WATER & ENVIRONMENT NEWSLETTER

A newsletter of the
Isotope Hydrology Section
International Atomic Energy Agency
Vienna

Issue 16, November 2002

SPECIAL ISSUE ON THE GLOBAL NETWORK OF ISOTOPES IN PRECIPITATION

(credit: L. Gourcy/IAEA)

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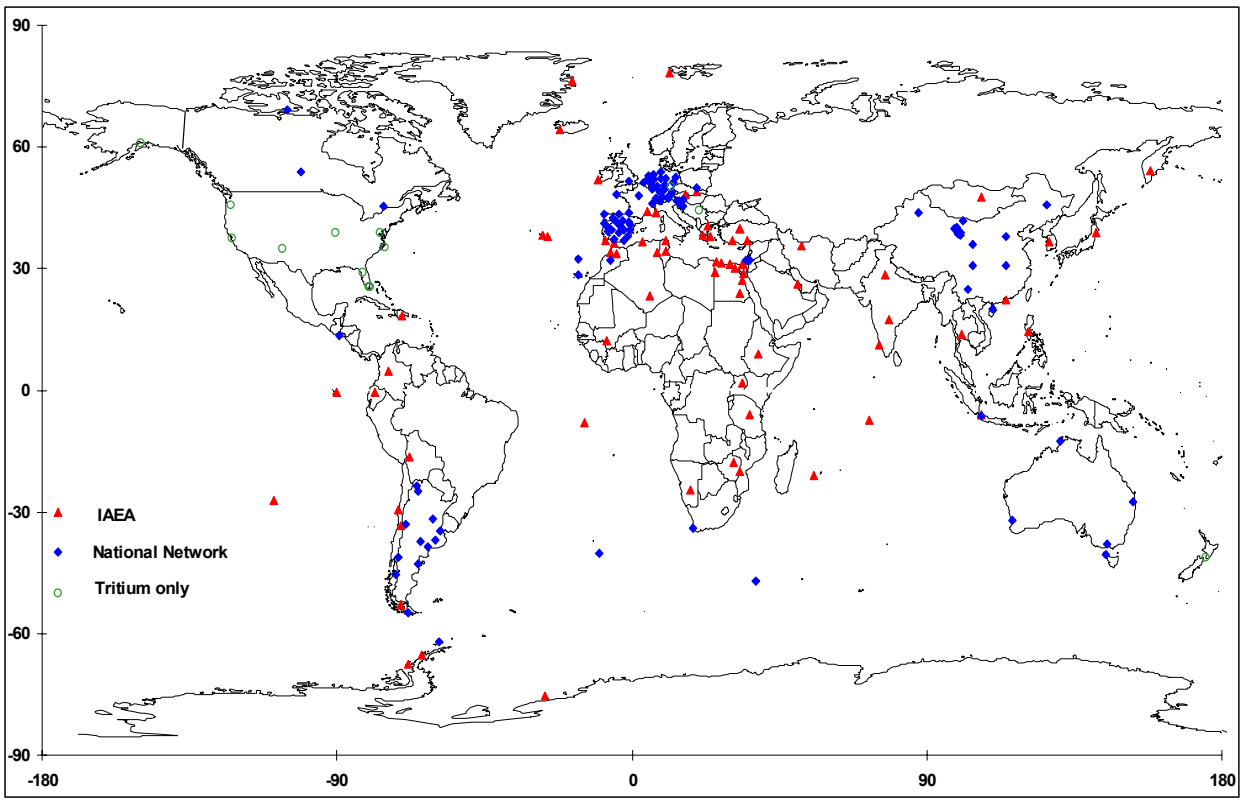
ISSN 1020-7120

STATUS OF THE GNIP NETWORK IN 2001



The Global Network of Isotopes in Precipitation consisted of 153 active stations in 2001. As can be seen in the map above, active stations are classified as " IAEA" or " National Network" (NN). The "IAEA" stations are those where national institutes are performing the monthly sampling, compiling the meteorological parameters and shipping samples to the IAEA for isotope analyses. The " National Networks" stations report results to the IAEA, once a year, for their incorporation into the GNIP database.

In 2001, efforts made to contact hydrologists and meteorological services permitted the reactivation of stations in New-Delhi (India), Santana (Dominican Republic), Teheran (Iran) and Jakarta (Indonesia). In addition, isotope and meteorological data from Alexandria and El Cairo (Egypt), N'Dola (Zambia) and Perth-CSIRO (Australia) were received once again for the GNIP database. These stations were previously active, but data was not being sent to the IAEA.

New stations were opened in Dax (France), Algiers (Algeria), Haut-de-Sainte-Rose (La Réunion, France) and Quezon City (Philippines). The national networks of Spain and China increased the number of active stations respectively by 15 and 9 units. As part of a research programme on Mediterranean climate study (see page 4), about 20 short-term stations were opened. It is expected that, after data interpretation, some of these stations will be selected for long-term observation of the Mediterranean basin.

A two-year delay is neede for data analyses and quality control and to allow data provider to publish their data if desired. Therefore, the 1999 data were recently entered into the GNIP/ISOHIS database and are now available for download through the Internet page. From the 153 active stations, the data of 44 stations are not yet in the database because part of the information is still missing.

The net increase of stable isotope data entered into the GNIP database, 10 % from 1998 to 1999, is very encouraging for the scientific and water management community but should not mask the still significant disparity in geographical distribution. Only 36 stations are active in the Southern hemisphere. Stations located on islands represent only 10 % of the total number of stations and are very difficult to maintain.

WEB NEWS ON GNIP/ISOHIS

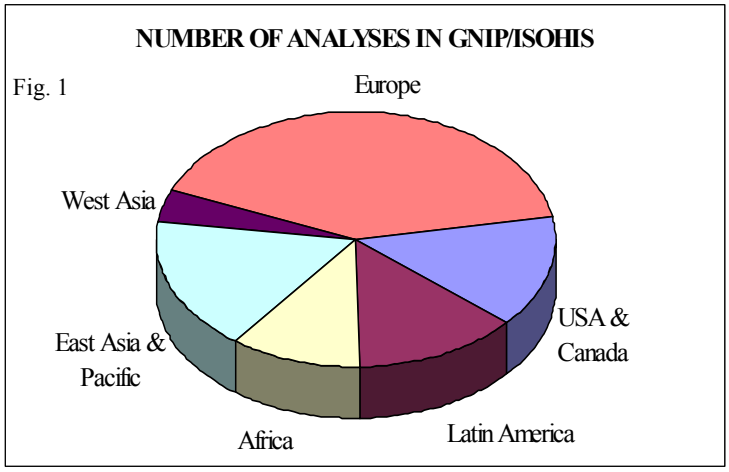
In 2001, the new Website including data from ISOHIS and GNIP was fully operational. Information on 1500 samples for hydrogeological projects and more than 86000 data on precipitation are actually available on the Internet and can be easily downloaded. For all statistics reported in this article, GNIP information is predominant the ISOHIS/GNIP database.

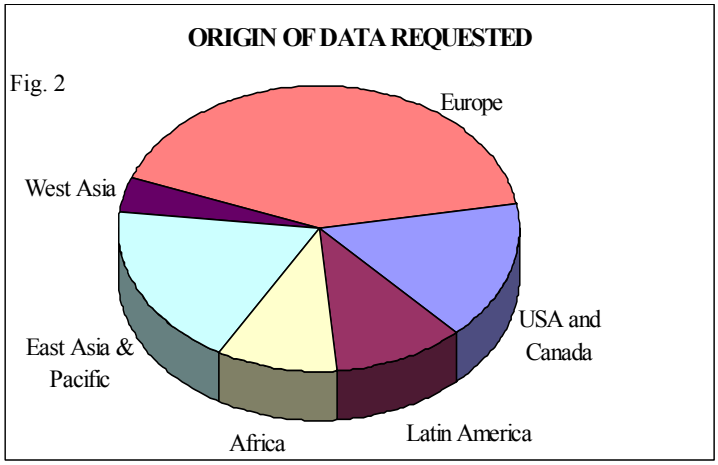
In 2001, 840 persons were registered to access the GNIP/ISOHIS Internet page with about 100 new users per month. Most of the users come from developed countries such as USA (30.3% of total registered users), France (7.9%), Germany (7.4%), UK (5.9%), Canada (4.7%), Japan (4.3%), Australia (4.2%) as they have easy and fast access to Internet and use isotope techniques as a classical hydrogeological tool.

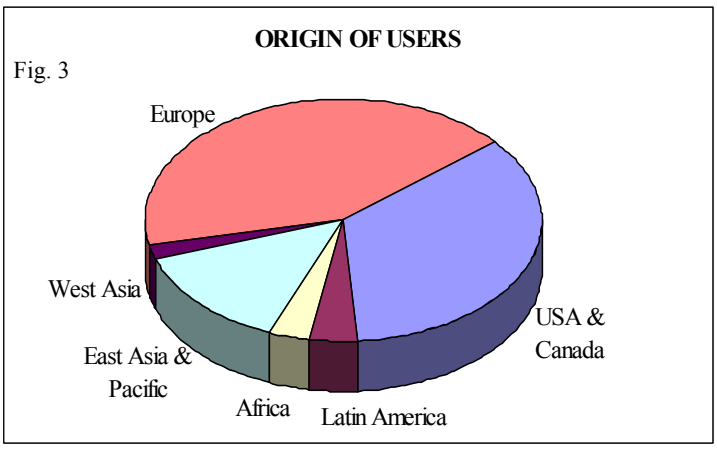
Looking at the origin of the data requested and analysis entered into the database (fig. 1 and 2), a similar regional distribution of the information can be observed. 41% of the downloads are in European countries, 55% of them from Germany, Austria, France, Switzerland, Spain, UK and Portugal.

In general, the number of users by region (fig. 3) is proportional to the number of data available in GNIP/ISOHIS. This means that, at a regional scale, data users are also data providers. A notable exception exists for the USA that represents 30% of the registered users and only 11% of the data available in GNIP. Graphics tools that could facilitate a wider and easier use of the isotope data and highlight their importance in climate and hydrogeological studies were prepared in 2001.

Global and regional maps of weighted mean annual and monthly $d^{18}O$, $d^{2}H$ and d-excess in precipitation. The GNIP maps and animation can be seen in the Internet at http://isohis.iaea.org.







THE THIRD GNIP SCIENTIFIC STEERING COMMITTEE MEETING

The 3rd meeting of the SSC took place in Geneva. This was the first time that the SSC meeting took place at WMO Headquarters and it was a good opportunity to identify links between the GNIP and other climate programmes of WMO. Stronger WMO involvement in the management of GNIP will give a boost to the programme and higher recognition with regard to the climate community.

Keith Alverson, Executive Director of PAGES, provided a letter on behalf of the CLIVAR/PAGES Intersection working group expressing strong support for the network. CLIVAR/PAGES recognized the value of GNIP data for both the paleo and climate dynamics communities.

It was suggested that GNIP could be included in the GCOS network to raise the profile of GNIP and facilitate an increased application of these data in climate and hydrology research. GCOS consists of several data networks related to atmospheric, oceanic, and terrestrial observations for climatology. GCOS was established to ensure that the observations necessary to address climate-related issues are defined, obtained and made available to all potential users.

A large part of the meeting was devoted to discuss the design of the network and selection of core stations. The design should reflect the needs of the climate and hydrology communities and be sustainable on a long-term basis.

There are multiple factors for selecting the stations of a core network. The selection process should take into account future development of the database and be based on the following criteria:

- availability of good quality meteorological data (air temperature, vapour pressure, precipitation)
- access to upper air elements (regional moisture, wind, air temperature…)
- reasonable length and high quality of historical record (isotope and rain gauge)
- strategic location within the general circulation

National networks will be asked to select the station(s) which can be entered into the list of core stations.

All information about national networks or individual sampling stations not included in the GNIP programme is welcome. The contact person for the management of the database is:
Laurence Gourcy
(L.Gourcy@iaea.org).

COORDINATED RESEARCH PROJECT ON THE MEDITERRANEAN CLIMATE

A Coordinated Research Project on "Isotopic composition of precipitation in the Mediterranean basin in relation to air circulation patterns and climate" was launched in 2000. The CRP aims to identify and to better define the interactions between climatic conditions and isotopic composition of precipitation in the Mediterranean basin, in order to assess the relative contribution of climatic parameters to the overall climatic change experienced in the region, including precipitation decrease, and to apply the information to hydrogeological systems, especially those that have rapid response to rain events. The scientists involved in this research project first met in Vienna in April 2001 to discuss the national results obtained so far, to describe the sampling methodology and to prepare a coordinated sampling strategy around the Mediterranean basin, in order to integrate data into a regional database as well as to discuss the regional circulation of air masses behaviour.

The work to be conducted in this CRP is expected to contribute to understanding of a) characteristics and variability of d-excess over the Mediterranean area; b) processes controlling mixing layers; c) extreme precipitation events: understanding their isotopic labelling; and d) tritium variability in recent years in the Mediterranean area.

For that purpose, a common precipitation and vapour network has been established for a short-term period (about six months). During this period, about 100 monthly-based precipitation-sampling stations, 30 daily or event-based precipitation sampling and 12 bi-weekly water vapour sampling stations will be active. Stable isotope (^{18}O and ^{2}H), tritium and chemistry will be analysed. The results to be obtained are expected to improve understanding of the relation between isotopes and meteorological parameters and accelerate the development of isotope techniques in climate research.

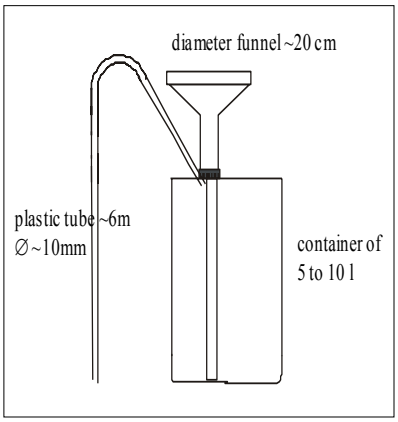
TRITIUM INTERLABORATORY COMPARISON FOR GNIP

The 6th IAEA intercomparison of low-level tritium measurements in water (TRIC2000) was initiated in 2000 and completed in October 2001. The full report is available on the Internet at http://www.iaea.org/programmes/rial/pci/isotopehydrology/interlaboratory_comparisons.htm.

From the 23 laboratories that performed, in recent years, tritium analyses of GNIP samples, 22 participated in the TRIC2000. A set of six water samples was sent to the laboratories. Four laboratories used gas proportional counting and others measured tritium by liquid scintillation counting. Two laboratories performed direct counting without prior tritium enrichment of samples. The results reported are usually consistent with the reported uncertainties.

Reliability of precision can also be visualized by looking at the uncertainty associated with each measurement. 30% of the laboratories reported a too high uncertainty (underestimating their precision) and 22 % a too low uncertainties (overestimating their precision). For almost all laboratories, the results obtained are correct, however, the sensitivity of the measurement is sometimes not sufficient for hydrological purposes. The tritium content in precipitation varied in 1998 from 0.4 to 41.4 TU with a yearly average of 8.7. The monthly variability for a given station ranges from 0.5 TU (Southern hemisphere) to 24.7 TU (Northern Hemisphere). For such a tritium level, accuracy is quite poor for four GNIP laboratories.

A NEW DEVICE FOR MONTHLY RAINFALL SAMPLING FOR GNIP



To simplify the actual procedure for monthly precipitation sampling using paraffin to avoid evaporation of rainwater stored in the rain gauge, the isotope hydrology laboratory designed and tested a new sampling device.

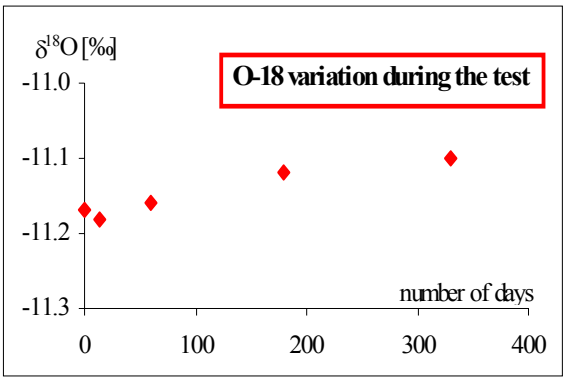
The plastic sampler is home-made and can be built locally. A scheme of the sampler is given below.

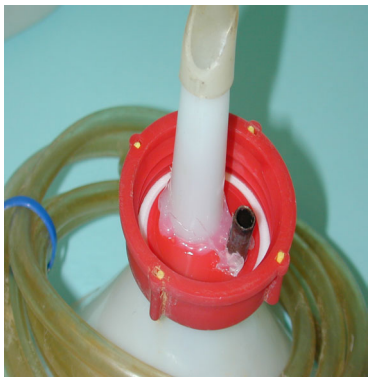
The inflow of the first precipitation prevents further contact of water moisture with the atmosphere. For that purpose, the inner tube has to go up to the bottom of the bottle and therefore only the surface of the diameter of the tube is in contact with the air. It is important that the tube connections at the lower part of the funnel are well welded in order to avoid air exchange through the cap. The external tube is needed for pressure equilibration and it should be long enough to avoid atmospheric air exchange. The system should allow the measurement of the total rain amount.

A WMO standard rain gauge can also be installed close to the sampler system. The plastic container should be protected from the sun and if possible to overheat also. The size of the container depends on the maximum monthly precipitation expected in the region where the sampler is installed.

For example, in 94% of cases a 10-litre container would be sufficient (considering a funnel of 20 cm diameter) for the GNIP stations.

The test performed in the Isotope Hydrology Laboratory in 2001/2002 consisted of exposing outside, during one year, the sampling device filled with water and protected by a roof to avoid rain entry. A sample was taken from the container after 13, 60, 180 and 330 days. Samples were analysed for ^{18}O and ^{2}H content. There was no significant variation of stable isotope content within the first 60 days. The test included the hot summer period.





PERSPECTIVES - PREPARATION OF A RIVER NETWORK

While the scope of river basin hydrological research and monitoring has expanded in recent years, hydrological processes in river basins, particularly at the large scale, have remained difficult to quantify using conventional physical approaches alone.

The stable isotopes are particularly useful for assessing relative contributions of flow derived from uniquely labelled geographical sources or distributed components such as direct precipitation runoff, shallow and deep groundwater, and surface waters including lakes and wetlands. Contributions are expected to proportionately differ in each system depending on the physical setting of the drainage basin as well as climatic parameters. Isotopic composition of discharge in river waters will reflect the cumulative influence of hydrological processes from precipitation to discharge, including the influence of snow, melting glaciers, dams, lakes, karst terrain, altitude, arid zone evaporation, snow melt events, and tributaries. In particular, the rate and amplitude of seasonal isotope variations in large river basins is expected to be a good indicator of effective groundwater reservoir volumes and interaction. In this respect, sizeable, well-connected groundwater systems will tend to dampen short-term variability in river discharge.

The radioactive isotope, tritium (^{3}H), incorporated in the water molecule, has also proven to be an effective tracer for river basin studies. By comparative analysis with precipitation data from GNIP, historical tritium records have been helpful in resolving characteristics of river basins, including average residence time of water within the basin, and resolution in some cases has been substantially improved by use of combined ^{3}H-^{3}He methods and chlorofluorocarbons (CFCs).

The newly initiated Coordinated Research Project (2002-2005) on "Isotope Tracing of Hydrological Processes in Large River Basins" will provide a comprehensive and coordinated approach to study hydrological processes in large river basins. The study will focus on analysis of discharge records in river basins located in a variety of hydroclimatic regions. Overall, the CRP is expected to provide groundwork and a scientific rationale for development of an operational **"Global Network of Isotopes in Rivers" (GNIR)** to enhance understanding of the water cycle of river basins and to assess impacts of environmental and climatic changes on the water cycle.

Currently, the GNIP network is the only global isotope database available for large-scale hydrologic and climatic research and model validation. Monitoring of the isotope composition of discharge in large rivers is another potentially powerful hydrologic and climatic indicator that has to date only been systematically monitored in a few areas. Comparison of GNIP data and the isotopic composition of liquid outputs from a network of large rivers is expected to contribute significant additional information on the basin-integrated hydrological processes (evaporation, transpiration, runoff, storage, groundwater exchange etc.). The complimentary value of monitoring both discharge and precipitation is well known from physical studies of basin hydrology, and hence has remained a priority of national hydroclimate monitoring networks around the world. In an analogous way, the concurrent collection of precipitation and discharge for isotope composition is expected to be of particular value for isotope-based hydrologic research at the large scale, and could potentially open new doors and new opportunities for understanding the water cycle in large basins.

The first RCM of IAEA Coordinated Research Project on Isotope Tracing of Hydrological Processes in Large River Basins (2002-2005) was held in Vienna during 13-16 May 2002. The meeting involved research groups from 17 countries who met to discuss and develop a conceptual framework and methodology for the new large river basin programme which involves individual studies on all inhabited continents, spanning a wide range of hydrological and climatic regimes. The group will undertake the task to build and test a set of transferable isotope techniques that will help to demonstrate the scientific rationale for a global river isotope monitoring system. Although the groups have wide-ranging interests ranging from water budget studies, hydrologic change, water quality, salinity, pollution tracing and monitoring of climate changes and human development impacts, the common intersection of the groups' interest is the development of isotopes techniques for characterizing water balance processes using $d^{18}O$ and d^2H contained in the water molecule. While the next coordination meeting is planned for the 1st quarter of 2004, the group has made tentative plans to gather for a special session in Vienna during the 40th Anniversary Isotope Hydrology Meeting in May 2003.

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SYMPOSIUM ON ISOTOPE HYDROLOGY

INTERNATIONAL SYMPOSIUM ON ISOTOPE HYDROLOGY
- First Announcement and Call for Papers

The 40th Anniversary International Symposium on Isotope Hydrology and Integrated Water Resources Management will be held 19-23 May 2003 in Vienna, Austria!

1. INTRODUCTION

Scarcity of freshwater, degradation of its quality, and increasing demand has motivated ongoing concern in the international community for more effective utilization of freshwater resources. The IAEA's symposia on the use of isotope techniques in water resources development and management have become a recurrent event held every four years. They have provided an international forum for a comprehensive review of the present state-of-the-art and recent advances made in this specific field as well as a basis for delineation of further research and development needs. The year 2003 marks the 40th anniversary of the first IAEA water resources symposium. Increasing use of isotope techniques over the past four decades, in part due to efforts of IAEA, has enhanced availability and effective use of isotopes to address water resources management issues. On this occasion, the Symposium will address the major themes of the meeting by featuring invited reviews from both pioneering scientists and contemporary experts.

2. AUDIENCE AND TOPICS

The Symposium will cover a multi-disciplinary spectrum of research and applications of isotope techniques. The participation of isotope specialists, hydrologists, hydrogeologist, geochemists, environmental scientists and water managers is welcomed. The Organizers further encourage the participation and contribution of graduate students in these fields. The IAEA welcomes high-quality contributions that demonstrate the application of isotopes as an integrated part of water resources science and management practices, particularly in the following areas:.

-Water cycle processes in the atmosphere and hydrosphere, including surface water, groundwater, and watershed-based studies.
-Age dating of young groundwaters
-Water, carbon and nutrient cycling processes at the land-ocean-atmosphere interface
-Recent advances in analytical techniques for isotope hydrology
-Field applications of isotopes in groundwater or surface water resources management.

3. PAPERS AND POSTERS

Concise papers on issues falling within the topics outlined in Section 2 above may be submitted as contributions to the Symposium. All papers, apart from invited review papers, must present original work; they should not have been published elsewhere.

Persons who wish to present a paper or poster at the Symposium must submit a two page synopsis (in English) together with the completed Form for Submission of a Paper (Form B), and the Participation Form (Form A) to the competent national authority for official transmission to the IAEA. The two page synopsis must be sent electronically to the IAEA Scientific Secretariat, e-mail: confisohis@iaea.org. Authors are urged to make use of the Extended Synopsis Template in Word 2000 and its user instructions available on the Symposium webpage. The specifications and instructions for preparing the synopsis are given there.

The two page synopsis will be considered by the Programme Committee only if the Participation Form A and Paper Submission Form B have been received by the IAEA through the official governmental channels.

The working language of the meeting will be English. All communications, synopses, abstracts and papers must be sent to the Agency in English.

Water & Environment News, Isotope Hydrology Section, International Atomic Energy Agency, Wagramer Strasse 5, P.O.Box 100, A-1400, Vienna, Austria.
Printed by IAEA in Vienna, November 2002

02-02521