Land surface Phenology Subgroup- product Synthesis and validation status

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Phenology- subgroup

- Satellite data increasingly used for LSP

- First International Workshop 2010

- Second International Workshop in 2012
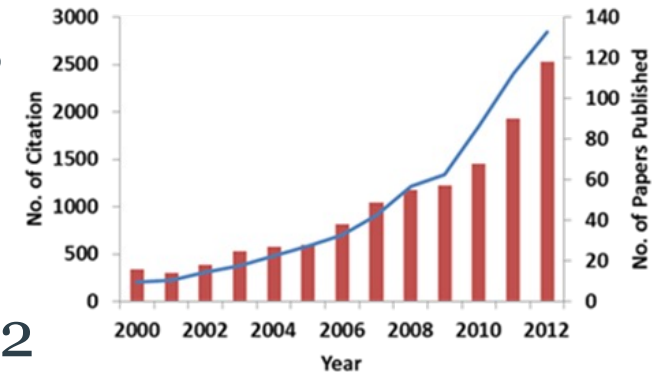
Source: ISI WoS

Aim is to:

- *develop a plan on how to effectively use ground- to airborne-level phenological measurements to validate satellite-based land surface phenology products*

- *internationally-coordinate remote sensing land surface phenology validation and inter-comparison activities*

Phenology- products

AVHRR-USGS

MODIS-MCD12Q2

MODIS-for-NACP

VGT-Phenology

MODIS/AVHRR
VIP Lab

LAND SURFACE PHENOLOGY: the seasonal pattern of variation in vegetated land surfaces as characterized by remote sensing.

➢ **While the observed patterns are related to biological phenomena, land surface phenology is distinct from traditional definitions of vegetation phenology.**

➢ **Traditional definitions refer to specific life cycle events such as budbreak, flowering, or leaf senescence using in-situ observations of individual plants or species.**
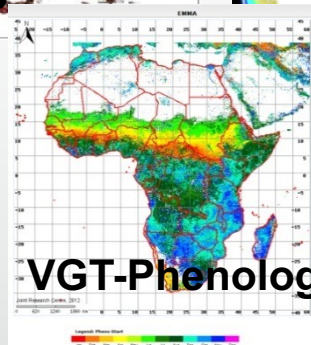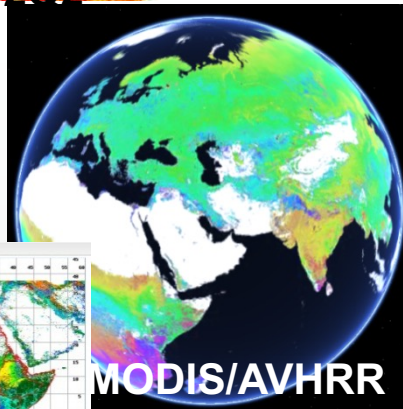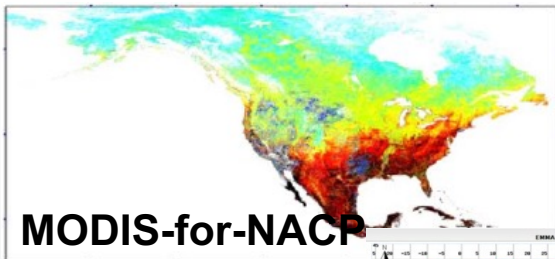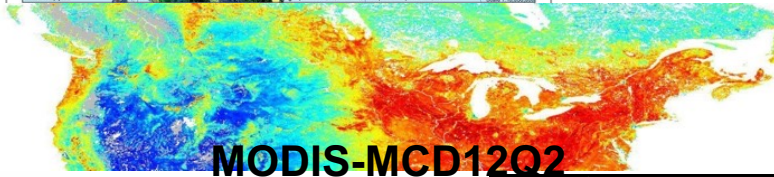
Some examples of Phenology products

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Phenology- products

	MCD12 Q2	VIP	MODIS-for-NACP	USGS-RSP	VGT4Africa
Satellite sensor	Terra MODIS[1]	AVHRR/ MODIS[2]	MODIS	AVHRR, MODIS	SPOT VGT
Spatial domain	Global	Global	North America	USA (lower 48)	Africa
Spatial resolution	500m	0.05 deg	500m, 250m	1000m, 250m	1000m
Period of record	2001-2013	1980-2013	2000-2013	1989 - 2013	2007-2013
Time-series source data	EVI[4]	NDVI[5]/EVI2	NDVI, EVI, LAI	NDVI	NDVI
Projection	SIN[6]	Geographic	SIN	LAEA[7]	Geographic
Data Delivery Mechanism(s)	Web services	Direct ftp/http[8]	Web services and direct ftp/http	Direct ftp/http[8]	Ftp

Most of the products use different data processing methods which makes validation challenging
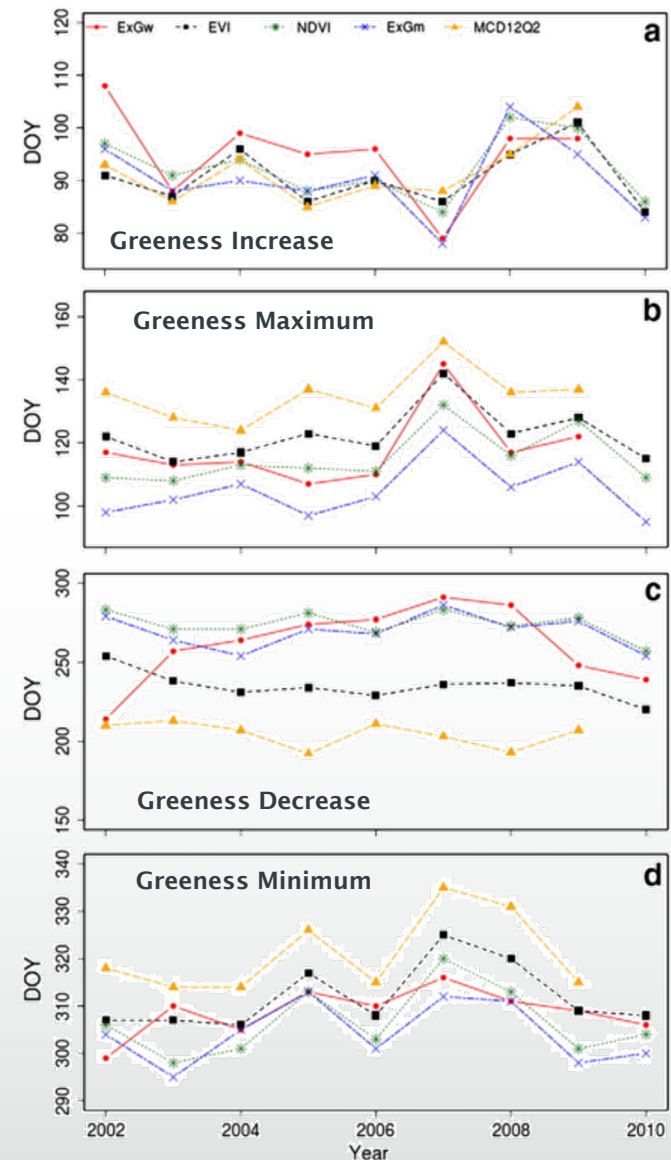
Phenology- products

One Dataset, Many Methods

One Method, Many Datasets
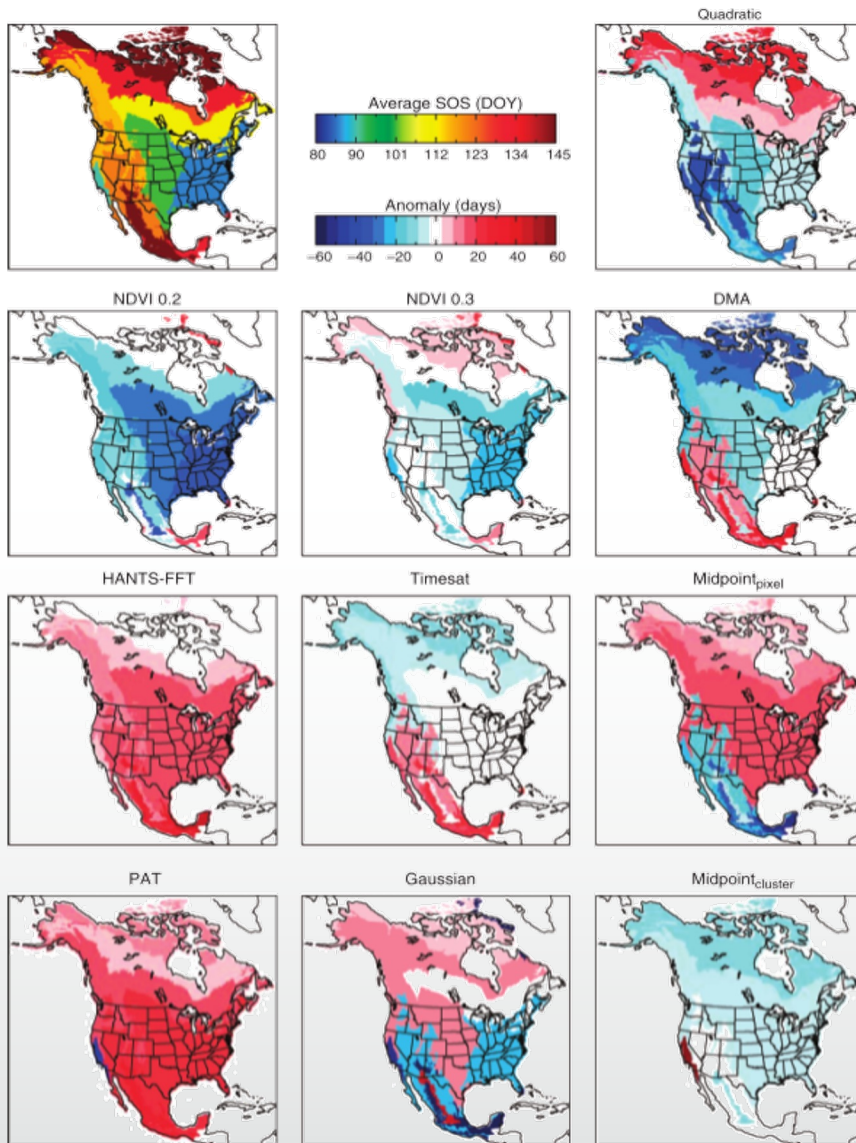
White et al., 2009, *Global Change Biology*
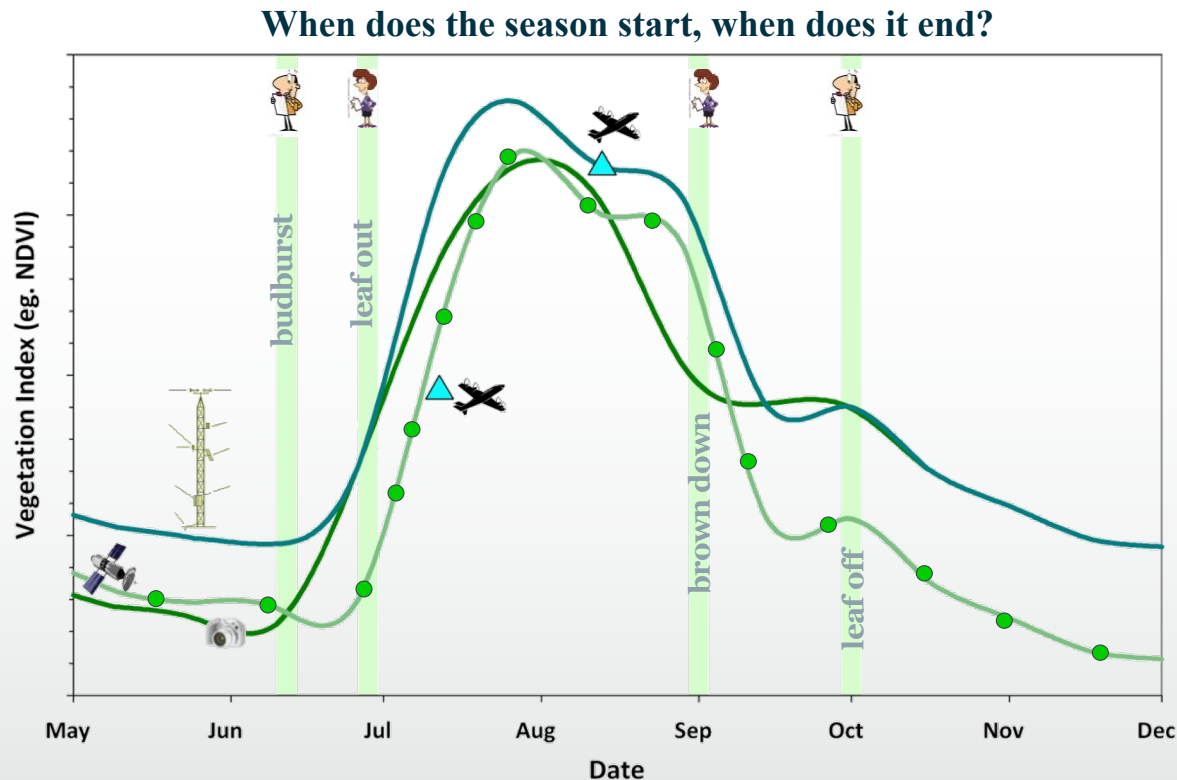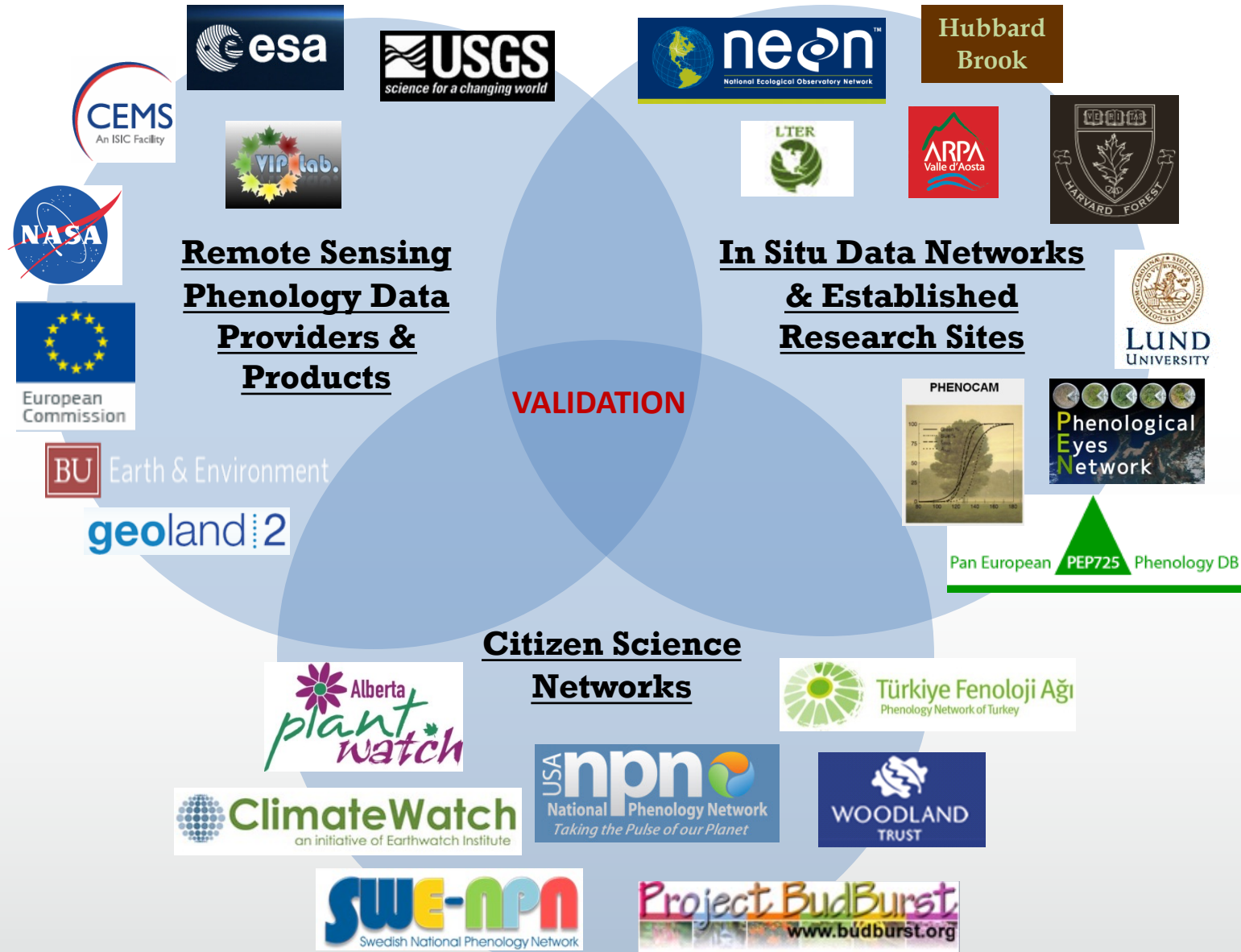
Hufkens et al., 2011, *RSE*

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Phenology- validation

The LPV Phenology Group is developing a protocol to use ground, camera, tower and airborne phenological measurements to validate satellite-based phenology products. (Need enough information /Literature to develop this protocol)

When does the season start, when does it end?

Phenology- validation

Remote Sensing Phenology Data Providers & Products

In Situ Data Networks & Established Research Sites

VALIDATION

Citizen Science Networks

Phenology- validation

Ground based

Citizen science, voluntary based, point-to pixel problem
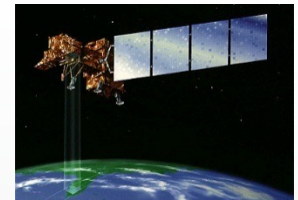

Ground based (intensive monitoring)

Limited coverage, point-to pixel problem

Satellite based (!)

High spatial resolution data, scaling up, Data availability

Camera based

High spatial (mostly horizontal) and hyper temporal resolution , effect of understorey, dominate foreground
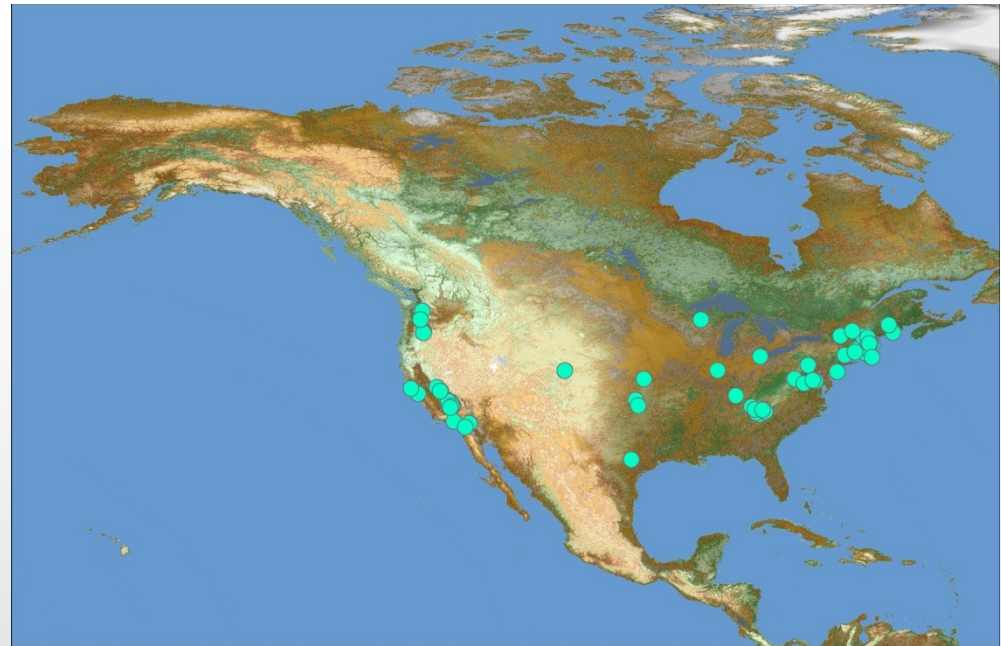
Phenology- validation

Core validation site selection

Level1 Sites: **Sites with phenocams and good representation of measurements of citizen observations or Detail sampling across the growing season (at least 60)**

Level 2 Sites: **Sites with detailed spatial and temporal ground phenological observations incorporating multiple resolution scaling opportunities (ideally incorporating advanced instrumentation such as spectral radiometers, PAR sensors, understory cameras, etc.)**
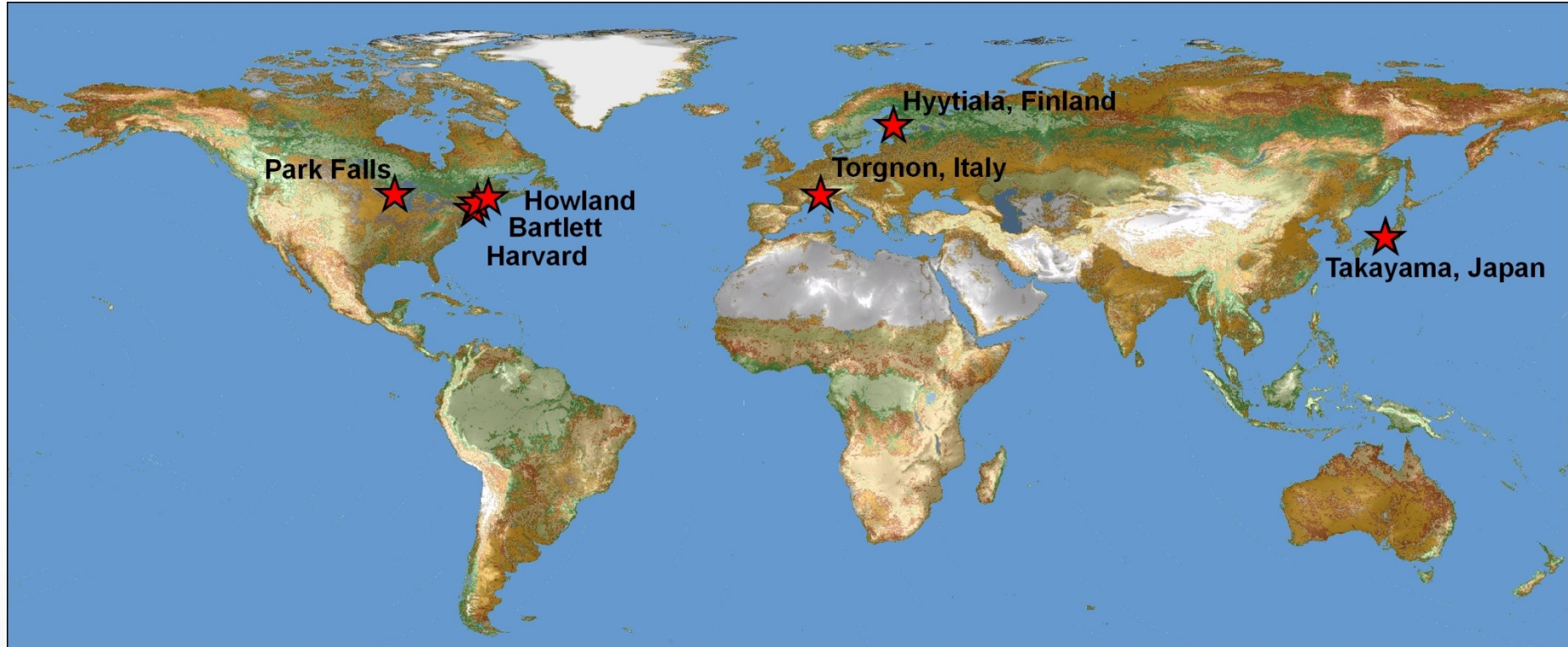
Phenology- validation site: type 1

➢ **Phenocam sites with at least 30 ground observations in 100km radius in USA.**

➢ **Working with Phenocam group and phenology network to define high quality sites.**

➢ **Goal 60 sites globally**

Phenology- validation site: type 2

Phenocam Sites, Ground Observations, Met/Flux Towers, Instrumentation

Site Name	Country	Cover Type
Torgnon – Tellinod	Italy	Grassland
Torgnon – Tronchaney	Italy	Larch Forest
Park Falls	USA	Deciduous Broadleaf
Hyytiala	Finland	Boreal Conifer
Harvard	USA	Mixed Forest
Bartlett	USA	Mixed Forest
Howland	USA	Boreal Hardwood Trans
Takayama	Japan	Deciduous Broadleaf
Takayama	Japan	Evergreen Coniferous

More Sites Needed:
- **Savanna / Woody Savanna**
- **Croplands**
- **Shrublands**

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Phenology- data distribution

Site Data Packages Include:
- ➤ **The complete suite of available remote sensing phenology products.**
- ➤ **Phenocam images**
- ➤ **Ground Observations**
- ➤ **Instrument Data (eg. CO_2 fluxes, PAR Sensors, spectrometer data)**

Harvard Forest Site
100km Grid
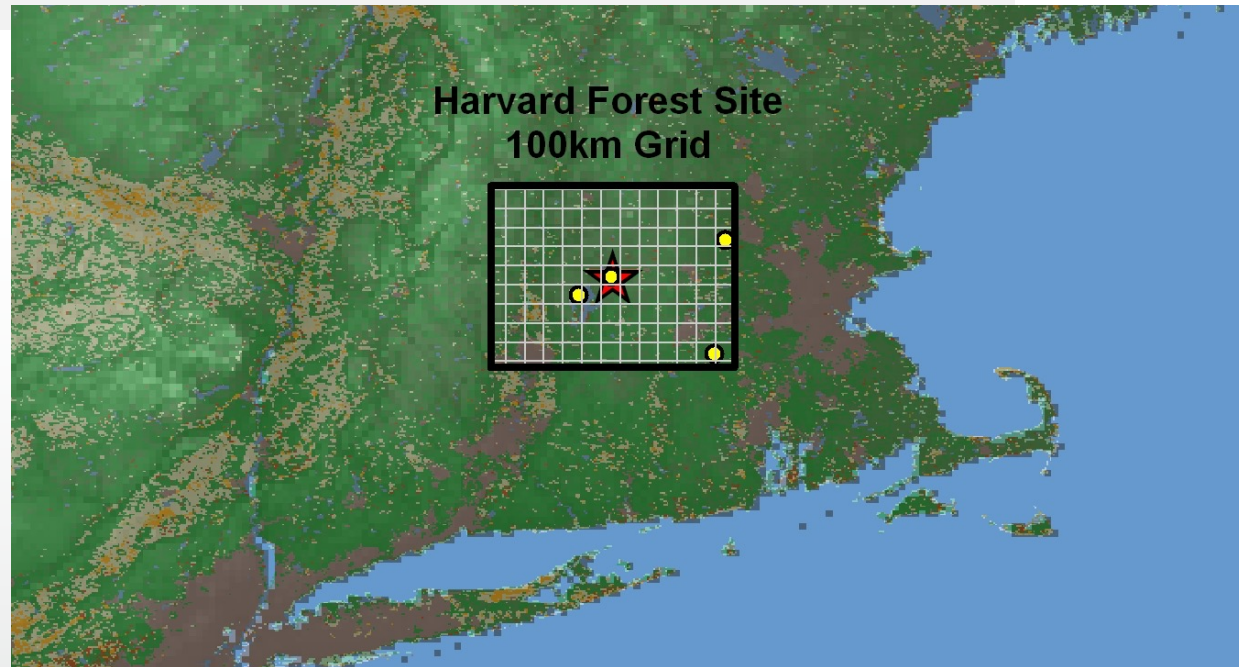
Goal: to allow for multiple temporal and spatial resolution scaling opportunities

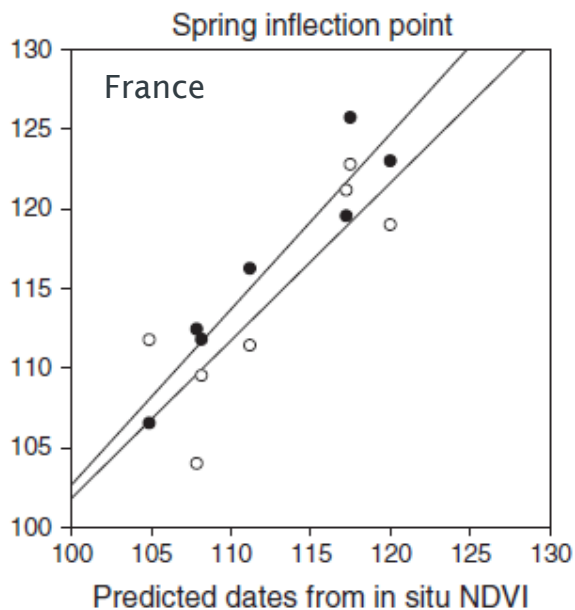# Phenology- GCOS Requirements

Land Surface Phenology is not an ECV, but a strong candidate for EBV. Given land surface phenology is one of the strongest measure of impact of climate on vegetation and interest of general public, there is a strong case to include this as an ECV.
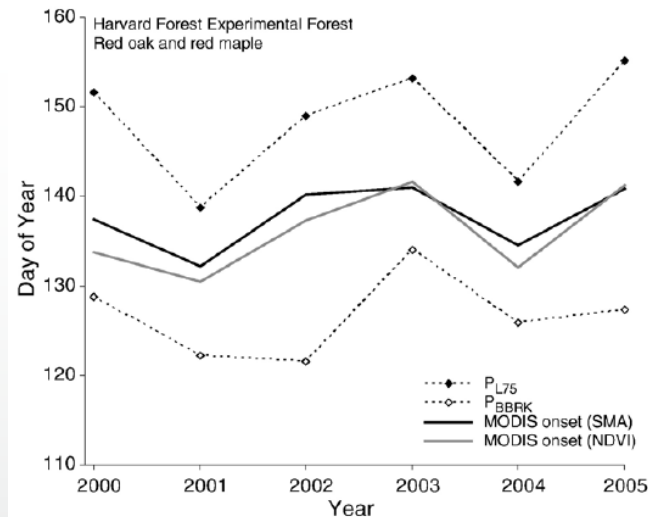
German
Climate Observing Systems

Inventory report on the Global Climate Observing System (GCOS)
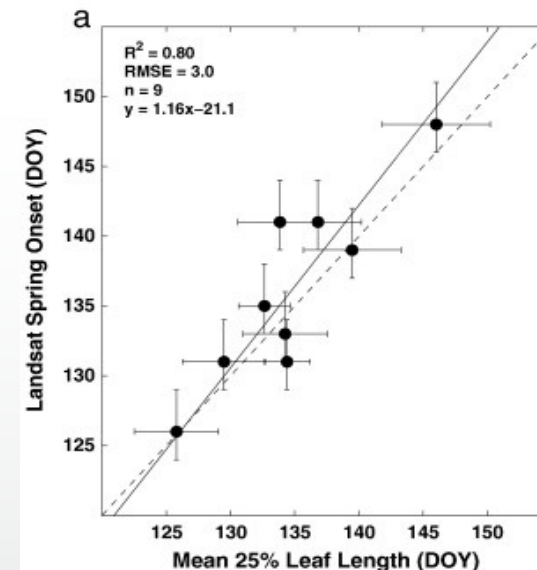
Phenology- LPV validation stage

> **Some attempts were made to validate LSP, mostly either at specific location or using regional data**

Hmiminia, 2013, RSE

Fisher and Mustard, 2007, RSE

Melaas, 2013, RSE

Phenology- LPV validation stage

Stage 1 Validation	Product accuracy is assessed from a small (typically < 30) **set of locations and time periods** by comparison with in-situ or other suitable reference data.	Product Vs Ground
Stage 2 Validation	significant set of locations and time periods by comparison with reference in situ or other suitable reference data. Spatial and temporal consistency of the product and **with similar products** has been evaluated over **globally representative locations and time periods**.	Product vs Product vs (more) Ground

Phenology- Conclusion

- A consensus needs to be reached regarding what LSP metrics mean in regards to biophysical vegetation properties, i.e. Should LSP start of season equate to bud burst, leaf unfolding, or full leaf expansion?

- Current validation efforts incorporate a range of methods to define LSP metrics and protocols for field data collection. Future efforts need to incorporate data from an established field protocol (eg. USA-NPN) and compare these to the range of LSP metrics derived across sensors and products.