Annex V

PLAN of WORK for the NOWPAP WORKING GROUP 4

(Reviewed by the First Meeting of NOWPAP WG 4)

1 Background

Establishment of a collaborative regional monitoring programme was identified as one of areas of the priority for implementation of NOWPAP in the first NOWPAP Intergovernmental Meeting in Seoul, September 1994. The responsibility for NOWPAP/3 (Regional Monitoring Programme) was jointly shared by the Special Monitoring and Coastal Environmental Assessment Regional Activity Center (CEARAC) and the Pollution Monitoring Regional Activity Center (POMRAC) to carry out regional activities.

The 7th Intergovernmental Meeting in March 2002 allocated NOWPAP CEARAC the responsibility to implement activities of Working Group (WG) 3 for HAB as a part of Coastal Environmental Assessment and WG4 for Remote Sensing (RS) of Marine Environment as a part of Special Monitoring. The present document proposes the Plan of Work for WG4.

In the first FPM of CEARAC in February 2003, the RS subgroup chaired by Dr. Asanuma agreed that four main issues needed to be focused on, and also decided to conduct a preliminary and preparatory meeting of four Focal Points at Vladivostok, Russia in April 2003. However, the meeting was cancelled due to the spread of SARS. Then, the CEARAC Secretariat conducted Internet meetings (NM) to define the provisional agenda items of the first meeting of WG4. The provisional agenda items and schedule of NM are shown in Table 1.

Table 1 Provisional agenda items and schedule of NM

	Agenda items of each NM	Schedule
NM1	#1.Disscussion on the agenda	At the beginning of September
NM2	#2. Applications supported by Remote Sensing ・ Eutrophication (red tide) ・ Oil spill #3. Definition of user's needs and gaps	In the middle of September
NM3	#4. Towards the operational monitoring ・ Definition of parameter(s) ・ Monitoring methods ・ Prediction of phenomena #5. Long-term strategy	At the beginning of October
NM4	#6. Public outreach ・ Website preparation for working group ・ Contributions to NOWPAP website #7. Capacity building of NOWPAP Members ・ Trainings ・ Facilities including acquisition, processing, storage, and network among RS centers #8. Cooperation with other regions and organizations #9. Capability of CEARAC Facility and Personnel: cooperation among RACs #10.Review of the integrated national reports which will be prepared by CEARAC with the view of standardizing and establishing a system to update national reports. #11. Proposed work plan for 2004/5 ・ Preparation for the second FPM ・ Intersessional activities	In the late of October (cancelled)

2 Objective and long-term strategy

The role of CEARAC is to coordinate with NOWPAP Members for establishing a collaborative, regional monitoring programme (Figure 1).

The objectives of CEARAC WG4 are to develop capability to provide scientists, policy makers, and ocean users with necessary data and information on RS, to enhance RS application to the monitoring of coastal and marine environment in NOWPAP region, and to propose activities to establish RS monitoring system and to collect data and information to realize the proposed activities.

This document provides subjects to be discussed concerning the Plan of Work for Development of RS Monitoring System in NOWPAP Region (Figure 2).

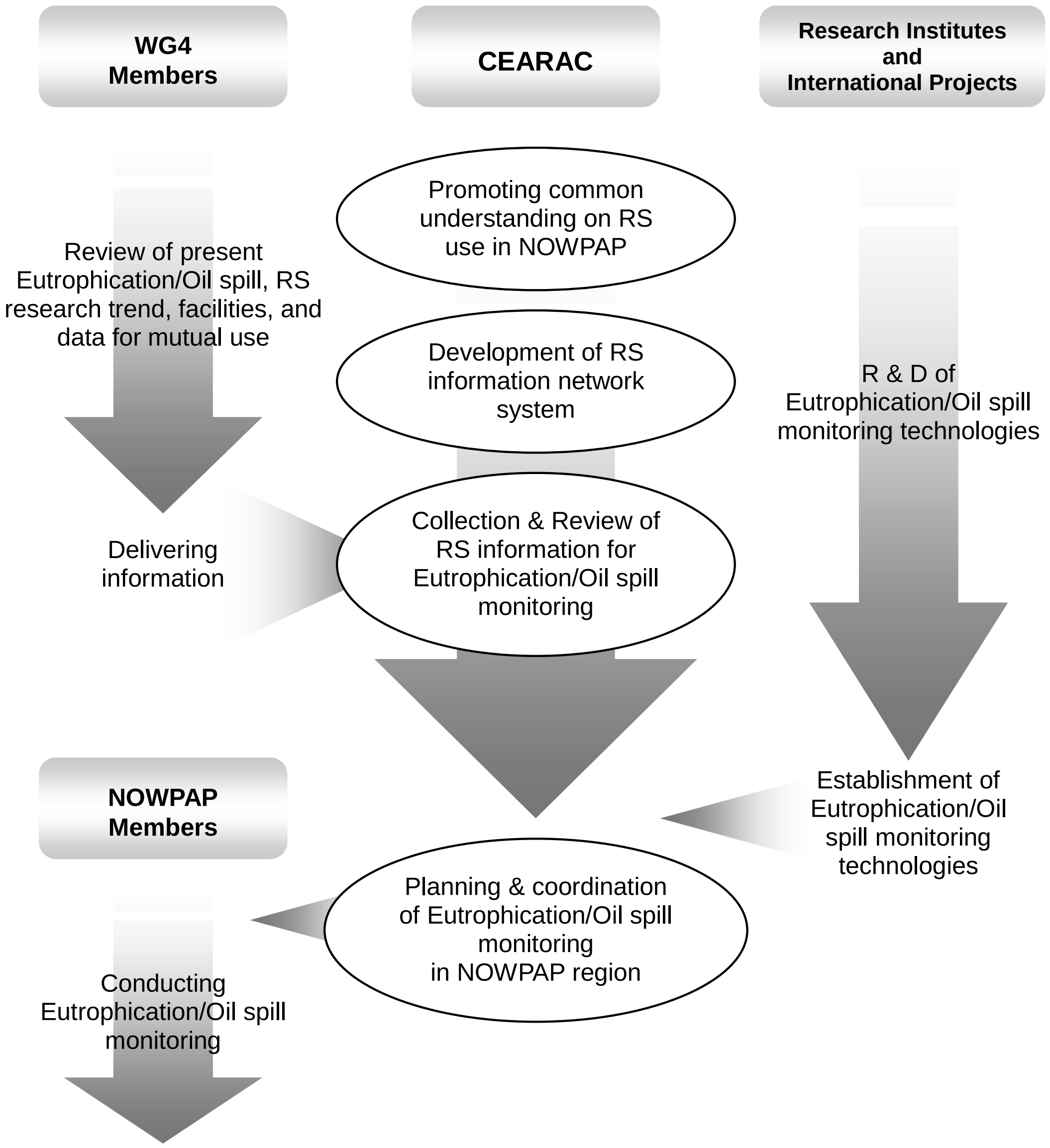

Figure 1 Image of long-term strategy

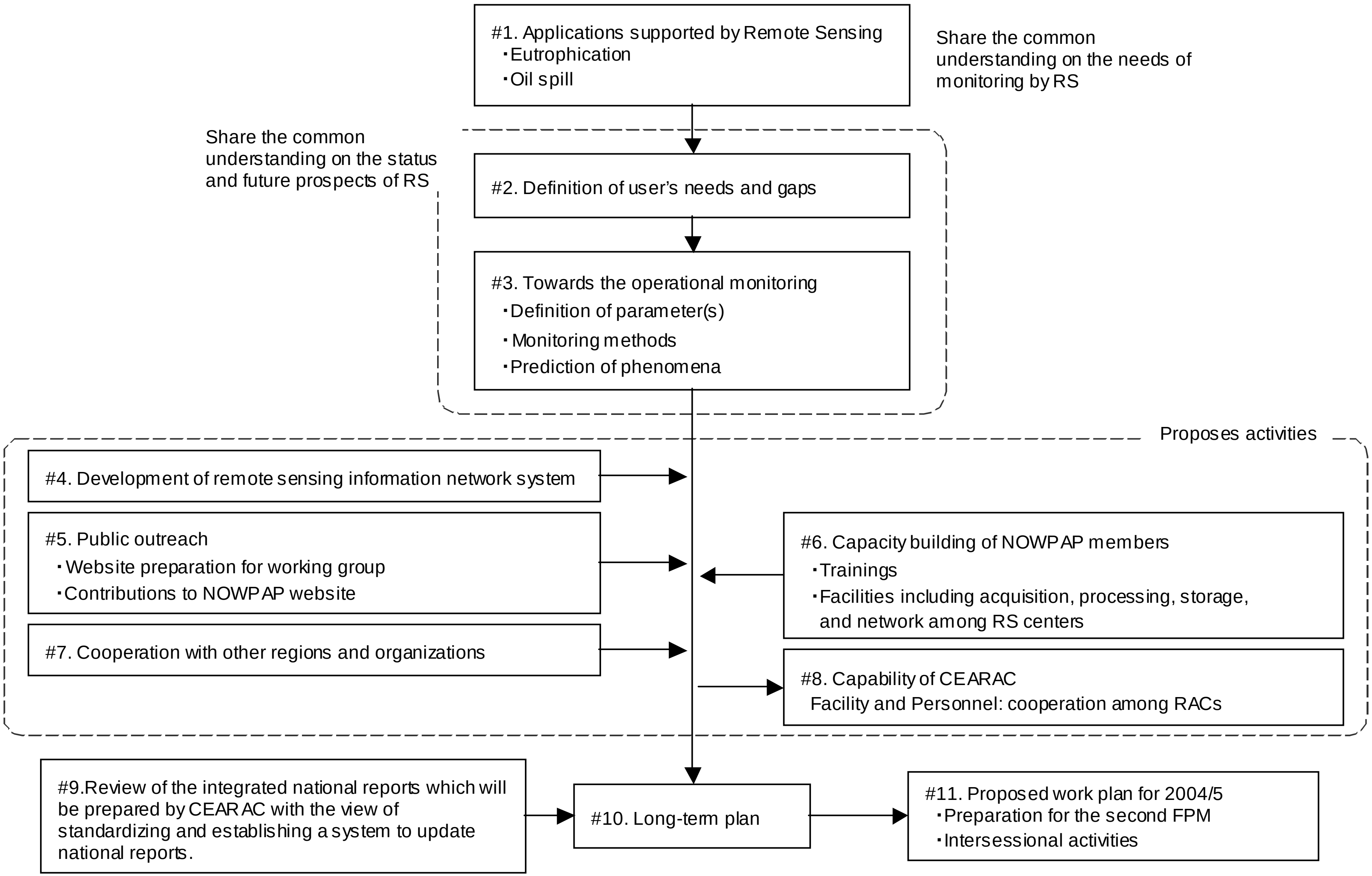

Figure 2　Diagram of activities of CEARAC WG4

3 Actions to be Taken

3.1 Applications supported by Remote Sensing

Frequent occurrence of large-scale red tide in the coastal areas of China and Korea, apparently originating from eutrophication, is now a serious issue causing increase in fishery damages, environment deterioration, and food poisoning from consumption of fish. Establishment of extensive and continuous monitoring system for observing the emergence of eutrophication and red tide is essential to prevent such issues. In the past, observation has been made through reports from fishermen and periodical measurements of water quality by research institutes, costing much labor and expense. Satellite ocean color sensor enables high frequency observation covering wide sea area, and captures spatial and temporal change of *chlorophyll-a* concentration, which is an indicator of eutrophication. Practical application of satellite RS as a monitoring tool for eutrophication and red tide is expected.

Meanwhile, much of the traffic in the Northwest Pacific Ocean, one of the most crowded sea area in the world, is comprised of many tankers and heavy fuel oil cargoes. The potential risk of oil spill by accidents from these vessels is very high, damaging the local fishery and tourism, and subsequently degrading the marine environment to a great degree. Also, illegal oil dumping is not a negligible issue. Satellite RS, having wider coverage than the conventional methods, is expected to detect widespread oil spill effectively and accurately, which is critical to minimize the damages.

Consequently, CEARAC proposes that Eutrophication and Oil spill should be the targets of marine environmental monitoring by RS for the time being due to the fact that both of them are common environmental issues in NOWPAP region and both are expected targets of RS applications.

At the 1st CEARAC FPM, there was an opinion that primary productivity is an important parameter because the change of primary productivity suggests eutrophication. Eutrophication (primary productivity) was originally agreed on as the research theme. Later, there was another opinion that eutrophication (red tide) is more appropriate as a target of RS application because 1) primary productivity itself is not an environmental problem; and 2) specific environmental problem should be chosen as a target of RS application. Based on the above discussion, CEARAC proposes that WG4 should simply target "eutrophication". Eutrophication here refers to a harmful situation in which nutrients are rich and excessive algal bloom occurs or can occur. Eutrophication includes red tide which causes damages to fishery.

Thus, for the time being, monitoring parameters should be 1) *chlorophyll-a* concentration that is already in practical use and is a good indicator of eutrophication; and 2) primary productivity that is estimated by the observed *chlorophyll-a* concentration, sea surface temperature (SST), and photosynthetically available radiation (PAR). Monitoring of red tide itself by RS would be considered in mid- and long-term range in accordance with the progress of observation technologies because it has issues yet to be solved.

Methodology of RS as a tool for monitoring:

Remote sensing can act as an important monitoring tool on EUTROPHICATION.

It can provide data and information on:

- *chlorophyll-a* concentration,
- suspended solids, colored dissolved organic matter,
- primary productivity of phytoplankton,
- red tide,
- SST fields, and

help

to analyze mechanisms of eutrophication and red tide,
to predict red tide, and
to provide information for adaptation and mitigation for eutrophication.

Remote sensing can act as an important monitoring tool on OIL SPILL.

It can provide data and information on:

early detection of slicks,
size estimates,
damage assessment,
location of oceanic dynamic features (current and river outflow fronts, eddies, etc.),
fields of physical oceanic and atmospheric parameters (wind, waves, SST, etc.), and

help

to identify the polluters including accidents and illegal discharge of waste waters from ships,
to predict the movement and weathering of the slick and possibly, and
the nature and thickness of the oil.

3.2 Definition of user's needs and gaps

NOWPAP requests each member to assess its needs and effectiveness of cooperative marine environmental monitoring for proper conservation and use of Northwest Pacific Ocean and to make and conduct a cooperative monitoring plan once its needs and effectiveness are clarified.

CEARAC will fulfill the following duties, through cooperating with NOWPAP Members, 1) to assess the needs and effectiveness of special monitoring of cooperative marine environmental monitoring, especially by RS; 2) to make a monitoring plan for the prioritized environmental issues; and 3) to adjust and improve the monitoring operation, data accumulation, and data exchange.

It is not the responsibility of CEARAC itself but that of NOWPAP Members to conduct monitoring by RS under a cooperative plan and to provide analyzed results.

Furthermore, NOWPAP, as a project, does not have any plan of new installation of satellite data acquisition and analysis system. NOWPAP Members that have installed already or that are going to introduce such equipment/facility are expected to construct cooperative monitoring network systems by their own equipment/facility.

Thus, it is necessary to clarify the gap between RS demand side (users, purposes, requirements) and RS supply side based on the observation of existing activities and future plans in each country as a first step to prioritize the cooperative monitoring needs and effectiveness.

Users of RS on eutrophication and oil spill can be administrative organizations (environment, infrastructure development, fishery etc.), fishery/maritime organizations, research institutes, and so on. CEARAC is going to grasp the gap between user's needs and the reality through comparing the needs with current status of RS technologies by user-, purpose-, and requirement-categories as shown in Table 2 and Table 3.

Table 2 User's Needs and Gaps on EUTROPHICATION

User	Purpose	Present Status	Future Status	Gaps
Administrative Organization (Environment, Fishery, Education, etc.)	• Monitoring for water quality conservation. (Distribution of *chlorophyll-a*, turbidity, SST etc.)	• Monthly or seasonal use • Spatial resolution 1km -	• Spatial resolution 250m - • Improvement of accuracy in coastal area	• Higher resolution and accuracy are expected. • Continuous monitoring plan
	• Fishery resource management (Distribution of *chlorophyll-a*, SST etc.)	• See above.	• See above.	• See above. • Preparation of effective dataset
	• Environmental education • Publicity and promotion of marine environmental conservation activities	• Spatial resolution 30m - 1km • Use as photos or images to effectively introduce marine environmental pollution (red tide etc)	• Spatial resolution 1m - 1km	• Delivery of user-friendly information (not for experts) • Preparation of image catalogue
Maritime Industry (Fishery, Tourism, etc.)	• Understanding of red tide phenomena that causes fishery damages • Understanding of red tide phenomena that causes marine environmental damages	• Daily or weekly use • Delivery by several days • Spatial resolution 1km -	• Spatial resolution 250m - • Delivery by several hours • Improvement of accuracy in coastal area	• Higher spatial resolution, temporal resolution and accuracy are expected. • Explanation to link products with red tide is also necessary. • Continuous monitoring plan
Research Institute	• Identification of red tide occurrence mechanisms (Distribution of *chlorophyll-a*, turbidity, SST, PAR, etc) • Accumulation of Observation data	• Daily or weekly use • Spatial resolution 1km - • Evaluation of accuracy by delivering organization	• Spatial resolution 250m - • Improvement of accuracy in coastal area	• Higher accuracy is expected. • Archive system to prevent data from getting scattered and lost • Continuous monitoring plan • Preparation of *in situ* dataset for accuracy examination

Note: Monitoring is difficult when rainy or cloudy due to clouds.

Table 3 User's Needs and Gaps on OIL SPILL

User	Purpose	Requirements	Gaps
Administrative Organization (coast guard, border patrols, fishery, environment, etc.)	• Detecting illegal discharges from the vessels • Warning alert • Detecting and prosecuting offenders	• All weather satellite observations 1-2 path/day • 25-150 m spatial resolution • Assessment of oil type and thickness. • Low probability of false alarm • Near-real-time processing, analysis and annotation of SAR data • Satellite-based and *in situ* quantitative information on weather conditions (wind and wave conditions, cloudiness), surface currents and sea state	• Revisit time of present satellites is larger than 3-4 days. Now daily satellite data are not available. • Detecting of oil spill is impossible at weak (<2-3 m/s) and high (8-10 m/s) wind speed. • Assessment of oil type and thickness can be done only from aircraft with UV sensors. • Better understanding of the appearance of look-alike features.
	• Tracking of oil patches, their area and weathering • Impact assessment	• See above. • Additional satellite SAR sensing, and/or aircraft observations • Availability of regional models of oil drift and transformation • Quantitative information on weather conditions, sea state and currents • System integrated RS with GIS	• See above. • Specialized aircrafts for coat zone monitoring are not available. • System integrated RS with GIS not available.
Research Institute	• Preparing of archive data on oil pollution • Statistics will increase reliability of oil pollution detection.	1) how many oil spills are identified by national (aircraft and satellite) monitoring in the Japan/East, Yellow and East-China Seas every year? 2) how many oil spills are there every year in these sea basins? - including false negatives and areas not monitored. 3) where are the hot-spots? 4) how much oil is spilled (m^3)? 5) where does it end up? - evaporates or hits coast? 6) what is its environmental impact?	• A set of archive data is limited. They are available for limited areas only.
	• Advancement of satellite, aircraft and ship techniques for oil pollution detection • Advancement of oil spill modeling	• Availability of satellite and subsatellite measurements obtained by the present and new sensors. • High spatial and temporal remote and *in situ* information to check the results of modeling.	

3.3 Towards the operational monitoring

3.3.1 Eutrophication

(1) Appropriate parameters for the monitoring of eutrophication

Chlorophyll-a concentration is currently regarded as the most practical parameter for the monitoring of eutrophication because its operational use in the ocean has been already realized. In addition, primary productivity estimated from *chlorophyll-a* concentration, SST, photosynthetically available radiation (PAR) etc could be the possible parameter.

(2) Monitoring method

To enable the eutrophication monitoring by RS, technical issues shown in Table 4-1 have to be solved.

Chlorophyll-a concentration is estimated from the general two steps as shown below:

1) Atmospheric correction algorithm retrieves water-leaving radiance (L_W), and then,

2) In-water bio-optical algorithm estimates *chlorophyll-a* concentration from L_W

Presently in the open ocean water, this method has been almost established for *chlorophyll-a* concentration.

In contrast, in the coastal water, the bio-optical algorithm is still under the research and development, because of complexities due to the existence of suspended solid (SS) and colored dissolved organic matter (CDOM) as well as *chlorophyll-a.* Recently, a neural network method is introduced to estimate *chlorophyll-a,* SS, and CDOM from the water-leaving radiance with an intensive education of the neural network using *in situ* data. Regarding atmospheric correction algorithm on the coastal water, an iterative method and a neural network method are in development. The iterative method estimates an aerosol contribution in short wavelengths with an assumption of *chlorophyll* and water leaving radiance at longer wavelength iteratively. The neural network method estimates an atmospheric effect through the education of the neural network with the known data and retrieve water leaving radiances.

Table 4-1 Issue of RS monitoring on eutrophication

Item	Current Status	Issue*
Chlorophyll-a concentration	• Many ocean color sensors are available such as MODIS, etc. • Monitoring is established in the ocean area.	Essential issue: • Estimation algorithm does not have enough accuracy in coastal area. • Small scale distribution is not available due to low resolution. • Detailed short-term variations of distribution are not available due to scarce observing frequency.
Sea Surface Temperature (SST)	• 1km resolution automatic monitoring is possible by AVHRR.	• Accurate monitoring in coastal area is difficult due to low resolution.
Photosynthetically Available Radiation (PAR)	• 1 km PAR is available by ocean color sensors, MODIS.	• Lower reliability as a daily product, but higher reliability as a weekly or a monthly PAR. • GMS based hourly PAR could be applied although a spatial resolution is low.

* Monitoring is difficult when rainy or cloudy due to clouds.

To develop an operational algorithm, it is indispensable to have enough *in situ* data for accuracy assessment of estimated values from RS data, as well as for understanding the optical characteristics of *chlorophyll-a,* SS, and CDOM in target sea area. However, in reality, *in situ* data obtained from vessels or mooring instruments are quite limited in time and space, compared with the vast sea area. In addition, it is necessary to reconsider the specification of *in situ* dataset itself to keep abreast with new satellite and sensor operation. In the future, establishment of more valuable *in situ* database, with well-organized and sufficient *in situ* data collection in time and space, is expected for effective monitoring.

(3) Modeling and prediction of eutrophication

RS data provide distribution of *chlorophyll-a* concentration and SST in global scale with a daily frequency. Such information is not available through observations by research vessels or buoys. The eutrophication should be analyzed and studied in physical-, chemical, and biological processes using these information. Models for the eutrophication or red tide should be proposed and validated based on these researches. Then an assimilation technique of RS data or *in situ* data to the model should be developed to realize a now-casting or forecasting of eutrophication and red tide.

To predict eutrophication and red tide, ecosystem model capable of predicting plankton activity is indispensable as well as hydrodynamic model capable of predicting currents and waves. On the one hand, various hydrodynamic models have already been developed and, for example, used in NEAR-GOOS to try to predict short-term variation of hydrodynamics utilizing accumulated data of current speed and water temperature. On the other hand, ecosystem modeling has not been well validated partly due to the shortage of biological data. RS will supply *chlorophyll-a* concentration data archives which will assist the reliable ecosystem model development.

3.3.2 Oil spill

(1) Appropriate parameter for the monitoring of oil spill

Oil spill is currently regarded as the most dangerous marine pollution. As the demand for oil based products increases, shipping routes will consequently become much busier; the likelihood of slicks occurring is increasing. Detection of oil spill location, their size and extent, direction and magnitude of oil movement as well as organization of effective monitoring of oil pollution are the urgent problems for all countries participating in the NOWPAP.

In the marine environment, conditions change rapidly and features are frequently obscured by cloud, thus requiring multiple looks. Systematic, routine monitoring of marine pollutants, fields of wind and wave and the dynamic systems (fronts of different origin, currents, eddies, upwellings, sea ice, etc.) that influence on and transport them as well as the weather systems require inputs of radar, infrared, visible and ultraviolet data in ways that take advantage of their respective strengths.

(2) Monitoring method

Marine monitoring of pollution and water quality can be carried out in many different ways, using aircraft observations, satellite data, ship observations, *in situ* measurements from automatic buoys and ferry systems, or by various combinations of these methods. If applied correctly, remote sensing can act as an important monitoring tool. It can provide early detection of slicks, provide size estimates, and help predict the movement and weathering of the slick and possibly the nature and thickness of the oil. This information will be invaluable in aiding clean up operations, and consequently help save wildlife and the balance of the local ecosystem, provide damage assessment and help to identify the polluters including illegal discharge of waste waters from ships.

Single sensor is unlikely to provide adequate temporal and spatial coverage at adequate spatial resolution for pollution monitoring; therefore networks of sensors are required which are coordinated in terms of the data formats, quality control information and distribution, in addition to initial acquisition.

Potential of the fusion of airborne and satellite data

Airborne	Satellite
+ High spatial resolution	+ Large-scale area coverage
+ Ground truth capability	+ Provides alert functionality
+ Classification of oil species	+ 24 hours operation
+ Determination of layer thickness	+ Independent of weather condition
+ Evidence ensuring	+ monitoring of shipping routes
+ Commandable	- Low repetition rate or high number of satellites needed
- Low spatial coverage	- Lower spatial resolution

Using satellite platforms to monitor oil slicks is more cost effective than applying airborne monitoring techniques and therefore would be beneficial when used in a continuous monitoring role. Satellite-borne sensors, particularly radar, provide valuable information; however their frequency of overpass (and lesser spatial resolution) should be improved significantly.

Table 4-2 shows the parameters (fields of parameters) that should be retrieved with the usage of satellite and/or aircraft RS techniques for detection and monitoring of oil spill. They are also required for modeling of drift and transformation of oil spills and for organization of clean up operations.

Algorithms for oil spill detection and assessment of polluted area, oil type and its thickness depend strongly on sensors used and weather conditions.

Table 4-2 Issue of RS monitoring on oil spill

Item	Current Status	Issue
Radar backscatter	• Synthetic Aperture Radar on ERS-2, RADARSAR and Envisat satellites. • Coastal radars • Aircraft radars and ship (navigation) radars	• Detection is impossible at low (< 2 m/s) and strong (> 8-10 m/s). • There are false alarm cases of different origin (look-alike). • Continuous sensing is absent. • Revisit time larger than 3-4 days. • High-speed raw data processing and interactive analysis are required to inform authorities, etc. • SAR data are expensive for everyday monitoring.
Induced Fluorescence	• Aircraft Laser-Fluoro Sensor (Germany, England,)	• Determination of oil layer thicknesses within 0,1 till 20 mm • Identification and classification of the oil types by means of a number of oil classes • Discrimination of natural oil alike substances on the sea surface and of mineral oil to prevent false alarms • Detection of oil quantities below the water surface • Concentration of algae by *chlorophyll* fluorescence e.g. for forecasting of algae blooms
Chlorophyll-a concentration	• Many ocean color sensors are available such as MODIS, GLI etc. • Envisat MERIS with spatial resolution of 250 m • Aircraft devices	• Patches and bands of natural films at the areas with high *chlorophyll-a* concentration are a principal cause of a false alarm at wind speed W < 5-6 m/s. • Accurate monitoring and detecting of small scale features from satellites is difficult in the coastal areas due to low resolution.

Sea Surface Temperature (SST)	• NOAA AVHRR • ERS-2 ATSR and Envisat AATSR • Aircraft radiometers	• Information on the location of the high thermal gradients (coastal and oceanic fronts, upwellings, eddies, etc.) can be used in modeling of oil spill drift and in interpretation of radar signatures.
Sea Surface Wind	• QuikScat • Aqua AMSR and ADEOS-II AMSR-E • Synthetic Aperture Radar on ERS-2, RADARSAR and Envisat satellites	• Areas where W < 2-3 m/s (convergence zones, cyclone centres, wind shadows, etc.) hinder oil spill detection by a SAR as well as they are a principal cause of a false alarm. • Low spatial resolution of QuikScat, Aqua and ADEOS-II data. • Revisit time of satellite SAR is larger 3-4 days.
Sea Ice	• NOAA AVHRR • Aqua AMSR and ADEOS-II AMSR-E • Synthetic Aperture Radar on ERS-2, RADARSAR and Envisat satellites	• Brightness, thermal and radar contrasts of sea ice depend on many parameters. • Low resolution of microwave radiometric data used under cloudiness. • Areas covered by grease ice look dark on SAR images (look-alike) and can be a source of false alarm.

(3) Modeling and prediction for oil spill

A large number of oil spill models are in use in the world today. These range in capability from simple trajectory, or particle-tracking models, to three-dimensional trajectory and fate models that include simulation of response actions and estimation of biological effects. Remotely sensed data will contribute to oil spill modeling in several ways by improvements in their acquisition, interpretation and transmission. First, nearly and real-time updating of drift and spreading computations will become possible, relying on fast processing of satellite data and direct transmission from over-flight aircraft. Second, the remote estimation of water content in slick may also become possible, in which case synoptic weathering pictures can be built up to supply calibration and test data sets for models. Third, the satellite and aircraft measurements provide quantitative data on the sea surface temperature, wind and waves, sea ice, cloudiness used as input information in oil weathering modeling. Fourth, the Internet is likely to result in significant changes in how oil spill models are designed in the future. Nearly real-time acquisition of input data, including winds, currents, satellite and over-flight images can be achieved in this way. Model results can also be disseminated rapidly via the Internet.

The oil spill models are currently used for predicting the behavior and fate of oil spilled in marine environment. All present models describe the following key physical and chemical processes that transport and weather the oil on and in the sea:

1) Advection
2) Spreading
3) Evaporation
4) Natural dispersion
5) Emulsification
6) Oil-shoreline interactions
7) Oil properties

3.4 Development of Remote Sensing Information Network System

3.4.1 Proposal of Establishment of Portal Site

A portal site is proposed as an option to share the common understanding on the status, challenges, and opportunities of marine environmental monitoring by RS in NOWPAP and to share the information for the future monitoring system establishment as shown in Figure 3. Annex V-1 shows the proposed portal site.

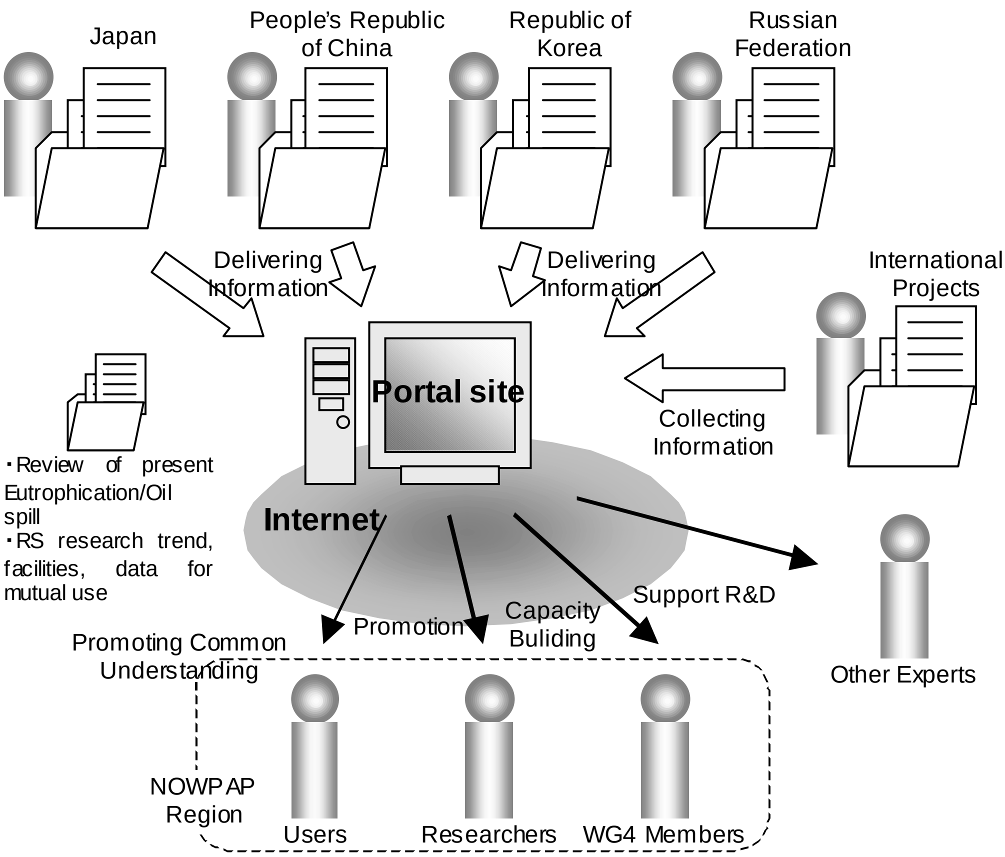

Figure 3 Image of portal site

3.4.2 Proposal of Establishment of Website of oil spill monitoring

Satellite and aircraft image database general concept has been elaborated in detail including input data format, database file system and web site presentation layout. General procedure for other NOWPAP CEARAC countries to submit data into the database was worked out as well. See Annex V-2.

3.5 Public Outreach

CEARAC website (http://cearac.nowpap.org/) and Newsletter are designed to introduce WG activities, to stress the usefulness of marine environmental monitoring by RS, and to broadcast the importance of putting the monitoring into effect. Together with the RS portal site to be developed, CEARAC website is expected to promote active R & D and RS application.

3.6 Capacity Building of NOWPAP Members

The final goal of WG4 is to establish RS monitoring system of Eutrophication and Oil spill. For that purpose, NOWPAP Members are expected to share the common understanding on marine environmental monitoring by RS and to establish cooperative relationship so that NOWPAP Members can help each other in technical aspects.

Firstly, we review and analyze the status of each member as described in 3.1, 3.2, and 3.3. Secondly, we grasp the technical gap of software and hardware among NOWPAP Members to consider the needs and contents of technical training and technology transfer. Thirdly, we consider the technical role of each member to establish the monitoring system.

To avoid duplicated effort, we should make the best use of existing training courses provided by other regions or organizations that are conducting similar activities.

3.7 Cooperation with Other Regions and Organizations

In other regions and projects, there are various on-going activities related to marine environmental monitoring using RS. To implement NOWPAP activities effectively and efficiently, it is vital for CEARAC to gain an understanding of these on-going activities in order to strengthen collaborative approach. The projects are listed as below.

(1) NEAR-GOOS

Established in 1993, NEAR-GOOS aims to establish a system that enables observation and study of various phenomena in the ocean, both globally and comprehensively. It is a pilot project proposed by UNESCO and IOC targeting the west Pacific Ocean region of GOOS (Global Ocean Observing System), and is now promoted jointly with WMO, etc. Japan, China, Korea, and Russia are currently NEAR-GOOS Members. The accumulated data on marine physics, and the upcoming prediction model of short-term variation may be available for use.

(2) COOP

COOP was established in 1998 to discuss the overall concept of monitoring system in coastal region. It consists of 3 different programs: Coastal-GOOS, HOTO (Health of the Oceans), and LMR (Living Marine Resources). Coastal-GOOS is a sub-program of GOOS targeting at coastal region. HOTO evaluates the effect of oceans to the environment and organisms. LMR monitors and evaluates marine resources. COOP guidelines and detailed programmes are of valuable reference.

(3) IOCCG

IOCCG was established in 1996 by IOC to propagate the usefulness of ocean color data and to promote its use by researchers and institutions. It is an international organization under CEOS (Committee on Earth Observation Satellites) facilitating opportunities for researchers and research institutions to share information on ocean color. Research results and training programs may be available for use.

(4) Red Tide Watcher in Asian Waters

In order to establish a wide-area red tide monitoring system in Asia, an international forum on satellite ocean color observation was established in October 2002 by a group of researchers in Japan, by supervising the management of red tide occurrence database and of information sharing system via internet. This forum was named Red Tide Watcher in Asian Waters. Its members are international organizations in the field of red tide and marine environment, researchers for red tide and ocean color RS, and organizations in satellite RS. Participating in its workshops on satellite observations and sharing of research results would be of our benefit.

(5) PICES

The North Pacific Marine Science Organization (PICES) was established in 1992 to promote interdisciplinary research and international cooperation that are necessary to exploit natural resource and to consider the environmental issues. Presently, Canada, Japan, China, Korea, Russia, USA, and Mexico participate as members. Study results on the estimation method for primary productivity by RS and red tide can be referenced.

3.8 Capability of CEARAC

Northwest Pacific Region Environmental Cooperation Center (NPEC) was designated as CEARAC in 1999. The present state of the capability of CEARAC is as follows:

- STAFF: 3 Full time (Director, Section Chief, Senior Researcher)
  2 Part time (2 Senior Researchers)
  Note: All CEARAC staff are NPEC staff. (NPEC has 14 staff as a whole)
- FUND: To implement a basic research on remote sensing, CEARAC has funds contributed by Toyama Prefectural Government besides UNEP Trust Fund.

CEARAC has some matters to be concerned to implement further activities, such as:

- FUND: To raise some funds from Japanese Central/ Local Government and other international/ domestic funds for further activities.
- Scientific Capacity: To establish a network with International / Local research institutes to expand the scientific capacity.

In order to support CEARAC, the Ministry of the Environment of Japan established the Marine Environmental Watch System for Northwest Pacific Region in 2002, which receives and processes satellite data and provides information on marine environments to users both in Japan and abroad. NPEC is managing and operating the system. Also, to support CEARAC activities, NPEC is implementing Toyama Bay Project, a pilot project of which the main objective is to develop monitoring methods of red tide in Toyama Bay by means of remote sensing.

3.9 Standardization of National Reports and Integrated Report

CEARAC will compile an integrated report based on the National Reports / Status Reports provided by NOWPAP Members at the 1st FPM in February 2003. The report will summarize the status of RS application in marine environmental monitoring, and will be a useful document that would guide the future activities of WG4. However, there were difficulties in comparing the status for each country, as the contents of each National Reports provided were different, even though they all followed the instructions provided by CEARAC. Therefore, standardization of the contents of National Reports would be called for in the future. Also, to reflect the activities in each member, updating frequency of National Reports should be adequate.

Recommended contents of integrated report were drafted and shown in Annex V-3. The National Reports submitted in the future are expected to follow the standardized format shown in Annex V-4. The proposed frequency for updating National Report is once in 2 years.

For the completion of the integrated report that is currently being compiled, additional information and/or confirmation on the context of National Reports submitted to the 1st FPM may be requested if necessary.

3.10 Long-term plan

Long-term plan is shown in Table 5, through which WG aims to establish the monitoring system of eutrophication and oil spill by RS. As mentioned in "2 Objective and long-term strategy", research institutes are expected to take a role of various R & D needed to establish the monitoring system while CEARAC coordinates planning/arrangement in NOWPAP framework. Thus, time frame to operate the monitoring system shown in Table 5 would depend on the activities of research institutes. The development of portal site mentioned in the section 3.4.1 will activate R & D.

3.11 Proposed Work Plan for 2004/5

The proposed work plan for 2004/5 includes compiling integrated report as shown in Table 6, convening FPM and WG, setting up a portal site of RS, disseminating information, and convening workshops. Activities with high priorities to be determined at this meeting will also be included in the work plan.

End of December 2003	Each WG member should feedback comments and suggestions on the Guidelines for the National Report (Annex V-4) to the secretariat.
January 2004	The secretariat should revise the guideline by referring to the comments and suggestions.
End of January 2004	Each WG member should feedback comments and suggestions on the Draft Integrated Report 2003 (Annex V-3) to the secretariat.
February 2004	The secretariat should revise the Draft Integrated Report 2003 by referring to the comments and suggestions.
15-17 March 2004	The Second FPM The secretariat submits the Draft Integrated Report 2003.
Autumn 2004	The Second Meeting of WG The secretariat reviews interim status of WG activities. Each WG member should prepare a draft of the National Report (trial version) based on the revised guideline. The adequacy of the guideline will be discussed and assessed.
Spring 2005	The Third FPM Each WG member submits the National Report.
Summer 2005	The secretariat prepares the Draft Integrated Report 2005.
Autumn 2005	The Third Meeting of WG The contents of the Draft Integrated Report 2005 will be discussed and assessed.
Spring 2006	The Fourth FPM The secretariat submits the Draft Integrated Report 2005.

Table 5 Long-term plan

Public outreach Website & Newsletter	Update & Publication
Development of Portal site	Ver.1 (2004) → Ver.2 (2005) → … Update & Maintenance
Eutrophication Monitoring and Oil Spill Detection in NOWPAP region	CEARAC: Planning & Coordination NOWPAP Members: Operation; Research & Development

Table 6 Work Plan for 2004/2005 (Reporting & Meetings)

		2004	2005	2006
Reporting	National Report by WG4 Members			
	Integrated Report by CEARAC		**D/I**	
Meetings	Meeting of Working Group 4	Mid-term Review	**F/I** Finalize Integrated Report	
	Focal Points Meeting	Review **F/I** 2003 (Approve Plan of Work 2004/5)	Mid-term Review	Review **F/I** 2005 (Approve Plan of Work 2006/7)

D/I: Draft Integrated Report, **F/I:** Final Integrated Report