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Operational short-term water quantity and quality forecasting in reservoirs intended for potable water production*.

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Harmful algae blooms outbreaks in freshwater reservoirs used for drinking water production can have negative effects in human health and ecological status as well as serious economic costs. Furthermore increased amounts of suspended solids and turbidity may interfere with water treatment operations, resulting in increased treatment costs for drinking water facilities. Short term water quantity and quality forecasts for reservoirs intended for potable use, may increase the responsiveness level of water managers against possible changes and thus enable proactive informed decision making on an operational level.

A fully operational service line for generating real-time water quality forecasts in reservoirs has been developed, by integrating state of the art hydrologic and water quality modelling with satellite technology and in-situ monitoring data using advanced ICT tools. The service is provided through a web-based platform which has been designed to facilitate data hosting, exchange and sharing among EO, in-situ monitoring and modelling components in order to establish a complete value adding chain from science to water business sector customized according to specific end-users needs.

Hydrological forecasting is performed by the pan-European setup of HYPE catchment modelling. HYPE is an open-source, process-oriented, semi-distributed hydrological model which simulates and provides 10-days forecasts of river discharges, water temperatures, nutrient and sediment loads in the upstream sub-basins of the reservoir. Hydrodynamic and water quality simulation are performed with the open-source FLOW and DELWAQ modules of Delft3D suite. Hydrological forecasts, along with local weather forecasted parameters (wind, humidity and air temperature) are fed into the hydrodynamic model which is used to estimate forecasts of velocity fields, water elevation and temperatures in the reservoir domain. Near real-time water level observations from in-situ monitoring stations are incorporated as corrective water fluxes in the hydrodynamic model in order to keep simulated water level as close as possible with measured. The hydrodynamic model is coupled with the water quality model which is used to estimate the spatial and temporal distribution of critical water quality parameters for the next 10 days. Simulated parameters include various algae species, nitrogen, phosphorus, dissolved oxygen, suspended sediment, etc. Operational data assimilation of satellite imagery of water temperature, turbidity and chlorophyll-a concentrations obtained from Landsat 7&8 and Sentinel 2 missions are used to correct the model state using the Ensemble Kalman Filter technique. An ensemble of 30 coupled hydrodynamic and water quality members with random noise both in forcing data and model parameters is constantly evolved through time and is used to correct model state when observations are available using an assimilation window of 7 days.

Forecasted data are fed into a decision support system for performance optimization (i.e. improved chemical and energy consumption) of critical water treatment plant units as well as for calculation of aggregated overall water quality indices for early warning alerts. The operational service has been setup in Aposelemis reservoir (Crete, Greece) and in Mulargia reservoir (Sardinia, Italy).

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