

The Atmospheric Effects on the Extratropical Transition of Hurricane Sandy

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1. Introduction / Background

- Hurricane Sandy formed in the Caribbean in late October 2012 and intensified to a Category 3 hurricane before making landfall in Cuba and later New Jersey (Blake et al., 2013). Sandy caused approximately \$68.7 billion in damages and over 250 fatalities, making it one of the most impactful storms in U.S. history.
- During extratropical transition (ET), tropical cyclones interact with mid-latitude systems, leading to structural changes such as expansion of the wind field, development of frontal boundaries, and increased baroclinicity (Hart and Evans, 2001). Sandy is a key example of a hybrid cyclone where ET did not weaken impacts but instead expanded the storm's influence.
- This study investigates the role of synoptic-scale forcing, including blocking patterns and upper-level dynamics, in controlling Sandy's evolution.

2. Data and Methods

- Surface observations obtained from the Iowa Environmental Mesonet for Atlantic City International Airport (KACY). Variables analyzed: temperature, wind speed, and sea-level pressure
- ERA5 hourly reanalysis data from the European Centre for Medium-Range Weather
- The reanalysis period spans 2012 and focuses on 26–31 October 2012

3. Results

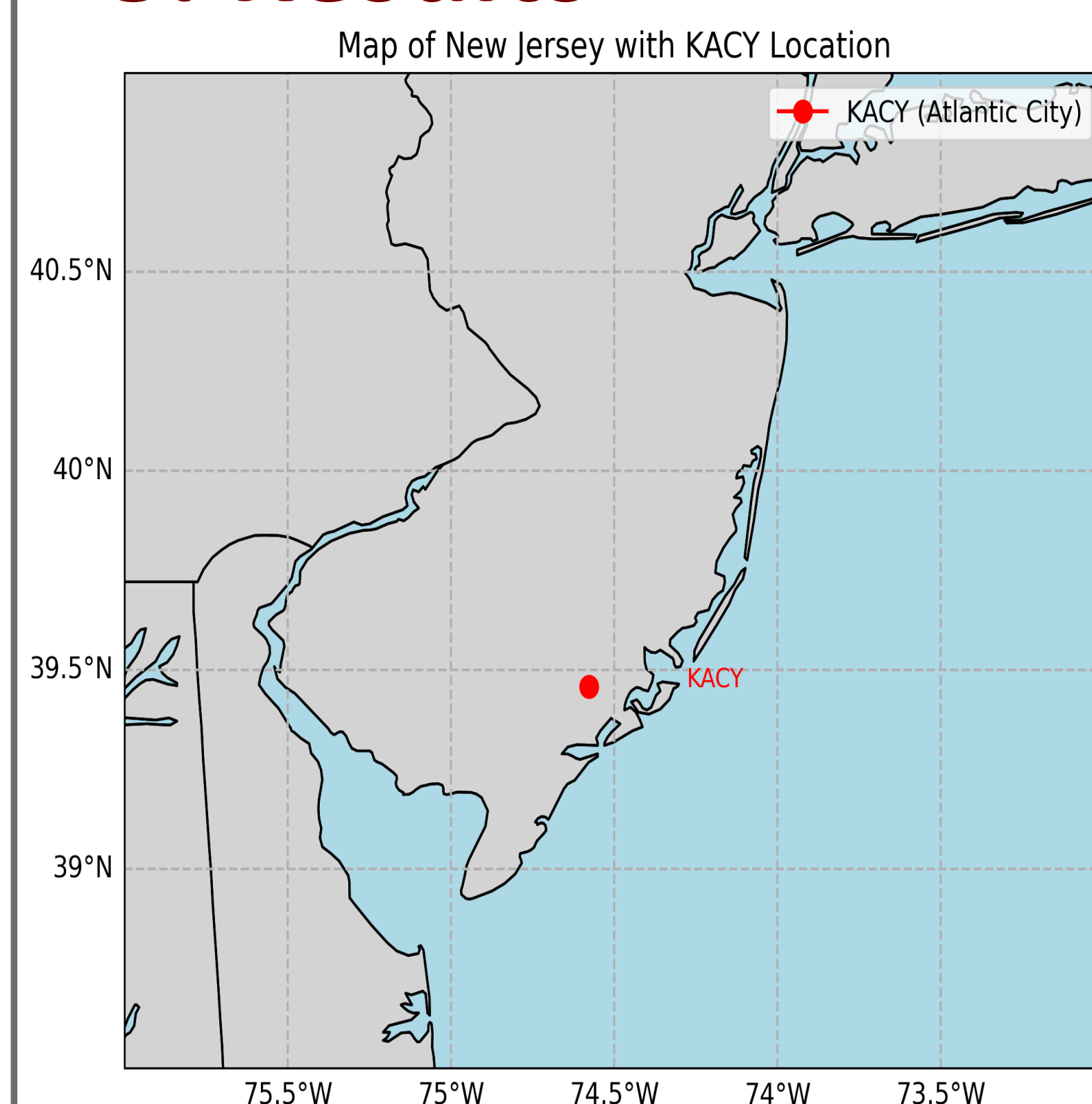


Figure 1. NJ Map with KACY (Atlantic City Airport)

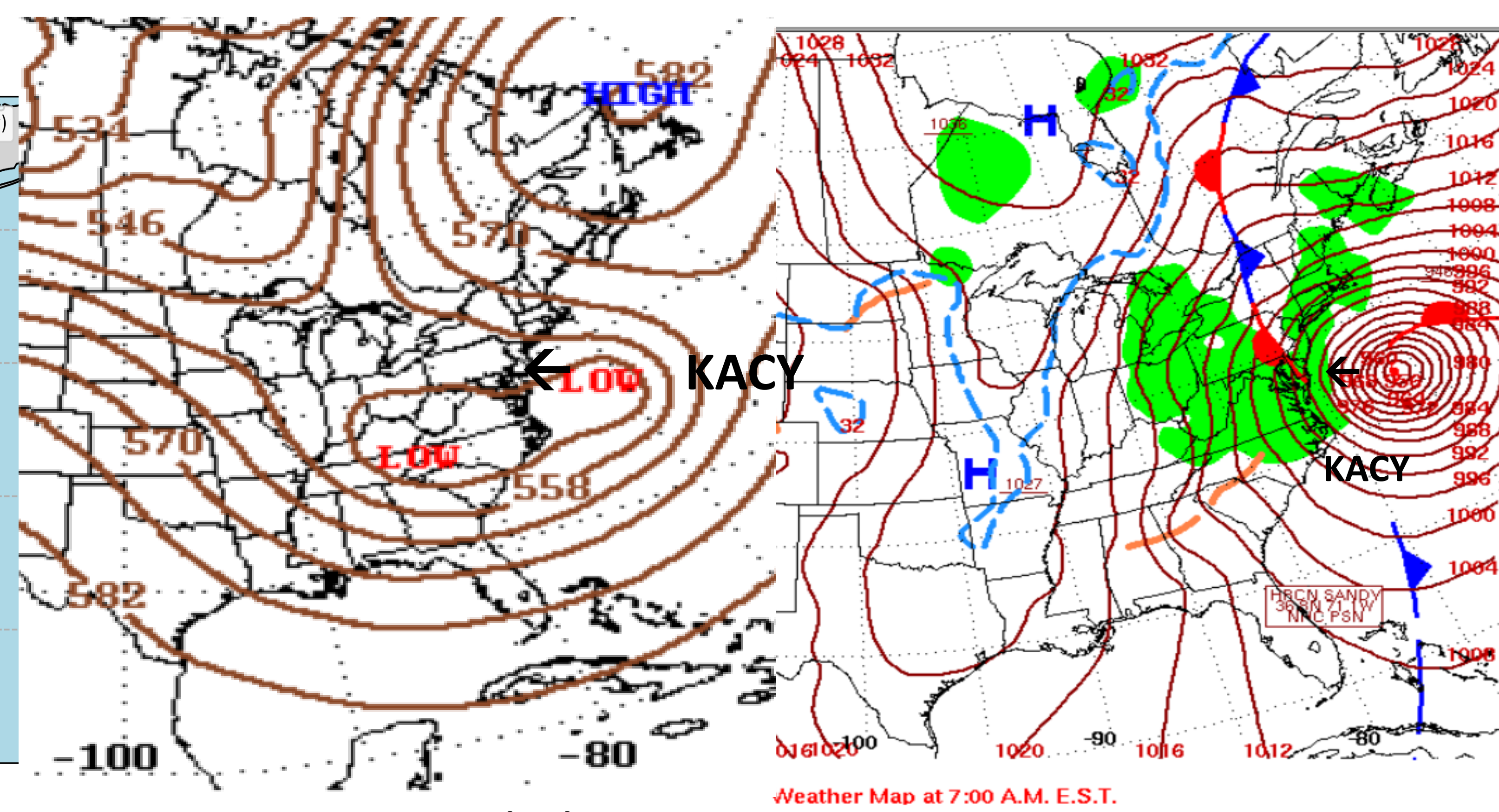


Figure 2. 500mb Chart 10/29/12 12Z (NCEP)

Figure 3. Surface Chart 10/29/12 12Z (NCEP)

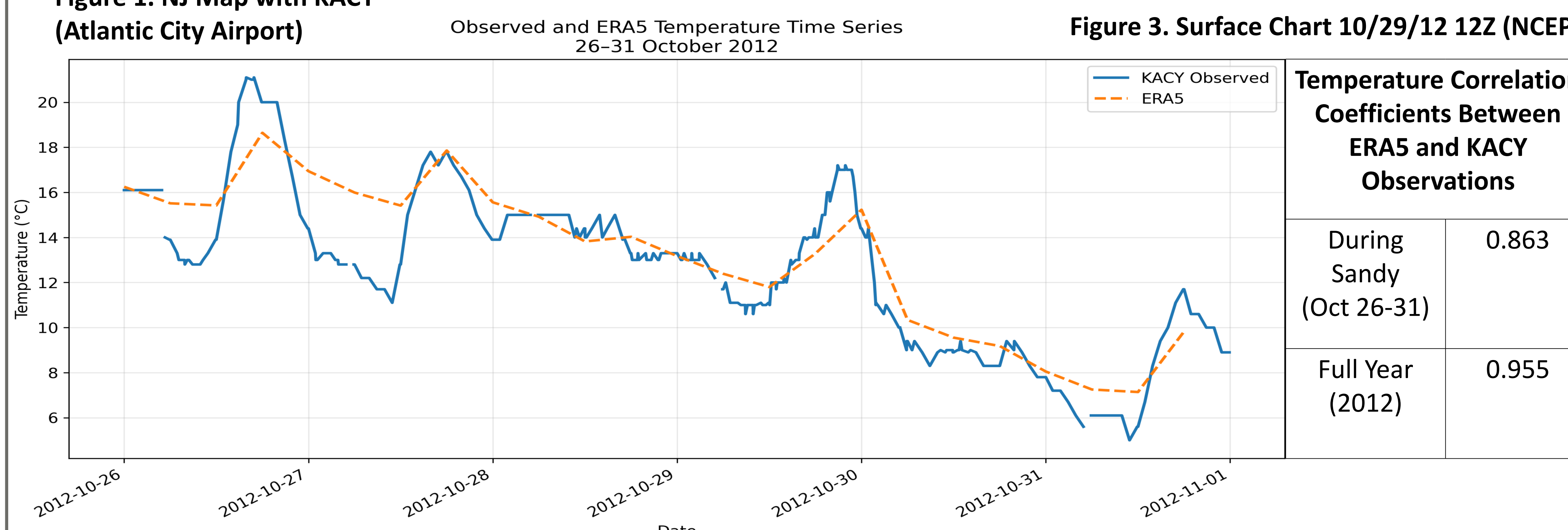


Figure 4. Time Series plot of ERA5 temperature and Observed temperature data from KACY station

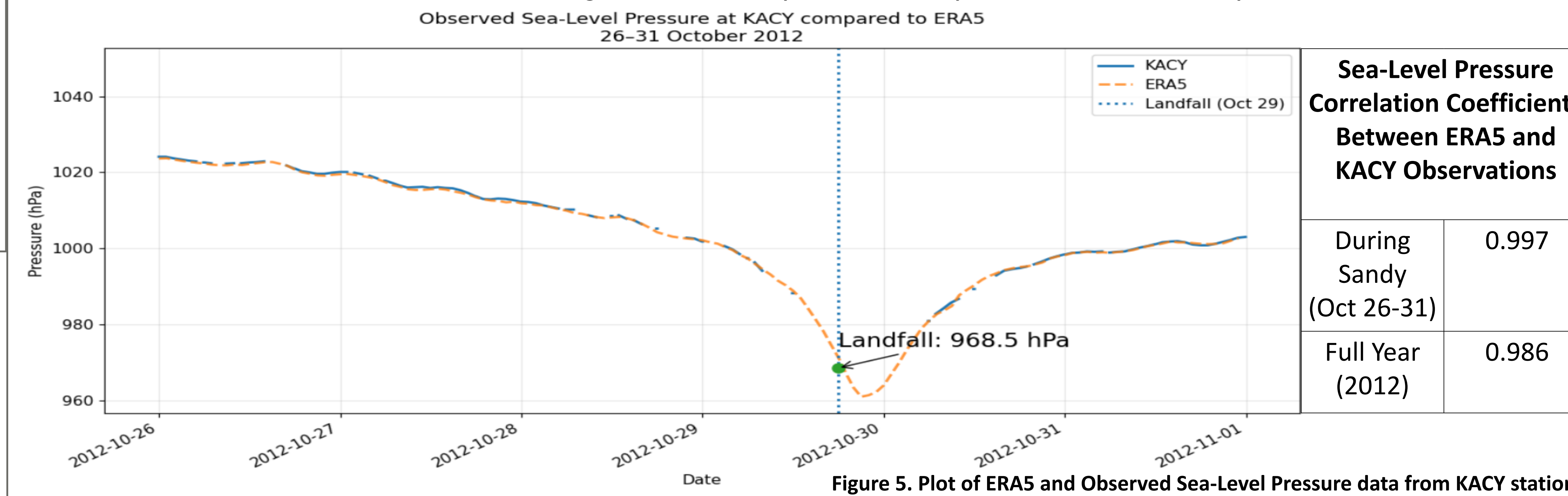


Figure 5. Plot of ERA5 and Observed Sea-Level Pressure data from KACY station

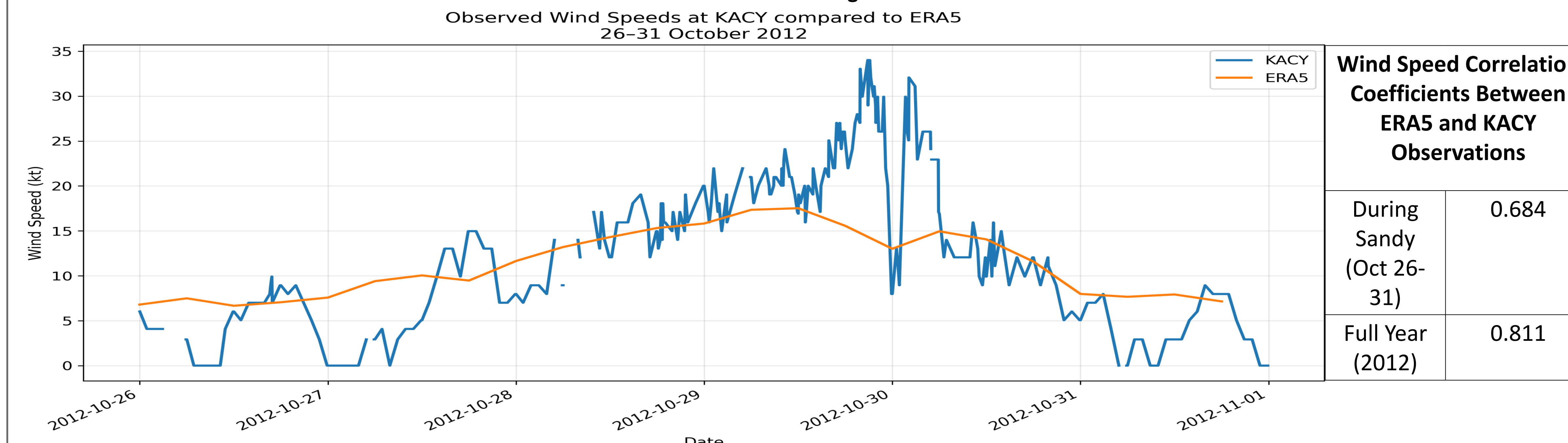


Figure 6. Plot of ERA5 and Observed Wind Speed data from KACY station

4. Discussion

- Temperature decreases indicate increasing baroclinicity during the transition.
- Synoptic analysis (Figures 2–3) shows a blocking high over the North Atlantic and a cutoff low over the eastern United States.
- The blocking high prevented the storm from recurving out to sea, while the cutoff low enhanced baroclinic forcing and vertical wind shear. These processes contributed to the expansion of the wind field and the development of frontal features.
- The strong agreement between ERA5 and observations for temperature and pressure confirms that reanalysis data effectively captures large-scale atmospheric structure (Figures 4-5).
- However, lower wind speed correlations highlight limitations in representing small-scale and coastal processes (Figure 6).

5. Future Work

- Future work should focus on improving representation of mesoscale processes and coastal interactions in reanalysis and forecast models to enhance prediction of high-impact hybrid cyclones.

6. References



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