Vulnerability Assessment of Deep Stratified Aquifers in the Context of Adapting to Climate Change

A case study under **IAEA TC Project RER7013** – Evaluating Groundwater Resources and Groundwater – Surface Water Interactions in the Context of Adapting to Climate Change

Armenia, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Latvia, Moldova, Romania, Russian Federation, Slovakia, Slovenia

Case Study Focus

Investigating recharge rates and risk of over-abstraction of transboundary aquifers using isotopic dating methods.

The opportunity

Many aquifers in Europe and Central Asia are used for drinking and agricultural or industrial purposes, but the increasing level of abstractions may compromise groundwater availability for generations. The effects of climate change, coupled with anthropogenic disturbances, such as increased human consumption or pollution, have already impaired groundwater quality and quantity in the region. Over-abstraction from deep stratified geothermal aquifers is of particular concern because these reservoirs are limited in volume and take decades to millennia to recharge.

Using nuclear science and technology, in-depth information about the properties and movement of water in aquifers can be determined and used to improve risk assessments and aquifer management policies to ensure sufficient groundwater availability. The study will help to determine the properties of 11 key aquifers that span depths from 20 to 2 000 metres in 13 countries. Participants in the study will have access to specialized instrumentation via regional partnerships and will develop research skills and practical knowledge related to sampling procedures, analytical methods and criteria to evaluate aquifer vulnerability.

The proposal

Sedimentary basins across Europe and Central Asia often form vertically stratified aquifers, but these are characterized by a large variety of precipitation regimes and groundwater flow patterns. These aquifers also differ widely in their recharge rates and water age.

As precipitation or surface water move through the subsurface, it carries hydro-chemical parameters and isotopic ‘fingerprints’ that can be used to determine the water’s origin and residence time, and to examine water-rock interactions. Nuclear analytic technology supported by the IAEA enables measurements of stable isotopes in water molecules, as well as tritium, radiocarbon and noble gases.

Water sampling methods vary based on the expected residence time in each water reservoir. Monitoring campaigns can range from the regular sampling of precipitation to the specific sampling of geothermal aquifers, which are over several kilometres deep and more than ten thousand years old. Together with regional partners, the IAEA will evaluate

Partners: Institute of Geological Sciences, Armenian National Academy of Sciences; Bulgarian National Institute of Meteorology and Hydrology; Biology Centre, Czech Academy of Sciences; Czech Technical University; University of Tartu; Estonian Geological Survey; Estonian Environmental Agency; Tallinn University of Technology; Ivane Javakhishvili Tbilisi State University, Georgia; Croatian Geological Survey; Hungarian Institute for Nuclear Research; University of Latvia; Latvian State Environmental Service; Institute of Geology and Seismology, Academy of Science of Moldova; Emil Racovita Institute of Speleology, Romanian Academy; University of Suceava; Babes-Bolya University; Lomonosov Moscow State University, Russian Federation; Geological Survey of Slovenia; Jožef Stefan Institute, Slovenia; Slovenian Environment Agency; State Geological Institute of Dionýz Štúr, Slovakia.

IAEA
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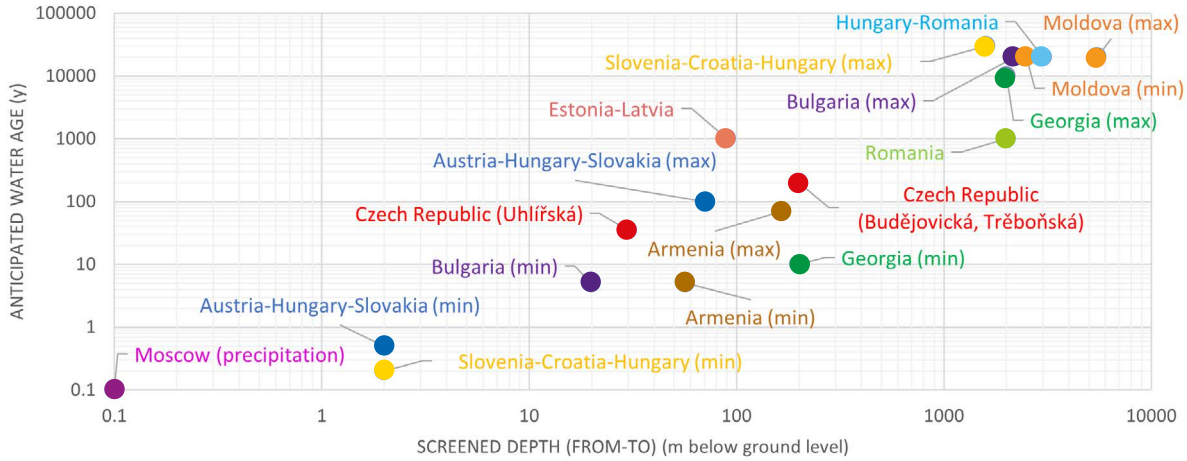


Schematic overview of case study investigation sites.

aquifer vulnerability through a variety of sampling procedures and analytical methods.

The results of the study, combined with specific hydrogeographic site data, will be used to evaluate the recharge rate, transit time and chemical evolution of water through various transboundary, multi-layered sedimentary basins. Based upon this data, the status and vulnerability of these aquifer systems can be quantified.

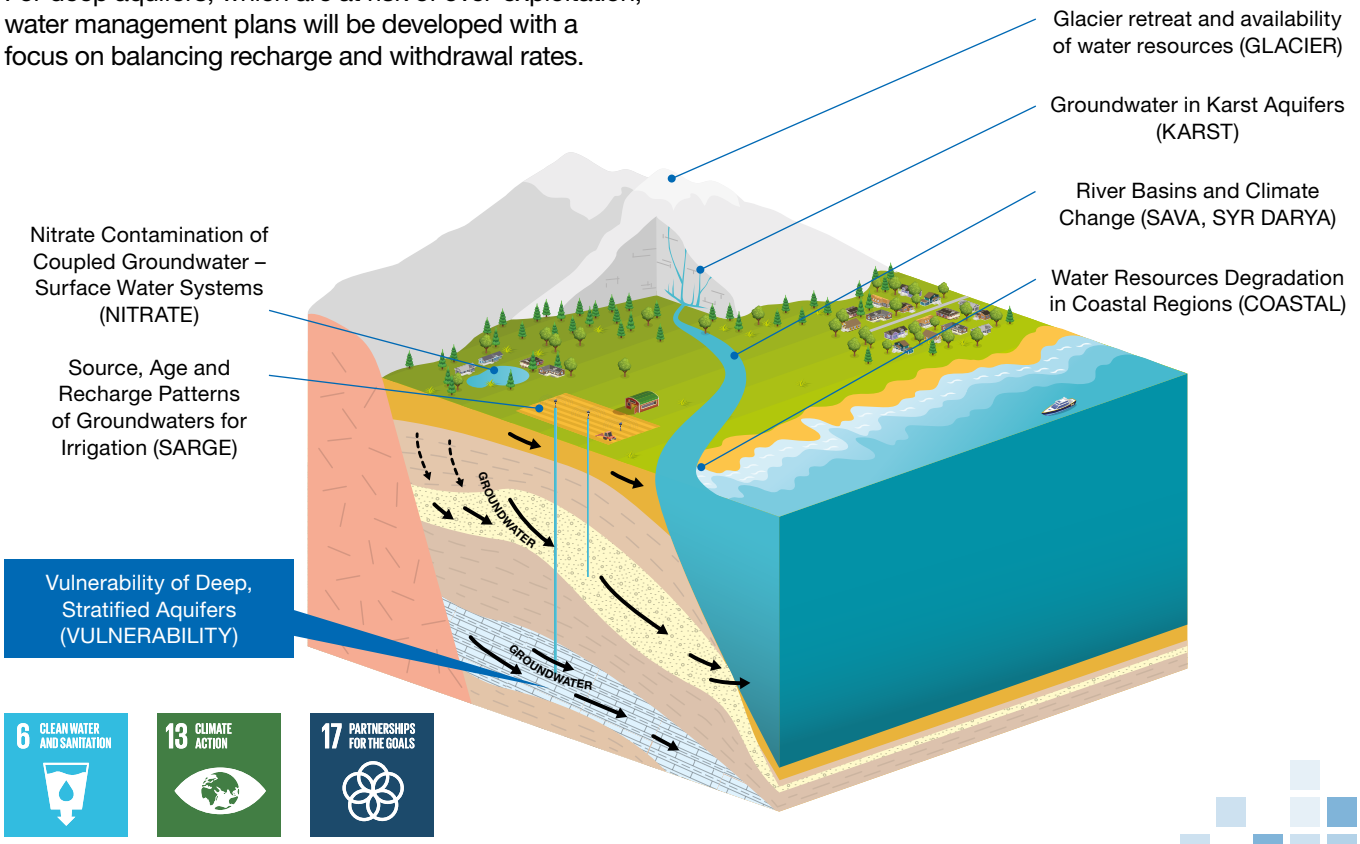
The benefits

The findings can contribute to water management practices to improve the water quality in shallow aquifers and to understand the effects of climate change on groundwater availability. Recent patterns of spatial and temporal water dynamics will be evaluated, as well as the influences of long-term hydro-climatic changes.

For deep aquifers, which are at risk of over-exploitation, water management plans will be developed with a focus on balancing recharge and withdrawal rates.

This project focuses on several transboundary aquifer basins, which include the Danube, Pannonian, Ararat and Baltic aquifers. It is necessary to collect and combine data from several countries to determine regional groundwater flow patterns. The findings of this project are expected to improve regional knowledge and awareness of groundwater recharge and evolution, especially in deep transboundary aquifers, which are rarely investigated and less understood in comparison to shallow and young groundwater.

The project will enhance regional analytical capacities in isotopic groundwater dating and improve the assessment and evaluation of aquifer vulnerability and best management practices. The combined findings will significantly improve the spatial and temporal resolution of data on regional hydrodynamics and contribute to ensuring future water availability in the region.



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