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Evaluation of water productivity under climate change in irrigated areas of the arid northwest China using an assemble statistical downscaling method and an agro-hydrological model

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The Heihe River Basin (HRB) is the second largest inland river basin, located in the arid region of northwest China with a serious water shortage. Evaluation of water productivity will provide scientific implications for agricultural water-saving in irrigated areas of the arid region under climate change. Based on observed meteorological data, 23 GCMs outputs and the ERA-40 reanalysis data, an assemble statistical downscaling model was developed to generate climate change scenarios under RCP2.6, RCP4.5, RCP8.5 respectively, which were then used to drive the SWAP-EPIC model to simulate crop growth in the irrigated areas of the middle HRB for the future period from 2021-2050. Crop yield showed an increasing trend, while crop water consumption decreased gradually in Gaotai and Zhangye irrigated areas. The water productivity in future 30 years showed an increasing trend in both Gaotai and Zhangye areas, with the most significant increase under RCP4.5 scenario which were both larger than 2kg/m3. Compared with that of the period from 2012 to 2015, the water productivity during 2021-205 under three RCP scenarios increased by 9.2%, 14.3% and 11.8% in Gaotai area, and 15.4%, 21.6%, 19.9% in Zhangye area, respectively.