NTT and Yokohama National University Begin Joint Research Aimed at Improving the Accuracy of Typhoon Forecasting
--Helping to mitigate the damage caused by typhoons to build a safer and more secure society--

NTT Corporation (Head Office: Chiyoda-ku, Tokyo; President & CEO: Akira Shimada; hereinafter, "NTT" [1]) and Yokohama National University (Head Office: Yokohama City, Kanagawa Prefecture; President: Izuru Umehara; hereinafter, "YNU") have concluded a joint research contract on "Research into methods of typhoon forecasting using ocean-atmosphere observation data over maritime areas."

The project aims to improve the accuracy of typhoon forecasting by enabling the observation of typhoons in real-time using NTT'S ultra-wide-area ocean-atmosphere observation technology[2], taking advantage of the respective strengths of both NTT and YNU.

1. Background

As typhoons become ever more devastating due to the advance of global warming, the question of how Japan as a typhoon-prone country can defend its safety and security in terms of this threat to its citizens' lives and property is becoming a social challenge of great import. In particular, cities along the western and eastern sides of Japan have been buffeted by major typhoons in the form of Typhoon Jebi in 2018, followed in rapid succession by Typhoon Faxai in 2019 and Typhoon Hagibis in the same year, engendering record-breaking levels of economic damage (Table 1). Unfortunately, despite the various disaster prevention and mitigation measures that have been put in place to date, there seems to be no end in sight to the damage caused by typhoons. To achieve a breakthrough in this situation, it is essential that typhoon forecasting information be provided with greater speed and accuracy, to mitigate the damage caused by these disasters.

Table 1: Insurance proceeds paid out due to major typhoon/flood-related damage in previous years[*3]

(Survey by the General Insurance Association of Japan, end March 2022)

Ranking	Name of disaster	Region	Month/year	Insurance proceeds paid out (hundreds of millions of yen)
1	Typhoon Jebi (2018)	Kinki region	September 2018	10,678
2	Typhoon Hagibis (known in Japan as the "Reiwa 1 East Japan Typhoon")	East Japan	October 2019	5,826
3	Typhoon Mireille (1991)	All of Japan	September 1991	5,680
4	Typhoon Faxai (known in Japan as the "Reiwa 1 Boso Peninsula Typhoon")	Kanto region	September 2019	4,656
5	Typhoon Songda (2004)	All of Japan	September 2004	3,874

The accuracy level of predictions of the path of typhoons has risen due to improvements in numerical prediction models and the like; however, unlike the improvements seen in path prediction, there have been no clear improvements in accuracy when it comes to predicting the intensity level of typhoons[*4]. If the accuracy of typhoon forecasting is to be improved, it is essential to improve the actual measurement data that serves as the initial values and as the outcomes with which prediction results are to be compared; correctly ascertaining the processes of change in typhoons that reach the mature stage over maritime waters is a particular challenge.

With the aim of enhancing its regular real-time observational data over maritime waters, NTT started to undertake ocean-atmosphere observations over maritime waters on an experimental basis in 2021, before commencing full-scale typhoon observations from 2022 onwards. In October 2021, YNU established Japan's only research institute dedicated to the study of typhoons, the Typhoon Science and Technology Research Center (hereinafter, "the TRC"); equipped with cutting-edge typhoon forecasting technology, the TRC gathers together first-

class researchers and practical specialists in the domain of typhoons. This joint research project represents the first-ever such initiative between the TRC and a private-sector company. Furthermore, with the TRC also undertaking typhoon observations from aircraft and moving forward with efforts to verify the practical usability of the actual data thus obtained, growing evidence is emerging of the importance of particular aspects of such data, including not only atmospheric pressure and wind speeds close to sea level (which indicate the strength of a typhoon), but also water vapor levels and seawater temperatures, which correlate strongly with the energy sources of typhoons.

2. Overview of the joint research project

Researchers at TRC will not only work on the observation and forecasting of typhoons, but will also look ahead to experimental endeavors that aim to look beyond mitigation of the damage caused by typhoons and to make use of typhoons' energy, with various research themes underway that are connected with controlling typhoons or using their power to generate electricity. NTT, meanwhile, aims to develop a sensing system that can communicate with low-earth-orbit satellites and high altitude platform stations (HAPSs) floating above the earth at high altitudes, with the aim of integration with NTT's Space Integrated Computing Network project. In this joint research project, NTT's ocean-atmosphere observation data obtained from the areas directly affected by typhoons will be incorporated into the TRC's typhoon forecasting model, and the contribution that this makes to improving the accuracy of forecasting will be verified.

Main aspects covered under the joint research
- Candidate areas for observations (areas that are expected to provide helpful data for improving forecasting results based on deductions made from typhoon forecasting models) will be sifted out
- An observation plan will be formulated based on the candidate observation areas
- Improvements in typhoon forecasting accuracy will be verified, using typhoon observation data

NTT's role
- To formulate an observation plan aligned with the measurement equipment and the operation of such equipment, based on the candidate observation areas that will provide helpful data for forecasting the path and intensity of typhoons, and to obtain typhoon observation data
- To define and set out the requirements needed for the optimization of observation, in order to ensure the accuracy of typhoon forecasting, with the aim of developing real-time typhoon observation based on ultra-wide-area ocean-atmosphere observation technology

YNU's role

- To sift out candidate areas for typhoon observation that will provide helpful data for forecasting the path and intensity of typhoons
- To undertake and verify forecasting using typhoon forecasting models

3. Future expansion of the project

TRC aims to become a global leader by pushing forward innovative research that aims to make use of typhoons as a source of "benefits," rather than positioning them merely as "threats." NTT aims to enable observations over a wider area and in real time, including unexplored areas, by making use of its Space Integrated Computing Network project which enables use of low-cost sensing over an ultra-wide area. By making it possible to conduct real-time observation of maritime weather conditions over an ultra-wide area through collaborating with a variety of industries and organizations, NTT will help to develop high-accuracy forecasting of future typhoons as part of environmental and social activities, transforming typhoons into a "benefit" for humanity, and helping to build resilience among the countries of the Pacific Rim.

From left to right: Masaki Hisada, Senior Research Engineer / Group Leader of Global Environmental Futures Forecasting Technology Group, NTT Space Environment and Energy Laboratories; Yuji Maeda, Vice President/Head of NTT Space Environment and Energy Laboratories; Izuru Umehara, President, YNU; Hironori Fudeyasu, Professor and Director, TRC

[NTT logo] [YNU 横浜国立大学 logo]

[1] Presentation on the project by NTT
https://group.ntt/en/newsrelease/2023/01/25/230125a.html

[2] Press release, September 26, 2022
NTT and JAMSTEC Begin Joint Research on Advanced Ocean-Atmosphere Observations
--Achieving Global Environment Simulation and Contributing to Understanding, Regeneration, and Preservation of the Global Environment—
https://group.ntt/en/newsrelease/2022/09/26/220926a.html

[3] 10 Largest Claims Paid for Typhoons and Windstorms in Japan (Japanese)
https://www.sonpo.or.jp/report/statistics/disaster/ctuevu000000530r-att/c_fusuigai.pdf

[4] Japan Meteorological Agency: Typhoon route forecasting accuracy verification results (forecasting of typhoons' central points) (Japanese)
https://www.data.jma.go.jp/fcd/yoho/typ_kensho/typ_hyoka_top.html