Issues on heavy rainfall forecast and disaster information detected from events with band-shaped precipitation systems

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In Japan, single or several band-shaped precipitation systems (BPSs) with the width of 20~50km and the length of 50~200 km occur especially during the rainy season, and stagnate almost in the same area for several hours, which often causes heavy rainfall. Except for heavy rainfall directly associated with typhoons, it was statistically examined that about two third of heavy rainfall events are caused by BPSs, and this rate increases about three fourth for the rainy season (Tsuguti and Kato 2014). The formation processes of BPSs in Japan are majorly classified into two types; one is the break line type in which convective clouds simultaneously generate over a local front formed by the terrain effect and so on, and the other is the back-building type in which convective clouds successively generate on the low-level upstream side. The former example is the heavy rainfall event of Izu Oshima Island in 2013, and the latter is that of Hiroshima in 2014. Here, the accuracy of present numerical prediction for these examples including the 2015 Kanto-Tohoku heavy rainfall is introduced, and some issues on disaster prevent information produced using the prediction are discussed with showing areas where BPSs can likely to occur with high frequency.

The heavy rainfall event of Isu Oshima in 2013 was caused by a BPS occurring over a local front that was formed between cold outflow from Kanto Plain, and warm and humid inflow from the surrounding of Typhoon 1326. The same mechanism can be applied to that of Izu Peninsula associated with Kanogawa Typhoon in 1959. It is needless to say that the location of predicted local front determines the accuracy of heavy rainfall prediction. Most of the front initiated from Kanto Plain is, however, located over the sea, and it is not necessary to pass over islands and Izu Peninsula, which suggests that some ideas are need for disaster prevent information.

In the 2014 Hiroshima heavy rainfall, low-level humid air continuously flowed into the surrounding of the boundary between Hiroshima and Yamaguchi Prefectures, over which convective clouds successively formed, and single BPS was organized. Different initial conditions of numerical predictions yielded different precipitation amounts; however, predicted rainfall areas hardly changed because the inflow region of low-level humid air could be specified. On the other hand, in the 2015 Kanto-Tohoku heavy rainfall since low-level humid air widely flowed into Kanto Plain from the southwest, many BPSs formed over different regions of southern Kanto, which caused 24 hourly accumulated precipitation amounts exceeding 500 mm in northern Tochigi Prefecture. Such a heavy rainfall area was successfully predicted in northern Kanto; however, its detail location was changed in numerical predictions with different initial conditions. This suggests that the disaster prevent information on heavy rainfall associated with BSPs could be broadcasted for wide areas of northern Kanto.

Present numerical predictions are difficult to quantitatively and directly reproduce BSPs; however, understanding of favorable atmospheric conditions for BSP formation is proceeding (Kato 2014; 2015). In the Kanto-Tohoku heavy rainfall case, numerical models could predict heavy rainfall in northern Kanto before 24 hours, while favorable atmospheric conditions for BSP formation could be predicted before further 12 hours. A statistical study on the appearance frequency of favorable atmospheric conditions for BSP formation showed that high rates of about 9 % were analyzed in western Kyushu during the warm season, while it was about 1 % in Kanto. This low rate well corresponds to the fact that heavy rainfall associated with BSPs was rarely observed in Kanto. These results indicate that the disaster prevent information for areas where heavy rainfall

associated with BSPs was observed with low frequency should be discussed and the edification for its understanding is necessary.

Keywords: heavy rainfall, band-shaped precipitation system, numerical prediction, disaster prevent information

