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PEPIC – understanding the impacts of different PET methods on simulating global crop-water relations of maize

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Abstract: Previous research investigating the impacts of different potential evapotranspiration (PET) estimation methods on crop modelling have mostly been conducted at the field level or regional scale. These investigations have focused on either yields or crop water use. A comprehensive assessment of impacts of different PET methods on crop-water relations has been absent on a global scale. Here, PEPIC, a grid-based EPIC (Environmental Policy Integrated Climate) model within a Python environment, was developed to enhance our understanding of such impacts on global crop-water relations of maize at a spatial resolution of 30 arc minutes. The estimated national yields match well with the reported yields especially by using the Penman-Monteith estimation method, indicating the robustness of the PEPIC model on representing global yield patterns. Results show that the estimated PET varies largely among different PET methods in the same climate zones. Variations of crop water use (CWU) estimates and irrigation water requirements caused by the PET method were greater than the effect of the PET method on crop yield. Water availability plays an important role in such uncertainties. There were low variations for irrigated yields and rainfed CWU in the regions with limited rainfall, but the variations for irrigated CWU and rainfed CWU in the regions with sufficient rainfall were quite high. This study highlights the significance of considering the uncertainties derived from different PET estimation methods for investigating crop-water relations.

Keywords: PEPIC; PET; maize; crop-water relations; global modelling.