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Recent changes in the probability of agrometeorological risks over the southern Mediterranean region, and potential impacts on crop growth

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Climate change, as one of the most significant challenges that humans currently face, is defined as a shift in climate patterns in response to increasing greenhouse gas emissions in the atmosphere. Notably, climate change has been associated with global warming temperature, regional changes in rainfall patterns and extreme events. Such changes in climate are emerging at a time of rapid growth for many economies in the southern Mediterranean region, stressing the need to understand their impacts on sectors better. In addition, unlike other regions, very little research has been undertaken to understand how climate has changed (and will change) over the area and how such changes may affect the agricultural sector. Here, using trend analysis and the non-stationary generalized extreme value (GEV) model, we examine whether the probability of extreme agrometeorological risks has changed over the last 60 years in response to the globally warming temperature. We then quantify the magnitude of such changes over different phenological stages for wheat, maize and rice, highlighting the most vulnerable areas to extreme conditions in the southern Mediterranean region. Extreme agrometeorological risks are estimated using multiple state-of-the-art observational and reanalyzed daily datasets (REGEN, BERKELEY, CHIRPS, ERA5 and ERA5-land), and using multiple drought indices (standardized precipitation-evapotranspiration index [SPEI], standardized antecedent precipitation-evapotranspiration index [SAPEI], frequency and duration of dry spells) and heat stress indices (wet-bulb globe temperature [WBGT], effective temperature, discomfort index, heat index, frequency and duration of hot and cold spells). As such, this study, identifying areas in which crop growth and productivity are becoming particularly threatened by the increasing frequency and duration of extremes, provides vital evidence for climate change adaptation and mitigation plans in the southern Mediterranean region.

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