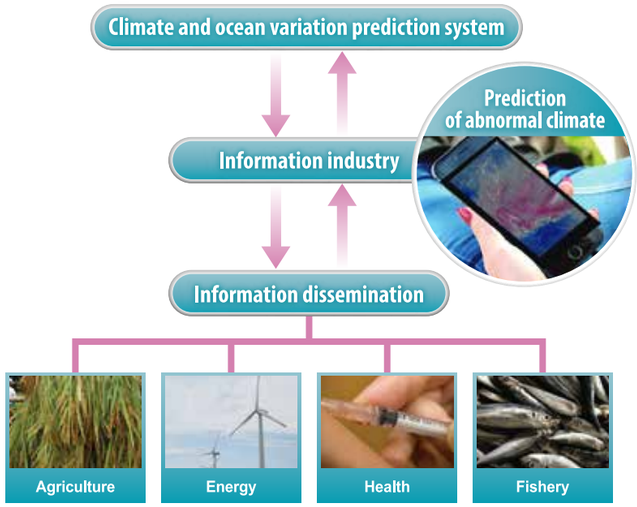
Earth Simulator
is a large vector supercomputer, which is particularly suitable for simulations of the atmosphere, oceans, and other fluids.

Our predictions are used globally in various sectors



Application potential of model prediction data to various fields

Climate predictions for agriculture

In 2006, the positive Indian Ocean Dipole (IOD) mode resulted in drought and brought enormous damage to Australia's agriculture. The SINTEX-F system predicted this event months ahead. Also, IOD and subtropical IOD play an important role in the rainfall variability of eastern and southern Africa. Risks can be mitigated if droughts are foreseen based on seasonal forecasts and countermeasures are taken. Hence, SINTEX-F predictions have been used for crop and livestock management in Australia and Africa.

Climate predictions for human health

Infectious diseases, largely associated with climate variations, pose immense health risks in many parts of the world. In collaboration with the Institute of Tropical Medicine at Nagasaki University, APL scientists have investigated the climate link to some of the infectious diseases (malaria, respiratory and diarrheal diseases) in southern Africa under the AMED/JICA SATREPS framework. Regional rainfall variations as well as climate phenomena such as La Niña and Indian Ocean Subtropical Dipole are found to be linked with malaria incidence in South Africa. A malaria early warning system has been developed based on these pieces of information and skillful SINTEX-F predictions. Diarrheal diseases in the region are also seen to be linked with the regional temperature and rainfall variations, and thus there is potential to develop an early warning system for these diseases as well.

We are also investigating the potential to predict cholera outbreaks in India under a trilateral framework, *Towards a Sustainable Earth* (TaSE), involving institutes in the UK and India.

Ocean and climate predictions for energy sector

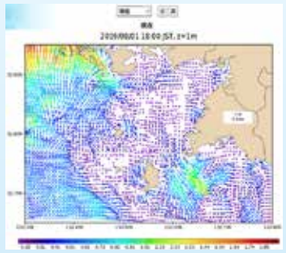
Ocean and atmospheric conditions influence several renewable as well as conventional energy sectors. APL researchers are working on projects to understand the usefulness of ocean predictions in renewable energy generation and climate predictions in energy management.

SIMSEA

The Sustainability Initiative in the Marginal Seas of South and East Asia (SIMSEA), initiated by Application Laboratory, is an international alliance of natural and social scientists working together to meet the regional challenges of biodiversity conservation, sustainability of marine ecosystem services, and protection of human well-being in light of population pressure, environmental degradation, and climate change/variability. The overall goal is to generate knowledge that can bring about transformative change toward sustainability in the marginal seas of South and East Asia, and to contribute toward sustainability at the global level.

SUKUMO

Co-working with local stakeholders in Sukumo Bay, Kochi Prefecture, APL has developed a fine-resolution (200m) ocean prediction system (SUKUMO500) that provides hourly updates via the APL website. The information has been used for fishery activity as well as oil spill removal. Local stakeholders have provided in-situ observation data in order to evaluate and improve the ocean prediction system. Interaction between local stakeholders and scientists will benefit the integrated coastal management in Sukumo Bay.



Application Laboratory http://www.jamstec.go.jp/apl/

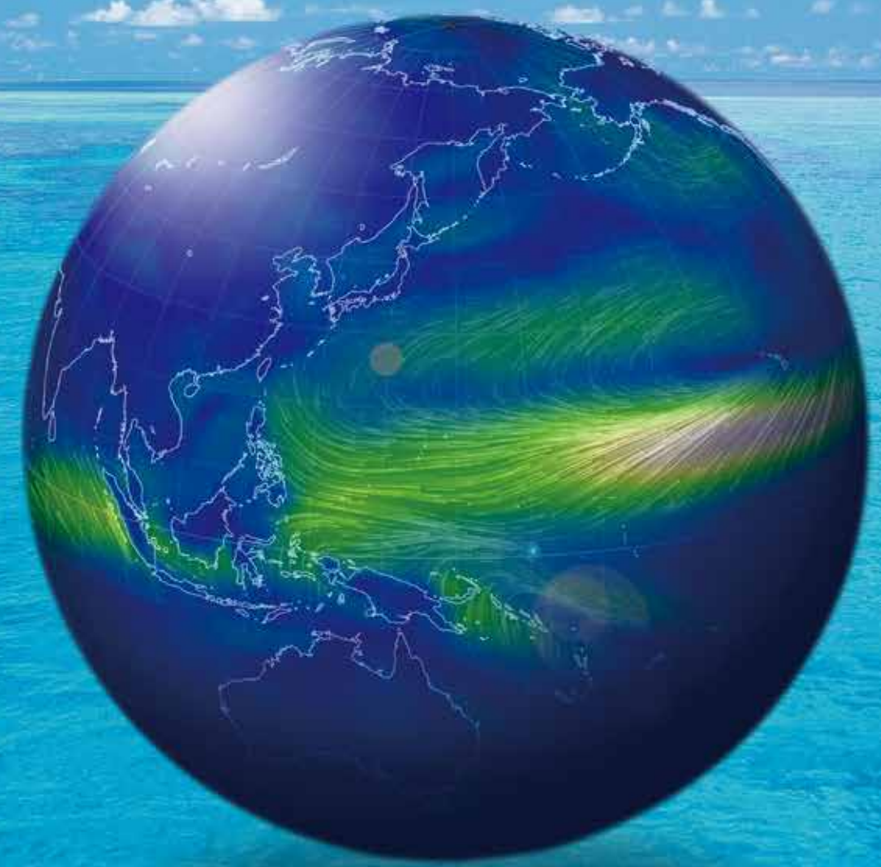
Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
Yokohama Institute for Earth Sciences
3173-25 Showa-machi, Kanazawa-ku, Yokohama 236-0001, Japan
PHONE : +81-45-778-3811 FAX : +81-45-778-5497

2019.08

APL aims for realizing innovation through mutual enlightenment and sustainable research

Application Laboratory

Innovations from Earth Science



JAMSTEC

Application Laboratory (APL) endeavors to realize a sustainable world through innovations and prudent interactions between science and society.

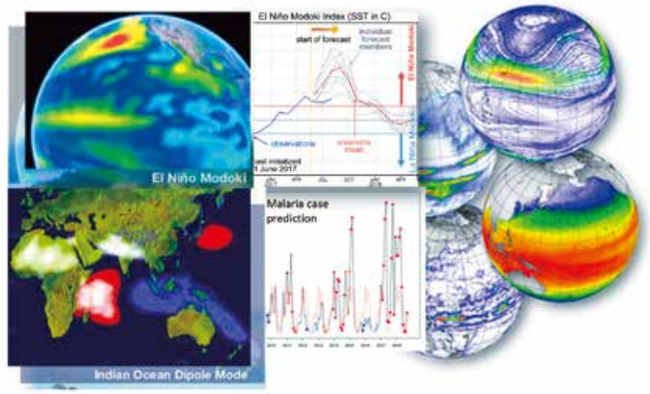
The Application Laboratory a premier research establishment in JAMSTEC aims to contribute to the society by developing numerical simulation technologies and by finding ways and means to apply ensemble model predictions for the benefit of human health, agriculture, fisheries, water management, and air and water quality.

Director, Application Laboratory ***Swadhin Behera***

CVPARG Climate Variability Prediction and Application Research Group

Group Leader ***Masami Nonaka***

We carry out climate predictions that aim to forecast events, such as El Niño, up to two years in advance using the state-of-the-art coupled ocean-atmosphere model *SINTEX-F*. The model can calculate the evolution of atmosphere and ocean simultaneously, and its forecast skills rank as one of the highest among the world's leading prediction centers. These forecasts can be displayed through the publicly accessible APL web page. We are currently working on societal applications of these prediction data, including efforts toward reducing the spread of infectious diseases in South Africa and India, and toward energy management in Japan. Our vision is to develop a prediction system that can predict climate events with time scales from one month to one decade. We also strive to predict the midlatitudes, which remain one of the grand challenges of climate prediction, by improving the SINTEX-F system and developing a multi-model prediction system together with CFES, another prediction model operated by APL.



EVPARG Environmental Variability Prediction and Application Research Group

Group Leader ***Yasumasa Miyazawa***

Our group performs research on both the ocean and the atmosphere. The oceanic component aims to understand the detailed variability of the ocean currents in the global ocean. The atmospheric component studies air-sea interactions focusing on atmospheric convective processes to understand the generation mechanisms of clouds and rainfall and their possible impacts on oceanic and climate predictability. In order to understand predictability of ocean currents, especially that around Japan, we perform and validate daily ocean forecasts (JCOPE). Using the ocean forecast information, we investigate biogeochemical/marine ecosystem phenomena including plankton and fish behaviors. Our forecast information is currently utilized by various stakeholders and will be improved by further including newly available observations, partly provided from the stakeholders themselves.

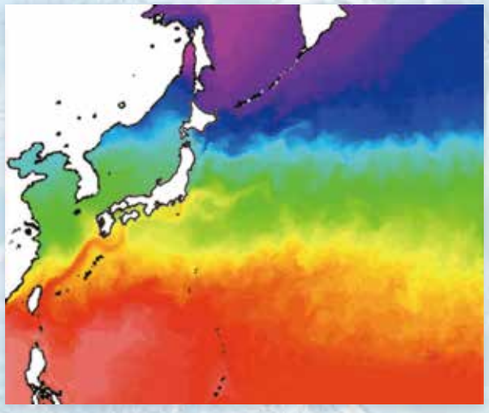
APL provides beneficial predictions for the world

The forecasts are available on the following pages.

http://www.jamstec.go.jp/apl/
http://www.jamstec.go.jp/virtualearth/

Regional Ocean Prediction (JCOPE)

Ocean forecasts from the sea surface to the seafloor are achieved by using global ocean observation data from satellites, ships, floating buoys and so on. These forecasts are utilized by cargo ships and the Japanese off-shore fishing industry.



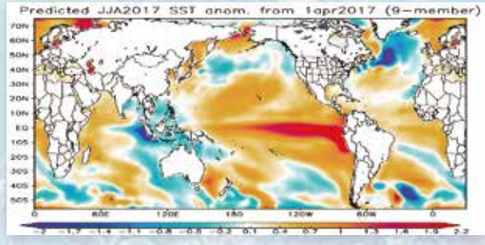
Climate Watch

APL maintains a webpage dedicated to the discussion of seasonal forecasts and current climate events, called *Climate Watch*. The site contains regular updates of the SINTEX-F seasonal predictions (both in English and Japanese) as well as posts on various topics of current interest, such as the Peru flooding in March 2017 or the extreme warming off the coast of southwest Africa in January 2016.

http://www.jamstec.go.jp/aplinfo/climate/?lang=en

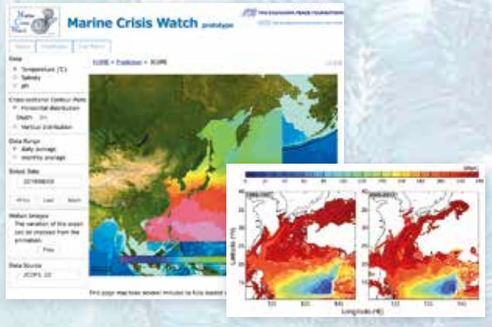
Seasonal Prediction (SINTEX-F)

The SINTEX-F coupled model system is used to predict the occurrence of tropical climate variability such as El Niño, La Niña, and the Indian Ocean Dipole (IOD). The predictions are global and therefore also provide forecast information (e.g., about the severity of winter and summer seasons) in the mid-and high-latitudes. We are also currently testing a decadal prediction system to investigate long-term variations in various regions around the globe, including the southern Atlantic and Indian Oceans.



Fishery and Biogeochemical Studies

In one of our recent projects we have used the JCOPE system to investigate the long-term population decline of eel and how it is related to changes in ocean currents. Other projects include the development of an ecosystem model (including parameters related to the carbon cycle) that uses JCOPE ocean-current forecasts as input and forecasts ocean acidity in the coastal regions of Japan.



Kuroshio-Oyashio Watch

Using the results from JCOPE, this website discusses recent predictions, scientific issues, and hot topics regarding phenomena in the coastal regions around Japan, especially in the Kuroshio and the Oyashio.

http://www.jamstec.go.jp/aplinfo/kowatch/e/