Development of the stretch-atmosphere and ocean model to study air-sea interaction associated with tropical cyclones

*Hiroyasu Kubokawa[1], Masaki Satoh[1,2], Takashi Arakawa[3], Hiroyasu Hasumi[1,2]

1. Atomosphere and Ocean Rerearch Institute, The University of Tokyo, 2. Japan Agency for Marine-Earth Science and Technology, 3. Research Organization for Information Science and Technology

The tropical cyclones have the large impacts on our lives. While the track of tropical cyclone is mainly controlled by wind fields associated with the Pacific high, development is influenced by heat flux from the oceans. A global nonhydrostatic atmospheric model (NICAM) can simulate the tropical cyclones and deep convection in the tropical regions. In order to understand the interactions between atmosphere and ocean associated with tropical cyclone, we need develop the atmosphere-ocean coupling model.
We select the stretched-version NICAM (Tomita et al., 2008) as an atmospheric model and also select the CCSR Ocean Component Model (COCO) as an ocean model. The Stretch-NICAM saves computational resources by focusing on a specific region at high resolution. However, the horizontal resolution becomes coarser for the region outside of the target region. The horizontal spacing of stretched-version NICAM and COCO is about 6 km and 1 degree grid, respectively. This is the first time to use the stretched atmospheric model as a coupling model. Hereafter we call this new coupling model as stretched-version NICOCO. The horizontal grid configuration is difference between stretched-version NICAM and COCO. Here we insert the coupler model (called Jcup) between the two models and exchange fluxes with every 1 hour. The initial condition of the NICAM is prepared by NCEP Tropospheric Analysis data.
In this study, we chose the tropical cyclone generated at 28 August 2004 near Japan and investigate the air-sea interaction associated with the tropical cyclone. The model integration was performed with 7 days. To compare the real ocean, we also use the 4-dimensional Ocean Reanalysis dataset (FORA) and Argo floats data. For a comparison, we also performed simulation by only oceanic model (COCO) with 33 days (18 Aug. 2004 to 19 Sep. 2004). In this simulation, atmospheric forcing is given by ERA-Interim (1.25degree). Horizontal resolution of atmospheric forcing is different from stretched-version NICOCO. Our new model shows that sea surface temperature near tropical cyclone drops and which is 1 K colder compared with FORA data. The sea surface height (SSH) and mixed layer depth (MLD) are also changed. These variables decreased associated with tropical cyclone. Mei et al. (2013) showed that SSH decreases associated with tropical cyclone. The negative anomaly reached 6 cm at maximum. While FORA shows the good results, stretched-version NICOCO shows the rapid recovery of SSH compared with observations. In stretched-version NICOCO and FORA, MLD becomes deepen associated with tropical cyclones. However, similar with SSH, recovery is rapid in stretched-version NICOCO. Compared with COCO, stretched-version NICOCO shows the large amplitude of SSH and MLD variation, it may be caused by difference of horizontal resolution of atmospheric forcing.
In the presentation, we will discuss the results about the boundary layer and state in the sea.

Keywords: stretch-atmosphere and ocean coupling model

