

Dramatic changes in the inner-core structure of Typhoon Jebi (2018) at landfall and relationship between a mesovortex, heavy rainfall, and strong wind gusts

*Udai Shimada¹, Ryo Oyama¹, Akihito Umehara¹, Shingo Shimizu²

1. Meteorological Research Institute, 2. National Research Institute for Earth Science and Disaster Prevention

Landfalling tropical cyclones experience dramatic structural changes due to increased friction, topography, reduced surface heat fluxes, and reduced moisture supply. Typhoon Jebi (2018) made landfall in Shikoku Island on September 4, 2018, and then it caused record-breaking gust wind speeds greater than 40 m s^{-1} and heavy rainfall greater than 50 mm h^{-1} along its track. Dramatic changes in the inner-core structure of Jebi at landfall and the relationship between heavy rainfall and strong wind gusts, and structural features were examined by using observations including Doppler and polarimetric radar data. The azimuthal-mean structure of Jebi after landfall shows that while the tangential wind at 1-km altitude decreased from 45 m s^{-1} to 30 m s^{-1} , the structure became more compact, with the radius of maximum wind (RMW) at $\sim 50 \text{ km}$ and radar reflectivity increasing inside the RMW at altitudes from 1 to 5 km. Inside the RMW, a mesovortex with a scale of 50 km formed in the downshear-left quadrant when the direction of the vortex tilt changed to the downshear-left quadrant. The mesovortex developed in the convergent region of enhanced frictional inflow. The mesovortex contributed to the strong wind gusts and heavy rainfall. Polarimetric radar variables suggest that the heavy rainfall was mainly caused by warm-rain processes. And, the fast forward speed of more than 15 m s^{-1} increased wind gusts on the right-hand side of Jebi's track. The structural evolution and features of Jebi at landfall were likely caused by two key factors: (i) increase in frictional inflow; and (ii) effect of vertical wind shear.

Keywords: landfalling tropical cyclones, radar analysis, mesovortices