THE IMPACT OF DECADAL COLD WAVES OVER EUROPE ON FUTURE VITICULTURAL PRACTICES

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Abstract:

Context and purpose of the study - A crucial issue associated with the long-term impact of climate change in viticulture concerns the capacity of resilience of the typical varieties currently cultivated in traditional areas. Indeed, regions that are currently characterized by optimal climatic conditions can cease to be so in the future. At the same time, new premium wine production regions may arise north of 50°N. Both these threats and opportunities are based on the assessment of a very likely gradual temperature increase along the 21st century, resulting from the ensemble mean of the state-of-the-art climate projections. Such an assessment is orienting decision-makers and stakeholders to rethink the grapevine cultivation zoning, prefiguring, for each variety, a shift at higher latitudes and/or at higher altitudes areas. However, model uncertainty is very large over Europe, as it is associated with the fate of the of the North Atlantic subpolar gyre (SPG) oceanic convection, which is simulated to collapse in a few climate models, producing single or multiple abrupt temperature drop over the North Atlantic. These "cold waves" strongly influence the temperature evolution over Europe, yet are ruled out in a multi-model ensemble analysis, since hidden by the procedure of averaging. Here, we isolate and investigate the implications that such large decadal-scale temperature variations potentially have for viticulture over Europe.

Material and methods - Our methodology consists in coupling dynamical downscaled EUR-44 CORDEX temperature projections with a hierarchy of phenological models simulating the main developmental stages of the grapevine. In particular, we use a set of 7 different climate models - one of which, the CSIRO-Mk3-6-0 model, exhibits a SPG convection collapse - and 3 different phenological models, namely (*i*) a linear non-sequential, (*ii*) a linear sequential and (*iii*) a non-linear sequential model.

Results - The general increase of temperature over Europe projected by all the climate models over the 21st century leads to an anticipation of all the developmental stages of the grapevine. This warming trend makes climate conditions adequate for high-quality wine production in some regions that are currently not. However, projections from CSIRO-Mk3-6-0 show that this long-term warming trend is suddenly interrupted by cold waves lasting several years over most of Europe, abruptly pushing the climate back to conditions that are very similar to the present. By defining the climatic suitability for premium wine production as those conditions satisfying the temperature requirements for the grapevine ripening to fall within a specific period of the year, we report a loss of suitability during the cold wave events in most of those regions that became favourable due to the 21st century gradual warming. Abrupt cooling in the North Atlantic, although simulated by only a few climate models, has been shown to be physically plausible in the context of climate change. Our findings therefore disclose that varietal northward shift may be not the most appropriate strategy if applied over those regions strongly hit by the cold waves, and so provide additional information for long-term plans of adaptation, which, so far, are mainly oriented towards the possibility of continuous warming conditions.

Keywords: Climate Change, Grapevine Phenology, Climatic suitability, Decadal-scale Cold Waves.

1. Introduction

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