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From weather forcing to economic losses: an integrated climate service for long term projections on water availability.

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Long term projections suggest the Mediterranean area as a hotspot for increasing drought and extreme heat events with remarkable cascading effects on several economic sectors, such as agriculture, energy production, urban uses and on ecosystem services. The adoption of climate services designed to aid near real time operational choices, including seasonal forecasts, could help in better planning the use of a scarce resource, as water, both at the local (e.g., farm) and the basin level.

These short-term tools may have positive feedback also in a longer run. The PRIMA Project ACQUAOUNT (https://www.acquaount.eu/) aims to produce climate services to support robust decision making for water resource allocation at an operational time scale, and an off-line tool to evaluate how the adoption of such tools together with innovative management policies will affect water availability in a longer perspective. It will integrate the hydrological, climatological, and economic dimensions to provide information on long term sustainability of water availability to decision makers and water users in four pilot sites, namely the Tirso basin (Sardinia), Zarqa river basin (Jordan), Jeffara basin (Tunisia), and Upper Litani River basin (Lebanon). They are characterized by remarkable differences in terms of water availability, water sources, users, and management options; thus, the off-line tool will combine users' needs and a simplified framework to be applied both in information rich and scarce contexts.

The tool is forced by weather observations available in-situ (where available) and complemented/replaced by authoritative data sources freely available (e.g., Copernicus Regional Reanalysis, CERRA); over the future time horizons up to 2100, an ensemble of global climate projections is adopted, which included in 6th Coupled Model Intercomparison Project (CMIP6) informing the most update cycle of IPCC Assessment Reports. The main weather outputs regulating soil water budget are statistically downscaled by exploiting a non-parametric quantile mapping approach calibrated by using CERRA reanalysis under two concentration scenarios (Shared Socio-Economic Pathway, SSP): SSP2_4.5 and SSP5_8.5, a "mid-way" and "pessimistic"

scenario, respectively.

Finally, the physical effects, (i.e., water anomalies), are translated into economic terms using a simplified avoided losses approach, evaluating changes in co-designed indicators for water uses according to different scenarios. Future water availability is compared with a management rule for water provisioning, such that there will be a connection between physical water availability and restrictions that affect the amount of water available for different uses in the pilot site. Finally, water restrictions impact the economic, social, and environmental performance of selected sectors. Primarily, the socio-economic part will assess changes in economic, social, and environmental indicators to evaluate and compare costs in each scenario.

The final aim of the integrated service is to compare alternative future pathways of water availability. These pathways are co-developed with local stakeholders and include a *status quo* scenario, where current management rules for water distribution are supposed, an *ACQUAOUNT integrated* scenario, where the water resource is supposed to be deployed using the AQUAOUNT short term tools, and site-specific scenarios e.g. inclusion of new management rules or new water sources.