Earth Observation Promotion Strategy

(Provisional Translation from the Official Document in Japanese)

Council for Science and Technology Policy, Cabinet Office, Government of Japan

(27th December 2004)

I. Introduction

In recent years, massive natural disasters have occurred with alarming frequency, threatening people's ways of life. The results of wide-ranging and large-scale human activities are beginning to be witnessed across the globe in the form of transboundary dispersal of pollutants, climate change, the extinction of species, exhaustion of resources, and other phenomena.

Earth observation, which looks at the physical and chemical properties of atmosphere, oceans, land and the Earth's interior, as well as ecosystems and their functions, is a way of gaining basic data to help us reach a comprehensive understanding of the present state of the planet and to predict its future. The importance of Earth observation is becoming increasingly acknowledged because, in addition to the provision of daily weather forecasting and natural disaster information, it also helps to ensure that appropriate steps are taken to deal with global environmental issues such as climate change and stratospheric ozone destruction.

In Japan, the ministries and institutions concerned have made various efforts to meet the wide-ranging demands for Earth observation: observation systems using platforms such as artificial satellites, aircraft, ships and ground based observatories; improvements in data collation and provision systems; and R&D to raise the sophistication of observation technologies. However, since Japan's preparation of a systematic observation plan has been insufficient and the collaboration of its ministries and institutions ineffective, the systematic acquisition of Earth observation data has not been carried out in an adequate manner. Japan thus needs to integrate its Earth observation systems and pursue a strategic approach.

On the international stage, the Declaration of the Earth Observation Summit, which included the formulation of the 10-year Implementation Plan, was adopted at the summit held in Washington DC in July 2003, and the construction of an Earth observation system through international cooperation was proposed. The Framework Document for the 10-year Implementation Plan was decided upon at the 2nd Earth Observation Summit, held in Tokyo in April 2004. The formulation of the 10-year Implementation Plan continues today with a target of achieving an agreement at the 3rd Earth Observation Summit, to be held in Brussels during February 2005. Against a background such as this, Japan needs to clarify its position on international Earth observation efforts and how it intends to contribute to them, and to strategically pursue international responses.

In order to clarify the basic stance of Japan's future approach to Earth observation, the Council for Science & Technology Policy set up the Earth Observation Survey and Examination Working Group within the Environmental R&D Promotion Project Team of the Expert Panel on Promotion Strategy of Prioritized Areas on September 26th 2003. After the working group had completed its intensive survey and examinations, the results of their considerations were compiled in the Earth Observation Promotion Strategy.

In line with the three principle strategies under the long-term views established in March 2004's Interim Report on the Basic Polices on approaching Earth observation in Japan, this promotion strategy shows Japan's policy on approaching Earth observation, and the crucial issues that need to be addressed within the next ten years or so.

It is hoped that this promotion strategy will be appropriately reflected in the annual financial guidelines on Budgetary/Personnel Resources Allocation in Science and Technology, so that the limited R&D resources of finance and personnel may be effectively used in the midst of the severe public finance situation. It is also hoped that the promotion strategy will become national policy on the domestic measures taken to address each ministry's approach to Earth observation and the international 10-year Implementation Plan.

Finally, it should be stressed that the promotion strategy will need to be reviewed flexibly in the light of advances in Earth observation technologies and of shifts in the state of society.

II. Japan's basic Earth observation strategy

The promotion strategy defines Earth observation as follows. "Earth observation" is here is taken as "the observation of the physical and chemical properties of the atmosphere, ocean, land and the Earth's interior, as well as the functions of ecosystems, with the purpose of addressing global environmental issues through monitoring, detection and the prediction of the effects of global environmental changes, continuous meteorological and oceanographic survey, surveillance of natural disasters, mapping (developing geographical information), resource exploration and management, and the enhancing of earth science knowledge; it includes both global and regional observations, of which the latter are inseparably related to global phenomena". As a sound policy decision towards ensuring the sustainability and welfare of mankind, and with consideration of our nation's prominent position in Earth observation, Japan's basic strategy on Earth observation consists of the following three aims: 1) Constructing an integrated Earth observation system driven by user needs; 2) Maintaining Japan's autonomy while exercising leadership in the integration of international Earth observation systems; 3) Establishing an Earth observation system through strengthened collaborative relationships with the Asia and Oceania regions.

1) Constructing an integrated Earth observation system driven by user needs

In order to move on from the tool development and data requirements assessment stage, and in order to promote Earth observations that are based on user needs, we need to improve cooperation between the bodies involved, and build an integrated Earth observation system based on these user needs, following a long-term forward-looking strategy. This will entail a clarification of the roles to be taken by each relevant institution, and an attempt to select from amongst the problems and issues those that are most important so as to assign budgetary and personnel resources on a prioritized basis.

2) Maintaining Japan's autonomy while exercising leadership in the integration of international Earth observation systems

By participating in the construction of comprehensive, coordinated and sustained Earth observations through international cooperation, Japan will promote effective and efficient Earth observation with the collaboration of other countries and regions. By putting to good use the advantages in Japanese technologies and regional characteristics, and by strategically and selectively approaching the subjects, regions and duration of observations, Japan will maintain its autonomy while exercising international leadership.

3) Establishing an Earth observation system through strengthened collaboration with the Asia and Oceania region

Collaboration with Asia, particularly East and Southeast Asia and Oceania, will be considerably strengthened taking into consideration Japan's geographical position. With appropriate role-sharing amongst countries and regions, the creation of an Earth observation system centering on the Asia and Oceania region will be pursued. The ability of developing countries to take part will be encouraged by offering them assistance in personnel training and infrastructure improvements.

III. Japan's Earth Observation Promotion Strategy

1. Japan's views on approaching Earth observation

(1) Perceptions

The solid Earth, the oceans, land and the atmosphere surrounding it, the organisms and humans that inhabit it and their numerous subsystems interact with each other, creating a single and highly complex earth system. The whole picture of this elaborately shifting earth system and its mutually interrelated subsystems cannot be gained by merely accumulating individual and fragmentary data on each subsystem.

The timescales of the changes in this complex system are numerous, varying from a few hours to billions of years. Among the long-term changes, the existence of phenomena that become irreversible once they occur has been identified. The possibility that a change originating in one specific region can trigger a phenomenon with global scale effects has also been pointed to.

If we are to obtain a flawless understanding of the entire earth system, the accumulation of knowledge, not only about natural phenomena but also about social phenomena, and about how these interact with each other, is essential. This will mean improving the functions of Earth observation so it can thoroughly grasp the state of the earth system and its changes. It will also mean the systematic collection and preparation of Earth observation data.

The results of Earth observation will be widely used by scientists, decision makers, and communities in industry, education, NGOs and the general public. The information these users will require will be diverse, and alter from time to time as the nature of society itself changes.

(2) The current situation

Contemporary Earth observation requires a large-scale infrastructure including observation platforms such as artificial satellites, ships and aircraft; observation networks including ground based observatories, radars, sondes (observation balloons), and oceanographic observation buoys; networks for the observation of solid Earth relating earthquakes, volcanoes, geodetic and geomagnetic phenomena; the accompanying information and telecommunication systems; and data systems for the management, storage and provision of observation data.

While we need to use an observation system containing this large-scale infrastructure in order to meet the changing and diverse requirements of Earth observation, there are also indications that we will have to make substantial improvements and progress in the following areas: 1) the parameters of observation; 2) the quality of the data; 3) continuity and consistency; 4) time-space resolution, 5) time-space data coverage; and 6) convenience of access to data and information.

Japan, Asia's key nation, must take advantage of its geographical position, look beyond domestic needs and fulfill its share of responsibilities in the implementation of international Earth observation plans.

Earth observation has been carried out as an operation of government ministries and institutions for administrative purposes and as research activities of R&D institutes and universities for academic purposes. However, that fact is that not all of these activities are being systematically carried out in the manner of the observations structure necessary for a comprehensive understanding of the Earth. Consequently, it could hardly be said that Japan is effectively utilizing its Earth observation abilities.

(3) Future approaches

The requirements of Earth observation are that: 1) It doesn't just provide data to researchers dealing with the understanding of the Earth; 2) It also provides the data necessary for the government to decide on policies; 3) It provides the data needed for the management base of industry; and 4) It provides data inextricably related to the everyday lives of the general public. In particular, the information pertaining to 2) and 4) above needs to be comprehensive if is to be of use to the government in policy-making or to society in the establishing of codes of conduct.

If effective and efficient Earth observation is to be implemented in the midst of limited financial and personnel resources, governmental ministries and institutions will have to join in an attempt to construct an integrated Earth observation system driven by user needs, and put Japan's Earth observation resources to good

use. It is critical that Japan makes a precise assessment of what it should do as a nation, and develop a system that reflects Earth observation policy. The cooperation of other countries is also essential if global-wide observation is to be effectively and efficiently conducted.

Regarding development and utilization of space technology, including the crucial Earth observation platform of artificial satellites, we will adopt the approach outlined in the Basic Strategy for Space Development and Utilization in Japan, which was decided upon by the Council for Science & Technology Policy on September 9th 2004.

An integrated Earth observation system driven by user needs will be a considerable boost to Japan's Earth observation abilities, will enable Japan to maintain its autonomy while exercising leadership in the integration of international Earth observation systems, and will be a step towards establishing an Earth observation system through stronger collaboration with the partners in Asia and Oceania regions. This will also help to reinforce the international Earth observation framework. And the new expertise obtained from integrated Earth observation will in turn lead to the creation of wisdom through understanding of the Earth system.

2. Strategic prioritization

(1) Prioritization perspectives

Japan must clarify the pressing needs to be addressed as a nation in line with the points presented below, and strategically implement a prioritized program that can precisely respond to these needs. Since Earth observation, as a part of basic research, leads to the accumulation of intellectual assets common to all of mankind, we need to carefully consider both the long-term and short-term perspectives.

1) Ensuring the public's ease of mind and security

Reducing the risks incurred by natural and human-induced activities, and securing the health and welfare of the citizens are the government's responsibilities, and a government-led approach to these is essential. Comprehensive observation and monitoring of the global environment in order to conserve it, and steady observation and monitoring that will lead to the reduction of natural disasters and better crisis management, are an important part of the government's efforts to ensure the public's ease of mind and security, and are vital to government policy decisions in this area.

2) Development of economic society and improving quality of life

The stable supply of energy and mineral resources and the appropriate management of water, agricultural, forestry and fishery resources provide support for all sorts of economic activity. Reducing uncertainties surrounding their sustainable supply, and ensuring stability is important, and will require the preparation of comprehensive information as a result of Earth observation.

3) Contributing to international society

Bearing in mind Japan's geographical situation, it is important to contribute to international society through the promotion of fully-fledged Earth observation. Promoting international cooperation with countries in the Asia and Oceania regions, and addressing common concerns in these regions are absolutely vital to the creation of a sustainable international society.

(2) Strategic prioritization to address needs

Looking at the three perspectives outlined above, the areas of global environmental conservation, water resource management and the reduction of damage caused by natural disasters can be identified as example areas which need to be addressed urgently through governmental promotion of Earth observation. The following is a detailed outline of the five areas that need to have a prioritized approach over the next ten years or so.

Chapter IV of this volume, which explains the promotion strategy field-by-field, also shows what issues and matters should be systematically dealt with in each observation area in order to gain a comprehensive understanding of the Earth and its systems.

1) Elucidation of phenomena related to global warming, predictions of its effects, and mitigation and adaptation methods

It is predicted that the effects of the global warming caused by human activity will become more conspicuous as it advances. The advance of global warming is evident not just in direct effects such as rising temperatures in atmosphere and surface ocean, rising sea levels, or changes in the cryosphere, but is also thought to wreak massive indirect effects on precipitation volumes and distribution, agricultural productivity, ecosystems, and human health. Perceived as the major environmental problem of the 21st Century, global warming is a matter of grave concern; measures to redress it will need to be implemented with accuracy and timeliness.

The Kyoto Protocol, which sought to contain greenhouse gas emissions, was adopted in 1997 at the 3rd Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC-COP3) in Kyoto, and was scheduled to come into force in February 2005. Policy decisions about the timing and extent of global warming countermeasures require reliable forecasting about future climate change, based on a deepened appreciation of the current meteorological situation. Improving the reliability of the global system model for attaining the projection of future climate change requires comprehensive observation data on many matters relating to greenhouse gases and climate change. Likewise, it is important to detect the direct and indirect effects of global warming at an early stage through observations to estimate the future effect and appropriately implement measures.

From this perspective, the worldwide and comprehensive understanding of global warming phenomena clearly needs to be conducted through international cooperation. Japan in particular needs to focus its efforts on the Asian and Oceania regions by conducting atmospheric, terrestrial and oceanic observation of greenhouse gases, terrestrial and oceanic observation of carbon cycles and ecosystems, and by observing the effects of global warming on coastal, cryospheric and other regions vulnerable to climate change.

2) Understanding water cycles, and water management

Water-related problems such as water shortages, pollution, and the damage caused by floods are occurring on a worldwide basis, particularly affecting developing countries. It is expected that food shortages, the spread of infectious diseases and the deterioration of ecosystems due to water-related problems will become increasingly apparent and international conflicts over water increasingly severe.

The mutual interaction of the atmosphere, land and oceans intricately affects fluctuations in water cycles, and these effects can occur on many different spatiotemporal scales. The coordinated implementation of comprehensive water cycle observation and the provision of valid data for appropriate water management help to ensure the safety of the public's everyday lives, and political and economic stability.

We therefore need to develop a system that will promote the collecting, sharing and provision of comprehensive water cycle data and associated data. In particular, if we are to solve the water problems afflicting Asia, which is home to 60 % of the world's population, we must develop comprehensive observation system for the Asian monsoon regions, deepen our understanding of the fluctuations in the monsoons, help to improve the predictive accuracy of water cycle changes for the appropriate management of water resources, and reduce the damage caused by natural disasters.

3) Understanding atmospheric changes

The sudden increases in population and urban expansion witnessed in recent years in Asia, and the subsequent environmental problems seen in the region threaten to spill over into the rest of the world. There are particular fears that the increase of airborne pollutants caused by the burning of fossil fuels will result not only in environmental damage to the source regions through sulfur and nitrogen oxides, ozone and aerosols, but also in the cross-border transport of acid precipitation, leading to widespread environmental damage in Japan and other adjacent countries. It has been pointed out that changes in patterns of land-use and desertification are leading to changes in the emergence and transport of yellow dust and aerosols, and that this could have a major influence on the lives of people in surrounding regions. The airborne pollutants increasingly emitted in Asia have a considerable influence on the atmospheric behavior of trace greenhouse gases; the observation of these is important.

The observation of acid precipitation and other phenomena is currently being conducted in Asia's developing nations, with the cooperation of the region's developed countries such as Japan. But the present infrastructure development of the research and observation system is still inadequate, and we will need to reinforce the observation stations in cooperation with other Asian nations, and further improve the observation network's facilities.

4) Reducing wind and flood damage

Major socioeconomic damage is caused across large areas of Japan and the rest of Asia by massive flooding due to torrential rainfall, typhoons and cyclones, as well as droughts caused by prolonged dry spells. Typhoons and cyclones, which wreak havoc across wide areas, are a particular threat to the people of Asia.
Japan possesses artificial satellite observation technology, a ground based observation network, and superior technology and know-how in the field of wind and water damage prediction models. By cooperating with the international framework, it is hoped that we will be able to carry out comprehensive observations that will make a contribution to alleviating the harm caused in Asia's developing countries and in regions that experience frequent wind and water damage.

We will seek to address these hopes by methodically maintaining and improving the terrestrial observation network, which is an essential feature of the observation system to predict and alleviate wind and water damage. Furthermore, we need to carry out prioritized observations of regions that frequently experience natural disasters with the use of artificial satellites, and develop our techniques for forecasting and taking measures with the use of digital geographic information systems.

5) Reducing the impact of earthquakes and tsunamis

Huge earthquakes and tsunamis in Asia cause massive loss of human life and assets. The potential of huge damage caused by serious earthquakes exists in the earthquake-prone belt in central and western Asia, and in the Pacific Rim in which Japan is situated. We need to improve our observation technologies in order to reduce the impacts of Earthquakes and tsunamis, take steps to elucidate the mechanisms that cause these phenomena, and put the results to good use in our disaster prevention measures.

A seamless ground based and oceanic observation system should be developed in Japan by making effective use of the observation networks operated by government ministries and universities. Sharing the highly developed observation networks and other infrastructure technologies possessed by Japan with the rest of Asia would make a considerable contribution to the reduction of earthquake and tsunami damage in those regions where the observation system is inadequate. Japan needs to make full use of all its resources and technology to elucidate the Earthquake and tsunami mechanisms caused by the movement of the Pacific plate and so on.

3. Integrating the Earth observations system

(1) The benefits of integration

The observations and research carried out in line with their administrative goals by government ministries and institutions and the research-led observations carried out at universities for academic purposes, need to be coordinated so that we can work towards the construction of an Earth observation system in which every stage, from data collection through to provision, is integrated. This should be carried out under a promotion strategy formulated with foresight, and while capitalizing upon characteristics and strengths of ministries and institutions.

A continuously operated and integrated Earth observation system, created through close governmental and institutional cooperation, would offer the following benefits:

(i) It would enable the comprehensive collection of Earth observation data.
(ii) The personnel, facilities and other resources of ministries and institutions could be used effectively, the observations would be made effectively, and the coordination of policy would prevent the duplication of work and ensure efficient observation.
(iii) While the burdens placed on ministries and institutions by their individual efforts and the entailing development and maintenance of the observation systems are massive, cooperation between these parties would make the sustainable operation of the observation system feasible.
(iv) By enabling government ministries and institutions to use the resources of other organizations, they will be able to choose the best observation methods from a wide range of choices.
(v) The effective use of the data collected by ministries and institutions would become possible, and the user-friendliness of the data improved.

(2) The ideal nature of an integrated Earth observation system

1) Gathering user needs and incorporating them in the implementation plan

The Earth observation plans, including the essential parameters to be observed, the quality of the data, the spatiotemporal resolution, coverage, data span and other features should be aligned with individual observation goals or data utilization purposes. It is vital that the institutions conducting the observations cooperate closely with policy makers, governmental administrators and researchers, that the wide-ranging user needs are gathered so the demands of these users are adequately reflected in the observation implementation plan, and that the plan is implemented accordingly.

2) Mutual use and joint operation of facilities and equipment

It is important that the systematic integration of current and future observations is promoted, that the mutual use and joint operation of facilities and equipment used by ministries and institutions in their observations is encouraged, and that their observation system is mutually and complementarily enhanced.

3) The logical introduction of new observation technologies

As Earth observation abilities and data analysis techniques improve, and the fields in which observation results are used expand, their needs are expected to become increasingly sophisticated and diverse. The introduction of new observation technologies to meet these needs must be carried out in a logical manner, consistent with the integrated Earth observation system. The use of advanced technologies will seek an increase in efficiency by the upgrading of our Earth observation functions.

4) Utilization of private sector vitality

There are limits to the observation platforms and networks of government institutions. Ensuring that we obtain the necessary observation coverage through cooperation with the private sector

is a valid option. Another option for improving Earth observations, in which long-term and routine observations carried out by the government are transferred to the private sector after developing a system to ensure their continuation, needs to be carefully examined.

*5) Ensuring the transparency of the implementation plan and publicizing its achievement*s

It is important that the government keenly publicizes information about the implementation of observation projects it is involved with, and gains the understanding of society. Making public the implementation plan for the project and the roles of the ministries and institutions involved would encourage domestic collaboration in observation activities and is a valuable way of effectively promoting the project.

It is important to create a system in which the data obtained is swiftly publicized both inside and outside Japan in order to achieve the effective use of the results and to facilitate a contribution to international society.

The international observation projects in which Japan participates should be regarded as being within the integrated observation system, and the roles of the ministries and institutions that serve as the contact points need to be clarified. Japan will have to balance the maintenance of its autonomy in the promotion of the projects with its vigorous international contributions.

6) Improving quality assessment and management

In order to effectively use the data and information obtained from Earth observations, the bodies involved have to carry out quality control using the appropriate methods and technologies; the resultant data from each observation and its quality must be suitably evaluated and presented to users. It is particularly important that the quality of the data is clearly established and that the accompanying information is accurately described in order to integrate the data obtained by numerous observation bodies inside and outside Japan and obtain useful information from the integrated data. And to obtain consistency in the comparisons of data intercomparisons of the methods and standardization are necessary.

We must strive to obtain information on quality control at each stage of the integrated Earth observation system, from data collection through to quality management.

7) Achieving the continuous long-term observation

Very few of the important changes in the Earth's system can be elucidated with short-term observation. A correct understanding of these phenomena also requires continuous long-term observation. However, even research projects that it is hoped will bring good results with long-term observation often struggle due to organizational or budgetary factors. There are many examples in which the further pursuit of the results of observations has been reluctantly abandoned.

It is crucial that a mechanism is developed that enables the collaboration of ministries, institutions and universities involved in continuous long-term observations, and ministerial and institutional facilities and personnel and the technologies of research bodies and universities are fully used, thus preparing an institutional support system for continuous long-term observations. We also needs to examine the idea of using competitive research funds to encourage the development of new observation techniques and equipment that could help to enable continuous long-term observations.

Since most of the observations carried out at R&D institutes and universities for international research projects are the work of individual researchers or relatively small teams, their long-term survival is far from assured. The government should evaluate the importance of observation activities related to international projects, strengthen ministerial and institutional support for the important projects, and a system must be set up to ensure the long-term operation of such projects. This is also vital in order to gain the trust of international society.

8) Encouraging the sharing and use of data

Improving the efficacy of Earth observation entails the well-balanced development of observation systems and data utilization systems. In specific fields such as meteorology, the international sharing of Earth observation data is occurring in line with internationally agreed frameworks. The bulk of the remaining observation data is, however, maintained by a diffuse range of institutions, making it extremely difficult for users to obtain the sort of data they need.

It is expected that the automation of observations and utilization of new artificial satellites will lead to a larger amount of data to be managed. Likewise, it is anticipated that the diversification of user needs will lead to a diversification of data formats. In response to this situation, we need to transform observation data into scientifically and social relevant information through the systematic collection, logical management and integration of data and merging of information, and build a system for sharing this knowledge on an international basis. A system, in other words, for the collection, sharing and provision of data from which users can obtain the data they need, whenever they want it and in whatever format they require.

In cases in which large amounts of heterogeneous and diverse Earth observation data are handled, this data along with socioeconomic and other related data must be dealt with systematically in order to extract the useful scientific knowledge within and translate it into information pertinent to users. Handling comparatively lighter amounts of heterogeneous data requires the standardization of data formats and protocols, and the development of a network-linked distributed data system. The systemization of Earth observation data will also require the steady development of global geographic information as its common basis.

9) Fostering the personnel resources for the next generation

Japan must treat the education and securing of personnel resources to support Japan's own Earth observations as a matter of urgency in order to assure the sustainable operation of an integrated Earth observation system. We need to make sure that we have personnel resources who can play a leading role in international projects in order to achieve harmony with the international Earth observation system, and to promote Japan's own Earth observations.

Japan needs to build an organic and constructive collaborative system between universities, educational and research institutes and government bodies as a part of the integrated Earth observation system. It also needs to examine creating mechanisms for implementing a program to train the personnel resources who will play prominent roles in this set up.

4. Responding to the international Earth observations framework

The Framework Document formulated at the 2nd Earth Observations Summit points to the following societal benefit areas of a comprehensive, coordinated and sustained Earth observation system, which would lead to:

1) Reducing loss of life and property from natural and human-induced disasters;
2) Understanding environmental factors affecting human health and well being;
3) Improving management of energy resources;
4) Understanding, assessing, predicting, mitigating, and adapting to climate variability and change;
5) Improving water resource management through better understanding of the water cycle;

6) Improving weather information, forecasting, and warning;
7) Improving the management and protection of terrestrial, coastal and marine ecosystems;
8) Supporting sustainable agriculture and combating desertification:
9) Understanding, monitoring, and conserving biodiversity.

The 10-year Implementation Plan for the Global Earth Observation System of Systems (GEOSS), suggested in response to the Framework Document, aims to prescribe a new framework for Earth observation through international cooperation; it aims to consistently link up existing and future Earth observations, amongst countries, regions and institutions across the world, and establish a comprehensive Earth observations system.

Efforts to urgently address the needs set out in this Earth Observation Promotion Strategy will make an important contribution to the pursuit of the societal benefits noted in the Framework Document. Improving Japan's Earth observation abilities by creating an integrated Earth observation system will be a tremendous spur to the 10-year Implementation Plan, and will ensure that Japan fulfills its international obligations as an advanced nation in the field.

5. Promotional structure and organization of the integrated Earth observation system

(1) Functions required of the promotional structure and organization

A promotional structure with the following functions is needed in order to create an integrated Earth observation system in Japan, in accordance with the importance and the characteristics of Earth observation, its current situation in Japan, the direction it should be pointed towards in the future, and with international developments in the field, as well as in line with sections 1 to 4 of this document.

1) It must be able to formulate a concrete annual implementation policy for Japan concerning the promotion of Earth observations, the development of the Earth observation system, and international contribution policies, while accurately reflecting Earth observation user-needs and international trends and taking a panoramic view of a wide range of Earth observation fields in line with this Earth Observation Promotion Strategy. At the same time it must achieve close collaboration and coordination of relevant ministries and institutions. This implementation policy must also be in-synch with the international framework.

2) Concerning prioritized areas to be particular national importance, the results of which will contribute to the societal benefit areas outlined in GEOSS, it must swiftly obtain inter-departmental collaboration in Earth observation activities, in line with the implementation policies formulated from long perspective. In order to effectively and efficiently promote these activities it must bring them together by individual area, or collectively as appropriate, and seek closer collaboration between the bodies concerned, including during the stage at which the implementation plan is formulated. Attention should be paid to ensuring the mobility and flexibility of the structure, so that it can respond appropriately to sudden issues that might arise.

3) It must, with the cooperation of the relevant ministries and institutions, assess the state of progress of projects carried out under the above implementation policy from the point of view of operating an integrated Earth observation system, and reflect these assessments in subsequent Earth observation implementation policies.

(2) The desirable nature of the promotional structure and organization

The Environmental R&D Promotion Project Team of the Expert Panel on Promotion Strategy of Prioritized Areas of the Council for Science & Technology Policy formulated the Earth Observation Promotion Strategy from a long-term perspective. Its implementation requires the creation of a permanent promotional structure and organization.

Regarding Japan's stance at the Earth observation summits and other related meetings, survey and examinations have been effectively conducted through interdepartmental collaboration and cooperation, and the enthusiastic and systematic involvement of the Ministry of Education, Culture, Sports, Science and Technology's International Earth Observation Strategy Formulation Study Group, its Implementation Plan Panel, as well as the Cabinet Office, the Ministry of Internal Affairs and Communications, the Ministry of Foreign Affairs, the Agriculture, Forestry and Fisheries Ministry, the Ministry of Economy, Trade and Industry, the Land, Infrastructure and Transportation Ministry, and the Ministry of the Environment. The fact that this sort of interdepartmental collaboration and cooperation has been achieved can be cited as one of the major reasons that the 2nd Earth Observation summit, hosted by Japan in April 2004, was such a success.

The survey and examinations group and the panel mentioned above have played central roles in the consideration of Japan's international response to Earth observation, and are close to accomplishing their intended goals. It should be pointed out, however, that they are provisional groups whose main objective is to assist in the formulation of policies for the 10-year Implementation Plan, and they are not responsible for creating the structure and organization demanded by the Promotion Strategy.

This leads to the conclusion that realizing the requisite abilities outlined in (1)-1) above would best be achieved by establishing the necessary integrated promotional organization on a permanent basis at the Council for Science and Technology within the Ministry of Education, Culture, Sports, Science and Technology. The promotional organization would formulate the concrete implementation policies mentioned in (1)-1) on an annual basis according to the budgetary situation and with the close collaboration and coordination of all the other related ministries and institutions, which would in turn devise implementation plans in line with the implementation policies and then carry out the subsequent projects. These ministries and institutions will need to work closely with the operation of the Council in order that implementation policies drawn up reflect the need for global environmental conservation, water resource management, and the reduction of the damage caused by natural disasters. They will also have to collaborate to ensure that Earth observations are effectively promoted in line with implementation plans reflecting policy.

Regarding the functions mentioned in (1)-2) above, these need to be brought together (either by individual area or collectively as appropriate) making the best use of the existing frameworks, and a system encouraging collaboration between ministries and institutions developed. The ministries and institutions that will play the role of a coordination core in these efforts will collaborate with the Council in combining Japan's observation needs and information on their state of progress, and fulfill their function of promoting collaboration between ministries and institutions.

One of the Council for Science and Technology Policy's functions mentioned in 1-3 above will be to receive reports from the Council for Science and Technology about the progress of projects carried out in line with the implementation policies, and, when necessary, to obtain reports from ministries and institutions, and keep watch over the operation of the integrated Earth observation system by making a comprehensive evaluation of these reports. This Earth Observation Promotions Strategy will be reviewed as deemed necessary, taking into account both the comprehensive evaluations mentioned above, and developments in Japan and overseas.

IV. The Individual Fields Promotion Strategy

The Individual Fields Promotion Strategy identifies (1) the requirements for Earth observation and general objectives over a ten-year period, and (2) the problems and issues to be addressed over the next ten years in individual fields, in order to provide a clear overall picture of the sort of comprehensive Earth observations needed. The promotion strategy also prescribes the creation of nine subcommittees consisting of people with academic experience, under the Earth Observation Survey and Examination Working Group. The implementation of comprehensive Earth observation necessitates close coordination between individual fields, choosing from amongst these problems and issues, and concentrating on them so as to assign resources on a prioritized basis.

It is hoped that the Individual Fields Promotion Strategy will serve as a set of guidelines for use in the creation of observation implementation plans by the organizations responsible for performing them. Detailed information on the studies performed by individual subcommittees can be found in the Earth Observation Survey and Examination Working Group's Individual Subcommittee Reports (released at the November 2004 Meeting of the Priority Areas Survey Working Group Environmental Research and Development Project Team).

1. Global warming

(1) Requirements for Earth observation and general goals over the next ten years

It is imperative that we monitor climate change, construct a comprehensive observation system that will allow us to accurately detect the direct effects of global warming on sea levels and the cryosphere, and evaluate the direct and indirect effects of global warming on human health and on global ecosystems. There is also a need for comprehensive and ongoing observation of the state of greenhouse gases and other substances causing global warming so that we can improve our understanding of the processes by which the phenomenon takes place and reduce the levels of uncertainty involved in making predictions of future climate change. This kind of observation is essential if we are to be able to accumulate information on the elucidation of phenomena related to global warming, the predictions of its effects, and the mitigation of and adaptation to global warming. It would also help in improving our overall understanding of the global environment.

(2)Problems and issues to be addressed over the next ten years

1) Global monitoring

Research and development work will be conducted on systems for monitoring greenhouse gases on a global basis, monitoring land-based flora and marine phytoplankton, and artificial satellite monitoring of clouds, aerosol, and precipitation. Meteorological and marine observation networks will be used and improved to gain an accurate understanding of current climactic conditions and to learn about the effects of global warming.

2) Comprehensive atmospheric observation in Asia and Oceania

In addition to upgrading observation networks of greenhouse gases using ground-based observatories, ships for maritime atmosphere, and commercial/noncommercial aircrafts for vertical distribution measurement, we will conduct atmospheric observation of cloud cover and aerosol.

3) Integration of observations of the terrestrial carbon cycle and ecosystems in Asia

Using terrestrial carbon cycle observation stations (stations with carbon flux monitoring towers), we will construct an ecosystem observation network to enable us to learn about the combined effects of terrestrial carbon cycles and the disruption of ecosystems.

4) Construction of the observation network of carbon dioxide in sea water

In order to learn about the mechanisms by which oceans absorb carbon dioxide, an observation network will be built which will combine the monitoring of carbon dioxide at the ocean surface (through the use of research vessels, volunteer observation ships including commercial ships, and automated buoys), hydrographic section measurement of carbon dioxide, and monitoring at ocean time series stations for biogeochemical parameters.

5) Monitoring of the effects of global warming in areas vulnerable to climate change

Systems will be constructed to make it possible to gain correct information on the effects of global warming on areas vulnerable to climate change (such as cryospheric and coastal areas).

6) Integration of observation data with socioeconomic data

Observation data will be integrated with socioeconomic data to create a database that will serve as a foundation for forming predictions on human-induced global warming.

2. Global water cycles

(1) Requirements for observation and general goals over the next ten years

An international effort must be made to build an integrated observation system on a global basis for the observation of water cycles in order to prevent water hazard, to make proper use of ground water, underground water, and other water resources, and to preserve and manage the water resources in a sustainable and sensible manner. It is also necessary to integrate observation data with socioeconomic data in order to enable the provision of the kind of information needed to formulate government policy on crisis management, resource management, and environmental management.

(2)Problems and issues to be addressed over the next ten years

1) Construction of an integrated observation system for global water cycles

In addition to establishing observation hub-networks in critical areas to study the principles determining water cycles and make predictions about such cycles, local observation networks using automated observation systems able to systematically cover wider areas will also be constructed. Efforts will also be made to improve our ability to observe levels of precipitation, soil water content, levels of water vapor, and other aspects of water cycles by artificial satellite. These will then in turn be used to construct a system for observing changes in water cycles caused by the Asian and Australian monsoons, which affect large parts of Asia, and for observing changes in water cycles in high-latitude regions of the Eurasian continent.

2) Integration and fusion of global water cycles data and information

Large-volume and heterogeneous data will be collected, checked for quality, compiled, and analyzed over a long period. This data set will be used in an integrated manner with numerical models and with socioeconomic data, and the information obtained will be merged. In addition to performing research and development into technologies to share these results on an international basis, an international effort will also be made to develop a system whereby this data and information may be shared.

3) Improving skills in observation data integration and use of information

A training program will be developed to improve the skill levels of foreign and Japanese researchers, and observation; to foster their development and improve their ability to integrate, analyze, and use data; and to improve their ability to manage and implement international projects related to changes in water

cycles.

3. The global environment

(1) Requirements for observation and general goals over the next ten years

To perform observations that will enable an understanding of the dynamics of the composition of the atmosphere and oceans and to gain an overall understanding of the generation of anthropogenic materials, their movement, their diffusion and the processes by which they react with other materials, observation stations must be established at suitable locations, and quantitative evaluations made of their influence on the environment of humans and other living organisms so as to learn what is needed in order to formulate government policies and come up with effective measures for preserving the global environment. There is also a need to take measures towards the construction of a global environmental observation and monitoring system that would enable a comprehensive understanding of changes in the atmospheric composition of the troposphere in the Asian region and of global environmental change.

(2) Problems and issues to be addressed over the next ten years

1) Observation of short-lived tropospheric chemical species

Observation will be conducted on the research and development of satellite-borne short-lived tropospheric chemical species sensors observation equipment designed to be mounted on aircraft and observation balloons, remote sensing technologies, and other atmospheric observation technologies. These will then be used to ascertain the current state of and general trends in atmospheric pollution in major Asian cities, trans-boundary air pollution, and hemispheric pollution.

2) Observation of ozone, aerosol and other atmospheric pollutants

Observations will be made of ozone, aerosol, and other atmospheric pollutants in order to obtain a quantitative understanding of their spatial distribution and influence on local climate change. Aircraft and balloons will also be used to collect samples of aerosol in order to study their characteristics.

3) Observation aimed at identifying the dynamics of the ozone layer

In addition to observations of the recovery of the stratospheric ozone layer, work will also be performed to establish a system for the long-term observation of climactic factors, ultraviolet radiation, water vapor, nitrous oxides, aerosols and other gases that may harm the ozone layer.

4) Long-term continuous observation of stratospheric transport

A system will be established for performing continuous long-term observations of the stratosphere using spectroscopic techniques, laser radar, aircraft and balloons designed to enable us to learn and understand about the distribution and dynamics of the substances in the stratosphere.

5) Long-term observation of changes in the marine environment

The development of a comprehensive observation system making use of observation platforms such as research vessels, volunteer observing ships including commercial ships, satellites, and buoys will be promoted, as well as networks for the sharing of the information thereby obtained.

6) Identifying the scope of human-induced pollution in ocean

Work will be conducted to establish observation systems designed to enable us to learn about current conditions and ongoing trends in persistent organic pollutants, oil, aerosol and acidic pollutants transported over large distances, ballast water transported by marine vessels, and other forms of widespread pollution from human sources.

7) Studying the influence of anthropogenic pollutants on ecosystems

Work will be conducted to establish systems for observing not only marine pollution but also the spread of pollution in sediments and ecosystems.

4. Ecosystems

(1) Requirements for observation and general goals over the next ten years

Demand has grown in recent years for the use of global observation systems designed to monitor ecosystems and biodiversity. Gaining a correct understanding not only of the effects of human activity such as environmental pollution or development but also of the influence of global warming and other types of global environmental changes on natural ecosystems and biodiversity is also essential if we are to be able to predict how the Earth will change in the future. Observations in Asia and Oceania are of particular urgency when considering ecosystems and biodiversity on a global scale. Sufficient frameworks for conducting observations in these regions are not yet in place, and there is a need to provide aid to foster the development of skilled observation technicians and improve Earth observation abilities in these regions. Demand is also growing for the establishment of observation stations that will be able to be operated on a long-term and continuous basis with proper coordination between researchers and observation technicians.

(2) Problems and issues to be addressed over the next ten years

1) The establishment of multi-purpose observation centers in Asia and Oceania

Observation stations designed to conduct comprehensive observations related to the functions and structure of ecosystems and biodiversity in a wide variety of environments are to be established and systems for the operation of such facilities will be developed together in conjunction with the local persons concerned.

2) Creation of a network of observation centers

Work will be done to establish a well-organized network of observation stations and to construct comprehensive databases.

3) Establishment of standardization of observation method

Standardization of observation methods will be established, which will make it possible to perform meaningful comparisons between observation data from different countries or regions and to promote the use of such standardized methods.

4) Promoting the development of observation technicians in Asia and Oceania

The very nature of the problems associated with ecosystems and biodiversity necessitates personnel resources to observe them, and in addition to creating observation centers work will also be done to promote the development of local observation technicians.

5. Windstorm and flood damages

(1) Requirements for observation and general goals over the next ten years

In order to build local societies able to withstand windstorm and flood damages, it is necessary to establish observation systems which make it possible to detect the abnormal meteorological phenomena which cause such damage, to quickly assess the range and degree of damage inflicted, to predict possible disastrous events, and to prevent or mitigate the damage inflicted. In Asia and Oceania social changes such as rapidly increasing populations and the increasing concentration of populations in urban centers have made many local areas within these regions more susceptible to natural disasters. In consideration of Japan’s geographical position and responsibilities as a nation, we will work towards the creation of the types of

observation systems which would make it possible to reduce the extent of windstorm and flood damage caused in Asia and Oceania regions.

(2) Problems and issues to be addressed over the next ten years

1) Development of more advanced observation networks for the detection of abnormal meteorological phenomena

Satellite observation systems and other advanced technologies will be introduced to enable the construction of effective observation and communications networks. Systems for coordinating action between nations and regions to promote the international sharing of information will also be established. A particular effort will be made to maintain and upgrade the ground-based meteorological and hydrological observation frameworks and systems in Asia and Oceania, which are currently becoming increasingly obsolete.

2) Creating a system for prioritized observations in regions subject to frequent windstorm and flood damages

Work will be conducted to implement an intensive program of natural disaster monitoring using both ground-based and satellite observation systems in areas subject to frequent windstorm and flood damages.

3) Increasing coordination between satellite observation systems and meteorological and hydrological observation systems

Systems designed for use in assessing damage will be constructed in which land observing satellite technologies and other satellite observation systems will be made to work effectively in conjunction with local meteorological and hydrological observation systems.

4) Integrating Earth observation data with forecasting and damage control technologies

Research will be performed to develop simulations using accurate models of meteorological and hydrological phenomena, thereby making it possible to use Earth observation data in conjunction with technologies for preventing or reducing windstorm and flood damages.

5) Improving skill levels in developing nations

A wider and richer variety of training and education programs will be offered to promote technology transfer in terms of the forecasting and analysis of meteorological and hydrological phenomena, creating hazard maps, transmitting data in real time, forecasting and early warning systems, and performing frequency analyses of extreme events.

6. Large-scale fires

(1) Requirements for observation and general goals over the next ten years

The number of large-scale fires occurring worldwide is increasing steadily, and while human activities have played a large role in these fires, abnormal weather conditions resulting from global warming and other forms of environmental changes on a global scale are also believed to have played a major part. These fires cause not only direct damage to houses and other property and forest resources but also indirect damage to human health through smoke; the problem is thus international in its scope. To reduce the damage caused, there is a need to strengthen cooperation among Asian countries and regions within an international framework and also to construct systems for providing information which would make it possible to look out for large-scale fires and to take rapid action to control such fires when they occur.

(2) Problems and issues to be addressed over the next ten years

1) Assessing the combustible biomass and potential for forest fires

Annual estimates of the volume of fallen leaves and branches in forests that help to feed large-scale forest fires will be made, and historical data compiled so that such information can be shared on an international basis. Systems will also be established for the collection of data on degrees of aridity to create maps indicating the potential for forest fires occurring, and the maps will be made publicly available.

2) Detection of forest fires and assessment of their state

Work will be carried out towards the creation of a system for the early detection of forest fires, the assessment of their state, and the provision of data, to contribute to improved levels of environmental preservation in Asia.

3) R&D and application of systems for forecasting the spread of forest fires

Research will be performed towards the development of assessment systems designed to enable quick and accurate forecasts of the spread of forest fires and to promote the use of such systems.

4) Monitoring and forecasting of gases emitted by forest fires

Research will be conducted towards the development of systems for forecasting the release of gases from forest fires in Asia and the range of their dispersion, and practical applications will be pursued.

7. Earthquakes, tsunamis, and volcanic activity

(1) Requirements for observation and general goals over the next ten years

To reduce the extent of the damage caused by earthquakes, tsunamis, and volcanic activity, efforts shall be made to develop improved comprehensive observation systems covering both land and sea, to build and bring into operation a long-term observation network capable of conducting uninterrupted seamless observations, and to work towards identifying the mechanisms whereby such events occur. A system will also be created whereby up-to-the-minute reports could be provided to local residents and government authorities containing observation data and disaster control information based on such data.

(2) Problems and issues to be addressed over the next ten years

1) Construction of a seamless, continuous and long-term earthquake and tsunami observation network

A monitoring and observation system designed to take continuous observations in real time with spatial homogeneity, consisting of a network of seismometers, global positioning system (GPS) equipment, tsunami detection systems, and other related equipment, will be created. A particular effort will be made to construct such a system for use in the Asia and Oceania regions, the most vulnerable to frequent damage from earthquakes and tsunamis.

2) Construction of systems for the transmission and sharing of disaster control information on earthquakes and tsunamis

Data from the continuous observation systems described above will be used to construct a system for the provision and sharing of information during all stages of disasters, from outbreak to extinguishing.

3) Construction of a continuous long-term observation network of volcanic activity

Seismographic and GPS monitoring, geomagnetic monitoring, and other geophysical observation methods shall be used together with geochemical approaches for the observation of volcanic gases to construct a real-time observation network for the observation of volcanic activity on a regular basis. A particular effort shall be made to construct such a system for use in the Asian and Oceania regions most vulnerable to frequent damage from volcanic activity. Efforts shall also be made to develop methods

for performing observations and collecting data in endangered areas during volcanic eruptions.

4) Creation of a system for the transmission and sharing of information on volcanic activity disaster control

Data from the continuous observation systems described above shall be used to develop a system for the provision and sharing of information during all stages of disasters, from outset to recovery.

5) Development of improved satellite remote sensing technologies

Satellite data will be used in conjunction with ground-based and ocean floor observation network data to make it possible to provide disaster control information at higher grid resolutions and to increase the range of the areas to which such information may be provided.

8. Energy and mineral resources

(1) Requirements for observation and general goals over the next ten years

Observations will be conducted on a global and local basis to help assure national security in terms of energy and mineral resources. It is particularly important that we create a comprehensive system for the gathering of information on oil and mineral reserves and areas in which oil and mineralogical reserves exist, information on the development, use, and transport of oil, natural gas, minerals, methane hydrates, and other existing developable reserves, and information on damage and problems and related issues concerning production bases and pipelines.

(2) Problems and issues to be addressed over the next ten years

1) Development of advanced satellite-borne sensors and the creation of analysis technologies for their use

Hyperspectrum observation technologies will be developed that are designed for use in performing detailed observations of the material composition of the Earth's surface and its condition. Synthetic aperture radar observation and other advanced satellite observation technology, databases and analysis technology will also be developed.

2) Development of advanced stereo satellite observation technologies and standardization of numerical elevation models

Work will be carried out to develop more advanced stereo satellite observation technologies, to provide quality numerical elevation models and standardized data.

3) Creation of global energy and mineral resources base maps

Using satellite observation data and other data, information for medium-term and long-term energy and mineralogical resource surveys will be provided.

9. Forest resources

(1) Requirements for observation and general goals over the next ten years

The world's forests continue to decline year-by-year, and illegal logging and forest fires are a particularly severe social issue in Asia. Global environmental change has also contributed to deforestation and has made the restoration of such lands more difficult. Japan must redouble its efforts in pursuing international cooperation beginning with its proposed Asia Forest Partnership, and construct a practical system whereby it will be possible to monitor forest areas in real-time, and deliver information on such areas.

(2) Problems and issues to be addressed over the next ten years

1) Constructing a regular system for the monitoring of forest resources in Asia

In addition to developing a monitoring system designed to provide information on the state of logging and forest resources in forested areas of Southeast Asia, an automated satellite monitoring system to detect illegal logging will be constructed.

2) Monitoring of forest carbon fixation

R&D will be conducted to measure changes in forest biomass through the use of advanced air-based laser measurements and high-resolution satellite observation in order to provide usable data on forest carbon level fluctuations.

3) Constructing an early alert and warning system for forest damage

R&D will be carried out on the construction of a system for providing early detection and warning about the effects on forests of global environmental change and disease and pest damage thought to afflict managed forests.

4) Encouraging the centralized management and use of forest observation data

To make it possible to integrate the use of all sorts of forestation data, from data collected from ground based observations to data collected by satellite, efforts will be made to assemble the data within a single database and a wider range of utilization explored.

10. Agricultural resources

(1) Requirements for observation and general goals over the next ten years

The management of water resources and soil fertility is critical to agricultural production, and it is important to collect thorough data on the characteristics of agricultural land in surrounding areas and information on predicted crop yields and land where crop damage may be expected. Working with other nations, we shall work to construct an extensive observation data processing system that will make it possible to obtain data about the growth of crops in Asia and other regions on an ongoing basis.

(2) Problems and issues to be addressed over the next ten years

1) Monitoring of agricultural lands

Efforts will be made to create a database on agricultural lands and to create a system whereby it will be possible to monitor the worldwide amount of arable land, changes in arable area, and the amount of water available to such land.

2) Monitoring of agricultural production

Using extensive satellite observation data, planting areas and harvest conditions will be monitored on an on-going basis. R&D will also be conducted on a measuring system to collect regional data from satellite-based and land-based data, and on the practical use of such data.

3) Detection of crop damage

Work will be carried out to develop a practical system for the monitoring of crop damage through aircraft- and satellite-based monitoring systems designed for the early detection of crop damage.

4) Monitoring of agricultural land damage

Ground-based and satellite-based observations will be used to determine weather conditions, water resource, foliage, soil, and land use conditions, and to evaluate levels of desertification.

11. Marine resources

(1) Requirements for observation and general goals over the next ten years

In order to sustain and secure marine resources, it is necessary to have an international framework for the observation of such resources. From the point of view of food supply and ensuring the safety of food in Japan and Asia, there is a need to gain a general understanding of the biological environment of the phytoplankton and zooplankton that support marine resources as ecosystem

components, the chemical environment of nutrients and other components, and the physical environment of seawater temperature, currents and other factors in the North Pacific and the waters of Japan. These elements are very closely related in ecosystems, and for this reason it is necessary to develop ways of observing them that will enable R&D on models of their underlying processes, and to collect, manage, and provide information.

(2) Problems and issues to be addressed over the next ten years

1) Construction of a comprehensive observation system for the Northwest Pacific

In addition to observations performed using sea-based vessels in the Northwest Pacific, automated buoys and mooring systems, manned and unmanned vessels mounted with observation sensors will be used to create a comprehensive observation network.

2) Creation of a long-term observation system and R&D of related technologies

Work will be conducted to develop a comprehensive observation network, which will include a satellite observation network designed for performing long-term observations of marine resources and the environment. Efforts will also be made to develop labor saving technologies and to automate observation sensors.

3) Improved collection, management, and provision of data

Work will be conducted to improve methods for estimating available resources and standardizing methods for developing estimates and to develop better ways of collecting, managing, and providing biological data and data on biological marine resources.

12. Spatial data Infrastructure

(1) Requirements for observation and general goals over the next ten years

In addition to being essential for decision-making and the formation of analyses, geographical data is also vital to society in order to make integrated use of various Earth observation data; such data must be collected on a planned, efficient, and continuous basis. Japan is playing an important role in this area in the Global Mapping Project, and it is important that we continue to play a leading role in the future.

(2) Problems and issues to be addressed over the next ten years

1) Creation of a spatial data

In order to respond properly to the needs for a spatial data infrastructure that can serve as the basis for the integration of global observation data, in addition to responding rapidly to technological progress, we will work to create and share basic geographical information with other nations and make such information more practical.

2) Global Mapping

Under the leadership of Japan and in cooperation with the national mapping organizations of other countries, work will be conducted to create and make available maps with basic information on all land areas. We will also develop a distributed data base function for the management of all the geographical information provided by other countries.

3) Contributing to international geodetic observation programs

A vigorous contribution will be made to international initiatives such as the International Global Geodetic Observing System, International VLBI Service for Geodesy and Astronomy and the International GPS service, and to other international efforts such as the Asia-Pacific international observation network for earthquake and volcanic activities.

4) Development of geographical data on land cover

Land cover data, vegetation data and data on their changes will be developed using satellite and ground truth data.

5) Compilation of detailed 10 meter mesh topographic data

Detailed 10meter digital elevation data on Asian and Oceania will be compiled using stereo image data obtained from satellites and interferograms from synthetic aperture radar.

13. Geographical data on land use and human activity

(1) Requirements for observation and general goals over the next ten years

With global warming expected to continue, the adaptability of society and the movement towards a sustainable society are important policy issues; the consensus is that we must move towards a more sustainable use of land and natural resources. This is why there is a need to collect land use data and spatial distribution data about human activities and their effects in Asia, Oceania, and other regions, which will be helpful in policy formulation and decision-making.

(2) Problems and issues to be addressed over the next ten years

1) Compilation of cities and settlements distribution data

We will develop detailed data on the concentration and spatial distribution of cities and settlements in Asia and Oceania by classifying and examining high-resolution images obtained from satellite observations. The integration of statistical data on populations will also be attempted.

2) Creation of a farmland distribution data

Local surveys and satellite analyses will be used to create spatial distribution data on cropping systems according to land and cultivation type, and data on irrigation schedules.

3) Creation of maps showing the distribution sources of atmospheric pollutants

Combining the cities and settlements distribution data with on-site research, the state of transport networks will be ascertained, and atmospheric pollutant emissions estimated.

14. Meteorological and oceanographic phenomena

(1) Requirements for observation and general goals over the next ten years

Data obtained from long-term observations of the atmosphere and oceans carried out by ministries and institutions in line with administrative requirements are valuable in a wide variety of scientific, technological, and socioeconomic applications. Conducting these observations on a regular, planned, efficient, and effective basis is a desirable goal. We must continue to maintain the existing periodic observation of meteorological and oceanographic phenomena without lowering the precision or quality of that data. Particularly, with respect to the satellites, ARGO-floats (floating automated gauges for the vertical profiling of ocean temperature and salinity), large fixed buoys and other systems for observing long-term meteorological and oceanographic phenomena, it is important for their continuous operation that we develop observation systems and at the same time work toward the development of commercially viable systems. Collaboration between the organizations and R&D institutions carrying out regular observations of meteorological and oceanographic phenomena should also be encouraged.

(2) Problems and issues to be addressed over the next ten years

1) Maintenance of meteorological and oceanographic observation systems

In addition to working to maintain our network systems for meteorological observation on land and in the upper atmosphere performed under an international framework, we shall also continue to perform coastal marine observations of sea levels, wave levels and marine phenomena, ship based marine

meteorological observations, and work to ensure the precision and quality of data from these observations. Efforts will also be made to ensure the stable ongoing operation of the fixed-orbit satellites so important and useful to the world at large.

2) Elucidating long-term changes in maritime meteorological phenomena

A worldwide observation network using ARGO-floats and a global tropical observation network using large-scale stationary buoys, also providing coverage of the Indian Ocean, will be completed and maintained. Monitoring vessels will also be used to perform high-precision observations of physical and chemical characteristics of ocean water from the sea's surface to its bottom in around 10-year intervals.

3) Improving the atmospheric chemistry observation system

The development of observations of the persistence or increasing concentration of new air borne trace components, comprehensive observations of aerosols, three-dimensional observations of greenhouse gases, and a regional observation network covering Asia will all be promoted.

4) Improving meteorological and oceanographic observation using artificial satellites

Long-term observations will be conducted, and practical systems created for artificial satellite observation of global rainfall distribution, cloud cover, aerosols, water vapor, ozone and greenhouse gas distribution in the troposphere, directions and velocities of tropospheric and sea surface winds, sea surface temperature and salinity, soil water content, and other physical data.

5) Promoting international cooperation

Assistance will be provided to developing nations in Asia and Oceania in order to ensure the continuation of steady meteorological and oceanographic observation in these countries, within the framework of international cooperation. Technological transfers will be made in order to achieve the automation of observations and to maintain data quality control. Education and publicity about the value of observation data will be given in order to obtain the cooperation of the countries involved.

15. Earth science

(1) Requirements for observation and general goals over the next ten years

Work will be conducted to develop an increased understanding of the solid Earth and its interaction and the feedback mechanisms whereby it interacts with the atmosphere, the oceans, the ionosphere, and magnetosphere. Research and the collection of data in this field are essential to obtain the basic knowledge needed to understand how the Earth's systems work, and it is particularly important to perform the kinds of observation described below in order to understand extra and intra- induced changes in the Earth's systems and their interaction.

(2) Problems and issues to be addressed over the next ten years

1) Making Geo-space environment observations more sophisticated and widening their coverage

The monitoring systems designed to enable the elucidation of Geo-space — the outermost sphere of the earth, which may interfere with transmissions from communication, broadcast, observation, or environment satellites — will be made more sophisticated and the areas they are able to cover extended.

2) Precise observations of solar activity and understanding of the mechanisms of climate change

To enable the formulation of predictions about climate change, and to make such predictions more accurate, a comprehensive and organized effort shall be made using globally installed stationary observation platforms and satellites to perform observations on levels of stratospheric ozone and nitrogen oxides, interaction of cosmic rays and of cosmic rays with clouds, radio wave absorption, and ionospheric and magnetospheric particles. A radar-based observation network will be developed, and efforts made to realize an observation network for the upper atmosphere in Asian and Oceania, and atmosphere research satellite observations.

3) Polar atmospheric observation from the troposphere to the upper atmosphere

By conducting atmospheric observations covering the troposphere to the upper atmosphere, a system will be created to monitor climate change signals related to warming temperature in the troposphere and dropping temperature in the upper atmosphere, changes in atmospheric general circulation and other atmospheric phenomena over polar regions.

4) Interpretation of climate change as seen in sediment and ice cores

Past climate change data will be analyzed and work will be conducted to recreate data on changes in levels of carbon dioxide and data particularly strongly linked to climate change.

5) Multi-component analysis of marine and lake sediments

Attempts will be made to recreate the data on climate change over the last 800,000 years in monsoon areas in Asia, which are recorded in its marine and lake sediments data.

6) Ultra-deep drilling

Ultra-deep observations of the Earth's crust or upper mantel levels will be carried out (by analyzing the samples excavated, and internal inspection of the cavities drilled) to elucidate the characteristics of materials between the Earth's interior and surface layer, its energy transfer and interaction, as well as to explore the life forms existing in the extremities of the ultra deep environment.

7) Creation of a solid Earth observation network covering Asia and Oceania region

Comprehensive observation of seismic and volcanic activity will be performed in the subduction zone of the Pacific plate in conjunction with other APEC nations. A sea floor cable network will be used to elucidate the mechanism of major earthquakes, the propagation of tsunami waves, deep currents, fluctuations in the earth's magnetic field and other geophysical features. Observations will also be conducted in the seas of Japan on earthquakes in the Japanese archipelago and surrounding areas.

Contact:
Director for Environment
Bureau of the Council for Science and Technology Policy
Cabinet Office, Government of Japan
3-1-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-8970, Japan
Phone: +81-3581-9265; FAX +81-3581-9969
URL: http://www8.cao.go.jp/cstp/project/envpt/english/index.html