

# Combined Hazard and Vulnerability Analysis for Power Transmission Lines

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## Motivation and Objective

- Power transmission lines are critical infrastructure vulnerable to natural hazards
- Hurricane hazard assessments focus on wind velocity, but there is a need to consider wind direction on the structural integrity of transmission towers.
- Combining hazard and vulnerability analysis allows assessment of the susceptibility of power transmission lines to wind-direction related risks

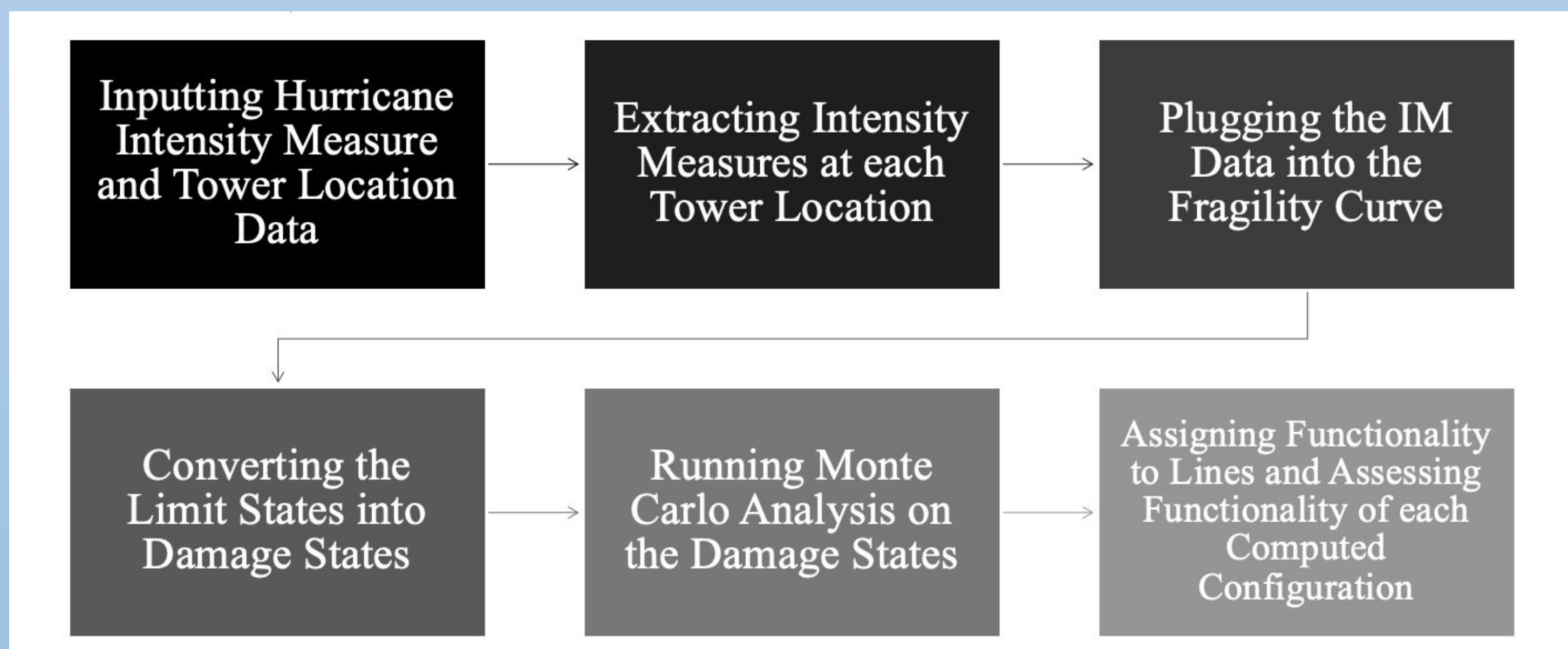


Figure 2: IN-CORE Workflow

## Results and Further Research

- Findings reveal that wind direction does impact the structural response of towers.
- Generalizing wind direction to be the same for each tower can lead to under or over-estimating the potential functionality of the power network.
- Future research includes more particular case studies in IN-CORE using functionality assemesnets built into their program.

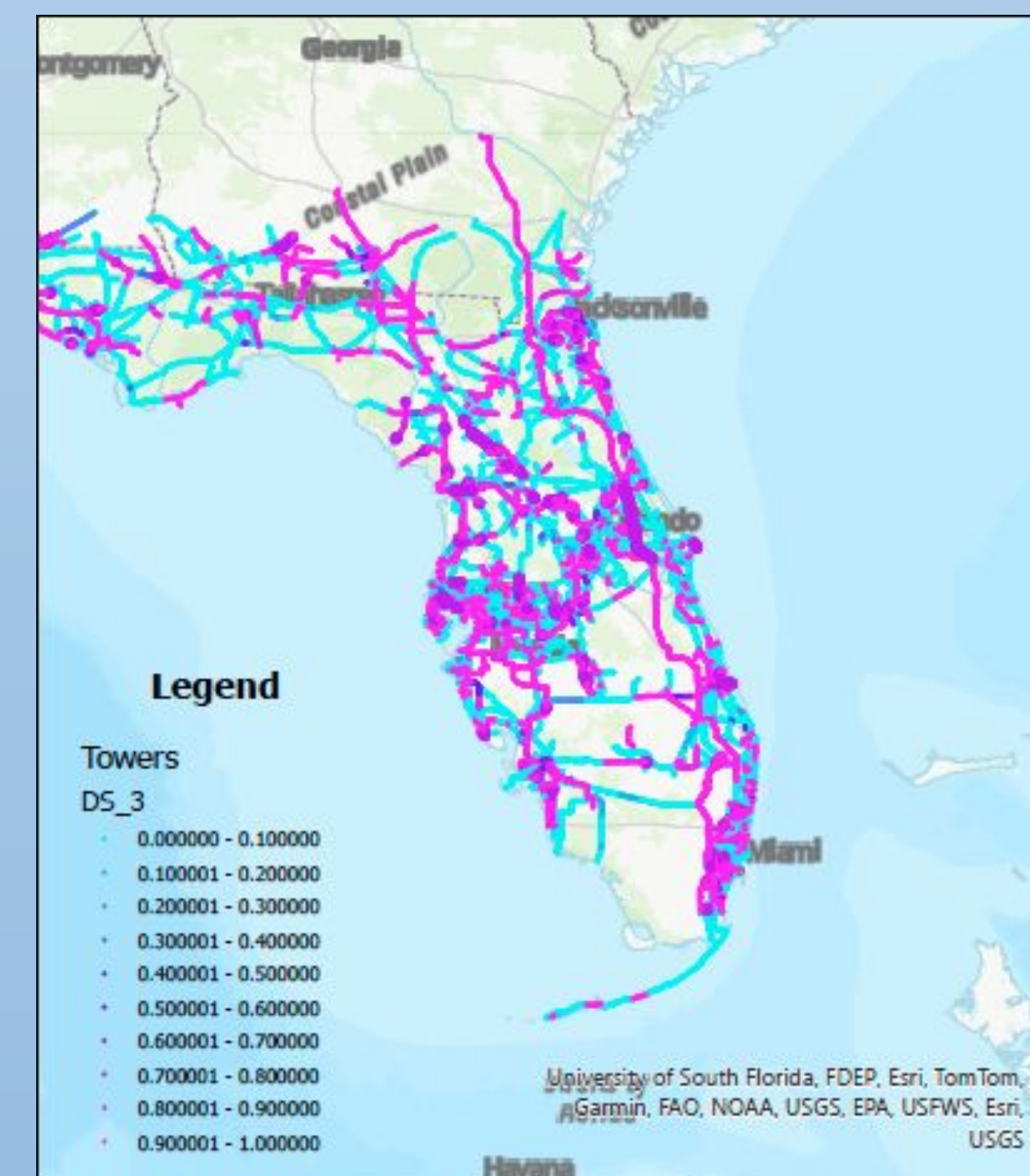


Figure 5: 0-Degree Wind Direction Damage States



Figure 6: 30-Degree Wind Direction Damage States

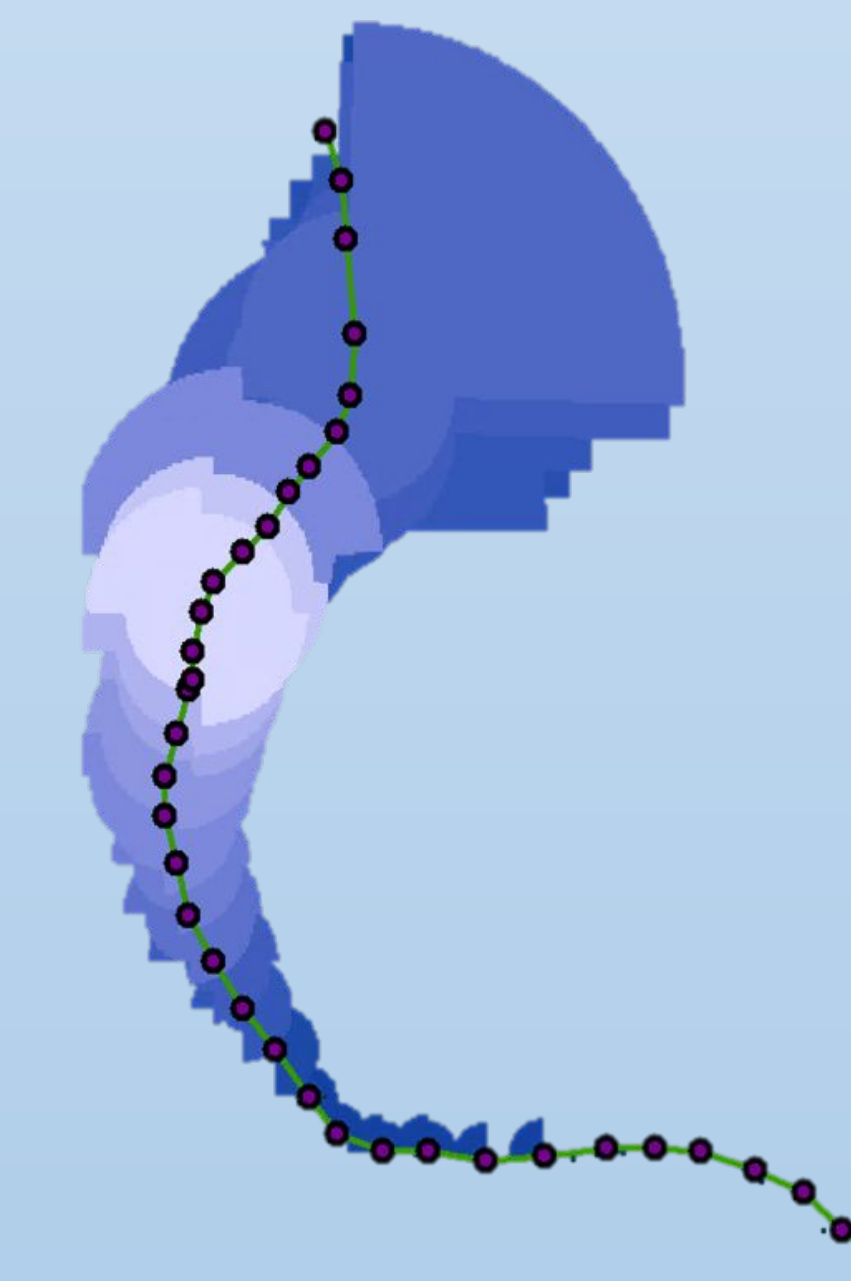
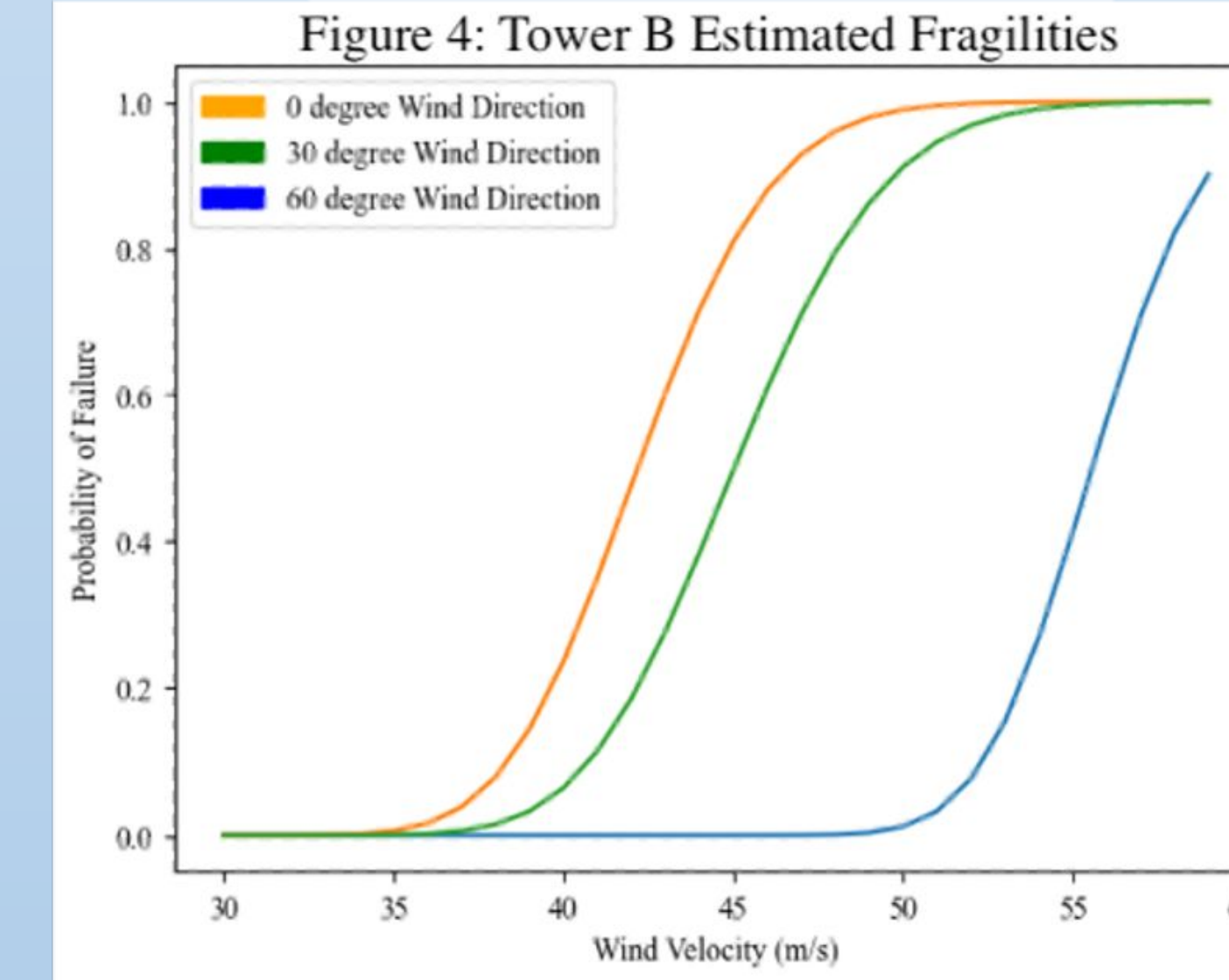
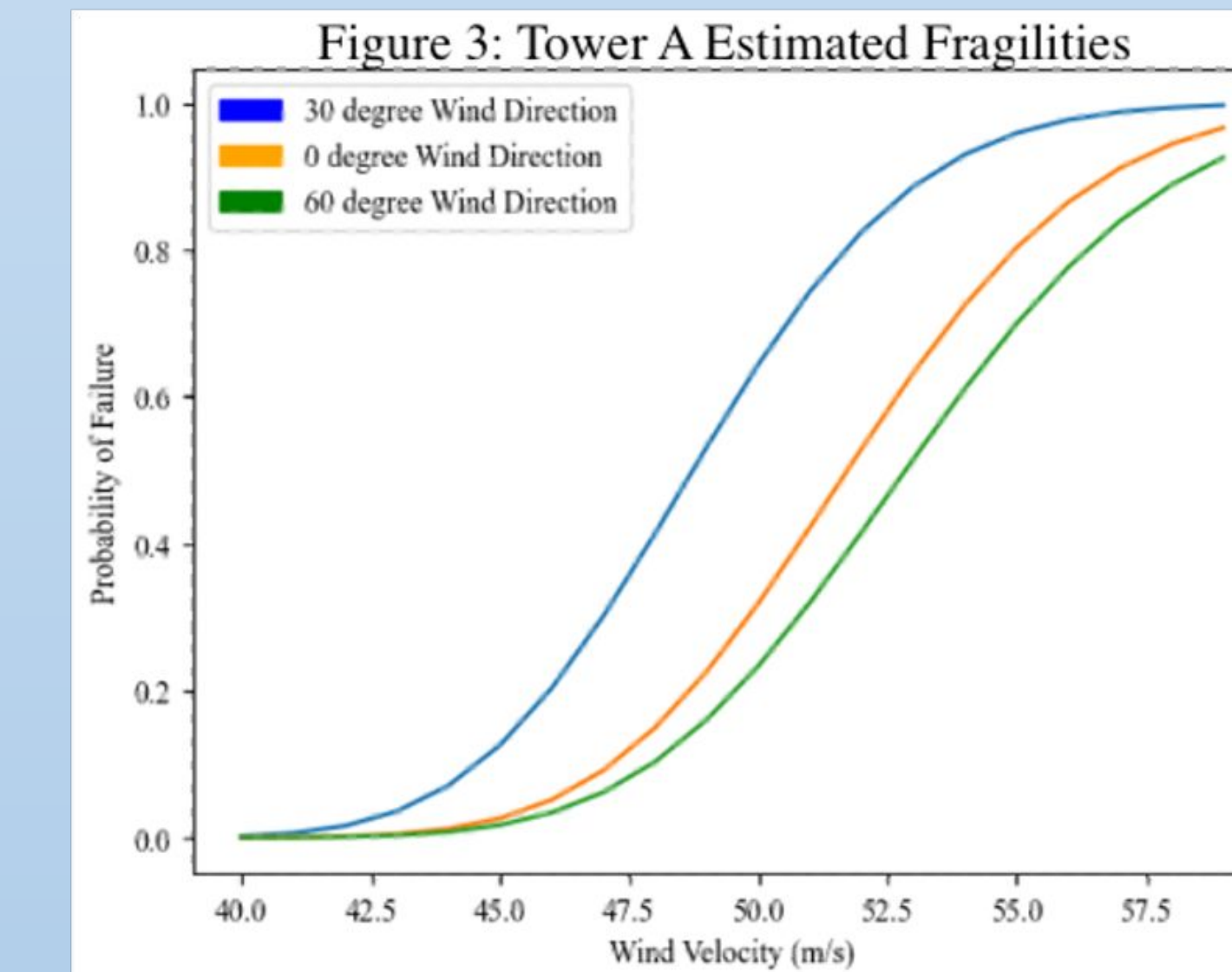


Figure 1: Hurricane Ian Wind Track



## Methods

- Using IN-CORE, a model is made using historical data from Hurricane Ian in Florida.
- IN-CORE's process is detailed in the flow chart
- The functionality assessment was coded separately from IN-CORE's functions, mathematically expressed by EQ 1.

$$Q_{benchmark} = \frac{\sum (V \times L)_{configuration}}{\sum (V \times L)_{network}}$$

Equation 1: Calculation of benchmark functionality

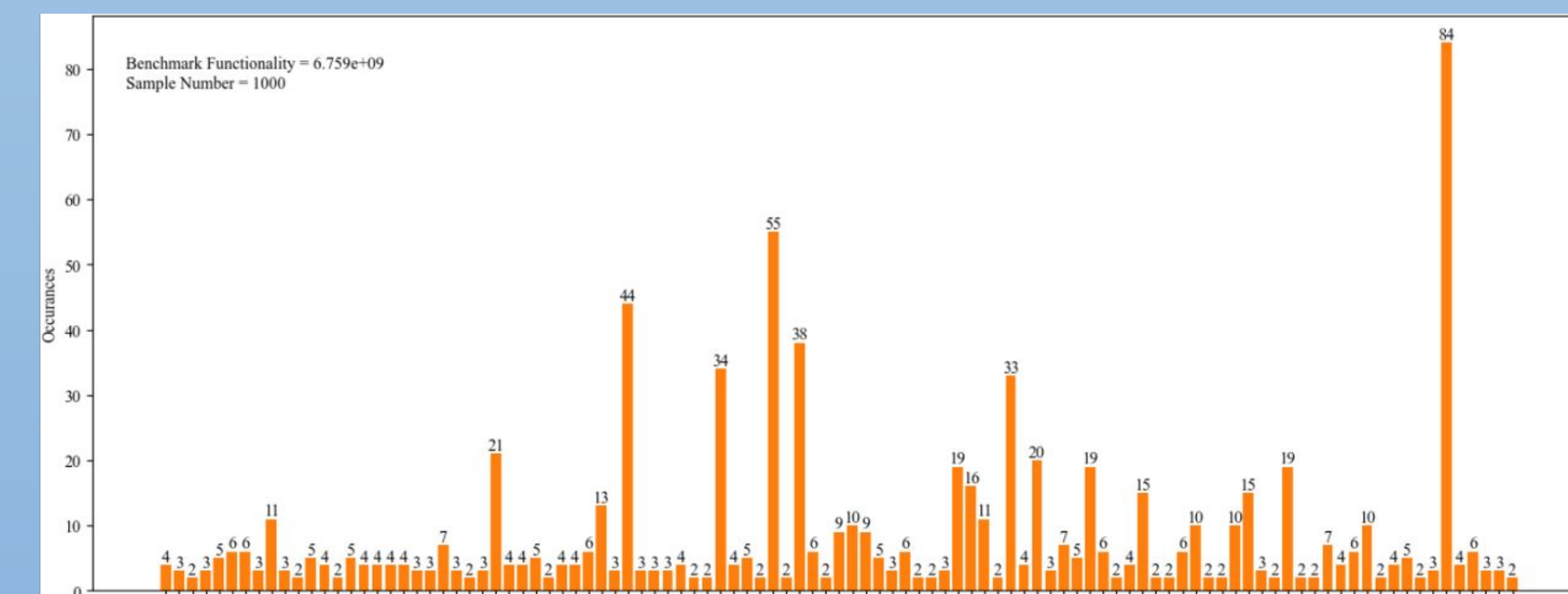


Figure 7: 30-Degree Wind Direction Functionality Configuration Occurrence

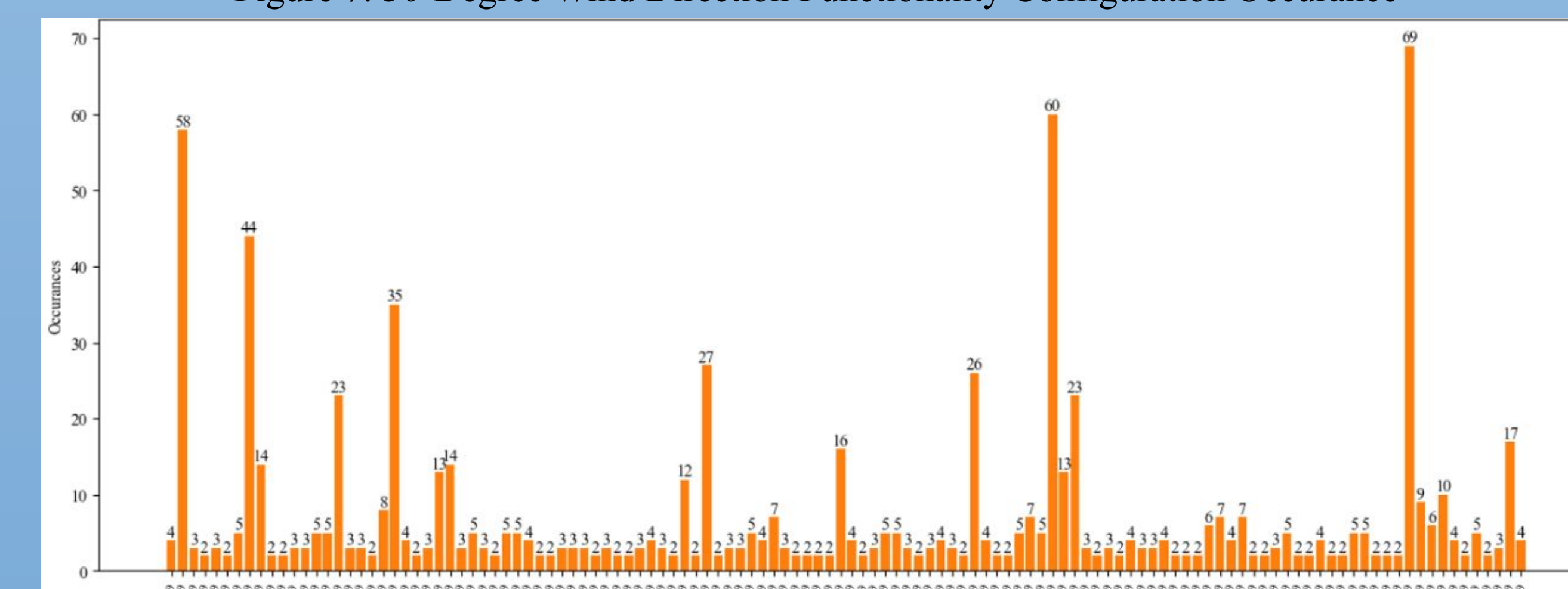


Figure 8: 0-Degree Wind Direction Functionality Configuration Occurrence

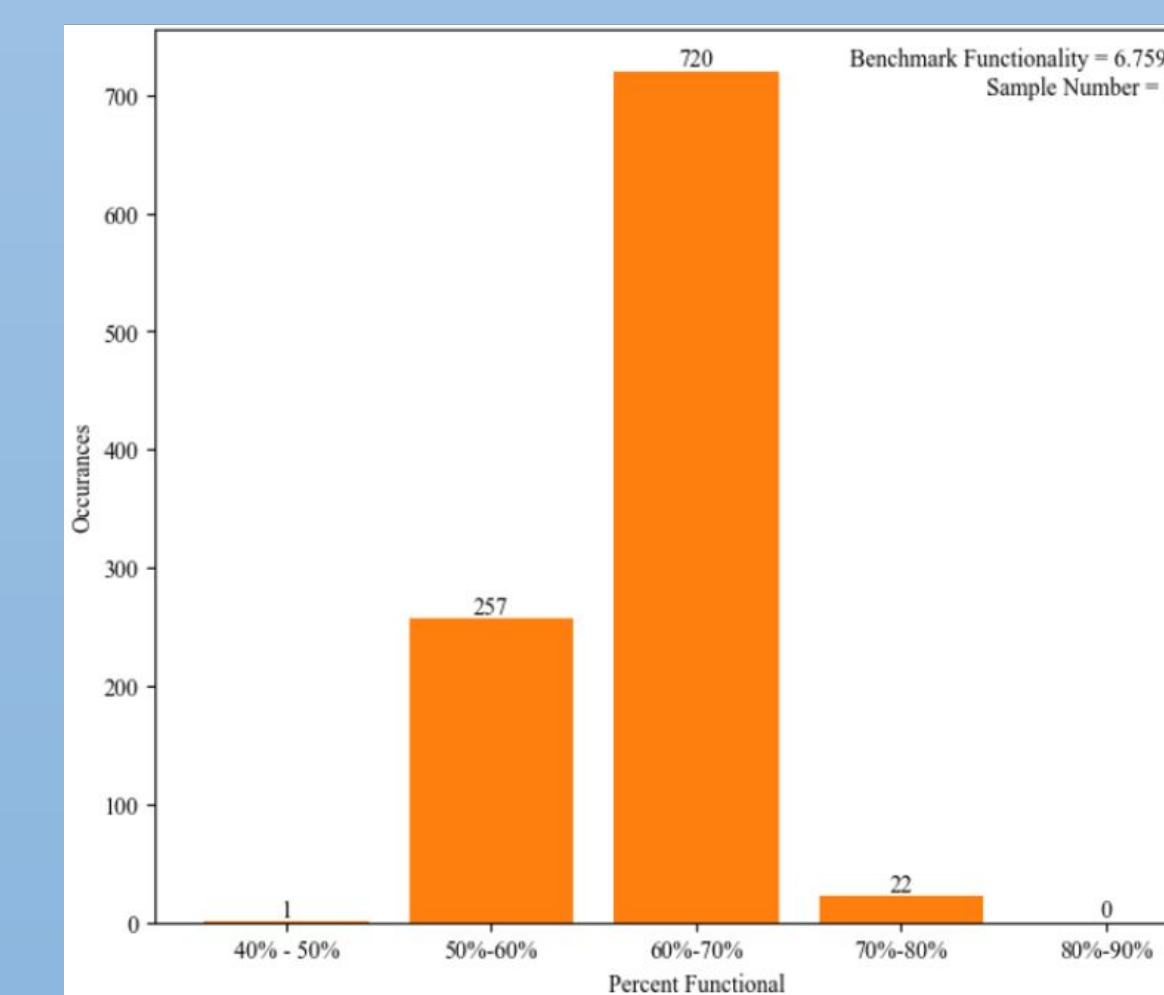


Figure 9: 30-Degree Wind Direction Distribution of Functionality

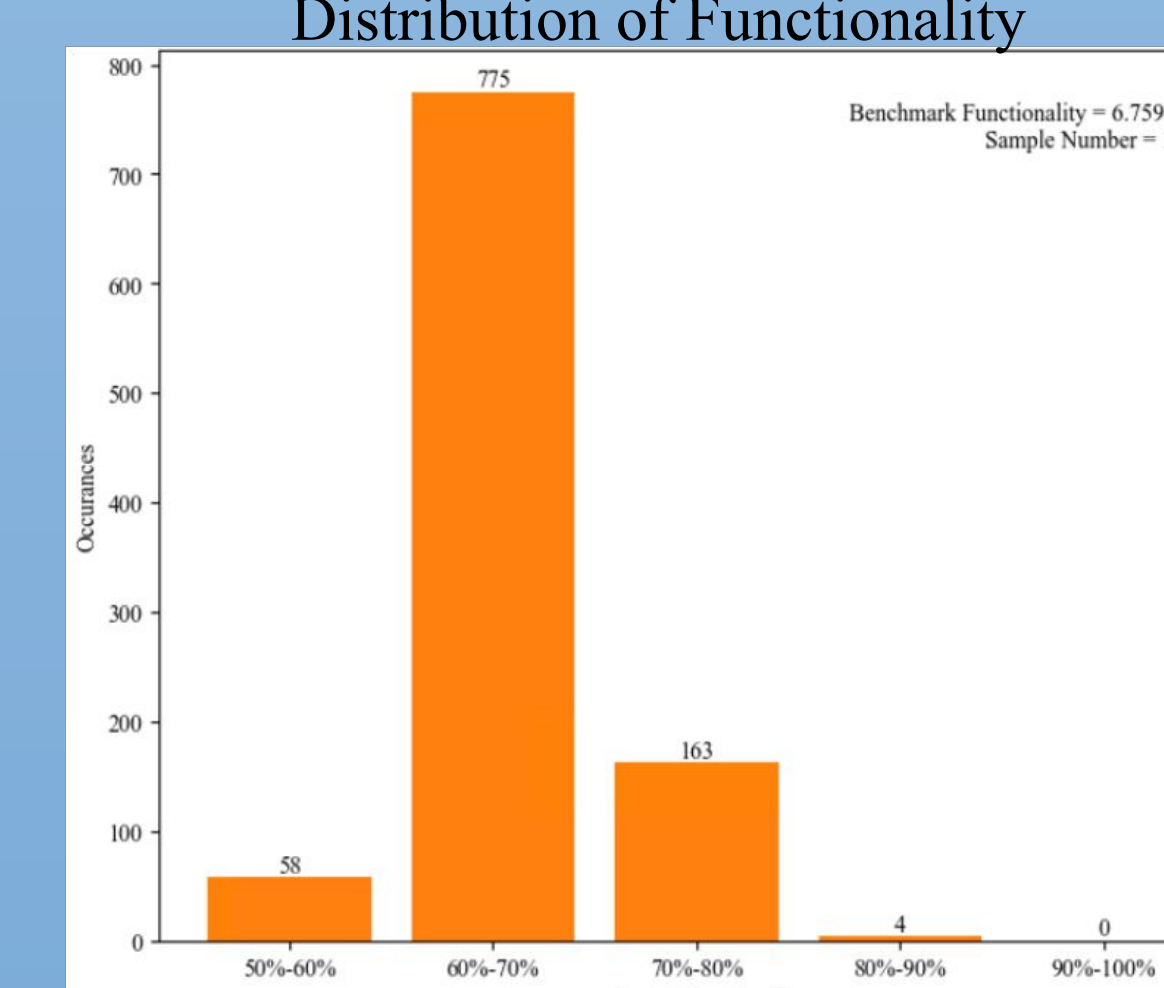


Figure 10: 0-Degree Wind Direction Distribution of Functionality

## Acknowledgement(s):

David and Lorraine Freed Undergraduate Research Symposium, Lehigh University Professor, Paolo Bocchini, Xinyue Wang