R&D Theme

Examining ELSI on Typhoon Control

Progress until FY2022

1. Outline of the project

Controlling typhoons is expected to result in social benefits such as disaster prevention and mitigation. This "social implementation" of typhoon control technology has already been mentioned in the Basic Act on Disaster Management (Law No. 223 of 1961), enacted in response to the catastrophe of the Ise Bay Typhoon of 1959.

Most of weather modification technologies, including typhoon control, may cause negative impacts on third parties other than those who benefit from them (beneficiaries). Let us assume: is it ethically permissible to apply typhoon control technology when, even if it is possible to prevent a river A from overflowing, that rain will fall in another area B, resulting in a landslide disaster? Also, if the attempt to control happens to have an unpredictable negative impact on a third party (meaning that the "control" fails), who should bear this loss and how?

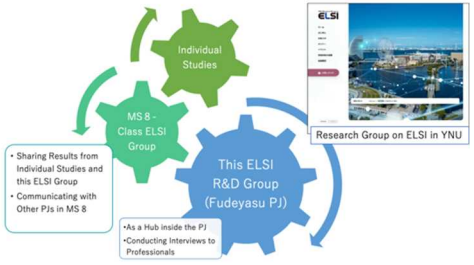

Figure 1 The Role of This Group

This group, led by researchers in the humanities and social sciences, will study the ethical, legal, and social issues (ELSI) that could result from the social implementation of typhoon control technology through multidisciplinary perspectives. In FY2022, the group is also involved in building a framework for collaboration (Figure 1).

2. Outcome so far

In this project, the following three categories of ELSI are examined.

The first is **issues related to environmental justice and environmental ethics**. Intervention in natural phenomena like typhoons may conflict with the concept of the right of nature, meaning nature shall be preserved as it is. In addition, typhoons are a blessing that brings water resources to various regions, creating an adversarial relationship not only between disaster mitigation versus collateral damage but also disaster mitigation versus unexpected drought. We have struggled with the issues from the perspective of the theory of justice.

The second is **legal and institutional issues** which divide into three levels (Figure 2).

Legal Permissibility of Each Method Used for Control	• Permissibility of navigating drones or unmanned airplanes, and unmanned ships even in the engine department	• Examining the possible way to obtain permission
Issues in Operational Phase	• Requirements for control and key criteria (central pressure, maximum wind speed, maximum rainfall, or damage prediction) • Operation of the system • *Ex ante* compensation for predictable negative impact on third parties • *Ex post* compensation for unpredictable negative impact on third parties (introduction of strict liability regime, mandatory insurance, and governmental compensation)	• Assessing possible risks regarding typhoon control • Comparing similar activities such as space activities, generation of nuclear power, navigation of oil tankers
International Relations	• Allocation of water resources between related countries • International collaborations to control typhoons • Building instruments restraining weaponization	• Investigating current international instruments and their limits

Figure 2 Legal Issues

Finally, we also conducted **fundamental research** from historical and comparative perspectives. For example, we conducted a historical analysis of hurricane control experiments (*Project Stormfury*) in the United States in the 1960s and weather modification studies in Japan stimulated by that project (Figure 3). In addition, we compared typhoon control and other weather modification activities such as artificial rainmaking and geoengineering (methods such as modifying solar radiation and absorbing CO_2), by investigating regulations (including voluntary regulations) and social receptivity in each country.

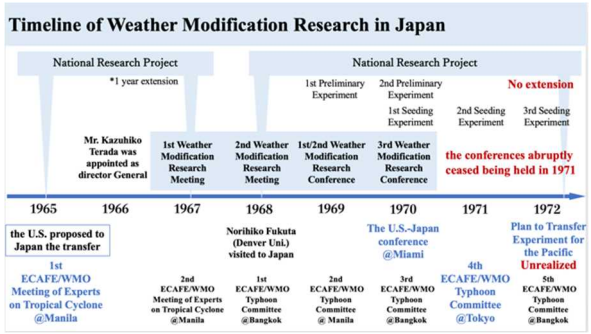

Figure 3 Weather Modification Studies in Japan

3. Future plans

Analyzing and examining ELSI requires a broad network over several academic disciplines. We intend to expand our research network by collaborating with ELSI research groups in other R&D projects and traditional humanities and social science fields (law, political science, ethics, sociology, etc.). In addition, in cooperation with the TRC Consortium aiming at social implementation, we plan to expand our research field into business development related to typhoons and disaster prevention.