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Temporal variability of green and blue water footprint worldwide

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Water footprint assessment is becoming widely used in the scientific literature and it is proving useful in a number of multidisciplinary contexts. Given this increasing popularity, measures of green and blue water footprint (or virtual water content, VWC) require evaluations of uncertainty and variability to quantify the reliability of proposed analyses. As of today, no studies are known to assess the temporal variability of crop VWC at the global scale; the present contribution aims at filling this gap.
We use a global high-resolution distributed model to compute the VWC of staple crops (wheat and maize), basing on the soil water balance, forced by hydroclimatic imputs, and on the total crop evapotranspiration in multiple growing seasons. Crop actual yield is estimated using country-based yield data, adjusted to account for spatial variability, allowing for the analysis of the different role played by climatic and management factors in the definition of crop yield. The model is then run using hydroclimatic data, i.e. precipitation and potential evapotranspiration, for the period 1961-2013 as taken from the CRU database (CRU TS v. 3.23) and using the corresponding country-based yield data from FAOSTAT. Results provide the time series of total evapotranspiration, actual yield and VWC, with separation between green and blue VWC, and the overall volume of water used for crop production, both at the cell scale (5x5 arc-min) and aggregated at the country scale. Preliminary results indicate that total (green+blue) VWC is, in general, weekly dependent on hydroclimatic forcings if water for irrigation is unlimited, because irrigated agriculture allows to compensate temporary water shortage. Conversely, most part of the VWC variability is found to be determined by the temporal evolution of crop yield. At the country scale, the total water used by countries for agricultural production has seen a limited change in time, but the marked increase in the water-use efficiency expressed by VWC has determined an increase of production. Such increase has helped to meet the increasing global food demand in the past 50 years.