Almond blooming: estimating cultivar-specific chill and heat requirements by a statistical approach.

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INTRODUCTION

For any crop, choosing the right cultivar for a given climate regime is crucial. A key determinant of cultivar adequacy to a specific location is **fulfilling flowering requirements** (chill and heat requirements), known to be cultivar-specific. One of the main features of almond is its **early blooming time**: flowering starts in mid to late winter, before leaf emergence.

OBJECTIVE AND JUSTIFICATION

The main objective of this study is to estimate cultivar-specific **chill and heat requirements (CR and HR)** of some almond cultivars as these requirements are a useful tool to **characterize and predict the adaptation** of these cultivars to other locations with different environmental conditions, as well as **predicting how climate change** and increasing temperatures **could impact their phenology**.
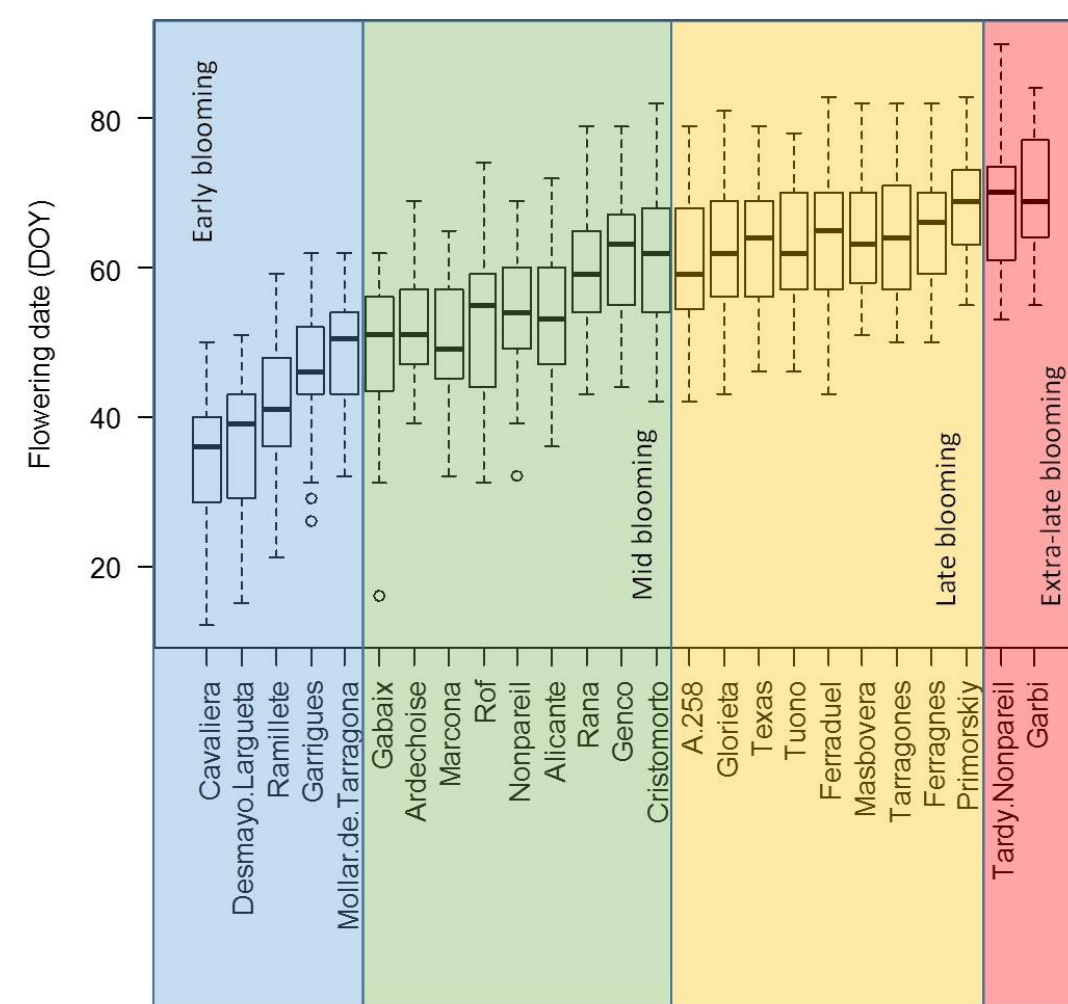
MATERIAL AND METHODS

MEDACC
Adapting the Mediterranean to Climate Change
LIFE

**Study area location (IRTA- Mas de Bover) and weather stations location in the area.**
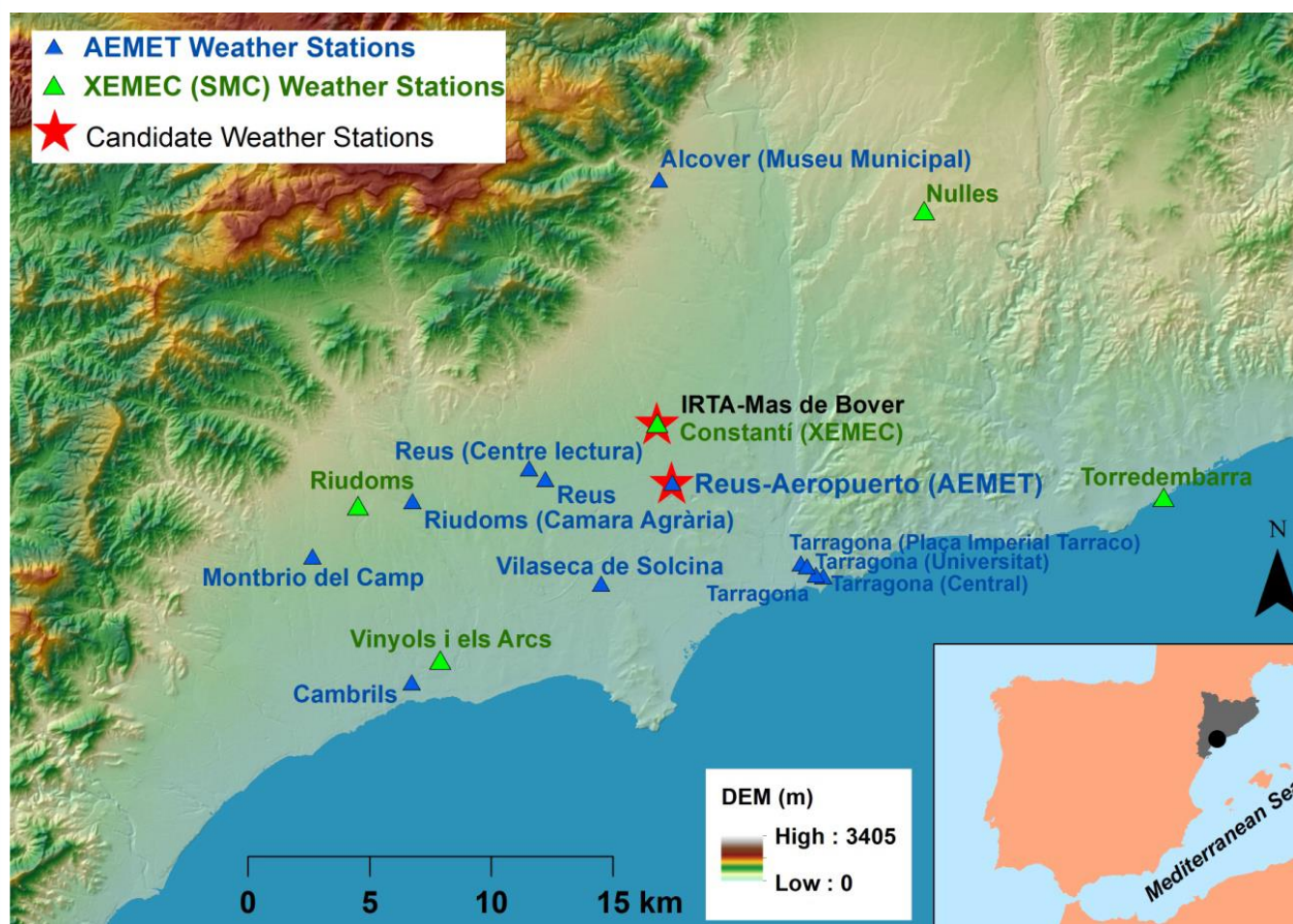
**Statistical distribution of flowering date records of 25 almond cultivars in Mas de Bover from 1979 to 2015.**

Model input

Phenology data:

✓ **25 Almond cultivars** flowering records: **1979-2015** at **IRTA-Mas de Bover**

Meteorological data:

✓ **Reconstruction** of two temperature series candidates to be used in the model at **daily level**: _Constantí_ and _Reus-Aeropuerto_, by using data from the nearest stations.
✓ Finally, **Reus-Aeropuerto was used** in the model because of its larger period of available data
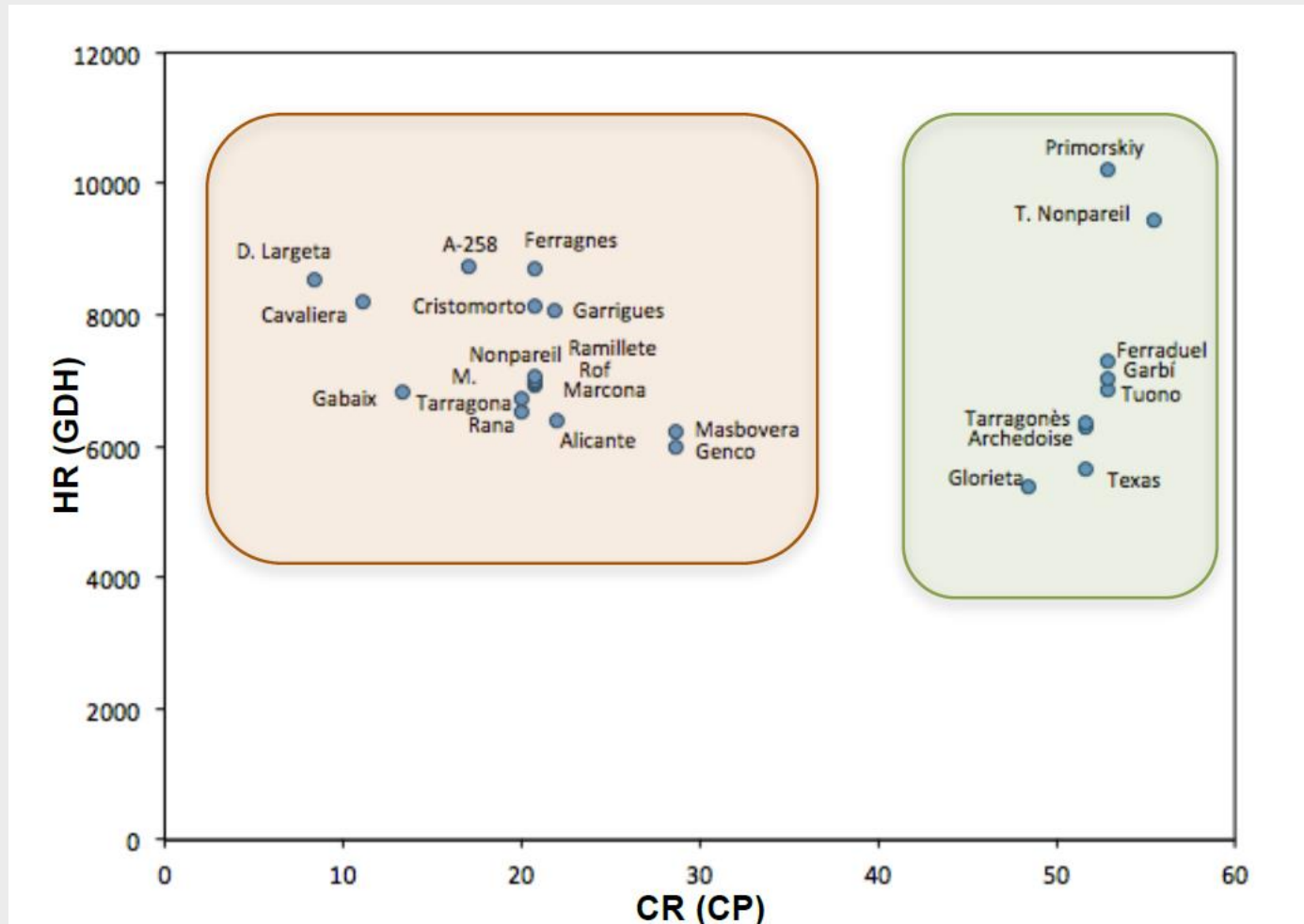
MODELING

**chillR 0.62**: Package in R (Luedeling et al., 2016)
✓ Partial Least Square Regression (PLS)
✓ Chill model: Dynamic model (chill portions, CP)
✓ Heat model: GDH(growing degree hours)

RESULTS

**Estimating Chill and Heat requirements of 25 Almond cultivars**

**PLS output. Delineating chilling (left) and forcing (right) phases for almond cultivars:**
'Desmayo Largueta'

Red bars identify days when chill or heat accumulation are affecting flowering date. Continuity of red bars helps to delineate both phases: chill (blue background) and forcing (pink background) phases.
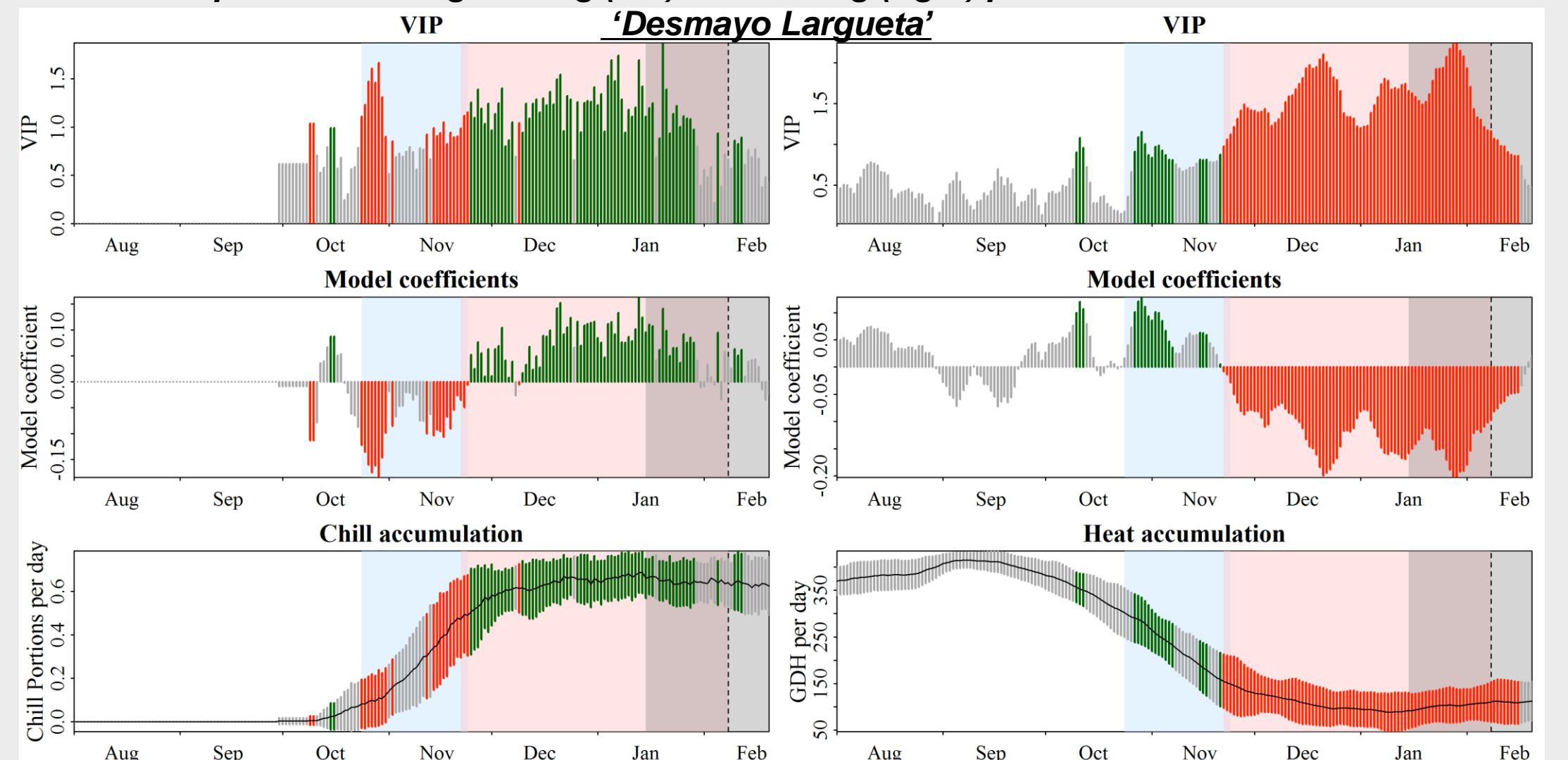
**Response of 'D. Largueta' and 'T. Non Pareil' blooming dates to mean temperatures during the chilling and forcing phases in Mas de Bover.**
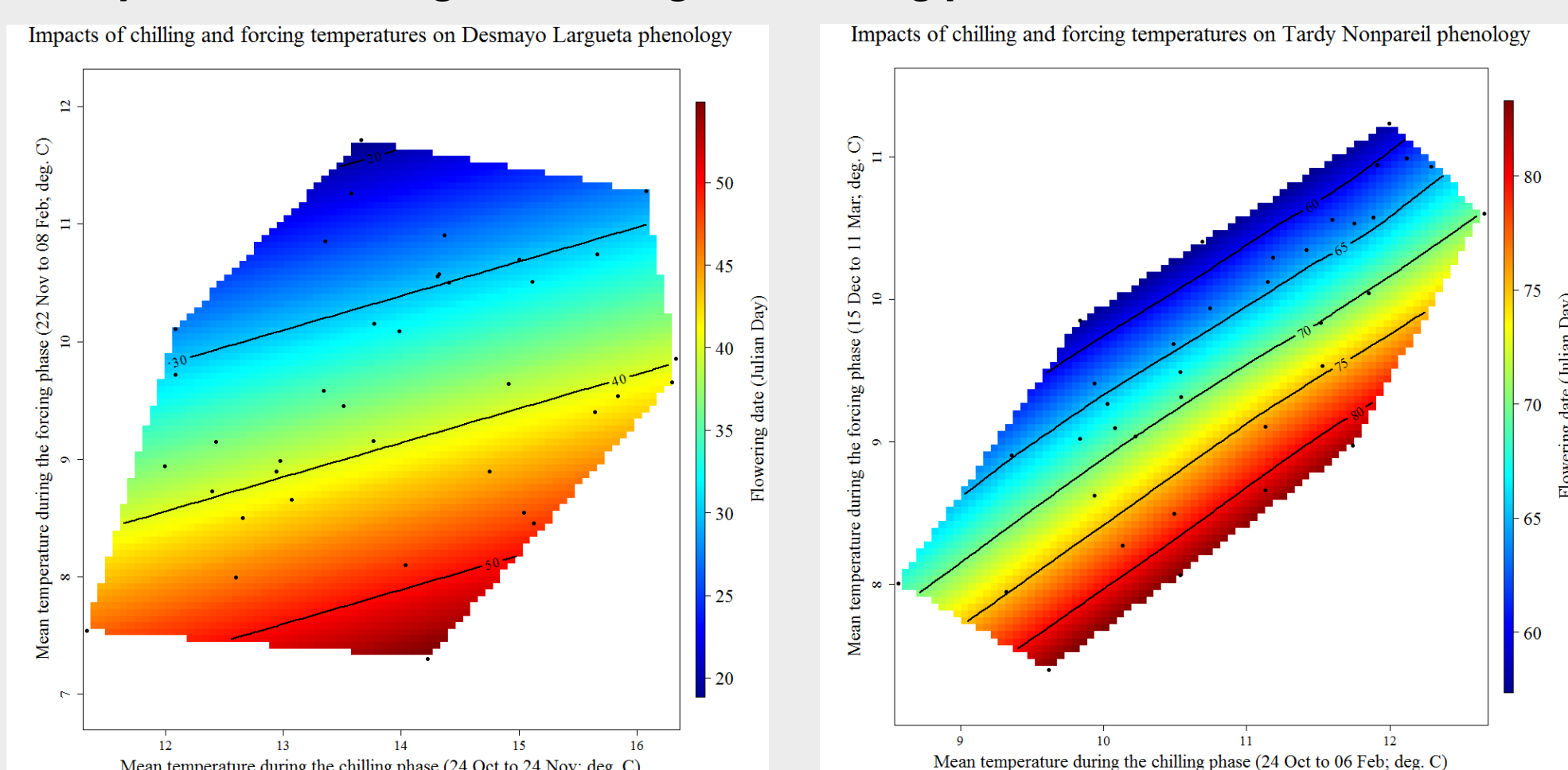
The color spectrum has to be interpreted as variation of the flowering dates. Black dots represent the blooming dates recorded for the studied period. Blooming date variability of **early bloomers** ('D. Largueta', left) is mostly sensitive to mean temperature during the forcing phase (quite horizontal isolines) and little sensitive to small temperature variations (high distance between isolines), while **late bloomers** ('T. Non Pareil', right) are sensitive to both phases mean temperatures (diagonal contour lines) and more sensitive to small temperature variations (short distance between isolines).

DISCUSSION AND CONCLUSION

The principal results showed that **the main trait defining early to late blooming cultivars was the chill requirement** due to its considerable variability between cultivars.

These results would be combined with regionalized climate change projections to investigate **risks for almond blooming** in the next decades:

✓ all almond cultivars have relatively low chill requirements, without problems to achieve them, compared with most fruit crops.
✓ However, risk of late spring frost should be examined if bloom advances result from easy chill requirement fulfillment and quicker forcing requirement fulfillment in scenarios of higher winter and spring temperatures.

References: Luedeling , E. (2016). chillR: Statistical Methods for Phenology Analysis in Temperate Fruit Trees. R package version 0.62.
http://CRAN.R-project.org/package=chillR