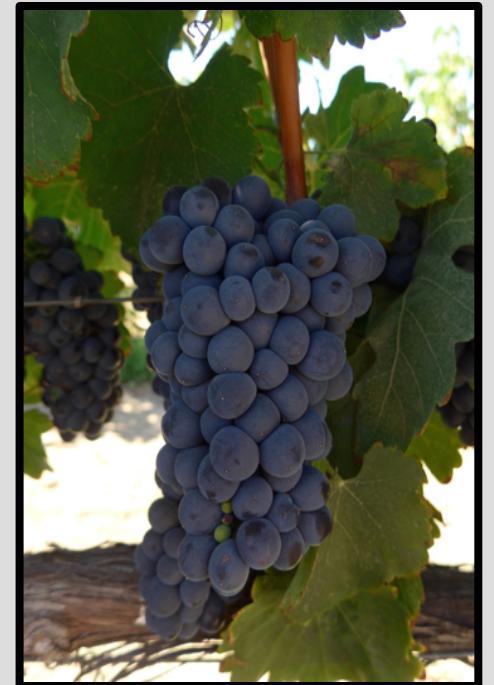


BAYES CLASS 30 MARCH 2021: WINEGRAPE INTERPHENOPHASES

Mira Garner

Interphenophase: the duration between individual phenological events

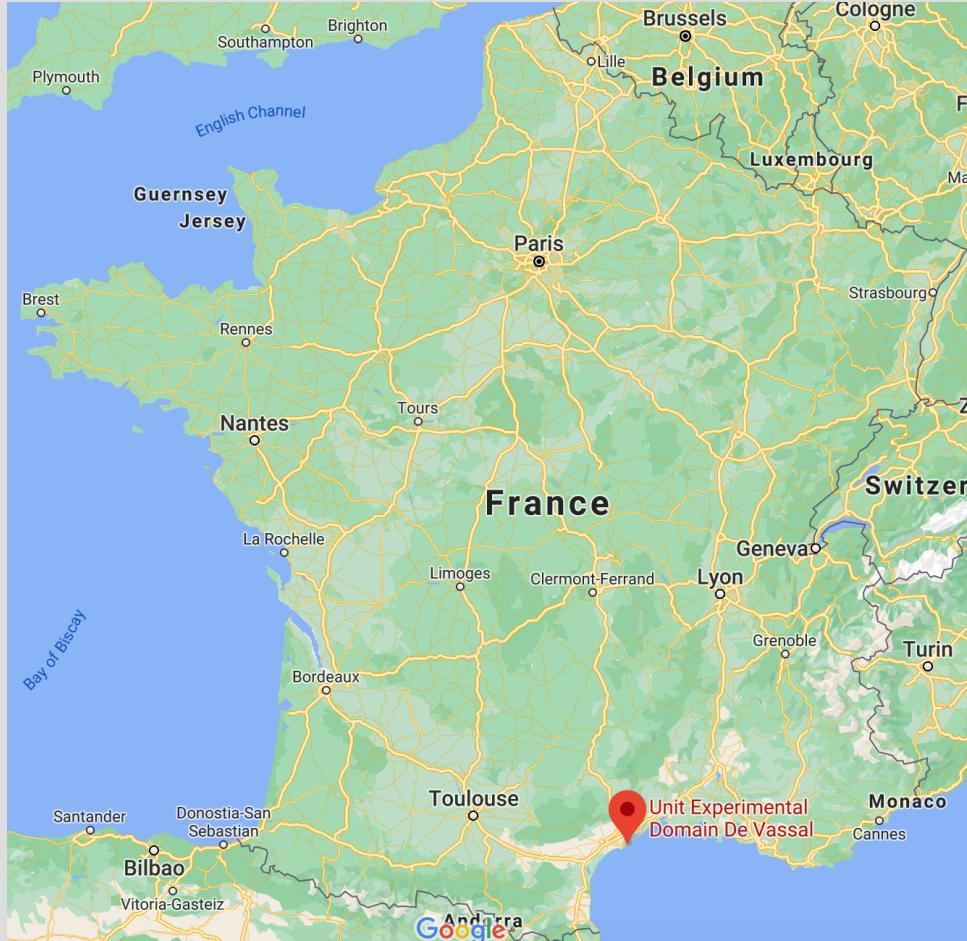


Budburst to Flowering

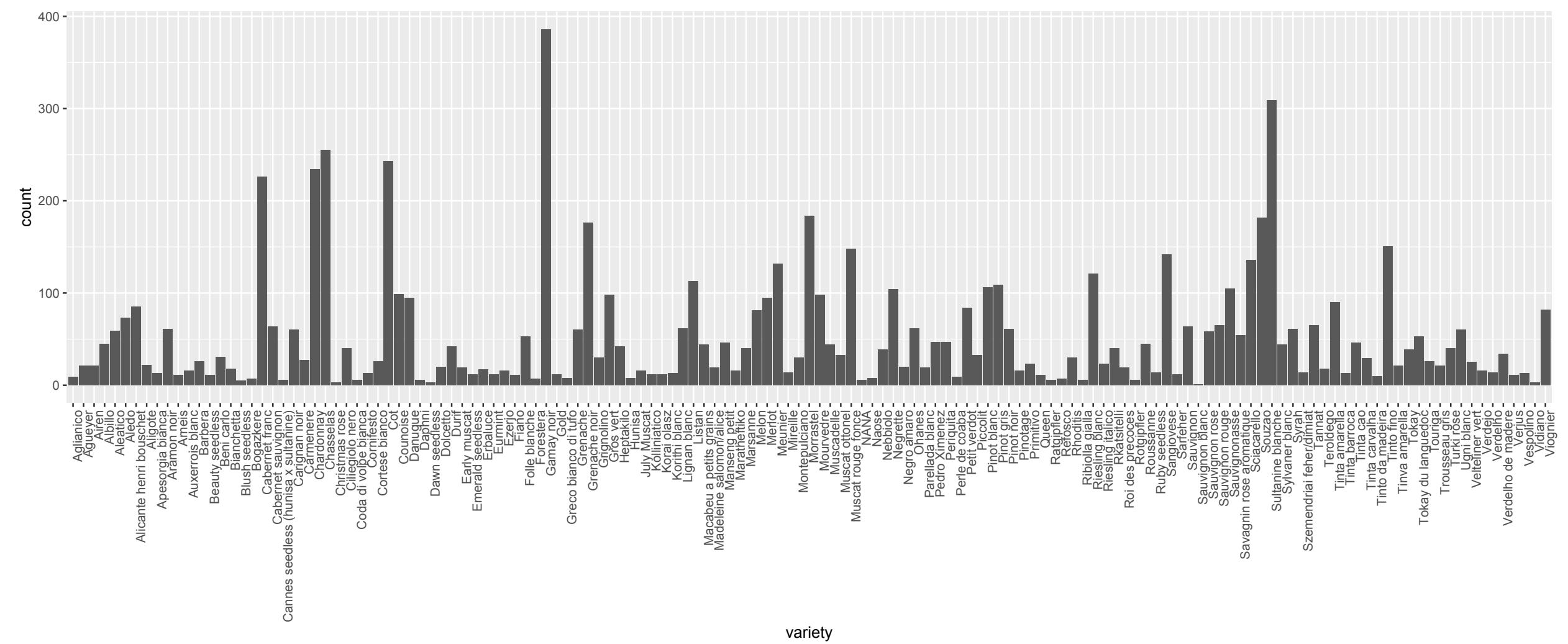
Flowering to Veraison

Veraison to Maturity

THE DATASETS: DOMAINE DE VASSAL



<https://amarchinthevines.org/2015/11/05/domaine-vassal-wine-worlds-heritage-site/>



V A R I E T Y D I V E R S I T Y

RESEARCH QUESTIONS

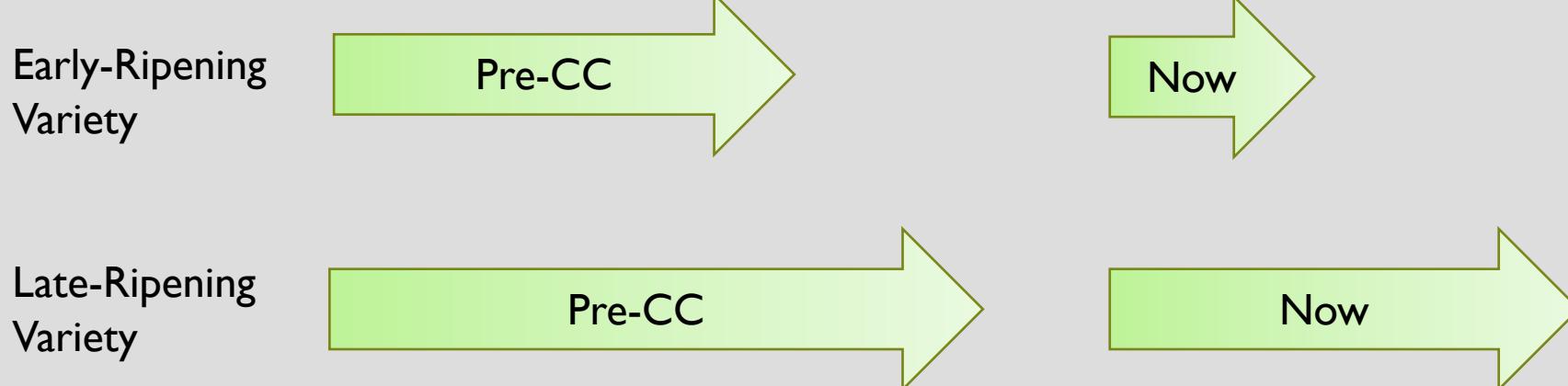
- I. Have the durations of the interphenophases changed since the 1980s?
 - Veraison and maturity (harvest) 
 - Flowering and veraison 
 - Budburst and flowering 

RESEARCH QUESTIONS

2. If so, do these changes differ among varieties?

- We expect to see difference among varieties.
- Late-ripening vs early-ripening

Fruit Ripening Interphenophase



RESEARCH QUESTIONS

3. Have growing degree days (GDD) between phenological events changed since the 1980s?

GDD Pre-CC



GDD Now

RESEARCH QUESTIONS

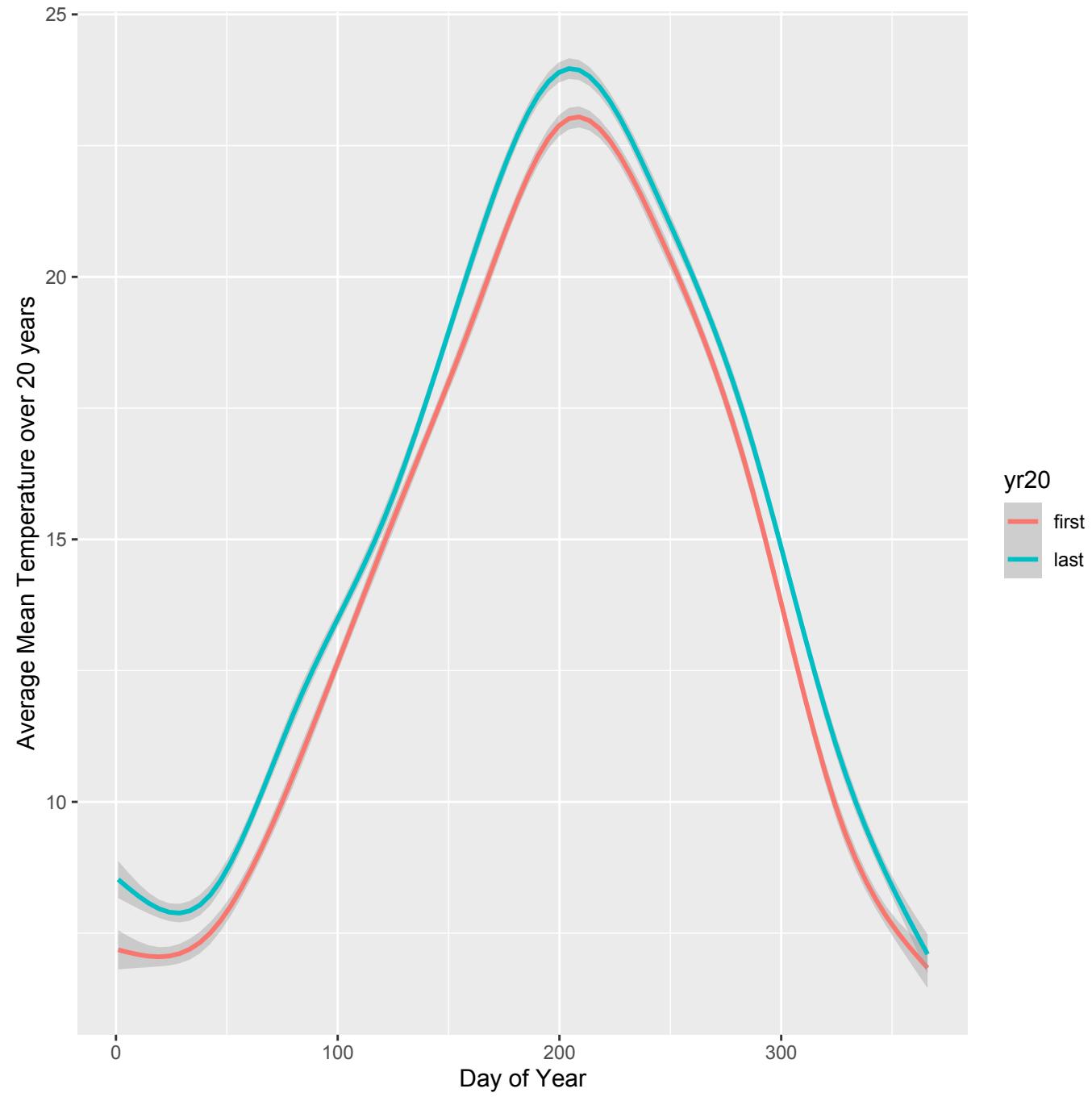
4. Is warming equal across seasons?

Uneven warming is more likely but I don't have specific predictions.

1955-1975

VS

1995-2015



MODEL: DURATION IN DAYS:

- I. Have the durations of the interphenophases changed since the 1980s?

$$\text{Predicted Duration} \sim N(\mu_{variety}, e) \quad (1)$$

$$\mu_{variety} = \alpha_{variety} + \beta_{variety} * year \quad (2)$$

$$\alpha_{variety} \sim N(\mu_a, \sigma_a) \quad (3)$$

$$\beta_{variety} \sim N(\mu_b, \sigma_b) \quad (4)$$

*year hinged!

MODEL: DURATION IN GDD:

3. Have growing degree days (GDD) between phenological events changed since the 1980s?

$$GDD \sim N(\mu_{variety}, e) \quad (5)$$

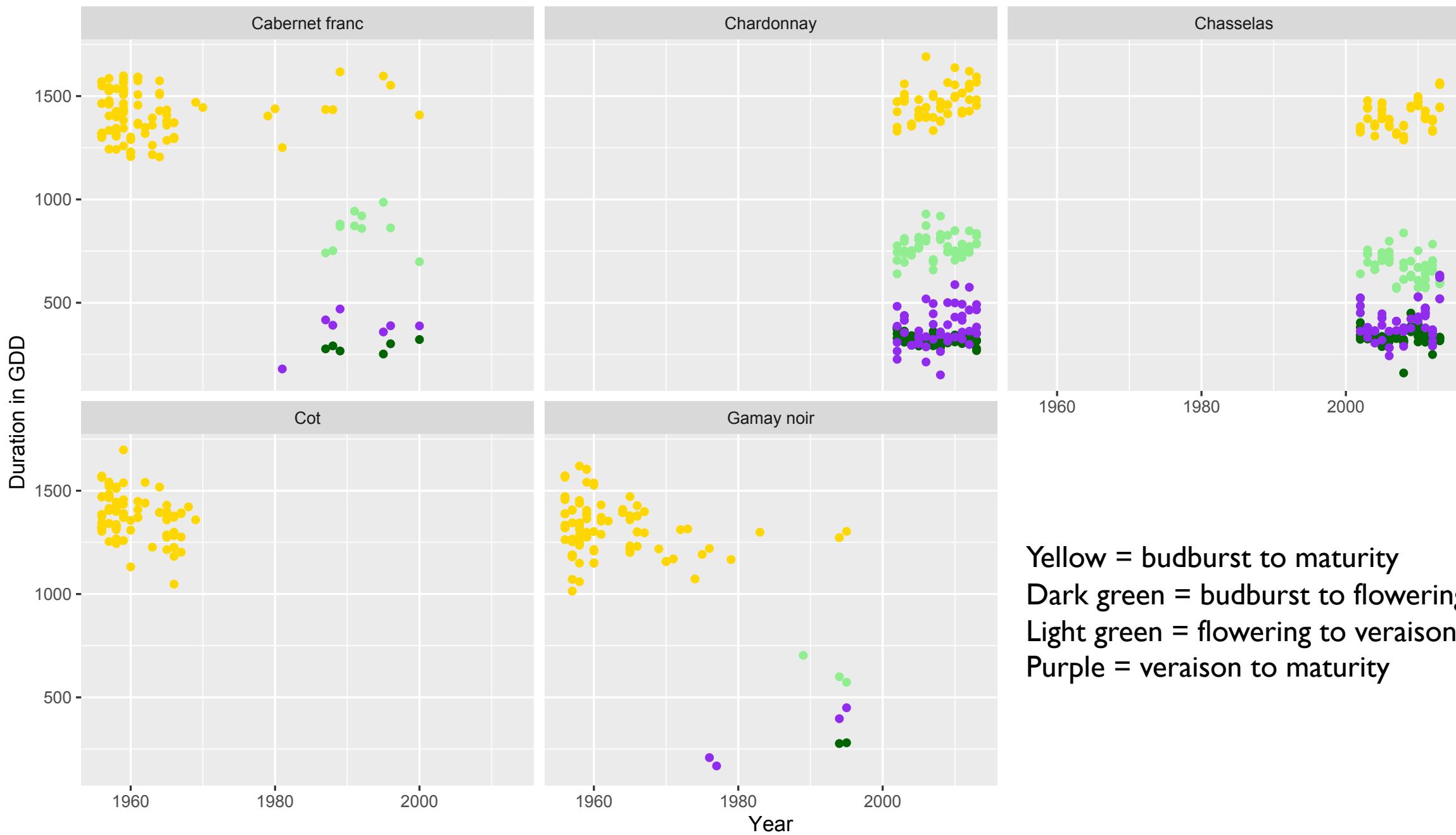
$$\mu_{variety} = \alpha_{variety} + \beta_{variety} * year \quad (6)$$

$$\alpha_{variety} \sim N(\mu_a, \sigma_a) \quad (7)$$

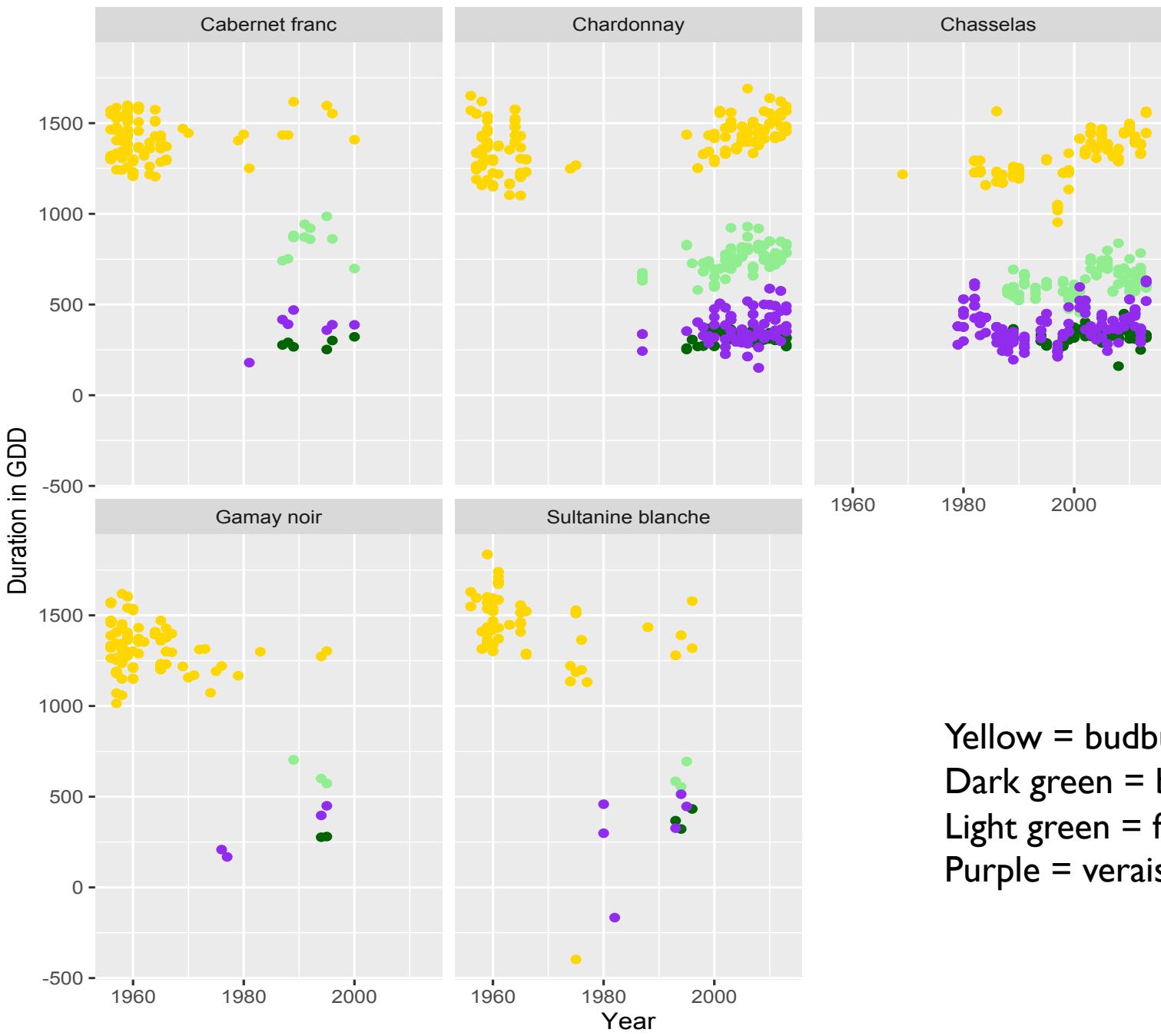
$$\beta_{variety} \sim N(\mu_b, \sigma_b) \quad (8)$$

*year hinged!

PROBLEM FROM LAST CLASS



NEW WITNESS VARIETIES GDD



AMOUNT OF DATA

Wide dataset: 13035 rows

Budburst to flowering: 1794 rows

Flowering to veraison: 2038 rows

Veraison to maturity: 2131 rows

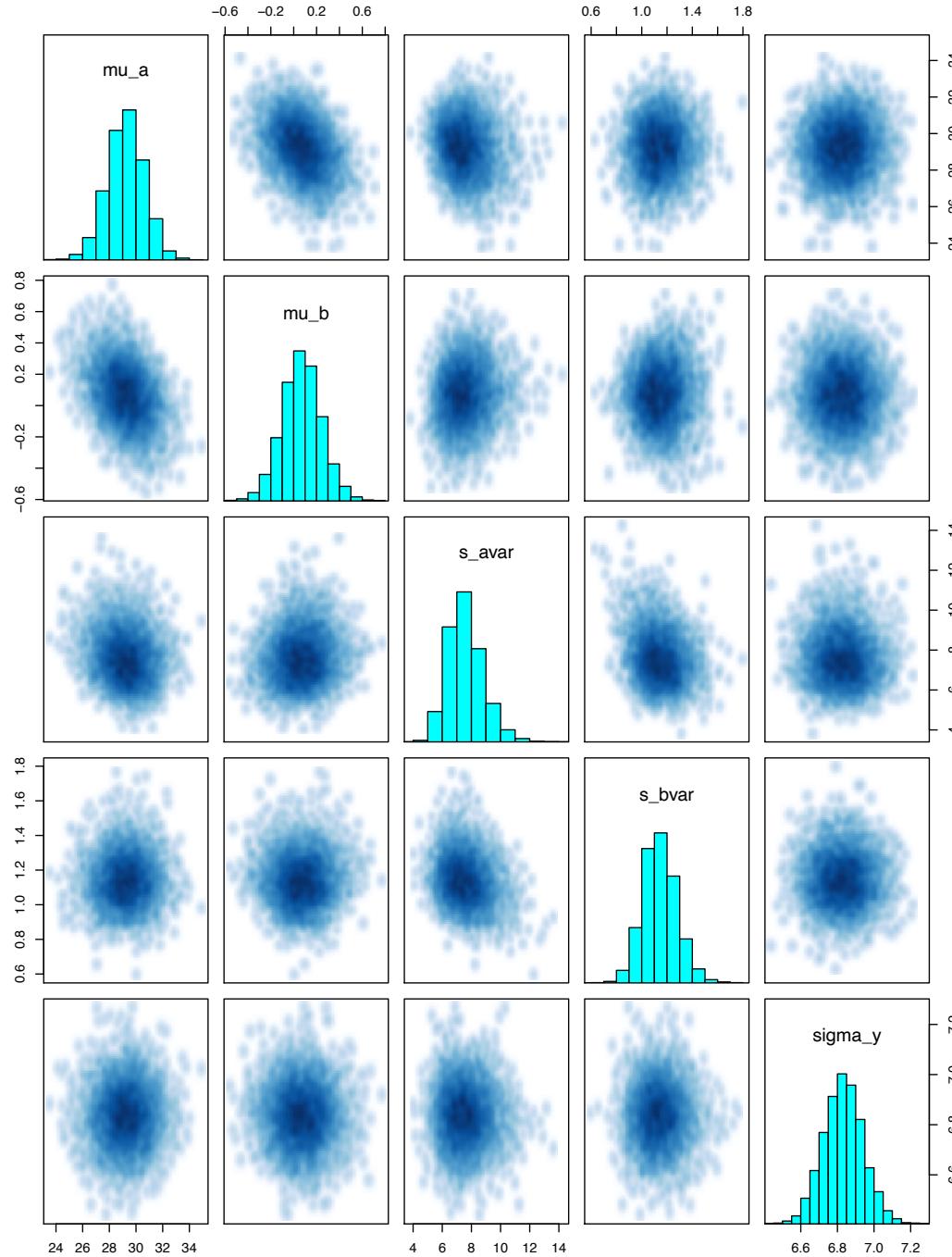
Budburst to maturity: 4577 rows

DAYS MODEL

- Iter = 8000, warmup=6000
- Ran without warning
- a low n_eff?

```
> summy <- summary(daysDuration)$summary
> summy[grep("mu_", rownames(summy)),]
      mean    se_mean     sd    2.5%    25%    50%    75%
mu_a 29.23099090 0.020944747 1.3945564 26.4478980 28.33482072 29.25270213 30.1612878
mu_b  0.07011705 0.002195086 0.1730454 -0.2742719 -0.04384784  0.06877056  0.1845221
         97.5%   n_eff     Rhat
mu_a 31.9123144 4433.247 0.9997159
mu_b  0.4156404 6214.658 1.0000130
> summy[grep("s\\\_ ", rownames(summy)),]
      mean    se_mean     sd    2.5%    25%    50%    75%   97.5%
s_avar 7.598256 0.022021429 1.2014811 5.5972910 6.754348 7.494097 8.319543 10.295115
s_bvar 1.143264 0.001732009 0.1351187 0.8945913 1.051849 1.135727 1.230549 1.426518
         n_eff     Rhat
s_avar 2976.753 1.0015372
s_bvar 6085.978 0.9998293
> summy[grep("sigma_y", rownames(summy)),]
      mean    se_mean     sd    2.5%    25%    50%    75%
6.832515e+00 1.018327e-03 1.092861e-01 6.620672e+00 6.759069e+00 6.832488e+00 6.903886e+00
         97.5%   n_eff     Rhat
7.051166e+00 1.151742e+04 9.997496e-01
> |
```

DAYS MODEL: VERAISON TO MATURITY

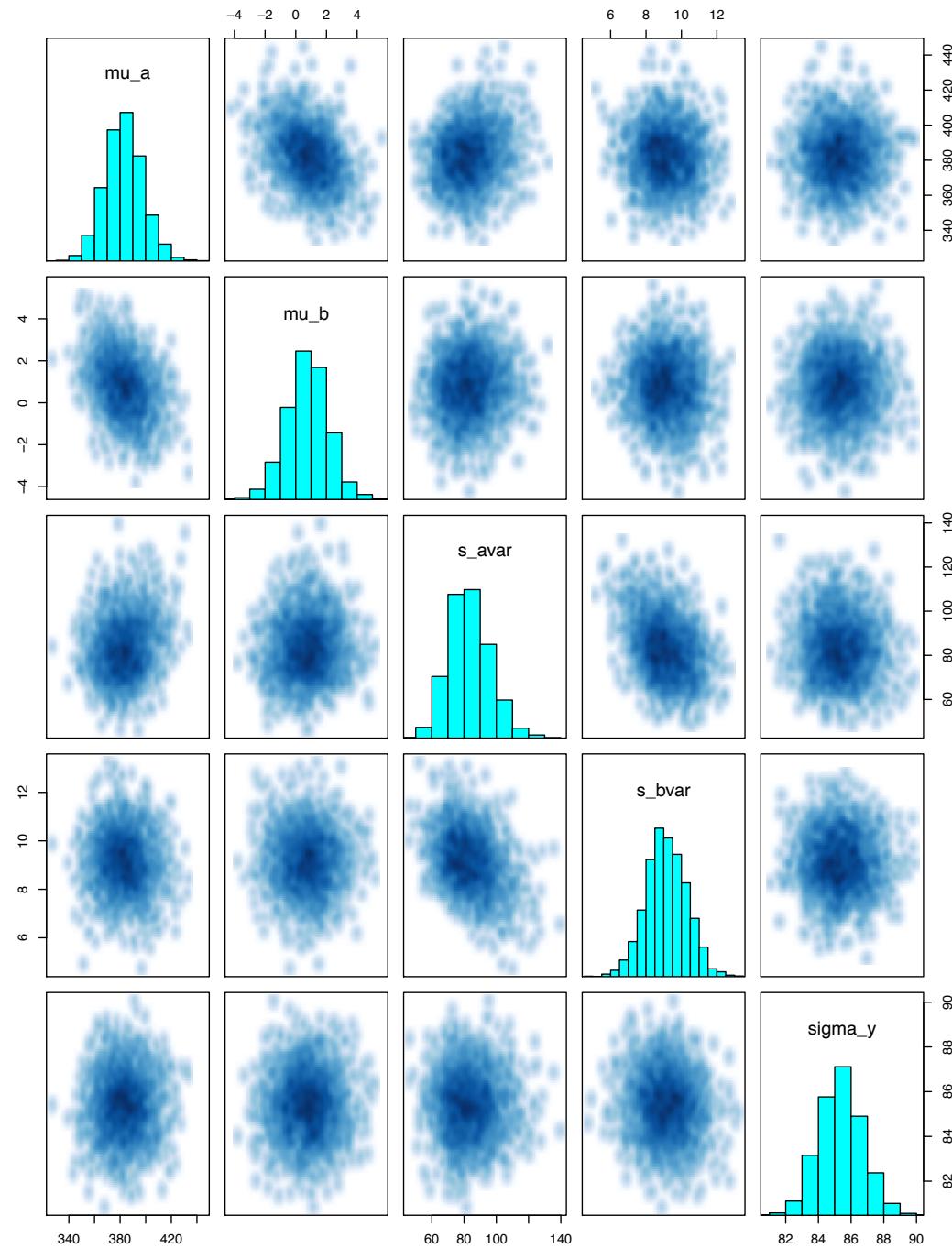


GDD MODEL

- Iter = 8000,
warmup = 7000
- ran without
warning
- n_eff okay?

```
> summo <- summary(gddDuration)$summary
> summo[grep("mu_", rownames(summo)),]
      mean   se_mean     sd    2.5%    25%    50%    75%
mu_a 382.9806771 0.32584272 14.816646 354.550642 373.0011045 382.9033614 392.575154
mu_b  0.7743466 0.02829425  1.353215 -1.969991 -0.1180344  0.7965065  1.678058
                  97.5%  n_eff   Rhat
mu_a 413.157131 2067.682 1.000179
mu_b  3.433142 2287.373 0.999917
> summo[grep("s\\_\\_", rownames(summo)),]
      mean   se_mean     sd    2.5%    25%    50%    75%   97.5%
s_avar 83.310197 0.33706880 12.820993 60.935921 74.314281 82.381334 91.38273 110.32803
s_bvar  9.146217 0.02764999  1.145644  6.895373  8.389041  9.112282  9.92094  11.35982
      n_eff   Rhat
s_avar 1446.793 1.002244
s_bvar 1716.760 1.000790
> summo[grep("sigma_y", rownames(summo)),]
      mean   se_mean     sd    2.5%    25%    50%    75%
8.536824e+01 1.583244e-02 1.331745e+00 8.284559e+01 8.446087e+01 8.532980e+01 8.624828e+01
                  97.5%  n_eff   Rhat
8.808595e+01 7.075330e+03 9.995826e-01
> |
```

GDD MODEL: VERAISON TO MATURITY



NEXT STEPS

- Try other interphenophases
- Deal with duplicates?
- Variety differences – add dummy variable into models for early, middle, late (as classified by Jancis Robinson)
- Uneven warming graphs
- Event date changes – eventually...