



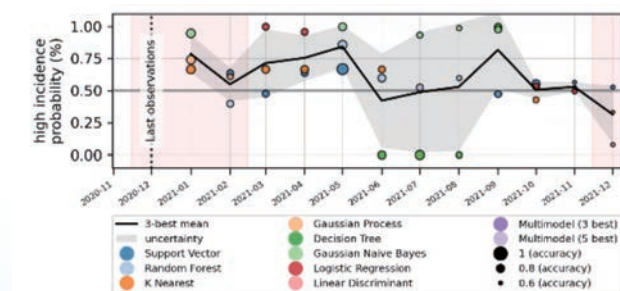
Earth Simulator
is a large vector and scalar supercomputer, that is particularly well-suited for environmental simulations including ocean, atmosphere, eco-system and ice.

Our predictions are used globally in various sectors

Infectious disease predictions based on climate variability

Infectious diseases pose significant socioeconomic challenges, affecting the well-being of communities while straining economies, healthcare systems, and education. Climate is a key factor in shaping the transmission of these diseases. In collaboration with the Institute of Tropical Medicine at the University of Nagasaki, we are harnessing the power of machine learning to develop early warning prediction models. These models predict outbreaks of diseases such as malaria in South Africa, dengue in Vietnam, and cholera in India by leveraging the impact of modes of climate variability such as sea surface temperature variability in the tropical Pacific Ocean associated with El Niño and La Niña as well as the Indian Ocean Dipole.

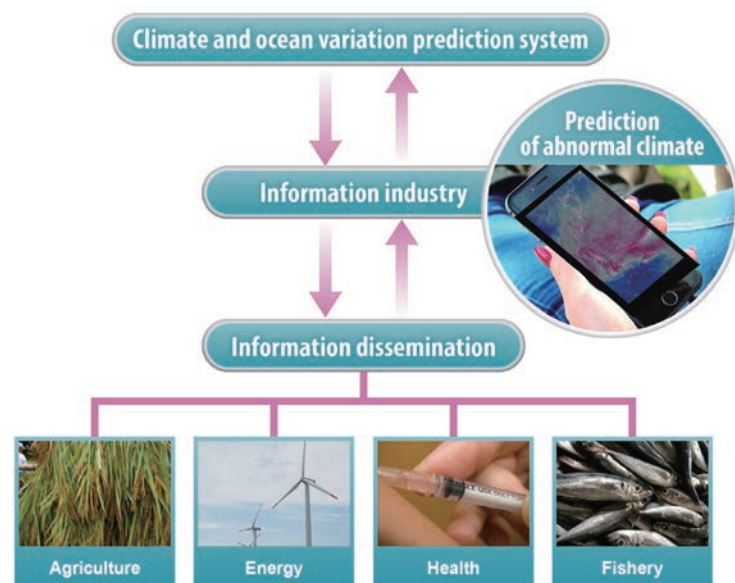
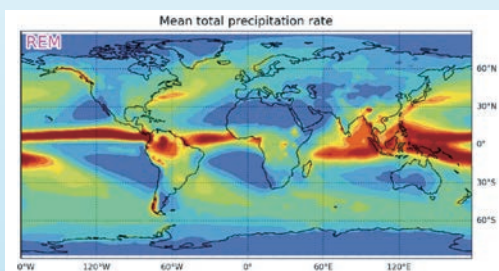
<https://www.jamstec.go.jp/4dvep/project02.html>



The Critical Role of Climate Monitoring

Climate monitoring is essential for understanding the far-reaching impacts on the environment, society, and the global economy. Reanalysis datasets play a pivotal role in this effort, offering comprehensive and consistent historical climate data, including insights into weather extremes. We curate an extensive collection of the world's leading reanalysis datasets and provide enhanced diagnostics on weather extremes and other key climate factors through our user-friendly data portal.

<https://www.jamstec.go.jp/ridinfo/>



Application potential of model prediction data to various fields

Digital Twin

We are leading the development of the Four-Dimensional Virtual Earth (4DVE), a digital twin of the Earth, in collaboration with other groups. The 4DVE is a virtual Earth, in the sense that users can experiment on it to get answers to their questions about the Earth. If, for instance, a submarine volcano erupts and emits pumice stones, where will they end up and when will they reach a specific bay? To help users find answers quickly to such issues, we will build apps with specific functions that connect to the 4DVE's underlying system, which combines data, simulations, and analysis tools.

WPMSEA and SynObs

We are participating in the Ocean Prediction Decadal Collaborative Centre, which is a framework for intensive collaboration between Decade Actions and key players to establish "A Predicted Ocean" in the framework of the UN Ocean Decade, and leading the relevant activities in Western Pacific and Marginal seas of South and East Asia (WPMSEA). We are also participating in SynObs, an international project aimed at evaluating the impact of various observational platforms through a comparative study of ocean forecasting systems from around the world. We will not only contribute to results using the JCOPE system but also plan to set up servers for aggregating the data.

WRF interactive server

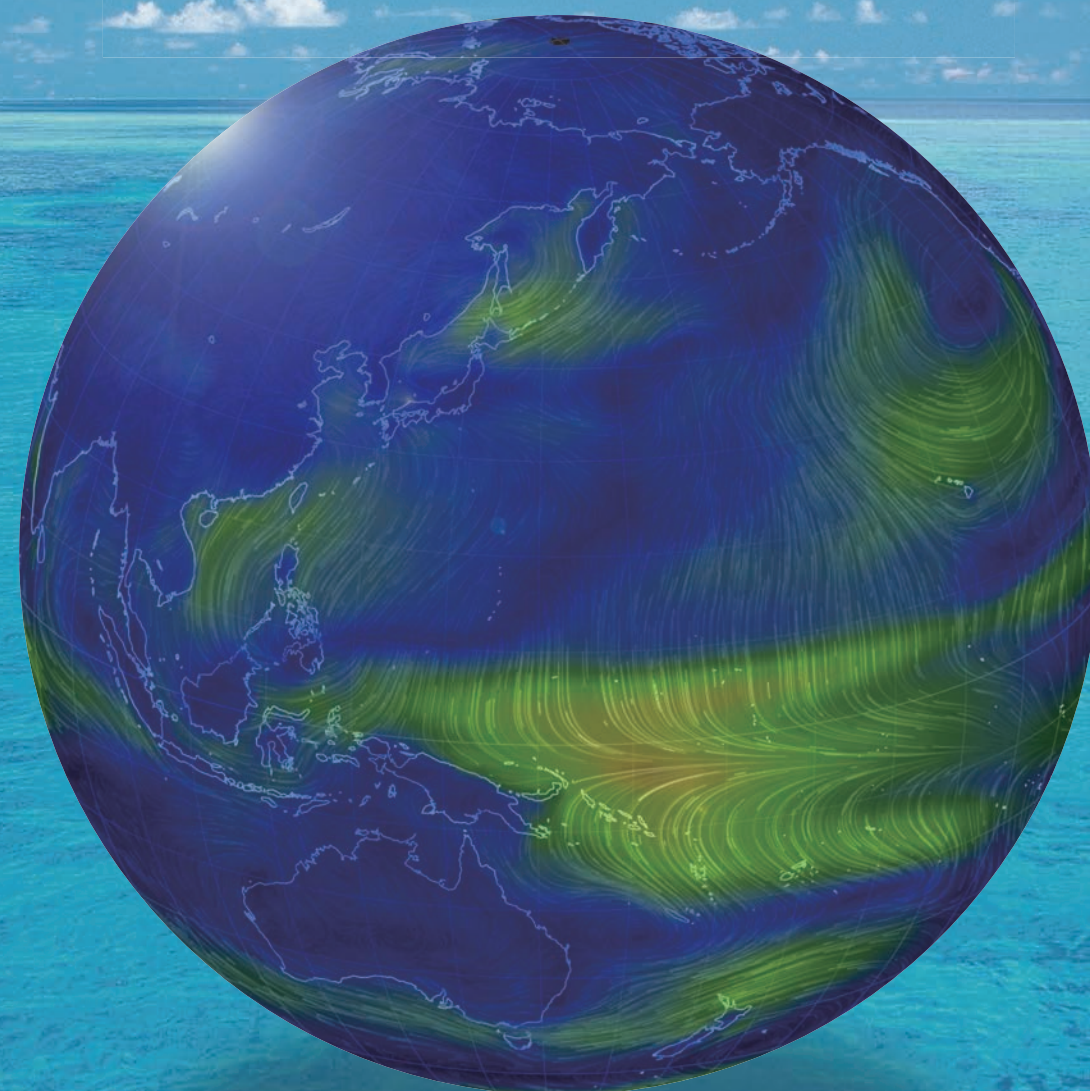
With the increased frequency of extreme precipitation events due to climate change, it is crucial to be able to accurately predict the intensity of precipitation. Dynamical regional models are the tools for achieving such a goal. However, setting up a regional model for predictions is a cumbersome process. We have simplified the process of setting up a regional model, called Weather Research and Forecasting (WRF), for predicting precipitation by developing an interactive GUI. The users have a choice to use many model outputs as the boundary conditions for the regional model.



“Digital Twins”
for Discoveries and Sustainable Development Goals

Application Laboratory

Innovations from Earth Science



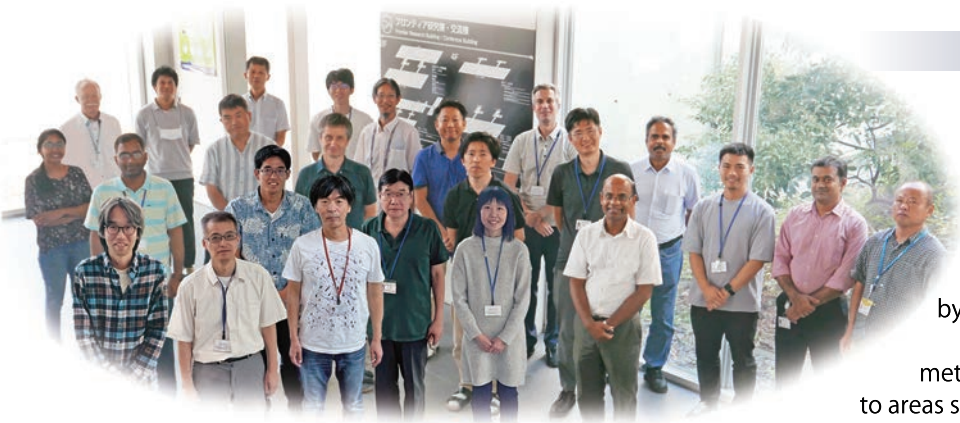
Application Laboratory <https://www.jamstec.go.jp/apl/>

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



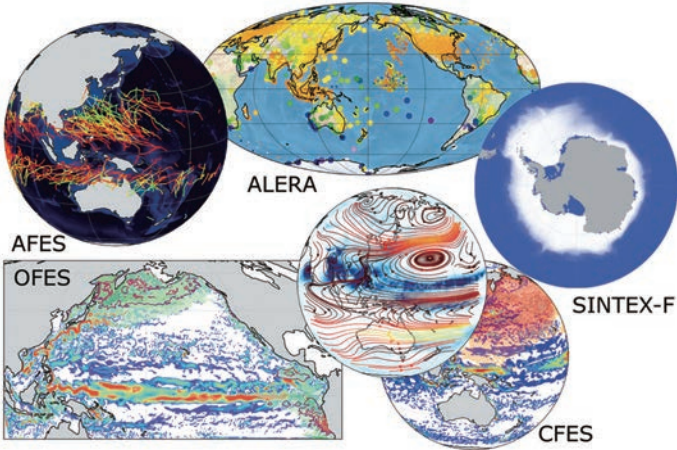
The Application Laboratory, a leading research center within JAMSTEC, is dedicated to enhancing societal well-being by advancing numerical simulation technologies, fostering digital twinning, and developing methods for applying ensemble model predictions to areas such as human health, agriculture, and fisheries.

Director, Application Laboratory *Swadhin Behera*

CVPARG Climate Variability Prediction and Application Research Group

Group Leader *Masami Nonaka*

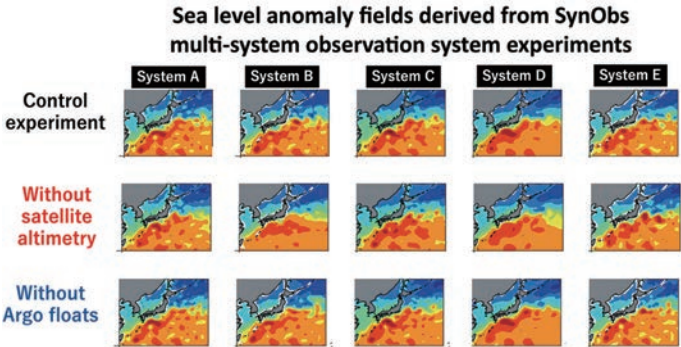
We perform experimental operational climate predictions for events, such as El Niño and the Indian Ocean Dipole, up to two years in advance using the state-of-the-art coupled ocean atmosphere model, SINTEX-F. The model can calculate the evolution of atmosphere and ocean simultaneously, and its forecast skill is on par with the world's leading prediction centers. These forecasts can be displayed through the publicly accessible APL web page and are part of a larger online information system called 4D Virtual Earth. We are currently working on developing societal applications from these prediction data, including early warning systems for infectious diseases in South Africa, and toward agricultural prediction. Our vision is to develop a system that can predict climate events from one month to one decade. We also endeavor to predict extreme events, by improving our prediction system and by 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 using Japan Coastal Ocean Prediction Experiment (JCOPE) system. 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.



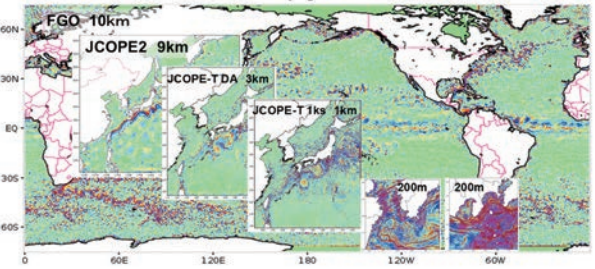
APL provides beneficial predictions for the world

The forecasts are available on the following pages.

<https://www.jamstec.go.jp/apl/>
<https://www.jamstec.go.jp/virtualearth/>

Regional Ocean Prediction (JCOPE)

We are developing a series of ocean forecasting systems with varying resolutions and regions from global to coastal scales, which are operationally updated to forecast oceanic conditions from the surface to the seafloor. These systems rely on global ocean data from satellites, ships, and buoys, and are utilized not only in scientific research but also in a wide range of societal activities, such as fisheries and maritime operations.



Climate Watch

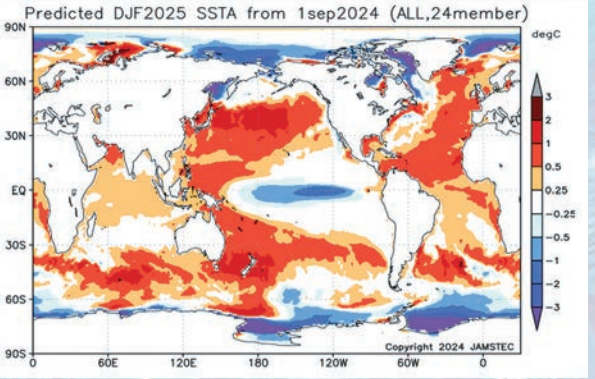
APL maintains a webpage dedicated to the discussion of seasonal forecasts based on the SINTEX-F. The so-called Climate Watch provides for the public, temperature and rainfall prediction information and the underlying climate phenomena in a comprehensible way once a season.

<https://www.jamstec.go.jp/aplinfo/climate/>



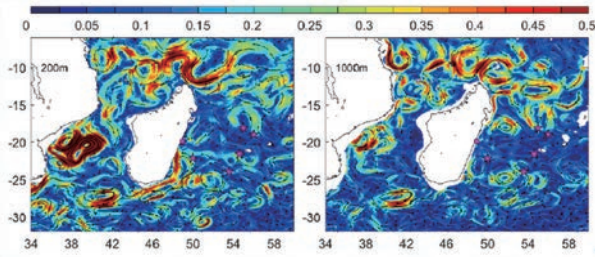
Seasonal Prediction (SINTEX-F)

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. The predictions are global so that it also provides forecast information (e.g., severity of summer and winter seasons) in the mid-high latitudes. We are currently developing the next-generation SINTEX-F with an eddy-permitting resolution.



Fishery and Biogeochemical Research

Biogeochemical conditions such as chlorophyll-a, pH, and dissolved oxygen are important indicators of the ocean ecosystem health. We develop and apply a lower trophic level ecosystem model to improve the detection of suitable fishing grounds and provide early warnings for extreme events. Using the newly developed semi-global model JCOPE-FGO, the fisheries application studies are extended worldwide, including searching for the spawning area of eel in the Indian Ocean.



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 Oyashio.

<https://www.jamstec.go.jp/aplinfo/kowatch/>

