Numerical simulation of severe weather events in South/Southeast Asia using NHM

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1. Introduction Severe disasters, e.g. heavy rainfall, flood, ground slide, frequently occur in Southeaster Asia. On the other hand, JMA has developed the NHM, and then NHM has been used as operational model to predict the severe phenomena in and around Japan. In this report, numerical simulations of the strong wind and heavy rainfall events were performed by using NHM of JMA to investigate the usefulness of it for the prediction of weather phenomena in the tropical region. Preliminary results on these events will be presented.

2. Strong wind event First event is the strong wind on 29 November 2006 over the Java Sea. A ferryboat was wrecked by the strong wind and high waves, and more than 500 people were claimed. Sea surface wind speed and rainfall intensity when the ferryboat was in distress were observed by AMSR-E (Fig. 1). The wind and rainfall intensity near the accident scene exceeded 20 m/s and 30 mm/hour, respectively (http://www.eorc.jaxa.jp/imgdata/topics2007/tp07024.html). The strong wind event was simulated by NHM with the grid interval of 5 km. The JMA global analysis data were employed for the initial and boundary conditions. A low-pressure system developed south of the Java Island, and then westerly flow intensified by this low pressure system expanded eastward over the Java Sea (Fig. 2). Strong wind region moved to the north of Bali by 16 UTC 29, and then the wind speed at the height of 20 m reached the maximum speed of 27 m/s. A convective region is seen in the Java Sea, while this cluster seems not to much affect the simulated strong wind because it was located far from the strong wind region.

3. Heavy rainfall event Second event is the heavy rainfall occurred at Mumbai on 26 July 2005 (Bohra et al, 2005). Rainfall more than 900 mm/day was observed at Santa Cruz, a suburb of Mumbai (Fig. 3). Although this heavy rainfall occurred at the localized area of 20-30 km, rainfall system that produced the intense rainfall lasted for more than 6 hours. This heavy rainfall was also simulated by NHM with the grid interval of 5 km using the JMA global analysis data. Localized intense rainfall was reproduced near Mumbai while relatively weak rains (less than 10 mm/hour) were generated along the southern coastal line (Fig. 4). Because the heavy rainfall was developed at the coastal line near Mumbai, the topographic effect seems to be essential for its generation. As the convection of the heavy rainfall was developing, the surface pressure near the convection decreased. This drop of the surface pressure intensified the convergence, and maintained the heavy rainfall. As for the horizontal flow around the heavy rainfall, the zonal wind reverses its direction as the height increases. These airflows around the heavy rainfall were favorable to stay the heavy rainfall near the Mumbai.

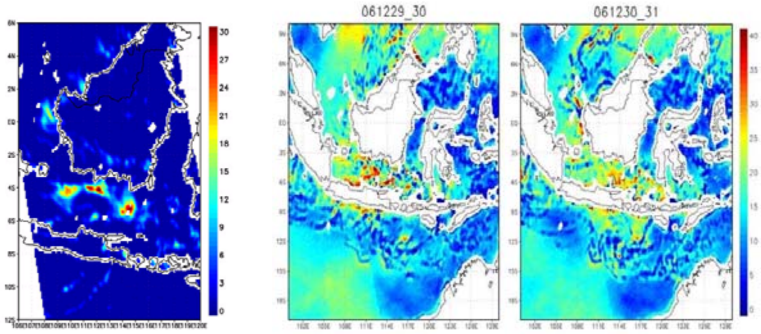

Fig.1 (left) Rainfall intensity and (right) surface wind velocity observed by AMSR-E (From home page of JAXA).

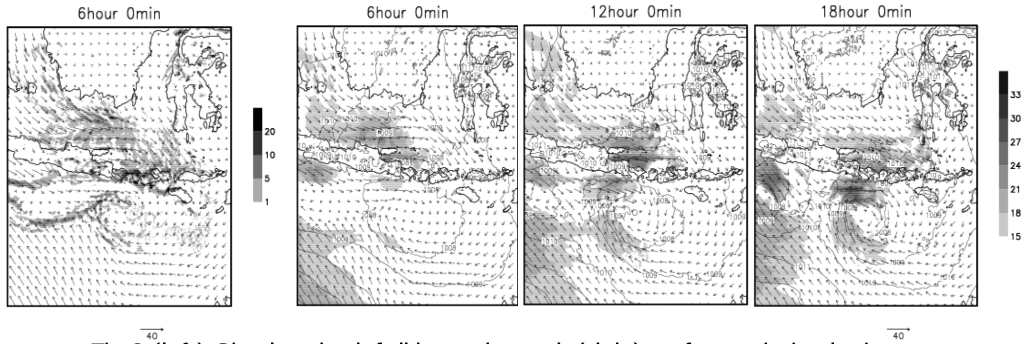

Fig.2 (left) Simulated rainfall intensity and (right) surface wind velocity.

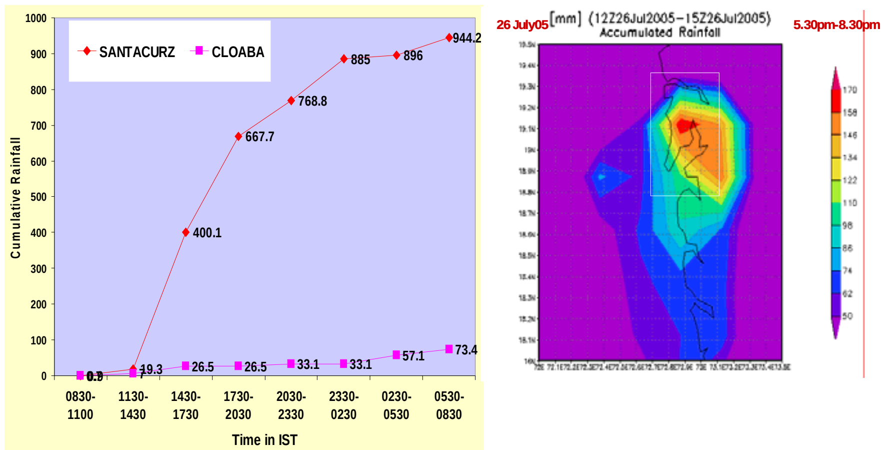

Fig.3 (left) Accumulated rainfall at SANTACURZ and rainfall distribution observed by TRMM (from fig.1 and fig.2 in Bohra et al. 2005).

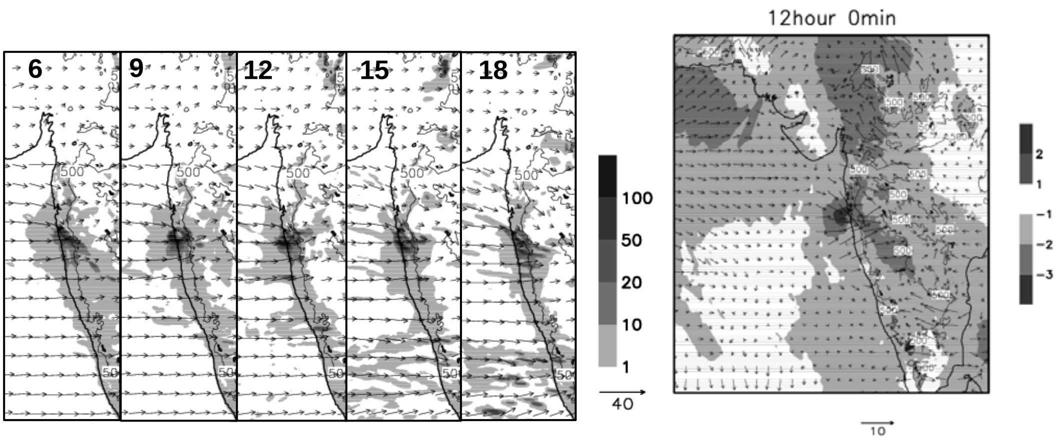

Fig.4 (left) rainfall distribution from FT =6 hour to 18 hour, and (right) the increments of surface pressure and horizontal wind at FT=12 hour from the initial condition.