AgriCLASS – Agricultural Climate Advisory Services
A Proof of Concept Study Looking at Climate Change Impact on Agriculture

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Introduction

Climate change will affect agriculture and forestry, changing the conditions for crop and plant growth, causing significant social and economic impacts. The AgriCLASS Sectoral Information System (SIS) takes climate data and transforms them into products that can be used with agricultural data and crop models to assess the impact of climate change on agriculture. The principal products will be Europe-wide gridded bioclimatic indicators based on selected climate projections from Climate Model Inter-comparison Project phase 5 (CMIP5). These products will be freely accessible as a public service.

Methodology

Bioclimatic indicators (e.g. mean summer temperature, Degree Days, etc.) are computed from simulated daily weather data derived from climate projections. These products may then be used as input to crop models to generate future projections of crop indicators. A schematic diagram is presented in Figure 1.

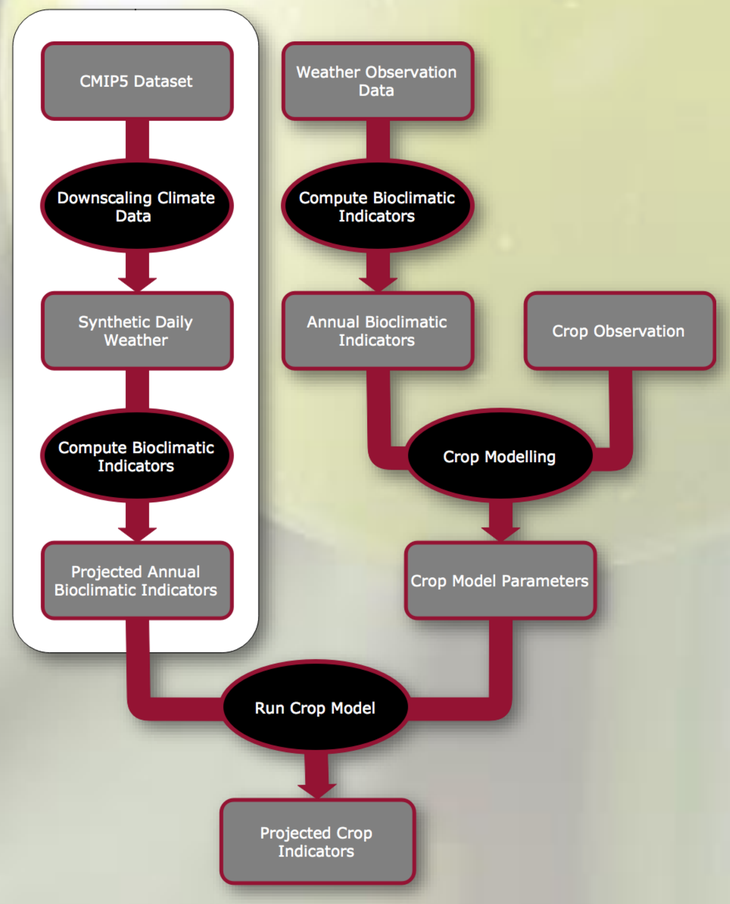

Figure 1. Use of AgriCLASS products (white box) in crop modelling

Here we present a proof-of-concept study, demonstrating climate change impact on two permanent crops: grapevines in southwest France and olives in Tuscany region, central Italy. To consider the range of plausible climate projections within the full CMIP5 ensemble, a representative subset of 8 models was selected. Two standard IPCC emission scenarios were considered: RCP4.5 and RCP8.5. For each case study, crop indicators were projected over the time period from 2011 to 2090.

Olives

Population dynamics of insect pests can be significantly altered by temperature change, through modification of developmental rate, reproduction, and mortality (Marchi et al. 2016). In the case of olives, we were interested in assessment of olive infestation by *Bactrocera oleae* fruit fly in early summer. Figure 2 shows an example of impact of B. oleae infestation on olive fruits.

Figure 2. Olives infestation by fruit fly

A correlation model was developed, using a combination of bioclimatic indicators to predict the percentage of infested fruits. The results are shown in Figure 3, projecting increasing levels of infestation over the period 2011 to 2090 under both scenarios.

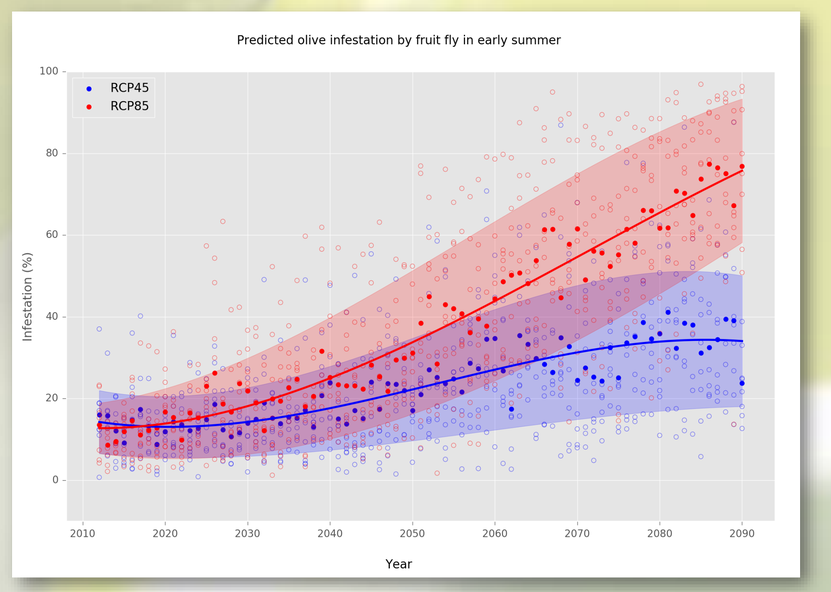

Figure 3. Projected olive infestation by fruit fly in early summer under two emission scenarios. Projected infestation rates from all models are represented by circles and the average of 8 models for each year are shown by filled circles. Fitted polynomial spline and ±1SD of the data are presented by solid line and shadowed area respectively.

The olives case study was developed in response to surveys and interviews with prospective users, including olive growers (38%), agronomists or agricultural experts (37%) and technical public administration bodies (19%).

References

Marchi, S., Guidotti, D., Ricciolini, M. and Petacchi, R., 2016. Towards understanding temporal and spatial dynamics of Bactrocera oleae (Rossi) infestations using decade-long agrometeorological time series. International journal of biometeorology, 60(11), pp.1681-1694.

Santibáñez, F., Sierra, H. and Santibanez, P., 2014. Degree Day Model of Table Grape (Vitis Vinifera L.) Phenology in Mediterranean Temperate Climates. International Journal of Science, Environment and Technology, 3(1), pp.10-22.

Vines

Vine phenology, like many other cultivated plants, is highly determined by temperature variables (Santibáñez et al. 2014). A key bioclimatic indicator is the integration of temperature over time, commonly expressed in Degree Days. Changes in this indicator directly affect the vine phenology, hence the wine quality, taste and yield. We investigated the climate change impact on four key phenological stages of interest to viticulture: Budbreak, Flowering, Veraison and Maturity (Figure 4).

Figure 4. Four phenological stages of grape, from left to right: Budbreak, Flowering, Veraison and Maturity.

A correlation model was developed, using accumulated Degree Days to predict day of year (DOY) of each phenological stage. The results are shown in Figure 5, projecting advancing DOY for the later stages and harvest dates over the period 2011 to 2090 under both scenarios.

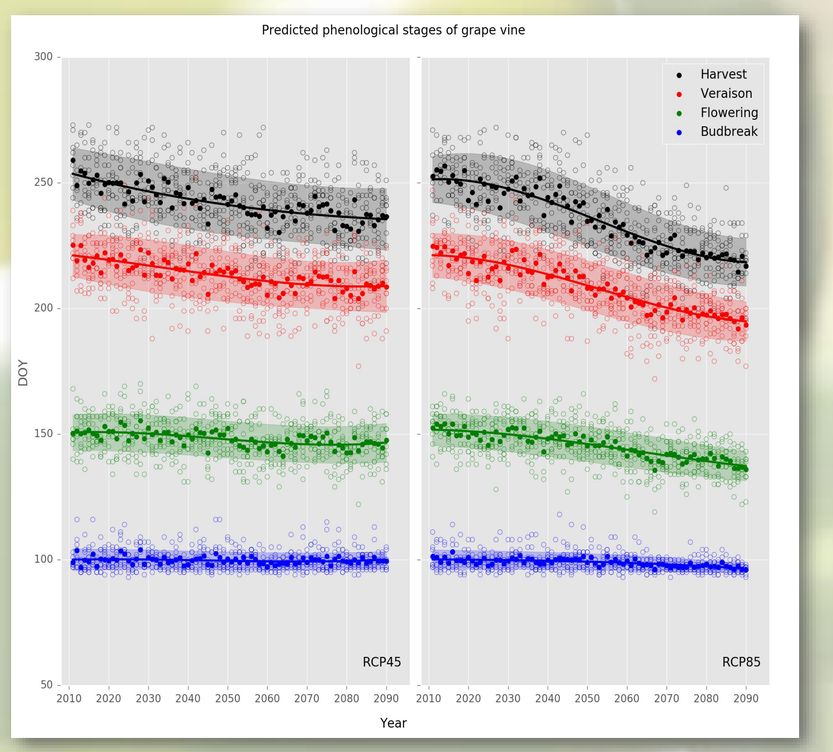

Figure 5. Projected phenological stages of vine. Symbology is the same as Figure 3.

In the surveys and interviews carried out for this case study, 78% of survey respondents were vine growers or wine makers, 17% were agronomists, and 5% were academics.