Comment la viticulture européenne conçoit son adaptation au changement climatique et quelle place elle peut tenir vis à vis avis de la production mondiale dans les prochains décennies dans le contexte de dérèglement climatique". ?

Hans R. Schultz Hochschule Geisenheim University

A sense of place

Hans R. Schultz

A sense of place

Hochschule Geisenheim University

Outline

Hochschule Geisenheim University

- some key factors on global grape production
- Regional Trends for some grape growing areas
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- Soils, the under rated climate factor
- Biodiversity and genetics
- Other challenges

The image of Viticulture

Le Monde
MARDI 1ER DÉCEMBRE 2015

Tuesday, 1st of December 2015
The start of the Paris climate summit

Le pactole du réchauffement

PARIS CLIMAT 2015

Transition énergétique, transports alternatifs, nouvelles normes... Les milliards vont pleuvoir sur certains secteurs. Les financiers se positionnent et les industriels tentent d'en profiter. Il en va parfois de leur survie

Quelles sont les entreprises qui vont tirer profit du réchauffement climatique ? La question hérisse encore. *« Le jeu des gagnants et des perdants n'est pas la*

tion en mars 2014 à la Bourse de Paris, cette start-up spécialisée dans la compression de l'hydrogène et son stockage a fait tourner les têtes des investisseurs. *« L'action a été sursouscrite dix fois »*, raconte M. Mauberger. McPhy obtient 32 millions d'euros d'argent frais alors qu'il en espérait 25.

Cette appétence se manifeste aussi sur les réseaux alternatifs de financement. Le







LACCAVE : Long term impacts and adaptations to Climatic Changes in Viticulture and Enology

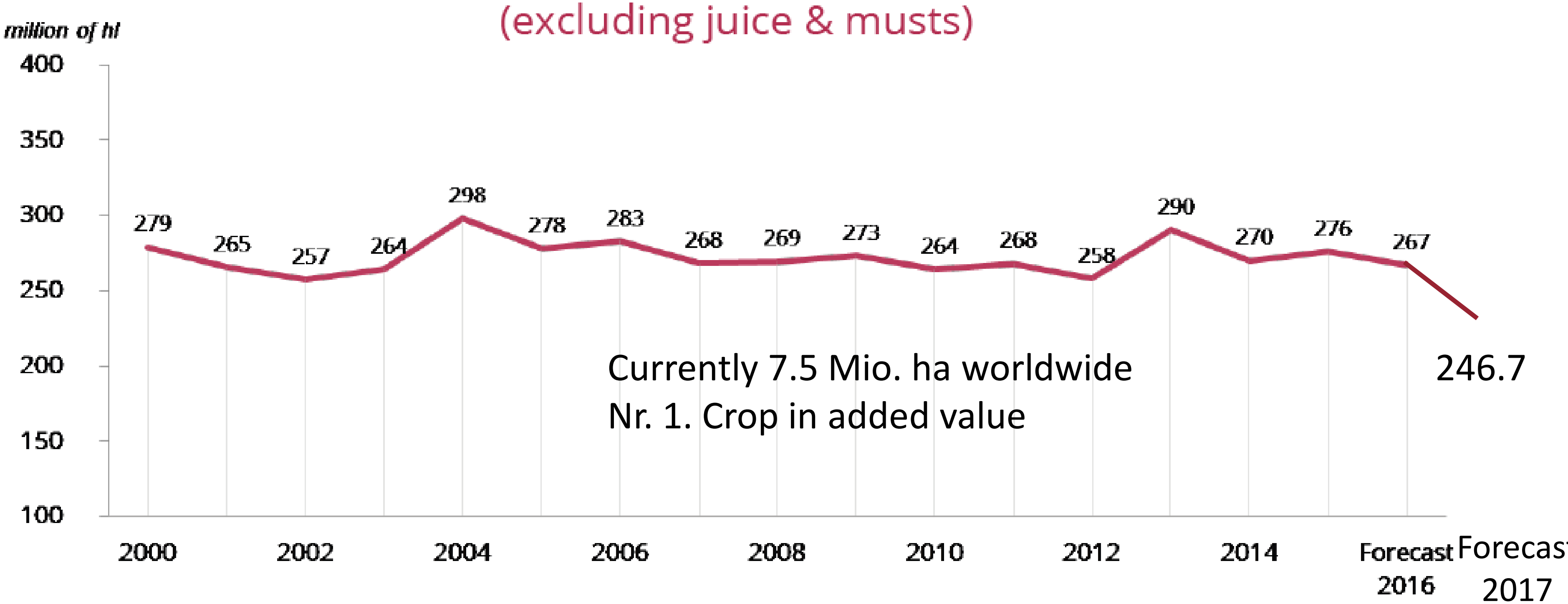
Objectives: 1- to predict at a long term scale, the impacts of climate change on grape growing and wine making,

2- to build-up the necessary knowledge to develop innovations allowing the required adaptations, 3- to propose adaptation strategies at the level of the wine industry (including viticulture) and 4- to evaluate their economic, sociological ad environmental consequences.

5-To unify and structure the french research on this issue, in order to interact with the growers and wine industry, and to be part of the international network on CC.

Coordination : Nathalie OLLAT – Jean Marc TOUZARD

Trend of world wine production
(excluding juice & musts)



Currently 7.5 Mio. ha worldwide
Nr. 1. Crop in added value

Wine production

2017 World Vitiviniculture Situation
OIV Statistical Report on World Vitiviniculture

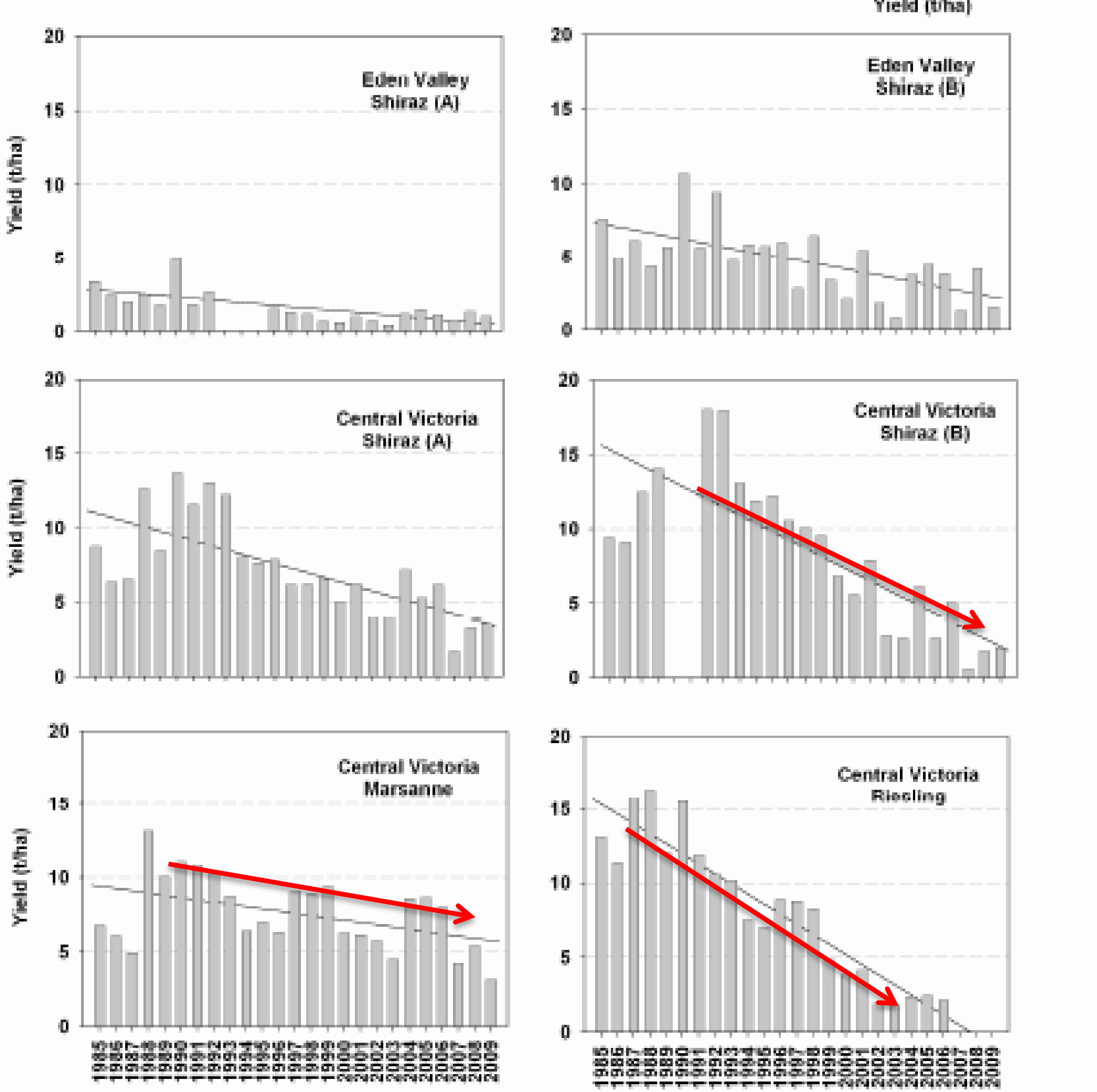


Figure 1 Crop-yield (t/ha) for sites in the study for the period 1985-
shown.

Yield

Diminishing yields in Australia correlated to changes in the climate?

Webb et al. 2013 nature climate change 26 February

Questions

- are recent fluctuations in global (regional) yield climate driven?
- spring frost, hail, drought; 2017 had everything, climate driven?

Spring frost 19.4.2017-21.4.2017, Lake Constance, Rheingau area

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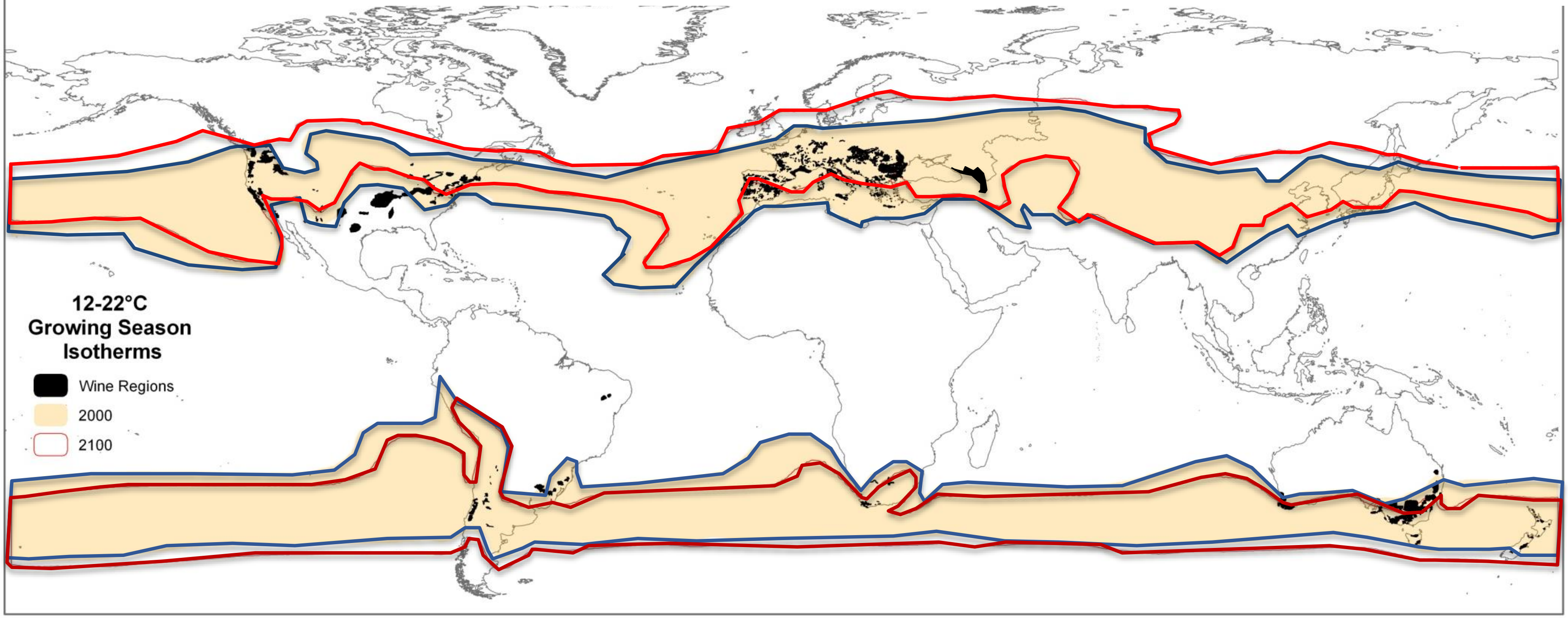
Global Viticultural zones

Hochschule Geisenheim University

Temperature isothermes during the growing season (12-22 °C)

Northern hemisphere (Apr.-Oct.), southern hemisphere (Oct.-April)



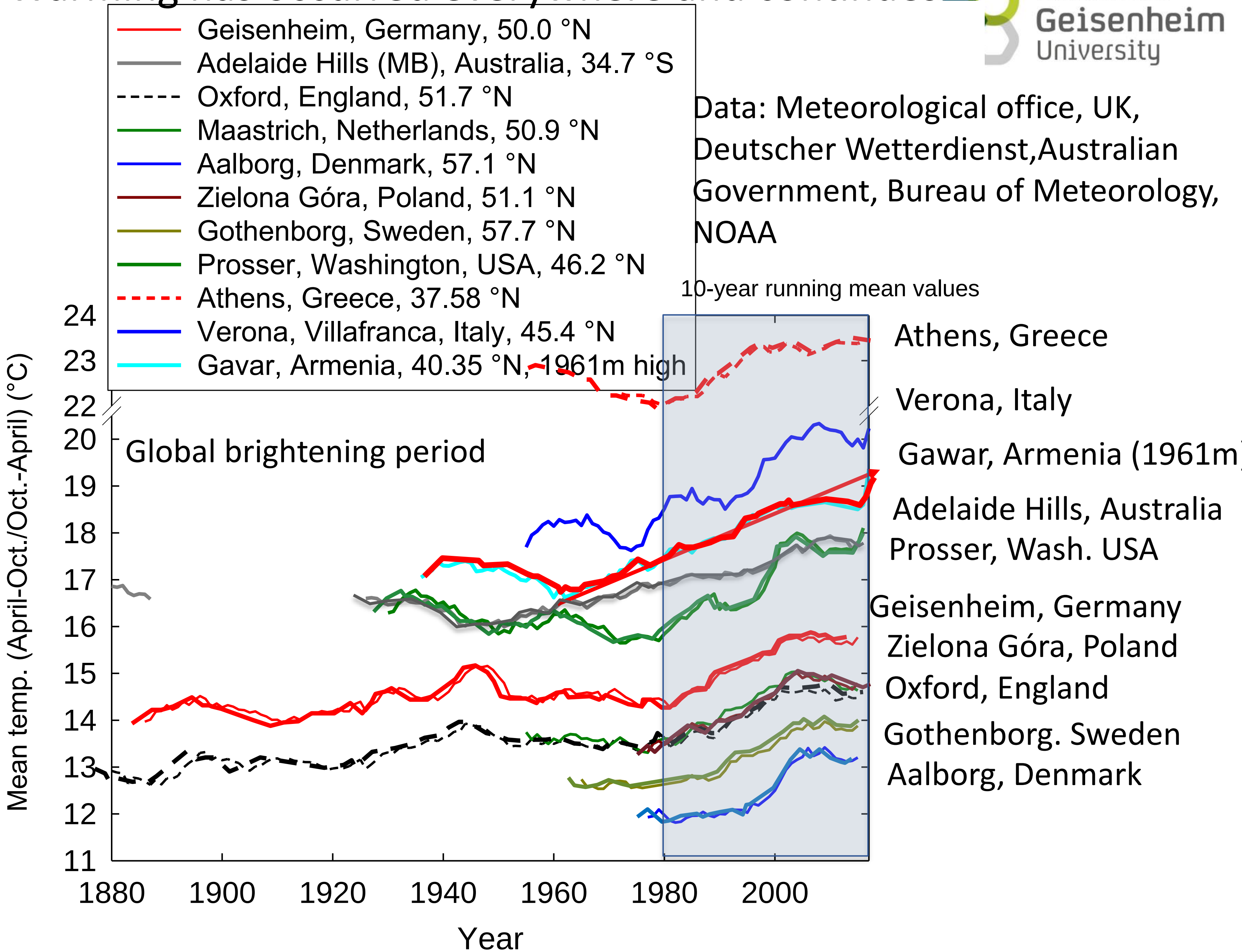
Isothermes move to the poles~280-500 km (basis 2000)
extension NH, reduction SH

National Center for Atmospheric Research's Community Climate System Model (CCSM) A1B (mid-range scenario): 1.4° x 1.4° Lat/Lon

Schultz and Jones (2010) Climate induced Historic and Future Changes in Viticulture. Journal of Wine Research 21: 137-145

Warming has occurred everywhere and continues

Data: Meteorological office, UK, Deutscher Wetterdienst,Australian Government, Bureau of Meteorology, NOAA



The variety question, Truth and speculation - Consequences of misunderstandings

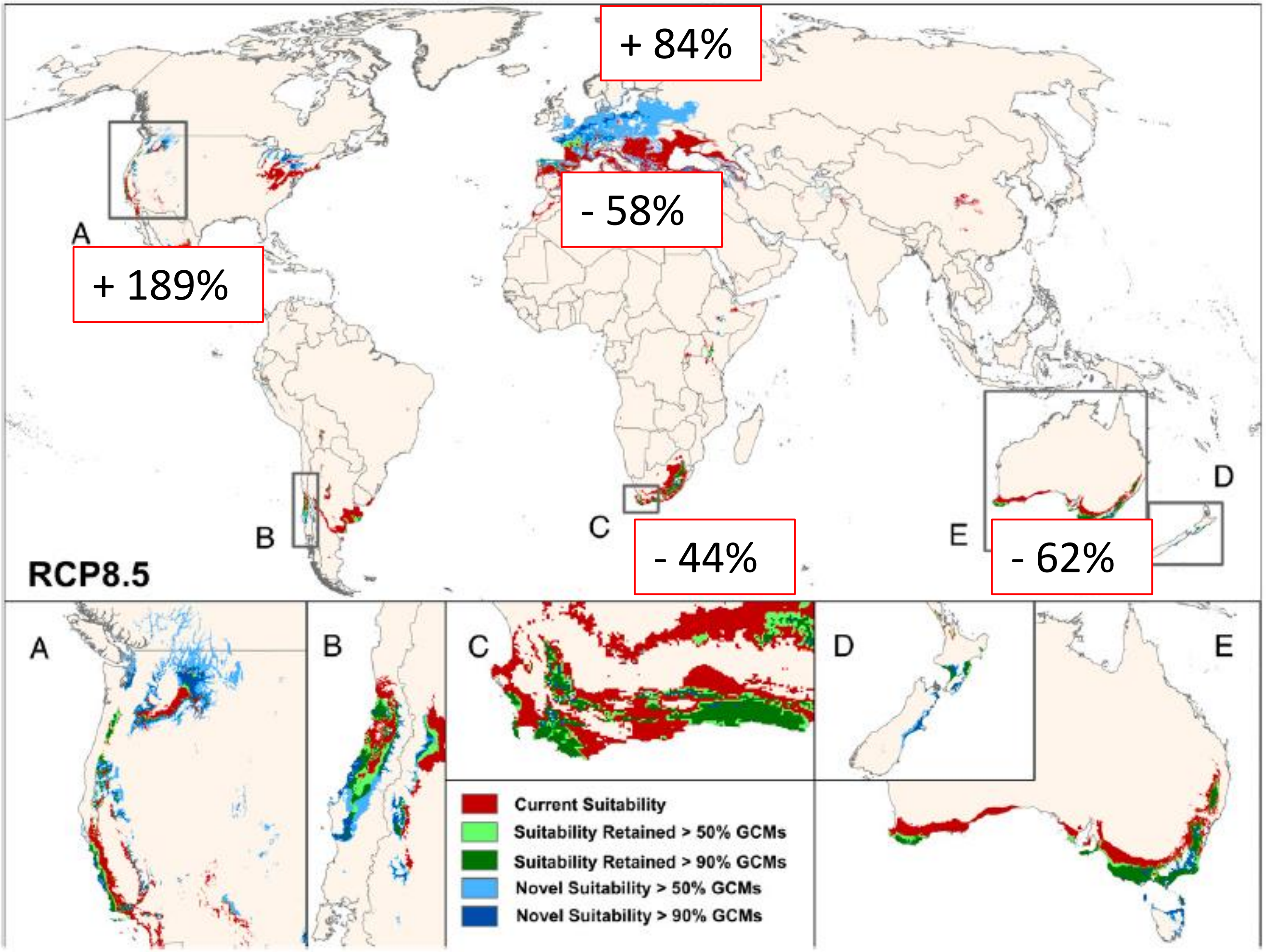
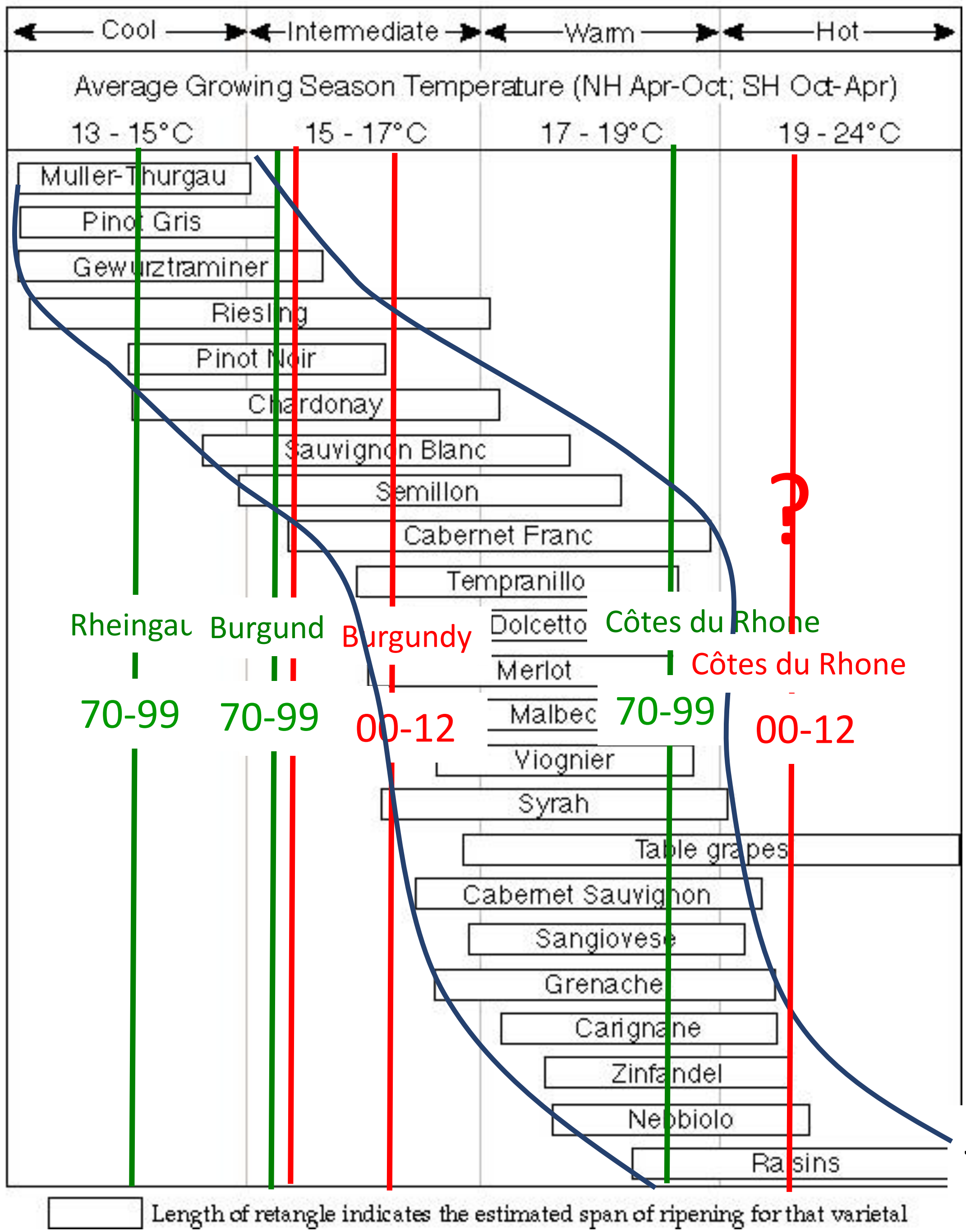


Fig. 1. Global change in viticulture suitability RCP 8.5. Change in viticulture suitability is shown between current (1961–2000) and 2050 (2041–2060) time periods, showing agreement among a 17-GCM ensemble. Areas with current suitability that decreases by midcentury are indicated in red (>50% GCM agreement). Areas with current suitability that is retained are indicated in light green (>50% GCM agreement) and dark green (>90% GCM agreement), whereas areas not suitable in the current time period but suitable in the future are shown in light blue (>50% GCM agreement) and dark blue (>90% GCM agreement). *Insets*: Greater detail for major wine-growing regions: California/western North America (*A*), Chile (*B*), Cape of South Africa (*C*), New Zealand (*D*), and Australia (*E*).

Climate change, wine and conservation

Hannah et al. 2013, www.pnas.org/cgi/doi

Grapevine Climate/Maturity Groupings



Response of OIV-group climate:

V. Leeuwen, H.R. Schultz, I.G. Cortazar-Autauri, E. Dûchene, N. Ollat, P. Pieri, B. Bois, J.-P. Goutouly, H. Quinol, J.-M. Touzard, A.C. Malheiro, L. Bavaresco, S. Delrot

Why climate change will not dramatically decrease viticultural suitability in main wine-producing areas by 2050 (2013) PNAS, 1307927110, 1-2

Jones et al. 2005; Climate Change 73: 319-343

Questions

- is the increase in temperature a problem for some grape varieties?
- What is the adaptive potential?

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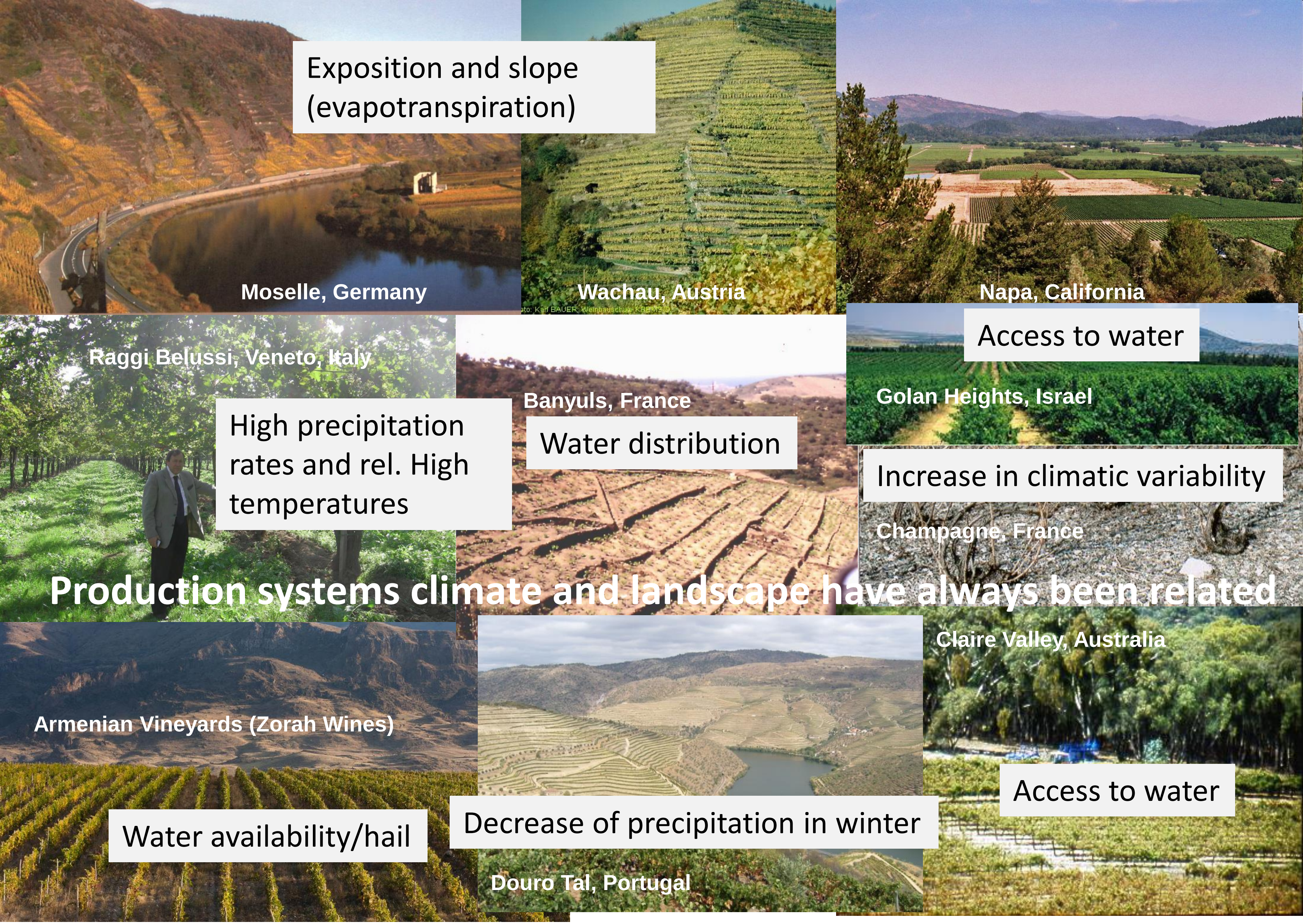
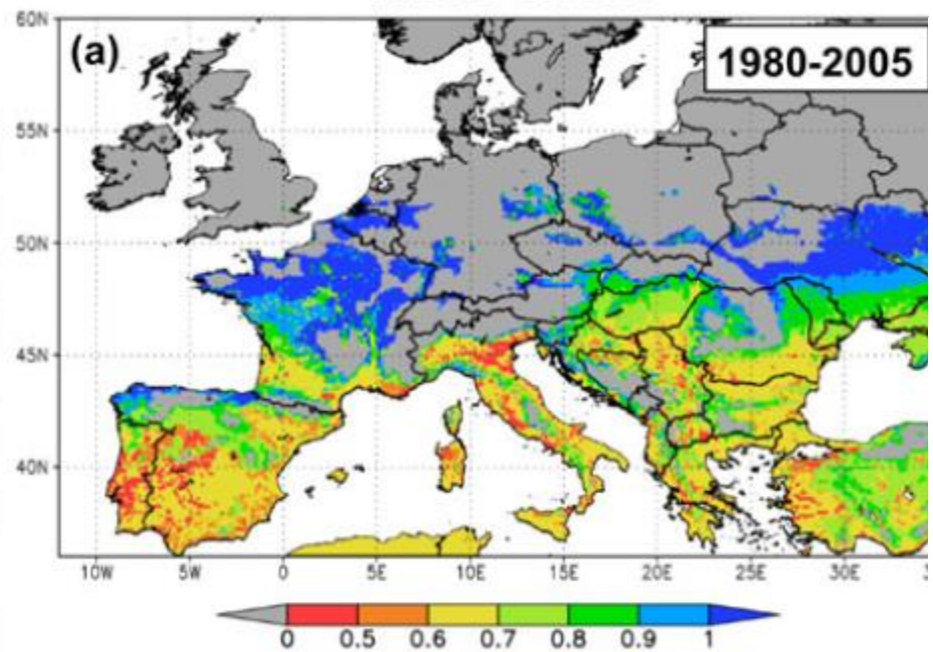
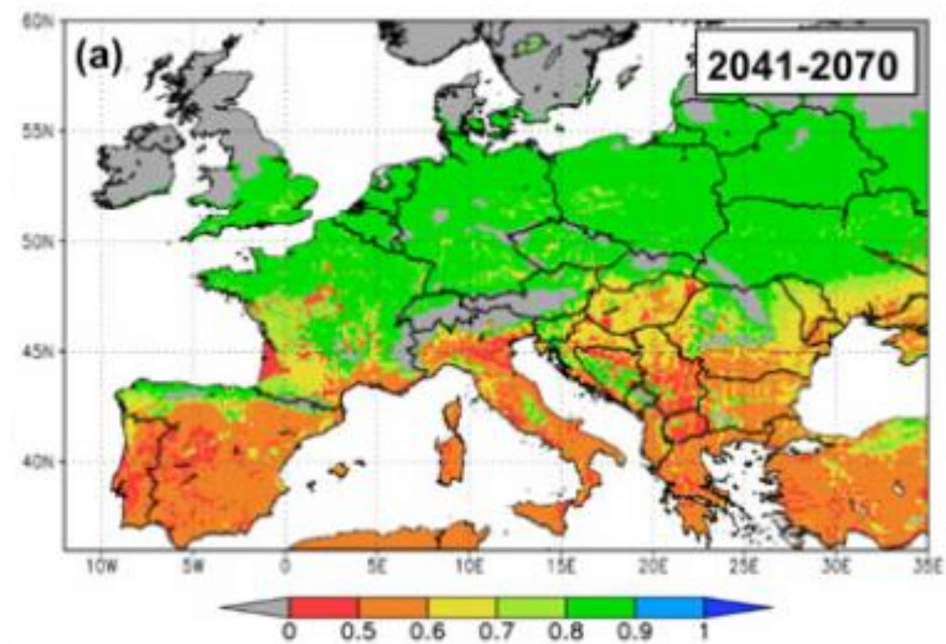

Exposition and slope
(evapotranspiration)
Moselle, Germany
Wachau, Austria
Napa, California
Raggi Belussi, Veneto, Italy
High precipitation
rates and rel. High
temperatures
Banyuls, France
Water distribution
Access to water
Golan Heights, Israel
Increase in climatic variability
Champagne, France
Production systems climate and landscape have always been related
Claire Valley, Australia
Armenian Vineyards (Zorah Wines)
Water availability/hail
Decrease of precipitation in winter
Access to water
Douro Tal, Portugal

Dryness indices are getting better but are still only rough indicators of current and past vulnerability

Water stress



Including the CO_2 effect on water use



severe water deficit

No water deficit

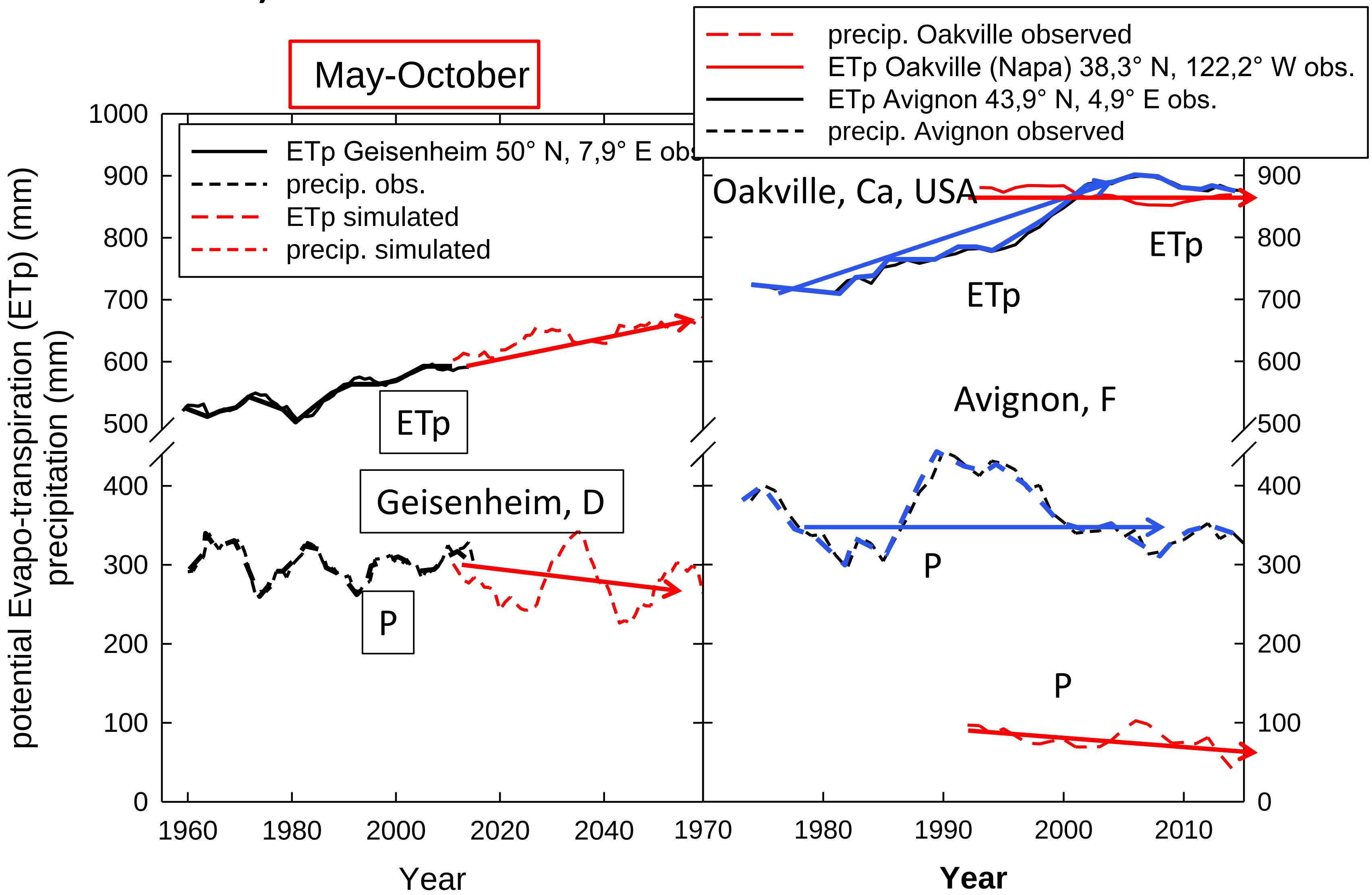
Fraga et al. (2016) Modelling climate change impacts on viticultural yield, phenology and stress conditions in Europe. Global Change Biology 22, 3774-3788

The Clausius-Clapeyron relationship tells us, a 1°K (or 1°C) warming at 15 °C means about a 7% increase in evaporation but it also means a 1-2% increase in precipitation!

In some regions we find increases in evaporative demand according to theory, however in many regions we don‘t!

Regional effects need to be studied carefully.

Observations and simulations (hydrological summer)



French data: DB, CLIMATIK, Agroclim, INRA; German data: Deutscher Wetterdienst; US data: IPM set, Univ. of Calif. Davis

Difficult terroir

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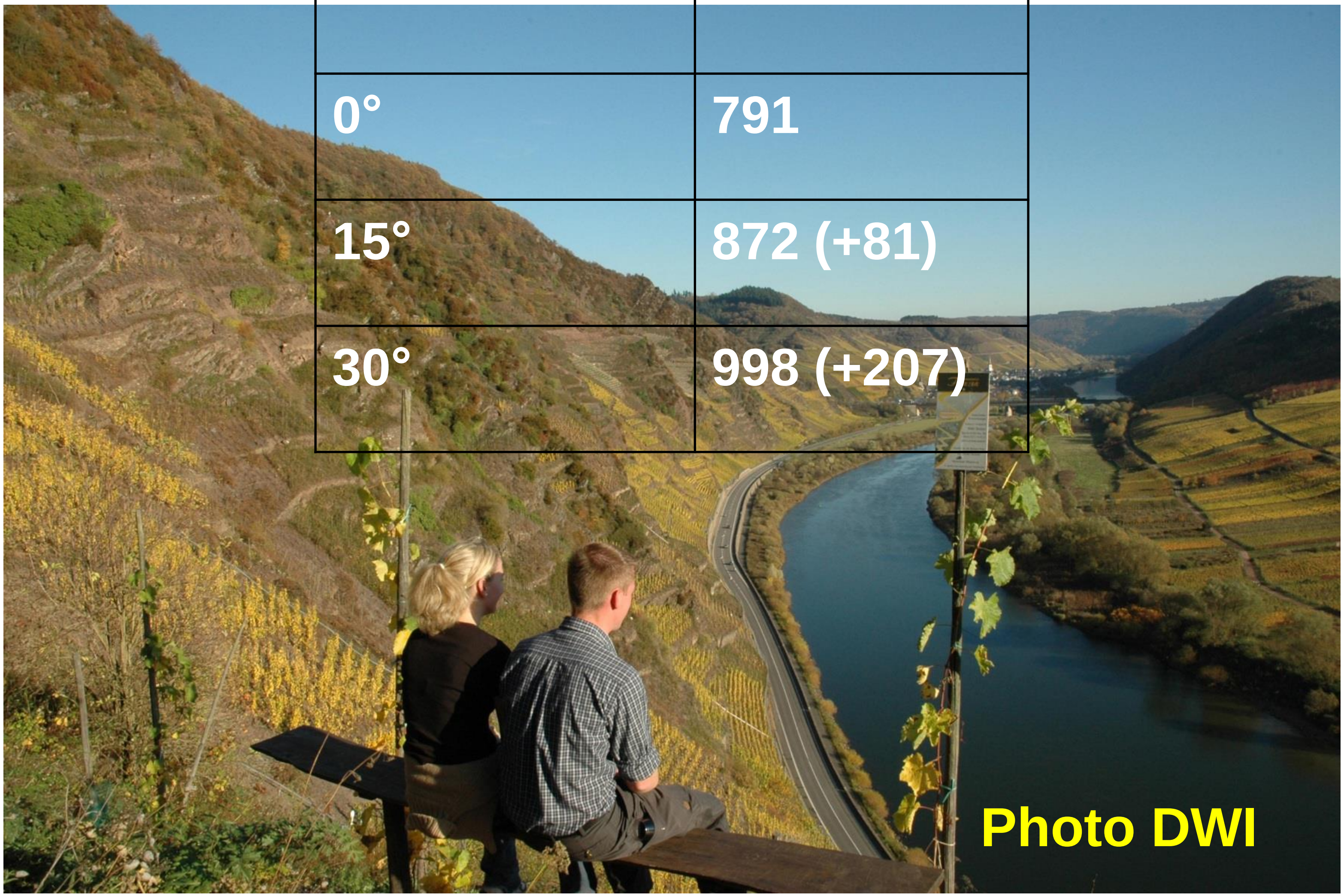
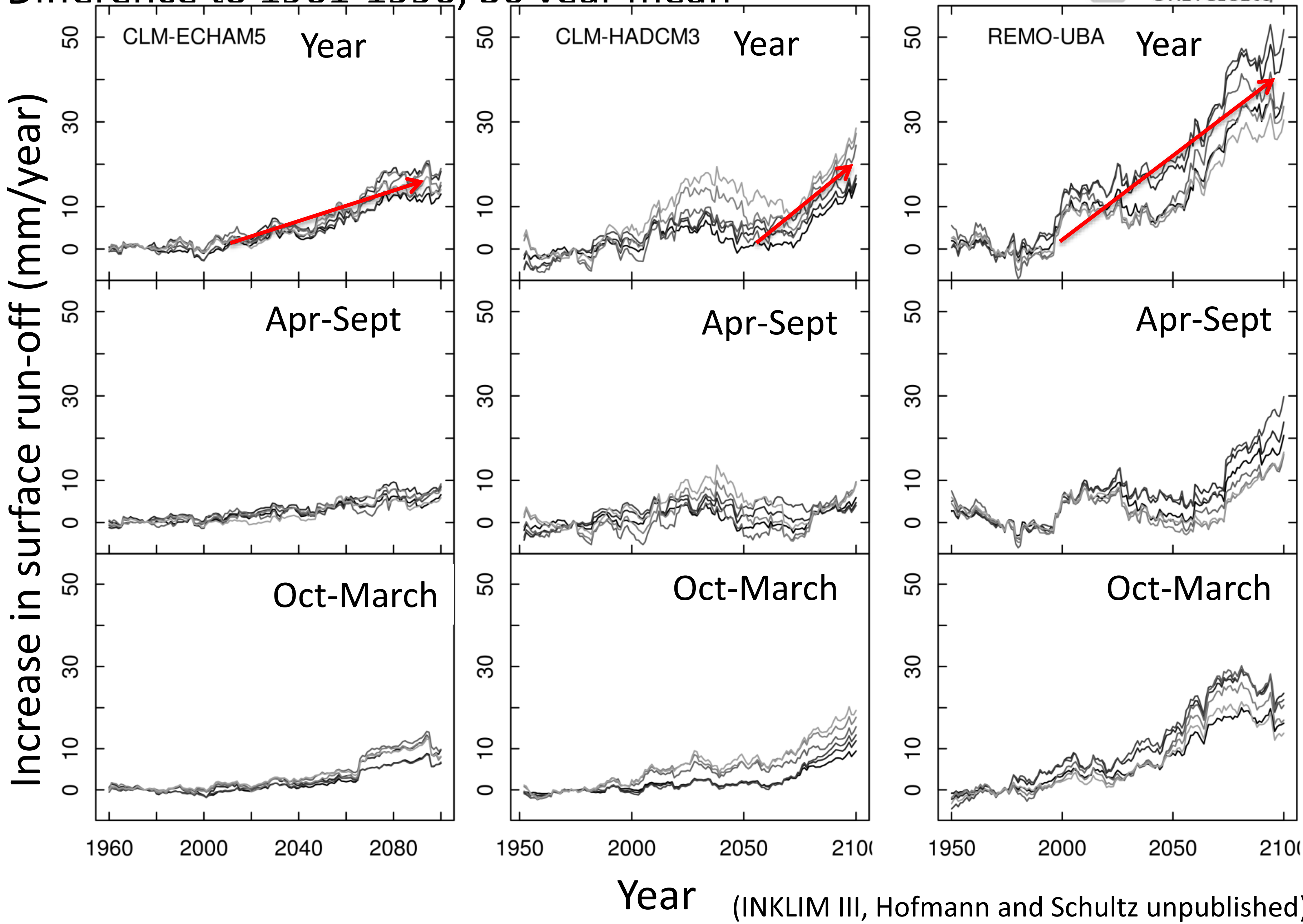
Degree of slope	Total evapo-transpiration (mm/year)
0°	791
15°	872 (+81)
30°	998 (+207)



Surface water run-off (erosion)

Difference to 1961-1990, 30 year mean

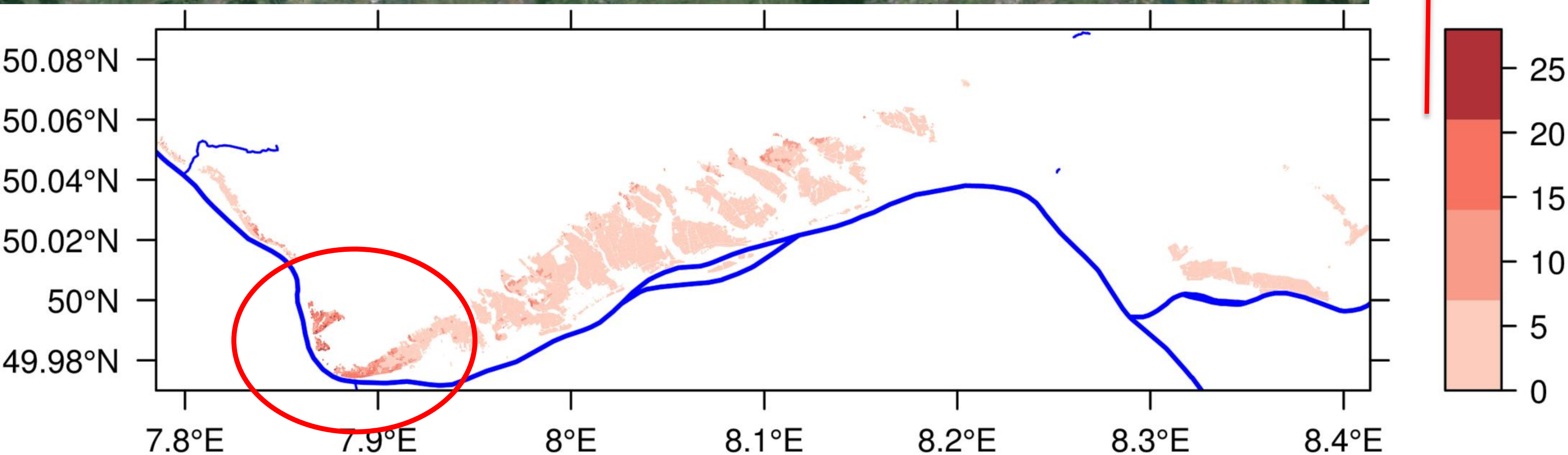


(INKLIM III, Hofmann and Schultz unpublished)

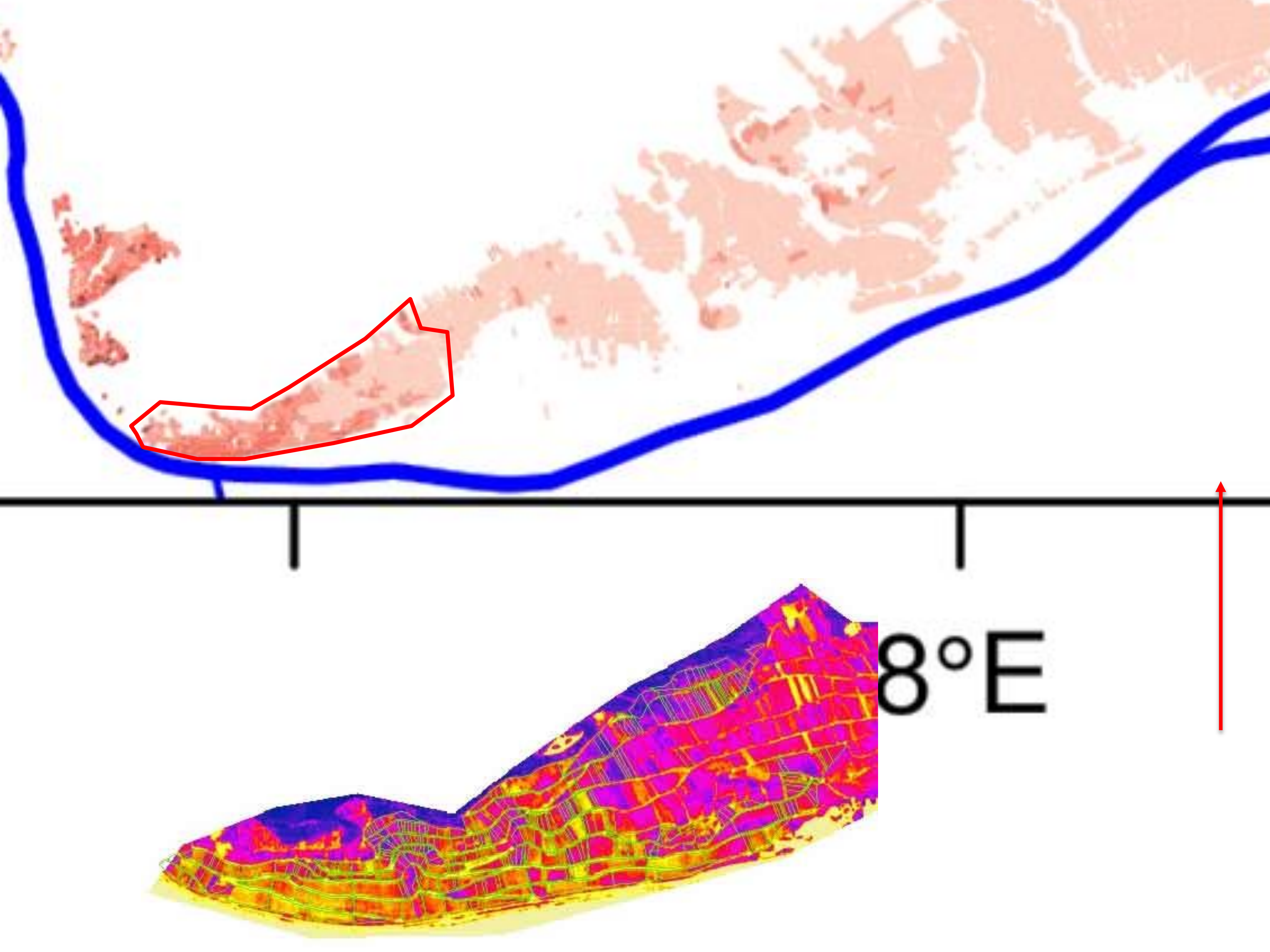
These differences are also one of the resons we need specific regional based modelling efforts

Expl. REMO-UBA, changes in drought days 2041-2070 minus abseline 1971-2000, region Rheingau, Germany

Numb. of drought days (- 0.6 MPa water pot.) pre-dawn



Marco Hofmann et Hans Reiner Schultz unpublished


8°E

Questions

- why is the potential evapotranspiration in some areas increasing (according to theory and all model predictions); why is it constant and even decreasing in other areas (South Africa, Australia, China) against theory and model predictions?
- will irrigation by the only solution or other means (rootstocks a.s.o)?
- Water use in a future world – in which direction?

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Climate effects on soils, increase in **soil temperature** (the Potsdam time-series)

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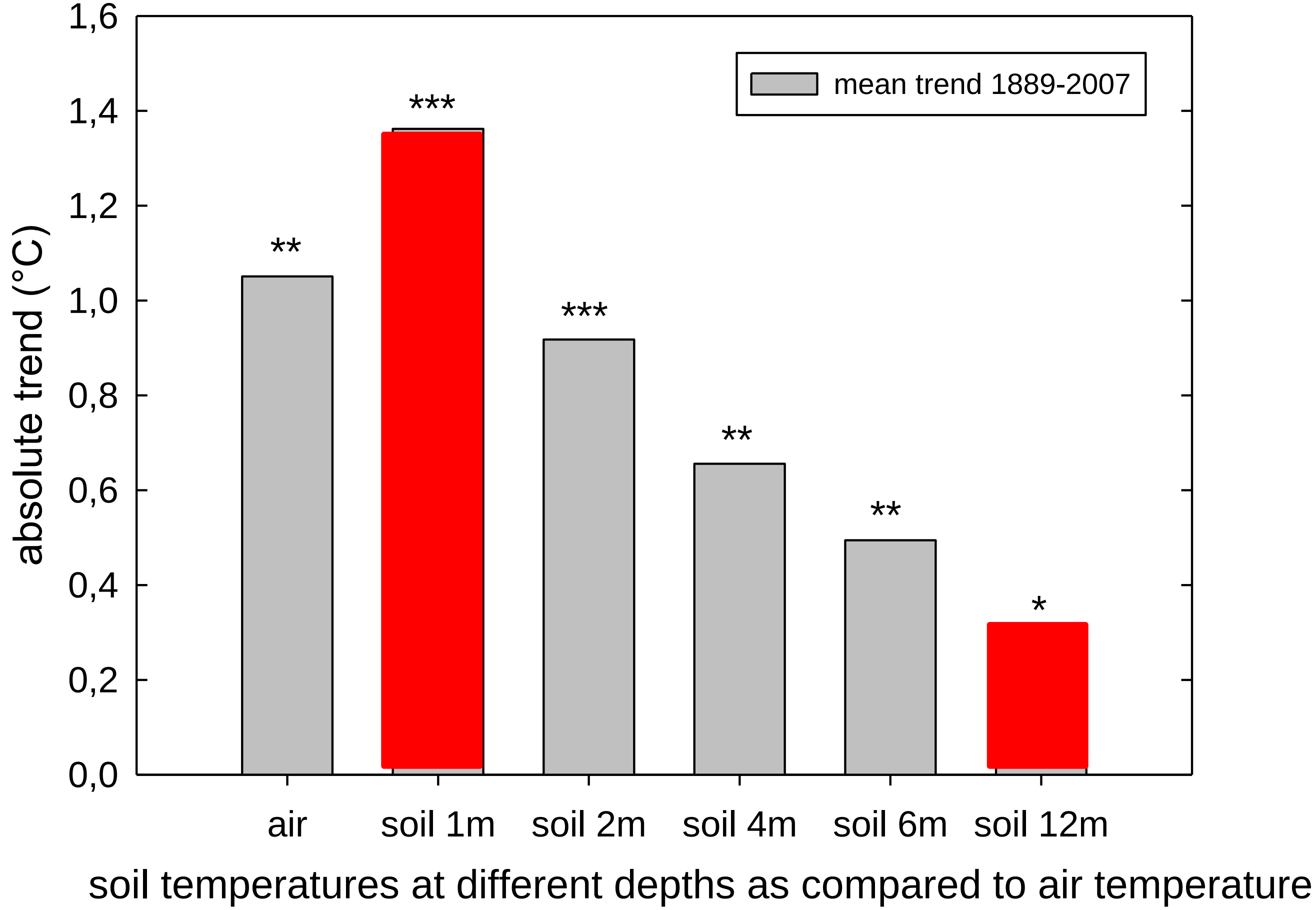
Since 1889 strong warming May-August (1m depth **2.4° - 3.2°C !!**)

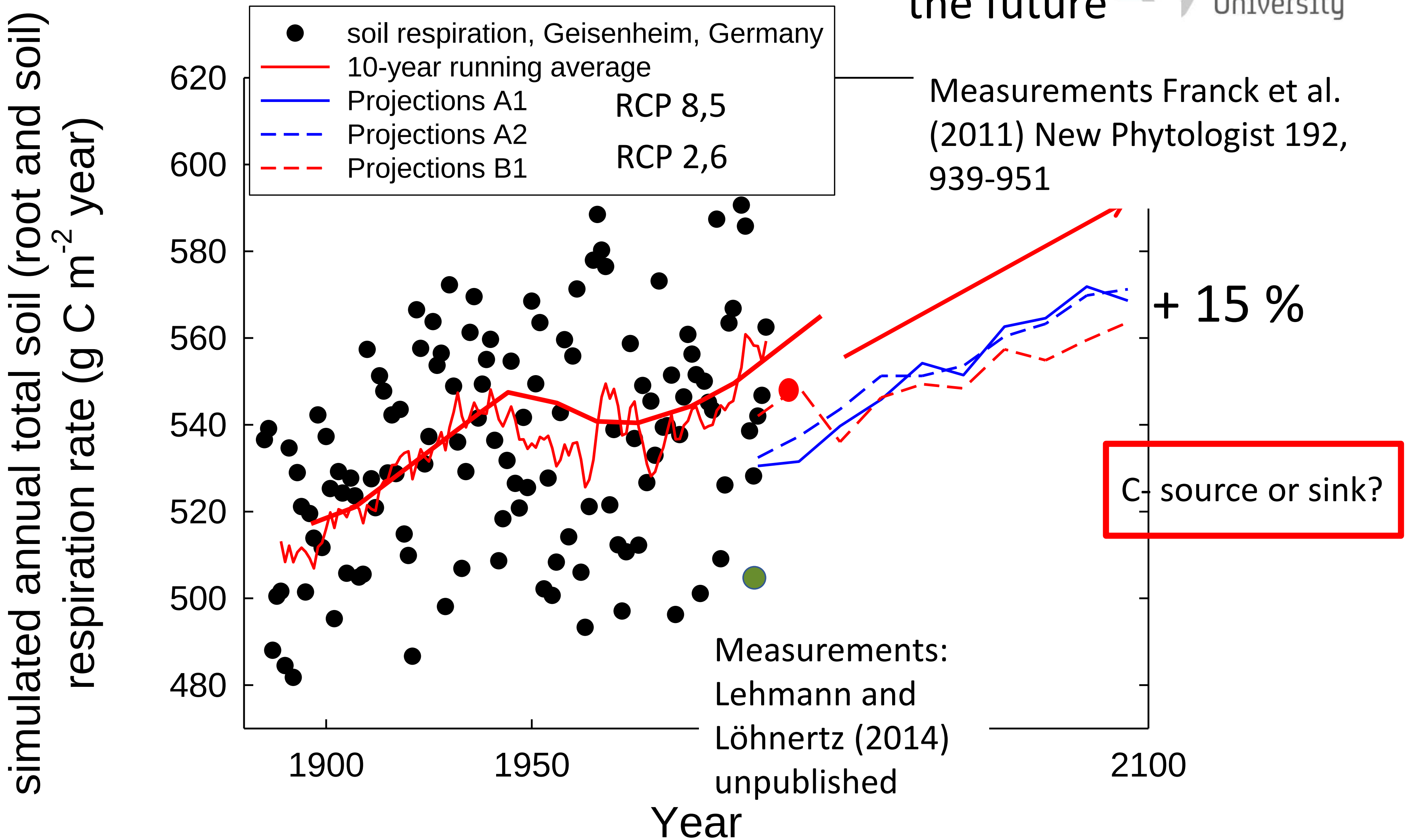
Trend in °K



Böhme und Böttcher, Klimastatusbericht des Deutschen Wetterdienstes 2011

soil GHG emission estimation

the future

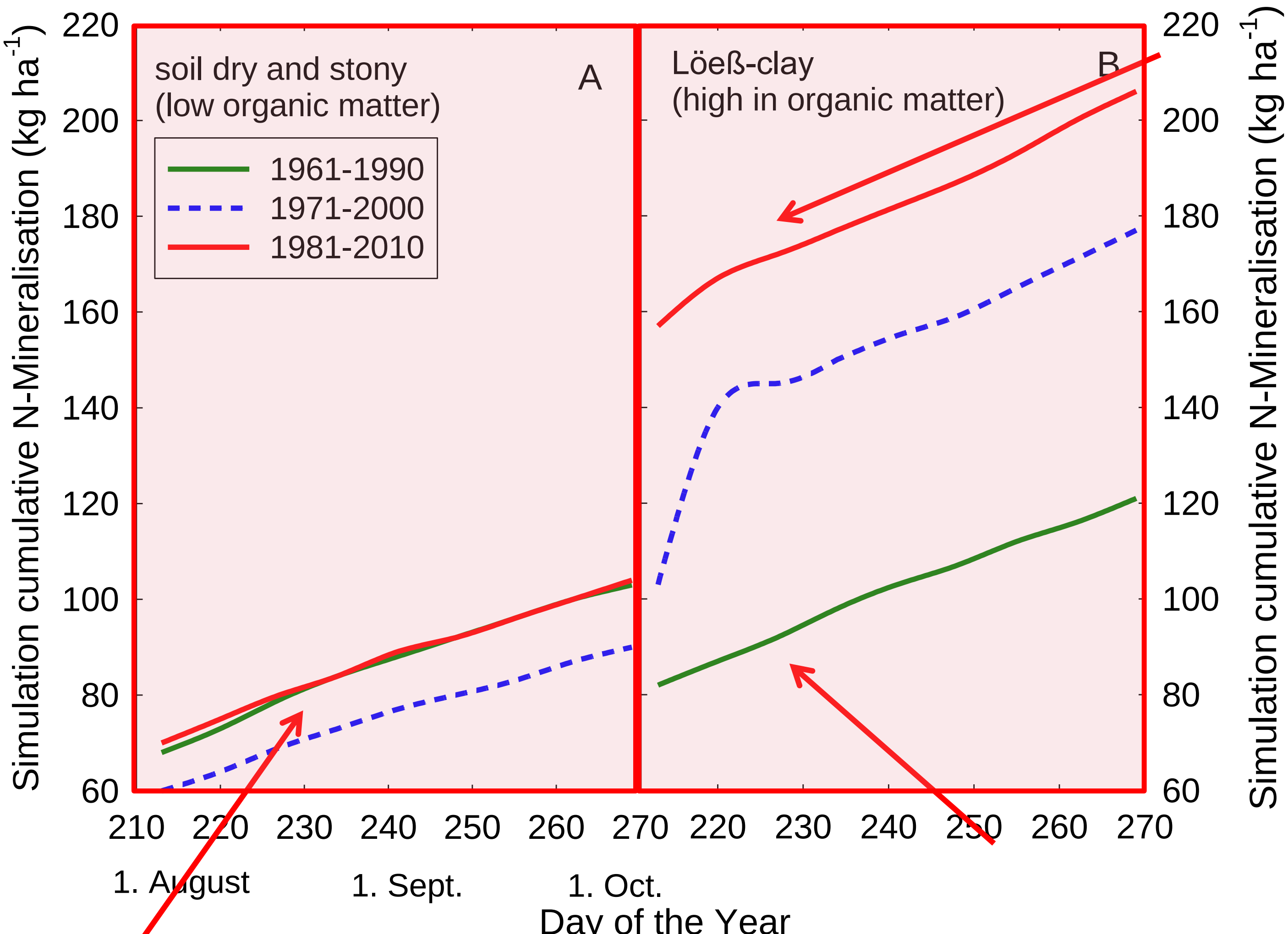


Analysis based on: Robinet, J. (1994) Statistical study of soil respiration: calculation of present day rates and anticipation of a double CO_2 world. In: NATO ASI Series, Vol. I Soil responses to climate change. Springer, 237-241

3. Soils are the key to sustainability its our most valuable resource

But soils in Viticulture are mostely C-sources and not C-sinks, and 0.4% increase in C-sequestration in the soil PER YEAR are unrealistic.

Modeling of soil nitrogen dynamics (first estimates)



Schultz, Ehlig, Hassemer-Schwarz unpublished

Questions

- soil carbon, how to increase it?
- underground dynamics of nitrogen, how to control it?
- how to add biomass without degradation of water quality through nitrogen leaching?

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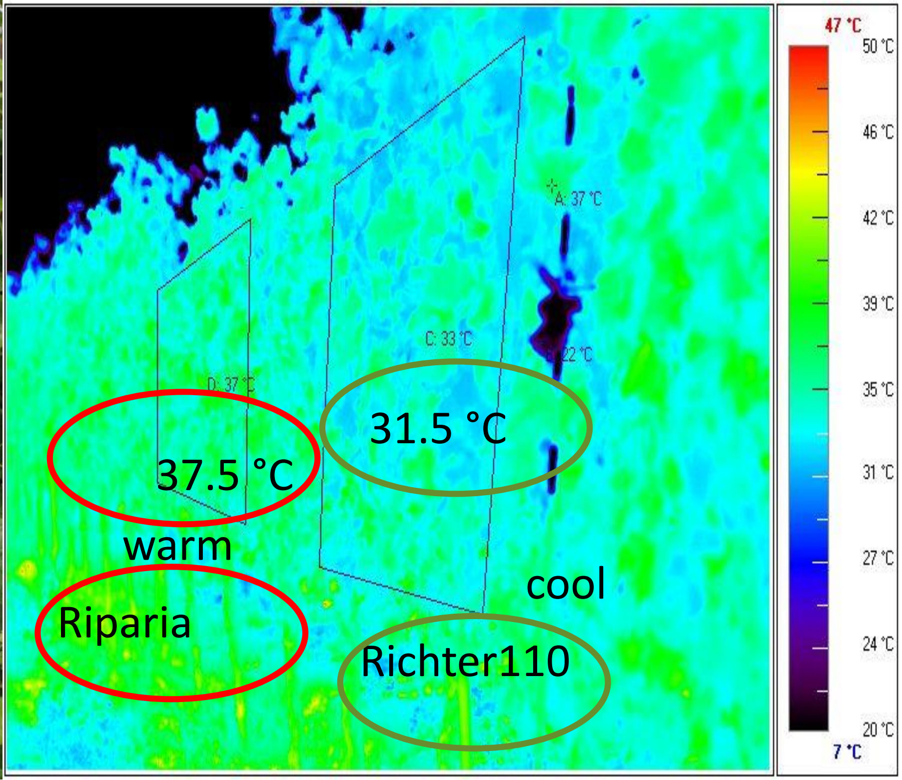
Genetic progress/genetic losses: We have a **large** clonal and **varietal** variability – but the potential is largely unused

Expl. Italy, around **400 varieties** in production

Expl. French varietal catalogue (Pinot noir) 48 clones (318 varieties / 820 clone) Catalogue des variétés et clones de vigne en France

We do not use disease resistant varieties, although they exist, we have not sufficiently exploited the gene pool around us

The rootstock question needs to be newly adressed



The Geisenheim Population – Phenotypic Variance

- Large spectrum of „biotypes“
- *V. berlandieri* approx. 3800

Questions

Hochschule Geisenheim University

- selection and collection projects are expensive, could there be an international effort?

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Sustainable disease management – may be the greatest challenge

Cabernet Franc grapevines showing red blotch disease (top left and bottom) and harvested normal grapevine (top right), October 2012

- Old problems are becomming more difficult
- New diseases
- Wood diseases
- New insects
- There are certainly more surprises ahead

2016 was a European downy mildew desaster
Never before was such a disease pressure observed

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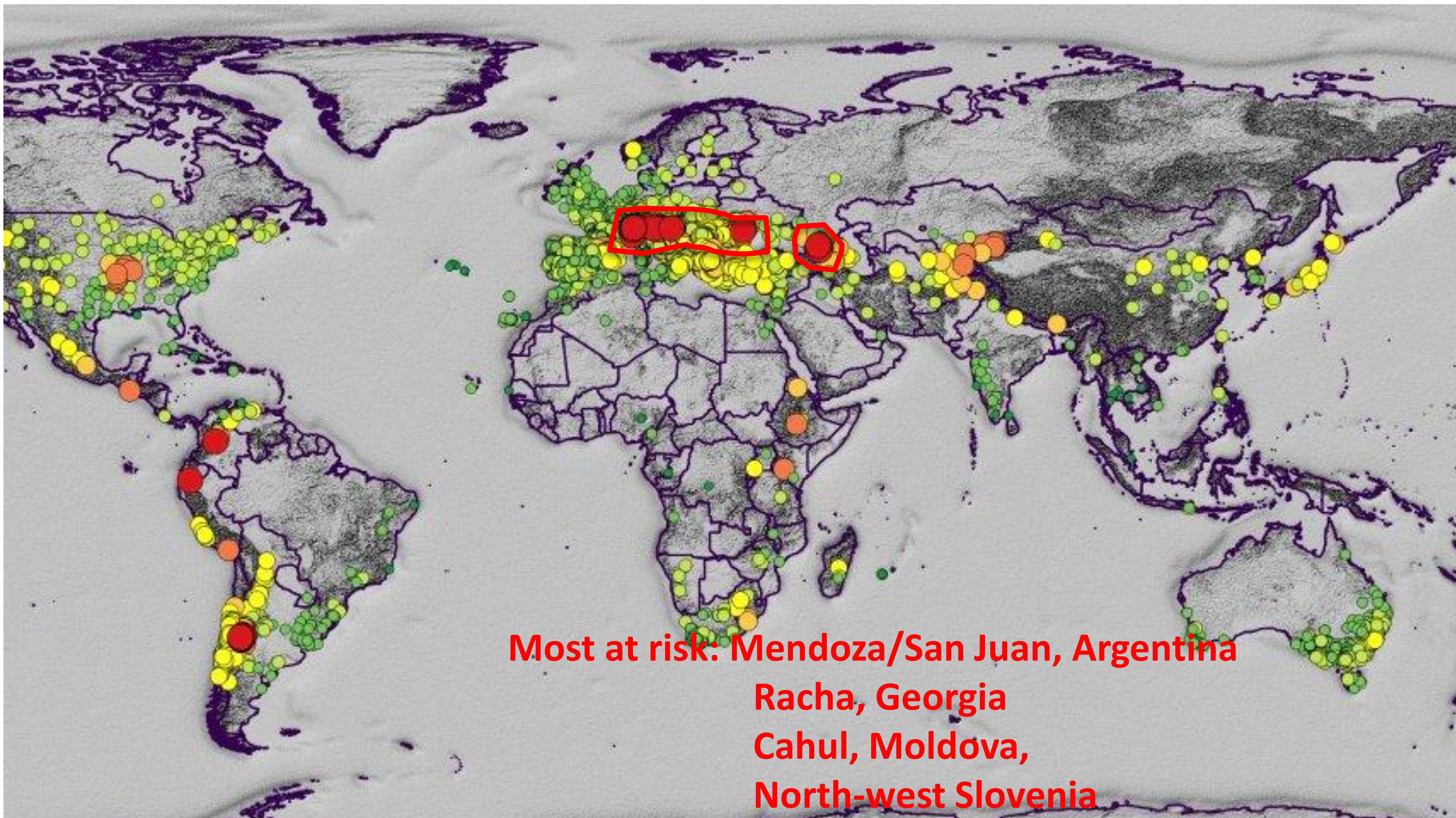
Worldwide **wine risk map** (James Daniell of the Karlsruher Institut für Technologie (KIT) presented at the Europe Geosciences Union (EGU), Vienna) (Spiegel-online, 27.4.2017)

red = high, yellow = medium, green = low



Most at risk: Mendoza/San Juan, Argentina
Racha, Georgia
Cahul, Moldova,
North-west Slovenia

CO_2, an experimental view into the future

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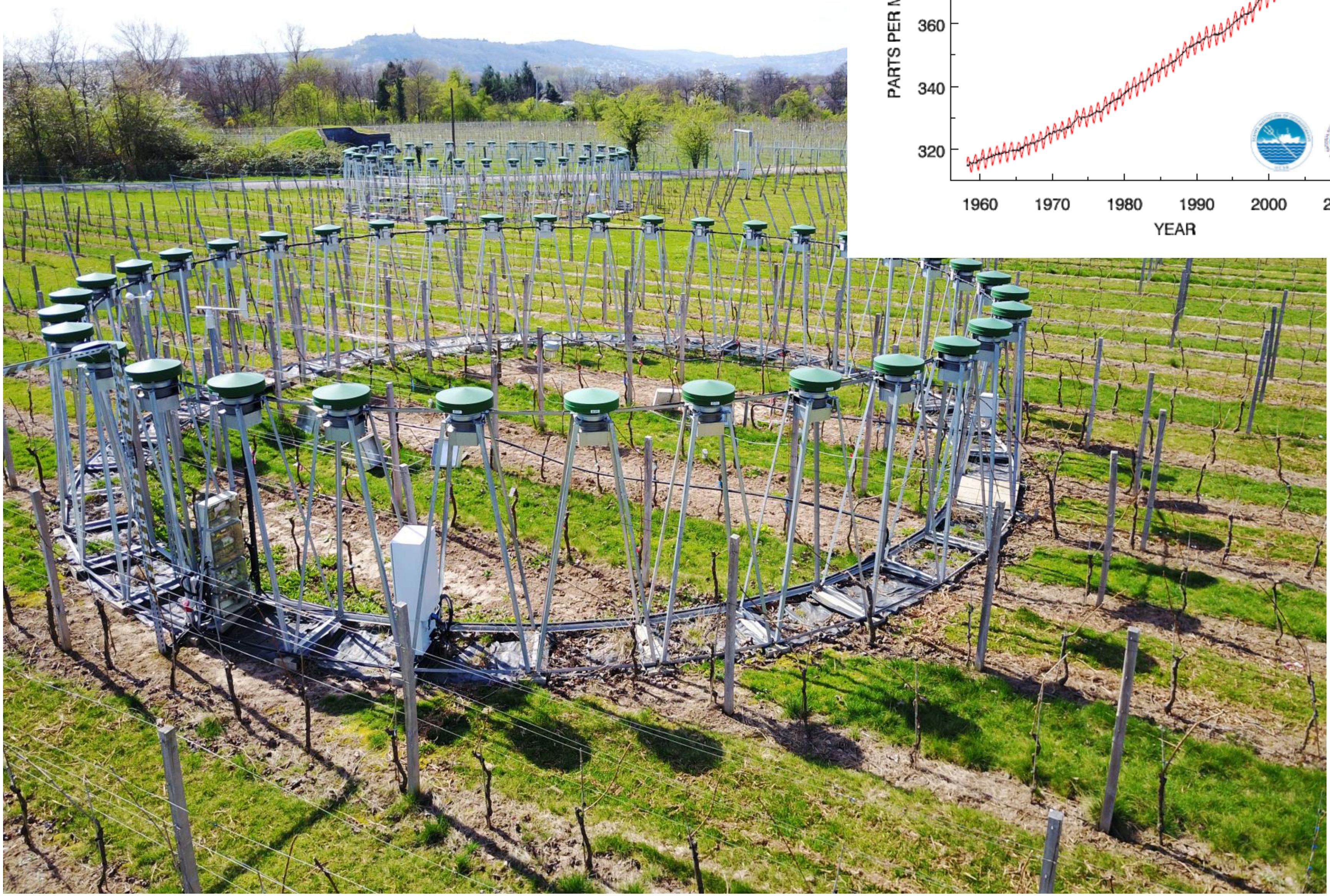
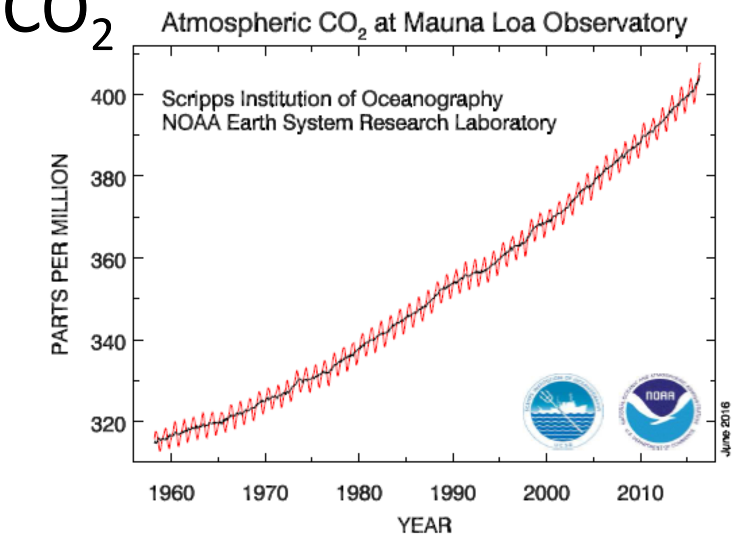
Grapevines in a future higher CO_2 world: The Geisenheim FACE system for special crops





The Geisenheim FACE for special crops to takle the big questions

- Will water consumption decrease in a higher CO_2 world?
- How will different varieties behave (plant and fruit physiology)?
- soil population of micro-organisms, will they be affected?
- gene expression of insects, what to expect?
- greenhouse gas emissions, where to go?

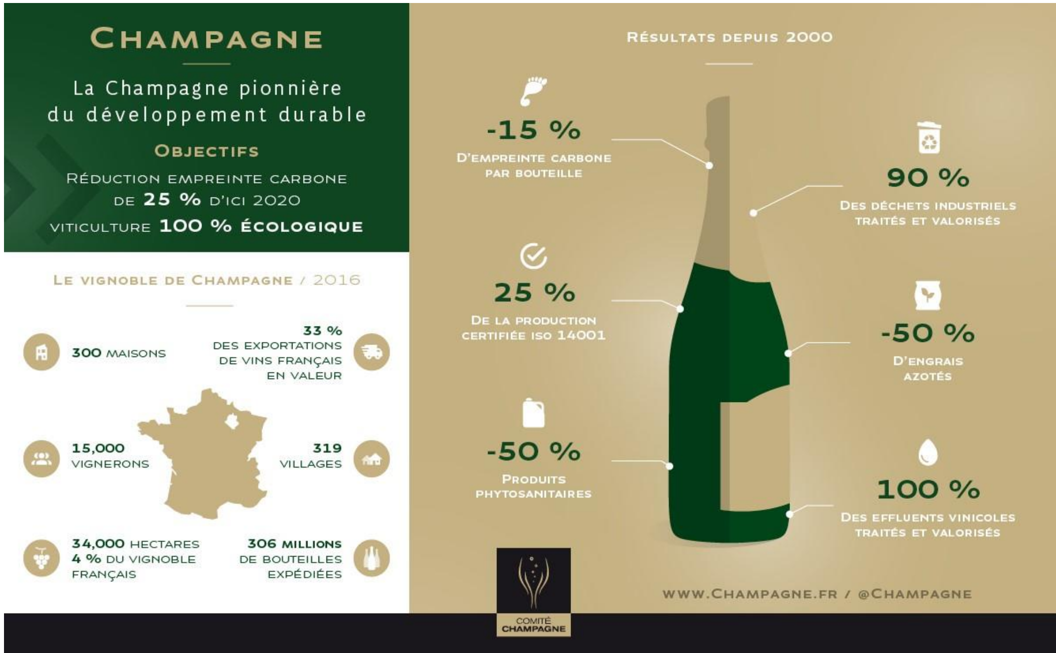
Summary

- Many new potential regions are emerging due to climate evolution, but regional/local factors need to be considered
- Water will be the dominant issue in the future (both, too much and too little)
- Why is ETp not changing in many regions despite increases in temperature?
- How to control erosion in a future world?
- How to control greenhouse gas emissions in a future world?

Summary

- The dangers of soil warming (organic matter decay, nitrogen release)
- Restart programs on rootstock biodiversity
- Preservation of varietal and clonal diversity
- We need large experimental systems to study the future

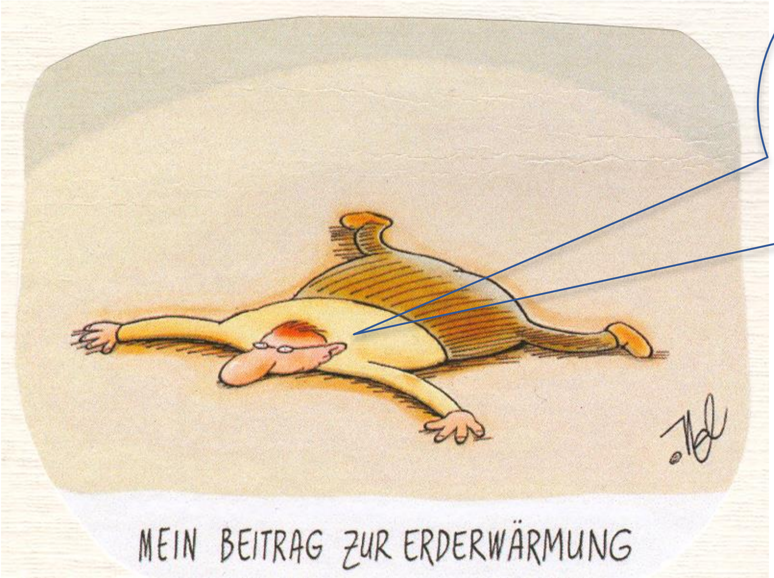
La strategie Champenois



Look at it differently

1ha vineyard produces 10 Mio L of oxygen, enough for 20 people, worldwide we have 7.6 Mio ha, producing enough oxygen for 121 Mio. people

And: save the earth, it‘s the only planet with WINE!



My contribution to global warming!

Thanks for the opportunity to be here, and thank you for your attention