



Assessing local climate vulnerability and winegrowers' adaptive processes in the context of climate change

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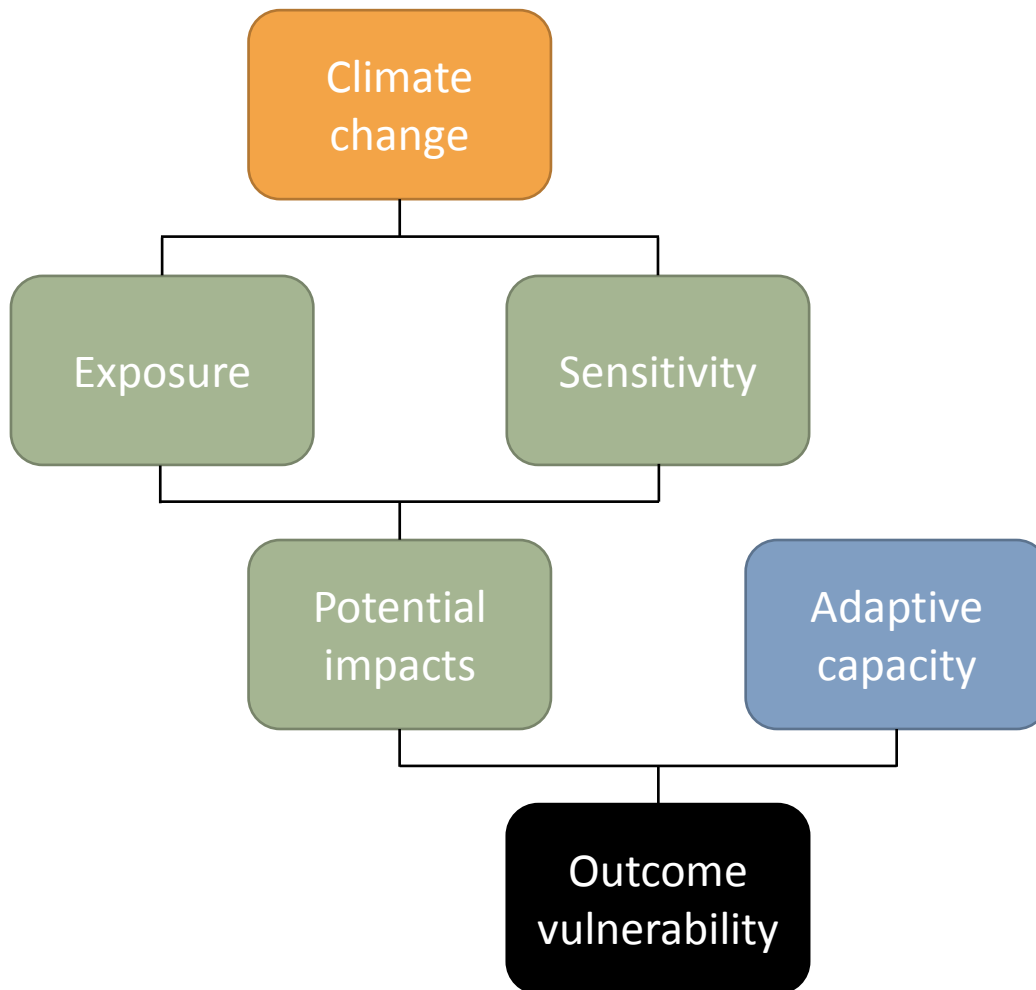
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Under the contract number: LIFE13 ENV/FR/001512

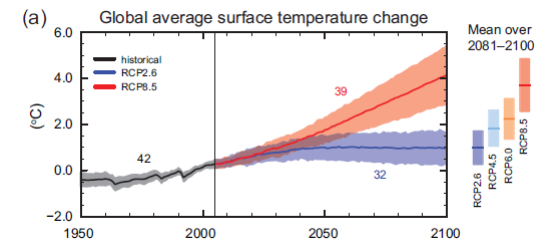


Outcome vulnerability assessments

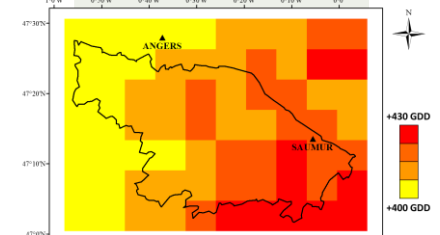


O'Brien et al. 2007

Sequence of successive steps

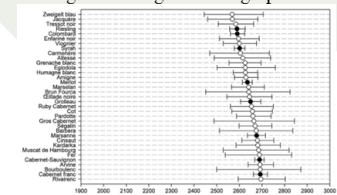


Increase in Growing Degree-Days (GDD)
Anjou-Saumur wine growing region, France



Scenario RCP 4.5, Mean changes for 2071-2100, compared to 1986-2005

Impacts on the phenological growth stages of the grapevine



Parker et al. 2013

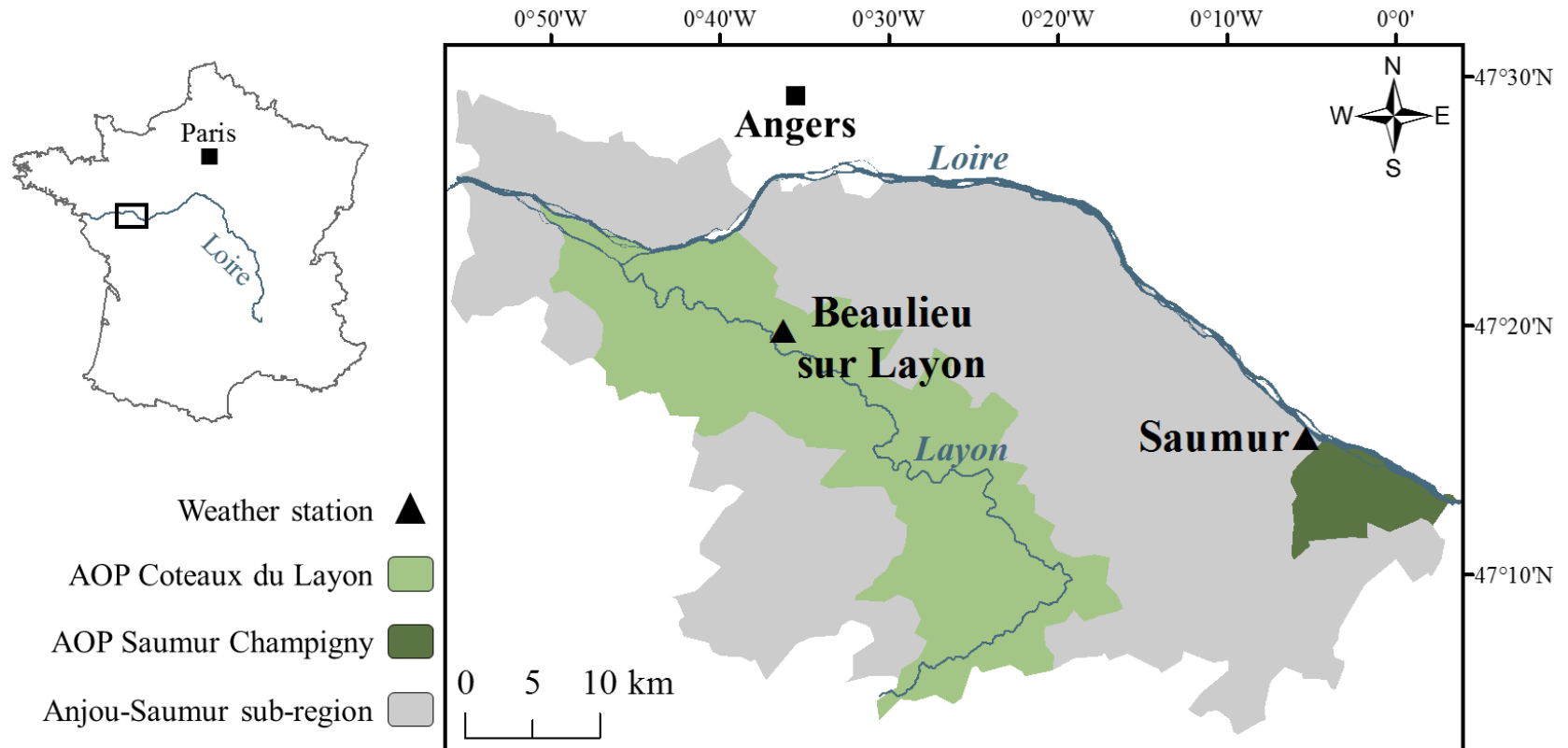
Contextual vulnerability assessments

- Emerge as a **key concept** to inform adaptation
 - Conducted in a few wine-growing regions
 - E.g. Okanagan Valley (Belliveau et al. 2006)
 - Northern California (Nicholas and Durham 2012)
 - Roussillon and McLaren Vale (Lereboullet et al. 2013)
- **More explicitly** for the internal and external factors and processes
 - Defines exposure, sensitivity, and adaptive capacity to changing conditions
- Particular importance in the viticulture sector
 - ✓ Wine quality → Unique characteristics of its geographical location, where winegrowers' decision-making play a significant role

Study goals

1. Exposure and sensitivity of wine quality to past and current climate conditions
2. Changes in viticultural practices over recent decades
3. Winegrowers' adaptive responses to climate conditions
4. Perceptions and adaptation priorities of winegrowers to potential future climate changes

Anjou-Saumur wine-growing sub-region, France



Coteaux du Layon and Saumur Champigny



AOP COTEAUX DU LAYON

Surface 1400 ha

Soil properties Shallow slate soils with low to moderate water reserves

Landscape features Steep to moderate slopes

Grapevine Chenin

Wine style Sweet white wine

Data collection and analysis

Participating winegrowers

- Each study area → 15 winegrowers (seniority, geographical position, farm size, production strategies, ...)

Semi-structured interviews

- Many open-ended questions → Understanding participants' experiences and opinions on a particular event or topic
 - ✓ Questions are prepared → some may arise naturally during the interview
 - ✓ Prior to fieldwork, pre-test interviews were completed

Exposure and sensitivity of wine quality to climate conditions

- Good coherence in describing wine quality
 - **Capacity to recall detailed descriptions** of wine quality
 - Structured perceptions of past climate characteristics
- Favorable and unfavorable climate conditions :

Amount of
heat units

Amount
and timing
of rainfall

Incidence of
late spring
frost

Climate-related exposure and sensitivity :

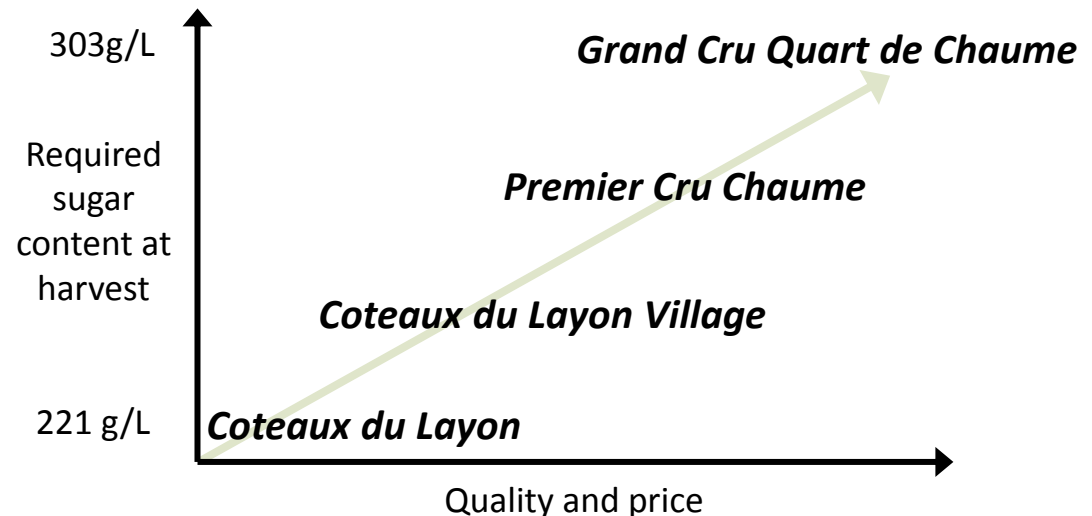
→ Dependent on **many contextual factors** interacting with the regional oceanic climate

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- Favorable and unfavorable climate conditions :

Amount of
heat units

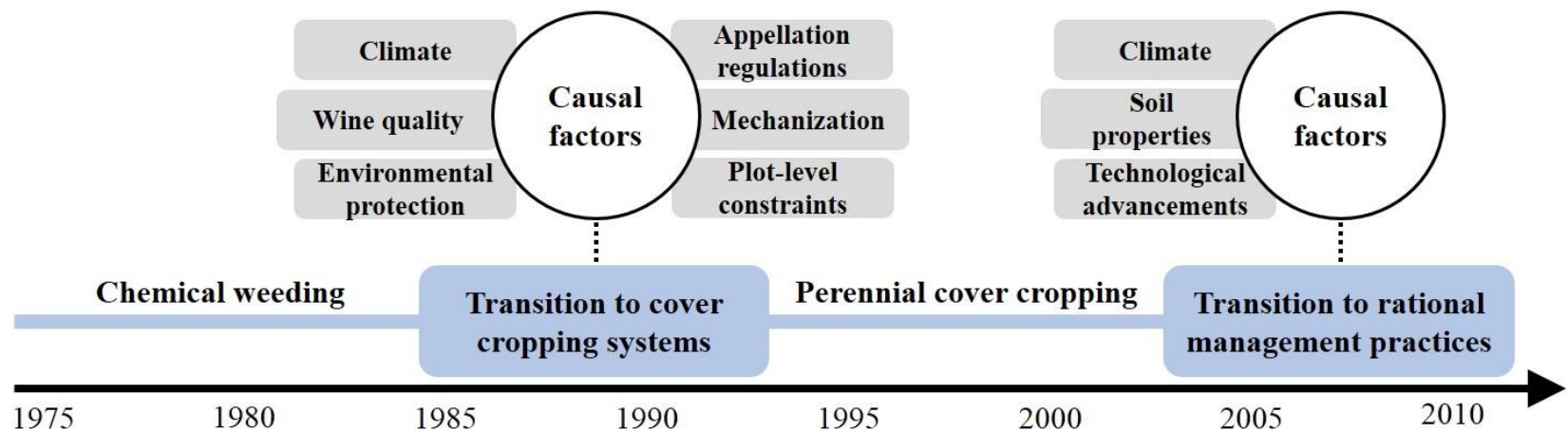
Example of AOP
Coteaux du Layon
Variety : Chenin



Changing viticultural practices

- **Important changes** occurred over recent decades
- 1990s marked a turning point
 - Reconsider practices → Better manage climate-related risks and opportunities

Temporal trends and causal factors identified for vine inter-row management practices



Winegrowers' adaptive responses to climate conditions

- Most adaptive responses occur during harvest and winemaking (i.e., tactical/short-term and reactive)
 - ✓ E.g. Adjusting harvest date (especially for wet ripening periods)
- Impacts of climate variations → **not new**
- Adaptation has always been a constant challenge faced by winegrowers
 - ✓ Through various learning experiences
 - ✓ Shared knowledge (i.e., practical and scientific)
 - Enhance their adaptive responses
- Adaptive capacity is **dynamic** → will affect future climate-related exposure and sensitivity

Winegrowers' adaptive responses to climate conditions

Examples of types of adaptive responses used by winegrowers to manage diverse climate conditions

Adaptive responses	Climatic stimuli	Examples of viticultural practices
<i>Tactical, reactive</i>	Cool, wet	More severe leaf, shoot, crop thinning
	Warm, dry	Less severe leaf, shoot thinning Foliar nitrogen fertilization
	Wet ripening period	Several harvests via bunch selection Harvesting at night by machine
	Frost	Requesting crop insurance Turning on heaters/wind machines
<i>Tactical, anticipatory</i>	Cool, wet	Advancing canopy management practices Allowing natural vegetation to grow Higher number of fungicide treatments
	Warm, dry	Delaying canopy management practices Shallow soil tillage
	Frost	Delaying winter pruning Mowing cover crops
<i>Strategic, reactive</i>	Cool, wet	Longer cane pruning
	Warm, dry	Changing perennial cover crop species Increasing the trellis system height
<i>Strategic, anticipatory</i>	Cool, wet	Site selection
	Dry	Choice of rootstock variety
	Frost	Site selection, choice of grapevine variety

Winegrowers' perceptions and adaptation priorities

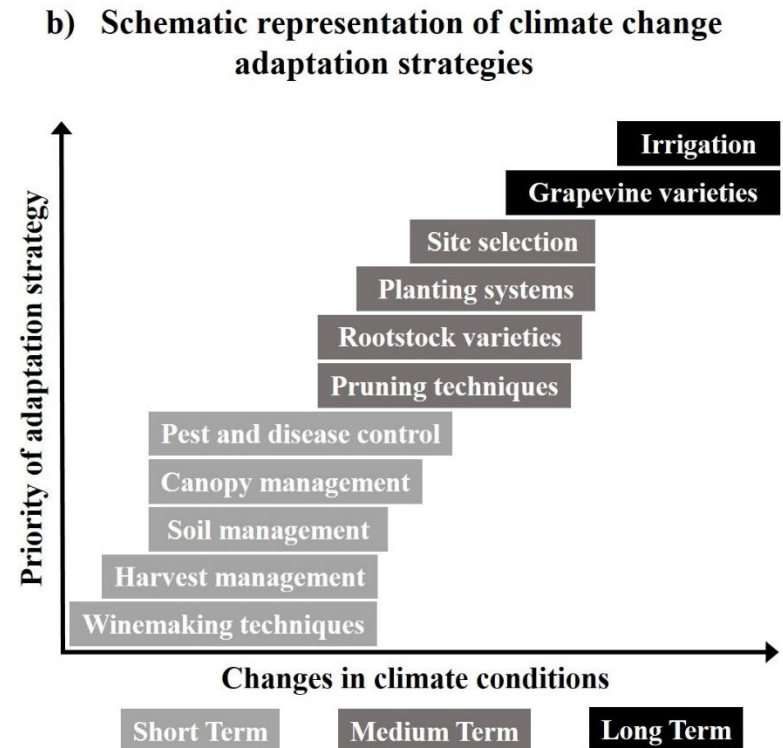
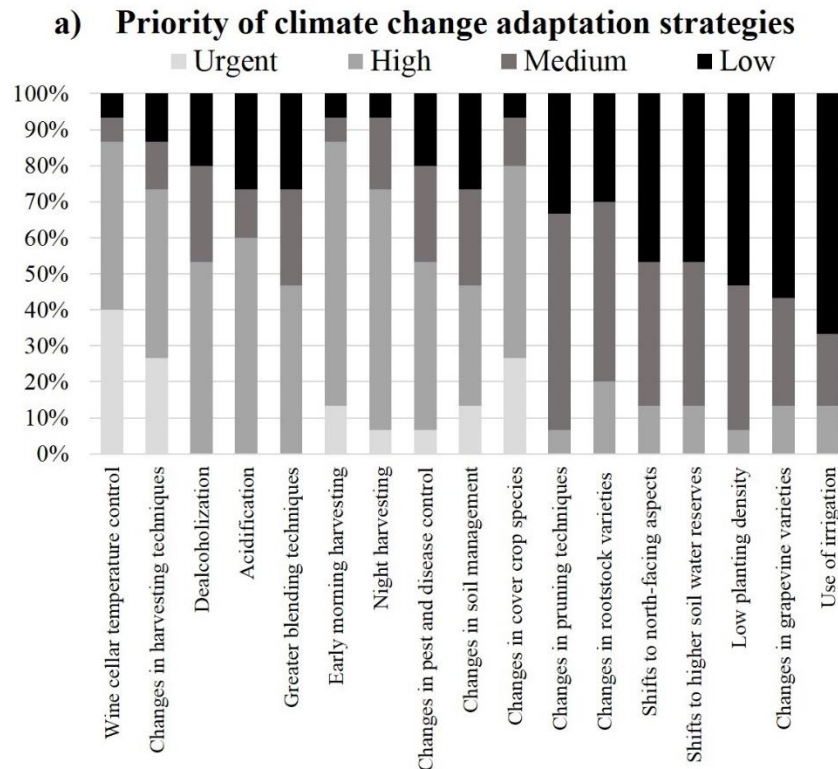
- Agreed with studies realized in France and Europe (Battaglini et al. 2009; Rochard et al. 2010)
 - ✓ Observed regional climate changes and their impacts on vine phenology and grape quality
- **Yet**, to identify climate change as the main causal factor, stressing that their evolving viticultural practices have played a significant role in improving grapevine behavior and wine quality
- Concerning the persistence and future direction of regional climate changes
 - All winegrowers described a **great uncertainty**
 - Perceive climate changes to be due to natural decadal variability

Winegrowers' perceptions and adaptation priorities

Based on the responses of winegrowers from Saumur Champigny :

a) Priority of climate change adaptation strategies

b) Schematic representation in the short, medium, and long term

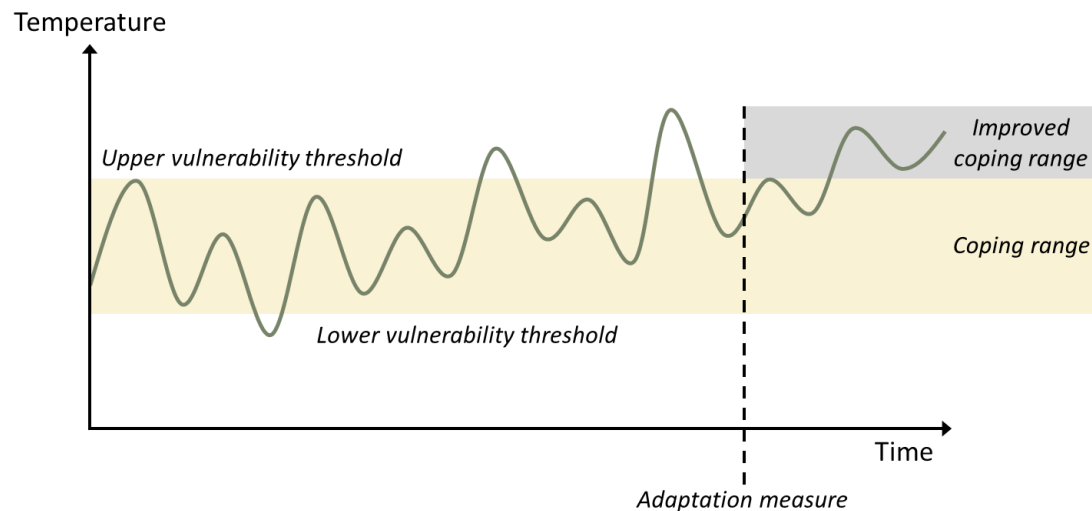


Conclusion and perspectives

- Importance of contextual knowledge
 - Framing vulnerability and understanding its differences across and within wine growing regions
- With a focus on wine quality :
 - Local environmental features and socio-economic aspects are key determining factors of exposure and sensitivity
- As each wine growing region consist of unique contexts :
 - Knowledge and understanding of those contextual factors, and their interaction with the regional climate, will be essential to identify adaptation initiatives

Conclusion and perspectives

- Winegrowers' decision-making is an on-going and dynamic process



Adapted from IPCC, 2007: Relationship between climate change and threshold exceedance, and how adaptation can establish a new critical threshold, reducing vulnerability to climate change

Conclusion and perspectives

- Winegrowers' decision-making is an on-going and dynamic process
- Contextual vulnerability assessment approaches
 - Outline deciding factors that assist or constrain the process of autonomous adaptations
 - E.g. production regulations
- Alongside winegrowers' autonomous adaptations
 - Need for policy and research to assist winegrowers in planning adaptation responses to uncertain long-term climate changes



Thank you for your attention

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Exposure and sensitivity of wine quality to past and current climate conditions

Wine quality	Growing season	Growing season climate characteristics	Examples of impacts on grapevine behavior and wine production
Excellent	1989, 1990, 2005, 2010	Sunny, warm, dry season	Early vine phenology
		Rain at the right moment	Regular budburst and bloom
Very good	1995 1996 1997 2011	Warm, dry ripening period	Grapes fully ripened
		Sunny, warm, dry season	Grapes fully ripened
		Sunny spring, dry season	High sugar, phenolic content
		Warm, dry ripening period	Grapes fully ripened
		Dry spring, wet summer	Very early vine phenology
Very good but atypical	2003	Warm, dry ripening period	Grapes fully ripened
		Very warm summer	Very early vine phenology
		Heatwave	Overripe grapes
		Fairly dry season	Atypical wine profile
		⋮	
Poor	1999, 2006	Warm season	High level of grey rot
		Wet ripening period	Short harvesting period
	2000, 2012	Wet, cool season	High Downy Mildew outbreaks
		Wet ripening period	Late vine phenology, unripe grapes
Very poor	2008	Late-spring frost	Late vine phenology
		Wet, cool season	Low yields, unripe grapes
	1991	Late-spring frost	Very low yields Irregular grapevine behavior
	1994	Wet ripening period	High level of grey rot
	1992	Wet, cool season	Very high yields, unripe grapes