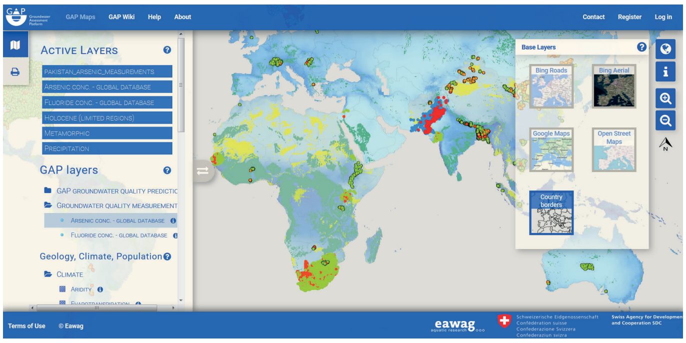
Now online

Groundwater Assessment Platform (GAP)

Over 300 million people worldwide use groundwater as a source of drinking water that is naturally contaminated with arsenic or fluoride. The Swiss Federal Institute for Aquatic Science and Technology (Eawag) has refined a method whereby the risk of geogenic contamination in a given area can be estimated using geological, topographical and other environmental data without having to test all groundwater wells. This knowledge is now available free of charge on the online Groundwater Assessment Platform (GAP), accessible at www.gapmaps.org. GAP enables relevant civil societies, water authorities and other groundwater managers to upload own data and creat hazard maps of their area of interest.



GAP's interactive webGIS interface

Groundwater serves as drinking water for over 50% of the world's population and is indispensable for irrigation in many regions. In general, groundwater is likely to contain fewer pathogens than water from lakes or rivers. Nevertheless, contamination with geogenic contaminants such as arsenic or fluoride is widespread and affects over 200 million people worldwide.

At high concentrations or when ingested over long periods, As and F have serious effects on human health. Excessive fluoride intake can lead to brittle, discoloured teeth, as well as bone and joint deformities. Chronic exposure to arsenic results in an elevated likelihood to develop cardiovascular disorders and cancer.

Risk Mapping Method

In 2008, an Eawag reserach group presented a new method that makes it possible to produce hazard maps for the occurrence of geogenic contaminants without haveing to sample all wells and groundwater resources in a given region (Amini et al., 2008a, 2008b). These maps were an innovative development in the field of groundwater research.

The accuracy of these models was demonstrated in various regional- and country-scale maps, including South-East Asia (Winkel et al., 2008), China (Rodriguez-Lado et al., 2013), Burkina Faso (Bretzler et al., 2017), Pakistan (Podgorski et al., 2017) and India (Podgorski et al., 2018). Some areas affected by arsenic or fluoride contamination were identified for the first time, leading to targeted drinking water surveys.

The predictive modelling essentially involves correlation (logistic regression) between various data sets such as measured groundwater quality point data – in this case arsenic or fluoride – with geospatial data sets of predictor variables, for example, geology, soil types and averaged climate variables.

Our Vision

Our long term aspirations have been summarised in the following vision statement:

To assist communities, national and international institutions, civil society and research organizations in having access to maps, data and relevant information to enable all people and the environment to have an equitable right to safe groundwater

In doing so, we would like to contribute directly to achieving SDG6.

Groundwater Assessment Platform

eawag aquatic research

Facilitating local research

In low-income countries, owing to lack of technical and financial resources, it is challenging for water resource managers and planners to perform the complex task of producing arsenic or fluoride hazard maps without assistance. With continued support from the Swiss Agency for Development and Cooperation (SDC), the Eawag team has developed a free GIS online interface known as the Groundwater Assessment Platform or GAP (www.gapmaps.org). GAP makes it possible for professionals around the world to visualise their own data with relatively little effort and to produce their own hazard maps. GAP makes it easier to identify areas that may need investigating should a high risk of natural contamination exist.

Sharing information

GAP is not only an online repository for groundwater quality-related data, but also serves as a platform for data sharing and information exchange. With the "Community" functionality, users can create and manage user groups, which can facilitate data sharing in a secure environment, fostering collaboration on specific case studies.
The GAP Wiki features information on various topics related to groundwater quality and successful mitigation: water sampling and analysis, treatment technologies, financing mechanisms and techniques to induce lasting behaviour change. Contributions by users are encouraged and moderated by GAP staff.

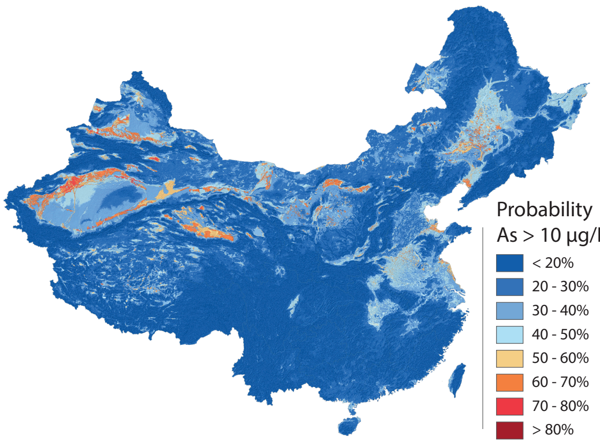
GAP Groundwater Assessment Platform

- Mapping
- Modelling
- Sharing
- Wiki

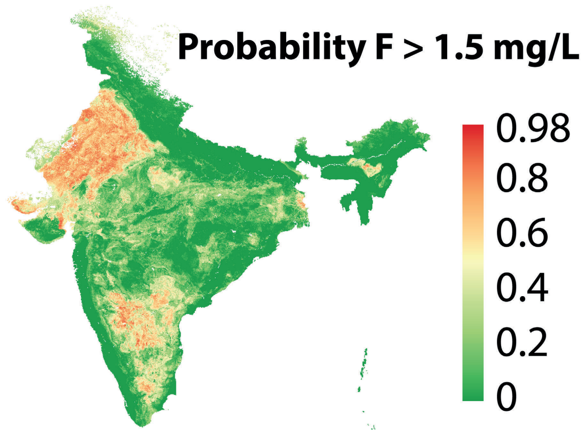
The potential of GAP

Initially, GAP's focus has been on groundwater quality, especially the geogenic contaminants arsenic and fluoride. However, the online GIS interface, logistic regression modelling framework and Wiki exchange platform are features that can be applied equally well to different data and topics. We envision broadening the scope of GAP to subjects such as

- Contaminants in soils and food crops
- Surface water quality
- Groundwater recharge



Modelled probability of geogenic arsenic contamination in groundwater greater than 10 µg/L for China (Rodriguez-Lado et al., 2013)



Modelled probability of geogenic fluoride contamination in groundwater greater than 1.5 mg/L for India (Podgorski et al., 2018)

Original Publications

Amini, M. et al., (2008a) Statistical modeling of global geogenic fluoride contamination in groundwater. Environmental Science and Technology, 42(10), 3662 – 3668, doi:10.1021/es071958y

Amini, M. et al., (2008b) Statistical modeling of global geogenic arsenic contamination in groundwater. Environmental Science and Technology, 42(10), 3669 – 3675, doi.org/10.1021/es702859e

Bretzler, A. et al. (2017) Groundwater arsenic contamination in Burkina Faso, West Africa: Predicting and verifying regions at risk. Science of the Total Environment, 584-585, 958-970, doi:10.1016/j.scitotenv.2017.01.147

Podgorski, J.E. et al. (2017) Extensive arsenic contamination in high-pH unconfined aquifers in Pakistan. Science Advances, e1700935, doi:10.1126/sciadv.1700935

Rodríguez-Lado, L. et al. (2013) Groundwater arsenic contamination throughout China. Science, 341(6148), 866 – 868, doi:10.1126/science.1237484

Winkel, L. et al., (2008) Predicting groundwater arsenic contamination in Southeast Asia from surface parameters. Nature Geoscience, 1, 536 – 542, doi.org/10.1038/ngeo254

Winkel, L. et al., (2011) Arsenic pollution of groundwater in Vietnam exacerbated by deep aquifer exploitation for more than a century. PNAS 108(4), 1246-1251, doi:10.1073/pnas.1011915108

Podgorski, J.E. et al. (2018) Prediction Modeling and Mapping of Groundwater Fluoride Contamination throughout India. Environmental Science and Technology, 52(17), 9889-9898, doi:10.1021/acs.est.8b01679

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