# Water Resources

## Objective

*To enable Member States to use isotope hydrology for the assessment, use and management of their water resources.*

## The IAEA Water Availability Enhancement Project

The IAEA Water Availability Enhancement (IWAVE) project assists Member States in increasing the availability and sustainability of fresh water using comprehensive, science based assessments of national water resources. Specifically, the project strengthens national capacities for collecting, managing and interpreting water resources data using advanced techniques. A side event on the progress made in this project was held during the Agency's 56th General Conference in September. Ministerial representatives from Costa Rica, Oman and the Philippines highlighted achievements and shared their experience.

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For example, in Costa Rica, a new initiative by the Ministry of Environment, Energy and Telecommunications, known as the 'Agenda for Water', was initiated with the involvement of IWAVE and major national stakeholders. In Oman, work focused on completion of the third assessment of the national monitoring networks, involving substantial field work as well as upgrading of monitoring networks and national hydrological databases. And through the IWAVE project, the Agency assisted the Philippines in publishing a document identifying the main gaps in the data and scientific capacity required to provide a sound assessment of surface water and groundwater systems as well as the specific investments required to fill those gaps. Field studies to acquire hydrological data have been initiated in the three Member States (Fig. 1).

*FIG. 1. Water sampling in the Philippines as part of the IWAVE project.*

## Technical Publications in Isotope Hydrology

More than 20 scientific articles on different aspects of isotope hydrology were published describing new methods for isotope data collection and interpretation. These include a new interpretation of the factors controlling the isotope contents in precipitation at global and regional scales, overcoming the inconsistencies and limitations of previous approaches. Other work dealt with the development of a simplified graphical interpretation of carbon-14 data in groundwater, which will help the counterparts of Agency projects to better assess groundwater flow and transport. In addition, the tritium content of precipitation in Japan following the accident at the Fukushima Daiichi nuclear power plant was evaluated to assess the environmental impact of accidental releases of radioactivity.

## Technical Cooperation Projects on the Assessment of Water Resources

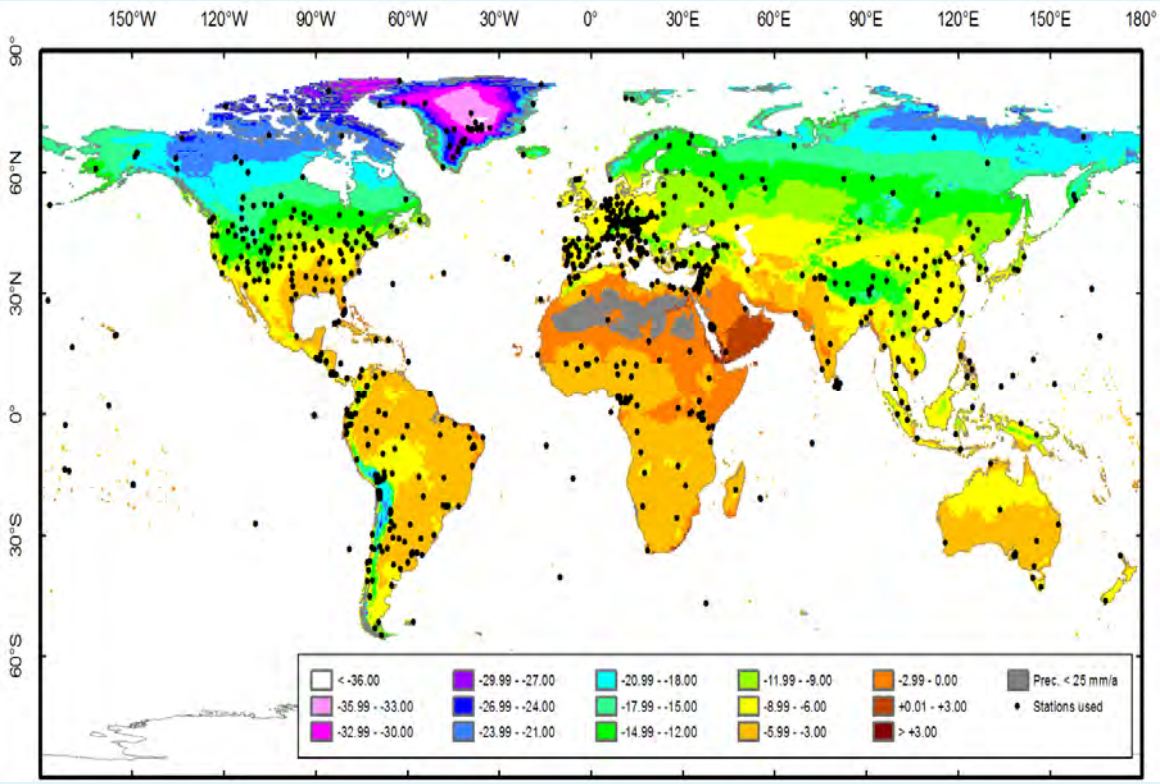
In Ghana, an Agency technical cooperation project focusing on the assessment of water quality issues in the coastal zone of the Central Region demonstrated, through the use of stable water isotopes, tritium and carbon-14, that seawater intrusion was not the main mechanism responsible for the high salinity observed in groundwater

near the coast. The study proved that there are at least two main types of aquifer in the area, one in fractured media, which is poorly replenished, and a shallower one, formed by fluvial sediments, which has a significantly higher rate of recharge and is more prone to water quality deterioration. The findings of this project have provided a sound basis for sustainable water resource development and management in the area. The Agency's technical cooperation projects in Ghana also contributed to developing the expertise required to interpret isotope data, as well as to building capabilities for

## MORE ACCURATE ISOTOPE MAPS

The stable oxygen and hydrogen isotope compositions of meteoric waters (i.e. precipitation, rivers, lakes and shallow groundwater) are used to trace water sources and hydrological processes in a wide range of environmental disciplines, including hydrology, climate and palaeoclimate studies, atmospheric sciences, ecology and forensics. These applications use the isotopic composition of present-day precipitation for which the Agency's Global Network of Isotopes in Precipitation (GNIP), a programme operated since 1961 in cooperation with the World Meteorological Organization, is the primary source of global data. In recent years, there has been a growing demand in many environmental sciences for isotope maps covering different spatial and temporal scales. Because the data are provided by individual stations and GNIP is limited to point measurements, there are substantial gaps, in both time and space, requiring the estimation of isotope contents of meteoric waters at the global scale based on the observations provided by the GNIP data set.

To address this need, the Agency has developed a new method for the interpolation of isotope data. This method, based on the use of regionally defined climatic regression coefficients, resulted in the production of more accurate isotope maps than those previously available. In addition, the Agency's new method provides the ability to generate isotope maps at variable time and space intervals (for example, monthly or yearly at regional or local scales). Different isotope maps are being made accessible on-line to scientists and other users of environmental isotopes in many disciplines.




*Distribution of long term oxygen-18 contents of precipitation obtained through the interpolation of data from GNIP.*

*FIG. 2. Sampling campaign for isotope and hydrochemical analysis of groundwater in southern Ghana.*

the analysis of stable water isotopes and tritium (Fig. 2).

An Agency regional technical cooperation project in the Asia and Pacific area addressing the assessment of fresh water quality using environmental isotopes and chemical techniques was completed. Thirteen Member States showed marked progress in the acquisition and interpretation of isotope data to address key issues related to water resources assessment and management. These issues included the identification of groundwater recharge sources, and groundwater flow and transport, as well as inter-aquifer hydraulic connections, and characterization and assessment of the impact caused by natural and human-made pollution sources, such as arsenic, fluoride, iron or nitrate.