2016 Global Ocean Expedition

2014. 09. 01

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KIOST
PIioneer (Pacific-Indian Ocean Network Establishment for Environmental Research)

Maiden Voyage
June ~ Dec 2016

W. Pacific
C. Pacific
E. Pacific
S. Atlantic

S.C. SEA
Indonesia
W. INDIAN
E. INDIAN
## Pacific Ocean Network

| W.Pac  | • NPIW Variability in the region of Kuroshio Extension ~ Oyashio NPIW  
|        | • Bifurcation of NEC and Transport variability of Mindanao Current  
|        | • Ocean Acidification Monitoring at the Chuuk Lagoon |
| C.Pac  | • CP-El Nino & Typhoon Monitoring  
|        | • Equatorial Current System and Biogeochemical Flux Variability |
| E.Pac  | • E. Boundary Current System  
|        | • Disappearance of EUC & Kelvin & Rossby Wave Dynamics  
|        | • El Nino and Costal Upwelling |
Underwater Glider Mission

**W.Pac**
- NEC Section (20N ~ 10N)
- ITF Section
- TAO 165E line (8N ~ 8S)

**S.Atlantic**
- Punta ~ Cape Town in S. Atlantic
- Around S. Africa

**Indian**
- RAMA Section in Indian Ocean
- Sumatra and Java Section (Eq. Jets)
Indian Ocean Network

**E. Ind**
- Variability of the *Equatorial Jet* with respect to the monsoons
- *Tsunami and coastal inundation* Monitoring
- Propagation of *Eq. Kelvin Waves* and Coastal Upwelling

**W. Ind**
- Mid-Ocean Ridge and *Hydrothermal Vents*
- Transport through *Mozambique Channel* and I.O. Circulation

**ITF/SCS**
- Indonesian Throughflow
- *Mixing* Processes and *Upwelling/Downwelling*
- *IOD* and *El Nino* Dynamics
GOE: Voyage & KIOST’s Vision

KIOST’s Function

- Ocean Policy, Improving Technical System
- Overseas Bases, Ocean Infrastructures
- Collaboration with Domestic Universities, Ocean Industries
- Pre-proposals for Global Ocean Expedition
- Planning for Maiden Voyage Testing R/V’s Capability
- Collaborative Planning with International Research Programs
<table>
<thead>
<tr>
<th>Region</th>
<th>Number of R/V’s</th>
<th>Details</th>
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<tbody>
<tr>
<td>USA</td>
<td>5 R/V’s</td>
<td>• 5 R/V’s including Bruce C. Heezen (&gt; 4.7K tons)</td>
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| Japan    | 5 R/V’s         | • Mirai (~8.6K), Chikyu (57K), Shirase (11K)  
• Pacific & Indian Oceans, Arctic Sea |
| China    | 5 R/V’s         | • 5 R/V’s including Dayang-1 (> 5K tons)  
• Geology and Ocean Resources Research |
| EU       | 6 R/V’s         | • France (2), Germany (2), UK (2) (> 5K tons)  
• New Discovery(NOC/UK), R/V SONNE II (AWI/Germany) |
Domestic Status

**Araon**
- 6,900 ton ice-breaker to research the role of polar system and the influence on global climate
- independent research at frozen regions both in Arctic and Antarctic
- support for both in Arctic and Antarctic bases

**Onnuri**
- Deep-sea ore expedition both in Pacific and Indian Oceans (with 1,500 tons R/V)
- Ocean Circulation and Climate Study in the Western Pacific

**KNRV-5000**
- Implementation Planning for building-up and making up a schedule of KNRV-5,000 for the next few decades
History to build up KNRV

- 2008.12: pre-planning of KNRV
- 2010.04: task team to build up KNRV
- 2010.11: completing basic design of KNRV
- 2011.12: getting budget to build up KNRV
- 2012.12: contracting to build up KNRV
- 2013.09: getting an ownership of KNRV by KIOST
- 2014.03: implementing design of KNRV
- 2014.04: assessing the implementing design of KNRV
- 2014.04: starting to build up KNRV
- 2015.04: launching KNRV (planned)
- 2015.12: getting delivered KNRV (planned)
- 2015.12~2016.06: deep-sea testing of KNRV (planned)

Overall schedule to build up KNRV

- First voyage in June 2016 (~Dec. 2016)
- Length = 100m, Weight = 5,900 tons equipped with 40 or more surveying sensors/equipment
- Cruising for 60 days with max. 60 personnel
Final Goals

Planning/Evaluating Research Proposals using KNRV-5,000

Planning Maiden Voyage

Long-term Global Research Program
Contents

I. Planning the Maiden Voyage

✓ Making a complete Scenario with Existing Projects
✓ Proposing Regional Anchorage Pt.s for cruising and testing KNRV

II. Planning/Evaluating long-term research proposals

✓ Planning Global Programs to solve recent ocean research issues (climate change, biodiversity, ocean acidification, hydrothermal vents, etc.) and National Agenda
✓ Planning Global Programs to connect with KIOST’s overseas’ Bases (NOAA, PML, FIO, FMS, IMARRPE, etc.)
✓ Joining International Joint program
✓ Collaborating Domestic Universities, Ocean Industries
✓ National R&D projects
Pacific Program

- **PETS** (trans-Pacific Eq. Teleconnection Study)
  - W.Pac ↔ C.Pac ↔ E.Pac

- WBC/WBUC ↔ NEC/NEUC/STCC
  - NEUC/STCC in E. Pac? Disappear?

- Disappearance of EUC at E.P. coastal region
  - El Nino & Coastal Upwelling

- Ocean Acidification

- Air-Sea Biogeochemical (e.g., CO₂) Fluxes

- Spreading Path of NPIW
Time series of the Zonal Currents in the NW. Pacific
(Oct. 2007 ~ May 2014)
Surface Drifter Tracks (May 16 ~ Sept. 30)
The movement of surface drifters indicates that the eastward flowing STCC is maintained by the interaction between rotating eddies and the primary eastward flow, which forms a zonal-band with meandering-pattern.
The mechanism persisting the STCC centered at around 18°N is summarized as

- The increasing and decreasing trends of SSH are strengthened around 16°-18°N and 19°-21°N, respectively, and then the southern STCC flowing eastward due to the gradients of SSH are basically stronger.
- The variation of the southern STCC gradually changes from seasonal into annual event.
- The anticyclonic and the cyclonic eddies appear to be around 17.5° and 20.5°N, respectively.
- The rotation of the eddies contribute to eastward flowing of the STCC to generate the meandering structure of the STCC
Surface Drifter Tracks from 165E (5N~7N)  
(June2 ~ Sept.30, 2014)
Cs-137 has been dispersed southward beneath the depths of Kuroshio (from Aug. 2012 ~ March 2013)
Indian Ocean Program

- **IIOE-2** (International Indian Ocean Expedition)
  
  W. Ind ↔ E. Ind

- Equatorial (Wyrtki) Jets
- ITF & Coastal Upwelling
- Transports by ITF and through Mozambique Channel
- IOD & ENSO (RAMA Network)
- Tsunamis & Coastal Hazards
RAMA in Indian Ocean

Research Moored Array for African–Asian–Australian Monsoon Analysis and Prediction (RAMA)

- Surface Mooring
- Flux Reference Site
- ADCP
- Deep Ocean

Solid = existing, open = planned

Japan (2000)
India (2000)
USA/India (2004)
USA/Indonesia (2006)
USA/France (2007)
China/Indonesia (2007)
USA/ASCLME (2008)
ITF Program

- **TIPEX** (Tropical Indo-Pacific water transport and ecosystem monitoring Experiment)
  E. Ind $\longleftrightarrow$ W. Pac

- ITF (Indonesian Through-Flow)
- SCSTF (SCS Through-Flow)
- MC/NGCC/NGCUC from W. Pac
- Mixing Processes & Vertical Heat Flux
- Coral Triangle & Biodiversity
A= B + C

The imbalance of the westward flow [Mindanao-xx] and eastward flow [xx-Halmahera] marks the feed of tropical Pacific Water into Makassar Strait and Maluku Sea.
NEC Bifurcation & LLWBC

Mean sea surface height field (cm)

Surface-drifter trajectories

for 2005 (black lines). The green dot is the deployment point in 2005. The red dot is the last point in the 2005 within the map domain. The red drifter tracks are the 2005 drifter tracks shown on the map that fall within the map domain in 2006.

Western boundary surface flow
Mindanao Current along the Philippine coasts

JAMSTEC ADCP section across the Mindanao Current at 7N in September 2011
CPIES array and topography map. Squares show proposed positions of the CPIES. Contour. JAMSTEC moorings are shown as red + symbols. Jason-1/2 altimetry tracks are shown as dots.

Meridional mean velocity during 1/1/2007-6/30/2012 from HYCOM output.
The tracks of Araon
Call for Pre-proposals with KNRV-5000

- Origin of Typhoon and Variability of CP-El Nino in the W. Pacific (≈ 165E)
- Monitoring of CO$_2$ flux at the Chuuk Lagoon
- Coastal Upwelling and its Impact on Fisheries Resources in the E. Eq. Current System
- Mindanao Current and ITF Transport Variability
- Dispersion Characteristics of Radioactive Materials with sinking and spreading of NPIW
- ITF and Biodiversity in the Coral Triangle