

Annex IX

Workplan for NOWPAP Working Group 4 (Reviewed and Adopted by the 2nd CEARAC Focal Points Meeting)

Full text of the plan of work for the NOWPAP Working Group 4 is showed in Report of the First Meeting of NOWPAP Working Group 4 (Remote Sensing) (UNEP/NOWPAP/CEARAC/WG4.1/5)

Annex IX

Workplan for NOWPAP Working Group 4

(Reviewed and Adopted by the 2nd CEARAC Focal Points Meeting)

1. Background

Following the results of discussions at the First Meeting of the Coordinating Committee (CC), the Seventh IGM (Vladivostok, 20-22 March 2002) approved the resolution on the demarcation of the responsibilities and activities between CEARAC and POMRAC. Subsequently CEARAC was allocated with the responsibility to implement activities related to Working Group 3: HAB (Harmful Algal Blooms) and Working Group 4: Remote Sensing of Marine Environment.

In the First FPM of CEARAC in February 2003, the remote sensing (RS) subgroup chaired by Dr. Asanuma agreed that the main issues needed to be focused on by Working Group 4. The first FPM agreed on five main issues as follows.

- 1) Applications supported by remote sensing
 - Oil spill
 - Eutrophication (primary productivity)
- 2) User's needs and gaps should be defined
- 3) Towards the operational monitoring
 - Modeling of phenomena
 - Monitoring methods
 - Prediction of phenomena
 - Funds
- 4) Public outreach
 - Website preparation for working group
 - Contributions to NOWPAP website
- 5) Capacity building of NOWPAP Members
 - Trainings
 - Facilities including acquisition, processing, storage, and network among RS center
 - Funds

The first FPM had also agreed that the following issues will be discussed in both Working Group 3 and 4 meetings:

- 6) Long-term strategy
- 7) Proposed working plan for 2004/5
 - Prepare for the second FPM
 - Inter-session activities
- 8) Capability of CEARAC
 - Facility and personnel, cooperation among RACs

Then, CEARAC organized the Internet meetings to define the provisional agenda items of the First NOWPAP Working Group 4 Meeting and to have preliminary discussion on each item.

In the First NOWPAP Working Group 4 Meeting (Vladivostok, Russian Federation, 1-3 December 2003), CEARAC proposed 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. The First NOWPAP Working Group 4 Meeting (hereinafter 'the First WG4 Meeting') agreed the Working Group 4 (hereinafter 'WG4') would focus on eutrophication and oil spill. CEARAC proposed a 'Plan of Work for the NOWPAP Working Group 4'. After a productive discussion, the First WG4 Meeting agreed on the 'Plan of Work for the NOWPAP Working Group 4'.

2. Objective and Long-term Strategy

The role of CEARAC is to coordinate with NOWPAP Members for establishing a collaborative, regional monitoring programme using remote sensing (Figure 1). In order to do that, CEARAC will continue to cooperate with NOWPAP Members, and research institutions and international projects, even though 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.

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.

3. Workplan for Working Group 4

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 and environment deterioration. 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, 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 is expected to detect widespread oil spill effectively and accurately, which is critical to minimize the damages.

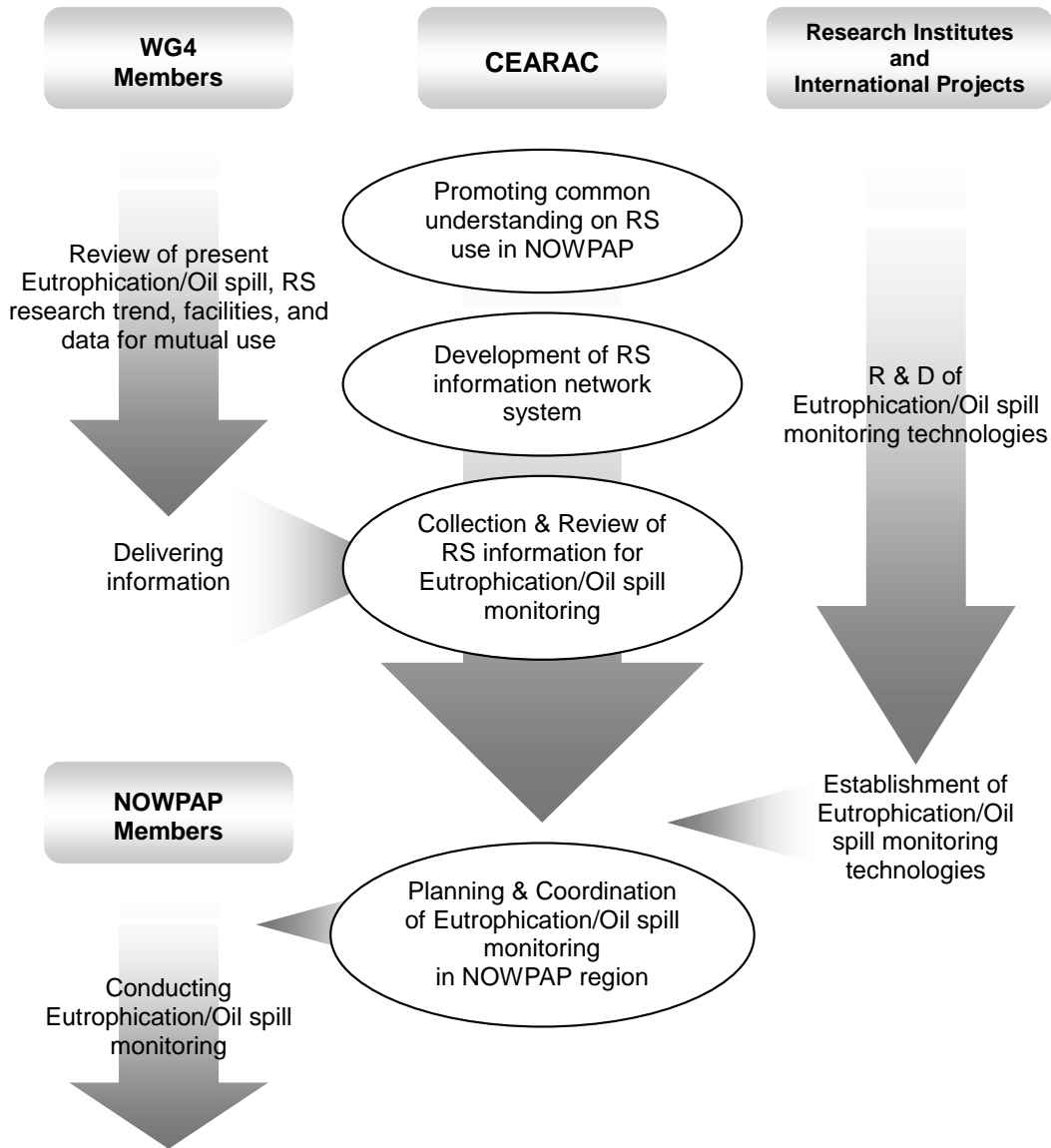


Figure 1 Diagram of long-term strategy

Remote sensing can provide data and information on *chlorophyll-a* concentration, suspended solids (SS), colored dissolved organic matter (CDOM), primary productivity of phytoplankton, red tide, sea surface temperature (SST) fields, and can help to analyze mechanisms of eutrophication and red tide, to predict red tide, and to provide information for adaptation and mitigation for eutrophication. Concerning eutrophication monitoring, 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 observed *chlorophyll-a* concentration, sea surface temperature (SST), and photosynthetically available radiation (PAR). Monitoring red tide by RS would be considered in a mid- and long-term range in accordance with the progress of observation technologies because it has many issues yet to be solved.

Concerning oil spill monitoring, remote sensing 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 can 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 the nature and thickness of the oil.

3.2 Definition of User's Needs and Gaps

It would be necessary to clarify the gap between remote sensing requirements and present remote sensing capacity on eutrophication monitoring and oil spill detection. 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.

The First WG4 Meeting suggested that the needs and gaps should be further clarified on a basis of the each country's situation. NOWPAP requests each member to assess its needs and effectiveness of cooperative marine environmental monitoring for proper conservation and use of Northwest Pacific and to make and conduct a cooperative monitoring plan once its needs and effectiveness are clarified.

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 open ocean water 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 1 have to be solved.

Generally, *chlorophyll-a* concentration is estimated from two steps as shown below:

- 1) Atmospheric correction algorithm retrieves water-leaving radiance (L_w), and
- 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 research and development, because of complexities due to the existence of SS and 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 in the coastal water, an iterative method and a neural network method are in development. The iterative method estimates an aerosol contribution in short wavelengths iteratively with an assumption of *chlorophyll* and water leaving radiance at longer wavelength. 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 1 Issue of RS monitoring on eutrophication

Item	Current Status	Issue*
<i>Chlorophyll-a</i> concentration	<ul style="list-style-type: none"> • Many ocean color sensors are available such as MODIS, etc. • Monitoring is established in the open ocean water. 	<ul style="list-style-type: none"> • 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 low observing frequency.
Sea Surface Temperature (SST)	<ul style="list-style-type: none"> • 1km resolution automatic monitoring is possible by AVHRR. 	<ul style="list-style-type: none"> • Accurate monitoring in coastal area is difficult due to low resolution.
Photosynthetically Available Radiation (PAR)	<ul style="list-style-type: none"> • 1 km PAR is available by ocean color sensors, such as MODIS. 	<ul style="list-style-type: none"> • 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 under rainy or cloudy conditions.

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

Remotely sensed 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 this information. Models for the eutrophication and red tide should be developed and validated based on researches. Then an assimilation technique of RS data and *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 as well as hydrodynamic model capable of predicting currents and waves can be used. Various hydrodynamic models have already been developed and used, for example in NEAR-GOOS, to predict short-term variation of hydrodynamics utilizing accumulated data of current speed and water temperature. But 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 observations. Routine systematic monitoring of marine pollutants, fields of wind and wave and the dynamic systems (fronts of different origin, currents, eddies, upwelling, 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

Monitoring oil spill 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.

Table 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. 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.

(3) Modeling and prediction for oil spill

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.

Table 2 Issue of RS monitoring on oil spill

Item	Current Status	Issue
Radar Backscatter	<ul style="list-style-type: none"> • Synthetic Aperture Radar on ERS-2, RADARSAT and Envisat satellites • Coastal radars • Aircraft radars and ship (navigation) radars 	<ul style="list-style-type: none"> • Detection is impossible at low (< 2 m/s) and strong (> 8-10 m/s) wind speed. • 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	<ul style="list-style-type: none"> • Aircraft Laser-Fluoro Sensor (Germany, England) 	<ul style="list-style-type: none"> • Determination of oil layer thicknesses within 0.1 till 20 mm. • Identification and classification of the oil types by 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 <i>chlorophyll</i> fluorescence e.g. for forecasting algae blooms.
<i>Chlorophyll-a</i> concentration	<ul style="list-style-type: none"> • Many ocean color sensors, such as MODIS, are available • Envisat MERIS with spatial resolution of 250 m • Aircraft devices 	<ul style="list-style-type: none"> • Patches and bands of natural films at the areas with high <i>chlorophyll-a</i> 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)	<ul style="list-style-type: none"> • NOAA AVHRR • ERS-2 ATSR and Envisat AATSR • Aircraft radiometers 	<ul style="list-style-type: none"> • Information on the location of the high thermal gradients (coastal and oceanic fronts, upwelling, eddies, etc.) can be used in modeling of oil spill drift and in interpretation of radar signatures.
Sea Surface Wind	<ul style="list-style-type: none"> • QuikScat • Aqua AMSR • SAR on ERS-2, RADARSAT and Envisat satellites 	<ul style="list-style-type: none"> • Areas where $W < 2-3$ m/s (convergence zones, cyclone centres, wind shadows, etc.) hinder oil spill detection by SAR. • Low spatial resolution of QuikScat, and Aqua data. • Revisit time of satellite SAR is larger (3-4 days).

Sea Ice	<ul style="list-style-type: none"> • NOAA AVHRR • Aqua AMSR • SAR on ERS-2, RADARSAT and Envisat satellites 	<ul style="list-style-type: none"> • 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.
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A large number of oil spill models are being used for predicting the behavior and fate of oil spills in marine environment. 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. All present models describe the key physical and chemical processes, such as 1) advection, 2) spreading, 3) evaporation, 4) natural dispersion, 5) emulsification, 6) oil-shoreline interactions, and 7) oil properties, which transport and weather the oil on and in the sea.

3.4 Development of Remote Sensing Information Network System

One of the final goals of WG4 is to establish marine environmental monitoring systems by remote sensing in the NOWPAP region. For establishing the monitoring systems, collecting data and information, including satellite images, forecasting the development and behavior of eutrophication and oil spill, and then disseminating data and information on the present conditions of eutrophication and oil spill and the forecasting results speedily are very important. Based on the precise data and information provided, the policy-makers, monitoring and/or mitigation executing agencies, scientists and researchers, and ocean users in the region can make suitable measurements when eutrophication and oil spill might cause pollution problems.

However, data and information about the marine environment by remote sensing are actually scattered in different organizations in the NOWPAP region. In order to share their usability, to share existing research and development resources and to understand the future trends in marine environmental monitoring, developing remote sensing information network system, which integrates the scattered information, is the basic work. Current information technology could make this work come true. In addition, the information network system can be used for promoting common recognition on environmental monitoring by remote sensing, capacity building and public outreach in the NOWPAP region. Furthermore, with the contents being enriched, it can be used for supporting research and development work inside and outside NOWPAP region.

The First WG4 Meeting agreed on the development of the portal site on remote sensing in the NOWPAP region as the first step for the remote sensing information network system.

CEARAC also supported the development of the website on oil spill remote sensing at the V.I. Il'ichev Pacific Oceanological Institute (POI).

3.4.1 Establishment of Portal Site

(1) Objective of the portal site

Establishment of the information network system related to the marine environmental monitoring by RS should be carried out step by step because of the cost and technical difficulties. As the first step, establishing a portal site is one of the solutions to find and address the scattered data and information in the NOWPAP region. As the next step, establishment of a digital library, which can play a role in providing information and data together with the support of the portal site, would be proposed.

CEARAC takes the first step by establishing a portal site for the purpose mentioned above as one of the primal activities. 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 region and to share the information for the future monitoring system establishment. Figure 2 shows a basic concept of the portal site.

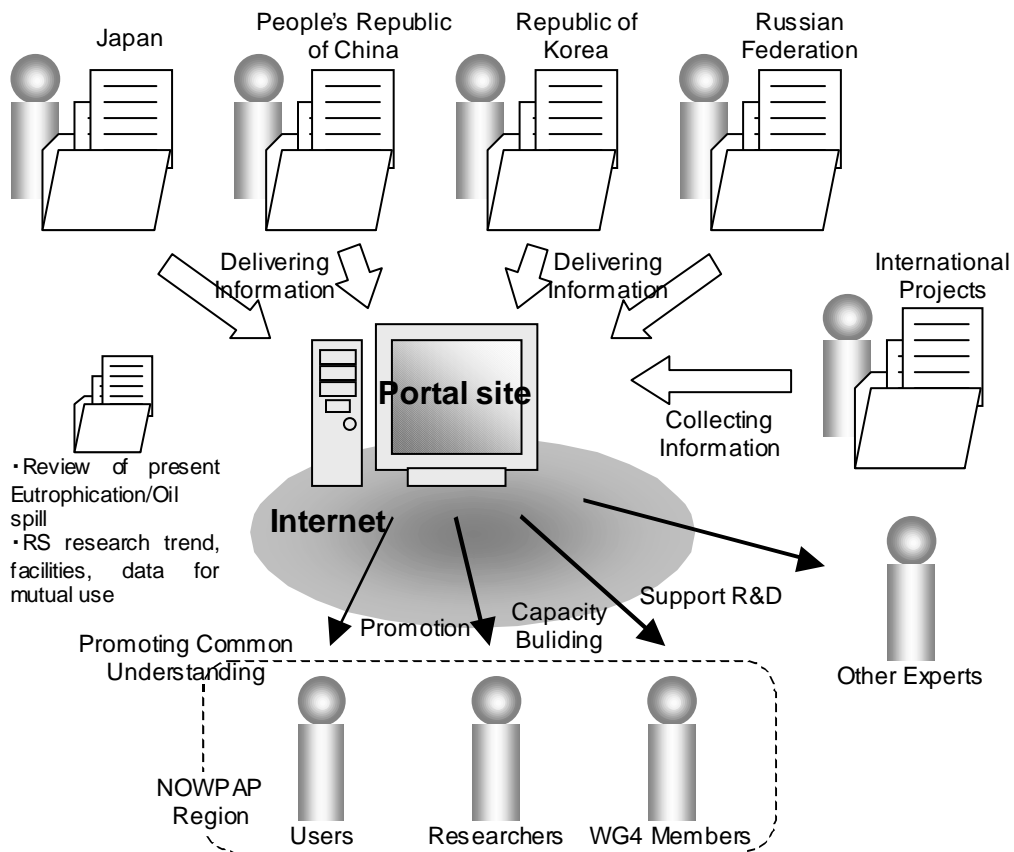


Figure 2 Diagram of portal site

(2) Contents in the portal site

The portal site consists of many website addresses which provides information on marine remote sensing as shown below. The main information sources of the portal site are NOWPAP Members. Each NOWPAP Member will be requested providing website addresses of related information to CEARAC. The information will also be referred from national reports as well as from other regions and projects if necessary. Information is organized and can be searched by items such as sensor, utilization field, or country.

- Specification of available sensors (agency, satellite, operation period, bands, spatial resolution, swath, observing cycle, variables, etc.)
- Information on data and products (specification, how to get, etc.)

- Reference list on monitoring of eutrophication and oil spill (author, presented year, title, source, etc.)
- Utilization examples of monitoring eutrophication and oil spill (organization, objective, monitoring method, results, problems, etc.)
- Research trend (organization/researcher, abstract, etc.)
- List of related organizations
- News (schedule of symposium, workshop sponsored by NOWPAP or other regions and projects, etc.)
- Education materials and publicity materials useful for capacity building

To operate the portal site as an useful tool, the priority would be put on activities such as 1) active supply of information by NOWPAP Members, 2) sufficient collection of information from other regions and projects, 3) providing easy-to-use interface to guarantee reliable free access, and 4) effective publicity by CEARAC website and Newsletter to encourage frequent access by many people in and outside NOWPAP region.

3.4.2 Establishment of Website on Oil Spill Monitoring

(1) Objective of the CEARAC website on oil spill monitoring

Currently there is little information on space-based monitoring of oil pollution of the Northwest Pacific and Okhotsk Sea. Collecting, updating and disseminating this information are the basic and important work for establishing remote sensing monitoring systems for oil spill in the NOWAP region. In order to collect, update and disseminate information on oil pollution by remote sensing, it is necessary to develop a new CEARAC website on oil spill monitoring by remote sensing. The objectives of developing the CEARAC website are as follows:

- (a) Providing statistical data on oil pollution of the Northwest Pacific with a special attention to the coastal areas and to the areas where there are potential sources of oil pollution.
- (b) Providing description of state of art of space-borne and airborne remote sensing techniques of oil pollution detection and monitoring.
- (c) Providing short description of oil behaviour in the marine conditions.

- (d) Providing program for visualization of the trajectory of a pollution spreading using the pollution spreading forecast system.
- (e) Providing information on similar projects in Europe and the United States.

(2) Contributions of the CEARAC website on oil spill monitoring to CEARAC activities

- (a) Providing information on availability of airborne and satellite-borne remote sensing instruments for oil pollution monitoring in China, Japan, Korea and Russia.
- (b) Providing information where and how to obtain the satellite SAR measurements over the particular area in a case of detection of oil pollution due to ship transport operation, fishery activity, river outflow as well as accidents.
- (c) Dissemination of CEARAC activities and results in the community of potential users of remote sensing techniques for marine pollution and in the public organizations.
- (d) Providing links to the environmental information important for oil pollution monitoring/ evolution (wind, currents, weather forecasts, etc.).

(3) Contents of the CEARAC website on oil spill monitoring

It is designed to develop the following sections (pages) in the website:

- Remote sensing techniques of oil pollution detection; comparison of their efficiency; algorithms of interactive and automatic detection of oil spills (Links).
- Updated database of the georeferenced satellite SAR images of the Northwest Pacific.
- Updated database of the annotated georeferenced satellite SAR images of the Northwest Pacific with revealed oil pollution.
- Oil pollution of the Northwest Pacific; main sources of oil pollution; current situation and tendency (search via Internet).
- News (global and regional, tanker incidence, description, pictures, hot satellite images, role of remote sensing, etc.) – mainly via Links.

- Oil pollution spreading models (Links).
- Environmental information important for oil pollution monitoring/evolution (winds, currents, ice, weather forecast) – Links to the Japan, Korea, China and Russia sources of data.
- Influence of oil pollution on marine ecosystems (Links).
- International regulations on marine oil pollution – Links (UNEP)

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 and the website on oil spill monitoring to be developed, CEARAC website is expected to promote active R & D and RS applications.

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.

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.

With regards to training courses, in order to avoid duplicated work, NOWPAP Members should make the best use of existing training courses provided by other regions or organizations that are conducting similar activities. The First WG4 Meeting suggested posting the information about existing training courses and projects provided by other international organizations on the proposed portal site.

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 below.

- (1) **NEAR-GOOS (North-East Asian Regional Global Ocean Observing System).** 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. The accumulated data on marine physics, and the upcoming prediction model of short-term variation may be available for use.
- (2) **COOP (Coastal Ocean Observations Panel).** COOP was established in 1998 to discuss the overall concept of monitoring system in coastal region. COOP guidelines and detailed programmes are of valuable reference.
- (3) **IOCCG (International Ocean Colour Coordinating Group).** 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) **PICES (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. Study results on the estimation method for primary productivity by RS and red tide can be referenced.
- (5) **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, with an approach of 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 benefit.

Besides these projects, CEARAC will consider the possibility to cooperate with European projects on oil spill observation.

3.8 Capability of CEARAC

In order to support CEARAC, in 2002 the Ministry of the Environment of Japan established the Marine Environmental Watch System for Northwest Pacific Region, which is receiving and processing NOAA and FY-1 data and disseminating the data and products such as SST and *chlorophyll-a* on the Internet. NPEC is managing and operating the system. Also, to support CEARAC activities, NPEC is implementing the Toyama Bay Project, a pilot project of which the main objective is to develop algorithms for monitoring the environment in Toyama Bay by means of remote sensing.

3.9 Standardization of National Reports and Integrated Report

CEARAC proposed the Guidelines for National Report. The First WG4 Meeting agreed that each Working Group member would feedback comments and suggestions on the guideline, and CEARAC would revise the guideline by referring to the comments and suggestions. Each NOWPAP Member will prepare a draft of the national report based on the revised guideline by the Second Working Group 4 Meeting. The adequacy of the guideline will be discussed and assessed at the Second Working Group 4 Meeting.

The First WG4 Meeting discussed the draft integrated report provided by CEARAC. The First WG4 Meeting agreed that each Working Group member would feedback comments and suggestions on the report. Following the First WG4 Meeting, CEARAC prepared the Integrated Report of Working Group 4 with minor revision. CEARAC submits this Report to the Second Focal Points Meeting (see UNEP/NOWPAP/CEARAC/FPM 2/10 Annex IX-1).

The First WG4 Meeting agreed that WG4 Members would submit the national report to the Working Group 4 every two years, and also agreed that CEARAC would prepare the integrated report every two years based on the national reports. The Director of CEARAC will submit the integrated report to CEARAC Focal Points Meetings.

3.10 Long-term Plan

The First WG4 Meeting reviewed and revised the draft long-term plan for Working Group 4. Long-term plan is shown in Table 3, through which WG aims to establish the monitoring system of eutrophication and oil spill by RS.

3.11 Proposed Work Plan for 2004/5

The proposed work plan for 2004/5 (Table 4) includes compiling integrated report, convening FPM and WG4 meetings, setting up a portal site and website on oil spill monitoring, disseminating information, and convening workshops. Details are described as follows.

February 2004	CEARAC revises the Draft Integrated Report 2003 by referring to the comments and suggestions from WG4 experts.
15-17 March 2004	The Second FPM CEARAC submits the Draft Integrated Report 2003.
Autumn 2004	The Second WG4 Meeting Each WG4 Member prepares a draft National Report 2004 based on the revised guideline on the national report. The adequacy of the guideline will be discussed and assessed.
Spring 2005	The Third FPM Each WG4 Member submits the National Report 2004.
Summer 2005	CEARAC prepares the Draft Integrated Report 2005.
Autumn 2005	The Third WG4 Meeting The contents of the Draft Integrated Report 2005 will be discussed and assessed.
Spring 2006	The Fourth FPM CEARAC submits the Draft Integrated Report 2005.

Table 3 Long-term plan

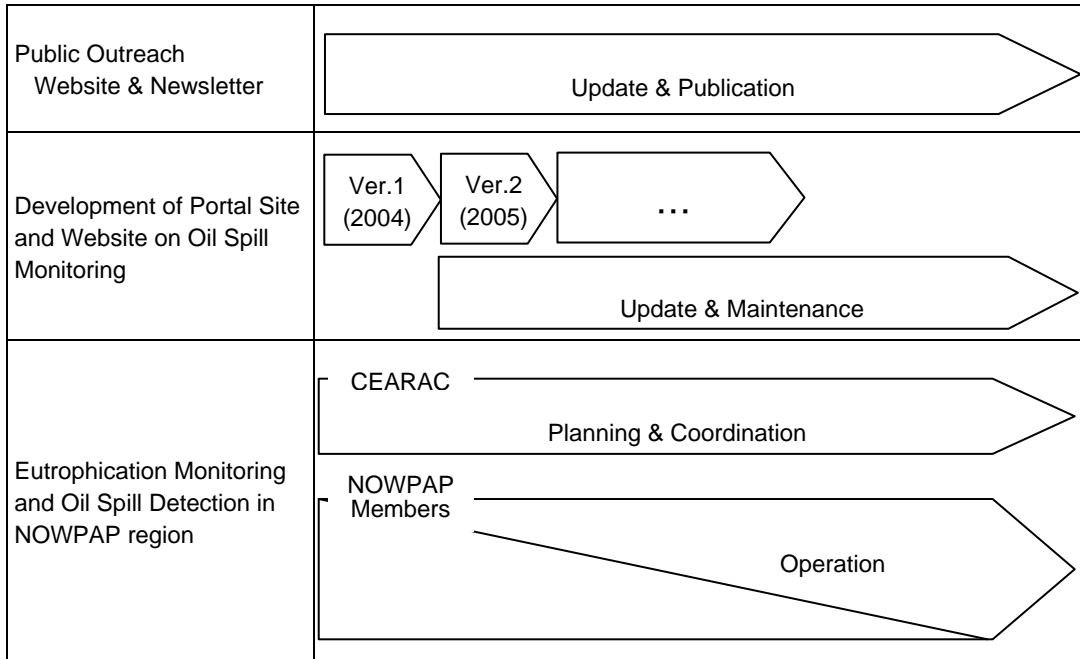
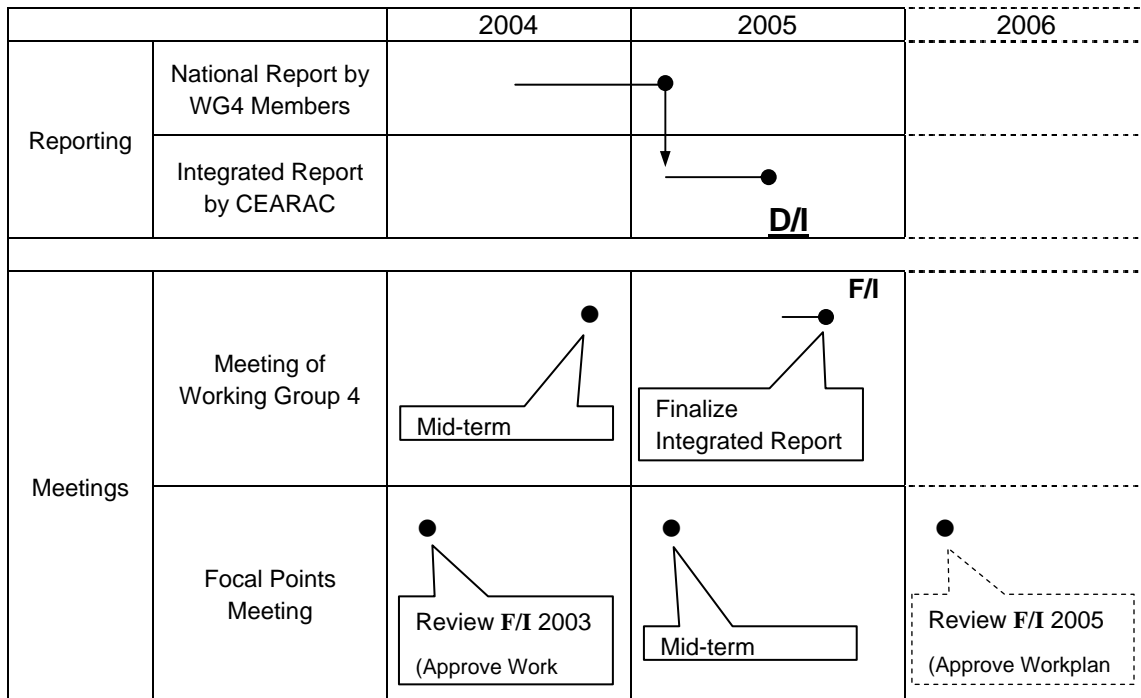


Table 4 Workplan for 2004/2005 (Reporting & Meetings)



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