Modeling the Suitability of Pinot Noir in Oregon's Willamette Valley in a Changing Climate

Bryan Berenguer[1], Brian Skahill[1], and Manfred Stoll[2]

[1] Chemeketa Community College, Northwest Wine Studies Center, Salem, OR, 97304, United States
[2] Hochschule Geisenheim University, Department of General and Organic Viticulture, Von-Lade-Strasse 1, 65366 Geisenheim, Germany
Presenting author: bryan.berenguer@chemeketa.edu

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AIMS: In this study, an ensemble was developed to optimize the calculation of the growing season average temperature (GST) climate classification index throughout the Willamette Valley (WV) American Viticultural Area (AVA) by considering the complete archive of the 32 Coupled Model Intercomparison Project Phase 5 (CMIP5) daily Localized Constructed Analogs (LOCA) downscaled historic datasets. Spatiotemporal calculations, using LOCA CMIP5 historic and RCP4.5 future datasets of minimum and maximum daily temperature, were performed throughout the WV AVA for the GST index and Pinot noir specific applications of the grapevine sugar ripeness (GSR) model at a 220 g/L target sugar concentration.

RESULTS & CONCLUSIONS: A strong invertible relationship between the GST index and GSR model calculations was observed and exploited to update the Pinot noir specific lower and upper bounds (14.8 °C, 17.6 °C) for the GST index throughout the WV AVA. Both models revealed a warming trend with time for the WV AVA. A 3.1 °C increase in the GST index was predicted from the 1950s to the 2090s as well as a rate advance of approximately 2.9 days a decade in sugar ripeness. Pinot noir specific applications of the GSR model or the GST index with updated bounds indicate that the percent of the WV AVA area suitable for Pinot noir production is currently at or near its peak, and by 2070 will be limited to high elevations or may require other long term viticultural adaptation strategies.
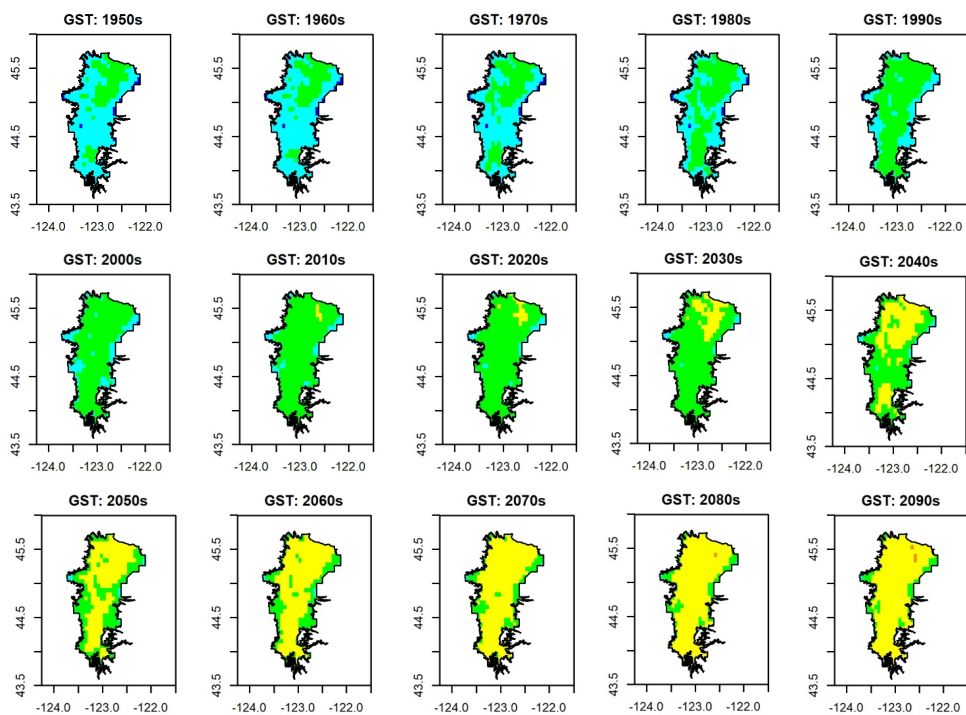

Figure 1: Decadal mean GST index climate classification throughout the WV-AVA from the 1950s through the 2090s using historic and RCP4.5 future LOCA CMIP5 model datasets.
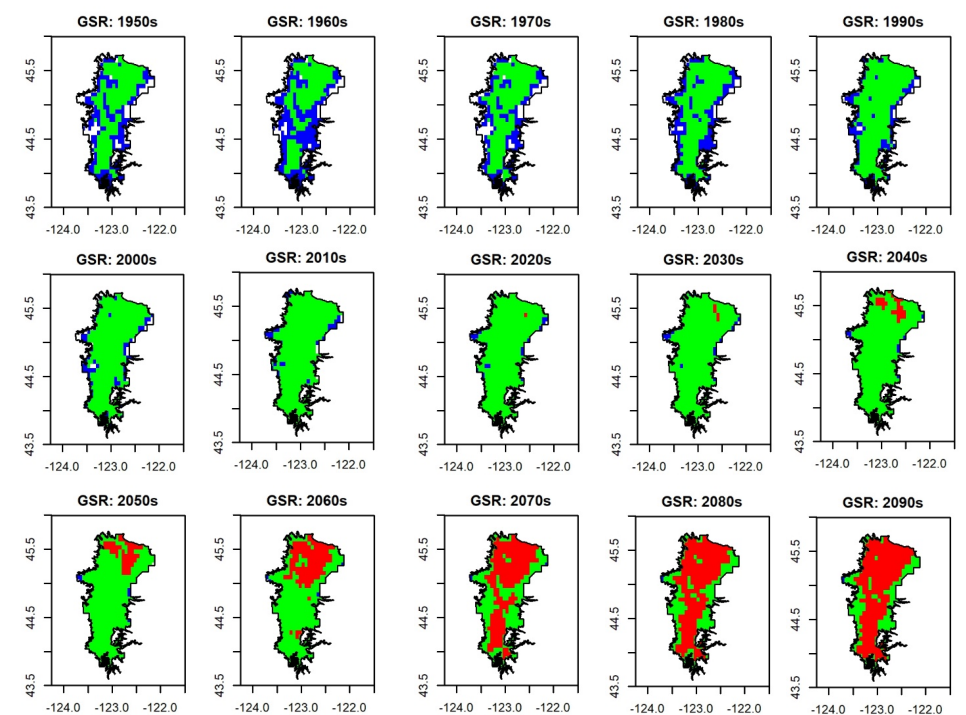

Figure 2: Decadal mean GSR model throughout the WV-AVA from the 1950s through the 2090s using historic and RCP4.5 future LOCA CMIP5 model datasets.

Legend figure 1: GST
- Too Cool
- Cool
- Intermediate
- Warm
- Hot
- Very Hot
- Too Hot
- Willamette Valley

Legend figure 2: GSR (220 gL^{-1})
- Before Sep. 10
- Sep. 10 - Oct. 10
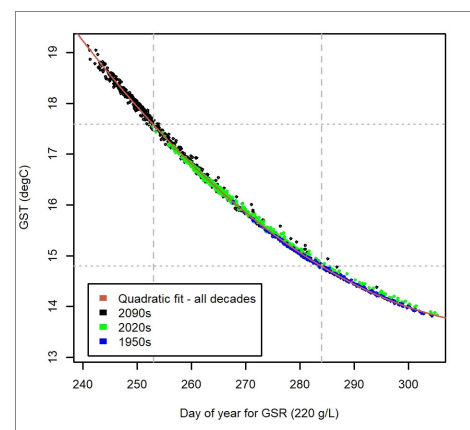- After Oct. 10
- Willamette Valley

Figure 3: Scatter plot of the decadal mean grapevine sugar ripeness (GSR) model day of year from 1 January for Pinot noir to reach a 220 g/L sugar concentration level and the growing season average temperature (GST) index throughout the WV-AVA.
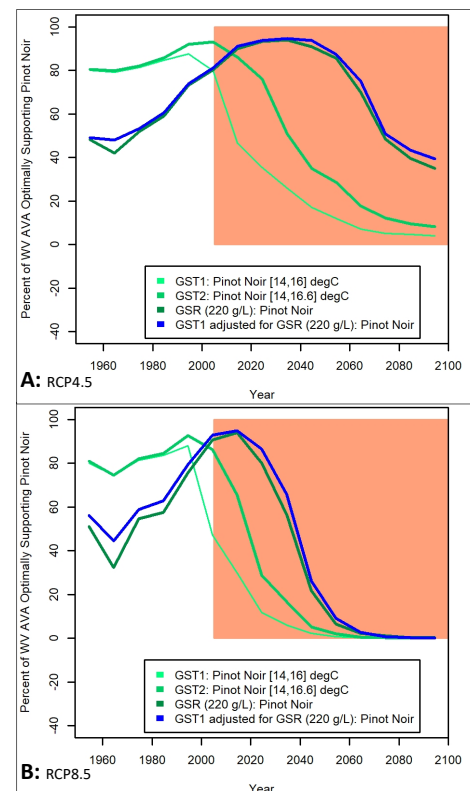

Figure 4 A, B: Percent of the WV-AVA that would support Pinot noir production based on the application of the GST index with its original bounds of 14.0-16.0 °C and its maximum reported uncertainty of 0.6 °C (Jones, 2007) as well as GSR modelled by Parker et al. (2020) that reach certain sugar concentration levels using A) historic and RCP4.5 future LOCACMIP5 model datasets and B) historic and RCP8.5 future LOCA CMIP5 CanESM2 modelled data.

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