# Case Study: 1998 Kissimmee, Florida Tornado Outbreak Effects on Residential Areas

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## Abstract

Florida is not typically known for tornado outbreaks, but such an event can pose significant risks to unprepared residents in a heavily populated area. This project examines the mechanisms behind such a dangerous and rare tornado outbreak to better prepare for and assess the impacts on communities. This project studied the 1998 Kissimmee tornado outbreak, the deadliest in Florida's history, which struck overnight on February 22nd, killing 42 people. Contributing factors to the high death toll included a lack of awareness of strong tornadoes in the region, the timing of the outbreak, poor construction of affected residences, and the high population density of the impacted area. Using historical satellite, reanalysis, and observational data, the study explores the genesis and intensification of this event, its long-term effects, and shows the recovery effects taken after the event. The goal is to develop effective strategies to safeguard communities in regions unaccustomed to significant tornado outbreaks.

## Introduction and Background

- Population of Florida (figure 2) in 1998 was 15 million with 6 million living in Central Florida.
- The high population is due to the lower cost of living and mild climate.
- The humid subtropical climate is defined by 2 season: a dry season and a wet season, with more severe weather in the dry season.
- Most tornadoes that impact Florida are small and weak, with outbreaks being rare.
- This study looked at 1998 Kissimmee outbreak, Florida's deadliest outbreak 10 tornadoes $ 107 million in damage, 42 deaths, and over 200 injuries.
- Florida was influenced by El-Niño in 1998, with mild temperatures and wetter winters allowing for low-pressure systems to move further south than typical due to a stronger sub-tropical jet stream. (figure 1)
- This allowed for warm front and low-level jet to cause instability. (figure 1)
- Region is unstable and the cold sector moved through Florida which caused lift and allowed for tornadic development ahead of cold front. (figure 1)

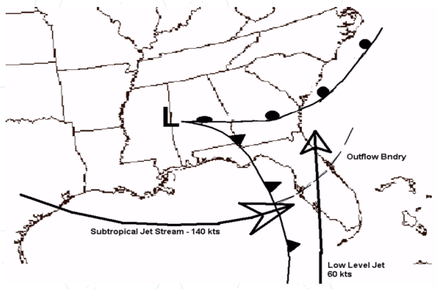



Figure 1: Storm Setup and location: Source NSSL.

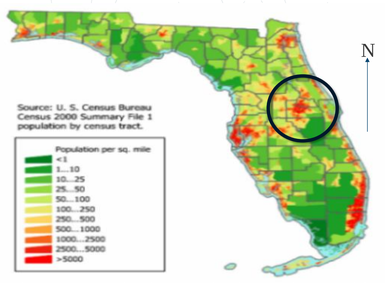



Figure 2: Population statistics map. The study and damage area are in the black circle: Source U.S. Census Bureau.

## Methodology

- Data was collected was from ECMWF, Iowa Environmental Mesonet, Wyoming Upper Air Sounding, and NSSL.
- Reanalysis data included temperature, rainfall totals, relative humidity, wind components, and vorticity. Reanalysis data used mandatory air pressure levels from surface to 250mb.
- Observation data included temperature dew point and rainfall totals.
- The data sets were collected hourly from Feb 20-23, 1998, from MCO ASOS.
- Historical satellite imaging data, radar data, and Tornado Archives.com were used to study damage paths.

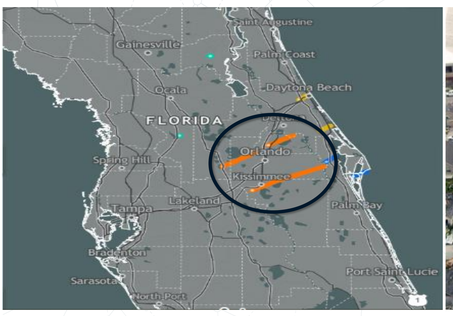



Figure 3: Paths of tornados. Orange lines inside circle indicate F3 Tornadoes and damage area: Source Tornado Archives.com.



Figure 4: Damage to the Lakeside Estates Neighborhood: Source U.S. Department of Commerce.

## Observation vs Reanalysis Data

| Observation Data (in) | Reanalysis Data (in) | Percentage Difference | Correlation |
|---|---|---|---|
| 43.71 | 38. 56 | 12.51% | 0.88 |

Table 1: Observation and reanalysis data comparison for 1998-year rainfall in inches at KMCO ASOS station. This is here to make sure the observation and reanalysis data matched, as one year of data is more accurate.

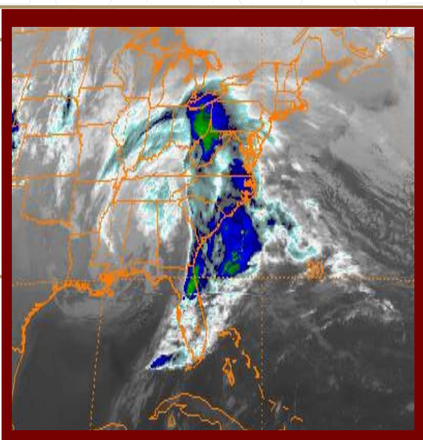


Figure 5: GOES 8 satellite view: Source NOOA.

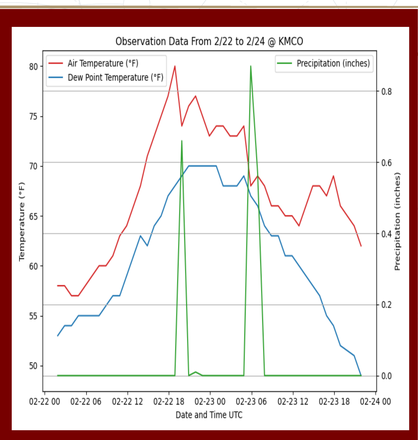



Figure 6: Observation data at KMCO.

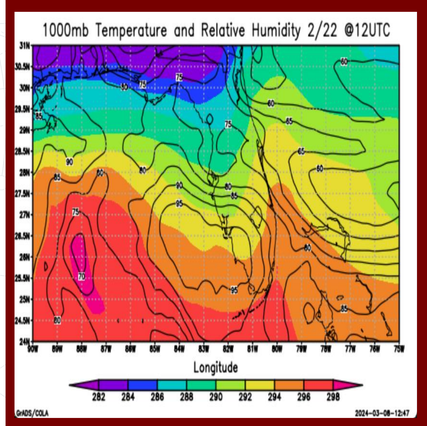



Figure 7: Temperature in Kelvin and relative humidity at 1000mb.

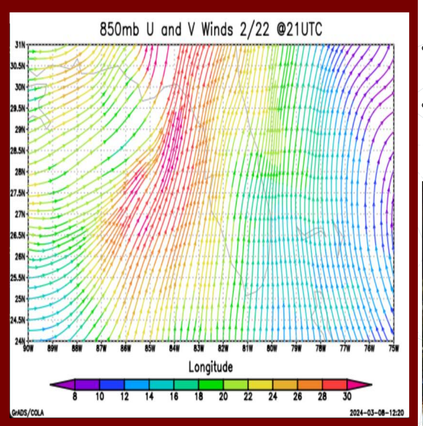



Figure 8: U and V winds in meters per second (m/s) at 850mb.

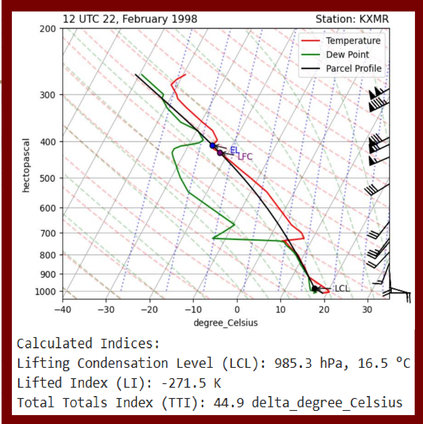



Figure 9: Skew-T chart from Cape Canaveral, FL on February 22 at 12 UTC: Source Wyoming Upper Air.

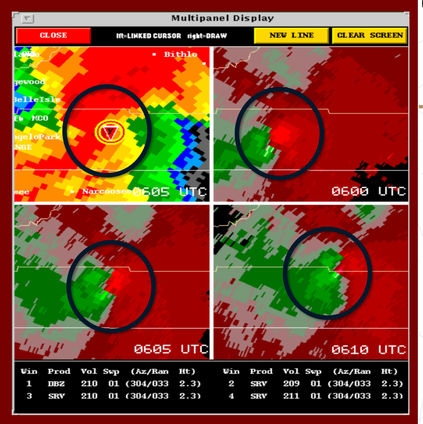



Figure 10: Radar data from Kissimmee tornado. Area circled is tornado signature on radar: Source NSSL.

| Areas Affected | Rebuilt |
|---|---|
| Country Garden Apartment Complex | Yes |
| Hyde Park Villages | Yes |
| Car Dealership in Longwood, FL | Yes |
| Neighborhoods in Sanford | Yes |
| Ponderosa RV Park | Yes |
| Lakeside Estates | Yes |
| Morningside Acres mobile home park | Partly |
| Buenaventura Lakes Subdivision | Yes |
| Boggy Creek Shopping Center | Partly |

Table 2: The Communities impacted by the tornadoes and if they were rebuilt or not.

## Results and Conclusions

- Reanalysis data (figures 7) showed abnormally high temperatures and humidity. 12z was chosen as the time for figures 7 because the warm sector was best shown at this time.
- Skew-t sounding (figure 9) showed a capping inversion around 700mb and low-level wind shear between 1,000 and 800mb. This type of sounding is indicative of severe weather due to warm air braking through the cap.
- Reanalysis data and satellite imaging (figures 8 and 5) showed strong winds aloft associated with low pressure system causing strong tornadoes. 21z is used for both figures to display the cold front as it makes landfall.
- Observation data (figure 6) shows a drop in temperature and an increase in precipitation as the cold front moved through on the 23rd.
- Tornado Archives.com and radar data (figures 3 and 10) showed tornado path, classification on the Fujita Scale, and Kissimmee tornado on radar.
- Despite the major damages (figures 4 and 11), repairs to the affected communities were relatively quick due to preparedness and relatively localized area of damage suggesting the area is prepared for high wind weather events, as shown in table 2 and figure 12.
- By 2024, most affected areas have been rebuilt indicating little long-term impact on residents and communities. (see figure 12 and table 2)
- Central Florida learned a lot of lessons regarding the safeguard of residents from a tornado outbreak, with the population continuing to increase to 23 million in the state and 8.5 million in Central Florida as of 2024.



Figure 11: Damage to Pondarosa RV Park: Source U.S. DEPARTMENT OF COMMERCE.



Figure 12: Ponderosa RV Park today: Source RV and Mobile Home Parks.

## Future Works

- Proposed addition would analyze how other tornado events affected different residential communities around the U.S. and world.
- The process would be similar to how this tornado case was studied, with a background of the storm system and how the affected communitas recovered after the storm.
- This would allow for the comparisons of tornado impacts and recovery from other tornado outbreaks events worldwide.
- This addition could enhance the understanding of tornado impacts and recovery processes in various regions worldwide.
- Its not if a major tornado outbreak will impact an unprepared populated center, but when.

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