An Analysis of Rapidly Intensifying Tropical Cyclones Derived from 13 Years of TRMM Data

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Introduction

Accurately predicting tropical cyclone (TC) intensity change remains troublesome to operational forecasters. One reason for this difficulty is the presence of similar environmental conditions between slowly intensifying (SI) storms and rapidly intensifying (RI) storms. This suggests the internal storm structure has a significant role on the intensification rate. The employment of 37 GHz color composite microwave satellite imagery from the Naval Research Laboratory grants the ability to examine different components of TC structure due to its ability to detect the ocean surface (green colors), liquid hydrometeors (cyan colors), as well as frozen hydrometeors (pink colors). Incorporating 37 GHz color imagery into established RI predictors, such as the Statistical Hurricane Intensity Prediction Scheme (SHIPS), has already proven it can improve the accuracy of RI forecasts. The goal of this study is to analyze the relationship between TC structure and the rate of intensification using microwave satellite imagery for TCs in the Atlantic (ATL) and East Pacific (EPA) basins.

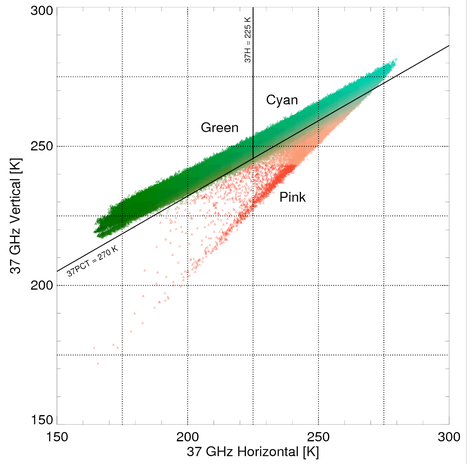
Methodology

- TCs in the ATL and EPA were filtered and placed into four bins based on each storm's future 24-hour intensity change: Weakening (W), Neutral (N), SI, and RI
- Only analyzed storms with maximum winds ≤ 95 kt
- Microwave satellite imagery from the Tropical Rainfall Measuring Mission (TRMM) from 1998–2011 was analyzed
- Data from the European Center for Medium-Range Weather Forecasts (ECMWF) interim reanalysis was used to obtain environmental conditions
- Composites are normalized by shear direction

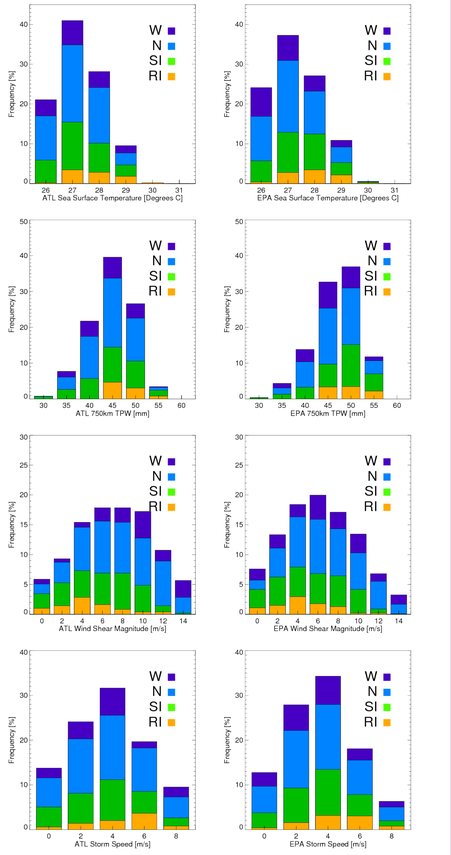
Results

- RI storms have a significantly greater coverage of pink and cyan pixels, especially upshear
- ATL storms have a maximum frequency of pink and cyan pixels focused more downshear than EPA storms, which have a maximum frequency focused more to the left of the shear vector
- The peak frequency in cyan pixels in the RI composites is located much closer to the center of circulation than the peak frequency in pink pixels
- This suggests symmetric heating plays a key role in RI
- RI storms feature colder cloud top temperatures
- 85 GHz PCT is not sensitive to emission from liquid

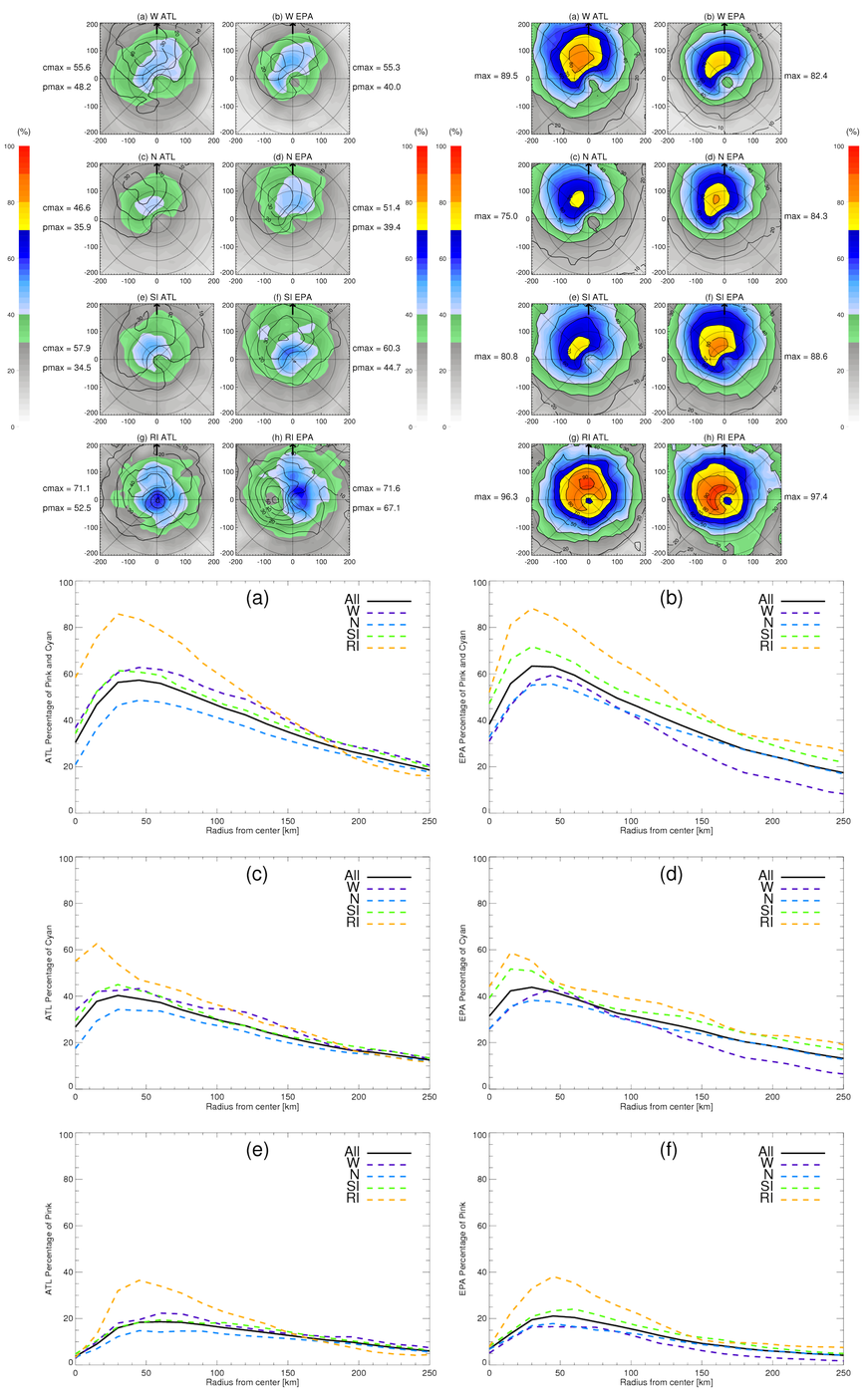
Pixel Database



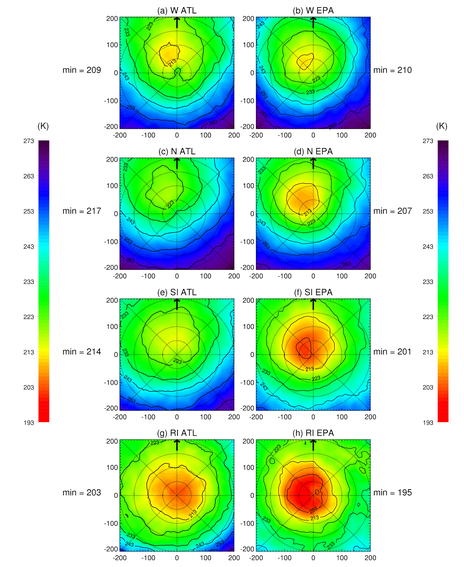
Environment



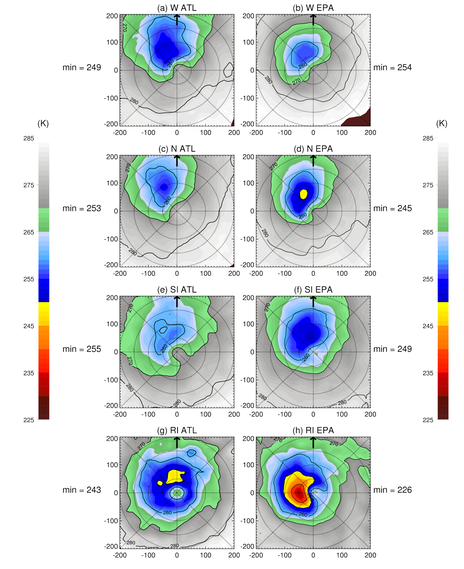
Pink and Cyan Distribution



IR Temperatures



Mean 85 PCT



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