

Motivation

- A tropical cyclone (TC) is defined to experience Rapid Intensification (RI) when it experiences a 15.4 m s⁻¹ increase in maximum sustained wind speed (Vmax) or a 42 hPa decrease in minimum sea level pressure (MSLP) over a 24 hour period (Kaplan and DeMaria 2003, KD03; Holliday and Thompson 1979, HT79).
- Processes which cause RI can occur on time scales <24</p> hours.
- Were, we define RI based on changes in Vmax and MSLP on shorter time scales
- We also use observations of Vmax and MSLP from the Hurricane Database (HURDAT) for Atlantic Basin TCs and environmental parameters from the Statistical Hurricane Intensification Prediction Scheme (SHIPS) database to assess conditions associated with RI.



New Definitions for the Rapid Intensification of Hurricanes

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Time(hours)

Fig. 6: Histogram of relative ^{12 hour} frequency of occurrence of 200-850 hPa wind shear averaged 200-800 km from storm center determined for TCs undergoing RI. Average shear computed over 6,12, and 24 hour periods used in RI definition.

> Fig. 7: Histogram of relative frequency of occurrence of wind shear determined for TCs undergoing and not undergoing RI based on 6 hour definition.

Fig. 8: Histogram of relative frequency of occurrence of sea surface temperatures (SST) for 6, 12, and 24 hour intervals used in RI definition.

Fig. 9: Histogram of relative frequency of occurrence of SST for TCs undergoing RI and not undergoing RII based on 6 hour definition.

Fig. 10: Time of RI using 6 and 12 hour KD03 definition against RI using 24 hour KD03 definition. *Time t=0 represents time at* which TC became hurricane. Black line represents 1:1 line.

Fig. 11: As in Fig.10, except 12 vs. 24 KD03 HT79 definition used to determine RI.



Statistical Significance

The Wilcoxon Rank Sum was used to calculate the probability test statistic (P-value) to determine if datasets in Fig.6 through 9 had a statistically significant difference, defined as a P-values \leq 0.05 (highlighted in red).

Table 2: P-values for Wilcoxon Rank Sum Test.

Probability Statistic (p-value)	Wind Shear	SST
KD03 6h RI and non-RI	4.1084.10-4	5.5782-10 ⁻⁵
KD03 12h RI and non-RI	3.6635·10 ⁻⁹	2.6234·10 ⁻⁵
KD03 24h RI and non-RI	6.8735·10 ⁻⁸	9.1717-10 ⁻⁵
KD03 6h and 12h	0.5890	0.9631
KD03 12h and 24h	0.5526	0.2978
KD03 6h and 24h	0.2127	0.2525
HT79 6h RI and non-RI	2.8576.10-4	0.0020
HT79 12h RI and non-RI	6.2903·10 ⁻⁶	9.2945.10-4
HT79 24h RI and non-RI	8.0038·10 ⁻⁷	0.0046
HT79 6h and 12h	0.9086	0.3733
HT79 12h and 24h	0.1328	0.2851
HT79 6h and 24h	0.1487	0.8074

Conclusions

- Intensity change (MSLP, Vmax) per hour is larger for shorter time interval definitions of RI.(Fig. 5, Table 1)
- RI is detected sooner using shorter time definitions for RI (Fig. 10, Fig.11)
- There is a statistically significant difference between wind shear and SST distributions for RI and non-RI cases. (Fig. 7, Fig. 9, Table 2)
- There is no statistically significant difference between wind shear and SST distributions depending on the time scale averaged over (Fig.6, Fig. 8, Table 2).
- For more accurate analysis on RI, Vmax data requires a much higher resolution.

References

- Waplan, John; DeMaria Mark; "Large-Scale Characteristics of Charact Rapidly Intensifying Tropical Cyclones in the North Atlantic Basin", Weather and Forecasting, 2003, 18(6), 1093-1108
- Holliday, Charles R.; Thompson, Aylmer H.; "Climatological Characteristics of Rapidly Intensifying Typhoons", Monthly Weather Review, **1979**, 107(8), 1022-1034

Acknowledgments

This work was supported by Grant NNX09AB82G from the NASA Hurricane Science Research Program.

The Atlantic Basin HURDAT and SHIPS databases was obtained from the NHC Data Archive.