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Title: High-Resolution Modeling of Localized Heavy Rain Associated with Mesoscale Convective Systems during the Baiu Season

Abstract: In East Asia, heavy rain is often caused in association with the Baiu/Changma/Meiyu front. Understanding and numerical prediction of heavy rain are one of the most important objectives of the mesoscale meteorology. Since intense convective systems are usually composed of cumulonimbus clouds, a cloud resolving numerical model is necessary for simulation of heavy rain. In order to perform simulations and numerical experiments of cloud and precipitation systems, we have been developing a cloud-resolving numerical model named ``the Cloud Resolving Storm Simulator'' (CReSS).

Since heavy rainfall systems often have a multi-scale structure ranging from a cumulonimbus cloud to synoptic-scale, a large computational domain and very high resolution grid to resolve individual classes of the multi-scale structure are necessary to simulate evolution of convective systems. The purpose of this research is simulation of a localized heavy rain associated with mesoscale convective systems during the Baiu season. In this research, we optimized CReSS for the Earth Simulator and performed numerical simulation of the localized heavy rain.

The heavy rain event occurred on 19-20 July 2003 in Kyushu, which is the western Japan. During this period, the Baiu front was located to the north of Kyushu. The most intense rain occurred during the period of 16-22 UTC, 20 July and the area of the heavy rain was roughly 100 x 100 km. The total amount of rain of this period reached about 210 mm at Minamata City which is located in the western Kyushu. The heavy rain caused a flood and 21 people were killed. Radar data provided by JMA (the Japan Meteorological Agency) shows that intense echo systems developed within a mesoscale convective system and moved into the west coast of Kyushu. An intense rainband extended in the east-west direction and some orographic rainfall echoes developed in the western Kyushu.

The initial time of the simulation experiment with a horizontal resolution of 2 km was 00 UTC, 19 July 2003 and 24-hour integration was performed. The experiment successfully simulated the localized heavy rain. The result showed that an intense rainband developed to the west of Kyushu and the intense rain occurred along the west coast of Kyushu. The rainfall pattern in the simulation is quite similar to the observation with regard to the pattern and intensity of rain. We also performed prediction experiment with a fine gird size of 500 m. The increase of horizontal resolution shows the detailed structure of the convective system. The rainband extends from SW to NE. It is composed of intense convective cells. The simulation resolves individual convective cells. The experiment with the high resolution also shows orographic precipitation. The simulation shows that another rainband is present to the south of the main rainband. It forms on the lee side of small islands over the sea, which is named the Koshiki islands. We consider that both the two rainbands caused the localized heavy rainfall.

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