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Evaluating potentials and corresponding risks of optimal deficit irrigation strategies under climate change and other sources of uncertainty

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Abstract In this contribution we introduce a stochastic framework for decision support for optimal planning and operation of water supply in irrigation. This consists of: (i) a weather generator for simulating regional impacts of climate change on the basis of IPCC scenarios; (ii) a tailor-made evolutionary optimization algorithm for optimal irrigation scheduling with limited water supply; (iii) a mechanistic model for simulating water transport and crop growth in a sound manner; and (iv) a kernel density estimator for estimating stochastic productivity, profit and demand functions by a nonparametric method. As a result of several simulation/optimization runs within the framework, we present stochastic crop–water production functions (SCWPF) for different crops, which can be used as a basic tool for assessing the impact of climate variability on the risk for the potential yield or, furthermore, for generating maps of uncertainty of yield for specific crops and specific agricultural areas. In addition, micro-economic impacts of climate change and the vulnerability of the agro-ecological systems are discussed. Finally, we show how additional sources of uncertainty (e.g. soil conditions and management) can be included in the new stochastic framework.

Key words deficit irrigation; crop–water production function; optimal scheduling; risk assessment; climate uncertainty; climate change