A Climatological Study of Cold Season Tornadoes Along Alabama's Gulf Coast

Kelsey F. Netherton

John M. Lanicci

Department of Earth Sciences at The University of South Alabama

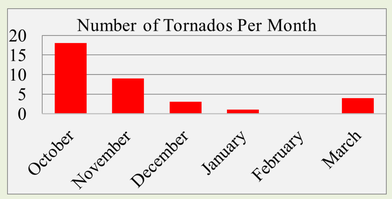
Introduction

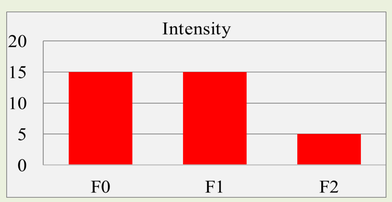
This research focuses on cold season tornados along Alabama's Gulf Coast. We have compiled tornado data from 2003-2023 in Alabama's Climatic Zone 8 (NCEI CONUS Climate Divisions) for the cool season, defined as late October into early March. There are a total of 35 tornados and 13 individual case days. Of the 13 case days, two subtypes have been identified based on the position of the 1000hPa low relative to the study area. The first subtype shows a low-pressure system just to the west of the study area. Six out of the 13 case days are associated with this subtype. The second subtype shows a low-pressure system to the northwest of the study area. Four of the 13 case days are associated with this subtype. The composites presented here combine all 13 case days to gain a clearer understanding of the atmospheric conditions 12 and 24 hours prior to the occurrence of any tornados.

Data & Methods

The table below includes the 35 case days date, intensity, time, location and subtype. Subtype 1 is highlighted yellow and subtype 2 is highlighted pink.

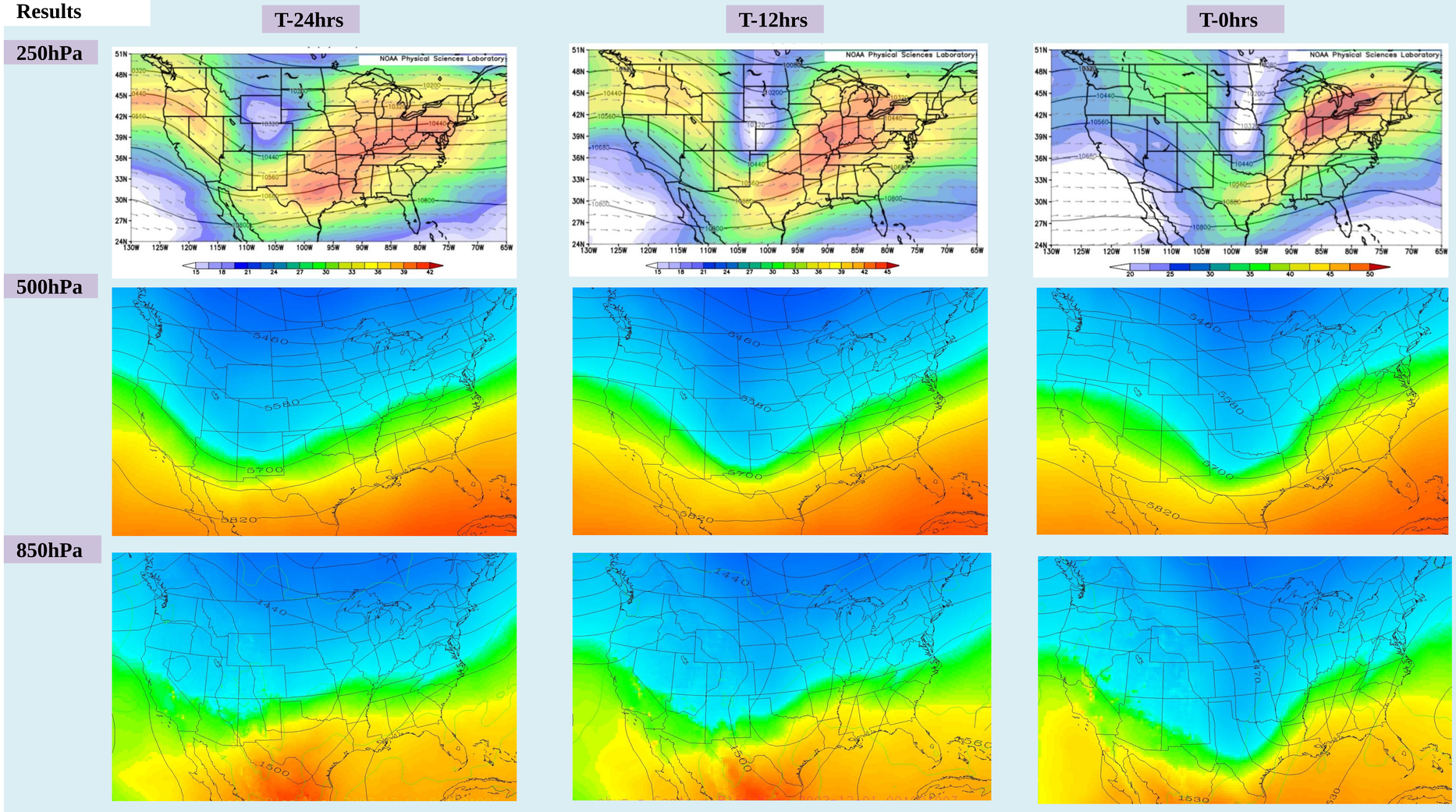
Date	Intensity	Start Time (CST)	End Time (CST)	Begin lat	Begin long	End lat	End long	Location	ZULU Start Time	Subtype
11/24/2004	F0	7:10	7:12	30.43333	-88.1	30.43333	-88.1	Mon Louis	13:10	1
11/24/2004	F0	7:55	7:56	30.51667	-87.9	30.51667	-87.9	Fairhope	13:55	1
11/27/2004	F0	11:35	11:37	30.56667	-87.7333	30.56667	-87.7333	Robertsdale	17:35	2
11/27/2004	F0	11:45	11:46	30.53333	-87.5833	30.53333	-87.5833	Elsanor	17:45	2
11/27/2004	F1	11:55	11:57	30.51667	-87.4833	30.51667	-87.4833	Seminole	17:55	2
11/27/2004	F2	11:35	11:40	30.48333	-87.7	30.48333	-87.7	Summerdale	17:35	2
11/15/2006	F0	8:48	8:50	31.07	-87.77	31.08	-87.75	Rabun	14:48	1
11/15/2006	F1	9:09	9:12	30.97	-87.68	30.98	-87.66	Dyas	15:09	1
10/22/2007	EF0	14:07	14:08	30.25	-88.12	30.25	-88.12	Dauphin Island	20:07	1
10/22/2007	EF1	15:33	15:36	30.4433	-88.2122	30.4539	-88.2092	Bayou La Batre ARPT	21:33	1
10/24/2010	EF1	20:10	20:14	30.526	-87.5688	30.5497	-87.5603	Elsanor	2:10	
10/25/2010	EF1	4:17	4:21	30.6706	-88.1535	30.6717	-88.1333	Cottage Hill	10:17	
3/9/2011	EF1	8:31	8:32	30.547	-88.37	30.549	-88.368	Grand Bay	14:31	2
3/9/2011	EF2	8:37	8:40	30.5607	-88.2169	30.5679	-88.204	Theodore	14:37	2
3/9/2011	EF2	9:17	9:21	30.5341	-87.761	30.557	-87.739	Silverhill	15:17	2
12/20/2012	EF1	4:49	5:05	30.6671	-88.1383	30.7442	-88.0707	Cottage Hill	10:49	2
12/25/2012	EF2	16:54	17:05	30.67	-88.09	30.74	-88.06	Mertz	22:54	1
12/25/2012	EF1	19:22	19:27	30.7937	-88.4133	30.8293	-88.3091	Peircie	1:22	1
10/25/2019	EF1	15:12	15:14	30.6144	-88.2686	30.6337	-88.2715	Dawes	21:12	1
10/25/2019	EF0	15:19	15:20	30.6698	-88.2714	30.6711	-88.2716	Seven Hills	21:19	1
10/25/2019	EF1	15:37	15:42	30.7973	-88.273	30.8452	-88.2739	Semmes	21:37	1
11/7/2019	EF0	13:35	13:37	30.7248	-88.0548	30.726	-88.0486	Prichard	19:35	
3/8/2022	EF1	0:42	0:45	30.6102	-88.3371	30.6301	-88.3189	Seven Hills	6:42	
10/29/2022	EF0	16:10	16:12	30.3159	-87.7587	30.3232	-87.7585	Bon Secour	22:10	1
10/29/2022	EF1	16:16	16:18	30.3638	-87.7665	30.3703	-87.773	Magnolia SPGS	22:16	1
10/29/2022	EF1	17:50	17:59	30.2785	-87.7249	30.3144	-87.7262	Gulf Shores	23:50	1
10/29/2022	EF0	19:51	19:52	30.4426	-87.9109	30.4429	-87.9109	Point Clear	1:51	1
10/29/2022	EF0	20:19	20:20	30.6028	-87.894	30.6108	-87.8901	Daphne	2:19	1
10/29/2022	EF1	20:29	20:30	30.6688	-87.8956	30.6723	-87.8944	Spanish Fort	2:29	1
10/29/2022	EF0	16:03	16:08	30.516	-88.1968	30.5427	-88.1978	Laurendine	22:03	1
10/29/2022	EF0	16:23	16:30	30.613	-88.0551	30.6488	-88.0721	Mobile Brookley	22:23	1
10/29/2022	EF1	17:40	17:50	30.537	-88.2623	30.6075	-88.2537	St. Elmo Arpt	23:40	1
10/29/2022	EF0	17:57	18:02	30.7087	-88.1346	30.739	-88.1271	Spring Hill	23:57	1
10/29/2022	EF0	18:09	18:15	30.713	-88.1879	30.7483	-88.1846	Orchard	9:09	1
1/12/2023	EF2	12:15	12:33	31.0196	-88.203	31.0668	-88.0183	Gulf Crest	18:15	2





To create composite analyses for geopotential heights, wind, temperature, and specific humidity, we used 3-hourly gridded data from the North American Regional Reanalysis on NOAA's ESRL website. We took the closest NARR time prior to the first tornado occurrence for each case day. The 250-hPa composite analysis displays were taken directly from the ESRL website, while the 500- and 850-hPa composite analysis displays were generated using the Integrated Data Viewer (IDV).

Results



Conclusion

By compositing the 13 case days up to 24 hours prior to any tornado occurrence, distinct atmospheric features at each level become apparent. At the 250-hPa level, the jet maximum shifts from Texas to the Indiana/Ohio/Michigan border, increasing by 8 ms^{-1}, and the jet becomes more concentrated as it moves northeast. At the 500-hPa level, the trough axis moves across the Central Plains while deepening. Additionally, the thermal trough lags the height trough at T-0 hours, suggesting the trough may deepen further. At the 850-hPa level, a low and associated trough become more organized as they develop over the Central Plains. At T-0 hours, both the thermal trough and ridge amplify, clearly indicating warm advection from the Gulf of Mexico. All-in-all, the system comes together and amplifies allowing for severe weather to occur over the study region.

If you want to get a closer look at how the two subtypes evolved over a 24-hour period, scan the QR code!

Bibliography

Beebe, R.G., 1958: Tornado Proximity Soundings, *Bull. Amer. Meteor. Soc.*, **39**, 195-201, https://doi.org/10.1175/1520-0477-39.4.195

Crisp, C.A., and J.M. Lewis, 1992: Return Flow in the Gulf of Mexico. Part 1: A Classificatory Approach with a Global Historical Perspective, *J. Appl. Meteor.*, **31**, 868-881, https://doi.org/10.1175/1520-0450(1992)031%3C0868:RFITGO%3E2.0.CO;2

DiMego, G.J., L.F. Bosart, G.W. Endersen, 1976: An Examination of the Frequency and Mean Conditions Surrounding Frontal Incursions into the Gulf of Mexico and Caribbean Sea, *Mon. Wea. Rev.*, **104**, 709-718,https://doi.org/10.1175/1520-0493(1976)104%3C0709:AEOTFA%3E2.0.CO;2

Evans, J.S., and J.L. Guyer, 2006: The Relationship of Cool Season Significant Tornado Events and Buoy Data in the Western Gulf of Mexico. *Preprints, 23rd Conf. Severe Local Storms*, St. Louis MO.

Henry, W.K., 1979: Some Aspects of the Fate of Cold Fronts in the Gulf of Mexico, *Mon. Wea. Rev.*, **107,** 1078-1082, https://doi.org/10.1175/1520-0493(1979)107%3C1078:SAOTFO%3E2.0.CO;2

Klepatzki, J. P. and S. M. Milrad, 2020: Multiscale environmental analysis of cool-season Florida tornado and null events. *J. Severe Storms Meteor*., **15** (1), 1-34.