

Investigating the effect of climatic extremes on wheat yield in the Mediterranean countries

Mustapha El-Maayar, Panos Hadjinicolaou and Manfred A. Lange
Energy, Environment and Water Research Center, The Cyprus Institute, Nicosia, Cyprus
p.hadjinicolaou@cyi.ac.cy

Unravelling the effect of climate change on crop yield represents one of the most challenging current scientific issues; particularly because of its direct relevance to food security and human well-being. An issue that becomes even more challenging in regions where important crops grow at already sub-optimal conditions and are projected to face substantial future changes in climate conditions, such as the case of the Mediterranean basin. Numerous studies have already attempted to tackle this problematic, through statistical and crop model simulation analyses. While these studies have mostly investigated the response of crop yield to changes in average climatic conditions, there is growing evidences that acquiring knowledge about the response of crop yield to climatic extremes is essential to reduce uncertainties in previous future projections.

Using a combination of modelling and statistical analyses, our study investigates the effects of temperature and dry spell extremes on yield of the most important crop grown in the Mediterranean region, namely wheat crop. To this end, our approach consisted of, firstly, using records of wheat yield and daily mean, minimum, maximum temperature and precipitation between 1961 and 2010 in seventeen countries of the Mediterranean basin to examine the relationship between crop yield and climate conditions during years where yield deviates significantly from average. This part of the study allowed us to derive a relationship between yield and extreme climate events in each of the studied countries. Secondly, climate change scenarios, using daily outputs of regional climate model simulations at 25kmx25km resolution, were used to simulate wheat crop cycle evolution between years 2010 and 2100, to examine potential changes in the frequency of occurrence of extreme climatic events during key phenological stages of wheat, and to infer an estimate of the magnitude of wheat yield response to climatic extremes in this part of the world using the previously obtained relationship between wheat yield and climatic extremes for the 1960-2010 period.

Our analyses revealed two main results:

- The magnitude of the response of wheat yield to temperature and dry spell extremes varies substantially across the Mediterranean basin.
- Wheat yield response to climatic extremes is likely to be more dramatic in the southern countries of the basin.