Statistical and Machine Learning Approaches to Understanding Synoptic-scale Influences on Waterspouts in the Florida Keys

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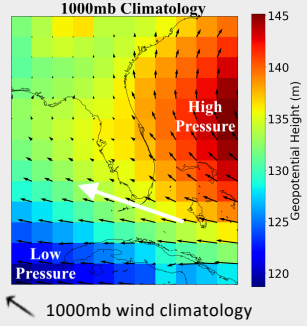
Background

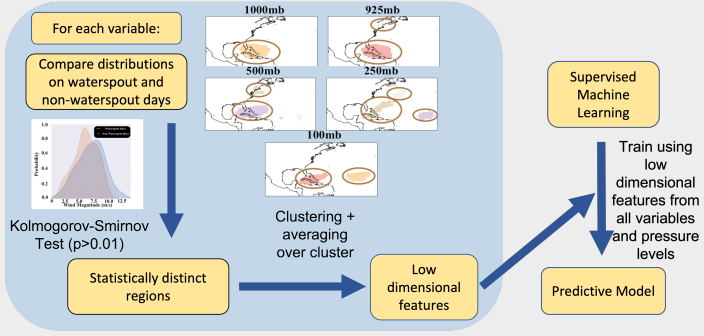
- Past research has found local-level predictors of waterspout favorability from in situ measurements in the Florida Keys (Devanas & Stefanova 2018)
- The aims of this work is put waterspout favorability in a synoptic (~1000km) context using ERA5 reanalysis data
- Machine learning, as a form of automated pattern recognition, serves as a useful tool for detecting synoptic-scale predictors of waterspout favorability

Meteorological Context

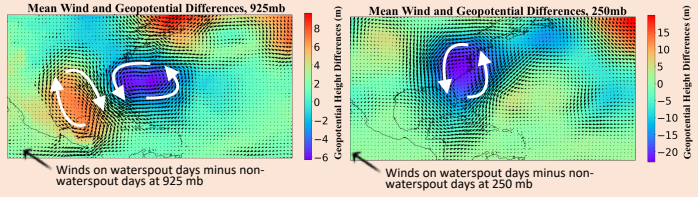


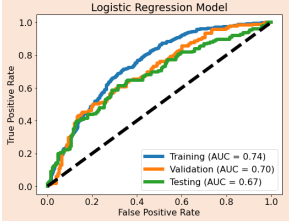
- Bermuda High to the east
- Low pressure to the southwest
- Predominant southeasterly winds

Methods



Results





- Statistically significant (p<0.01) predictors found across many variables at synoptic scale
- Predictors are used to train a logistic regression model with AUC>0.67

Conclusions

- Northwesterly wind anomalies (weakened southeasterlies) correlate with favorable waterspouts conditions
- Many synoptic scale features correspond to waterspout favorability
  - Surface cyclone east of Florida
  - Surface anticyclone over Gulf of Mexico
  - Upper atmosphere cyclone over the Southeast U.S.
- These synoptic features are effective inputs for a machine learning model to predict waterspout favorability

Future Work

- Combine in-situ and model data
- Strong potential in an operational forecasting setting when applied to real-time numerical weather prediction output
- Understand causal mechanisms

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