Improvement of the early detection and quantitative risk prediction method with the three-dimensional wind field from multiple-doppler radar analysis

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The localized severe heavy rainfalls, which has not been experienced in the past, have frequently occurred in Japan due to the effects of climate change. Especially, the Guerrilla heavy rainfall (abbreviated as GHR) by isolated rapidly growing single cumulonimbus is triggering flash floods in a small river basin and has caused huge damage to human life and property. If we alert the hazardous rainfall in 5 to 10 min earlier for evacuation, we could minimize human injuries such as isolation, death, and disappearance. For hydrometeorological disaster prevention, a system of the early detection and quantitative risk prediction methods is necessary to detect the initial stage of a cumulonimbus cloud before it is generated into heavy rainfall. In previous research, by analyzing the volume scan with some heavy rainfall events, an important sign named as the first echo (Baby-rain cell) was verified. Also, the vertical vortex tubes with positive and negative pairs did exist in the GHR. Most of the severely developed storm had a certain criterion of vertical vorticity. By using those analyses, we developed the early detection and quantitative risk prediction method as follows. We collect the radar variables (i.e. the vorticity, doppler velocity, and reflectivity, etc.) at each event and set the risk level when the maximum rainfall reached the ground. Then, we select an appropriate set of explaining variables considering the risk level. With the Receiver Operating Characteristic (ROC) analysis, we could find the most appropriate method to predict the risk level. However, we would like to improve the early detection and quantitative risk prediction method by estimating vertical vorticity, divergence and convergence with real wind field data. So, we apply the multiple-doppler radar analysis to estimate the variables reflecting real phenomena. As a result, the improved early detection and quantitative risk prediction method could predict the risk of GHR development accurately by using only the observed radar data. It is expected that the quantitative risk prediction could represent realistic flood prediction system and increase the leading time enough to reduce disaster.