EMS Annual Meeting Abstracts
Vol. 15, EMS2018-797, 2018

Irrigation and crop yield scenarios in the Danube river basin using an integrated agro-hydrologic model

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We present irrigation and crop yield scenarios for the Danube river basin simulated with integrated crop-water models. Potential trade-offs between crop yield increases and reductions in downstream water availability, which might be caused by possible future irrigation intensification, are explored via scenario simulations. We couple the crop growth equations of the field-scale agricultural model EPIC with the distributed water resources modelling platform LISFLOOD. The integrated model is designed to represent consistently the interactions between catchment hydrology and key water-demanding sectors (household, industry, energy, livestock and irrigation). The newly embedded crop model simulates biophysical plant development processes, accounting for weather conditions, atmospheric CO_2 concentration, and abiotic stress factors (including soil water deficit and over-saturation, heat and cold stresses, and frost damage). It is coupled with the hydrological model through soil moisture, plant water uptake and freshwater availability for irrigation. Irrigation water may be withdrawn from groundwater, rivers, lakes and reservoirs. Four irrigation application systems are represented: localized, sprinkler, surface, and rice paddy. Additionally, the WOFOST crop model, used for operational crop yield forecasting within the MARS Crop Yield Forecasting SYSTEM (MCYFS), has been combined with LISFLOOD output to assess the effect of irrigation management strategies for MCYFS crop yield and crop water requirements modelling. The results from the two modelling platforms are evaluated by comparing simulated crop yield and irrigation water use with Eurostat and FAO national statistics. Irrigation development scenarios are designed to assess the potential impacts of irrigating currently rainfed cropland and of implementing deficit irrigation strategies. These impacts encompass agricultural productivity, downstream water availability and allocation conflicts with other water demands.