Federal Ministry of Education and Research

FONA
Sustainable Water Management

# OUTLAST—Development of an Operational, Multi-sectoral, Global Drought Hazard Forecasting System

## Water as a Global Resource (GRoW)

**Droughts are a global problem and affect water supply, agriculture, and ecosystems on land and in water. Is it possible to forecast droughts over periods of several months? How reliable are such forecasts? The OUTLAST joint research project aims to answer these questions. It will develop and test a model system that provides monthly drought forecasts covering a six months period for all land areas on Earth. The value of such forecasts for reducing drought impacts will be optimized by regional project partners in data-poor regions of Africa and Asia. It is planned to implement an operational prototype of the forecasting system in cooperation with the World Meteorological Organization (WMO).**

### Improved Protection Against Drought Impacts Needed

Droughts exceed all other natural hazards in terms of number of people affected, with a large variety of negative impacts. For example, they can lead to shortages in water supply for human consumption, industry and agriculture. Falling water levels can restrict inland navigation and the supply of cooling water to power plants. Natural ecosystems are also threatened by drying out soils and decreasing groundwater levels.

A range of adaptation measures are being taken to limit the effects of drought: these include reservoirs and canals, the pumping of groundwater and the irrigation of agricultural crops. However, the capacity of this infrastructure is limited and only partially protects the affected sectors.

Regulations and laws govern water abstraction and distribution. They are designed to prevent overuse and damage to natural ecosystems. A major problem, however, is the uncertainty about how the water situation will develop in the coming months. Up to now, drought management has been largely based on experience gained in dealing with historical droughts. Common drought forecasting systems are mostly limited to describing the current status. Active drought management, however, requires information on the possible further course of a drought over a relevant period of time, usually several months. The aim of the joint project OUTLAST is to provide global seasonal drought forecasts for water supply, riverine ecosystems, non-agricultural terrestrial ecosystems, rainfed agriculture and irrigated agriculture.

Irrigation (here in rice cultivation in Ticino, Switzerland) protects plants from drought as long as sufficient water is available

### Active Drought Management

To this end, the OUTLAST project partners are developing a model system consisting of the global hydrological model WaterGAP and the Global Crop Water Model (GCWM). The models are driven by seasonal hydrometeorological forecasts that have been corrected for bias. The differences between the individual hydrometeorological forecasts are also transferred to the drought risk indicators calculated by the models and thus allow an estimation of uncertainties. The researchers examine the forecast quality of the models by comparing them with historical forecasts and with measured values. Thus, differences in forecast quality between regions, sectors, indicators and seasons can be systematically identified.

The choice of indicators to be modelled, as well as the way in which information is provided, will be jointly determined with regional pilot users in East Africa and West Asia. They will also help to validate the predicative quality for drought management in their region.

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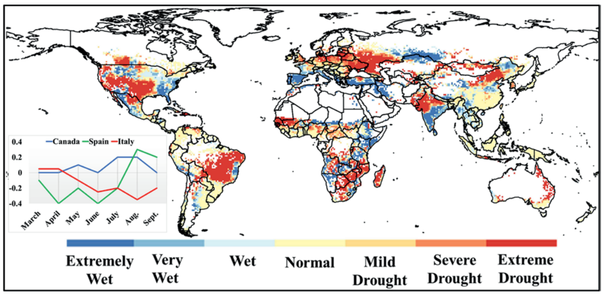
## Trial Run

During the last six months of the project, the OUTLAST drought forecasting system will be tested at the International Center for Water Resources and Global Change (ICWRGC) in Koblenz. This will provide experience for an operational use of the system. The researchers will also develop a manual for setting up and operating the system. A flexible implementation as a cloud solution will ensure that the forecasting system can be used at different locations.

With the new drought forecasting system, the project participants aim to generate monthly forecasts, each covering the next six months period. The processed results will be visualized and described in the HydroSOS portal of the World Meteorological Organization (WMO). The results will be also available as open source geodata for further use.




The currently developed system will provide multisectoral drought forecasts in high spatial and temporal resolution

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# SPS-Blue Nile—Development and Transfer of a Seamless Prediction System for Decision Support in Transboundary Water Management of the Blue Nile

## Water as a Global Resource (GRoW)

**The Nile and its tributaries are the most important source of water for 400 million people in eleven riparian countries. The largest tributary, accounting for about 60 percent of the total runoff and 75 percent of the sediment, is the Blue Nile in Ethiopia and Sudan. How much water will the Blue Nile bring to these regions in the future? What can be done to better manage irrigated agriculture and water reservoirs, in particular the new Grand Ethiopian Renaissance Dam? German, Sudanese and Ethiopian participants in the joint project SPS-Blue Nile aim to develop a meteorological-hydrological forecasting system for the transboundary water management of the Blue Nile. The goal is to create a "seamless" approach with interconnected forecast horizons ranging from days to several months. This will enable a comprehensive, transboundary assessment and derivation of recommended actions within the water-food-energy nexus.**

### Loking into the Near and More Distant Future

Extreme events such as heat waves and droughts, but also heavy rainfall, have been increasing worldwide. Despite their uncertainties, forecasts with horizons of several months are therefore becoming ever more important. They can be used, for example, to develop strategies on how to adapt to climate change and mitigate its effects. A forecast horizon of up to seven months in advance is particularly valuable with regard to upcoming droughts or heat episodes. Heavy rainfall events, however, need to be predicted on shorter time scales and with higher spatial and temporal precision.

To initiate measures against a variety of extreme events at an early stage, it is required to combine seasonal forecasts covering several months with those of shorter horizons from two to six weeks in advance. Within the joint project SPS-Blue Nile, participants from science, politics and water management are therefore developing methods to integrate information from different forecasting horizons into a consistent, seamless prediction system (SPS).

Water management in Sudan: the Upper Atbara Dam

### Predictive Dam Management

The forecasting system provides precipitation and temperature information that allows estimating future water availability for predictive dam management. However, a key problem in dam operation is the progressive sedimentation of the reservoirs: heavy precipitation or large-scale flooding release large amounts of sediments that eventually settle in the reservoirs and severely limit their operation and lifetime. Thus, the project partners do not only integrate inflow into the reservoir, they also include information on sediment transport and deposition into the seamless climate-hydrological prediction system. In addition, expected crop yields are taken into account for further recommended actions.

In order to guarantee the long-term benefits of such a system, it is essential that the modules developed can be easily transferred to different computer infrastructures. Consequently, the project consortium devises cloud-ready methods in all model phases and uses interfaces that allow remote access. This enables simple data and system transfer to local and business partners at a later stage.

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## Transboundary Collaboration

Given the importance of the Blue Nile, it is vital that the Grand Ethiopian Renaissance Dam, Africa's largest hydropower plant, is operated jointly with the downstream countries of Sudan and Egypt. Particularly during extreme events such as prolonged droughts, concerted, transboundary and sustainable water management is required to ensure sufficient water resources for power generation, water supply and downstream irrigation. Tensions related to the dam are exacerbated partly by problems with shared data. Hence, the results of the SPS prediction system need to be communicated in a transparent manner, and transboundary cooperation should also be promoted.

The project closely involves local partners from Ethiopia and Sudan. Regular workshops and training courses online and in the target region as well as the exchange of PhD students ensure co-development of the SPS Blue Nile prediction system. Researchers share their methods and information and carry out joint research activities. A close involment of participants in politics and water management in both countries allows for a transfer of results into practice and thus a sustainable implementation of the developed methods beyond project completion.

Close exchange of all project participants on site

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