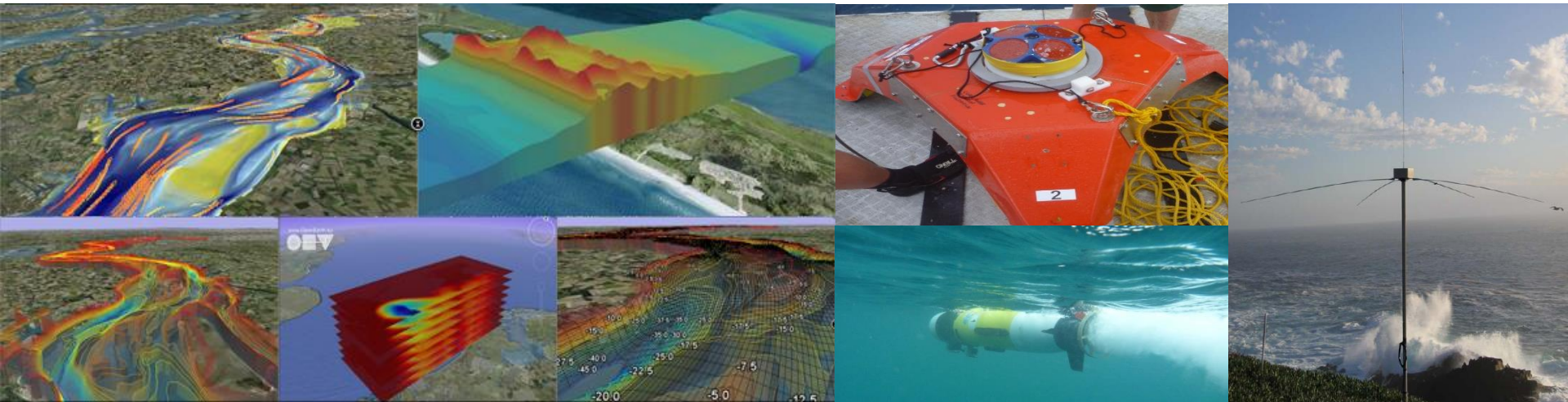
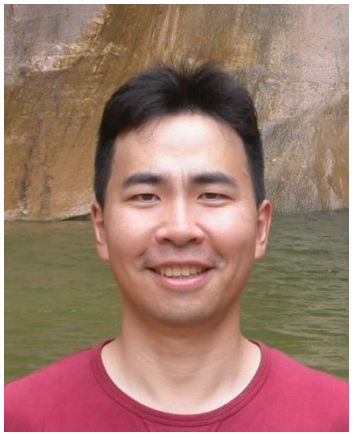
# Integrated Marine Physical Coastal Ocean Observing Laboratory (IMCOOL)

Sung Yong Kim

Division of Ocean Systems Engineering
School of Mechanical, Aerospace & Systems Engineering
Korea Advanced Institute of Science and Technology (KAIST)



# IMCOOL @ KAIST



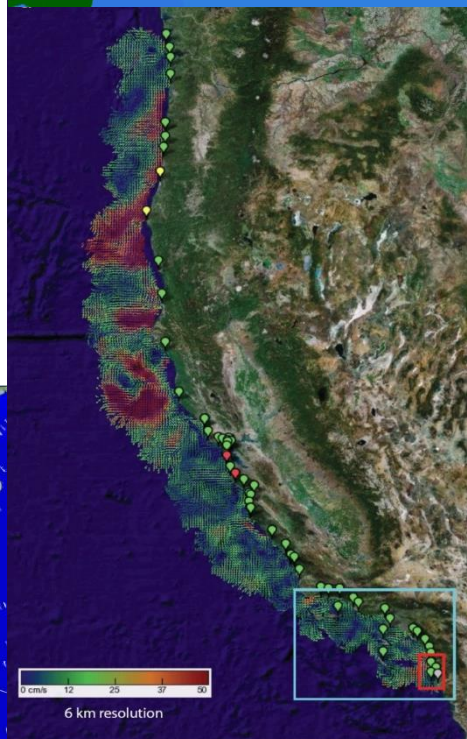
- Prof. Sung Yong Kim (김 성용)
- Education
  - Ph.D. in Oceanography, Scripps Institution of Oceanography (SIO)/UC San Diego (2009)
  - B.S. in Naval Architecture and Ocean Engineering, Seoul National University (1999)
- Research Interests
  - Coastal oceanography and environmental hydrodynamic models (ROMS, MITgcm, Delft3d)
  - Ocean sensing using acoustic and electromagnetic sensors
  - Ocean big data analysis and mining
  - Air-sea and air-sea-land interactions
  - Mesoscale and submesoscale eddies
- Lab: http://imcool.kaist.ac.kr
- Email: syongkim@kaist.ac.kr

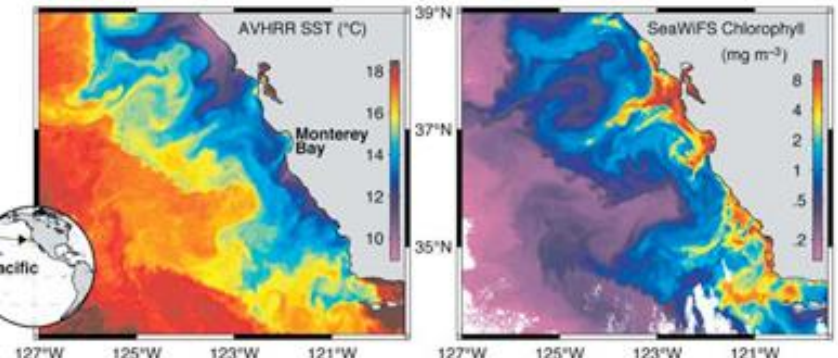
# Research themes

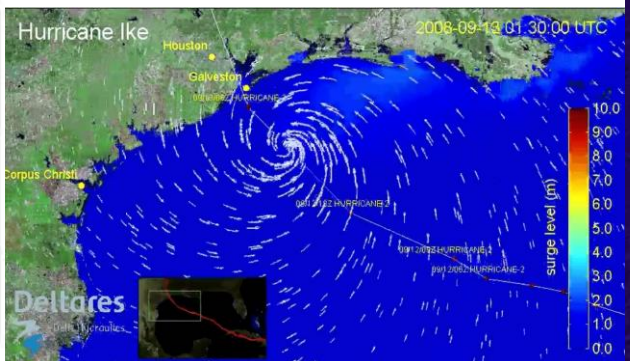
- Coastal Circulation Study
- Ocean Sensing
- Ocean Big Data
- Air-sea-land Interactions

# Coastal Circulation Study

- Coastal oceanography
- Bio-physical interactions (Red tide, Jelly fish)
- Numerical simulations (ROMS, MITgcm, Delft3d)
- Extreme events and disaster (oil spill, tsunami, garbage patch)

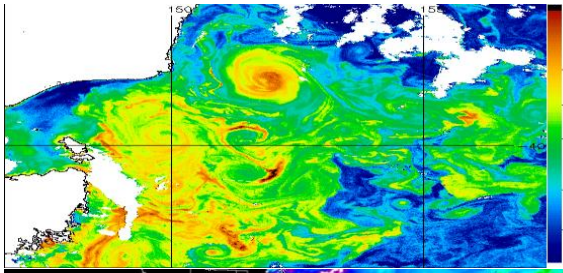



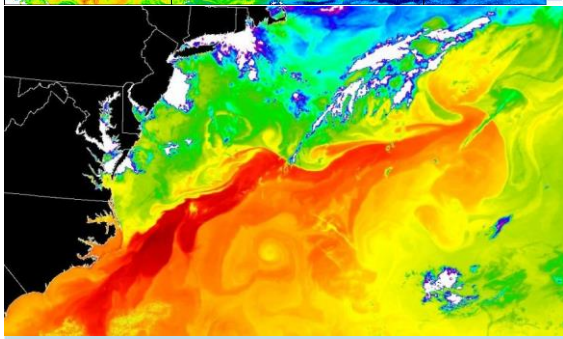



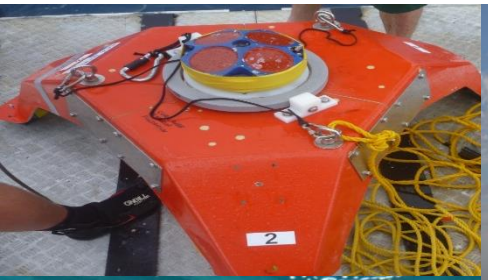



# Ocean Sensing

- Instrument development and fab
- Using acoustic/electromagnetic sensors
- Data QA/QC
- Field observations
- Integrated Coastal Ocean Observing System

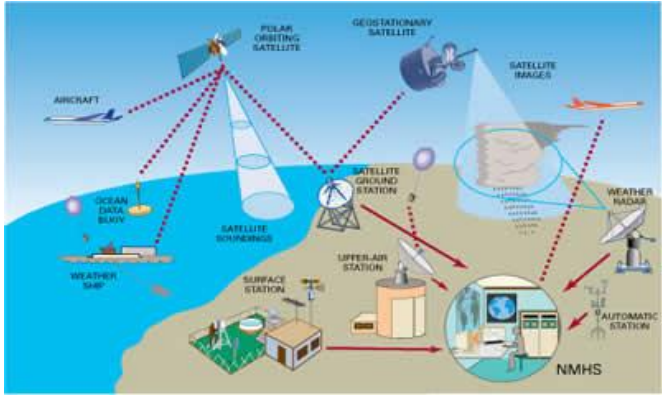


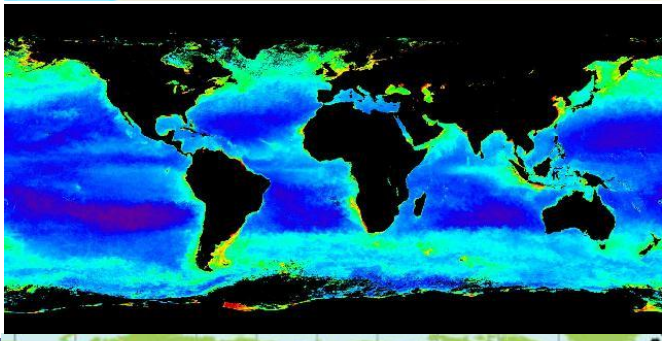


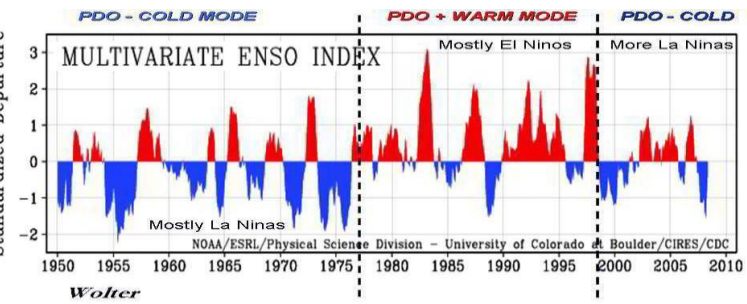



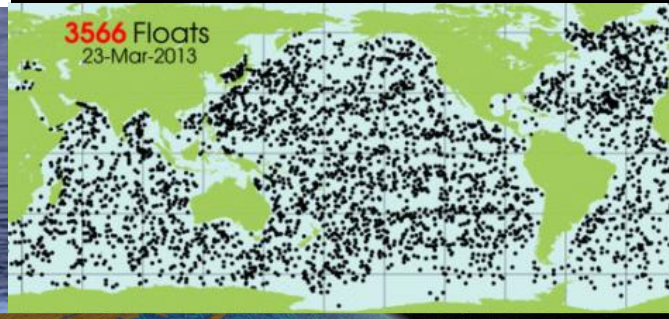
# Ocean Big Data

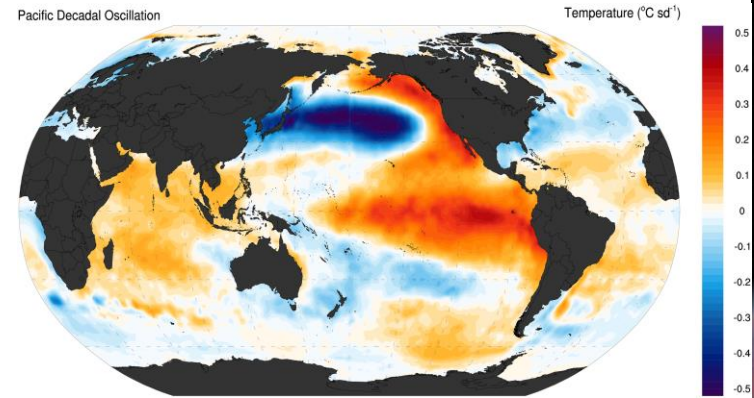
- Mining and integration of ocean big data
- Data-driven forecast model
- Climate index development



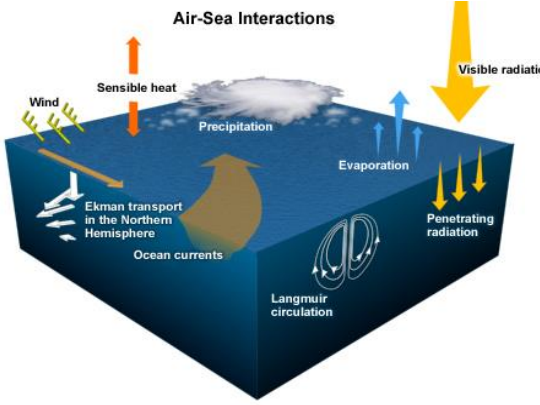


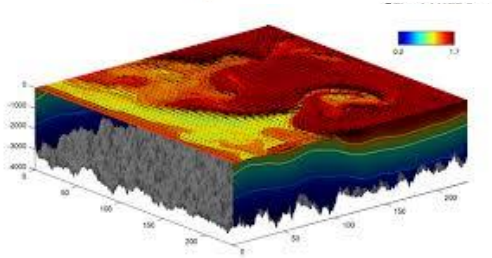



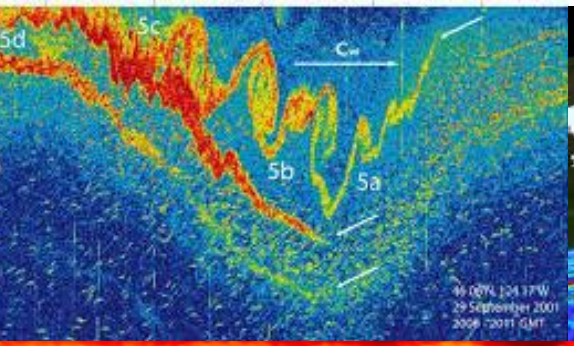



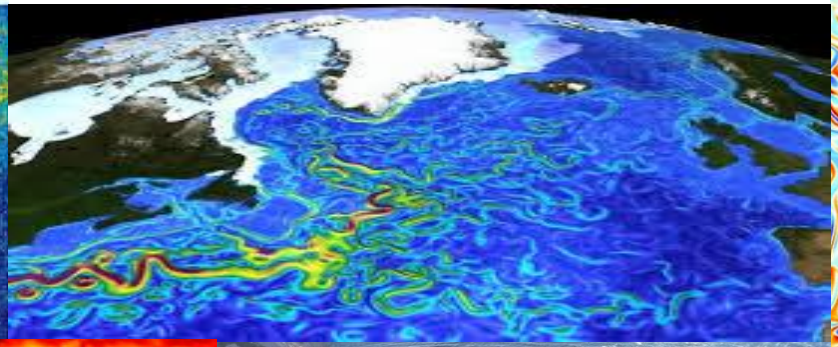

# Air-sea-land Interactions

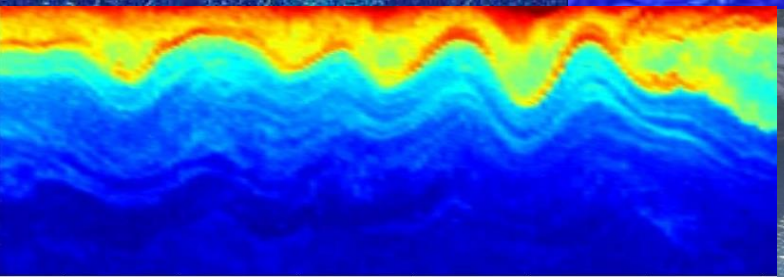
- Submesoscale front and eddies
- Internal waves
- Oceanic energy budget

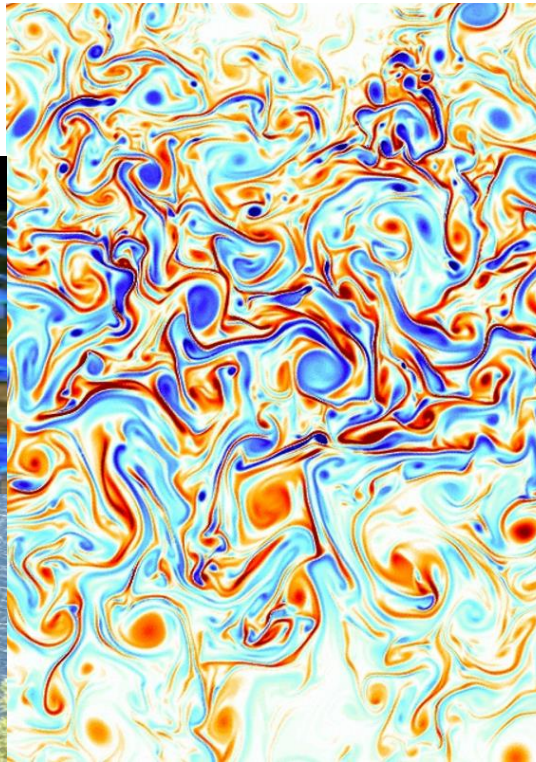




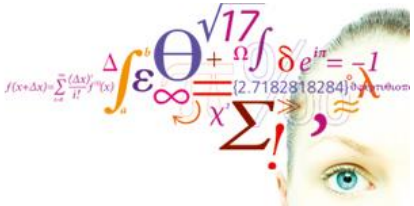




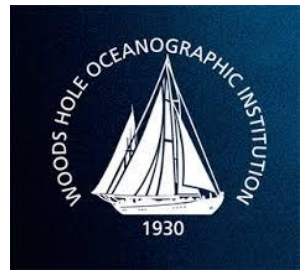
# Collaboration

- Domestic
  - Government-funded research institutions and major national universities in Korea
  - Major heavy industries
- Foreign institutions, universities, and industries
  - Scripps Institution of Oceanography
  - Oregon State University
  - MIT/Woods Hole Oceanographic Institution
  - University of Hawaii
  - DTU (Technical University of Denmark)
  - British Petroleum









# Awards & Research Spotlights

- Young Frontier Research Scientists Award, The Korean Academy of Science and Technology (한국과학기술 한림원)| 2013
- AGU EOS Research Spotlight | 2011 2013
- AGU Editors' Highlight | 2011

EOS

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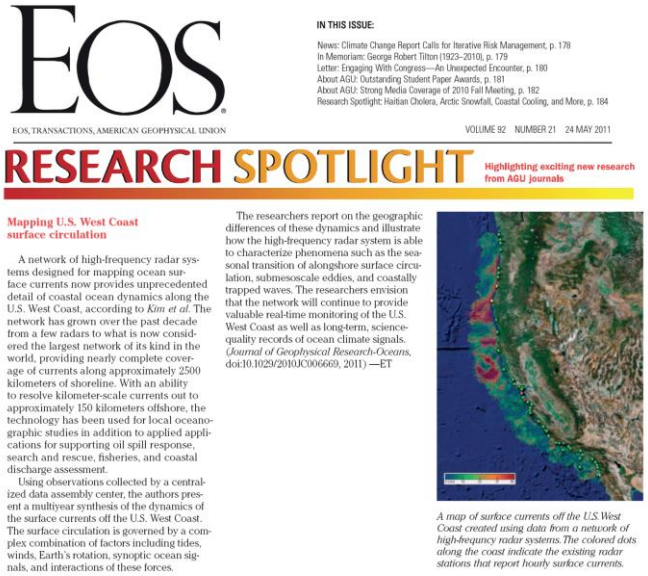
RESEARCH SPOTLIGHT

Highlighting exciting new research from AGU Journals

**Coastal radar observations reveal complex surface circulations**

The behavior of nearshore ocean surface currents has important effects on the coastal ecosystem, with the alongshore propagating waves helping transport marine organisms and affecting how nutrients, salt, and heat are distributed. Using a network of 61 high-frequency radar stations off the U.S. West Coast, *Kim et al.* got a detailed look at the motion of the coastal ocean. They found that there are essentially two distinct sets of poleward propagating waves driving the nearshore flow.

Using the coastal radar observations, along with a simplified ocean circulation model and surface wind measurements, the authors determined that one set of waves moves northward at 100 to 300 kilometers per day, while the second set travels northward at around 10 kilometers per day. In agreement with previous studies, the authors concluded that the higher speed signals are likely coastally trapped waves. The cause of the slower speed signals, however, is less certain. The authors suggest that the slower signals may be the scattered or reflected remnants of the faster waves, or they may be caused by nearshore advection or pressure gradients. (*Journal of Geophysical Research-Oceans*, doi:10.1002/jgrc.20400, 2013) —CS



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RESEARCH SPOTLIGHT

Highlighting exciting new research from AGU Journals

**Mapping U.S. West Coast surface circulation**

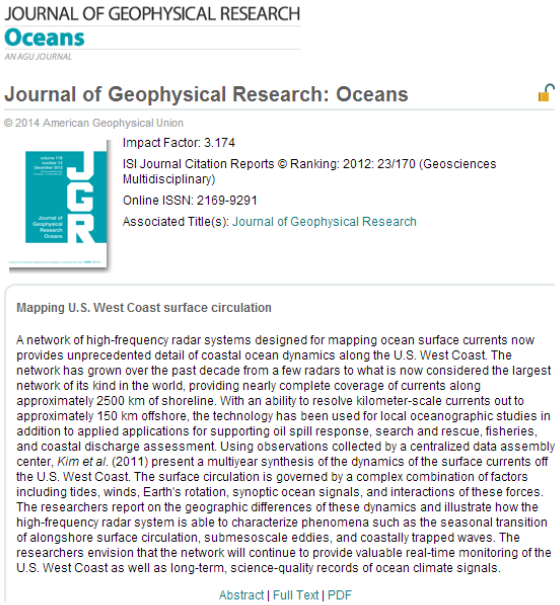
A network of high-frequency radar systems designed for mapping ocean surface currents now provides unprecedented detail of coastal ocean dynamics along the U.S. West Coast, according to *Kim et al.* The network has grown over the past decade from a few radars to what is now considered the largest network of its kind in the world, providing nearly complete coverage of currents along approximately 2500 kilometers of shoreline. With an ability to resolve kilometer-scale currents out to approximately 150 kilometers offshore, the technology has been used for local oceanographic studies in addition to applied applications for supporting oil spill response, search and rescue, fisheries, and coastal discharge assessment.

Using observations collected by a centralized data assembly center, the authors present a multiyear synthesis of the dynamics of the surface currents off the U.S. West Coast. The surface circulation is governed by a complex combination of factors including tides, winds, Earth's rotation, synoptic ocean signals, and interactions of these forces.

The researchers report on the geographic differences of these dynamics and illustrate how the high-frequency radar system is able to characterize phenomena such as the seasonal transition of alongshore surface circulation, submesoscale eddies, and coastally trapped waves. The researchers envision that the network will continue to provide valuable real-time monitoring of the U.S. West Coast as well as long-term, science-quality records of ocean climate signals. (*Journal of Geophysical Research-Oceans*, doi:10.1029/2010JC006669, 2011) —ET



*A map of surface currents off the U.S. West Coast created using data from a network of high-frequency radar systems. The colored dots along the coast indicate the existing radar stations that report hourly surface currents.*



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Abstract | Full Text | PDF

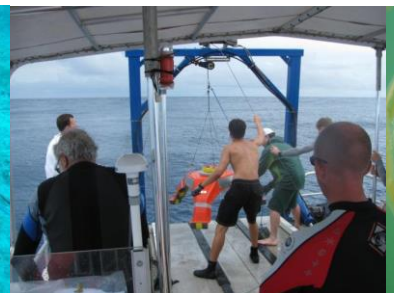
## Benefits

- Oversea conferences
- Field observations

## Preferred skills

- Passion
- Basic knowledge on computing languages (MATLAB, R, Python) and platforms (linux, Windows, Mac)




# Available Positions @ IMCOOL

- Master/Ph.D. graduate students
  - Tuition waiver; Dormitory in campus & stipend
  - Visit http://admission.kaist.ac.kr/web/intl for more details
- Postdoctoral Fellows
- Undergraduate-/MS-degree Researchers
- Undergraduate Research Program (URP)

- Point of Contracts
  - Prof. Sung Yong Kim syongkim@kaist.ac.kr
  - Secretary Eun Yeh Park imcool.kaist@gmail.com

# Primary classes

- Data analysis for ocean science and engineering
- Applied mathematics for ocean science and engineering
- Advanced wave mechanics
- Underwater acoustics
- Wave physics