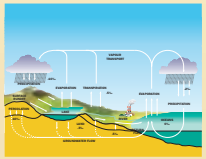
Nubian Aquifer Project

IAEA Water Resources Programme | UNDP | GEF

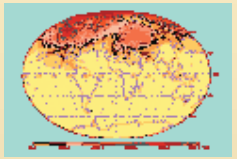
Water "fingerprints" where do they come from?

During evaporation and condensation of water, the concentration of oxygen and hydrogen isotopes (naturally-occurring atoms of different mass) change. Water vapour rising from the oceans carries a lower concentration of heavy isotopes than seawater. When the resulting clouds release water, the heavy isotopes fall out first. As clouds move inland, their isotopic composition again changes, and the water acquires individual and characteristic "fingerprints" in different environments.

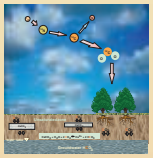
There are other isotopes in rainwater, such as tritium and carbon-14, whose concentration decreases with time. These isotopes in surface or groundwater can be measured to determine the "age" or residence time of water within a particular water body.



Oxygen isotopes in the water cycle



Mean tritium concentration in rain and snow, July 1963 (82 stations)



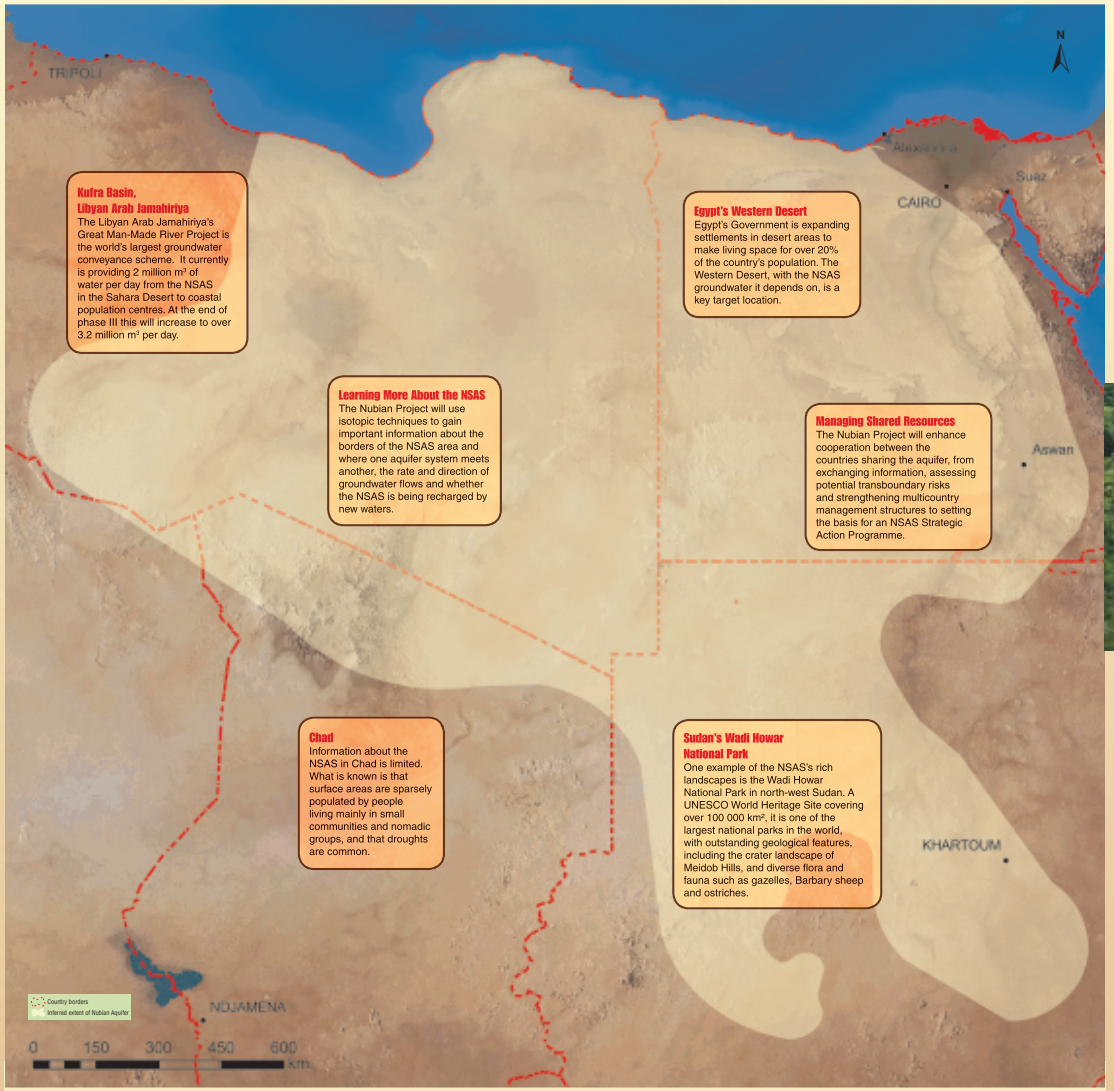
Schematic of how Carbon-14 gets into groundwater

What can we learn from rain and moisture?

The ultimate source of our water resources is air moisture, which condenses to produce rainfall and snow. Knowledge of the isotopic composition of precipitation is essential for the practice of isotope hydrology.

The GNIP database currently includes nearly 90 000 records from 700 stations located in 101 countries

The IAEA coordinates a Global Network of Isotopes in Precipitation (GNIP), which is used to identify the source areas of surface water catchments and groundwater reservoirs. It is also used to help predict changes in rainfall patterns due to climate change. An initiative "Moisture Isotopes in the Biosphere and the Atmosphere" (MIBA), was launched in 2005 to monitor the isotope composition of moisture in plants, soils and air. This effort will provide an understanding of how soil moisture availability and atmospheric humidity affect precipitation patterns under changing climatic conditions.



Kufra Basin, Libyan Arab Jamahiriya
The Libyan Arab Jamahiriya's Great Man-Made River Project is the world's largest groundwater conveyance scheme. It currently is providing 2 million m³ of water per day from the NSAS in the Sahara Desert to coastal population centres. At the end of phase III this will increase to over 3.2 million m³ per day.

Egypt's Western Desert
Egypt's Government is expanding settlements in desert areas to make living space for over 20% of the country's population. The Western Desert, with the NSAS groundwater it depends on, is a key target location.

Learning More About the NSAS
The Nubian Project will use isotopic techniques to gain important information about the borders of the NSAS area and where one aquifer system meets another, the rate and direction of groundwater flows and whether the NSAS is being recharged by new waters.

Managing Shared Resources
The Nubian Project will enhance cooperation between the countries sharing the aquifer, from exchanging information, assessing potential transboundary risks and strengthening multicountry management structures to setting the basis for an NSAS Strategic Action Programme.

Chad
Information about the NSAS in Chad is limited. What is known is that surface areas are sparsely populated by people living mainly in small communities and nomadic groups, and that droughts are common.

Sudan's Wadi Howar National Park
One example of the NSAS's rich landscapes is the Wadi Howar National Park in north-west Sudan. A UNESCO World Heritage Site covering over 100 000 km², it is one of the largest national parks in the world, with outstanding geological features, including the crater landscape of Meidob Hills, and diverse flora and fauna such as gazelles, Barbary sheep and ostriches.

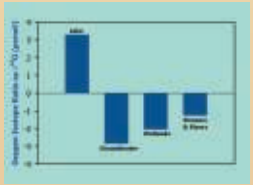
Where does river water come from?

Stream and river waters originate through contribution from various sources. The changes in isotopic composition of a river along its length allow one to quantify inputs from groundwater and tributaries. New developments in dating techniques of groundwater will permit managers to predict the response of surface water to land use change.

The IAEA has initiated the Global Network of Isotopes in Rivers (GNIR) to help monitor and pre-empt hydrological changes that may have a deleterious effect on water quality.

Does groundwater contribute to lakes and wetlands?

Lakes and wetland habitats serve an important role in maintaining water quality within catchments. Managing these systems depend on knowledge of the sources of water, especially at a time of stress such as extended droughts.



For example, the water balance of Lake Victoria is dominated by direct precipitation and evaporation. Isotopic data show that no significant lake water is lost by flow into the adjacent shallow aquifer system. Furthermore, the wetlands at the fringes of Lake Victoria are sustained by groundwater and not lateral flow from the lake.