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Analysis of economic impacts of climate change on agricultural water management in Europe

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This contribution presents an analysis of impacts of climate change on agricultural water management in Europe. The analysis of climate change impacts on agriculture is composed of two main categories: rainfed agriculture and irrigated agriculture. Impacts on rainfed agriculture are mostly conditioned by climatic factors and were evaluated through the estimation of changes in agricultural productivity induced by climatic changes using the SARA model. At each site, process-based crop responses to climate and management are simulated by using the DSSAT crop models for cereals (wheat and rice), coarse grains (maize) and leguminous (soybeans). Changes in the rest of the crops are derived from analogies to these main crops. For each of the sites we conducted a sensitivity analysis to environmental variables (temperature, precipitation and CO_2 levels) and management variables (planting date, nitrogen and irrigation applications) to obtain a database of crop responses. The resulting site output was used to define statistical models of yield response for each site which were used to obtain estimates of changes in agricultural productivity of representative production systems in European agro-climatic regions. Impacts on irrigated agriculture are mostly conditioned by water availability and were evaluated through the estimation of changes in water availability using the WAAPA model, which simulates the operation of a water resources system to maximize water availability. Basic components of WAAPA are inflows, reservoirs and demands. These components are linked to nodes of the river network. WAAPA allows the simulation of reservoir operation and the computation of supply to demands from a system of reservoirs accounting for ecological flows and evaporation losses. WAAPA model was used to estimate maximum potential water availability in the European river network applying gross volume reliability as performance criterion. Impacts on agricultural production are also dependent on changes in management practices due to adaptation or land use changes. These have been estimated through a socio-economic model that accounts for the evolution of population, GDP, agricultural land use and other relevant socio-economic variables linked to climate change adaptation. The combination of the results of the SARA model, the WAAPA model and the socioeconomic model allow the estimation of total economic value of agricultural production in terms of fraction of GDP.