R&D Theme

Typhoon simulations using novel flux models and suggestions for typhoon control

Progress until FY2022

1. Outline of the project

The prediction accuracy of typhoon tracks has increased notably over the past 40 years, whereas that of typhoon intensities has not been improved. One of the causes is the difficulty of representing the momentum and heat transfer mechanisms across the sea surface in extremely high wind speed conditions using conventional transfer models for typhoon simulations because the momentum and heat fluxes significantly influence typhoon energies.

This R&D theme aims to conduct accurate numerical simulations of typhoons using the detailed parameterization of drag and heat transfer coefficients measured in the world's largest typhoon simulation tank. The simulations are performed by using the Multi-Scale Simulator for the Geoenvironment (MSSG, Fig, 1), which is a numerical model developed in JAMSTEC, and the Earth Simulator supercomputer system. The goal of this theme is to numerically suggest whether typhoons are controlled (weakened) by manipulating sea surface conditions or not.

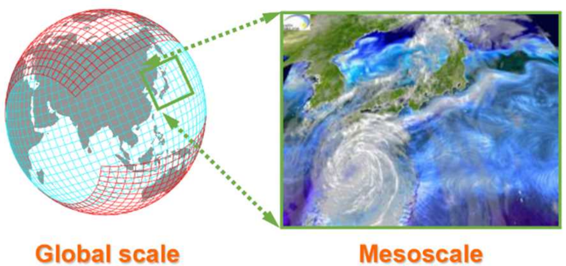

Fig. 1: Multiscale numerical model MSSG

2. Outcome so far

① Simulations for predicting typhoon intensities

The MSSG incorporates equations for computing the momentum and heat transfer between the sea surface and atmosphere. We first implemented a new flux parameterization based on laboratory measurements conducted by our project members (Komori et al., *J. Phys. Oceanogr.*, 2018) and examined how reasonably the MSSG predicts typhoon tracks and intensities using the parameterization. The test case was Typhoon T1330 (Haiyan), which developed on November 4, 2013 near Chuuk Lagoon.

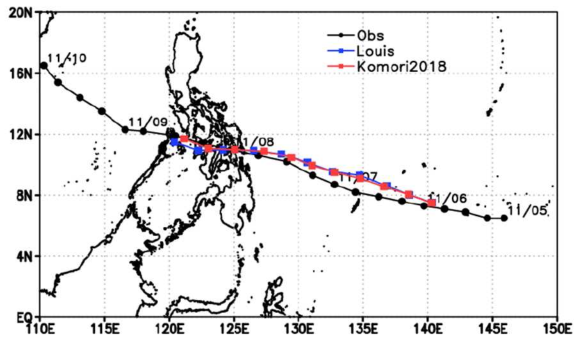

Fig. 2: Track of T1330 obtained by the simulation

② Controlling typhoon via wave modification

Further typhoon simulations were conducted by modifying the transfer coefficients for computing the momentum and heat fluxes across the sea surface. The predictions for the minimum sea-level pressure and maximum wind speed suggested that typhoons are influenced by altering the energy transfer across the sea surface.

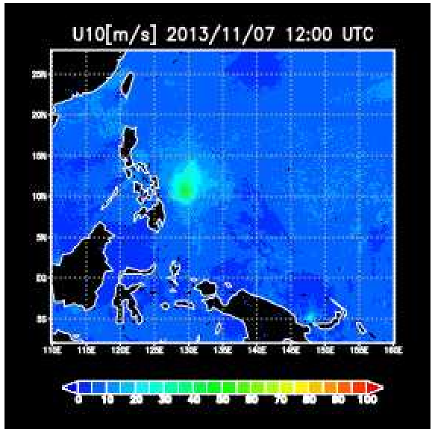

Fig. 3: Wind speed of T1330 obtained by the simulation

3. Future plans

We will conduct more accurate numerical simulations of typhoons by incorporating the latest experimental information on momentum and heat fluxes which will be provided from our experimental R&D themes. Furthermore, to contribute to the Moonshot Goal, we will conduct numerical investigation to examine whether the manipulation method of sea surface conditions, proposed by our experimental group, allows us to control (weaken) typhoons by significantly altering the momentum and heat fluxes across the sea surface.