AOGS 2006

The Formation Process of Heavy Rainfall Caused by the Typhoon T0423 in the Mid-Latitude

KAZUHISA TSUBOKI

Hydrospheric Atmospheric Research Center (HyARC), Nagoya University

When a typhoon is located over the low-latitude ocean, it is composed of active cumulonimbus clouds. The eye-wall and spiral rainbands are conspicuous within the typhoon. On the other hand, they are often modified and become indistinct when the typhoon comes to the mid-latitude around the Japanese islands or the Korean Peninsula. Although the latent heat from the sea is reduced, a heavy rainfall occasionally occurs over the land and it results in floods and landslides. One of significant cases of heavy rainfall caused by typhoons in the mid-latitude occurred in the central part of Japan on 20 October 2004. The typhoon T0423 brought the heavy rainfall and caused a severe disaster due to the flood. Even though the eye-wall and spiral rainbands were indistinct when T0423 approached the area, the intense rainfall more than 30 mm/hr was brought to the area. We studied the heavy rainfall associated with T0423 using the cloud-resolving model. The purpose of the present study is to clarify the formation process of the heavy rainfall caused by the typhoon when it came to the mid-latitude. In order to perform simulation and numerical experiments of high-impact weather systems, we have been developing a cloud-resolving numerical model named the Cloud Resolving Storm Simulator (CReSS), which is a non-hydrostatic and compressible equation model with detailed cloud microphysics. Since typhoons are a large system and consist of both convective and stratiform clouds, a large domain and a very high-resolution grid are necessary to simulate evolution of the typhoon and associated precipitation system. In this research, we improved the CReSS model and optimized it for the Earth Simulator, which is a huge parallel computer system of Japan. In order to simulate both the overall structure of T0423 and the detailed structure of the heavy rainfall, the domain of calculation is as large as 1536 times 1408 km in horizontal and the horizontal resolution is as high as 1 km. We performed 30-hour simulation of T0423 from 1200UTC, 19 October 2004. The initial and boundary conditions were provided by the JMA (Japan Meteorological Agency)-RSM (Regional Spectral Model) output. The movement of T0423 and the rainfall were successfully simulated. Since the distribution and intensity of precipitation well corresponded to the observation, we will describe the heavy rainfall using the result of the simulation. When T0423 landed over the Japanese islands from the Pacific Ocean, the heavy rainfall began in the central Japan. The intense rainfall more than 20 mm/hr was maintained for the period from 04 to 09 UTC, 20 October 2004. The vertical cross section of the heavy rainfall system shows that the mixing ratio of precipitation increases at a height of 6 km, which is higher than the melting level. Snow mixing ratio is large above the melting level

and increases with time. Snow is significantly dominant than the graupel above the melting level. The heavy rainfall is formed from the melting of the solid phase precipitation particles. The streaks below the melting level are simulated in the region of the heavy rainfall. This indicates that the heavy rainfall was brought by rather a stratifrom precipitation system than intense organized convective clouds. When the typhoon comes to the mid-latitude, convections are weakened while the intense accumulation of snow above the melting level occurs. We infer that melting of the accumulated snow particles results in the formation of the heavy rainfall in the central part of Japan.