

応用海洋物理学分野

海上作業と航行の安全、海洋再生可能エネルギーの利用、漁業やレジャー、防災のための海洋情報について研究を行っています

Marine Engineering
海洋工学



海のScienceとTechnologyを
つなぐ架け橋、それが海洋情報

Oceanography
海洋学

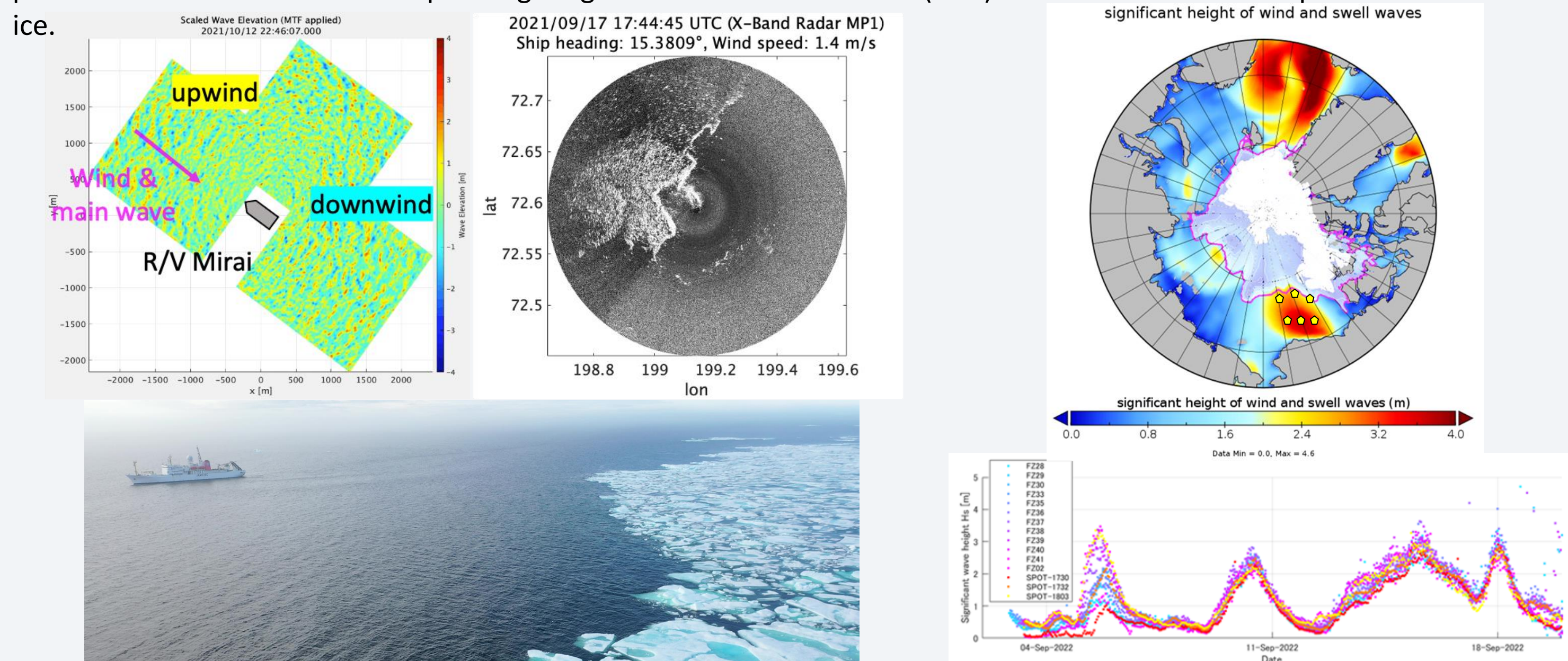
研究テーマの紹介



ARCTIC & ANTARCTIC RESEARCH EXPEDITION

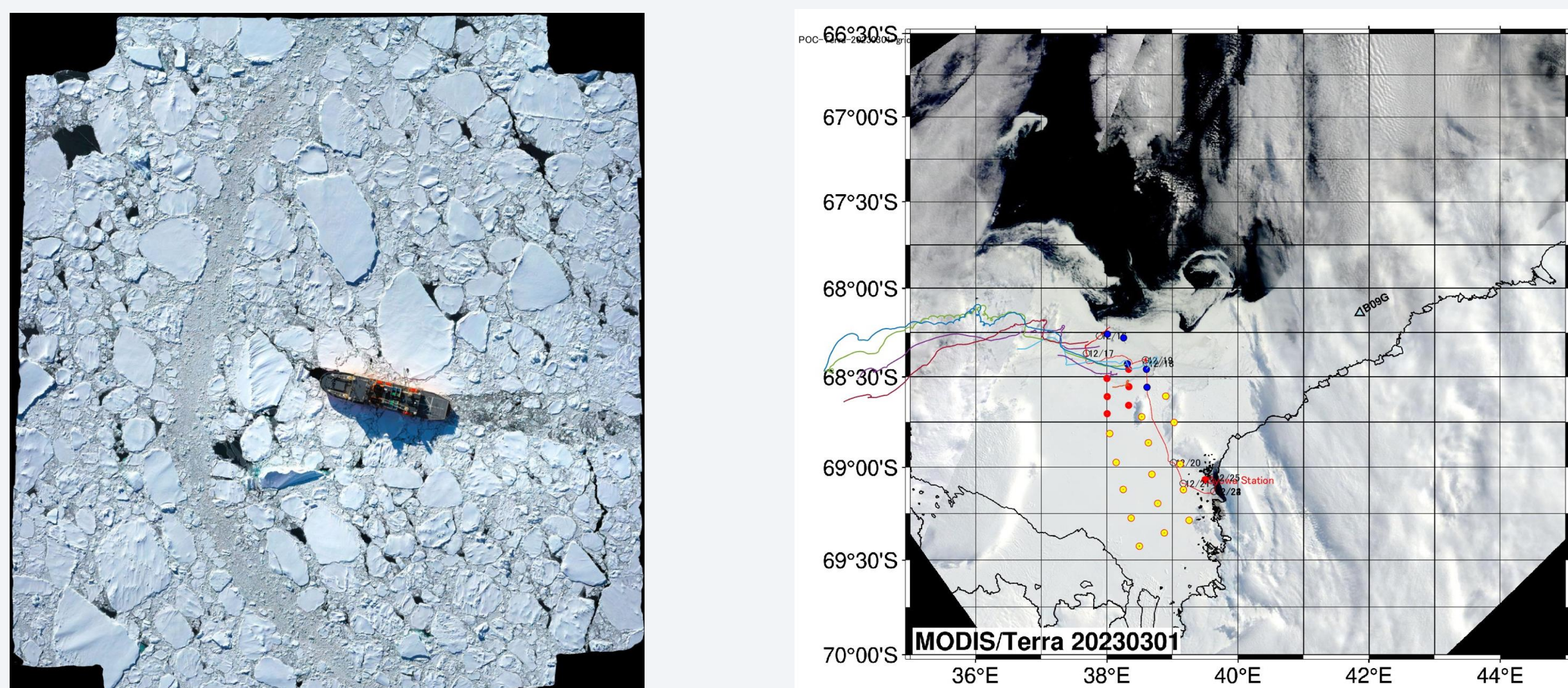
Research title: Wave and ice observation in Arctic Ocean

Research goal: In recent years, environmental changes including a decrease in sea ice coverage due to global warming have been a topic of discussion in the Arctic Ocean. Since 2016, we have been conducting wave observations using onboard observation equipment on ships (marine radar, stereo camera, microwave wave gauge, etc.) and drifting wave buoys to investigate the actual state of waves in the Arctic Ocean. By clarifying the nature of waves in the Arctic Ocean, we hope to provide wave information to ships navigating the Northern Sea Route (NSR) and understand the impact of waves on sea ice.



Research title: Research on the mechanisms of change of Marginal ice zone and fast ice and the selection of the icebreaker route (Japan Antarctic Research Expedition; 2022-2028)

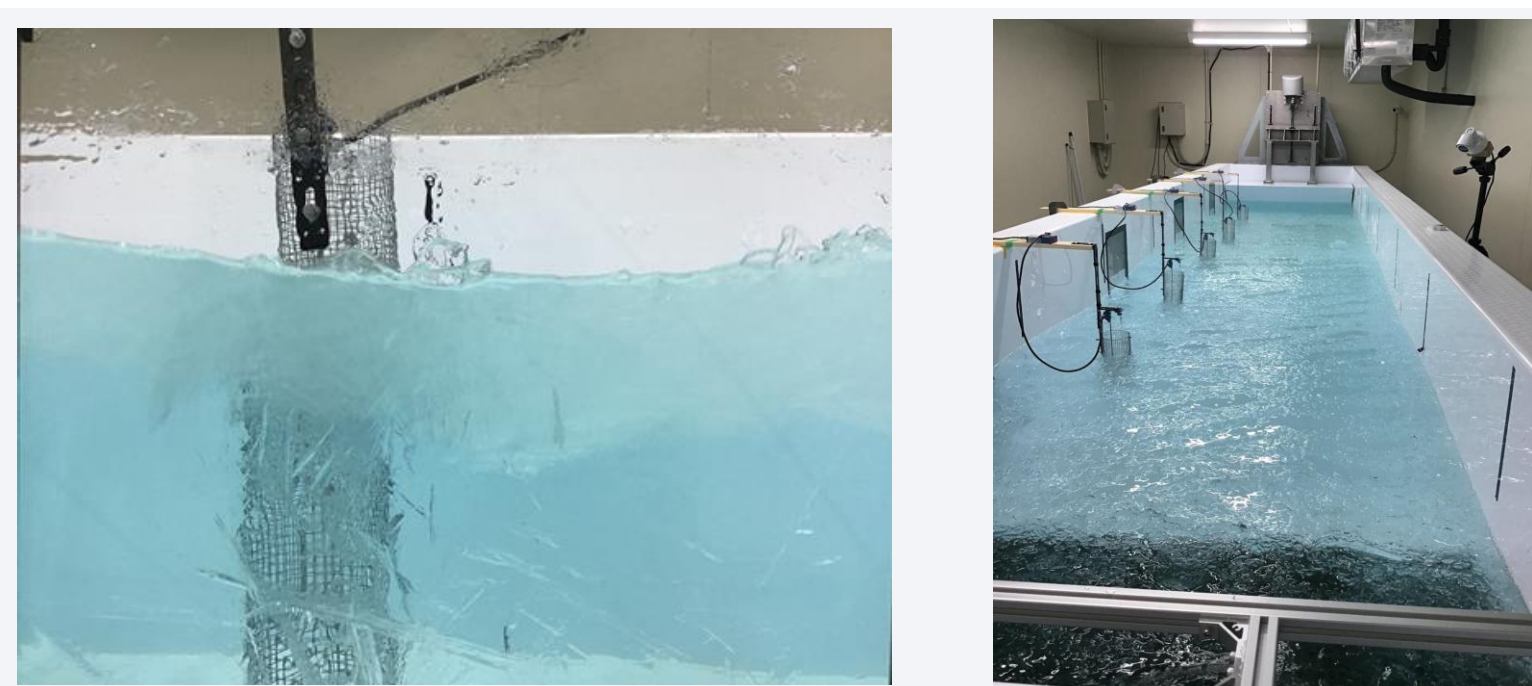
Research goal: We investigate the impact of waves on the quasi-periodic decadal variation of the land-fast ice, in the Lutzow-Holm Bay. Remote and in-situ observations will be made to study wave-ice interaction in the MIZ and packed ice zone that blocks wave from the land-fast ice. The research outcome will be used to establish an optimum routing scheme for icebreakers and ice-resistant vessels and will be utilized for the development of the Northern Sea Route.



WAVE-ICE INTERACTION

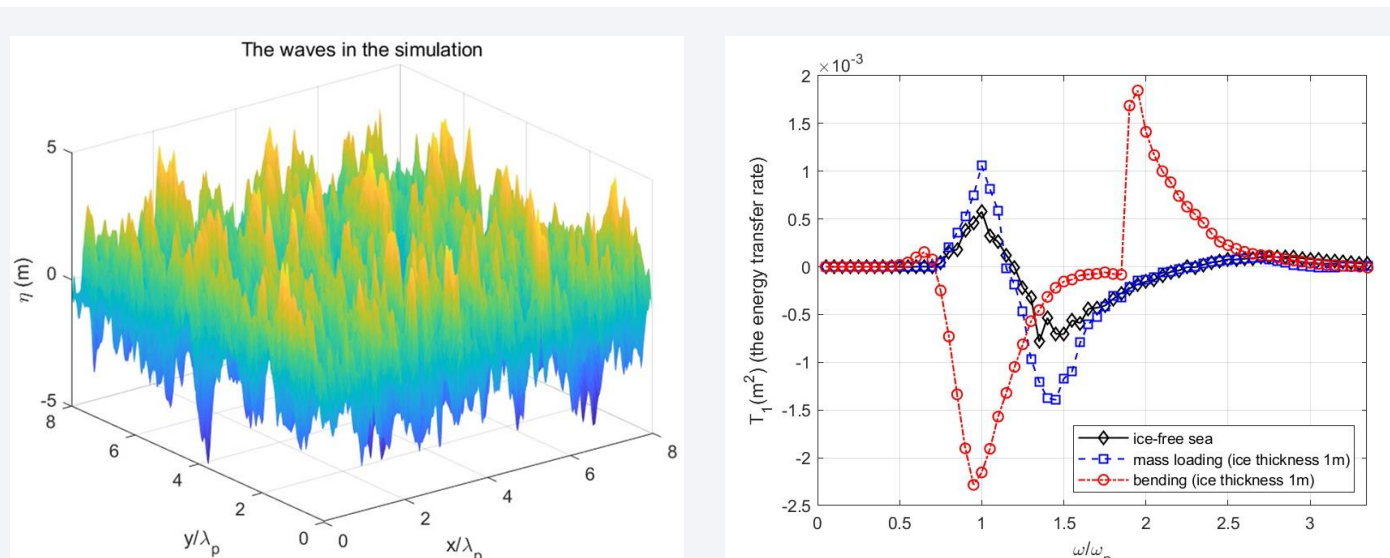
Research title: Reproduction of the Arctic Ocean in Wave Ice Tank

Research goal: Wave Ice Tank enables the generation of ice while creating waves and reproduces the ice-covered ocean environment. It aims to elucidate the detail of the wave-ice interactions by measuring wave parameters and monitoring ice distribution/motion, consecutively.



Research title: Numerical simulations of nonlinear waves in ice

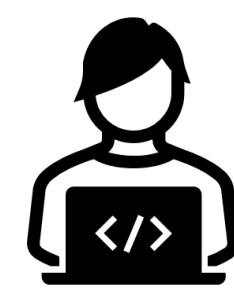
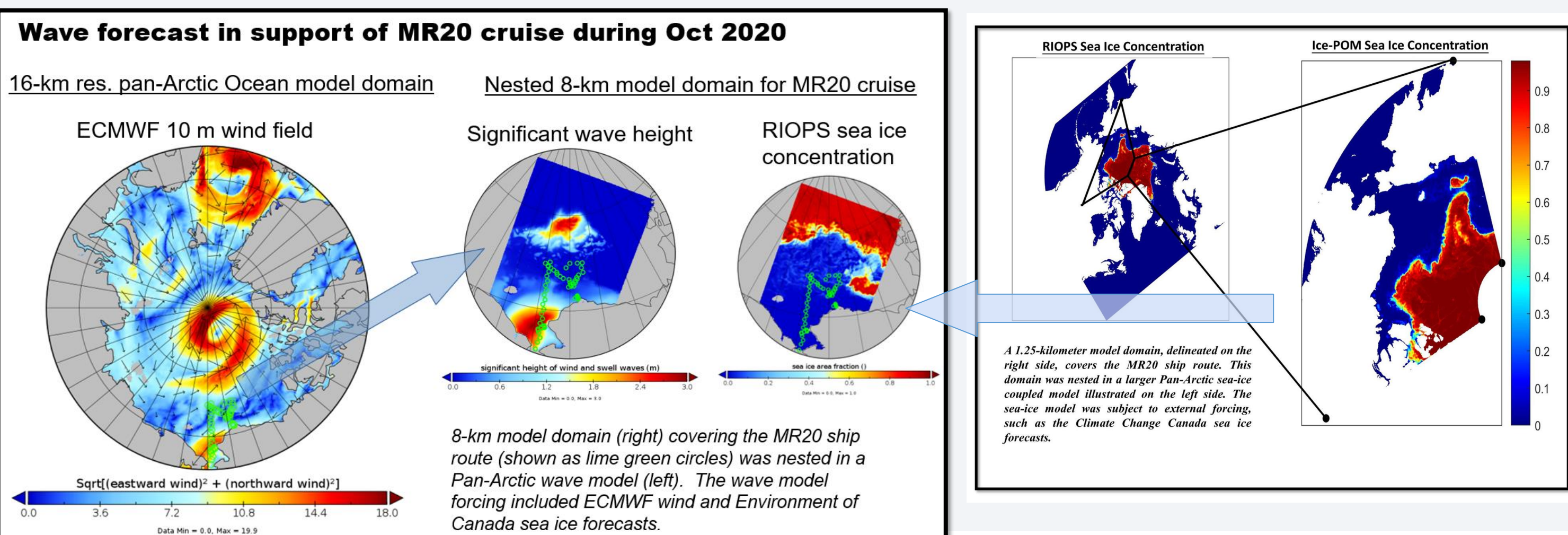
Research goal: The nonlinear interaction of waves is a possible reason for the generation of freak waves in the ocean. The numerical simulation is a tool to reveal the mechanism of nonlinear wave interaction and investigate the influence of ice on the nonlinear waves. The bottom-right figure shows that the ice has a significant influence on the nonlinear energy transfer of waves.



WAVE AND ICE FORECAST IN SUPPORT OF THE NSR

Research title: ArCS II: Wave and ice forecast in support of the Northern Sea Route (NSR)

Research goal: ArCS II stands as one of Japan's most distinguished endeavors in Arctic research, dedicated to ensuring the sustainable advancement of the changing Arctic Ocean. One of the pivotal issues in this respect involves enhancing the accuracy of weather and climate predictions. The research interests of our team members primarily revolve around improving the skills required for forecasting waves in polar oceans. This involves carrying out comprehensive observations, laboratory experiments, and numerical simulations to gain a better understanding of the intricate processes of wave-ice interaction.



MARINE IOT

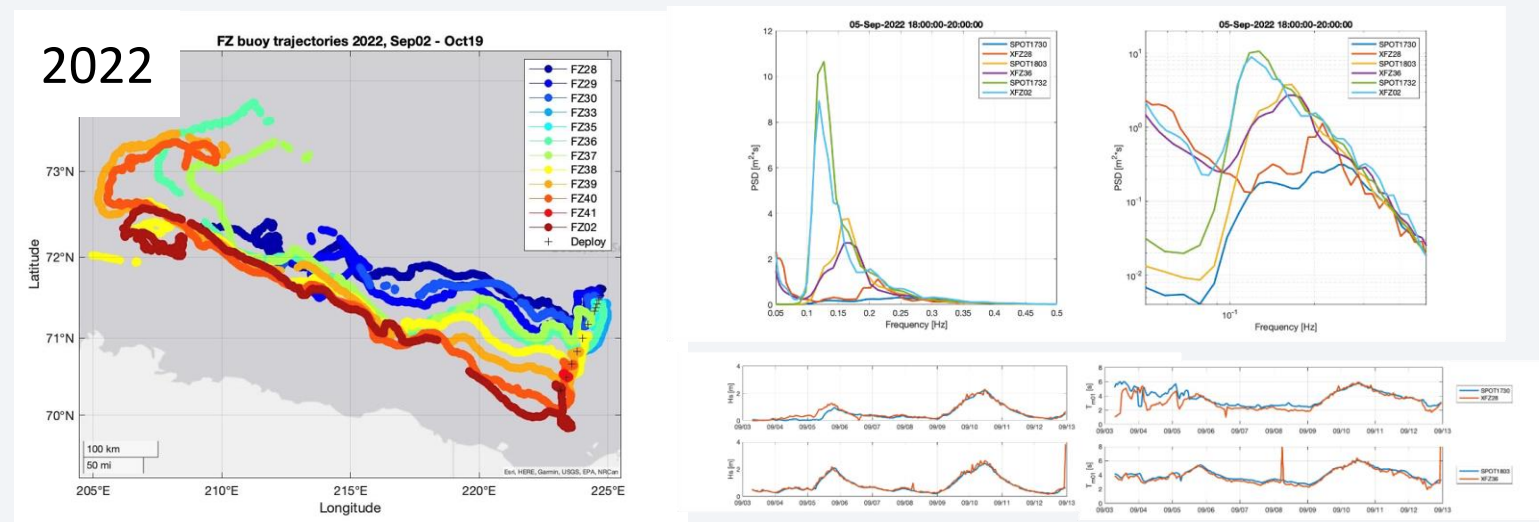
Research Title: Development of smart ocean surface measurement buoy with two-way satellite communication

Research Goal: Recent progress in low-cost electronics has facilitated the creation of reasonably priced devices for researching waves. We have introduced a novel design concept for an affordable and customizable wave buoy using rapid prototyping technologies. Our aim is to explore the scientific frontier of physical ocean surface processes by employing cutting edge technologies.

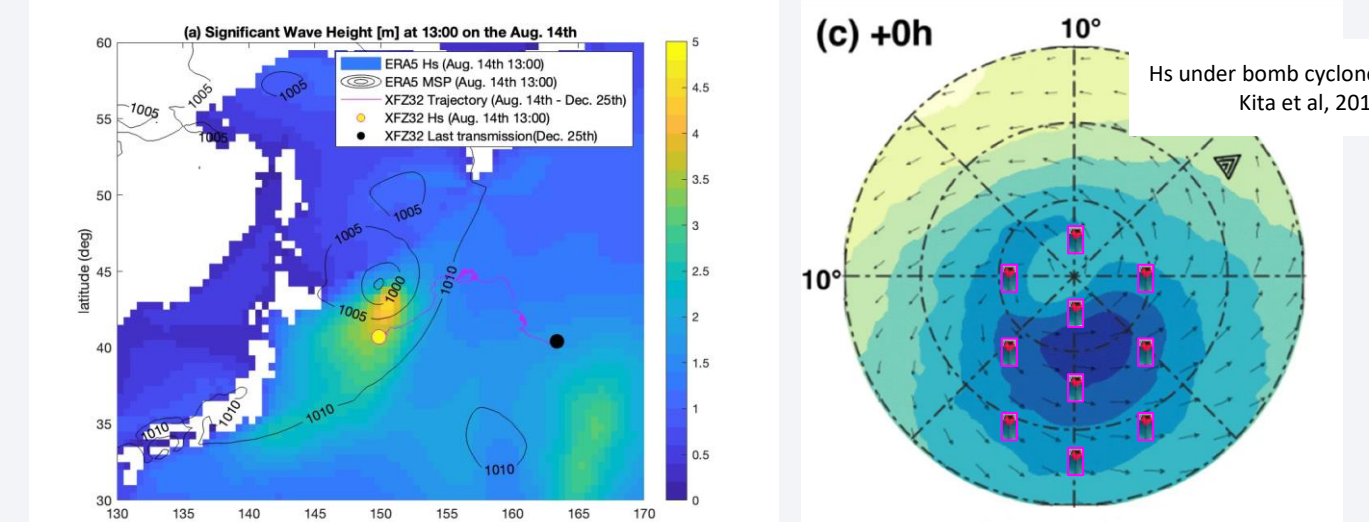
Developed IMU-based wave buoy FZ and XFZ



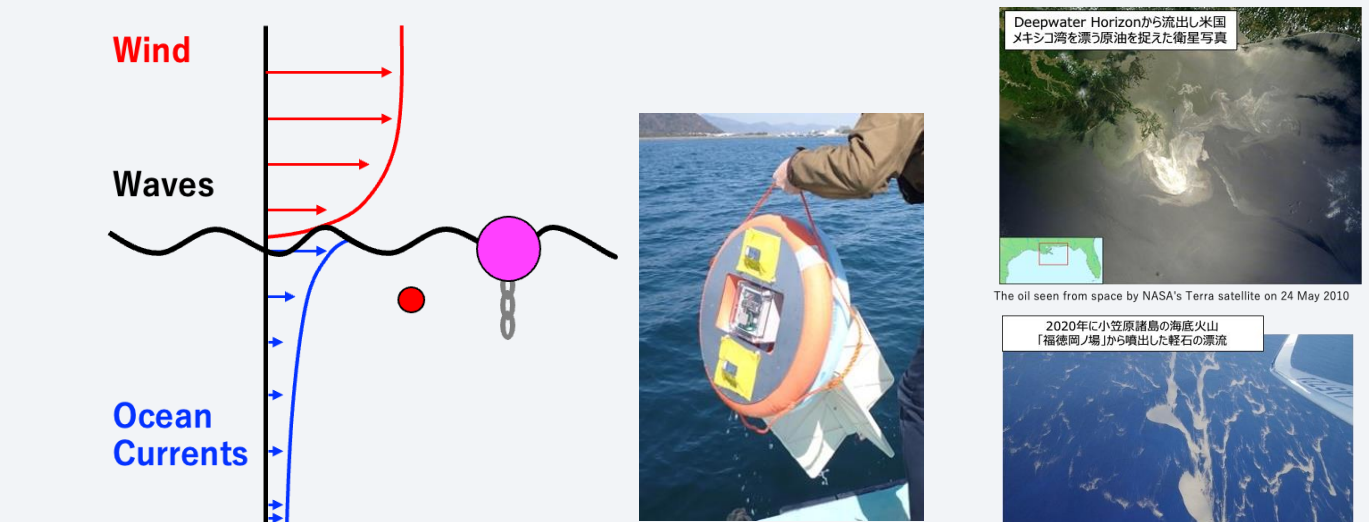
Deployments of 12 XFZs in the Beaufort Sea in Sep. 2022



Future Research #1 Waves under a hurricane/typhoon



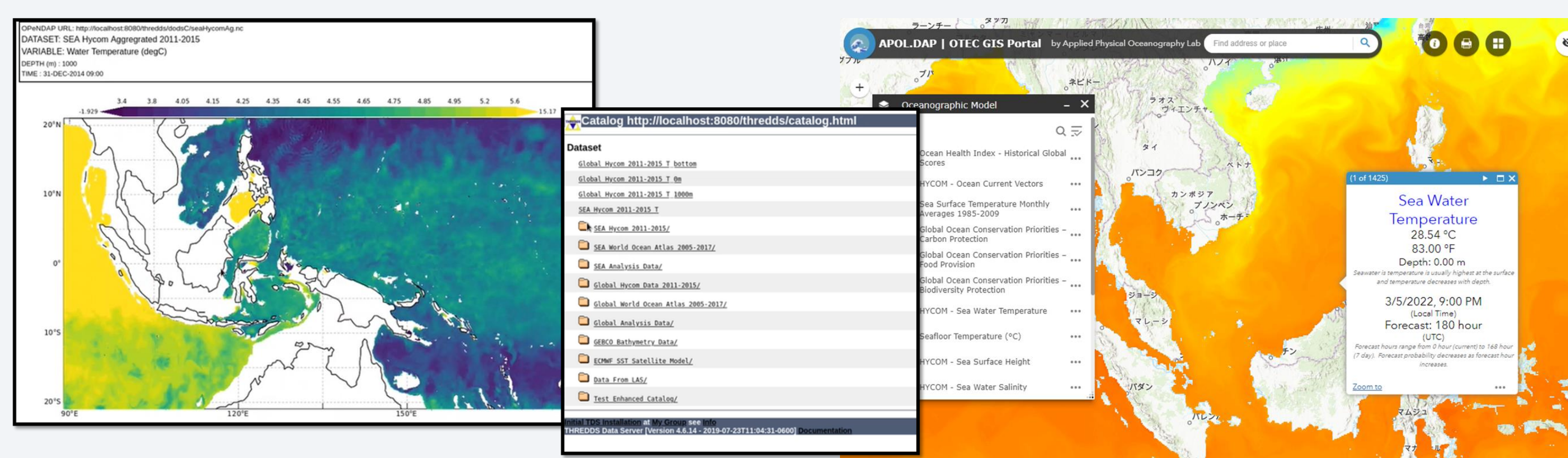
Future Research #2 Oceanic drift and dispersion



DATA SERVER

Research title: Establishing data servers and web applications for ocean renewable energy data

Research goal: Combine oceanographic, atmospheric and land datasets that are related to ocean renewable energy using different types of servers while keeping it user-friendly. Currently the themes for datasets are expanding and becoming more diverse, as we would like to adjust to the user needs. Our initiative is called Applied Physical Oceanographic Laboratory Data Archive Portal (APOL.DAP) and it includes a THREDDS data server (TDS), Live Access Server (LAS), and a Web GIS platform. This project is part of a partnership between Japan and Malaysia through SATREPS. Additionally, there is the Marine Energy Portal that includes high-resolution marine energy data for Japan at http://www.todaiww3.k.u-tokyo.ac.jp/nedo_p/en/



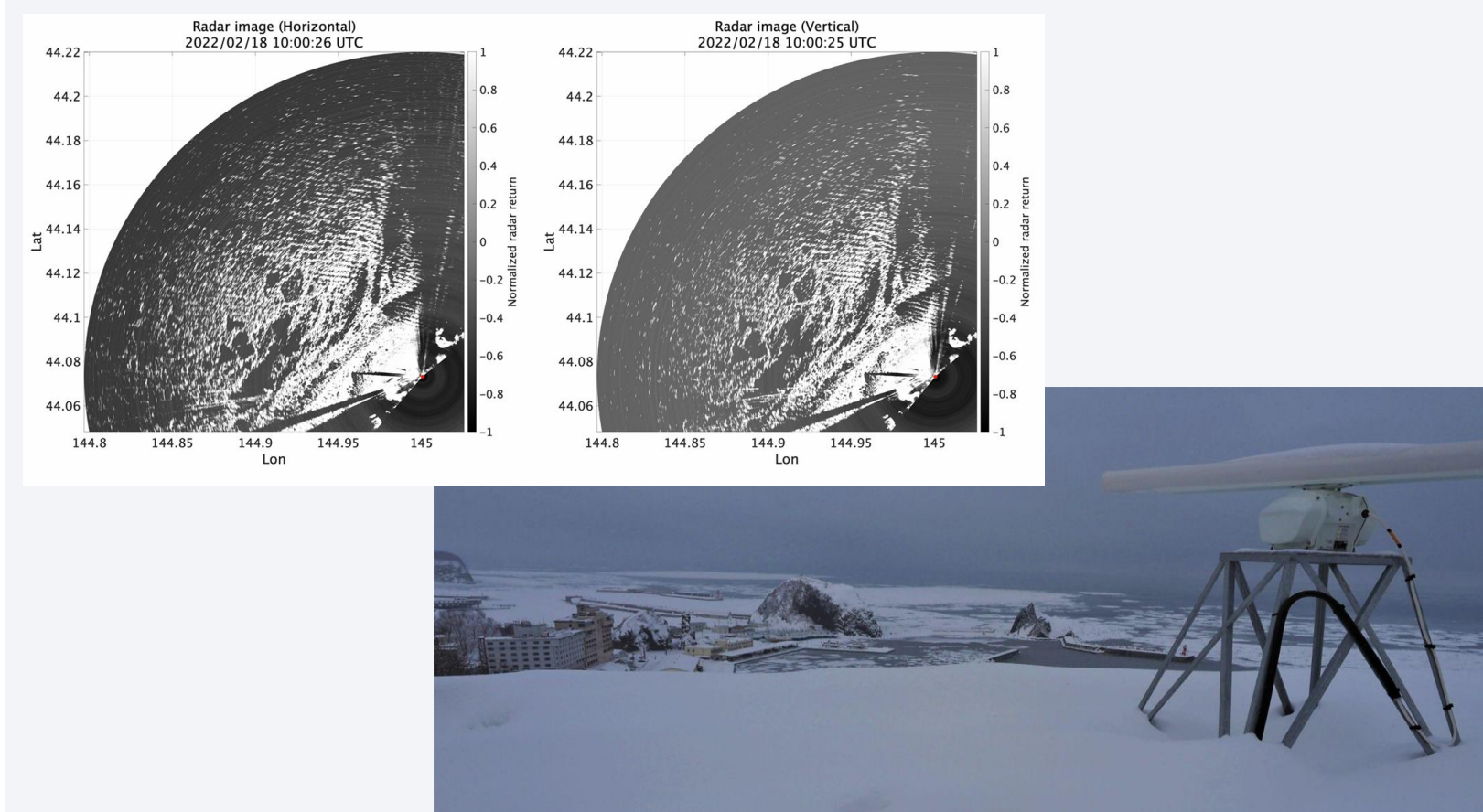
Ocean temperature plot created through LAS, TDS catalogue, and Web GIS interface showing ocean temperature.



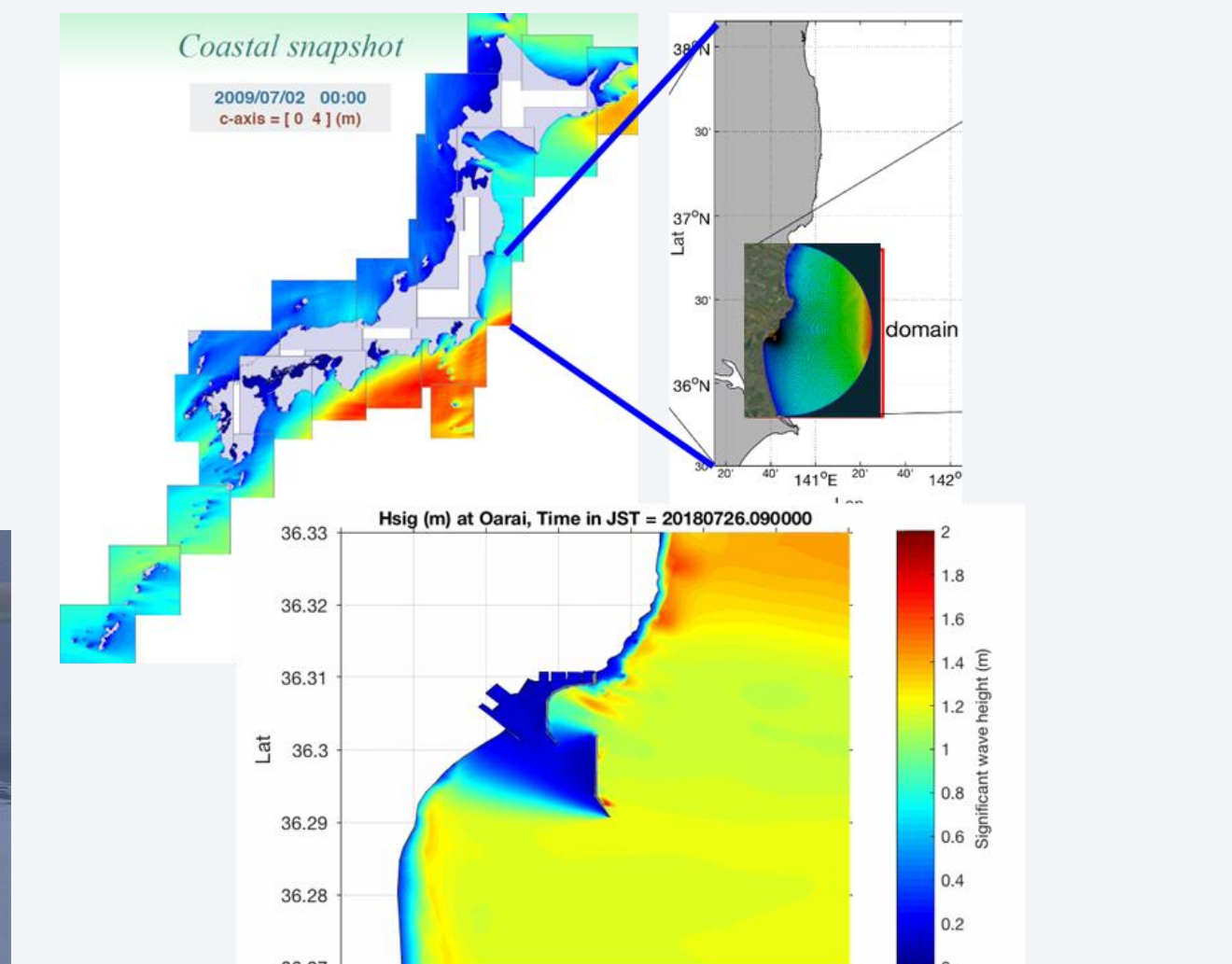
SOCIETAL IMPLEMENTATION:

APPLICATION OF OCEAN INFORMATION

Research title: Developing a marine wave-ice radar
Research goal: The Japanese government is developing an icebreaking research vessel planned to be in service in 2026. In collaboration with JAMSTEC, NMRI, and KIT, we are developing a marine wave-ice radar for the new icebreaker. An extensive test were conducted during the Mirai cruise in 2022, and at Utoro, Hokkaido, in 2021-2022 winter and in 2022-2023 winter. Concurrent detection of sea ice and waves is essential for the safe navigation of ships in the Northern Sea Route as the sea ice recedes and waves are generated by wind in the open water.



Research title: Development of a high-resolution ocean wave hindcast along the Japanese coast (TodaiWW3-GF)
Research goal: TodaiWW3-GF is a 1 km resolution ocean wave hindcast covering the Japanese coast from 1994 to the present. It is an expansion of TodaiWW3-NEDO, which forms the basis of the wave resource assessment presented in the Marine Energy Portal. The Gap Fund of the University of Tokyo aims to share the knowledge gained from advanced research and create a new business opportunity. The plan is to develop TodaiWW3-GF and sell the data through a company.



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ウェブサイトを訪問