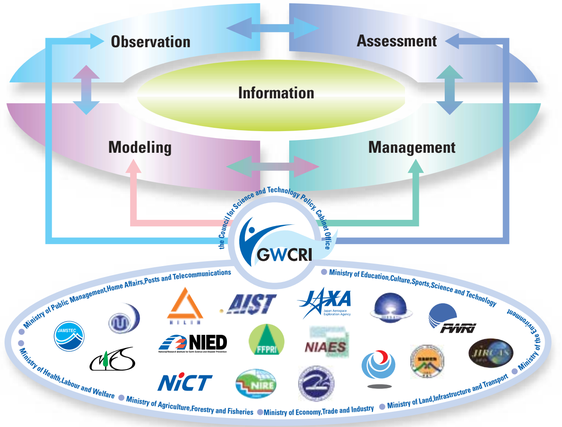
Global Water Cycle Research Initiative



Consolidating R&D specialties in order to tackle water issues

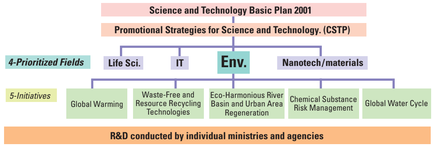
The GWCRI is developing an optimum water management scenario and related measures for Asia that promote scientific knowledge for predicting and assessing global water cycle changes. The GWCRI is also devising a technological infrastructure for water control technologies that will make possible sustained global development.

Under this initiative, research projects currently being conducted within government ministries and agencies were identified and hierarchically structured in order to clarify roles, objectives, and mutual relationships. This was done through the following four Programs: (a) Observation; (b) Modeling; (c) Impact assessment, and (d) Management of global cycle.

Coordination among ministries and agencies is crucial

Water cycle research, which involves meteorology, hydrology, agriculture, the environment, disaster prevention, etc., requires cooperation among a number of experts. Therefore, the CSTP encourages the administrative and operational sectors of ministries and agencies, research institutions and universities to coordinate their activities. Through cooperation and coordination, the GWCRI can help resolve water issues.

Five R&D Initiatives in the Environmental Field



International cooperation

The Plan of Implementation adopted by the World Summit on Sustainable Development in Johannesburg in 2002 recognized that it was necessary to "improve water resource management and scientific understanding of the water cycle through cooperation in joint observation and research, and encourage and promote knowledge sharing, and provide capacity-building and the transfer of technology, as mutually agreed, including remote-sensing and satellite technologies, particularly to developing countries as well as countries with economies in transition, for this purpose." (WSSD Paragraph 28).

At the Third World Water Forum in Kyoto in 2003, the ministerial conference declared, "We will further encourage scientific research on predicting and monitoring the global water cycle, including the effect of climate change, and develop information systems that enable the sharing of such valuable data worldwide." A Group of 8 (G8) Action Plan for Water agreed in Evian, France in 2003 to promote "coordination of mechanisms for information sharing and monitoring."

The First Earth Observation Summit held in Washington, DC, in July 31, 2003, affirmed the need for timely, quality controlled, long-term, global information as a basis for sound decision-making. It also recognized the need to support improved coordination of strategies and systems for observations of the Earth and identification of measures to minimize data gaps. "Improving global water resource management and understanding of the water cycle" was recognized as vitally important social issues and potential benefits by the Subgroup on User Requirements and Outreach under the ad hoc Group on Earth Observations (GEO), which is preparing a 10-year Implementation Plan for a comprehensive, coordinated, and sustained Earth observation system. The Integrated Earth Observation Strategy (IGOS) is needed to understand and monitor the Earth system and to assess human impacts with cooperation among many programs, agencies, or governments. The IGOS-Partnership (IGOS-P) was established to address the user requirements and explore the collaboration and integration strategy. The IGOS-P currently has several themes, including one on the water cycle. Space agencies, such as NASA, JAXA and ESA, UN organizations such as UNESCO, WMO, and research organizations such as WCRP, IGBP and other international organizations have joined as partners in the IGOS Water Theme. The Water Theme will be led by the WCRP, the WMO and the CEOS. The activities of the GWCRI will be part of the Japanese implementation of the Water Theme.

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Toward a sound and sustainable water policy for our world

GWCRI

Japan's Global Water Cycle Research Initiative

Global water problems are becoming more serious

Since the latter half of the 20th century, rapid population growth and expanding human activities have given rise to a variety of serious water problems at the global, regional, and local levels. These problems include global climate changes due to increases in carbon dioxide and other greenhouse gases, water shortages due to imbalances between water demand and supply, water pollution and ecosystem deterioration due to increases in urban and industrial wastewater, and increased potential for flood damage caused by improper land use.

The expression, "the 21st century will be an age of water," embodies both the concern that water issues may cause international conflicts and the hope that these same issues will promote international cooperation.

Significance of scientific approaches in understanding the global water cycle

Except for fossil water, all water on the planet Earth circulates throughout the atmosphere, geosphere and hydrosphere. All life on earth is dependent upon the water circulating through these systems.

Expanding human activities have greatly impacted this water cycle, resulting in growing number of global water problems and life-threatening hazards, including the more frequent occurrence of floods and droughts.

To solve these water problems, we must promote science-based research efforts to clarify the structural relationship between the water cycle and human activities, as well as establish a sound and sustainable relationship between them.

As used in this text, the term "global water cycle" covers not only variations and changes in the water cycle caused by global climate variations and changes, but also the water issues that these variations and changes induce at the regional and local levels.

Steps toward resolving water issues in Asia

Asia has a number of water cycle variations and water problems that are remarkably different from those in Europe and North America. These dramatic differences are related to climatic conditions associated with the Asian monsoon and with land conditions formed by unique plate tectonic dynamics. Water utilization, flood disaster mitigation measures and environmental conservation are all water issues that are unique to the Asian monsoon. Issues arising from the geographical characteristics of the region include large seasonal and annual variations in precipitation, agriculture (primarily paddy cultivation), and the urbanization of alluvial flood plains. There is also a wide variety of regional experience and knowledge in dealing with specific water issues.

Rapid growth since the latter half of the previous century has made Asia the most densely populated region in the world. Asia is currently home to about 60% of the present world population of 6 billion. The Asian population is still growing and is projected to reach about 5.3 billion by the middle of this century. This growth will worsen Asia's water problems.

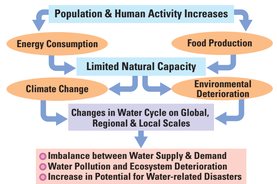
Japan is located in monsoon Asia. Because it has already undergone very rapid population growth, its experiences with water and population issues may be useful to other Asian countries that are facing similar issues.

Water issues are some of the most important policy challenges in Japan

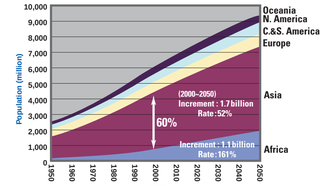
The Second Basic Plan for Science and Technology (2001-2005), which was enacted in March 2001 by the Cabinet of the Japanese Government, describes a policy that emphasizes research and development (R&D) from national and social standpoints. In addition to the basic science areas, the plan focuses on four prioritized fields: life sciences, information technologies, the environment, and nanotechnology. In September 2001, the Council for Science and Technology Policy (CSTP), which was formed under the Cabinet Office, adopted a plan called "Promotion Strategies in Prioritized Fields," which was proposed by the "Expert Panel on Promotion Strategies in Prioritized Fields," a smaller body within the CSTP.

Regarding the environment, several topics were recognized as being critical. These include establishing scenario-driven R&D, forming a comprehensive and interdisciplinary framework, merging social and human sciences, and providing projection and/or early warning information. In order to promote these topics, five research initiatives were established, one of which was the Global Water Cycle Research Initiative (GWCRI). This initiative was launched in April 2003.

Development of Global Water Problems



Projection of World Population

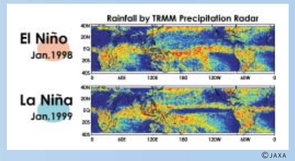


Toward a sound and sustainable water policy for our world

Program for integrated observation of the global water cycle

Comprehensive, coordinated, and sustained global observation
The water cycle varies globally as well as locally. It also varies over time in both the short term and the long term. These variations have significant effects on a wide range of phenomena that operate on spatial and temporal scales. Comprehensive and long-term systems for monitoring the water cycle in the atmosphere, on land, and in the ocean should be established by integrating local and satellite observations with systems that collect data on socio-economic water-related issues. This will require international coordination, cooperation between research communities and operational organizations, and enhanced capacity for sustained observation and effective use of data.

Data integration is the key to improved understanding and modeling
To effectively use the enormous amount and variety of water cycle data that will be collected, we must develop advanced data integration systems that have state-of-the-art database and mining functions as well as data assimilation functions for filling in gaps in the data. To maximize the social benefits of the data, the systems should be able to convert unrefined data into usable information that can be shared worldwide. Such systems will combine advanced geographical information systems with data integration systems and be able to merge natural scientific information with socio-economic metrics.



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For Sound Decision Making & Societal Benefits

Natural Scientific Information	Data to Information	Socio-economic Information
In-situ Observations Satellite Observations Model Outputs	Integration Interpretation Interface	Population/ Food Water Use/ Land Use Hazard Map


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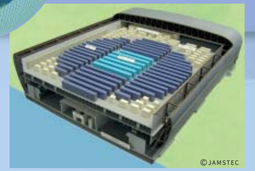
Program for water cycle modeling

Using modeling to improve the precision of quantitative prediction
This program facilitates super-computer based numerical modeling for quantitatively predicting variability in the global water cycle, with emphasis on models for precipitation, evapotranspiration, and river flow. Variability in water use by human activities must also be considered.

From short-term to long-term, and from local to global scale
Short-term forecasts, ranging from a few hours to tens of days, are needed to mitigate floods and other water related disasters, while long-term predictions, ranging from a few years to decades, are needed to effectively utilize water resources. An important part of the measures against floods or droughts are long-term predictions of average values and year-to-year amplitudes. Models are needed for predicting detailed changes of precipitation and evapotranspiration at regional scales and the effects of human activities, such as dam building, irrigation, and land use. Large-scale models are needed for projecting global climate changes.

Predicting various aspects of the Asian water cycle
The water cycle and the water usage pattern in Japan and other parts of Asia have several unique characteristics, including monsoons and rice paddies. These vary by region and river basin, and extend from the rainforests in Southeast Asia to the dry areas in Northeast Asia. Thus, both numerical modeling and forecasting of the water cycle must be region-specific.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Advanced observations through data assimilation
Data assimilation integrates observations into a numerical model. It includes remote sensing measurements by satellites as well as other types of observations from around the world. Data assimilation produces valuable information for understanding the water cycle.

Program for integrated observation of the global water cycle

This program promotes systematic observation activities (satellite observations, marine observations, land surveys and monitoring, etc.) and develops a global system of water cycle observations that enable mutual use of observational data. It also promotes the accumulation of data, etc., in the monsoon areas of Asia.

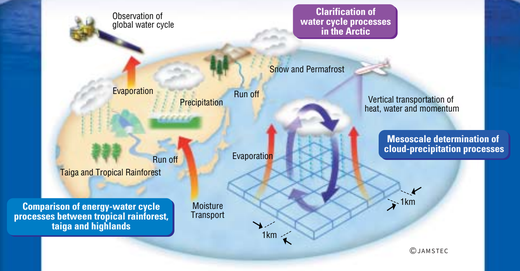
GWCRI

Overall goal of the Global Water Cycle Research Initiative (GWCRI)

The GWCRI provides scientific knowledge and a technological foundation for establishing water management methods that can avert or minimize the adverse effects of changes in the supply, demand, and circulation of water, and for achieving sustainable development into the future. Based on this knowledge and foundation, it has developed optimum water management methods for the Asian region. In order to achieve its goals, the GWCRI has formulated four programs that are integrated by means of Global water cycle information.

Program for water cycle modeling

This program develops a model for projecting water cycle changes associated with fluctuations in the supply and demand of water and with climate changes. It also creates a scenario for analyzing the trends of human activities that affect water circulation so as to form the basis for a model capable of projecting water cycle changes and accompanying environmental changes.



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Program for interaction of water cycle and society

This program forecasts changes in the water cycle and their impact on the environment, food production, water resources, ecosystems, human health, society, and the economy.


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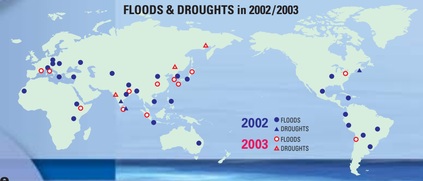

Understanding the structures of problems induced by the water cycle

The effects of the water cycle and extreme events on society
Meteorological and hydrological variations in time and space bring floods and droughts to all parts of the world. Too much water causes rivers to flood and mountain slopes to fail, resulting in severe damage. Too little precipitation causes water shortages and lowers water quality. This program looks at the influence of water cycle variations and extreme events on food production, water resources, ecosystems, human health, society, and the economy, and provides quantitative evidence that reflects the long history and role of water in our society.

Water cycles and the future of various regions: the consequences of human activities
Human activities in river basins affect the water cycle. Population growth makes the development of river basins inevitable, but this development results in deforestation, reductions in arable land, urbanization, and increased demand for both water and systems to manage agricultural, industrial, and urban wastewater. The situation is more serious in Asia and Africa where population growth is remarkably high. This program predicts how human activities affect the water cycle and what will happen in various regions in the future

Program for comprehensive assessment of scenarios and technologies

This program assesses the applicability of existing technology, develops new technologies, and suggests scenarios for achieving optimum water management.

Program for comprehensive assessment of countermeasures and technologies


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Exploring ways to link the understanding and prediction of phenomena and the characterization of problems to the resolution of water issues

Scientific and universal knowledge must incorporate regional experiences and wisdom
It is extremely important for the GWCRI to integrate the above three programs into a single, concrete, and practical form. This idea is closely related to the framework of the various water problems also described above, making it essential to advance these programs while maintaining a close relationship between them. It is also important to integrate observation data with other useful water information as well as with scientific and universal knowledge obtained from a highly accurate prediction model of water circulation. Finally, it is important to analyze and incorporate the regional experiences and knowledge gathered from case studies.

Scenarios for a society that can accommodate changes in the water cycle and develop new techniques
It is important to establish scenarios to accommodate future changes in the water cycle, and to predict and assess the effects of the measures proposed in each scenario. The government and people of each nation will select the appropriate scenario, but in order to preserve the global environment in the future, it is essential to have in place a readily understandable scientific foundation and the necessary political tools for developing the appropriate measures. It is also necessary to develop techniques to accommodate changes in the water cycle. Based on this research, the GWCRI will propose scenarios for creating a society that can accommodate changes in the water cycle. These scenarios will include the formation of an infrastructure, the preparation of a social system, the introduction of an economic structure and the development of new techniques.