



# Impact of climate change in Mexican winegrape regions



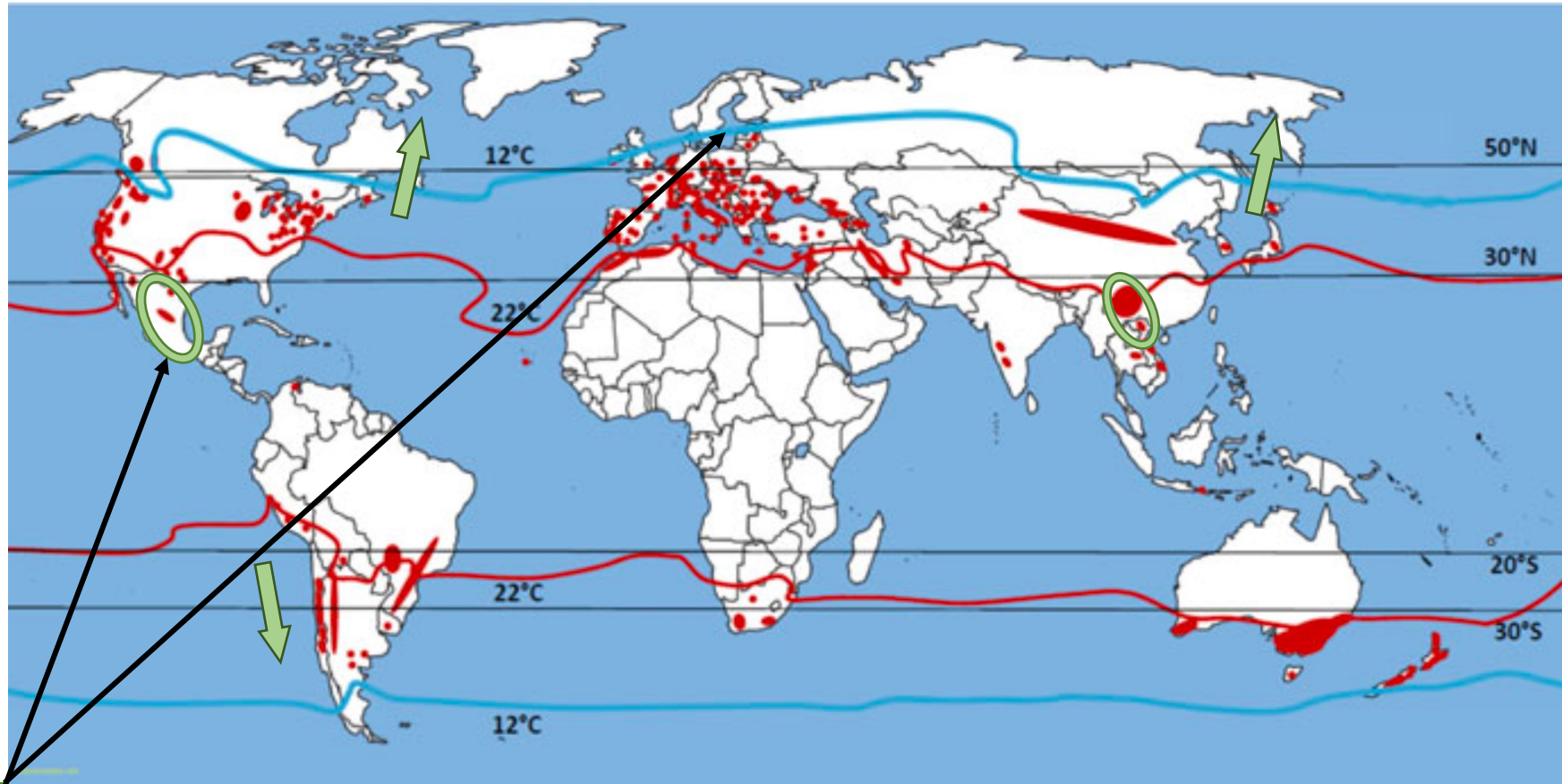
Scuola Universitaria Superiore Pavia

Natalia Castillo

Tereza Cavazos

Edgar Pavia

# Main winegrowing regions

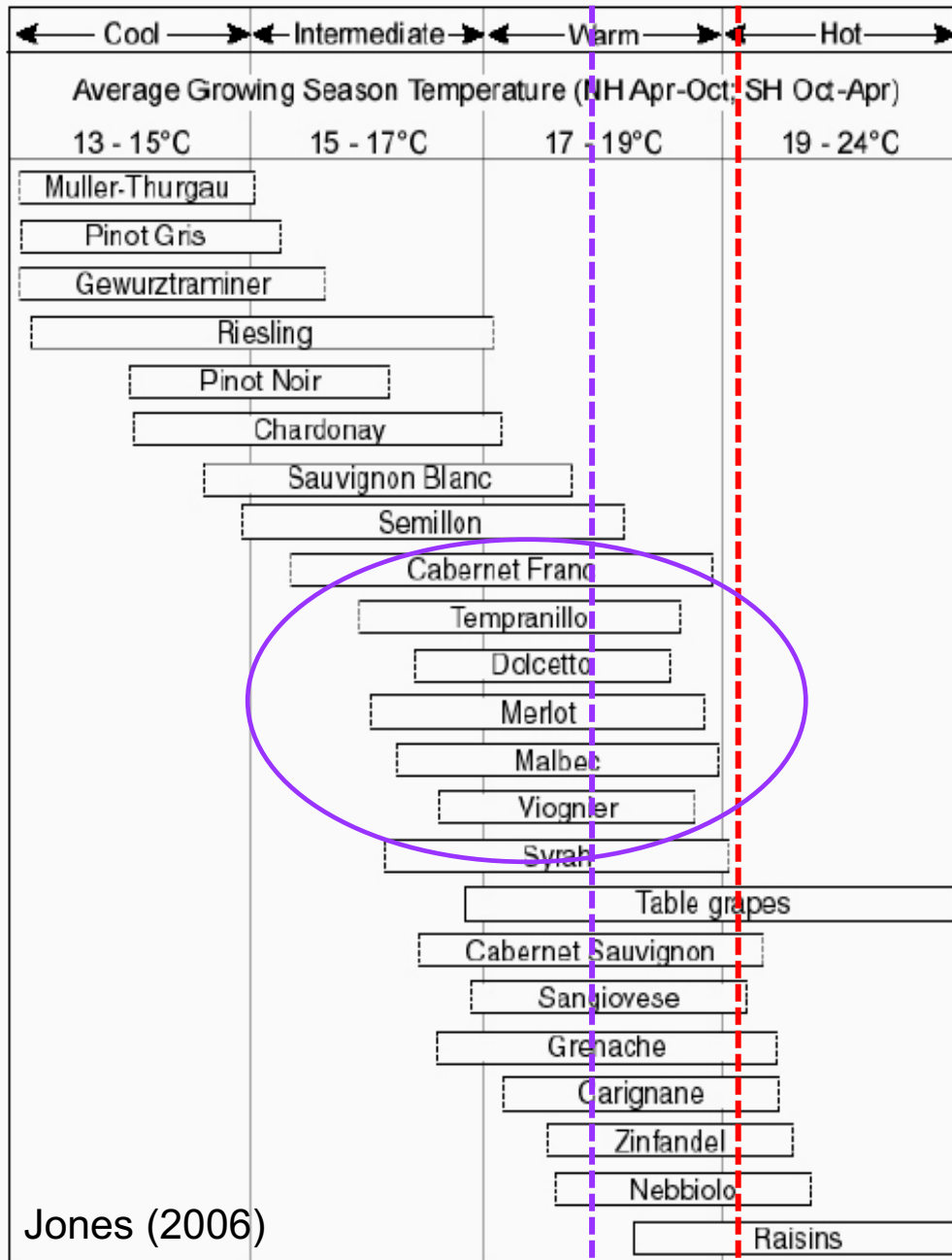


“New varieties  
hybridized or adapted”

Schultz and Jones, 2010

Roviello et al., 2021

# Grapevine Climate/Maturity Groupings



Winegrapes  
according with GS

Temp (NH: Apr-Oct)



✓ Tm winegrowing regions in  
Baja California: 19.7 °

# What was this research about? Why?

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- . Investigate current climate of major winegrape growing regions in Mexico
- . Possible changes of climatic indices during the 21<sup>st</sup> century using RegCM and RCA4

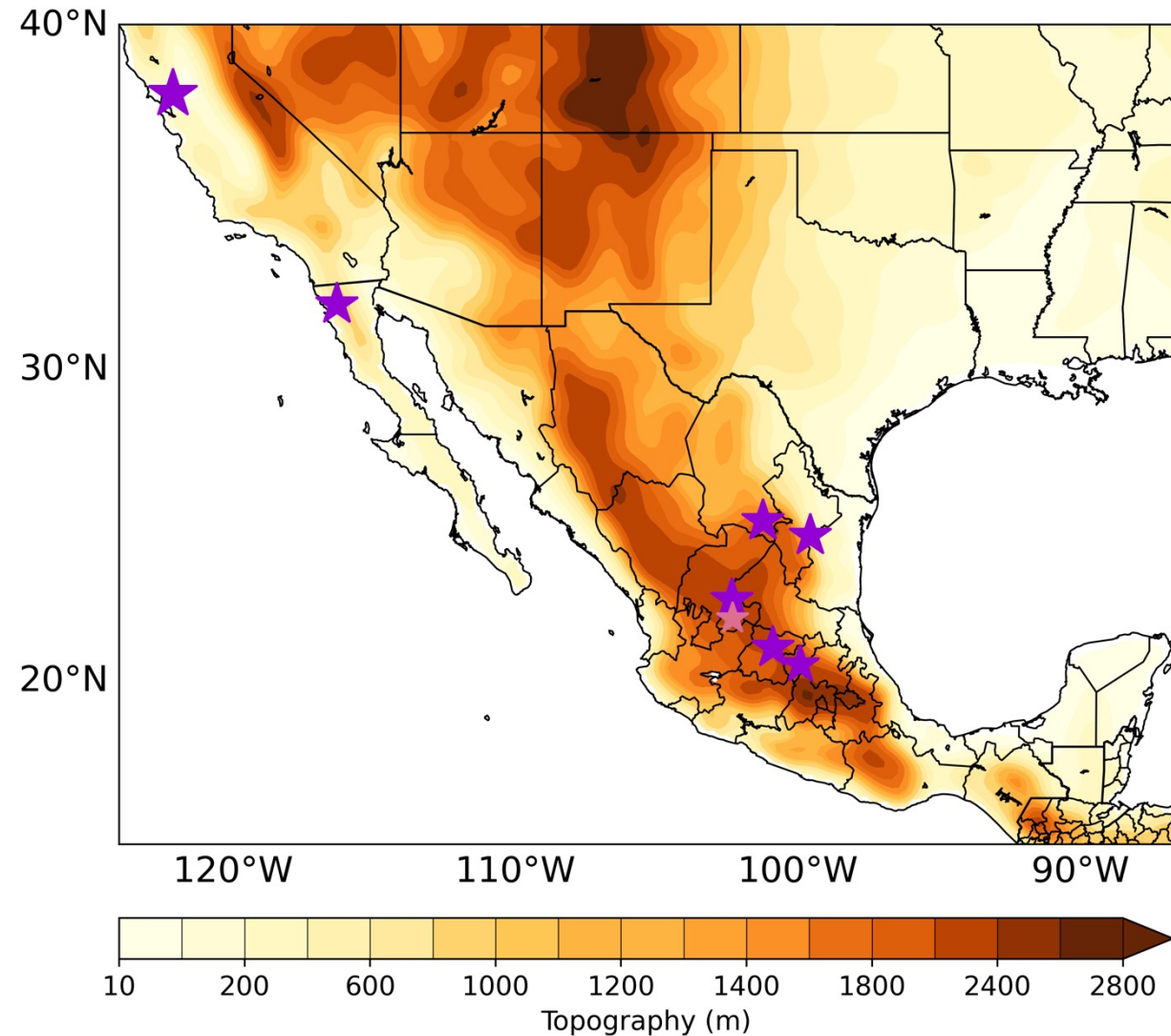
State	Industrial grape production (tons)
Zacatecas	28,676
Baja California	24,748
Aguascalientes	8572.9
Coahuila	3889
Guanajuato	3205
Querétaro	2851
Nuevo León	29

# Six top Mexican wine regions

**Baja California, Coahuila, Querétaro,  
Guanajuato, Aguascalientes, Zacatecas  
(and Nuevo León)**

Type	Winegrape	States
White	Chardonay	BC, Coah, Zac, Qro
	Chenin blanc	BC, Coah, Qro
	Sauvignon blanc	BC, Coah, Zac, Qro, Gto
	Muscat	Coah, Zac, Ags
	Saint Emilion	Zac
Red	Cabernet Sauvignon	BC, Coah, Zac, Gto, Qro
	Merlot	BC, Coah, Zac, Gto
	Tempranillo	BC, Ags, Qro
	Malbec	Coah, Zac, Ags, Qro
	Nebbiolo	BC, Ags
	Syrah	BC, Coah, Zac, Ags, Gto

Castillo et al., 2023



# Bioclimatic indices and other indicators

Index
<b>Growing Degree Days (GDD)</b> Baskerville and Emin (1969) and Jones et al. (2010)
<b>Cool Night Index (CI: °C)</b> (Tonietto y Carbonneau, 2004)
<b>Hydrothermal coefficient (HTC)</b> (Mesterházy et al., 2014)
<b>Growing season temperature (GST: °C)</b> Jones et al. (2010)
<b>Growing season precipitation (GSP: mm)</b> Firth et al. (2017)

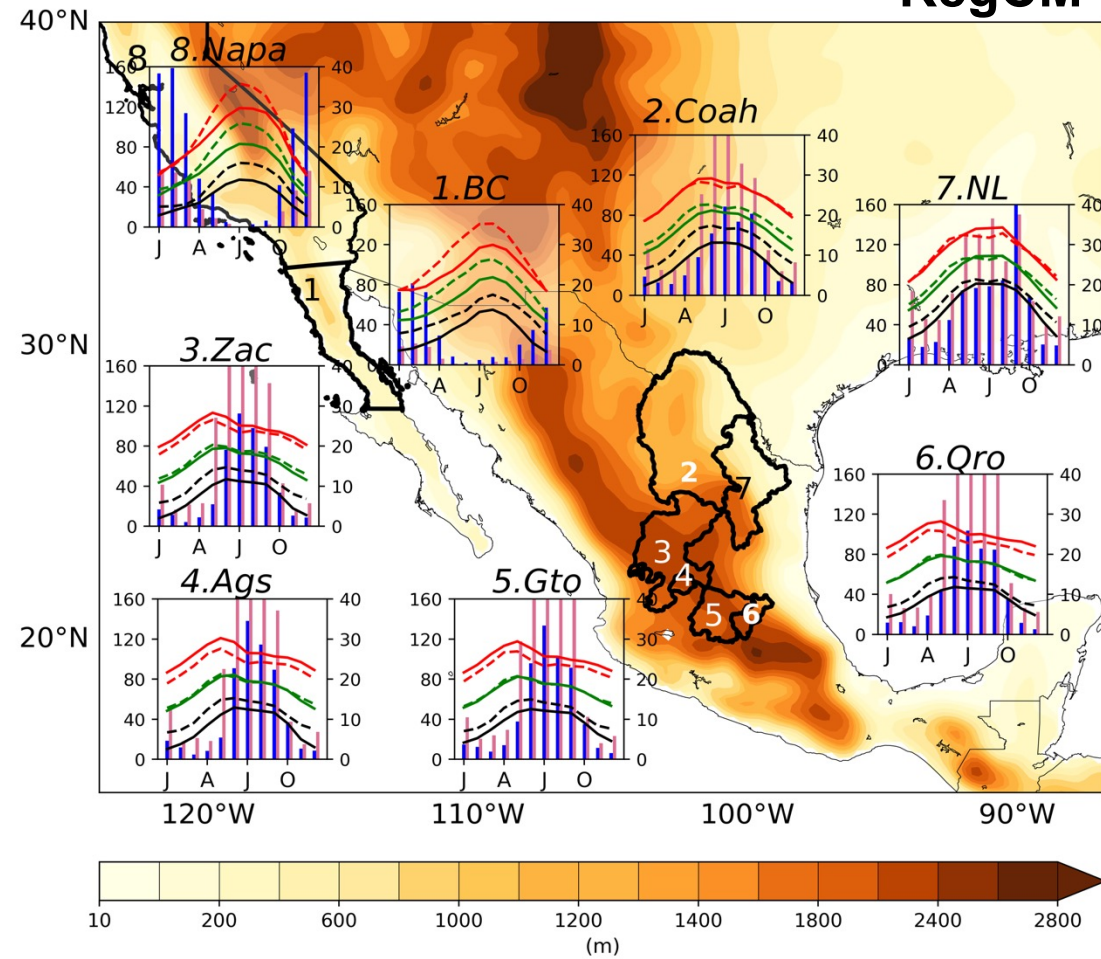
**Suitability of wine regions  
(Apr-Oct Northern Hemisphere)**

**2700 > GDD > 850**

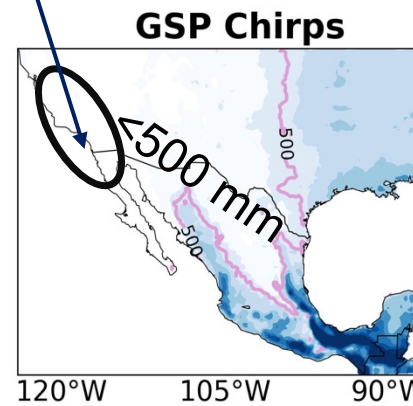


# How is the climate of these winegrape growing regions? Is all tropical over there?

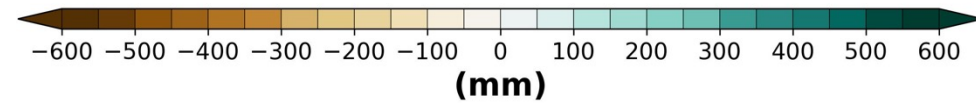
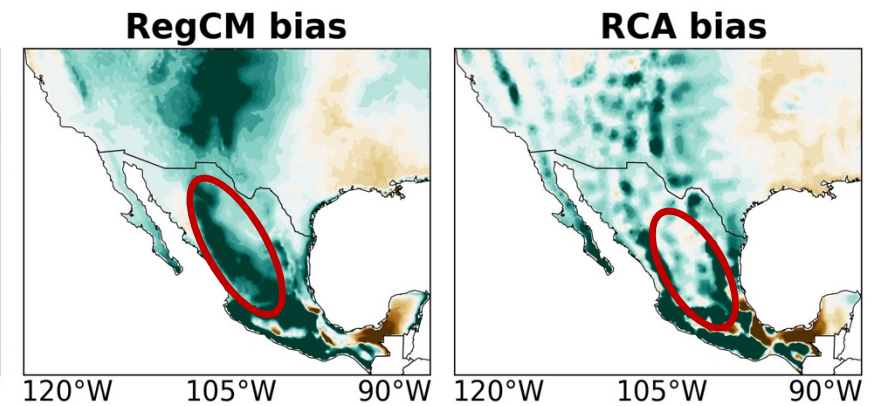
## RegCM-ERA and RCA4 evaluation



-Mediterranean Climate



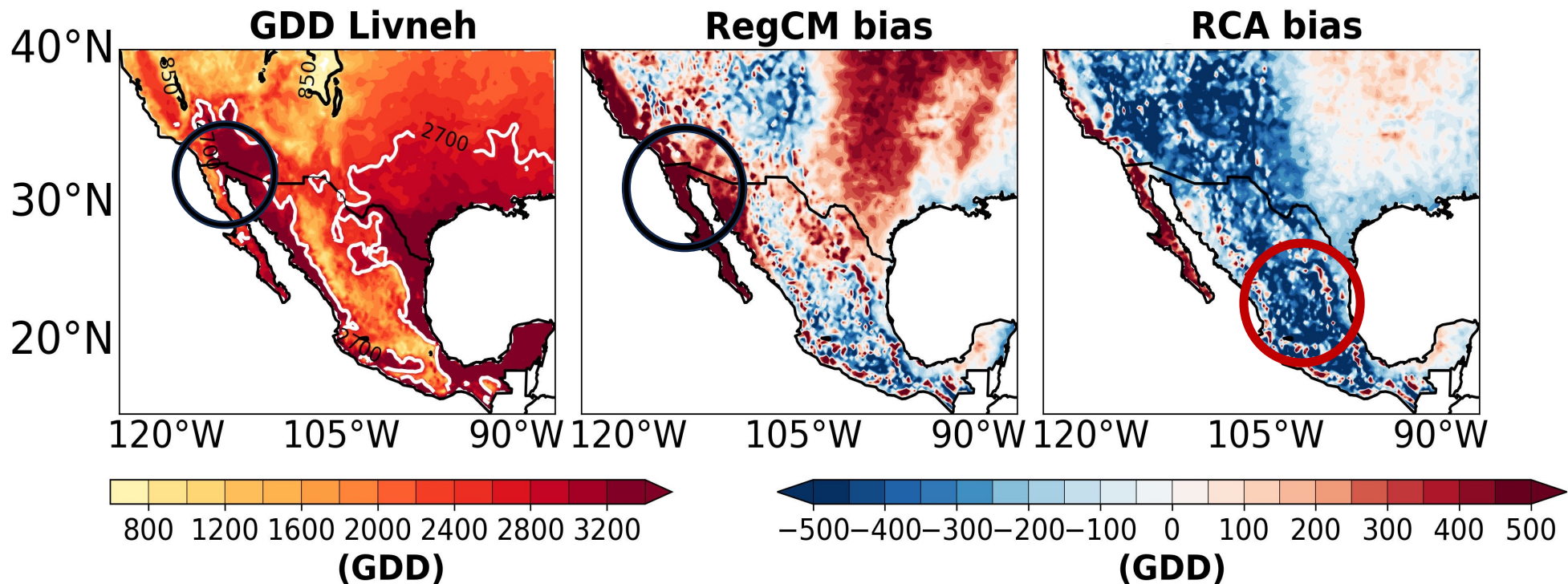
-Semiarid continental



# What about the evaluation of bioclimatic indices?

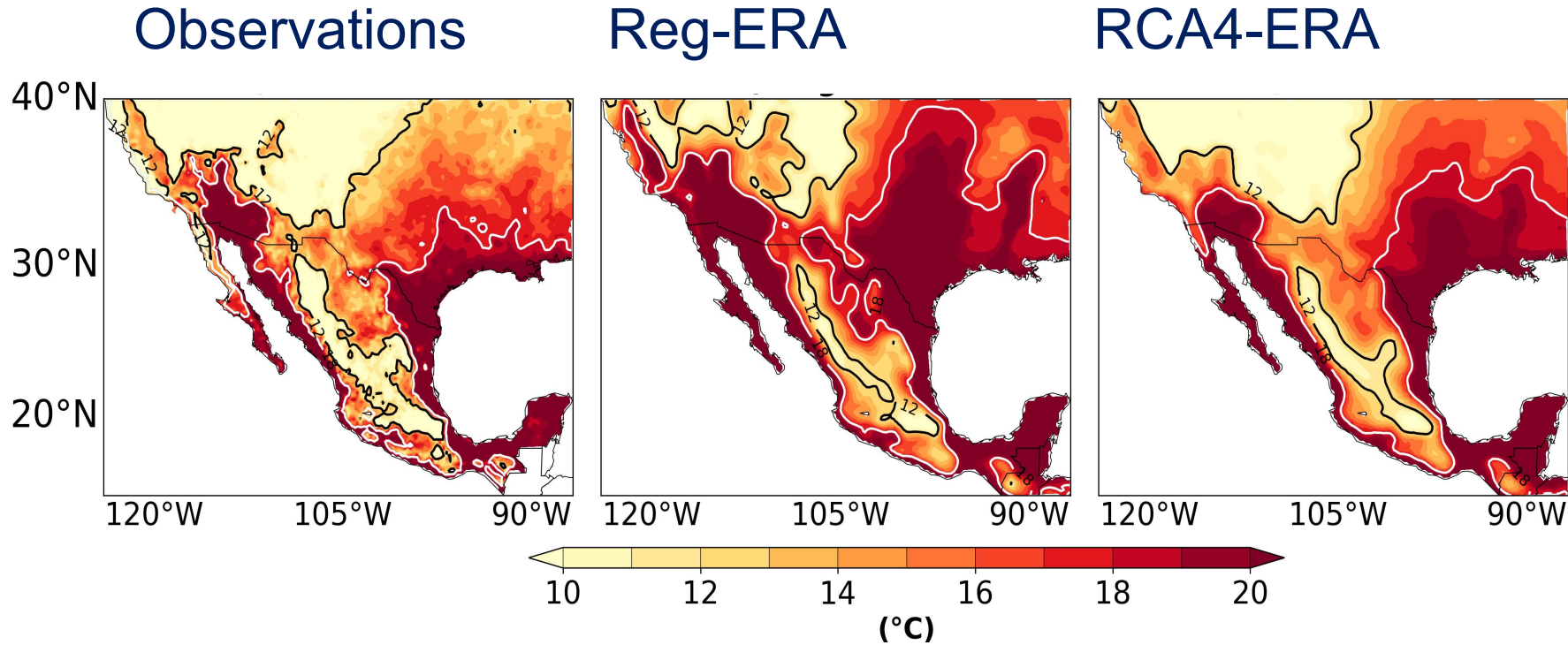
>2700 too Hot

< 850 too cool





# How are September nights? → CI of harvest season

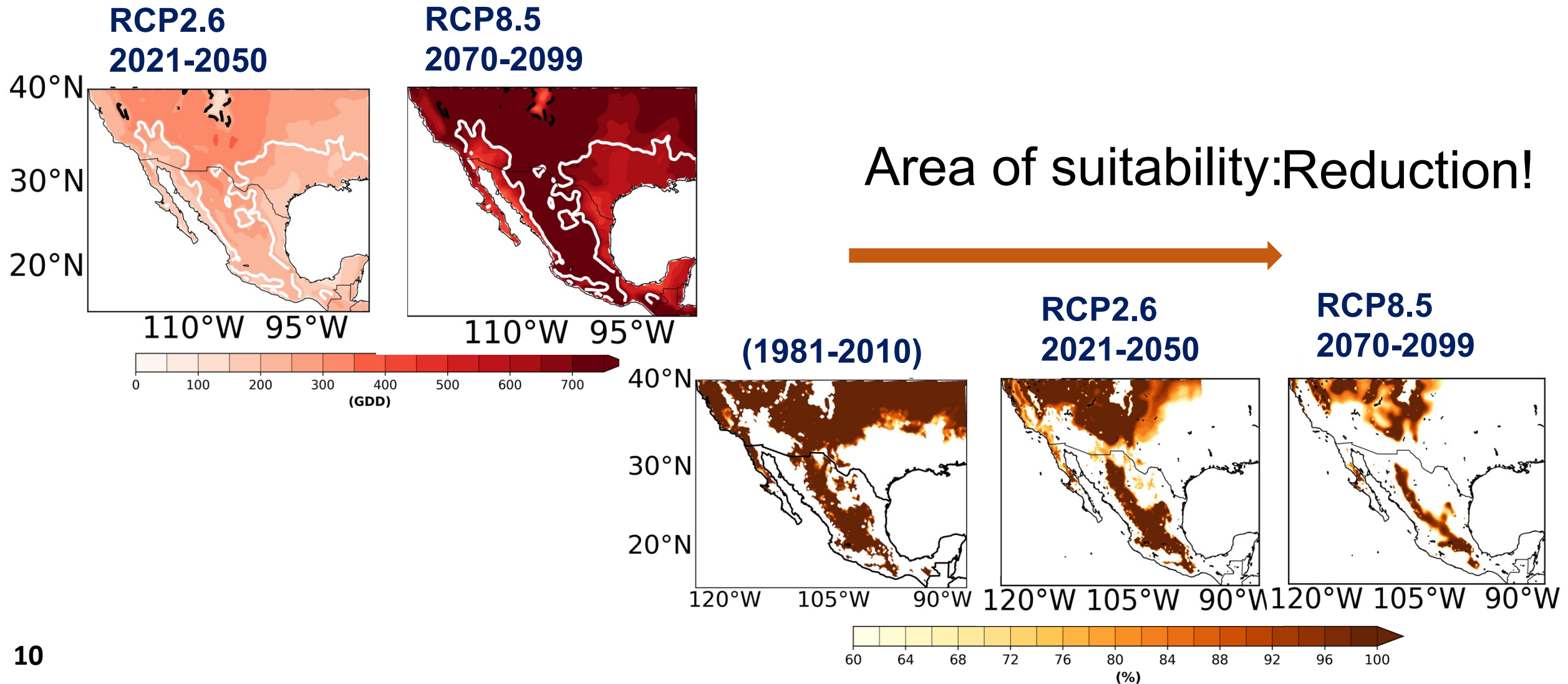


≤12 (Very cool nights)  
>12 ≤ 14 (Cool nights)

>14 ≤ 18 (Temperate nights)  
>18 (Warm nights)

# And... what about the future GDDs?

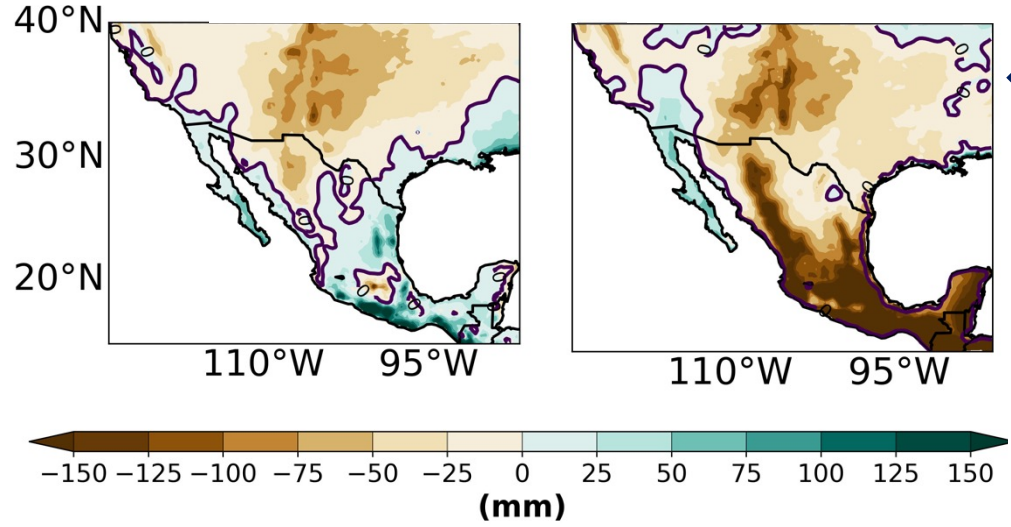
## + Changes



# And... what about the future?

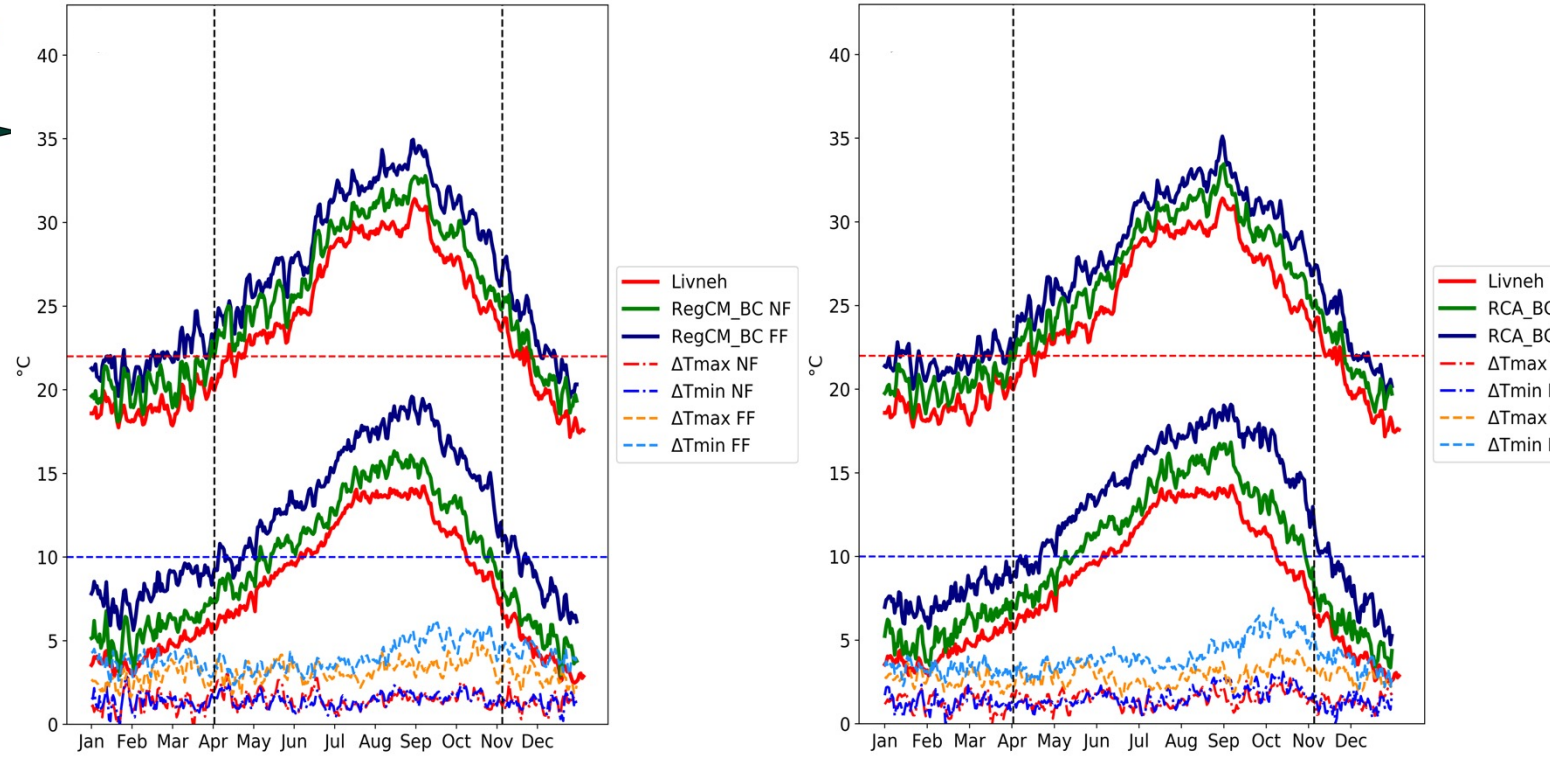
**RCP2.6  
2021-2050**

**RCP8.5  
2070-2099**



← **Precipitation changes**

**Tmax and Tmin changes (°C) in Baja California wine region  
NF and FF under RCP8.5**



# Summary

Temp ↑

Prec ↓↑ ?

Area ↓

Phenology ?

ADAPTATIONS! ↑

<p>↑ Increase during GS: 1.5 to 4 °C</p> <p>↑ Nocturnal: affecting grape's aroma and colour</p> <p>Possible GS shift (earlier as in NL)</p> <p>↑ Variability in winter (RCP8.5): dormancy? -&gt; false springs</p>	<p>↑ Uncertainty Regions opposite signals RCP2.6 (GS)</p> <p>RCP8.5 FF (GS): BC: + 30 mm HP: -126.5 mm -&gt; evapotranspiration -&gt; vine's stress</p> <p>↑ Seasonal uncertainty (drought, extremes, heat waves)</p>	<p>↓ Fraction area suitable for viticulture</p> <p>Possible new regions in higher elevation sites of Mex and US</p> <p>NF in BC: might still suitable</p> <p>↑ Variability % freq years suit area</p>	<p>Earlier beginning GS, flowering, harvest</p> <p>↓ Grapevine's physiology:</p> <p>Sugar, acidity, phenols -&gt; different wine's flavours</p>	<p>Shifting harvest to August</p> <p>Hybridized varieties</p> <p>Solar energy to power:</p> <ul style="list-style-type: none"> <li>• Atmospheric humidity condensers</li> <li>• Water recycling plants:</li> </ul> <p>Irrigation, desalination vineyards close coast</p>
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# Where can I find this information?

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## RESEARCH ARTICLE

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## Impact of climate change in Mexican winegrape regions

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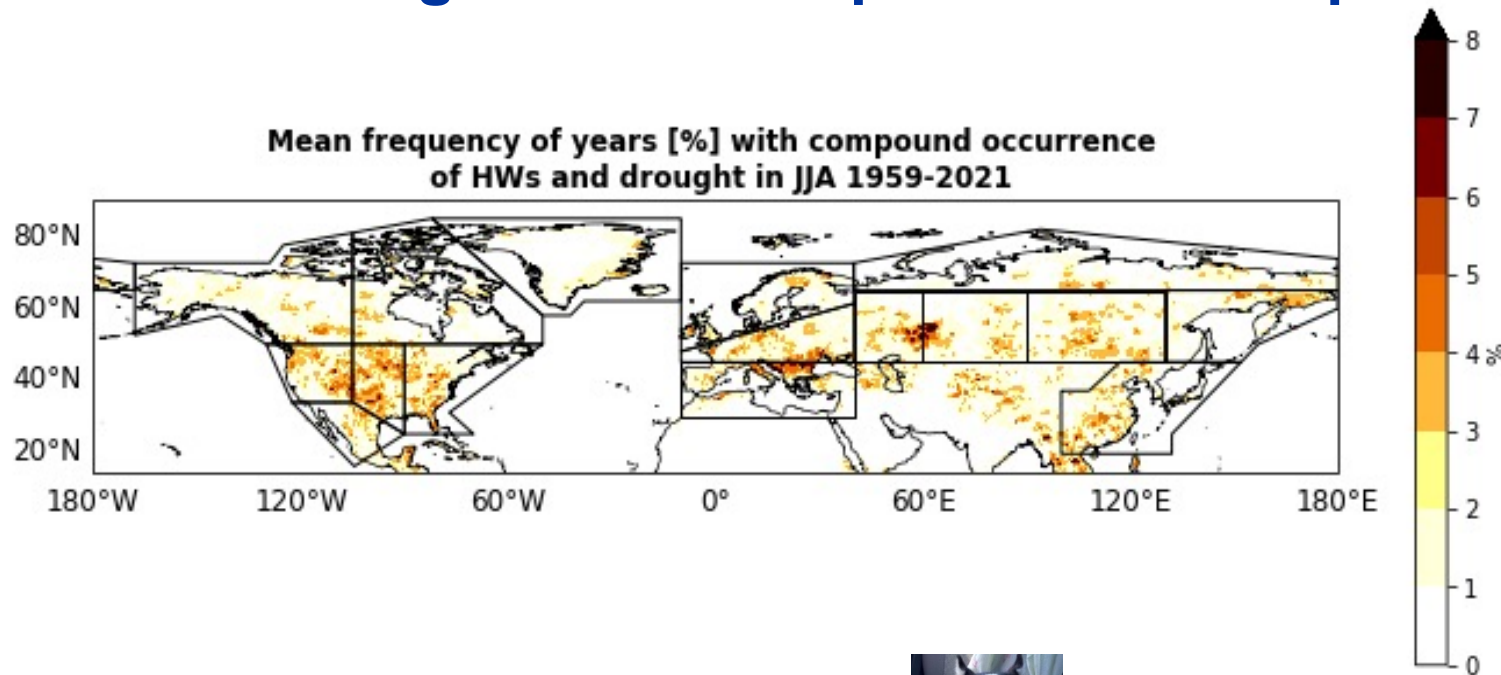
### Abstract

We analysed the current climate of seven winegrowing regions of Mexico and their possible changes during the 21st century. Various bioclimatic indices were calculated with observations and simulations over a wide domain that covers Mexico and the south and southwest United States. We used two regional climate models (RegCM4.7 and RCA4) for historical (1981–2010), near future (NF: 2021–2050) and far future (FF: 2070–2099) periods under two greenhouse gas emissions scenarios (RCP2.6 and RCP8.5). Both models reproduced the main characteristics of the Mediterranean and semiarid climates typical of the winegrape regions with some biases. Despite the errors, the models suggest similar future changes during the growing season (GS: April–October) in winegrape regions. Increases in temperature ( $\sim 1.2^\circ\text{C}$ ) are expected in the NF, which could produce an early start from the growth (mid-March) season to the harvest. More significant changes are expected in the FF under the RCP8.5 scenario; temperature during April–October may increase  $\sim 4^\circ\text{C}$ , and growing degree-days (GDD) and minimum temperature could also increase ( $\sim 700$  and  $4.5^\circ\text{C}$ , respectively), especially in the northern Mexican high plateau, substantially reducing the suitable areas for viticulture. In Baja California (BC) the suitable years for viticulture may decline by 30%–50%, suggesting an increase in the interannual uncertainty. Moreover, in BC and California the number of cool nights ( $T_{\text{min}} < 12^\circ\text{C}$ ) could be reduced during the

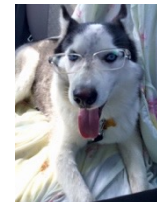
Go for it!

# Currently, future steps...

## Characterization of compound extremes: heat waves and drought, associated large circulation patterns and impacts



Thank you!



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