# Eco-hydrological modeling using field-based and Earth Observations to assess water use efficiency and support agricultural water resources management

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The objective of this NASA project is to develop an integrated modeling platform using Earth Observations to simulate large-scale hydrological processes and food production in support of water use decision and agricultural policy. The decision tool will provide timely and relevant assessments of crop growth, agricultural water use and available water supply from local to regional scales, with the capability to predict the impact of different climate and water resources management scenarios on food production. The approach is based on the use of field and Earth observations to calibrate an eco-hydrological model, and climate simulations to forecast crop condition and yield through the crop season. The expected primary outcomes and results for stakeholders is potential best water management practices to improve water use efficiency and prevent excessive losses of water and nitrogen to the environment. These will be provided to in-country end-users within various relevant Ministries and Departments, in order to inform regional and national decisions. Changing precipitation patterns, droughts of increasing duration and severity and growing demand for food have significant implications on water management practices, spurring an increased need for irrigation in a sustainable manner and better monitoring of water resources for the agricultural sector in general. Understanding the context and water resource constraints that stakeholders and smallholder farmers face in climate sensitive regions is critical to target and understand the potential impact of water use management. We focus on a diverse set of regional pilot cases in Argentina, South Africa, Tanzania and the United States that are representative of a range of agricultural systems, water issues and climate impacts. The application is integrated in the GEOGLAM project, an existing widely-used web-based platform which will aid synthesizing the project outcomes and expert domain knowledge to provide timely and actionable water resources and crop condition information to assist local, regional and national water management decisions. At the end, the application will be interactive and will offer the end-user organizations the possibility to submit new water resource management scenarios online for impact evaluation.

Earth Observations are critical to characterize and monitor the different components of agricultural ecosystems and change (forests, croplands and marginal lands availability, for example) across temporal and spatial scales. Satellite data in the shortwave, thermal infrared and microwave spectral domains from US (MODIS, VIIRS, Landsat, SMAP) and European (Sentinel 1 and 2) sensors will be used to characterize changes in land surfaces and water use from 2000 to the present in support of agricultural planning decisions. In a research context, the potential of new satellite missions (i.e., ECOSTRESS, SWOT and SAOACOM) to derive surface hydrology information will be evaluated. The Agricultural Policy/Environmental eXtender (APEX) watershed model is proposed as the modeling tool to understand the biophysical and human-decision processes associated with the food-energy-water nexus. Model simulations will use climate data from the NASA Goddard Earth Observing System Model (GEOS-5) Atmosphere-Ocean General Circulation Model: MERRA-2 for simulation of past conditions and seasonal (6-month) forecasts for projections in the future. The study focus on large, key agricultural regions where agricultural ecosystems are vulnerable to demographic expansion and/or climate variability and change including drought and flood events.

 

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