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High-Resolution Simulations of Typhoons Using the Cloud-Resolving Model

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The horizontal scale of a typhoon ranges from several 100 km to a few 1000 km while that of the cumulonimbus clouds is an order of 10 km. Heavy rain is localized in the eye wall and spiral rainbands which develop within the typhoon. These characteristics make it difficult to perform numerical simulations of typhoons. Since cumulonimbus clouds are essentially important for typhoon development, a cloud resolving model is necessary for a detailed numerical simulation. In order to perform simulations and numerical experiments of the severe storm systems such as typhoons, we have been developing a cloud-resolving numerical model named 'the Cloud Resolving Storm Simulator' (CReSS).

Some typhoons usually attack Japan and its surroundings and causes, severe disaster. In particular, ten typhoons landed over the main lands of Japan in 2004. Accurate prediction of the associated intense wind and rainfall is very important for disaster prevention. In the present paper, we show two simulation experiments of typhoons. One is the typhoon T0418 which brought a very intense wind and caused huge disaster due to the strong wind. The other is T0423 which brought a heavy rainfall and caused severe floods.

The main objectives of the simulation experiments of T0418 are to study the eye wall as well as spiral rainbands, and to examine structure of the strong wind associated with the typhoon around Okinawa Island. The simulation experiments of T0418 started from 0000UTC, 5 September 2004. The simulation experiment of the horizontal resolution of 5km shows a large eye wall. A weak precipitation forms around the central part of the eye. The maximum tangential velocity is located along the eye wall and at a height of 1km. It is larger than 65m/s. The low-level inflow in the radial direction reaches to the eye wall. Weak radial wind leaks into the central part of eye. This causes the precipitation within the eye. The maximum vorticity is located along the eye wall and around the height of 1km. A second maximum is present within the eye.

In contrast to T0418, T0423 is characterized by heavy rainfall over Japan. Heavy rainfalls associated with T0423 caused severe floods and disasters in Japan. In the simulation, a northward moisture flux is large in the east side of the typhoon center. When the large moisture flux reaches to the Japan Islands, heavy rainfalls occur along the Pacific Ocean side. The heavy rainfall moved with the movement of the typhoon eastward. Heavy rainfall began in the Kinki District as well as along the east coast of the Kii Peninsula around 04UTC, 20 October. The heavy rainfall along the Pacific Ocean sides moved eastward, while that in the Kinki District lasted until 09UTC. After the typhoon moved to the east of the Kinki District, the northeasterly intensified significantly. Consequently, orographic rainfall formed in the norther part of the Kinki District. As a result, the accumulated rainfall was large and the severe flood occurred.