Improving coastal forecasting in Southern Delaware is important for agriculture, the fishing industry, tourism, wind and solar power production, and for disaster preparedness. This project explores whether using in situ wind and surface temperature data in the Weather Research and Forecasting Model (WRF) improves prediction of coastal weather. Since 2011, the Cape May-Lewes Ferry has been collecting atmospheric and water quality data as it crosses the mouth of the Delaware Bay. New methods were developed to process the data from this moving platform such that it could be used as forcing data for the model. When processed, the data will be assimilated into the models to study sea breezes, which are the largest source of summertime wind variability and are challenging to forecast.

### Introduction

- Sea breezes form near land and large bodies of water in the spring and summer months due to strong diurnal forcing [2].
- Atmospheric mesoscale models like WRF tend to favor synoptic scale forcing over local scale forcing, which causes sea breezes to develop late relative to when they are observed and finish early.
- The same models tend to over estimate wind speeds [2].
- However, WRF has been shown to be a useful tool for studying coastal wind forecasting [2].
- Synoptic typing, used to identify weather patterns, can help identify days favorable for sea breeze development.

### Methods

- Configure the models on high-performance computing cluster Farber
- Weather Research & Forecasting Model (WRF) [3]
- Coupled-Ocean-Atmosphere-Wave-Sediment Transport Model (COAWST) [4]
- Set up a three nested model for the Delaware Bay (Figure 1)
  - Grid Spacing: 9 km, 3 km, and 1 km
  - Data Resolution: 30 s for each nest
- Convert longitude and latitude to degrees
- Quality control ferry data
- Recreate model domain in MATLAB
- Identify ferry track in model domains
- Bin data for each domain
- Take hourly averages for each grid box
- Verify binning process
- Write data to netCDF format
- Assimilate ferry data into model runs

### Results

- Created a multi-year record of hourly and daily measurements across the mouth of the Delaware Bay that provides forcing data when ferry data are available (Figures 2, 3).
- Produced hourly average of wind speed, wind direction, surface water temperature, air temperature, and atmospheric relative humidity that are provided at specific locations along the ferry track and are collocated with model grid cells (Figure 4).
- Binned data for each of the 3 domain grids.
- Analyzed synoptic typing data to identify days favorable to sea breeze development.
- Created a program to efficiently process big data as it is collected from the ferry in the future.

### References


### Future Directions

- Select sea breeze case studies using NEXRAD and synoptic typing data.
- Verify case studies match days with ample ferry observation data.
- Run the models for each scenario of forcing data (Reanalysis Only, Ferry Only, Both).
- Identify strengths and weaknesses in each method to identify the best method for data assimilation that improves coastal weather prediction.
- Build an operational forecasting model for the Delaware Bay that will best predict sea breezes.

### Acknowledgements

Eric Allen was supported by the Delaware Environmental Institute through the DENIN Scholars program. This research was made possible by the National Science Foundation EPSCoR Grant No. IIA-1301765. This research is funded through the Delaware Sea Grant.