

Reflectivity Structure of Hurricanes Undergoing an Eyewall Replacement Cycle

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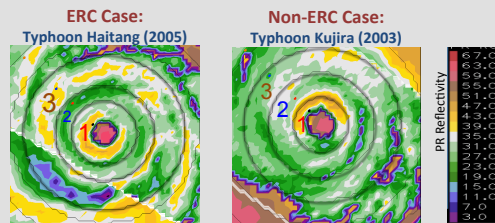
Introduction

- Intense Hurricanes (Category 4-5 Saffir-Simpson Scale) often undergo a process called an eyewall replacement cycle (ERC)
- ERC: Concentric precipitation feature develops, contracts and replaces the primary precipitation feature (the eyewall) that surrounds the eye
- ERC's are associated with quick and substantial shifts in maximum wind speeds and a significant broadening of the surface wind field → Hindrance to intensity predictions

This study empirically examines the precipitation structure of ERC's and conducts statistical comparisons of ERC and non-ERC cases

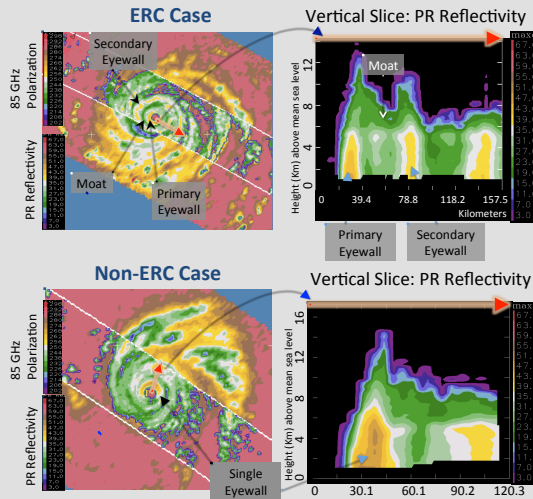
Data and Methodology

- 3D Reflectivity is a radar measurement of precipitation intensity (measured in decibels, dBZ) obtained by the Tropical Rainfall Measuring Mission (TRMM) satellite's Precipitation Radar (PR)
- TRMM overpasses from 1998 – 2007 for major hurricane-strength tropical cyclones reaching category 4-5 at some point during their lifetime in the Atlantic and Northwest Pacific basins

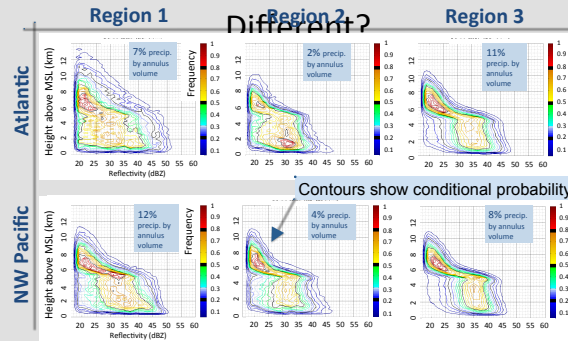


- A storm is an ERC case if it has the following characteristics:
 - Secondary circular convective precipitation feature
 - Moat of reduced reflectivity
- Annuli for **ERC cases** (above left) are subjectively constructed such that Annulus 1 (red), 2 (blue) and 3 (orange) contain the eyewall, moat and secondary eyewall, respectively.
- Annuli for **Non-ERC cases** (above right) are based on eye radius (R_e)
 - Annulus 1 (red) (R_1) = $R_e + 17$ km
 - Annulus 2 (blue) = $2R_1$
 - Annulus 3 (orange) = $3R_1$, etc.

Vertical Structure Differences



Are Atlantic and Pacific ERC's Different?



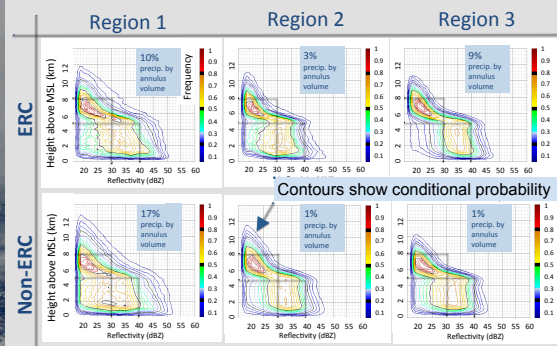
Atlantic & NW Pacific Basins Compared: Frequency distributions of TRMM PR data show that storms are **similar** the two ocean regions. Some minor differences are: In Region 1, the Atlantic cases have precipitation extending to higher altitudes and the NW Pac distribution is generally more uniform and intense. In Region 2, the NW Pacific has precipitation extending to higher altitudes, while lower-level distributions are similar.

Conclusion

Comparison the TRMM satellite data in tropical cyclones undergoing an eyewall replacement cycle (ERC) with those displaying only a single eyewall (Non-ERC) shows that:

- Storms undergoing eyewall replacement have similar structures in the NW Pacific and Atlantic Oceans.
- ERC cases differ from non-ERC cases such that:
 - In the ERC cases, region 2 has lower intensity, while regions 1 and 3 are similar in structure, except the outliers are more intense in region 1.
 - In the non-ERC cases, reflectivity height and intensity decrease from region 1 to 3.

Are ERC & Non-ERC Storms Different?



Comparison of ERC and Non-ERC Cases

- Region 1:** ERC distribution is more intense and uniform, Non-ERC cases have more intense outliers
- Region 2:** Non-ERC cases tend to have more intense precipitation at higher altitudes than the ERC cases
- Region 3:** The ERC distribution is more uniform and intense
- Overall:** Differences between Region 1 and 3 are minor for ERC cases and pronounced for Non-ERC cases

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