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Modeling Interactions between Water Footprints, Agricultural Management and Land Use Change in Brazil

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Meeting the demand for water and land for food, feed and bioenergy is one of the main future global challenges. Green water alone amounts to 84% of the water footprint of food production, and over 60% of global food supply is produced on rain-fed lands. Appropriation of green water is intimately linked to land use, and use of green water for agriculture competes with use for ecosystems and other purposes. The level of detail in water footprint assessments has recently undergone strong improvements, and as a result, these have enabled better policy decisions, as well as more transparency in supply chains. Brazil is a main global exporter of agricultural commodities and virtual water, and as land and water resources become relatively scarcer globally, dependency on Brazilian exports is set to increase. Despite this, few attempts have been made to estimate green and blue water footprints with high resolution for Brazil on a national scale. This study aims to contribute to this development by estimating changes water footprints for food production in Brazil, improving upon current approaches through updated biophysical input data, higher spatial-explicitness, and partitioning of different drivers of changes in water footprints. This is carried out by employing recent biophysical and management data to model crop water requirements in Brazil between 1992 and 2015 for the country's six most representative crops. The water footprints are estimated with the use of the EPIC (Environmental Policy Integrated Climate) model, with updated inputs of soil properties, climate, land cover, water use and agricultural management at a 1 km resolution, and was run for approximately 250 thousand simulation units. The model was validated for different management practices and crop calendar scenarios. The comparison between the simulated and statistical yields suggests a satisfactory performance of the EPIC model, and the validation of the blue water requirements shows the reliability of the estimation of water footprints in irrigated cropland. The results were analyzed not only in terms of the average water footprint during the study period, but also through the analysis of the temporal trends and yield vs water footprint curves. In accordance to previous studies, the results show a dominance of green water as the main resource for food production. The analysis of temporal trends also points to the importance of management practices in changes water productivity, as well as land use change as a major driver of changes in green water footprints.