




WATER & ENVIRONMENT

NEWS

A Quarterly Newsletter of the IAEA Subprogramme on Development and Management of Water Resources



Group photo of the 1997 IAEA Symposium on Isotope Studies of Climate Change

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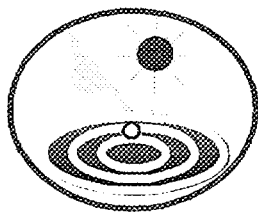
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IAEA SUB-PROGRAMME DEVELOPMENT AND MANAGEMENT OF WATER RESOURCES (1997-1998)

SUB-PROGRAMME OBJECTIVES

- to assist, through integration of isotope techniques in applied research and practical applications, in solving practical problems related to sustainable and efficient management of water resources.
- to promote research and field studies related to man-induced changes and hydro-climatic influences on the water cycle and its interaction with other geospheric systems.

PROJECTS IN THE SUB-PROGRAMME

Human Impact on Water Resources (F4.01)

- to further develop and enhance applications of isotope methodologies in the assessment of adverse consequences of present water utilization practices.

- to achieve improved water utilization policies that would minimize water quality degradation caused by human activities.

Water Resources in Regions of Water Scarcity (F4.02)

- to contribute to and improve the assessment and protection of water resources in regions of water scarcity, in particular in arid and semi-arid areas.

- to assist Member States in such regions to incorporate isotope methods into routine practices for the determination of hydrological parameters for optimum utilization of scarce water resources.

Hydro-climatic Changes and Impact on Catchment and Surface Water Systems (F4.03)

- to assess and demonstrate the applicability of isotope techniques in selected studies of the hydro-sphere and atmosphere related to natural and man-induced environmental

changes

- to enable better prediction of their future implications on water resources.

- to enhance the contribution of isotope applications for improved understanding of fluvial processes and

- to minimize the adverse effects of such fluvial processes on soil and water resources.

Analytical Services and Quality Assurance (F4.04)

- to provide assistance in the determination of the isotope and chemical composition of water and other environmental materials and to assure analytical quality.

Support to Technical Co-operation Programmes (F4.05)

- to provide technical support to the Agency's technical co-operation projects in Member States.

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These projects are being implemented by the Isotope Hydrology Section and the Agency's Laboratories

FOREWORD

In recent years, isotope applications in hydrology and water resources assessment have reached a notable level of maturity. Adequate investigations have been carried out to provide sufficient examples for practical applications in combination with other hydrological methods.

Since it was founded in 1958, the International Atomic Energy Agency has been actively engaged in the promotion of applied research directed towards the development of isotope techniques and their applications in the water sector of Member States.

Keeping in mind that integrated planning and management covering the whole water cycle is related to the goal of sustainable development in many parts of the world, the thrust of the Agency's activities in this field is towards incorporation of isotope techniques in regional and national programmes in water resources development and

management, with emphasis on regions suffering from water scarcity. Issues such as the assessment of human impact on water resources (e.g. water pollution of the drinking water supply in large urban areas) and hydrological aspects of geothermal resources development are currently matters of concern.

Recognizing the impact of global warming on water resources, the applied research programme on isotope hydrology has recently been expanded to include a component on hydroclimatic changes and impact on catchment and surface water systems including, inter alia, studies on the isotopic composition of atmospheric greenhouse gases. An integral part of the programme is the furthering of analytical developments and provision of analytical services and quality assurance by the Agency's isotope hydrology laboratory. New challenges of the programme include the enhanced use of the Global Network for Isotopes

in Precipitation (GNIP), especially for climatological studies, and the establishment of an isotope hydrology database.

The efficient implementation of this programme requires closer collaboration and enhanced co-operation with international organizations and the whole scientific community engaged in water and environment investigations. This News Bulletin was conceived to this end, and it is hoped and expected that it may contribute to the exchange of information among the scientific community in isotope hydrology.

I would like to encourage the efforts to launch the first issue of the news bulletin and I wish this endeavor full success.

R.M. Iyer, Director
Division of Physical and
Chemical Sciences

EDITORIAL

"Water and Environment News" will brief the reader on news related to isotope applications in the water and environment sector. It will bring the reader up to date on what is going on in the various projects constituting the IAEA sub-programme entitled "Development and Management of Water Resources", and will highlight new results and achievements made in implementing the programme activities, including those jointly carried out with other organizations and institutes. Furthermore, the news bulletin will serve as an international open forum for the exchange of information in isotope hydrology and related fields. Instructions for contributors to the bulletin may be found in this issue.

This news bulletin will address both professionals and interested

non-professionals and thus its layout has been chosen accordingly. The contributions will be concise and, to the extent possible, illustrated by figures and tables.

"Water and Environment News" edited by the Isotope Hydrology Section, Division of Physical and Chemical Sciences of the IAEA Department of Research and Isotopes, will be published quarterly by the Division of Publications of the IAEA. At a later stage, this news bulletin is expected to be also available through the Internet.

The first issue will make our readers acquainted with general aspects of the Agency's sub-programme on Development and Management of Water Resources, give an overview on past activities and achievements, and highlight current

ones. The Agency's staff involved in all these activities is briefly introduced, and the reader interested in specific aspects of a staff member's work may wish to contact her or him through the given E-Mail address.

I hope "Water and Environment News" will arouse the readers' interest, and we would be pleased to get comments and suggestions which will help us to refine the technical content and/or the layout of this news bulletin. The first issue of "Water and Environment News" is expected to join the multiple contributions to the Agency's 40th anniversary.

Klaus Froehlich, Head
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ISOTOPE HYDROLOGY: A HISTORICAL OVERVIEW OF ACHIEVEMENTS

INTRODUCTION

Development, field verification and application of nuclear science and technology in the overall spectrum of hydrological and hydro-

engineering problems encountered in water resources assessment, development and management has been an integral part of the Agency's programme since its inception in 1958, within the framework of activities related to peaceful applications of nuclear energy. The Agency has been an international focal point for re-

search and development of nuclear technologies in the water sector, for the dissemination of information, and for providing assistance in wide scale applications. The field of "Isotope Hydrology" is now internationally recognized as a scientific discipline within the overall field of earth sciences.

The Agency's efforts in the water sector cover all aspects of the three main categories of isotope methodologies, such as the use of radioactive isotopes as tracers for site-specific investigations related to water movement; the use of sealed radioactive sources for in-situ measurement of hydrological field parameters; and the use of naturally occurring isotopic species for the assessment and study of water occurrence, genesis and flow pathways/dynamics at regional-scale hydrological systems. At present, substantial effort is being directed towards practical

use of proven methods in the Member States through the Technical Co-operation Programme; development and refinement of environmental isotope methodologies through Co-ordinated Research Programmes; and dissemination of

systems, including sediment transport and hydro-engineering problems; and analytical and instrumentation techniques. The number of TC projects in the field of hydrology implemented during the last fifteen years is shown in Figure 1. A total

number of 160 technical co-operation projects in 63 countries have been implemented in the last ten years and countries with individual TC projects are shown in Figure 2. The required human resources development in the Member States related to isotope hydrology is being supported by training courses,

workshops and seminars; and the Agency's efforts in this regard during the last few years are illustrated in Figure 3.

Support to research and development has been one of the major contribution, for example, Co-ordinated Research Programmes (CRP) implemented in specific fields have provided substantial impact on the development and verification of new methodologies as well as refinement of the existing applications. The titles of the CRP's implemented and completed during the last ten years are listed below.

Completed Co-ordinated Research Programmes

- Nuclear Techniques in the Study of Pollutant Transport in the Environment
- Application of Environmental Isotope Techniques in Ground-

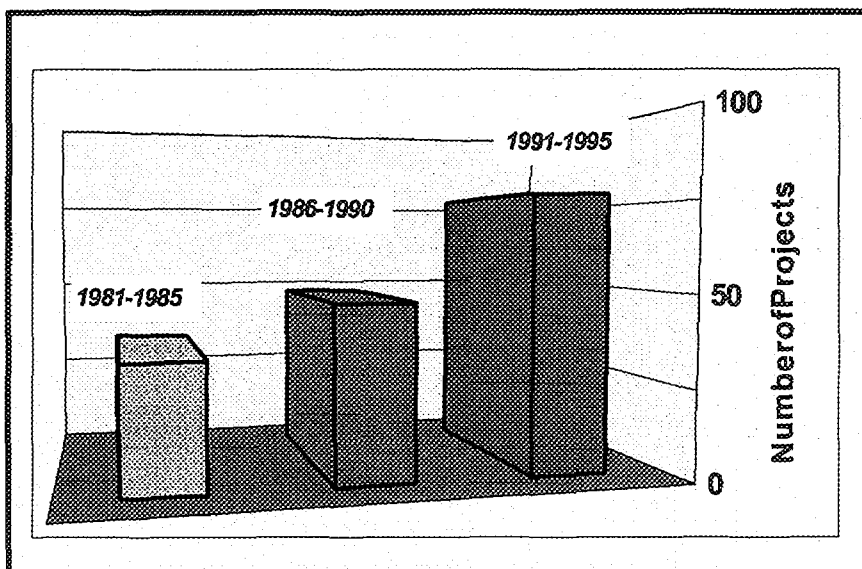


Fig. 1. IAEA Technical co-operation projects in Isotope Hydrology (1981-1995)

information through meetings, training courses and seminars.

HIGHLIGHTS OF PAST ACHIEVEMENTS

Assistance provided by the Agency in the field of isotope hydrology through the Technical Co-operation programmes aimed at the transfer of know-how and technology, and the number of projects implemented during the last four decades have had a continuous increasing trend to meet the needs and requirements of the Member States. The TC programme of the Agency in isotope hydrology covers a broad spectrum, involving applications related to hydrogeological investigations of groundwater occurrence, sub-surface flow, transport dynamics and hydraulic interactions (including geothermal systems); applications in surface water

- waterProblems
- Application of Isotope and Geochemical Techniques in GeothermalResources ExplorationinLatinAmerica
 - Application of Isotope Techniques to Hydrology in the LatinAmericanRegion
 - Comparison of Methods for "Age" Determination of GroundwaterBasedonDecay ofLong-livedRadioisotopes
 - DatingofOldGroundwater
 - IsotopeTechniquesforthe Assessment of Slow Moving Deep Groundwater and Their Potential Application for the Assessment of Waste DisposalSites
 - Isotope Variations of Carbon Dioxide and Other Trace GasesintheAtmosphere
 - Isotopes and Geochemistry in Geothermal Exploration in Africa, Asia and the Pacific, andtheMiddleEast
 - Joint IAEA/GSF Programme for Studying the Physical and IsotopicBehaviorofSoil MoistureintheZoneofAeration
 - Mathematical Models for QuantitativeEvaluationof IsotopeDatainHydrology
 - Use of Nuclear Techniques in palaeoclimatology - ContinentsIsotopeIndicatorsof Paleoclimate

Exchange of information through Agencypublicationsresultingfrom specificmeetings,symposia organized,CRP'sandTCprojects providedvastamountofscientificand practical information covering the whole spectrum of isotope methodologies. Someofthemajor publications produced by the Agency related to isotope hydrologyaregiveninthefollowinglist.

Priced Publications

- StudiesonSulfurIsotope Variations in Nature, 1987, Mono-graph;
- Isotope Techniques in Water Resources Development, 1987, Proceedings of a symposium;
- Isotope Techniques in The

- Study of The Hydrology of Fractured and Fissured Rocks, 1989, Monograph;
- Environmental Isotope Data No.9:WorldSurveyofIsotope Concentration in Precipitation (1984-1987),1990, Series Publication;
- Isotope Techniques in Water Resources Development 1991, 1992;
- StatisticalTreatmentofDataon EnvironmentalIsotopesin Precipitation, 1992;
- Isotopes of Noble Gases as TracersinEnvironmental Studies, 1992;
- Isotope Techniques in the StudyofPastandCurrent Environmental Changes in the HydrosphereandtheAtmosphere, 1993

- EnvironmentalIsotopeDataNo. 10: World Survey of Isotope Concentration in Precipitation (1988-1991),1994
- Isotopes in Water Resources Management, 1996

Technical Documents (unpriced)

- Isotope Applications in Hydrology in Asia and the Pacific, 1988;
- Isotope Hydrology InvestigationsinLatinAmerica, 1989;
- Isotope Methods in Environmental Studies, Hydrology and Geochemistry, 1990;
- Use of Artificial Tracers in Hydrology, 1990;

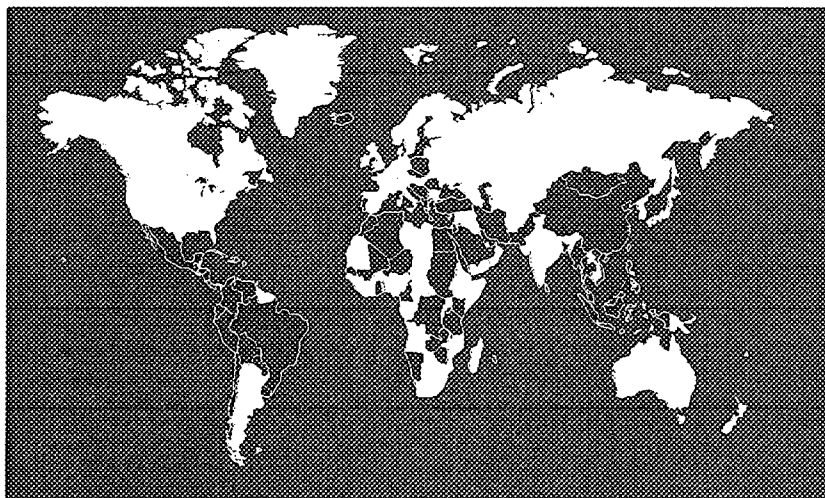


Fig. 2. Countries with National Technical Co-operation Projects from IAEA in Isotope Hydrology (1987-1997).

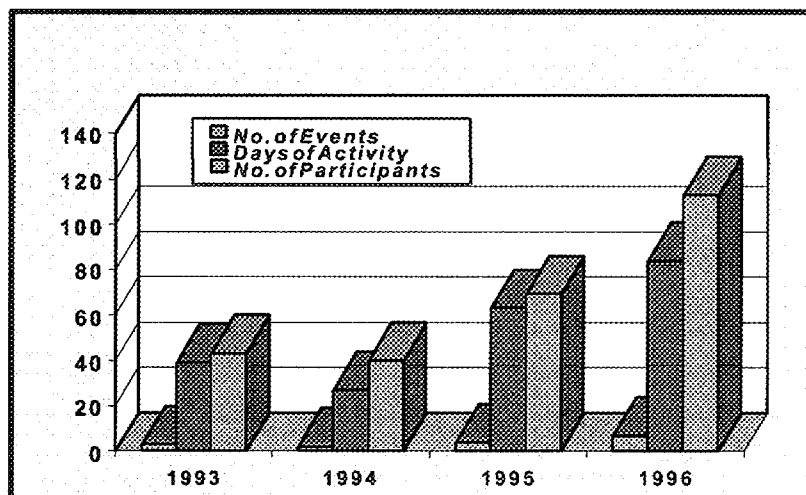


Fig. 3. IAEA Training Courses, Workshops and Seminars in Isotope Hydrology (1993-1996).

- Geothermal Investigations with Isotopes and Geochemical Techniques in Latin America, 1992;
- Nuclear Techniques in the Study of Pollutant Transport in the Environment. Interactions of Solutes with Geological Media (Methodological Aspects), 1993;
- Water Resources in the Sahel: Hydrogeological and Hydrological Studies in West Africa Using Isotope Techniques (in French) 1993;
- Isotopic and Geochemical Precursors of Earthquakes and Volcanic Eruptions, 1993;
- Mathematical Models and their Application to Isotope Studies in Groundwater Hydrology, 1994;
- Isotope Hydrology Investigations in Latin America, 1994;
- Use of Nuclear Techniques in Studying Soil Erosion and Siltation, 1995;
- Reference and Inter-comparison Materials for Stable Isotopes of Light Elements, 1995;
- Isotope and Geochemical Techniques Applied to Geothermal Investigations, 1995;
- Isotope Field Applications for Groundwater Studies in the Middle East, 1996;
- Manual on Mathematical Models in Isotope Hydrology, 1996.

FUTURE OUTLOOK

At present, more than a quarter of the world's population lack the basic need of a clean water supply, and finite amounts of freshwater resources are under severe stress, both in terms of quantity and quality. The UN International Conference on "Water and Environment" (Dublin, 1992) has reiterated that:

"Scarcity and misuse of freshwater pose a serious and growing threat to sustainable development and the protection of the environment; and human health and welfare, food security, industrial development and the eco-systems on which they depend are all at risk unless water resources are managed more effectively in the present decade and beyond than they have been in the past."

In recognition of the utmost global importance of reliable assessment

of available freshwater resources and the need for more effective management practices to minimize the adverse man-induced effects on water resources, the Agency's programme component on "Development and Management of Water Resources" will emphasize development and wider scale application of nuclear science and technology in high priority areas including problems related to human impact on water resources, such as over-exploitation, water pollution including water salinization, impact of urbanization on water resources (particularly urban hydrology of megacities), improved water resources management in water scarce arid regions and isotope applications related to climate change and its impact on water resources. The overall activities supported and implemented by the Agency will emphasize a mandate of achieving a visible practical impact of nuclear science and technology in the effective management of water resources.

BECOME A CONTRIBUTOR TO WATER AND ENVIRONMENT NEWS

Contributions from counterparts in Member States and organizations (institutes cooperating with the Agency in the water and environment sector) are most welcome for inclusion in the newsletter. Contributions could be for one of the following sectors for which the scope has been proposed as follows.

Features publishes articles with views & opinions, reviews of isotope hydrology and relevant programmes, reviews of technological development.

Research & Development highlights outcomes of CRPs completed, scopes and objectives of new ones, suggestions and criticisms from participating institutes or chief investigators involved.

Technical Cooperation highlights TC activities and major achievements, views and opinion towards the implementation of the projects from counterparts.

Training Activities reports on training activities completed, early information on planned new ones, views from trainees.

Scientific Highlights introduces new approaches, achievements and successful practical applications or case studies in isotope hydrology and related disciplines.

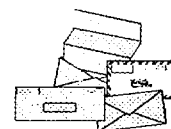
Letters to the editor reflects feedback from readers, comments, criticisms and suggestions on the newsletter.

Articles and reports must not ex-

ceed 2000 words (figures and tables inclusive). Informative figures and tables are always encouraged to be combined with the text. An electronic version accompanying the hardcopy is preferred.

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CURRENT PROGRAMME AND PROJECTS: A PROFILE

A complete description of the Agency's sub-programme in isotope hydrology entitled "Development and Management of Water Resources" for the 2-year cycle of 1997-1998 can be found on the inside front cover of this newsletter. In the following, a brief review of current activities related to the projects "Human Impact on Water Resources", "Water resources in Regions of Water Scarcity", "Hydroclimatic Changes and Impact on Catchment and Surface Water Systems" and "Support to Technical Cooperation Programmes" will be given. Information on the Isotope Hydrology Laboratory's involvement in the sub-programme, especially the project "Analytical Services and Quality Assurance" will be provided under a specific headline.

CO-ORDINATED RESEARCH PROJECTS

The co-ordinated research programme (CRP), which brings together a group of related contracts and agreements with a concrete research focus, is a common form of implementation in terms of research and development. The main scopes and objectives of the operational CRPs are as follows:

Isotope Techniques in Groundwater Pollution Studies (1994-1998)

to investigate by isotope techniques the various sources of pollution of groundwater, including the identification of pollution sources, level of pollution, prediction of movement of pollutants and possible control as well as mitigation of contamination.

Isotope Techniques in Lake Dynamics Investigations (1994-1997)

to foster the application of environmental isotope techniques in lake

studies, in order to assess in a systematic way their potential and limitations. Studies related to lake water and chemical balance, lake water dynamics, particle and dissolved solid dynamics (including contaminants), sediment dynamics, and palaeolimnological studies are supported.

Isotope Techniques in Water Resources Investigations in Arid and Semi-Arid Regions (1994-1997)

to focus on topics such as salinization and irrigation return flux, and aquifer vulnerability to diffusive pollution in order to improve the assessment of groundwater resources in terms of their replenishment and protection towards more efficient management and sustainable development of groundwater resources in arid and semi-arid regions.

Isotope-Aided Studies of Atmospheric Carbon Dioxide and Other Greenhouse Gases-Phase 2 (1995-1998)

to understand the behavior of major greenhouse gases (carbon dioxide and methane, and some other trace

gases such as carbon monoxide and possibly krypton and radon) in the global ecosystem through observations of temporal and spatial variability of their isotopic composition at selected locations, combined with relevant modeling work.

Isotope-Based Assessment of Groundwater Renewal and Related Anthropogenic Effects in Water Scarce Areas (1995-1998)

isotope-based determination of recharge and discharge regime of aquifers in selected regions of water scarce areas in the Middle East, Africa and several areas of Asia and Latin America, where an alarming prognosis of depletion of available water resources has been made due to population growth and intensive use of water for agricultural and other purposes.

Sedimentation Assessment Studies by Environmental Radionuclides and their Application to Soil Conservation Measures (1995-1998)

to control the accelerated erosion and associated soil degradation through development of relevant technologies for measuring soil ero-

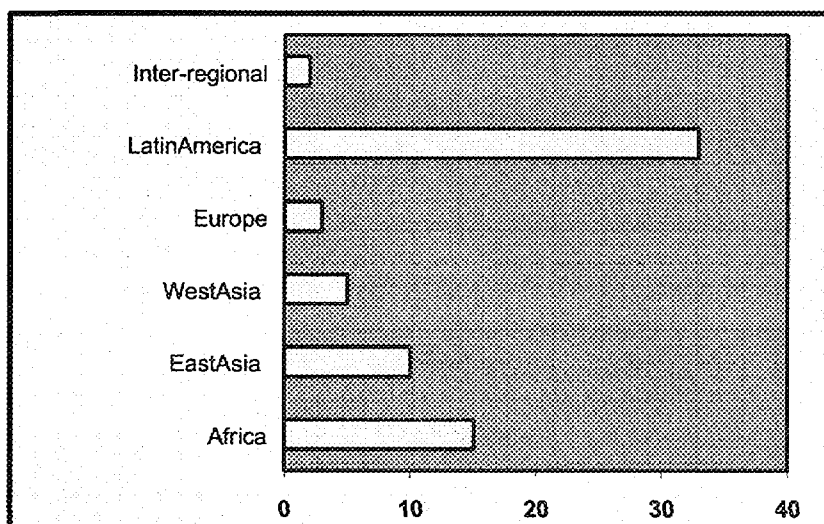


Fig. 4. Regional Distribution of Operational Technical Co-operation Projects.

sion and siltation using fallout and other cosmogenic radionuclides and the generation of reliable erosion data in various agro-ecosystems and land uses using ¹³⁷Cs and other radionuclides.

The Application of Isotope Techniques to the Assessment of Aquifer Systems in Major Urban Areas (1997-1999)

to assess the usefulness of selected geochemical and isotope techniques in addressing the identified assessment needs of aquifer systems located in urban areas. These new methodologies, which in some cases provide unique information, should be further developed and tested under different hydrological and climatic conditions.

The Use of Isotope Techniques in Investigating Acidic Fluids in Geothermal Exploitation (1997-1999)

to improve the application of ³⁴S and ¹⁸O in aqueous SO₄, together with ¹⁸O and ²H in water to field investigations in geothermal energy development. Emphasis is placed on the investigation of the origin of acidic fluids in geothermal systems by the use of isotope techniques integrated with geochemical tools. Studies are also supported towards better application of the SO₄-H₂O geothermometry for estimating temperatures and detecting various reservoir processes due to exploitation.

Use of Isotopes for Analyses of Flow and Transport Dynamics in Groundwater Systems (1995-1998)

to assess the applicability of existing conceptual model formulations to field cases through intercomparison of results from different model formulations on actual test cases in order to identify the most efficient modeling procedures for application of isotopes in studies related to pollutant transport simula-

tioning groundwater for water quality management, pollution control and hydrogeological assessment of waste-sites (toxic or nuclear).

Isotope Techniques for the Assessment of Slow Moving Deep Groundwater and Their Relation to Waste Disposal Sites (1997-1999)

to understand groundwater movement in low permeable strata in order to assist the planning of radioactive waste disposal sites. Isotope investigations will be carried out on water extracted from drill cores due to poor availability of free groundwater samples.

TECHNICAL CO-OPERATION PROJECTS

In the appraisal of new TC project proposals for the 1997-1998 programme, due consideration was given to assigning higher priority to those proposals with an immediate practical impact on the assessment/management of water resources.

There are sixty-eight Technical Co-operation Projects on isotope hydrology currently operational. Among these projects, thirty-three are in Latin America (49%), fifteen in Asia (22%), fifteen in Africa (22

%), three in Europe (4%), and 2 inter-regional (3%). This reflects the relatively high demand for technical assistance from Latin American countries in the water sector (Figure 4).

The distribution of topic areas of the projects, on the other hand, shows that a large portion of technical assistance is in the application of isotope hydrology methodologies to groundwater and geothermal studies, which together take up 54% of the total projects; the rest are in the order from high to low according to the number of projects: sedimentology (14%), surface water dynamics (12%), surface and groundwater pollution (12%), and laboratory activity dominated ones (8%) (Figure 5).

TRAINING ACTIVITIES

Training courses held recently are listed below.

Completed Training Courses

- National Training Course on Isotope Techniques in the Unsaturated Zone 1-8 April, 1996, Rabat, Morocco
- Regional Training Course on Advanced Applications of Isotope Techniques to Water Resources Development, 27 May to 7 June, 1996, Lushan, China
- Regional Training Course on the

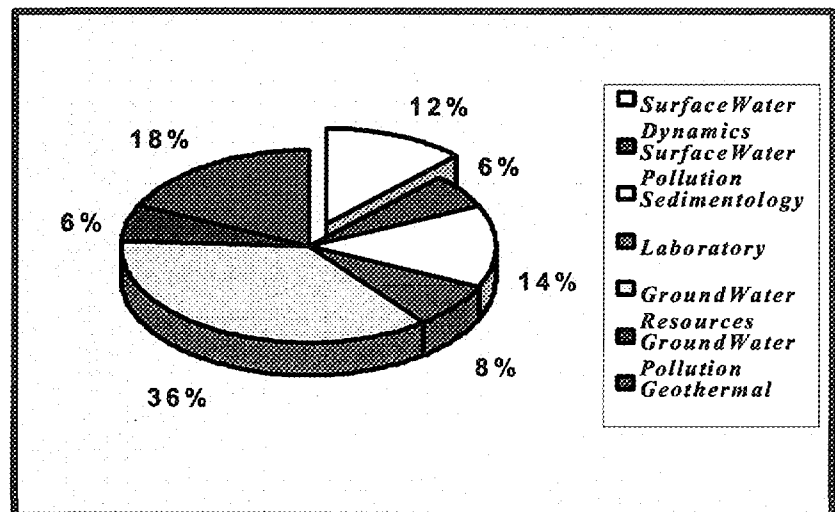


Fig. 5. Topical Distribution of Operational Technical Co-operation Projects.

Application of Nuclear Techniques in Studies of Interconnection Between Surface and Underground Waters, 2-13 September 1996, Santiago, Chile

- Regional Training Course on the Application of Isotope and Geochemical Techniques to Reservoir Management in Geothermal Areas in Latin America, 23 September to 1 October 1996, El Salvador
- Regional Training Course on the Use of Isotope Techniques in Water Resources Development and Management, 11-29 November, 1996, Rabat, Morocco

A group fellowship training in isotope hydrology is being held from 1 September to 31 October, 1997. Another training course entitled "Analytical techniques and quality assurance in environmental isotope analysis" will be held in 1998.

Regular budget resources have been increased by about 2.4% in 1997 to allow for additional tasks to enhance the impact of isotope applications to end users in the water sector of developing Member States.

Activities have been restructured to emphasize the need for integration

of isotope techniques in comprehensive approaches directed towards efficient water resources management, and to encourage cooperation at the national level and between United Nations organizations involved in the water sector. In particular, some additional meetings are planned in which senior management from national water institutions will participate to assess the findings of isotope-aided field investigations and their implications for water resources development programmes.

THE ISOTOPE HYDROLOGY LABORATORY QUALITY ASSURANCE AS ITS PROGRAMME

The Isotope Hydrology Laboratory, located at the IAEA Headquarters in Vienna, plays a substantial role in the dissemination of knowledge about state-of-the-art analytical techniques in isotope hydrology.

The laboratory, employing a staff of often specialists (see the "who is who" sector of this issue) and equipped with advanced analytical facilities (Table 1), is engaged in the analysis of stable isotope ratios of hydrogen, oxygen and carbon in water and solid materials, in low-level radioactivity counting of tritium and ^{14}C , in analysis of water chemistry, and in measurements of CFCs in water and air.

Various sample preparation methods are available for the different scopes of investigations and the required analytical precision. Those methods are continuously upgraded and improved to maintain a high level of analytical performance.

Over the years, isotope hydrology laboratories in 42 Member States were installed or upgraded with the technical assistance of IAEA (Figure 6) and a significant contribution was made by the technical expertise of the IAEA Isotope Hydrology Laboratory through expert

missions and technical assistance.

Special emphasis is put on training in analytical quality assurance for staff of these laboratories. Each year scientists from IAEA Member States are trained in the various analytical methods to enable them to successfully operate these laboratories at high quality standards.

The IAEA Isotope Hydrology Laboratory provides analytical services to Technical Cooperation projects in those Member States without established national isotope hydrology laboratories through measurement

of several thousands of samples each year for about 50 different projects worldwide (Table 2).

The provision of reference materials for isotope hydrology laboratories is a further major part of the activities of the Isotope Hydrology Laboratory. Through the establishment of internationally accepted quality assurance standards in the IAEA laboratories following the ISO 9000 guidelines, the Isotope Hydrology Laboratory will intensify its services as a reference laboratory and will further promote the use of quality assurance schemes in laboratories work-

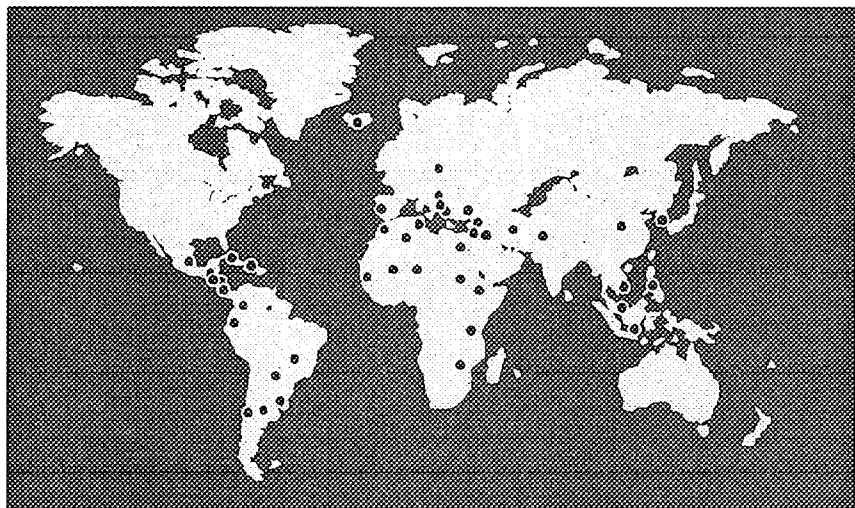


Fig. 6. Countries with Isotope Hydrology Laboratories Assisted by the IAEA.

Table 1. Analytical capability of the IAEA Isotope Hydrology Laboratory

Equipment	Quantity	Type	Duty
Mass Spectrometers	4	Self-made MS	² H, ¹⁸ O, ¹³ C
		Finnigan MAT 250	² H
		Finnigan MAT 251	² H
		Finnigan Delta+	² H, ¹⁸ O, ¹³ C
Liquid Scintillation Analyzers	5	Kontron	³ H
		Aloka	³ H
		Packard 1550	³ H
		Packard 2000	³ H
		Packard 2770	³ H
Proportional Gas Counters	4	Cu Tubes, Quartz Tubes	³ H, ¹⁴ C
Gas Chromatographs	2	Carlo-Erba 6000+TCD	Natural Gas Composition
		Shimadzu 8A+ECD +Sample Preparation	CFCs in Water and Air
ICP Emission Spectrometer	1	Perkin-Elmer Plasma 400	Water Chemistry
Ion Chromatograph	1	Dionex Dx-100	Water Chemistry
UV/VIS Photospectrometer	1	Perkin-Elmer Lambda 2S	Water Chemistry
Sample Preparation Lines	9	H ₂ -Zinc Reduction	² H in Water
		H ₂ -Equilibration	² H in Water
		CO ₂ -Equilibration	¹⁸ O, ¹³ C in Water
		H ₂ /CO ₂ -Equilibration	² H, ¹⁸ O, ¹³ C in Water
		CaCO ₃ Acid Reaction	¹⁸ O, ¹³ C in Carbonate
		SO ₂ -Reduction	¹⁸ O in Sulfate
		2 Tritium Electrolytic Enrichment Lines	³ H in Water
		Air Moisture Extraction	³ H, ² H, ¹⁸ O
		Soil Moisture Extraction	³ H, ² H, ¹⁸ O

ing in the field of isotope hydrology. An isotope hydrology database is under development, which is intended to provide easy access to all relevant hydrogeological data and isotope analysis results within IAEA Technical Cooperation projects. This database will be implemented on an SQL server and will considerably facilitate the availability of results of former studies and other research projects.

This software will also be available for national counterparts to initiate compatible databases in the field of isotope hydrology on an international scale.

Table 2. Approximate Number of Samples Analyzed per Year in the Isotope Hydrology Laboratory

Type of Analyses	Number of Samples
Tritium (³ H)	1200
Hydrogen isotope Ratios (² H/H)	3000
Oxygen isotope Ratios (¹⁸ O/ ¹⁶ O)	3000
Carbon isotope Ratios (¹³ C/ ¹² C)	300
¹⁴ C	150
Water Chemistry	150
CFC	Just Started

UNDERSTANDING CLIMATIC CHANGES

Changes in the atmosphere are heavily influenced by human activities. Assessment of such changes is greatly benefited by examining historical records through isotope measurements in ice cores and sediments, for example. To examine the distinct role that isotopes can play in understanding complex processes affecting climate changes, the IAEA convened the International Symposium on Isotope Techniques in the Study of Past and Current Environmental Changes in the Hydrosphere and the Atmosphere 14-18 April 1997 in Vienna.

In opening the symposium, IAEA Director General Hans Blix expressed concern over the increasing concentration of noxious gases such as SO₂, NO_x and CO₂ from the burning of fossil fuels. He mentioned that nuclear power is economically feasible and at present meets 17% of the world's demand for electricity. It is free of the air polluting gases that

threaten the global climate. He also underlined that programmes of the IAEA on isotope hydrology are helping countries to assess, more fully understand, and manage their water resources, especially where they are affected by environmental changes.

The symposium brought together 180 scientists representing 46 Member States, the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Food and Agriculture Organization (FAO), the World Meteorological Organization (WMO), the World Climate Research Programme (WCRP), and the International Geosphere-Biosphere Programme (IGBP).

In all, 65 scientific papers and 59 posters were presented reflecting scientific efforts towards determining changes in the atmosphere and global ecosystems and to identify anthropogenic influences. Isotopic measurements in natural archives-

such as deep ice cores, palaeowater and lake deposits - are prerequisites for any successful reconstruction of past climates and environmental changes. Only this knowledge can lead to a quantitative understanding of what might happen in the near future. The information, therefore, enables forecasting of the impacts on forest ecosystems, desertification, and water resources, as well as the possible occurrence of floods and droughts.

It was also clear from the symposium that isotope methodologies are essential for precise determination of the atmospheric budget of greenhouse gases, especially their sources and sinks, to enable prediction and identification of the impact of climate change. The proceedings of the symposium are being published by the IAEA.

CO-OPERATION WITH OTHER INTERNATIONAL ORGANIZATIONS

The Agency has established close collaboration with governmental and non-governmental organizations in the field of isotope hydrology, in which special emphasis was placed on activities related to cooperation with UNESCO and WMO. The ongoing International Hydrology Programme (IHP) of UNESCO and the Operational Hydrology Programme (OHP) of WMO are two main international scale projects of specific relevance for enhancing the incorporation of isotope methodologies into regional and international programmes on water and environment.

As priority areas for the collaboration between IAEA and UNESCO within the scope of IHP-V, three main themes were identified: Sedimentation processes in reservoirs and delta areas, the role of unsaturated zone processes in groundwa-

ter quality, and water resources assessment in arid and semi-arid zones. In this regard the Agency will be supporting isotope methodologies to be incorporated into the plan of implementation of two new UNESCO regional projects in arid zones related to "Wadi Hydrology" and "Groundwater Protection".

The collaboration with WMO within their programme on "Operational Hydrology" will be strengthened in the following areas, also included in the Agency's programme on Development and Management of Water Resources: water pollution, groundwater modeling, monitoring of natural and artificial recharge to aquifers (particularly in arid regions), and use of general circulation models to predict changes in hydrological regimes. Steps were taken during 1996 to further strengthen the operation of the Global Network for "Isotopes in precipitation" (GNIP). A

Memorandum of Understanding describing the operational aspects, the commitments of the parties and legal aspects of their cooperation, has been elaborated. The Memorandum of Understanding is aimed at ensuring the continuity of the operation of the Network and the active involvement of IAEA, WMO, and other organizations (IGBP-PAGES and WCRP) supporting the further development of the Network and the multidisciplinary use of its database.

Initiatives were also undertaken to cooperate with other international scientific organizations in the implementation of the Agency's programme on water resources, in particular the International Committee on Tracers (ICT) of the International Association of Hydrological Sciences (IAHS).

ISOTOPE HYDROLOGY CALENDAR

1997

IAEAMEETINGS

1 September-31 October, Vienna, Austria

Group fellowship training in isotope hydrology, Inter-regional Training Course (ITC).

6-9 October, Vienna, Austria
Isotope techniques in water resource investigations in arid and semi-arid regions (RCM)

21-23 October, Vienna, Austria
Use of isotope techniques in investigating acidic fluids in geothermal exploitation (RCM)

28-31 October, Vienna, Austria
Isotope techniques in studying dynamics of slow moving groundwater for the hydrological appraisal of radioactive waste disposal sites, Research Coordination Meeting (RCM)

3-7 November, Vienna, Austria
Potential of isotope methods for water resources management in major urban areas, Advisory Group Meeting (AGM)

2-5 December, Vienna, Austria
Isotope techniques in groundwater pollution studies (RCM)

8-12 December, Vienna, Austria
Isotope-based assessment of

groundwater renewal and related anthropogenic effects in water scarce areas (RCM)

OTHER MEETINGS

29 September-3 October, Vienna, Austria
18th Session of the UN ACC Subcommittee on Water Resources

1998

IAEAMEETINGS

9-13 March, Vienna, Austria
Workshop on isotope-based environmental investigations in the Caspian Sea (International Year of the Ocean)

RCMs to be held for the following CRPs:
Isotope Techniques in Groundwater Pollution Studies" (1994-1998).

Isotope-Aided Studies of Atmospheric Carbon Dioxide And Other Greenhouse Gases - Phase 2 (1995-1998).

Isotope-Based Assessment of Groundwater Renewal and Related Anthropogenic Effects in Water Scarce Areas (1995-1998).

Sedimentation Assessment Studies by Environmental Radionuclides

and their Application to Soil Conservation Measures (1995-1998).

Use of Isotopes for Analyses of Flow and Transport Dynamics in Groundwater Systems (1995-1998).

The Application of Isotope Techniques to the Assessment of Aquifer Systems in Major Urban Areas (1997-1999)

OTHER MEETINGS

16-19 February, Christchurch, New Zealand
SPERA98, Environmental Radioactivity and its Application in Environmental Studies

April, London, UK
PAGES Open Science Meeting

13-17 July, Vienna, Austria
Descriptive, Qualitative and Quantitative Approaches in Soil Erosion and Sediment Transport

16-19 November, Abidjan, Cote d'Ivoire
Hydrological Changes in Africa

16-18 December, Hong Kong, China
International Symposium on River Sedimentation Environmental Hydraulics

ISOTOPES IN WATER RESOURCES MANAGEMENT

The proceedings of a symposium on "Isotopes in Water Resources Management" organized by IAEA in co-operation with UNESCO and held in Vienna, 20-24 March 1995, have recently been published by IAEA.

The main topics addressed in the two-volume book are water resources management, with emphasis on origin and recharge of groundwater, groundwater dynamics and pollution, modeling ap-

proaches, geothermal and palaeowater resources. The remaining discussions were concerned with surface water and sediments, unsaturated zones and methodological aspects.

The proceedings contain the papers of 43 oral presentations and the extended synopses of over 100 poster presentations.



GNIP WITHIN YOUR REACH

A home page on the Global Network for Isotopes in Precipitation (GNIP) was created (Figure 7) and put on the WWW in 1995, associated with a database accessible to the net users. The Web site is <http://www.iaea.or.at/programs/ri/gnip/gnipmain.htm>.

Both the data and the format have been updated. A new version of the database is being prepared and will be ready for visits soon (Figure 8). According to recent statistics, the home page is visited about 200 times per month by users worldwide. Welcome to GNIP on the Internet!

In addition to this, a brochure focused on the GNIP has been published recently by IAEA, IGBP-PAGES, WMO and IAHS. Isotopes in the water molecule are described as an "indispensable tool for understanding both past changes and present behavior of global circulation" in the study on the water cycle.

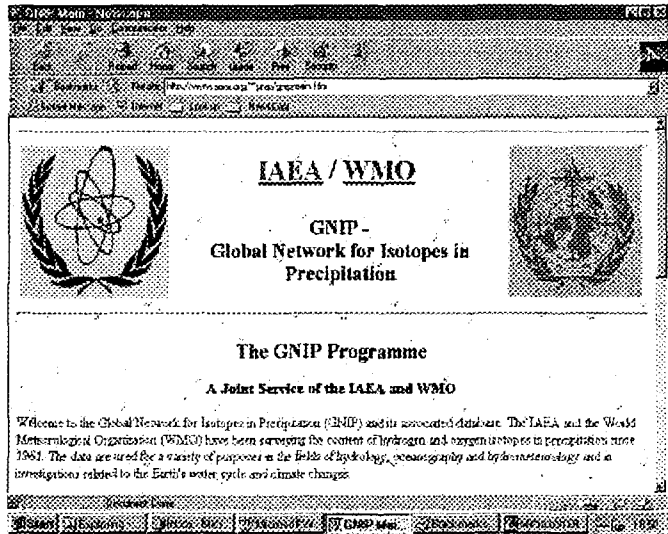


Fig. 7. GNIP home page.

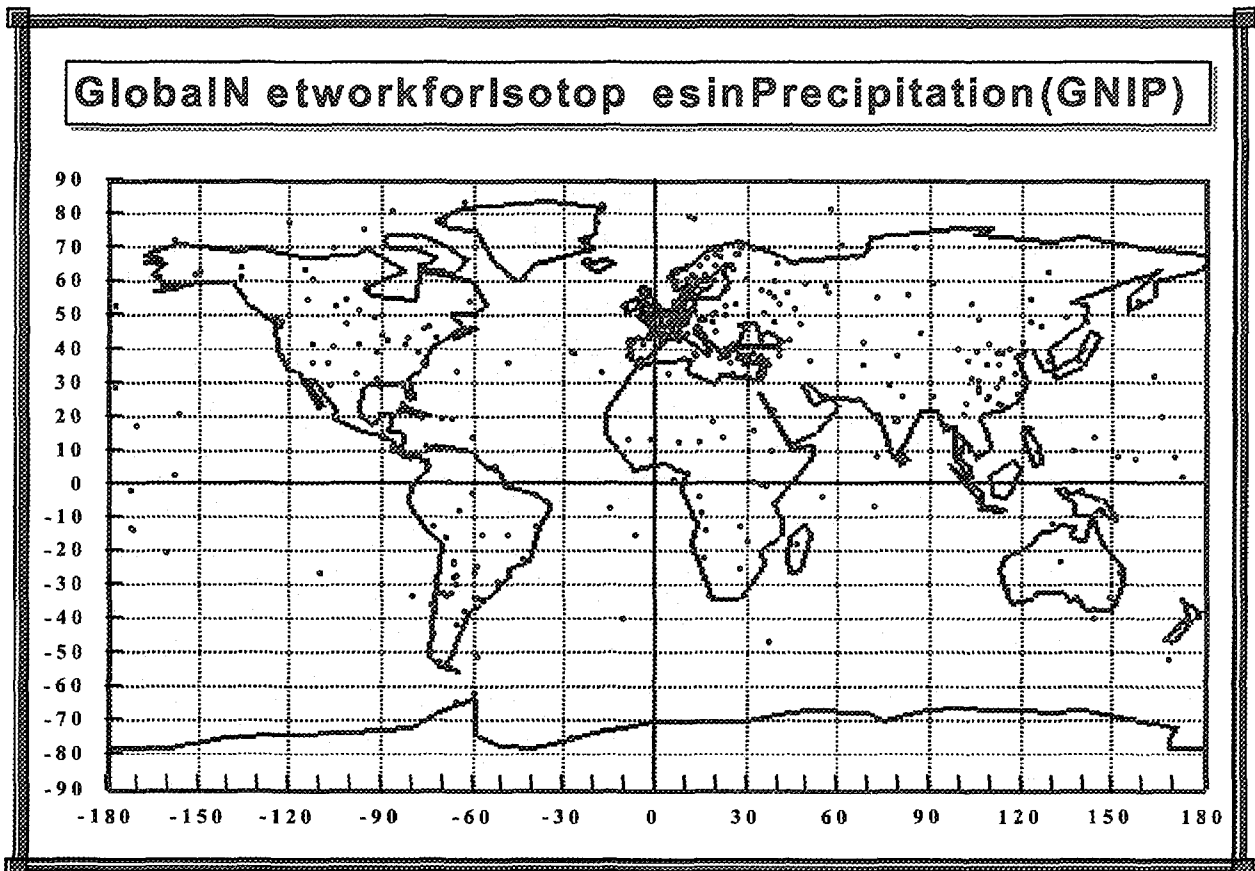


Fig. 8. Map of the world showing the location of GNIP stations

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