An Analysis of the First Ever DOW-Observed Mesolow

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1. Motivation

- Embry-Riddle Aeronautical University Convective-Boundary Research Engaging Educational Student Experiences 2.0 (ERAU C-BREESE 2) was a 15-day Doppler-on-Wheels (DOW) and Mobile Mesonet educational deployment through the Center for Severe Weather Research (CSWR).
- Building off the success of ERAU CBREESE in May 2015, the educational deployment was designed to observe and measure sea-breeze processes and convection during the warm season, with a specific focus on Central Florida sub-regions that contain multiple mesoscale breezes and boundary collisions.

- On 6 July 2018, the first ever DOW-observed mesolow occurred during sea-breeze thunderstorms on the Florida Space Coast.

2. Data and Methods

DATA

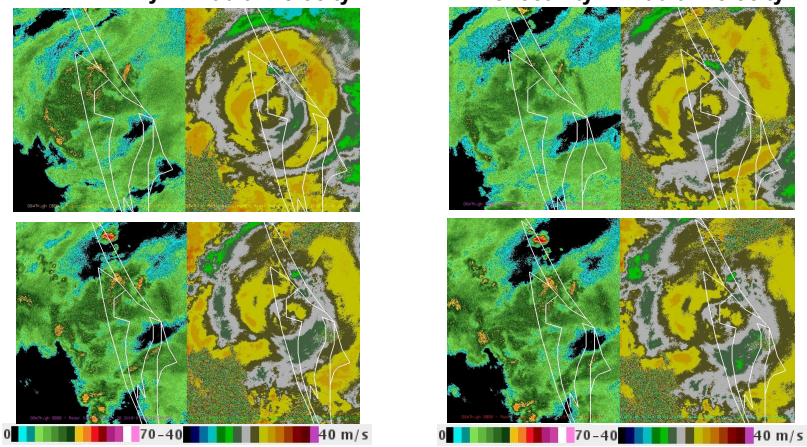
- Data was archived from the DOW, Terminal Doppler Weather Radar (TDWR) at Orlando International Airport (KMCO), Melbourne, Florida (KMLB) WSR-88D radar, and from the NOAA High Resolution Rapid Refresh (HRRR) model.
- Data was analyzed using Unidata's Integrated Data Viewer (IDV).

METHODS

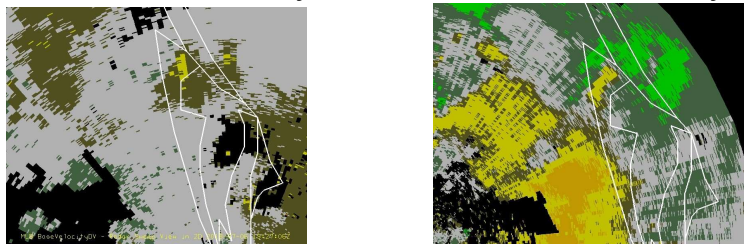
- The DOW was by chance situated near the center of the mesolow, making it the primary radar used.
- The TDWR and WSR-88D were able to see the mesolow, but because both sites are ~65 km from the center of the mesolow, the signature is much weaker.
- Each of these radars were cross-referenced with Skew-T Log-P calculated heights from the 12 UTC balloon launch from Ruskin, Florida (TBW) and the Cape Canaveral Air Force Station (XMR) to determine appropriate HRRR pressure levels for analysis.
- The 750 hPa level represents the mean layer where the mesolow was observed.

3. Observations – 1930 UTC

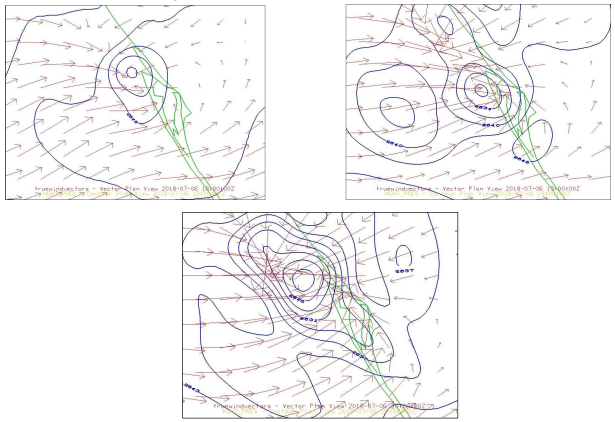
14.5, 11.5° Reflectivity | 14.5, 11.5° Radial Velocity | 9.5, 8.5° Reflectivity | 9.5, 8.5° Radial Velocity



WSR-88D 3.1° Base Velocity | TDWR 3.3° Radial Velocity

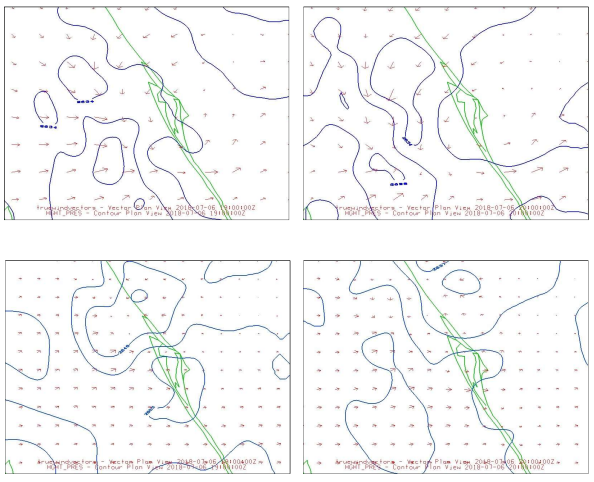


4. HRRR Analysis – 750 hPa



From 18 UTC to 20 UTC, the HRRR was able to objectively analyze the mesolow as it was occurring. This is likely due to the HRRR's ability to rapidly assimilate real-time satellite and radar data.

5. HRRR Forecasts – 750 hPa



HRRR forecasts yielded ambiguous results. The upper charts show the 15 UTC HRRR forecast for 19 and 20 UTC. There is no well-defined circulation where the winds and pressure should actually converge. The 15 UTC HRRR was very aggressive with the precipitation, and it subsequently simulated the strongest convection west of where it actually occurred.

A similar trend was noticed in the 18 UTC run. Despite being present at the time, the mesolow was not forecast by the HRRR to last until 20 UTC, as actually occurred.

6. Conclusions

- Mesolows are difficult to observe. In this instance, the DOW clearly depicted the feature because of its chance scanning location at the center of the mesolow. It would be easy to overlook on the other radars.
- The HRRR's ability to ingest satellite and radar data greatly improves the initial conditions for each model run.
- Despite the HRRR's ability to assimilate this data, it still struggled to correctly initiate and sustain sea-breeze convection in the correct location. As a result, the HRRR did not accurately forecast the mesolow.