

Chapter 7

Research and Systematic Observation

7.1 Comprehensive Government Policies and Fundraising for Research and Systematic Observation

The Council of Ministers for Global Environment Conservation draws up a Comprehensive Program for the Promotion of Global Environmental Research, Monitoring and Technological Development each fiscal year. This program is designed to build a solid foundation for global environmental conservation and to clarify the priority areas that Japan should address in order to contribute positively to international initiatives. The program comprehensively promotes surveys, research, observation, monitoring, and technological development for the protection of the global environment and follows up on the implementation of efforts in these fields.

While bearing in mind consistency with the annual program, a budgeting system for the Global Environmental Research Fund has been established for its promotion. This is a system to comprehensively promote all types of scientific and international research on global environmental conservation. The 'Fund for Global Environmental Conservation Tests and Studies' has been established since April 2001 to promote studies into global warming from mid and long-term perspectives. In addition, some related surveys and research are funded under two other national budget categories; "Promotion of Science and Technology" and "Government Subsidies for Scientific Research." The application of these funds is determined by the Council for Science and Technology Policy and the Japan Science and Technology Council, respectively.

In August 1990, the government's basic stance and policies on research and development for global science and technology were compiled as the 'Basic Program for Research and Development in Global Science and Technology', which was approved by the Prime minister.

The program specifies that Japan shall prioritize international activities for global scientific research and development, and also promote the construction of an observation network that combines observation on the ground with observation by artificial satellites, aircraft, and ships. Under such a concept, Japan has been promoting the 'Integrated Global Observing Strategy Partnership (IGOS-P)' that cooperates with and coordinates international study programs, observation systems, and international organizations, etc.

To promote studies of prediction of global changes comprehensively, including global warming, under cooperation with various universities, ministries and agencies concerned, Japan established 'Frontier Research System for Global Change' to implement process research in October 1997, and established

‘Frontier Observing Research System for Global Change’ to implement observation of global changes in August 1999. Furthermore, Japan is developing the world’s fastest supercomputer system ‘Earth Simulator’ to be used for such prediction and studies, which is scheduled to begin operation in 2002.

In June 1998, the ‘Global Warming Prevention Headquarters’ drew up the Guideline of Measures to Prevent Global Warming, determined the items for strengthening research and development of innovative environmental and energy technologies, and specified guidelines for ways to address global warming.

In December 2000, the cabinet drew up a new Basic Environment Plan in accordance with the Basic Environment Law with the long-term target of creating a society in which recycling, symbiosis, participation, and international measures can be realized, and it strives to comprehensively and deliberately promote measures for environmental conservation with a view towards the mid-21st century. This states the promotion of global warming-related measures as one of its strategic programs, and also specifies measures for the government to take in this field by including sections on ‘adequate surveys, research, monitoring, and observation, and promotion of proper technologies’ and ‘ensuring international cooperation for surveys, research, monitoring, and observation, etc.’.

In March 2001, the Government of Japan decided the second Science and Technology Basic Plan in accordance with the Science and Technology Basic Law, and the academic field of ‘Environment Sciences’ was selected as one of the four priority fields for allocating research and development resources. Accordingly, a promotion strategy for the Environment Sciences was decided in September 2001, the government as a whole will “carry out observation and prediction related to global warming; assess the effects of environmental changes such as temperature increase and sea level rise on nature, the economy, and society; and develop technologies and means to avoid or minimize any detrimental effects” in a global warming-related study as one of its priorities.

7.2 Research

7.2.1 Basic Principles

- Individual research projects should be integrated into the following research programs based on the ‘Global Warming Research Initiative’ included in the promotion strategy of environmental sciences decided by the Council for Science and Technology Policy, and research and development is promoted under collaboration among industry, academia, and government.
 - a. Comprehensive monitoring program for global warming
 - b. Research program for predicting global warming and climate change
 - c. Research program for assessing impacts and risks of global warming
 - d. Program for developing technologies to fix and sequester greenhouse gases
 - e. Technological development program for controlling emission of greenhouse gases caused by human activities, such as energy generation

f. Policy research program to control global warming

- Japan participates and cooperates in the World Climate Research Programme (WCRP), the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions Programme of Global Environmental Change (IHDP), and other international global environmental research programs, conducts surveys and research based upon an appropriate international division of tasks, and otherwise promotes joint research and other initiatives together with overseas research organs.
- Based on the agreement reached among the participating nations at the Sixth Inter-Governmental Meeting of the Asia-Pacific Network for Global Change Research (APN) held in March 2001, Japan is promoting research on global environmental change in the Asia-Pacific region in cooperation with researchers from throughout the area, as well as developing a regional research network on global environmental change.
- In an effort to contribute to the development of government policy on climate change and global warming, Japan actively promotes research on global environmental problems from a human and social perspective, academic research integrating the natural and social sciences, and research on socioeconomic systems.

Japan is also working to expand the international network of the Institute of Global Environmental Strategies (IGES) established in March 1998 as an international research institute for the study of political and practical strategies to realize sustainable development on a global scale, particularly with regard to the Asia-Pacific region.

7.2.2 Priority Fields

While giving full consideration to the United Nations Framework Convention on Climate Change and the Kyoto Protocol, the Government of Japan is comprehensively promoting surveys and research to better understand the present condition and predict the future impact of global warming, to fix, isolate, and reduce greenhouse gases, and to draw up appropriate countermeasures. While clarifying various issues related to the mechanisms behind global warming, and cooperating with the activities of the Intergovernmental Panel on Climate Change (IPCC), the Government of Japan will contribute to establish guidelines for the implementation of the Kyoto Protocol and methods for assessing the removal of greenhouse gases by forests, and so on. Moreover, the government will prioritize the promotion of relevant research to contribute to the IPCC Fourth Assessment Report, the preparation of which is scheduled to begin in the near future.

Also, studies based on ‘climate change and fluctuations’ and ‘societal viewpoints of global change’ which

were defined as priority issues at the Sixth Inter-Governmental Meeting of the Asia-Pacific Network for Global Change Research (APN) are promoted.

7.2.3 Main Research Fields

7.2.3.1 Research on climate processes and the climate system, including paleoclimate research

Research has been carried out as follows: study on the monitoring and prediction of El Niño/La Niña events and the warm pool in the western Pacific; study on the trends in climate extremes in the Asia-Pacific region; the analysis of sea level rise in the Asia monsoon region based on the coral dendroclimatology; the integration of impact/countermeasure assessment models with climate models for a comprehensive analysis of global warming

7.2.3.2 Modelling and prediction study, including an overall circulation model

Research has been carried out as follows: assessment of impact on the generation of greenhouse gases and the amount removed from the terrestrial ecosystem resulting from changes in land use in tropical Asia; research into the mutual interaction of the ecosystem and substance circulation such as from aerosols with the aim of improving the future prospects for climate changes; research to determine the quantity of carbon fixation within the East Asian monsoon ecosystem through the establishment of the Asia Flux Network; analysis into the removal of carbon dioxide resulting from human activity throughout the Pacific Ocean; international joint research on global mapping for carbon circulation and its advancement; research into the biological production in and removal of carbon dioxide in the ocean surface process in the Northern Pacific Ocean; estimation of the equilibrium of greenhouse gases in Western Siberia and forecasting future changes; assessment of removal source functions of the terrestrial ecosystem; comprehensive research into the accuracy of methane and nitrous oxide inventories; research into the methodology for establishing a system of greenhouse gas inventories; research into climate changes in Japan resulting from global warming; assessment of the amount of airborne particulates and research on its impact on the climate; joint international research on Northern Pacific subarctic zone circulation and climate change; model creation and estimation of climate change; water circulation, global warming, changes in air composition and ecosystems, as well as research on formation of such models and the use of data from satellite observation, such as from ADEOS-II and ALOS.

7.2.3.3 Impact study on the climate change

Research has been carried out as follows: 'Study of the prediction of regional climate over Japan due to global warming'; biosphere vulnerability assessment resulting from global warming, analysis of the impact of global warming and carbon statuses on alpine grassland ecosystems in the temperate zone; research into the impact on the distribution of viral diseases through arthropodan vectors resulting from global warming.

7.2.3.4 Socioeconomic analysis, including analysis of both the impact of climate change and its anticipated reaction

Research has been carried out as follows: forecasting disasters arising from climatic change; comprehensive assessment of the impact of sea level rise; research into the impact on domestic and international energy supply/demand resulting from trends in global environmental conservation policies and future plans; and comprehensive impact assessment of sea level rise and its countermeasures.

7.2.3.5 Research and development on reduction and adaptive technology

The following have been implemented; research and development into reductions in greenhouse gas emissions such as development of energy conservation technologies; innovative heat-resistant/insulation material project for controlling carbon dioxide emissions; research and development of global environment industrial technologies such as for the reduction of carbon dioxide; research and development of revolutionary coastal ship (Super Eco-Ship); projects for practical assessment of advanced low emission vehicles; projects for technological assessment of next generation low emission vehicles, and research and development into using alternative energies such as development of technology of using new/renewable energy and marine energy; technological development for practical use of biomass energy for agriculture and forestry; advanced technological developments for effective use of natural gas, and research and development into the removal and isolation of greenhouse gases such as research and development of deep ocean sequestration system of carbon dioxide; research and development of underground sequestration system of carbon dioxide; technological developments to put carbon dioxide fixation and utilization into practical use; research and development of carbon dioxide recovery and utilization technology from coal and natural gas; technological survey on environmental friendly method for effective collection and use of colliery gas; research into the impact on the marine ecosystem and strengthening the marine function for carbon dioxide removal by controlling the density of iron which is a trace element in sea water, and others, research into the low environmental load-type urban system to prevent global warming; research into the verification of reduction effects in global and local environment impact at low environmental load-type office buildings; development of planning support system for independent recycling-oriented-type urban and housing; research into the integrated assessment of global warming prevention effects through national land policy; technological development for creating a recycling-oriented-type industrial system using biological functions; research into the creation of a database using various technologies such as carbon dioxide reduction and fixation.

7.3 Systematic Observations

7.3.1 Basic Principles

- Observation and monitoring of climate change should be implemented in accordance with ‘the Science and Technology Basic Plan (decided by the Government of Japan in March 2001)’, and promoted comprehensively based on the ‘Comprehensive monitoring program for global warming’ included in the ‘Global warming research initiative’. In this case, organizations that carry out such observations and monitoring shall mutually exchange the results setting coherent methods with the international observation and monitoring projects, and shall strive to utilize such data effectively.
- The Government of Japan participates and cooperates in the Global Environmental Monitoring System (GEMS), the Global Atmosphere Watch (GAW) Program, the Global Climate Observing System (GCOS), the Global Ocean Observing System (GOOS), the Joint World Meteorological Organization (WMO) / UNESCO Intergovernmental Oceanographic Commission (IOC) Technical Commission for Oceanography and Marine Meteorology (JCOMM), and other international observation and monitoring programs, and conducts wide-ranging observations based on an appropriate sharing of international tasks. The Government is also working to promote the Asia-Pacific Network for Global Change Research (APN) and to facilitate implementation of observation and monitoring throughout the Asia-Pacific region.
- It is important to promote global observation by satellites effectively with coordination on a worldwide scale. Accordingly, the Government of Japan is actively participating in the activities of the Committee on Earth Observation Satellites (CEOS) and other international forums and is promoting the development, launch, and operation of satellites in conformity with these activities.

7.3.2 Priority Fields

The Government of Japan places special priority on promoting the observation and monitoring to identify the status, causes, and impacts of global warming and climate change.

Observation and monitoring related to climate changes and global warming cover a wide area or even the entire globe, so Japan has actively been promoting the development of effective methods such as utilization of satellite centers, as well as operating geostationary meteorological satellites.

7.3.3 Main Systematic Observations

7.3.3.1 Atmospheric observing system for climate including atmospheric constituent measurements

Homogeneous and high quality climate observations have been implemented by more than 150 meteorological stations in Japan for more than several decades. CLIMAT reports from some of the above stations have been exchanged internationally on a monthly basis. Japan has also been monitoring the reception rates and data quality of CLIMAT reports from the world jointly with Germany under the framework of the World Meteorological Organization (WMO). Japan has been providing climate change-related information, based on climate data collected and analyzed through the above activities, in quasi-real time within and outside Japan. Data from geostationary meteorological satellites, such as the cloud amount, are used to monitor long-term changes in global radiation, and climate change. The following has also been promoted: development of the Advanced Earth Observing Satellite-II (ADEOS-II, scheduled for launch in fiscal 2002) to make an international contribution to global observation; development of a system to comprehensively check and analyze the status of the solar winds and upper atmosphere; as well as producing observation equipment that will be carried aboard the satellite to monitor the stratospheric ozone layer, etc. (Improved Limb Atmospheric Spectrometer-II (ILAS-II), Global Imager (GLI), and Advanced Microwave Scanning Radiometer (AMSR)); international joint research for the development of comprehensive observation systems for the middle atmosphere; joint research into advanced global environmental instrumentation in Asia; and research and development of a stratospheric platform for directly observing the atmosphere at various altitudes ranging from the troposphere to stratosphere.

Table 7.1.1 Participation in the Global Atmospheric Observing System for Climate

	GSN	GUAN	GAW	Others
Number of stations	14	7	8	
Number of operating stations	14	7	8	
Number of stations operating to GCOS standards	14	1	8	
Number of stations expected to be operational in 2005	14	7	8	
Number of stations providing data to International Data Center	14	7	8	

As of February 2002, or as of December 31st 2001 for others, including the Syowa Station at the Antarctic

Table 7.1.2 Atmospheric observing systems for climate at the land surface (land surface meteorological observations)

Systems	Climate parameters	Total Stations	Appropriate for characterizing national/regional climates?			Time Series Stations [digitized]			Adequate Quality Control Procedures?			Meta data available Total stations [digitized (%)]	Continuity Stations expected to be operational in 2005
			Fully	Partly	No	30-50 years	50-100 years	More than 100 years	Fully	Partly	No		
Stations useful for national climate monitoring purposes	Atmospheric pressure	158				157[157]	0	0				158[100]	157
	Cloud	132				15[130]	57	58				131[100]	126
	Weather	157				19[157]	78	60				158[100]	156
	Humidity	158				19[157]	78	60				158[100]	157
	Precipitation	156				19[156]	77	60				157[100]	155
	Radiation	69				56[56]	0	0				69[100]	69
	Sunshine duration	157				18[155]	83	54				157[100]	156
	Temperature	158				19[157]	78	60				158[100]	157
	Visibility	156				15[155]	55	58				156[100]	155
Wind	158				17[157]	140	0				158[100]	157	
Stations reporting internationally		86											
CLIMAT reporting Stations		54											

As of December 31st 2001, including the Syowa Station at the Antarctic

Table 7.1.3 Available homogenous data sets for land surface meteorological observations

Data set name	Climate Parameters	Stations and Region covered	Time period	Enquiries
Surface meteorological observation monthly and 10-day mean/total data file	Atmospheric pressure, clouds, weather, humidity, precipitation, radiation, sunshine duration, temperature, wind	157 stations in Japan	1961 ~ 2001	Japan Meteorological Agency
Surface meteorological observation daily mean/total data file	As above	As above	1961 ~ 2001	Japan Meteorological Agency
Surface meteorological observation monthly mean/total data file	As above	As above	1880s ~ 2001	Japan Meteorological Agency

Table 7.1.4 Atmospheric observing system (Upper air meteorological observations)

System	Total observation points	Appropriate for characterizing national/regional climates?			Time series Stations [digitized]				Is the quality control appropriate?			Meta data available Stations [digitized (%)]	Continuity Stations expected to be operational in 2005
		Fully	Partly	No	5-10 years	10-30years	30-50 years	More than 50 years	Fully	Partly	No		
Radio Sonde Stations	19				0	1[1]	8[8]	10 [10]				19[100]	19
Stations reporting internationally	19												
CLIMAT TEMP Reporting stations	19												
Wind profiler stations	25				0	0	0	0				25[100]	31

As of December 31st 2001, including the Syowa Station at the Antarctic

Table 7.1.5 Available homogenous data sets for upper air meteorological observations

Data set names	Climate Parameters	Stations and Area covered	Time series	Enquiries
Upper air meteorological observation daily mean/total data file	Humidity, temperature, wind, altitude	18 stations in Japan data at standard atmospheric pressure levels	1981 ~ 2001	Japan Meteorological Agency
Upper air meteorological observation monthly mean/total data file	As above	As above	1951 ~ 2001	Japan Meteorological Agency

As of December 31st 2001

Table 7.1.6 Atmospheric constituent observing systems for climate

Constituent	Total stations	Appropriate for characterizing national climate?			Time Series Stations [digitized]				Is the quality control appropriate?			Meta data available Total stations [digitized (%)]	Continuity Stations expected to be operational in 2005
		Fully	Partly	No	10-20 years	20-30 years	30-50 years	More than 50 years	Fully	Partly	No		
Carbon dioxide	10				8[8]	0	0	0				10[100]	10
Surface ozone	5				3[3]	0	0	0				5[100]	5
Total ozone	6				0	1[1]	4[4]	0				6[100]	6
Vertical ozone distribution	7				3[3]	0	4[4]	0				7[100]	7
Other greenhouse gases	10				8[8]	0	0	0				10[100]	10
Aerosols	3				0	1[1]	0	0				3[100]	3

As of December 31st 2001, including the Syowa Station at the Antarctic

7.3.3.2 Ocean observing system for climate

Japan has been promoting the development of the Global Ocean Observing System (GOOS), and also contributing actively to its regional pilot project, 'North-East Asian Regional Global Ocean Observing System (NEAR-GOOS).

Furthermore, continuous observation has been implemented at nationwide observation points to monitor the change in the sea levels. Japan has been making efforts to enhance the observation and monitoring systems, and other measurements to determine time-and-space-related distributions of carbon dioxide in the ocean. Oceanographic observations have also been carried out to monitor the climate changes in the western North Pacific. Japan is also been promoting the 'Construction of Advanced Ocean Observing System' (ARGO project) with the aim of improving long-range weather forecasts. Japan has been improving the marine observation system by deploying Triton buoys in the tropical Pacific since 1998, and deploying ARGO floats since 2000. Moreover, the following has been implemented: preparation of bases for monitoring the marine environment in accordance with the Northwest Pacific Action Plan (NOWPAP); development of the Advanced Earth Observing Satellite-II (ADEOS-II) for observation of the marine environments and Advanced Microwave Scanning Radiometer-E (AMSR-E); and research into remote sensing technologies.

Table 7.2 Participattion in the Global Ocean Observing System

	VOS	SOOP	Tide gauges	SFC drifters	Sub-SFC floats	Moored buoy	ASAP
Number of stations	432	38	15 ²	41 ¹	78 ¹	11 ¹	6
Number of stations providing data to International Data Centers	332	38	15 ²	35 ¹	54 ¹	10 ¹	6
Number of stations expected to be operational in 2005	450	38	15 ²	40	350	11	6

1 : As of August 31st 2001, or as of December 31st 2001 for others

2 : Tide gauges participating in GLOSS, including the Showa Station at the Antarctic

7.3.3.3 Terrestrial observing system for climate

Japan is continuously strengthening its observation and monitoring systems and other measurements to scrutinize time and spatial distribution of greenhouse gases such as carbon dioxide, methane, nitrous oxide, chlorofluorocarbons, tropospheric ozone, and has been carrying out the following: monitoring of greenhouse gas flux in northern forests; development of the Advanced Earth Observing Satellite-II (ADEOS-II); Advanced Land Observing Satellite (ALOS) and sensors carried aboard this satellite (Advanced Visible and Near Infrared Radiometer Type 2 (AVNIR-2), Panchromatic Remote Sensing Instrument for Stereo Mapping (PRISM), Phased Array type L-band Synthetic Aperture Radar (PALSAR); research into remote inspection technology that carries out terrestrial environmental observations of vegetation amounts (biomass), land use, changes in land coverage, ground moisture, snow and ice.

7.3.3.4 Support for developing countries to establish and maintain observation systems, concerned data and monitoring systems

Japan has been jointly carrying out research on global environment measuring technologies in Asia, and has also been promoting the establishment of a strategic environment monitoring system using a satellite in the Asia-Pacific region.