AQUA
WATER SUPPLY ASSESSMENT TOOL

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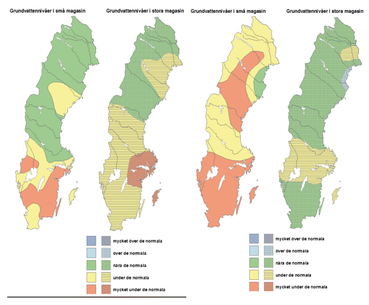
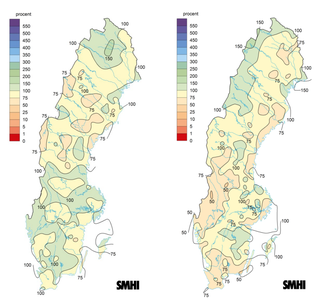
WATER MANAGEMENT IN CHANGING CLIMATE

The water management sector is strongly affected by weather seasonal variability and changes in precipitation and temperature patterns as they affect availability of the water resources.

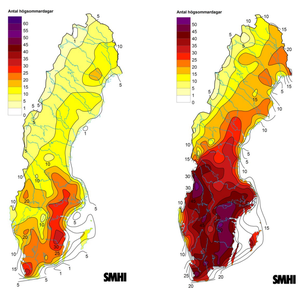
Due to the increasing frequency and severity of extreme weather events such as droughts and floods, a better understanding of available freshwater resources is needed for ensuring both urban water supply and compliance of current water regulations.



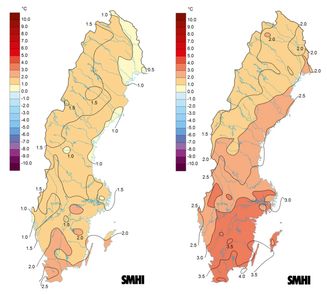
Groundwater levels in July 2019 (left) and 2018 (right) . (Source: SGU)



Precipitation as % of normal during summer 2019 (left) and 2018 (right). Source: SMHI



Number of consecutive days with temperature > 25° during summer 2019 (left) and 2018 (right). Source: SMHI.



Average temperature, deviation from normal during summer 2019 (left) and 2018 (right). Source: SMHI.

WATER SCARCITY IN GOTLAND

The climate service AQUA has been developed with Region Gotland in a process of co-generation under the CLARA project. In the past recent years, Gotland has experienced dry and hot summers causing difficulties in ensuring urban freshwater supply and maintain water levels according to law regulations.

Region Gotland expressed the inability of planning water exploitation in the following months without the availability of proper tools. This raised the need of seasonal forecasts to be implemented.

CLARA PROJECT

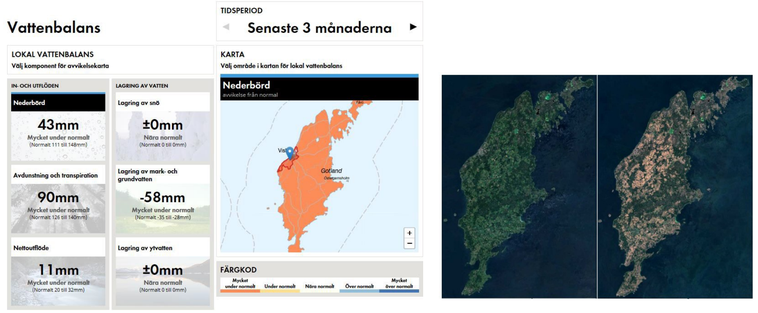
The AQUA service was developed in the framework of CLARA, a Horizon 2020 project aiming to develop fourteen climate services building upon the Copernicus Climate Change Service seasonal forecasts and Sectorial Information Systems, to demonstrate their value and ensure their market viability.

THE AQUA SERVICE

SMHI Aqua is a web-based presentation tool addressed to public authorities and private companies involved in the drinking water supply sector aiming at monitoring freshwater availability throughout the year. The service supports decision making process for optimal water resource management.

The service provides:

- Real-time hydro-meteorological measurements from stations
- Real-time hydro-meteorological modelling
- Short range forecasts (1-10 days) of precipitation, temperature, snow, water runoff and soil water content
- Seasonal forecasts (6 months) of water availability in the main freshwater reservoirs expressed as levels or inflow
- Inclusion of different raw water withdrawal strategies and critical water levels provided from the user
- Daily update of observations and modelled results
- Visualization of data in form of maps, graphs and tables



Water balance in Gotland July 2018. Precipitation, evapotranspiration, outflow and soil/groundwater recharge are highly under normal conditions. Source: SMHI.

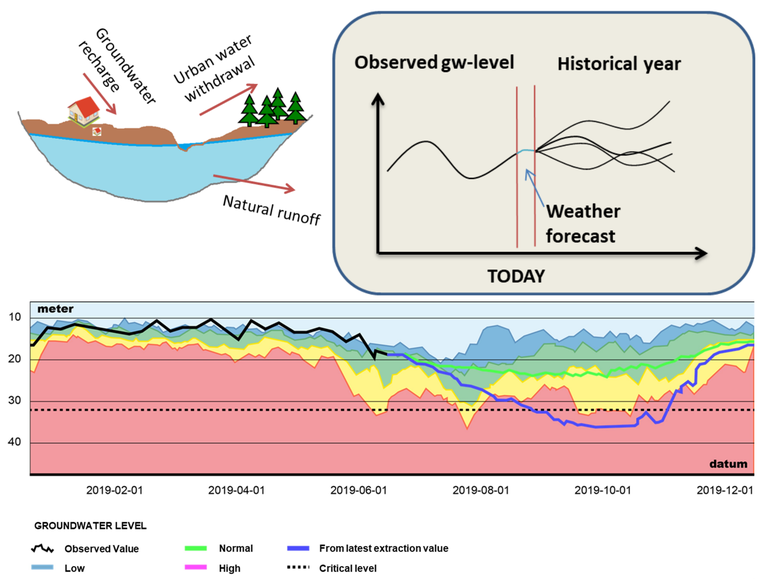
Gotland seen from satellite images in 2017 (left) and 2018. Photo: Rymdstyrelsen/Google/ Esa

RAW WATER FORECAST MODEL

A raw water model was developed to simulate the amount of water accumulating as groundwater recharge in the soil. The model combines locally calibrated and modelled parameters with HYPE. HYPE is SMHI's hydrological model, that allows simulating water flow and nutrient concentrations at the catchment level, with average area of 25 km2.

The groundwater model takes as inputs measurements of water withdrawal and groundwater levels together with modelled groundwater recharge [mm] from S-Hype. These inputs allow to calculate the water balance in the aquifer.

Two different forecasts are produced: 10-day weather forecasts and climatological forecasts. The latest day of the former initiates the latter, which is driven by historical weather conditions.



Top left: schematic visualization of the groundwater balance model. Top right: illustration of the forecasts. Observed groundwater levels until today, weather forecasts for the next 10 days. The last day drives the seasonal climatological forecasts, based on hystorical meteorological conditions. Bottom: example of visualization of seasonal forecasts. Forecasted groundwater level patterns are produced by considering different water management strategies prodived from the users. Background represents the historical measured levels in the reservoir and the color field is divided according to the deviation from normal condition.

CUSTOMIZED ACCORDING TO USERS' NEEDS

The AQUA service allows monitoring freshwater reservoirs in real time on desktop and mobile devices, and it can be set-up in any language. Two customizations are available:

- AQUA Basic: easy visualization of local real-time observations in form of graphs and tables.
- AQUA Plus: in addition to the basic version features, it includes local scale modelling of freshwater reservoirs and seasonal forecasts. The operational models are updated with real-time observations and run daily. Municipal water withdrawal strategies and critical levels provided from the user can be included. Modelled data are visualized in graphs and tables.

WORKFLOW

Workflow and structure of the AQUA climate service (from left to right). The users provide local measurement data of lake and groundwater levels and raw water withdrawal, that are stored in SMHI's database. Together with station observations, the users provide also different alternatives of withdrawal strategies throughout the year in an excel-formal file. These, together with 10-day meteorological forecast and hydro-meteorological variables modelled with hydrological model HYPE, are used to feed the hydrological model simulating the water balance in the water body. Results in NetCDF files are presented in the web interface. For each point where local modelling was performed, results are showed in graphs and easily exportable tables.

Pictures from the 3rd CLARA Multi User Forum in Venice, October 2019. Top left: Helen Ivars Grape (SMHI) closing the last session of the workshop. Top right: all the participants. Bottom left: breakout session with discussions between service developers and users. Bottom right: Carolina Cantone (SMHI) and Shadi El Abash (Region Gotland) posing with the AQUA poster.

ACKNOWLEDGEMENT

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