Wheat growing risks in France according to phenological sensitivities to climate change

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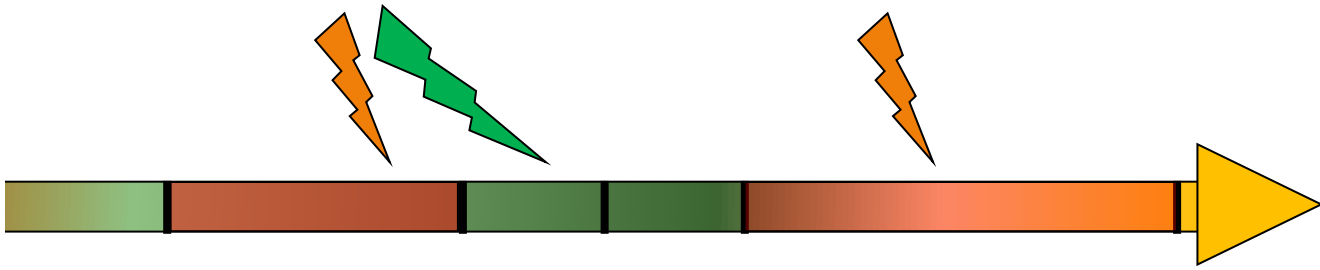
What and where will be the future wheat growing risks in France?

Climate risk

Wheat phenological phases

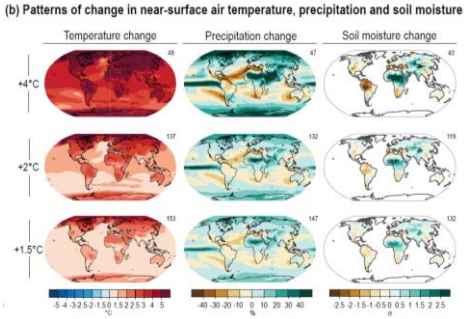


The sensitivity of wheat to a weather event differs according to:

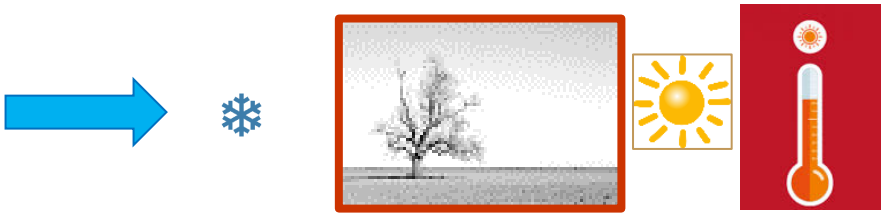
- its phenological stage
- the nature of the risk

What and where will be the future wheat growing risks in France?

Climate change



Climate risk



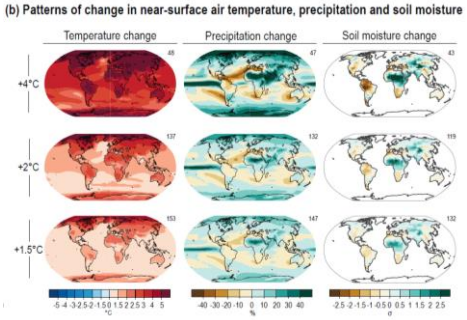
Wheat phenological phases

Climate change modifies:

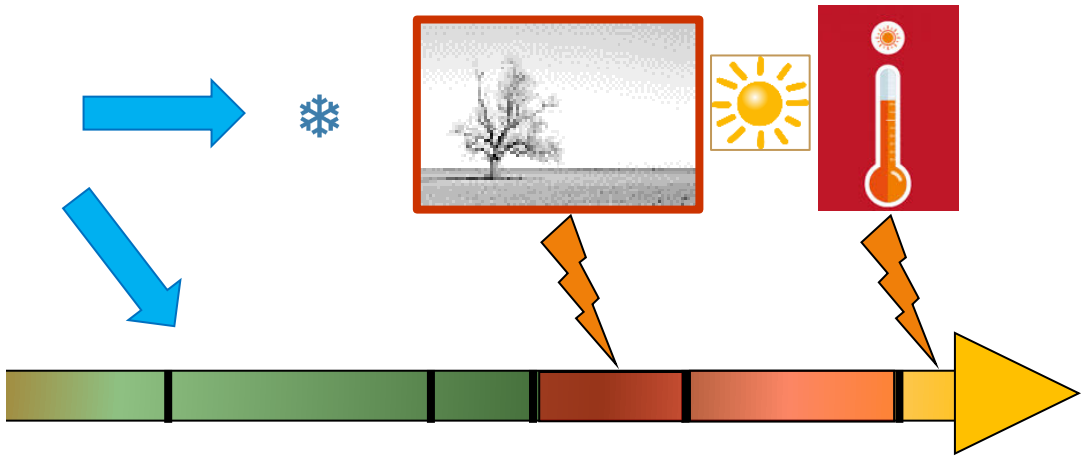
- The intensity, frequency and the nature of these risks
- Over time and regionally

What and where will be the future wheat growing risks in France?

Climate change



Climate risk



Wheat phenological phases

To anticipate future climate risk
and adapt wheat cropping systems,
we need to embed those multiple and interplaying effects

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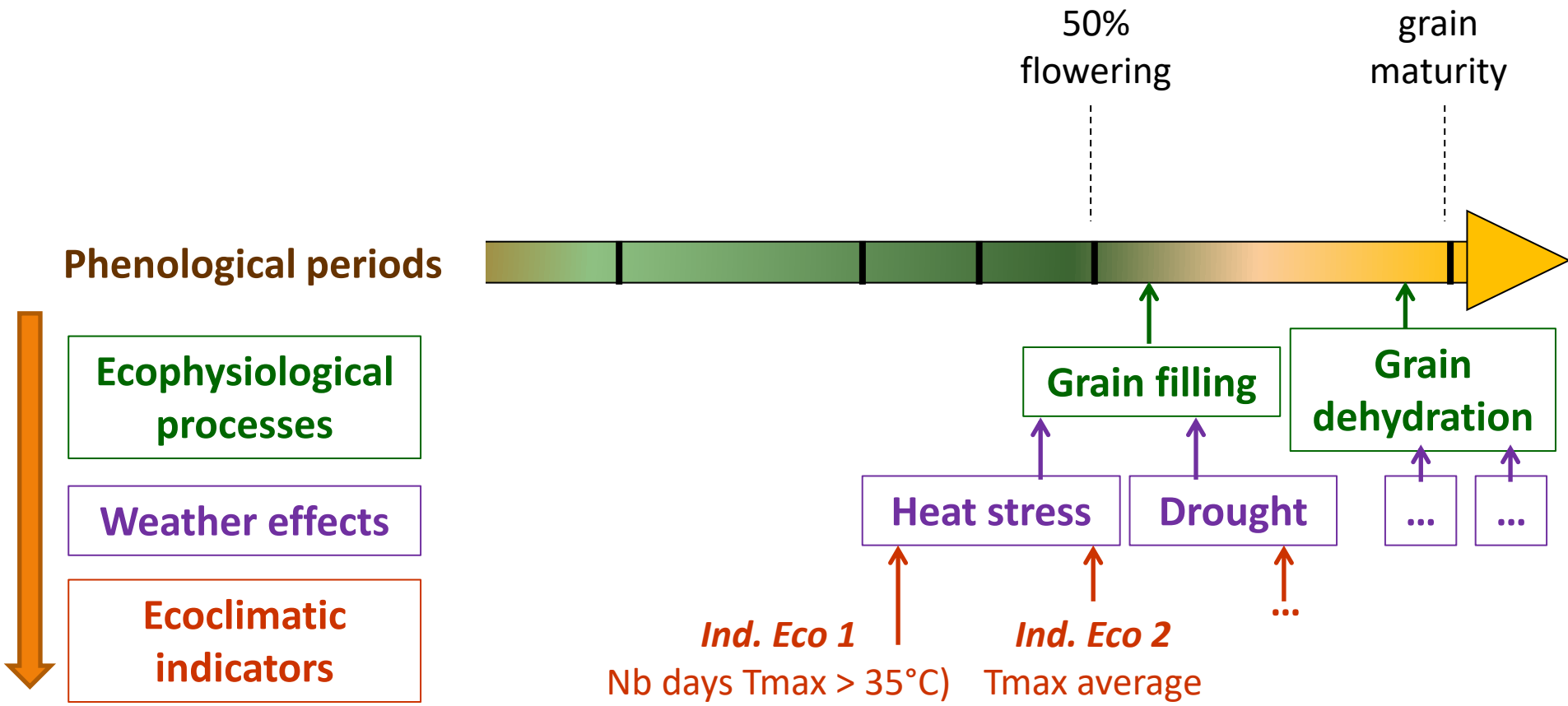
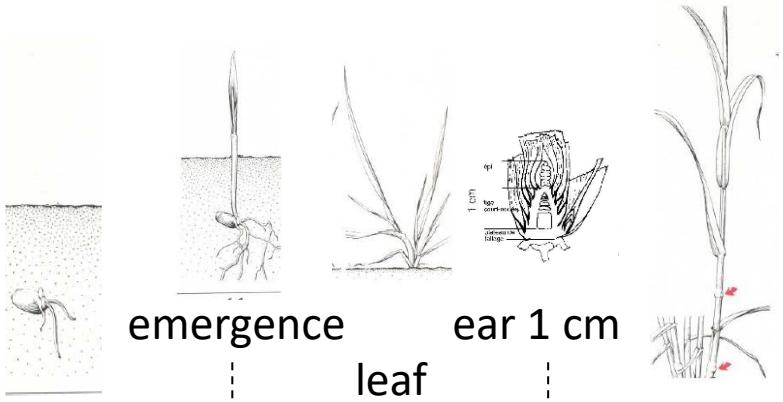
Building ecoclimatic indicators

Indicators integrating the occurrence of the weather events regarding the sensitivity of the plant according to its phenological development.



Ecoclimatic indicators / heat and cold effects



germination
emergence
leaf development & tillering
ear 1 cm
stem elongation
flag leaf
50% heading
50% flowering
grain filling
grain maturity

BBCH 05 09 30 39 55 65 89

Emergence delay, ↘ vigor
↘ foliar initiation
↘ growth rate

cold frost
death, density drop
↘ tillers number, stem apex killed
flowering delay, stem apex killed

excess drought
↘ tillers & plant growth
↘ pollen fertility & grain number
↘ grain filling rate & duration

heat
fulfillment of cold requirements fails
↗ tillers mortality
↘ grain filling rate

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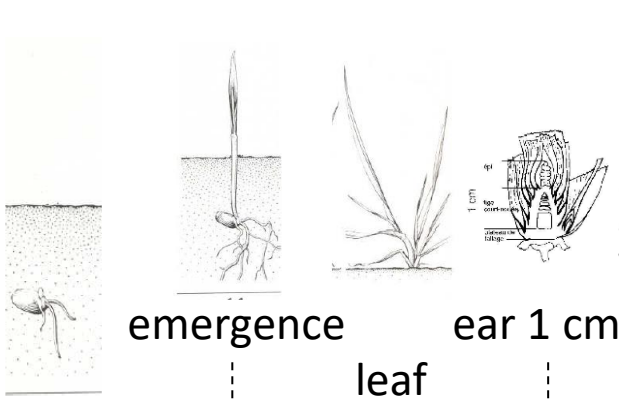
Ecoclimatic indicators / heat and cold effects



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BBCH 05 09 30 39 55 65 89

Ind. Eco 1
Nb vernalising days (1<Tmean<17°C)

Ind. Eco 2
Nb warm nights (Tmin > 12°C)

Ind. Eco 3
first day of Heat shock (Tmax > 30°C)

Ind. Eco 4
frequency of hot days (Tmax > 30°C)

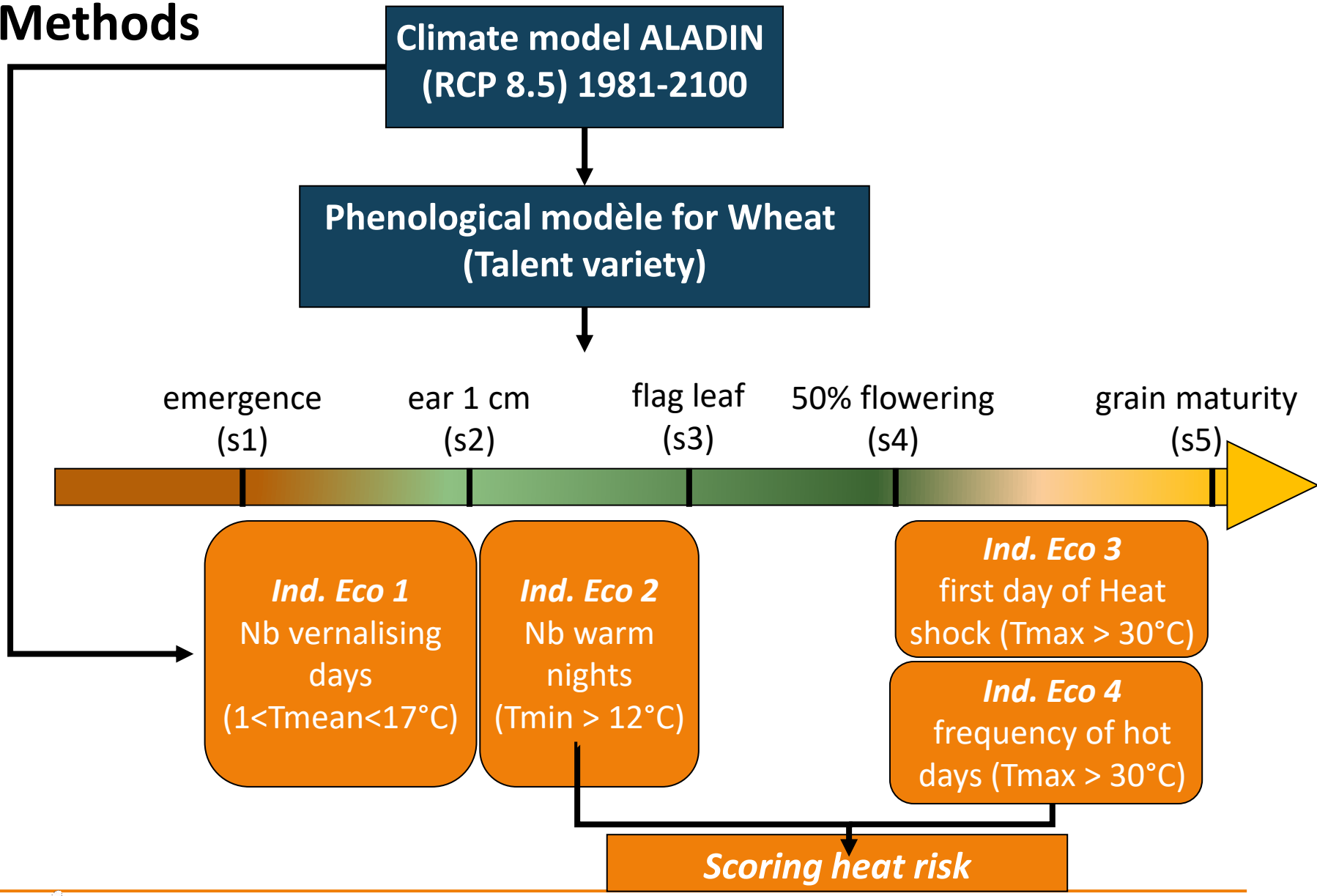
heat

fulfillment of cold requirements fails

↗ tillers mortality

↘ grain filling rate

Methods


Climate model ALADIN (RCP 8.5) 1981-2100
Phenological modèle for Wheat (Talent variety)
emergence (s1)
ear 1 cm (s2)
flag leaf (s3)
50% flowering (s4)
grain maturity (s5)
Ind. Eco 1 Nb vernalising days (1<Tmean<17°C)
Ind. Eco 2 Nb warm nights (Tmin > 12°C)
Ind. Eco 3 first day of Heat shock (Tmax > 30°C)
Ind. Eco 4 frequency of hot days (Tmax > 30°C)
Scoring heat risk

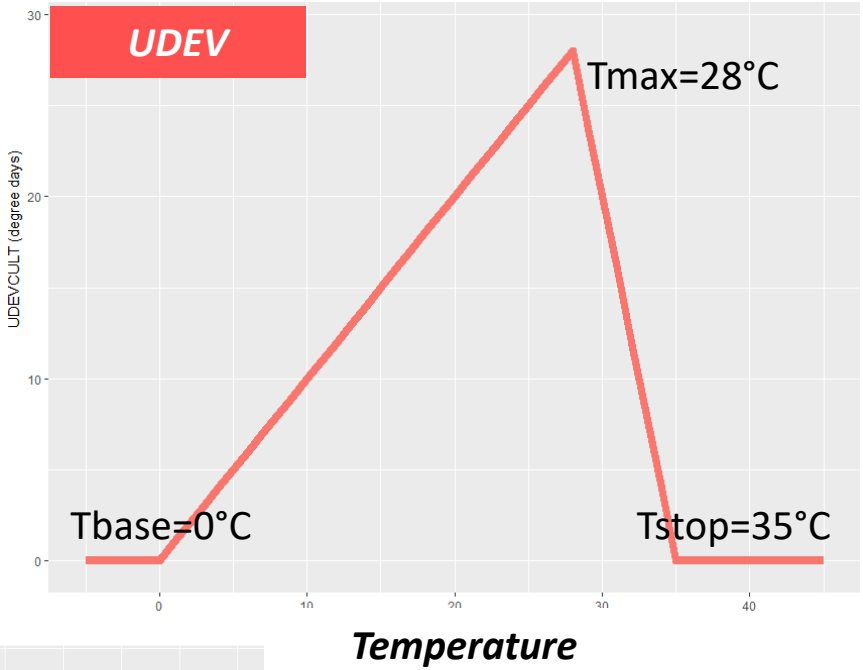
Focus on the phenological model

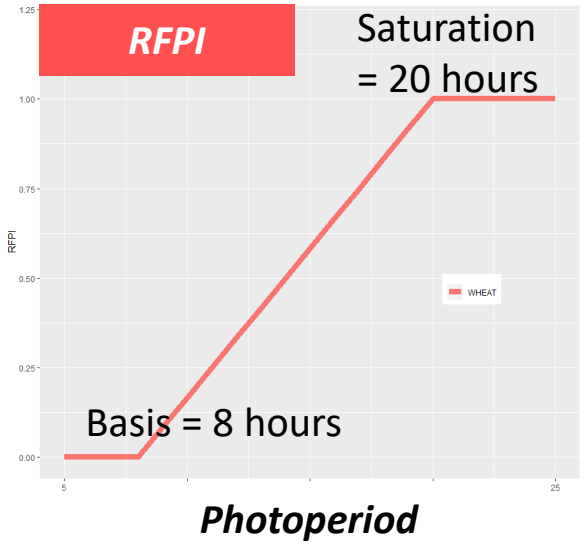
Actual development of a given day :
UDEV x RFPI x RFVI

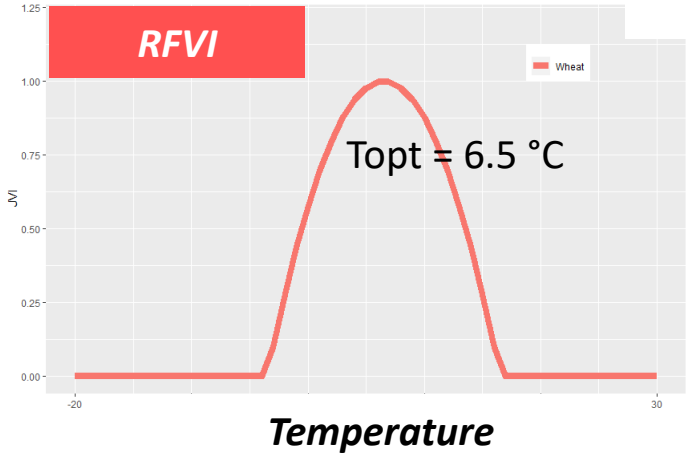
Temperature

Photoperiod

Vernalisation

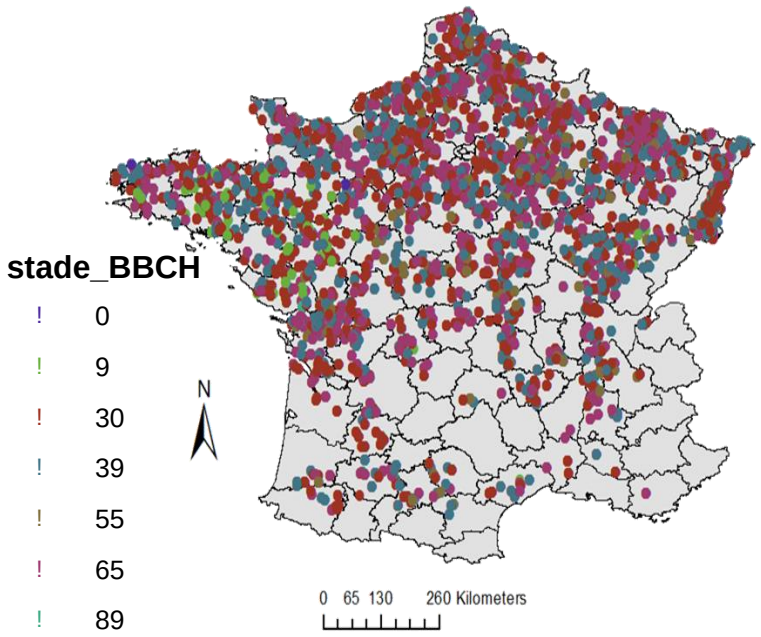


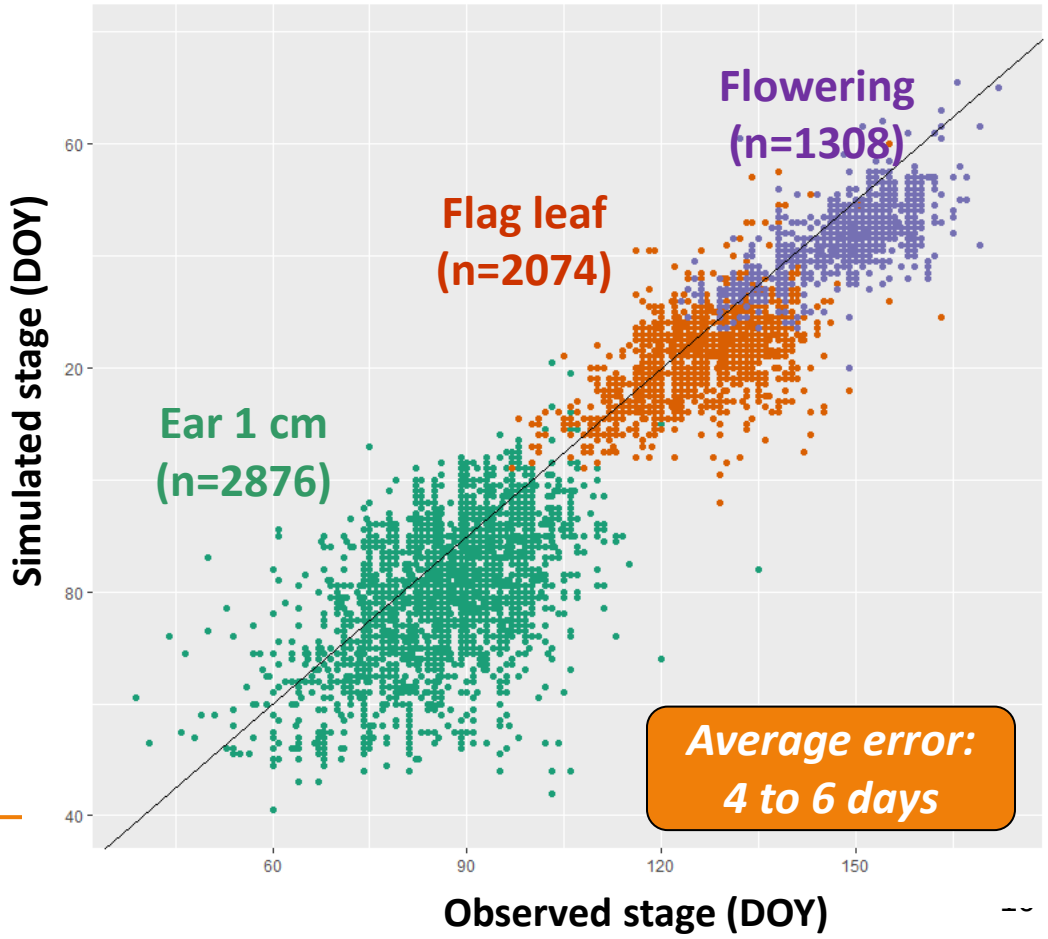




Results

- **Phenological model:** GDD x vernalisation x photoperiod effects applied on the Talent cultivar (median precocity) sown mid October
- **Evaluation on the Epiphyt database:** thousands of observed wheat stages with no information on sowing date neither cultivar





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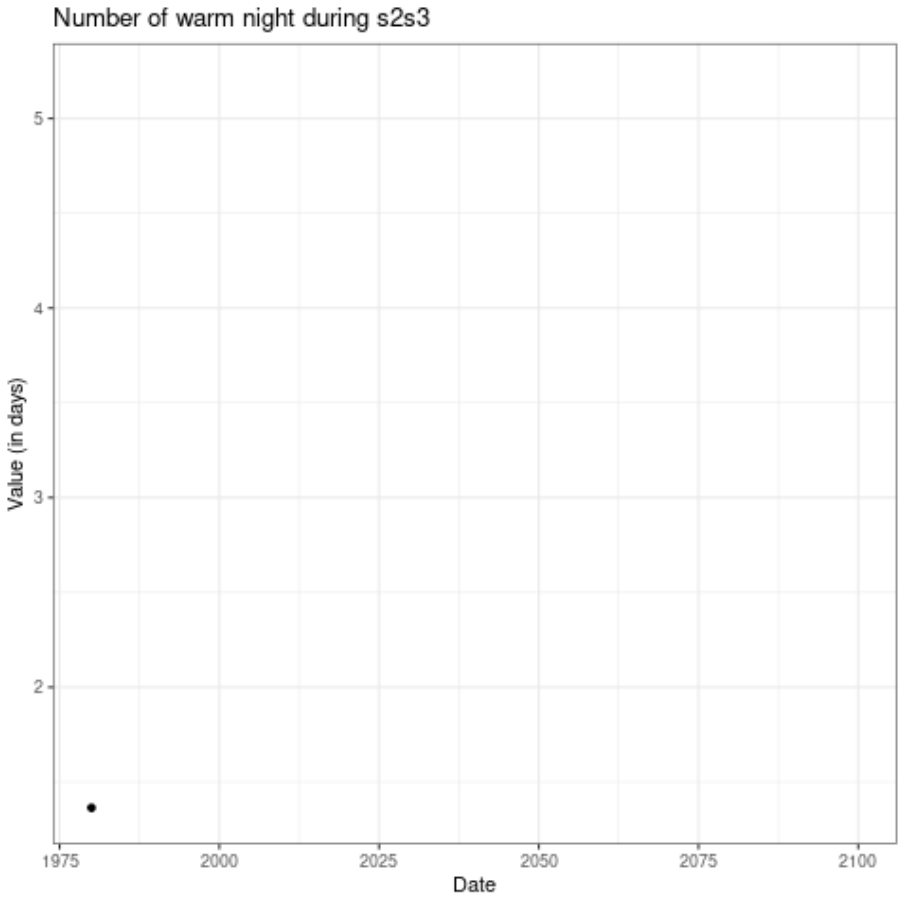
Results

➢ Number of warm nights between ear 1 cm and flag leaf stage

↗ tillers mortality

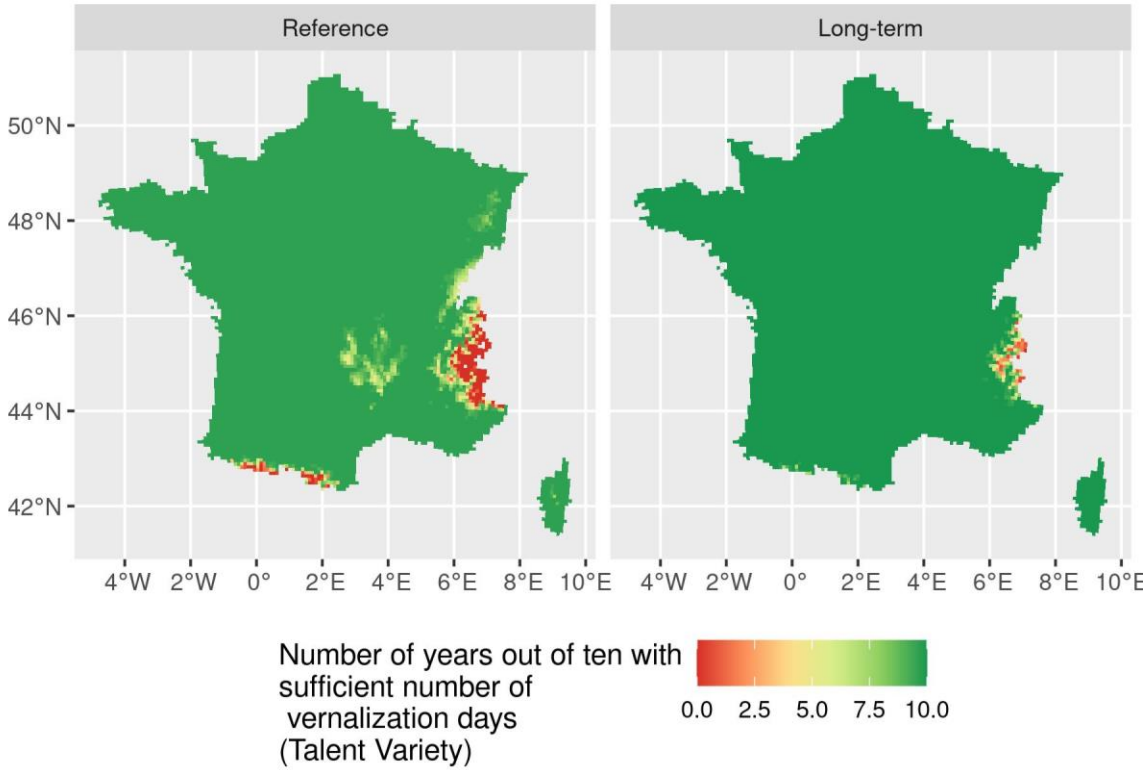


Results

➢ Evolution of Vernalisation days for Talent variety

- No area would be under a lack of Vernalisation days

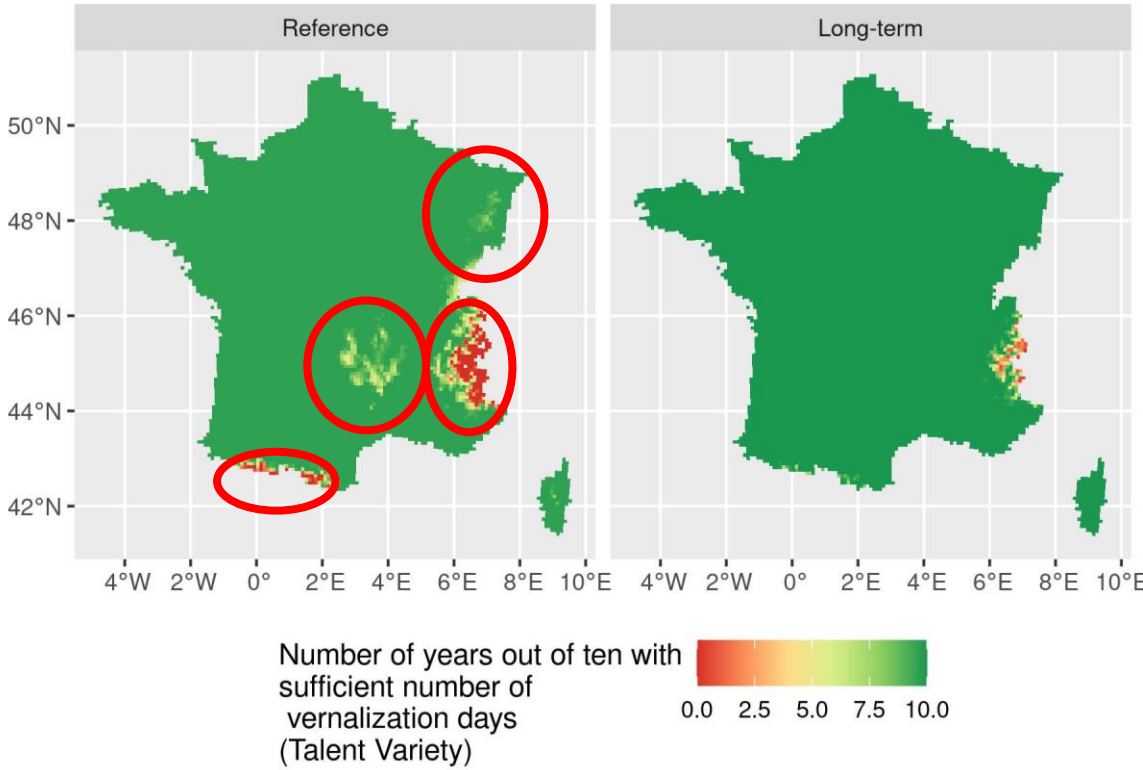
~~fulfillment of cold requirements fails~~



Results

➢ Evolution of Vernalisation days for Talent variety

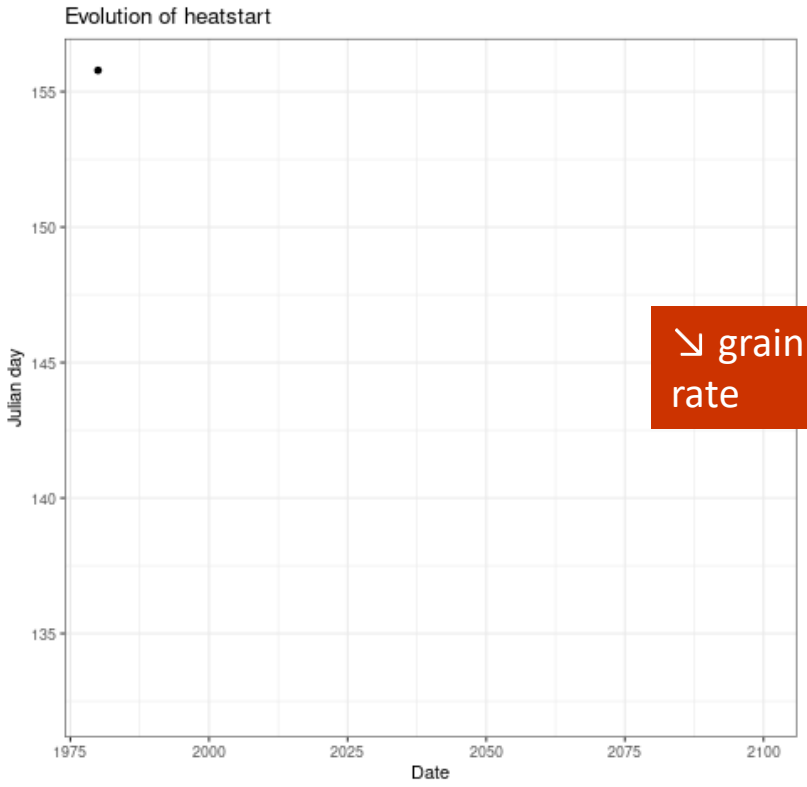
- No area would be under a lack of Vernalisation days
- News opportunities area appears in mountain landscape



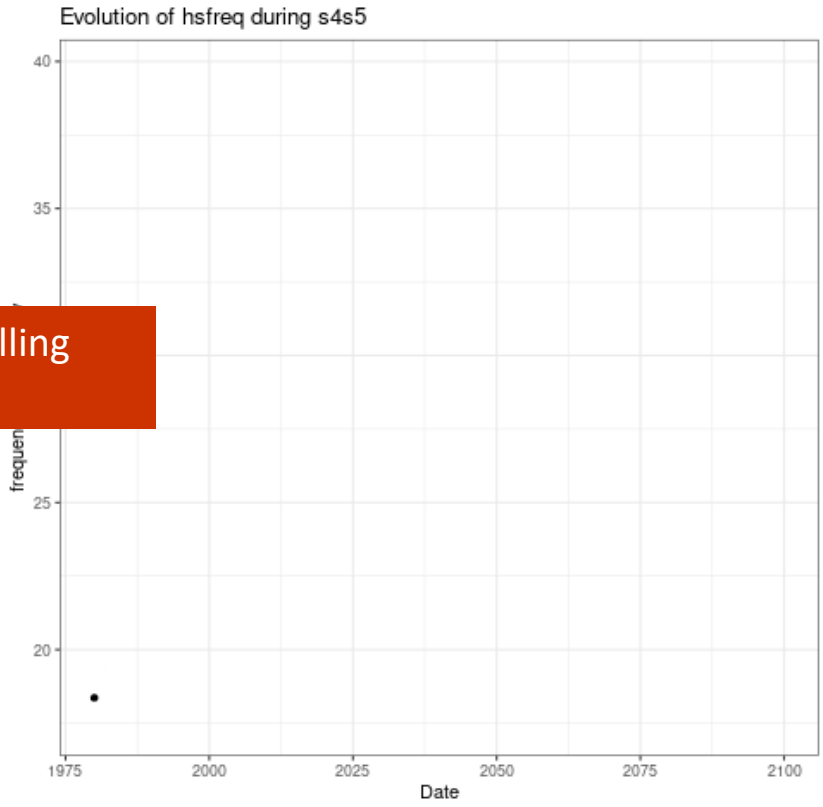
Results

➢ Evolution of heat indicators between flowering and grain filling

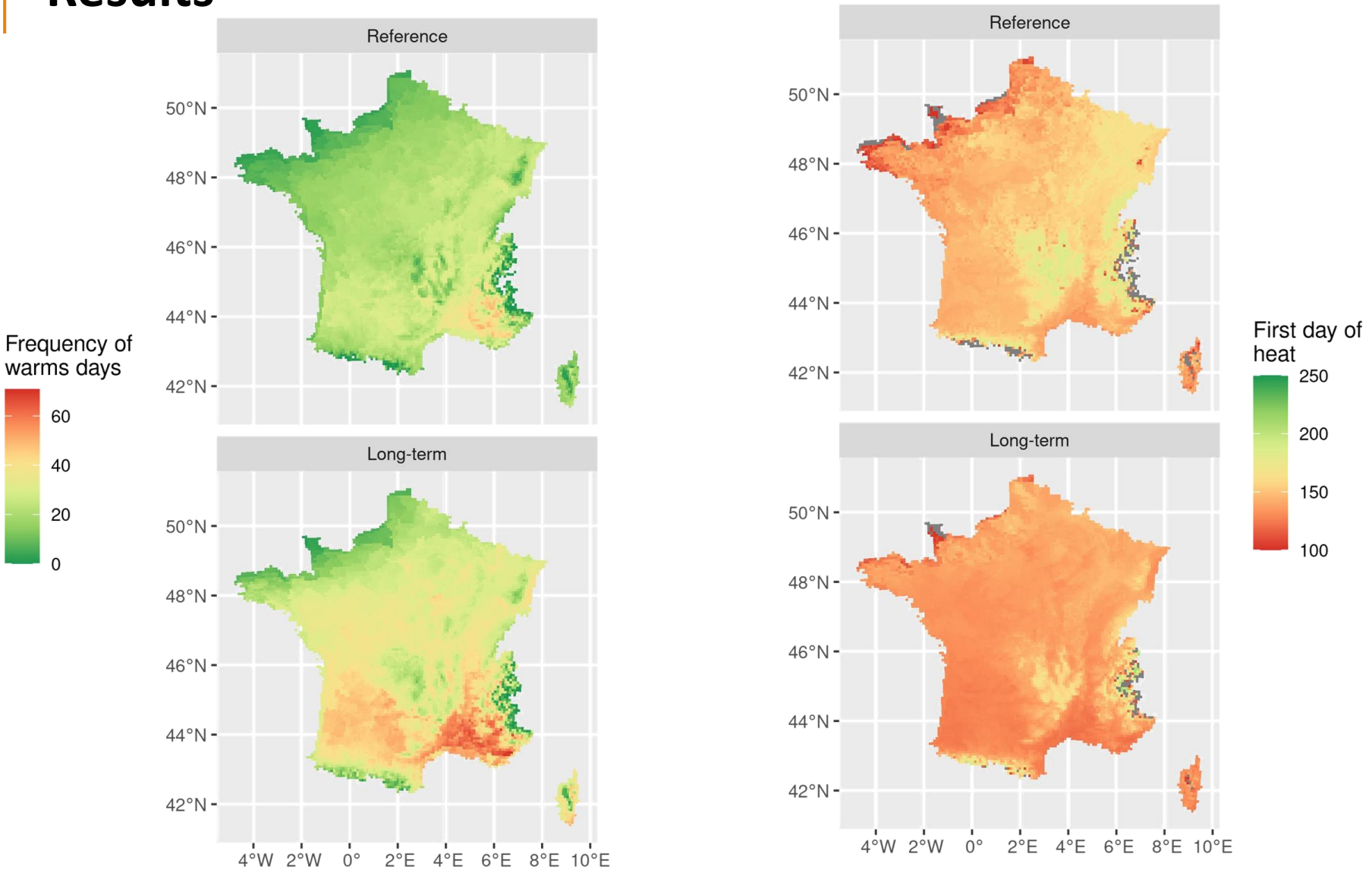
- Heat will begin early and the proportion of warm days (>35°C) rise



↘ grain filling rate



Results


Reference
Long-term
50°N
48°N
46°N
44°N
42°N
4°W 2°W 0° 2°E 4°E 6°E 8°E 10°E
Frequency of warms days
60
40
20
0
First day of heat
250
200
150
100

Conclusion

- **Scoring of both indicators (Warm night and Frequency of hot days)**

- A score of 1 means that both indicators have low values
- A score of 0 means that both indicators have hight values