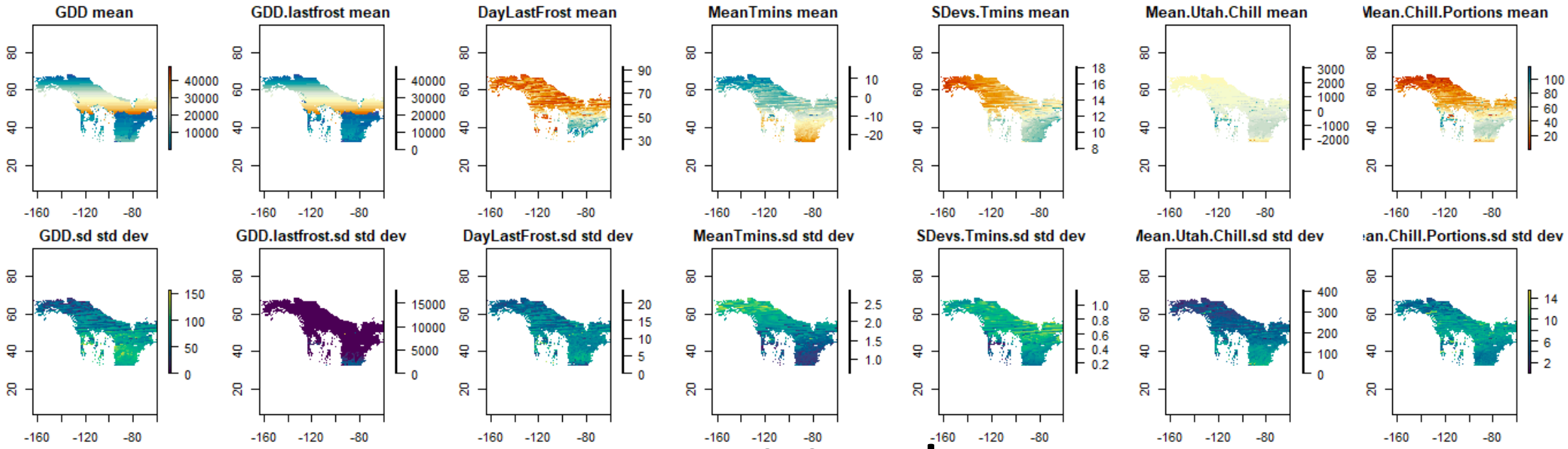
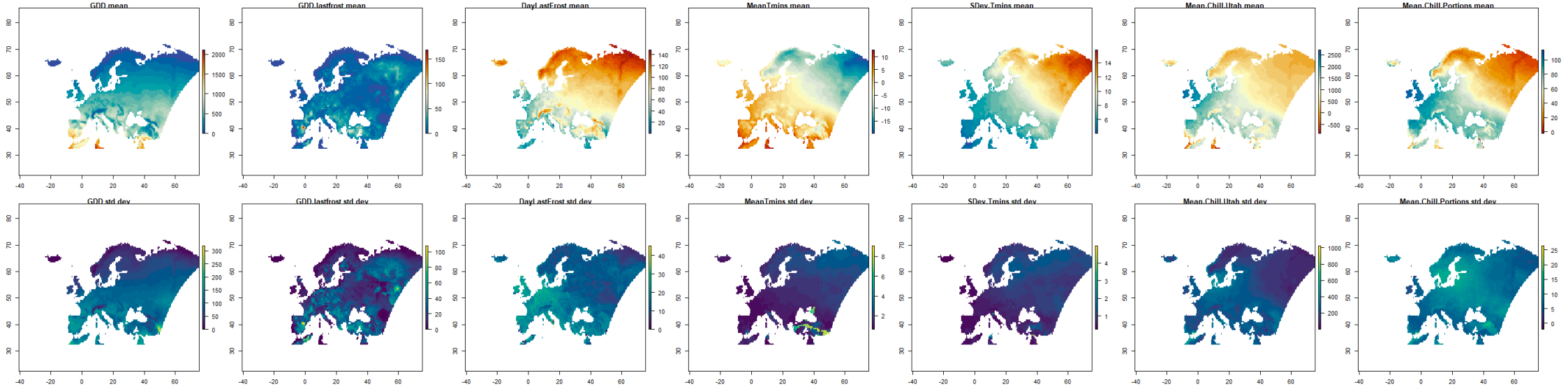


Range Update

18 March 2021



Project components

Data: so fresh and so clean

Hypothesis: Climatic variation increases secondary cue reliance

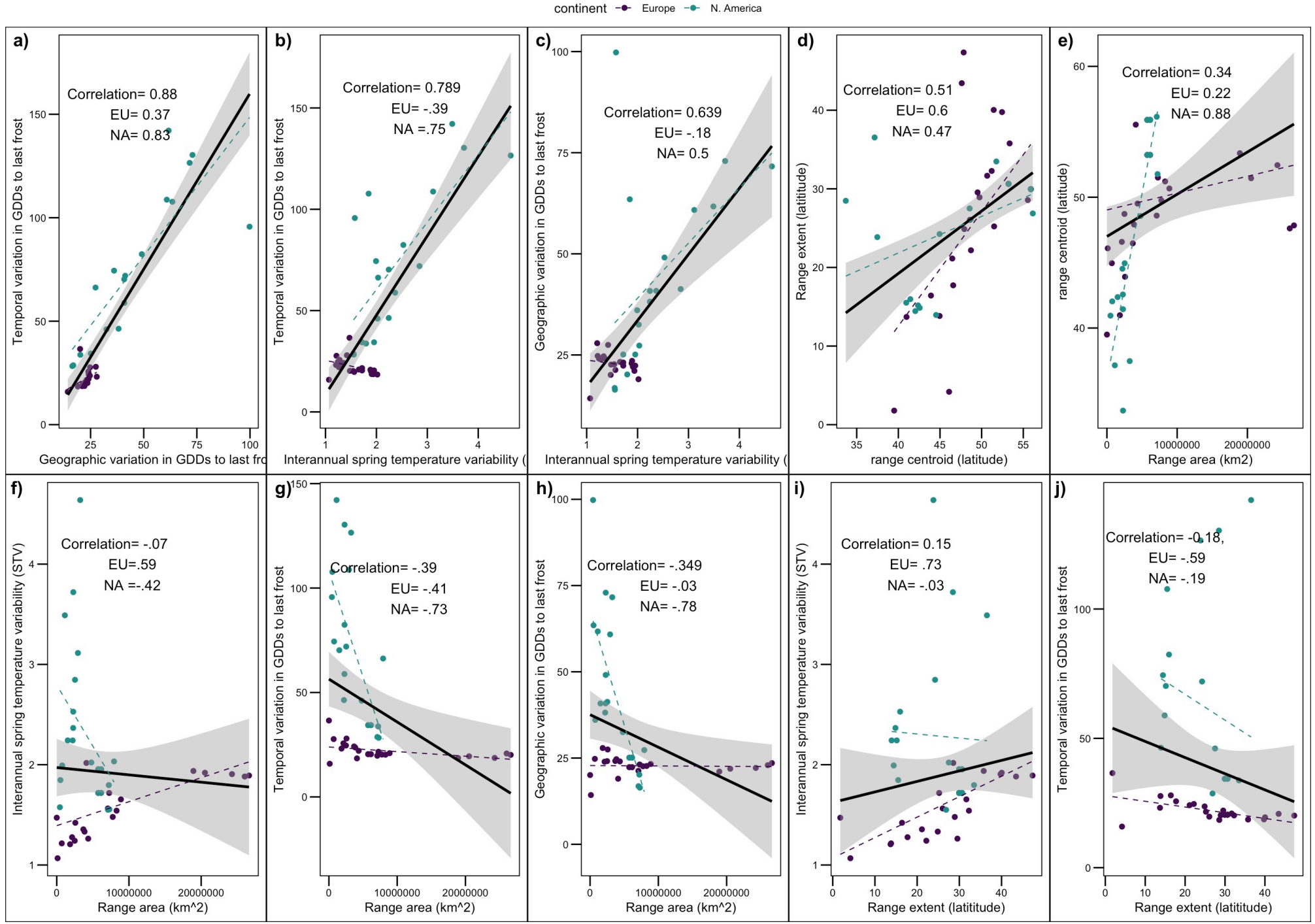
Metrics of variation and their relationships to each other:

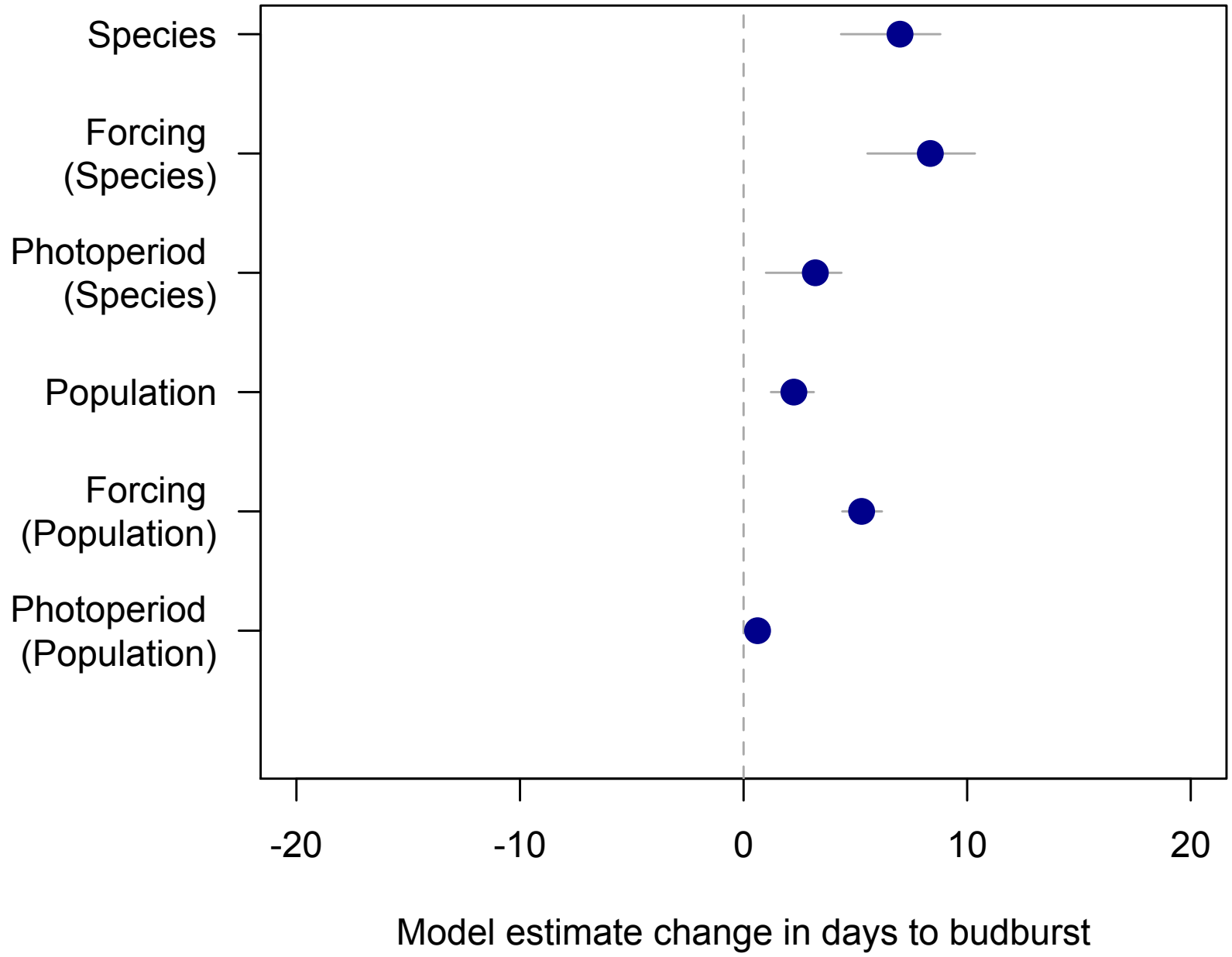
- GDD to last frost
- STV
- Range area (extent?) (“Rapoport’s rule”)

Intra. Vs. Interspecific

Modeling

Outline


continent
Europe
N. America
a)
Correlation= 0.88
EU= 0.37
NA= 0.83
Temporal variation in GDDs to last frost
Geographic variation in GDDs to last fro
b)
Correlation= 0.789
EU= -.39
NA =.75
Temporal variation in GDDs to last frost
Interannual spring temperature variability (
c)
Correlation= 0.639
EU= -.18
NA= 0.5
Geographic variation in GDDs to last frost
Interannual spring temperature variability (
d)
Correlation= 0.51
EU= 0.6
NA= 0.47
Range extent (latitude)
range centroid (latitude)
e)
Correlation= 0.34
EU= 0.22
NA= 0.88
range centroid (latitude)
Range area (km2)
f)
Correlation= -.07
EU=.59
NA =-.42
Interannual spring temperature variability (STV)
Range area (km^2)
g)
Correlation= -.39
EU= -.41
NA= -.73
Temporal variation in GDDs to last frost
Range area (km^2)
h)
Correlation= -.349
EU= -.03
NA= -.78
Geographic variation in GDDs to last frost
Range area (km^2)
i)
Correlation= 0.15
EU= .73
NA= -.03
Interannual spring temperature variability (STV)
Range extent (latititude)
j)
Correlation= -0.18,
EU= -.59
NA= -.19
Temporal variation in GDDs to last frost
Range extent (latititude)


Species
Forcing (Species)
Photoperiod (Species)
Population
Forcing (Population)
Photoperiod (Population)
-20
-10
0
10
20
Model estimate change in days to budburst

“Sequential model”

```
> fixef(mod.ggdlf.chill.pool.cont)
                                Estimate   Est.Error        Q2.5       Q97.5
Intercept                      3.3056210 0.102481171   3.1042728   3.5079765
Temp.SD                       -0.2441913 0.004630549 -0.2533462 -0.2349900
continentN.America            -7.0895617 0.109744110 -7.2987821 -6.8714916
Temp.SD:continentN.America     0.2386729 0.004663925   0.2293554   0.2478181
>
```

“Measurement error model”

```
> fixef(mod.alt2.c)
                                Estimate Est.Error        Q2.5       Q97.5
Intercept                      3.8916818 4.1963696  -4.4440446 12.2558695
Temp.SD                       -0.2660330 0.1911699  -0.6419031  0.1067461
continentN.America            -6.8210644 4.5235957 -15.8238970  2.0179121
Temp.SD:continentN.America     0.2558476 0.1930561  -0.1252807  0.6294491
>
```

Joint trait and phenology model formulated like this:

$$\hat{y}_{trait,i} = \alpha_{trait.grand} + \alpha_{trait,sp[i]} + \alpha_{study[i]}$$
$$\alpha_{trait,sp} \sim N(0, \sigma_{\alpha,trait})$$
$$\alpha_{study} \sim N(0, \sigma_{\alpha,study})$$
$$y_{trait} \sim N(\hat{y}_{trait}, \sigma^2_{trait,y})$$

$$\hat{y}_{pheno,i} = \alpha_{pheno,sp[i]} + \beta_{forcing_{sp[i]}} * F_i$$
$$\beta_{forcing_{sp}} = \alpha_{forcing_{sp}} + \beta_{traitxpheno} * \alpha_{trait,sp}$$
$$\alpha_{pheno,sp} \sim N(\mu_{\alpha,pheno}, \sigma_{\alpha,pheno})$$
$$\alpha_{forcing_{sp}} \sim N(\mu_{\alpha,forcing}, \sigma_{\alpha,forcing})$$
$$y_{pheno} \sim N(\hat{y}_{pheno}, \sigma^2_{y,pheno})$$

In our model, this parameter is data (the climate variable of interest)

- The 1 parameter and 3 parameter models converge but answers are different than the previous modeling techniques (clim betas positive for all 3 cues).
- Next step, run on fake data
- Decide how to deal with the continental differences.
- Write up