Critically Connected Communities

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Introduction

Motivations
- Climate change is having a wide range of impacts, especially to electricity infrastructure [1]
- Coastal communities have been and will continue to experience climate change induced disasters [1]
- Aboveground electricity transmission lines can be especially unstable when it comes to specific coastal disasters [2]

Questions Addressed
- How does electricity transmission infrastructure play into the community resilience of tracts?
- How vulnerable are aboveground electricity transmission lines to three selected natural hazards?

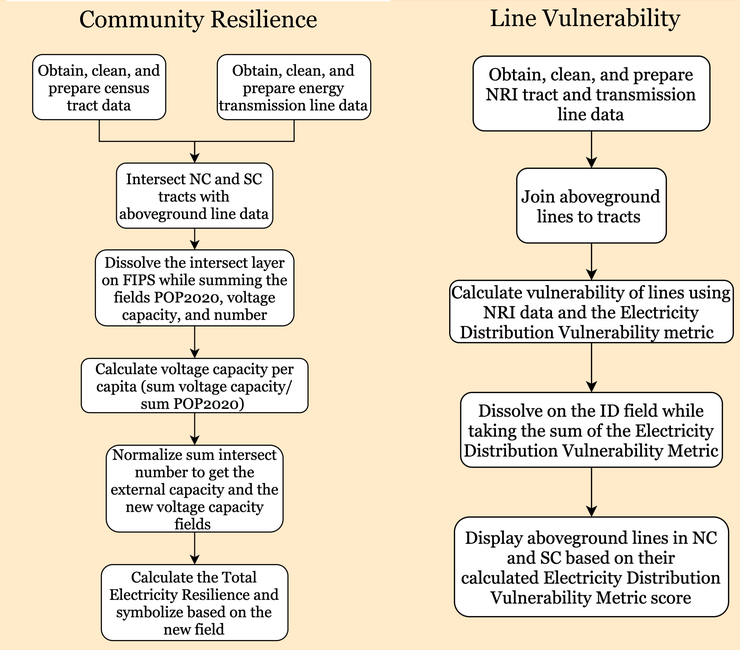
Methodology

- Focus on North Carolina (NC) and South Carolina (SC) census tracts
- Obtained tract level data from the National Risk Index (NRI) website [3]
- Electricity transmission infrastructure data obtained from the Homeland Infrastructure Foundation Level Database [4]
- The natural hazards this project focused on were strong winds, coastal flooding, and hurricanes
- Electricity Distribution Vulnerability Metric is an equal weighted metric based on the expected annual loss score

$$\frac{\text{Coast Fld.} + \text{Hurricanes} + \text{Str. Wind}}{3}$$

- Total Electricity Resilience Metric

Normalized volt. cap. +Normalized intersect. Number



Figures

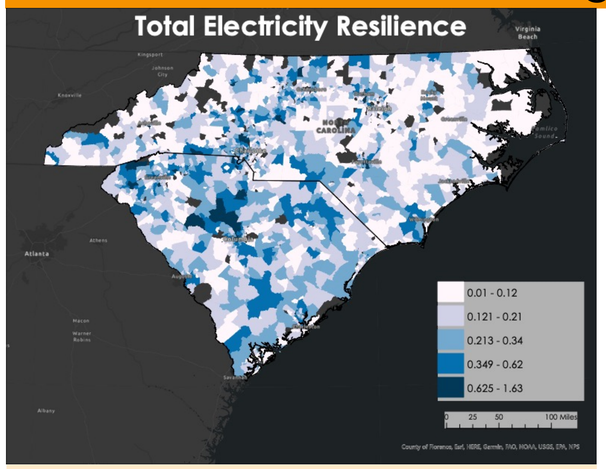


Figure 1: Greater electricity resilience in SC than NC

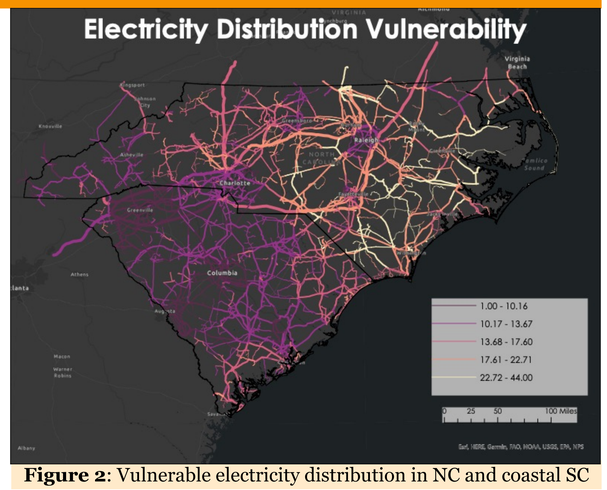


Figure 2: Vulnerable electricity distribution in NC and coastal SC

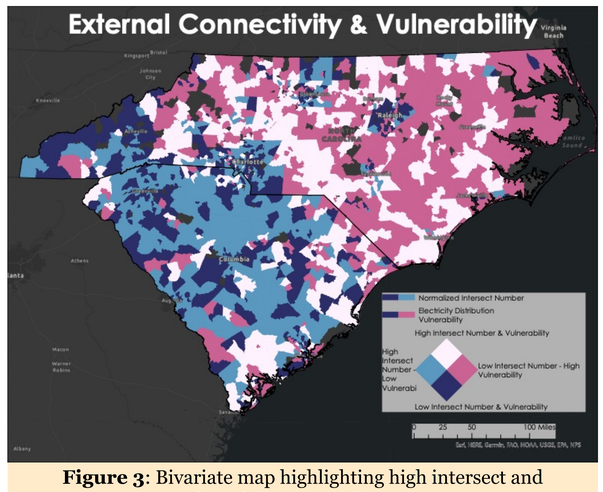


Figure 3: Bivariate map highlighting high intersect and vulnerability areas of interest

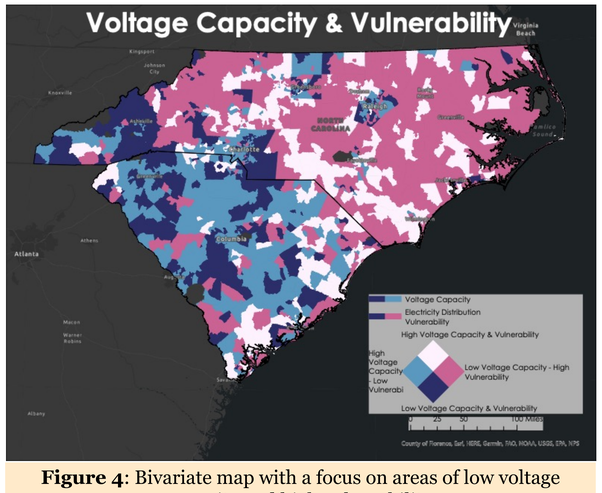


Figure 4: Bivariate map with a focus on areas of low voltage capacity and high vulnerability

Results and Discussion

- NC has lower total electricity resilience compared to SC and higher vulnerability (**Fig. 1**)
- A resilient community would have high voltage and intersection number
- SC lines are less vulnerable than NC lines (**Fig. 2**)
- High vulnerability is an internal problem for communities
- High intersection numbers are an external problem, especially for very vulnerable areas (**Fig. 3**)
- Focusing on electricity infrastructure playing into community resilience provides a framework for policy suggestions
- Tracts that have a high vulnerability score need fortification especially the tracts that also have low resilience (**Fig. 5**)
- Future work could include assessing demographics and poverty areas
- The methodology established for this project could also be applied to many other future research projects looking at other types of electricity transmission or any other types of community connectivity infrastructure

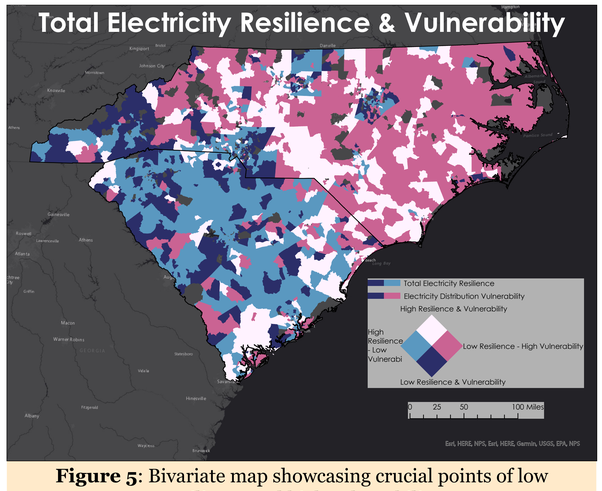


Figure 5: Bivariate map showcasing crucial points of low resilience and high vulnerability

References

[1] NOAA. (2021, March 29). *Global Warming and Hurricanes*. Geophysical Fluid Dynamics Laboratory. https://www.gfdl.noaa.gov/global-warming-and-hurricanes/.
[2] Bennett, J.A., Trevisan, C.N., DeCarolis, J.F. et al. Extending energy system modelling to include extreme weather risks and application to hurricane events in Puerto Rico. Nat Energy 6, 240–249 (2021). https://doi.org/10.1038/s41560-020-00758-6
[3] *The National Risk Index*. hazards.geoplatform.gov. (n.d.).
[4] *Homeland Infrastructure Foundation-Level Data (HIFLD)*. HIFLD. (n.d.).

Acknowledgements

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For further information use the QR code to look at my StoryMap or contact me at afink17@kent.edu