How can grapevine genetics contribute to the adaptation to climate change?

Eric Duchêne
SVQV, INRA - University of Strasbourg, Colmar, France

Ollat N., Marguerit E.
EGFV, INRA, *Bordeaux-Sciences Agro, University of Bordeaux, Bordeaux, France*
Coupel-Ledru A., Lebon E., Simonneau T.
LEPSE, INRA, Montpellier, France

What are the main objectives of the adaptation to climate change?

1. Maintaining berry composition:
- shifting the ripening period later in the season,
- maintaining a constant berry composition under higher temperatures,
- maintaining a constant berry composition under water restriction.

2. Maintaining the yield level
- Better tolerance to water stress, better water use efficiency,
- Maintaining fertility (number of flowers) under water restriction

What are the main objectives of the adaptation to climate change?

1. Maintaining berry composition:
- shifting the ripening period later in the season,
- maintaining a constant berry composition under higher temperatures,
- maintaining a constant berry composition under water restriction.

2. Maintaining the yield level
- Better tolerance to water stress, better water use efficiency,
- Maintaining fertility (number of flowers) under water restriction-> data on genetic response?

UNIVERSITÉ DE STRASBOURG

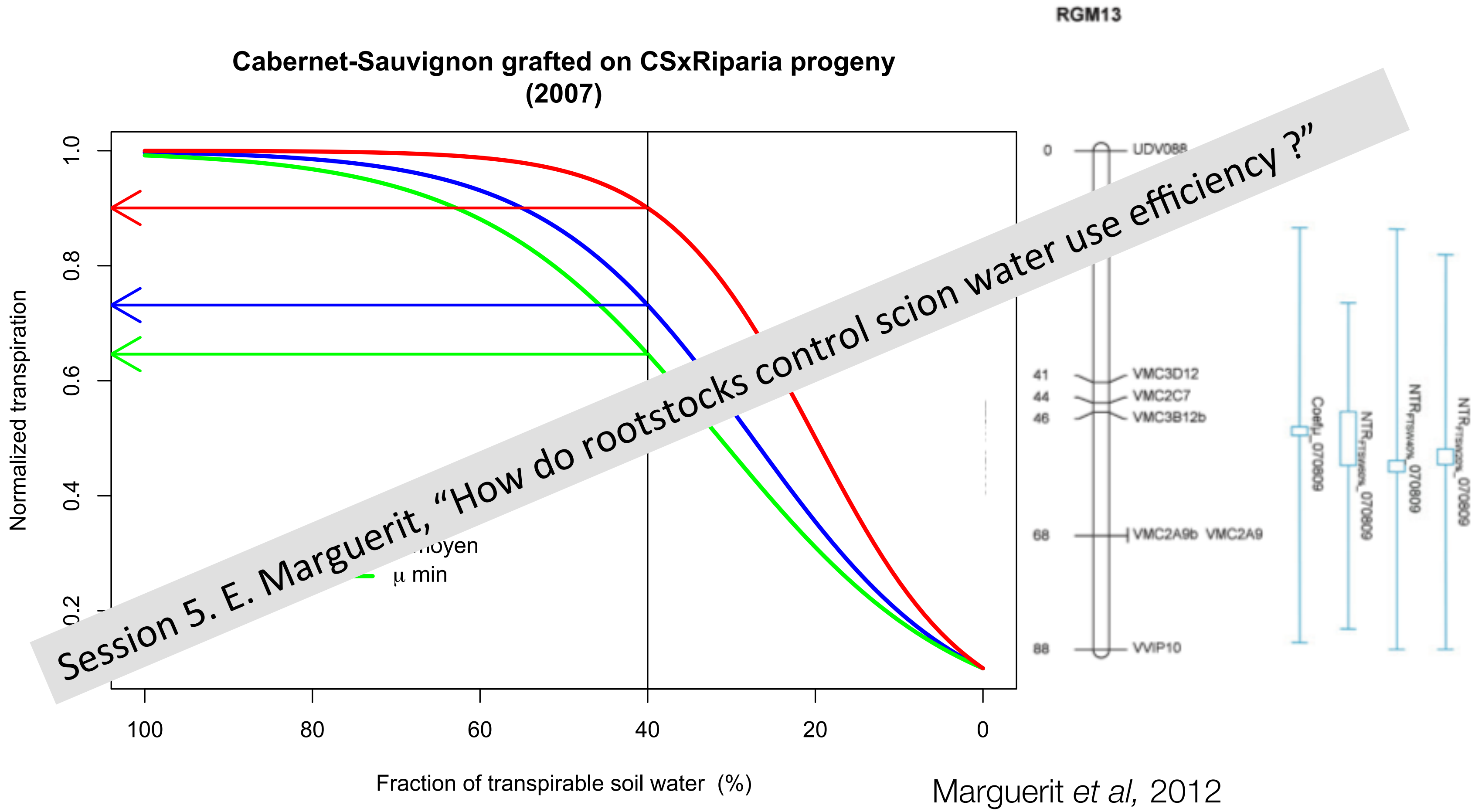
INRA SCIENCE & IMPACT

What are the main objectives of the adaptation to climate change?

1. Maintaining berry composition:
- shifting the ripening period later in the season,
- maintaining a constant berry composition under higher temperatures,
- maintaining a constant berry composition under water restriction.

2. Maintaining the yield level
- Better tolerance to water stress, better water use efficiency,
- Maintaining fertility (number of flowers) under water restriction

Rootstocks can modify the response of the scions



Marguerit *et al,* 2012

There is a genetic variability for the response to drought among scions varieties

$\delta^{13}C$ on grape musts in the vineyard

Chenin
Carignan
Colombard
Syrah
Pinot noir
Sauvignon
Cabernet
Sauvignon
Sémillon
Merlot
Pinot gris
Tannat
Mourvèdre
Chardonnay
Grenache
Cabernet franc
Viognier
Malbec
Petit verdot
Riesling

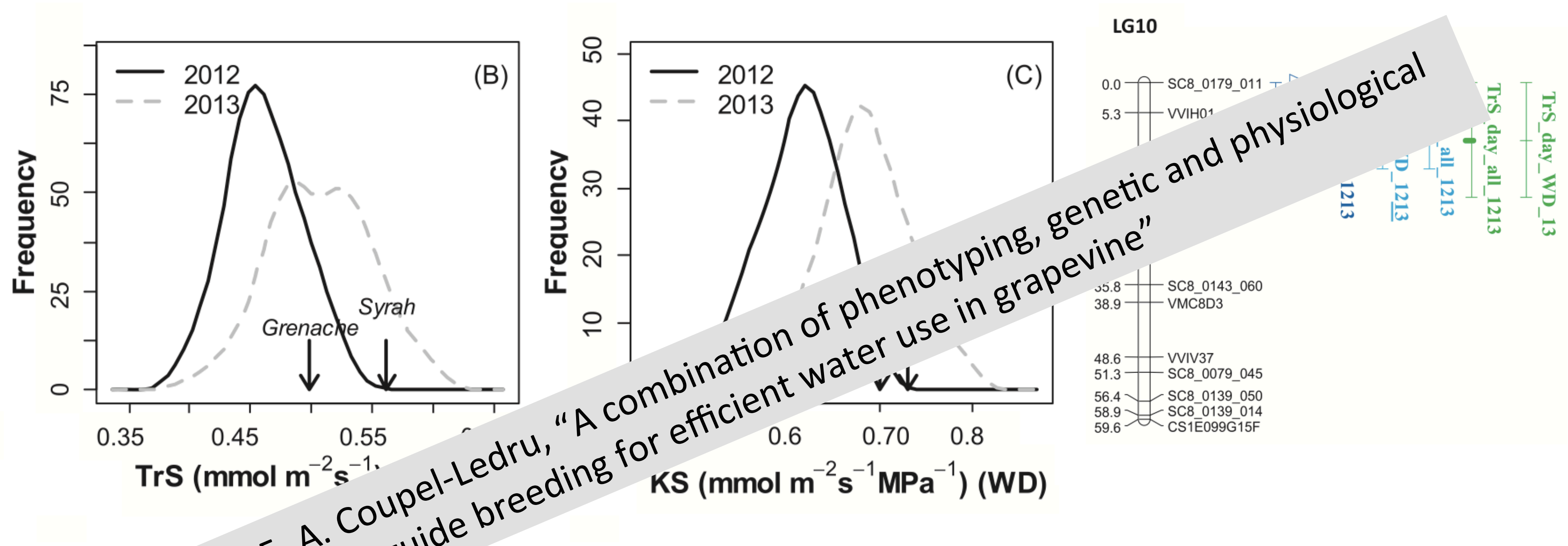
Increasing stomatal closure during the growing season

Gaudillere et al., 2002

UNIVERSITÉ DE STRASBOURG

INRA SCIENCE & IMPACT

QTLs for water economy among scions varieties are identified



Session 5. A. Coupel-Ledru, "A combination of phenotyping, genetic and physiological approaches to guide breeding for efficient water use in grapevine"

TrS : ... ation rate

KS : specific soil-to-leaf hydraulic conductance

Coupel-Ledru et al, 2014

UNIVERSITÉ DE STRASBOURG

INRA SCIENCE & IMPACT

What are the main objectives of the adaptation to climate change?

1. Maintaining berry composition:
- shifting the ripening period later in the season,
- maintaining a constant berry composition under higher temperatures,
- maintaining a constant berry composition under water restriction.->no data?

2. Maintaining the yield level
- Better tolerance to water stress, better water use efficiency,
- Maintaining fertility (number of flowers) under water restriction.

UNIVERSITÉ DE STRASBOURG

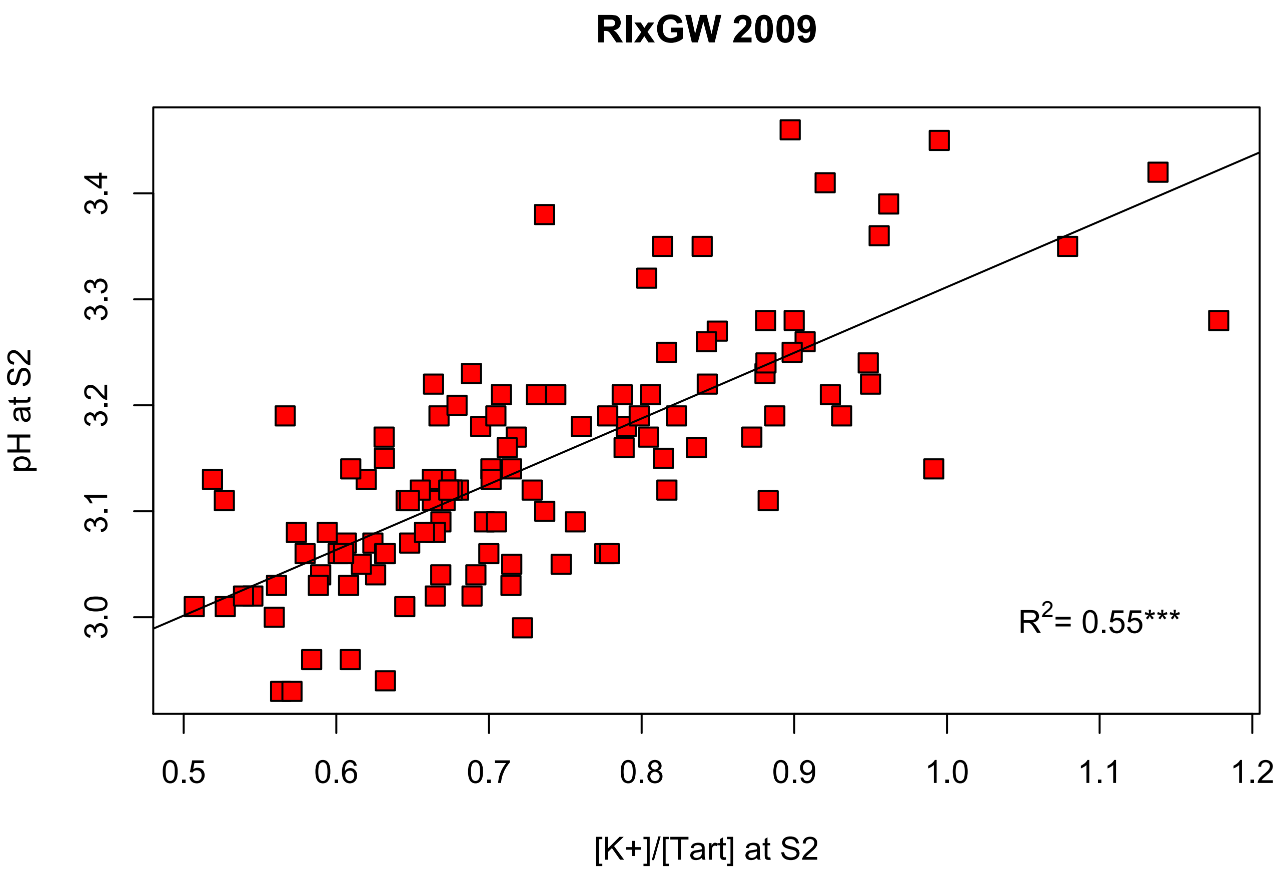
INRA SCIENCE & IMPACT

What are the main objectives of the adaptation to climate change?

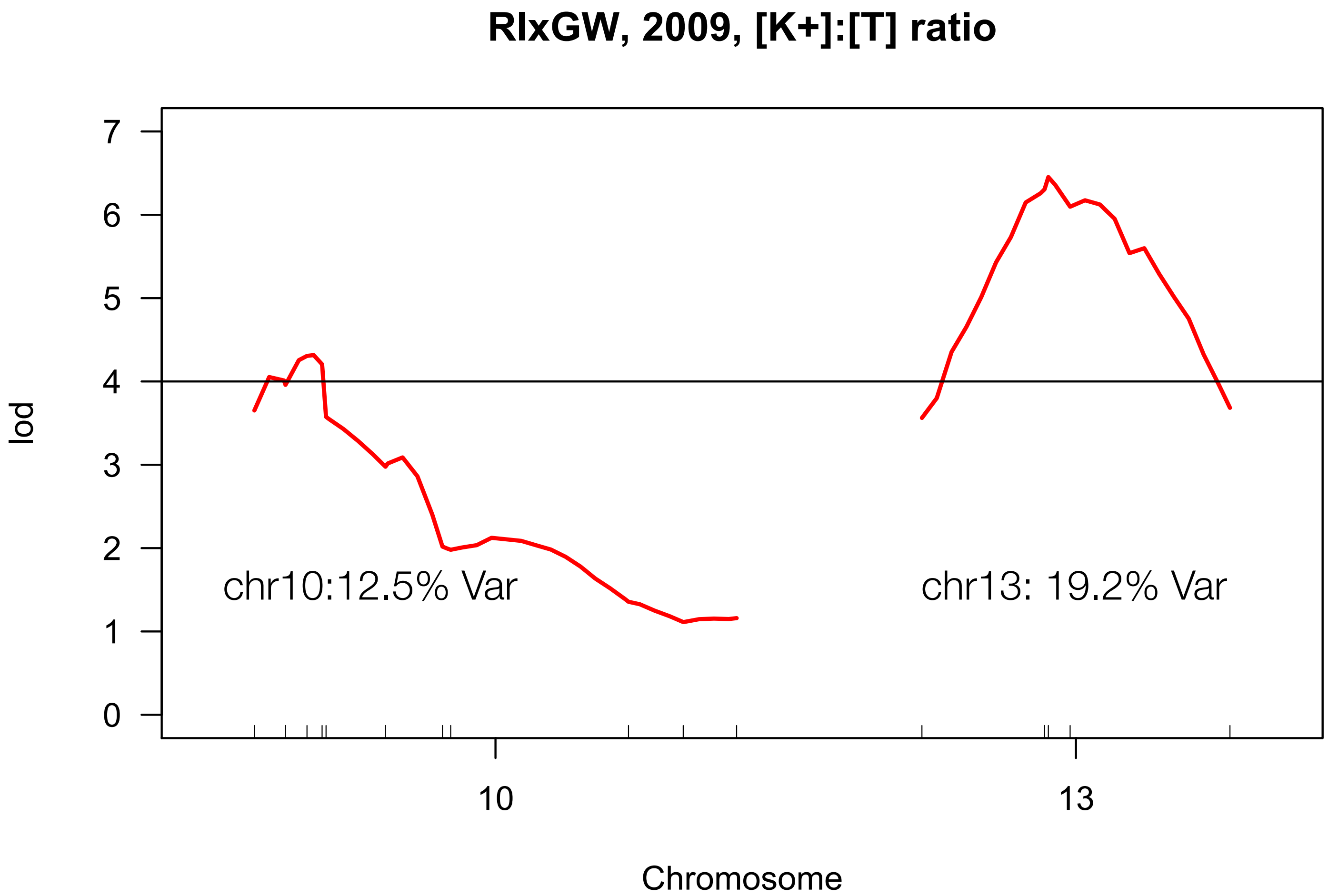
1. Maintaining berry composition:
- shifting the ripening period later in the season,
- maintaining a constant berry composition under higher temperatures: acidity
- maintaining a constant berry composition under water restriction.

2. Maintaining the yield level
- Better tolerance to water stress, better water use efficiency,
- Maintaining fertility (number of flowers) under water restriction

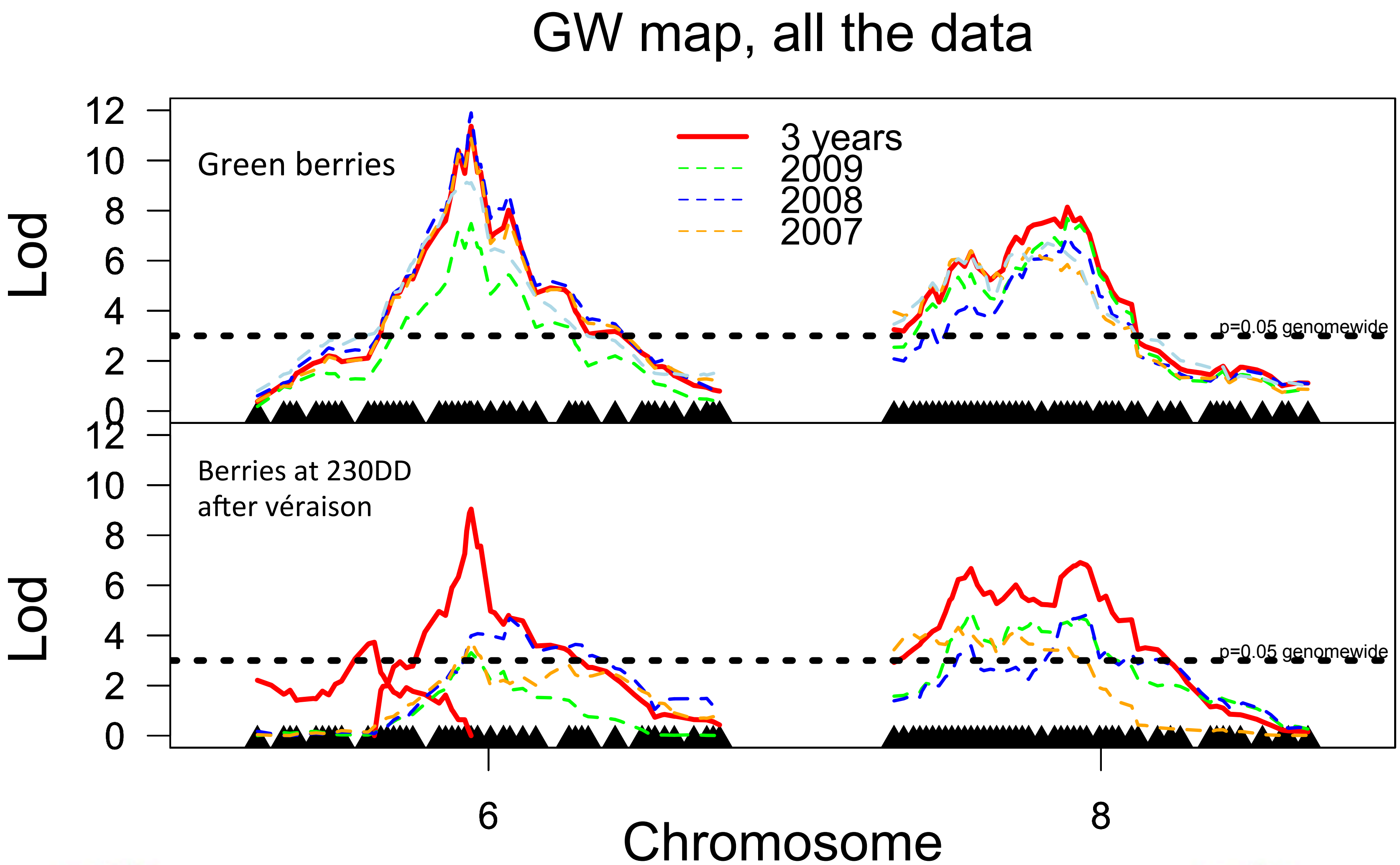
The [K+]:[tartaric acid] ratio is the main driver of the pH of the berries



QTLs for the [K+]:[Tartaric acid] ratio



QTLs can be detected for the ratio [Mal]/[Tart]



What are the main objectives of the adaptation to climate change?

1. Maintaining berry composition:

- shifting the ripening period later in the season,
- maintaining a constant berry composition under higher temperatures: aroma precursors
- maintaining a constant berry composition under water restriction.

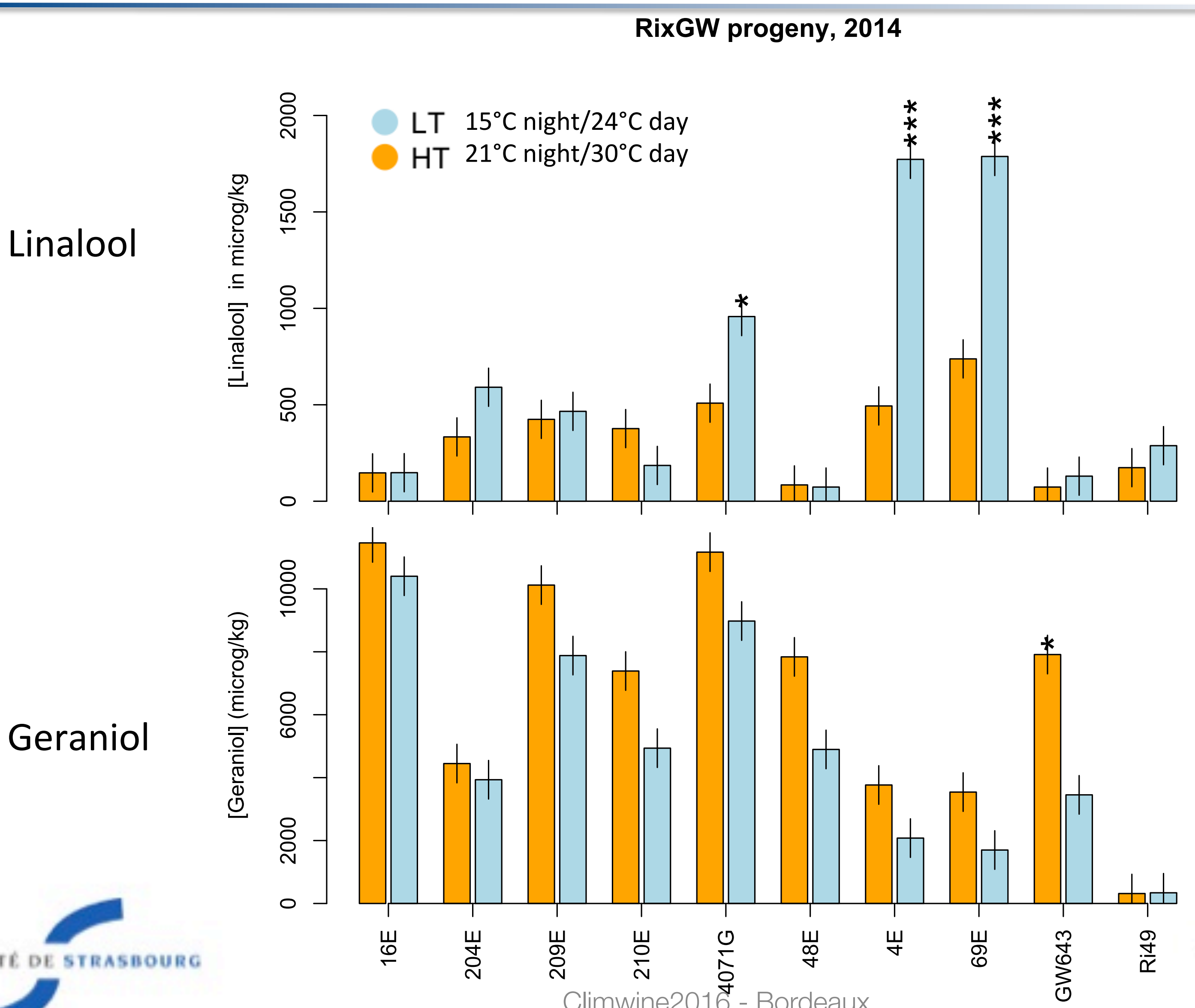
2. Maintaining the yield level

- Better tolerance to water stress, better water use efficiency,
- Maintaining fertility (number of flowers) under water restriction

UNIVERSITÉ DE STRASBOURG

INRA SCIENCE & IMPACT

Aroma profiles are modified under elevated temperatures



UNIVERSITÉ DE STRASBOURG

INRA SCIENCE & IMPACT

What are the main objectives of the adaptation to climate change?

1. Maintaining berry composition:

- shifting the ripening period later in the season,
- maintaining a constant berry composition under higher temperatures,
- maintaining a constant berry composition under water restriction.

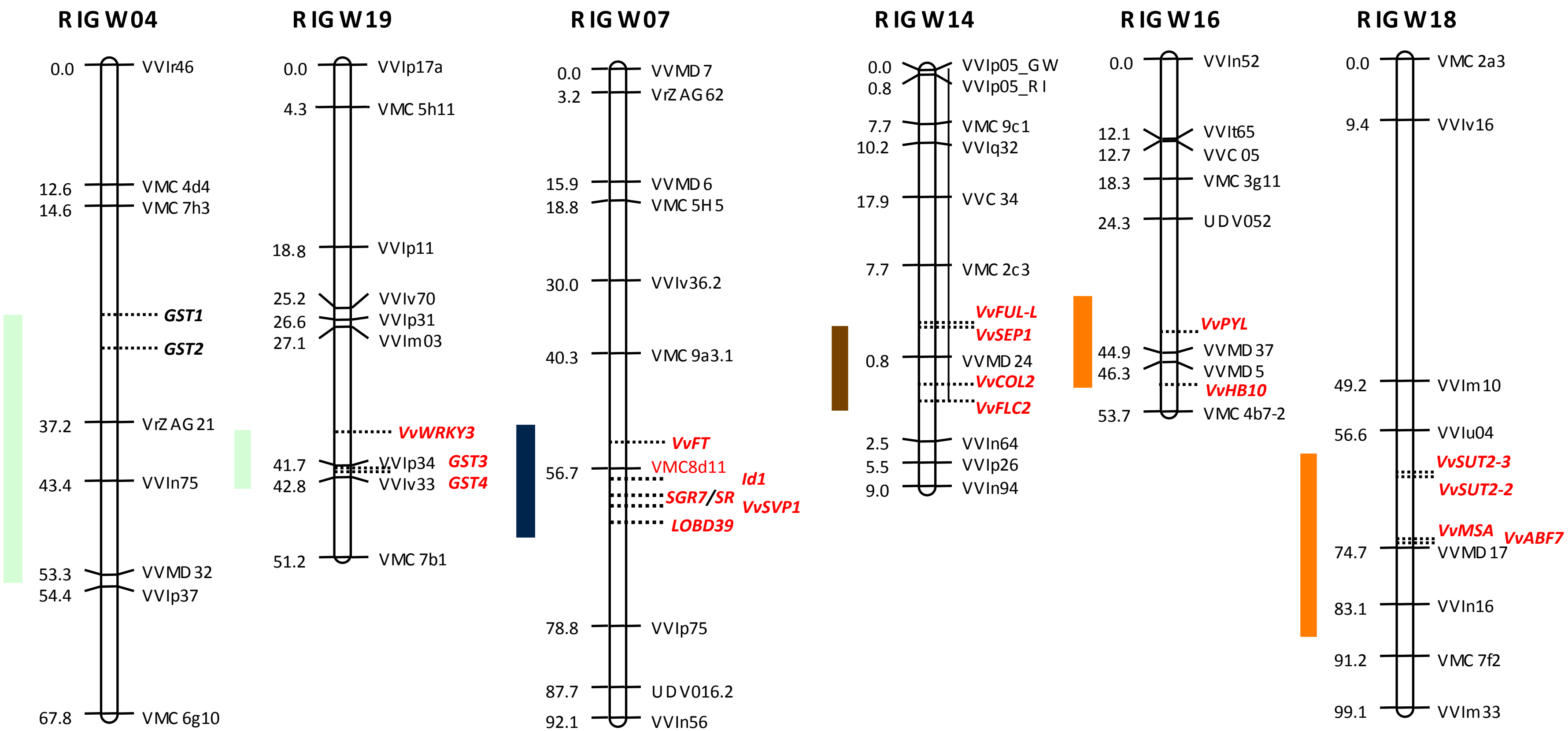
2. Maintaining the yield level

- Better tolerance to water stress, better water use efficiency,
- Maintaining fertility (number of flowers) under water restriction

UNIVERSITÉ DE STRASBOURG

INRA SCIENCE & IMPACT

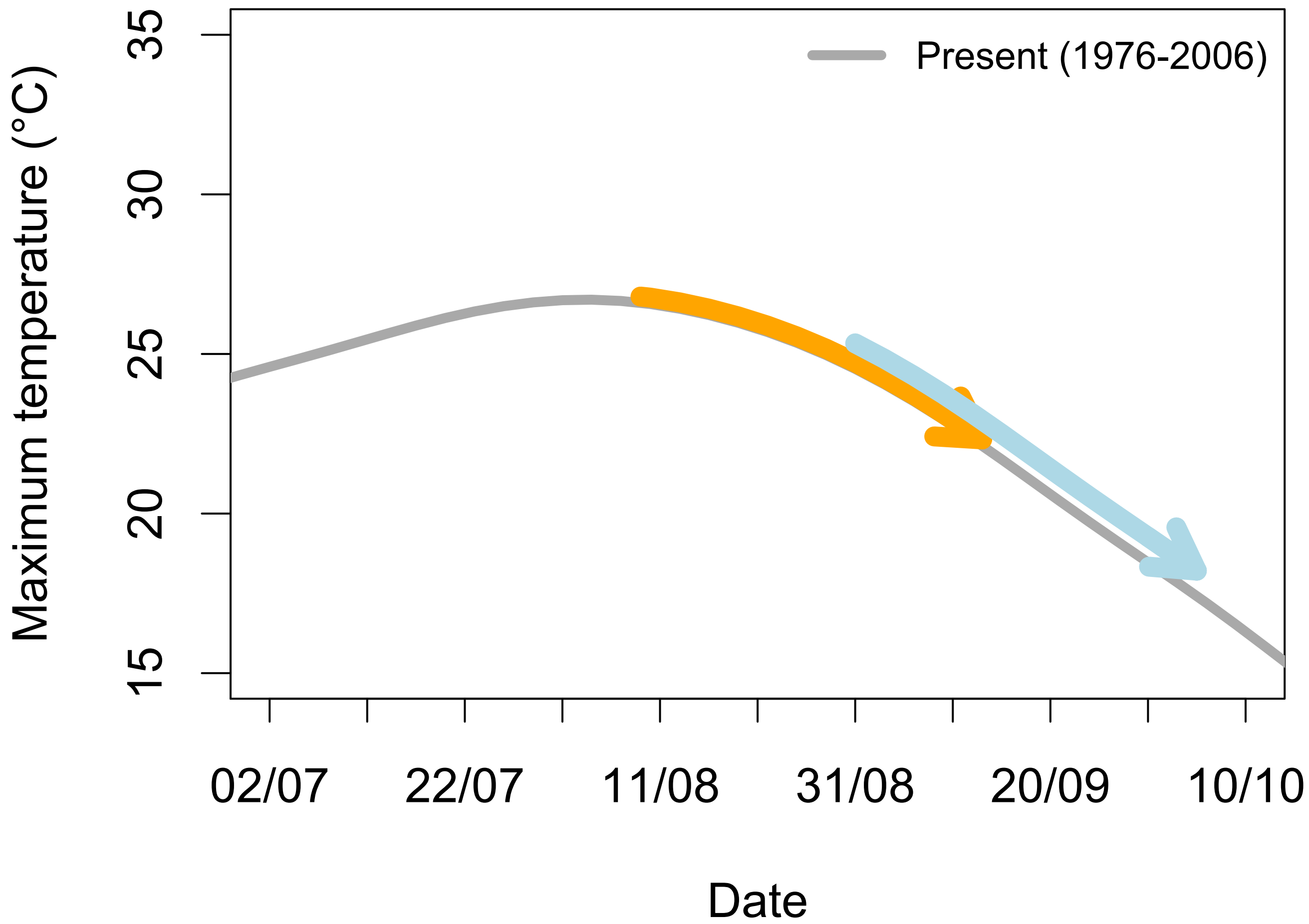
QTLs for development phases expressed as degree.days (RIxGW progeny)



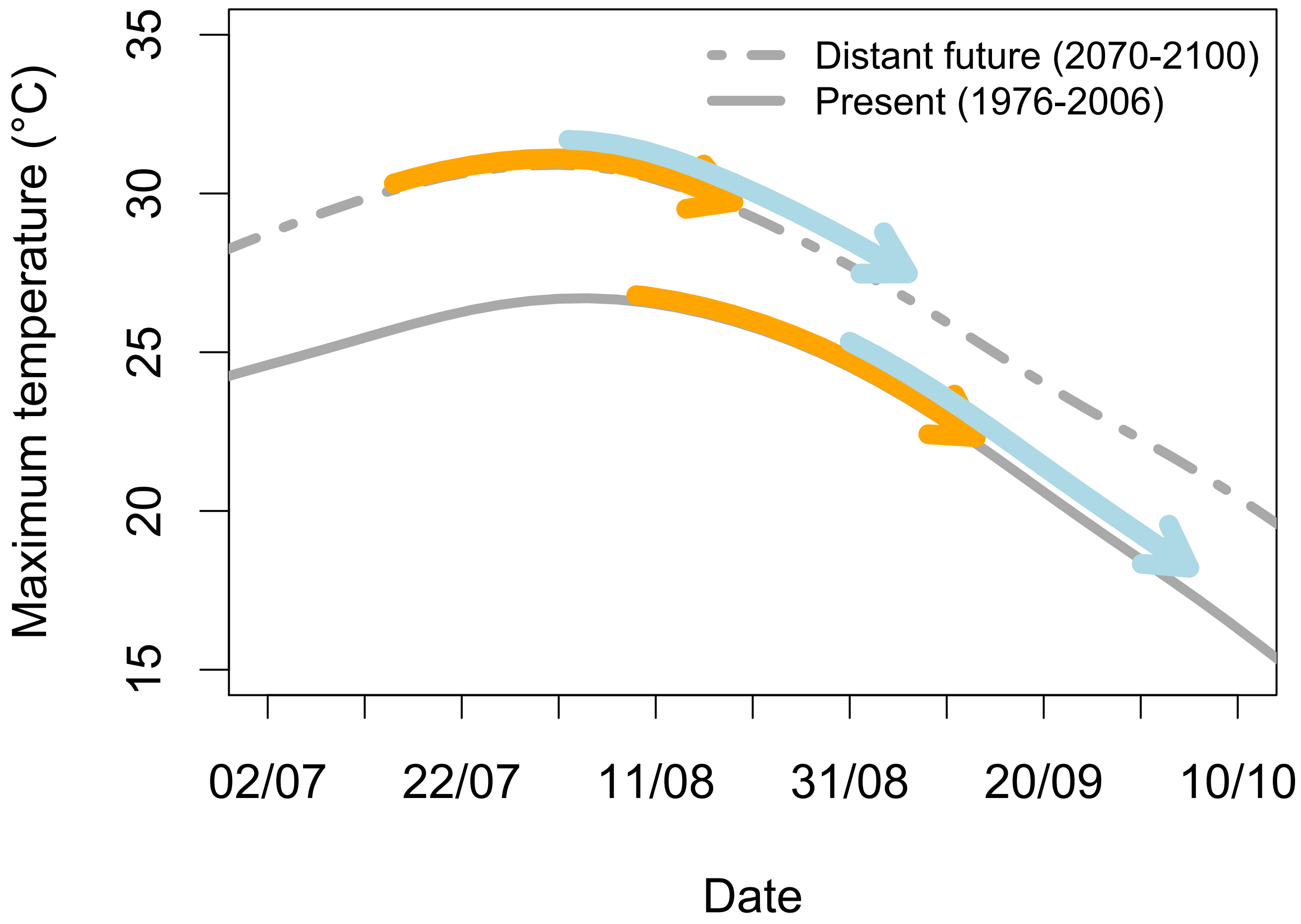
Budburst Flowering Véraison

Duchêne *et al*, 2012

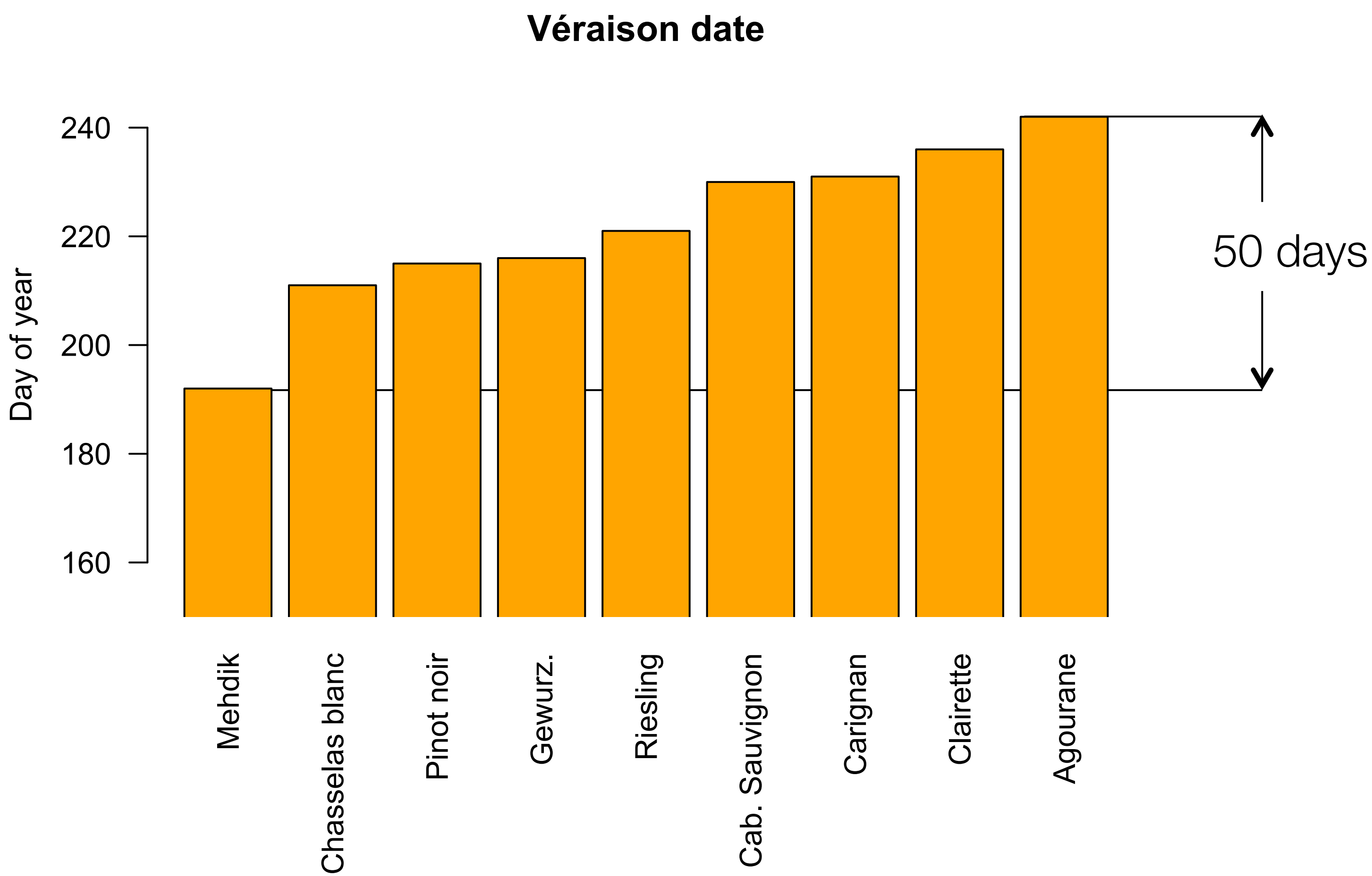
Temperatures during ripening will converge in the future



Temperatures during ripening will converge in the future



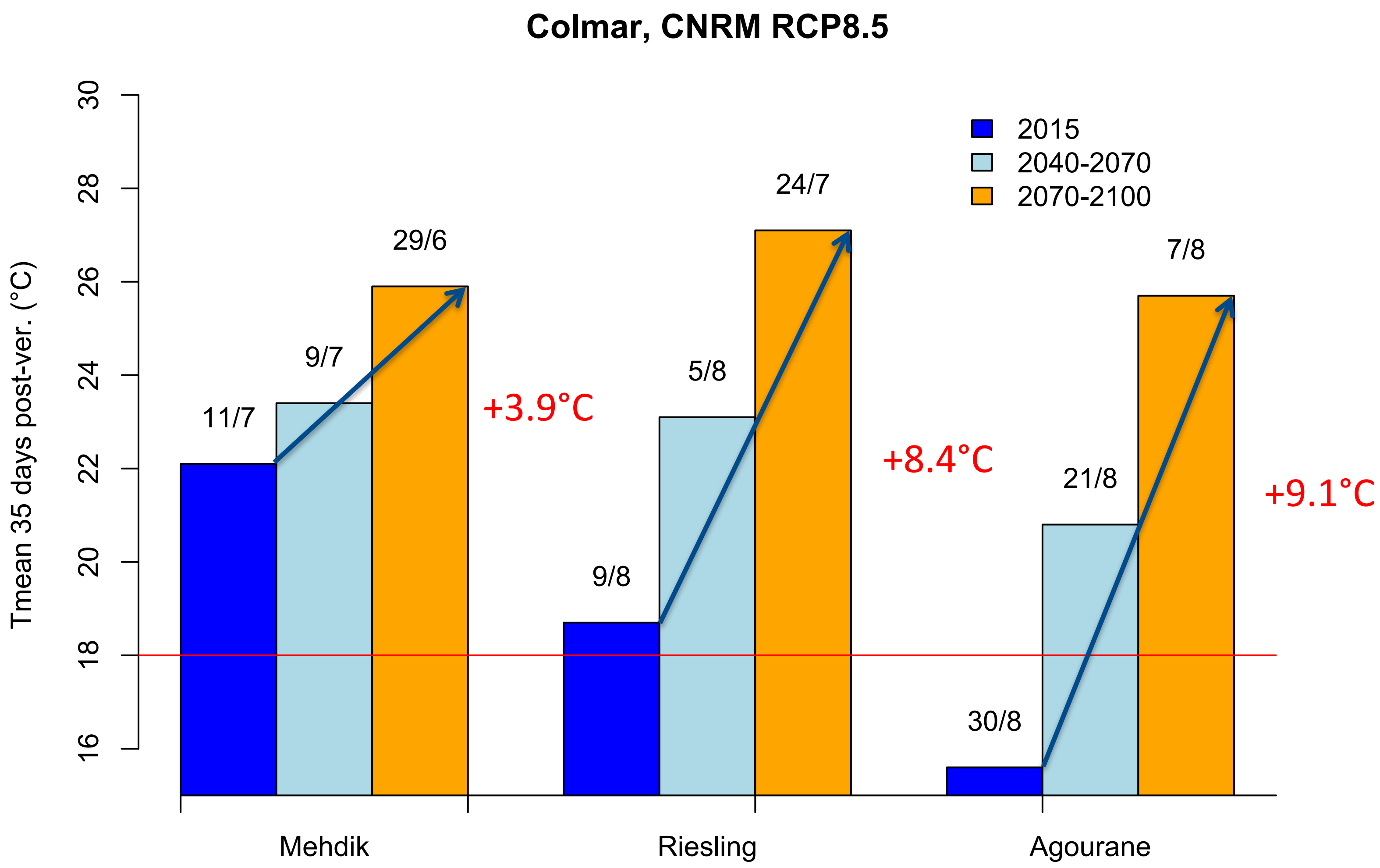
Genetic variability for véraison dates
(Colmar, 2015)



UNIVERSITÉ DE STRASBOURG

INRA SCIENCE & IMPACT

Late or early genotypes?



Conclusion

There is genetic variability and detected QTLs for:

- Berry acidity parameters,
- Responses to water availability,
- Phenological stages,

To be explored:

- Responses of fertility to heat/drought
- Responses of secondary metabolism to temperatures and water stress

UNIVERSITÉ DE STRASBOURG

INRA SCIENCE & IMPACT

Ackowledgements

INRA Colmar

Olivier Loeffler
Gisèle Butterlin
Vincent Dumas
Nathalie Jaegli

INRA Montpellier
for the 92 genotypes
core-collection

Climate simulations from
DRIAS (http://www.drias-climat.fr)

INRA Perphéclim and Laccave projects for financial support

UNIVERSITÉ DE STRASBOURG

INRA
SCIENCE & IMPACT

Thank you for attention