

Pour la médaille d'argent-Dufrenoy de l'Académie d'agriculture de France

Inversion du modèle bilan hydrique avec les données issues du Crowdsourcing en viticulture

Yulin ZHANG
24 Septembre, 2025

Léo Pichon, UMR ITAP, l'Institut Agro Montpellier
Bruno Tisseyre, UMP ITAP, l'Institut Agro Montpellier

Encadrant de thèse
Directeur de thèse

TTSW and vine water status

Climate conditions,
Farming practices

(Ritchie., 1981)
Total Transpirable
Soil Water

Vine water status

Yield
(Deloire and Pellegrino, 2021)

Wine quality

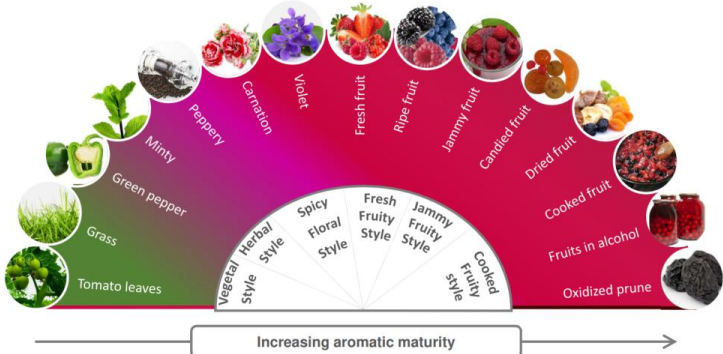
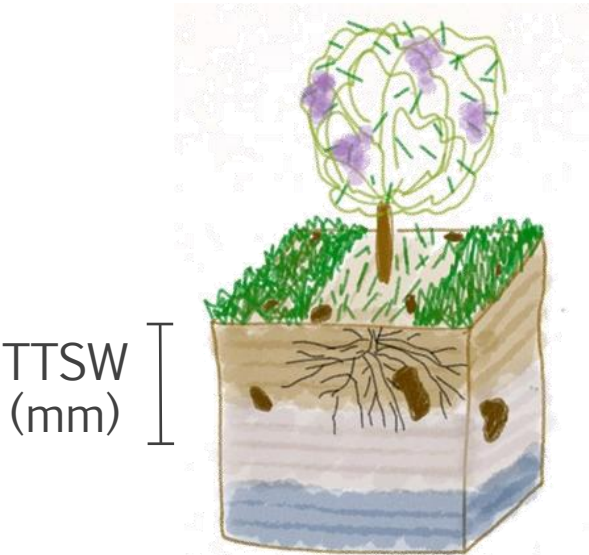


*Mechanistic
models*

Available
soil water
(mm)



(Celette et al., 2010)



(van Leeuwen et al., 2022)

Crowdsourcing and the ApeX-Vigne dataset

(Minet et al., 2017)



ApeX-Vigne

A tool for monitoring vine water status



50 vine shoots
(Pichon et al., 2022)

Less than five
minutes per
measurement

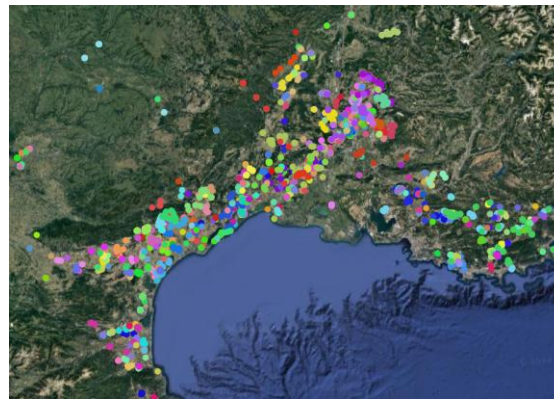
$iG\text{-Apex} \in [0; 1]$

Research question

Is it possible to retrieve TTSW with an inverse modeling approach using Crowdsourced iG-Apex?

TTSW ← **Inverse modeling** Farmsourced iG-Apex

- Difficult to measure/estimate
- Poorly known in space



- Easy to collect
- Abundant observations at a regional scale

Literature research on inverse modeling



Computers and Electronics in Agriculture

Volume 217, February 2024, 108624



Why make inverse modeling and which methods to use in agriculture? A review

Yulin Zhang ^a  , Léo Pichon ^a, Sébastien Roux ^b, Anne Pellegrino ^c,
Thierry Simonneau ^c, Bruno Tisseyre ^a

(Zhang et al., 2024a)

Crowdsourced data's specificities

- A **large number** of locations
- A high level of environmental **diversity**



**Rapid
Generalizable**

Adapt a TTSW inverse model for non-irrigated vineyards

Soil water balance model

*simplification under
specific conditions*

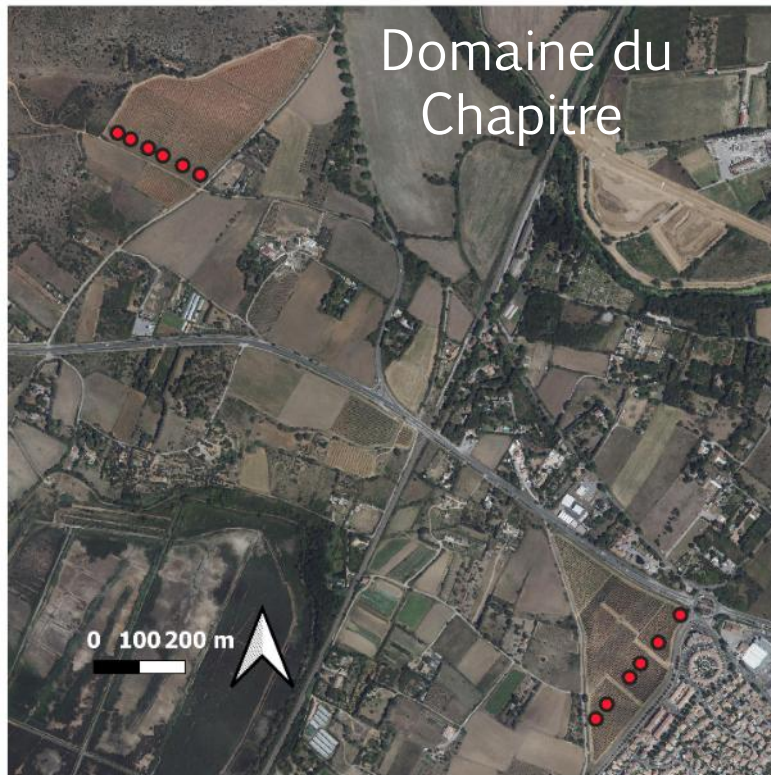


The inverse model of
Gaudin et al. (2017)

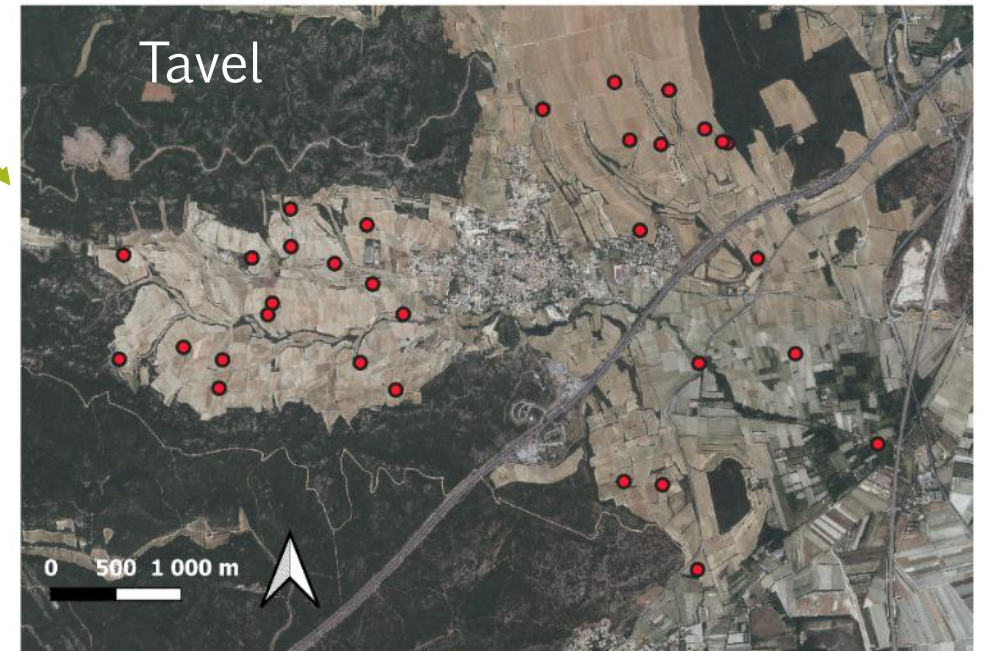
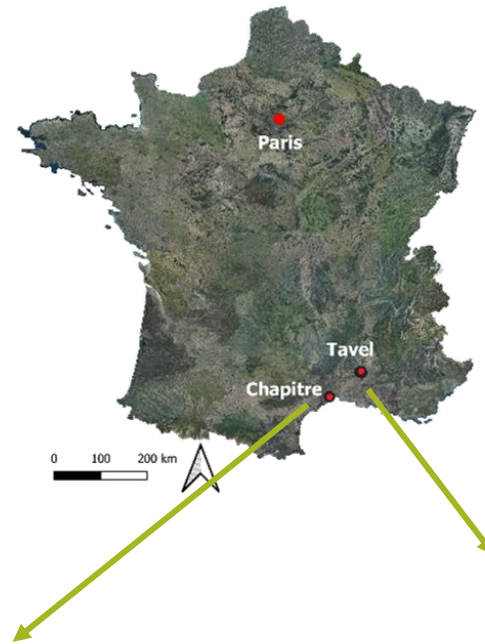
- Dry period
- No capillary rise
- Activated stomatic regulation

A situation where the only source of variation of soil water storage is related to plant transpiration under water deficit

Experimental data

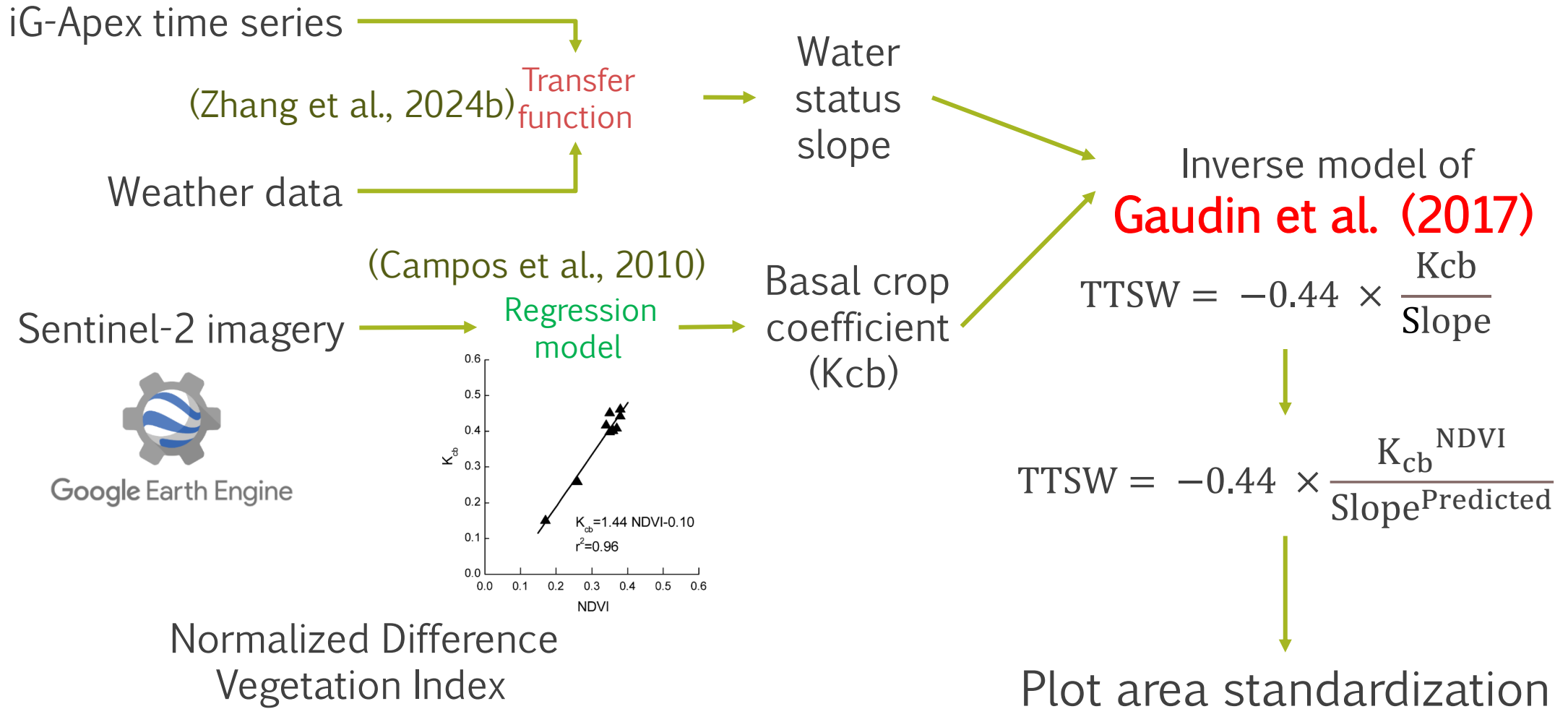


2022
(cv. Syrah)

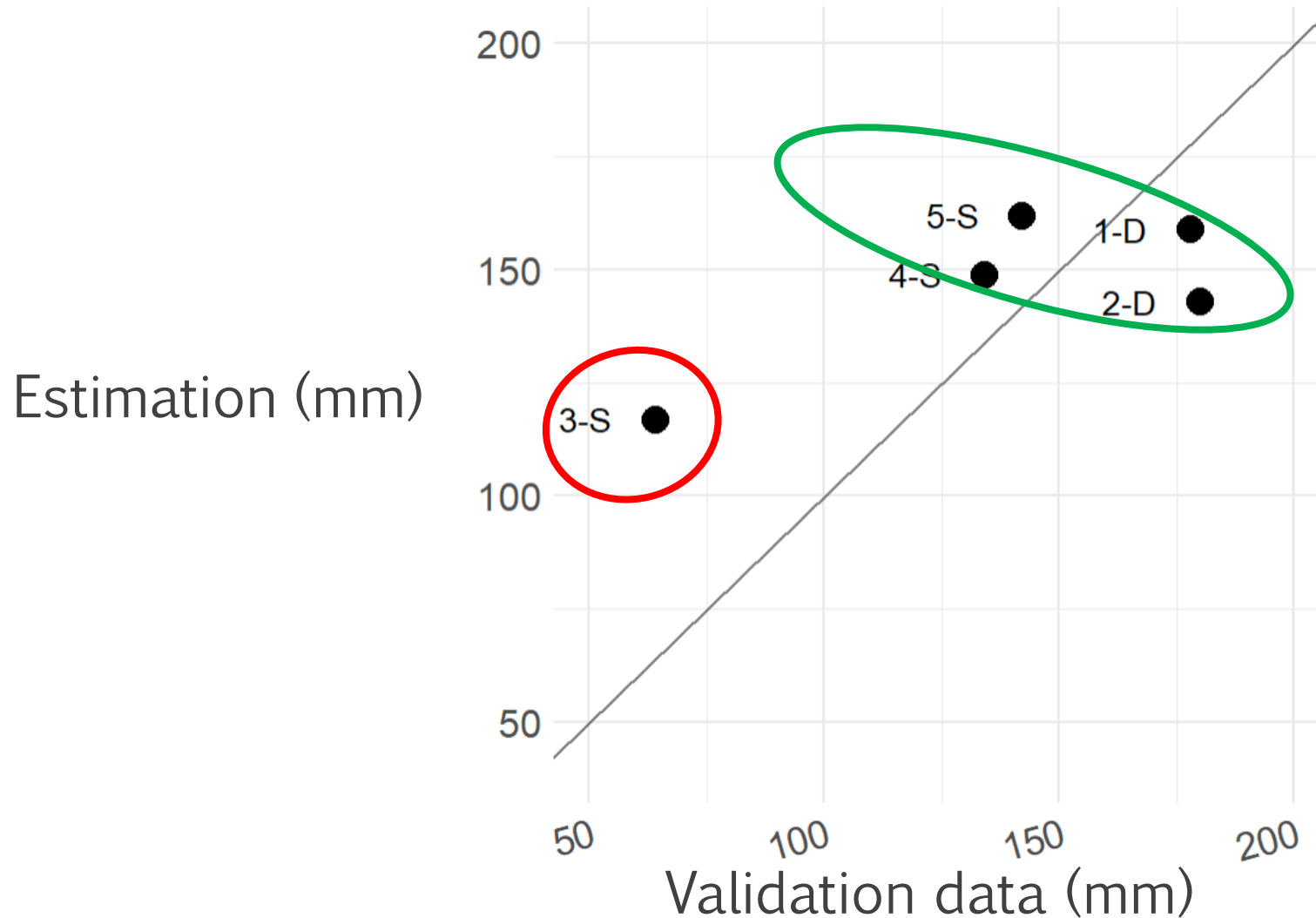


2008 – 2012
(cv. Grenache)

Inverse model inputs



Global estimation accuracy



$R^2 = 0.59$
RMSE = 32 mm
MAE = 29 mm

Publications



Agricultural Water Management

Volume 302, 1 September 2024, 108998



Predicting predawn leaf water potential while accounting for uncertainty using vine shoot growth and weather data in Mediterranean rainfed vineyards

Yulin Zhang ^a , Léo Pichon ^a, Anne Pellegrino ^b, Sébastien Roux ^c,
Cécile Péruzzaro ^a, Bruno Tisseyre ^a

(Zhang et al., 2024b)



Data in Brief

Volume 59, April 2025, 111295



Data Article

A dataset of three vine water status indicators, weather records and soil available water capacity components collected from a rain-fed Mediterranean vineyard

Yulin Zhang, Léo Pichon , Bruno Tisseyre

(Zhang et al., 2025a)



Agricultural Water Management

Volume 318, 1 September 2025, 109760

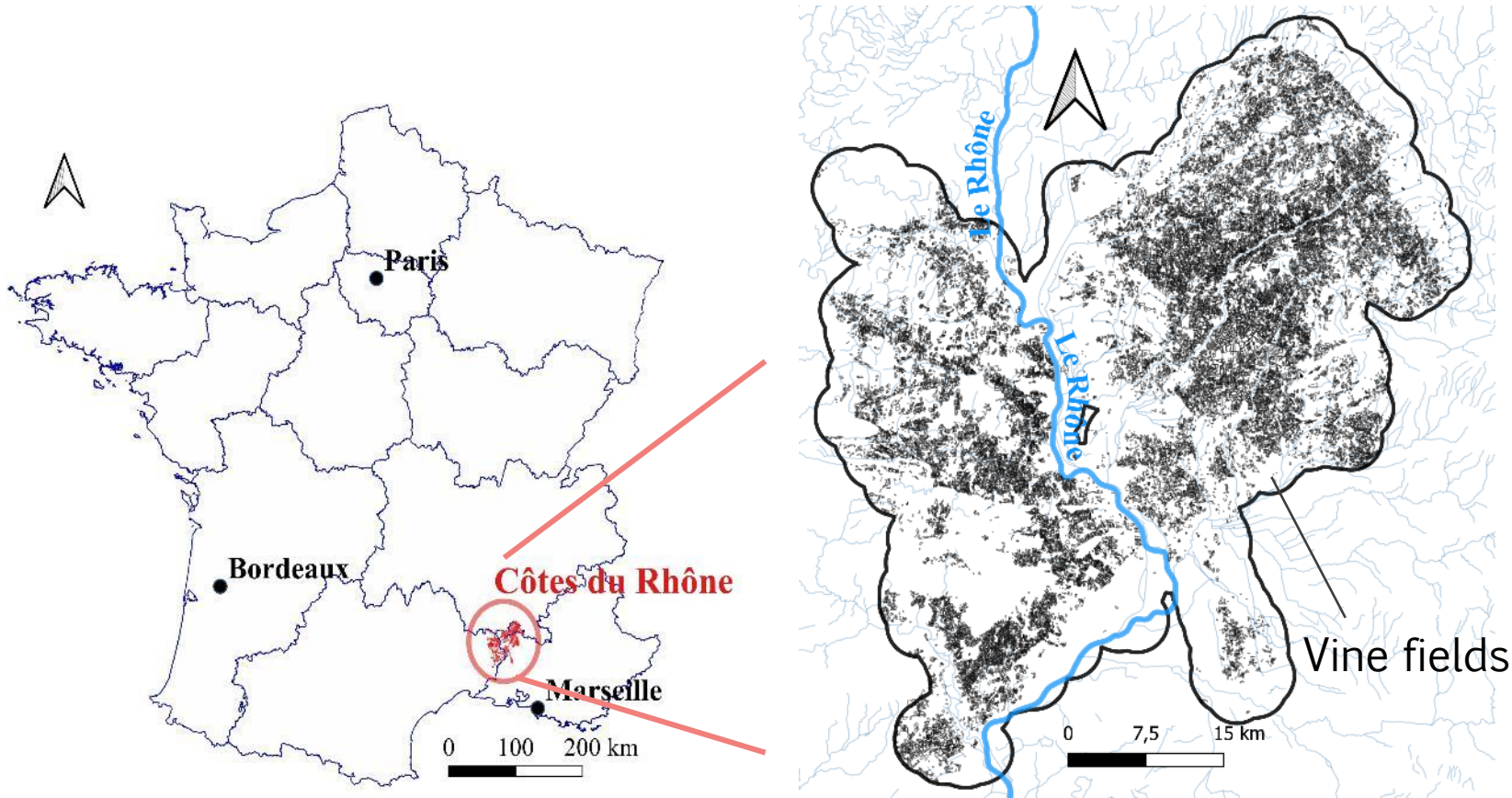


Retrieving total transpirable soil water in a rainfed vineyard using vine shoot growth, weather, and Sentinel-2 data

Yulin Zhang ^a , Léo Pichon ^a , Sébastien Roux ^b, Anne Pellegrino ^c,
Guillaume Coulouma ^d, Bruno Tisseyre ^a

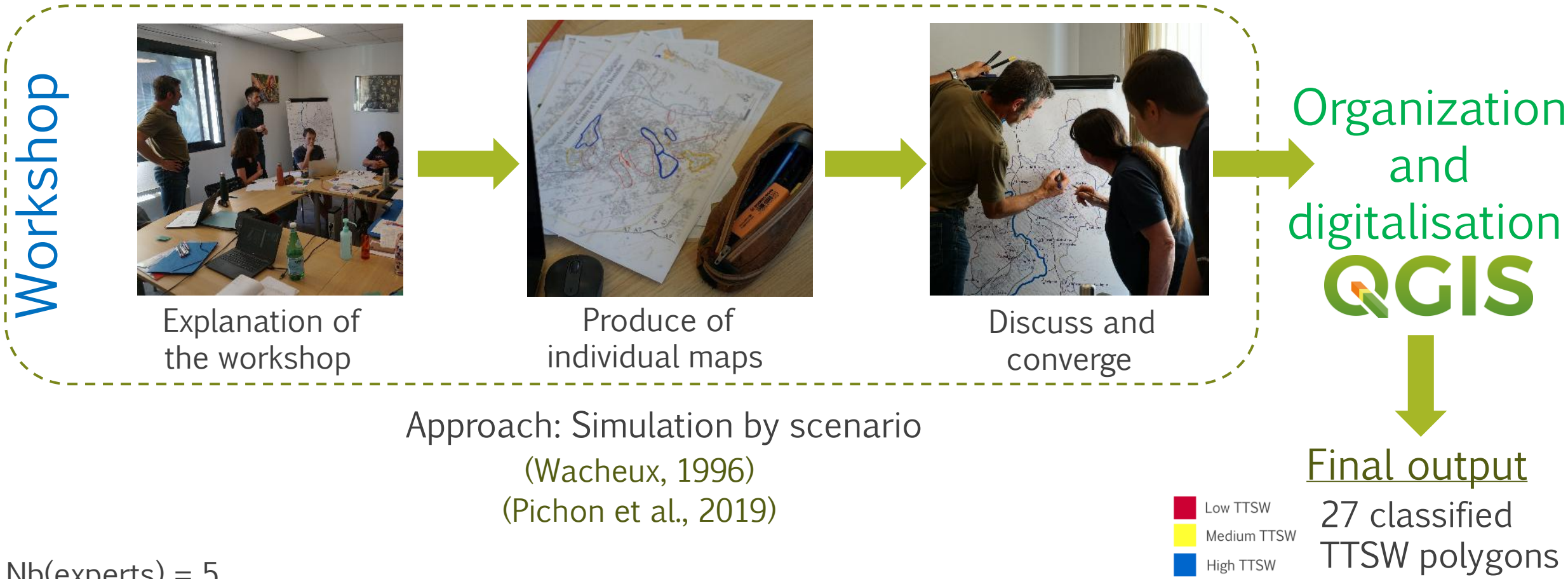
(Zhang et al., 2025b)

Case-study: Côtes du Rhône

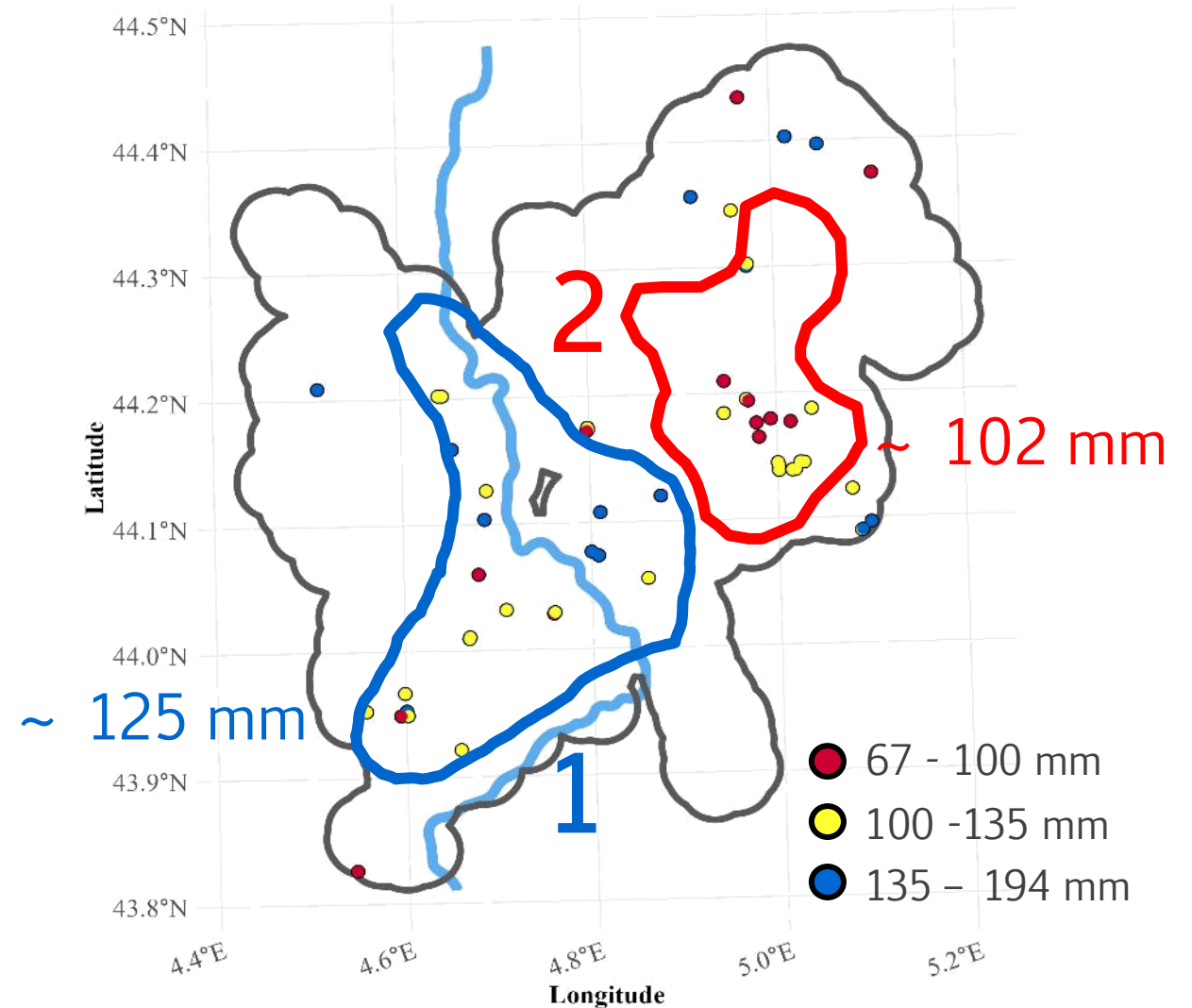
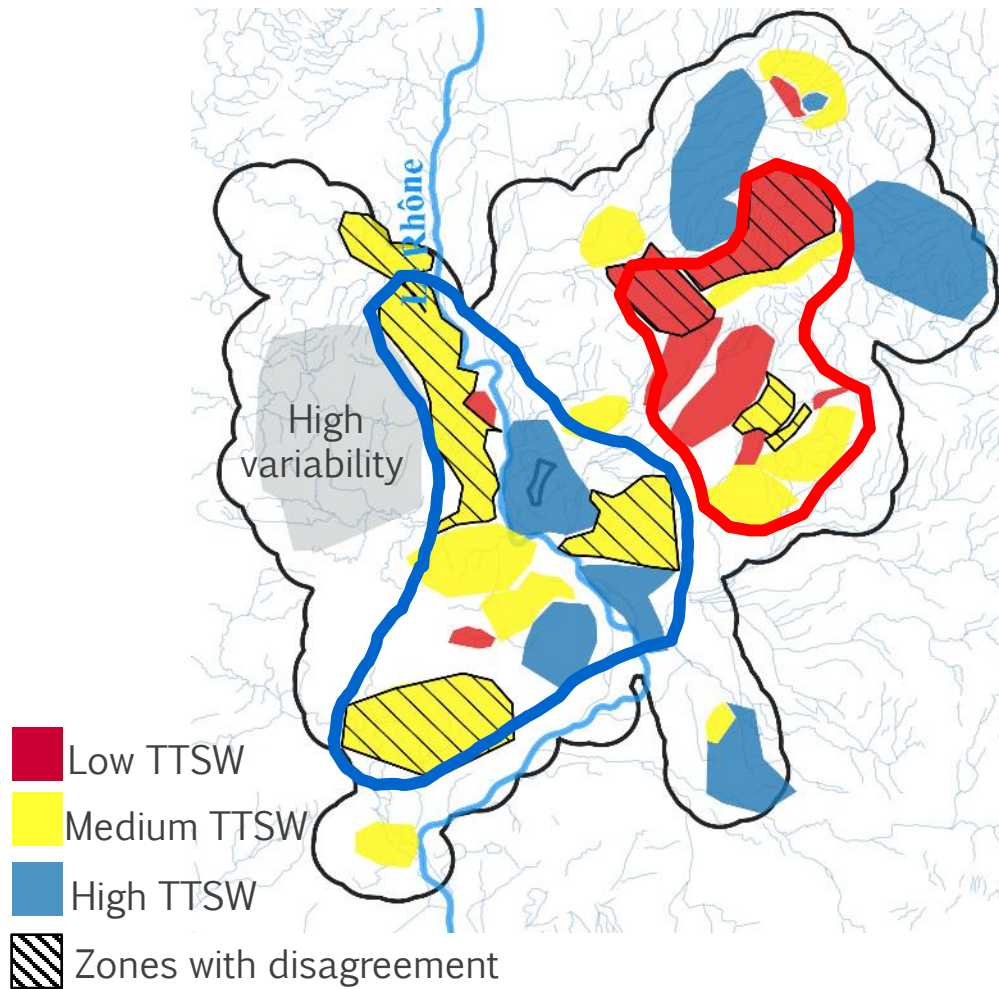


- Mainly warm temperate climate, with dry hot summer (Kottek et al., 2006)
- Over 1,200 km²
- 3,000 farmsourced measurements (1,749 time series)
- Short time series (less than 2 observations per time series)

Using expert knowledge to evaluate regional TTSW estimations



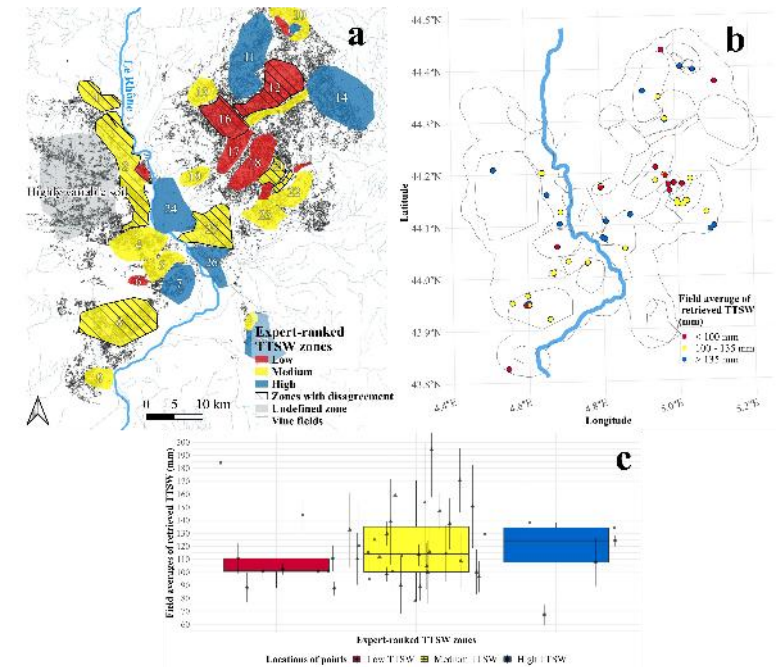
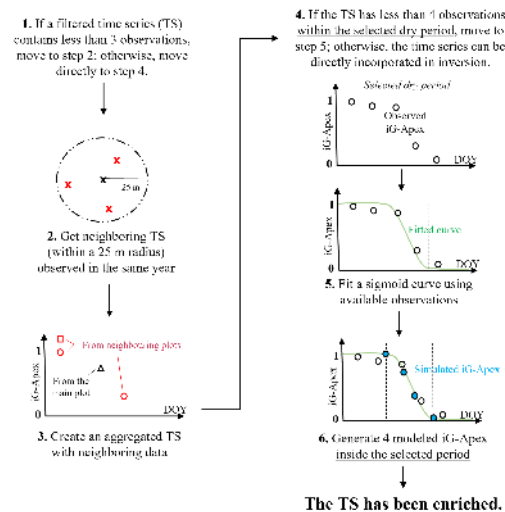
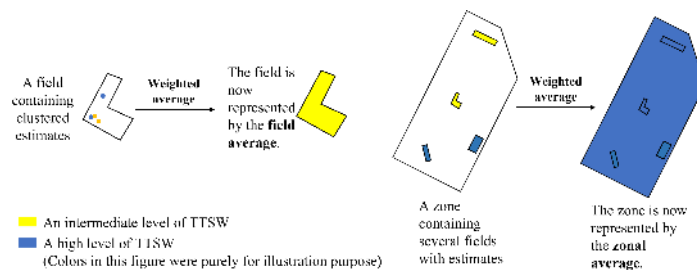
Comparison with the expert-generated map



Publication (forthcoming)

Potentials of crowdsourcing data for retrieving total transpirable soil water in a wine appellation

(Zhang et al., to be submitted (Oeno-one))



Scientific contributions and perspectives

- A water status model using the index of vine shoot growth and weather data
 - A TTSW inverse model based on iG-Apex, weather and Sentinel-2 data
 - Using crowdsourced observations to reveal large-scale TTSW variation
-
- Broadening the validation conditions
 - Combining ancillary data for handling missing information
 - Improving Crowdsourcing practices



Merci pour votre attention.

