Applications of flying boat for ocean time-series observations

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A spatiotemporal network of observations is important for studying physical and biogeochemical processes in the ocean surface layer, as well as for validating satellite observations and model predictions, because there are many important processes that cannot be assessed from one-time (snapshot) observations. Repetitive observations by ships in the open ocean have provided some insights into these processes but remain rare because of difficulties associated with arranging observation vessels and staff. While, buoys attached to sensors and/or sediment traps in representative regions of the ocean are useful to obtain time-series dataset but need the expense of mooring tools and specific sensors. We propose that flying boats provide an important mechanism for enhancing the temporal resolution of ocean observations. In this presentation, we will provide examples of potential marine-science applications for a flying boat.

A flying boat can arrive to a sampling station in the open ocean more quickly than research vessels. Flying boats cannot be as extensively equipped with instruments as research vessels, but observations made from a flying boat are able to cover periods of time when ship observations are impossible. Thus, flying boats could enable collection of important time-series data on foundational biogeochemical observations that are easy to measure in the surface (euphotic) layer. Furthermore, a flying boat would allow investigation of moving phenomenon, which are difficult to track using traditional observation methods. For example, high primary productivity in cyclonic eddies are thought to be caused by nutrients supply associated with heaving of isopycnal surface. However, time-series observations of a moving eddy are challenging to obtain. A flying boat could permit high-resolution observations made from inside an eddy (with the location of the eddy estimate from sea surface height data). Overall, we believe that a flying boat for ocean observation would enable the collection of higher resolution time-series datasets than is currently possible, thus improving understanding of short term variations in physical and biogeochemical processes in the global material cycle.

Keywords: oceanography, flying boat observation, time-series observation, biogeochemical processes

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Amplification of Arctic hydrologic system explained by ocean-atmosphere-land observational network

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The areal extent and thickness of the Arctic sea ice have significantly decreased during recent decades. The shrunk sea ice cover and reduced sea ice thickness apparently increase heat and moisture fluxes from the ocean to atmosphere mainly in autumn and early winter, which may locally increase air temperature, moisture, and cloud cover, and in turn remotely cause anomalous climate and weather, such as cold and snowy winters, in the subarctic and mid-latitude terrestrial regions. Consequently, there might be related changes in the hydrological regime and its thermal conditions. In fact, the declined sea ice induced snowy winters contributed to increases in summer river discharge, whose relationships had identified by statistical analysis and model simulations. However, there were no yet observations demonstrating the feedback of the declining sea ice to the Arctic hydrologic regimes. Isotope is a useful tool to figure out the questioned realities. We have an observational plan that simultaneously monitors oxygen and hydrogen isotope ratios of water vapor in both ocean by research vessel and land. Although the observations help understanding about the variations of isotopic ratio of the moisture in individual areas, it is limited in tracking the routes that moisture flows to the terrestrial area from the ocean. Therein, observations by flying boat can specify dynamics and transporting routes in the atmosphere of water vapor sourced from the oceanic surface. Dynamics of the moisture in the terrestrial system will be identified by a land surface model coupling an isotope model for water flux. Moreover, the combination of global isotope climatic model with the observational network makes it possible to assess the sea-ice decline induced changes in the Arctic hydrologic system. This research plan is probably the first challenge to explain the amplification of the Arctic hydrologic system under climate changes, based on the observational results.

Keywords: Arctic, sea-ice retreat, isotope, flying boat

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Possible applications of floatplanes for lake sampling

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We will introduce some plans to collect water samples in lakes and semi-enclosed seas using floatplanes.

Keywords: floatplane, lake observation, biogeochemical cycles

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Application of large flying boat for making observation in response to events in the Earth and Planetary Sciences

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The one of the benefits of using a large flying boat for Earth and Planetary Sciences research is the capability to respond quickly to events that occurred in the atmosphere and ocean. For example, large scale volcanic eruption, earthquake, forest fire, yellow dust blown over from China by a gust of wind and artificial pollution from a nuclear accident and tanker accident release large amounts of material and gases onto Earth’ s surface and into the atmosphere. These substances are often eventually transported to, or deposited on, the ocean. Unfortunately, important opportunities to measure the effects of such events on the ocean may be missed, because the traditional means of collecting samples from the ocean (i.e., large ships) require response times ranging from several days to months. However, a flying boat could be deployed, and allow field surveys to be conducted, within 24 hours, if necessary. As an example, several recent studies that investigated the influence of typhoons on the marine environment have pointed out that typhoons may cause marine phytoplankton blooms, and this phenomenon is of increasing interest throughout the world. However, the mechanisms by which typhoons may stimulate phytoplankton blooms are poorly understood, because the necessary samples often cannot be obtained because of the risks of conducting research on ships during such events. A flying boat would allow such challenges to be overcome. We will discuss our vision for using a flying boat to make observations during and immediately following events of Earth and Planetary Sciences.

Keywords: Flying boat, Events of Earth and Planetary Sciences

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