IAHS2017-216
IAHS Scientific Assembly 2017
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Uncertainties of PET estimation methods in simulating crop-water relations

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Estimation of potential evapotranspiration (PET) is basis for investigating crop-water relations. However, a comprehensive assessment of the uncertainties of different PET estimation methods on simulating such relations has been absent on a global scale. Here, a large-scale crop model PEPIC, i.e. Python-based Environmental Policy Integrated Climate, was used to simulate global crop-water relations at a spatial resolution of 0.5-degree. Global maize cultivation was selected as a case study. Results show that the simulated yields by the PEPIC model agree well with the reported yields at the country level, especially by using the Penman-Monteith estimation method. The estimated PET presents large variations by selecting different PET methods, even in the same climate zone. Uncertainties in estimating irrigation water requirements and crop water use (CWU) due to the choices of PET methods are greater than that in estimating crop yields. Water availability, e.g. growing season precipitation and irrigation, plays an important role in such uncertainties. There are high variations for estimating irrigated CWU and rainfed CWU in the regions with sufficient rainfall, however the variations are quite low for simulating irrigated yields and rainfed CWU in the regions with limited rainfall. This study highlights the importance of considering the uncertainties associated with the choice of different PET estimation methods for investigating crop-water relations and projecting the impacts of future climate change.