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Demand and Supply of Water for Agriculture: Influence of Topography and Climate in Pre-Alpine, Mesoscale Catchments

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ABSTRACT

With climate change, water may become limited for intensive agriculture even in regions presently considered "water-rich". Information about the potential water requirement and its temporal and spatial variability can help to develop future water management plans. A case study was carried out for Switzerland with its highly complex pre-alpine topography and steep gradients in climate. The hydrological model WaSiM-ETH was used to simulate net irrigation requirement (NIR) for cropland, grassland and orchards using criteria to define irrigation periods based either on the water stress level (expressed by the ratio of actual (*aET*) to potential evapotranspiration ((*pET*) (Method 1) or on thresholds for soil water potential (Method 2). Simulations for selected catchments were carried out with a daily time step for the period 1981-2010 using a 500 × 500 m spatial resolution. Catchment-scale NIR ranged between 0 and 4.3 million m3 and 0 and 7.3 million m^3 for the two methods, respectively, with no trend over the observation period in any catchment. During the heat wave in 2003, NIR increased by a factor of 1.5 to 2.3 relative to the mean, and in catchments where discharge is directly dependent on precipitation, NIR in the summer of 2003 reached the limits of river water availability. In contrast, in a region with water supply from glacier melt water, highest NIR in 2003 still remained far below total river discharge. The results show that NIR varies strongly between years and across the landscape, and even in a presently cool-temperate climate, irrigation may put pressure on regional water resources under extreme climatic conditions that may become more frequent by the end of the 21st century.

KEYWORDS

Agriculture; Irrigation; Climate; Discharge; WaSim-ETH

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