Projections of Suitable Wine Growing Regions & Varieties: Adaptation in Space or Place?

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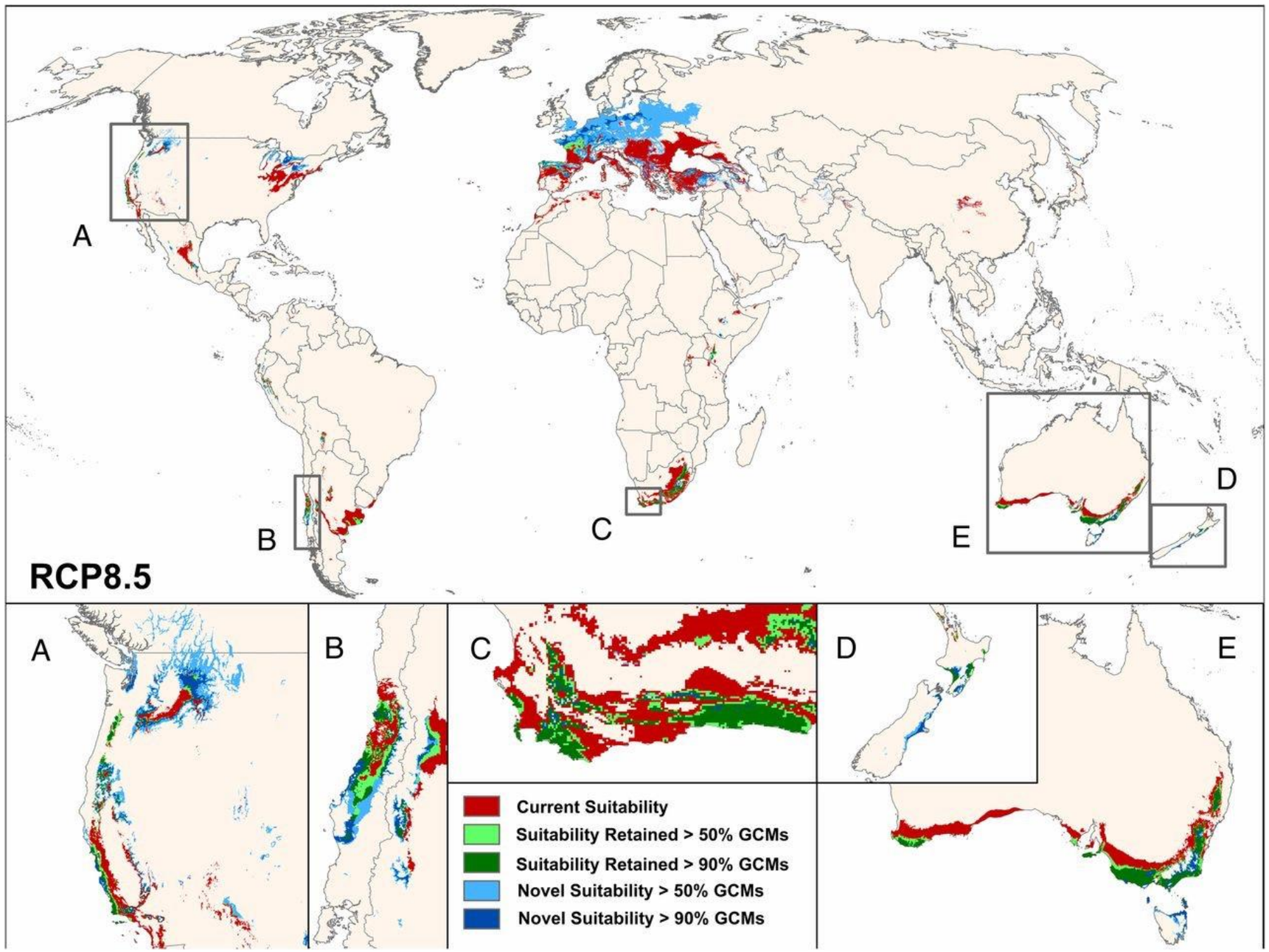
ClimWine 2016

Bordeaux, France

The ARNOLD ARBORETUM of HARVARD UNIVERSITY

Adaptation in Space



Hannah et al. 2013

Adaptation in Space

What about adaptation in place?

Hannah et al. 2013

Hyper-diversity of winegrapes: *Vitis vinifera* subsp. *vinifera*

Chitwood et al. 2014

Hyper-diversity of winegrapes: *Vitis vinifera* subsp. *vinifera*

Late - March

Chasselas

Mid - April

Pinot Noir

Mid - May

Cabernet Sauvignon

Hyper-diversity of winegrapes: *Vitis vinifera* subsp. *vinifera*

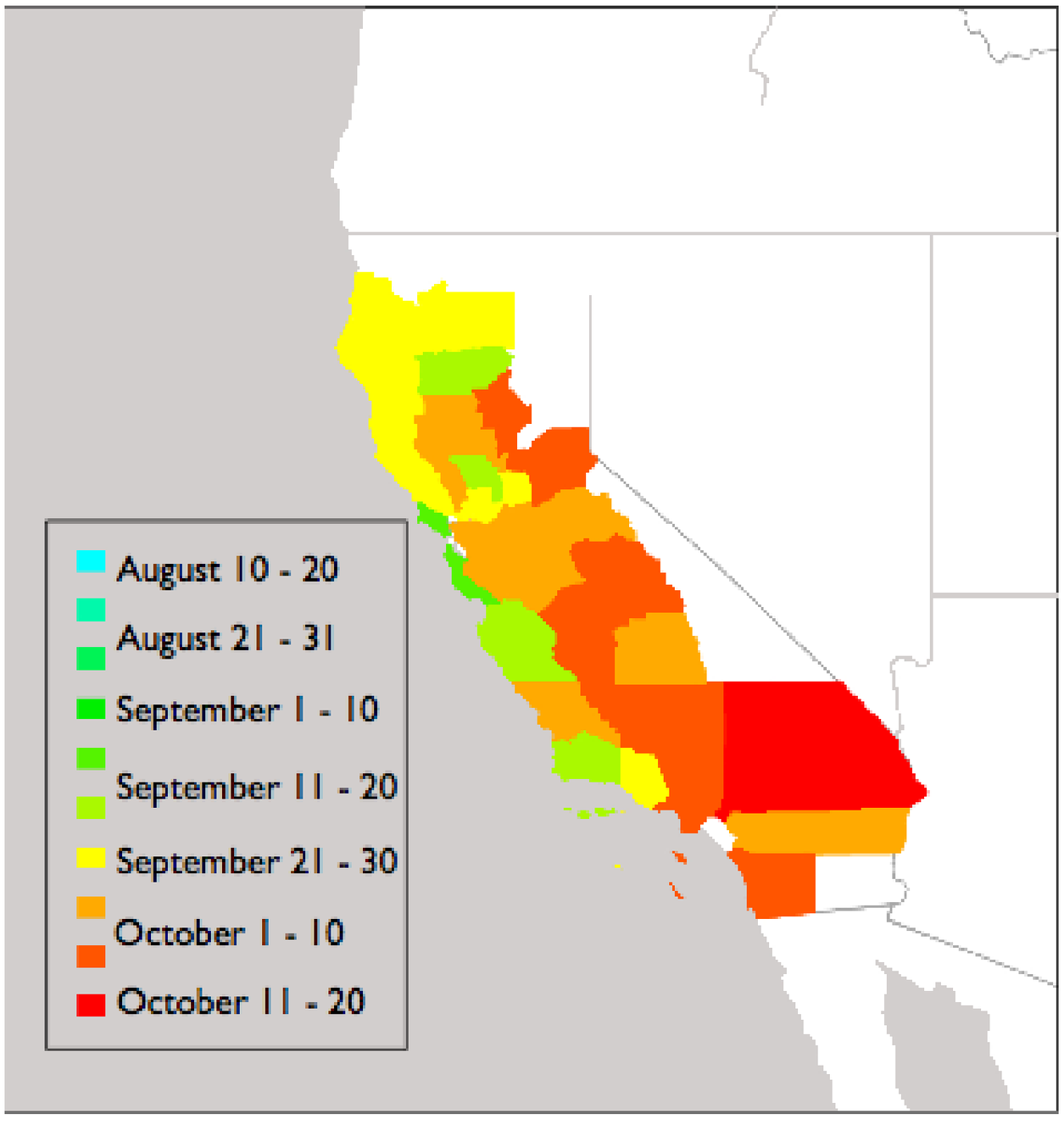
Budbreak

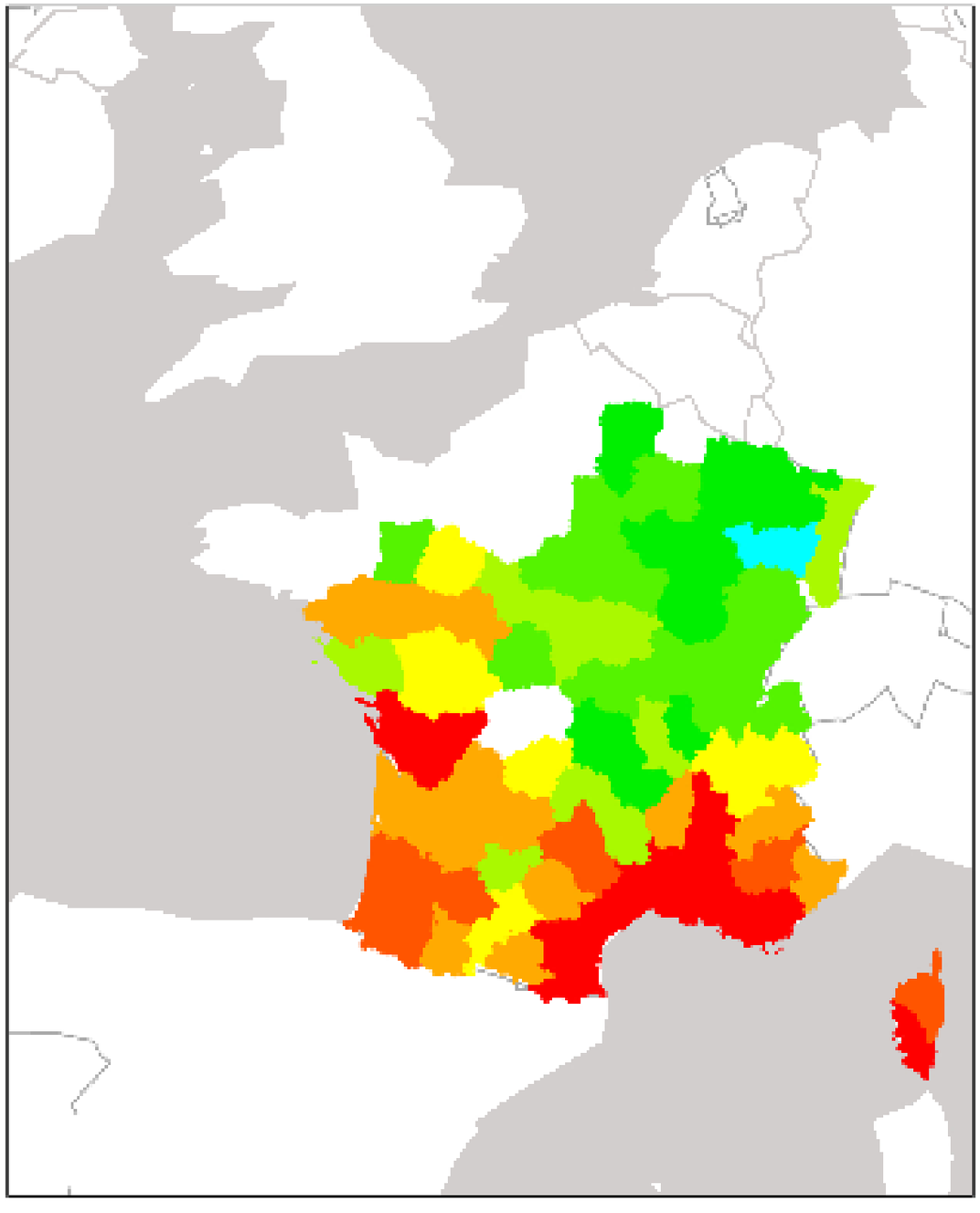
Flowering

Véraison

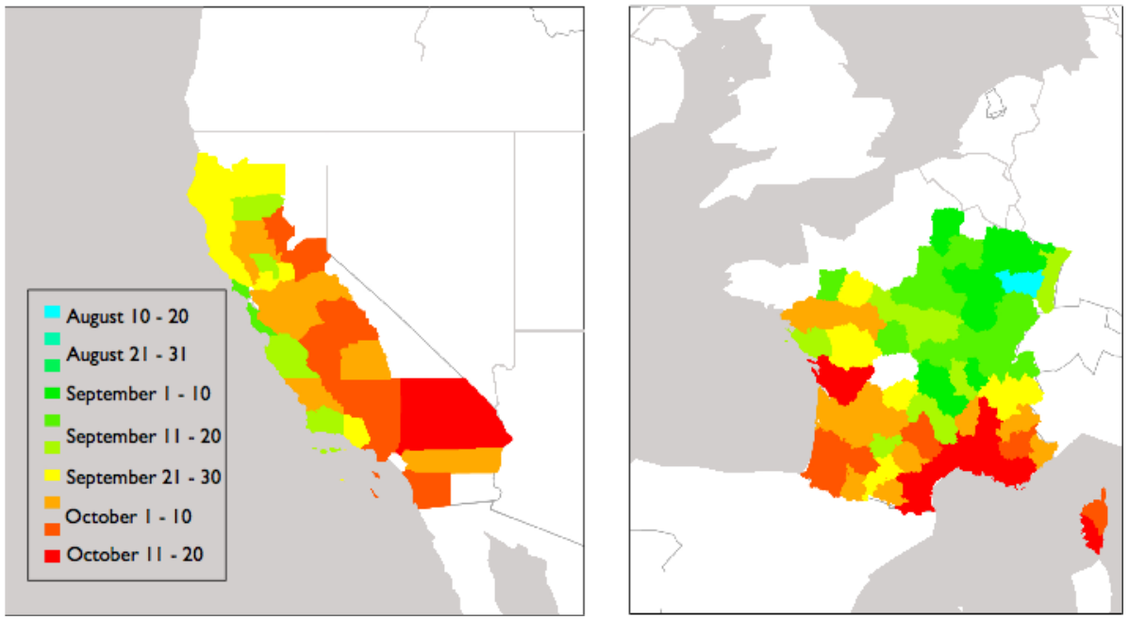
Maturity

Phenological diversity: *timing of maturity*



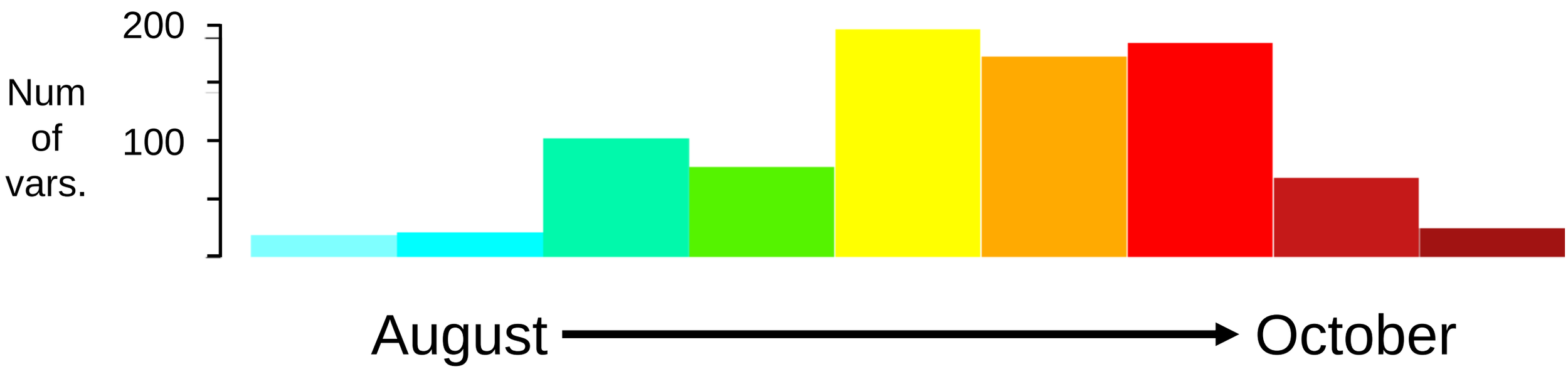


Phenological diversity: *timing of maturity*



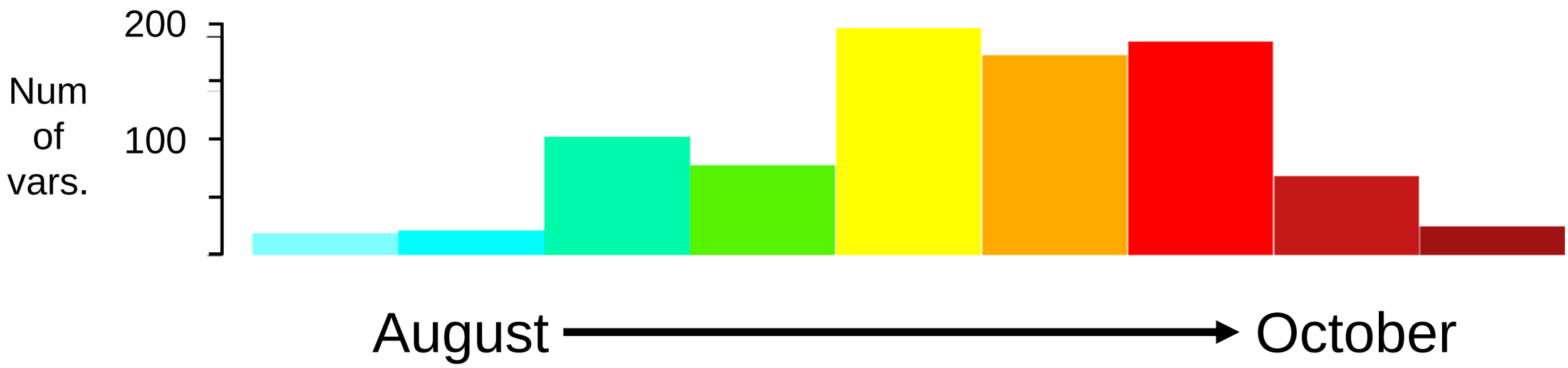
~1,300 varieties planted globally

Anderson 2013



Phenological diversity: *timing of maturity*

Can we adapt to climate change by utilizing this phenological hyperdiversity?



Objectives

1. Build phenological models for eleven winegrape varieties (most planted globally and phenologically diverse)

2. Generate a map of global wine growing regions

3. Predict the future timing of winegrape maturity using global climate projections

Objectives

1. Build phenological models for eleven winegrape varieties (most planted globally and phenologically diverse)

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Assess the diversity of varieties that will be able to grow across wine growing regions with future climate change

Phenological models

August 1 - N. hemis.
February 1 - S. hemis.




Dormancy	Post - Dormancy	Bud break - Flowering	Flowering - Véraison	Véraison - Maturity

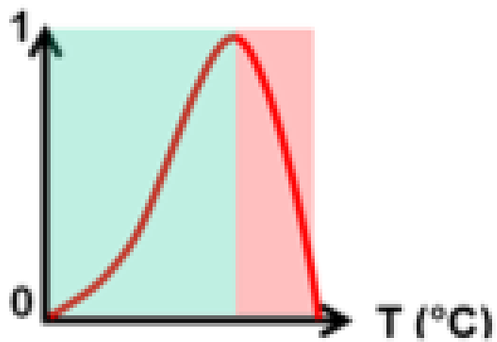
Cold Temp.

Chuine Unified Model 2000
(Chilling)
+
Wang & Engel 1998
(Forcing)

Hot Temperatures

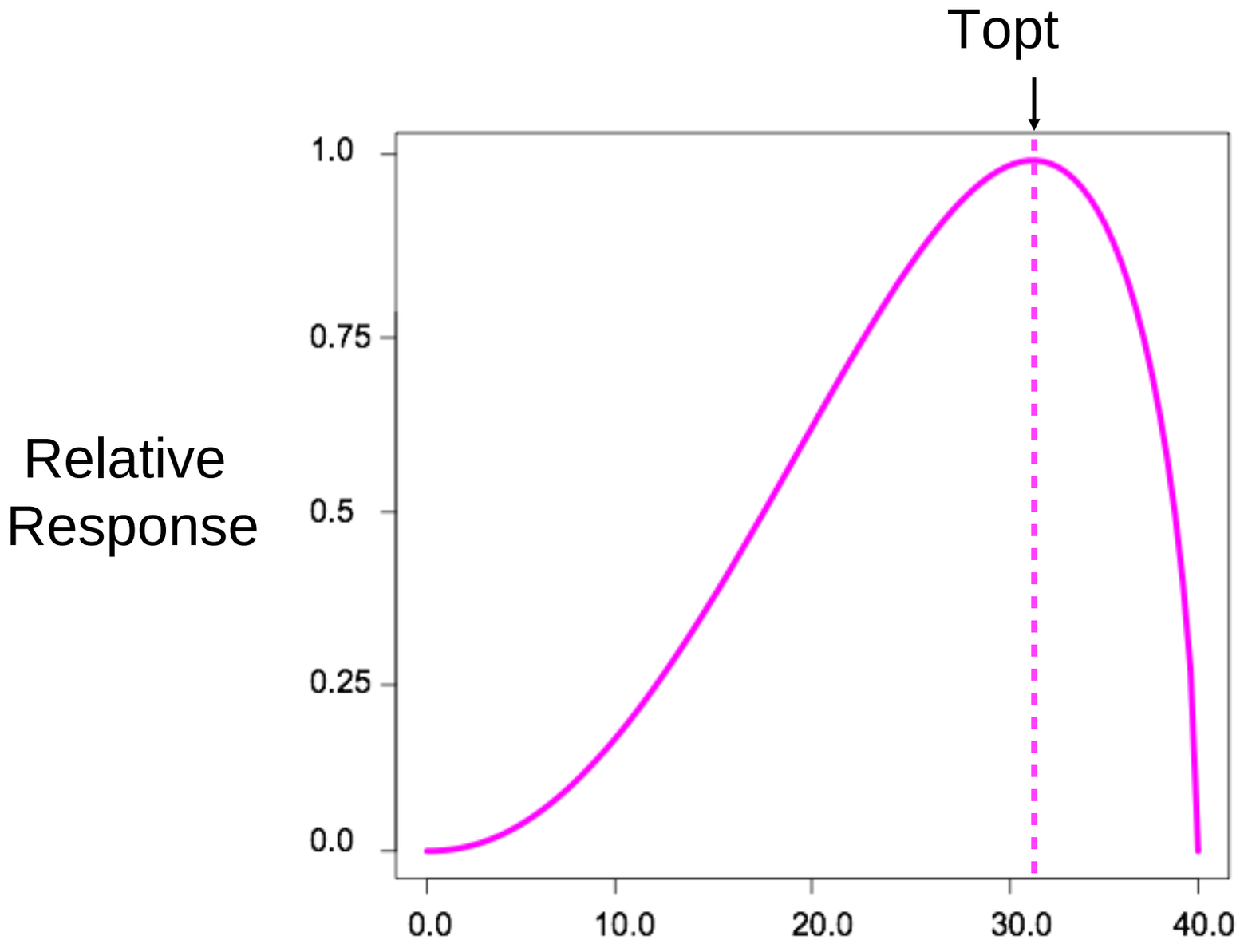
BETA model

Wang & Engel 1998

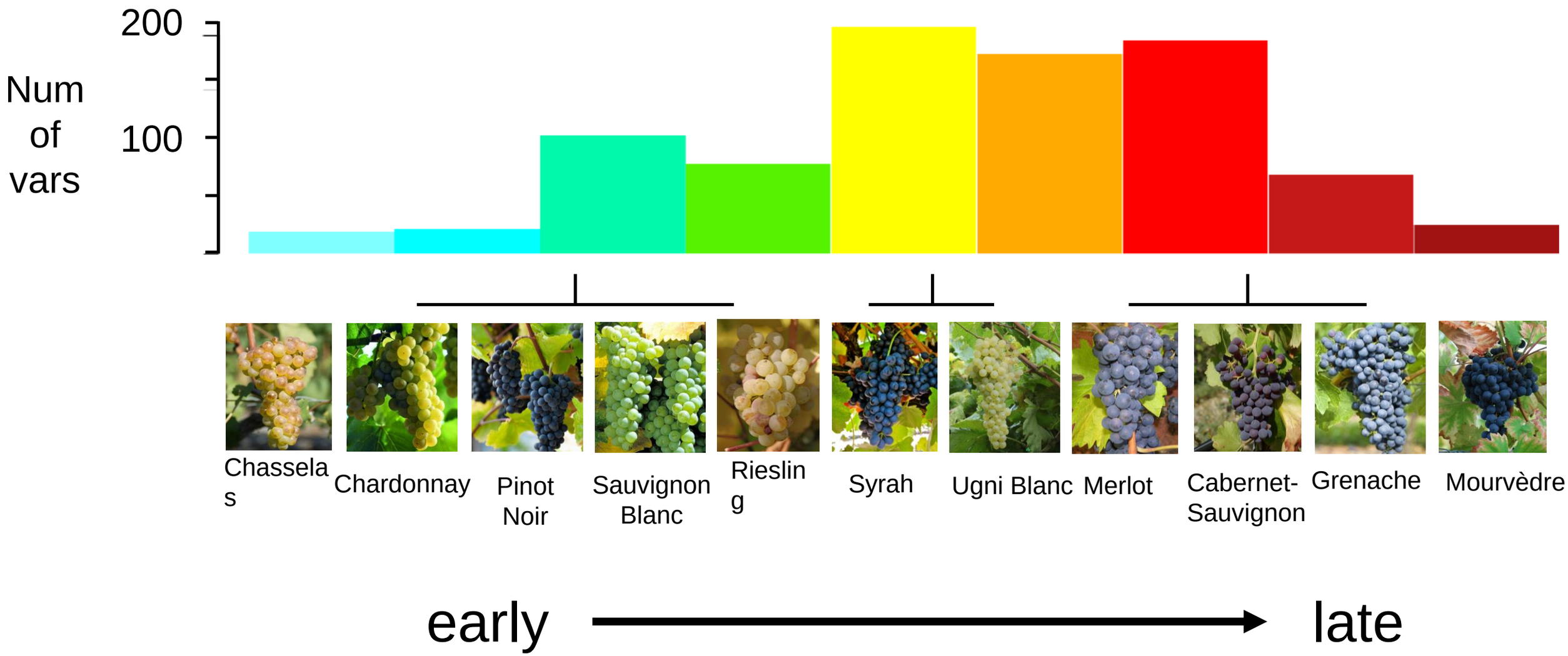


Garcia de Cortázar Atauri et al., 2009; Garcia de Cortázar Atauri et al., 2010

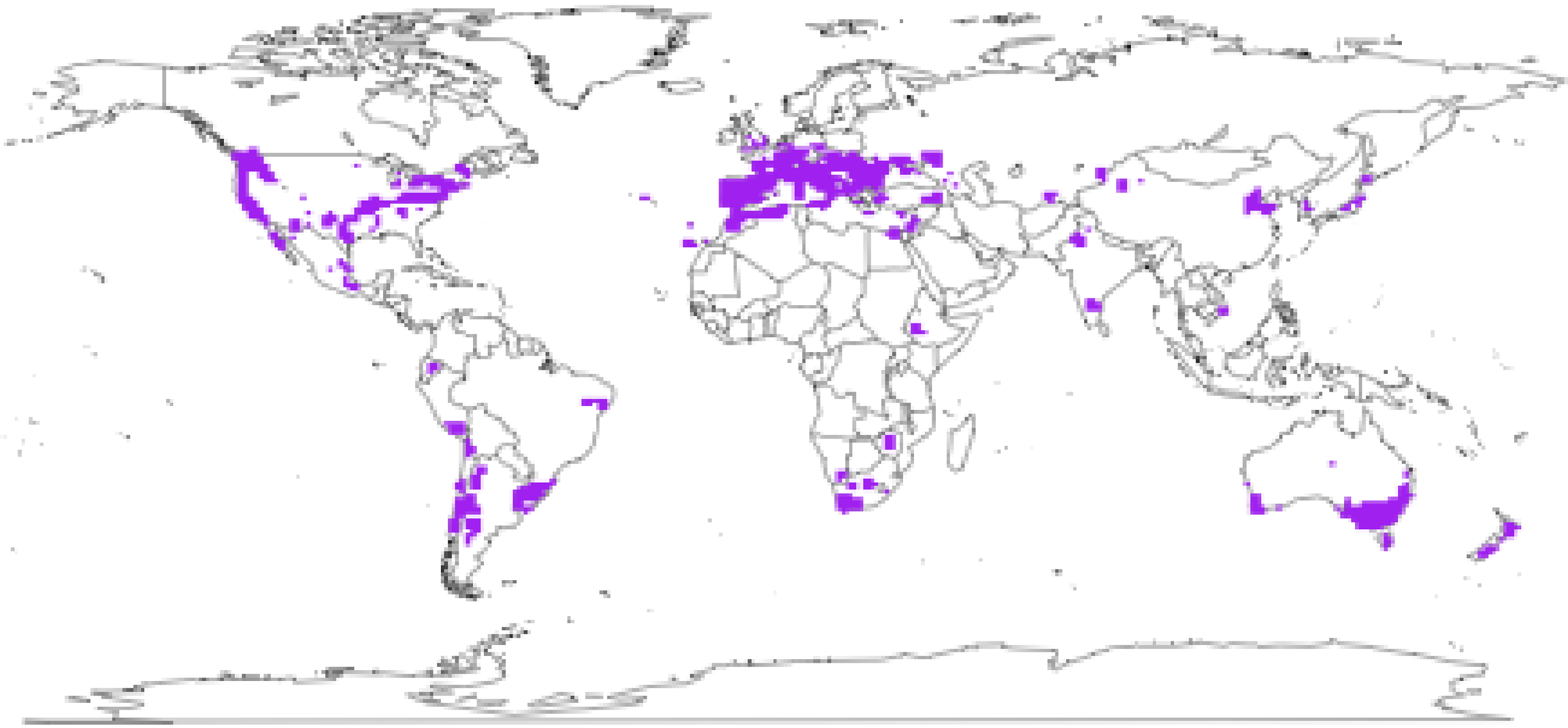
Phenological models



Phenological diversity: *timing of maturity*



Defining Global Wine Regions



Graça 2006, 2012; Anderson 2013; Bois unpublished

Assessing Variety Suitability

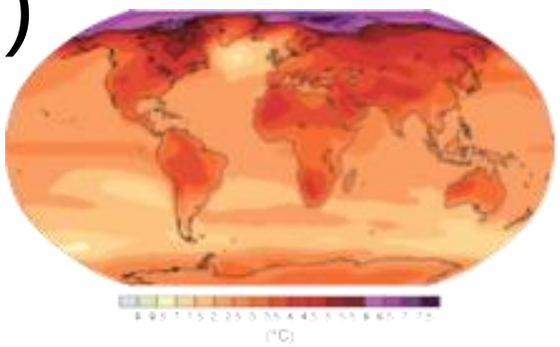
Timing of maturity = Véraison + 35 days

Maturity must occur between September 1 and October 31 in the Northern Hemisphere.

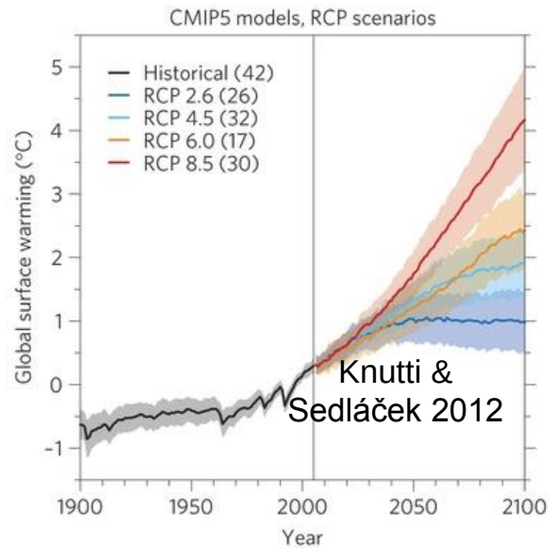
Graça 2006, 2012; Anderson 2013; Bois unpublished

Climate Projections

- 32 runs of 3 global circulation model (GCM) from CMIP5 with daily temperature at ~ 1 degree resolution
  - CESM1-CAM5
  - CESM1-BGC
  - CCSM4 (30 members)

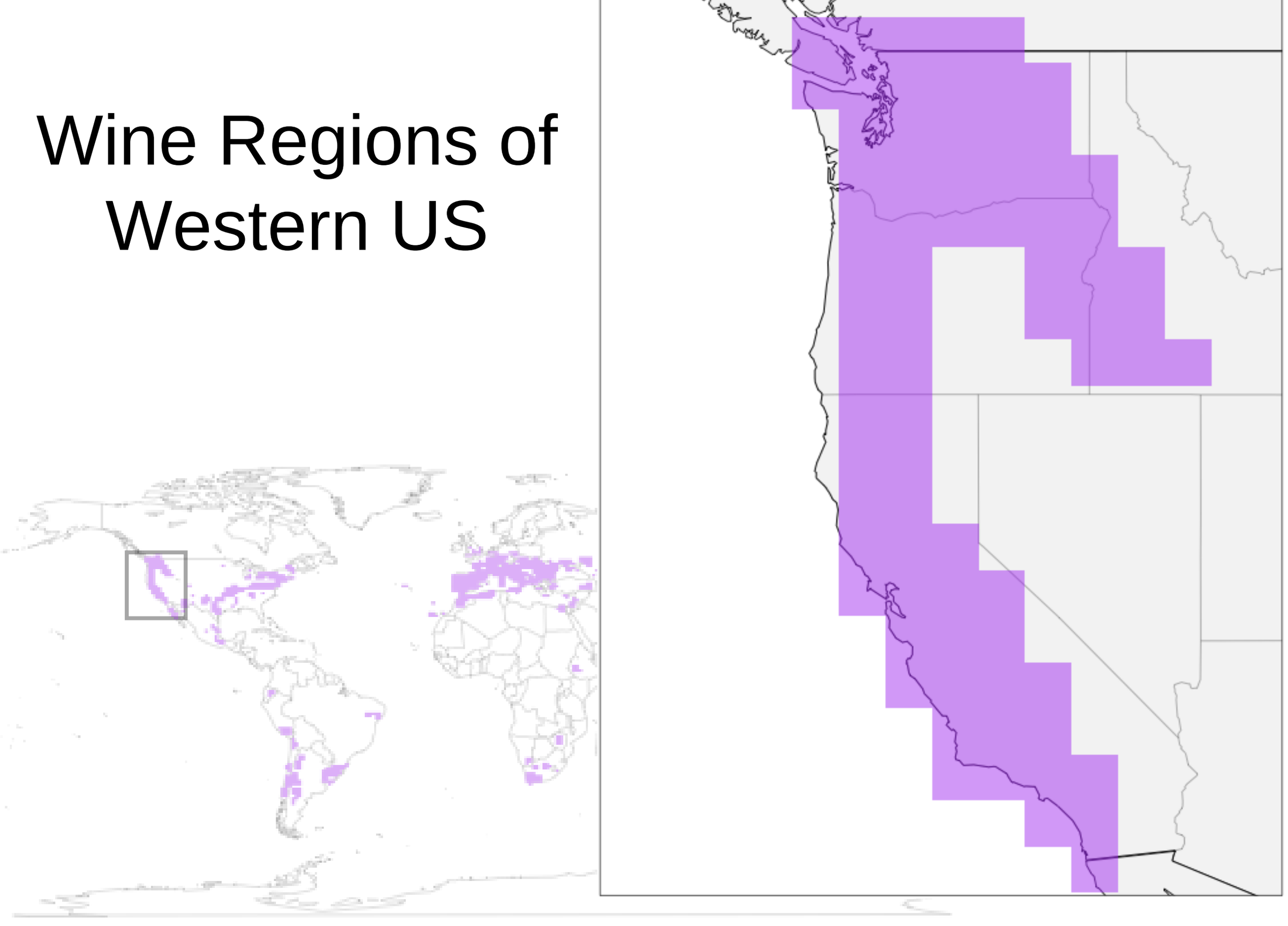


- RCP 8.5 emissions scenarios (& 4.5)



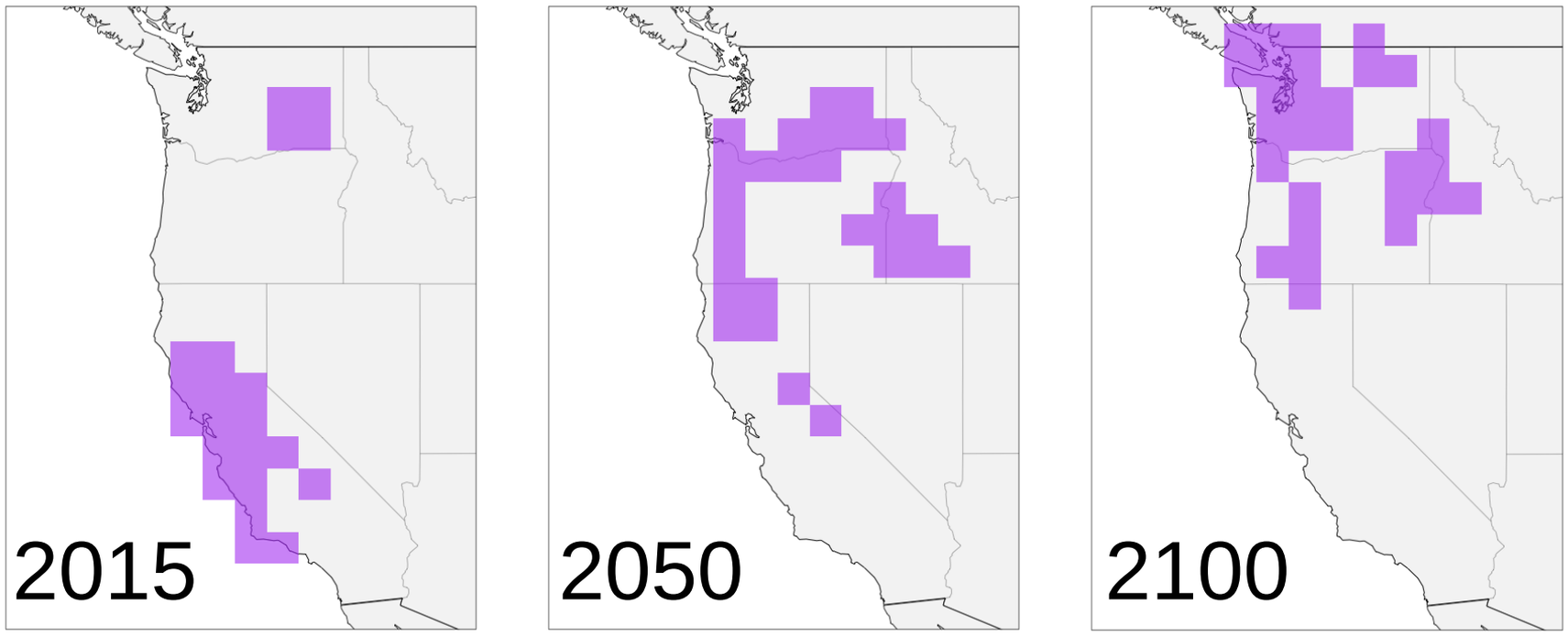
- GCMs were bias corrected for daily differences in the mean using observational climate data (BEST) between 1955 - 1999 (efficacy assessed using K-S tests)

Wine Regions of Western US



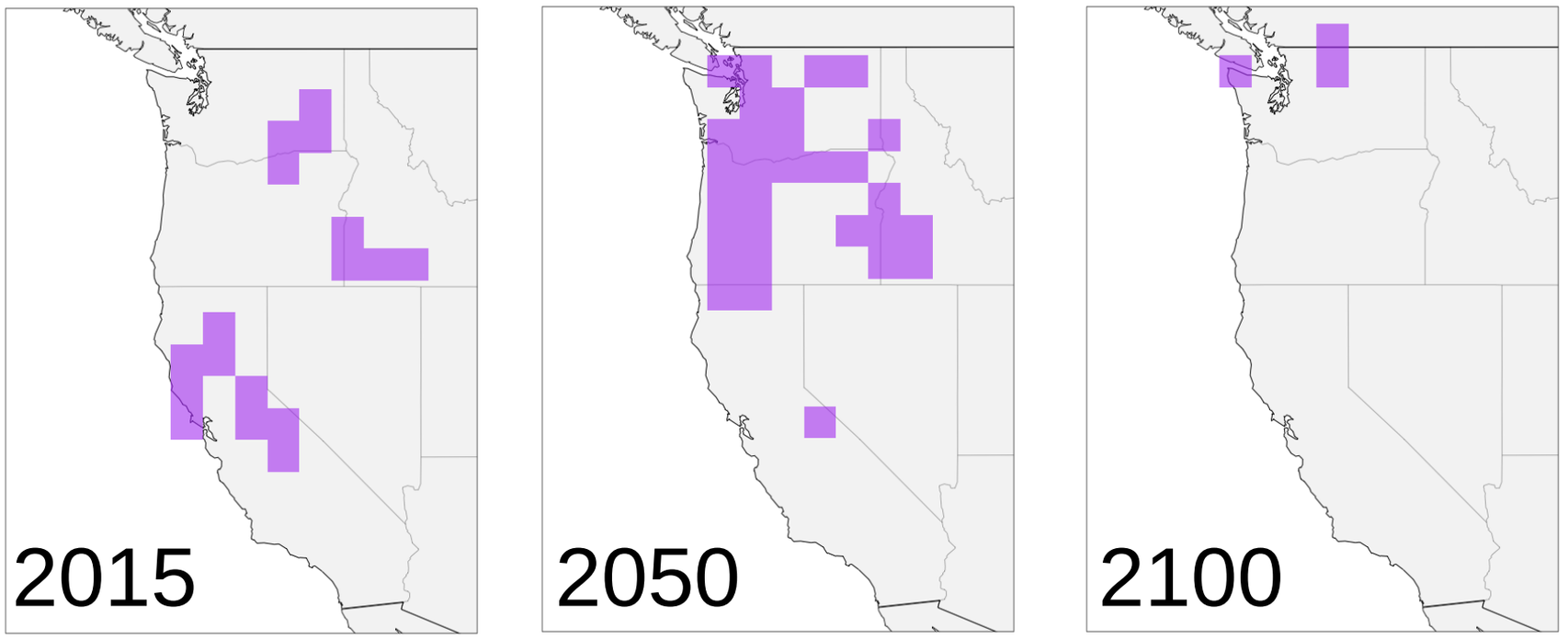
Cabernet Sauvignon

late variety

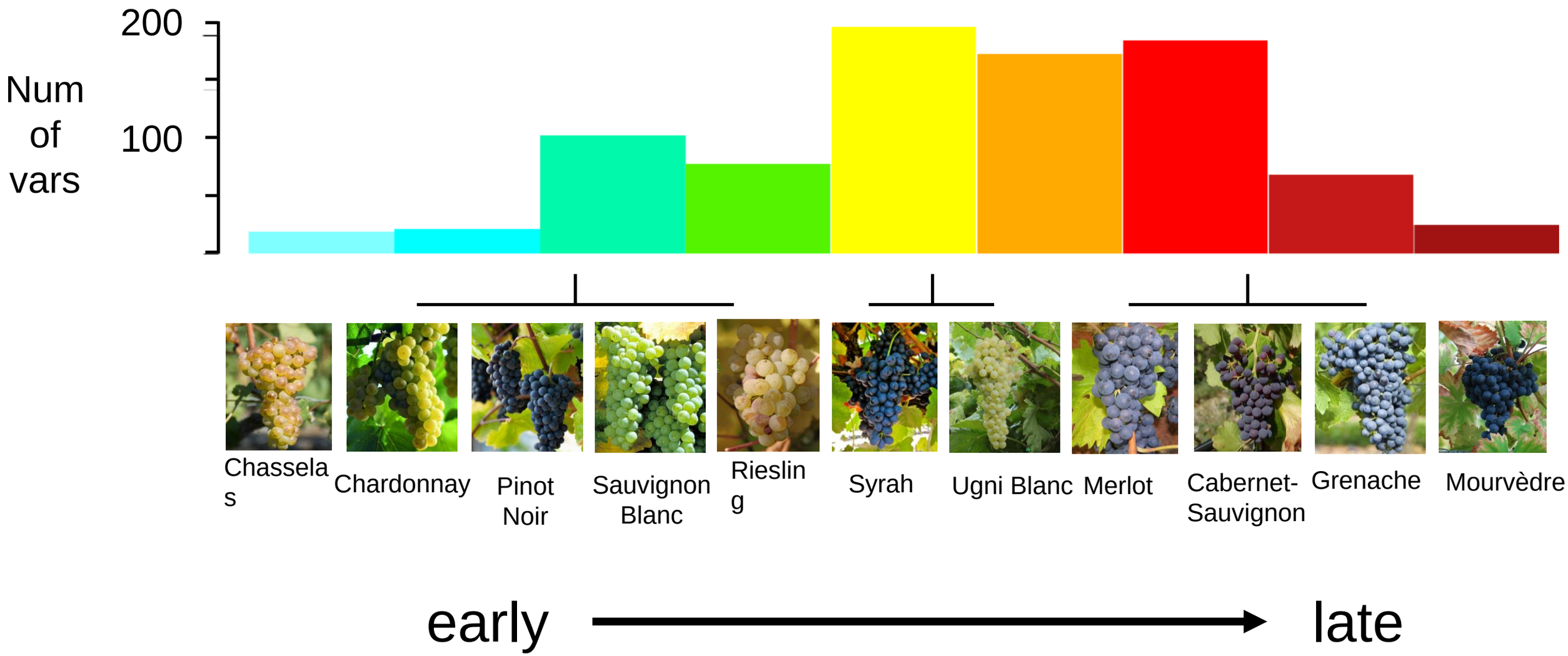


Pinot Noir

early variety



Number of Varieties



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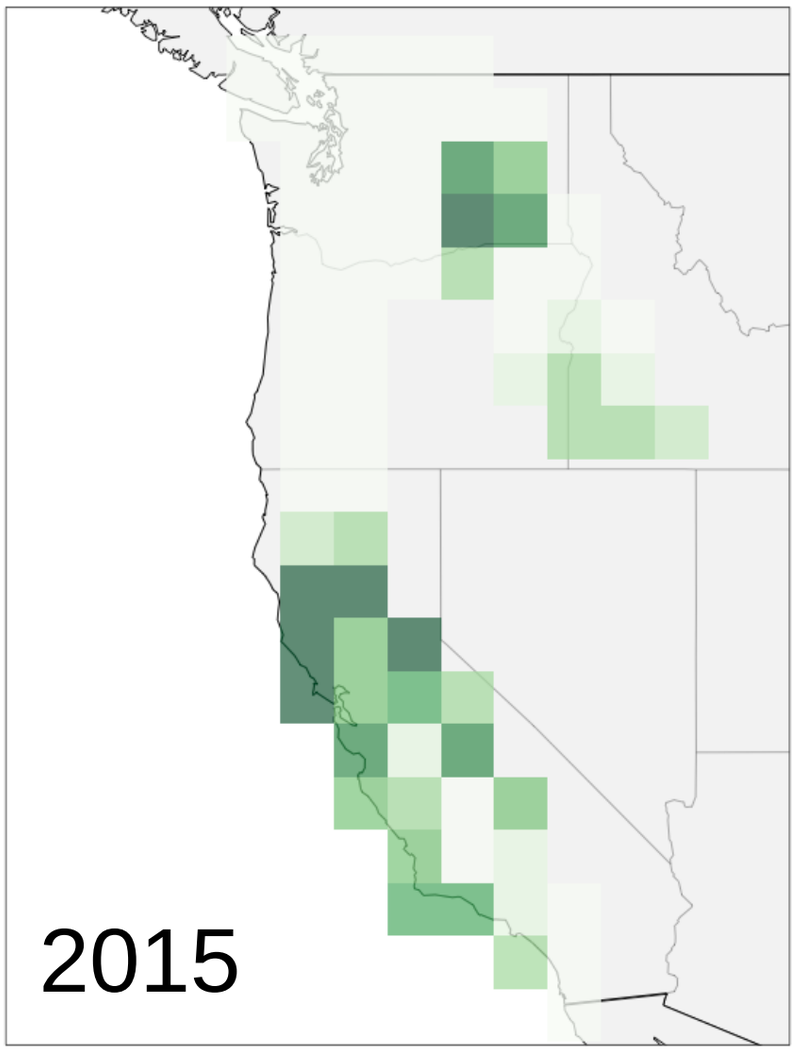
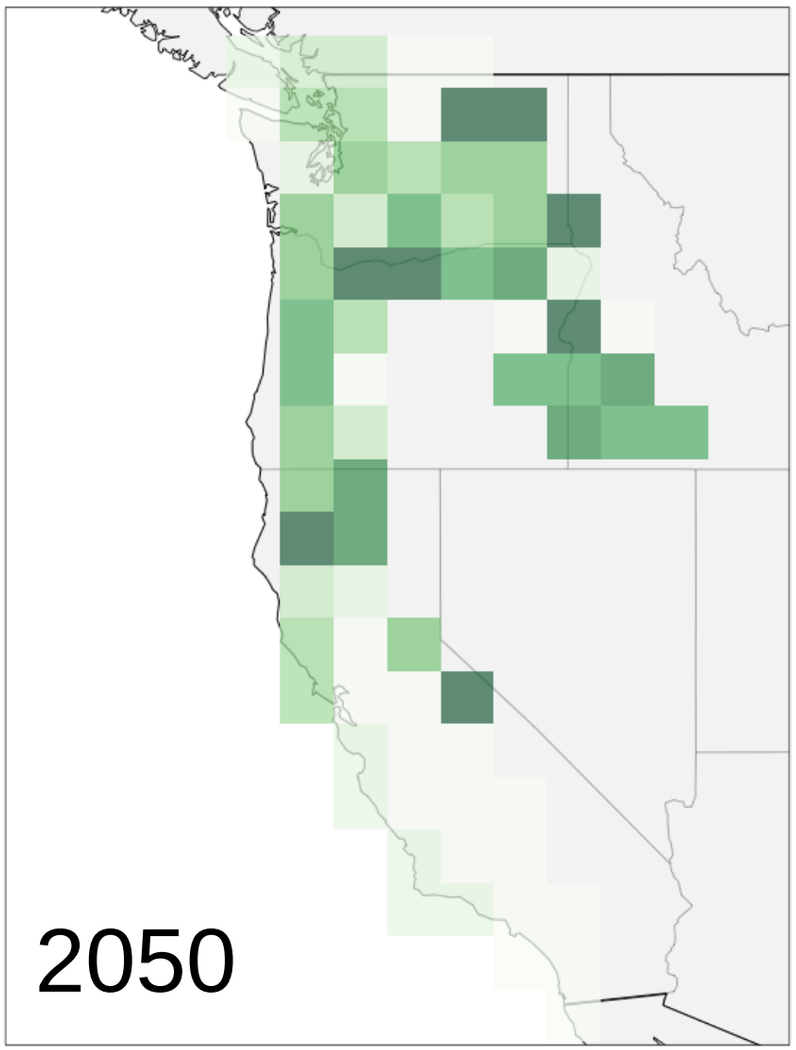
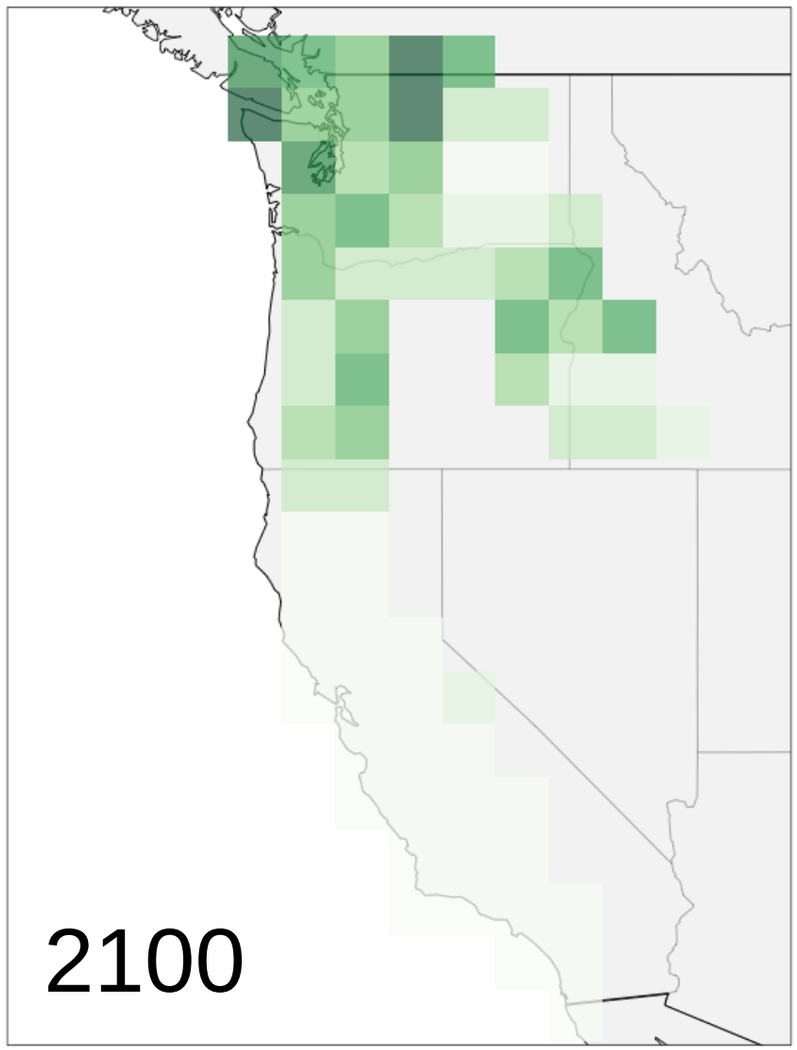
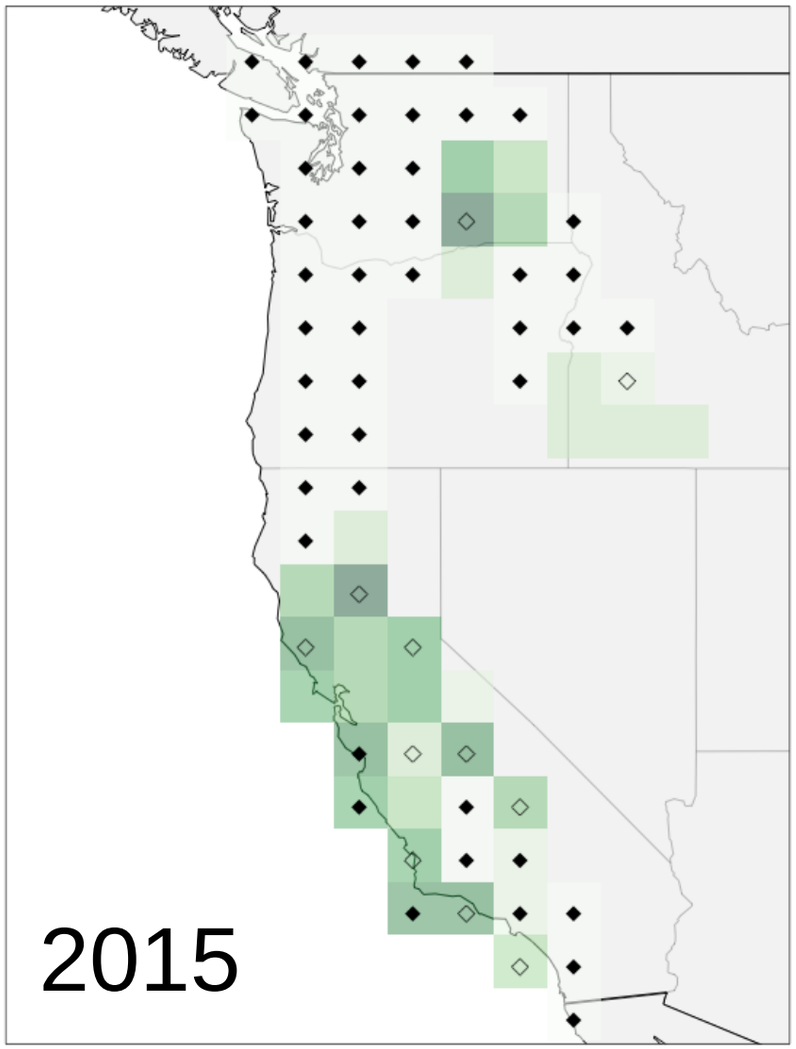


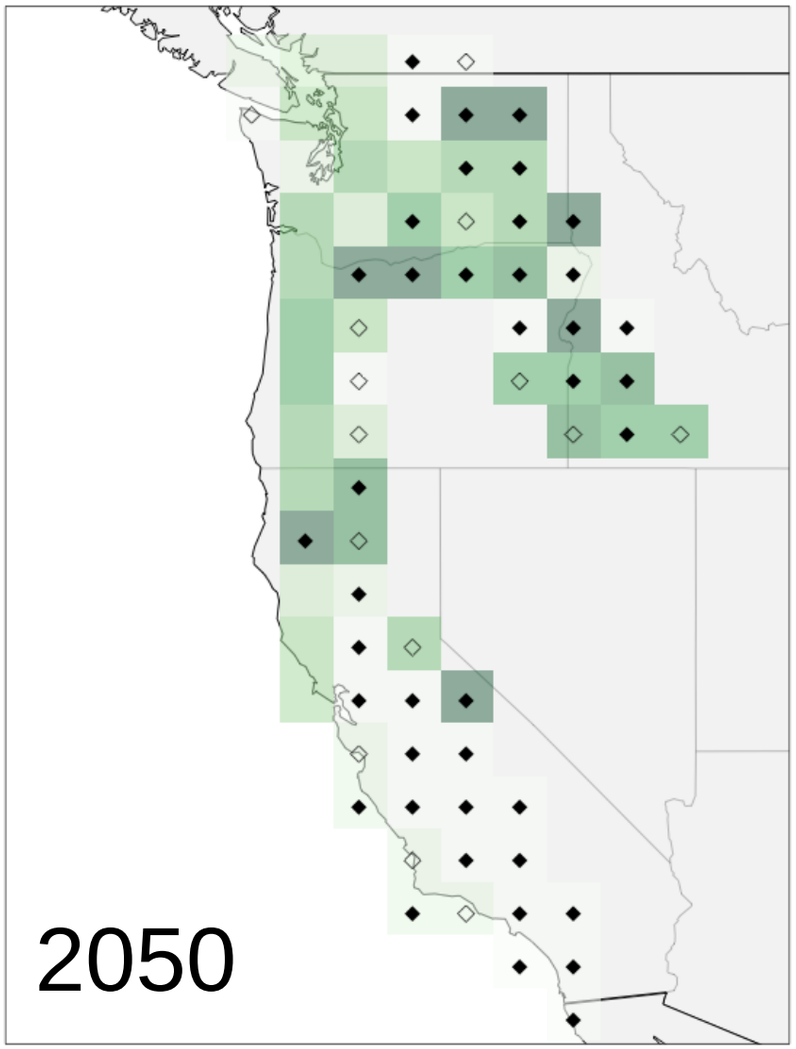


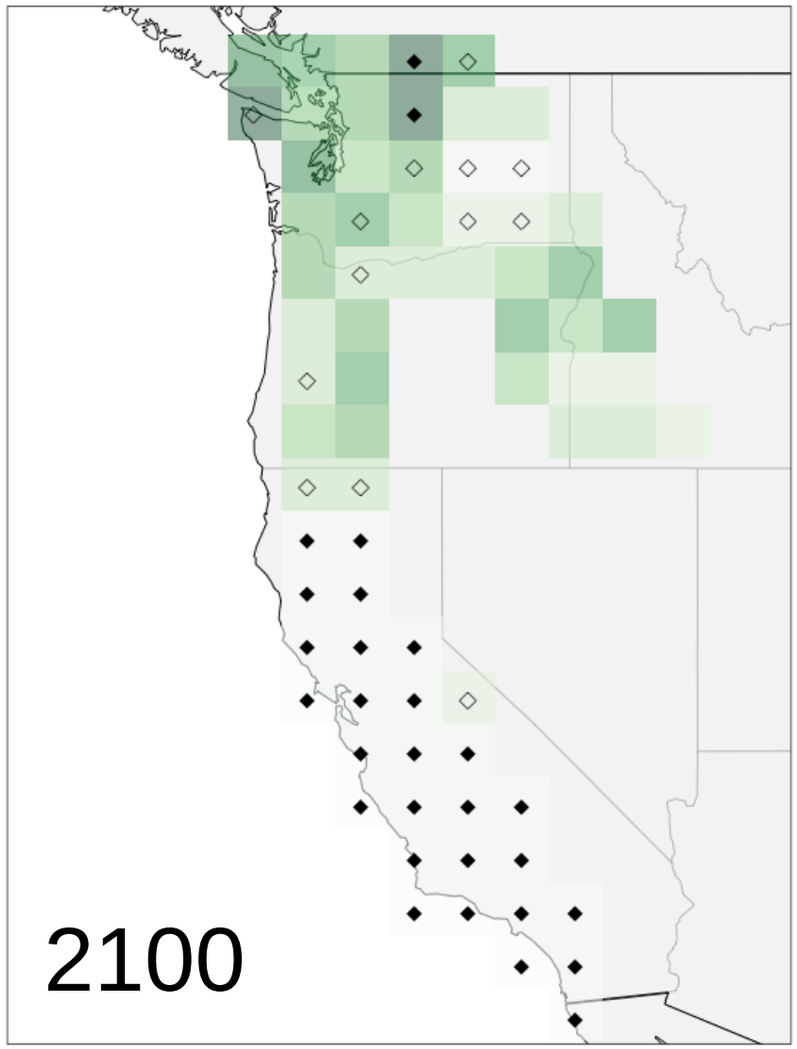


Low ⟶ High

Number of Varieties







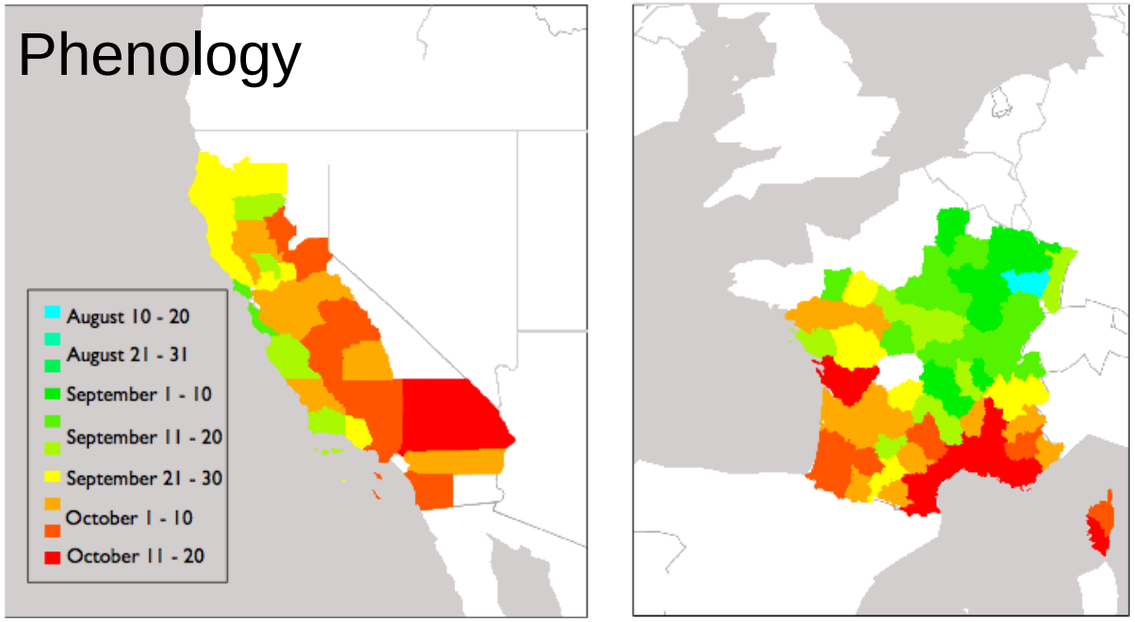
Model Agreement

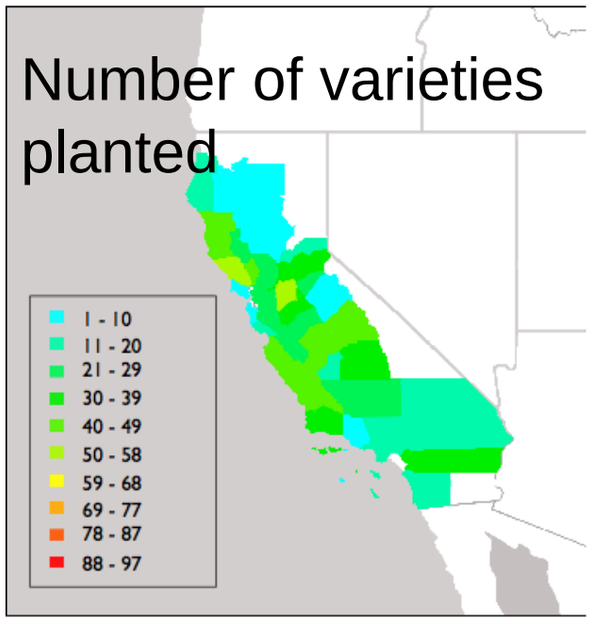
◆ Strong (<1 s.d.)

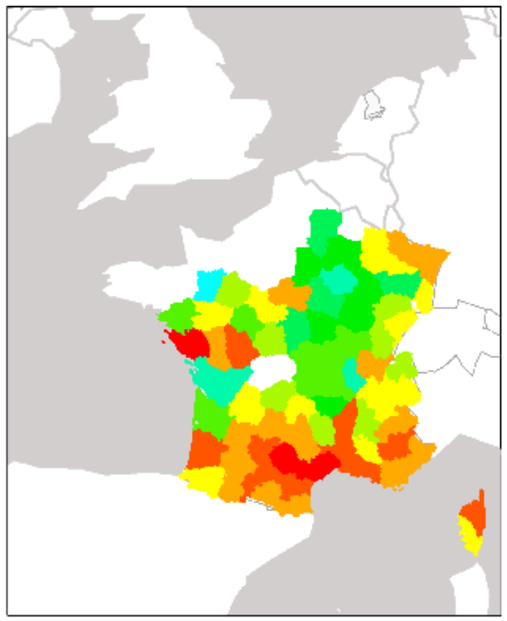
◇ Moderate (1-2 s.d.)

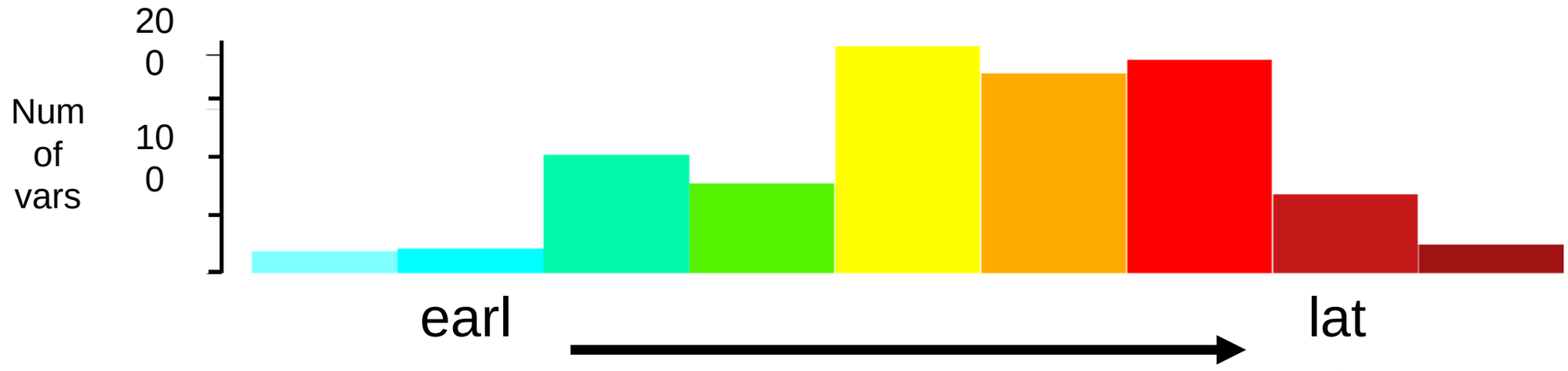
Weak (>2 s.d.)

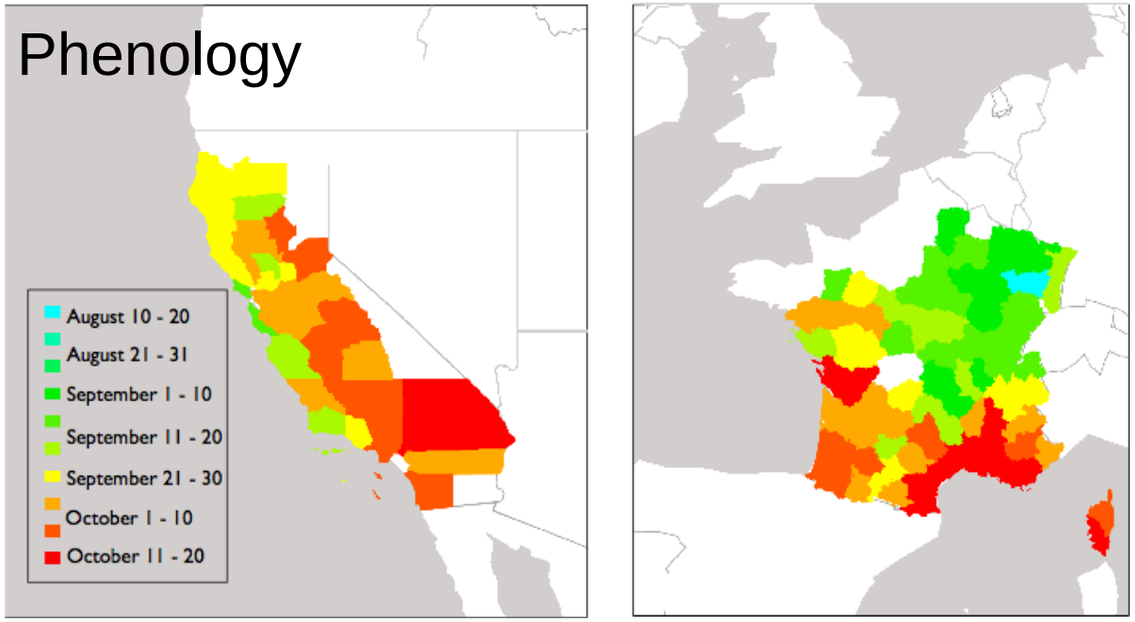
Low ⟶ High

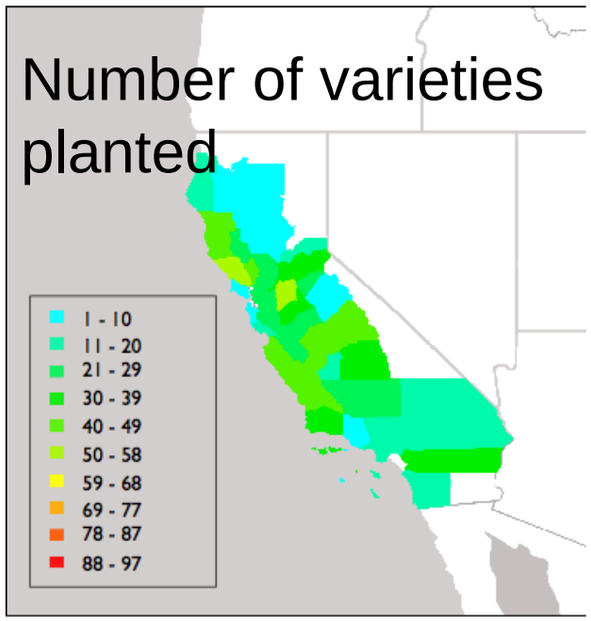

Phenology
August 10 - 20
August 21 - 31
September 1 - 10
September 11 - 20
September 21 - 30
October 1 - 10
October 11 - 20

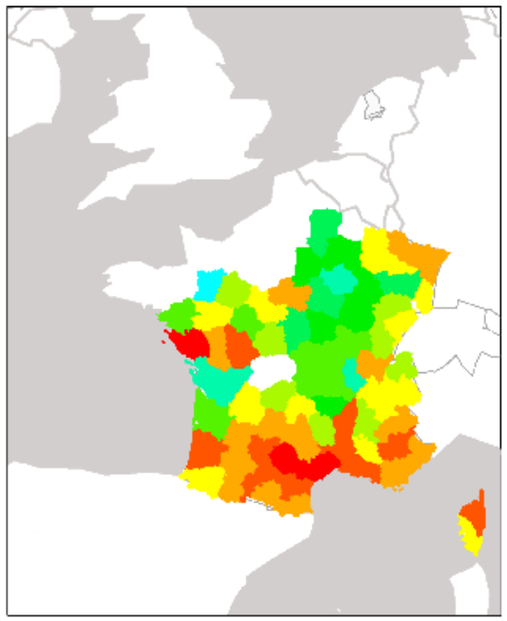

Number of varieties planted
1 - 10
11 - 20
21 - 29
30 - 39
40 - 49
50 - 58
59 - 68
69 - 77
78 - 87
88 - 97



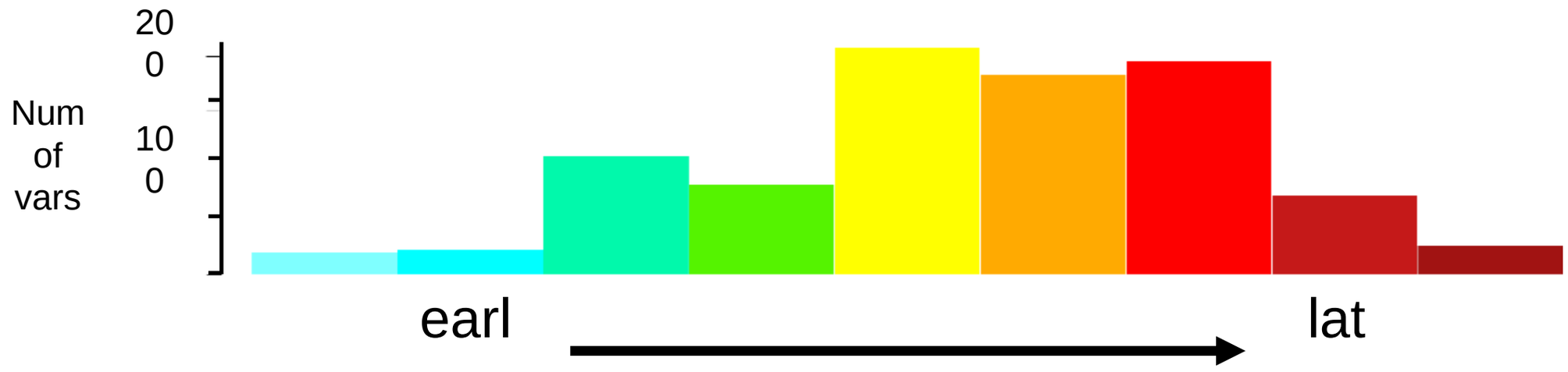

Num of vars
20 0
10 0
earl y
lat e







Phenological diversity: *an opportunity for adaptation in place*



Acknowledgements

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Questions?