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Uncertainties in modelling the climate impact of irrigation

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Many issues related to the climate impact of irrigation are addressed in studies that apply a wide range of models. These involve uncertainties related to differences in the model's general structure and parametrizations on the one hand and the need for simplifying assumptions with respect to the representation of irrigation on the other hand. To address these uncertainties, we used the Max Planck Institute for Meteorology's Earth System model into which a simple irrigation scheme was implemented. In several simulations, we varied certain irrigation characteristics to estimate the resulting variations in irrigation's climate impact and found a large sensitivity with respect to the irrigation effectiveness. Here, the assumed effectiveness of the scheme is a combination of the target soil moisture and the degree to which water losses are accounted for. In general, the simulated impact of irrigation on the state of the land surface and the atmosphere is more than three times larger when assuming a low irrigation effectiveness compared to a high effectiveness. In an additional set of simulations, we varied certain aspects of the model's general structure, namely the land-surface–atmosphere coupling, to estimate the related uncertainties. Here we compared the impact of irrigation between simulations using a parameter aggregation, a simple flux aggregation scheme and a coupling scheme that also accounts for spatial heterogeneity within the lowest layers of the atmosphere. It was found that changes in the land-surface–atmosphere coupling do not only affect the magnitude of climate impacts but they can even affect the direction of the impacts.