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Assessment of agricultural water demand using SIMETAW

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In most arid regions, irrigation uses the majority of the developed water resource, and water scarcity and the misuse of water resources is a threat to sustainability. Since agricultural production is vulnerable to weather conditions, future climate change may lead to water shortages and reduced yield. Efficient water resource management can help to match available resources and agricultural needs, thereby reducing the risks for crops during periods of drought. Knowing the agricultural demand for water is, therefore, an important factor for developing infrastructure and for managing the distribution of water. Sardinia was selected as one of the five case studies included in the WASSERMed European project to improve water resources planning in response to climate change. The aim of the research was to assess agricultural water demand for North Sardinia using evapotranspiration (ET) and a daily water balance using information on the crop, soil, management, and climate data. The water balance was determined using the Simulation of ET of Applied Water (SIMETAW) model, which was developed by the University of California, Davis. The model estimates the ET of applied water (ETaw), which is the amount of irrigation water needed to produce a crop assuming minimal water stress and 100% application efficiency. Dividing the ETaw by an estimate of the application efficiency provides an estimate of how much water needs to be diverted or pumped to irrigate a crop. The SIMETAW model can use either observed daily climate data or daily data that are simulated from monthly data using a weather generator. Because the model simulates daily from monthly data, it is easy to input monthly mean data from downscaled climate projection models to determine the possible effects of climate change on water demand. ETaw is determined by first computing reference evapotranspiration using the daily standardized Penman-Monteith equation and observed or simulated daily data. SIMETAW has the ability to change the canopy resistance in response to CO_2 concentration, and the simulation allows it to adjust the ETo estimates for climate change. Crop evapotranspiration is estimated as ETc = ETo x Kc, where Kc is a crop coefficient to adjust for the difference between ETo and ETc. SIMETAW uses input soil, crop, and irrigation management information with precipitation and ETc data to perform a daily water balance and to determine ETaw by irrigating when the soil water depletion reaches a management allowable depletion. This is repeated for all soil and crop combinations within a region having similar ETo rates, so the SIMETAW program is run separately for each ETo region. In Sardinian, the average of ETo was computed for all available climate stations, and the data were used to create a regional ETo map using ArcGIS 9.3 software. Then, SIMETAW was used to estimate ETaw by all crop and soil combinations within each ETo regions using observed and downscaled climate projections. The SIMETAW output and GIS were linked to obtain maps of evapotranspiration for the main crops. The results of the analyses will be discussed.