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Quantitative analysis of precipitation over Fukushima to understand the wet deposition process in March 2011

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The Great East Japan Earthquake caused a severe accident at the Fukushima-Daiichi nuclear power plant (NPP), leading to the emission of large amounts of radioactive pollutants into the environment. The transport and diffusion of these radioactive pollutants in the atmosphere caused a disaster for residents in and around Fukushima. Studies have sought to understand the transport, diffusion, and deposition process, and to understand the movement of radioactive pollutants through the soil, vegetation, rivers, and groundwater. However, a detailed simulation and understanding of the distribution of radioactive compounds depend on a simulation of precipitation and on the information on the timing of the emission of these radioactive pollutants from the NPP. Past nuclear expansion studies have demonstrated the importance of wet deposition in distributing pollutants. Hence, this study examined the quantitative precipitation pattern in March 2011 using rain-gauge observations and X-band radar data from Fukushima University.

We used the AMeDAS rain-gauge network data of 1) the Japan Meteorological Agency (1273 stations in Japan) and 2) the Water Information System (47 stations in Fukushima prefecture) and 3) the rain-gauge data of the Environmental Information Network of NTT Docomo (30 stations in Fukushima) to construct 0.05-degree mesh data using the same method used to create the APHRODITE daily grid precipitation data (Yatagai et al., 2009, 2012). Since some AMeDAS data for the coastal region were lost due to the earthquake, the complementary network of 2) and 3) yielded better precipitation estimates.

The data clarified that snowfall was observed on the night of Mar 15 into the morning of Mar 16 throughout Fukushima prefecture. This had an important effect on the radioactive contamination pattern in Fukushima prefecture. The precipitation pattern itself does not show one-on-one correspondence with the contamination pattern. While the pollutants transported northeast of the NPP and through north Kanto (about 200 km southwest of Fukushima and, 100 km north of Tokyo) went to the northwest, the timing of the precipitation causing the fallout, i.e., wet-deposition, is important.

Although the hourly Radar-AMeDAS 1-km-mesh precipitation data of JMA are available publically, it does not represent the precipitation pattern in Nakadori, in central Fukushima prefecture. Hence, we used 10-minute interval X-band radar, located in north Nakadori to determine the start and detailed horizontal pattern (120-m mesh) of the precipitation. Since 1) and 3) are 10-minute intervals and 2) is hourly data, we are developing hourly gridded data and using 1?3) to verify and quantify the rain rate observed by the Fukushima University X-band data.

Keywords: precipitation, snowfall, wet deposition, fallout, radar, Fukushima

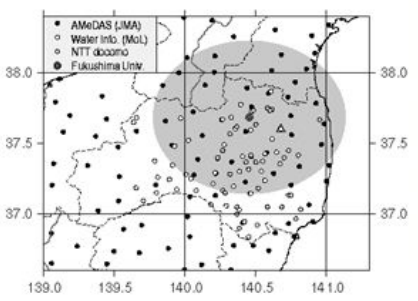

Fig.1 Rain-gauge distribution used in this study, and coverage of Fukushima University's X-band radar.

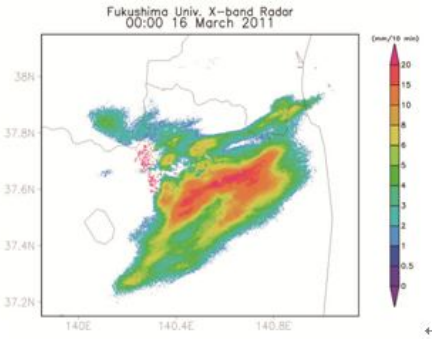

Fig.2 An example of rain rate pattern observed by the X-band Radar of Fukushima University.