GEWEX WCRP

Global Energy and Water Cycle Experiment

NEWS

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World Climate Research Programme–WCRP

THE GLOBAL ENERGY AND WATER CYCLE EXPERIMENT

Dr. Moustafa T. Chahine, Chairman,
GEWEX Scientific Steering Group

The Global Energy and Water Cycle Experiment (GEWEX) is a program initiated by the World Climate Research Programme (WCRP) to observe, understand, and model the hydrological cycle and energy fluxes in the atmosphere, at land surface, and in the upper oceans. The goal of the GEWEX program is to reproduce and predict, by means of suitable models, variations of the global hydrological regime, its impact on atmospheric and surface dynamics, and variations in regional hydrological processes and water resources and their response to changes in the environment, such as the increase in greenhouse gases. GEWEX will provide an order of magnitude improvement in the ability to model global precipitation and evaporation as well as accurate assessment of the sensitivity of atmospheric radiation and clouds to climate change.

I. Objectives of the GEWEX Program

1. Determine the hydrological cycle and energy fluxes by means of global measurements of atmospheric and surface properties.
2. Model the global hydrological cycle and its impact on the atmosphere and oceans.
3. Develop the ability to predict the variations of global and regional hydrological processes and water resources and their response to environmental change.
4. Foster the development of observing techniques and data management and assimilation systems.

II. GEWEX Program Strategy

1. Build on existing programs and data.

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COMMENTARY

Professor Pierre Morel
Director, WCRP

A little thought about the problem of climate and climatic variations leads to understanding that the main difficulty lies with getting the coupling right between the different components of the climate system, the global atmosphere, the world oceans, land and sea-ice, and the land surface hydrology including snow and vegetation. Furthermore, the quantities that account for these interactions are not just dynamical, although wind does play an important role in coupling the atmospheric and oceanic circulations. The essence of the climate problem is of thermodynamical nature. We must determine and predict more accurately the processes (mostly in the atmosphere) that control the exchanges of energy: radiation, sensible heat, and latent heat, as well as the transport, precipitation and evaporation of water.

Water in all three physical states has molded the face of the Earth and strongly controls the energetics of the atmosphere, that is, the regime of the heat engine, fueled by solar radiation, which drives all other components of the climate system. Understanding the dynamics and thermodynamics of

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2. Conduct modeling programs to model all aspects of the hydrologic and energy cycles with evolving, fully coupled atmosphere-land-ocean components.

3. Make recommendations to the European Space Agency (ESA), National Aeronautics and Space Administration (NASA), and National Space Development Agency (Japan) (NASDA) with respect to instruments planned for space platforms.

4. Conduct studies with international participation encompassing the full range of experimental scales:

   - small scale process studies (1 x 1 to 100 x 100 km)
   - continental scale
   - global

Currently, GEWEX is planning to conduct the GEWEX Continental-Scale International Project (GCIP) from 1992-1998; the site will be the Mississippi Basin in the United States. The objective of GEWEX is to develop and validate macroscale models and coupled hydrologic-atmospheric models to obtain a quantitative understanding of the energy and water cycles over extended land areas using in situ and space data.

III. GEWEX Implementation Plan

The GEWEX Science Plan has now been published and the Implementation Plan is currently in preparation. Both an International GEWEX Project Office and a U.S. GEWEX Project Office have been established in Washington, DC. The overall approach to implementing the GEWEX program includes the following elements:

1. The GEWEX Implementation Plan, consisting of two phases: a buildup phase (1992-1998, or later) and a global observing phase to coincide with the deployment of the international Earth observing platforms, beginning in 1998.

2. Major tasks that need to be undertaken: (a) preparation of the global data and information system for the platforms, (b) investigation of various processes (e.g., atmosphere-vegetation-hydrology interactions), and (c) refinement and improvement of models at all scales.

3. GCIP, the central focus of the GEWEX buildup phase: emulates, by means of a combination of existing space systems and advanced ground-based observations (e.g., NEXRAD), the information we expect to obtain later from the international space platforms. The first GCIP planning meeting was held the week of 8 October 1990, in Reston, Virginia at the U.S. Geological Survey National Center. A GCIP Science Panel has been established to formulate the detailed scientific plans for the project. (The next issue of GEWEX News will give more details regarding GCIP.)

4. Development of the space component: substantial investments during the buildup phase in the Earth Observing System (EOS), ESA and Japanese platforms, and instrument payloads.

IV. Supporting Organizations

The Executive Board of the International Council of Scientific Unions (ICSU) has endorsed GEWEX as a core program of WCRP and a major contribution to the study of global climate change. The major space agencies, ESA, NASA, National Oceanic and Atmospheric Administration (NOAA), NASDA, Centre National d'Etudes Spatiales (CNES), and Deutsche Forschungsanstalt für Luft- und Raumfahrt (DLR), have stated strong interest in the GEWEX program. The U.S. Committee on Earth and Environmental Sciences (CEES) has identified climate and the hydrological cycle as the highest priority issues for research on global change. The International Association of the Hydrological Sciences (IAHS) and the World Meteorological Organization (WMO), through its Hydrology and Water Resources Programme, have established a joint working group on GEWEX to develop scientific initiatives to be undertaken in the field of global or large-scale hydrology in support of GEWEX. Currently, several U.S. and international agencies are actively engaged in planning for GCIP.

Commentary–Prof. Morel *(continued from page 1)*

the "fast component" of the climate system, that is, the atmosphere, land surface, and possibly the upper ocean mixed layer, is essential for determining the equilibrium sensitivity of the Earth's climate to changes in "external" forcings such as an increase in the greenhouse effect or variations in the mean solar radiation flux. Actually, considerable further work is needed if we judge from the lack of noticeable progress toward reducing uncertainties in our estimation of the equilibrium climate to changes in the concentration of greenhouse gases. The first international assessment of the result of doubling the pre-industrial concentration of carbon dioxide (World Climate Programme,1981) indicated a mean global warming of the surface in the range 1.5 to 4.5 K, based on the physical intuition of the few climate modelers who had conducted meaningful numerical experiments at that time. Last year, on the basis of a much wider set of model simulations of the Earth's climate and the expenditure of many thousands of hours of computer time, the scientific assessment carried out under the aegis of the WMO/United Nations Environmental Program Intergovernmental Panel on Climate Change concluded its analysis by indicating precisely the same margin of error. We owe it to ourselves as scientists, and to the people of the Earth who are concerned by the threat of climate change and who support our research, to do much better. The GEWEX program will extend over more than a decade laying an internationally coordinated scientific strategy for proceeding toward this goal. To that effect GEWEX will build upon the latest developments in surface-based aerological and hydrological observations, including the forthcoming NEXRAD meteorological radar network in the continental United States and the Earth observation satellite missions of the late 1990s. GEWEX is moving ahead now, on a broad international and scientific front, to become the first dimension of a program that when expanded to the global scale will constitute the international "Earth Observing System" of the next century.

COMMENTARY
Dr. Moustafa T. Chahine

In predicting global changes of the future, we are faced with questions that can be answered only through a better knowledge of the present climate system and how it functions. GEWEX is the most important new scientific undertaking aimed at understanding the functions of the Earth's cycles of water and energy. Water in its various phases plays a dominant role in nearly all aspects of the Earth's system. As vapor, it is the Earth's most powerful greenhouse gas and the main carrier of atmospheric energy. Condensed water plays competing and conflicting roles in both warming and cooling the atmosphere. To determine the net effect, the full cycle of evaporation, cloud formation, and precipitation must be observed. This is the highest priority scientific investigation for climate change, and the goal of GEWEX.

In less than 4 years since its inception at a meeting at McGill University in Montreal, Canada, GEWEX has attracted considerable international support. The Executive Board of the ICSU has endorsed GEWEX as a core program of WCRP and a major contribution to the study of global climate change. The major space agencies have stated their strong interest in the GEWEX program. The U.S. Committee on Earth and Environmental Sciences (CEES) has identified climate and the hydrological cycle as the highest priority issues for research on global change. Currently, several U.S. and international agencies are actively engaged in planning for the GEWEX Continental-Scale International Project.

By virtue of its breadth, GEWEX is not an "experiment" in the traditional sense; rather it is an integrated "program" of research, observations, and science activities ultimately leading to prediction of variations in the global and regional hydrological regimes. By virtue of its duration, GEWEX activities will be undertaken incrementally. The activities of each phase are constructed to produce results that support the implementation and timing of the next phase. From the start, GEWEX will rely on ongoing activities to the extent possible to achieve its goals (see Fig. 1). For example, the

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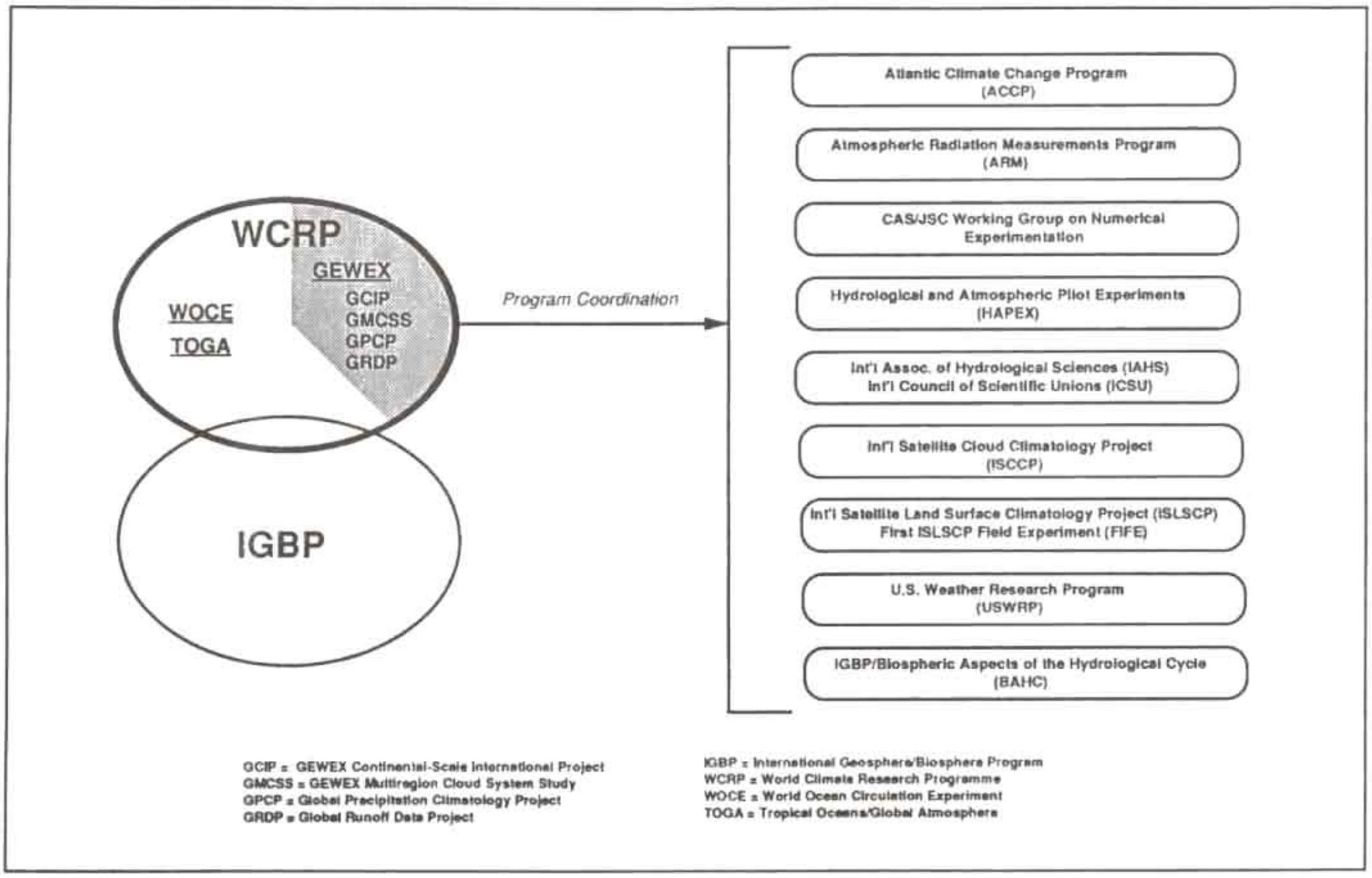

Figure 1. Relationship of GEWEX to other programs

Commentary–Dr. Chahine *(continued from page 3)*

organization of GEWEX land surface process studies will be planned in cooperation with the International Geosphere-Biosphere Program (IGBP) Core Project on the Biospheric Aspects of the Hydrological Cycle (BAHC). Likewise, the U.S. Atmospheric Radiation Measurements (ARM) Program and U.S. Weather Research Program will contribute significantly to GCIP. These activities, in and of themselves, will produce significant benefits to the study of global change in addition to the GEWEX investigations.

Programs of this scope require some years before their results are assimilated and their impact is felt. The scientific strategy of GEWEX described in this newsletter will result in improved understanding of the global energy and hydrologic cycles and the ability to predict with more confidence the causes and effects of their variations. The urgent need for obtaining such improvements is compelling motivation for implementing the GEWEX program now.

GEWEX MEETINGS CALENDAR

20-21 MAY 1991 - GLOBAL PRECIPITATION CLIMATOLOGY PROJECT (GPCP). THE WORKING GROUP ON DATA MANAGEMENT (WGDM) meeting will be held in WASHINGTON, DC, U.S.A. Contact Phil Arkin for information: NOAA/OAR Office of Global Programs, 1335 East-West Hwy, Mail Stop: R/CAR, Room 4208, Silver Spring, Maryland 20910. Phone: 301-427-247 FAX: 301-603-3979.

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GEWEX Meetings Calendar *(continued from page 4)*

22-24 MAY 1991 - GLOBAL PRECIPITATION CLIMATOLOGY PROJECT (GPCP). First Algorithm Intercomparison Project (AIP/1) meeting will be held in WASHINGTON, DC, U.S.A. Contact Phil Arkin for information: NOAA/OAR Office of Global Programs, 1335 East-West Hwy, Mail Stop: R/CAR, Room 4208, Silver Spring, Maryland 20910. Phone: 301-427-2471; FAX: 301-603-3979.

30 SEPTEMBER-11 OCTOBER 1991 - A NATO ADVANCED STUDY INSTITUTE (NATO-ASI) ON ENERGY AND WATER CYCLES IN THE CLIMATE SYSTEM will be held in Glucksburg, Germany. The objectives of ASI are to review the present status of our knowledge and encourage research in various scientific problems that are all of vital importance for the current and future climate research as formulated in the WCRP and its subprograms (e.g., GEWEX). Applications were due by 30 April 1991, to be sent to Prof. Dr. E. Raschke, Director of NATO-ASI (Water Cycles), GKSS-Research Centre, P. O. Box 1160, D-2054 Geesthacht, Germany. Tel: 49-4152-871834; FAX: 49-4152-871888.

28 OCTOBER-1 NOVEMBER 1991 – 1991 GEWEX WORKSHOP ON HYDROLOGY AND SURFACE RADIATION IN ATMOSPHERIC MODELS will be held at the European Centre for Medium-Range Weather Forecasts, Reading, UK. A small invited group will meet to discuss the ability of the general circulation models to handle hydrology and surface radiation processes. Contact Paul Try at the International GEWEX Project Office (IGPO) for further information.

GEWEX MEETINGS SUMMARIES

21-25 JANUARY 1991
SCIENTIFIC STEERING GROUP FOR THE GLOBAL ENERGY AND WATER CYCLE EXPERIMENT (GEWEX) THIRD SESSION, HAMILTON, BERMUDA.

The third session of the Joint Scientific Committee (JSC) Scientific Steering Group (SSG) for GEWEX was opened on 21 January 1991 in Hamilton, Bermuda. The meeting was called to order by the Chairman, Moustafa Chahine, who summarized national and international developments in the overall perception of global climate change research and consequences for further GEWEX planning. Agenda topics included the review of relationships with other WCRP and ICSU activities including the IGBP, establishment of the IGPO, review of satellite missions relevant to GEWEX, air-sea interaction problems for GEWEX, the GEWEX Continental-Scale International Project, hydrological-atmospheric field experiments, GEWEX cloud and radiation research activities, rainfall measurements and data, and GEWEX models. The next session of the GEWEX SSG is tentatively planned for Tokyo, Japan, 27-31 January 1992. Check the GEWEX available reports section of the GEWEX status bulletin board for the publication date of the report of this meeting.

30 OCTOBER 1990-1 NOVEMBER 1990
GLOBAL ENERGY AND WATER CYCLE EXPERIMENT (GEWEX)–WORKSHOP ON THE ROLE OF WATER VAPOR IN CLIMATE PROCESSES, EASTON, MARYLAND, U.S.A.

This workshop was convened by Dr. S. Harvey Melfi of NASA/Goddard Space Flight Center (GSFC) under the auspices of the GEWEX SSG. Its purpose was to bring together interested members of the scientific community to discuss the needs and the direction for a research program designed to increase our knowledge of atmospheric water vapor and our understanding of moist processes. In addition to discussions and presentations, a preliminary version of a strategic plan entitled "The Role of Water Vapor in Climate, a Strategic Research Plan for the GEWEX Water Vapor Project (GVaP)," edited by Dr. David Starr, NASA/GSFC, was presented to the workshop and modified extensively by workshop attendees. This document is still in draft form and is expected to be available for distribution shortly.

23-26 OCTOBER, 1990
GLOBAL ENERGY AND WATER CYCLE EXPERIMENT (GEWEX)–REPORT OF THE FIRST GEWEX TEMPERATURE/HUMIDITY RETRIEVAL WORKSHOP, GREENBELT, MARYLAND, U.S.A.

This workshop was convened by the Chairman of the GEWEX SSG, Dr. Moustafa Chahine, at NASA/GSFC, Greenbelt, Maryland, U.S.A. The workshop was attended by more than 50 international scientists, including specialists in modeling, hydrological processes, spectroscopy, satellite remote sensing, and atmospheric, cloud and surface radiative transfer. The workshop was devoted to the problem of assessing the accuracy of atmospheric temperature and humidity profiles derived from satellites for application to climate modeling, primarily for studies related to GEWEX. The workshop summary report is in draft form and will be available this summer. (See note below.)

8-10 OCTOBER 1990
GEWEX CONTINENTAL-SCALE INTERNATIONAL PROJECT (GCIP)–REPORT OF THE FIRST GCIP PLANNING WORKSHOP, RESTON, VIRGINIA, U.S.A.

The First Planning Workshop of GCIP was held at the Headquarters of the U.S. Geological Survey in Reston, Virginia, U.S.A. GCIP is the first major experiment under GEWEX, a core component of the WCRP. The principal aim of the workshop was to develop a framework for a GCIP science plan. Nearly 100 attendees from 10 countries participated in the workshop. The workshop summary report is available as International GEWEX Project Office Publication No. 1. (See note below.)

*** Note: Requests for documents can be made to the IGPO via Electronic Mail: INTL.GEWEX/OMNET; Fax: 202-488-5364; by mail: International GEWEX Project Office (IGPO), c/o Science and Technology Corporation, Suite 203, 409 Third Street S.W., Washington, DC 20024; Phone: 202-863-1435/0012.**

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GEWEX REPORTS/DOCUMENTS

GLOBAL CLIMATE CHANGE–A SCIENTIFIC REVIEW PRESENTED BY THE WORLD CLIMATE RESEARCH PROGRAMME (WCRP), JANUARY 1990.
The WCRP is the international scientific programme chartered jointly by the International Council of Scientific Unions and the World Meteorological Organization to provide a quantitative understanding of climate and predictions of global and regional climate changes on all time scales. This document is a review of global climate change as of 1990. (See note on page 5.)

SCIENTIFIC PLAN FOR THE GLOBAL ENERGY AND WATER CYCLE EXPERIMENT–WCRP-40, AUGUST 1990, (WMO/TD - No. 376). (See note on page 5.)

GEWEX CONTINENTAL-SCALE INTERNATIONAL PROJECT (GCIP). REPORT OF THE FIRST GCIP PLANNING WORKSHOP, RESTON, VIRGINIA., U.S.A., 8-10 OCTOBER 1990.
The workshop summary report is available as an International GEWEX Project Office (IGPO) Publication No. 1. (See note on page 5.)

GLOBAL ENERGY AND WATER CYCLE EXPERIMENT (GEWEX)–REPORT OF THE FIRST GEWEX TEMPERATURE/HUMIDITY RETRIEVAL WORKSHOP, GREENBELT, MARYLAND, U.S.A., 23-26 OCTOBER 1990.
The workshop summary report is in draft form and will be available summer 1991.

THE ROLE OF WATER VAPOR IN CLIMATE, A STRATEGIC RESEARCH PLAN FOR THE PROPOSED GEWEX WATER VAPOR PROJECT (GVaP)
This document is still in draft form and is expected to be available for distribution in the summer of 1991.

REPORT OF THE THIRD SESSION OF THE JSC SCIENTIFIC STEERING GROUP FOR THE GLOBAL ENERGY AND WATER CYCLE EXPERIMENT (GEWEX), HAMILTON, BERMUDA, 21-25 JANUARY 1991.
The publication date of this report is to be determined.

INTERNATIONAL GEWEX PROJECT OFFICE

The IGPO has been established to support the planning of the GEWEX program as well as the international coordination of activities contributing to the implementation of GEWEX. The IGPO operates as a component of the Joint Planning Staff. Dr. Paul D. Try has been appointed Director of IGPO and in this capacity is responsible to the Director of the World Climate Research Programme. The IGPO is located in Washington, DC, U.S.A.

Specific tasks of the IGPO include preparation and updating of detailed implementation and/or operational plans for the program; ensuring the timely flow of operational and other relevant information to GEWEX participants and members of the JSC and GEWEX SSG; preparation of documentation pertaining to the international coordination of GEWEX projects and providing information on GEWEX activities for the broad scientific community; and providing general organizational support for GEWEX. In addition to the full-time staff, it is anticipated that a number of secondments will be provided from international participants to support GEWEX program development.

GEWEX News

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