

# P172 VISUALIZATION TOOLS FOR THE STORM PREDICTION CENTER'S TROPICAL CYCLONE DATABASE

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## 1. Introduction

The Storm Prediction Center (SPC) has maintained a database of tropical cyclone tornadoes since the early 2000s (Edwards 2010; hereafter E10). This database, known as TCTOR, was created by comparing each potential tropical cyclone (TC) tornado record in the U.S to available surface and upper air maps, and archived satellite and radar imagery to determine if it occurred within the circulation envelope of either a classified or remnant TC. Qualifying events were segregated from the nationwide SPC one-tornado (ONETOR) database and assigned to their respective TC by name. National Hurricane Center (NHC) best-track records (HURDAT2, Landsea and Franklin 2013) then were examined for each tornado event, from which the most recent 6-hourly central pressure and wind intensity were assigned to each tornado. More information regarding the underlying methodology used to compile this database is described in detail in E10, with updated information available in Edwards and Mosier (2022, hereafter EM22).

Forecasting tropical cyclone tornadoes has evolved from largely climatology based to more ingredients based in recent years (Edwards 2012, EM22). However, climatology remains important, especially at longer time ranges when the mesoscale details are less certain. Consequently, there was a desire at SPC to increase the accessibility of TCTOR, which was primary impetus for developing additional visualization tools for the database.

## 2. Data and methodology

Data from SPC's TCTOR and the NHC's HURDAT2 anchor the page. The TCTOR dataset contains information regarding individual tornadoes as well as the strength and positions of

their associated TCs. HURDAT2 provides each TCs strength (via central pressure and maximum sustained winds) and center location (via latitude and longitude) on six-hourly intervals.

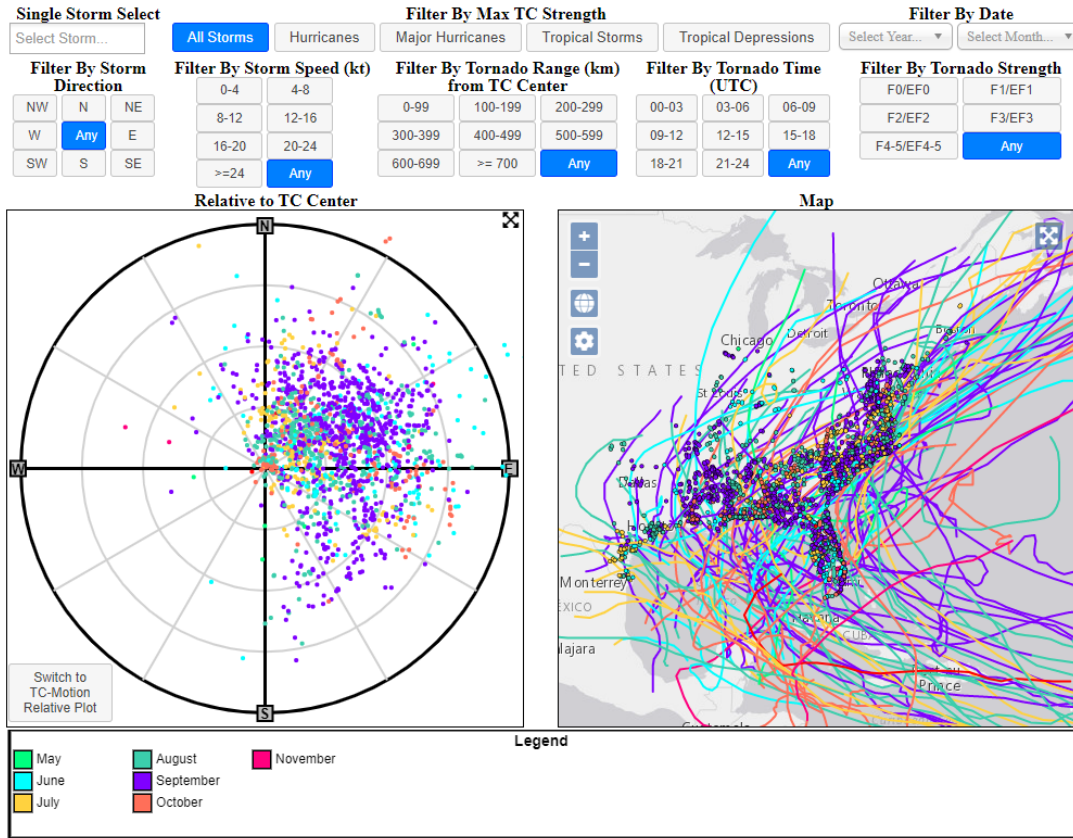
TCTOR already correlates tornadoes to six-hourly center points available in HURDAT2. However, an additional visualization was desired which linked tornadoes to the "segment" of HURDAT2 when they occurred. Here, a "segment" is just a line connecting two consecutive HURDAT2 points. Whenever a TC tornado occurred during the six-hour period between points, that segment was labeled as "tornado-producing segment" ..

## 3. Webpage development and features

Initial discussion at SPC determined that a webpage would likely be the most accessible way to visualize the TCTOR dataset. This involved polar-plot analysis—typically used in the literature in frameworks relative to true north and TC motion relative frameworks. Geographic representation of the dataset was included as well. A table with information about each tornado is also provided. The columns of this table are sortable. The maps and table are shown in Fig. 1.

Another highly desirable feature for this visualization webpage was the ability to filter the database. Numerous filters are available, including TC-related characteristics such as TC strength, TC direction, and TC speed. Filtering by tornado-related characteristics such as tornado distance from TC center, tornado time, and tornado damage-rating is available as well. All of these filters are shown in Figure 1.

# Tropical Cyclone Tornadoes



Color Code Plots By: Storm, Year, **Month**, TC Strength, TC Speed, TC Direction, Tornado Strength, Range from TC Center, Tornado Time, Tornado Segment

Reset All

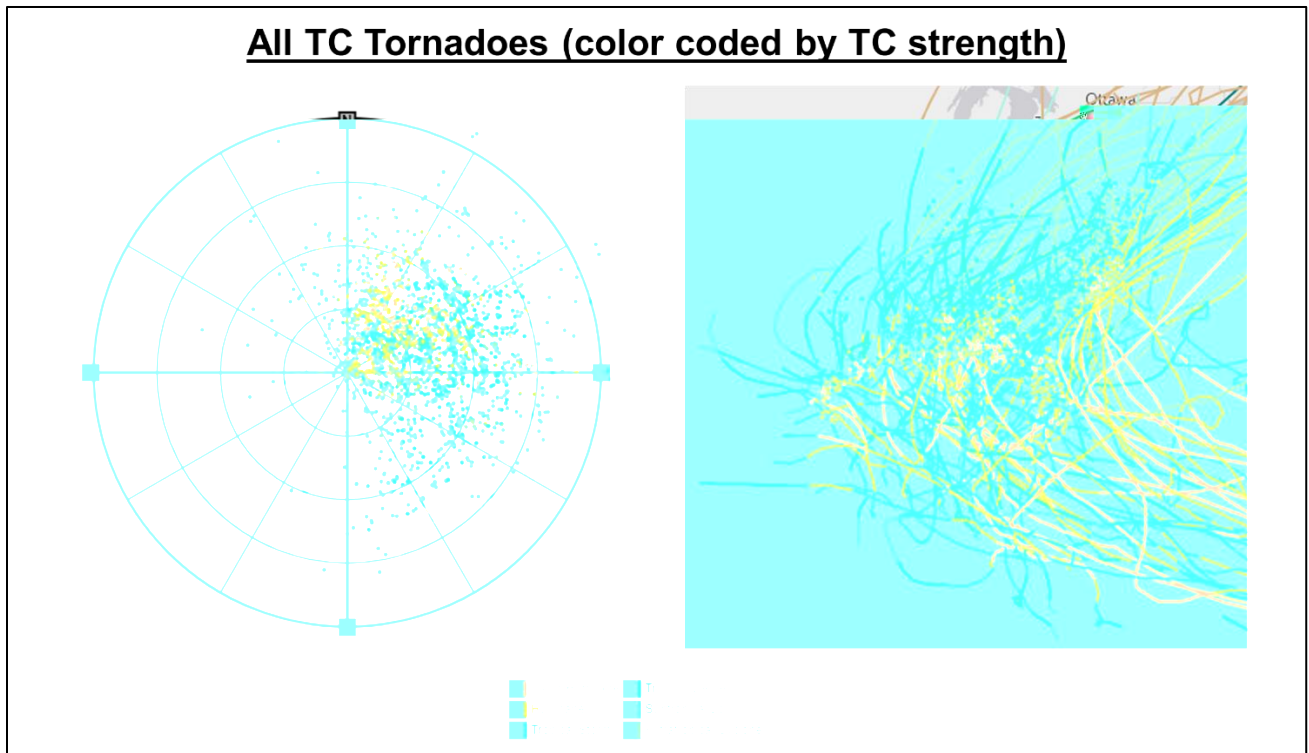
Show 25 entries

Tornado Table

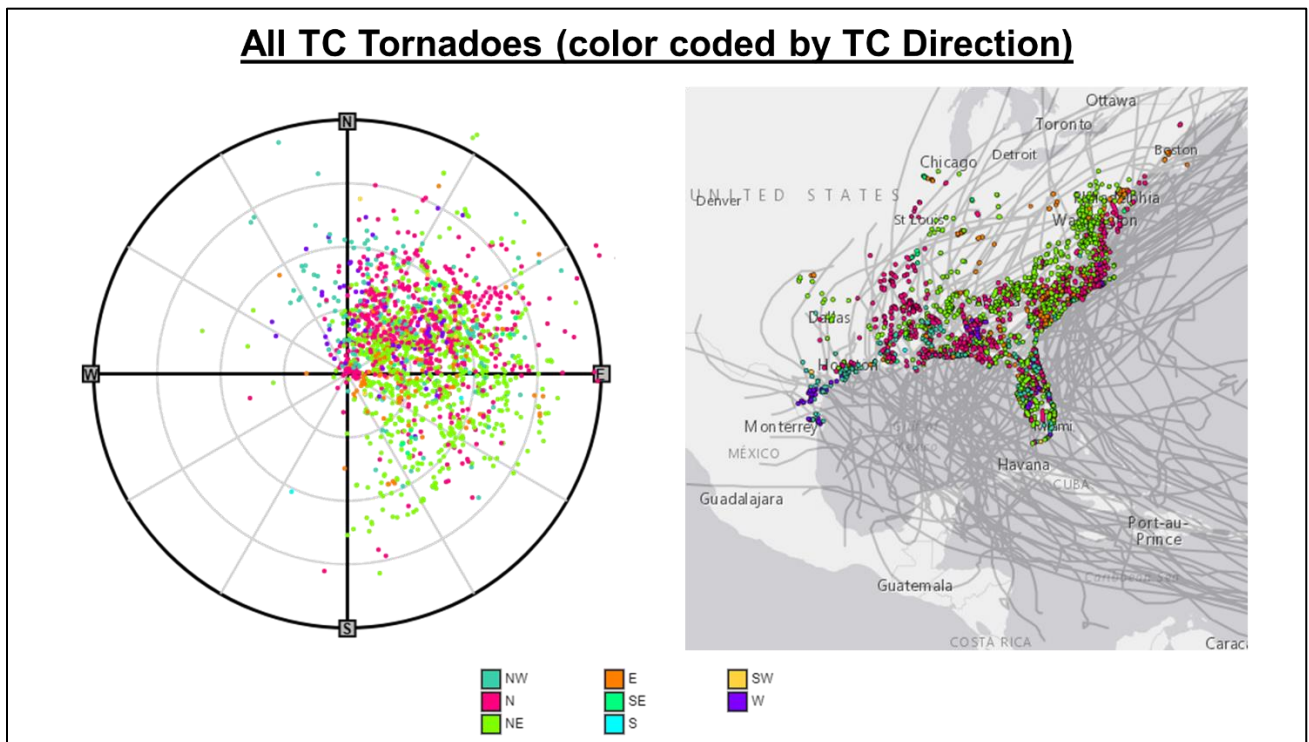
Search Tornado Table:

	Storm Name/Year	Date/Time (UTC)	F or EF	State	Start Lat/Lon	End Lat/Lon	Inj	Fat	Distance from Center (km)	Bearing from Center	Storm Motion
+	Mindy-21	2021/09/09 0108	0	FL	30.16/-84.45	30.18/-84.47	0	0	83.00	50.66	52.00
+	Ida-21	2021/09/02 0530	0	MA	41.74/-70.21	41.74/-70.21	0	0	271.96	59.45	68.00
+	Ida-21	2021/09/01 2332	0	NJ	40.31/-74.67	40.34/-74.64	0	0	117.31	56.74	69.00
+	Ida-21	2021/09/01 2259	1	NJ-PA	40.06/-74.89	40.10/-74.86	0	0	111.70	66.40	69.00
+	Ida-21	2021/09/01 2230	1	PA	40.30/-74.94	40.32/-74.92	0	0	141.57	56.16	69.00
+	Ida-21	2021/09/01 2210	3	NJ	39.68/-75.25	39.82/-75.11	2	0	106.86	82.34	69.00
+	Ida-21	2021/09/01 2159	1	PA	40.27/-75.11	40.33/-75.08	0	0	149.70	56.20	69.00
+	Ida-21	2021/09/01 2135	2	PA	40.11/-75.24	40.21/-75.16	2	1	148.43	61.36	69.00
+	Ida-21	2021/09/01 2045	0	MD	38.67/-75.86	38.62/-75.89	0	0	137.36	123.96	69.00
+	Ida-21	2021/09/01 2015	2	PA	39.77/-75.97	39.85/-75.93	0	0	134.44	66.64	69.00
+	Ida-21	2021/09/01 1848	0	MD	39.20/-76.44	39.28/-76.39	0	0	144.63	85.49	69.00
+	Ida-21	2021/09/01 1801	2	MD	38.85/-76.51	39.00/-76.51	0	0	172.51	95.01	69.00
+	Ida-21	2021/08/31 2334	0	AL	31.19/-85.61	31.21/-85.59	0	0	507.73	179.98	61.00
+	Ida-21	2021/08/31 2314	0	AL	31.32/-85.50	31.32/-85.49	0	0	489.17	177.77	61.00

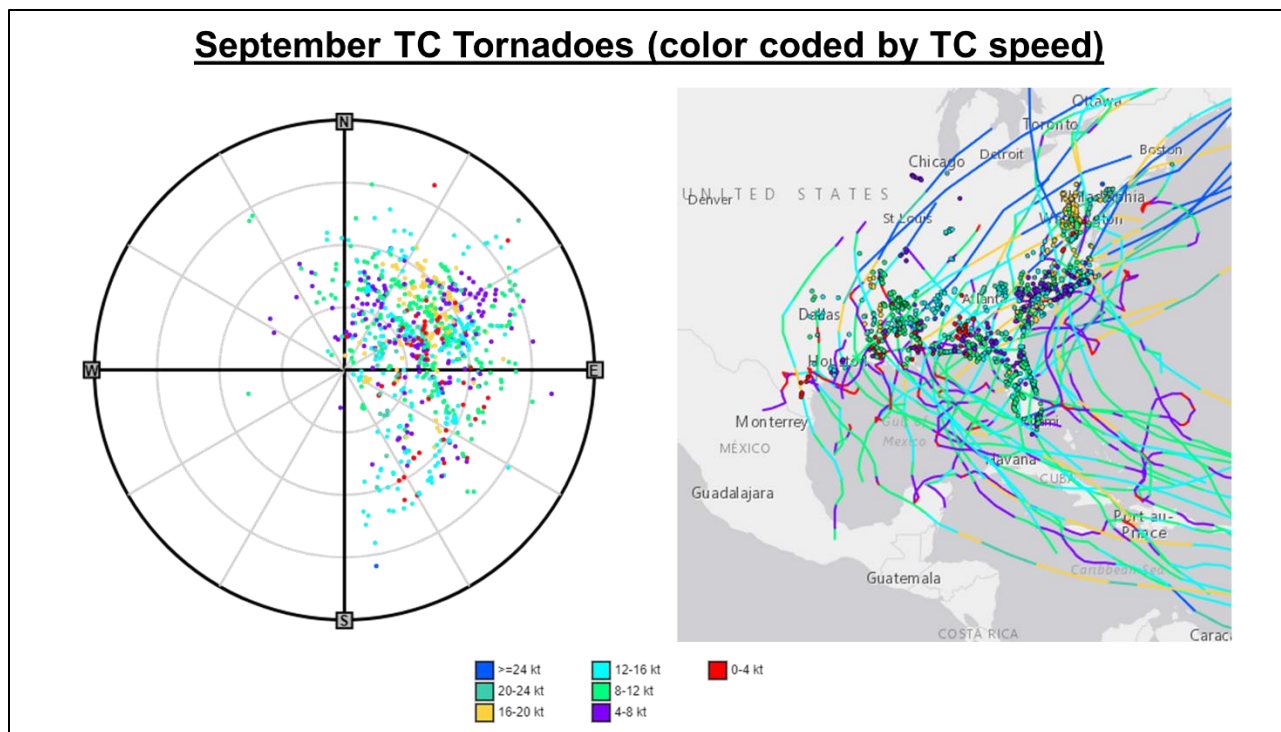
Figure 1. Example screenshot of the TCTOR visualization webpage.



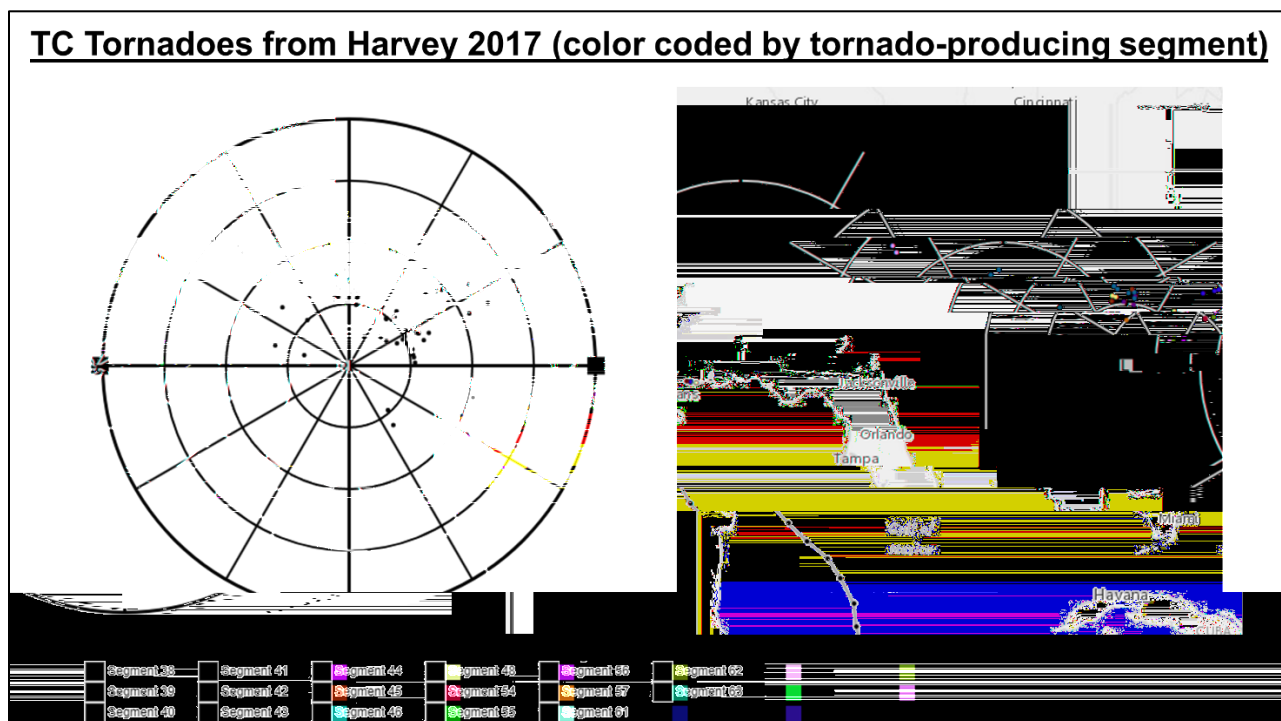
**Figure 2.** Visualization from the webpage, with a north-relative polar plot on the left and a graphic map of tropical cyclone tracks and tropical cyclone tornadoes on the right. Color coded by TC strength.



**Figure 3.** Visualization from the webpage, with a north-relative polar plot on the left and a graphic map of tropical cyclone tracks and tropical cyclone tornadoes on the right. Tornadoes are color coded by TC direction at time of occurrence.



**Figure 4.** Visualization from the webpage, with a north-relative polar plot on the left and a graphic map of tropical cyclone tracks and tropical cyclone tornadoes on the right. Color coded by TC speed at the time of tornado occurrence.



**Figure 5.** Visualization from the webpage, with a TC-motion-relative polar plot on the left and a graphic map of tropical cyclone tracks and tropical cyclone tornadoes on the right. Color coded by tornado-producing segment.



#### 4. Example Usage

Several example images, shown in Figs. 2–5, illustrate just a few of the different ways to visualize the TCTOR database. Figure 2 shows TC tracks and associated tornadoes, color coded by TC strength. Tornadoes are color coded by TC strength at the time of the tornado occurrence. Figure 3 is similar to Figure 2, but color coded by TC translation direction at tornado time. This figure also illustrates using a “gray scale” for TC tracks so that tornado locations are more readily visible. Figure 4 is similar to Figs. 2 and 3, but color coded by TC speed at the time of tornado occurrence. Fig. 5 shows an example of the “tornado-producing segments” discussed in Section 2a. Using these segment helps to determine the timeframe of the TC lifespan within which a tornado occurred.

#### 5. Webpage Location

These visualization tools are available on the SPC website at <http://www.spc.noaa.gov/exper/tctor>.

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