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Simulating climate change impact on viticultural systems

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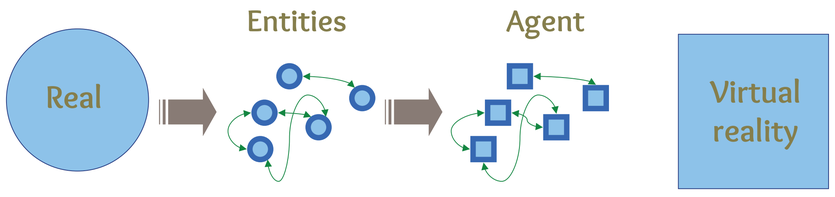
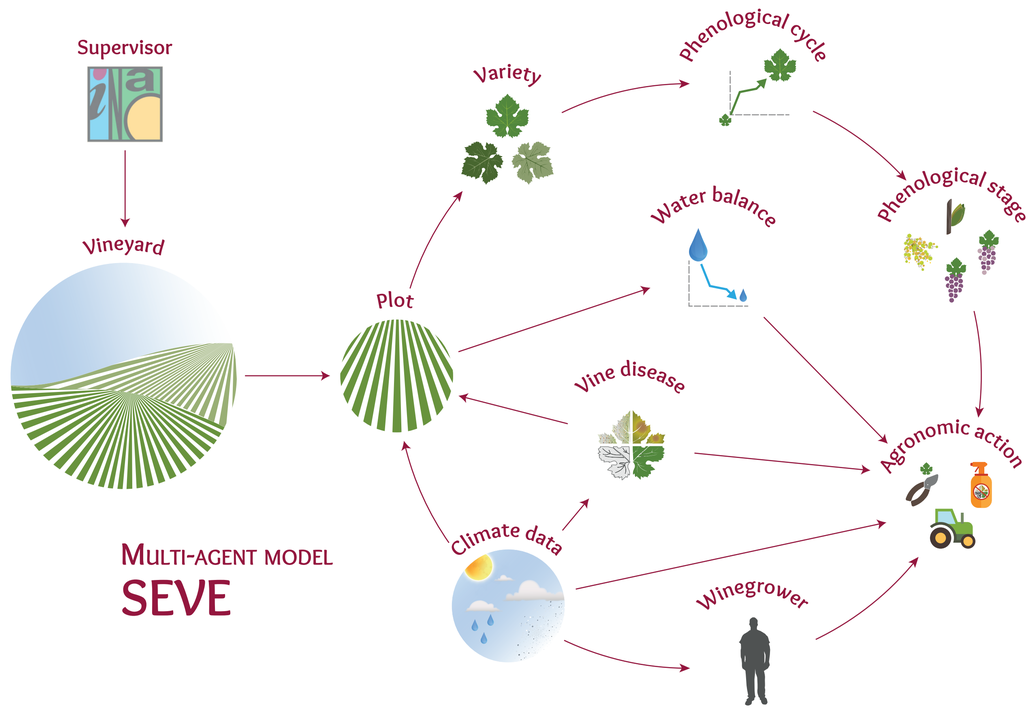
UMR 6554 CNRS LETG

Implemented during the LIFE ADVICLIM program, SEVE model (Simulating Environmental impacts on Viticultural Ecosystems), present a generic modeling environment for simulating grapevine growth and berry ripening under different conditions and constraints (slope, aspect, soil type, climate variability...) as well as production strategies and adaptation rules according to climate change scenarios.



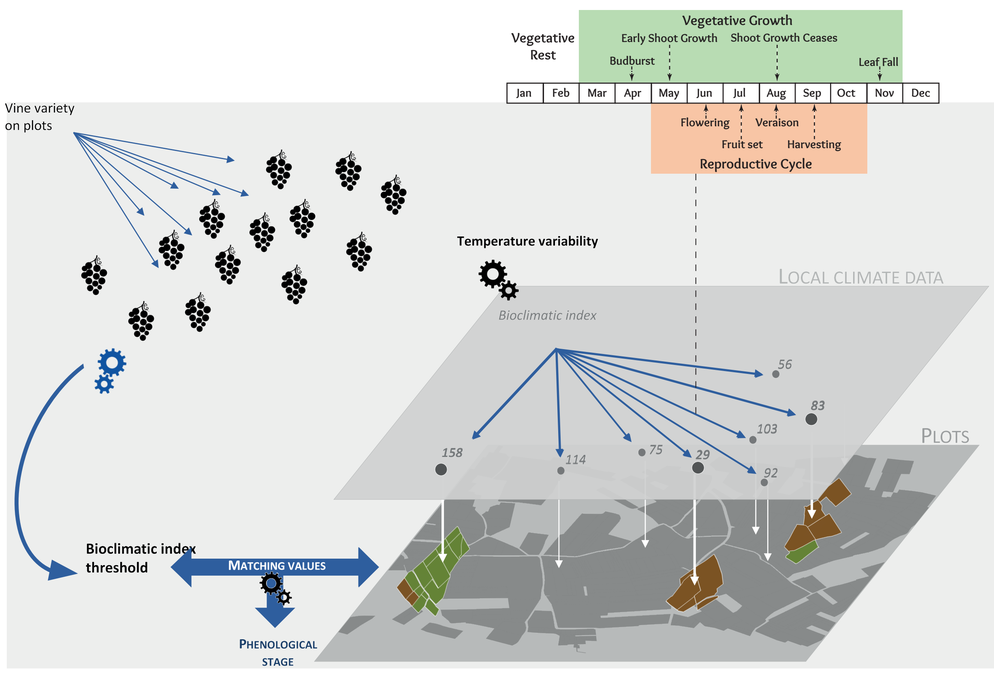
Each activity is represented by an autonomous agent able to react and adapt its reaction to the variability of environmental constraints.

Agents are distinguished according to their objectives: "Supervisors" Agent plays an overseeing role in the model, "Winegrower" Agents aim to grow grapes and produce wine that meets precise specifications according to their end-product goals and "Vine" Agents are grape production entities. The relationships between these three types of agents determine the production strategies adopted by the winegrowers.



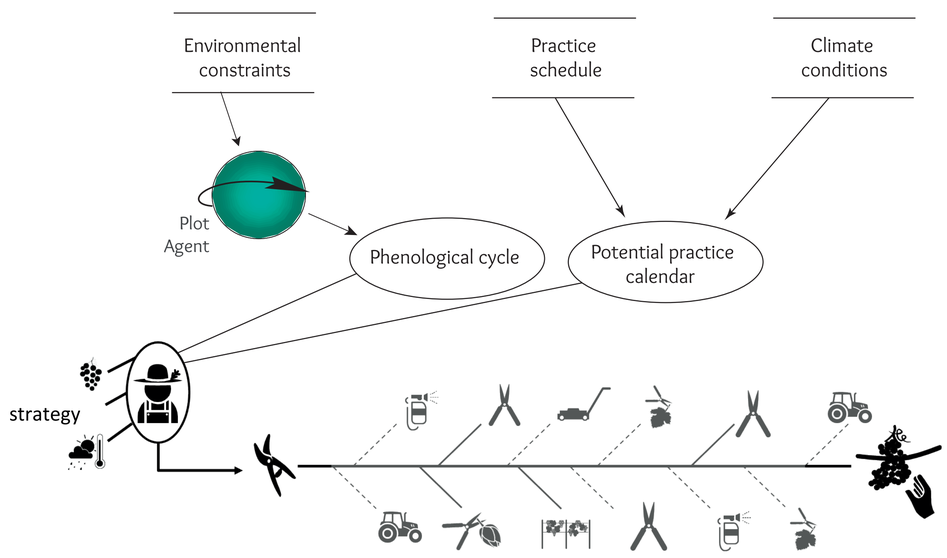
Simulating vine phenology

In SEVE model grapevine growth dynamics uses simple algorithms based on bioclimatic indices (Winkler, GFV and Huglin) specific to grapevine behaviour. These indices allows to study climate variability and change in relation with local environment characteristics and type of grapevine variety.

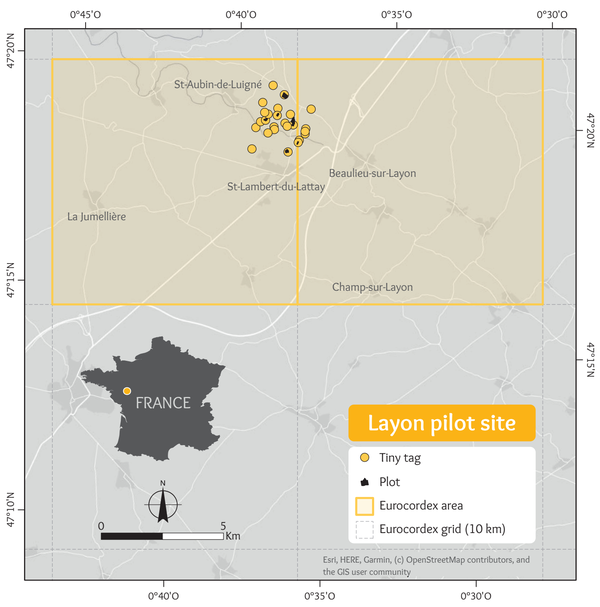


Assessing agronomic intineraries variability (Layon pilot site)

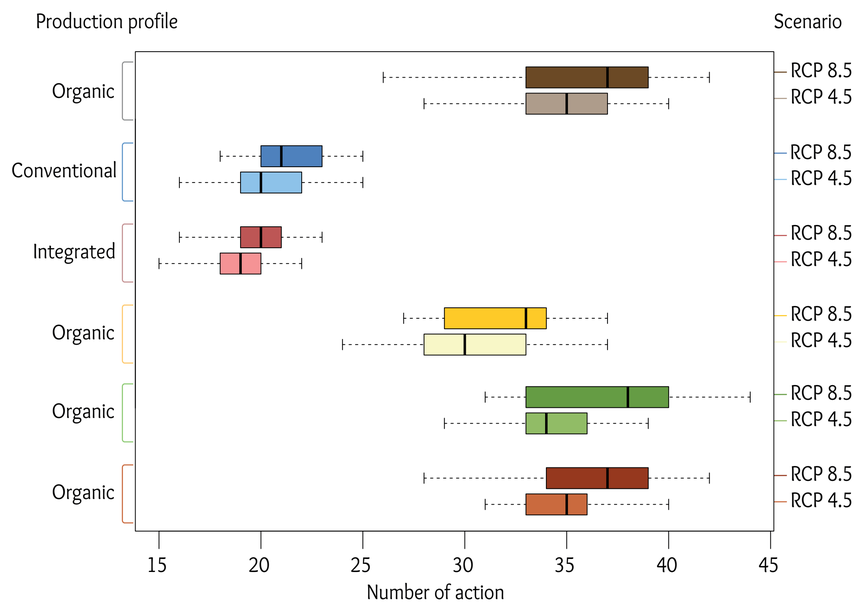
In SEVE model, winegrower agents are created from three production profiles: conventional (traditional viticulture), integrated (limitation of pesticides, fertilizers and weeding) and organic (strong limitation of pesticides, mechanical weeding...).
Surveys conducted at vineyard scale are used to define potential practice schedules for each production profiles. The main practice constraints are also integrated into the model. Climate data are used to calculate the available days for each agronomic action. According to these data, its production profile, vine phenological cycle and agro-climatic characteristics (soil type, slope, aspect, water balance ...), each wine grower agent performs specific agronomic actions.

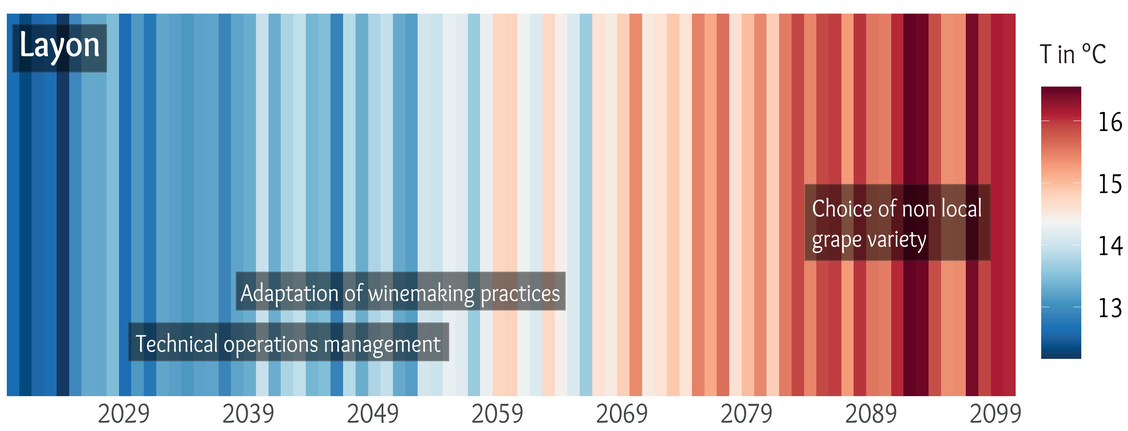


Highlighting potential adaptation strategies according to propective scenarios (Layon pilote site example)



At the local scale, for example at the Layon pilot site, simulation results show a significant increase in the number of actions, especially for organic plots. This result is largely related to the increase in the number of fungicide treatments. In organic production, the use of contact products requires a high spray frequency during periods of pathogenic risk (a few days between each spay depending on rainfall frequency). In conventional production, by using systemic product, wine growers reduce significantly this frequency (usually at least 15 days between spraying).
These results show that with a changing climate, The risk of disease is higher in most of the pilot sites. In some cases, the increased earliness of the grapevine partly compensates this risk by reducing the exposure period.





These results provide adaptation trajectories among a set of possible trajectories. Other adaptation strategies can be considered.
One of the principal challenges for winegrowers will be to manage increasing temperatures in order to delay grapevine phenology. A too early onset of ripening will lead to unbalanced grape compositions. Increased early phenology can also lead to an increased risk of frost during bud-break and flowering period. Linking the results of the SEVE model with the climate projections of RCP 4.5 and 8.5 shows that the risk of spring frost may be significant in some plots.

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