Introduction
- Remote sensing for the Northeast Asian Seas

Contents
1. Overview of Ocean Satellite Remote Sensing
2. Northeast Asian Sea and Coastal Ocean Observing System
3. Satellite Oceanography for Monitoring Regional Marine Environments

Hiroshi KAWAMURA
Graduate School of Science
Tohoku University

New Satellite Components of
Global Observing System
Operational + R&D Satellite

25-years
- Earth Environmental Problems and Needs of New Observation System
- Earth Observation Satellite Research and development in

Present Status (1)
1. The satellite remote sensing has become mature technology for measurements of ocean parameters in the last decade
   - Continuous data supply
   - Improvement of parameter retrieval skills
   - Increase of experts in the satellite oceanography

2. Experience has clearly demonstrated that space based observations are best when used in conjunction with complementary in situ data.
   - Most of retrieval algorithms tuned against the in situ obs.
   - The global tuning methodologies are well established at the operational meteorological/oceanographic agencies and the satellite agencies.
Present Status (2)

Series of OPERATIONAL and R&D satellite sensors for oceanography has been and will be **functioning more than ten years**

- Altimeter
- Scatterometer
- SST sensor
- Ice sensor
- Ocean Color sensor

El Nino/ La Nina (1997-2000); Sea Surface Height (TOPEX/POSEIDON)

High Resolution Vector Surface Winds (SeaWinds)

January 28, 2003
Microwave Radiometer (AMSR-E)

Wind Speed  SST  Rain Rate
Water Vapor  Cloud

GLI ocean products for the global coastal seas

High-resolution visible/infrared radiometer
1-km spatial resolution, Daily

IGOS Ocean Science Satellites
1. Overview of Ocean Satellite Remote Sensing

**Summary**

1. Increase of space platform (Satellite)
   - (Geostationary and polar orbiters)
2. Increase of satellite sensors for oceanography and marine meteorology
3. Several R&D satellites are planned for further technical improvements
4. Capability of ocean observation is increased drastically by the advanced satellite observing system

2. Northeast Asian Sea and Coastal Ocean Observing System

**The Coastal Zone: Where inputs from land, sea, air and people converge**

Quingdao City seen from the Quindao bay
Global Environment Change and Coastal Zone

**Land Side**
- Population increase
- High economical activities
- Coastal constructions
- Artificial modifications of coastal zone

**Sea Side**
- Global warming
- Sea level rise
- Violent weathers
- Coastal marine ecosystem change

Global warming

**Evidence (Observation)**
- Global surface temperature trend (Anomaly from mean of 1960-1990)

**Prediction**
- Predicted Sea Level Change during 21st Century
  - Mean = 48 cm
  - (From 35 Special Report on Emission Scenarios)

Population of Coastal East Asia 660 Millions

- China Coastal Provinces
  - 460M
    - 梁冬省 (42.4M)
    - 河南省 (90.8M)
    - 江蘇省 (74.4M)
    - 江西省 (16.7M)
    - 浙江省 (46.8M)
    - 福建省 (34.7M)
    - 江西省 (86.4M)
- Hong Kong 6.8M
- Taiwan 22M
- North Korea 24M
- South Korea 47M
- Russia Coast 2.3M
- Japan 120M

All Europe ~500M
All North America ~380M
Night lights in the East Asia

COOP Strategic Design Plan

**SIX GOALS**

1. Improve the safety and efficiency of marine operation
2. More effectively control and mitigate the effects of natural hazards
3. Improve the capacity to detect and predict the effects of global climate change on coastal ecosystems
4. Reduce public health risks
5. More effectively protect and restore healthy ecosystems
6. Restore and sustain living marine resources

Mixed Techniques

- Remote Sensing (Spatially synoptic observations)
- In situ autonomous sensing (High resolution time series)
- Discreet sampling followed by laboratory analysis (for many chemical and biological variables)
2. Northeast Asian Sea and Coastal Ocean Observing System Summary

1. The Asian coastal seas, our living area, face a variety of difficulties, i.e., marine environmental problems, coastal hazards, marine safety, etc.
2. Their threats enhanced by the global changes are transported crossing the national boundaries. (Needs of international cooperation)
3. In order to detect the threats and treat them properly, we need high-resolution information on the present status of oceans. (Regional Ocean Observing System)
4. Coastal applications of the advanced remote sensing are needed to be enhanced

(This training course)

3. Satellite Oceanography for Monitoring Regional Marine Environments

Remote Sensing Requirements
(From WMO/CEOS Database)
**GOOS SST requirements**

<table>
<thead>
<tr>
<th>Use</th>
<th>SST</th>
<th>Spatial Res.</th>
<th>Temporal Res.</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOOS Climate – large Scale</td>
<td>SST-bulk</td>
<td>10km</td>
<td>6h</td>
</tr>
<tr>
<td>GOOS Surface</td>
<td>SST-bulk</td>
<td>1km</td>
<td>6h</td>
</tr>
<tr>
<td>Marine biology (Coastal water)</td>
<td>SST-bulk</td>
<td>1km</td>
<td>24h</td>
</tr>
<tr>
<td>Marine biology (Open ocean)</td>
<td>SST-bulk</td>
<td>10km</td>
<td>24h</td>
</tr>
</tbody>
</table>

All Bulk Sea Surface Temperature

Highest Spatial Resolution: 1km

Highest Temporal Resolution: 6h

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**New Generation SST Ver.1.0 (2001)**

- Geostationary Met. Satellite
  - Hourly Infrared
- AVHRR, VIRS
- Merging by objective analyses
- TMI SST Microwave SST Cloud-free

Cloud-free, High Resolution, Quality-Controlled

5 Km Spatial Resolution, Daily SST Product

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No Gap > Filling All Model Grids
High Resolution > Capture Oceanic Structures
Daily > Capture Their Temporal Variations

Nowcasts and Forecasts of Ocean Short-term Variations (Ocean Weather)
Satellite Observation and Numerical Models (1)

Observing System

- Oceanographic Sensors
- Fluid Ocean
- Iced Sea
- 4-D Primitive Equation Model

Application Areas

- Atmospheric GCM
- Ocean Models
  - Sea-Ice Model
  - Ecosystem Model

Ocean Biology

Satellite Observation and Numerical Models (2)

- SST sensors
- Vector Wind
- Transparency
- Surface Current

Atmospheric GCM

Future Forcing Field

Assimilation

Fluid Ocean

Coastal observing system and numerical models

- Open Ocean Observing System
- Coastal Ocean Observing System
- Atmospheric GCM
- Oceanic GCM
- Ice Model
- Coastal Ocean Physics Model
- Local Atmosphere Model

PHENOMENA

- Natural Hazards
- Atmospheric, Ocean
- Sea Level
- Flooding
- Changes in Ecosystem
- Changes in Human Society
- Climate
- Sea Ice
- Shoreline Change
- Oil Pollution
- Eutrophication

GOOS/COOP, 2003
3. Satellite Oceanography for Monitoring Regional Marine Environments

Summary

1) High-resolution satellite-derived parameters provide new information for the regional sea

2) They can be used for a variety of purposes:
   - Various marine operations (Marine environment, Monitor of marine conditions, Marine safety, Coastal zone managements, etc.)
   - Marine forecasts (Initial conditions and boundary conditions of numerical models)
   - Research and education
   - Etc.

3) In order to enhance the satellite components of the regional ocean observing system, we need well-trained operators in the various fields and young researchers

(This training course)