Development of Unmanned Marine Observation Vehicles to Contribute to Forecasting and Monitoring of Typhoon Artificial Control

R&D Theme

Development of Atomosphere-Ocean Sensors for Stormy Environments

Progress until FY2022

1. Outline of the project

We develop atmosphere-ocean sensors outfitted on virtual mooring (VM) drones which can maintain sufficient accuracy even in stormy environment with large hull motion caused by strong wind and high waves around the center of typhoons and waterproofness enough to withstand temporary submergence and heavy rainfall.

In the first year (2002), atmospheric sensors were waterproofed and tested alone in a laboratory repeatedly. They were then outfitted on the VM drone prototype #1 for testing in coastal waters, and further improvements were made in preparation for a short-term (approx. one week) open-ocean test in 2023 in the east of Philippines, where typhoons are frequently generated during R/V *Mirai* tropical ocean cruise.

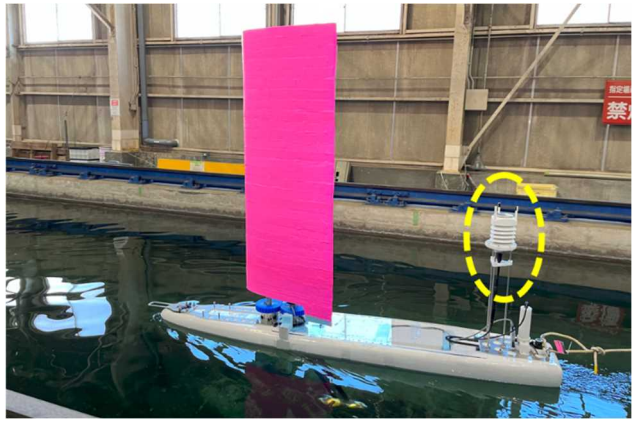

Fig. 1 Modified atmospheric sensor (yellow dashed circle) outfitted with the prototype #1. Prior to the test in coastal waters, it was validated in the multi-purpose water tank.

2. Outcome so far

The activities and results in 2022 are as follows.

1. We modified versatile automatic weather stations to improve their waterproofness, and tested them in a laboratory repeatedly to confirm their accuracy.
2. After outfitting the modified atmospheric sensor with VM drone prototype #1 developed in R&D Theme 1, it was tested in coastal waters of Suruga Bay in December 2022 and February 2023 to confirm its waterproof performance and accuracy. Although both tests were conducted in fair weather and weak wind conditions, we confirmed that data obtained by the modified atmospheric sensor have sufficient accuracy in comparison with that observed by AMeDAS (Mishima) located nearby the test waters.
3. We outfitted an ocean sensor (multipurpose observation float: MOF) on the bottom of prototype #1 at the 2nd test in the coastal waters, and compared its data with that obtained by a drifting buoy (SOFAR Spotter) that was deployed at the same time. The results showed that the MOF has sufficient accuracy though only in small waves.

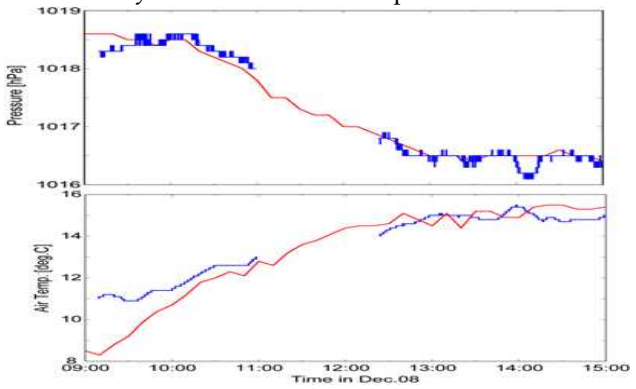

Fig. 2 Comparison of the data acquired by the modified atmosphere sensor outfitted on the prototype #1 during the test in coastal waters (December 2022) with the AMeDAS (Mishima) nearby. Sequential variations of atmospheric pressure (upper panel) and temperature (lower panel). The blue and red lines indicate atmospheric sensor data and AMeDAS data, respectively.

Fig. 3 Simultaneous observations with a Spotter drifting buoy (yellow dashed line) were conducted at the test in the coastal waters to validate the ocean sensor (MOF) outfitted on the VM Drone prototype #1 (red dashed line).

3. Future plans

In the next year (2023), we further improve the atmosphere-ocean sensor outfitted on prototype #2, and conduct a short-term (approx. one week) open-ocean test in the east of Philippines, where typhoons frequently occur, during R/V *Mirai* tropical ocean cruise operated by R&D Theme 3.

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