Impact of climate variability and change on grape yield in Italy

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INTRODUCTION

Viticulture is entangled with weather and climate. Therefore, areas currently suitable for grape production can be challenged by climate change. This work investigates the relationship between climate variability and wine productivity to estimate the impact of climate change on yield at the end of the century. The analysis focuses the Franciacorta territory in the Lombardy region in northern Italy (Fig 1), which is known for its wines (i.e. Bollicine di Franciacorta, Curtefranca DOC, Sebino IGT). This study is developed in collaboration with Franciacorta Consortium who provided grape productivity data and vineyard information

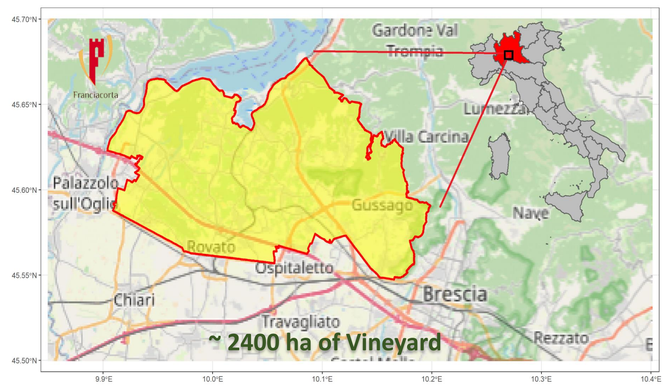
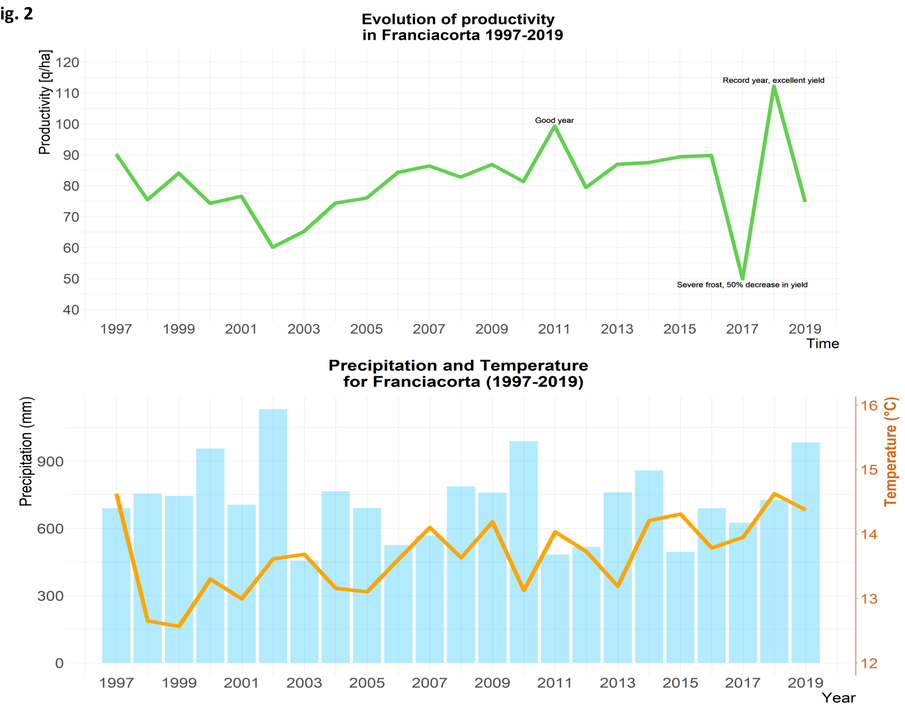


Fig 1

Fig. 2



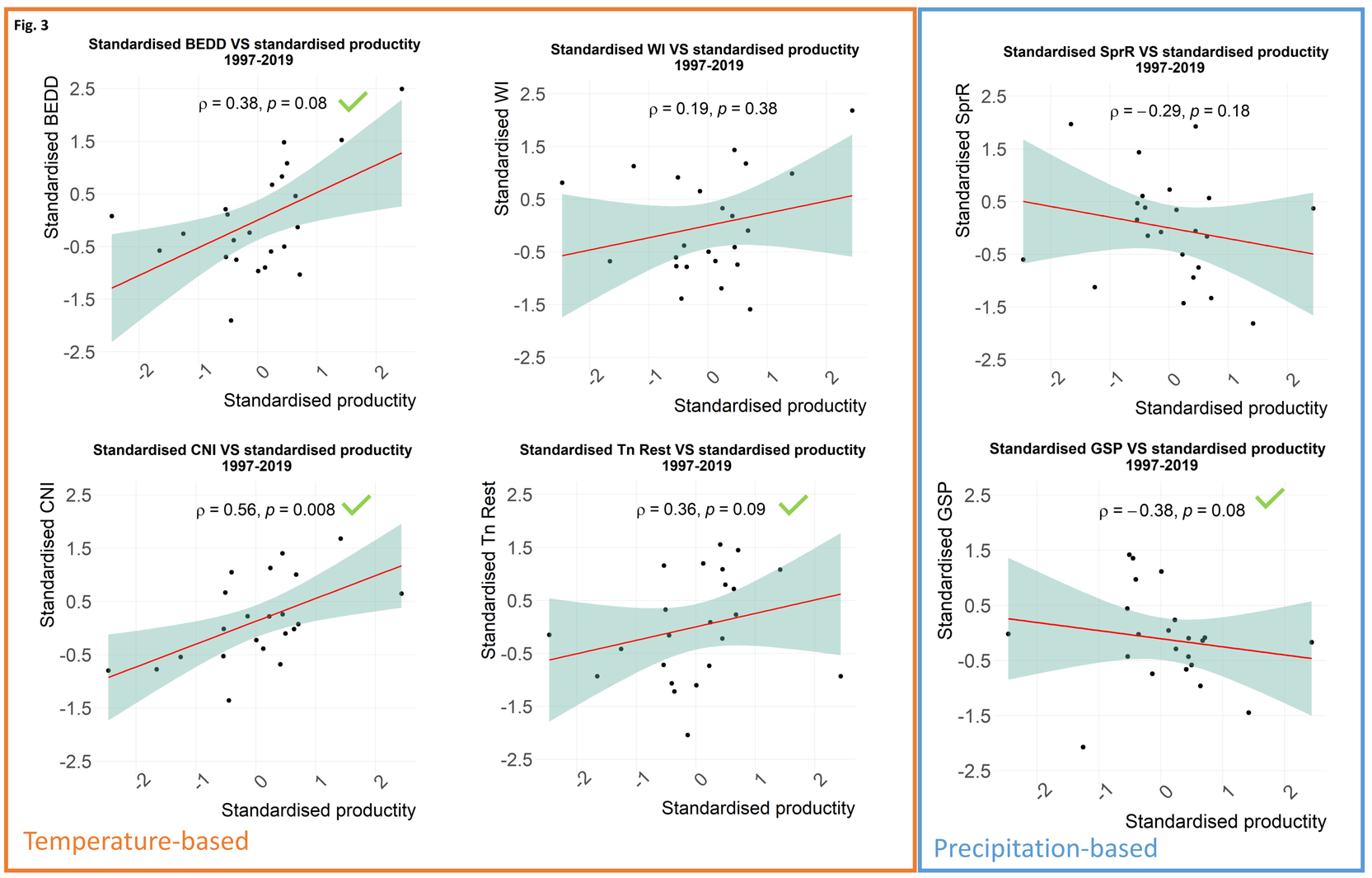
METHODOLOGY

Several bioclimatic indices were computed based on the observational dataset E-OBS and then correlated with grape productivity data for the time period 1997-2019. The indices selected are tailored for viticulture and they are based on temperature and precipitation. The productivity is calculated dividing the grape yield harvested in the area by the surface of the vineyard (i.e., quintals over hectares), without distinguishing between different cultivars or type of wines. Before computing the Spearman correlation between productivity and indices, all the series were standardized ((X - μ)/σ; where: X represents the data, μ is the mean over the time period and σ is the standard deviation). In this work the indices are used with a new approach: directly correlating bioclimatic indices and grape productivity to find a physical relationship between those variables, instead of using phenological phases

RESULTS

In the scatter plot (Fig.3) the green shade is the confidence interval, and the red line is the regression line. **BEDD**: Biologically Effective Degree Days - degree days with a lower threshold of 10 °C and an upper threshold at 19 °C; **WI**: Winkler Index - degree days with a 10 °C base, summation over vegetative period; **CNI**: Cool Night Index - mean of September (NH) minimum temperatures; **Tn Rest**: minimum temperature during rest period November - March (NH) - Useful for assessing winter severity; **GSP**: Growing Season Precipitation index - sum of precipitation from April to September (NH); **SprR**: Spring Rain index - precipitation accumulated between 21st April-to 21st June (NH)

Fig. 3



CONCLUSIONS

As shown in the scatter plots, temperature-based indices are positive correlated with grape productivity, suggesting that a slight increase (decrease) in temperatures leads to an increase (decrease) in production for the selected period. Considering only the statistically significant correlations ($p \leq 0.10$ ✓), the coefficients ranges from 0.36 to 0.56 for temperature base indices, thus explaining between 12% and 31% of the total productivity variability. Regarding the precipitation-based indices, both are negatively correlated with productivity, with GSP explaining 14% of the variability in wine productivity. An excess of rain during the growing season can trigger fungus diseases with detrimental effects on the final harvest. Growing grapes is a complex matter, and weather and climate are just one of the many factors that can influence the outcome. Vintage management, policy and market regulation can play a major role in this framework. For this reason, it is crucial to have not only good quality data, but also metadata to support the analysis. Examples of metadata are the annotations in Fig.2 that can help to better understand grape productivity fluctuation throughout the years. This study will then use high resolution climate model, i.e. convection permitting model at 2.2 km spatial resolution to evaluate the impact of climate change on wine productivity at the end of the century.

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