# Vineyard altitude as a climate change adaptation strategy and its effect on Riesling during grapes and wine composition during ripening

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## Abstract:

**Context and purpose of the study.** Climate is one of the main drivers of spatial and temporal variability in grapevine physiology and therefore a key determinant of grape composition and final wine value. The world has warmed 1.1 °C since pre-industrial times, and the latest IPCC report indicates an additional 0.5 to 1.3 °C of warming by mid-century with continental locations warming at a greater rate than the oceans. Changes in grapevine phenology have been widely observed over the past 30 years, and further warming will have marked consequences for grape and wine composition, which will require adaptation strategies for grape growers and winemakers. Elevation has a direct impact on air temperature (with average temperatures decreasing by about 6.5 °C per 1000 m), and wine regions with large elevations ranges provide ideal locations to study the effects of warming within a small area. The Canberra District wine region is characterised by its wide range of vineyard elevations, ranging from 264 to 1419 m, and is recognised as a producer of premium Riesling in a range of styles that suit local climatic conditions. The aim of this study was to evaluate the effect ~1 °C differences in growing season temperatures on Riesling grape and wine composition and sensory attributes in three vineyards located at different elevations.

**Materials and methods.** Riesling grapes were sampled from three different vineyards located at three altitudes (464 m, 596 m, and 800 m), in the Canberra, Australia, during the 2018 and 2019 vintages. Canopy and bunch temperature and stem water potential were monitored throughout the growing season. Basic chemical parameters as well as volatile compounds and carotenoids were measured on samples collected every two weeks between véraison and harvest. In 2019, wines were also made and their volatile composition and sensory attributes were assessed.

**Results.** Significant differences were found between all three sites, with night temperature variations impacting the concentration of benzenoid and terpenes measured in the both grape and wine samples. Wines made the from the coolest vineyard had a distinct floral and citrus sensory profile whilst those from the two warmer sites were characterised by more tropical and peach notes. This study provides an insight into understanding the influence of temperature differences due to altitude variations on grape and wine composition. Specific wine styles were able to be produced and the work can be utilised by grape growers in the selection of future vineyard sites to help mitigate future temperature increases.

**Keywords.** Climate change, Riesling, Altitude, Volatile compounds, Mitigation