R&D item

A-3. Exploring technologies to modify moist-convection over ocean

Progress until FY2023

1. Outline of the project

Background: When attempting to appropriately intervene in severe weather to mitigate its threats, it is critically important to consider what kind of intervention methods should be used. Phenomena that develop over the ocean, like tropical cyclones, ideally should be intervened over ocean. It is necessary to develop new intervention methods that do not currently exist, in collaboration with theoretical research.

Objective: Based on the other theoretical R&D item, **we will develop novel and realistic intervention methods** which can significantly alter the future of extreme weather events, including tropical cyclones.

Method: We will focus on the individual cumulonimbus clouds which are generated in tropical cyclones over ocean. By taking a multifaceted approach to these cumulonimbus clouds and the moist convection which produces them, we aim to suppress these clouds (see Fig. 1). We will explore methods that can be implemented over ocean.

2. Outcome so far

① This R&D item was launched in January 2024. In collaboration with other R&D items, as shown in Fig. 1, **we have formulated a strategy to intervine the weather systems which produce individual cumulonimbus clouds over ocean from both the top and bottom of the atmosphere**.

② To realize the effective intervention from the top of the atmosphere, **we are exploring ice-nucleating substances derived from plants and fungi**. By dispersing these from aircrafts and other means, we aim to control weather which produces cumulonimbus clouds. Compared to similar approaches, **our goal is to design solutions which have minimal environmental impacts and are more effective**. Fig. 2 summarizes the ice-nucleating activity inside blueberry branches. It has been found that ice can form inside blueberry branches even at relatively high temperatures (e.g., -1.6°C), which typically do not support ice formation. In FY2023, we advanced the analysis of ice-nucleating substances found in forsythia branches and fungi isolated from under snow.

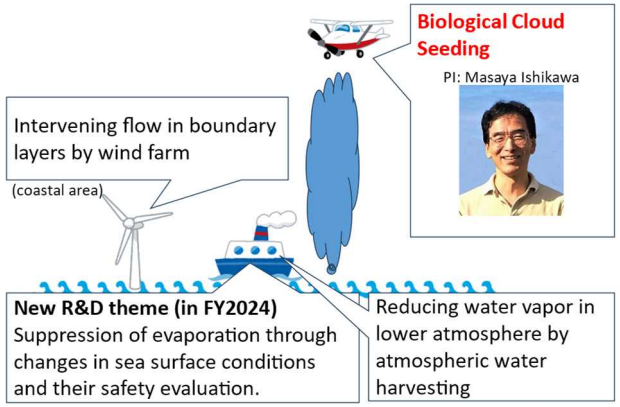

Fig. 1. Overview of this R&D item.

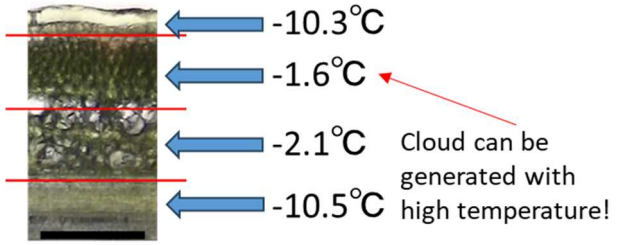

Fig. 2: Ice nucleation activity inside blueberry branches. The temperature at which freezing occurs varies depending on the location. From the perspective of weather control, it is desirable for freezing to occur at higher temperatures. It is important to search for substances that can freeze even at such high temperatures.

3. Future plans

In FY 2023, although the research period for this R&D item was three months, we were able to launch research activities and achieve initial results with methods which aims to intervene the top of cumulonimbus clouds. Going forward, we will continue to develop new substances which can efficiently create clouds and ice in the atmosphere.

Furthermore, as shown in Fig. 1, research on a wide variety of intervention methods is planned for the next fiscal year and beyond. In particular, approaches that intervene in the humidity of the lower atmosphere are considered promising based on theoretical research in other R&D items. Therefore, we plan to energetically develop intervention methods in this direction.