

Science and Engineering



Title of Project : Mid-latitude ocean-atmosphere interaction hotspots under the changing climate

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【Purpose of the Research Project】

Frequency of extreme rainfalls and snowfalls has been increasing these years, and those events severely affect human lives and properties.

It has been considered that tropical ocean and atmosphere variability such as El Niño, as well as the warming climate, remotely influences mid-latitude extreme weather/climate, while the mid-latitude ocean is passive to atmospheric variability. Current operational seasonal climate predictions are conducted based on this climate “assumption.”

Recent high-resolution ocean/atmospheric data analyses, however, have revealed that mid-latitude ocean also influences atmospheric circulations and their variability. Rediscovering strong warm current (e.g., the Kuroshio and the Gulf Stream) and associated strong ocean frontal zones as “*climate hotspot*”, we have elucidated mechanisms of ocean-atmosphere interactions and established a new paradigm of active roles of mid-latitude oceans in the climate system, replacing the conventional “assumption.”

The research progress has prompted a new crucial task: application of such new knowledge to predictions of extreme rainfalls/snowfalls and climate variability. In the present project, I) we will further our understandings of mid-latitude ocean-atmosphere interaction processes that span multiple spatio-temporal scales and interplay among them through tight collaborations of latest observational and numerical modeling tools. Also, based on the improved understandings, II) we investigate predictability of extreme weather (such as typhoons and bomb cyclones), of persistent atmospheric circulation anomalies that induce those extremes, projection of climate changes, and active roles of mid-latitude oceans in those phenomena. The purposes of the present project are then deepening of the previously established paradigm and showing its scientific and societal importance and validity.

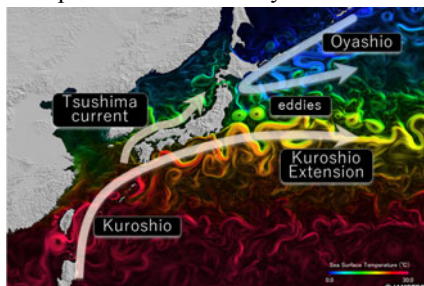


Figure 1. Ocean currents and temperature around Japan

【Content of the Research Project】

For I), we conduct an intensive observational campaign of both atmosphere and ocean in the Tsushima warm current region located upwind of Japan with directly impacts on its

climate, utilizing state-of-the-art observational equipment. We further expand our understanding of ocean-atmosphere interactions with their linkage to atmospheric substances through investigations of impacts of heat and aerosols exchanges between ocean and atmosphere on low-level clouds and marine ecosystems.

For II), our studies will extend to evaluations of potential improvements of prediction and/or uncertainty of disaster inducing atmospheric circulation anomalies and extreme rainfall/snowfall, by considering active influences from mid-latitude oceans. Also, we will try to obtain general understandings of roles of *climate hotspot* under the changing climate and its impacts on uncertainty of climate change projection.

【Expected Research Achievements and Scientific Significance】

Three achievements are expected: 1. Further deepening of our understandings of multi-scale ocean-atmosphere interactions and their mechanisms. 2. Evaluations of possible contributions of ocean-atmosphere interactions in *climate hotspot* and especially ocean's active roles onto improvements of predictability of extreme rainfall/snowfall, extreme weather events such as typhoon and bomb cyclones, and persistent atmospheric circulation anomalies associated with extreme climate. Also, estimations of predictability of ocean currents and eddies, which induce ocean temperature variability. 3. Basic and general knowledge on overlooked roles of mid-latitude air-sea interactions for the warming climate. This will make the first estimation of uncertainty of climate change projection caused by mid-latitude ocean-atmosphere interactions in climate projection models. Through these developments in the fields of *predictability* and *global warming*, wide societal impacts are expected from the present project.

【Key Words】

mid-latitude air-sea interactions (ocean and atmospheric affect each other to induce their structure and variability)
extreme weather/climate (unusual state such as extreme rainfalls and snowfalls with several days scale, and such as cool summer and warm winter with seasonal scale)

【Term of Project】 FY2019-2023

【Budget Allocation】 1,138,000 Thousand Yen

【Homepage Address and Other Contact Information】

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