An AI-Based Forecast Model for Hurricane-Induced Power Outages

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NOAA's Ernest F. Hollings Scholarship Program
National Hurricane Center
NOAA Mission Goal: A Weather-Ready Nation

Poster Showcase
#iaem25

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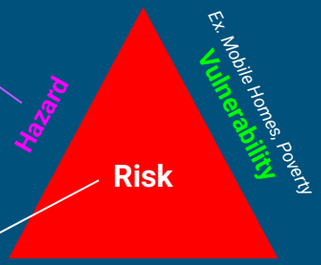
1. Background

- **Power outages**, extremely common in hurricanes, **disrupt** critical infrastructure and pose **serious risk** to safety/emergency response
- Many studies developing power outage models, but none are proactive/forecast-based
- Can we predict location/severity of power outages?

2. Data

36 US-landfalling tropical cyclones 2020-2024.

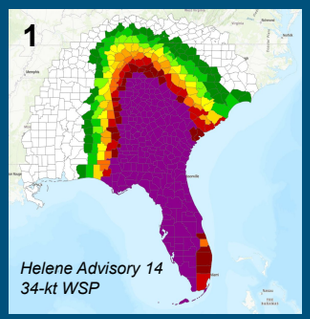
NOAA Forecast Center **(NHC/WPC/SPC) Products.** *Experts' interpretation of raw model data.*



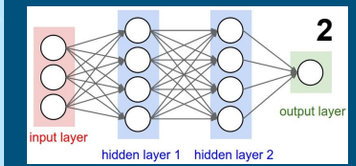
Percent of customers who lose power in the **120 hours** following a forecast advisory time, at county level.

3. Methodology

1. Interpolated **hazard data by county** per advisory. *Python automation in ArcGIS Pro.*

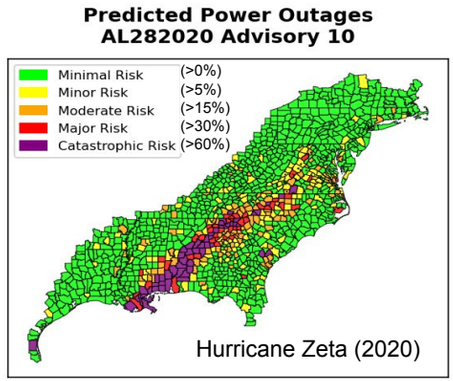


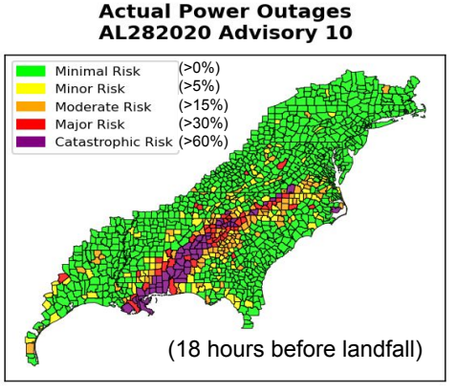
2. Neural Network Model
Deciphers complex patterns and makes predictions!

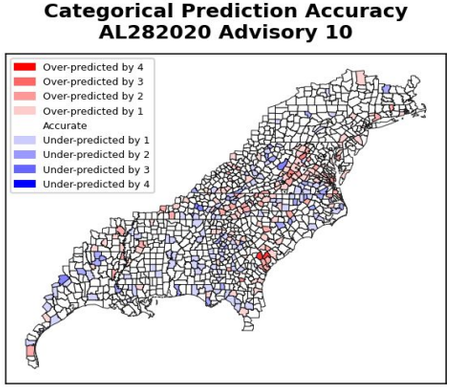


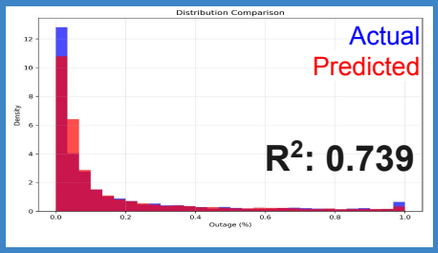
4. Results

High geographical & statistical similarity between predicted & actual outages!









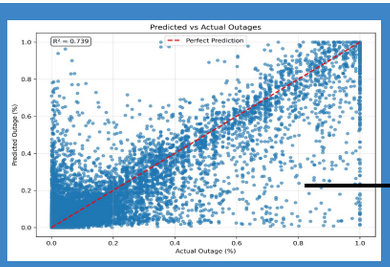
Most Important Variables

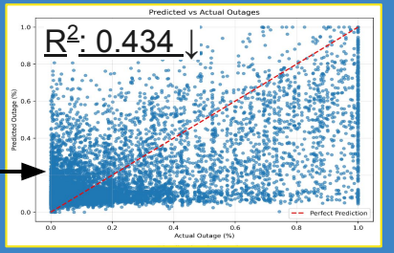
1. 50-kt Point WSP *(0.17)*
2. 34-kt WSP Duration *(0.04)*
3. 34-kt Point WSP *(0.04)*
4. 64-kt Point WSP *(0.04)*
5. 50-kt Areal WSP *(0.03)*

(A) **"Damaging" winds** (i.e. gusts) best determine power outage severity.

Hazard-Only Model

Predicted vs. Actual Outages.





(B) **Exposure/vulnerability metrics** are critical to accurately assess risk.

Severe Outage Only (30%+) Model

(C) **Exposure/ vulnerability metrics** determine if a severe outage will be catastrophic.

Most Important Variables

1. % Mobile Home Residents *(0.07)*
2. 34-kt WSP Duration *(0.05)*
3. Average Tree Height *(0.05)*
4. % Single-Parent Homes *(0.03)*
5. % 1960s Households *(0.03)*

5. Future Work

- Develop a fully-operational hurricane preparedness tool for EMs
- Add new inputs/outputs/storm cases to the model
  - Inputs: Elevation, Tree Species, Soil Moisture, Power Infrastructure
  - Outputs: Duration of Outages, Damage
- Accuracy and feature importance for different geographic regions of US
- Utilize satellite imagery as outage proxy for international application

6. Acknowledgements

I'm immensely grateful towards the NOAA Hollings Scholarship Program for funding this opportunity, as well as my attendance at this conference. I would also like to express my gratitude for my mentors – Josh, Jamie, and Wallace – for supporting me along every milestone of this project. Lastly, thank you to the National Hurricane Center staff for your mentorship and welcoming environment!

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