Detection of centers of tropical cyclones using Communication, Ocean, and Meteorological Satellite data

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Tropical cyclones are one of major natural disasters, which results in huge damages to human and society. Analyzing behaviors and characteristics of tropical cyclones is essential for mitigating the damages by tropical cyclones. In particular, it is important to keep track of the centers of tropical cyclones. Cyclone center and track information (called Best Track) provided by Joint Typhoon Warning Center (JTWC) are widely used for the reference data of tropical cyclone centers. However, JTWC uses multiple resources including numerical modeling, geostationary satellite data, and in situ measurements to determine the best track in a subjective way and makes it available to the public 6 months later after an event occurred. Thus, the best track data cannot be operationally used to identify the centers of tropical cyclones in real time. In this study, we proposed an automated approach for identifying the centers of tropical cyclones using only Communication, Ocean, and Meteorological Satellite (COMS) Meteorological Imager (MI) sensor derived data. It contains 5 bands—VIS (0.67μm), SWIR (3.7μm), WV (6.7μm), IR1 (10.8μm), and IR2 (12.0μm). We used IR1 band images to extract brightness temperatures of cloud tops over Western North Pacific between 2011 and 2012. The Angle deviation between brightness temperature-based gradient direction in a moving window and the reference angle toward the center of the window was extracted. Then, a spatial analysis index called circular variance was adopted to identify the centers of tropical cyclones based on the angle deviation. Finally, the locations of the minimum circular variance indexes were identified as the centers of tropical cyclones. While the proposed method has comparable performance for detecting cyclone centers in case of organized cloud convections when compared with the best track data, it identified the cyclone centers distant ($\sim$2 degrees) from the best track centers for unorganized convections.