Main impacts of climate change on fruit trees.

Recent changes, expected impacts and adaptation strategies

Iñaki Garcia de Cortazar-Atauri
US 1116 AGROCLIM – INRA PACA

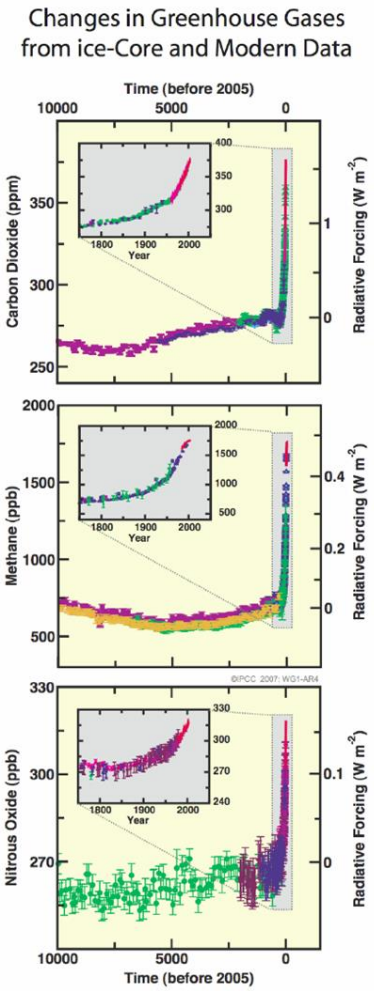
Some basis about climate change

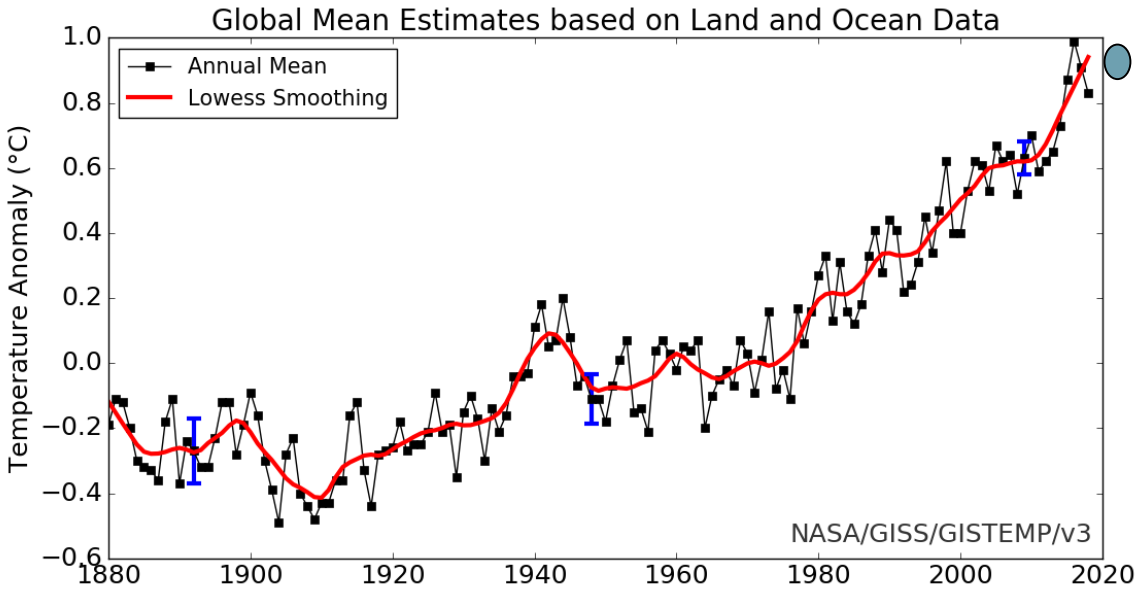
Changes in GHG concentrations and temperature

100 years

12 years

120 years



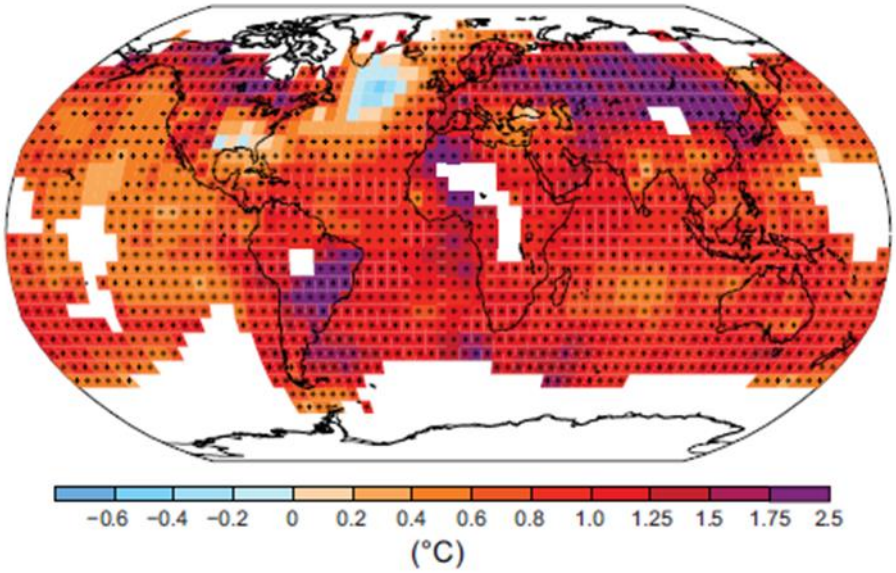


2016, 2017, 2015, 2018, 2014, 2010, 2005, 1998, 2013, 2003, 2002, 2006, 2009, 2007, 2004, 2012

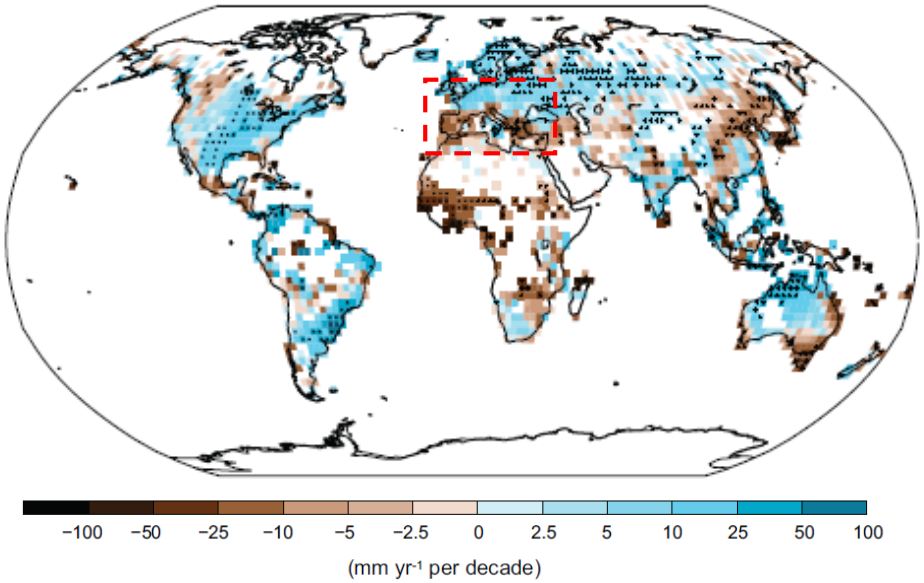
Some basis about climate change

Observed changes – World level

Observed change in surface temperature
1901 - 2012



Observed change in annual precipitation
1951– 2010

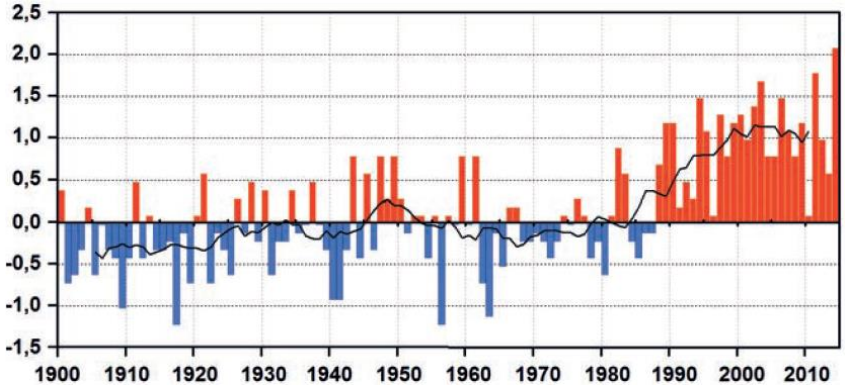


Not the sames changes depending of the variable and the region

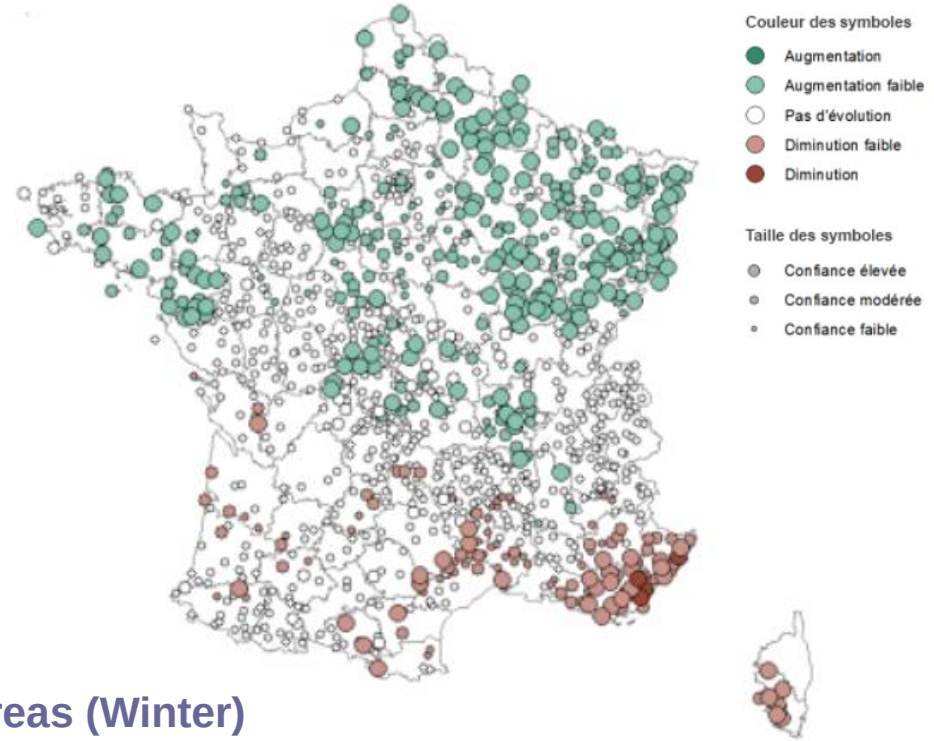
Some basis about climate change

Observed changes in France

Changes in the anomaly of the annual mean temperature (ref. 1961-1990)



Changes in annual rainfall accumulations – Period 1959-2009



Temperature increase – all the seasons

Rainfall – Differences Northern/Southern areas (Winter)

METEO FRANCE
Toujours un temps d'avance

Climat HD

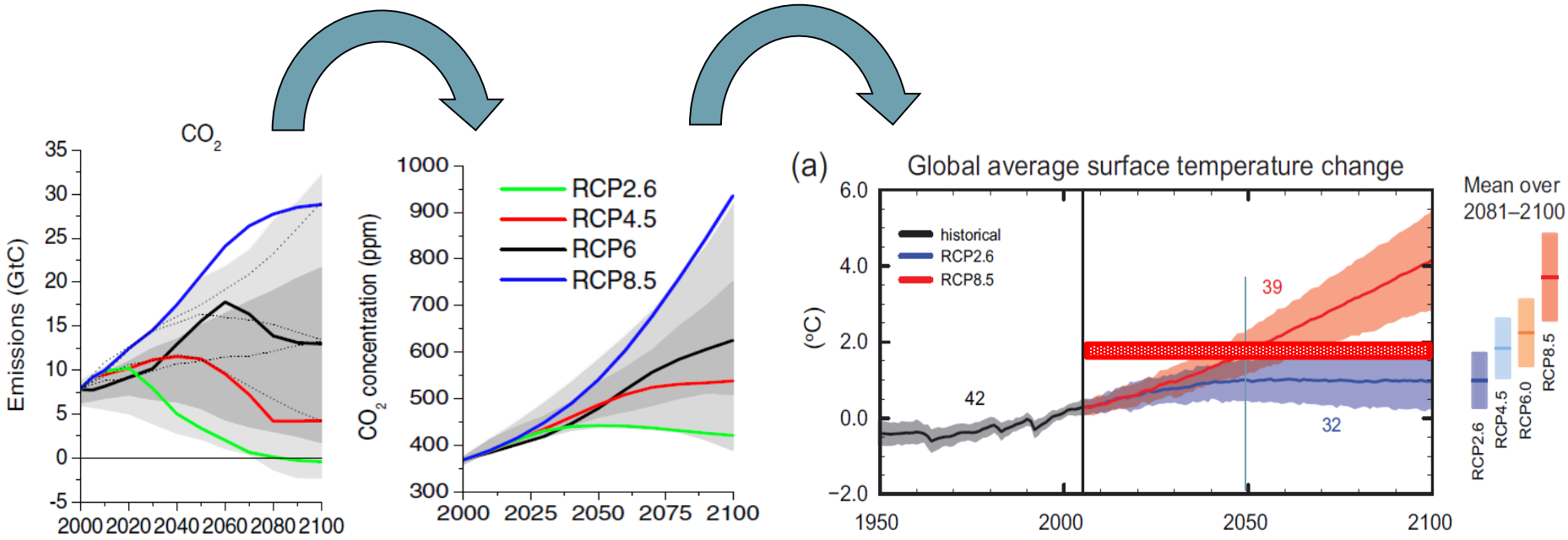
Some basis about climate change

Observed changes – Extreme events

Extreme event	Years	Periods	Impact
Heatwave	2003, 2006, 2015, 2016, 2017, 2018, **2019**	End June – Beginning August	Maturity, yield, physiology
Drought	2003, 2011, 2015 – 2018, **2019**	Spring, Summer, Winter	Localized and variable Growth, nutrition, quality, production
High temperatures	2007, 2011, 2015-2016, 2018	Winter, Spring	Earlier development, Mild winter-> less control of pathogens
Rainy periods	2002, 2004, 2011, 2013, 2016, 2018	Spring, Summer, Autumn	Flowering, Harvest
Frost	2012, 2016, 2017, **2019**	Winter end, Spring	Plant mortality
Hail	2008(3), 2009 (5), 2010(3), 2012(4), 2013(3), 2014(4), 2016(2), 2017, 2018	Spring - Summer	Localized - plant destruction and production

Some basis about climate change

How do you predict the future?



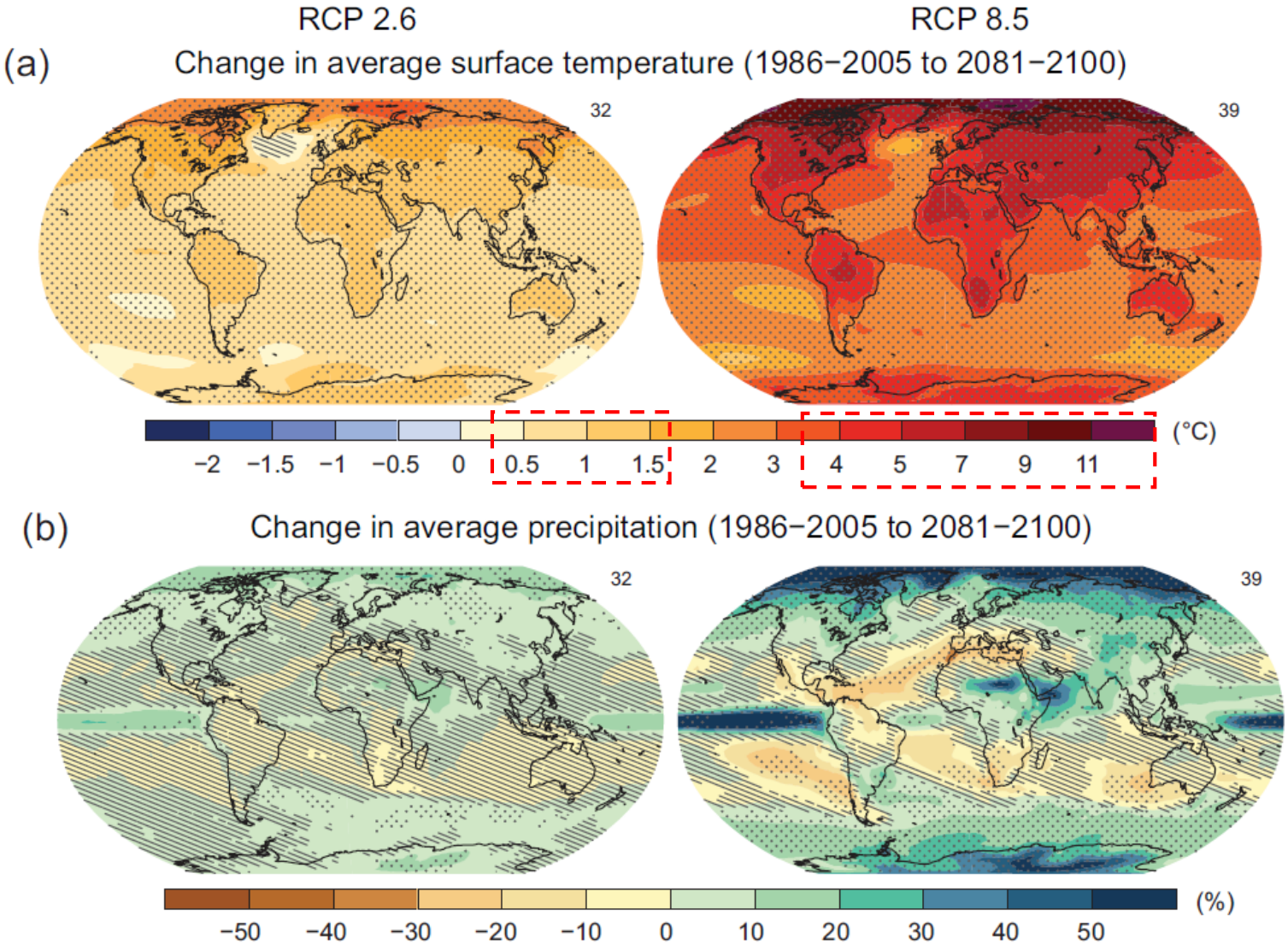
Rapport GIEC 2013

Different scenarios depending on various global policies!
Very high inertia of the system!

Some concepts about climate change

Global conditions

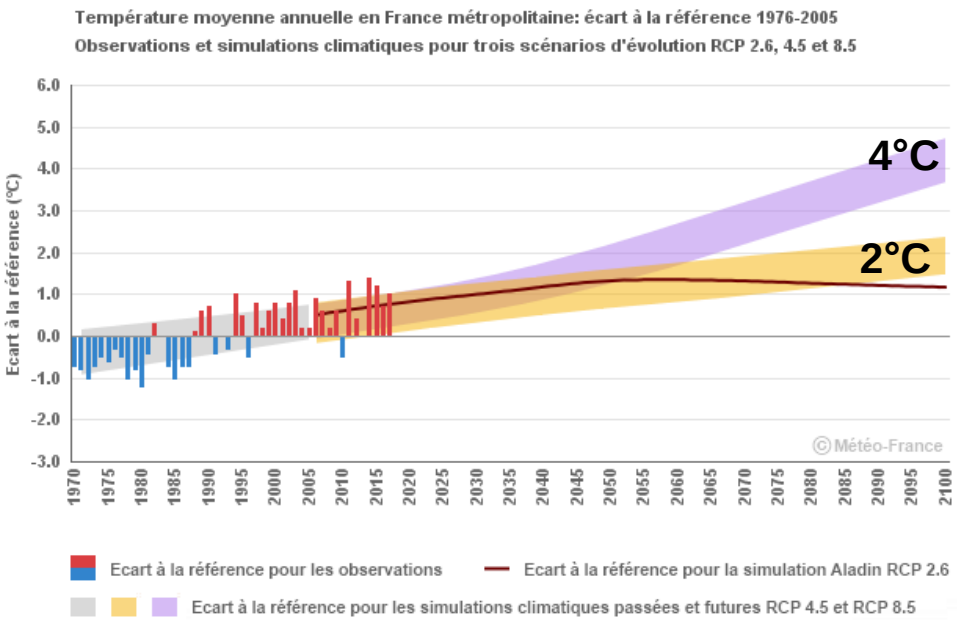
Uncertainties



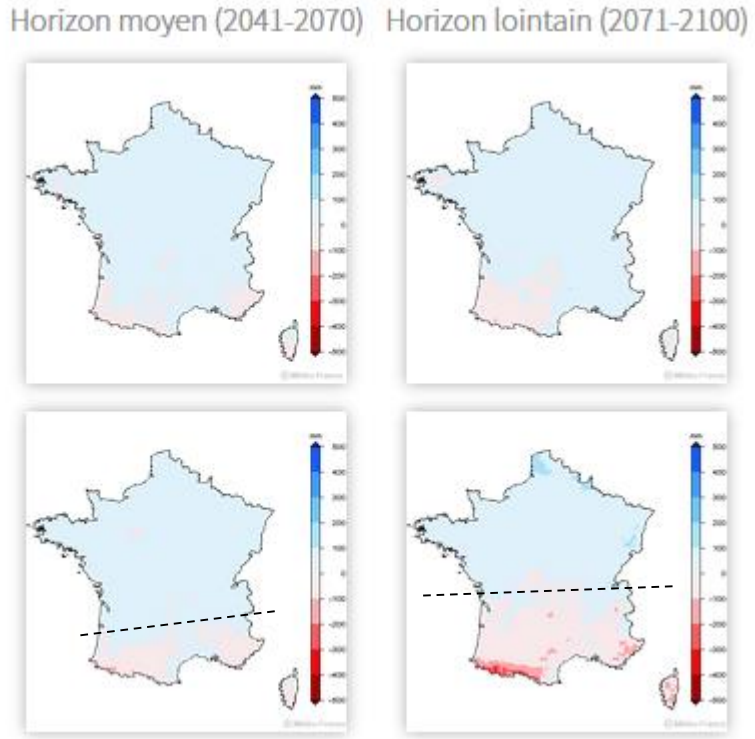
Some concepts about climate change

French conditions

Temperature



Rainfall



METEO FRANCE
Toujours un temps d'avance

Climat HD

Interactions between climatic conditions and crops

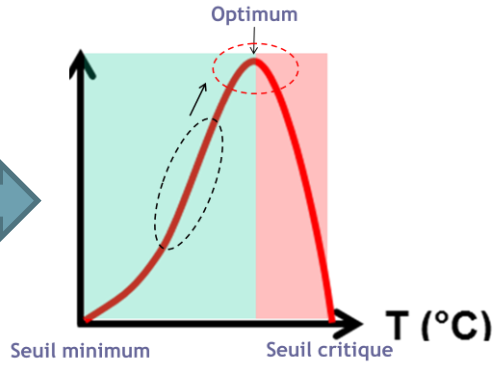
Temperature effect

Cold temperatures

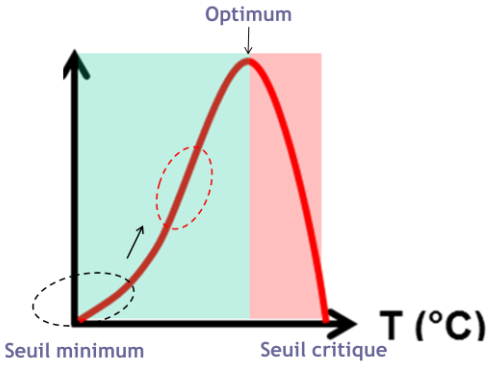
Autumn - Winter
Escape Frost

Important for budbreak
Flowering - production

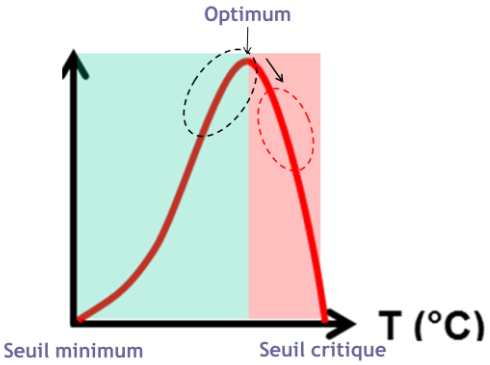
Warm temperatures



Reach optimum



New opportunities



Supra-optimal

Interactions between climatic conditions and crops

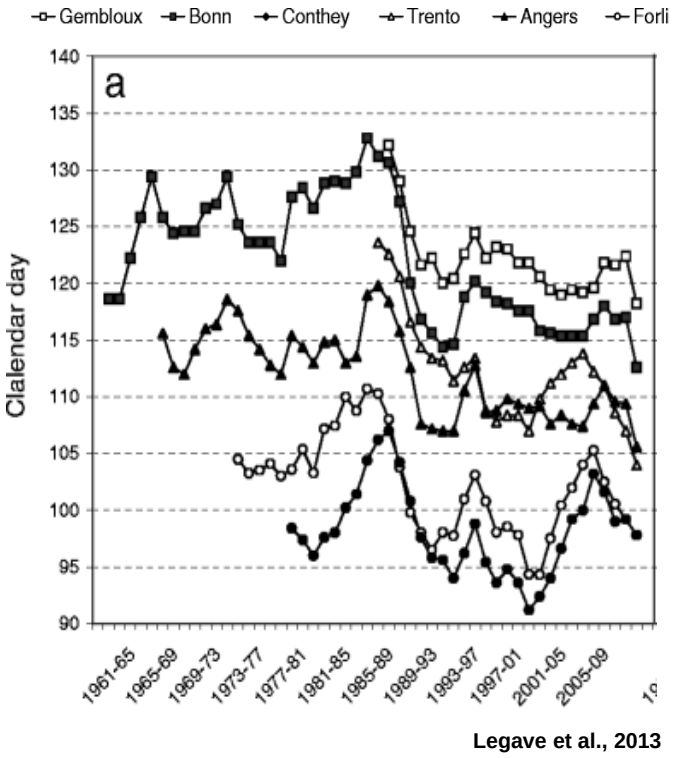
Complexity of interactions

Water and Nitrogen balances...
Carbon and Nitrogen reserves…
Water efficiency…

Observed changes

Phenology and Quality

Golden apple flowering date (F1)



Legave et al., 2013

Other changes: aromas, colour, typicity, physiological disorders …

Ctifl

Sugar +1°/10 years
Acidité -0.5 – 1g/L /10 years

Similar trends for many species (i.e. grapevine) but not the same intensity.
These changes are considered as problem in Southern areas and as a benefit in Northern areas

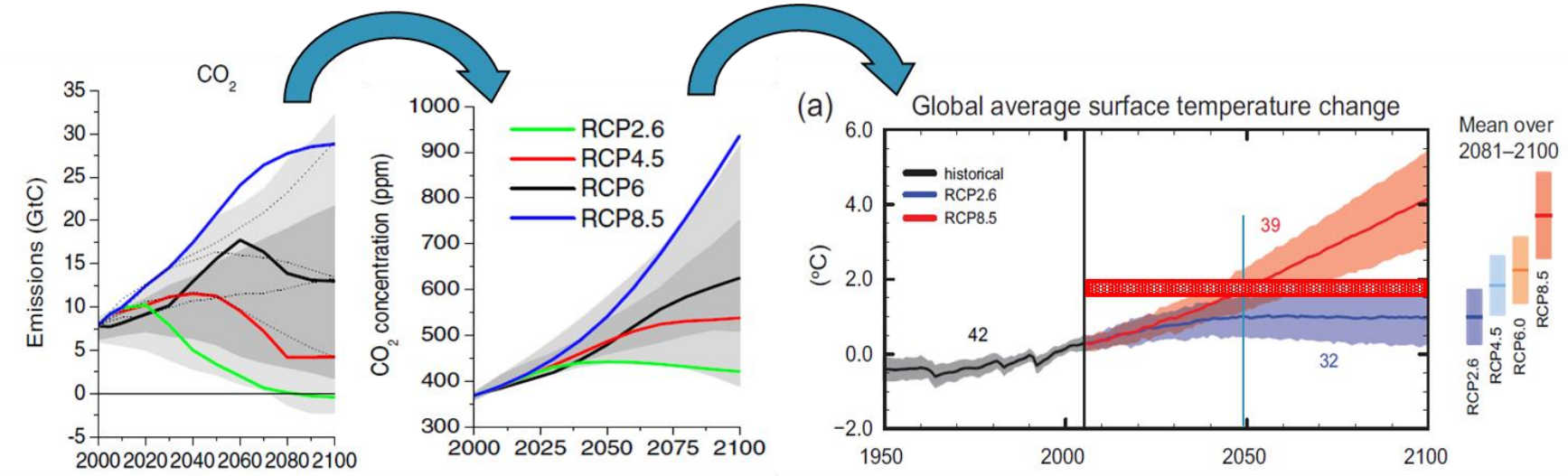
Observed changes

Other changes

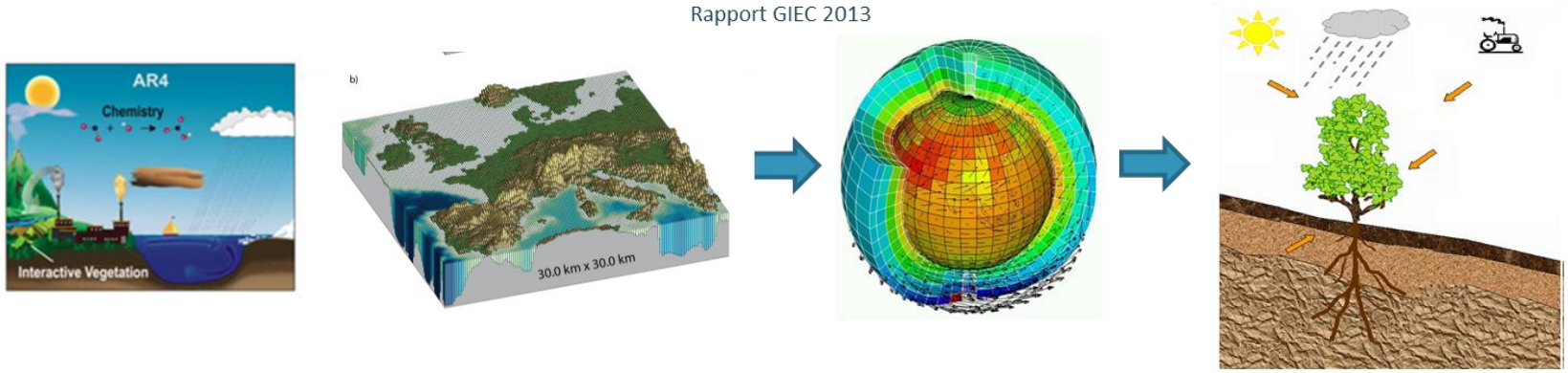
- Relationships between winter conditions (rest, dormancy) and yield → Apricot
- No evidence of changes on pest and diseases distribution and frequency **related to Climate change → more facilities to stay and development**
- **Changes in work organization**: number of days for harvest, harvest period, technical staff availability
- **Extreme events** – high variability (2003, 2006, 2011, 2013, 2015, 2016, 2017, 2018, 2019…)

Futur impacts

General framework



Rapport GIEC 2013



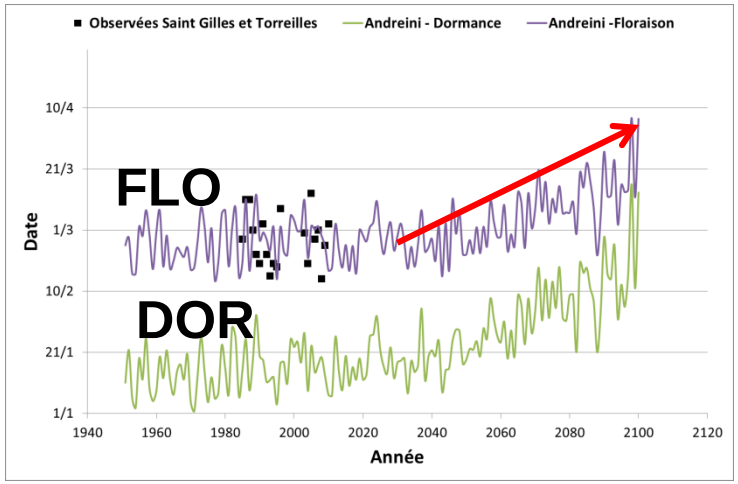
Futur impacts

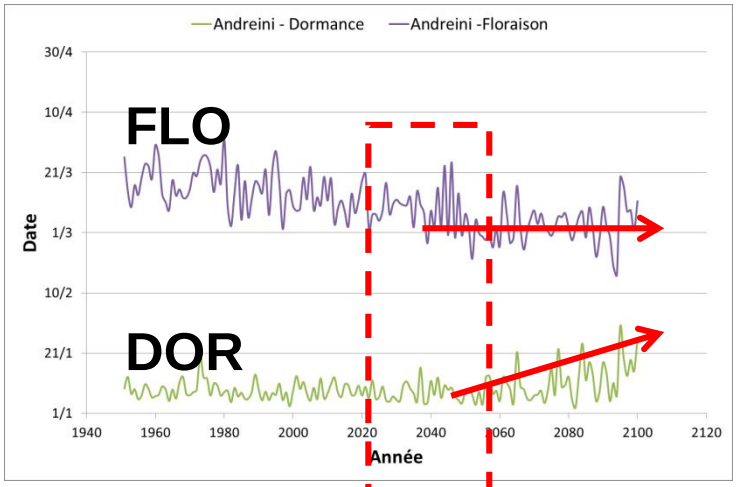
Phenology evolution - Apricot

Perpignan

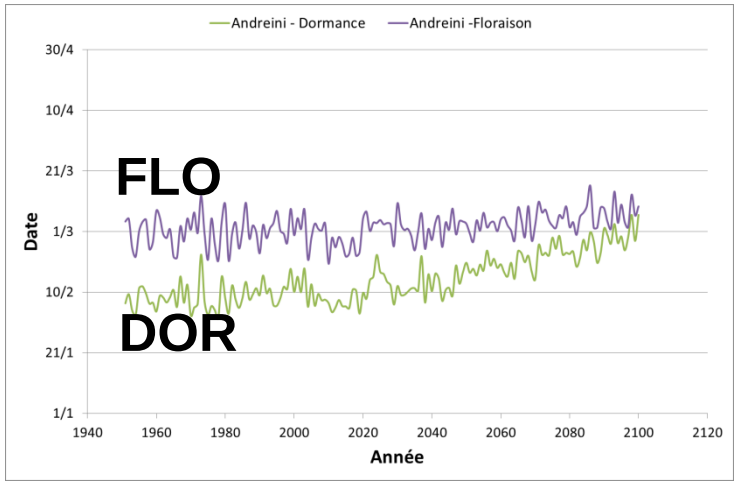
Valence

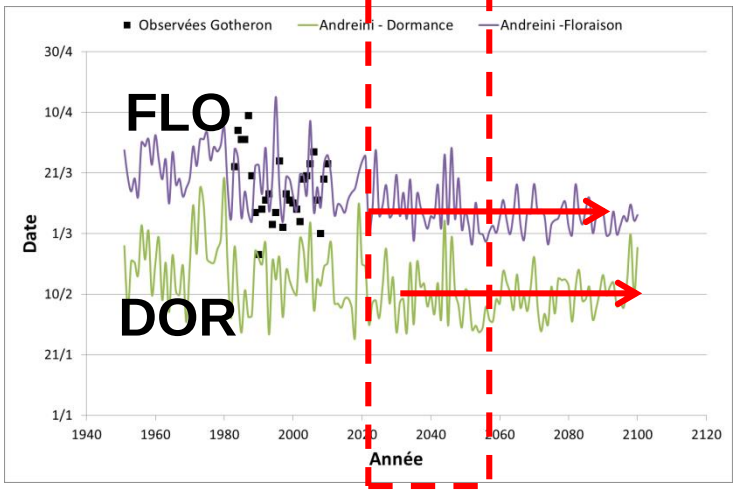
Early varieties





Late varieties





CTPS Abricot

Futur impacts

Other impacts

- **Maturity climatic conditions** will still change – typicity !!!
- **Dormancy problems** in Southern areas
- **Yield variability**
- **New regions**

Adaptation strategies

Harvest management, Transformation, Conservation

Genetics Knowledge / Phenotyping

New markets and consumers choices

Testing new training system (irrigation, rootstocks…)

Learn more about the quality and yield determinants (responses to stress)

Some adaptation strategies

Short term (incremental ch.)

Agronomy





Precision Agric.

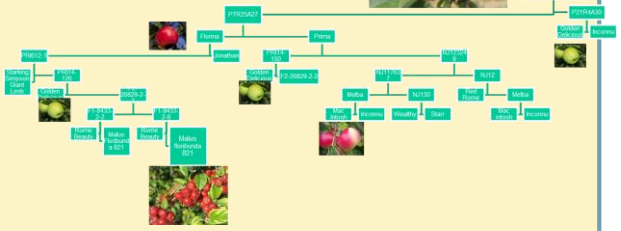
Mid term

Breeding



Résistance au bio-agresseur
Introduction du gène Vf contre la tavelure


Ariane cov



Spatial Diversification

Long term (transformation)

New species





N Areas /Altitude

Crédits photo: Ctifl, INRAE

Conclusions

- Big changes **have been and will be** observed
- If temperature **increases "only" 2°C**, we can adapt current regions without major changes (extreme events…)
- **Adaptation** is possible **at local scale** – no global solutions
- **No adaptation without mitigation**
- Importance of **involving different scales of analysis**, and various multidisciplinary approaches.

Merci beaucoup de votre attention