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Trends of crop daily water requirements driven by 50-years global hydro-climatic data

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The impact of climate forcings on the agricultural water demand is a key issue for a globalized food secure world. Most of the withdrawn freshwater is globally consumed by agriculture and assessing how climate variability affect the crop irrigation requirements is essential for effective irrigation policies and large-scale water management. Moreover, given that rainfed agriculture provides 60% of total food production and it is highly dependent on meteorological factors, the assessment of climate-driven changes of crop water requirements and water stress periods is very important to highlight potential impacts on the global food security.

This study deals with the spatio-temporal changes of crop water requirements over 50 years, considering 26 main agricultural products. A comprehensive model for the assessment of daily crop water requirement has been used, based on a soil water balance and considering both rainfed and irrigated scenarios. The analysis exploits the potential of the ERA5 reanalysis dataset from the Climate Change Service of the Copernicus Programme, providing hydro-climatic variables over a multi-decade period. The study analyses the variability of water requirement induced by climate variability and the consequent periods of water stress and irrigation volumes per unit harvested areas.

Results show the evolution of water requirement from 1970 to 2019, enabling the analysis of trends in stressed periods over rainfed areas and of changes in irrigation requirements over lands equipped for irrigation. Significant increases of water stress have been found in almost 40% of global rainfed areas, and 62% of irrigated lands require more irrigation comparing the 1970s and 2010s decades. The irrigation requirement has been estimated per crop, pointing out significant increases through the years and comparing the length of dry periods with the precipitation availability during the growing seasons. A global assessment of crop requirement changes can support policies of water management in different areas of the world, considering also the effects of climate change in the densely harvested areas of the world.