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# URBAN WATER SUPPLY SYSTEMS

New water quality forecast approaches by IMPREX enhance the operational efficiency of water treatment plants and help reduce freshwater resources' vulnerability to hydro-climatic extremes.

Billions of cubic meters of freshwater are used in Europe every day for drinking purposes, but also for irrigation, manufacturing, heating, cooling and in service sectors such as tourism. Research shows that urban water supply is susceptible to weather extremes such as droughts and floods, particularly in southern Europe. This vulnerability puts a huge strain on Europe's water supplies and quality, challenging treatment capacity, drinking water safety and supply reliability. Especially droughts frequently pose mayor threats to human health, as water quality can drop significantly even during short drought events.

## IMPREX developed operational methods to ensure optimal control of drinking water quality

Within IMPREX, various innovative services have been developed, including predictive water quality models, a methodology for linking meteorological and climate information to water quality models, and new treatment techniques to control water quality risks. The aim is to improve the operational and risk management procedures of drinking water treatment plants (DWTP) as well as the planning of water infrastructure.

The solutions developed within IMPRX help plant operators and water managers to anticipate the effects of heavy rain and drought episodes at an early stage, enabling effective and efficient decision-making within the operational plant management.

On longer time scales, water safety plans (WSPs), as constituted by the World Health Organisation (WHO), support a broad assessment and management approach to deal with risks caused by extreme events, including all steps in water supply from reservoir to consumer. Even though climatological and hydrological forecasts enable significant improvement in the definition and implementation of the WSPs, this is not a common practice in Europe. However, IMPREX results strongly support the uptake of water quality forecast approaches into the processes of successfully defining WSPs.

A considerable need for 'climate guidance' for plant operators and water planners has been observed within project activities. Guidance on how to anticipate future conditions and how to interpret and operationalise the corresponding scenarios is needed for efficient and effective management of urban water resources.

# IMPREX WATER QUALITY TOOLS

Within IMPREX, researchers developed and applied innovative methodologies to predict water quality changes with lead times up to several months. Advanced monitoring campaigns and pilot implementations of new treatment techniques to improve the management of climate-driven algal growth and cyanotoxins production have been conducted successfully in several Spanish river basins.

The target group of the IMPREX approaches includes managers of small, medium and large DWTPs using surface water as well as decision-makers in water infrastructure planning.

## IMPREX TOOLS:

A - Management of high turbidity events for DWTPs
B - Advanced control of the risk of cyanotoxins for DWTPs
C - Forecasting algae development in water reservoirs

### *A. Forecasting and management of high turbidity events based on meteorological drivers*

High turbidity events are generally caused by intense rainfall, which frequently leads to disruption of treatment processes and causes additional costs (through the need to use more chemicals in the treatment process) and health risks (due to the rapid modifications and changes in the treatment system).

The developed approach, tested in various Spanish river basins, optimises operational management of DWTPs, reducing the costs of chemicals and energy input. Safety risks were reduced, and water supply continuity was secured. The approach can be adapted to forecast different target variables tailored to the needs of the plant operator.

#### *AT A GLANCE*

- ***Forecast & processes tested:*** Forecasting of high turbidity events based on meteorological drivers (3 to 36 hours in advance).
- ***Methods and climate inputs:*** Statistical model based on machine learning, using observations (including radar), meteorological forecast (from ECMWF) and other variables.
- ***Results and integration in decision-making:*** The model skill is satisfactory to forecast events 36 hours out. The algorithms are currently tested with a larger database and integrated into one of the SUEZ* real-time platform for an operational use.

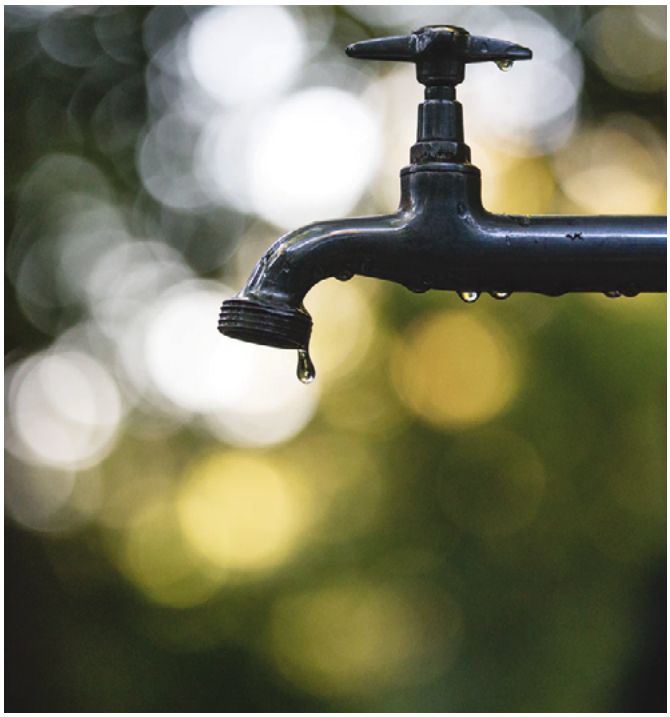
### *B. Advanced control of the risk of cyanotoxins for DWTP*

The management of water quality is based on detection of pathogens and toxic substances monitored at different key locations in the drinking water plant and supply channels. However, this methodology proved to be inefficient or too slow to identify and manage risks adequately, especially in case of cyanotoxins: water quality analyses can take several hours, are conducted at a low frequency (daily or weekly) and are particularly costly.

The new IMPREX approach supplements this monitoring by utilizing past information on the dependence of cyanotoxins on external hydrometeorological drivers (e.g. sunshine, temperature, wind and rainfall). The approach is very time-efficient and less costly than the usual water quality analyses.

#### *AT A GLANCE*

- ***Forecast & processes tested:*** Forecasting algae growth; new treatment processes.
- ***Methods and climate inputs:*** Statistical model using meteorological forecasts, regression based on multiple variables.
- ***Results and integration in decision-making:*** Risk management guidelines have been developed and capacity building events have been carried out to facilitate implementation processes enabling an easy uptake by other DWTPs in Europe. The indicators developed as part of IMPREX have been implemented in operational procedures of La Contraparada DWTP and are taken into account in the dosing of reagents for water treatment.



** Suez is an international utility company which operates i.a. in the water treatment sector.*

### *C. Forecasting algae development in reservoirs*

Algae development in water reservoirs challenges the water treatment due to an increase of suspended solids and the potential presence of toxins harmful to human health. Algae blooms can be caused by factors such as high temperatures or high concentrations of nutrients caused by droughts and heavy rain events.

The new forecasting approach combines the use of meteorological and seasonal forecasts with modelling of chlorophyll-a within reservoirs. Thus, risk management procedures and operational management as well as long-term infrastructure planning are supported by forecasting reliable baseline information.

***AT A GLANCE***

- ***Forecast & processes tested:*** Forecasting algae development under changing climatic conditions.
- ***Methods and climate inputs:*** HUMEDAL dynamic model, use of climate change projections (inflow), meteorological and seasonal predictions.
- ***Results and integration in decision-making:*** The model provides reliable information on the evolution of the trophic state of reservoirs.

## CASE STUDY

AQUATEC, a SUEZ company, is in charge of managing the water intake of a treatment plant in Spain, ensuring an adequate water quality and controlling the potential risk of cyanotoxins. The company worked with IMPREX, using the newly developed approach to control risks of cyanotoxins within the reservoir of a selected DWTP in south-eastern Spain.

During IMPREX, AQUATEC applied the approach in close cooperation with plant personnel, controlling the risk of cyanotoxins and improving risk management strategies. Together with AQUATEC, the DWTP analysed different drivers of algal growth and took additional samplings, contributing to the standardization of the identification and quantification of the algal community. It has been established that climate variables which are easily measurable (such as temperature and sunshine hours) considerably influence algal growth. This resulted in an update of the decision-making process of the DWTP, which now uses the algal growth indicators that have been identified. This allowed detecting risks at an early stage and preparing for emergency situations in order to guarantee both reliable and safe drinking water supply and the DWTP's economic efficiency.

During an extreme drought event in October 2018, a rare species of cyanobacteria affected the DWTP. With the information provided by the IMPREX approach, the algae growth was detected at an early stage, which facilitated adequate and timely management steps.

> *Working with IMPREX changed our company's strategy of managing cyanotoxins. Now, the risk management is characterised by a lot more certainty. We have a much safer basis for decision-making now, using a relatively simple but reliable approach developed within IMPREX*
>
> *Isabel Hurtado (AQUATEC)*

In order to upscale the use of the innovative approach, IMPREX successfully conducted a webinar for plant operators of SUEZ Spain to broadcast the approach to controlling the risk of cyanotoxins and to promote the accompanying risk management guidelines. The knowledge acquired will be useful for the SUEZ Group to follow the WSP approach as required by Spanish legislation.

In the face of changing climate, new species of bacteria are spreading, posing a major threat to water supply security. Each cyanobacteria bloom has different drivers and develops differently. New data, for instance from satellite platforms and historical data, are needed to allow for early risk detection.

**For further information please visit www.imprex.eu and check out our interactive product demonstrator!**

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This factsheet was compiled by adelphi based on the work carried out within the context of the research project IMPREX as well as interviews with involved users. Special contributions were made by Laurent Pouget (Cetaqua), Isabel Hurtado (AQUATEC), Javier Paredes (UPV) and Bart van den Hurk (Deltares).


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IMPREX is designed to help reduce Europe's vulnerability to hydrological extremes by achieving a better understanding of the intensity and frequency of potential disrupting events. Enhancing our forecasting capability will increase the resilience of European society as a whole, while reducing costs for strategic sectors and regions at the same time. The research project brings together 23 partners from 9 countries and has received funding from the European Union's Horizon 2020 Research and Innovation Programme.