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Impact of EO irrigation on LSM/HMs modelling: comparing water balance and model performance in the Po river basin.

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This study provides a comparison of water balance components and model performance, using the LSM/HMs models: TETIS, mesoscale Hydrologic Model (mHM), PCRaster Global Water Balance (PCR-GLOWBW) and Community Land Model (CLM), between three different experiments. The first one is a calibrated model using EMO1 [1] precipitation as the meteorological forcing, without explicit irrigation representation. The second experiment is a simulation with EO irrigation [2] added to the previous precipitation as a rainfall input. The resulting discharges are adjusted during post-processing stage to account for irrigation abstraction [3] from surface waters. Finally, the calibration of the latter is based on a naturalised discharge dataset, estimated as the sum of observed flow series and irrigation water abstractions [3] at several stations on the Po river. Simulations, calibrations and comparisons are carried out at two spatial scales, 5 km and 1 km, to take into account possible scale effects on the water balance and model performance.

The results show that, using the initial experiment as a baseline, there is an increase in evapotranspiration at both scales due to the additional irrigation. However, the streamflow may fluctuate between the second and first experiments depending on the model employed, with the difference being corrected through calibration in the third experiment. In terms of performance metrics, the Kling-Gupta Efficiency (KGE) decreased, thus the third experiment was conducted to improve the metrics on both scales, besides the representation of basin fluxes and storage.

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[2] J. Dari, L. Brocca, S. Modanesi, C. Massari, A. Tarpanelli, S. Barbetta, R. Quast, M. Vreugdenhil, V. Freeman, A. Barella-Ortiz, P. Quintana-Seguí, D. Bretreger y E. Volden, «Regional data sets of high-resolution (1 and 6 km) irrigation estimates from space,» *Earth System Science Data*, 15-4, pp. 1555–1575, 2023.

[3] Autorità di Bacino del Fiume Po, «Piano del Bilancio Idrico per il Distretto del fiume Po. Bilancio idrico dell'asta del fiume Po,» 2016.