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Spatio-temporal variability of global crop water requirement, during 1950-2020

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Intensification of studies of the agricultural water requirement is a main challenge in a globalized world, where food production is pushed to meet the needs of a growing population and the international trade network requires large-scale planning policies. Agriculture is the human activity that consumes most of the withdrawn freshwater and climate change can greatly influence the amount of irrigation required by crops. In recent years, the widespread availability of satellite images is providing an important contribution to water resources management, offering data at high spatio-temporal resolution over an interestingly long period of time.

This study deals with the temporal variability of global water requirement of the main crops, which is assessed through a comprehensive model, driven by climate forcings, that estimates the daily crop water requirement on a spatial resolution of 5 arc-min (or 0.0833°) from 1950 to 2020. The model computes a soil water balance using daily input data of precipitation and evapotranspiration, based on the high-resolution ERA5 reanalysis dataset from the Climate Change Service of the Copernicus Program, which combines satellite information and ground measurements. The distribution of harvested areas and the length of crop development phases are kept constant, to analyze the variability of crop water requirement strictly related to climate forcings, both in terms of precipitation (green water) and irrigation (blue water). The model considers the separation between irrigated and rainfed areas, in order to provide a consistent spatial distribution of irrigation requirements. Examining the spatio-temporal variability of the crop water requirement can support considerations on the effects of global warming in different areas in the world.