Environmental factors to influence the intensification and structural changes of Typhoon Noru (1705) indicated by satellite data analysis

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Typhoon Noru (1705) was a tropical cyclone (TC) which became a Tropical Storm (TS) near Minamitorishima at 1200 UTC on 20 July 2017, and was drifting counterclockwise over the western North Pacific Ocean. This TC finally made a landfall on the western part of Japan and became the typhoon which maintained the second longest in the list of the Japan Meteorological Agency (JMA). This TC developed first during 0600 UTC 22 July 2017 - 1200 UTC 23 July 2017, then the cloud system size analyzed by using Himawari-8 infrared band drastically contracted while the radius of 30 kt winds did not change very much. Then, it rapidly developed with a gradual expansion of the cloud system size. This study investigated these interesting changes in Noru’ s structure related to TC intensification/weakening by analyses using Himawari-8 and other satellite data, focusing on the atmospheric and oceanic environments. The investigations revealed several noticeable aspects regarding Noru’ s structural changes. First, several successive deep convections, i.e., convective bursts, were detected during the TC intensification phases as the rapid descents in the inner-core cloud top temperature by Himawari-8. Remarkably, the descent of the cloud top temperature occurring just before the rapid intensification phase, from 1800 UTC 29 July 2017 to 0000 UTC 31 July 2017, was the largest, and the height of warm core peak elevated. Second, the significant increases in the cloud-top outflow were revealed by the Himawari-8’ s Atmospheric Motion Vectors (AMVs) during the lifetime. The increases of the cloud-top outflow during the first intensification phase occurred in accordance with increases of the upper-tropospheric winds around the TC, suggesting that the environmental winds could facilitate the TC radial-vertical circulation (TC secondary circulation). Third, the cloud system size significantly contracted after the first intensification phase when the TC entered into the dry region which were identified by mid-to-low tropospheric water vapor amount from Himawari-8 observation and the total precipitable water retrieved from satellite microwave observations. According to the change in the high-resolution daily Sea Surface Temperature analysis (HIMSST) and ocean heat potential, it was possible that the relatively low heat and water vapor fluxes from the ocean could affect the atmosphere drying when Noru was shrinking.

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