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Investigating the drivers for crop yield changes during heatwaves and droughts

Arianna Valmassoi[1], Leonie T. Esters[1], Petra Friederichs[1], and Jan D. Keller[2]
[1]University of Bonn, Geophysics, Meteorology, Bonn, Germany (avalmass@uni-bonn.de)
[2]Deutscher Wetterdienst, Offenbach, Germany

The relationship between plant yield, food production, and climate conditions is becoming crucial, especially when climate extremes are considered.
Atmospheric numerical models and reanalyses generate valuable weather and climate information. They have been evaluated and used in the past to assess extreme climate events representation. However, they can also be used to force models from other research fields, such as plant production model used in agriculture. This approach allows to create scenarios and/or ensembles to assess the compound uncertainty deriving from the climatic and plant production aspect, especially under hydrometeorological extremes such as heatwaves and droughts.

In this work, we assess the response of the plant yield computed using the AquaCrop model to a prolonged heatwave and drought condition. We focus on the Po Valley, norther Italy, for the summer 2015 period due to its high dependency of irrigation.
The two atmospheric products used are a set of free simulations at 3km resolution using the Weather Research and Forecasting (WRF-ARW) model, which are used as scenarios for the irrigation water requirements, and the 6-km COSMO-REA6 reanalysis, which provides the best reference dataset within the atmospheric reanalyses. The AquaCrop model is forced only with the cropland gridpoints in the Po Valley, and we test the sensitivity of the crop model to parameters such as initial soil moisture, irrigation management, soil, and crop type. Further, we are going to investigate the relationship between plant state and CO_2, by using in-situ observations.

Preliminary results show that for wheat, the yield response depends on the meteorological input data, the COSMO-REA6 yields are higher than the ones obtained with WRF-ARW, and the clay content in the soil. Further, classical and machine learning clustering techniques in parameter space are used to understand the dependency of the yield.