Installation of the Dropsonde System on the New Jet Aircraft and Test Observation of Typhoon Mindulle (2021)

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Typhoon is the most intense weather system in the western North Pacific and causes severe disasters in Japan every year as well as in East Asia. Although an accurate prediction of typhoon intensity and track is the most important for disaster prevention, a significant uncertainty is present in a typhoon intensity estimation and almost no improvement of intensity forecast has been made in the last decades. Furthermore, rapid intensification makes intensity predictions even more difficult. To solve these problems, in situ observation using an aircraft is necessary. T-PARCII (Tropical cyclone-Pacific Asian Research Campaign for Improvement of Intensity estimations/forecasts) project has been performing in situ aircraft observations of typhoons since 2017. The first phase of T-PARCII ended in 2021 and the second phase that is supported by Grant-in-Aid for Scientific Research (S) has started in July 2021. The objective of the second phase is a mechanism of rapid intensification and thermodynamic structure of concentric eyewalls in addition to accurate measurements and predictions of typhoon intensity.
The jet aircraft, the Gulfstream II of Diamond Air Service Inc. was retired and a new one, the Gulfstream IV (G-IV) has been put into service. Nagoya University supported the installation of the dropsonde system of Meisei Electric CO., LTD. on G-IV in August 2021. A test flight for dropsonde launching was made September 7, 2021 over the Sea of Japan. Another aircraft followed G-IV and watched launching dropsondes at a height of 20,000 ft. G-IV also made another launching test of dropsonde at a height of 40,000 ft. Eight dropsondes were launched from G-IV and all launching were successful.
Using the dropsonde system on G-IV, the team T-PARCII performed observation test of a typhoon. Typhoon Mindulle (2021) was generated on September 23, 2021 at 13.6 ˚N and 143.3 ˚E and move northwestward toward Okinawa, Japan. Mindulle reached the supertyphoon intensity on September 26 to the east of the Philippines and showed a concentric eyewall structure. When Mindulle reached around 23 ˚N on September 29 to the southwest of the main island of Okinawa, T-PARCII made the aircraft observation of the typhoon. G-IV took off the Nagoya-Komaki Airport and went down to the south toward the Okinawa region. When G-IV passed over Minami-daito Island, a comparison between dropsonde and balloon-sonde launched from the island were made to verify the accuracy of dropsonde. After the comparison test, G-IV approached the eye of Mindulle from the southwest. To observe the inner region of Mindulle, the butterfly pattern of the flight pass was used with three penetration observations into the eye at a height of 45,000 ft. In this observation, altogether 31 dropsondes were launched in the eye and the surrounding region of the eye. All the dropsonde data were transmitted to Nagoya University in real time. When the observation was made, the concentric eyewall disappeared. However, the central pressure and the maximum wind were observed as well as the warm core structure in the eye. This test observation was promising for aircraft observations of future typhoons.

Keywords: typhoon, aircraft observation, dropsonde observation, rapid intensification

