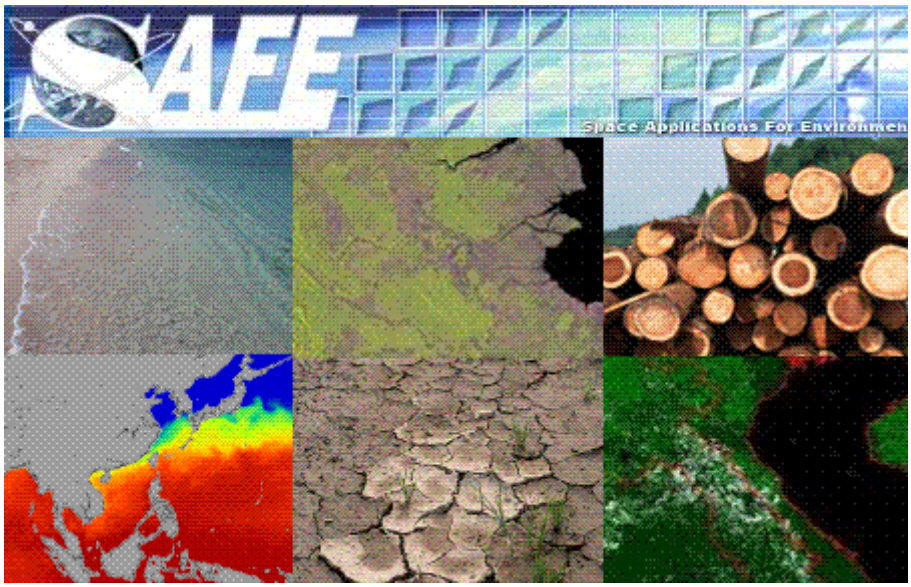
Space Applications For Environment

(SAFE)

Implementation Plan

Draft



Feb 26, 2009

Earth Observation Research Center
Japan Aerospace Exploration Agency (JAXA)

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1 **Background**

IPCC WGII Summary for Policy Makers says that observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases. This is an alarming situation requiring continuous observation of climatic parameters to keep abreast with the changes of global climatic situation. Further, timely and continuous observation of impacts on natural environment in all the scales; local, regional and global, too plays an important role to bring in appropriate natural resources management strategies and defining and implementing better adaptation methods reducing risks.

Asia-pacific with more than 2/3 of world population faces a huge threat with increase of natural disaster which could be due to the present changes in the global climatic situation as identified in IPCC reports where anthropogenic influence further escalates the intensity of disasters. Therefore, it is utmost important to monitor climatic parameters as well as possible effects related to such changes where satellite remote sensing can play an important role.

Given the diversified data requirement and unavailability of continuous and long-term data sharing mechanism in the Asia-pacific region use of satellite data is becoming vital and essential to understand various local, regional and global changes of the environment. The environment monitoring is important to track the threat to our society with the increase of various natural disasters and some of the disasters that could be related to present climatic changes are;

- Glacier lake outbreaks threatening several thousand resident living in the mountain regions of Hindu-Kush Himalaya,
- Record-breaking drought reducing 30% or more cereal harvesting leading to serious food shortage, daily life water shortage,
- Sea-level rise increasing the risk of water inundation over coastal region and small islands,
- Forest fire risk and related human health problems,
- Expansion of communicable disease such as malaria.

Every country as well as number of international organizations including United Nations are working hard to bring in appropriate solution to prevent these hazards or ways to adopt to this ever increasing threats to mankind. It is well documented that long-term monitoring of environmental changes is one of the key factor in realizing

appropriate solution to this global problem.

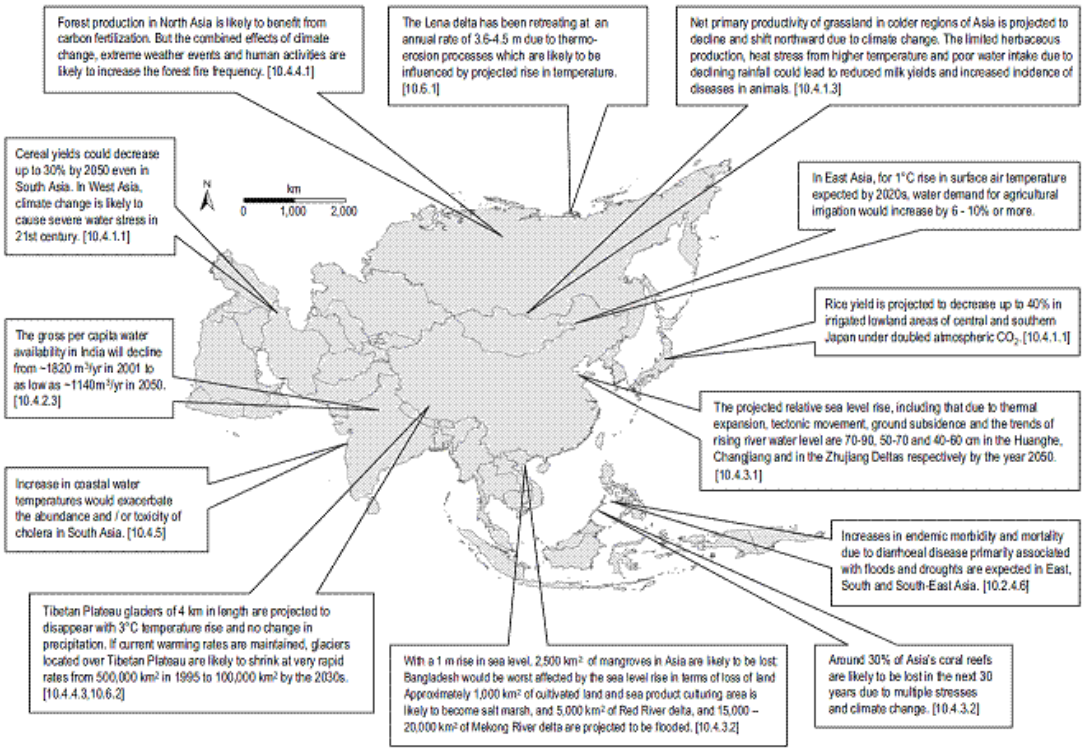


Figure1. The Hotspots of key future climate impacts and vulnerabilities in Asia, *IPCC Fourth Assessment Report Working Group II Report "Impacts, Adaptation and Vulnerability" p481*

In this context satellite remote sensing could play a significant role to provide continuous, regional to global, timely, and low cost data and information for each and every country to start their own monitoring system that could help appropriate solution in local context. Currently, many Asia-Pacific countries have planned or invested in monitoring activities by using of remote sensing whilst some of them have already launched or planned to launch their own earth observation satellites targeting long-term environment monitoring.

The Asia-Pacific Space Agency Forum (APRSAF) was established in 1993, to enhance the development of each country's space program and to exchange views toward future cooperation. (For details, http://www.aprsaf.org/). Through the discussion in APRSAF, Sentinel Asia was born in 2005. This is a voluntary and best-efforts-basis initiative to share disaster information in the Asia-Pacific region on Web-GIS platform and to make the best use of earth observation satellites data for disaster risk management in the Asia-Pacific region. With the support of number of space agencies and more than 50 disaster related agencies in the region, Sentinel Asia is one of the real operating system

that support to proper use of satellite data in emergency response. (For details, http://dmss.tksc.jaxa.jp/sentinel/)
Having initiated as a joint and voluntary activity of APRSAF members recognizing the benefits of Sentinel Asia, further discussion were carried out to find a solution for environmental monitoring in long-term scale. As a result of these discussions, during the APRSAF-14 Bangalore it was officially recommended to consider environmental monitoring as one of Sentinel Asia Step2 Activities. Later, in a meeting held in Kobe 2008, JAXA proposed to separate the environmental monitoring as new initiative under the Space Applications for Environment, SAFE. At the APRSAF-15 held in Hanoi, members recommended the official establishment of SAFE as a new initiative that provides information on environment using satellite based data. (For details of APRSAF-15, please see http://www.aprsaf.org/text/ap15_info.html)

2 SAFE: Space Applications for Environment

SAFE is a voluntary-based initiative. It aims to encourage the environmental monitoring in long–term to grasp the environmental changes that may be useful to bring in risk reduction and adaptation programs for disasters risk related activities to other climate change associated problems using space applications, especially satellite remote sensing technology. Some of the changing environment parameters in water resources, river water level, land cover, deforestation, agricultural production, and ecosystem could provide through satellite remote sensing.

The Sentinel Asia initiative takes the role of immediate response with satellite data for emergency situation with the coordination of Asian Disaster Reduction Center. Here the provision of data within a very short time is considered very important to visualize and use in recovery process after a disaster. On the other hand, SAFE is an initiative that could bring information about the environment status of a country or a region and its temporal changes that could help combating natural hazards and disasters and other sustainable environment management activities.

Both Sentinel Asia and SAFE are complementary to each other. SAFE could provide satellite based information for long-term monitoring of a natural phenomenon that could provide insight of forthcoming disaster event due to current climate changes. Also, SAFE can continue providing satellite based recovery information of a given disaster even after the cease of Sentinel Asia activities as an emergency response system. In

Sentinel Asia system, the speed of response is quite important because the lead time for immediate response is vital where information of infrastructure, location, population etc. need to be analyzed to reduce the damage. Also, the data should provide easy to understand information for emergency response activities. Contrast to this, SAFE considers continuous data provision with sensor data that could provide environment sensitive information with varying spectral and spatial resolution for better understanding the status of the environment and its changes.

In the application areas of space technology, both SAFE and Sentinel Asia has a clear distinction in timeline as well as information content. SAFE is a more robust approach for long-term monitoring of our natural environment with satellite remote sensing to evaluate current status, understand the changes, monitor the nature of changes and where possible use as base information for risk management and adaptation. Further, the end users of SAFE are the agencies and experts work on various agencies that are responsible for the environment. These agencies have their own mandate, functionalities and responsibilities to sustainable management of the environment whereas in Sentinel Asia system the focus was the collaboration of Disaster management agencies.

3 CATEGORIES OF SAFE PARTICIPANTS

The SAFE participants are categorized into three groups: prototyping executor, technical supporter, and data and application creator (Fig. 3). All SAFE activities are designed to be carried out by collaboration among these groups. Because SAFE is a volunteer-based initiative, each group should respect the other groups' regulation and motivation. SAFE provides opportunities to encourage collaboration among these three groups.

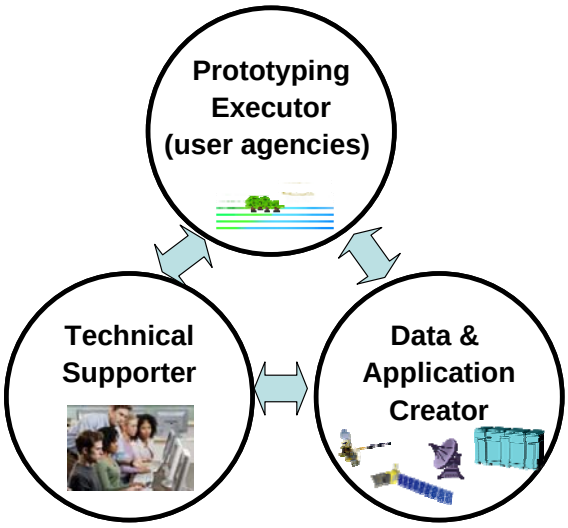


Fig. 3. relationship among SAFE participants

3.1 Prototyping Executor

The prototyping executor includes public agencies in charge of the environment (e.g., land use, forest, water resources, river management, agriculture, fishery, and environmental pollution). They have the authority to carry out SAFE activities to strengthen the official environmental monitoring activity in each country. Because of the variety of environmental monitoring standards in the Asia-Pacific region, the other two groups (technical supporter, and data and application creator) must interact with the prototyping executor. At the same time, the prototyping executor has the responsibility of addressing local issues to facilitate the other groups' activities.

3.2 Technical Supporter

The technical supporter is an educational agency that can support the prototyping executor regarding technical aspects. The technical supporter may support users through hands-on training and accommodation to the users' environment with the use of software and other tools. Because the objective of SAFE is operational, the technical supporter should focus on practical use. At the same time, the other two groups should respect the science focus of the technical supporter.

3.3 Data and Application Creator

The data and application creator can create satellite datasets and/or analyzing tools to support environment monitoring. Most APRSAF members, including future candidates, may fit in this category. The data and application creator may provide data and/or tools to the technical supporter and the prototyping executor. The other two groups should respect the creator's data policy; likewise, the data and application creator should provide datasets free or for a small fee, and consider data continuity.

4 STRUCTURE OF SAFE

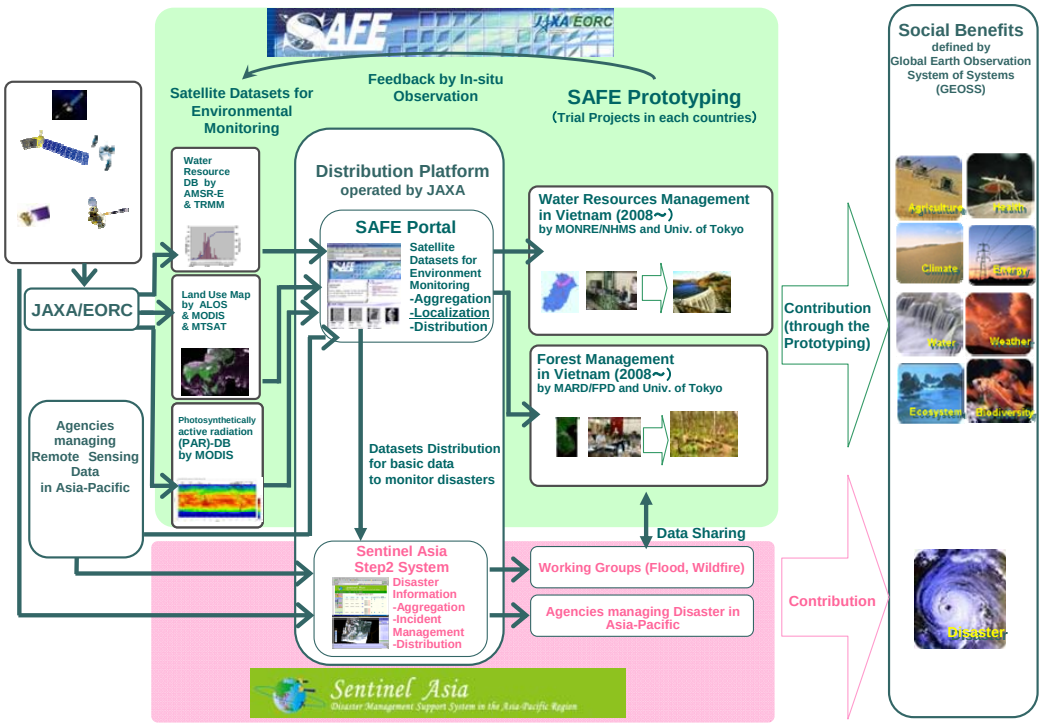


Fig. 4. Overview of SAFE

Figure 4 illustrates the structure of SAFE. It consists of three components: dataset creation, dataset distribution, and prototype activities. Each component includes information systems and human work flow.

4.1 Dataset Creation

The component of dataset creation involves making satellite datasets for environmental monitoring. This component is driven by the data and applications creator. During the SAFE workshop (WS), some agencies discussed their possible contributions (Chart 1).

Chart 1. Possible contributions from data and application providers

Agency	Country	Data source
Asian Institute of Technology (AIT)	Thailand	MODIS
The Centre for Remote Imaging, Sensing and Processing (CRISP)	Singapore	MODIS
Australian Commonwealth Scientific and Industrial Research Organization (CSIRO)	Australia	MODIS
Geo-Informatics and Space Technology Development Agency (GISTDA)	Thailand	THEOS, MODIS
Japan Aerospace Exploration Agency (JAXA)	Japan	ALOS, AMSR-E,MODIS
Mongolia Remote Sensing Center	Mongolia	MODIS
University of Tokyo	Japan	MTSAT, MODIS

The data and application creator may also consider utilizing the datasets created by other agencies or initiatives (Chart 2).

Chart 2. Possible datasets from other initiatives

Dataset	Creator
Global Satellite Mapping of Precipitation (GSMaP)	**GSMaP project (JAXA / JST / Osaka Prefectural Univ.)**
Global Forest Cover Map	**The ALOS Kyoto & Carbon Initiative (JAXA)**
Asian River basin datasets	**GEOSS / Asian Water Cycle Initiative ([AWCI)**
Landsat Asia Archive	**GISTDA**
Globecover	**ESA**
Global Climate Archive	**Coordinated Enhanced Observing Period (CEOP)**

In addition, as the advocator of SAFE, JAXA will contribute to SAFE by providing value-added datasets. Chart 3 describes JAXA's planned value-added datasets.

Chart 3. Planned datasets to be contributed by JAXA

Dataset	Description
Water-Cycle Database *Ready for operation	**JAXA prepares the dataset search and distribution website of Advanced Microwave Scanning Radiometer (AMSR-E) on NASA EOS Aqua and Precipitation Radar. The data are optimized for Asia, and user access and downloading are easy. In addition, JAXA will coordinate for customized near-real time distribution up to the prototype activity.**
Precise Land-Use and Land-Cover Map derived by AVNIR-2 *In preparation	**This dataset is applied to the decision-tree unsupervised classification method for multi-temporal AVNIR-2 images. The input AVNIR-2 images demonstrate the surface reflectance processed by atmospheric correction and ortho-rectification. The PALSAR data, digital elevation model (DEM), and seasonal changes of Normalized Difference Vegetation Index (NDVI) as the phenology of vegetation are also used as supplemental information. As a result, the accuracies of geometry and radiometry are improved.**
MODIS PAR Database *In preparation	**Photosynthetically available radiation is a physical quantity that affects vegetation growth and the amount of carbon sequestration.**

4.2 Data Distribution

JAXA operates the information platforms to store and distribute the satellite datasets. At this point, the Sentinel Asia System (SAS) is a strong partner of SAFE. The SAFE portal will be operated on the SAS platform, and it shares the distribution infrastructure, including JAXA's communication satellite WINDS. By using these resources, SAFE members can carry out SAFE activities without concern for limitations of Information and Communication Technology (ICT). The SAFE portal URL is http://www.eorc.jaxa.jp/SAFE/

4.3 Prototype Activity

Unlike disaster management, environmental monitoring has no real trigger to start something new. Its scope is the normal (non-disaster) situation, and its operations are strongly connected with each country's regulations and routine tasks. SAFE prototype activity aims to strengthen environmental monitoring in member countries. The activities are implemented by a project team that consists of the prototyping executor, the technical supporter, and the data and application creator. The project team members work together to support the environmental monitoring system in each member country. The team can ask other SAFE members to support their activities, and the members should react to the team's request. To ease barriers to start-up, the first stage of prototype activity is limited to two years. At the end of the first stage, the joint project team will consider follow-up activity with other SAFE members.

At APRSAF-15 in Hanoi, four issues to be considered prototypes were discussed. It was recommended that new prototypes may be applicable to these categories, and that other topics should not be excluded. The four prototypes were integrated water-resources management; glacier shrinkage and potential danger of glacier lake bursts; agriculture and forestry; and ocean environment, coastal process, and sea level rises.

SAFE prototype activity will be promoted by the voluntary project team members for each subject, and SAFE will encourage them by giving the authority for official SAFE activity. Figure 5 is a flow chart for the launching of a new prototype activity.

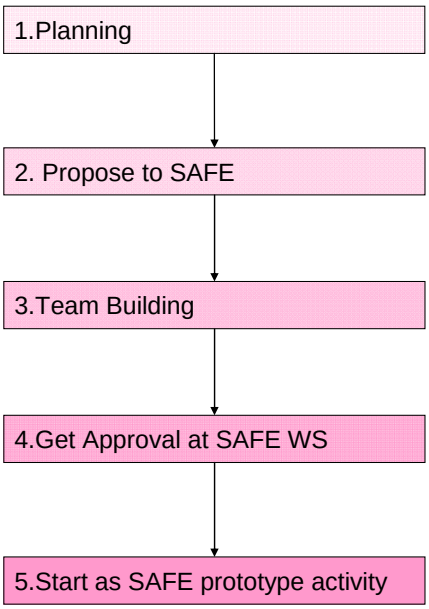


Fig. 5. Procedure for launching SAFE prototype activity

4.3.1 Phase 1 Planning

Any member may make a proposal. Members should consider the purpose, the resources, the schedule, and their partners. The ideal situation is to finish establishing an original project scheme in this phase. However, the proposer may ask other SAFE members to join the proposal in phases 2 and 3.

4.3.2 Phase 2 Propose to SAFE

Members make proposals through the portal. They may ask other members to support the project.

4.3.3 Phase 3 Team-building (if necessary)

All members should consider how to support the submitted proposal. As the SAFE secretariat, JAXA coordinates the team-building. The project team should be organized before the annual SAFE WS.

4.3.4 Phase 4 Get approval at the SAFE WS

At the annual SAFE WS, the project team should pass a peer review, which is organized by assigned reviewers approved by SAFE members. However, only at the first SAFE WS will the SAFE secretariat endorse the reviewers.

4.3.5 Phase 5 Start as SAFE prototype activity

After passing the peer review, the project will be authorized as an official SAFE activity. The project team can request support from other SAFE members to promote the prototype. Also, as the SAFE secretariat, JAXA will assist in their activity. At the same time, the project team should report the status of the activity to other SAFE members through SAFE WS and/or the SAFE portal.

5 SCHEDULE

Figure 6 presents the general schedule of SAFE activity. The first trial prototyping in Vietnam will be continued until the end of 2009, and new prototype activities will be approved at the first SAFE WS in Pattaya, Thailand. Details of the Pattaya WS will be announced by the SAFE secretariat by the end of February 2009. JAXA will open the SAFE portal site at the end of February 2009 and continue to establish datasets.

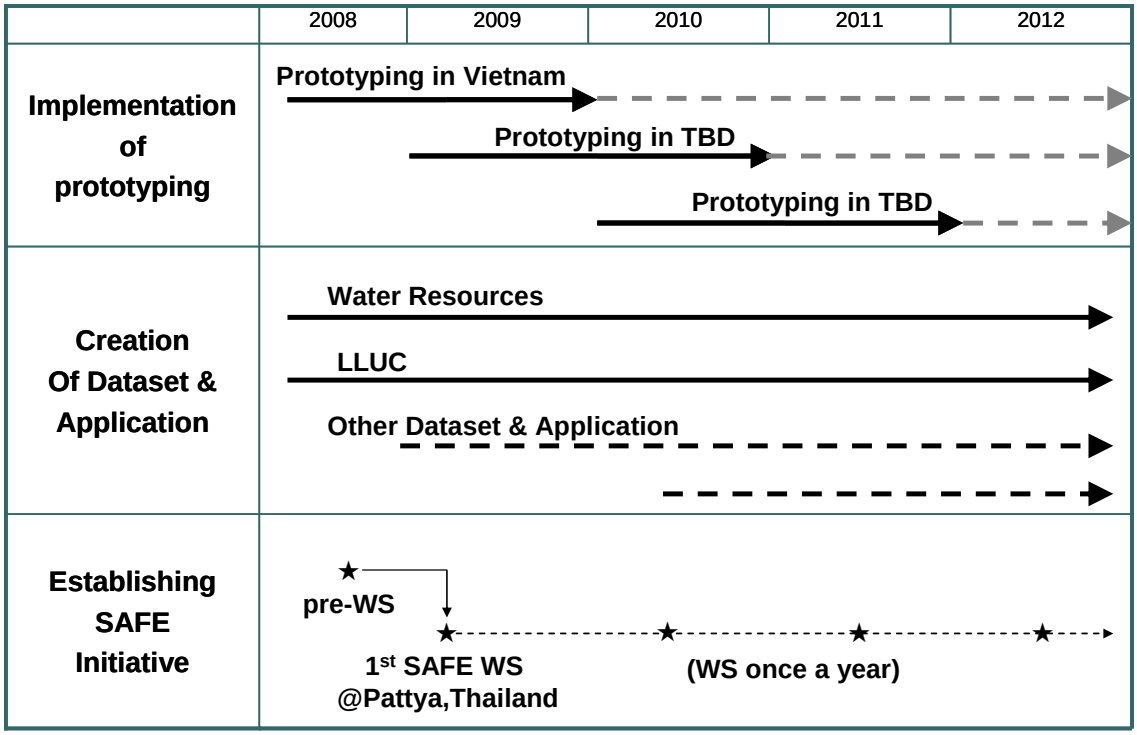


Fig. 6. General schedule for SAFE activity.

6 ISSUES TO BE CONSIDERED

6.1 Funding

Because SAFE is a volunteer-based initiative, all activities rely on the members' efforts. To establish continuous environmental monitoring, members should consider funding resources for the next step. For example, Japan has provided some programs for funding, such as Official Development Assistance (ODA) managed by the Japan International Cooperation Agency (JICA), and Science and Technology Research Partnership for Sustainable Development (jointly organized by the Japan Science and Technology Agency (JST) and JICA). JAXA will encourage the SAFE members to apply for assistance from these programs. Also, SAFE should be an initiative that appeals to related funding programs.

6.2 Localization vs. Creation of Common Tools

For effective environmental monitoring, it is important to localize solutions for each country. However, for effective SAFE project implementation, it is also important to create common tools that can apply to issues in any country. Therefore, all SAFE members should consider the balance between local and the common benefits.

6.3 Collaboration with Other Initiatives

Obviously, many significant initiatives can cooperate with SAFE. Considering interactions with those initiatives is quite important for developing SAFE.

6.3.1 GEO and GEOSS

The Group on Earth Observations (GEO) is a voluntary partnership of governments and international organizations. It provides a framework within which these partners can develop new projects and coordinate their strategies and investments. As of November 2008, GEO's members included 76 governments and the European Commission. In addition, 56 intergovernmental, international, and regional organizations with a mandate in Earth observation or related issues have been recognized as Participating Organizations. GEO is constructing the Global Earth Observation of System of Systems (GEOSS) on the basis of a 10-Year Implementation Plan for 2005 to 2015. This plan defines a vision statement for GEOSS, its purpose and scope, expected benefits, and the nine Societal Benefit Areas of disasters, health, energy, climate, water, weather, ecosystems, agriculture, and biodiversity.

6.3.2 Asian Water-Cycle Initiative

The Asian Water-Cycle Initiative (AWCI) is based on the regionally common and sharable ideas on water-related issues in Asia and their natural and socio-economical backgrounds. Contributing to GEOSS, the AWCI was organized by 18 countries in Asia, based on a series of discussions in 2005, just after the establishment of GEO. The AWCI develops an information system of systems for promoting the implementation of integrated water-resources management (IWRM) through data integration and the sharing and improvement of understanding and prediction of the water-cycle variation as a basis for sound decision-making regarding national water policies and management strategies.

Appendix-1 Early Success: SAFE Trial Prototyping in Vietnam.

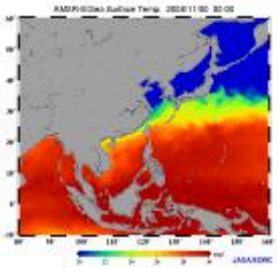
1 Background

JAXA proposed an environmental monitoring system, "Sentinel Asia For Environment" (formerly called as eSA, currently called SAFE), at APRSAF-13. As recommended at APRSAF-14, SAFE is regarded as a part of SA's Step 2 activities. In the summer of 2008, JAXA and the University of Tokyo began trials to build the SAFE prototypes in collaboration with partner agencies in Vietnam. Based on these trials, at APRSAF-15 JAXA proposed that SAFE be separate from SA. Recognizing the early success of the trials in Vietnam, APRSAF approved SAFE as a new initiative.

2 Water-resource monitoring

Period	**June 2008 – March 2010 (TBD)**
Objective	**Strengthen precipitation monitoring and reservoir management at Huong River and Red River by using satellite data and model calculation**
Prototyping Executor	**Vietnamese National Hydro-Meteorological Service, Ministry of Natural Resources and Environment (NHMS/MONRE)**
Technical Supporter	**University of Tokyo**
Data & Application Provider	**Japan Aerospace Exploration Agency (JAXA)**
Note	**Vietnamese Academy of Science and Technology (VAST) supervises the project.**

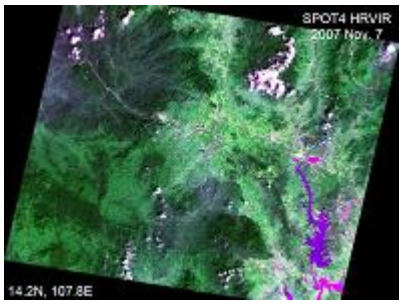
The Vietnamese National Hydro-Meteorological Service/Ministry of Natural Resources and Environment [NHMS/MONRE] is responsible for flood management and meteorological services in Vietnam. NHMS is trying to strengthen precipitation monitoring and reservoir management under the Asian Water-Cycle Initiative, in cooperation with the University of Tokyo and JAXA. Since June 2008, the University of Tokyo and NHMS have applied the Water and Energy Budget-based Distributed Hydrologic Model (WEB-DHM) to the Red River Basin, one of the most important basins in Vietnam. The University of Tokyo optimizes the model for the water reservoirs and provides training to the NHMS staff, and the NHMS collects the in-situ river run-off data for validation. The two NHMS staff members visited Tokyo and were trained to run the model. JAXA provides passive microwave sensor (AMSR-E) data to improve the initial conditions for the simulation.



3 Forest monitoring

Period	**June 2008 – March 2010 (TBD)**
Objective	**Strengthen precipitation monitoring and reservoir management at Huong River and Red River by using satellite data and model calculation.**
Prototyping Executor	**Forest Protection Department, Ministry of Agriculture and Rural Development (FPD/MARD)**
Technical Supporter	**University of Tokyo**
Data & Application Provider	**University of Tokyo (Analyzing tools and MODIS)** **Japan Aerospace Exploration Agency (ALOS/PALSAR, AVNIR-2)** **Vietnamese Remote Sensing Centre (SPOT)**
Note	**Vietnamese Academy of Science and Technology (VAST) supervises the project.**

The Vietnamese Forest Protection Department of the Ministry of Agriculture and Rural Development (FPD/MARD) is responsible for forest management in Vietnam. The FPD has a Moderate Resolution Imaging Spectroradiometer (MODIS) receiving station and provides wildfire hotspot information to its rural branches. The goal of the FPD is to strengthen forest management by using MODIS. In July 2008, the University of Tokyo and the Asian Institute of Technology began providing hands-on training to young FPD staff members in order to establish the capacity for MODIS data analysis. At the same time, the FPD staff members collected forest inventory data to validate the MODIS data. Keeping abreast of these activities, the Remote Sensing Center of the Ministry of Natural Resources and Environment (RSC/MONRE) and JAXA support the FPD and the University of Tokyo by providing high-resolution satellite imagery (ALOS and SPOT).



4 Future efforts

Both activities will continue until the end of 2009. Consideration will be given regarding

ways to apply these prototypes to the end users' daily work. Updates will be reported at the first SAFE WS and APRSAF-16.

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Appendix-2 SAFE Prototype Activity Application Form

Period	
Objective	
Prototyping Executor	
Technical Supporter	
Data and Application Provider	
Overview of the activity	
Estimated benefits	

Matters to be considered	
Necessary support resources (if your team requires assistance from other SAFE members)	
Note	

**Please attach any references to explain the details of your own format.*