

Denmark

Capital city: Copenhagen

Inhabitants: 5 Million



INSTITUTIONAL SETTING AND PURPOSE

The Ministry of Environment and Food of Denmark is in charge of environmental protection, farming and food production, with the Danish Environmental Protection Agency as one of the Departments in the Ministry.

The National Groundwater Monitoring Network (GRUMO) is part of the National Monitoring Program for Aquatic Environment and Nature (NOVANA). GRUMO, along with other related monitoring programmes as the Agricultural Catchment Monitoring Program (LOOP) included in NOVANA, was initiated in 1988 to monitor quality and quantity of groundwater throughout the country.

The National Geological Survey for Denmark and Greenland (GEUS) acts as a data centre and scientific advisor/reporter for the collection of groundwater and borehole information.

The objective of the groundwater monitoring programme, GRUMO, is to establish representative time series for the quality and quantity of the groundwater resources to ensure good quality of drinking water for the future. In addition to this, the program aims to provide data to monitor status and trends of groundwater bodies (administrative units to be used according to the WFD). Data collected are also to be used in the development of models for river basin management.

The Agricultural Catchment Monitoring Program (LOOP), which has a groundwater component, is dedicated to monitoring groundwater quality in the unsaturated zone, tile drains and shallow groundwater (approx. 3 to 5 meters depth) in six agricultural catchments in sandy and clayey areas across Denmark, mainly focusing on leaching of nutrients (N and P) to groundwater.

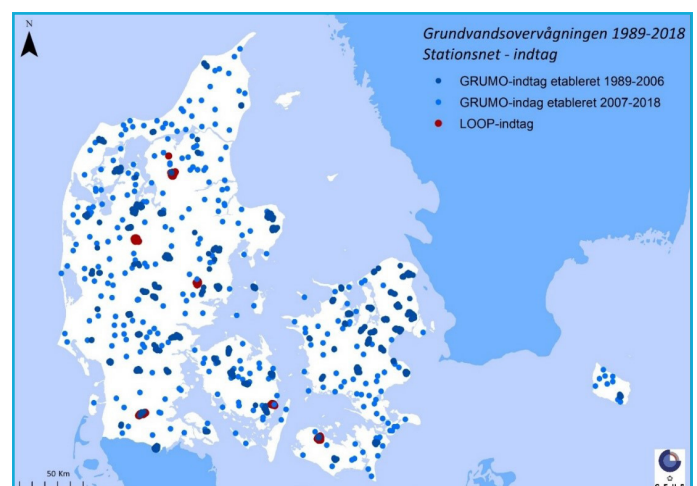
Moreover, the National Groundwater Level Monitoring Programme (Det Nationale Pejleprogram) was set up to monitor groundwater levels through sounding stations within five regional areas.

GRUMO was originally designed to provide a picture of the groundwater's condition and development in a number of selected catchments – the GRUMO areas – which were considered to be representative for groundwater of the country. The GRUMO program has since been updated and adapted continuously on the basis of greater knowledge and due to the varying administrative needs, including the fulfilment of the reporting obligations under EU directives, particularly the WFD and the Nitrates Directive.

CHARACTERISTICS OF THE NETWORK

Groundwater levels are monitored through approx. 1,000 GRUMO monitoring wells and the National Groundwater Level Monitoring Programme, where the groundwater level readings are taken several times daily for approximately 160 boreholes. In addition, all water abstractions (except single households) are reported on an annual basis as abstracted water volumes to the joint public database Jupiter hosted by GEUS.

Figure 1 - Monitoring points in the 73 groundwater monitoring areas ('GRUMO-indtag' 1989-2006) and monitoring wells in the distributed network established in the period 2007-2017 for the WFD ('GRUMO-indtag' 2007-2018). LOOP monitoring of six agricultural catchments are also included, one of which was later closed in Central Jutland. (Source: Thorling et al., 2019)



Monitoring wells included in the program in 2017, with a top screen depth of approximately 40 meters, are more or less evenly distributed over Denmark, while deeper monitoring points show significant regional differences. Thus, on Bornholm (easternmost island), the vast majority of monitoring points are within the upper 20 meters, while the vast majority of deep boreholes (80-372 m below the ground surface, b.g.s.) are found in Jutland (continental Denmark) with the largest occurrence in southern Jutland.

The situation is different for monitoring wells and “waterwork wells” (wells for drinking water) in 2018. 50-60% of GRUMO monitoring points are established within the upper 20 m, while just 10% are established deeper than 50 m below the ground surface. In the waterworks wells, the screens are placed deeper. Here, 50% of the waterworks boreholes have the top of the screen located at a depth greater than 40 m b.g.s., and 10% at depths greater than 80 m b.g.s.

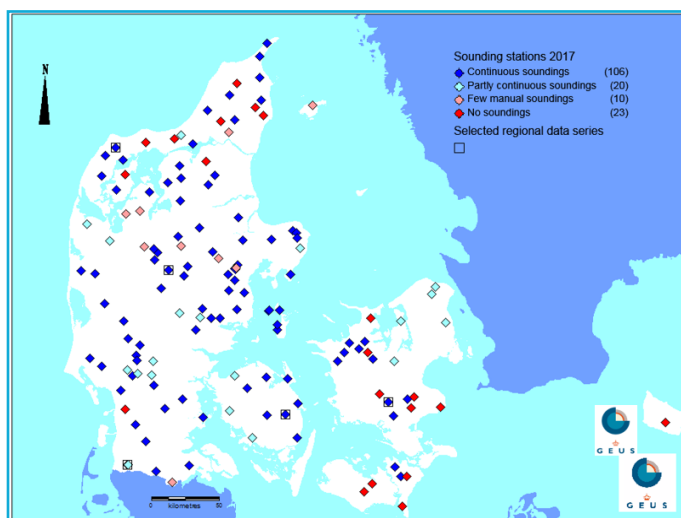


Figure 2 - Geographical distribution of wells that are part of the National Groundwater Table Monitoring Programme in 2017, including five regional indicator measurement stations with long time series (Source: GEUS)

PROCESSING AND DISSEMINATION

All monitoring data are freely available on GEUS homepage. Figure 2 shows the location of boreholes through the GEUS portal. It is also possible to download data in Excel format.

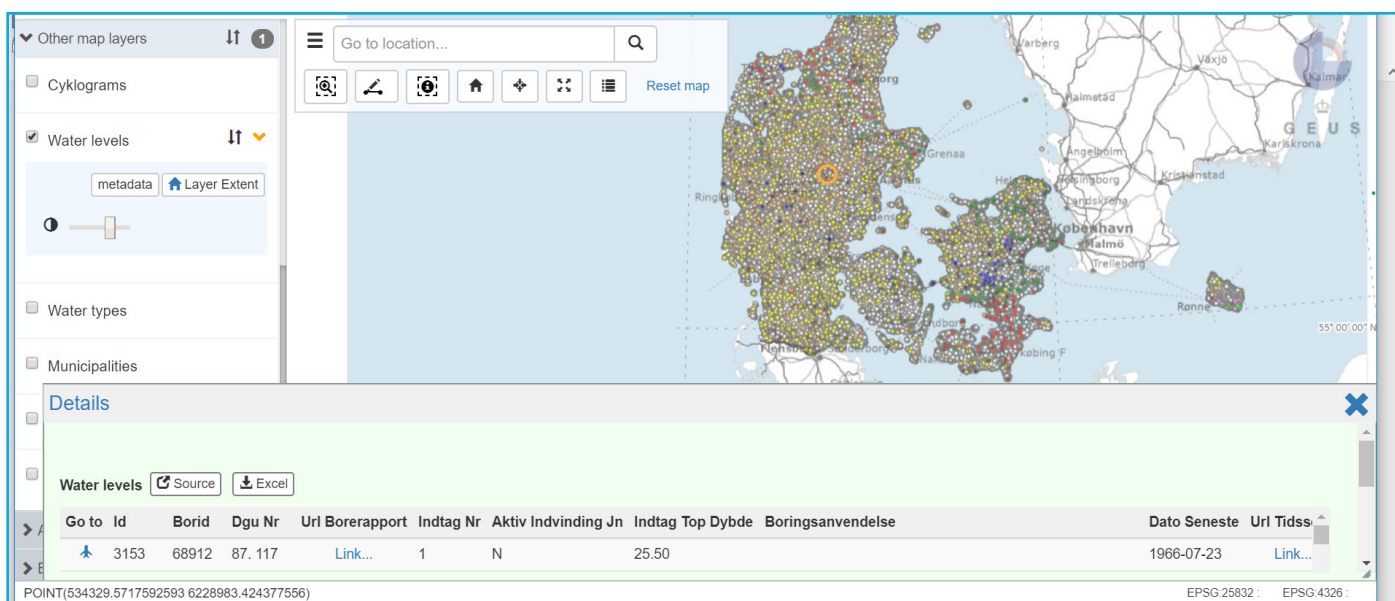


Figure 3 – GEUS portal for groundwater analyses with points measuring water level. Source: GEUS)

Sources

- **Data management by GEUS** - <https://www.eea.europa.eu/publications/92-9167-032-4/page005.html>;
- **Feedback from GEUS** - received on 27-01-2020;
- **Geological Survey of Denmark and Greenland (GEUS)** - <https://www.geus.dk/vandressourcer/overvaagningsprogrammer/grundvandsovervaagning/>;
- **Hansen B., Thorling L., Dalgaard T., Erlandsen M. 2010. Trend Reversal of Nitrate in Danish Groundwater - a Reflection of Agricultural Practices and Nitrogen Surpluses since 1950** - <https://pubs.acs.org/doi/pdf/10.1021/es102334u>; and
- **Jupiter (GEUS's nationwide drilling database for groundwater, drinking water, raw material, environmental and geotechnical data)** - <https://data.geus.dk/geusmap/>.