ARCTIC PHENOLOGICAL CHANGES IN CLM

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Phenology in the News

The bloom is off Augusta National

BY DOUG FERGUSON, ASSOCIATED PRESS | Like | +1 0

April 2, 2012
AP

D.C. cherry trees: Blooms won't wait in warming world, research finds

March 20, 2012 By Sandra Hines

Mary Levin/U of Washington

March 20, 2012
Phys.org

June 1, 2012
Summit County Voice

Global warming: Hummingbird migration falling out of synch with wildflower blossoms in the southern Rocky Mountains

Posted on June 1, 2012 by Bob Berwyn

Motivation

- how well does CLM handle phenology?
- what are the climate drivers of phenological change?
- changes in the terrestrial carbon balance

Simulations

- CLM4-CN forced with coupler data from MOAR simulations
- 1850-2004
- 2005-2100 with RCP 8.5 scenario

New Since February

- major change in phenology schemes
- revised phenology estimates
- phenology / synoptic weather pattern relationships

Revised Phenology Schemes

(1) Evergreen Scheme

- five types of evergreen trees and shrubs

(2) Stress Deciduous

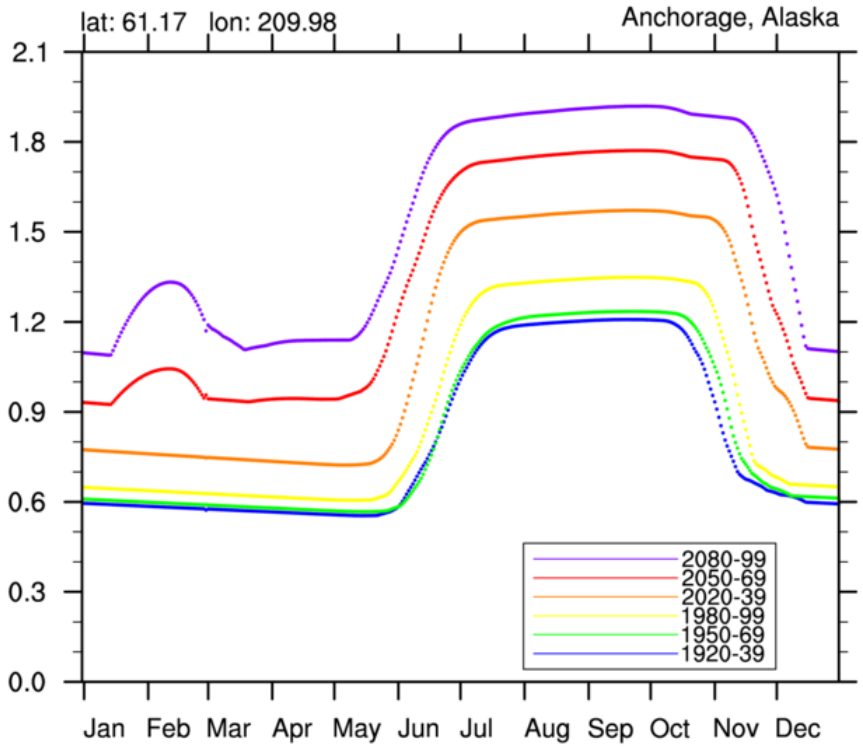
- one type of temperate tree
- one type of temperate shrub
- two types of non-Arctic grass
- crops
- boreal shrubs
- arctic grass

(3) Seasonal Deciduous

- three types of deciduous trees

Previously:

Leaf Area Index (plant greenness)



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- three types of deciduous trees
- boreal shrubs
- arctic grass

Revised:

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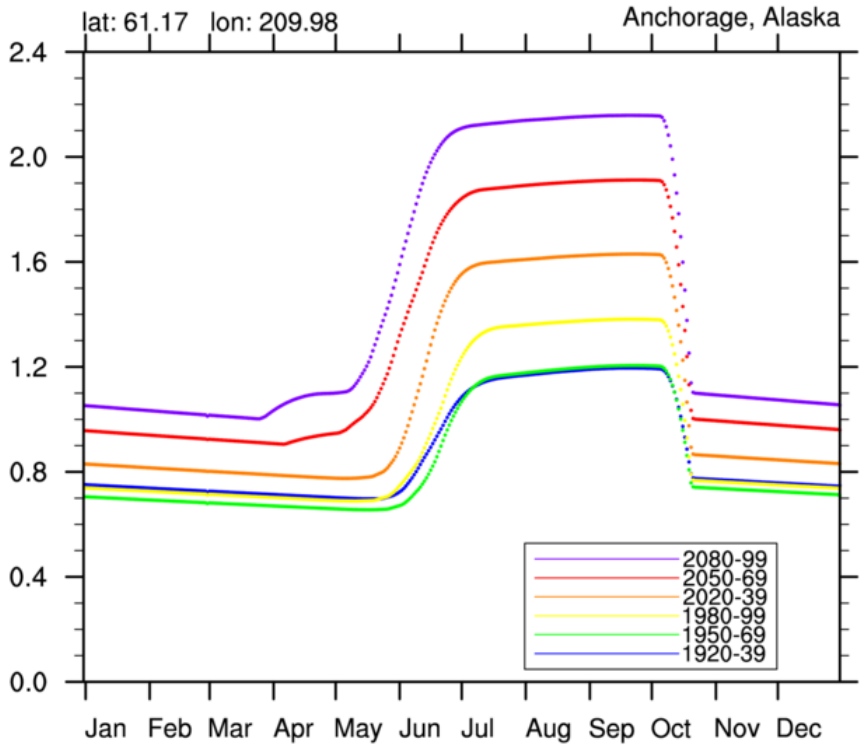
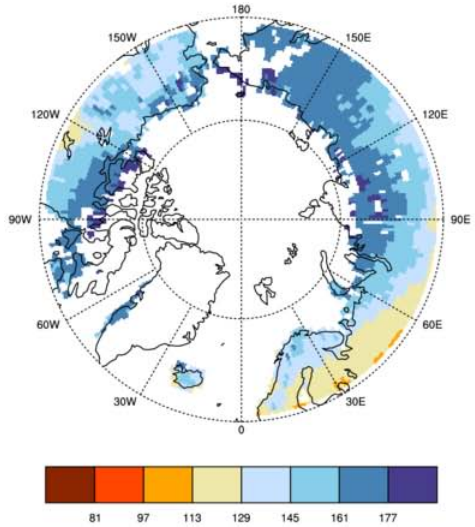


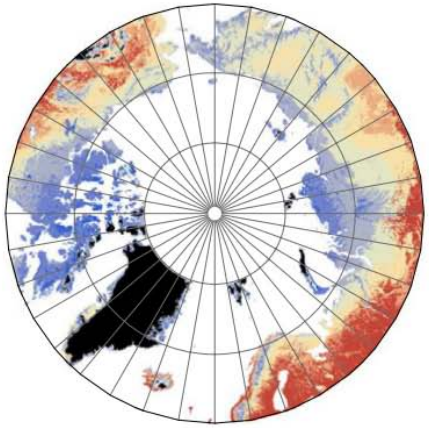
Revised Phenology in CLM

Start of Season

CLM4-CN
2000-2009



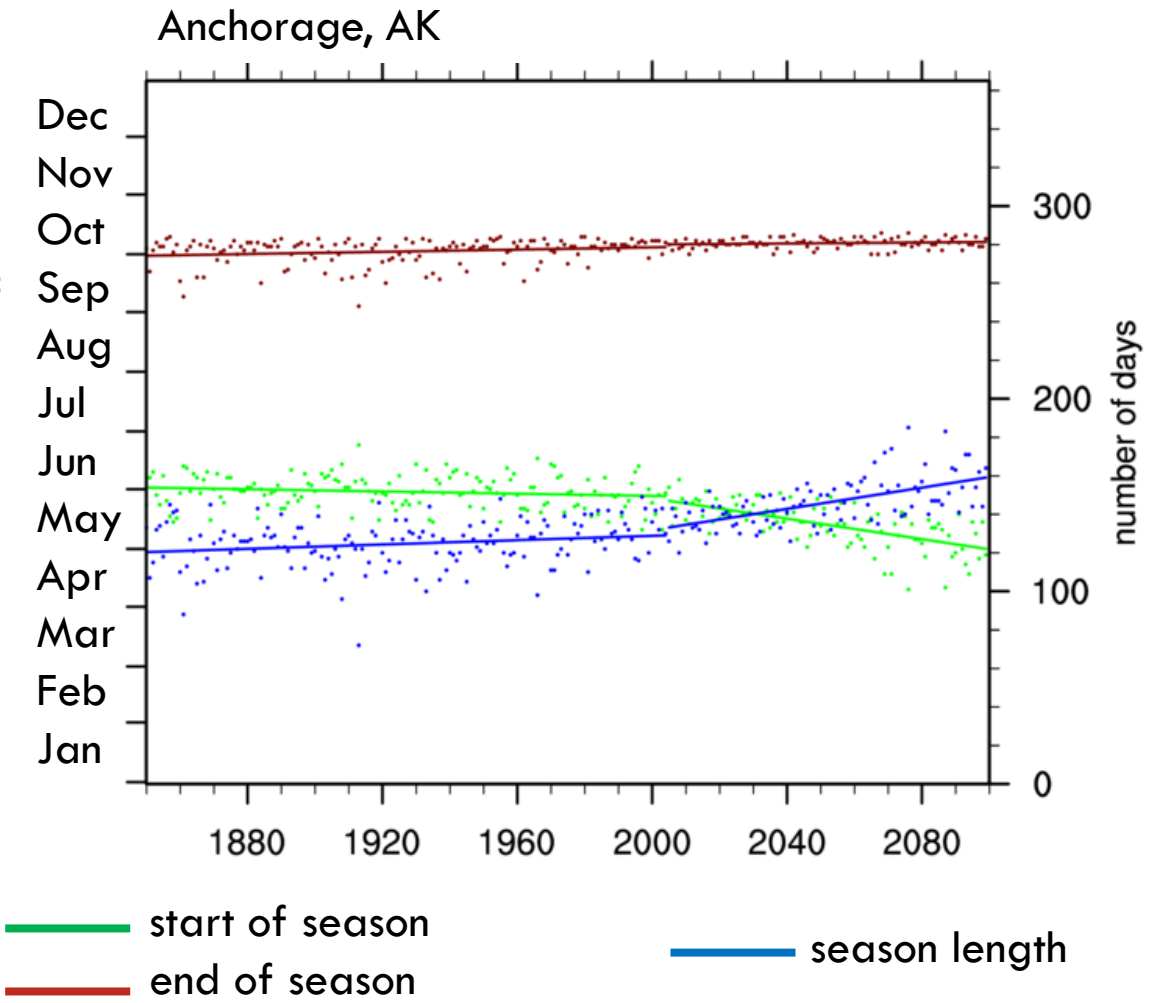
MODIS
2000-2010
(Zeng, 2011)



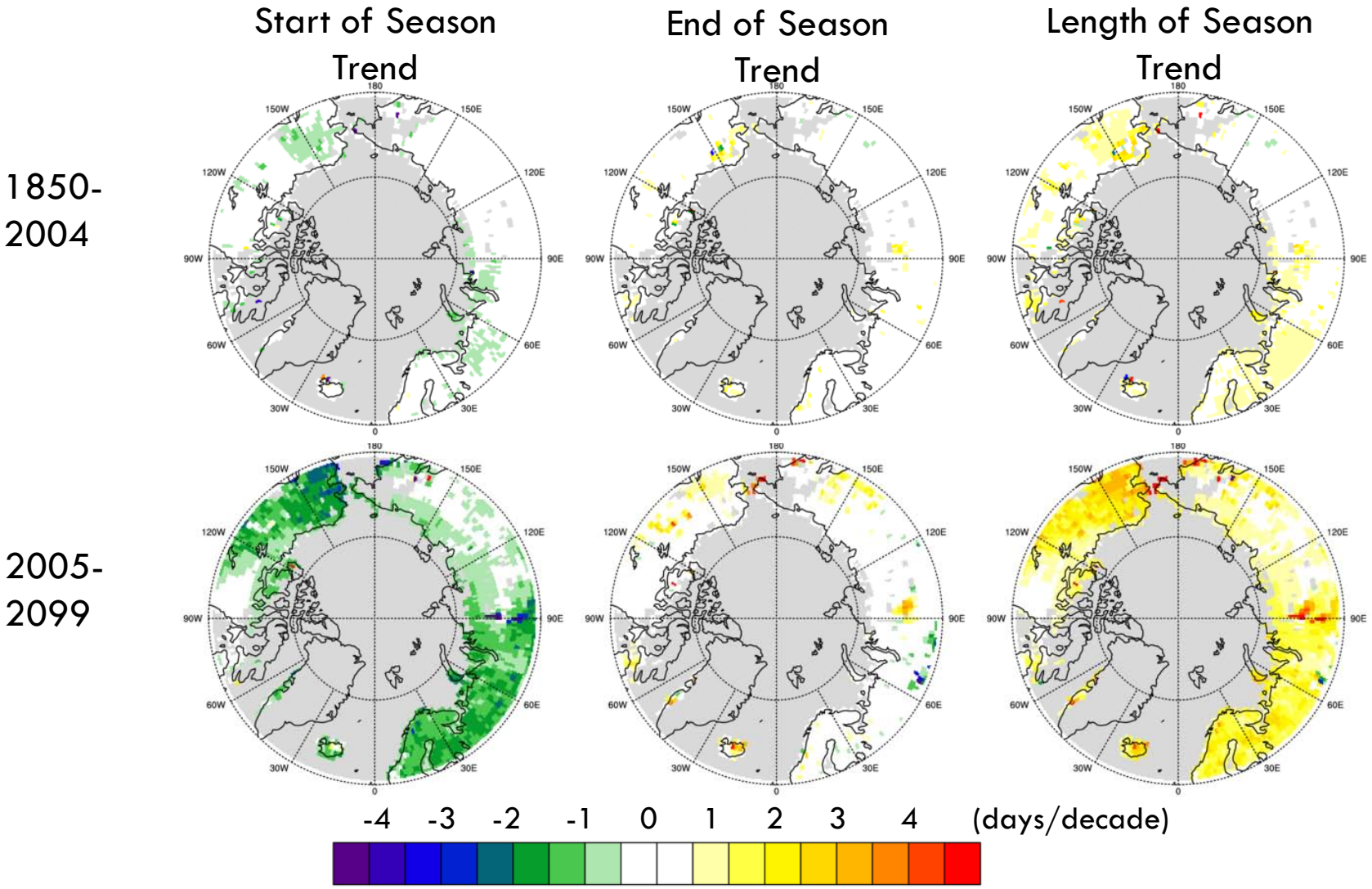
Modeled Phenological Trends

2005-2099:

- advance of 2.7 days/decade in start of season
- no significant trend in end of season



Modeled Phenological Trends

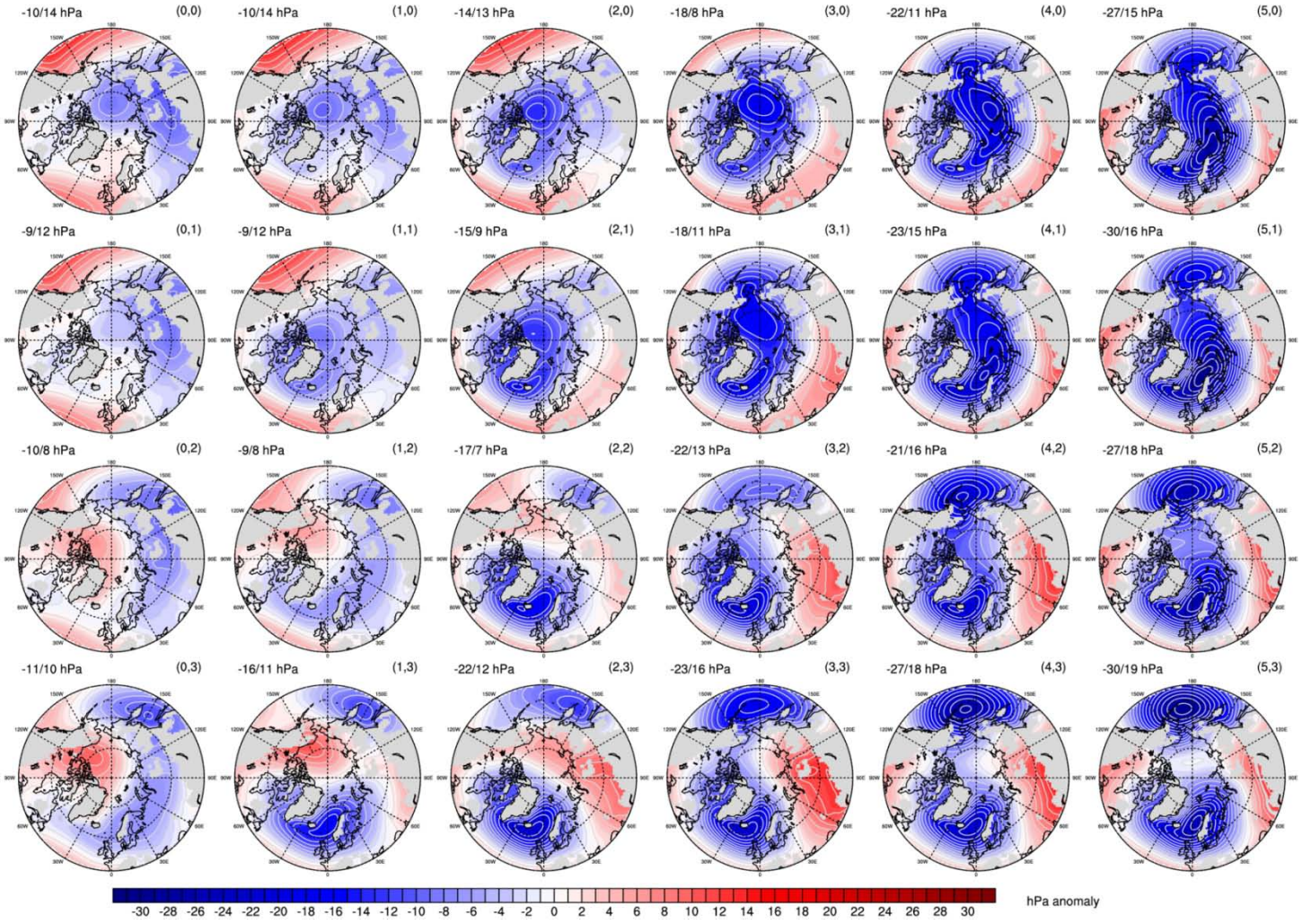


Self-Organizing Maps (SOM)

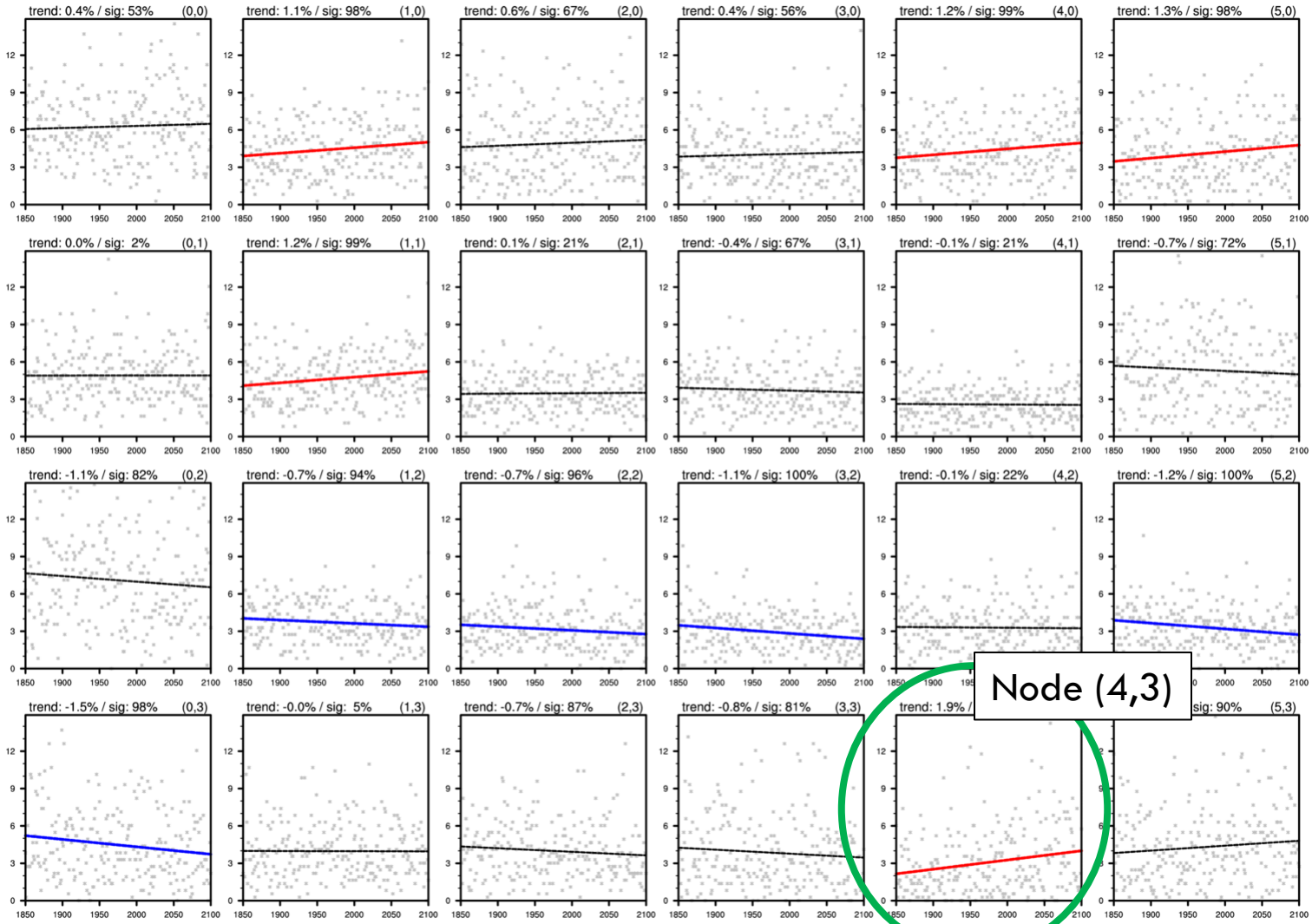
- a neural network clustering method used to distill huge datasets into meaningful patterns

- much like a fancy histogram for geophysical data

Self-organizing maps

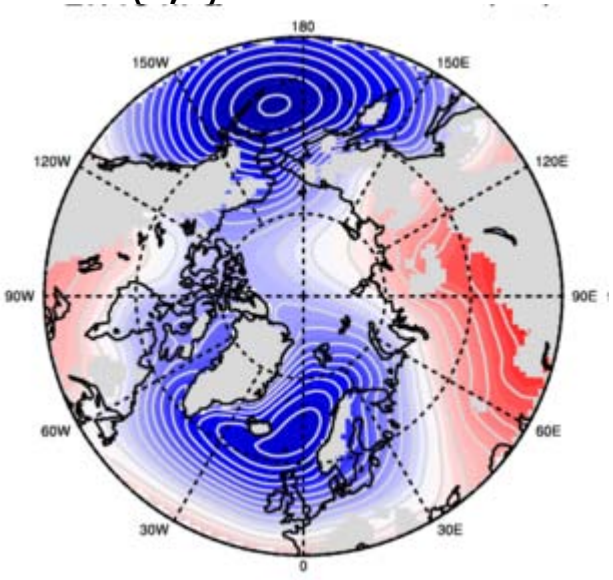


Pattern trends

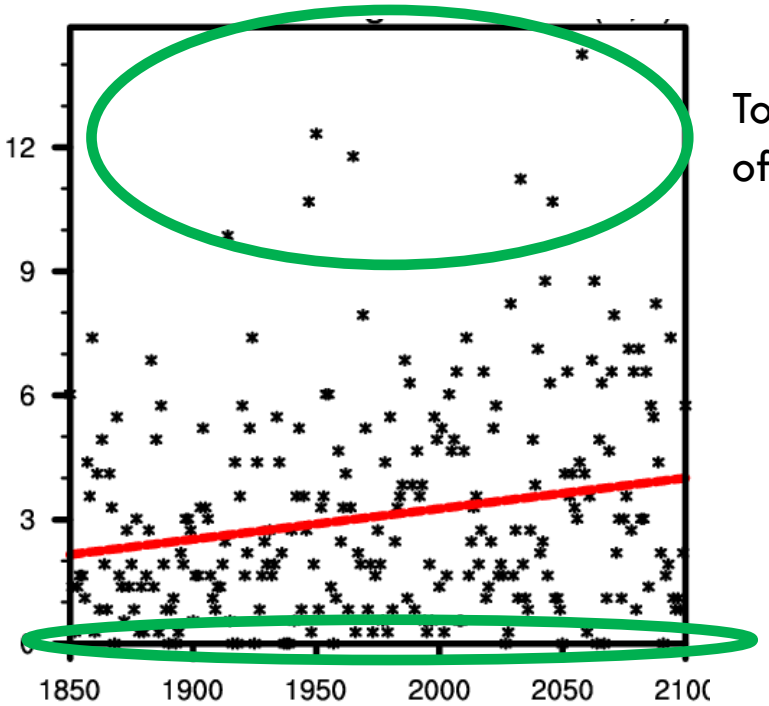


Pattern Trends

Sea level pressure anomaly
node (4,3)



Frequency of occurrence
node (4,3)

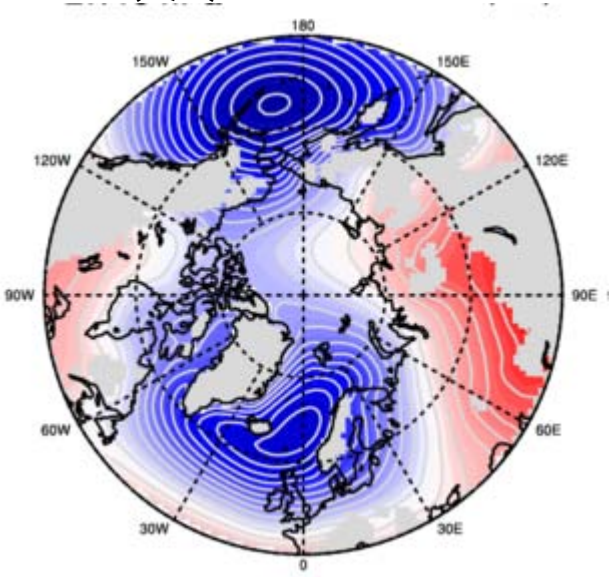


Top 5%
of years

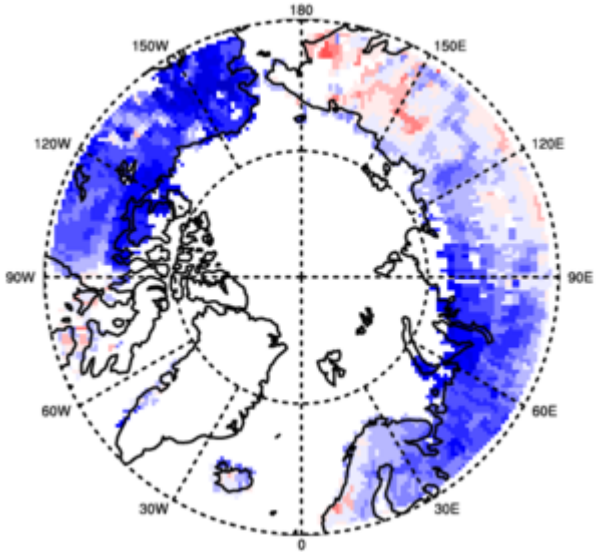
Bottom 5%
of years

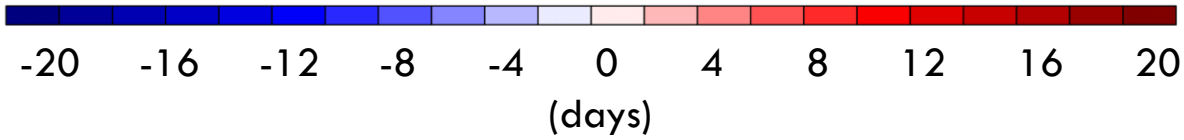
Difference in start of spring as a function of SOM pattern frequency

Sea level pressure anomaly node (4,3)



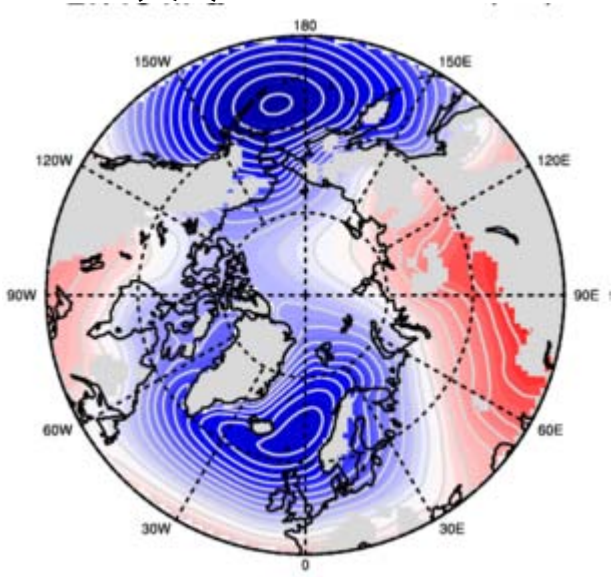
Difference in average start of spring date between years when pattern occurs very frequency and years when pattern rarely occurs.



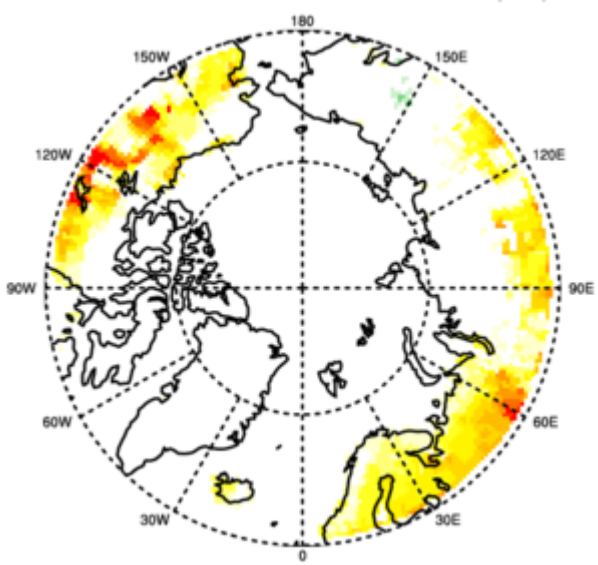


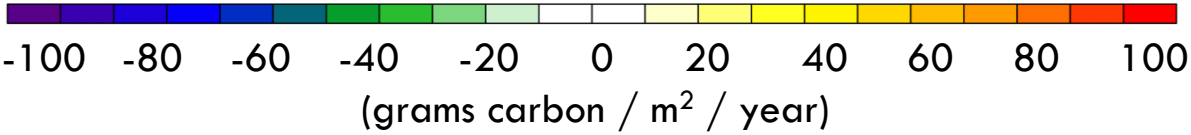
Difference in GPP as a function of SOM pattern frequency

Sea level pressure anomaly node (4,3)



Difference in average GPP between years when pattern occurs very frequency and years when pattern rarely occurs.





Summary

- major change in phenology scheme in CLM4-CN
- specific phenology in CLM is poor
- phenological trends are consistent with lower latitude observations
- relationship between phenology and GPP and occurrence of synoptic patterns