CLIMATE CHANGE IMPACTS ON EUROPEAN GRAPEVINE YIELDS THROUGH A DYNAMIC CROP MODELLING APPROACH

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Abstract
Climate has a predominant role on growth and development of grapevines. Therefore, climate change represents an important challenge to the winemaking sector. The present study aims to develop climate change projections for grapevine yields in Europe. For this purpose, gridded climatic variables over a recent-past (1950-2000) and RCP8.5 future scenarios (2041-2060), are coupled with the STICS crop model. For each grid-cell in the European sector, soil (e.g. type, texture, depth) and terrain parameters are determined and used as model inputs. Grapevine and crop management variables are also defined. Yield simulations under current and future climates are then compared to identify climate change signals. For the recent-past, the crop model is able to properly simulate yields for the main current European wine regions, showing lower yields in Southern Europe and higher yields in more central/northern regions. For the future, the results depict an increase in yield in the later regions, and a decrease in the former, mostly over inner Iberia. The projections also show a northwards extension of the potential grapevine growth areas, emerging new potential winemaking regions in northern Europe. The current study is a first attempt to apply the STICS crop model to the whole European sector, by using climatic, soil and terrain data as inputs, and the results are thereby preliminary. By using climate change projections as inputs to crop models, the present approach may represent a key decision support system for the European winemaking sector.

Keywords: grapevine yields, dynamic modelling, climate change, STICS, Europe

1 INTRODUCTION

Climate has a predominant role on growth and development of grapevine (Fraga et al., 2014; Jones et al., 2005; van Leeuwen et al., 2004). It is then clear that climate change is an unavoidable challenge for the winemaking sector. The present study aims to develop and analyse climate change projections for the viticultural yield in Europe. As such, the objectives of this study are to couple a dynamical crop model STICS (Brisson et al., 2008) with high resolution climatic simulations, for the recent-past and for future scenarios, in order to develop climate change projection for grapevine yield in Europe.

2 MATERIALS AND METHODS

In the present study, gridded climatic variables for minimum and maximum air temperatures, for the recent-past (1950-200) and for the RCP8.5 future scenario (2040-2060) are coupled with the STICS crop model (Brisson et al., 2008; Coucheney et al., 2015). For each grid-cell, in the European sector, soil characteristics (e.g. texture, depth) and terrain data are determined and used as model inputs. Grapevine and crop management variables are also defined within the model. STICS yield simulations for the recent-past and for the future are then compared and analysed to take into account the climate change impacts on European viticulture.

3 RESULTS AND DISCUSSION

For the recent-past the STICS model is able to properly simulate yield for the current European wineregions, showing lower yields in Southern Europe and higher yield in more central/northern regions (Fig. 1 – left panel). For the future, the results depict an increase in yield in the later regions, and a decrease in the former, especially in inner Iberia (Fig. 1 – right panel). The projections also show an expansion of the potential grapevine growth areas northwards, which will lead to new regions suitable for winemaking in northern Europe (Fig. 2).

4 CONCLUSION

The current study is a first attempt to apply the STICS crop model to the whole spatial European sector, by using climatic, soil and terrain data as inputs. Additionally, by using climate change projections as crop model inputs,

the results highlight the future changes in grapevine yield in Europe. These changes may bring significant challenges to the winemaking sector.

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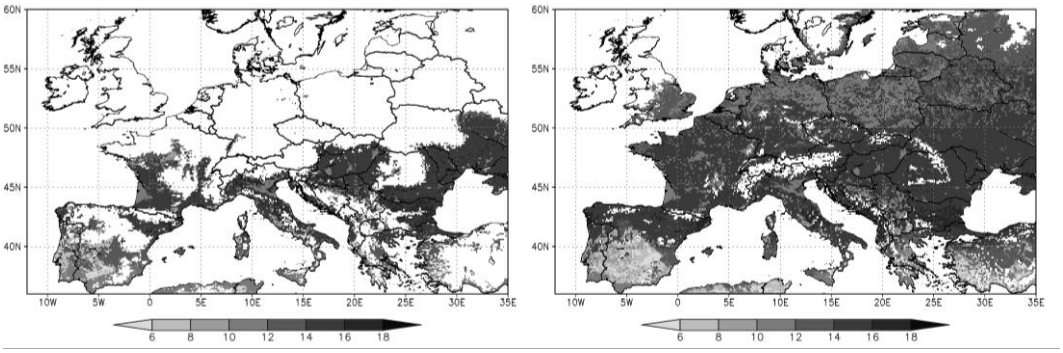

Figure 1: STICS simulations for yield (t/ha) over Europe for 1950-2000 (left panel) and 2040-2060 (right panel).

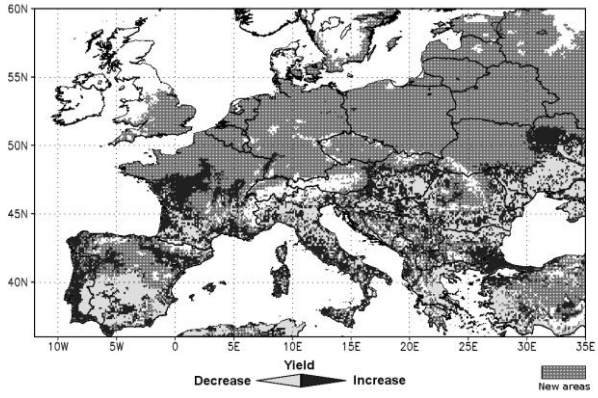

Figure 2: Future differences in STICS simulations for yield over Europe (2040-2060 minus 1950-2000).