SPATIOTEMPORAL IMPACT ANALYSIS OF HURRICANES AND STORM SURGES ON POWER SYSTEMS

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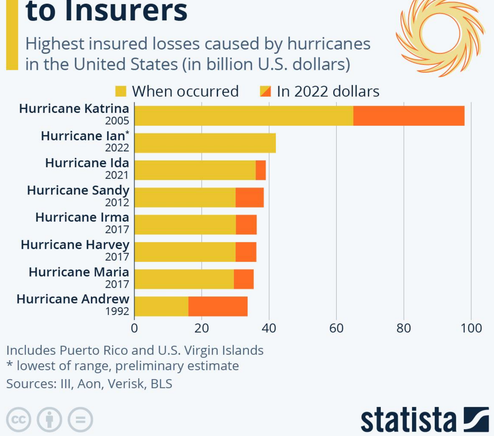
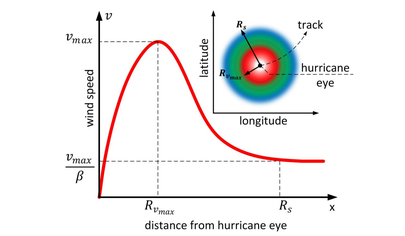
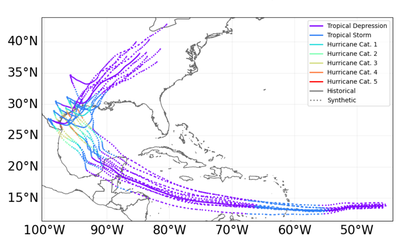
1. BACKGROUND AND MOTIVATION

- Almost $2.57 trillion economic loss due to weather-related events[1].
- Major reason of socioeconomic losses → high-impact low-probability events.
- 90% of those events are hurricanes → severe storms and tropical cyclones.
- Challenges → spatiotemporal (varying in space and in time) impact and uncertainty due to hurricanes and storm surges.
- Need of a framework to analyze the uncertain impacts of these events to proactively plan the available resources.

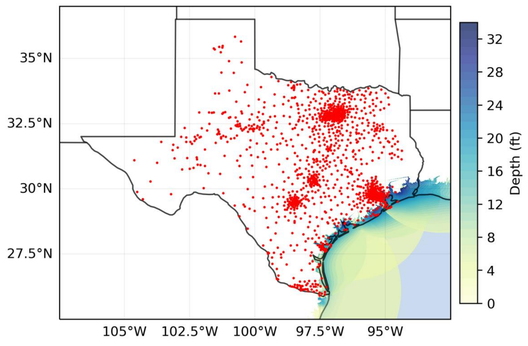


2. HURRICANE MODELING[2,3]

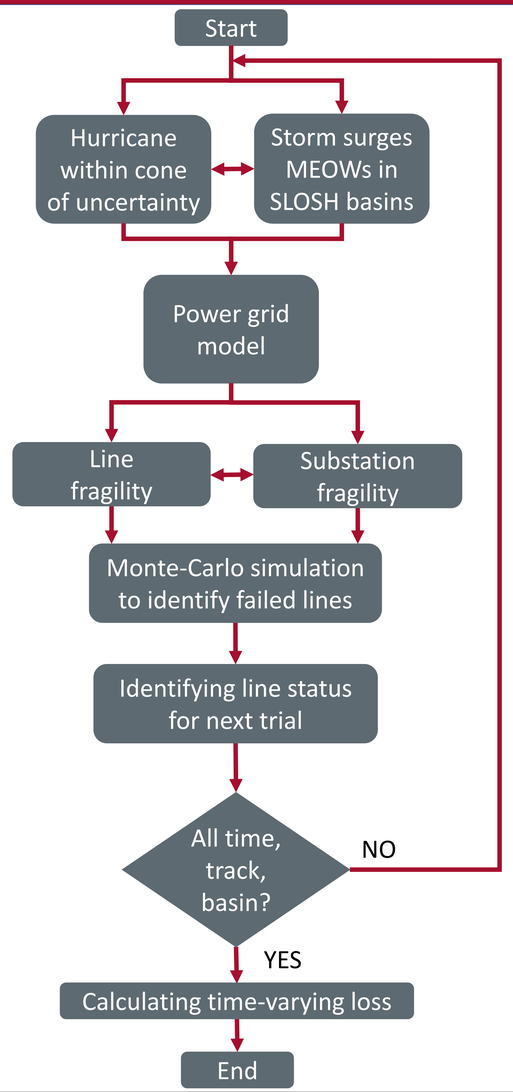




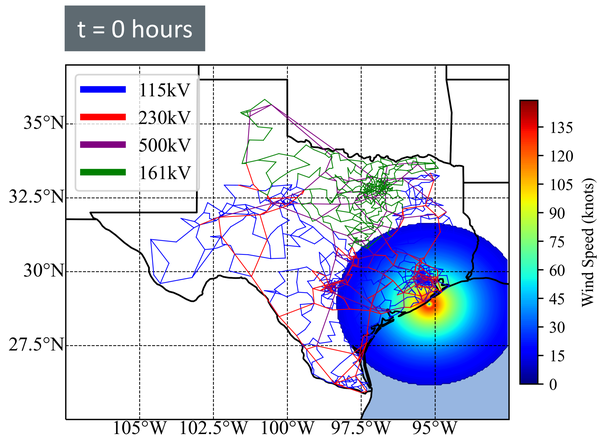
3. STORM SURGE MODELING[4]

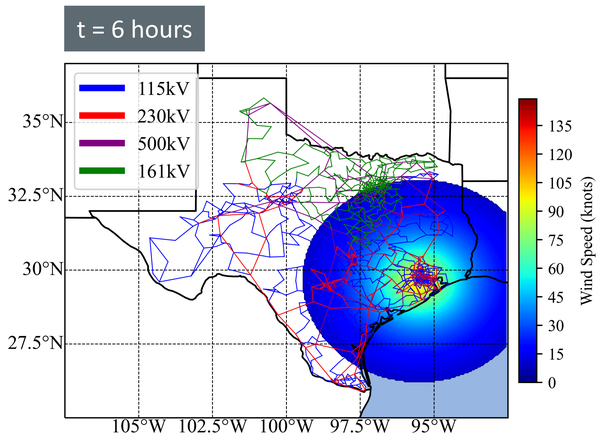


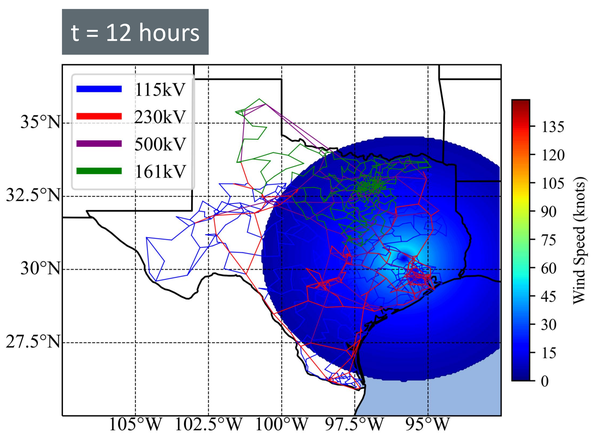
4. HURRICANE, STORM SURGE GENERATION AND IMPACT ASSESSMENT[2]



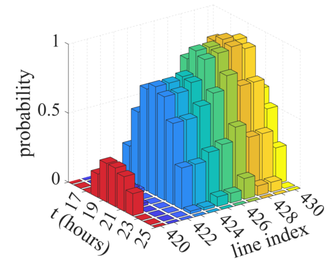
5. SPATIOTEMPORAL HURRICANE SCENARIOS





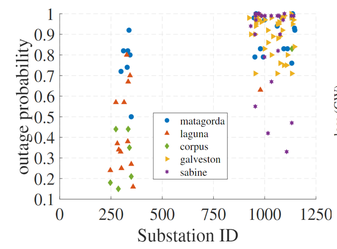


6. TIME-VARYING IMPACT OF HURRICANE & FLOOD

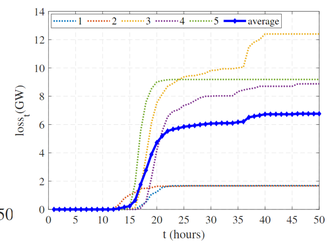


Line outage probability

- Monte-Carlo simulation converges in 800 trials.
- The inundation scenarios for each $\mathcal{B}$ and each hurricane tracks ζ are equally probable.
- Loss is high around landfall and saturates when moving inland.



Substation outage probability



Time-varying loss

7. CONCLUSION AND FUTURE WORK

- Simulations showed that storm surges could flood the coastal substations to incur an additional loss in the system.
- The suggested method can assist system operators in order to identify vulnerable areas and provide hardening techniques to prevent certain damage or accelerate restoration.
- A future extension of this research is to create a risk-map by identifying vulnerable locations and power system components based on hurricane and storm surge disasters for a power grid.

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2. A. Poudyal, A. Dubey, V. Iyengar and D. Garcia-Camargo, "Spatiotemporal Impact Assessment of Hurricanes on Electric Power Systems," 2022 IEEE Power & Energy Society General Meeting (PESGM), Denver, CO, USA, 2022, pp. 1-5
3. D. N. Bresch, and G. Aznar-Siguan, 2021: CLIMADA v1.4.1: towards a globally consistent adaptation options appraisal tool, Geosci. Model Dev., 14, 351-363
4. NOAA, Sea, Lake, & Overland Surges from Hurricanes (SLOSH)