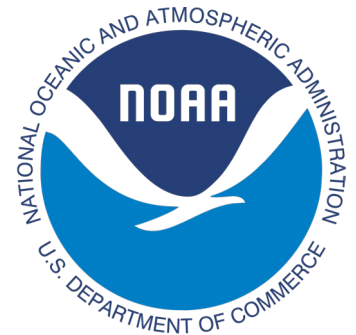


Barriers to Recognizing, Communicating and Mitigating Compound Flood Risk

A Case Study in Rural Eastern North Carolina

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Near Center for Climate Studies

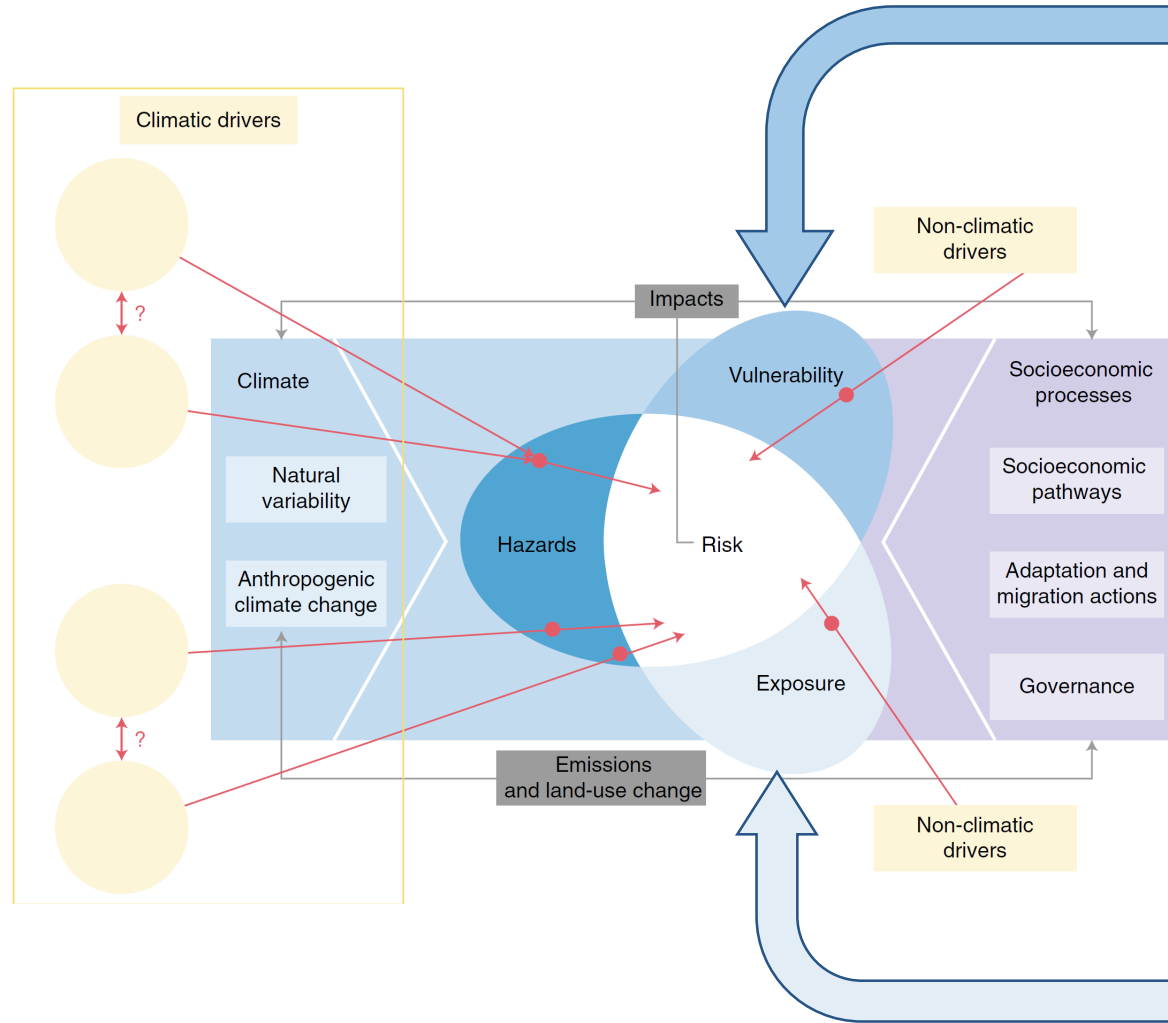
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Adeniji¹**



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Compound Hazards

- “Combination of multiple drivers and/or hazards that contributes to societal or environmental risk”
(Zscheischler et al. 2018)



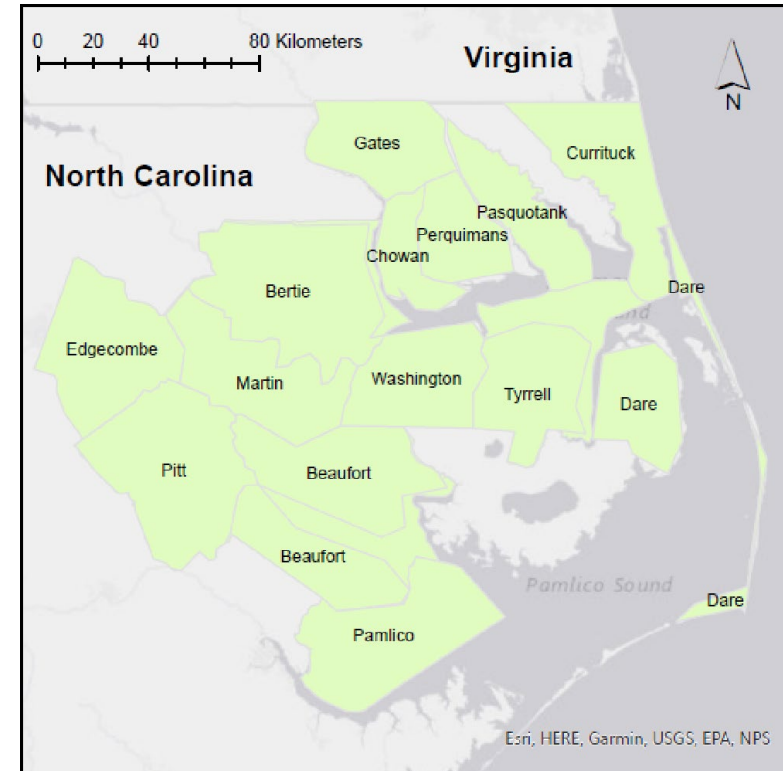
Rural Eastern NC

- Degraded infrastructure
- Reliance on well water
- Lack of broadband
- Insufficient flood and heat coping mechanisms
- Inadequate health care

- Coastal plain geographies

Objective & Data

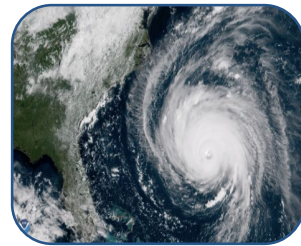
- Integrate economic, planning, and health research with atmospheric science to understand the nature and impacts of compound water hazards and produce actionable results of direct use to emergency managers and planners in underserved rural communities
- Historical observations of high-resolution rainfall, tidal height, and stream discharge
- Two workshops in February 2020 and 2022



Temporal Compounding



Matthew 2016



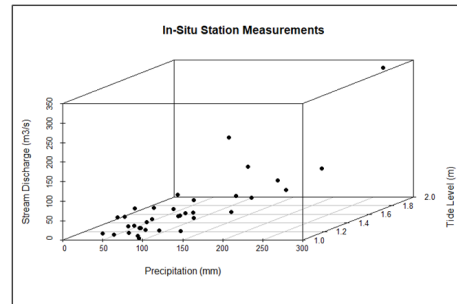
Florence 2018

Multi-variate Compounding

Fluvial

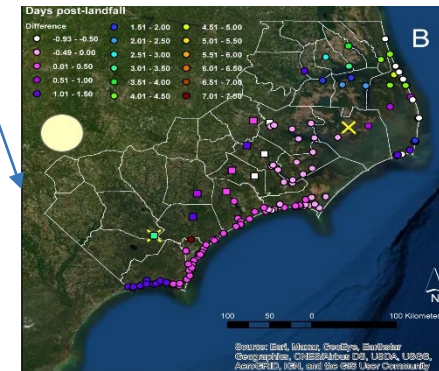
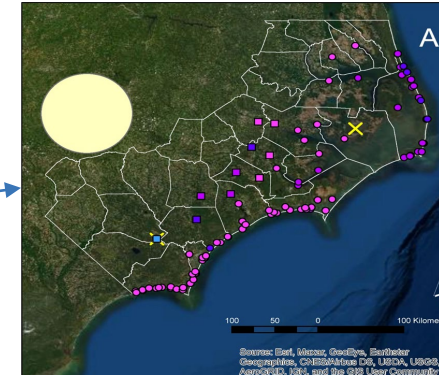
Surge

Pluvial



DePolt 2021

Spatial Compounding



Curtis et al. 2021

Compound Impacts

Health

Mukherji et al. (in review)

Economics

Helgeson et al. (in prep.)

Recovery

Preparedness

Curtis et al. 2022

Response

Mitigation

Mukherji et al. 2023

Disaster Risk Reduction cycle

Temporal Compounding and Recovery

- *"People can't afford to fix their houses because, hey here comes September about to bring another one for us"*
 - Curtis et al. (2022)

Temporal Compounding and Mental Health

- Participants explained that repeated hits from flooding have caused despair and severe stress among their populations.
 - Mukherji et al. (in review)

Multi-variate Compounding and Preparedness

- Pluvial flooding was seen as much more unexpected as compared to fluvial and tidal flooding
- *"We had a major rain... and our towns were flooded. Water was coming over our roads, and it was unexpected because it was supposed to be just a regular rainstorm coming through and it flooded"*

	Pluvial	Fluvial	Tidal
This type of flooding is very frequent or constant	38%	19%	20%
This type of flooding is becoming more frequent	79%	55%	58%
This type of flooding is surprising most of the time or always	29%	9%	0%
This type of flooding is becoming more surprising	26%	11%	0%

Multi-variate Compounding and Health Access

- Participants relayed that during hurricanes, riverine flooding can happen for an extended period and cause more damage as the wind pushes the water up the river, which when combined with rain and storm surge can cut off access to critical facilities such as shelters and hospitals.
 - Curtis et al. (2022)

Spatial Compounding and Response

- Spatially compounded events can restrict emergency response actions if the operational space experiences coincidental hazards
 - Leonard et al. (2014)

Spatial Compounding and Mental Health

- Stress impacts both those affected by compound coastal water events, and the first responders who are on the frontline of emergency preparedness and response work. One participant put it succinctly, *“mental health would be my biggest one [impact] (...) not just the victims of flooding (...) but the first responders (...). I know people that have walked away from this profession.”*
 - Mukherji et al. (in review)

Mitigation for Compound Impacts

- Infrastructure maintenance and repair
- Clearing streams and channels
- Floodplain planning and management to minimize exposure to floods
- Seeking mitigation funds for elevation projects and buyouts*
- There is a need for mitigation approaches that “compound” resiliency – are flexible, sensitive and responsive to the needs of rural coastal communities

* Concerns of “mal-mitigation”

Governance of Buyouts and Uncertainty

- Temporal
 - *“Working on the Hurricane Florence buyout. We still have not gotten funding to the homeowners that were impacted from Hurricane Matthew.”*
- Economic
 - *“So, a lot of the time, they will go out, and they will buy another house somewhere else, and they are having to pay two mortgages to ruin their credit. I mean, that could be a life changer. So, you have got an economic impact on the family.”*
- Housing Security
- This can lead to long-term economic and health impacts and implementation gaps

Outreach and Next Steps

- A public report was created (pdf and print copies)
- Follow-on grant (NOAA-RISA) **“Intended and Unintended Consequences of Buyout Programs as an Adaptive Response to Compound Flood Events and Coastal Inundation Risk in Rural Communities”**



- Risk, Impacts, Challenges and Policy Directions

Principal Investigators

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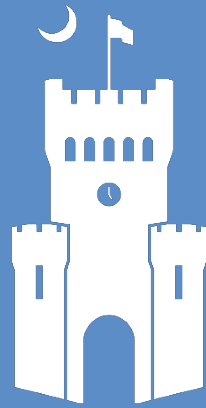
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