Remote Sensing as a Driving Tool for Citizen Science Phenology Monitoring Campaigns

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Phenology and Climate Change

Nature has its own rhythms: dairy rhythms, seasonal rhythms... Animals also present their own rhythms: migratory periods of birds, hibernation periods …

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Phenology and Climate Change

This rhythms are driven by internal factors and environmental factors **impacted by climate change**

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Phenology and Climate Change

phe·nol·o·gy *noun*

The scientific study of periodic biological phenomena, such as flowering, breeding, and migration, ***in relation to*** *climatic conditions.*

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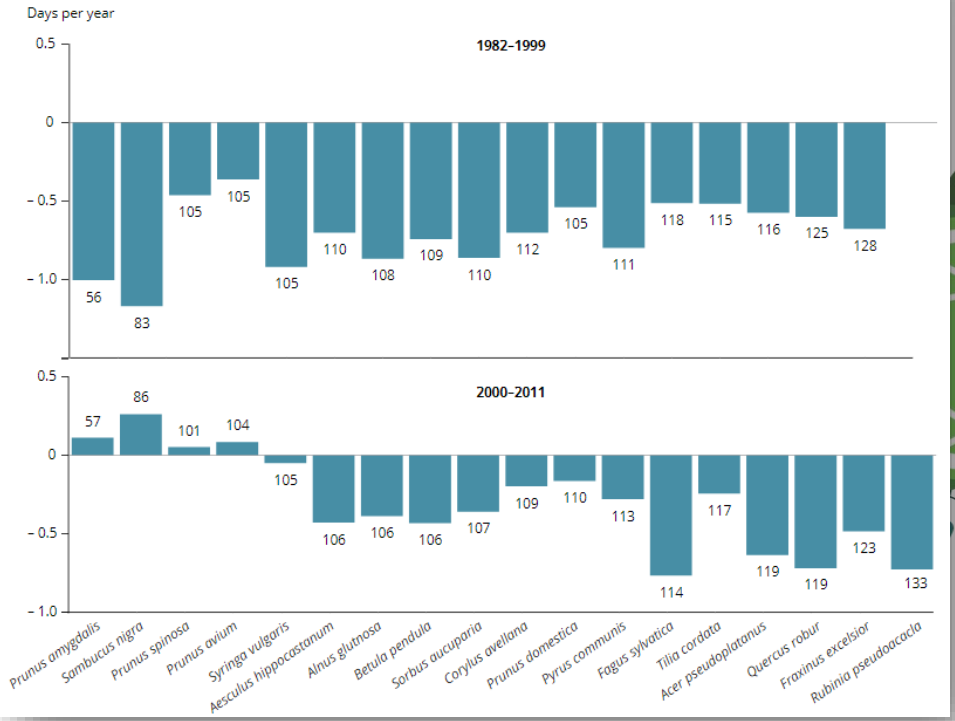
European policy indicator:

Figure 4.16 Species-specific trends of spring leaf unfolding during the two periods 1982–1999 and 2000–2011



Leaf unfold is up to 1 day early per year!

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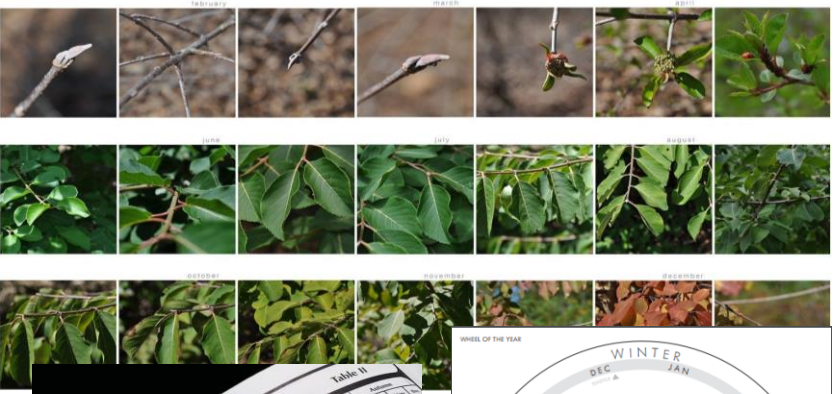
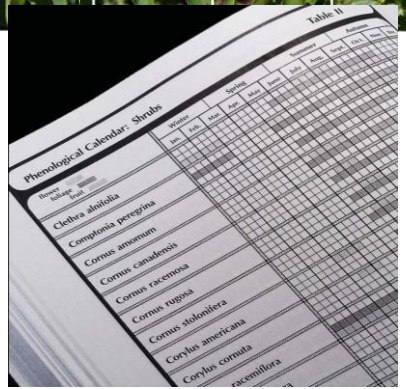
Phenology

Traditional monitoring systems:





- In paper
- Systematic effort
- Reduced number of species
- Close to observers home

☒ Reduced number of observations

☒ Not representative across biomes

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Some phenology monitoring networks

CATALUNYA
(north-east of Iberian Peninsula)

- ✓ **FENOCAT initiative** from the Catalan Meteorological

EUROPE

- ✓ **Pan European PEP725 Phenology DataBase**

Pan European PEP725 Phenology DB

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RitmeNatura.cat

RitmeNatura.cat

- Phenological **Citizen Science** observatory (H2020 Ground Truth 2.0) to collect phenological data in Catalunya
- Data stored in Natusfera/iNaturalist.org
- Monitors 12 species and specific phenophases
- Real-time searchable data for scientists, managers and politicians
- Correlate them with the effects of climate change

iNaturalist.org

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Phenology

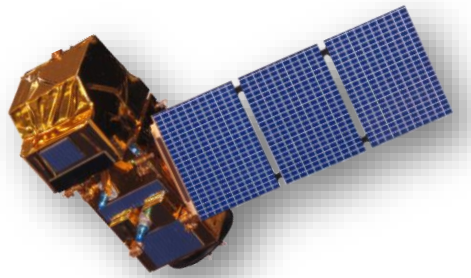
✓ Improve number of observations

☒ Not representative across biomes

What scientists can do to increase the collection of vegetation phenology data at global level

?

Use **REMOTE SENSING**



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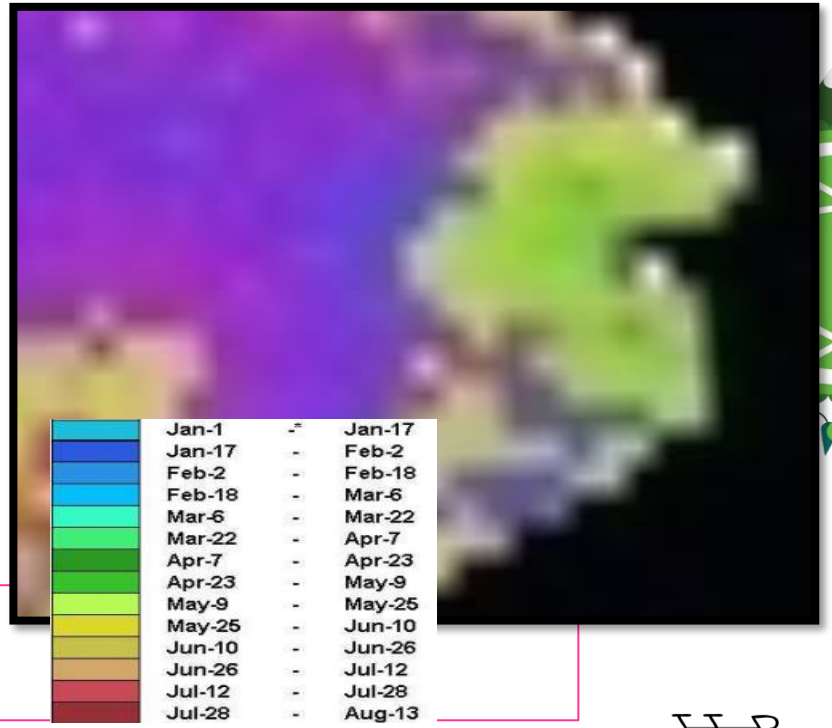
Phenology and Remote Sensing

Medium resolution optical satellites: (e.g. MODIS)

- ✓ Daily data
- ✓ Appropriate spectral configuration for vegetation monitoring
- ✓ Global coverage

- ☒ Spatial resolution too coarse
- ☒ No species separation

10 000 trees in one pixel **!**



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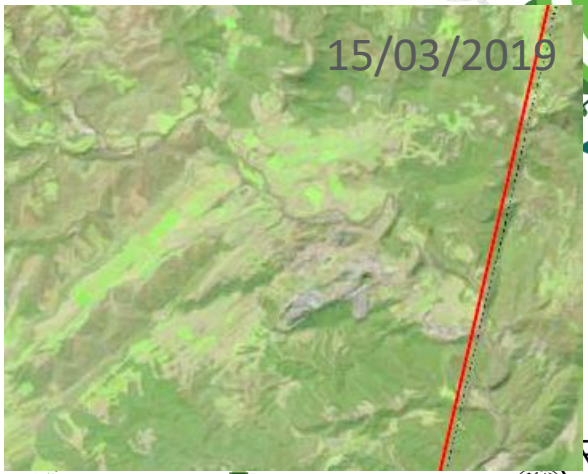
Phenology and Remote Sensing



<u>High resolution</u> optical satellites:

LANDSAT:

- ✓ Appropriate spectral configuration for vegetation monitoring
- ✓ 30 m spatial resolution
- ✓ Global coverage

- ☒ Revisiting period too low (16 days)

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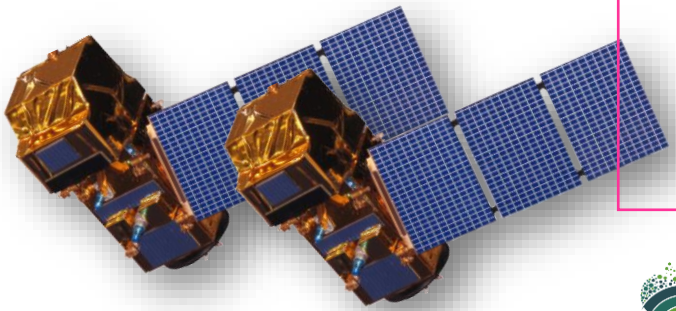
Phenology and Remote Sensing

High resolution optical satellites: Still….

SENTINEL 2A and 2B:

- ✓ Appropriate spectral configuration for vegetation monitoring
- ✓ 10 m spatial resolution
- ✓ Revisiting period between 3 and 5 days
- ✓ Global coverage



IN SITU Observations

≠

REMOTE SENSING Observations

☒ Hardly comparable

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PhenoTandem Approach

- What do we see on the ground?

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PhenoTandem Approach

- If there were many of them...

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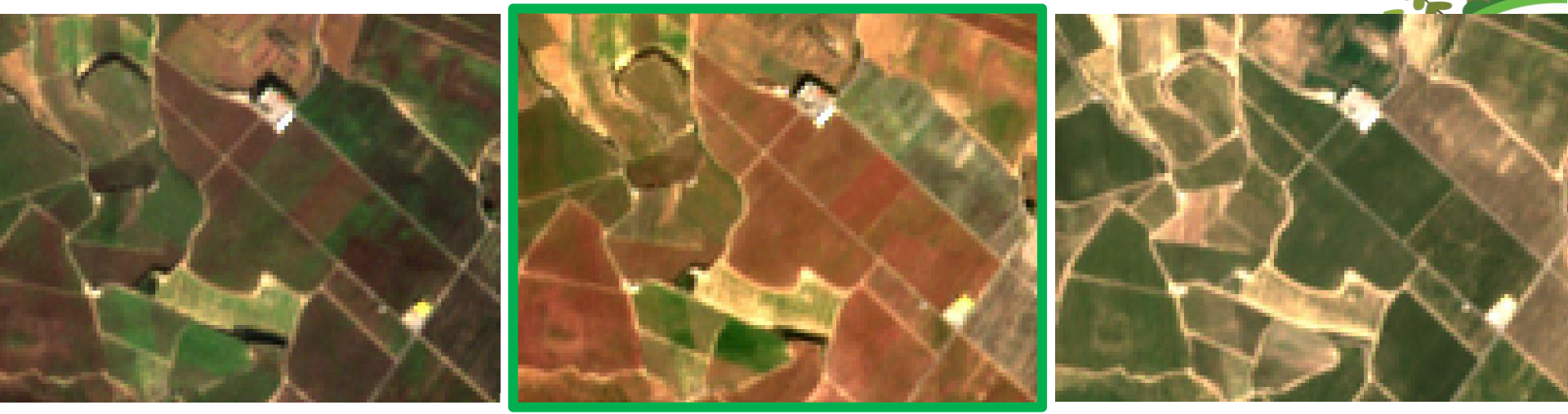
PhenoTandem Approach

- We can see the evolution of a homogeneous habitat with a DOMINANT species

11-01-2019 07-03-2019 31-05-2019



In March 2019, S2 recorded the same event from space

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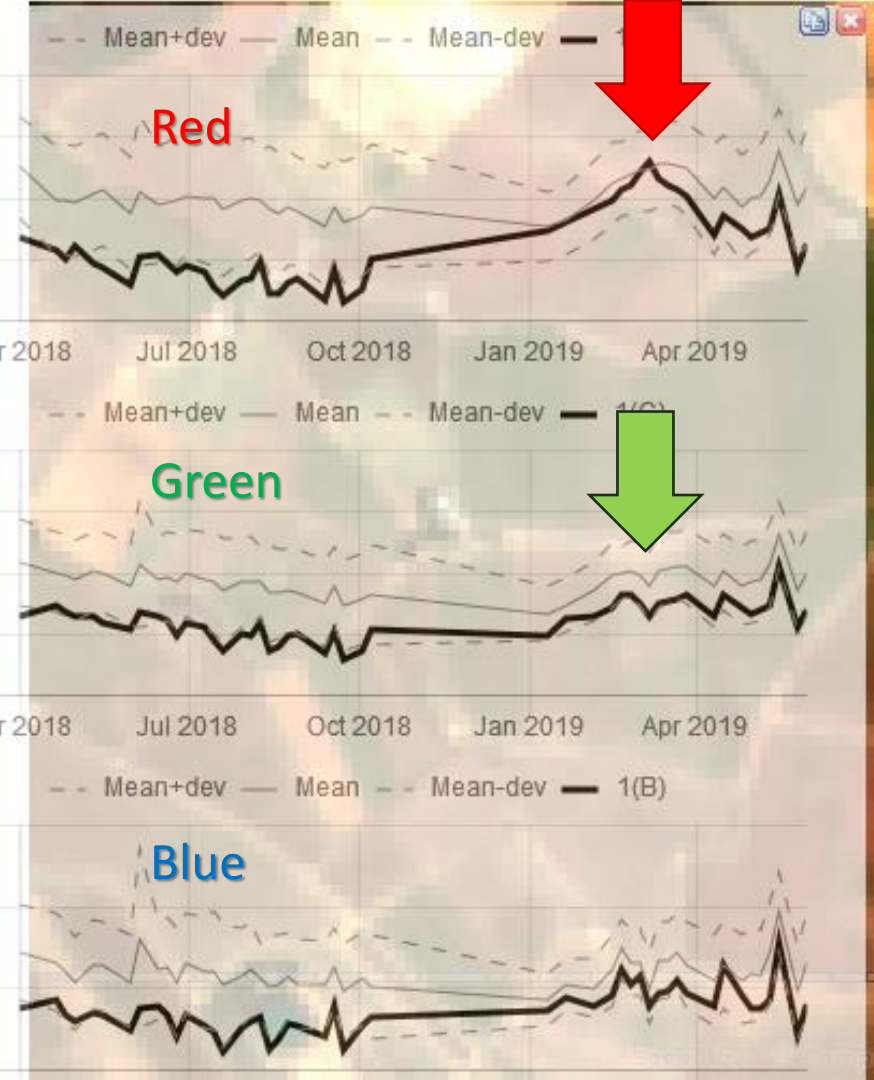
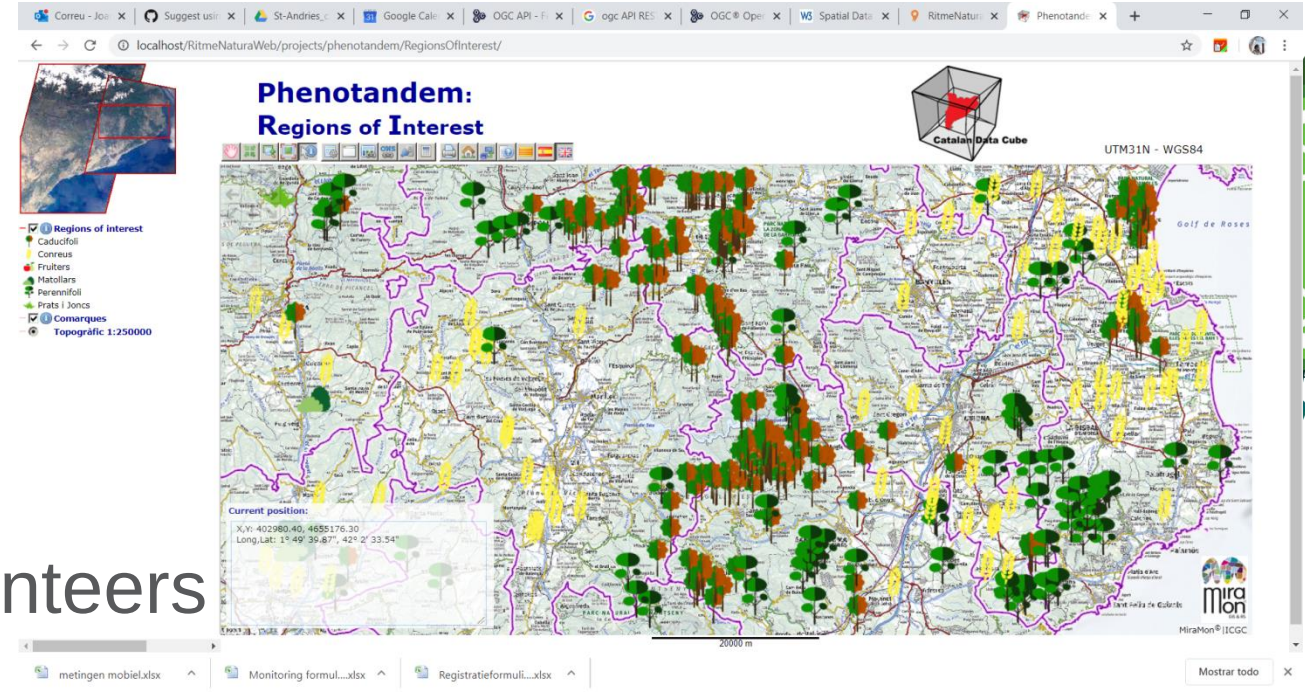


Time series analysis reveals the exact day blossoming occurs and, with this, we can track the blossoming dates over the years and monitor the effects of the climate change

PhenoTandem approach

Where the homogeneous habitats with as dominant species are?



Can we direct RitmeNatura.cat volunteers to this places?

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PhenoTandem Approach

- Make automated **remote sensing** observations that are compatible with the in-situ observations
  - Detect the phenological dynamics **ONLY** in **well known homogeneous habitats**.
- Use citizen science observations to validate remote sensed Sentinel-2 observations and better calibrate the automated measurements.

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Conclusions

- Remote sensing can provide the spatial, temporal and spectral resolutions suitable for vegetation phenology monitoring so…
- We can complement in-situ observations with remote sensing in homogeneous areas to monitor the phenological evolution of a single species from space

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Conclusions

- Citizens Science directed to the homogeneous patches to observe phenological changes is a necessary complement to validate and improve the methodology
  - and to cover non homogeneous areas.

- Together, RS and CS, are a good partnership for phenology monitoring

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THANK YOU!

Any Questions?

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