



Mapping global warming effects on the plant seasonal cycle

An Essential Biodiversity Variable for assessing the linkage between [the atmosphere](#) and [the biosphere](#)

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Introduction

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- Secondary effects, e.g. on the frequency of extreme weather events, food and water security, and biodiversity, however, are most threatening to humanity and life on earth.
- Monitoring the interactions between the climate and the biosphere is, therefore, important.
- Phenology is considered an 'Essential Biodiversity Variable'





Introduction

Here, we explore the question of what the ongoing rates of climate warming might mean for global land surface phenology.

Introduction

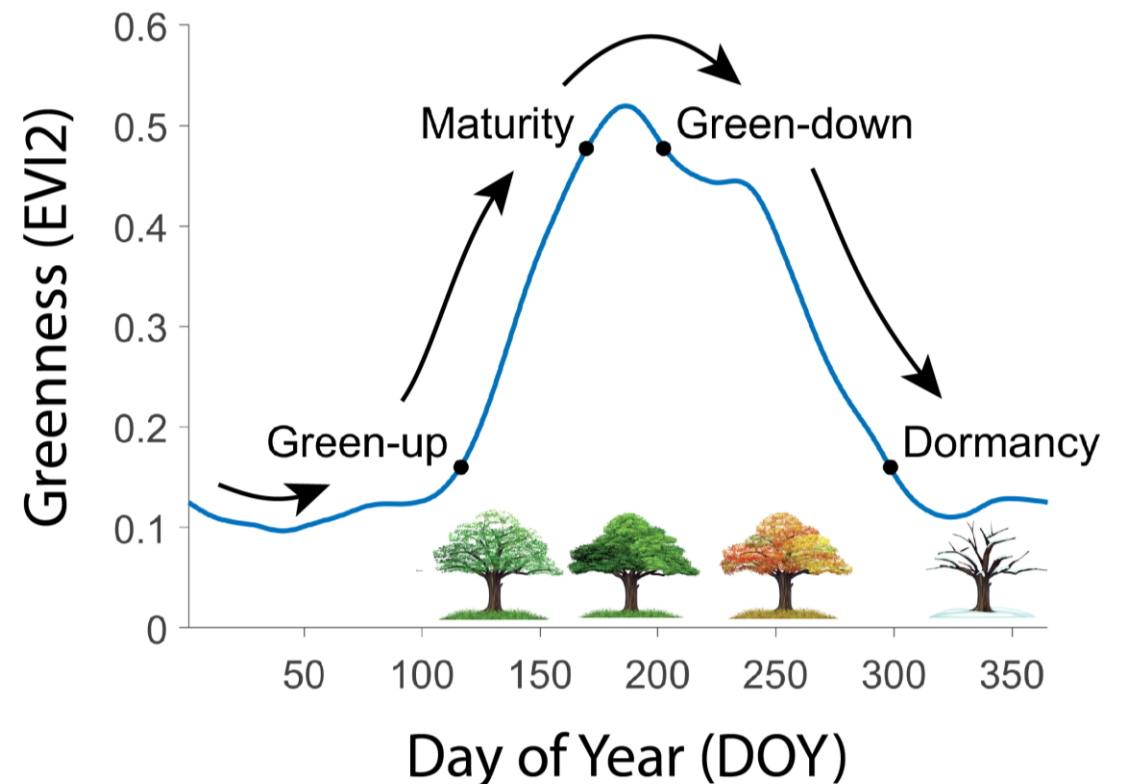
Here, we explore the question of what the ongoing rates of climate warming might mean for global land surface phenology

More specifically, ...

MODIS Land Cover Dynamics

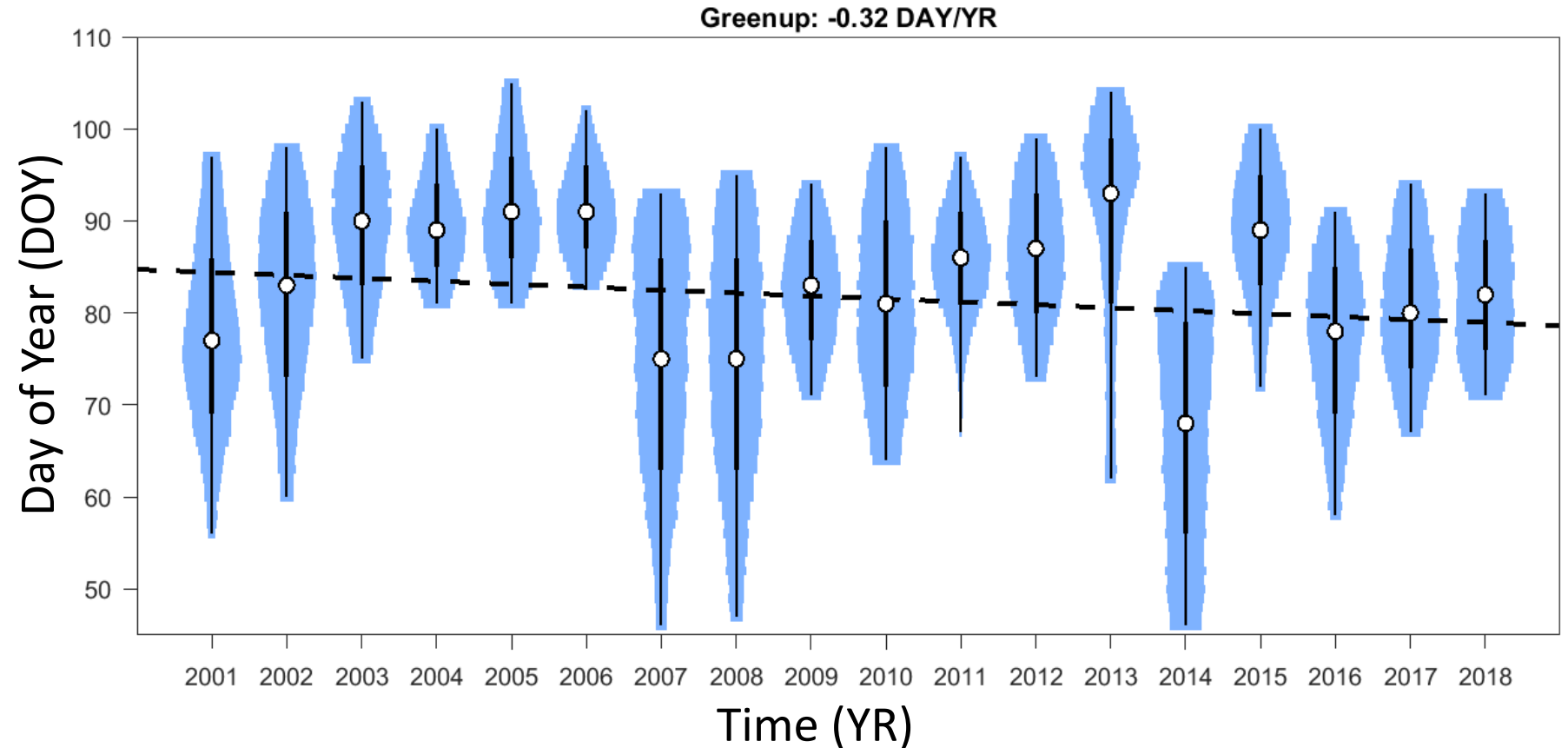
MCD12Q2.v6 (2001-2018)

ERA5 air temperature data



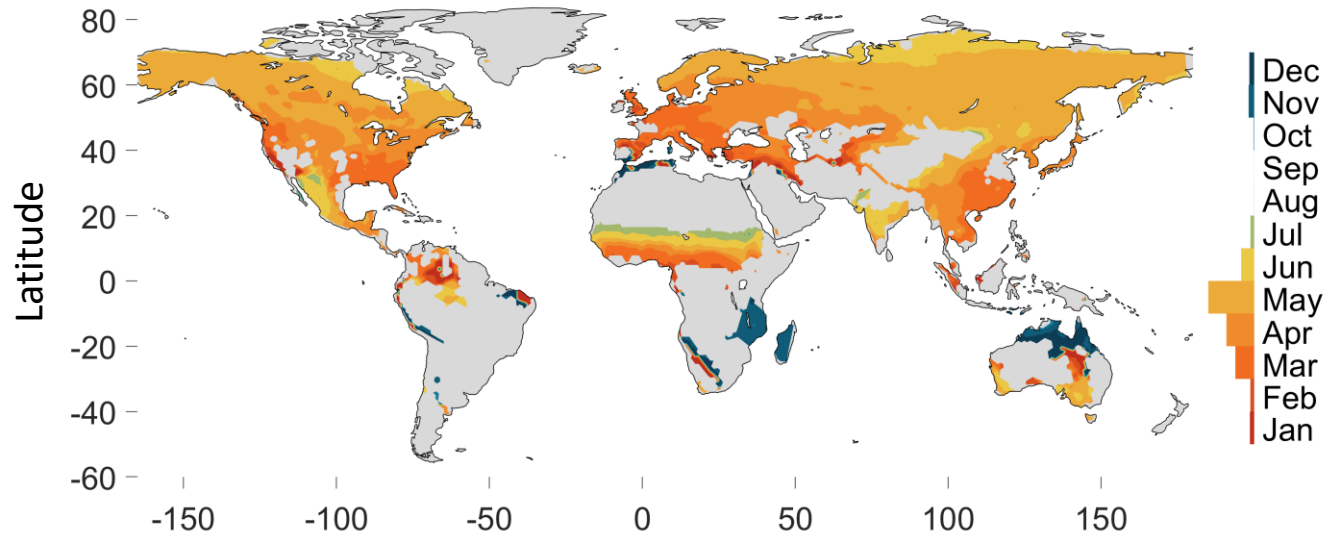
Introduction

Summary statistics at +10.000 point locations ...

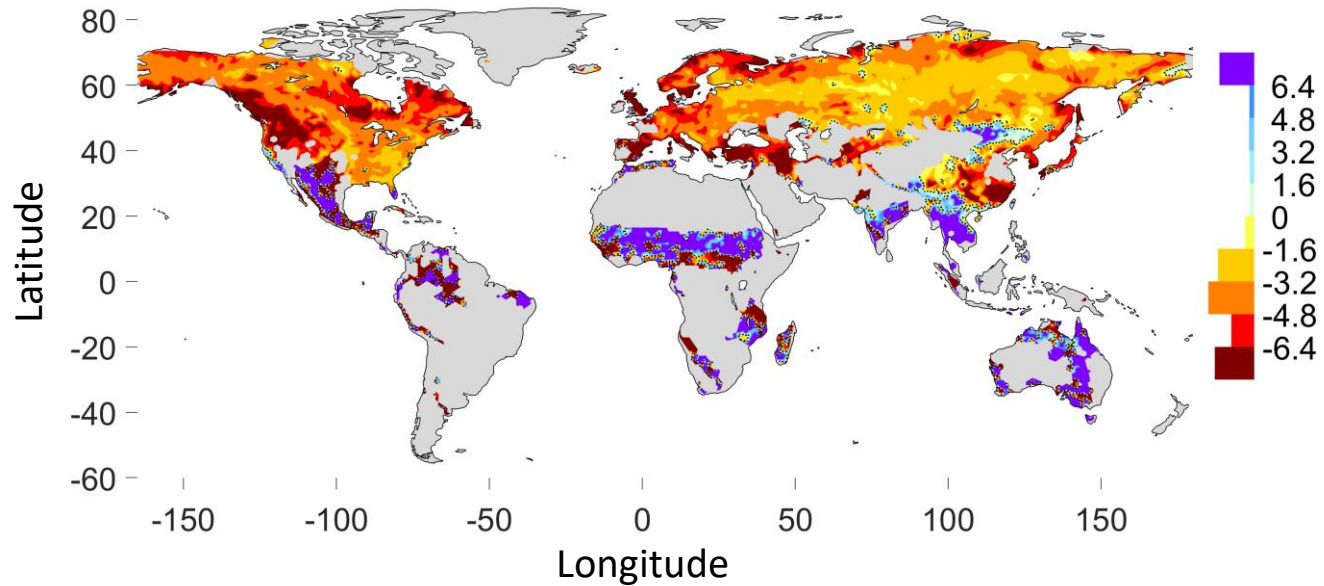


Green-up ...

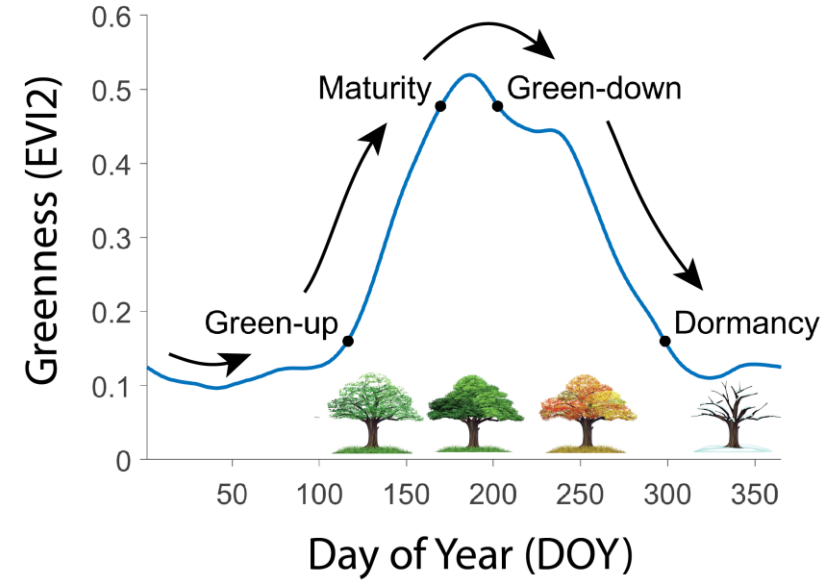
Median Day of Year (DOY)



Shifts in phenology (Days/Decade)

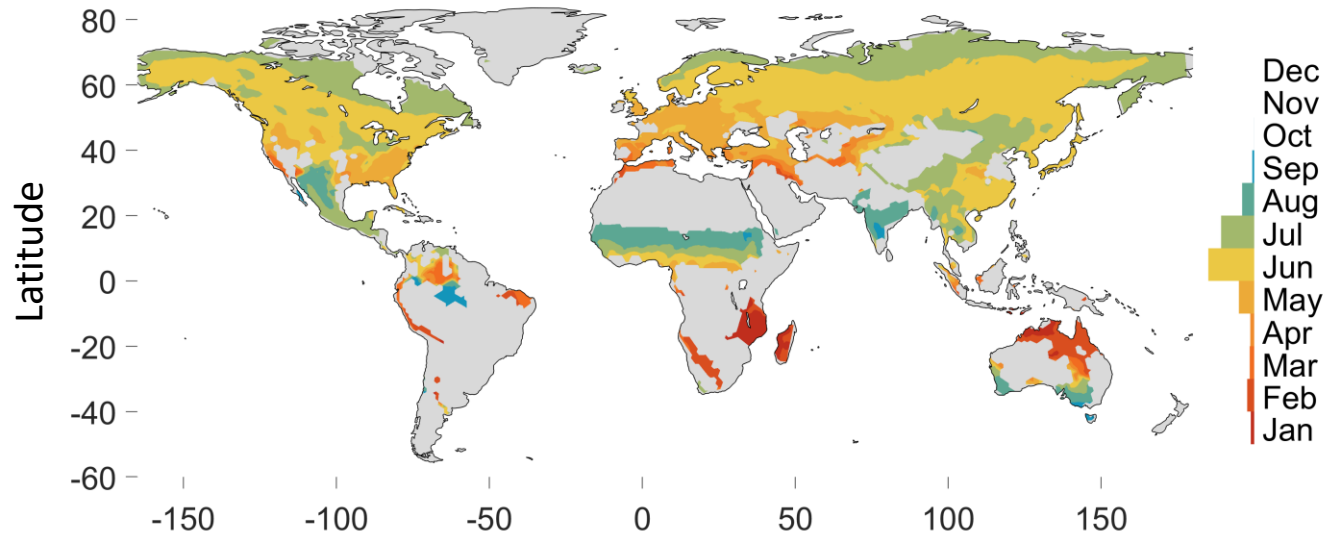


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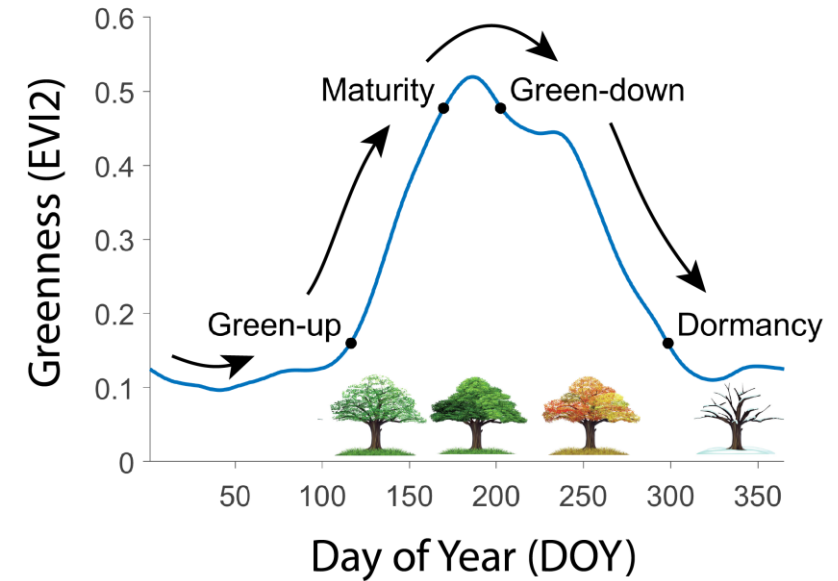
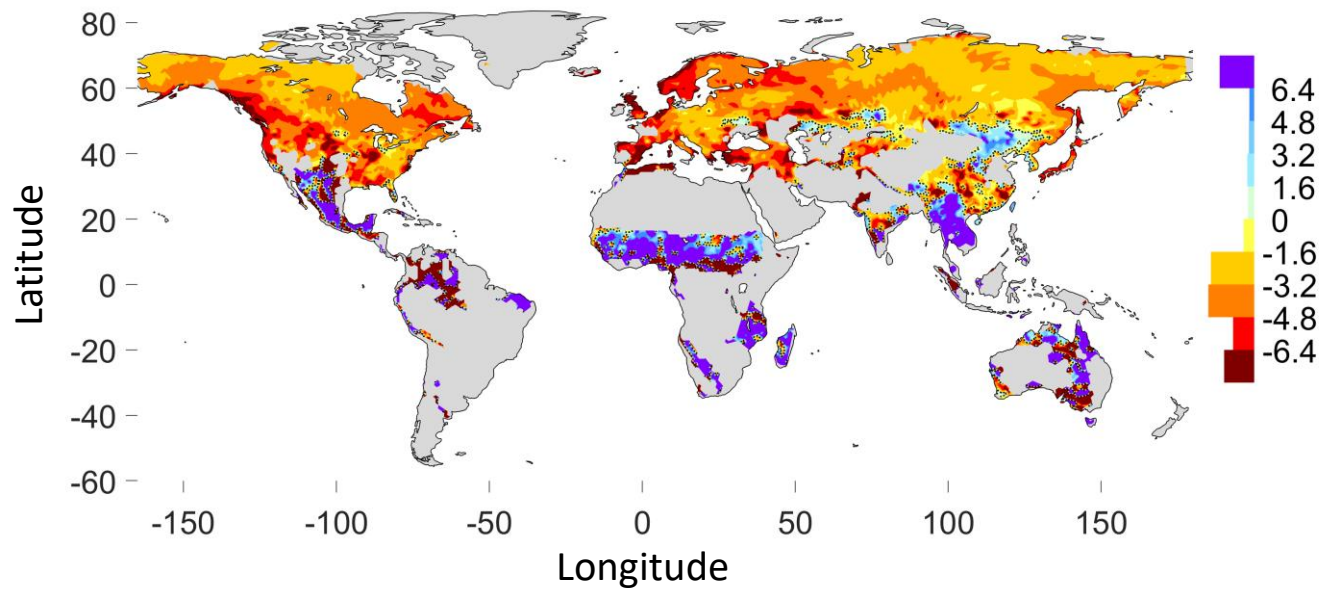


Maturity ...

Median Day of Year (DOY)



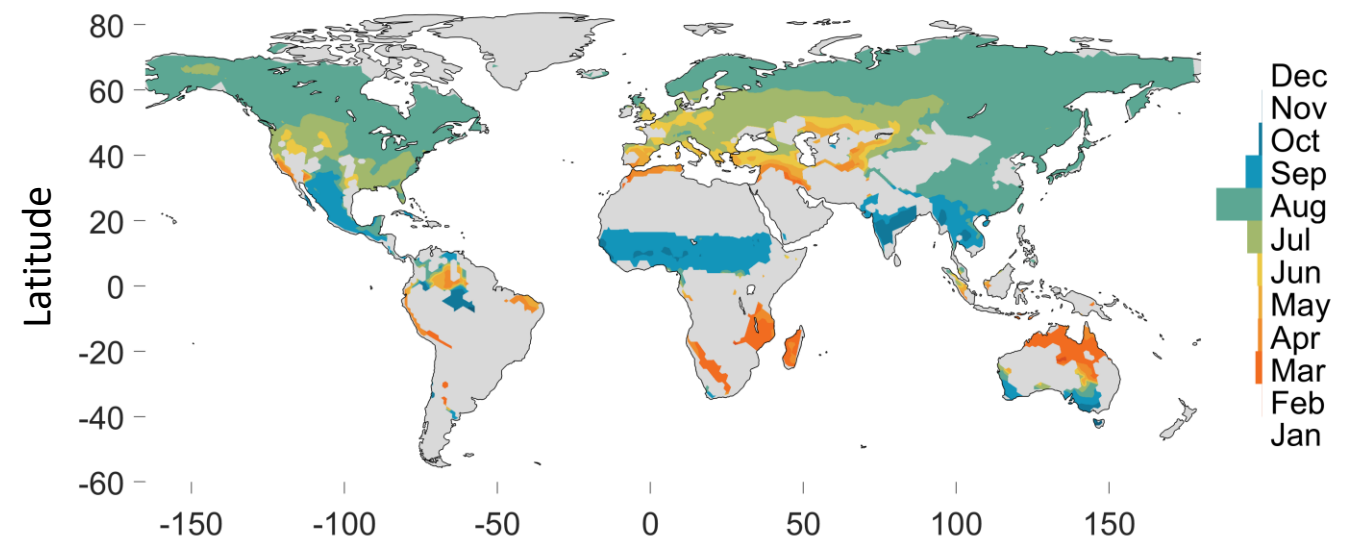
Shifts in phenology (Days/Decade)



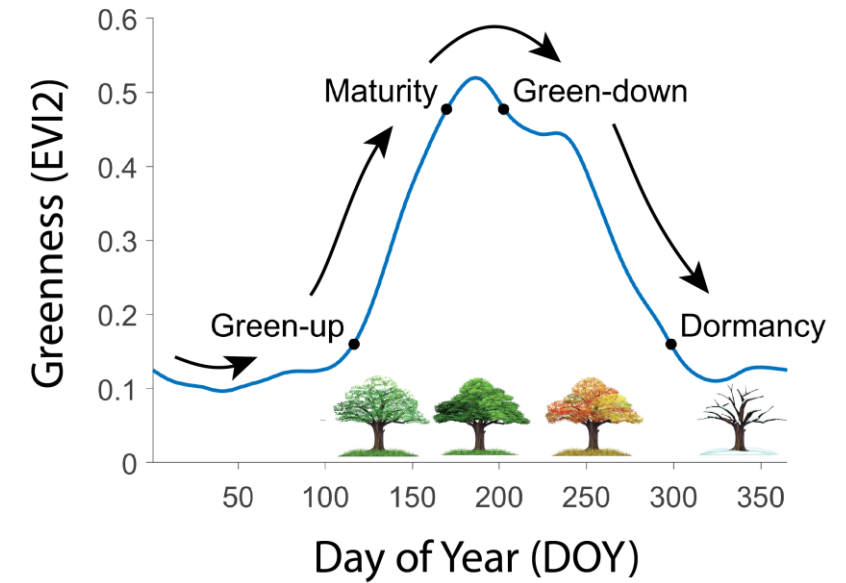
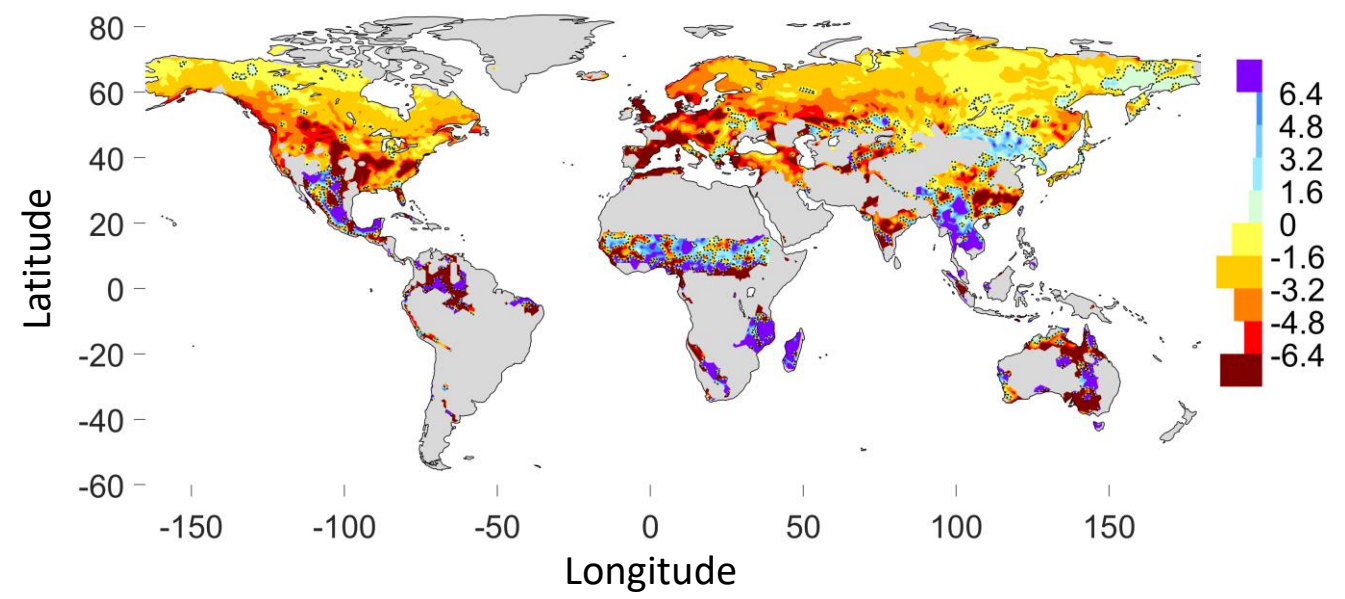
Green-down ...



Median Day of Year (DOY)

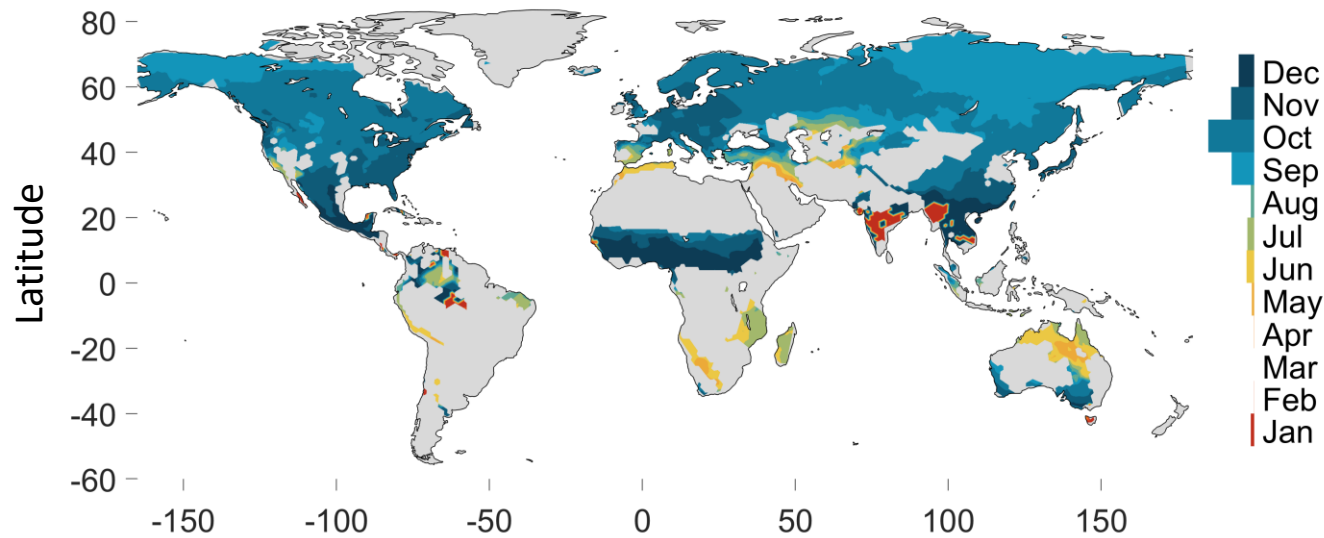


Shifts in phenology (Days/Decade)

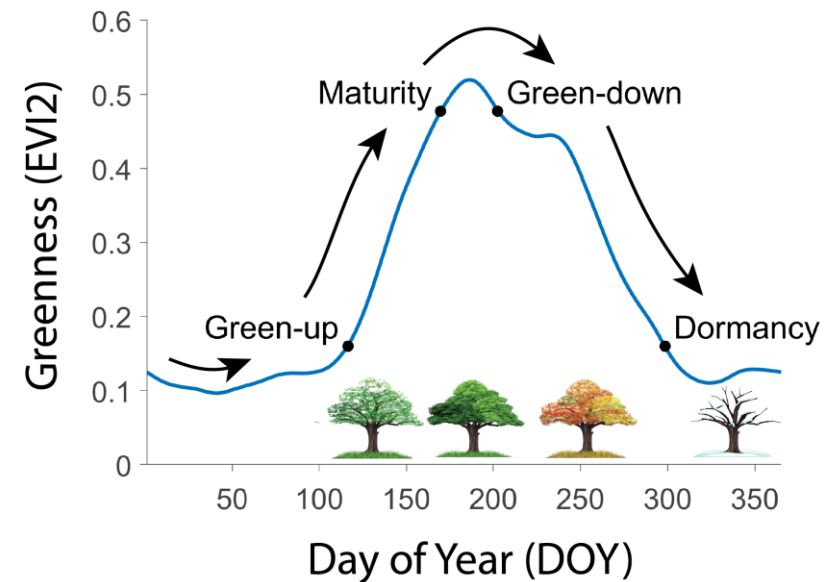
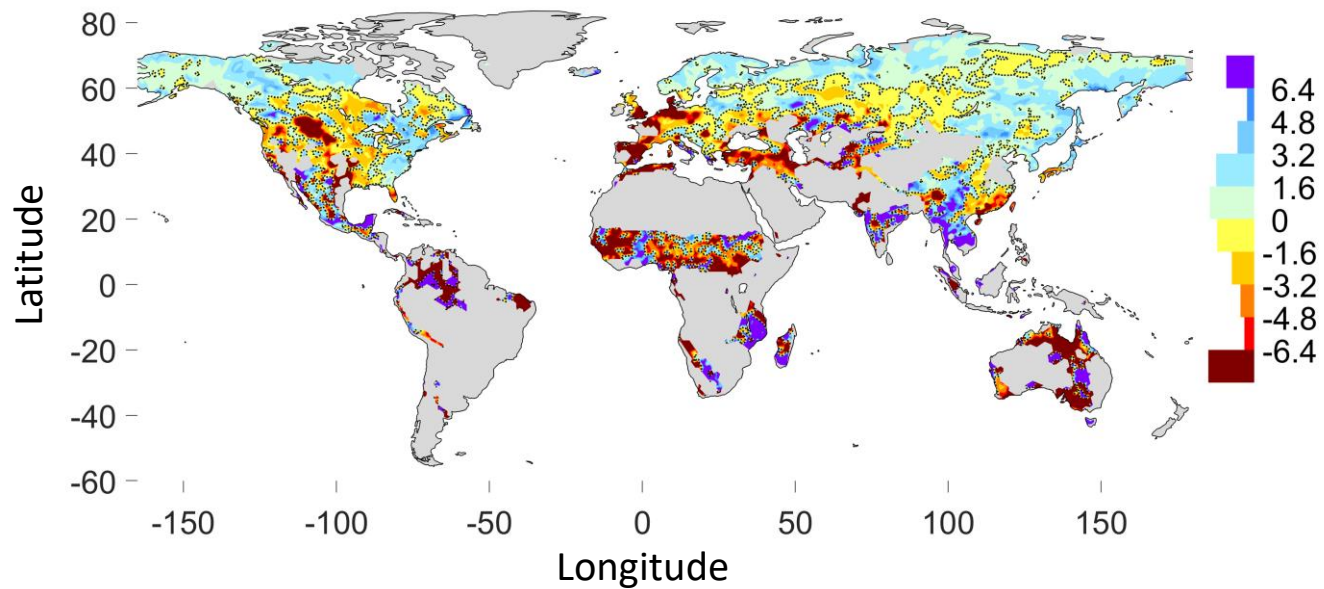


Dormancy ...

Median Day of Year (DOY)



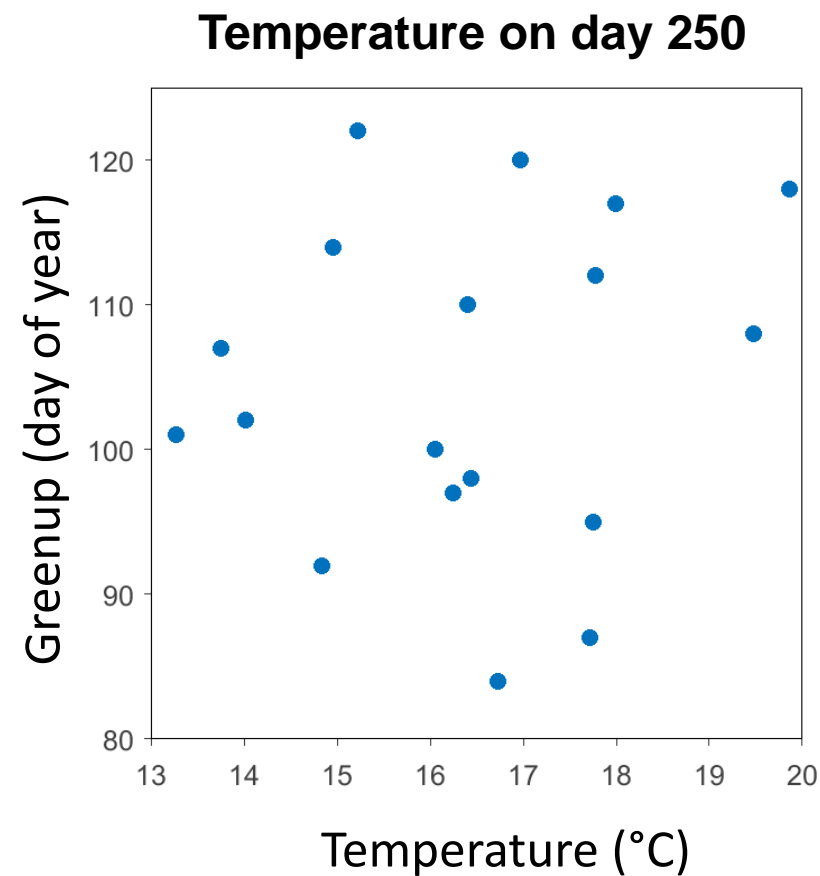
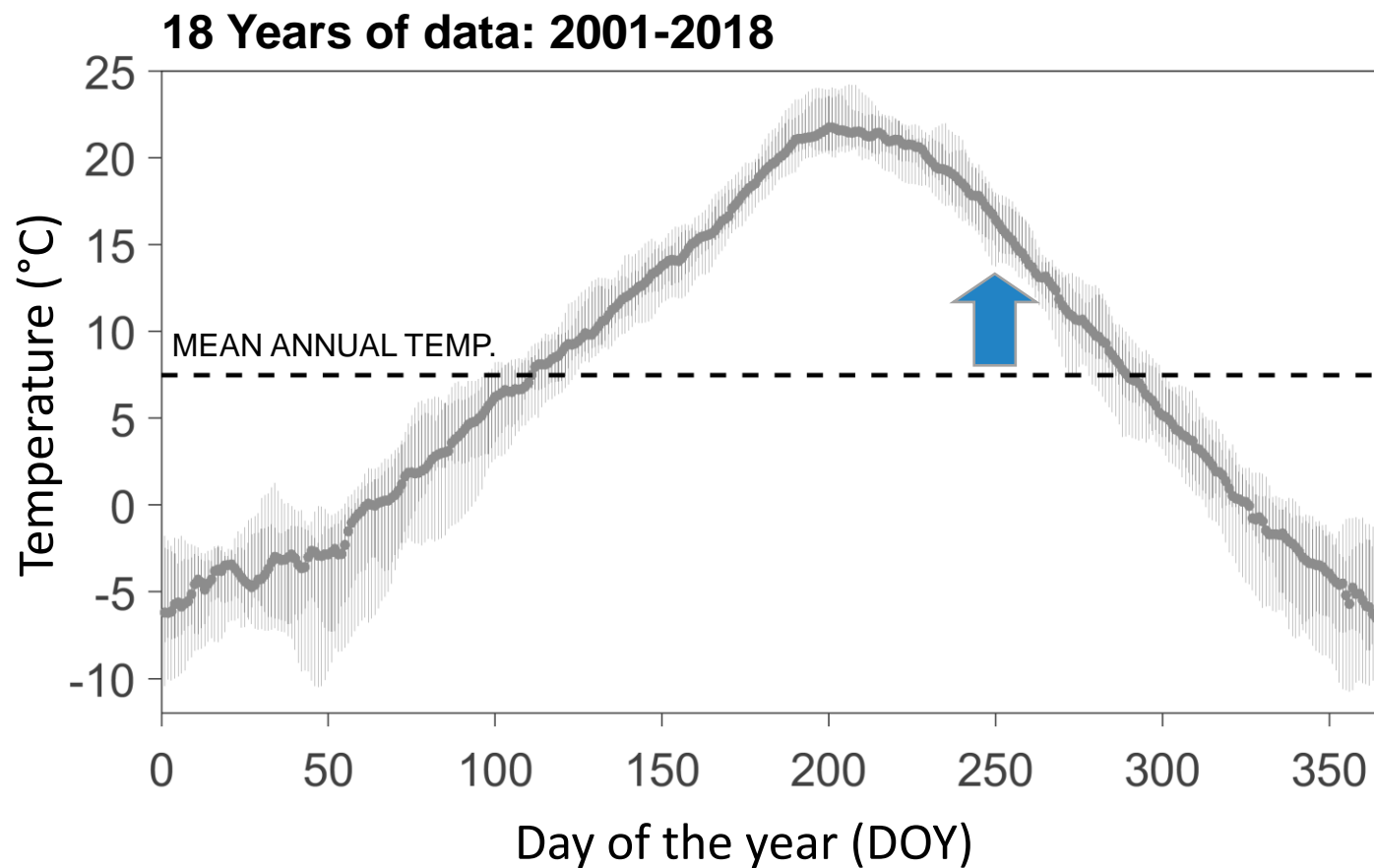
Shifts in phenology (Days/Decade)



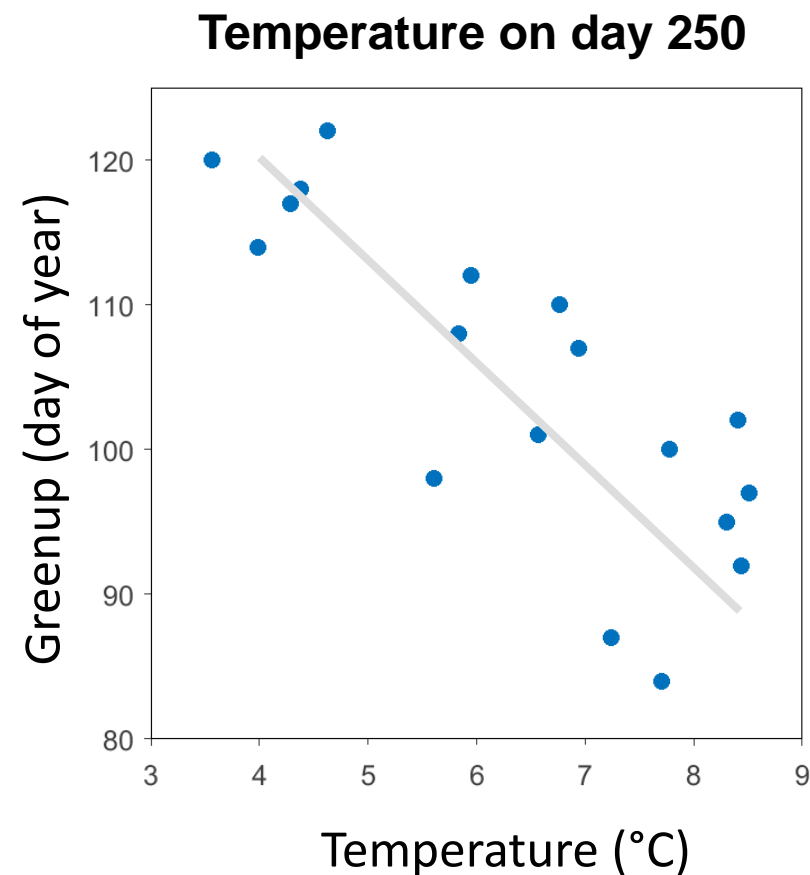
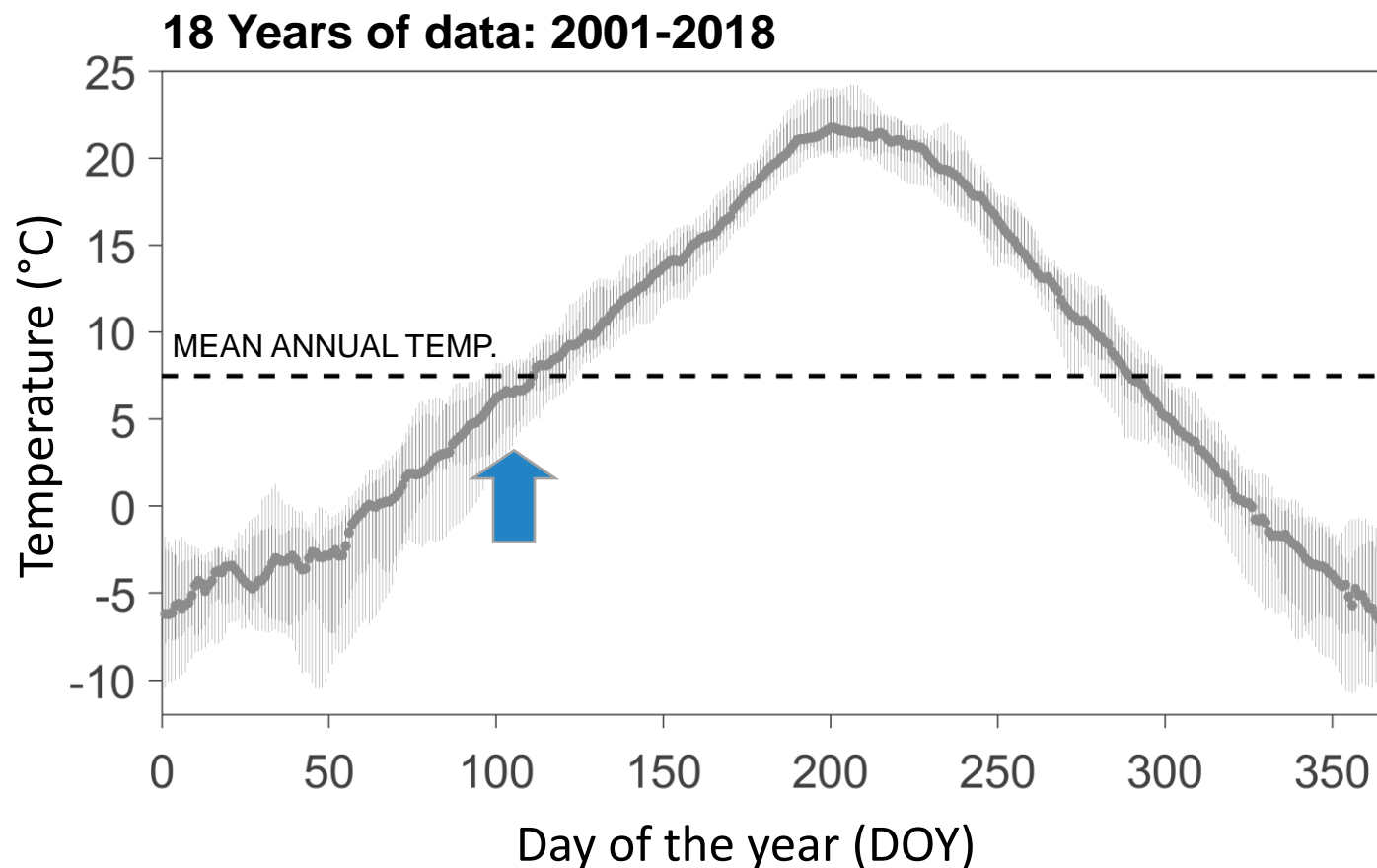


Temperature-phenology interrelationships?

Detecting the critical period ...



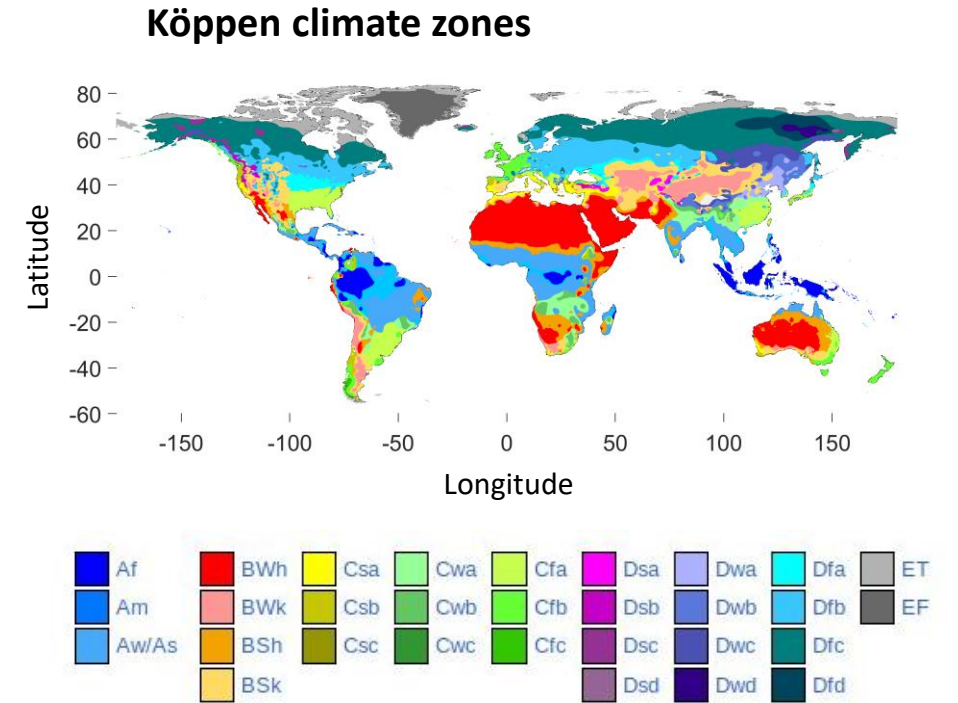
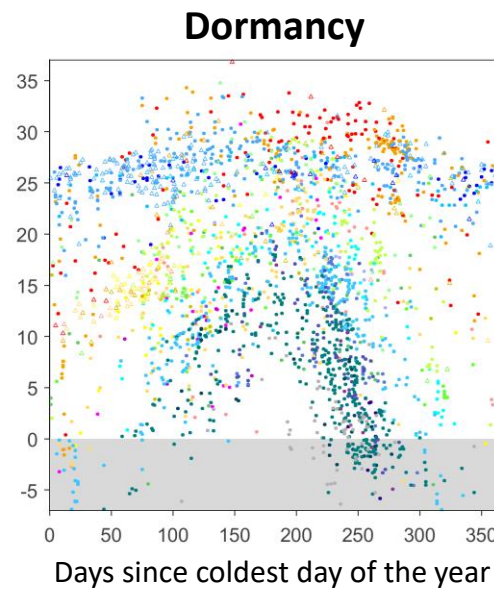
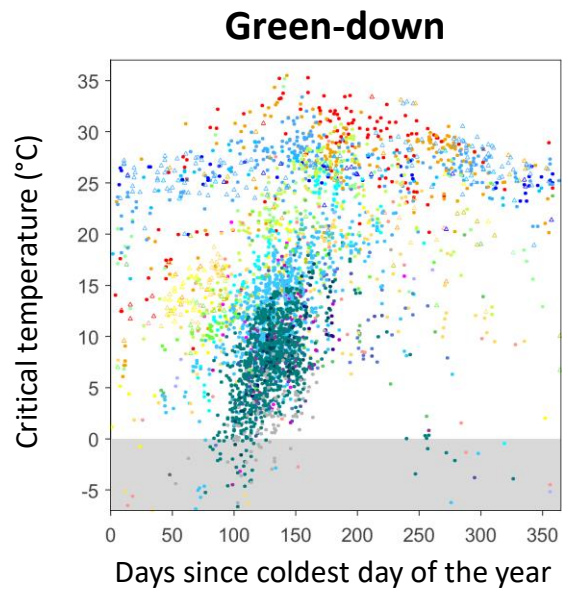
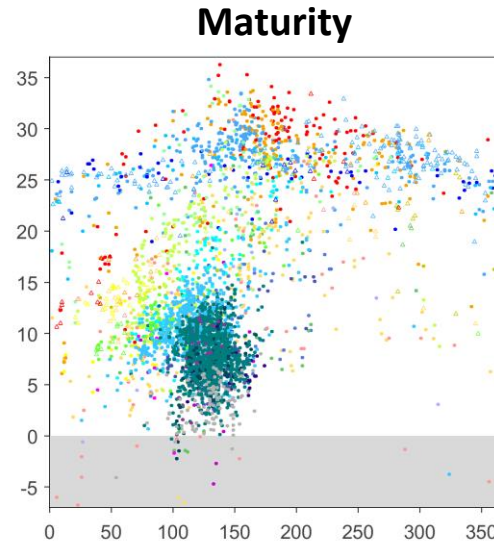
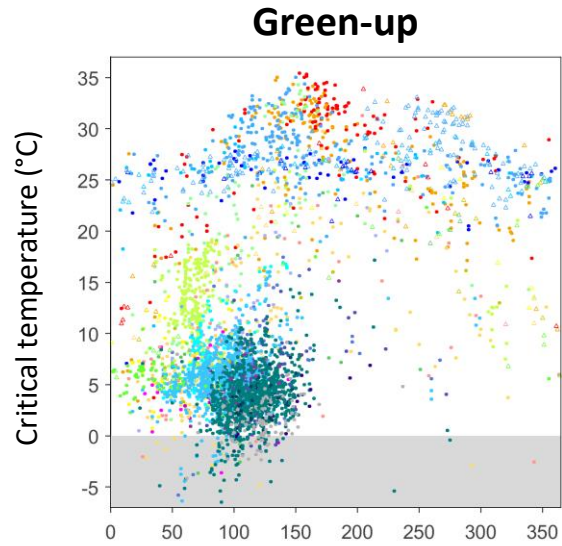
Detecting the critical period ...



The critical period ...



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Green-up

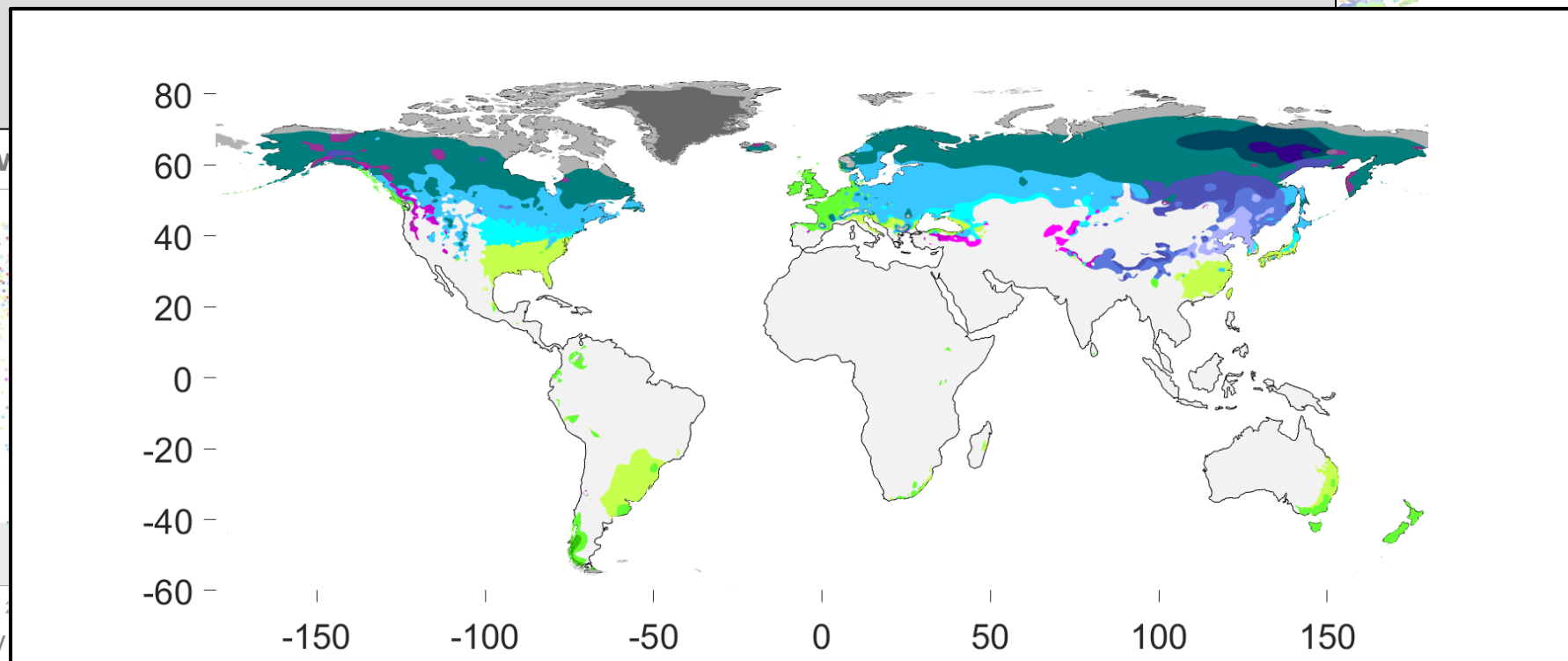
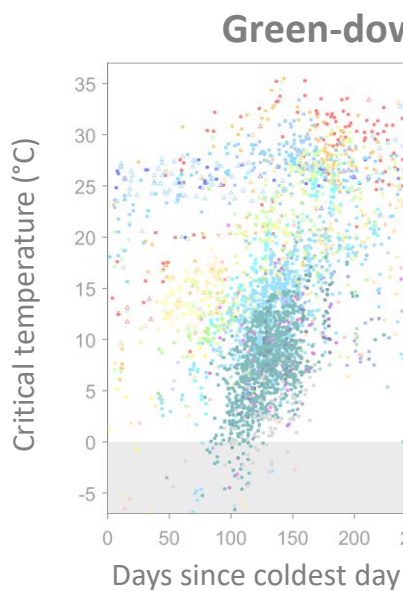
Maturity

ACCROSS CONTINENTAL AND TEMPERATE CLIMATE ZONES:

TEMPERATURE FLUCTUATIONS AROUND **THE SAME PERIOD OF THE YEAR** CORRELATE STRONGLY WITH GREEN-UP, MATURITY, AND GREEN-DOWN

I.E. BETWEEN DAY 50-150

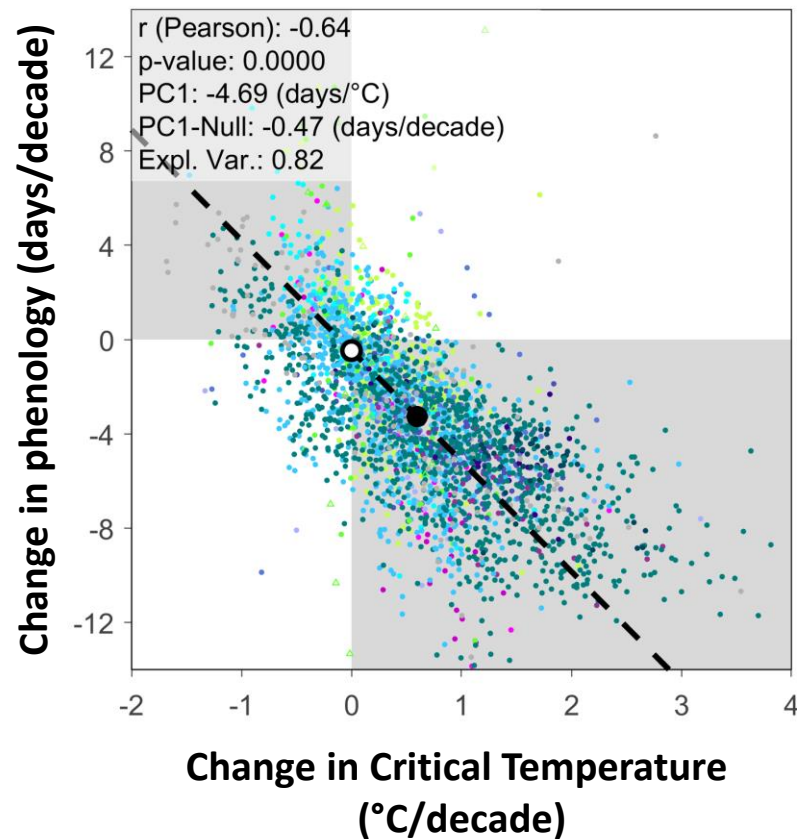
The critical p



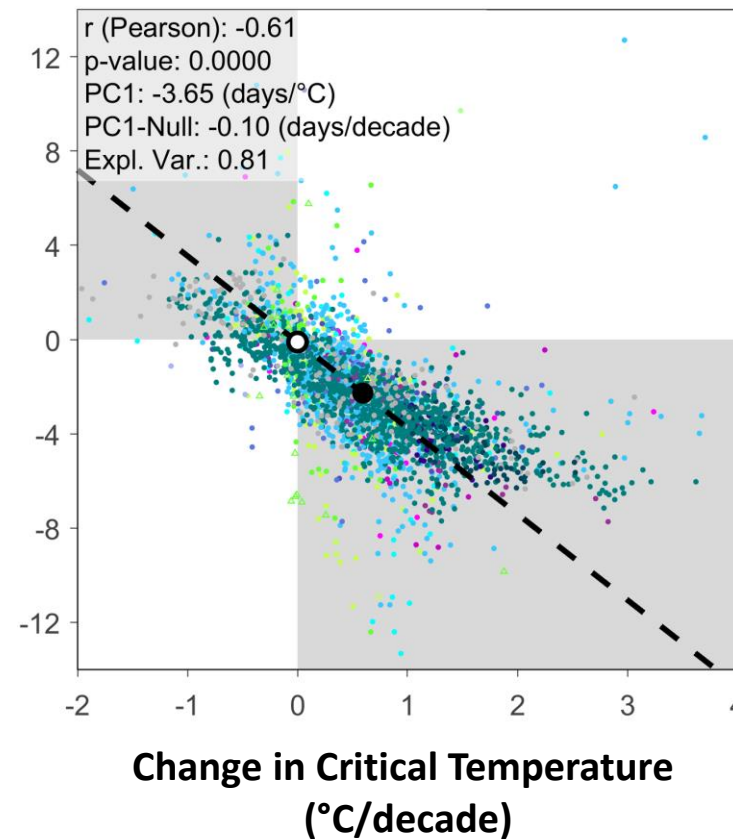
Temperature vs. Phenology trends

In continental and temperate climate zones

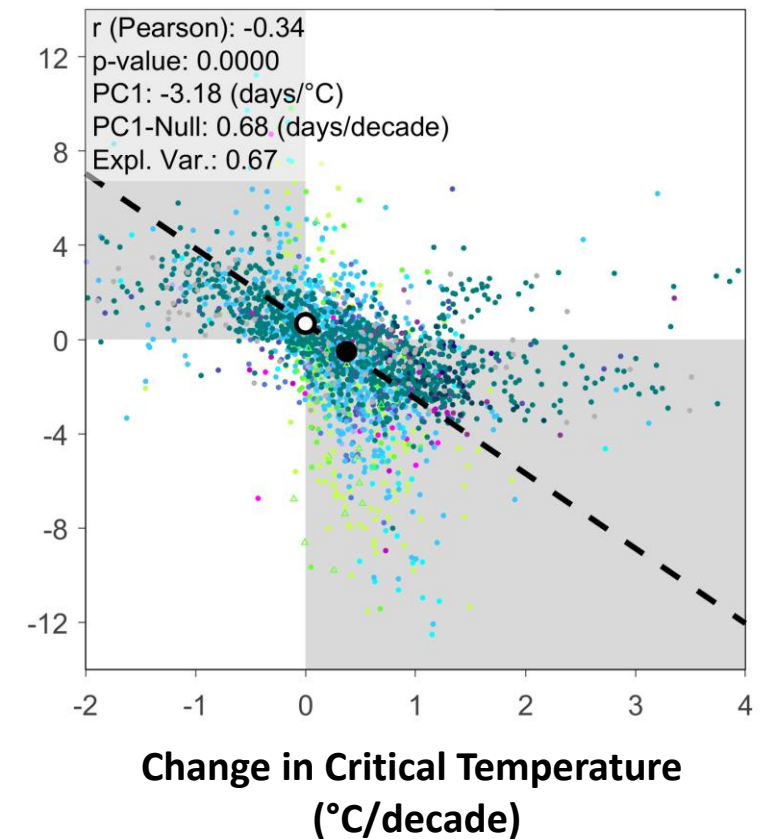
Green-up



Maturity



Green-down



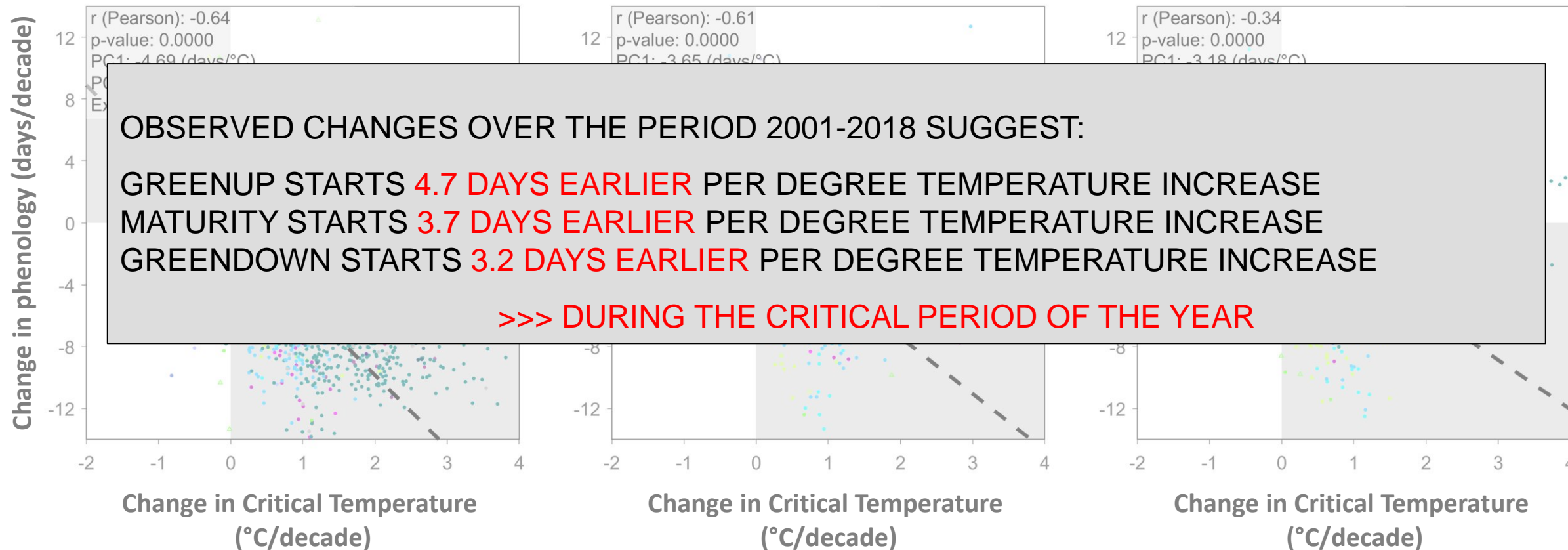
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Maturity

Green-down



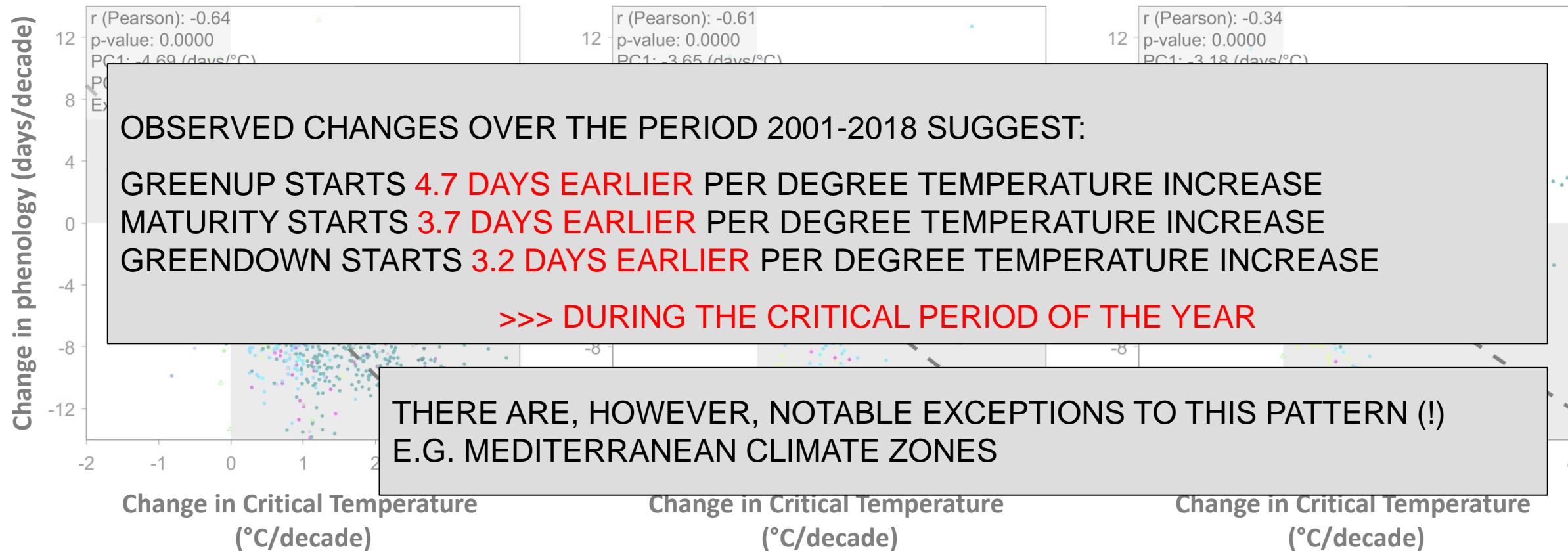
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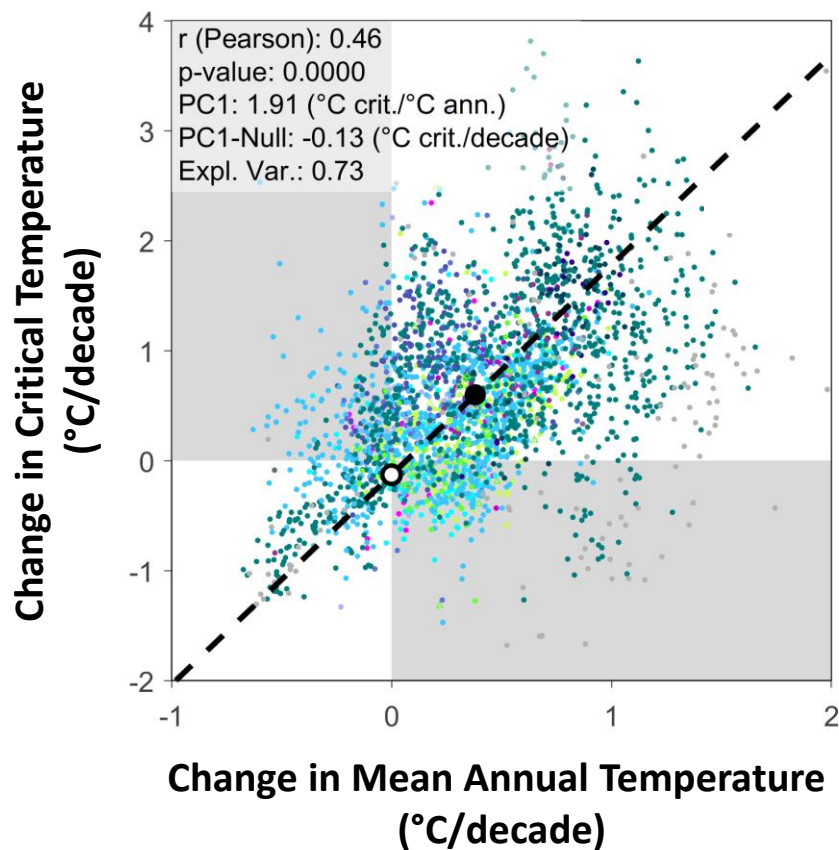
Green-down



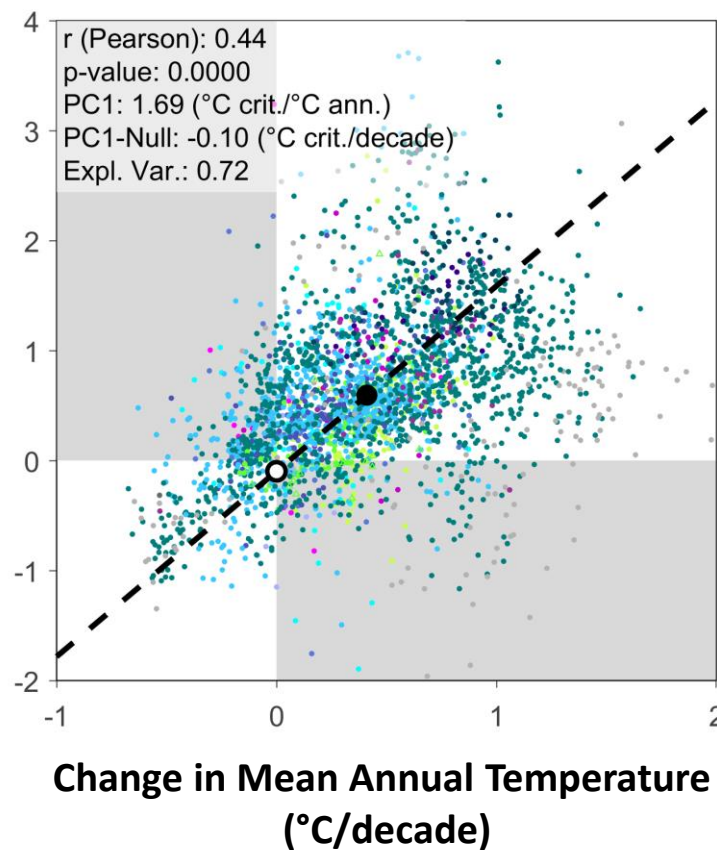
Amplified change when it matters ...

In continental climate zones

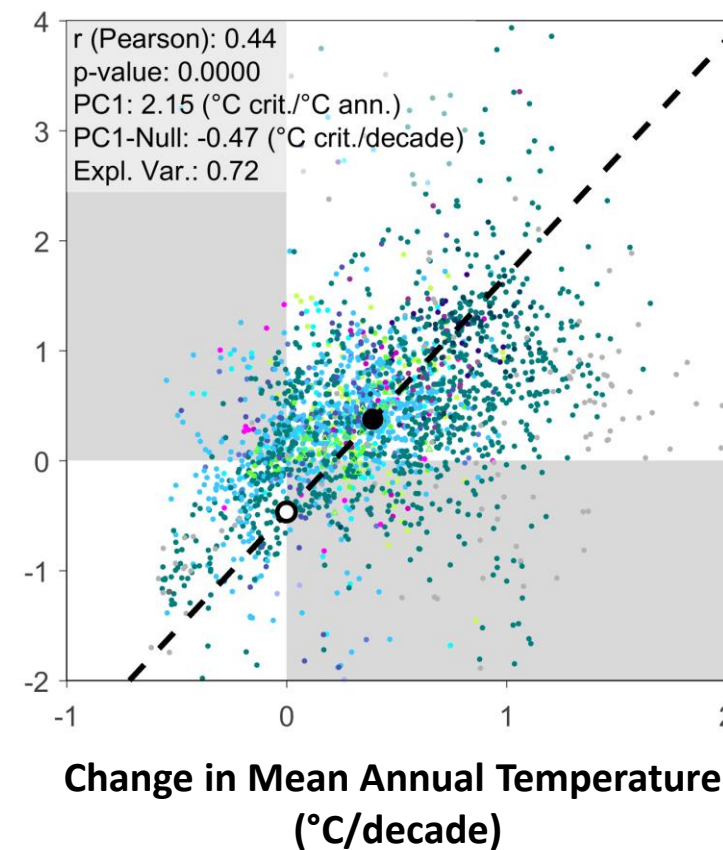
Green-up



Maturity



Green-down



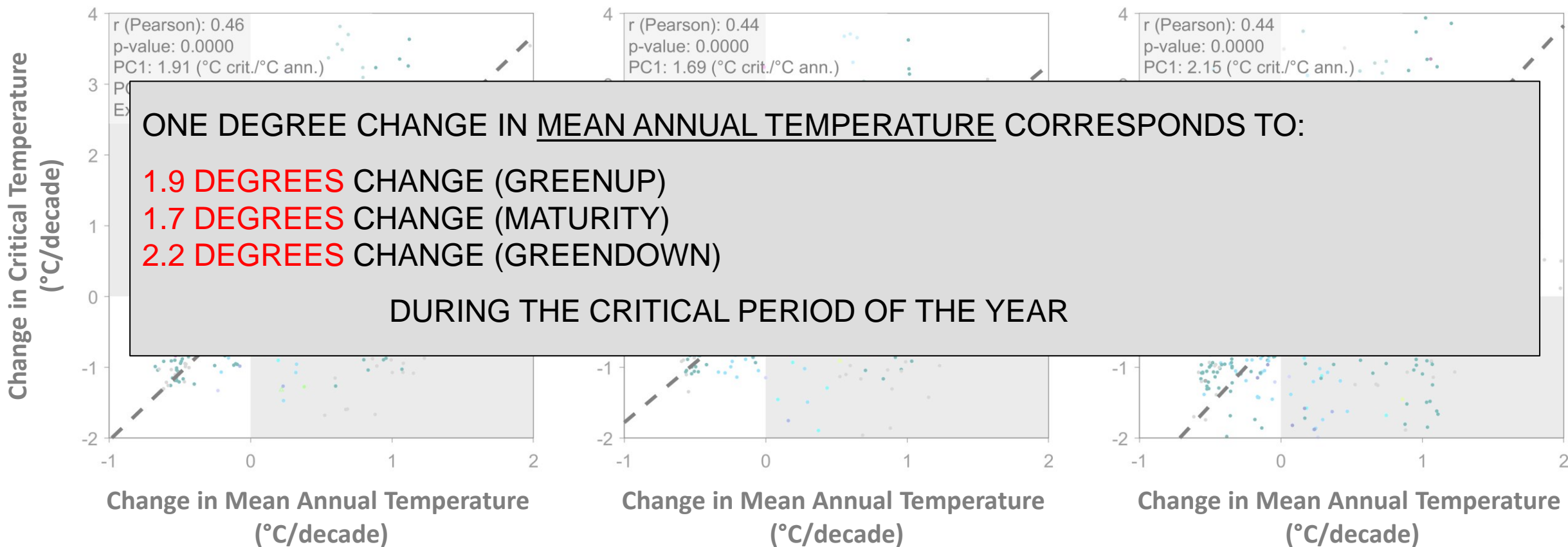
Amplified change when it matters ...

In continental climate zones

Greenup

Maturity

Greendown

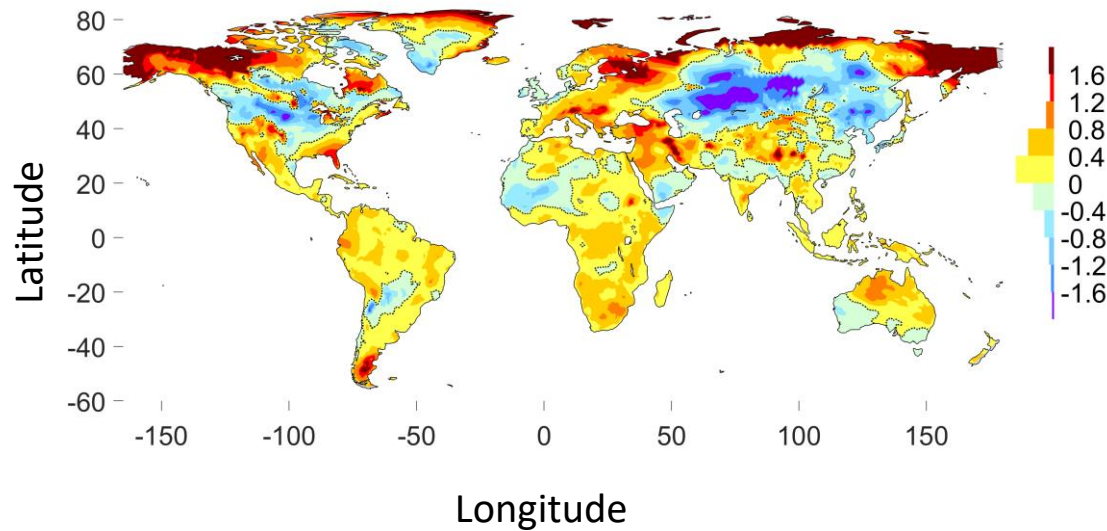


Why?

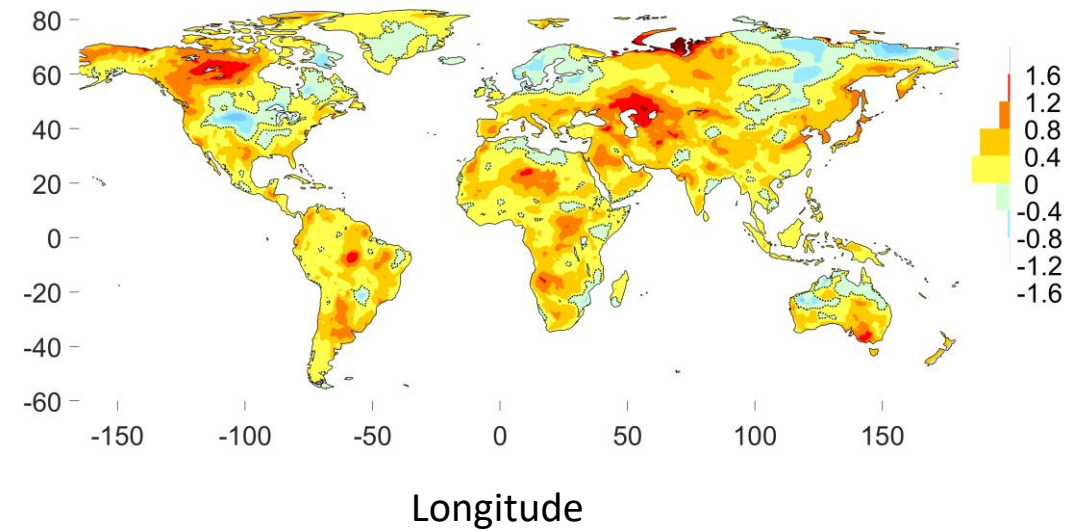


- Climate changes differ between the seasons ...

Coldest day of the year



Warmest day of the year

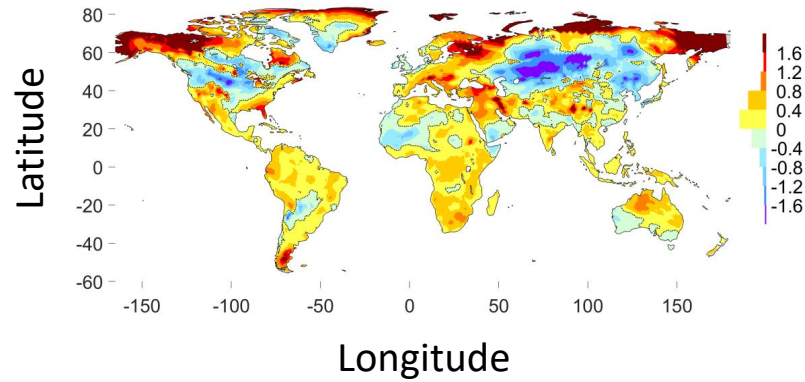


(Change in °C/decade)

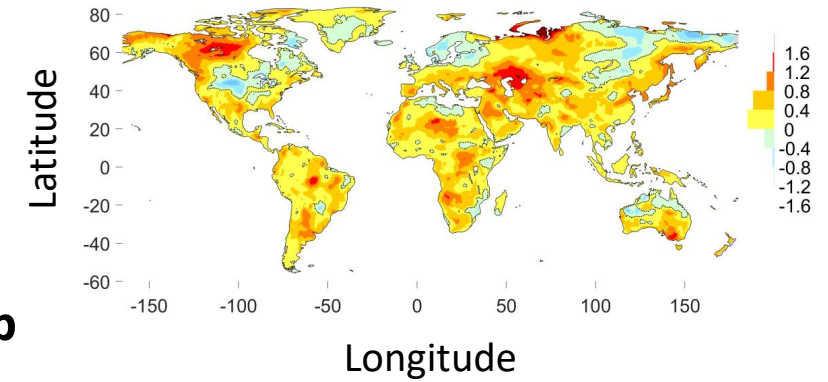
Why?



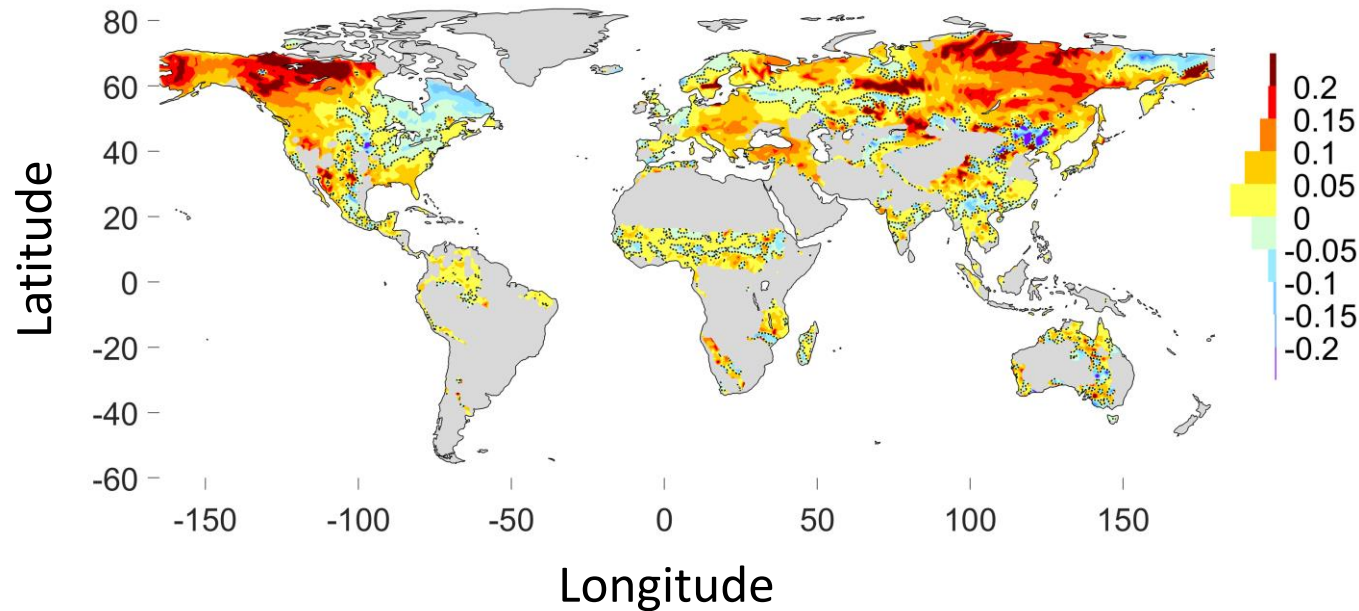
Coldest day of the year



Warmest day of the year



Critical period – green-up



(Change in °C/decade)



Discussion

- Global changes in land phenology are determined during a critical period of the year that is roughly similar for green-up, maturity, and perhaps surprisingly, green-down.
- One degree increase in mean annual temperature corresponds to approximately 2 degrees during the critical period.
- Differences between climate zones

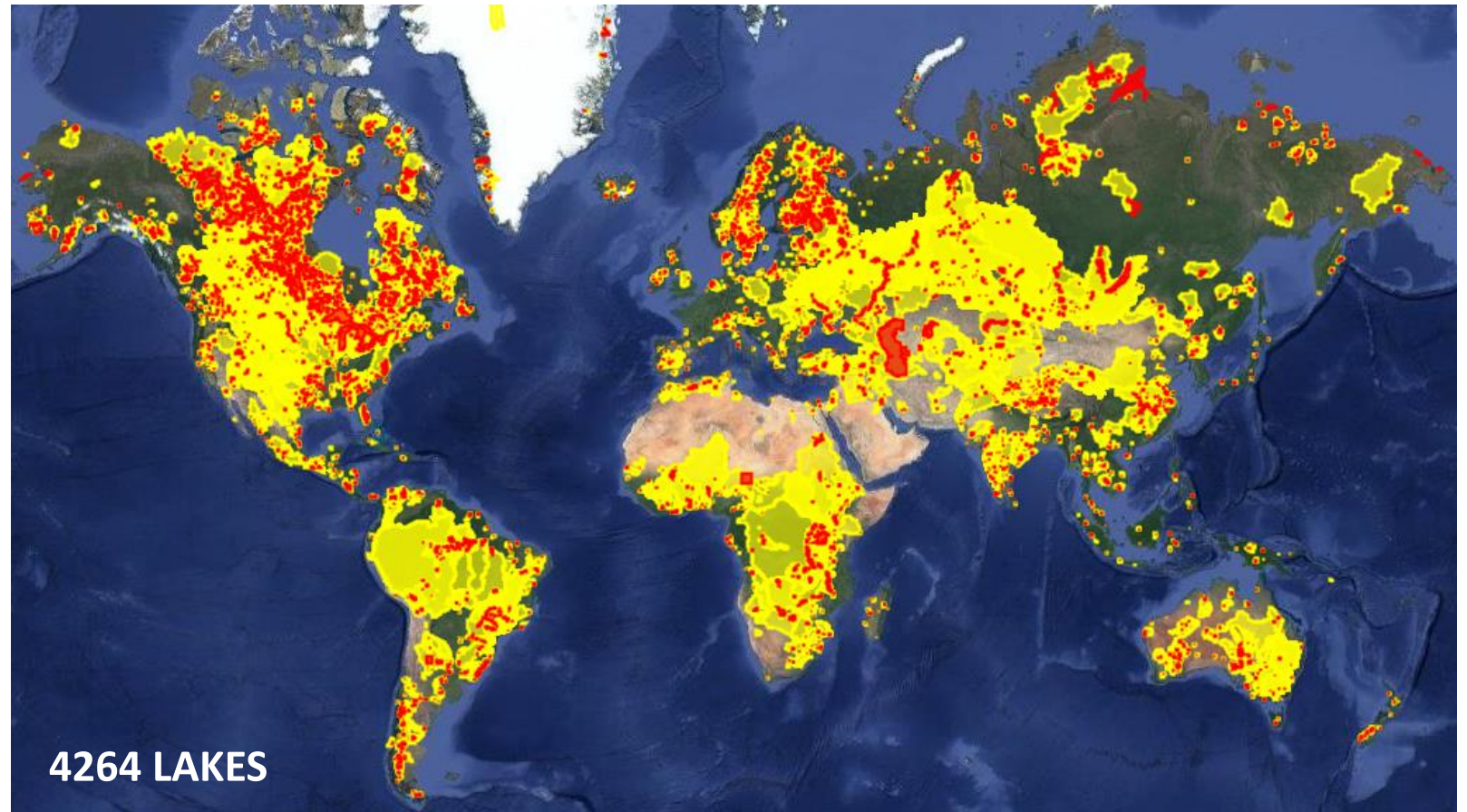


Thank you!

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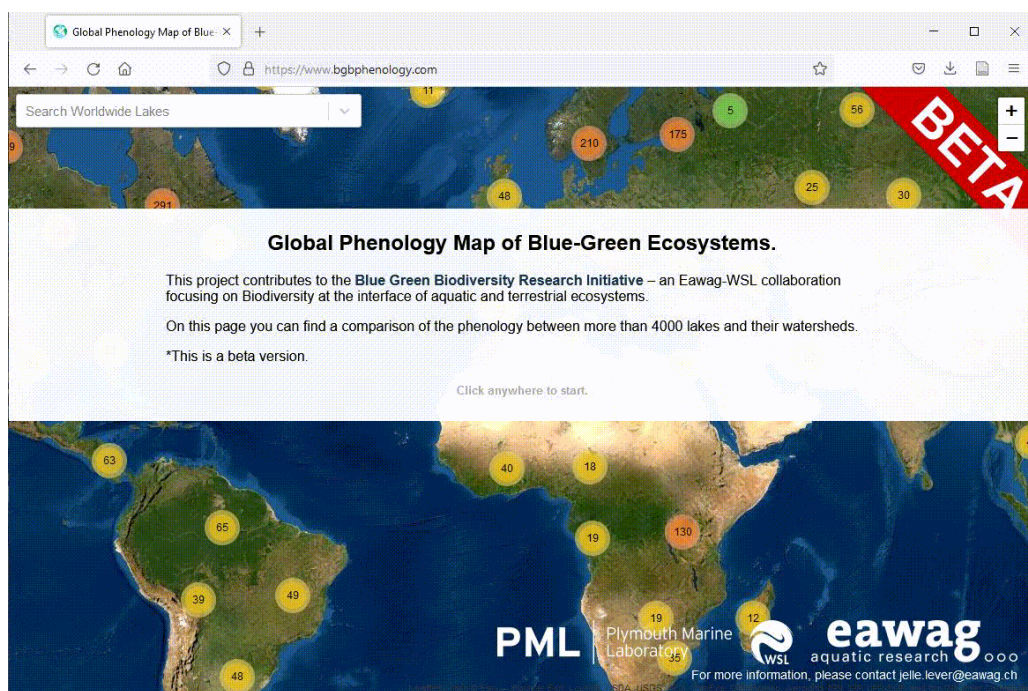


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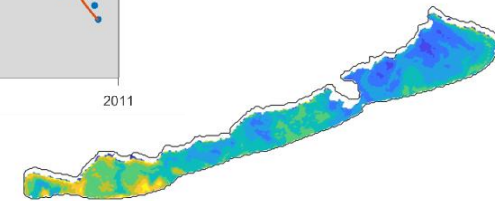
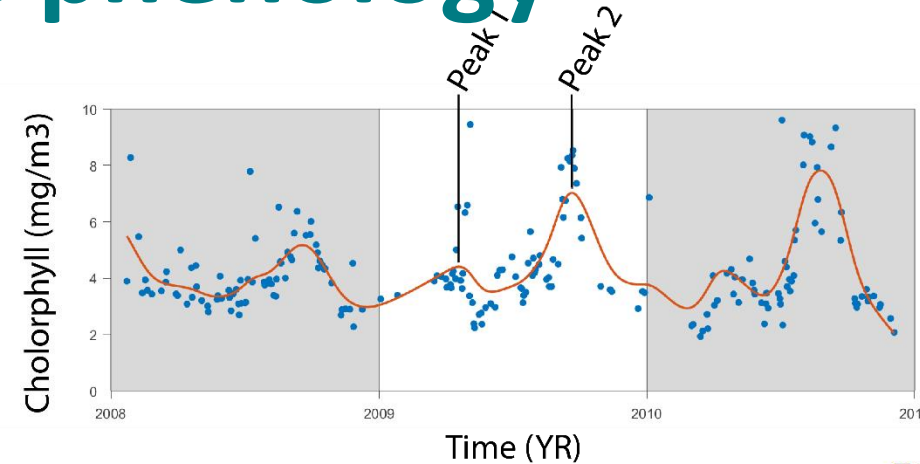
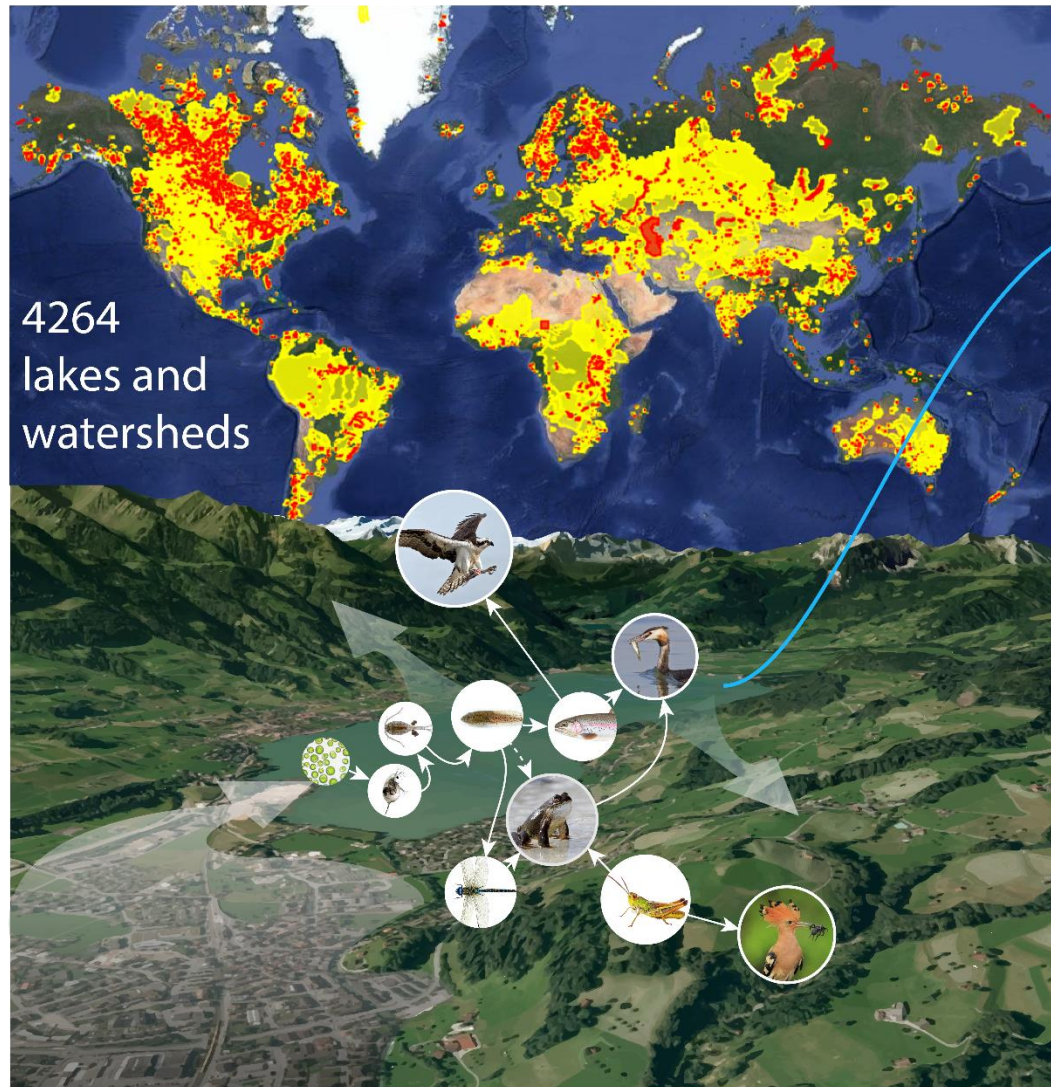
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Remotely sensed lake phenology



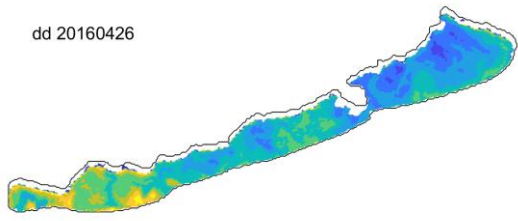
- Daily *Chlorophyll-a* estimates
MERIS (2002-2012) and Sentinel-3 (2016-2019)



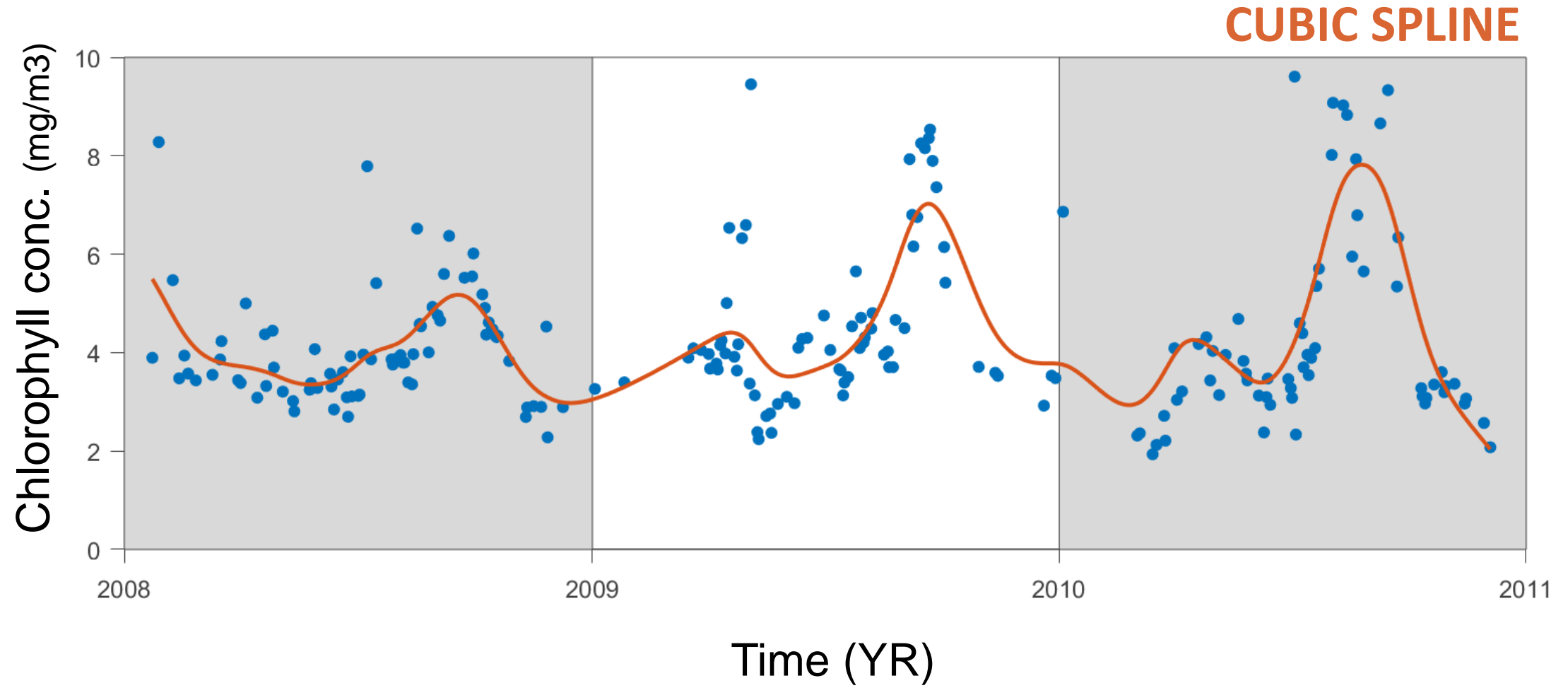
PML | Plymouth Marine
Laboratory

Stefan Simis

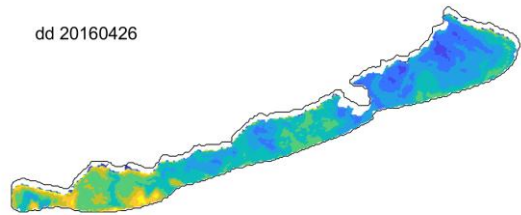
dd 20160426



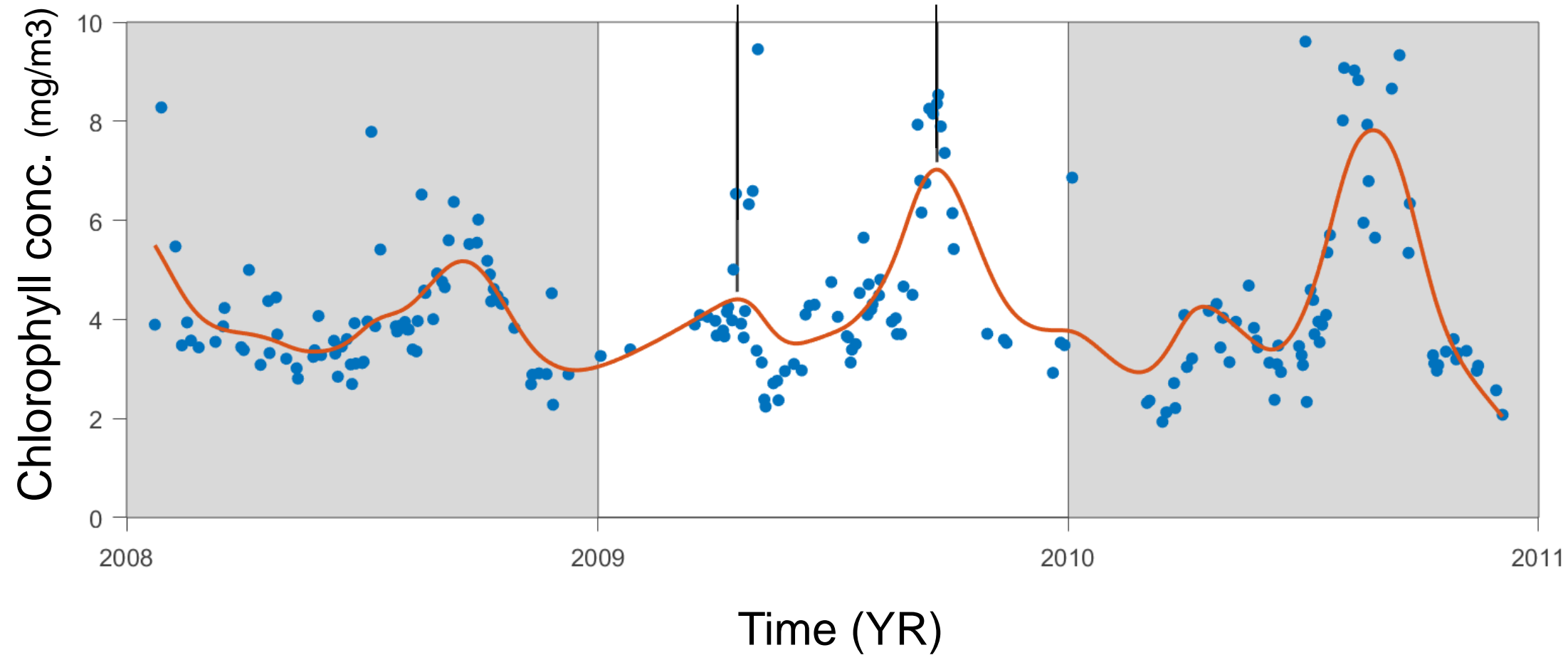
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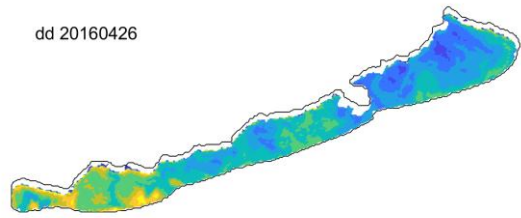
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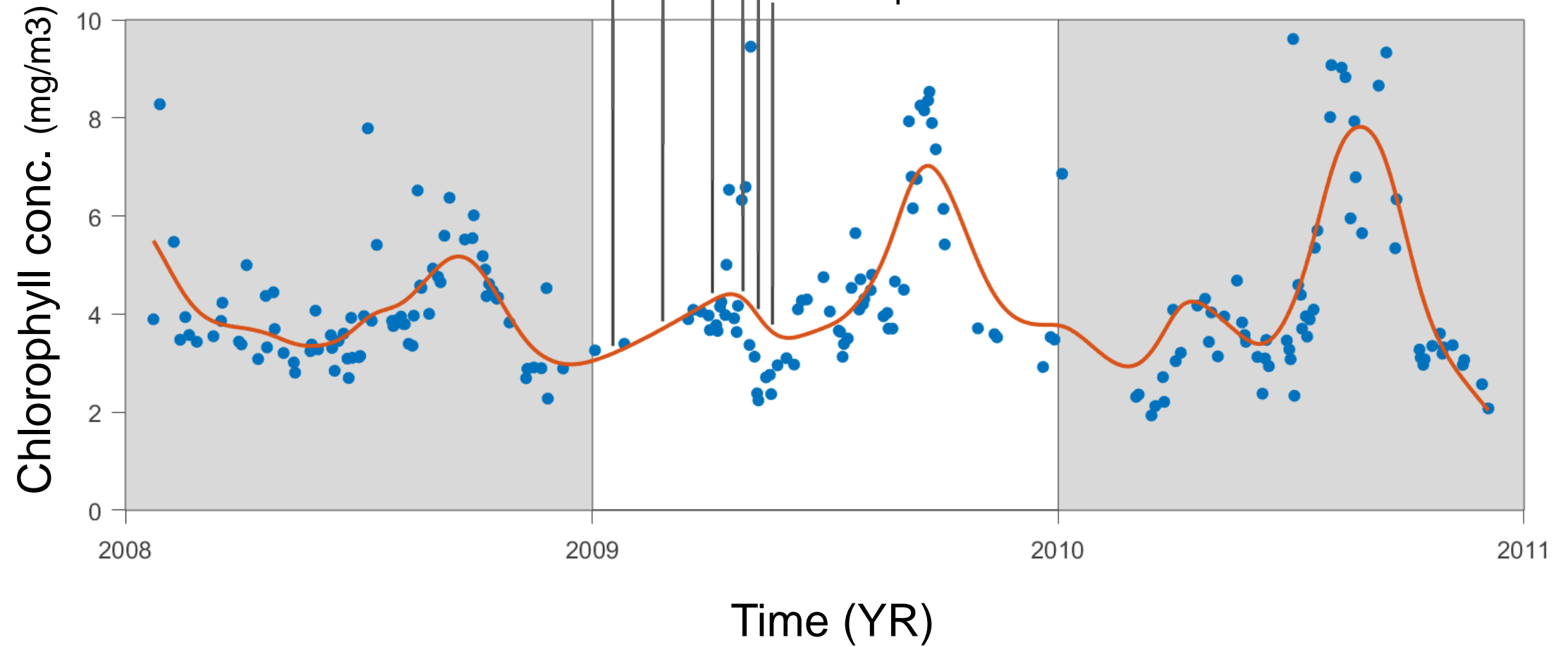
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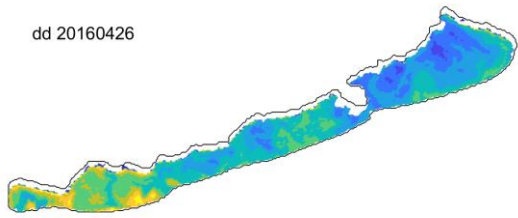
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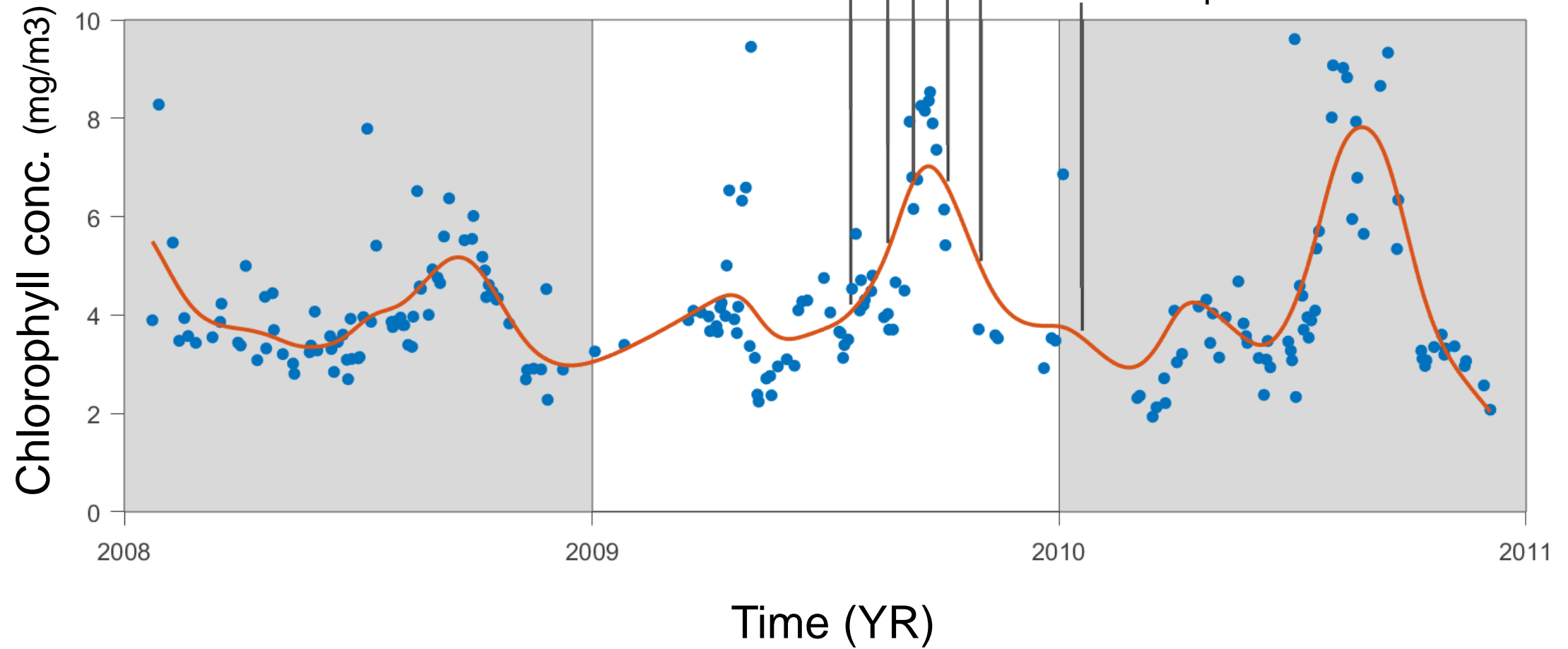
Greenup 1
Mid-Greenup 1
Greenup 1
Greendown 1
Mid-Greendown 1
End-of-peak 1

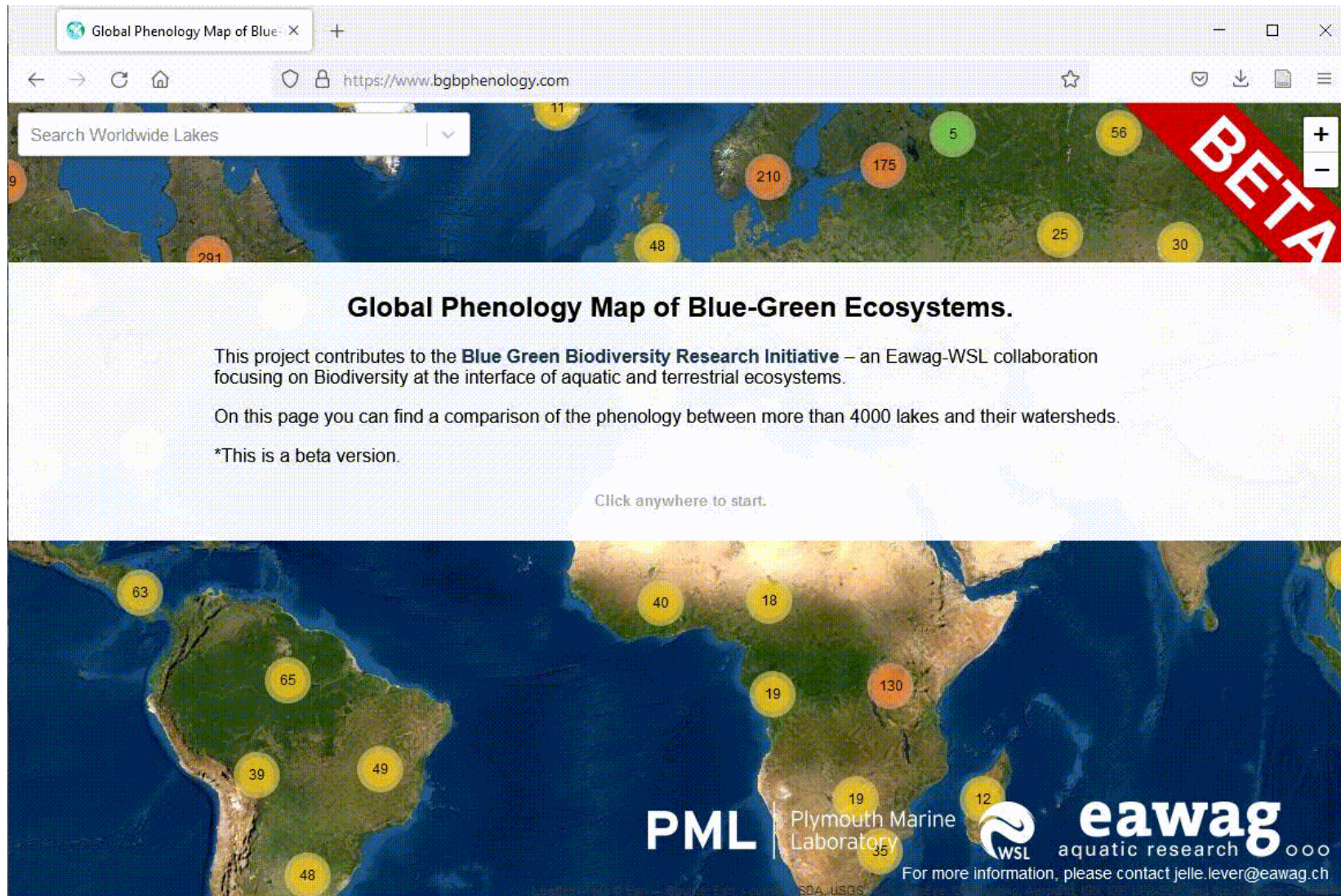


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Global Phenology Map of Blue- Green Ecosystems.

This project contributes to the **Blue Green Biodiversity Research Initiative** – an Eawag-WSL collaboration focusing on Biodiversity at the interface of aquatic and terrestrial ecosystems.

On this page you can find a comparison of the phenology between more than 4000 lakes and their watersheds.

*This is a beta version.

Click anywhere to start.

PML Plymouth Marine Laboratory

WSL eawag aquatic research

For more information, please contact jelle.lever@eawag.ch