5D.8 THE SIGNAL OF FUTURE TC INTENSIFICATION IN THE CLOUDSAT MEASUREMENTS

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1. Introduction

Convective heating is the primary energy source for TC in regulating its intensity. Based on previous theoretical and modeling researches (Schubert and Hack 1982, Hack and Schubert 1986, Nolan et al., 2007), the radial and especially vertical location of latent heat release may also be critical in determining intensity change. However, the direct observations of convective heating vertical profile are scarce. CloudSat Tropical Cyclone dataset includes profiles that the distance from TC center is less than 1000-km (Tourville et al., 2015) and this dataset has already proven useful in profiling the vertical structure of convective heating within TCs with a database of nearly 8000 TC overpasses. The CloudSat Tropical Cyclone dataset is adopted in this study for determining the vertical characters in weakening and strengthening TCs.

2. Methodology

CloudSat observation mission with cloud profiling radar has started collecting data since 2006. This study focused on the period from 2006 to 2010 in CloudSat observations of radar reflectivity, ice water content, and liquid water content. For rain rate, we use Aqua AMSR-E observations (whose observation time is one minute earlier than CloudSat) because of its superior ability to detect heavy rainfall. A total of 689 cases were selected from 3761 overpasses under the condition that the radial distance from TC center to an overpass is less than 300-km. Intensity change was retrieved from the difference in pressure between the time of observations and 6 hours after using estimates from the best track archive from Joint Typhoon Warning Center (JTWC) and National Hurricane Center (NHC).

3. Analysis of Satellite Observations

Four parameters are selected from satellite observations to understand how convective structure modulates TC intensity.

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3.1 Radar Reflectivity and Rain Rate

The strength of radar reflectivity depends on the number and the size of drops in the cloud system. The strong reflectivity is primarily under the height of 5-km (radar reflectivity is more sensitive to the water than the ice) and at the area along track distance from 400 to 600 (the shortest radial distance from the swath to TC center is at 501 in this study). Surprisingly, the weakening cases have a slightly larger radar reflectivity than strengthening cases in the areal mean, although there is no significant difference in vertical, as shown in fig. 1 (a),(b),(c). In contrast to the radar reflectivity, the rain rate (not shown) exhibits generally larger values near the storm center in strengthening cases.

3.2 Ice Water Content and Liquid Water Content

The ice water content (Fig. 1 d-f) has the largest values above 5km and within 100 km of the storm center, while the liquid water content is mostly located at nearly surface. The ice water content in strengthening cases is much larger than those in weakening cases in the areal average. On the other hand, the weakening cases hold more liquid water content than strengthening cases (fig.1 g-i). These results highlight the impact of the vertical distributions of convective heating on TC intensity change and for CloudSat measurements of ice water content to distinguish between strengthening and weakening TCs.

4. Discussion

This study aims to develop and evaluate methods for CloudSat measurements to predict the TC intensity change by analyzing the satellite observations. The difference in the vertical profiles of ice water content, in particular, demonstrate systematic differences that are indicative of future intensity change. Further investigation of the CloudSat Tropical Cyclone datasets to characterize patterns will expand samples to a longer period and categorize overpasses into different initial TC intensity.

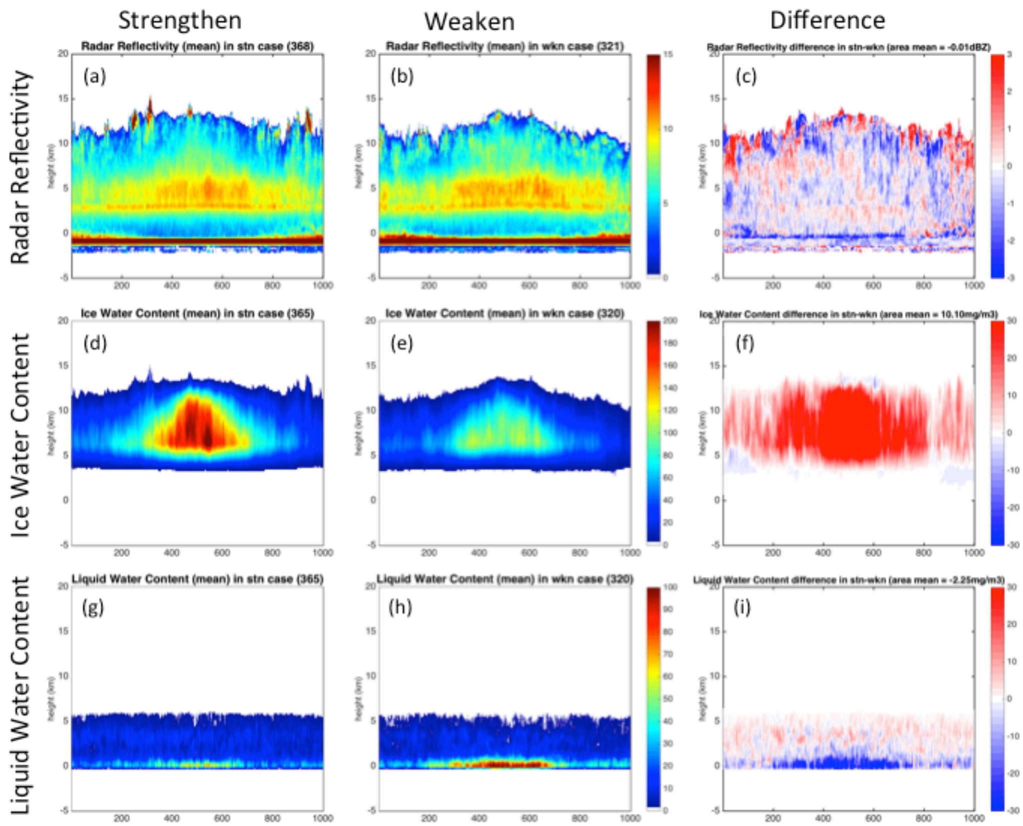

Fig. 1 The composite of CloudSat overpasses with the radial distance to TC center less than 300-km in strengthening (first column) and weakening (second column) cases and their difference (third column) in (a) (b) (c) radar reflectivity (dBZ), (d) (e) (f) ice water content (mg/m^3), and (g) (h) (i) liquid water content (mg/m^3).

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