# Improvement of grapevine yield simulation in Champagne with the STICS model

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# Introduction

- This work is a part of the project ViticCycle:
  - Nitrogen, water and carbone cycles in Champagne grapevine for a better adaptation to climate change and environmental impacts limitation

Context:

- Climate change leads to an increase of yield variation in Champagne
  - More common drought events
  - Increased risk of spring frosts

- These climatics events can reduced photosynthesis, bunch number and perennial reserves of *Vitis vinifera* L. and have a negative impact on yield

- To protect the environment, grass cover of grapevine field is encouraged by the administration, but this led to a competition for resources between grapevine and grass

# Introduction

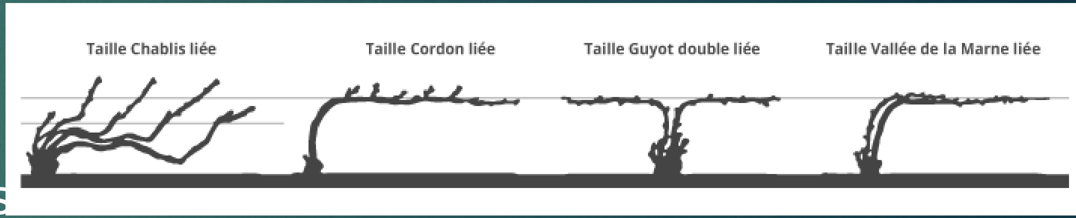
- ✓ It is important to understand the effect of growing conditions and crop management on annual and following years growth of grapevine

- ✓ Vine growers have to face to multiple chalanges and there is a need to develop a decision-making tool to help them in their practices

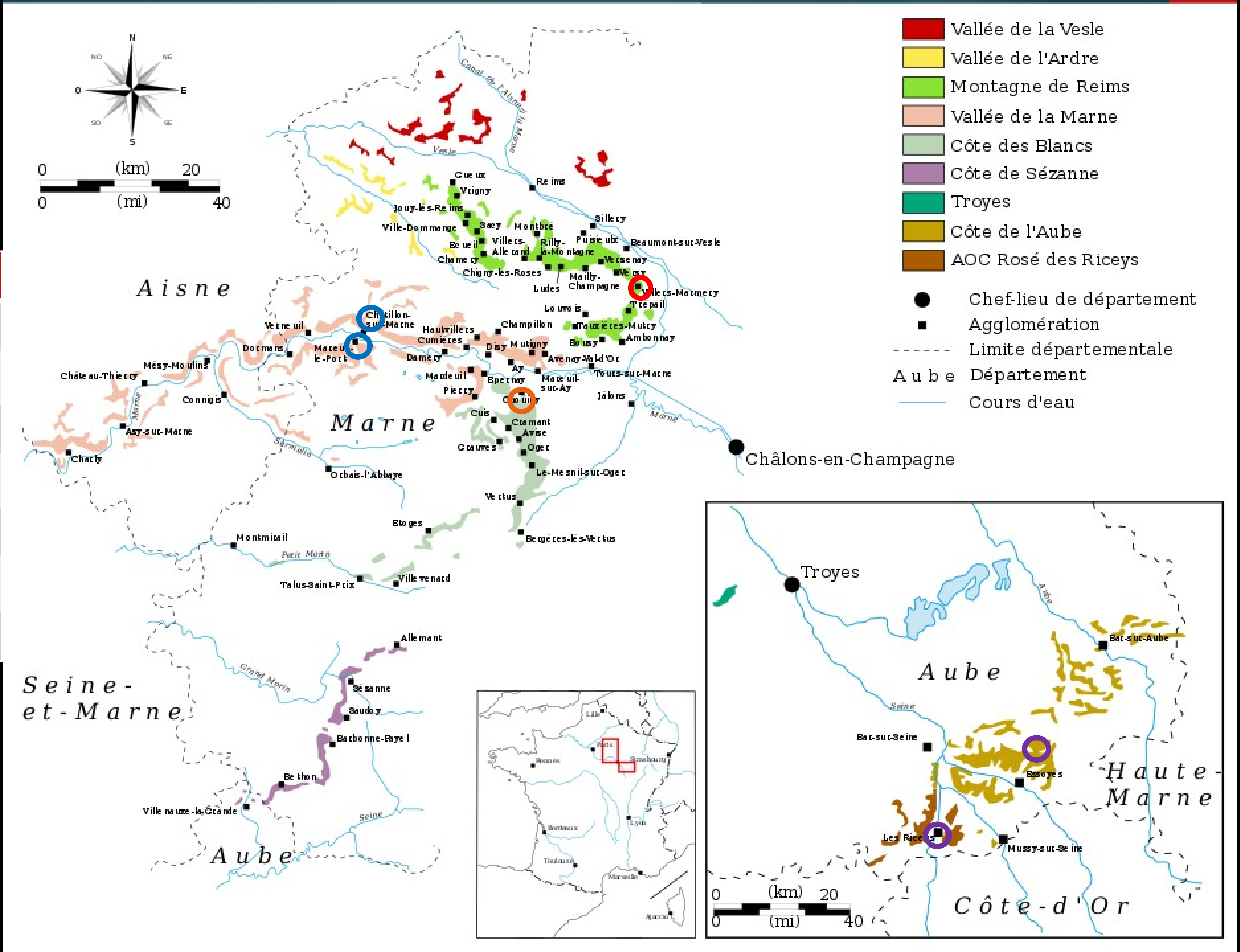
- ➢ Can we use the new capacities of the $10^{th}$ version of the STICS model to improve the simulation of grapevine yield on the long term?

# Material and methods

- ✓ Experimental data from the experiments « Réseau vigueur » and « Terroir » (CIVC):
  - 4 years: 2018 to 2021
  - 7 sites
  - 3 varieties: Chardonnay, Pinot noir, Pinot meunier
  - 3 pruning practices: Guyot, Vallée de la Marne, Chablis
  - 6 crop managements: Am (Amendment), Org (organic fertilization), Min (Mineral fertilization), Tem (No fertilization), Desh (chemical weed control), Wsol (mechanic weed control) and Enh (grass cover, not used!)



| Sites |
| --- |
| Belval |
| Festigny |
| Les Riceys |
| Plumecoq |
| Urville |
| Vaudemange |
| Villers-Marmery |



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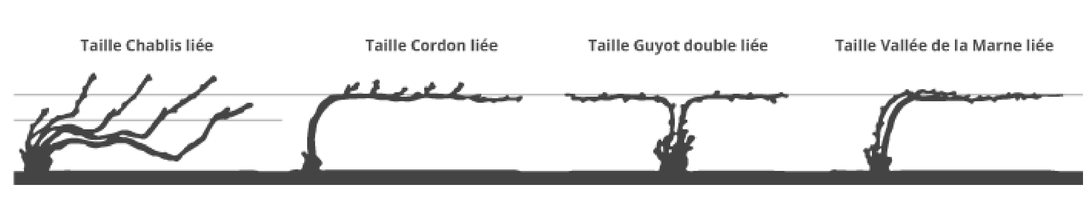


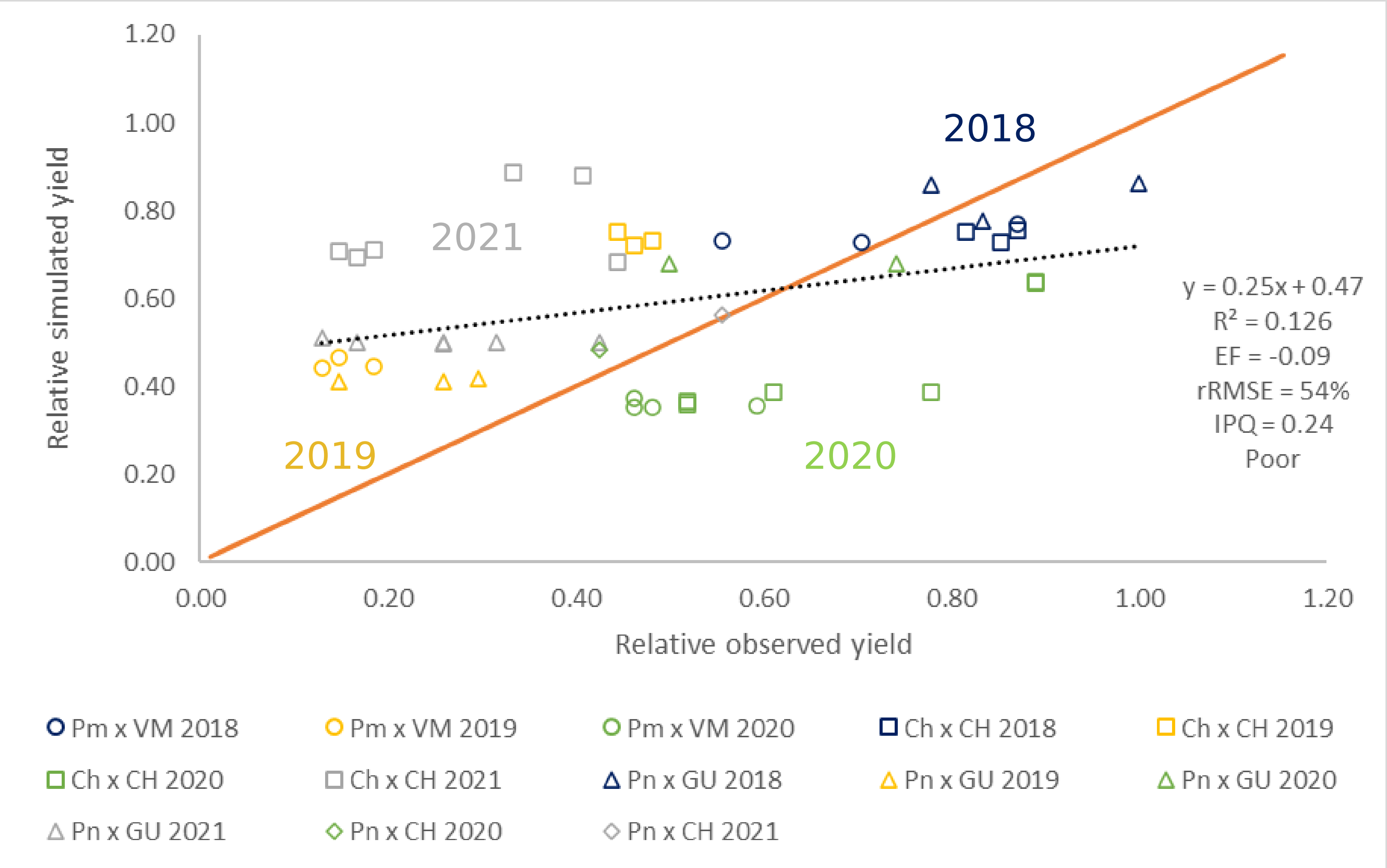

- Available data:
  - Plant stages: bud burst, flowering, veraison, harvest date, senescence
  - Plant growth: leaves, stems and fruits biomass and N content, leaf area index, bunch number, berrie number (some sites and years only)
  - Soil: humidity and mineral N content (mostly in the first 30 cm of soil)
- Due to a lack of informations, we simulate automatic topping after calibration

# Material and methods

- Model evaluation on independent data, not used for calibration:
  - Statistical evaluation of model simulations in dynamic and at harvest were done as in Strullu et al. (2020)

- Modifications brought to the model:
  - Simulation of N exportation due to pruning in function of environement
  - New module for the simulation of C and N fluxes due to topping
  - New module for simulation of capillary rise
  - New option to simulate a variable sink strength of fruits for C and N in function of bunch number (code_fpvar)
  - New formalisms to calculate the bunch number from model variables (code_calinflores)

# Yield simulation with imposed number of bunches

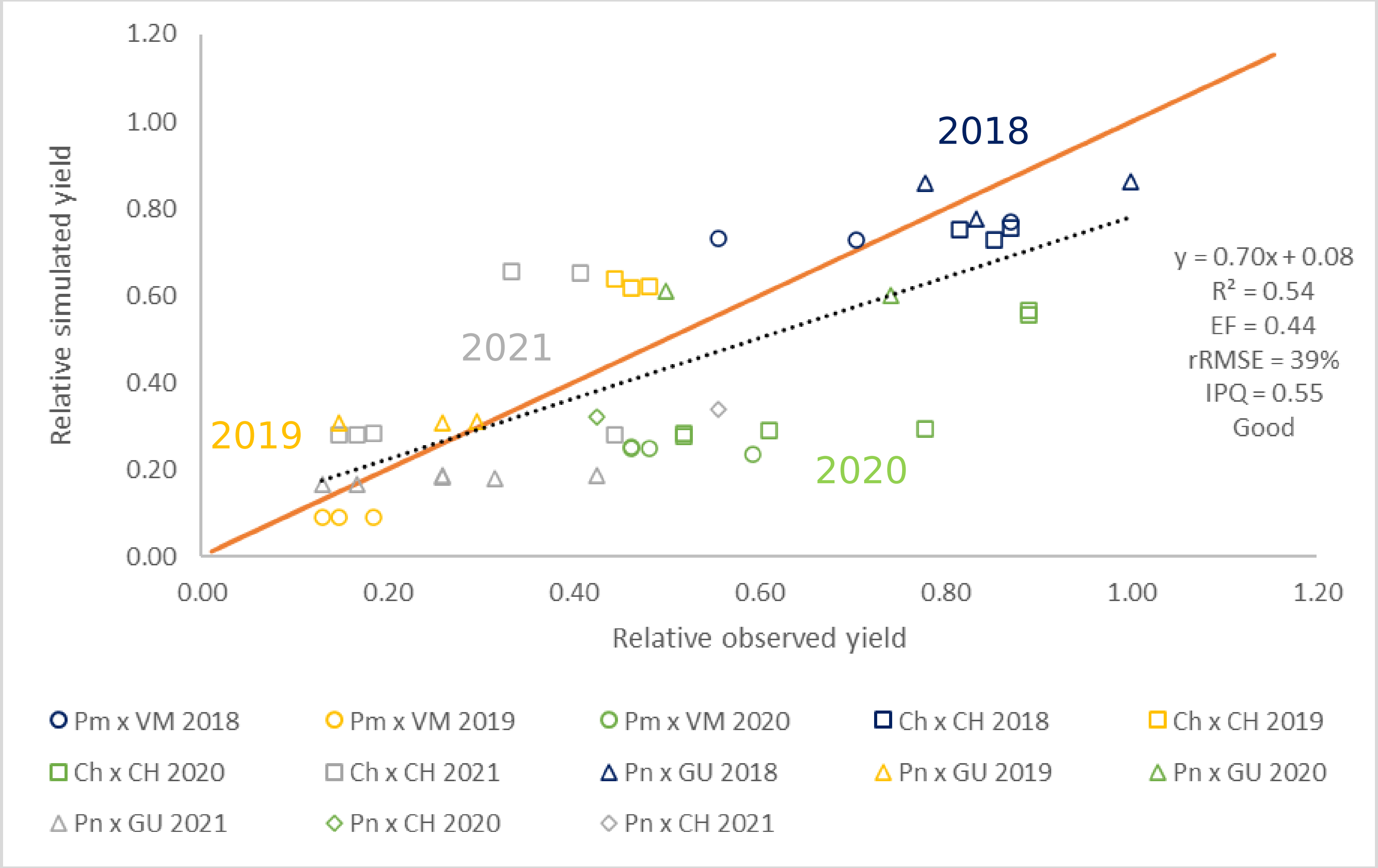



1. Fruits sink strength:

*pgrainmaxi*: varietal plant parameter *(g berrie$^{-1}$ °Cd$^{-1}$)*

- Yield overestimation in 2019 and 2021 when bunch number is low
- Yield underestimation in 2020 due to a lack of water
- Good yield simulation in 2018 when bunch number is equal or close to the maximal bunch number per plant

# Yield simulation with imposed number of bunches and a variable sink strength




1. Potential fruits sink strength:

*Pfmax = P_pgrainmaxi*

*pgrainmaxi*: varietal plant parameter *(g berrie$^{-1}$ °Cd$^{-1}$)*

2. Actual fruits sink strength:

*nbinflo*: varietal plant parameter *(bunch number per plant)*
*inflomax*: prunning practices parameter *(maximal bunch number per plant)*

- Good yield simulation in 2018, 2019 and 2021
- Yield underestimation in 2020 due to a lack of water

# Simulation of bunch number

1. Potential bunch number:

*nbinflores = min(P_pentinflores .resperenne0,P_inflomax)*

*Pentinflores*: varietal plant parameter; *Inflomax*: maximal bunch number (prunning practices parameter); resperenne0: initial biomass of metabolic reserves in perennial organs (initialized in 2018 or simulated in 2019 to 2021)

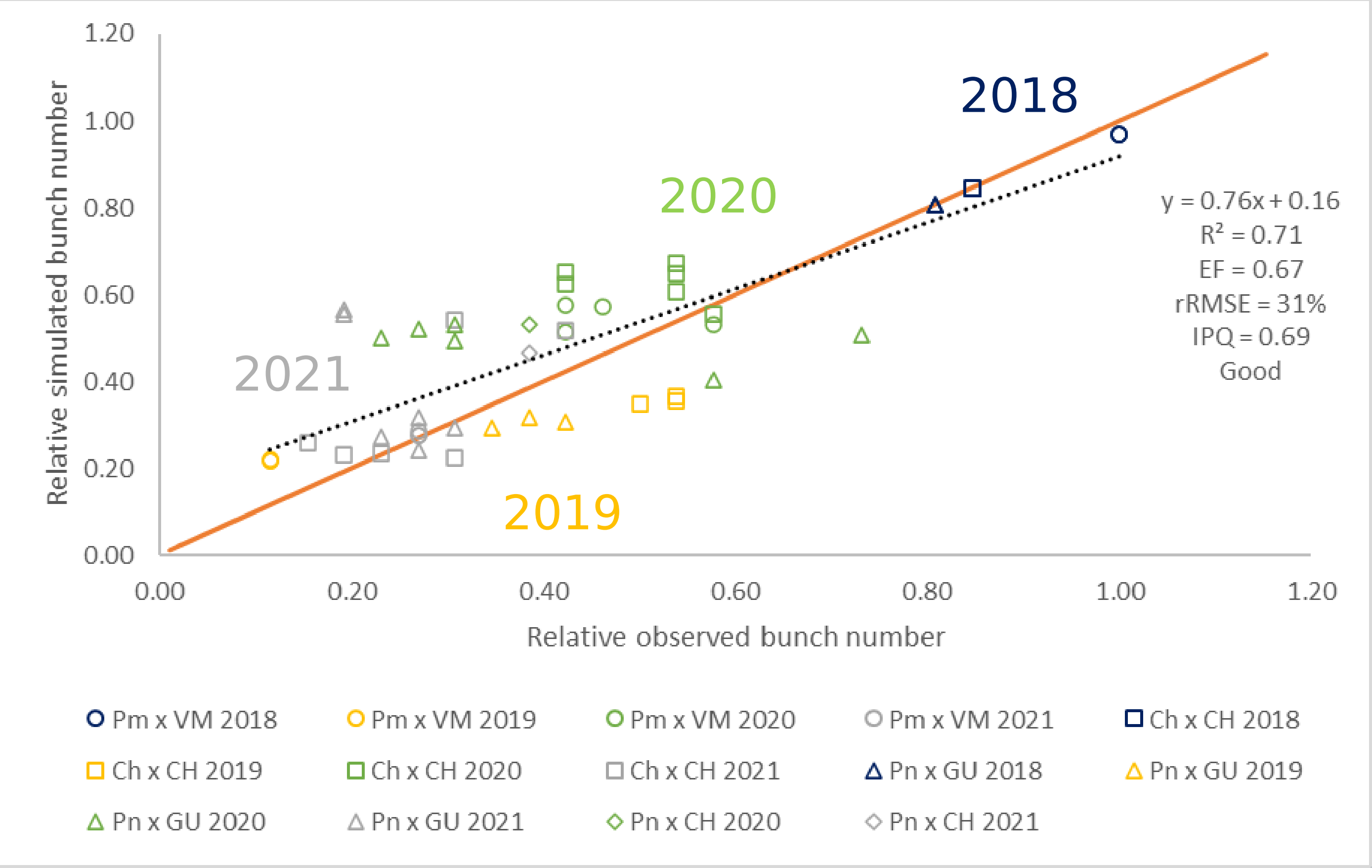
2. Actual bunch number after frost (if any):

*nbinflores = nbinflores . fgelflo*

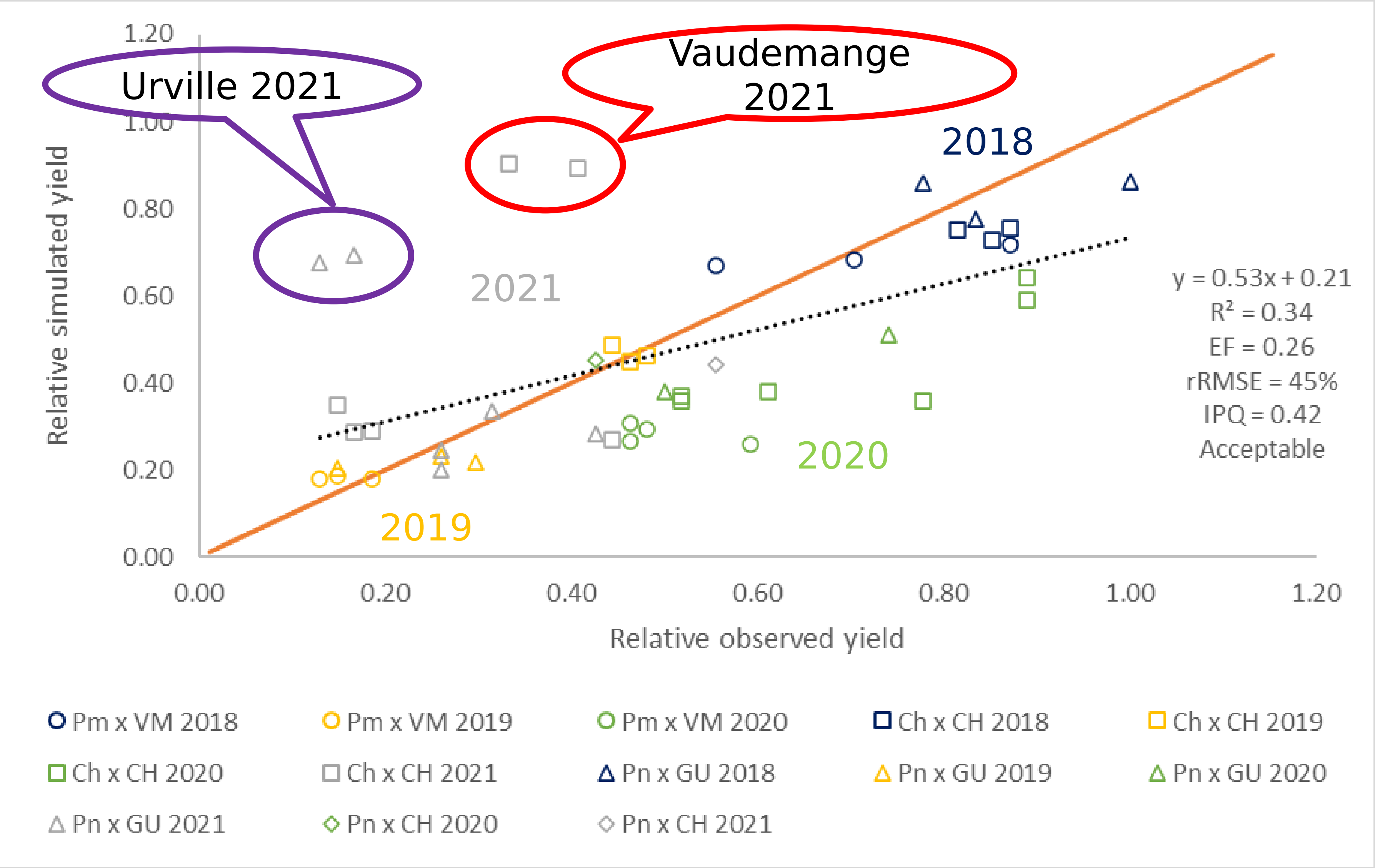
3. Actual bunch number at flowering:

*nbinflores = nbinflores . min(INNflo,1)*

*INNflo*: nitrogen nutrition index of the crop at flowering



# Yield simulation with both options activated




- Good yield simulation in 2018, 2019
- Yield overestimation in two sites in 2021 associated with an overestimation of bunch number
- Yield underestimation in 2020 due to a lack of water

# Conclusions & perspectives

- ✓ 3 varieties parametrized with options dedicated to perennial crops: Pinot noir, Pinot meunier and Chardonnay

- ✓ 3 prunning practices: Chablis, Guyot and Vallée de la Marne

- ✓ Parametrization is coherent with knowledge in term of productivity and « vigor »
  - ➢ Some parameters are considered as variety dependent (stages, potential fruits sink strength, parameters linked to bunch and berrie number calculations)
  - ➢ Some parameters are considered as prunning practices dependent (potential lai growth rate, stem to leaf ratio)

- ✓ Lack of data on berrie number did not allow us to check the model ability to simulate this variable

# Conclusions & perspectives

- ✓ Necessity to **work on intercroping!** We have data (in fact CIVC) but more data is always better to evaluate the model ability to simulate competition for resources
  - **You have it? You are interested? You are welcome!**

- ✓ Necessity to have measurements on the long term, on **the plant and the soil**, in order to evaluate the model ability to simulate grapevine cropping system behaviour
  - **You have it? You are interested? You are welcome!**

- ✓ Development of decision-making tool on the way, a 1st version should be available in 2024 but there is still a lot of work to do


* Why make it simple when you can make it complicated?

# Dédicace spéciale pour Domi !

# Merci pour votre attention