

Utility of operational meteorological data to diagnose environmental conditions for local-scale convective rain events

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Local-scale convective rain events develop rapidly and sometimes spawn water-related disasters. Densely populated urban areas are vulnerable to such disasters due to the local-scale convective rain events. From the perspective of disaster prevention and mitigation, the prediction and diagnosis of local-scale heavy rain events are critically important. In general, such local-scale heavy rain events occur under the influences of synoptic-scale weather disturbances such as typhoons and fronts; but they do develop without the influences of such synoptic-scale disturbances. It is well known that cumulonimbus clouds develop in the afternoon under synoptically undisturbed conditions; however, it is quite difficult to predict and diagnose the intensity of cumulonimbus clouds and when and where those cumulonimbus clouds develop. To overcome this difficulty, research projects that deploy a local-scale dense observation network and merge those high-resolution observed data to numerical weather prediction models are currently underway; these projects in general require a large amount of material and human resources. On the other hand, operational meteorological data compiled by Japan Meteorological Agency (JMA) can be used by research community outside JMA. We have been investigating mesoscale meteorological phenomena by use of the JMA operational data (Nomura and Takemi 2011, SOLA) and the outputs of the JMA/MRI climate simulations with a global warming scenario (Takemi et al. 2012, JMSJ). In the present study, we discuss the utility of operational meteorological data for local-scale analysis by investigating the characteristics of local-scale rain events and their environments under synoptically undisturbed conditions in summer. We focus on the rain events in the Nobi Plain during July and August after the end of the Baiu periods. We statistically analyze Radar-AMeDAS analysis precipitation, AMeDAS surface observations, radiosonde upper-air observations, and mesoscale objective analysis data (MANAL) during the period of 2003 and 2010. The diurnal and regional characteristics of the rain events and the relationship with surface wind and temperature fields are shown. After examining the representation and validity of the MANAL data with the upper-air observations at Hamamatsu, the environmental conditions over the Nobi Plain and the surrounding regions are investigated. By comparing the environmental conditions with and without the rain events, we show that the middle-level moisture contents control the development of local-scale convective rain events in the Nobi Plain. The utility of the operational meteorological data for the mesoscale analysis is demonstrated. We should recognize the utility of the JMA data both for operational and research perspectives; the JMA dataset is our national important property that nothing can be its substitute.

Keywords: Local-scale rainfall, precipitation, environmental condition, operational meteorological data, Japan Meteorological Agency