Low winter chill + reduction of fog

Objectives and hypotheses

FUNDAMENTAL

MANAGEMENT

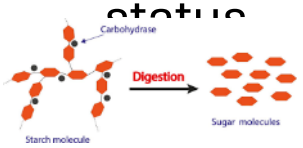
Improve the accuracy of chill estimation calculations

Meteorological approach

Physiological approach

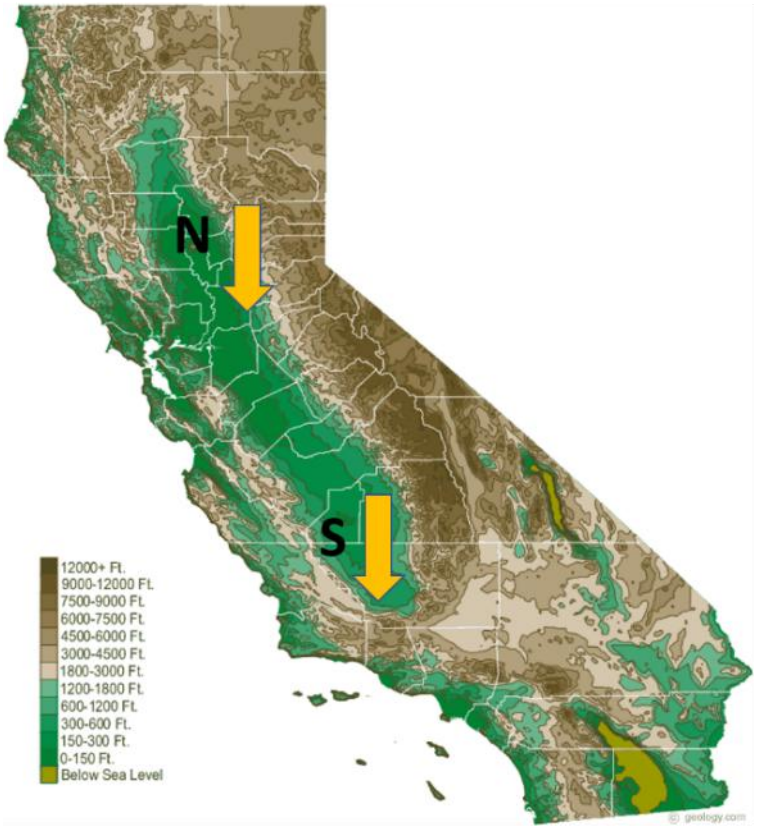
Tree temperature as predictor of chill accumulation

Non-structural carbohydrates as biomarkers of dormancy status



Improve climate change mitigation strategies

Methods



Historical chill portion (CP) accumulation: 70 (S) – 80 (N)

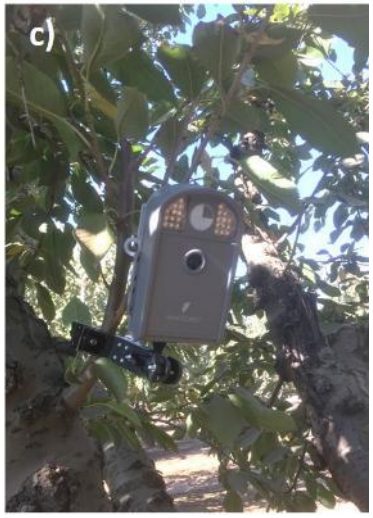
3 orchards, 3 years

Tree bark temperature

Orchard micro-climate

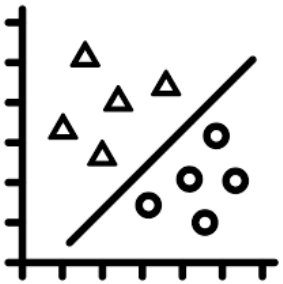
CIMIS
CALIFORNIA IRRIGATION MANAGEMENT INFORMATION SYSTEM
CALIFORNIA DEPARTMENT OF WATER RESOURCES

Macro-climate



Phenology

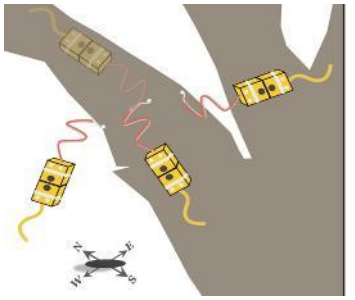
NSC sampling



Modelling

Guzmán-Delgado et al. 2025, Ag. For. Met.

Results



T branch

Common (warm) winters

Cold winter

2020-2021 | 2021-2022 | 2022-2023

N-1 | N-2 | S

Maximum weekly average temperature (°C)

0 10 20 30 40 50

Nov Dec Jan Feb Mar Apr

Temperature

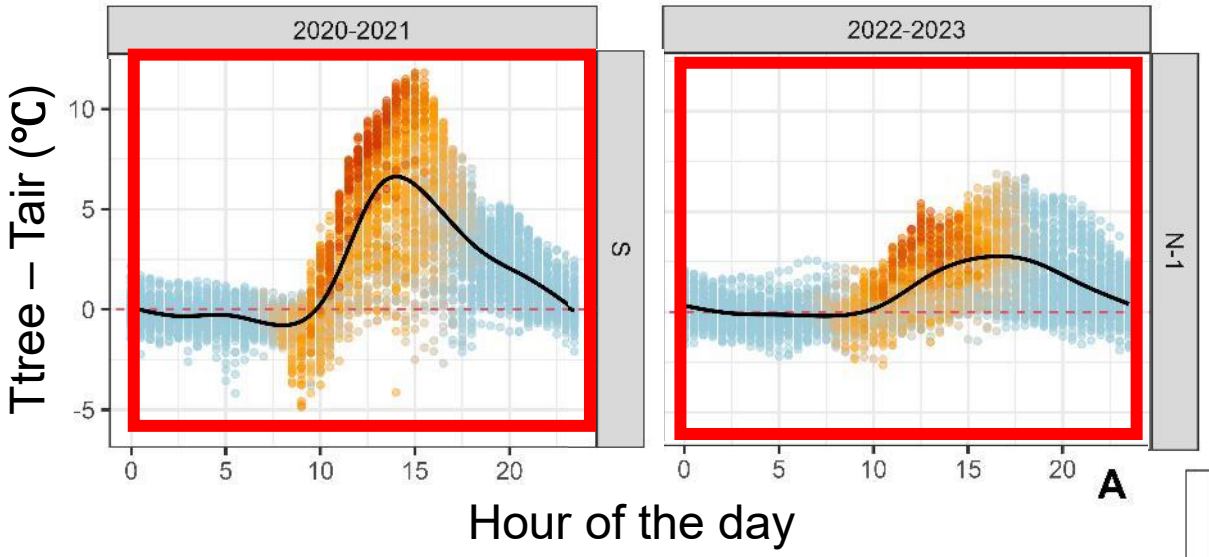
air

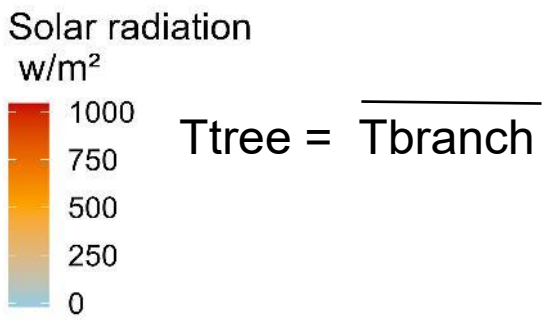
north

south

east

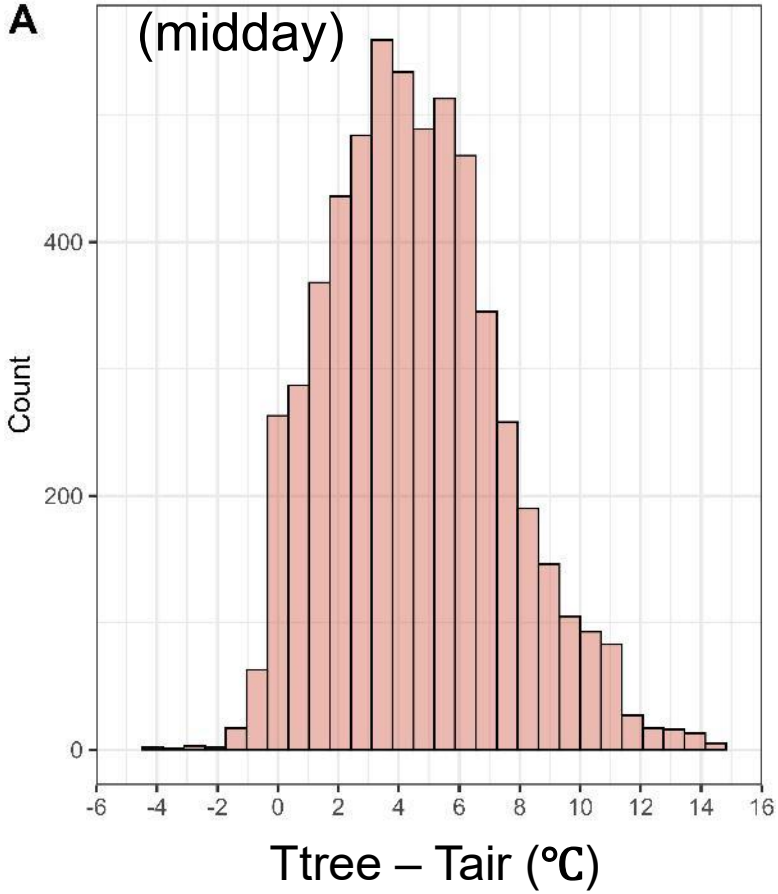
west





- ‘Tree temperature’ is affected by various weather variables, including solar radiation
- **‘Tree temperature’** is, on average, **3-7 ℃ higher** than ‘Air temperature’

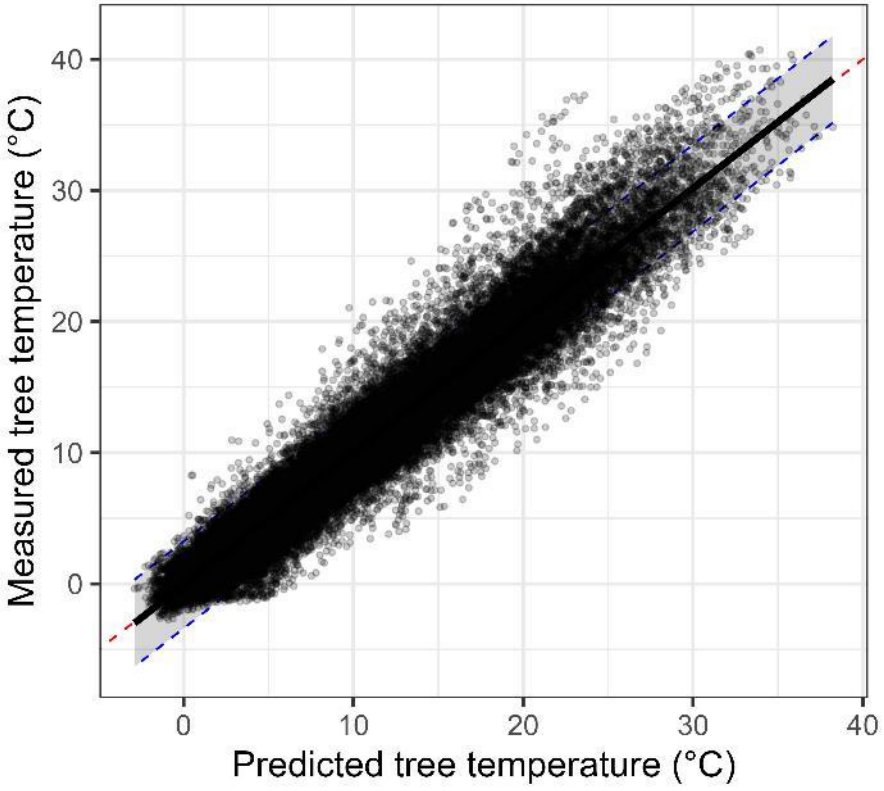
All years and locations (midday)



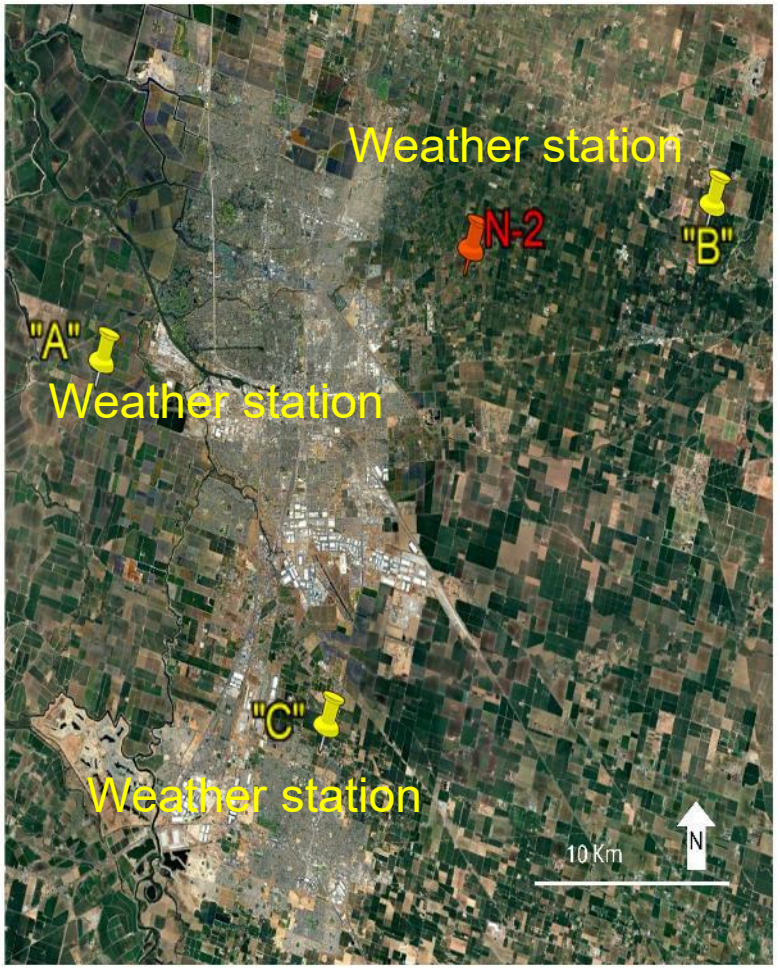
The *TreeChill* model

Cherry Chill Shiny App
https://ucanr-igis.shinyapps.io/cherrychill/

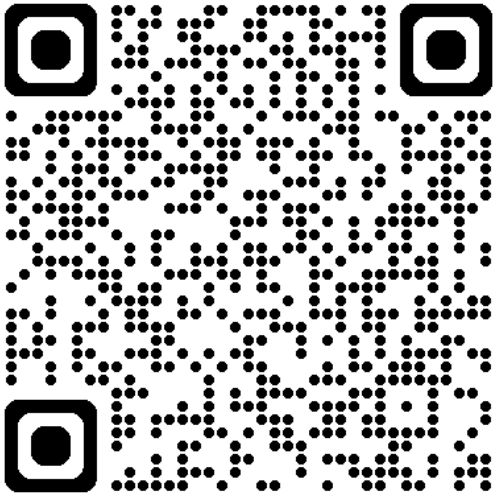
Predicts ‘Tree temperature’ from public weather data

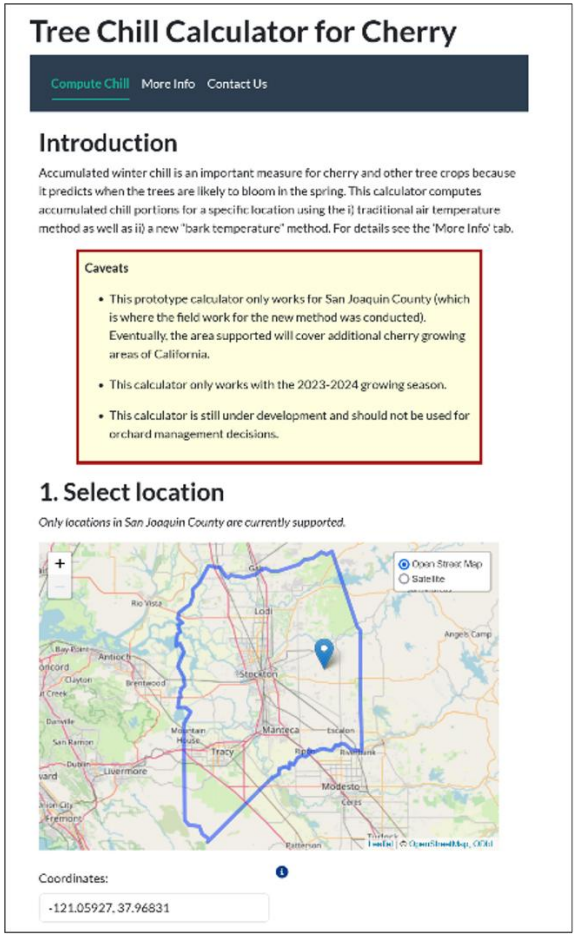


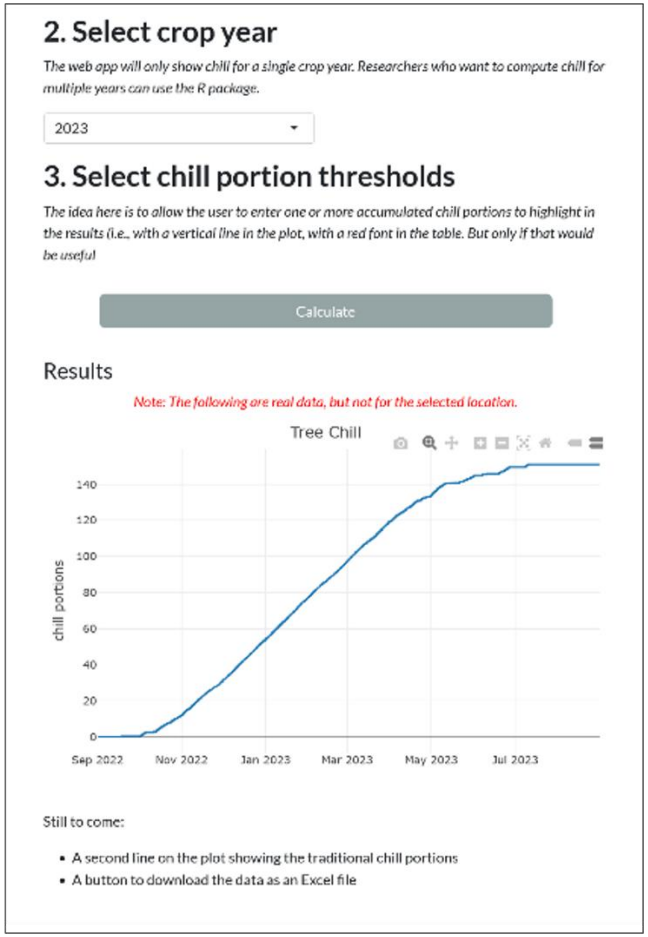
Test.data	RMSE.test	RMSE.train	R2.test	R2.train
N1	1.941	1.471	0.937	0.962
N2	1.526	1.631	0.956	0.956
S	2.406	1.416	0.917	0.961



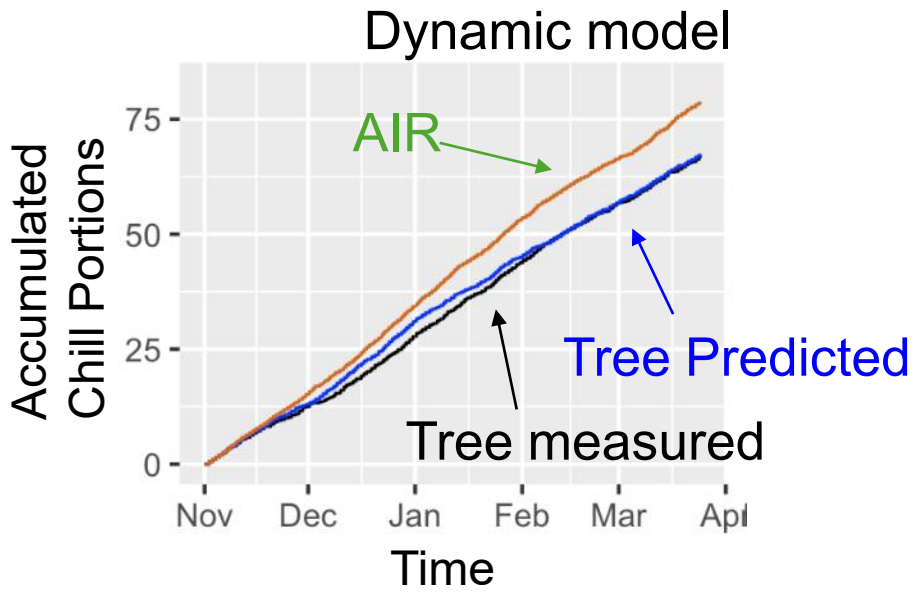
Objective 4: Developing an on line calculator for the TreeChill accumulation







Application - Chill accumulation calculations

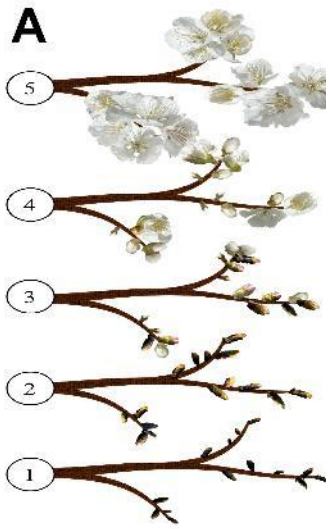


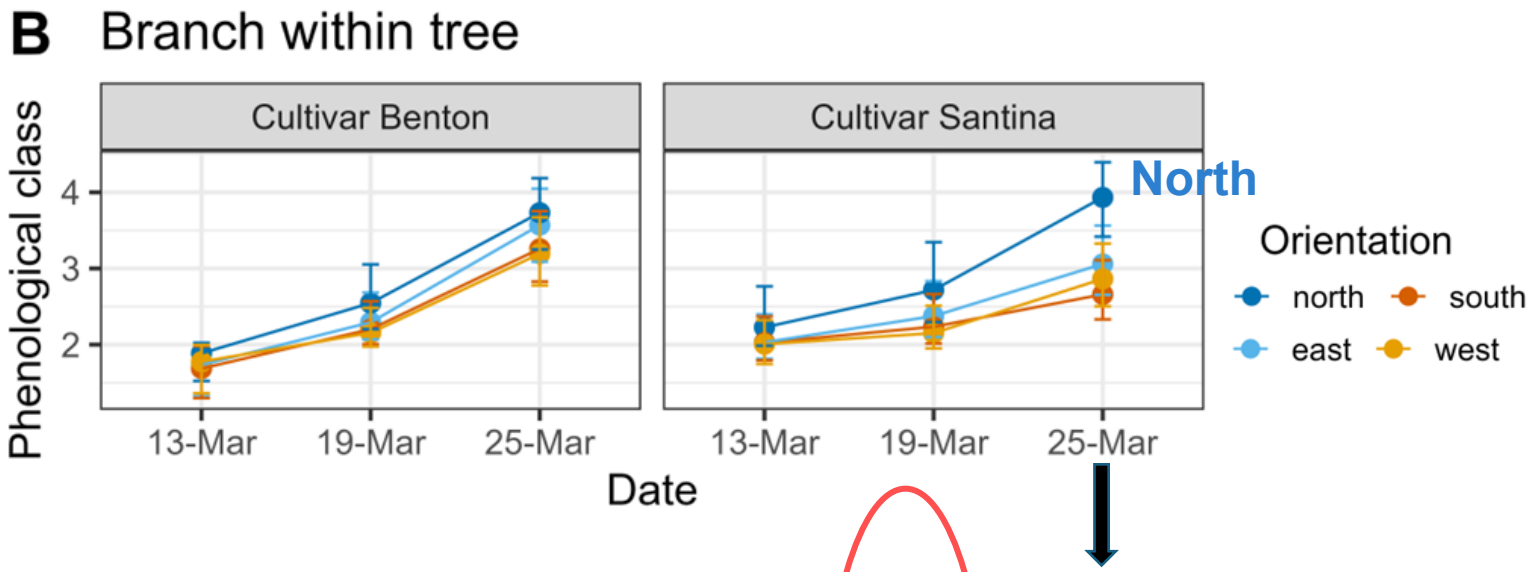
The ‘Chill_tree’ is **~10 CP lower** than the ‘Chill_Air’

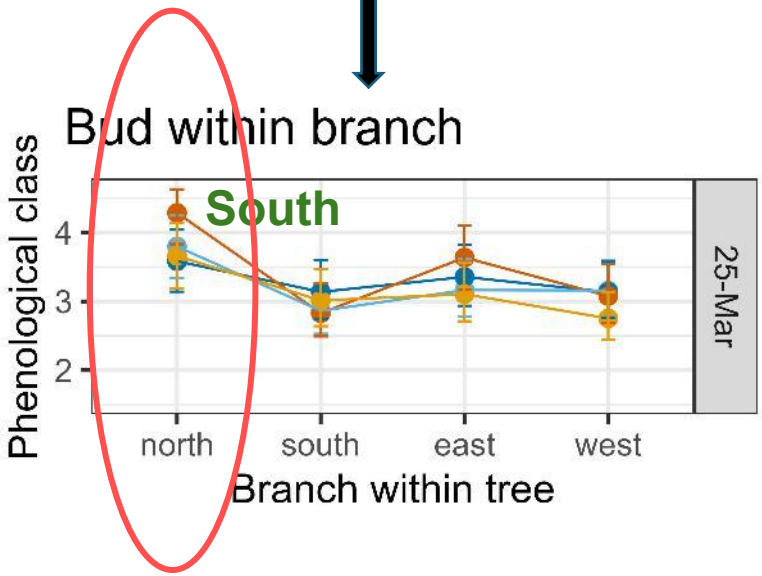
Orchard	Year	S	N	E	W	T_{tree}	pT_{tree}	T_{air}
N-1	2020–2021	58.9	67.5	65.0	59.5	62.6	62.9	71.4
	2021–2022	58.2	64.8	63.5	57.4	59.0	60.7	73.1
	2022–2023	69.2	70.9	68.4	67.2	68.7	71.5	78.3

‘Tree chill’ calculator: https://ucanr-igis.shinyapps.io/cherrychill/

Phenology





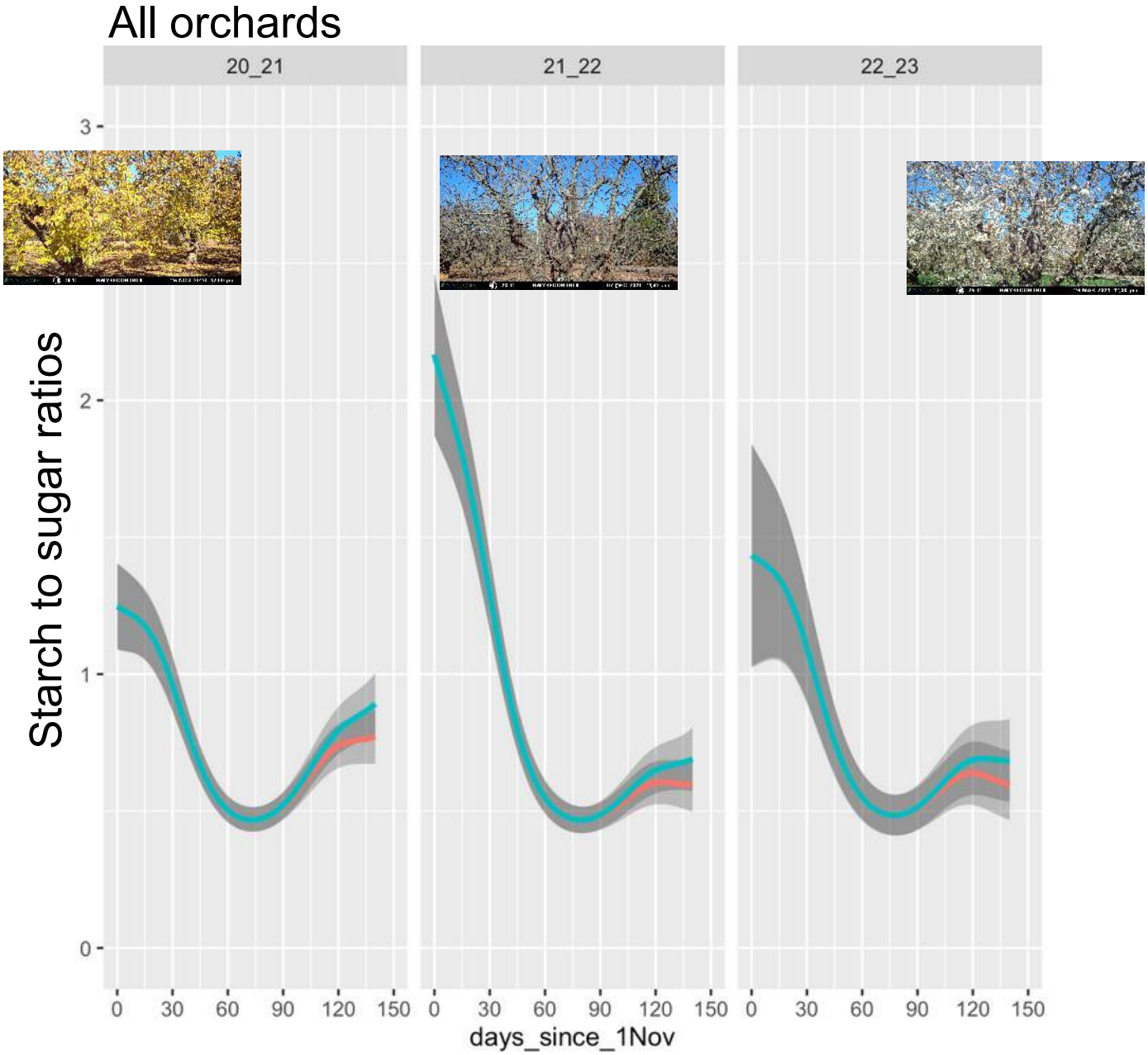


Buds located in the south of the north branches bloom first:

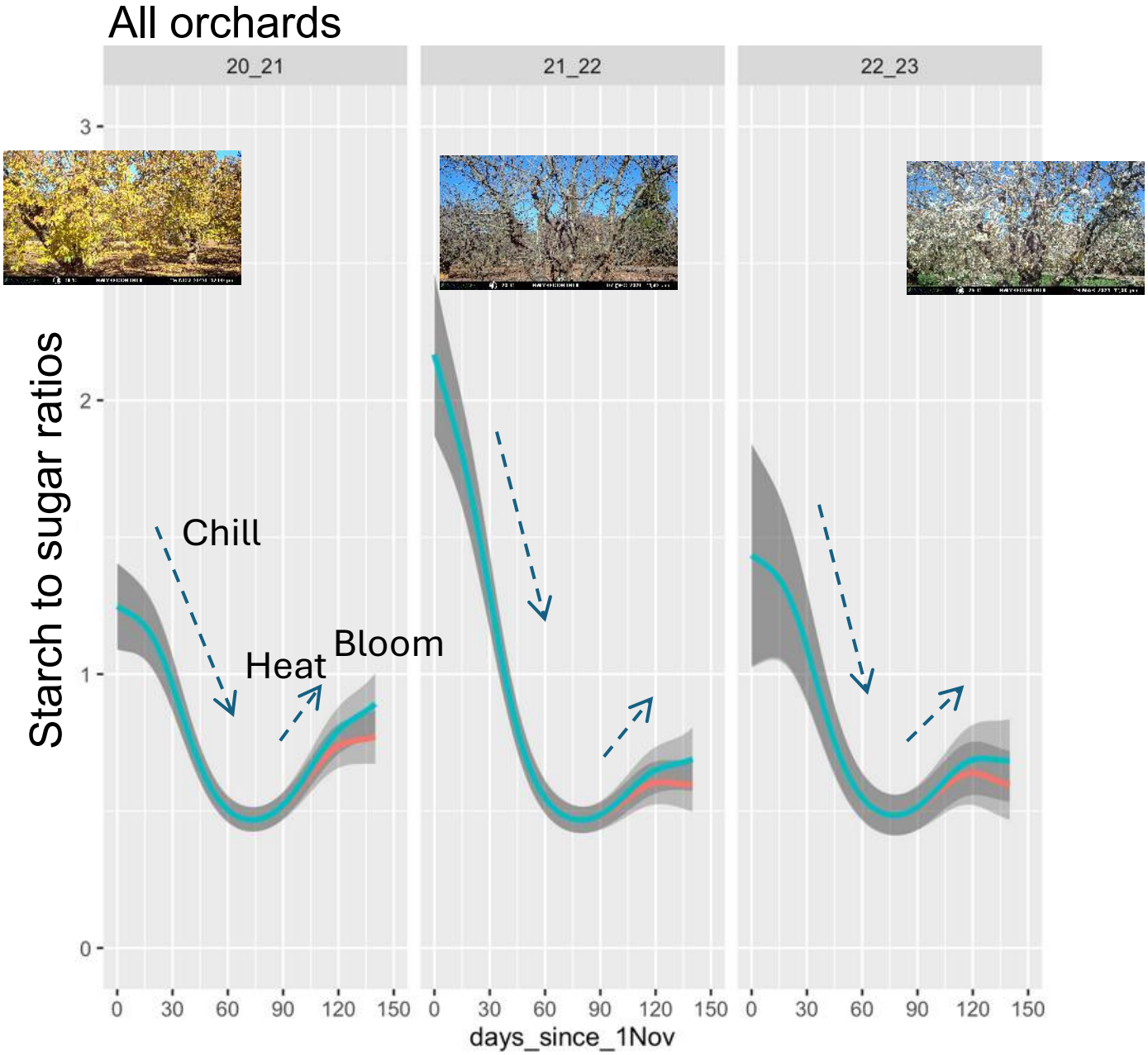
1st Colder branch orientations – chill accumulation

2nd Warmer bud orientations – heat accumulation

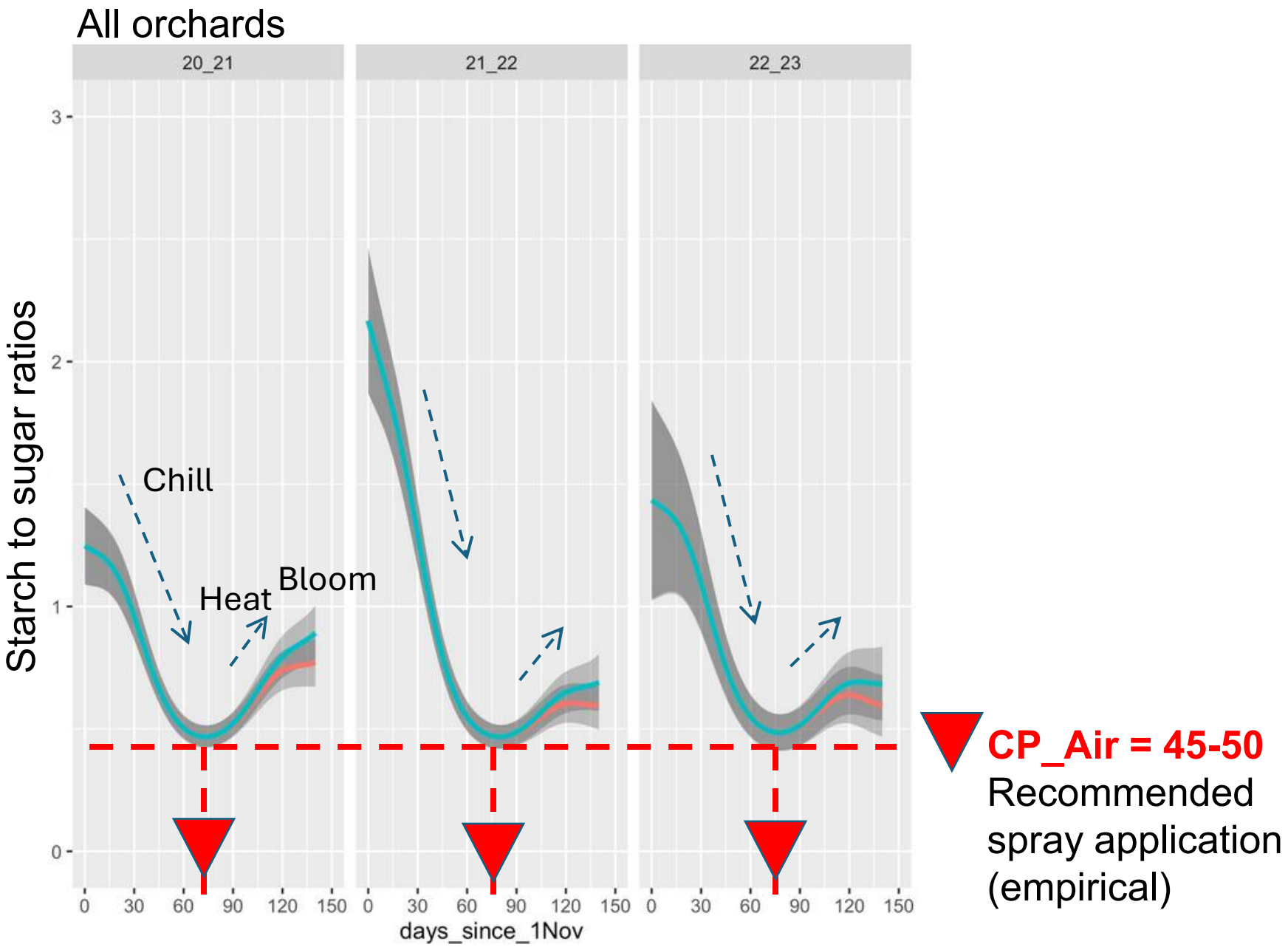
Non-structural carbohydrate dynamics



Non-structural carbohydrate dynamics



Non-structural carbohydrate dynamics



Applications and outcomes

- Better understanding of the mechanisms of chill
- Improve management: Dormancy breaking agent (DBA) timing, pest modeling, cultivar selection, orchard design, etc.

Next steps

- Timing DBA application based on '*TreeChill*' and NSC
- Apply an energy balance approach to the '*TreeChill'* model to adapt it to different locations
- Integrate whole-tree temperature dynamics