Lessons from a Prospective on the French Wine Industry Under Climate Change (2050)

Jean-Marc Touzard, Patrick Aigrain, Benjamin Bois, Eric Duchêne, Inaki Garcia de Cortazar Atauri, Eric Giraud-Heraud, Jacques Gautier, Hervé Hannin, Nathalie Ollat

Climate-Smart Agriculture 2017

Global Science Conference

November 28 to 30 2017
Johannesburg, South Africa

NEPAD
TRANSFORMING AFRICA

INRA
SCIENCE & IMPACT

Climate Smart Agriculture
Booster

Lessons from a Prospective on the French Wine Industry Under Climate Change (2050)

Jean-Marc Touzard[1], Patrick Aigrain[2], Benjamin Bois[5], Françoise Brugière[2], Eric Duchène[1], Inaki Garcia de Cortazar[1], Eric Giraud-Heraud[1], Jacques Gautier[3], Hervé Hannin[4], Nathalie Ollat[1]

[1]INRA; [2] FranceAgrimer; [3] INAO; [4] SupAgro, [5]University of Burgundy







Wine industry: key domain of research on agriculture and climate change

Economic and cultural importance of Wine in France

- 15% of value of French agricultural production, 250 000 jobs
- € 11 billions in export (2013), second export item
- Externalities on tourism, contribution to French culture…

Wine production is very sensitiv to climate

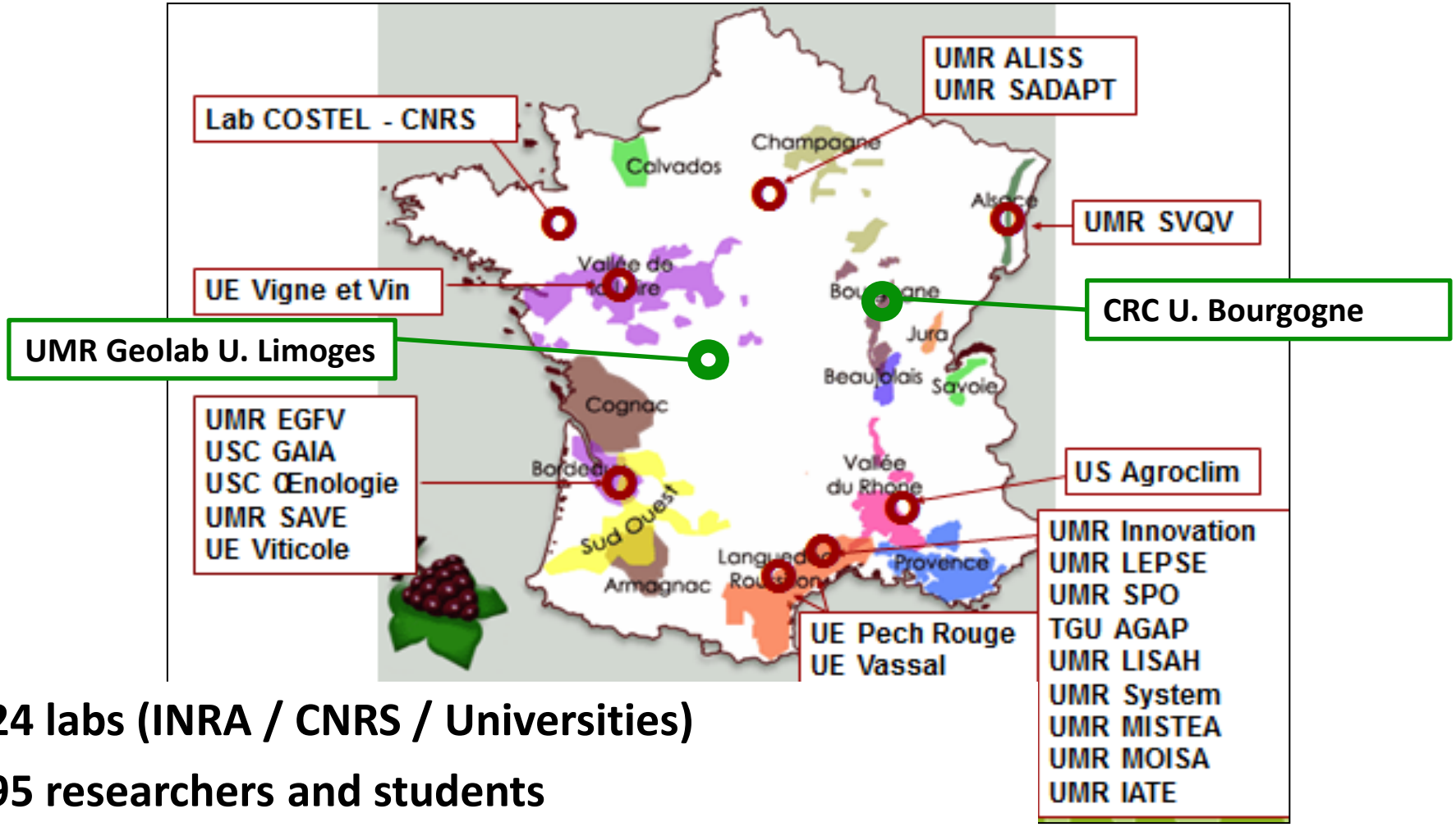
- Climate conditions affect both grape yield and wine quality
- wines are diferenciated by climate conditions (terroir, vintage)
- recognised as « **witness of CC** » (harvest dates…)

Wine industry raises key scientific issues on adaptation

- Perennial crop : short and long term strategies
- Complex interactions in the value chain, numerous levers
- Institutions (GI) codify practices, innovation and location…

LACCAVE project (2012-2016) (N. Ollat, J.-M.Touzard)

- Impacts of climate change on vine and wine
- solutions for adaptation in the wine industry



24 labs (INRA / CNRS / Universities)

95 researchers and students

Climatology, genetic, écophysiology, agronomy, œnology, économics, sociology….

Climate Change CO_2

Rise in variability and extrem events

Rise in average temperature

Dryness, change in pluviometry distribution

Ecosystem, soil, water

Pest and disease

Microflora

Grapevine physiology

Different scales and combinations of impacts (regional climatic scenarios)

Viticultural agrosystems

Grape

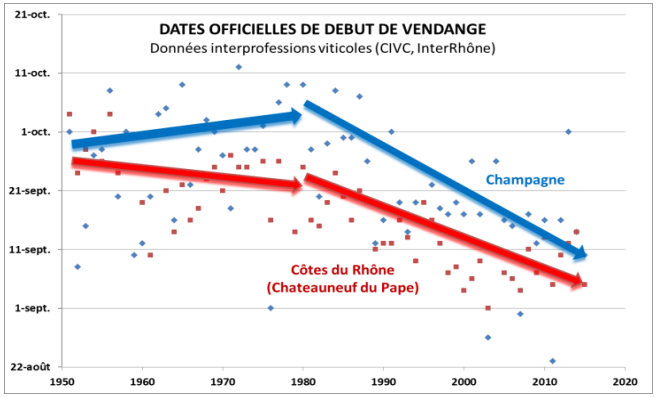
Wine making processes

Wine

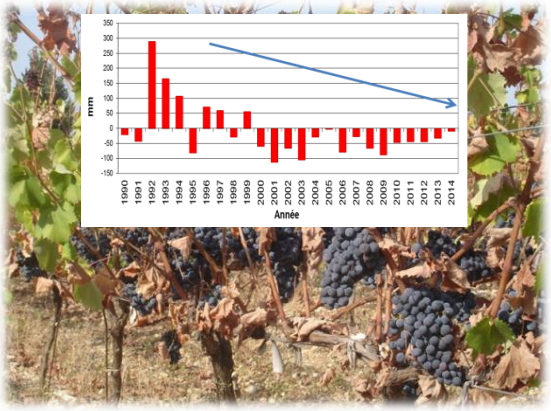
Wine marketing chains

Climate Change impacts on vine and wine

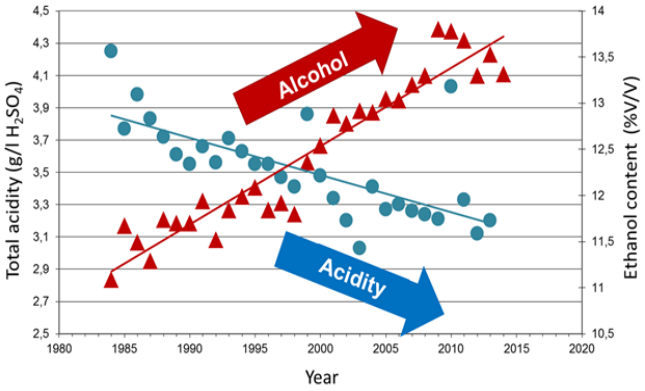
observed, simulated (Van Leuwen, Ollat, Touzard, 2016)



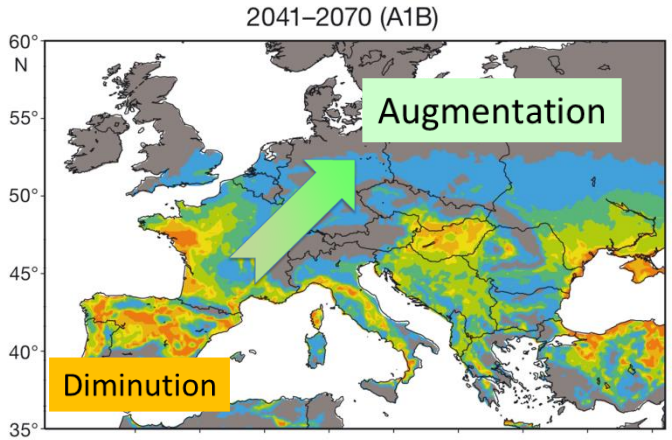
All development stages of vine are affected: earlier harvest



Water balance and stress
Affect yield (and quality)

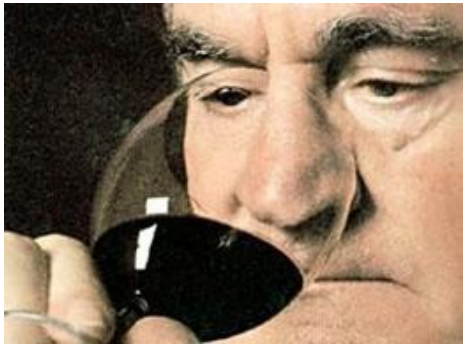


Change in berry composition
More sugar, less acidity
Modification of aromas

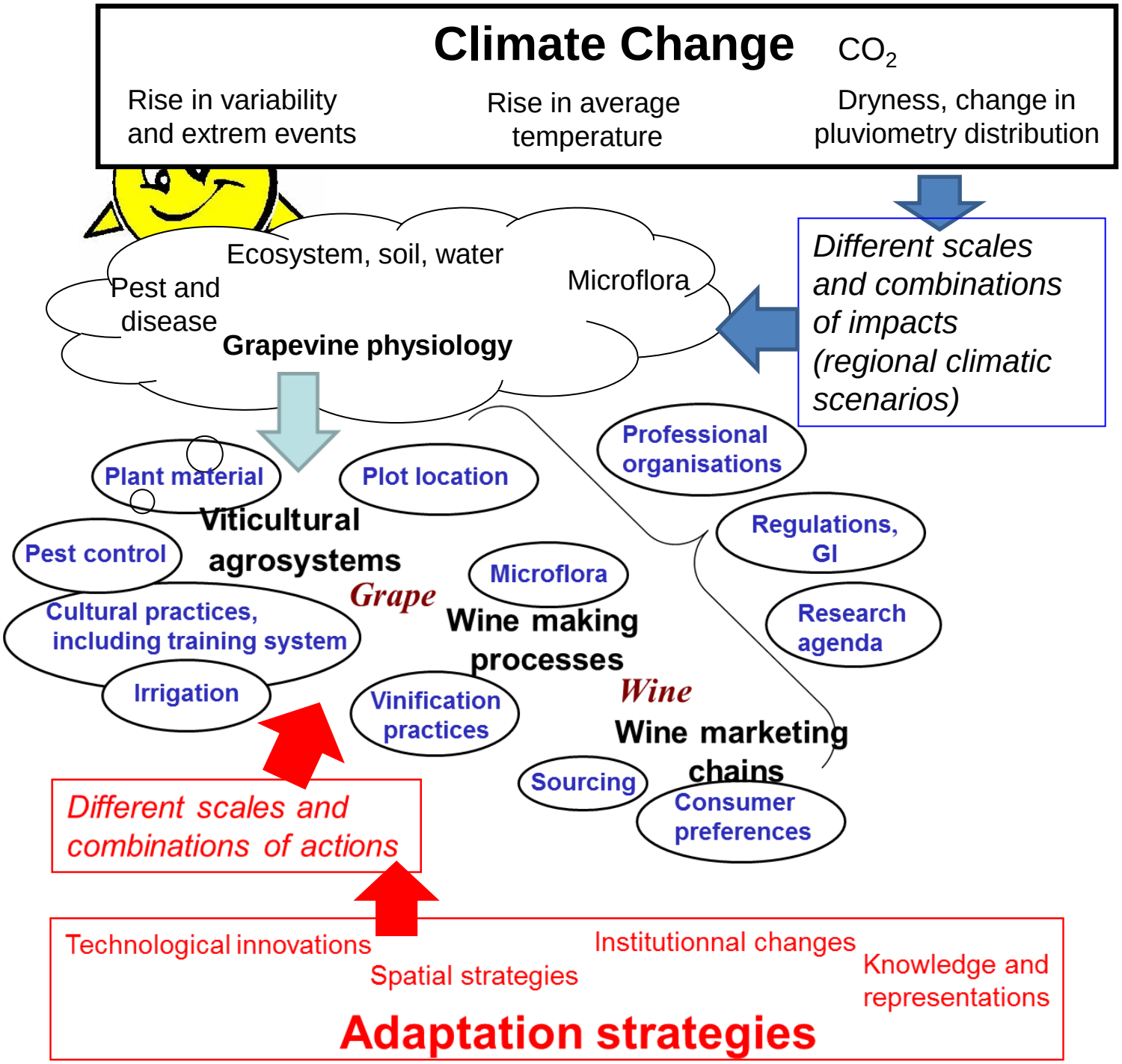


Evolution of potential planting areas

Economic impacts
Incomes, assets, competitivness



Perception of actors
Tensions on GI labels


Climate Change
CO_2
Rise in variability and extrem events
Rise in average temperature
Dryness, change in pluviometry distribution
Ecosystem, soil, water
Pest and disease
Microflora
Grapevine physiology
Different scales and combinations of impacts (regional climatic scenarios)
Plant material
Plot location
Viticultural agrosystems
Pest control
Cultural practices, including training system
Irrigation
Grape
Microflora
Wine making processes
Vinification practices
Professional organisations
Regulations, GI
Research agenda
Wine
Wine marketing chains
Sourcing
Consumer preferences
Different scales and combinations of actions
Technological innovations
Spatial strategies
Institutionnal changes
Knowledge and representations
Adaptation strategies

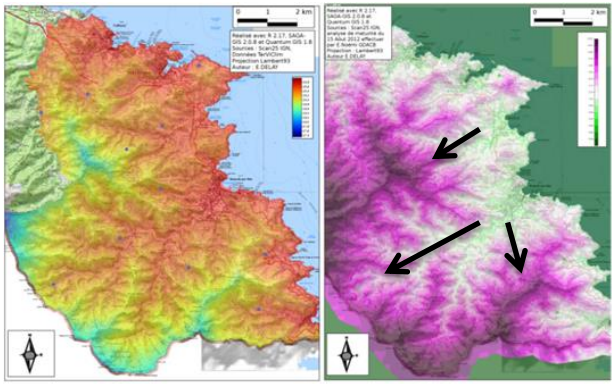
Focus on six main domains of adaptation

(Ollat, Touzard, Garcia de Cortazar, 2017)

« New » vine varieties
(old/foreign/created)
late, resistant to drought…

Changing viticultural practices
Pruning, soil managment, irrigation
digital viticulture, agroecology

Enological innovations
To control acidity, alcohol,
temperatue, yeast



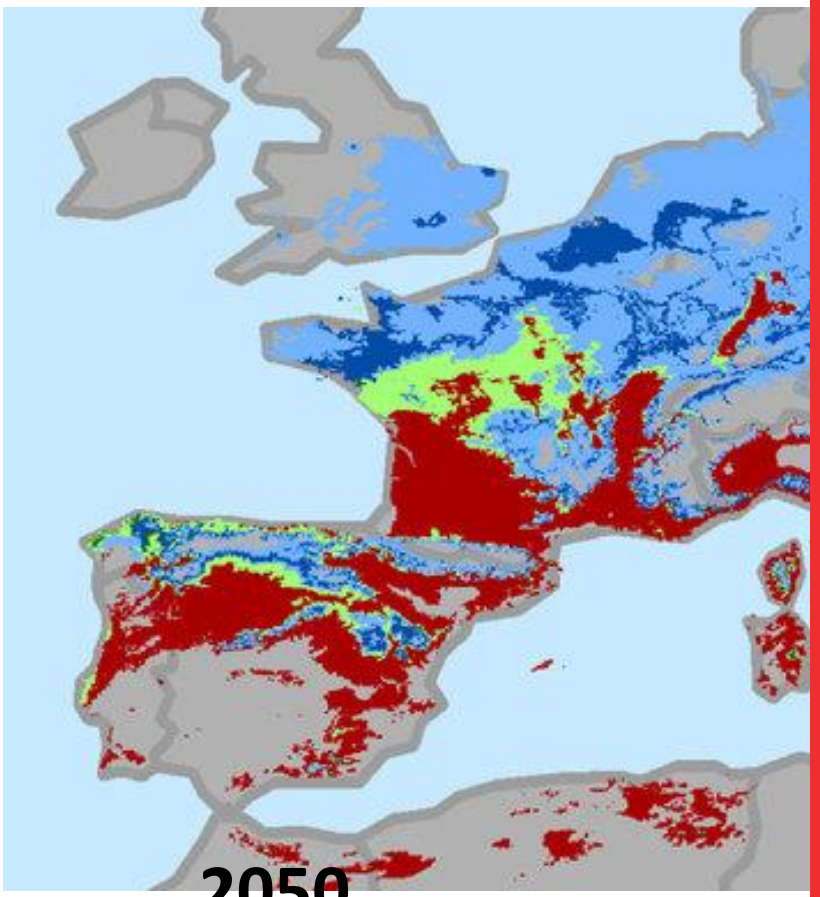
Changing the location of vine
Moving up, new frontier
creation of new vineyards…

Changing the institutions
Code of practices, insurance,
R&D policy

The role of consumers
Acceptance, involvement
(experimental economics)

Controversial simulation and PNAS publication : geographical impact of CC on European vineyards

(Hanna



2050

LETTER

Why climate change will not dramatically decrease viticultural suitability in main wine-producing areas by 2050

Hannah et al. (1) recently published a comprehensive study showing substantial impacts of climate change on viticultural suitability, leading to potential ecological issues. We agree that expansion of viticulture into new areas can lead to a decrease in biodiversity and that an increase in water use for irrigation might lead to major freshwater conservation impacts. However, we disagree with the alarming statement that suitability for winegrowing of main wine-producing areas worldwide will dramatically decrease over the next 40 y. We point out major methodological flaws in ref. 1, mostly linked to (*i*) the misuse of bibliographical data to compute suitability index, (*ii*) underestimation of adaptations of viticulture to warmer conditions, and (*iii*) the inadequacy of the monthly time step in the suitability approach.

The suitability index in ref. 1 is mainly compiled from grapevine maturity groupings as defined by Jones (ref. 2 is the wrong citation; this classification is given in ref. 3) and Gladstones [(4), not peer-reviewed]. In refs. 3 and 4, groupings were constructed from empirical observations collected in premium wine-growing areas and not based on grapevine physiological modeling. We argue that it is very difficult to establish precise upper limits by variety for growing high-quality wines and that those given in ref. 3 are underestimated. To illustrate this aspect, we compare average growing season temperature (AvGST) from 1971 to 1999 and from 2000 to 2012 for three major wine-growing regions: Rheingau (Germany), Burgundy (France), and Rhone Valley (France; Fig. 1). Burgundy continues to grow great wines with Pinot noir since 2000, although AvGST is already above the upper temperature limit cited in ref. 3. The same is true for Rheingau with Pinot Gris and the Rhone Valley with Syrah. High-quality viticulture is sustained in these regions despite increased temperatures and dry farming, because of both the evolution of consumer's preferences and implementation of adaptative strategies by growers.

A major flaw in ref. 1 is that noncapped growing degree days (GDDs) are computed and subsequently compared with varietal maturity groupings from ref. 4, wherein GDDs are capped at 19 °C [called biologically effective degree days (BEDDs)]. As the climate becomes warmer, the seasonal difference between BEDDs and noncapped GDDs increases up to several hundreds of DDs. Hence, projected ripeness in ref. 1 is weeks ahead of modeled ripeness, when ref. 4 would have been properly applied. This subsequently results in much higher temperatures during the projected last month before ripeness, which was the main criterion used in ref. 1 to consider a region suitable for viticulture or not.

A monthly time step was used in ref. 1. One month accounts for up to 270 BEDDs. When varieties are compared in maturity groupings that are 50 DDs apart, this resolution is too crude to yield reliable maturity predictions.

Although Hannah et al. make an interesting point in predicting which regions worldwide may become suitable for viticulture by 2050 as a consequence of climate change, but in estimating related potential ecological impact, their conclusion that most of the present wine-growing regions will become unsuitable for viticulture is erroneous.

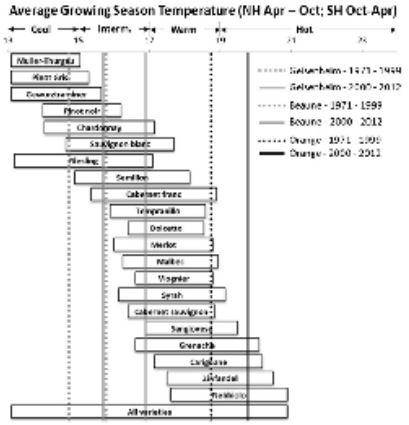


Fig. 1. Average growing season temperature from 1971 to 1999 and from 2000 to 2012 in Rheingau, Germany (Geisenheim station), Burgundy, France (Beaune station), and Rhone Valley, France (Orange station). Note that Müller-Thurgau and Pinot gris, Pinot noir, as well as Syrah and Viognier are already beyond the maximum value given in ref. 3

Cornelis van Leeuwen[a,b,1], Hans Schultz[c], Inaki Garcia de Cortazar-Atauri[d], Eric Duchêne[e], Nathalie Ollat[a,f], Philippe Pieri[a,f], Benjamin Bois[g], Jean-Pascal Goutouly[a,f], Hervé Quénol[h], Jean-Marc

Author contributions: C.v.L., H.S., I.G.d.C.-A., E.D., N.O., P.P., B.B., J.-P.G., H.Q., J.M.T., A.C.M., L.B., and S.D. performed research; C.v.L., I.G.d.C.-A., E.D., P.P., and B.B. analyzed data; and C.v.L. wrote the paper.

The authors declare no conflict of interest.

[1]To whom correspondence should be addressed. E-mail: vanleeu-

A prospective study on the French Wine System

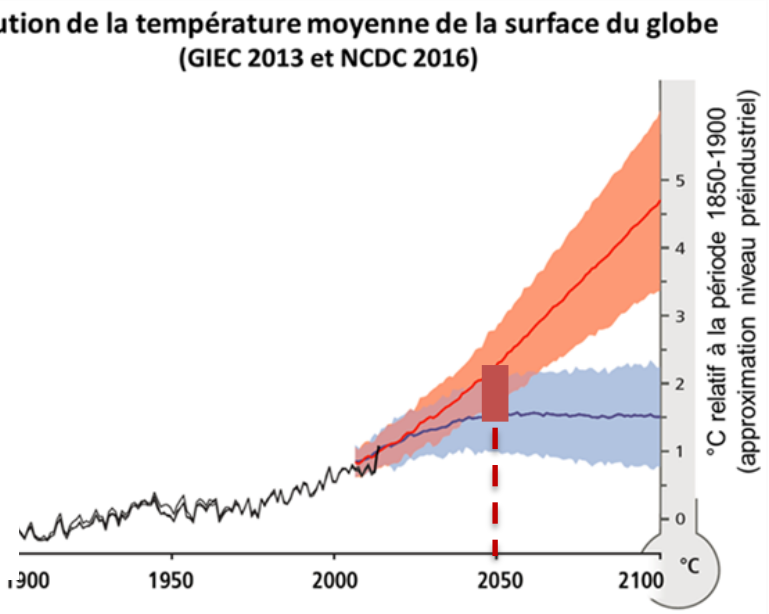
- To capitalise on the multidisciplinary LACCAVE project and to explore combinations of different levers of adaptation…
- To provide different scenarios for actors of the French wine industry by 2050, not only the catastrophic one
- To test a new prospective methodology focusing on adaptation pathways
- To build common vision and develop learning networks between researchers and stakeholders of the industry

A two steps approach

- 2014-16 : top down approach driven by a group of experts
- 2016-18 : bottom up participatory approach with stakeholders

Choice of horizon 2050, assumptions on climatic context and impacts on vine and wine

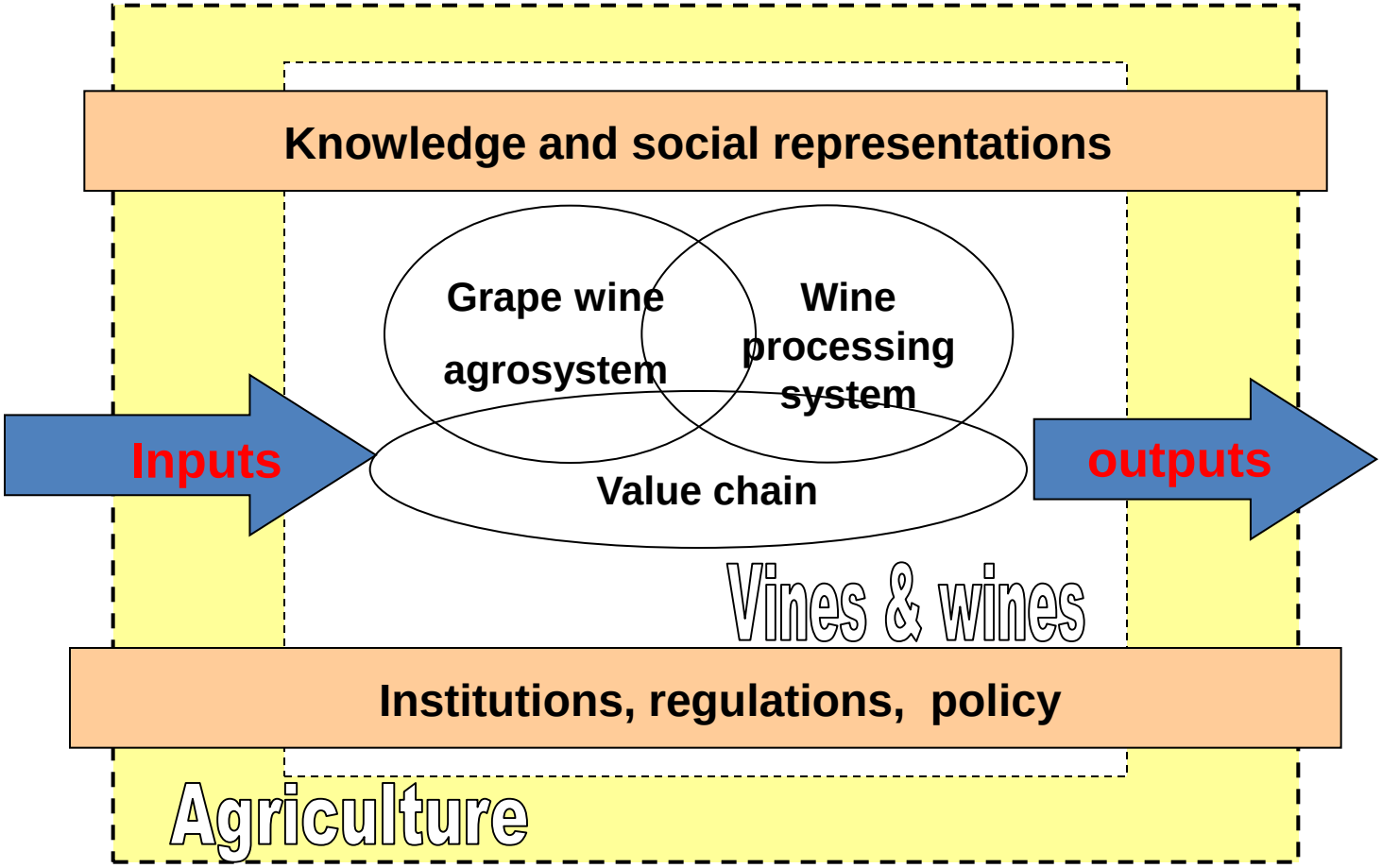
Median IPCC climatic scenario for 2050 :
- around + 2°C
- no radical change in rainfall but increasing water need for vine
- “moderate” increase of variability (extreme events)



Different impacts of CC according to a north-south gradient :

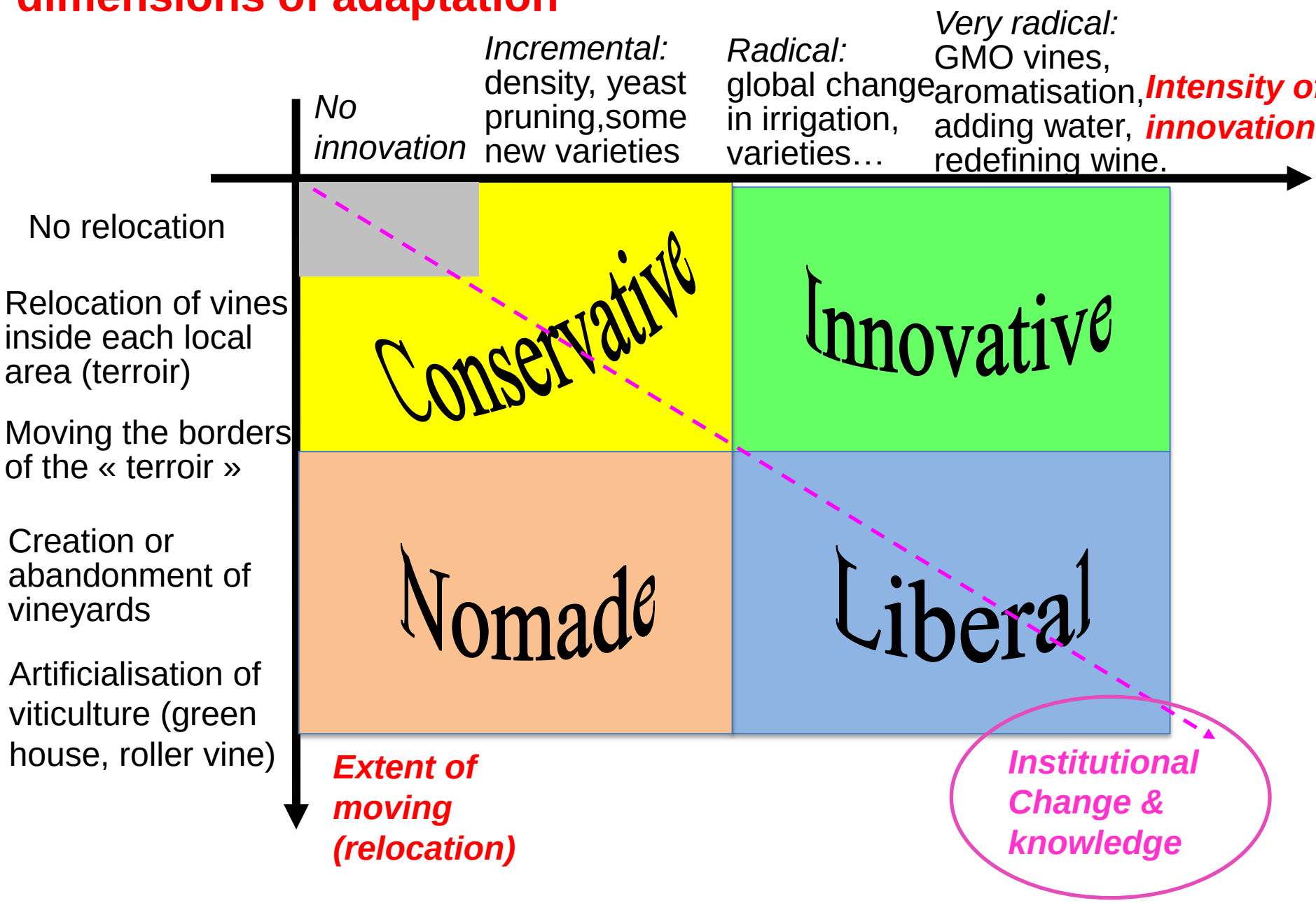
- In **the north:** maturity and productivity often favored by CC
  potential changes in wine caracteristics (acidity)
  main problem : increased disease pressure
- In **the south**: drought and water balance deficit
  lack of freshness during maturity stage
  potential changes in wine (excess of alcohol degree)

Systemic representation of the French wine sector

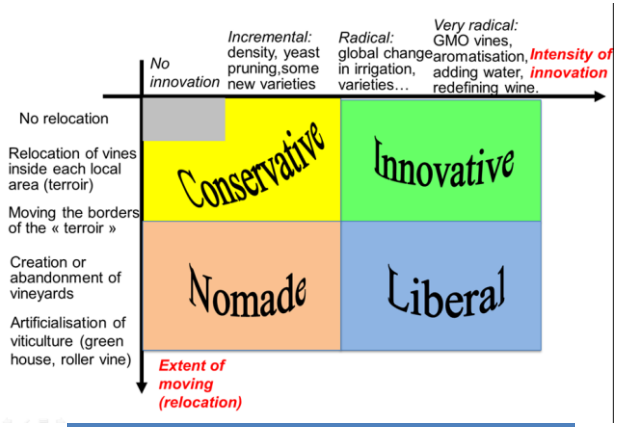


Actors, Technics and product, Flows

First construction of four scenarios by crossing two main dimensions of adaptation



Collection of data, selection of assumptions, construction of pathways

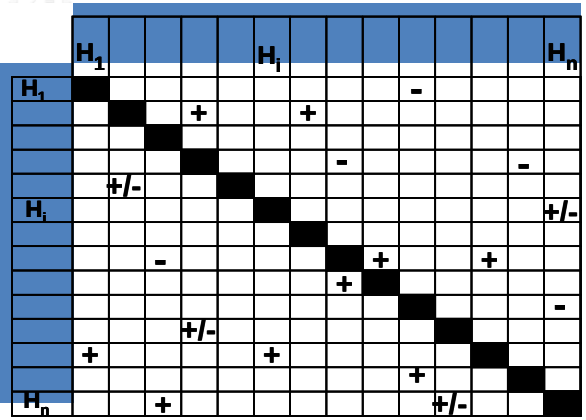


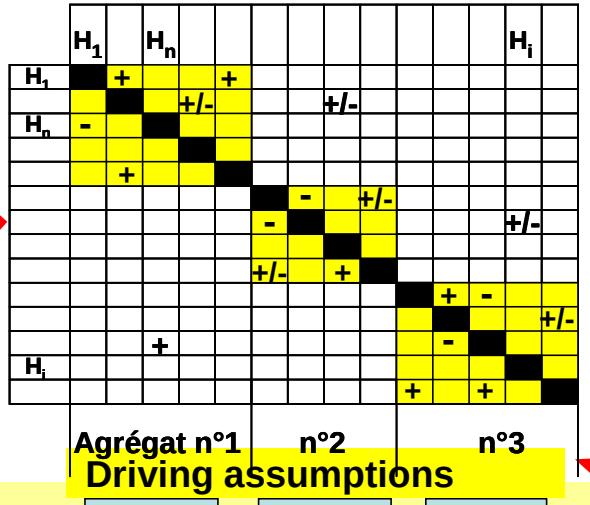
interviews in 3 regions

Interviews in Laccave

Previous studies

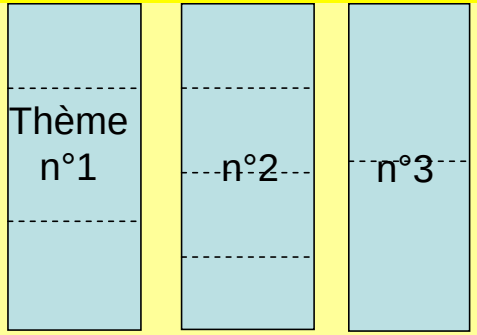
70 hyp. retenues

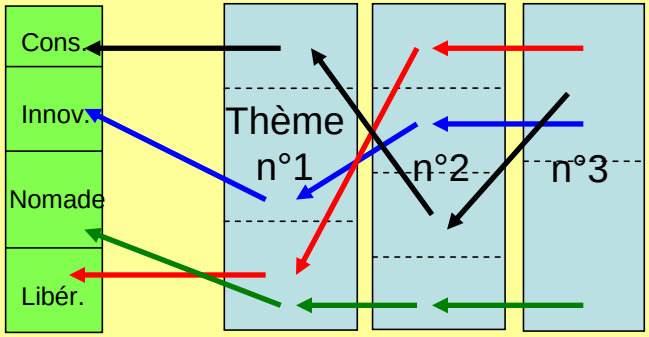




Driving assumptions

Finding the pathways which can build the adaptation scenarios

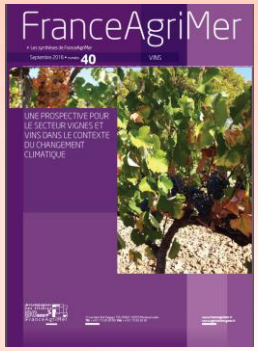


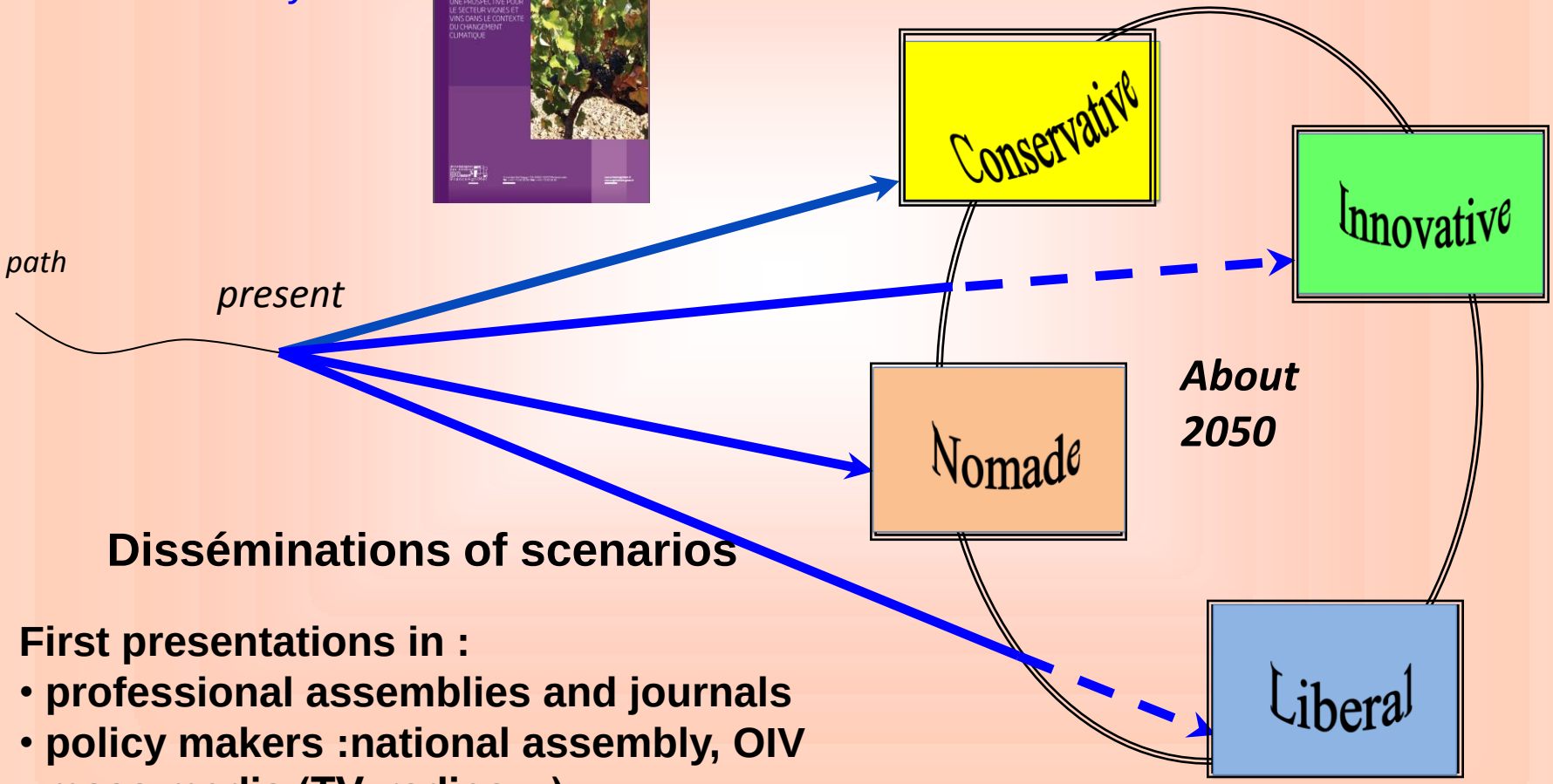


Publication and dissemination of first results

Each pathway is described by:

- Key assumptions
  (drivers, external and structural variables, events)
- Long narrative
- Summary





Disséminations of scenarios

First presentations in :

- **professional assemblies and journals**
- **policy makers :national assembly, OIV**
- **mass media (TV, radios…)**

Four pathways preferentially leading to the four adaptation scenarios.

…Conservative

Facing pressure from i) health authorities on alcoholic drinks and ii) agricultural policy giving priority to land and water use to food crops, the wine industry, which is weakly linked to the research, perceives CC as a threat. Promoting the cultural and landscape image, the wine producers try to distinguish wine from other alcoholic drinks, but Gis wines and their regions become “island of resistance”, for a viticulture which starts to decrease in volume, area and value. This strategy becomes difficult to follow as CC is more intense.

…Innovative

Environmental, health and CC issues become an opportunity for the wine industry by integrating more and more innovation from the vineyard to the cellar. This development is allowed by a favorable and cooperative context which allow to maintain a relative stability between the French wine regions. This innovative context also relies on i) a voluntary research and innovation policy (private/public partnerships), ii) a binding policy on agricultural land management in the EU (zoning) and iii) more liberal conditions in terms of winemaking.

…Nomade

In the context of i) restrictive policy on alcohol and ii) a research focusing on the reduction of inputs use (pesticides and water), the consumers are aware to find the taste of the origin of the wines. Without sufficient knowledge to develop at large scale a “precision viticulture”, the wine producers find difficulty to reduce the variability of the wine quality. Some of them, joined by new investors, try to find "elsewhere" the reputation of the appellations, while others move to the plains where water is still available for irrigation.

….Liberal

In a more liberal and relatively favorable context, new international investors, mainly in blending & trading, lead to the redistribution of viticulture towards three kinds of areas: irrigated areas, residual inherited terroirs, new vineyards benefiting from climate change. Some “Terroir wines” or “regional brands” are still marketed, but the supply is mainly composed of technological wines controlled by few wine merchants. Climatic instability, competition between vineyards, deregulation and the power of international traders weaken the wine producers which are disorganized and can not fully benefit from R&D

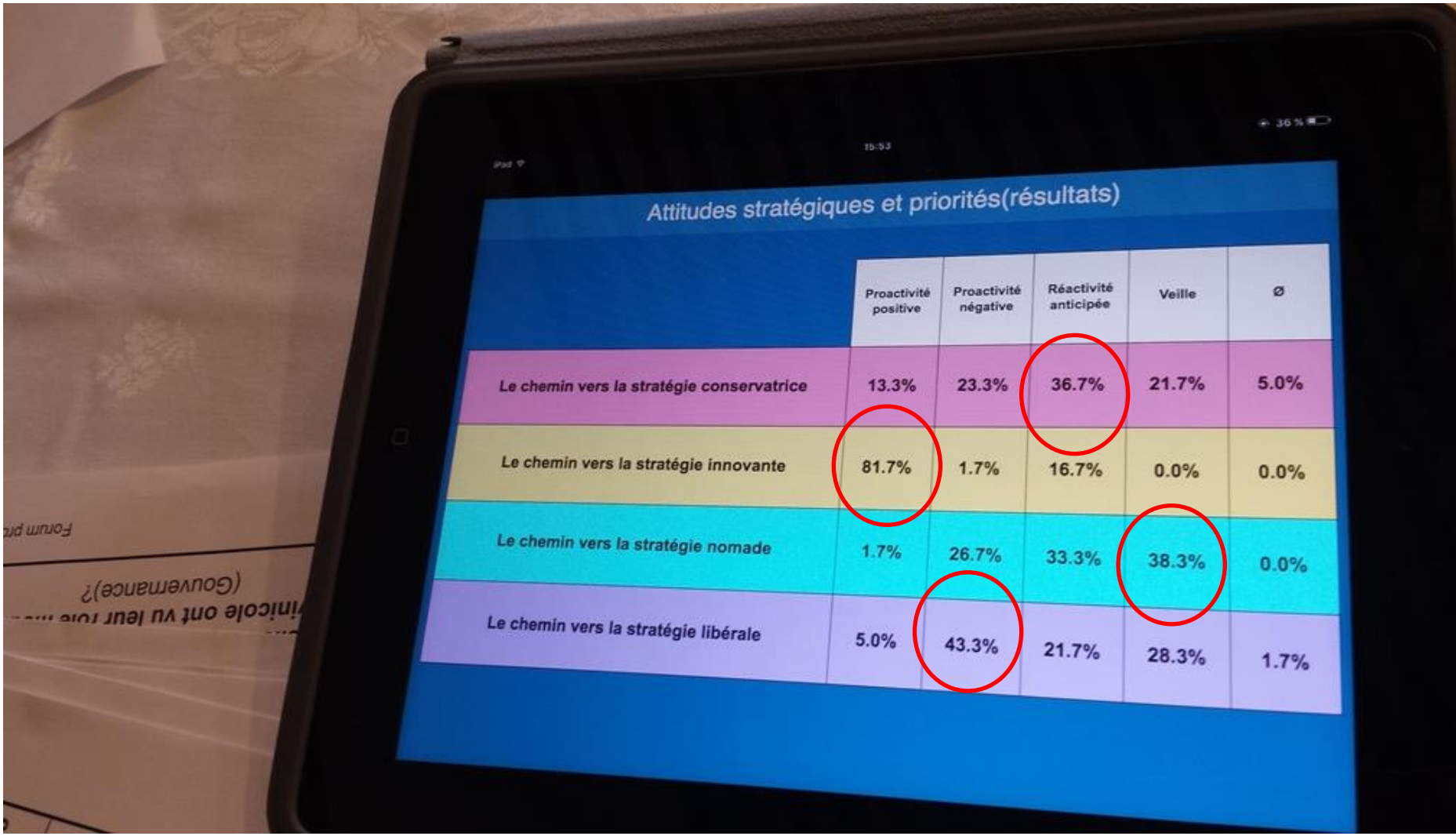
Second step (2017-2018): towards a participatory approach

Organisation of
« prospective workshops »
In six wine Regions

Bordeaux/Cognac
Champagne
Bourgundy
Languedoc
Rhône Valley
Alsace

80-100 stakeholders react on the scenarios and propose strategies by using tablets available on discussion tables.

1) They **specified the pathways** leading to the four scenarios and explore their impacts
2) They **constructed strategies** to promote or avoid them



Attitudes stratégiques et priorités(résultats)

	Proactivité positive	Proactivité négative	Réactivité anticipée	Veille	Ø
Le chemin vers la stratégie conservatrice	13.3%	23.3%	36.7%	21.7%	5.0%
Le chemin vers la stratégie innovante	81.7%	1.7%	16.7%	0.0%	0.0%
Le chemin vers la stratégie nomade	1.7%	26.7%	33.3%	38.3%	0.0%
Le chemin vers la stratégie libérale	5.0%	43.3%	21.7%	28.3%	1.7%

Some results: strategic attitude on each scenario/pathway

…Conservative

Positive proactivity : 10-23%
negative proactivity : 15-32%
anticipated reactivity: 21-37%
Strategic watch : 17-28%

Continuation of current adaptation strategies, with diversity of strategic attitude, and questions

Available in many regions if climate remains under 2C, but decrease of competitiveness .

Consumers keep preference on terroir and accept impact of CC on wine quality

…Innovative

Positive proactivity : 56-86 %
negative proactivity : 1-17%
anticipated reactivity: 9-24%
Strategic watch : 0-14%

Innovating to stay in current wine areas, to protect multiple investments and specific assets

Alliance between producers, research, consumers questioning cost and orientation of investment

Need of climate stabilization (located investment).

Consumers may accept technologies

…Nomade

Positive proactivity : 0-6%
negative proactivity : 15-32%
anticipated reactivity: 24-41%
Strategic watch : 35-49%

Difficult to imagine, combination of threats and opportunities…

New actors investing in the wine production

New notions of « terroir » as principe of action

Consumers still purchasing specific and local wines

….Liberal

Positive proactivity : 5-16%
negative proactivity : 41-72%
anticipated reactivity: 18-31%
Strategic watch : 12-22%

The end of current wine world, but a possible world !

Wine producers are excluded from the governance, dominated by wine merchants, blenders, retailers who are taking advantage from CC…

Consumers consider wine as industrial beverage

Main outcomes and impacts of the prospective

- Sucessfull **learning tool** in each wine region leading to awareness, capacity building, collective action that help the co-construction of climate strategy in regional vineyards
- **Political tool**: creation of a « national group on wine and CC » including the main wine organisations and administrations, and presentation at OIV (international organisation of vine and wine)
- **Innovation booster** : promoted by UE as an innovation for climate smart agriculture (Climate KIC)
- **Methodological outcomes** : interest of food system approach and prospective focusing contribution to the prospective methods for adaptation to CC on pathways
- Contribution to the Inra **research agenda** : new topics (soil, innovative systems, landscaping…) and new participatory method (living lab)
- **Impact on the society** (TV documentaries, national and international medias)

Construction of shared messages

- Adaptation strategies could be reasonably implemented in all French vineyards if global warming stays below 2°C
- Reduction of GHG emission is imperative , “if you like wine you must support Paris COP21 agreements”
- No single solution, but different combinations of technical innovations, spatial strategies and institutional changes.
- The integration of solutions must be elaborated considering the value chain, including the consumer preferences
- The adaptation strategies must be coordinated at local and regional levels where climate impacts are specific and where the use of resources can be optimized
- The best way to adapt is based on collaborative capacity between researchers and stakeholders, at regional and inter regional levels
- Prospective can be successful tool for climate smart agriculture