Supplements for: Changes and trends in budburst and leaf flush across Europe and North America

A meta-analysis of local adaptation in spring phenology studies

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Methods

Additional Methods

We had to exclude several studies that reported spring events on a quantitative scale. This was because (1) such studies usually only assessed where on the scale the spring event of a tree fell onto on the same days across different years (e.g. Robson et al., 2013; Vander et al., 2015; Santini et al., 2014; Schueler & Liesebach, 2004), and (2) scales are not always consistent across different studies (Chmura & Rozkowski 2002; Dhont et al., 2010; Wang et al., 2022). Such factors made it impossible to convert the quantitative scale to DOY.

We additionally excluded several studies because we could not pinpoint their location, or because they focused on non-native species or elevational trends. We excluded studies that did not provide the exact latitude and longitude of the common garden (Bongarten, 1978) or the provenances (Hall et al., 2007; Soolanayakanahally et al., 2013), or they did not link the latitude and longitude of each provenance to the DOY of spring events (Deans & Harvey, 1996). We also left out studies in which woody plants from North American provenances were planted in common gardens in Europe (Cannell et al., 1987; Lavadinovic et al., 2013) because we wanted to test continental variations. Finally, as we are focused on latitudinal trends we excluded studies that examined only provenance altitude (Vitasse et al., 2009; Vitasse et al., 2010; Li et al., 1997; Alberto et al., 2011; Acevedo-Rodríguez et al., 2006).

Table for all studies

Mapped locations for all studies

Results

Corrected DOY results

Fitting each species & common garden instead of just species

MAT difference

Might want to include how the model looked when we included studies with disagreeing provenance & gardens

Similar results across provenance latitude, absolute value of difference between provenance and garden latitude, and spherical distance

Placeholder text (Fig. 1).

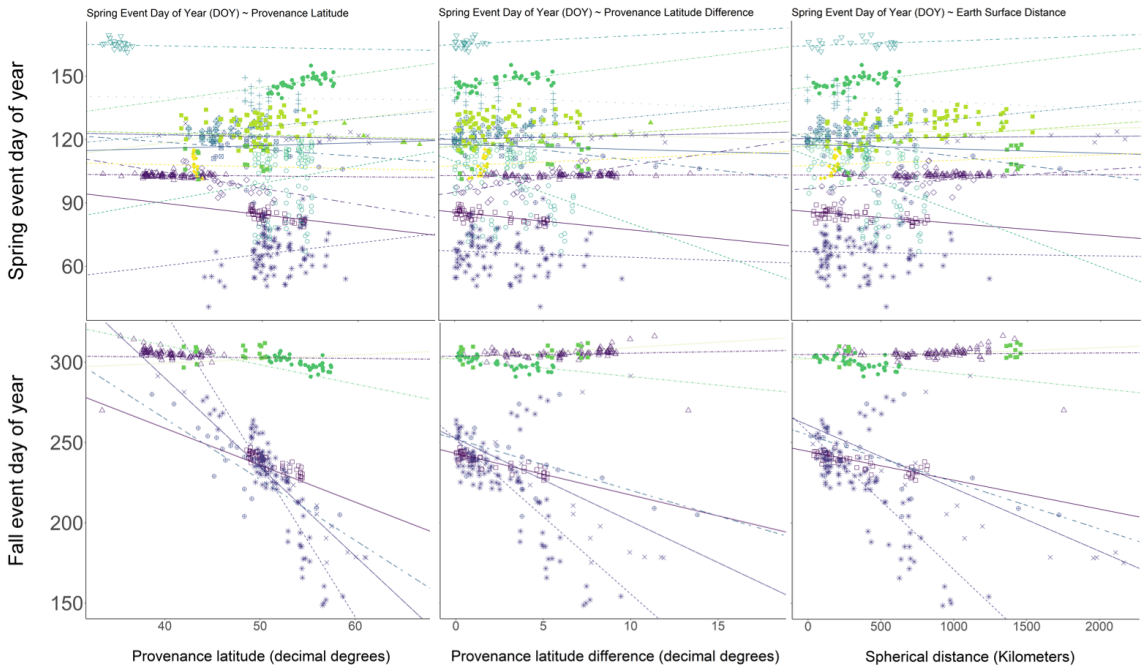

Figure 1: Similar results across provenance latitude, absolute value of difference between provenance and garden latitude, and spherical distance

change caption later

Strong relationship between provenance latitude, MAT, and GDDs

Flagged for Lizzie: I am unsure about how to commment on what we are seeing in this plot.
There is a strong relationship between GDDs of each event day recorded and the latitude and MAT, but isn't that self-apparent?

Placeholder text (Fig. 2).

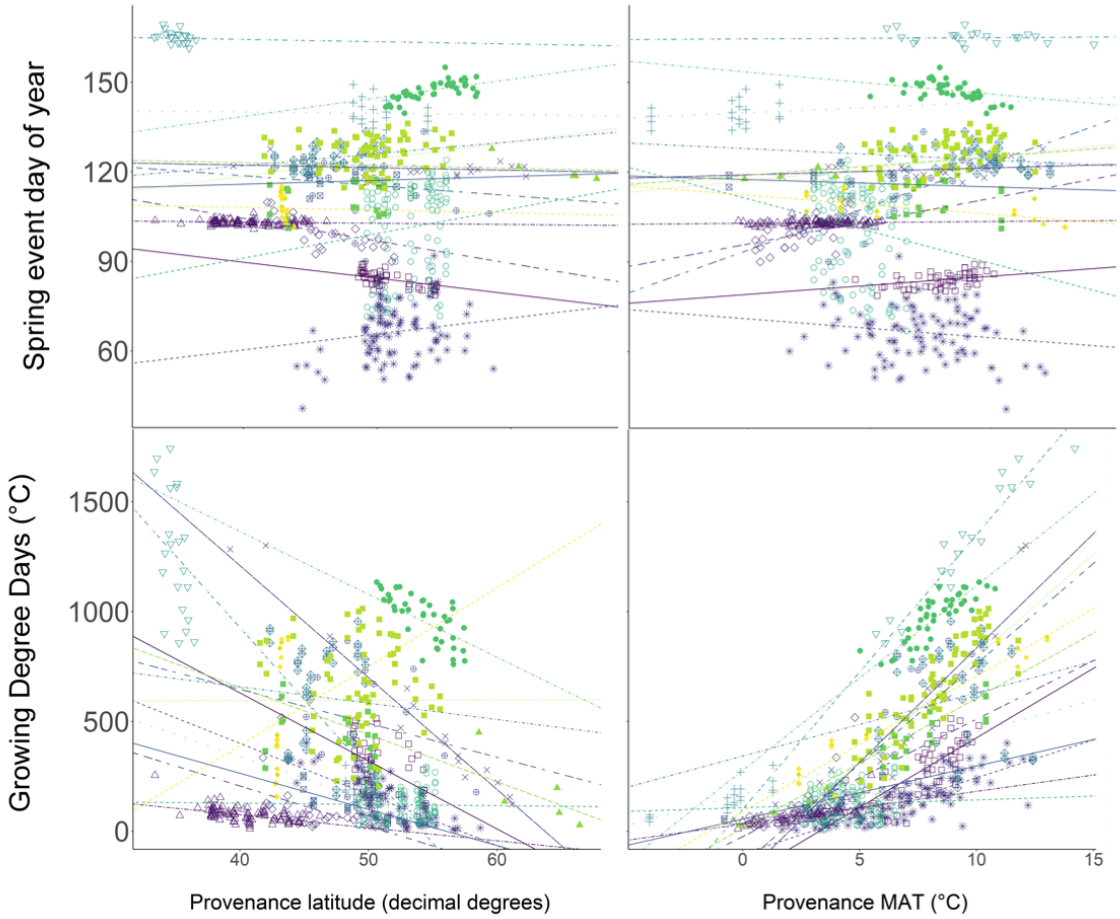

Figure 2: Growing Degree Days (GDD)on each day of spring event in relation to provenance latitude and MAT, coded by symbol for species and color for garden with linear fits from hierarchical Bayesian models.

1 Don't have a specific sections for these ones yet

Spring Lat VS. Fall Lat

Table 1: Model summary for the relationship between event day of year (DOY)and provenance latitude, fitted by species, in spring (left) and fall (right).

i'm not sure how to word this

	DOY_{Spring} $(Latitude\|Species)$	DOY_{Fall} $(Latitude\|Species)$
Intercept	114.219	316.736
	[100.511, 127.680]	[272.545, 415.373]
Sigma[Species × Intercept,Intercept]	1148.104	12 381.073
	[435.227, 2825.532]	[6176.075, 24 554.731]
Sigma[Species × Latitude,Intercept]	−13.454	−307.256
	[−41.733, −1.069]	[−621.049, −122.796]
Sigma[Species × Latitude,Latitude]	0.374	10.159
	[0.111, 1.030]	[5.266, 33.131]
Num.Obs.	671	349
R2	0.903	0.961
R2 Adj.	0.902	0.960
R2 Marg.	0.000	0.000
Log.Lik.	−2340.362	−1217.949
ELPD	−2358.2	−1231.9
ELPD s.e.	27.8	22.1
LOOIC	4716.4	2463.8
LOOIC s.e.	55.6	44.2
WAIC	4716.2	2463.3
RMSE	7.87	8.44
r2.adjusted.marginal	0.902	0.960

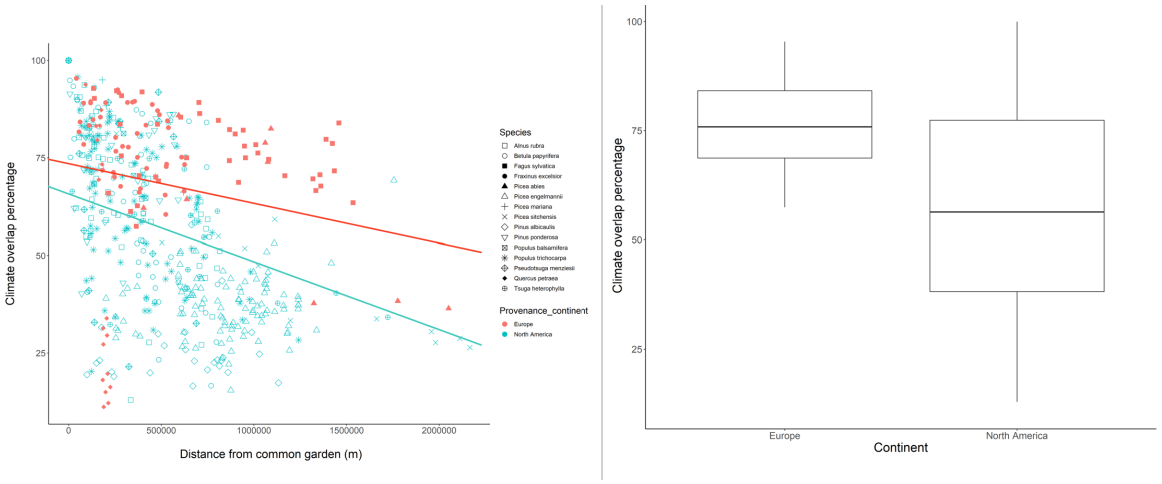

Figure 3: The closer a garden is to a provenance, the more overlap in temperature. Higher extend of climate overlap in European studies.

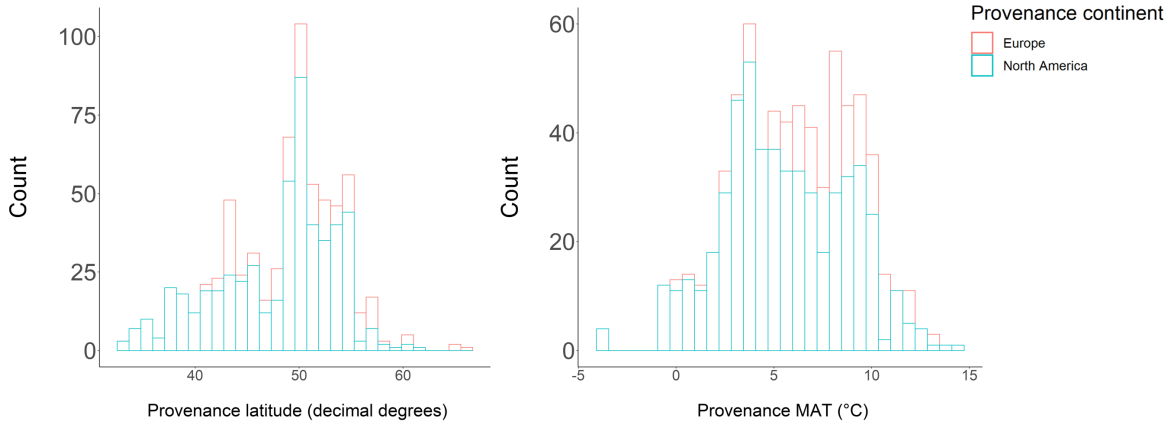

Figure 4: Placeholder.

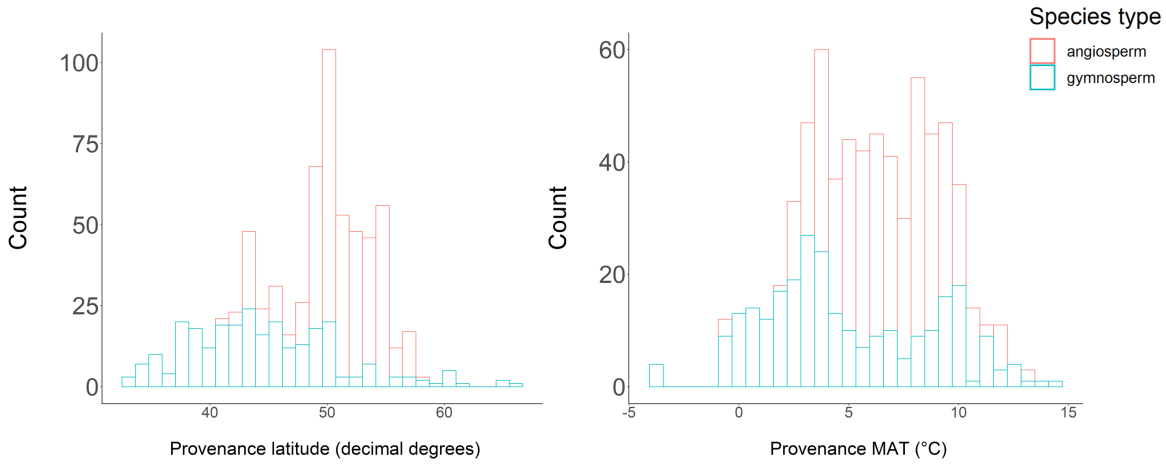

Figure 5: Placeholder