

The Relationship Between the Madden-Julian Oscillation and Tropical Cyclone Tornado Clusters

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Introduction

- ❖ Tropical cyclones (TCs) may produce tornadoes (TCTORs) prior to landfall, during landfall, and after landfall.
- ❖ TCTORs do not occur uniformly across space or through time
- ❖ MJO linked to TC activity [1] and Spring tornado outbreaks [2].

Data and Methodology

- ❖ Roger Edwards' TCTOR Dataset [3]
 - ❖ 1995–2010 POR, 65 TCs, 1163 TCTORs (Figure 1)
- ❖ Identify temporal clusters: 6 hour periods centered about 00, 06, 12, or 18 UTC with 3+ TCTORs . 42 TCs; 140 clusters.
- ❖ Daily phase and amplitude of MJO from Real-time Multivariate MJO (RMM) Index of Wheeler and Hendon [4]
- ❖ Construct frequency distributions of TCTOR clusters by MJO Index value.

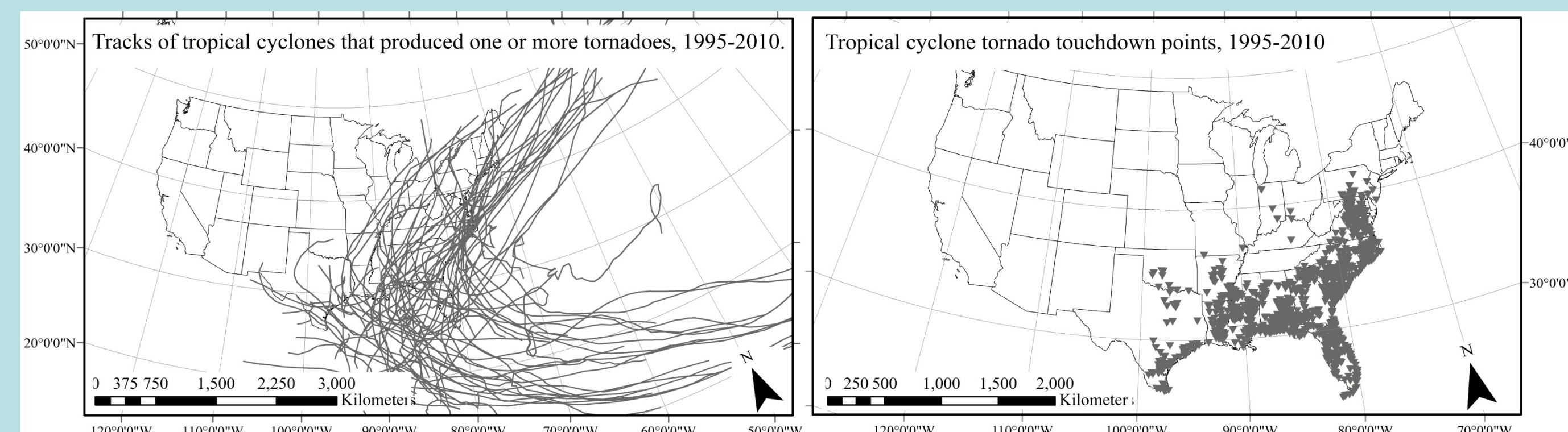


Figure 1. Tracks of TCs that produced TCTORs (left) and the touchdown points of these TCTORs (right) (1995–2010).

Overview of TCTOR Clusters

- ❖ 65% (42/65) of the TCs produced 1+ cluster
- ❖ 80% (930/1163) of the TCTORs occurred in a cluster
- ❖ 140 temporal clusters total (Figure 2)
 - ❖ Descriptive statistics for cluster severity
 - ❖ mean = 6.9
 - ❖ median = 5.0
 - ❖ max = 33.0
 - ❖ 25th percentile = 3.0
 - ❖ 75th percentile = 8.0
 - ❖ 90th percentile = 14.0

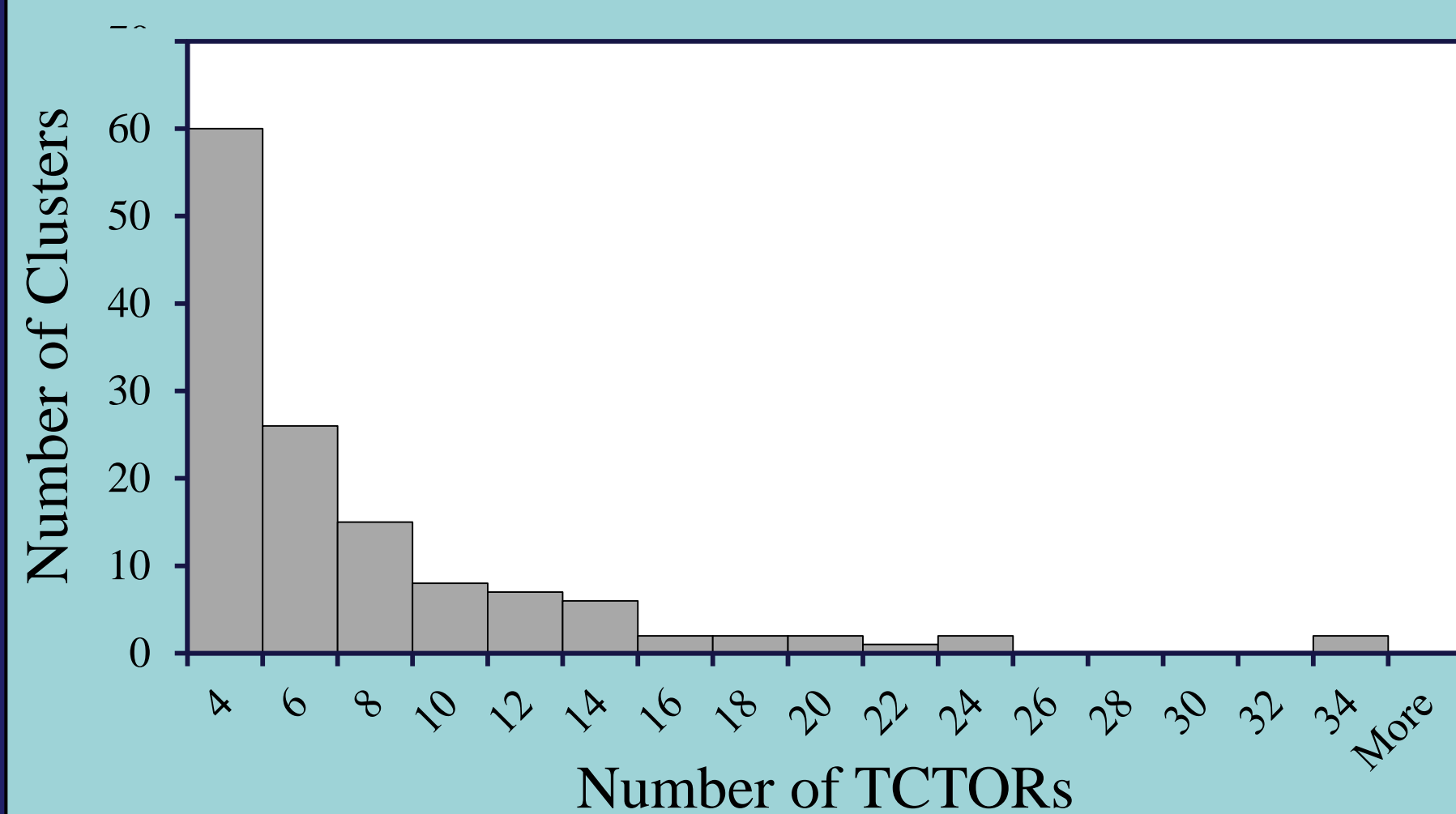


Figure 2. Histogram showing the frequency at which observed cluster severities occurred.

Geographic Location of Enhanced Convection in MJO Index

MJO Index Value	Location
1	Western Hemisphere and Africa
2	Indian Ocean
3	Indian Ocean
4	Maritime Continent
5	Maritime Continent
6	Western Pacific
7	Western Pacific
8	Western Hemisphere and Africa

Frequency of MJO Phase for all Cluster Sizes and all MJO Amplitudes (N = 140)

MJO Index Value	Frequency	Percent of Cases
1	30	21.4
2	44	31.4
3	19	13.6
4	7	5.0
5	13	9.3
6	8	5.7
7	1	0.7
8	18	12.9

Frequency of MJO Phase for all Cluster Sizes and Active Tropical Convection (MJO Amplitude 1.0 or Greater; N = 90)

MJO Index Value	Frequency	Percent of Cases
1	23	25.6
2	33	36.7
3	10	11.1
4	3	3.3
5	10	11.1
6	5	5.6
7	1	1.1
8	5	5.6

Frequency of MJO Phase for Cluster Sizes of Six or More and all MJO Amplitudes (N = 55)

MJO Index Value	Frequency	Percent of Cases
1	10	18.2
2	17	30.9
3	6	10.9
4	3	5.5
5	6	10.9
6	4	7.3
7	0	0.0
8	9	16.4

Frequency of MJO Phase for Active Tropical Convection and Cluster Sizes of Six or More (N = 35)

MJO Index Value	Frequency	Percent of Cases
1	7	20.0
2	14	40.0
3	4	11.4
4	2	5.7
5	5	14.3
6	2	5.7
7	0	0.0
8	1	2.9

Summary and Discussion

- ❖ TCTORs tend to occur in temporal clusters.
- ❖ Preference for phases 1-2 and active convection.
- ❖ Phases 6-7 inhibit Atlantic tropical activity [5].
- ❖ Phase 2 composite analysis shows preference for vertical wind shear and upward vertical motions [2] similar to synoptic pattern findings on TCTOR clusters [6].
- ❖ Linkage between intraseasonal and interannual modes?

References

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