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Simulating the effects of climate change on water provision for agriculture

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Spanish Pyrenean headwater catchments constitute main source of water for the dry and large Ebro basin (Spain). The Gallego-Cinca rivers system provide water to the Riegos del Alto Aragón (RAA) irrigation district which with a total irrigated area of 127,210 ha is currently the largest irrigated area in Spain and in the European Union. The system is already close to its average resource limit and some supply restrictions took place in the last years. Water provision from headwater catchments and agricultural demands are expected to be altered in different ways by climate change. Under this uncertainty situation of change a multi-model multi-scenario methodology was implemented to assess multiple combinations of climate change adaptation strategies in the RAA irrigation district. Adaptation strategies, or measures, were tested against an ensemble of regional climate datasets by linking a hydrologic and a water allocation model. The Soil and Water Assessment Tool (SWAT) was used to simulate water provisions from the Gallego-Cinca headwater system under the collection of regional climate dataset. Afterwards, SWAT outputs were fed into a water allocation model built with AQUATOOL to simulate the management of the system's reservoirs and the water supply to the different demands. The combination of strategies includes various measures oriented to enhance adaptation to climate change of the system (e.g. additional storage, irrigation modernisation, or crops adaptation), that take different intensities reflecting different aspects of the two models used in the simulation process. The performance of adaptation strategies under a large number of scenarios allows incorporating the inherent uncertainty of climate change into the decision making process. The comparison between the performance of the assessments, as well as the trade-offs between different alternatives, provide guidance to decision makers about which adaptation options are more robust under this highly uncertain future. This makes possible to find alternatives that perform satisfactorily over a larger number of situations instead of optimally within a single or a few scenarios. Additionally, this process has the potential to provide a better understanding of the system's dynamics under climatic change.