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Analysis of Climate Change Impacts on Water Resources in an Irrigation District in Northern Italy

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This work presents the results of an explorative modelling study on the impacts of climate change on the water resources of a large irrigation district in the Padana Plain (Northern Italy), the Muzza-Bassa Lodigiana district (about 700 km^2).

A distributed, integrated surface water - groundwater simulation system was implemented and applied to the study area. The system couples the groundwater model MODFLOW (McDonald e Harbaugh, 1988) with the conceptual vadose zone model ALHyMUS (Facchi *et al.*, 2004), in which a new module to simulate the effects of temperature on crop phenology was included. A GIS manages all the information relevant to the study area, as well as all the input, the spatially distributed parameters and the output of the system. The simulation package has been verified for the years 1999-2000 using the available data on water stage in rivers as well as groundwater level in alluvial aquifer system.

The climate series (period 1961 - 1990) collected in the study area was considered as baseline scenario. This local information, combined through a statistical procedure with predictions by the Regional Circulation Model (RCM) HadRM3, developed by the Hadley Centre for Climate (UK), was used to build the climate change scenarios for the period 2071-2100 (referred as 2080s). In particular, the climate change scenarios based on the greenhouse gas emissions scenarios A2 (medium-high emissions) and B2 (medium-low emissions) (IPCC, 2000) were taken into account. To derive climate change scenarios for intervening time periods (the 2020s or 2050s) a pattern-scaling procedure was used (Hulme et al., 2002).

For all the scenarios the simulated climate series show an increase in temperature and a significant alteration of the precipitation pattern (in the direction of wetter au-

tumns/winters and drier summers). Crop water requirement and, therefore, irrigation demand, increase in comparison with the baseline scenario, reaching a significant amount earlier in the irrigation season (as a consequence of the advanced seeding time and speeding of crop phenology induced by the increased temperature). Simulation results show that, keeping the current irrigation supply, the water deficit may become significant and is uniformly distributed over the whole irrigation season.