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Note

A Leading-Edge Operation Program of the East Sea Branch, KORDI

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Abstract : The East Sea Branch (ESB) of KORDI will be launched in 2008. She will take a role of monitoring the sea surface topography and temperature by satellites, short- and long-term sea levels by tide gauges, coastal currents and open-sea circulation by setting up coastal radars and mooring current-meters and acoustic equipments, as well as monitoring nearshore processes, coastal erosion and water pollution. A basic program of coastal zone management will help ocean-policy makers to set up right decisions based upon scientific background of the regional data in the East Sea. Networking among the neighboring countries around the sea will supply more useful information not only for experts but also for ordinary vacationers or fishermen. In order for this program to be successfully settled down during the next decade, it is necessary for a leader to have the right vision to attract more experts from global brain pools and to manage the ESB as a leading-edge observatory in the world. Details about this leading-edge operational program are introduced in the text.

Key words : the East Sea Branch of KORDI, monitoring the sea, leading-edge operation program, networking, coastal zone management

1. Background and Scope

The East Sea is one of the most important marginal seas in the northwestern Pacific not only as the source of various fish resources from warm and cold waters, (even with reduced quota due to the agreement with neighboring countries), but also as the learning field of a miniature ocean in such studies as water circulation with warm and cold currents, front and eddies, upwelling and other coastal phenomena. The beaches along the Korean coasts are more and more attractive as ocean resorts in accordance with the increasingly affluent lifestyes of Korean people.

In order to systematically manage coastal zones, it is necessary to set up a basic program for coastal zone management (CZM): to continuously monitor meteorology, sea-level trends and fluctuations, oceanic and nearshore circulations, coastal erosion and shoreline changes. The concept of CZM in Korea has been focused on 'management' of the object, and hence there has been an erroneous application of, for example, using the global average of sea-level change instead of a local one, with realistic variations, based upon continuous, long-term monitoring and repeated surveying. While the global average of relative sea-level (RSL) change is +1 mm to +2 mm/year, it reaches down to −10 mm/year due to tectonic rise of land in the Scandinavian Peninsula and reversely up to more than +6 mm/year due to subsidence of land such as Galveston, U.S.A., and Miyako, Japan (Barnett 1984). There is no doubt that it causes serious problems to use the global average as the reference of the CZM in Korea. An integrated CZM needs, first of all, direct and indirect current measurements as well as long-term tide-gauge data, shoreline monitoring and coastal erosion modeling both in short- and long-time scales, and modeling of water and heat exchanges between nearshore and open-sea regions and between sea and atmosphere, respectively.

There is a need for beach profile models which simulate shoreline change with forcings in different time scales such as waves, nearshore currents, sea-level fluctuations, and long-term sea-level rise. Previous models are either short-term models with wave forcing or long-term models modified from Bruun's concept. There is also a need for a

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coastal monitoring system which measures waves and nearshore currents and estimates the sediment transport in a proper way.

The East Korean Warm Current (EKWC), a branch of the Tsushima Warm Current (TWC) passing the western channel of the Korean Strait, influences the surface circulation primarily in the Ulleung Basin, and eventually in the whole basin of the East Sea. The meso-scale eddies, warm ones by the EKWC and cold ones by the North Korean Cold Current (NKCC), form natural fish nets mostly along the subpolar front. Local upwelling frequently occurs along the southeastern coasts of Korea in summer, which supplies not only nutrient-rich subsurface water to the local fishing ground but also causes severe traffic problem due to sea fog, especially during persistent southerly winds. Waters along the subpolar front, separated from the Korean coasts with meanders and meso-scale eddies, eventually escape through the Tsugaru and Soya Straits, the general surface circulation in the East Sea (Fig. 1).

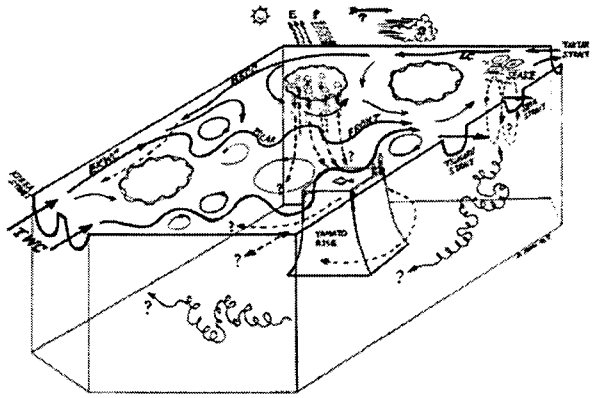

Fig. 1. Schematic diagram of the East Sea circulation (Jeon 1996).

The East Sea Branch (ESB) of KORDI will take the role of monitoring sea level and coastal erosion/shoreline changes and oceanic pollution, and will show the real-time variability of the sea state in areas such as waves and surface currents-- not only for oceanographers, but also for fishermen and ordinary citizens. This will be accomplished by constructing such a leading-edge survey system. This program will also provide basic evidence about nearshore currents and sediment transport for policy-making of CZM, especially along the beach resorts in the East Sea.

2. Contents of the program

Satellite data receiving system

A satellite receiving system will be set up for SST image data (AVHRR) from NOAA at the East Sea Branch of KORDI in Uljin (Fig. 2). Sea surface height (SSH) and synthetic aperture radar (SAR) data will also be processed to figure out the regional and the basin-scale waves, currents and circulation, and sea surface state of the East Sea. The data center will distribute the processed data to both domestic and foreign experts in neighboring countries. Annual or biannual scientific meeting based on a concrete

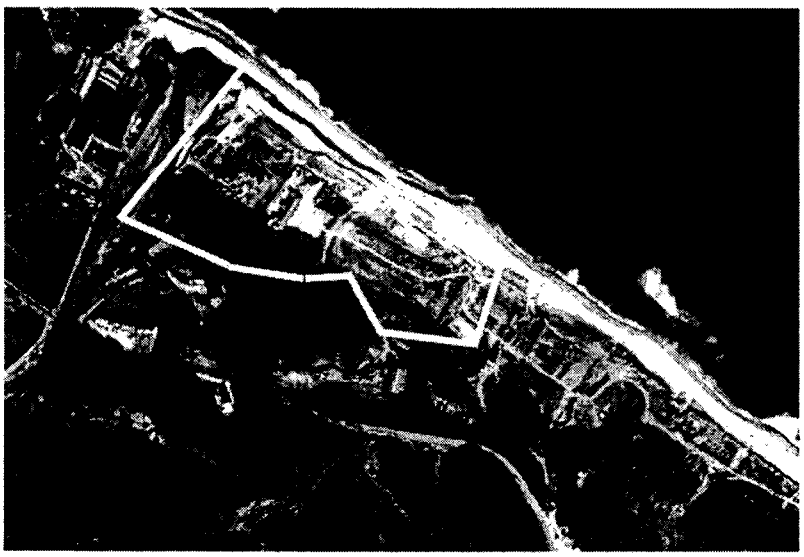

Fig. 2. Satellite image around the site (inside the yellow polygon) for the East Sea Branch, KORDI.

network among the neighboring countries will be the milestone of the operational program of the ESB of KORDI.

Beach erosion/shoreline changes

Beach erosion and shoreline changes could be monitored by the following methods:

a) surveying nearshore currents and sediment transport by mooring wave-tide gauges, current-meters, and sediment traps at the coastal zones and at the beaches.

b) taking aerial photographs (Fig. 3) and high spatial-resolution satellite data regularly and video monitoring continuously at the main beaches along the Korean coasts; the control center at the ESB of KORDI will synthetically monitor and warn of any potentially disastrous or catastrophic situations.

c) simulating beach erosion and shoreline change: a combined model applicable for both short- and long-time scales should be developed and tested for forecasting the status of the main beaches. Beach nourishment processes should be also monitored at the main beaches for making them more favorable resorts.

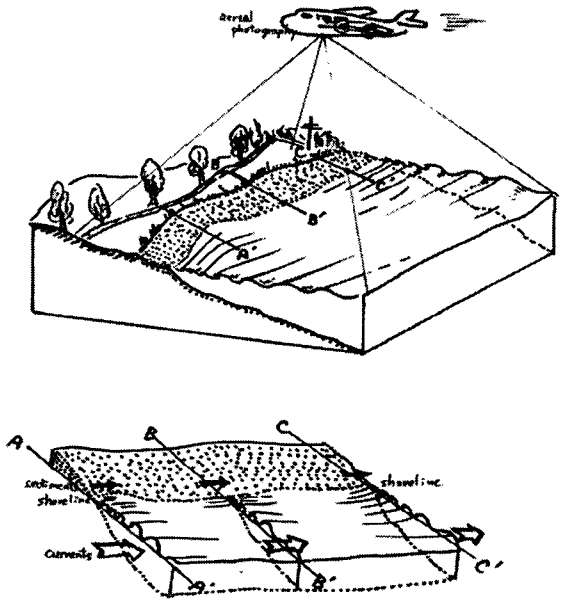

Fig. 3. Conceptual aerial photography (upper) and sediment budget of longshore transport monitoring (lower) at a beach along the east coasts of Korea.

Autonomous glider and platform

A pier from the beach to the offshore, horizontally about 250 meters long and vertically less than 10 meters deep, and a submerged laboratory with a platform (Fig. 4) are constructed at the end of the pier to operate and remotely control an autonomous glider (Fig. 5) for monitoring the interior of the sea. It is operated for monitoring the Ulleung Basin, cross-section between the laboratory and Ulleung-do/Dok-do, and is to be expanded later for monitoring the entire East Sea.

CODAR (HF coastal radar) system

The HF radar system at the coastal station is the most economic and robust method to continuously measure surface currents of the coastal sea.

At first, there will be three stations with a transmitting antenna and a receiving antenna unit along the east coast of Korea, and the logged data at each station will be sent to the central station at the ESB of KORDI where the collected data are processed and analyzed (Figs. 6 & 7). Surface currents may be covered about 100 km away from the coasts.

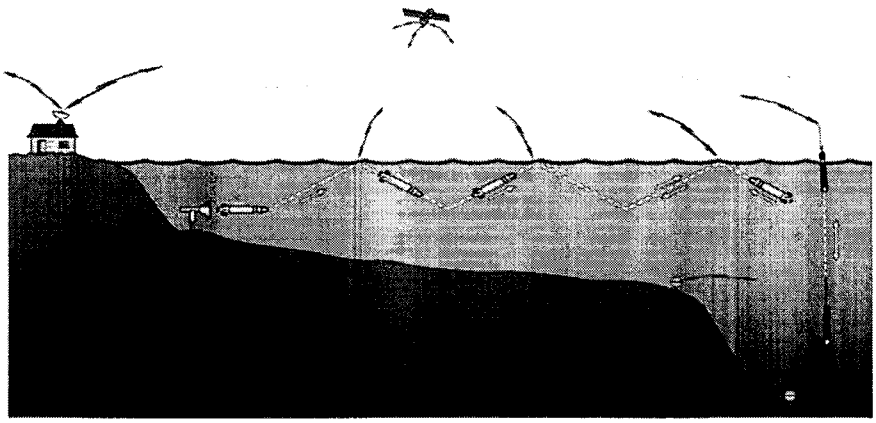

Fig. 4. The operation concept of an autonomous vehicle launched from the coastal platform controlled at the laboratory and the autonomous lagrangian float drifted in the open sea by WHOI.

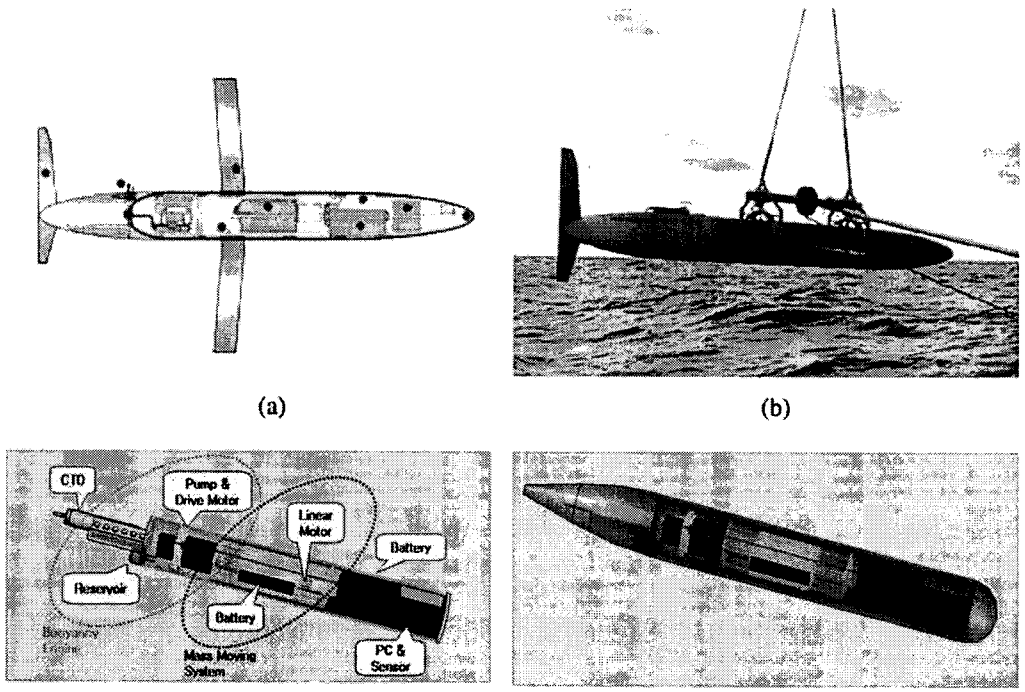

Fig. 5. (a) Structure of Spray Glider made by WHOI team (length = 2 m, width = 1.2 m, weight = 51 kg) (upper left), (b) real shape when launching Spray Glider off Nanticket Island from R/V Cape Hatterason (upper right), and (c) an underwater glider (AUV) designed by KORDI (length =1.8 m, diameter = 0.2 m, weight = 48 kg, operation depth = 200 m/1000 m, horizontal velocity = 0.25 m/s, operation time = 30 days, buoyancy-controlled, CTD/GPS/inclinometer) (lower left & right).

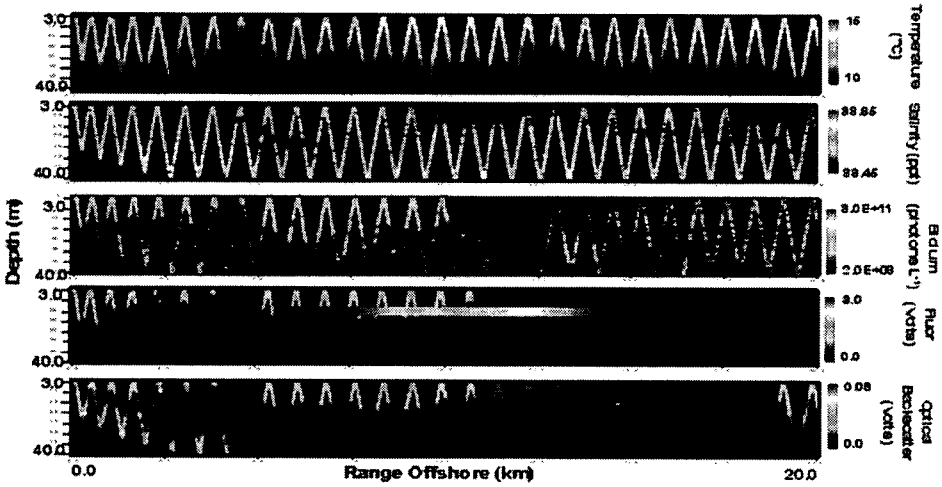

Fig. 6. An example of the profiles of temperature, salinity, bioluminescence, fluorescence, and optical back-scattering measured by Spay Glider, WHOI.

Subsurface monitoring observatory

The coastal observatory has another component, a subsurface monitoring basement (undersea node), which is connected with underground cables from the laboratory down to the depth of about 30 meters. The basic connections at the basement may include CTD, wave/tide gauge,

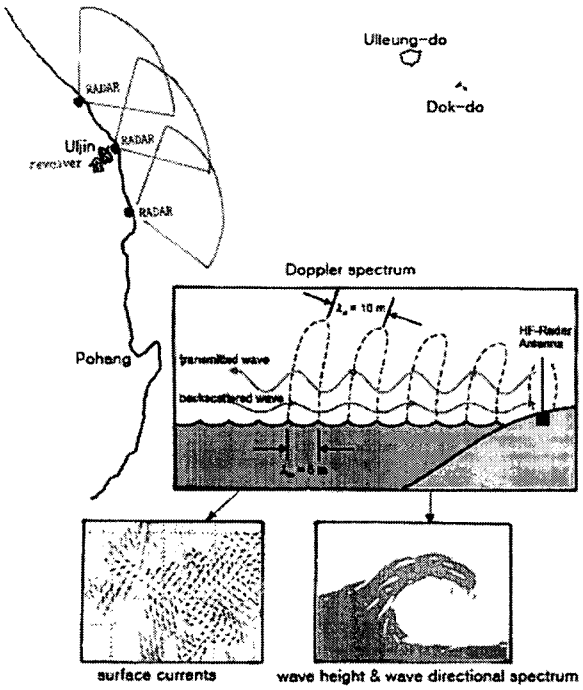

Fig. 7. Schematic diagram of the CODAR (HF radar) system designed along the east coasts of Korea (upper left). The principle of Doppler effect of the wave spectrum (middle), the estimated surface current field (lower left), and the wave directional spectrum (lower right).

current-meters, turbidity sensor, and other biogeochemical sensors. Unlike the WHOI's design (Fig. 8), there will be only one undersea node at the ESB of KORDI due to heavy fishing activities and the burdens of maintenance. The basement is extended about 1km longer from the end of the pier.

Data buoys

Mooring data buoys are often vulnerable because of heavy fishing activities, typhoons and storm waves, accidents by traffic and so on, especially around the coastal regions of the East Sea. The cross-section between Uljin and Ulleung-do is very important for monitoring the EKWC and meso-scale eddies in the Ulleung Basin. Three data-buoy stations are to be operated for measuring surface currents and temperature/salinity, and two temporary mooring arrays are given trials between Uljin and Ulleung-do for acoustic tomography (Fig. 9).

3. Concluding remarks

The East Sea Branch of KORDI will be established at the middle location of the east Korean coasts in 2008. She will be the central institute for studying the East Sea by setting up and operating the leading-edge oceanographic program monitoring the surface and interior of the sea, mostly in a real-time basis. However, in order for her to established as a prospective institution, a subsidiary exchange program between domestic and foreign experts to fill the manpower needs of the ESB of KORDI and networking around the neighboring countries should be successfully activated. An annual or biannual workshop will be the first step of the subsidiary program toward realizing the vision of the ESB of KORDI for the oceanographic study of the East Sea. The institute will also contribute to the

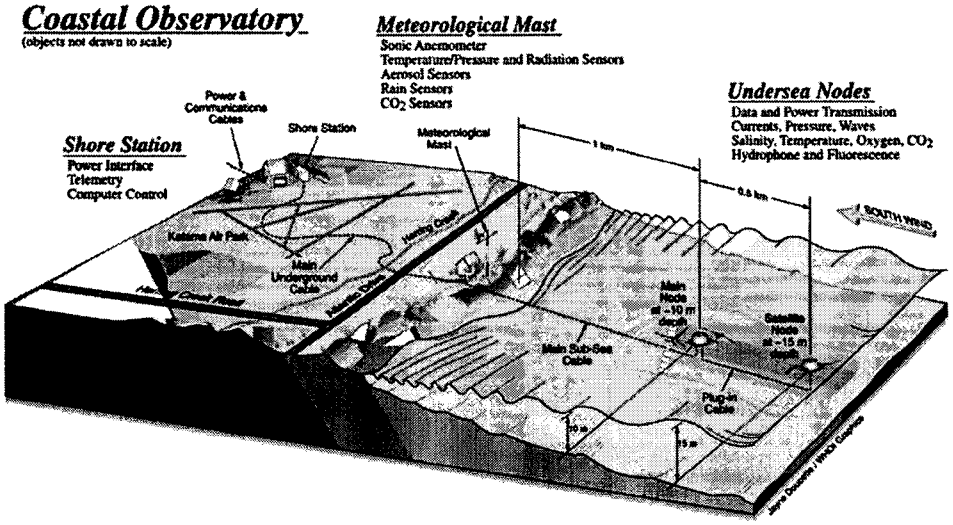

Fig. 8. Martha's Vineyard Coastal Observatory, WHOI.

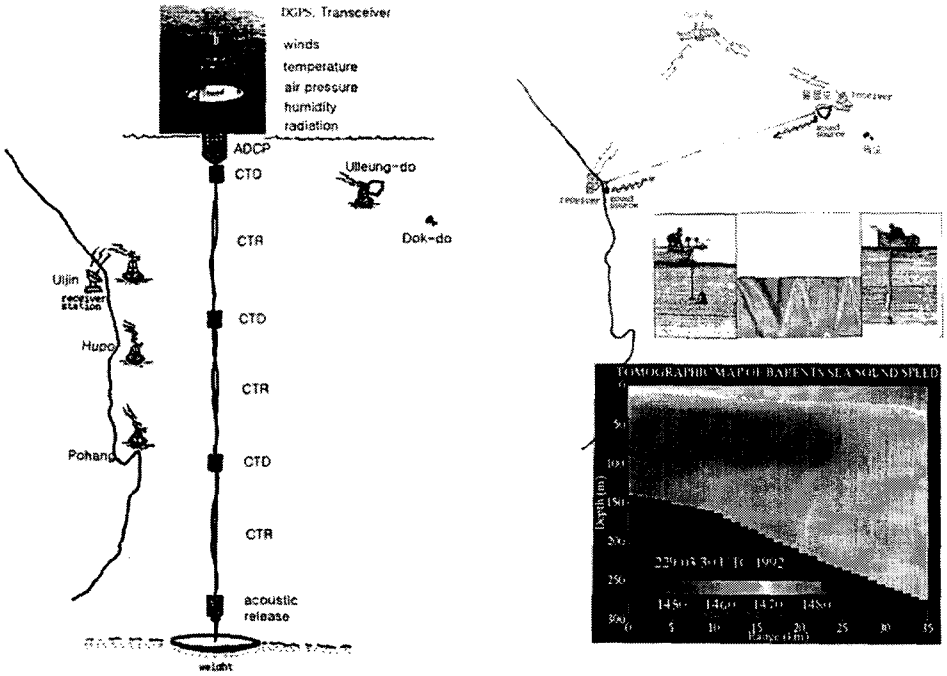

Fig. 9. Three mooring stations with the shape of the line along the east coasts (left) and two experimental arrays transceiving acoustic signals each other between Uljin and Ulleung-do (right).

regional and national economy by connecting the scientific results with the future ocean industry.

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