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Water constraints on future food supply: An integrated analysis of water resources for agriculture

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To feed the future population, global food and feed production needs to more than double by the end of the century. It is commonly recognized that increased crop production will use more water and that pressure on water resources is increasing. Still, most assessments of future agriculture implicitly assume that all irrigation water will be available, which might not be the case.
We apply the global hydrology and vegetation model LPJmL to study the relationship between future water availability and crop production. The model is run in combination with socio-economic and land use change scenarios from agricultural outlooks. Possible impacts of climate change are addressed by forcing the model with bias-corrected output of different earth system models. Future water needs for irrigation as well as water availability from different water sources are quantified at a 0.5 degree grid. Subsequently, we calculate where required crop production might not be realised because of a shortage in irrigation water.
We estimate that approximately 25% of the global irrigation water demand in 2100 cannot be met, resulting in a loss of global (irrigated) crop production around 400 Mton. Further decreases in irrigation water supply caused by groundwater depletion might lead to even more crop production losses.
Unless many efforts are made to improve water management in both rainfed and irrigated agriculture, water could put a serious constraint on food supply by 2100 due to both higher demands and changes in availability as a result of climate.
Results of this study clearly show the need for explicit consideration of water availability in integrated assessments of the future agriculture, as assuming that irrigation water is always available leads to unrealistic projections of land use and crop production.