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Campaign Observation at Keihanshin Area for Detecting Convection Genesis

YAMAGUCHI, Kosei[1*] ; NAKAKITA, Eiichi[1]

[1]Disaster Prevention Research Institute

In 2008, around 50 people who enjoyed sunny days along the riverside were flushed away by a sudden flash flood in a small river channel (Toga River) in Kobe urban area of Japan. This extreme event was a combinational result of steep basin slope, paved urban area, and severely localized heavy rainfall, which is more frequent happening in the recent summer of Japan. There are many short and steep rivers passing through urban areas in Japan, and the most of riverside along these rivers are used as a public open place. Because of the steep basin slope and the paved urban area, only short time of the localized heavy rainfall, such as 30 minutes of rainfall with 50mm/hr of intensity, can cause very dangerous situation in urban areas as in the Toga River case.

In order to prevent such flash flood damages, it is very necessary to detect the rain-cells, which may develop to sever storm, as soon as possible and to alert people to evacuate from riverfront before the severe events occur. In this study, we develop a detection technique for the early stage of rain-cell as the first cell aloft (hereafter, baby-cell) in the middle atmospheric layers before it generates heavy rainfall on the ground. The early detection technique is utilizing the 3-D volume scanning data from X-band Multi Parameter radars (X-MP radars), which are equipped near to the most urban area in Japan recently. In our recent study using the 3-D volume scanning information from the X-MP radars, we have successfully developed an algorithm (1) to detect newly generated baby-cells, (2) to identify dangerous level of the baby-cells, and (3) to trace the movement of the baby-cells.

In the developed algorithm, firstly, the detection of newly generated baby-cells is based on the information of 3-D volume scanning data with very fine resolution of the X-MP radars. Secondly, the identification of the dangerous level, whether the detected baby-cells will grow up to heavy rainfall on the ground, is evaluated with the information of vorticity of the baby-cells based on the Doppler velocity information from the radars. Finally, the tracking of the baby-cells is based on the conventional cell tracking scheme. The preliminary test of the algorithm shows that especially, the identification of the developing baby-cells with the vorticity information is very powerful, and most of baby-cells in the early stage of heavy rainfall events were successfully identified. In detail, all the 19 developing baby-cells under our surveillance were successfully detected, and there was only one false alarm (forecasted as a heavy rainfall event, but it was not).

In our presentation, upgraded performance index of our proposed algorithm will be introduced based on various rainfall events happened in Kyoto and Osaka area, Japan. In addition to improving this practical early detection algorithm for localized heavy rainfall events in urban area, we are conducting newly designed observation combination in Kansai area with numerous sensors and equipments as shown in figure to identify the mechanism of the localized heavy rainfall events in urban area, such as Osaka, Kobe and Kyoto. It is definitely our mission to realize a next-generation operational observation network with different types of sensors for earlier detection and/or prediction of generating storm from the stage of air plume and/or cloud. Presentation partly includes current situation and future plan of a plot type field experiment with X-band- polarimetric radar, Ku-band cloud radar, Lider, and X-band phased array radar.

Keywords: Radar, Lidar, Videosonde, Urban Meteorology