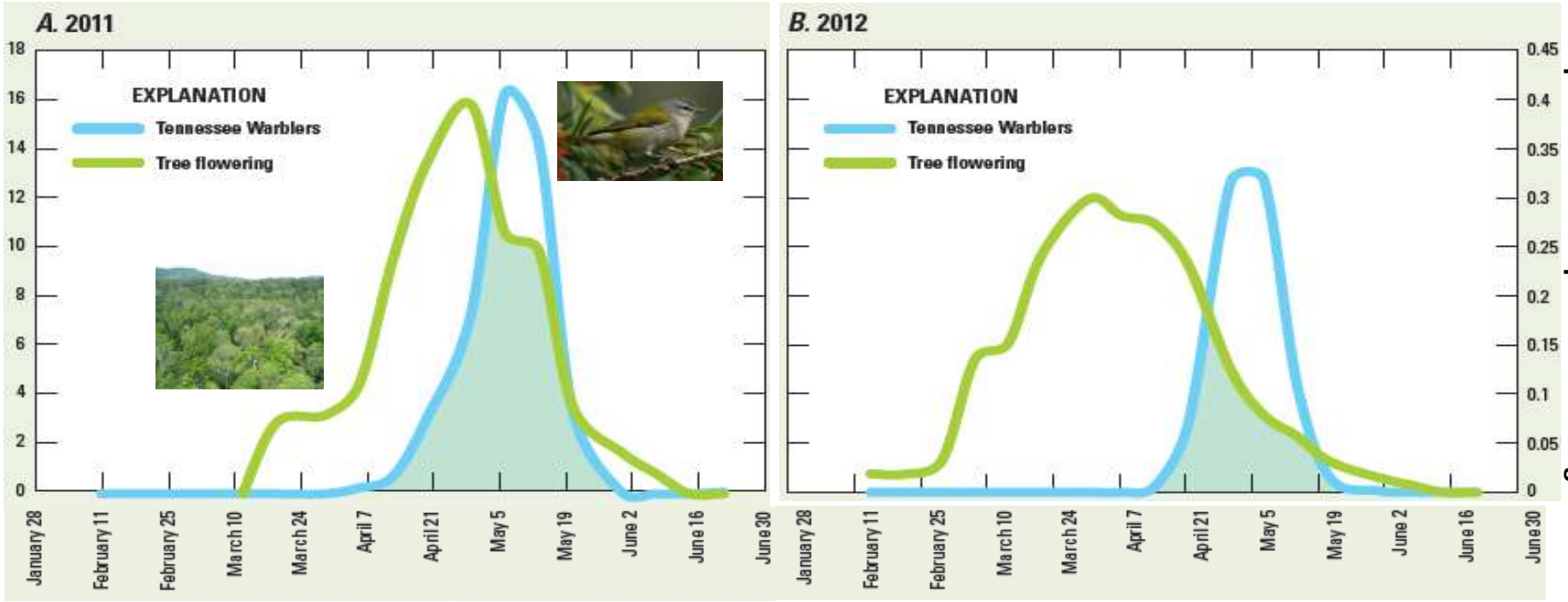
Integrate





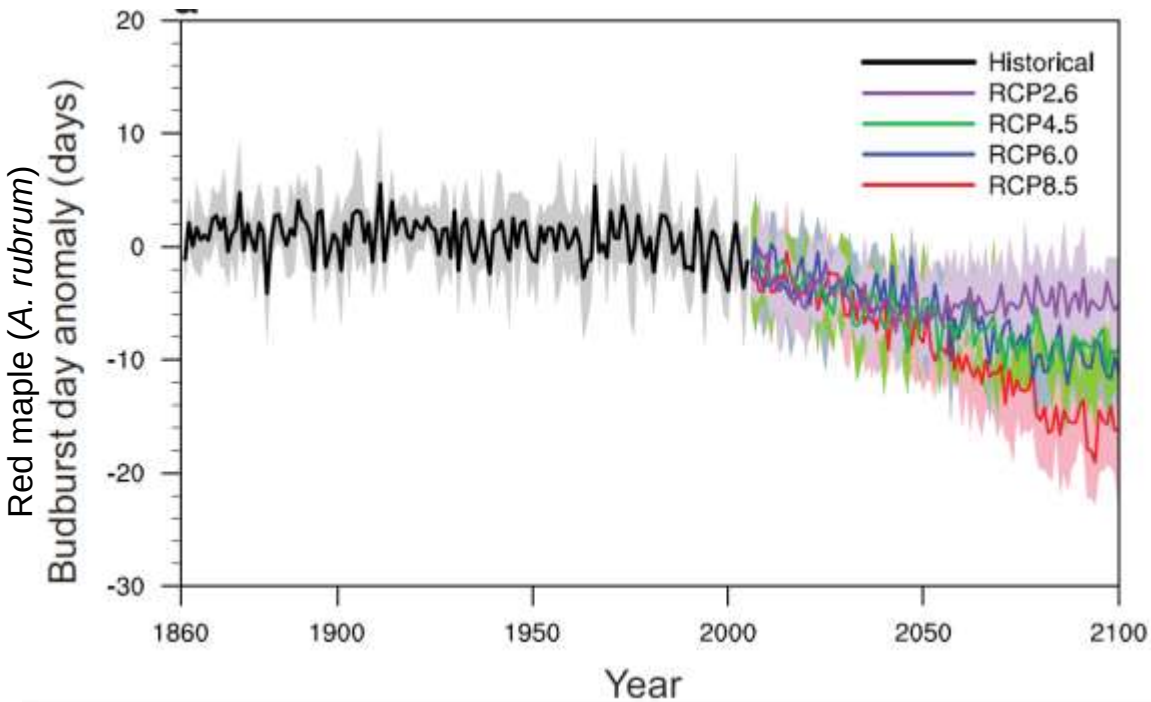
Brown et al. NASA ACCESS 2013 (pending)

Integrate

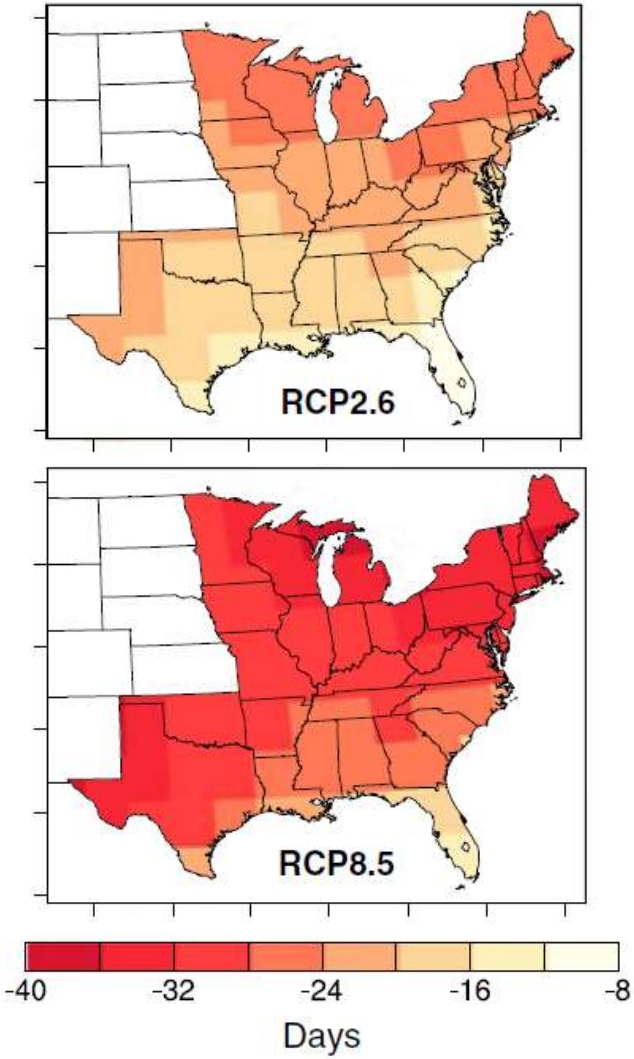


Williams et al. 2013

Forecast

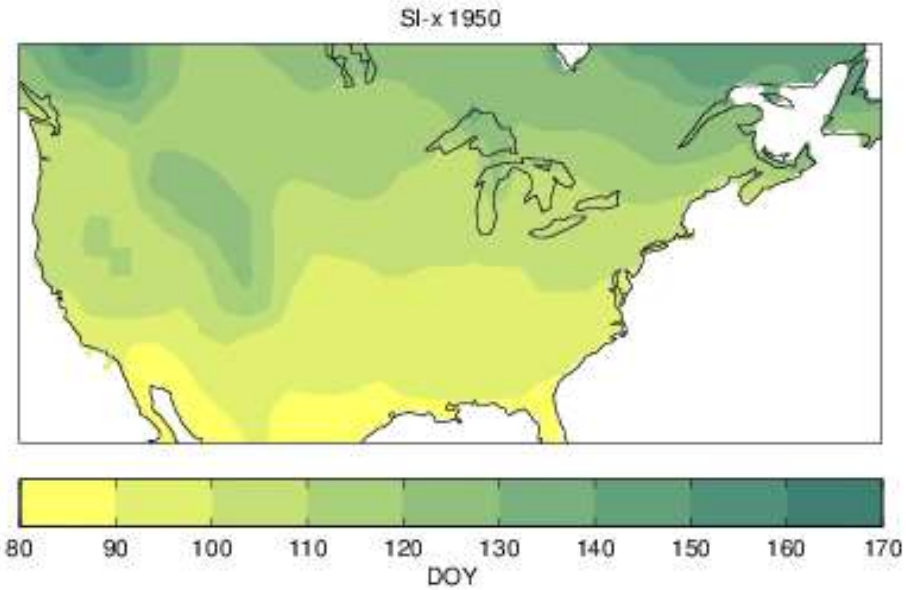


A. rubrum, 2080-2099



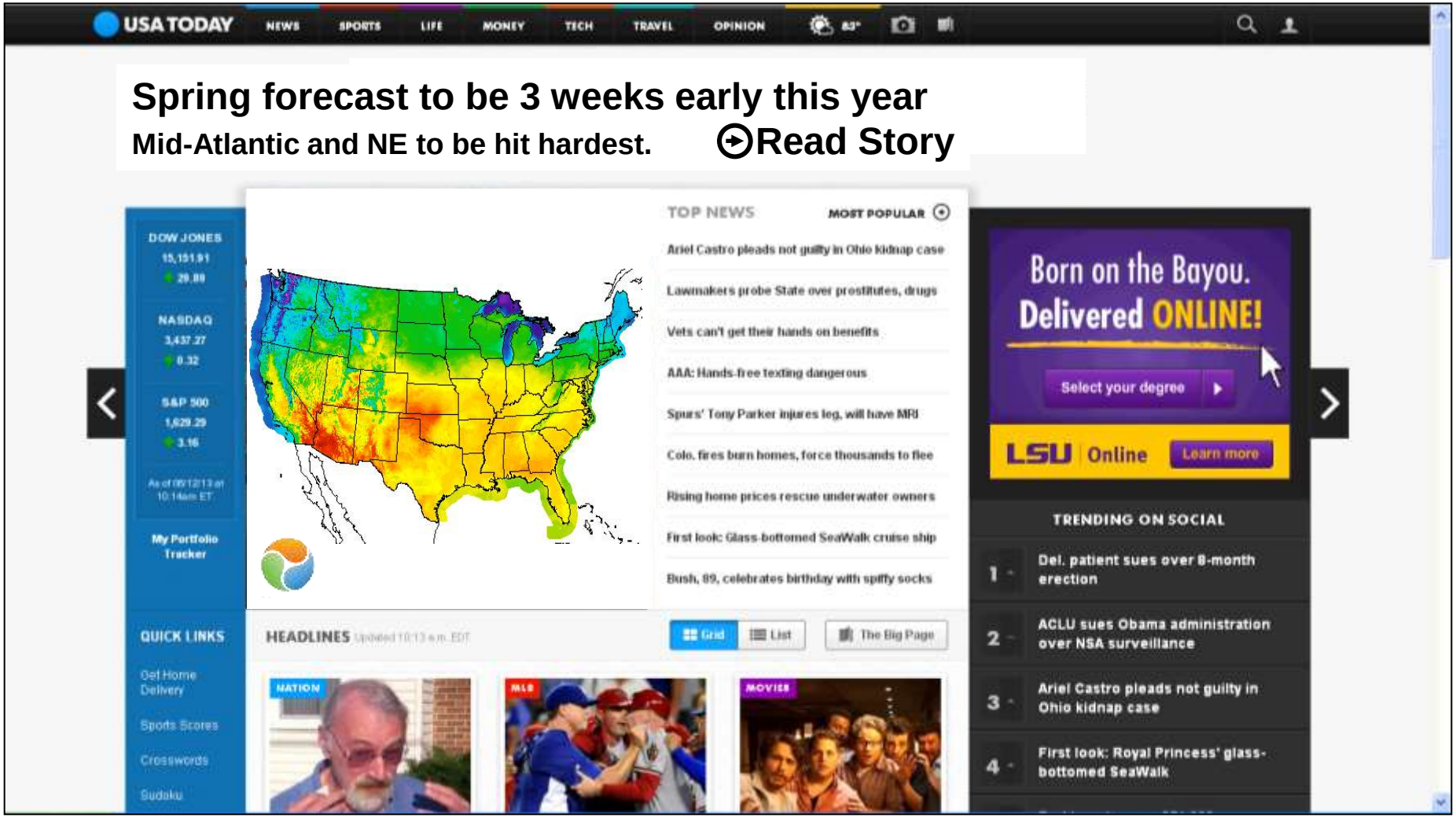
Jeong et al., GRL 2013

Towards a "signature product"
Understanding and forecasting spring



Ault et al., in prep

Communicate



Aspirational, 2016

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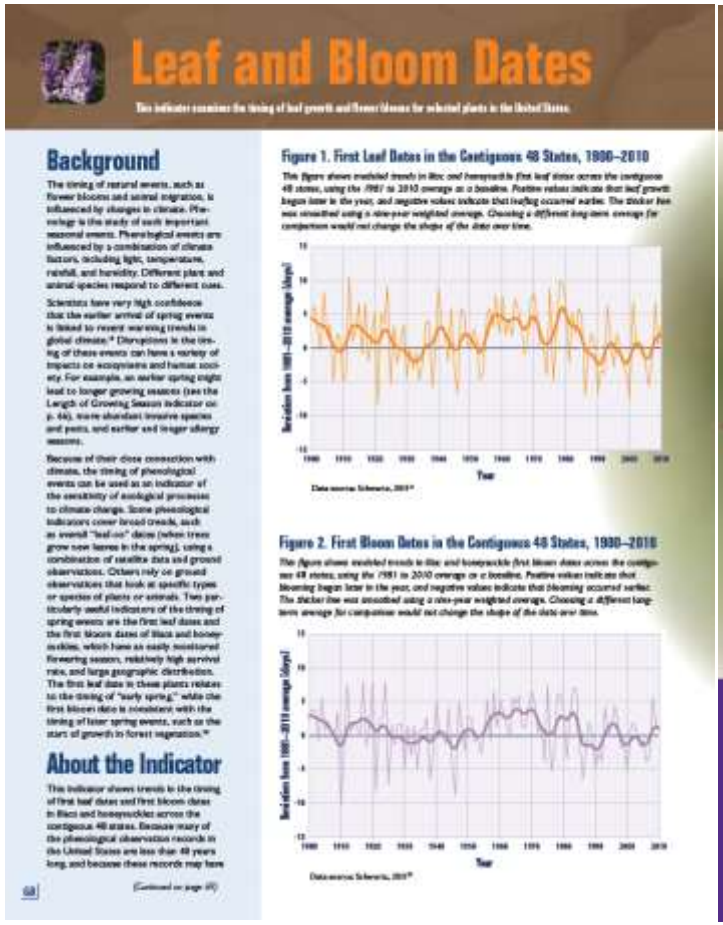
Communicate

nature's notebook
a project of the USA-NPN



Leaf and Bloom Dates

This indicator examines the timing of leaf growth and flower blooms for selected plants in the United States.

Background

The timing of natural events, such as flower blooms and animal migration, is influenced by changes in climate. Phenology is the study of such important seasonal events. Phenological events are influenced by a combination of climate factors, including light, temperature, rainfall, and humidity. Different plant and animal species respond to different cues.

Scientists have very high confidence that the earlier arrival of spring events is linked to recent warming trends in global climate.* Disruptions in the timing of these events can have a variety of impacts on ecosystems and human society. For example, an earlier spring might lead to longer growing seasons (see the Length of Growing Season indicator on p. 44), more abundant invasive species and pests, and earlier and longer allergy seasons.

Because of their close connection with climate, the timing of phenological events can be used as an indicator of the sensitivity of ecological processes to climate change. Some phenological indicators cover broad trends, such as overall "leaf-on" dates (when trees grow new leaves in the spring), using a combination of satellite data and ground observations. Others rely on ground observations that look at specific types or species of plants or animals. Two particularly useful indicators of the timing of spring events are the first leaf dates and the first bloom dates of lilacs and honeysuckles, which have an easily monitored flowering season, relatively high survival rate, and large geographic distribution. The first leaf date in these plants relates to the timing of "early spring," while the first bloom date is consistent with the timing of later spring events, such as the start of growth in forest vegetation.**

About the Indicator

This indicator shows trends in the timing of first leaf dates and first bloom dates in lilacs and honeysuckles across the contiguous 48 states. Because many of the phenological observation records in the United States are less than 48 years long, and because these records may have

(Continued on page 49)

Figure 1. First Leaf Dates in the Contiguous 48 States, 1980–2010

This figure shows smoothed trends in lilac and honeysuckle first leaf dates across the contiguous 48 states, using the 1981 to 2010 average as a baseline. Positive values indicate that leaf growth began later in the year, and negative values indicate that leafing occurred earlier. The thicker line was smoothed using a nine-year weighted average. Choosing a different long-term average for comparison would not change the shape of the data over time.

Data sources: Schwartz, 2013**

Figure 2. First Bloom Dates in the Contiguous 48 States, 1980–2010

This figure shows smoothed trends in lilac and honeysuckle first bloom dates across the contiguous 48 states, using the 1981 to 2010 average as a baseline. Positive values indicate that blooming began later in the year, and negative values indicate that blooming occurred earlier. The thicker line was smoothed using a nine-year weighted average. Choosing a different long-term average for comparison would not change the shape of the data over time.

Data sources: Schwartz, 2013**

Key Points

- First leaf growth in lilacs and honeysuckles in the contiguous 48 states is now occurring a few days earlier than it did in the early 1990s. Although the data show a great deal of year-to-year variability, a noticeable change toward earlier dates seems to have begun around the 1980s (see Figure 1).
- Lilac and honeysuckle bloom dates show a high degree of year-to-year variability, which makes it difficult to determine whether a statistically meaningful change has taken place (see Figure 2).
- Other studies have looked at trends in leaf and bloom dates across all of North America and the entire Northern Hemisphere. These studies have also found a trend toward earlier spring events—some more pronounced than the trends seen in just the contiguous 48 states.**

gaps in time or space, computer models have been used to provide a more complete understanding of long-term trends nationwide.

The models for this indicator were developed using data from the USA National Phenology Network, which collects ground observations from a network of federal agencies, field stations, educational institutions, and citizens who have been trained to log observations of leaf and bloom dates. For consistency, observations were limited to a few specific types of lilacs and honeysuckles. Next, models were created to relate actual leaf and bloom observations with records from nearby weather stations. Once scientists were able to determine the relationship between leaf and bloom dates and climate factors (particularly temperatures), they used this knowledge to estimate leaf and bloom dates for earlier years based on historical weather records. They also used the models to estimate how leaf and bloom dates would have changed in a few areas (mostly in the far South) where lilacs and honeysuckles are not widespread.

This indicator uses data from several hundred weather stations throughout the contiguous 48 states. The exact number of stations varies from year to year. For each year, the timing of first leaf and first bloom at each station was compared with the 1981 to 2010 average to determine the number of days "deviation from normal." This indicator presents the average deviation across all stations.

Indicator Notes

Plant phenological events are studied using several data collection methods, including satellite images, models, and direct observations. The use of varying data collection methods in addition to different phenological indicators (such as leaf or bloom dates for different types of plants) can lead to a range of estimates of the arrival of spring.

Climate is not the only factor that can affect phenology. Observed variations can also reflect plant genetics, changes in the surrounding ecosystem, and other factors. This indicator minimizes genetic influences by relying on cloned plant species (that is, plants with no genetic differences).

Data Sources

Leaf and bloom observations were compiled by the USA National Phenology Network and are available at: www.usanpn.org. This indicator is also based on climate data that were provided by the U.S. Historical Climatology Network and are available at: www.ncdc.noaa.gov/oa/climate/research/ushcn. Data for this indicator were analyzed using methods described by McCabe et al. (2011).**

National Climate Assessment
U.S. Global Change Research Program

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