Water Resources

Objective

To enable Member States to use isotope hydrology for the assessment and management of their water resources, including the characterization of climate change impacts on water availability.

Enhancing Groundwater Resources Availability

The Agency began mainstreaming the IAEA Water Availability Enhancement Project (IWAVE) methodology in 2018. Its use is now standard in evaluations of technical cooperation projects aimed at enhancing hydrological understanding in order to increase water availability and sustainability. The IWAVE methodology helps ensure the feasibility of isotope hydrology projects and their effective contribution to achieving Sustainable Development Goal (SDG) 6 on clean water and sanitation.

In 2018, comprehensive groundwater recharge assessments from environmental isotope mapping were completed by three counterparts, with Agency assistance, for five aquifers in Argentina, Brazil and Colombia. Isotopic data collected from the aquifers were used to establish a regional hydrogeochemical and isotope (oxygen-18, deuterium and tritium) database for precipitation, surface water and groundwater, to be maintained by counterpart institutes. The groundwater isotopic data are being integrated into new hydrological maps, highlighting the recharge areas where replenishment is taking place and the need for groundwater protection zones in areas with higher vulnerability to pollution.

Water Resource Assessment

Mining operations pose a water resources challenge. Mining activities use extensive water resources in processing ores, and important water quality issues may arise because of groundwater and surface water entering mine sites and encountering primary and secondary minerals. The potential role of isotope hydrology tools in addressing the environmental impact of these activities was the topic of a technical meeting held in Vienna in June. Experts from 11 Member States reviewed recent developments in the use of geochemical and isotope tools for water source identification and characterization, mine water management, contaminant (acid mine drainage) assessment, mine area restoration and management of abandoned mines, as well as the use of various tracers. Participants highlighted the need to better assess and expand the use of geochemical and isotope tools in characterizing sources, processes, pathways and environmental factors to enhance hydrogeological models in mining areas.

In 2018, the Agency completed a coordinated research project that focused on improving understanding of the hydrology of large river basins using geochemical and isotope

FIG. 1. Sampling in the St. Lawrence River as part of an isotope monitoring programme in Canada. (Photograph courtesy of J.-F. Hélie.)

parameters to constrain and model water, nutrient and sediment dynamics in large river basins (Fig. 1). Large rivers are a significant source of fresh water for drinking, agricultural and industrial supplies, fisheries, transportation and energy production. Human impacts on large watersheds — including intensive agriculture, discharge of wastewater, impoundments, irrigation and damming — have profound effects on river water balance, biogeochemistry and sediment transport. The four year coordinated research project, involving participants from 17 Member States, contributed to strengthening the Agency's Global Network of Isotopes in Rivers (GNIR) programme by improving understanding of the relationship between hydrological and biogeochemical processes in large river basins, thus contributing to achieving SDG target 6.6 on restoring water related ecosystems, including mountains, forests, wetland, rivers, aquifers and lakes.

The Ping River is a major artery that provides water and livelihoods to the northern and central regions of Thailand. Severe drought during the dry season and flooding in the rainy season cause severe water challenges in this region. In 2018, the Agency, through the technical cooperation programme, helped complete the construction of a river bank filtration system that improves understanding of the interaction between surface water and groundwater needed to measure the impact of drought on water availability for agriculture and domestic uses. The feasibility of this system was established using hydrochemical and isotope tools to generate essential hydrological information.

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A regional project completed in 2018, carried out under the African Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology, built capacity and developed human resources in 17 Member States in the use of isotope hydrology techniques in water management. Teaching modules on isotope hydrology tools and methods were updated to provide basic knowledge for integrating isotope hydrology tools as part of water resources assessment. These modules will be incorporated into university curricula in the participating Member States, including at the three regional designated centres in Egypt, Morocco and Tunisia.

Analytical Capacity and Services

Increasing concentrations of dissolved nitrate and other nutrients in rivers, lakes, groundwater and estuaries can cause negative effects on water and ecosystems, such as eutrophication and hypoxic zones in coastal oceans, often leading to undrinkable water. At the Technical Meeting on Advanced Analytical Methods for Tritium and Stable Isotopes of Carbon and Nitrogen, participants from eight Member States reviewed advances in sample preparation and analysis using low cost laser isotope analysers. Isotope tools may significantly improve analytical accessibility and facilitate widespread use of nitrate isotopes for coordinated research projects and technical cooperation projects. The use of nitrogen and oxygen isotope fingerprinting of nitrate is critical to allow isotope hydrologists to identify and distinguish sources of nitrate in aquatic systems and to quantify natural remediation processes like denitrification. The experts recommended ways to expand the use of nitrate isotopes for pollution studies and recommended an international intercomparison exercise of nitrate isotopes to ensure the reliability of laboratories in preparation and analytical methods.