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Lunch & Learn

Communities and Climate

Presented by the Office of the Vice Chancellor for Research and UNC Carolina Population Center

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Communities and Climate Panel

Panel Emcee: Karen Guzzo

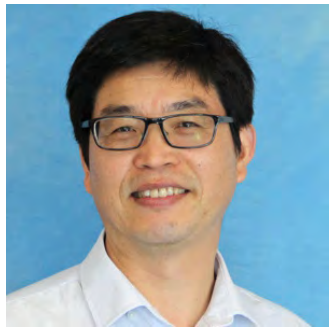
Director, Carolina Population Center

Nathan Dollar

Director, Carolina Demography

Fern Hickey

Research Associate, UNC Coastal Resilience Center



Conghe Song

Professor and Chair, Department of Geography and Environment

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Nathan Dollar

Director, Carolina Demography

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DEEPP

Dynamics of Extreme Events People and Places

DEEPP.cpc.unc.edu

Nathan T. Dollar
Director of Carolina Demography
Carolina Population Center

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The Problem and Our Approach

- Extreme weather events threaten lives, destroy property, and expose people to trauma which has long-term effects
- Data are limited
- Research is typically reactive, short-term, and siloed in one discipline.

Flooding in Canton, NC from Tropical Storm Fred
Source: Washington Post

Urgent need for policies and programs that promote

Healthy People
Sustainable Communities
Resilient Ecosystems

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Effective solutions require accelerated integration across fields

Our Approach

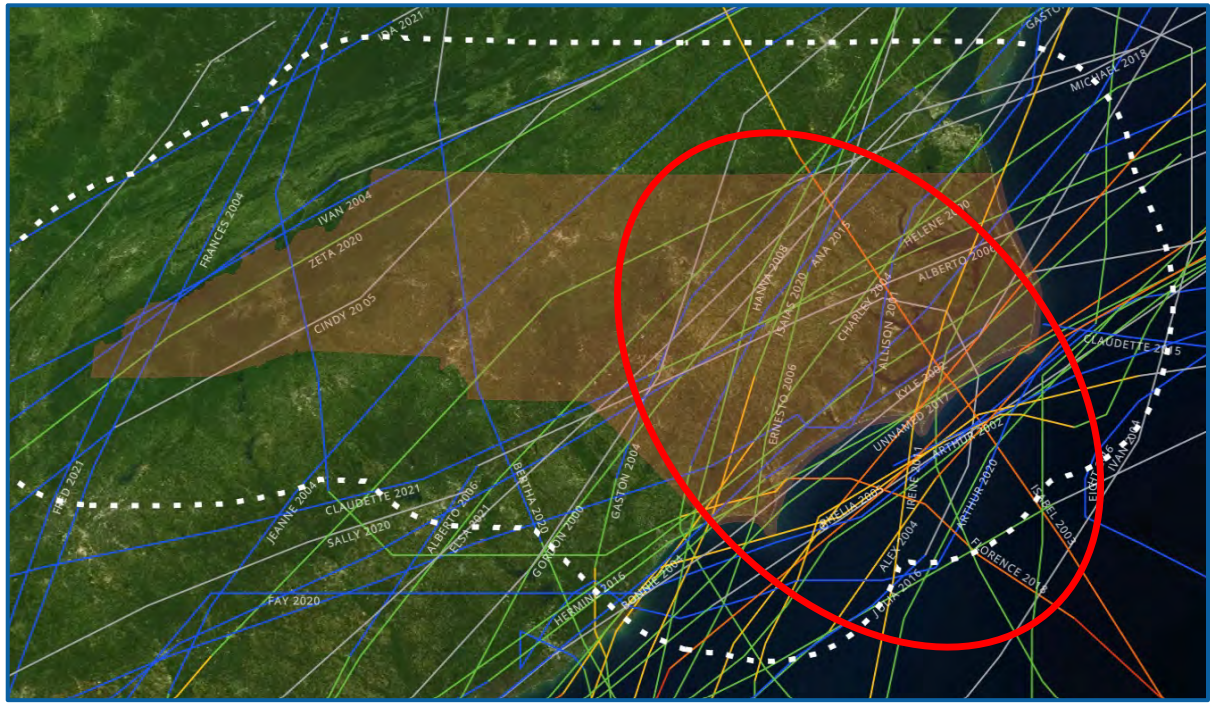
- Integrate across disciplines
- Build a platform for longitudinal multi-dimensional data collection
- Develop tools to predict storm impacts on short- and long-term outcomes, model impacts of mitigation and assistance.

How do we do it?

Study Site: **Eastern North Carolina**

- Predominately rural region
- Environmental, economic, & demographic changes over last 3 decades
- Complex system of rivers, estuaries, sounds, & barrier islands
- Lots of flooding from hurricanes, milder storms, wind, rain, and high tide

Hurricane/Tropical Storm Tracks Across NC since 2000



Source: NOAA

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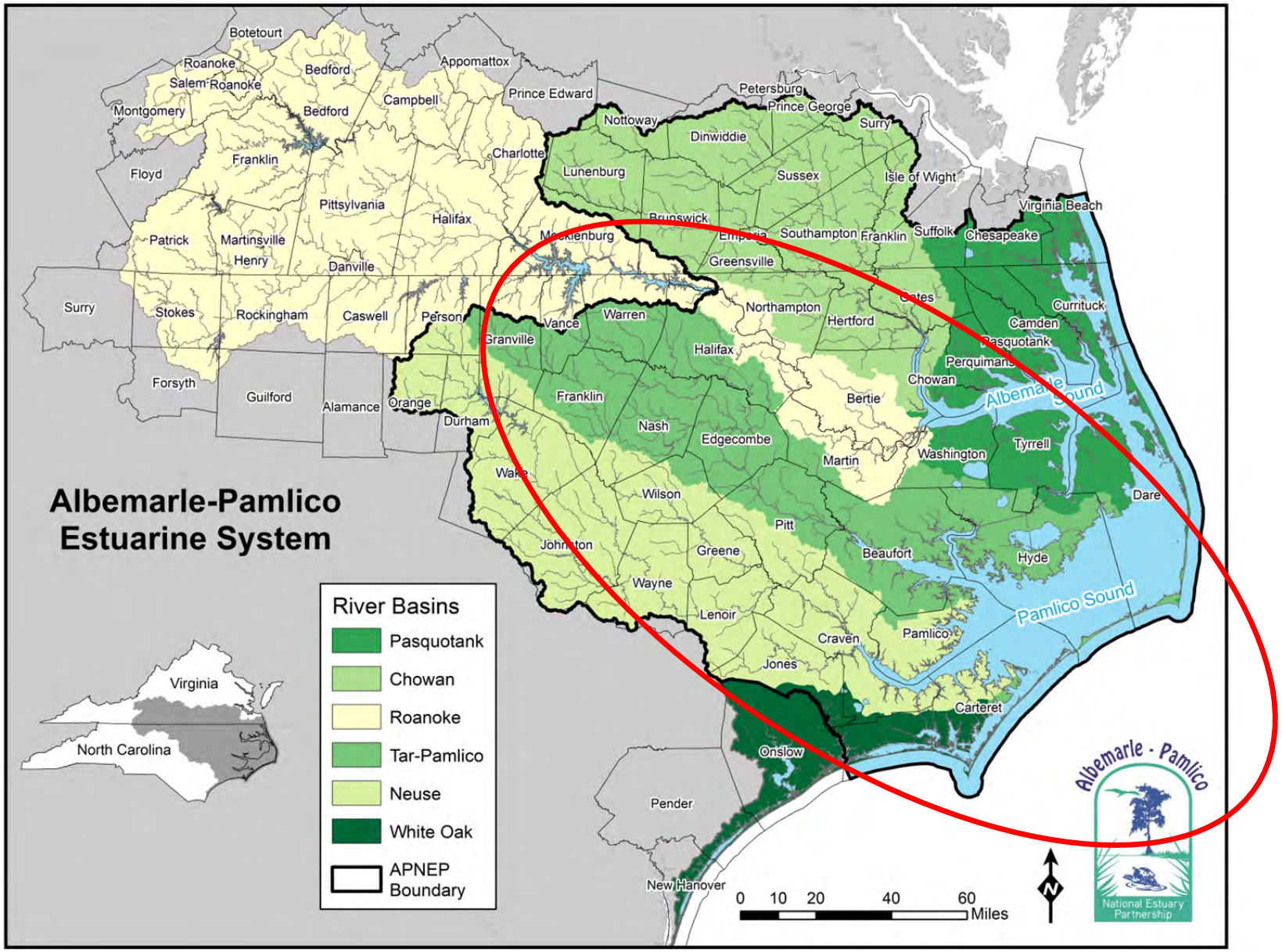

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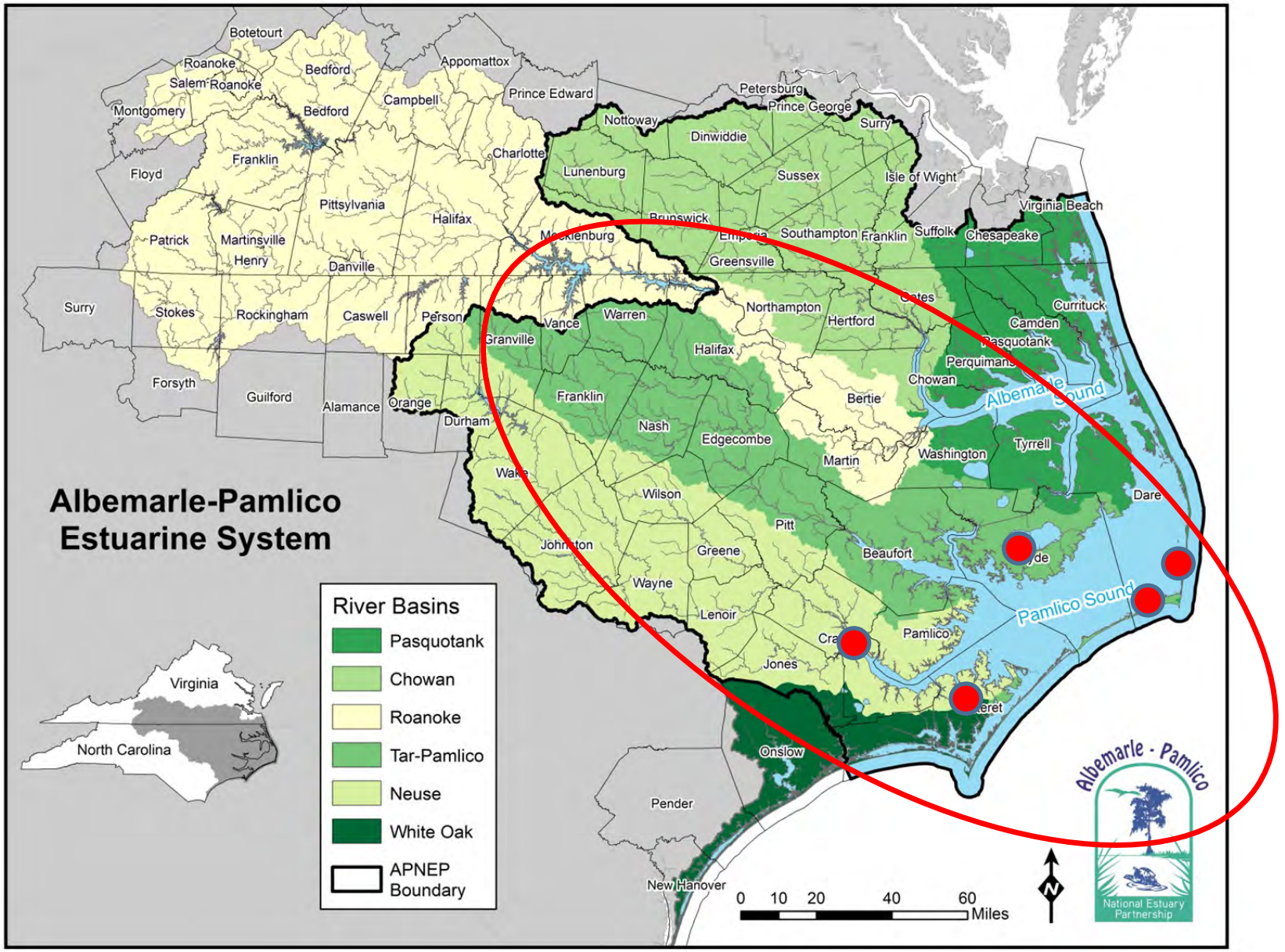

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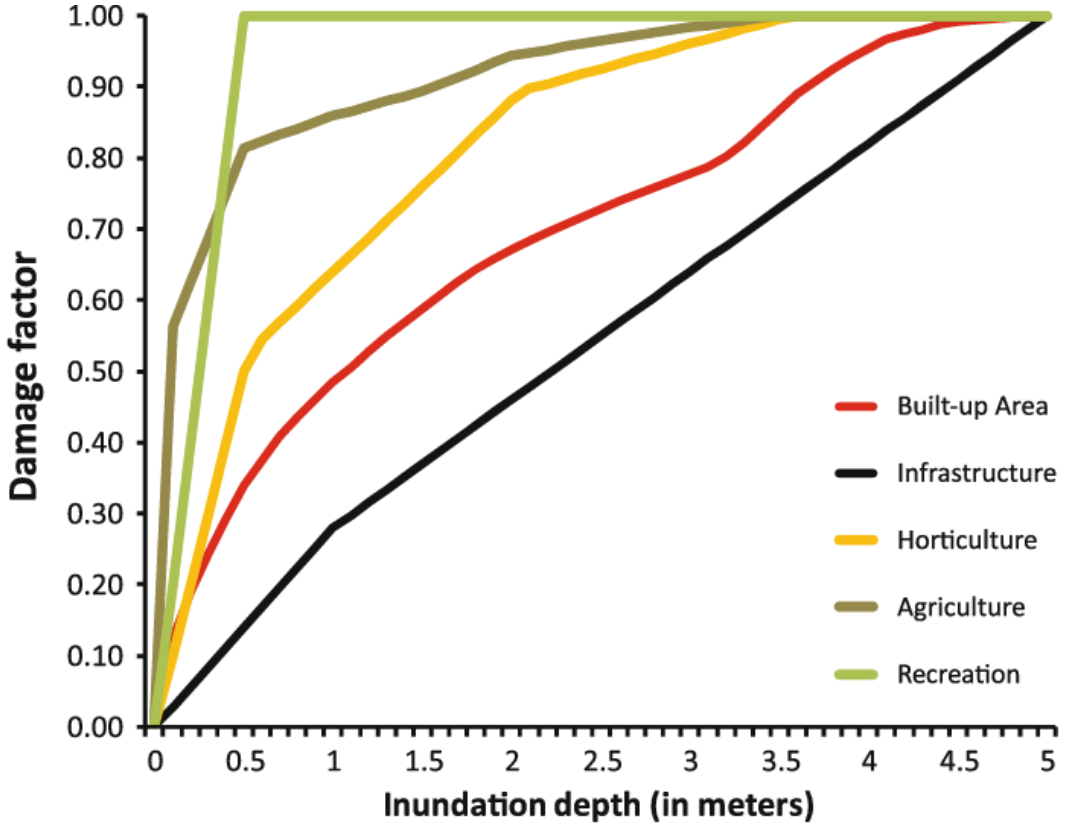
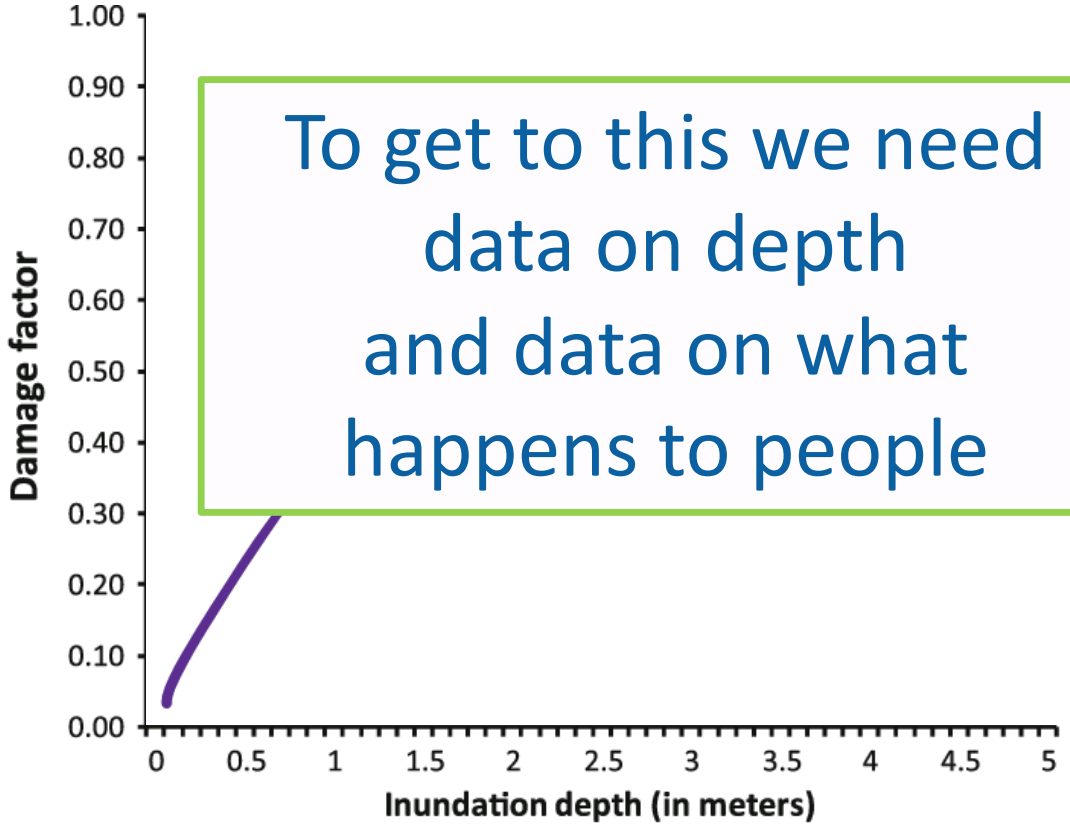
Depth Damage Curves / Dose-Response Relationships

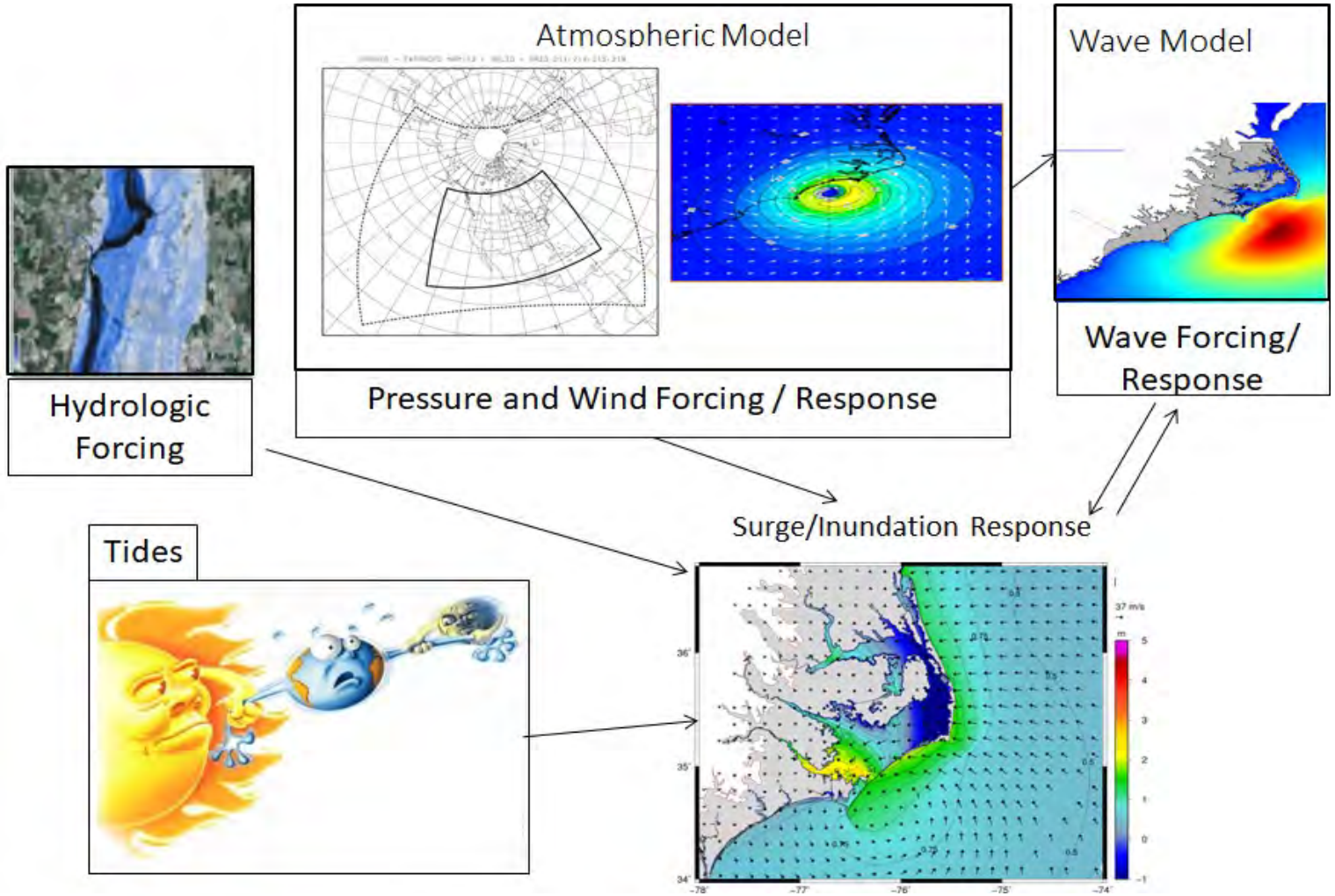




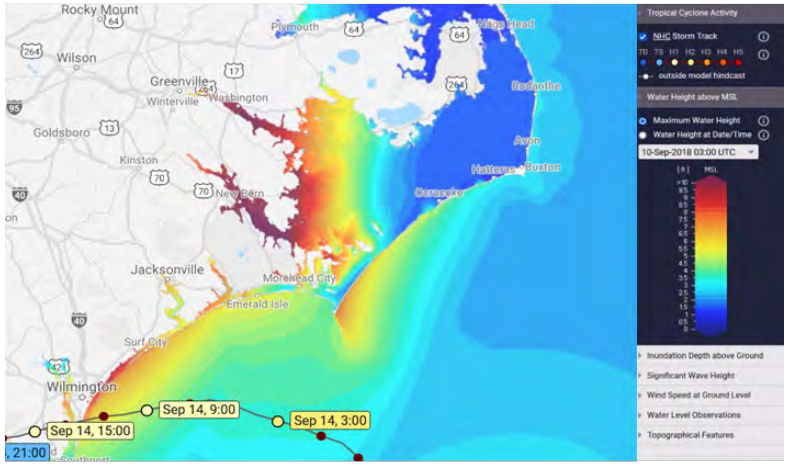
To get to this we need data on depth and data on what happens to people

Depth: Predicting Flooding (Rick Luettich, UNC)

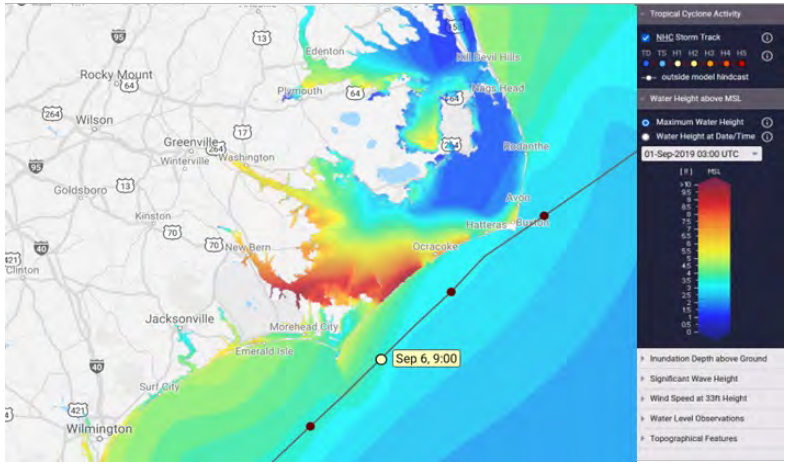
ADCIRC Prediction System



Hurricane Florence 2018



Hurricane Dorian 2019



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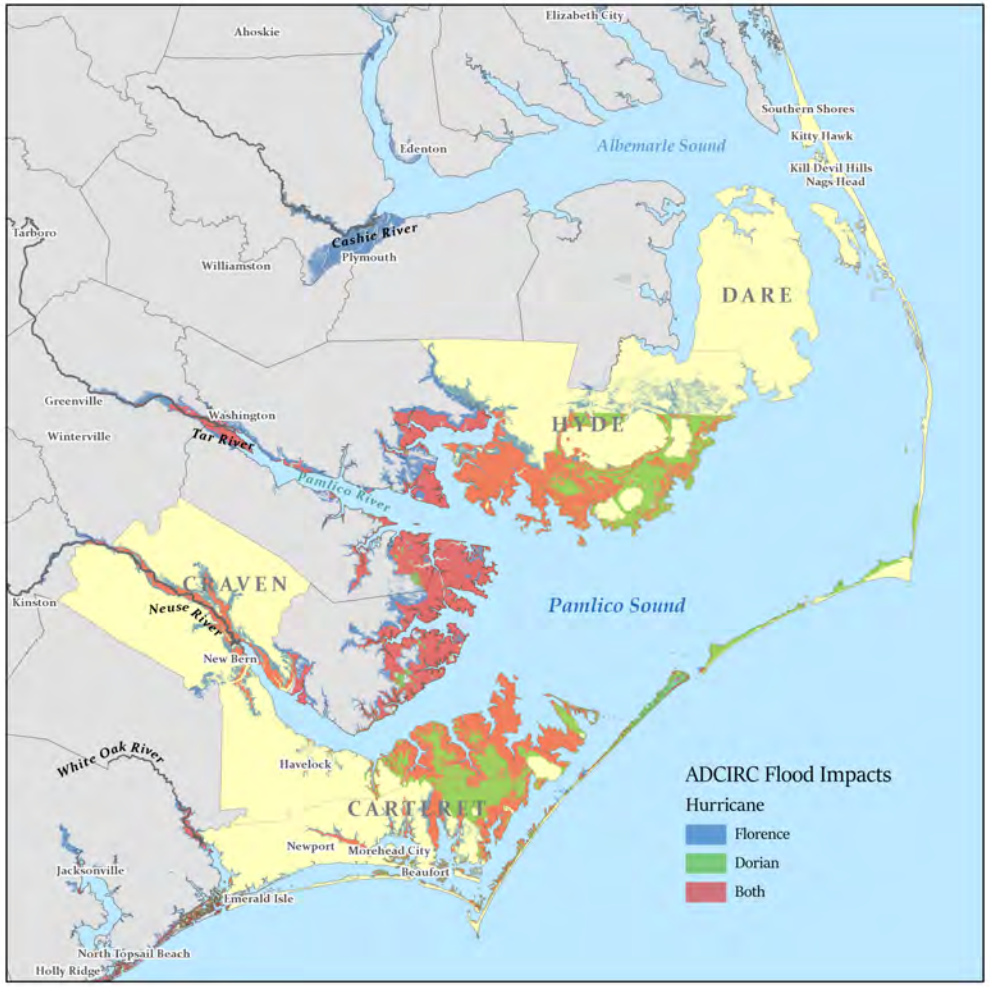
Data on Flood Exposure



Household Survey

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Random Selection of Addresses from tax parcel database

ADCIRC Predictions of Sampled Parcels

Site	N	Flooding (Dorian)	Flooding Florence)
East Carteret	423	35%	45%
New Bern	300	0.1%	62%
Hatteras	100	0%	69%
Mainland Hyde	101	68%	59%
Ocracoke	181	76%	3%

Household Survey

Damage to human populations: household survey

Questions developed with input from all project scientists & community and state stakeholders

- Experiences before, during, and after the storm(s)
- Modules on post-traumatic stress and depressive symptoms
- Disruptions to work school
- Impacts on income and business activity
- Property damage

Damage to human populations: household survey

- Recruit and train local interviewers and UNC students
- Determine eligibility (i.e., full-time residents)
- Interview all residents ages 15+

DEEPP Survey – Wave I

- Visited 1,042 Parcels
- 833 (80%) were residential and not too damaged for occupancy. > Contacted 583
- Interviewed 453 HHs
- 673 Individuals (~82% of eligible HH members responded; 90% in Pilot Site!)

DEEPP Survey – Wave I

HOUSING TENURE

- **82%** own their homes
- **18%** rent or have some other arrangement

Racial and Ethnic Composition of Sample

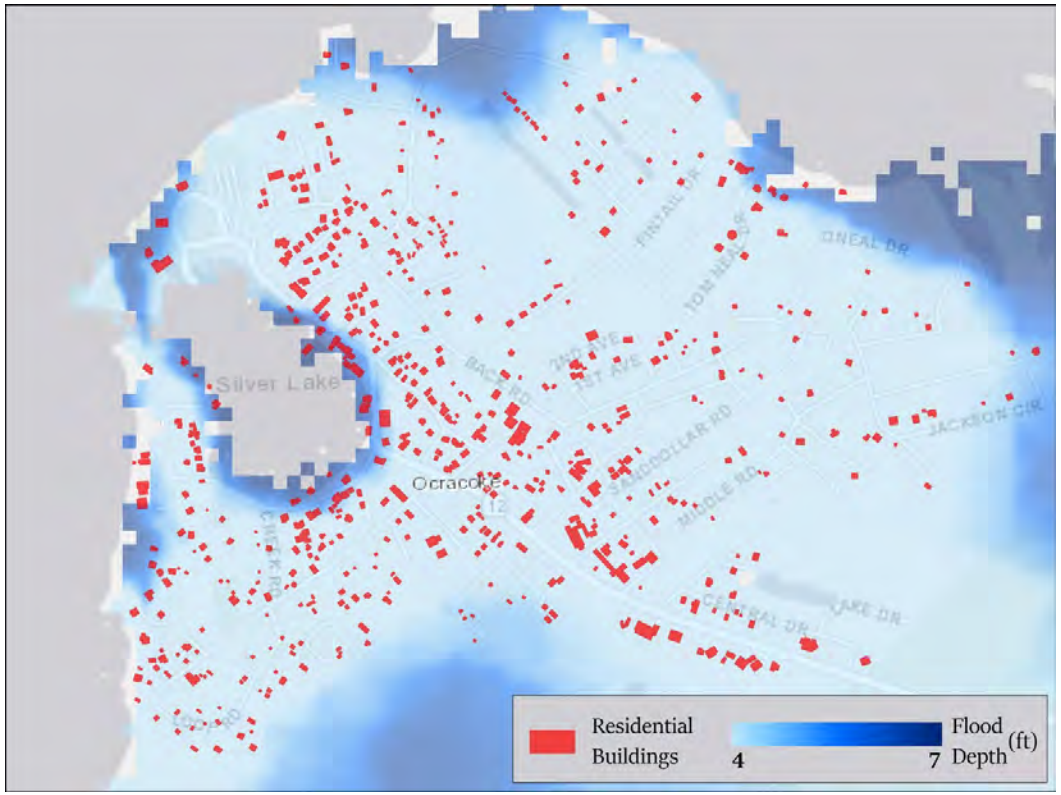
Race/Ethnicity	Pct of Sample
NH White	78.3%
NH Black or African American	15.1%
Hispanic	6.2%
American Indian/Alaskan Native	0.3%

Many Impacted by both Dorian & Florence

Percent of Households Reporting Flood Damage to Home or Property from Hurricanes Dorian or Florence

Site	Neither	Florence Only	Dorian Only	Both
East Carteret	11.2%	3.0%	19.5%	66.3%
New Bern	32.4%	15.9%	22.1%	29.7%
Hatteras	15.2%	0.0%	81.8%	3.0%
Mainland Hyde	6.8%	0.0%	65.9%	27.2%
Ocracoke	12.5%	0.7%	83.1%	3.7%
TOTAL	17.3%	5.5%	44.4%	32.8%

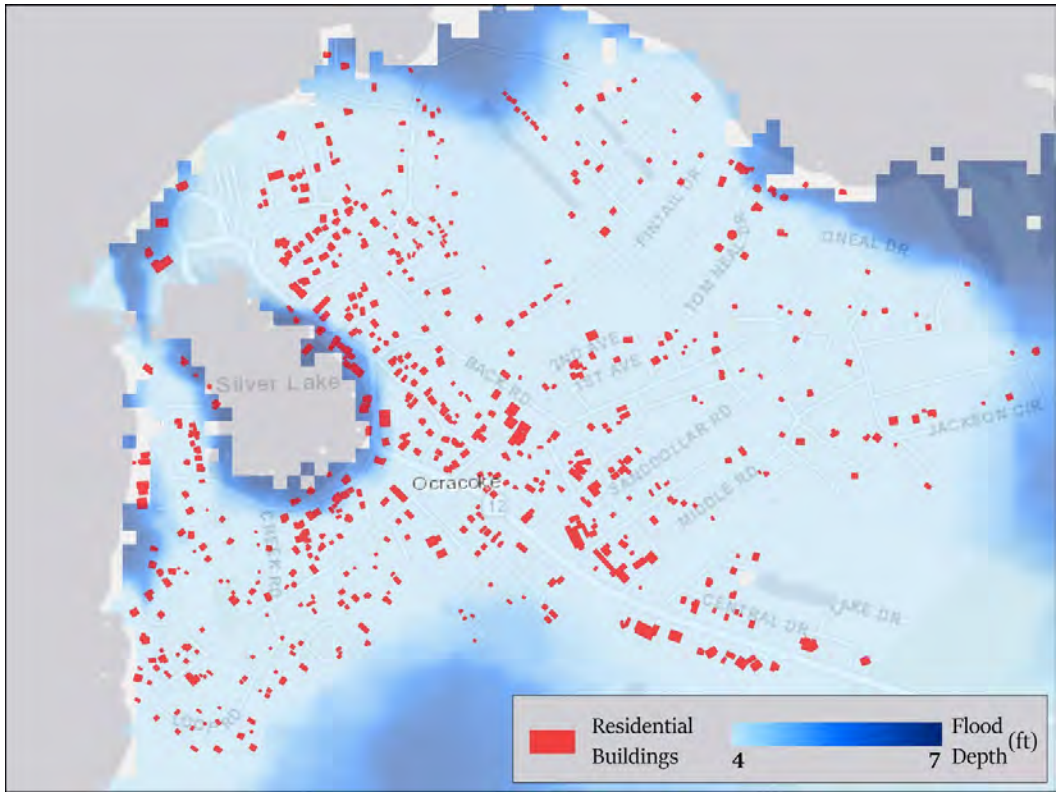
DEEPP Wave I Pilot Site – Ocracoke, NC



DEEPP Wave I Pilot Site – Ocracoke, NC

Flooding during Dorian on Ocracoke Parcels (ADCIRC Model Results)

	Parcel Flooded	Estimated Water Depth on Flooded Parcels (feet)	N
All Parcels	72%	5.2	1592
Sampled Parcels	70%	5.1	181
Primary Residents	80%		104
Second Homes	61%		50
No Residents	89%		27



DEEPP Wave I Pilot Site – Ocracoke, NC

Consequences of Home Damage and Household Displacement				
		Residence Type at Interview		
	Total	Renter	Owned home and primary resident	Owned home but not primary resident
Home could not be lived in after the storm	38%	50%	38%	32%
Still unlivable at time of interview	38%	78%	23%	50%
Average # of months home could not be inhabited (only for those who returned)	7.5	-	8.2	6.7
Average # of places lived	3	4	2	-
N	132	20	80	32

Psychosocial Health as a Function of Depth & Exposure

- The higher the water relative to floor height, the more likely a home was to be flooded
- Individuals in homes that were flooded experienced a larger number of potentially traumatizing experiences during Hurricane Dorian
- More of those experiences is positively associated with levels of post-traumatic stress and with depressive symptoms, even 12-18 months later

What's Next for Our Team

Evaluate compound flood models near the coast, upstream, and expand to additional river basins throughout the state
Innovate in measurement, incorporate in surveys:

- Attitudes toward financial and climate risk
- Decision-making about the future in fragile environments
- Collection of biomarker data
- Benefits of ecosystem services and historical ties for connection to place
- Trade-offs between sustainability and economic opportunity
- Water quality surveillance
- Collection of Biomarker Data

Incorporate green engineering and adaptation vs retreat as policy options for reducing risk

Combine flood modelling over multi-decadal period with dose-response parameters from survey data to project longer-term evolution for people and places

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We'd love to hear from you!

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DEEPP
Dynamics of Extreme Events People and Places

DEEPP.cpc.unc.edu

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Thank you!

Contact Nathan Dollar at
ntdollar@email.unc.edu

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Fern Hickey

Research Associate, UNC Coastal Resilience Center

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A Landscape Study of Social Equity Data Needs and its Access and Availability to Support the Disaster Resilience of Marginalized Communities

Cassandra R. Davis, Ph.D. (PI), Philip Berke, Ph.D. (Co-PI), Miyuki Hino, Ph.D. (Co-PI)
Simona Goldin, Ph.D., Ruth Fetaw, B.A., Fern Hickey, M.A., Megan Lacey, B.A., Tristyn Morgan
Christy Fierros, M.A., Will Anderson, M.A., Helena Garcia, M.A. & students in UNC's Public Policy Capstone Class

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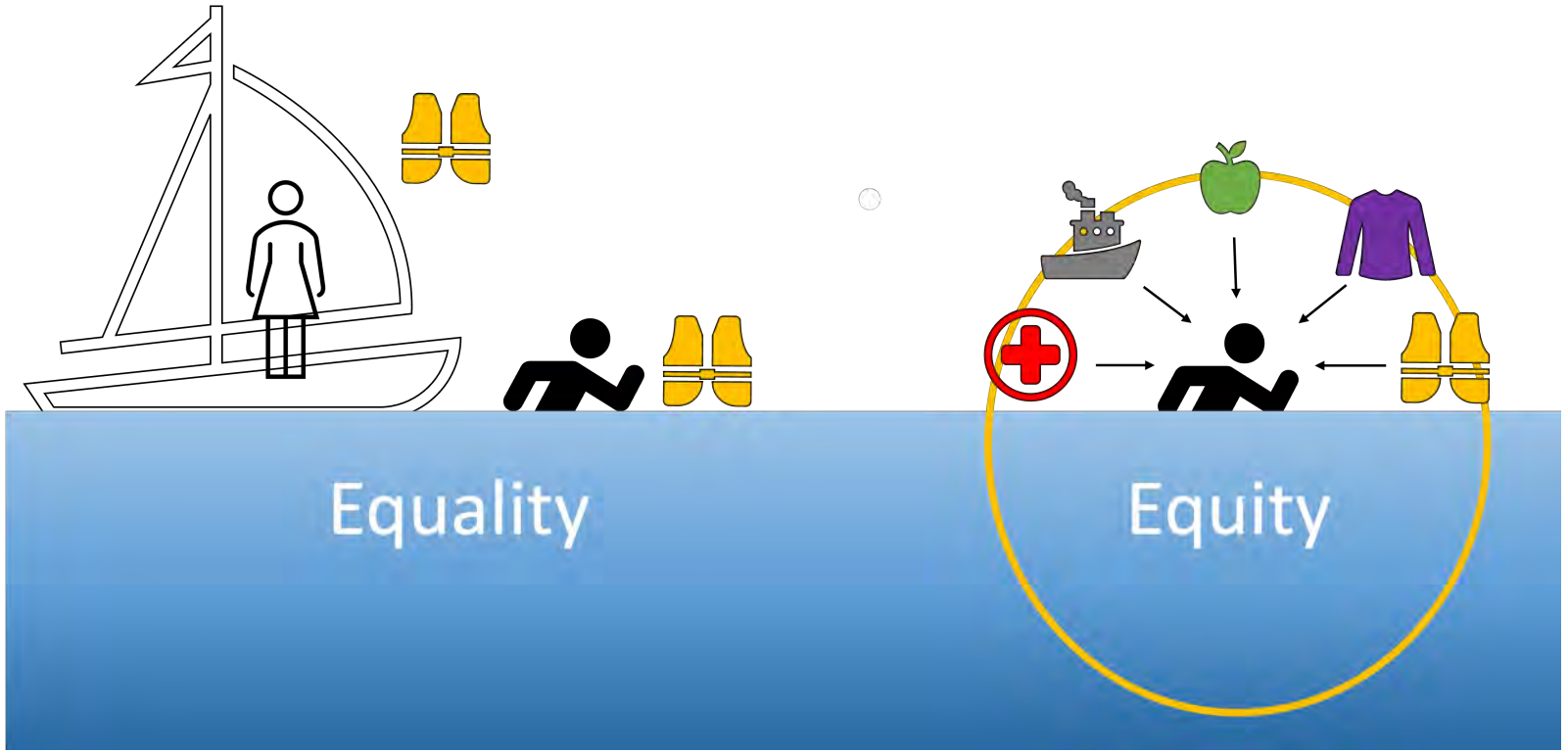
Purpose of Study

To provide insight on how to transform the disaster risk management community so that equity is an embedded practice that encapsulates the needs of all, including the most marginalized.



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Mixed Methods Study
Three Critical Dimensions

Social Vulnerability Metrics

- What quantitative indicators are currently used to inform equity in resilience plans and investments, and what are the implications of those choices?
- How are hazard mitigation and disaster recovery funds distributed in relation to factors like race, income, and housing type?

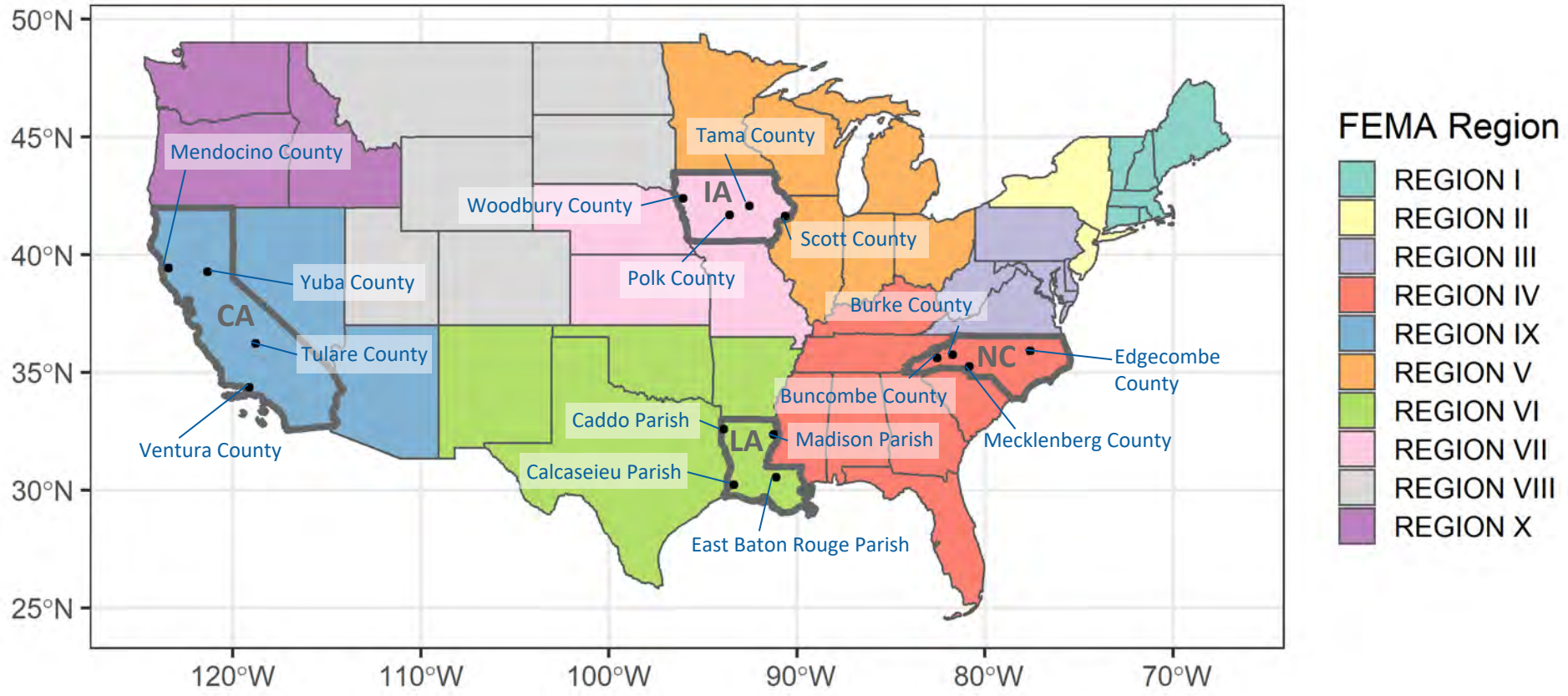
Plan Evaluation

- To what extent do hazard mitigation and comprehensive plans include equity as a core value to organize the content and format of plans?
- To what extent do hazard mitigation and comprehensive plans include indicators that could be used to document, measure, and monitor equity in disaster resilience?

Community Voice

- How does the disaster risk management community plan for equity and what opportunities exist to better incorporate equity and support the resilience of marginalized communities?
- To what extent are marginalized communities organizing or relying on informal planning or support in the face of local hazards, in place of or in addition to formalized planning and support from the public sector?

Case Study Sites



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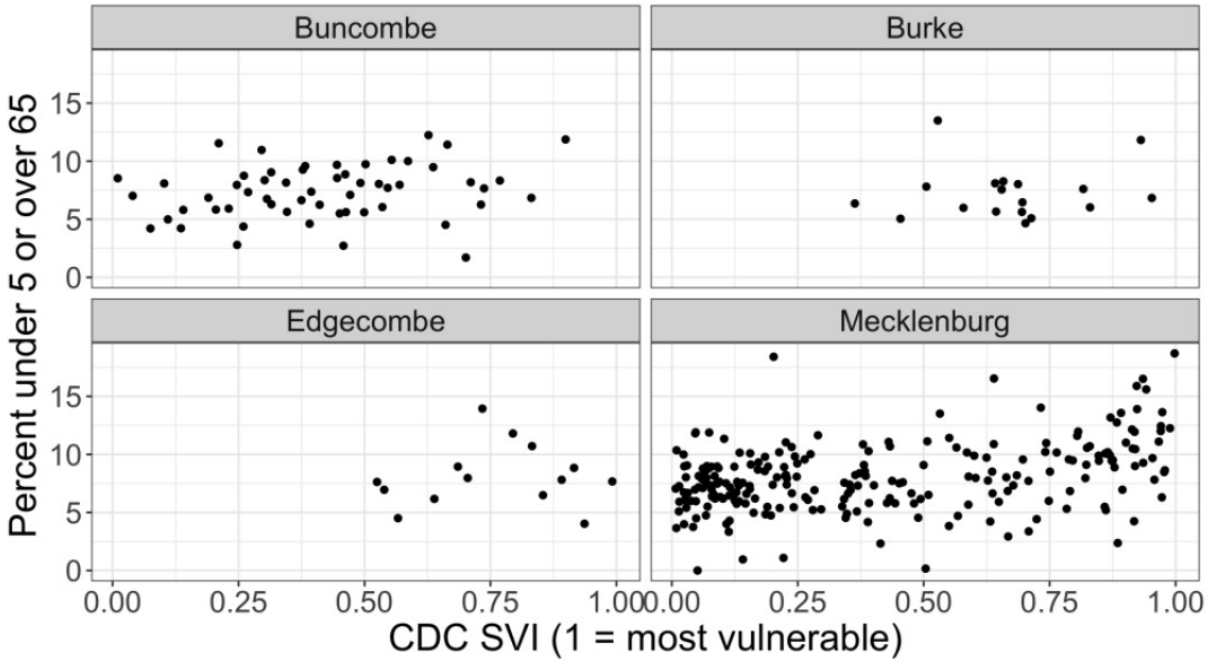
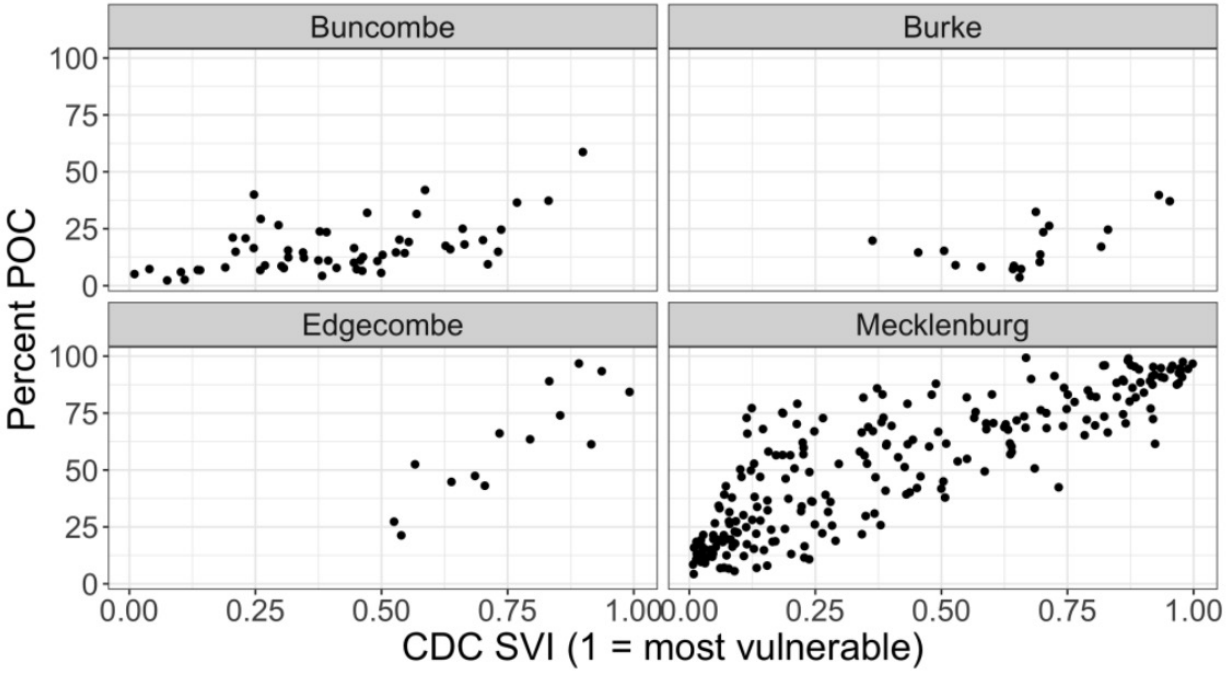
Key Findings: Social Vulnerability Metrics

Different indicators yield different results on social vulnerability

Share of population in vulnerable age groups vs. CDC SVI



Percentage of people of color vs. CDC SVI



**Each point represents a census tract and tracts are grouped by county*

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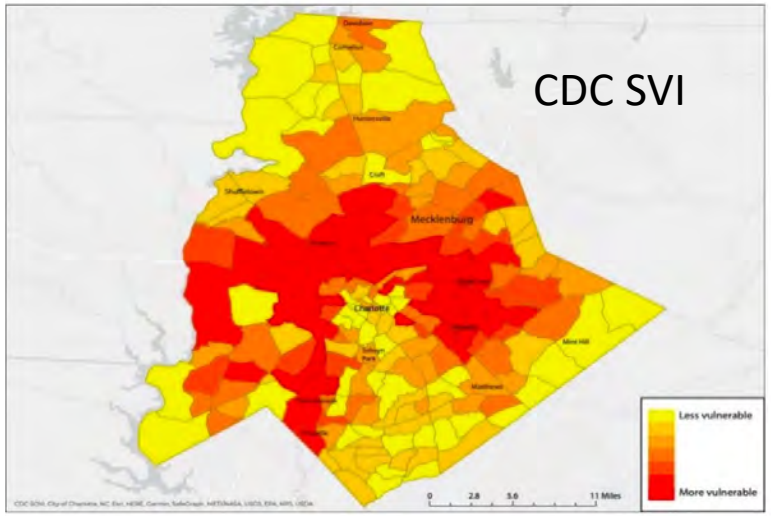
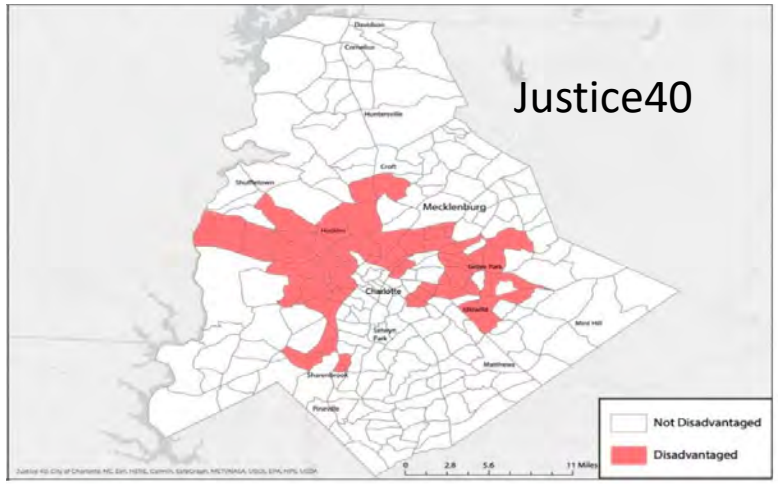
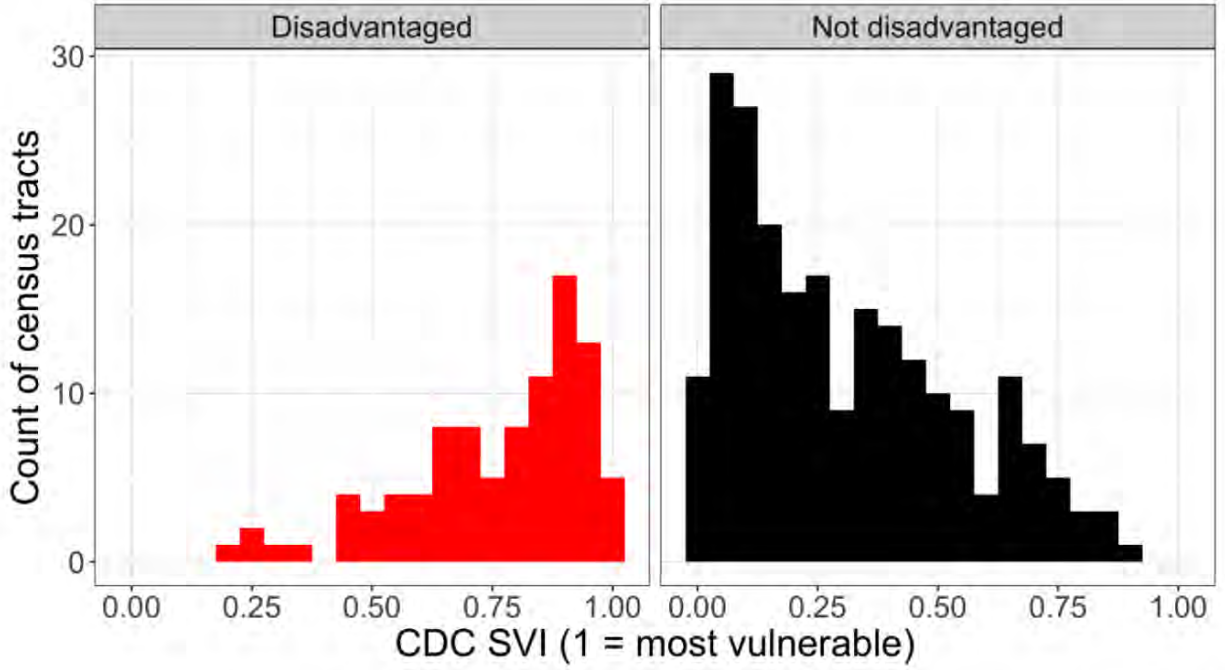
Key Findings: Social Vulnerability Metrics

Choice of indicator matters, especially when this data drives funding and policy





Comparing Justice40 disadvantaged and not disadvantaged census tracts as a function of the CDC SVI



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Key Findings: Social Vulnerability Metrics

Likelihood of aid denial does not vary substantially across income or housing type, but reason for denial does

Figure 7. Housing assistance by eligibility and income

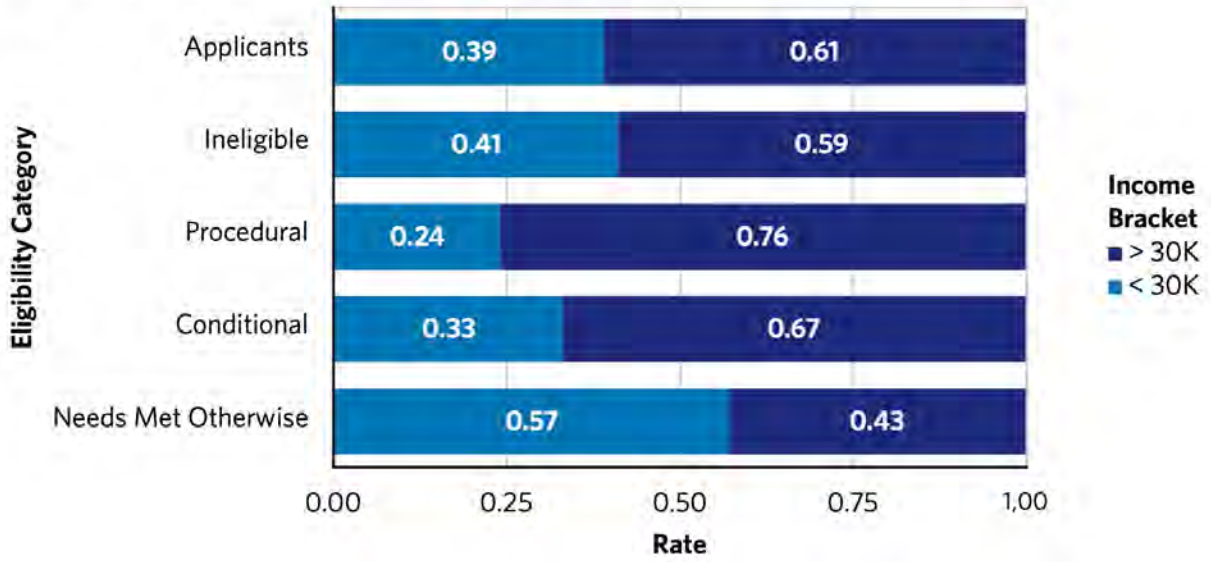
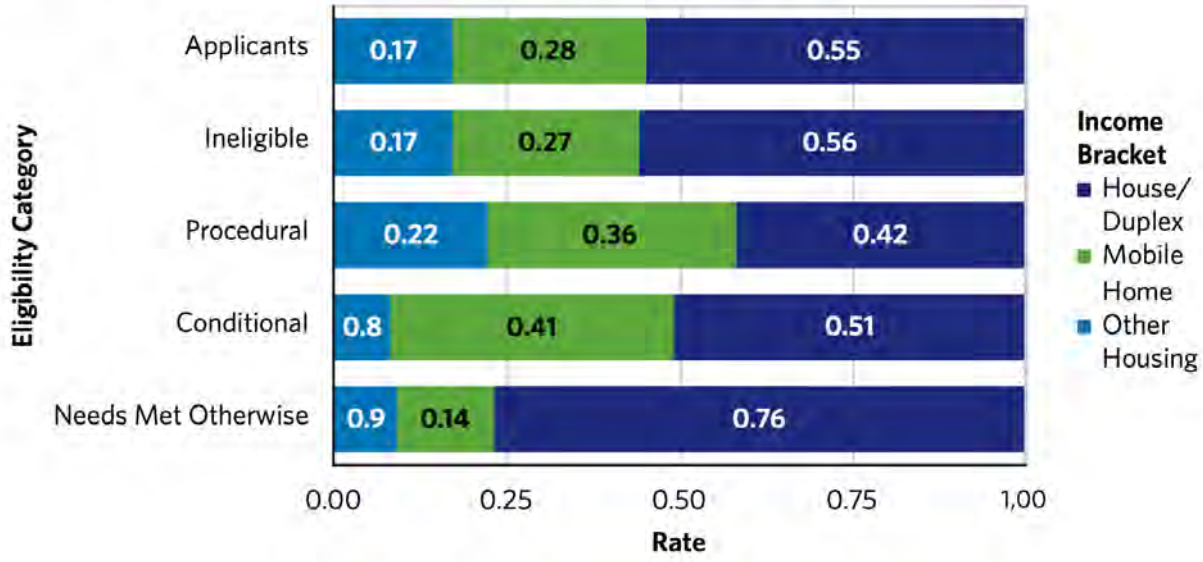


Figure 8. Housing assistance by eligibility and housing type



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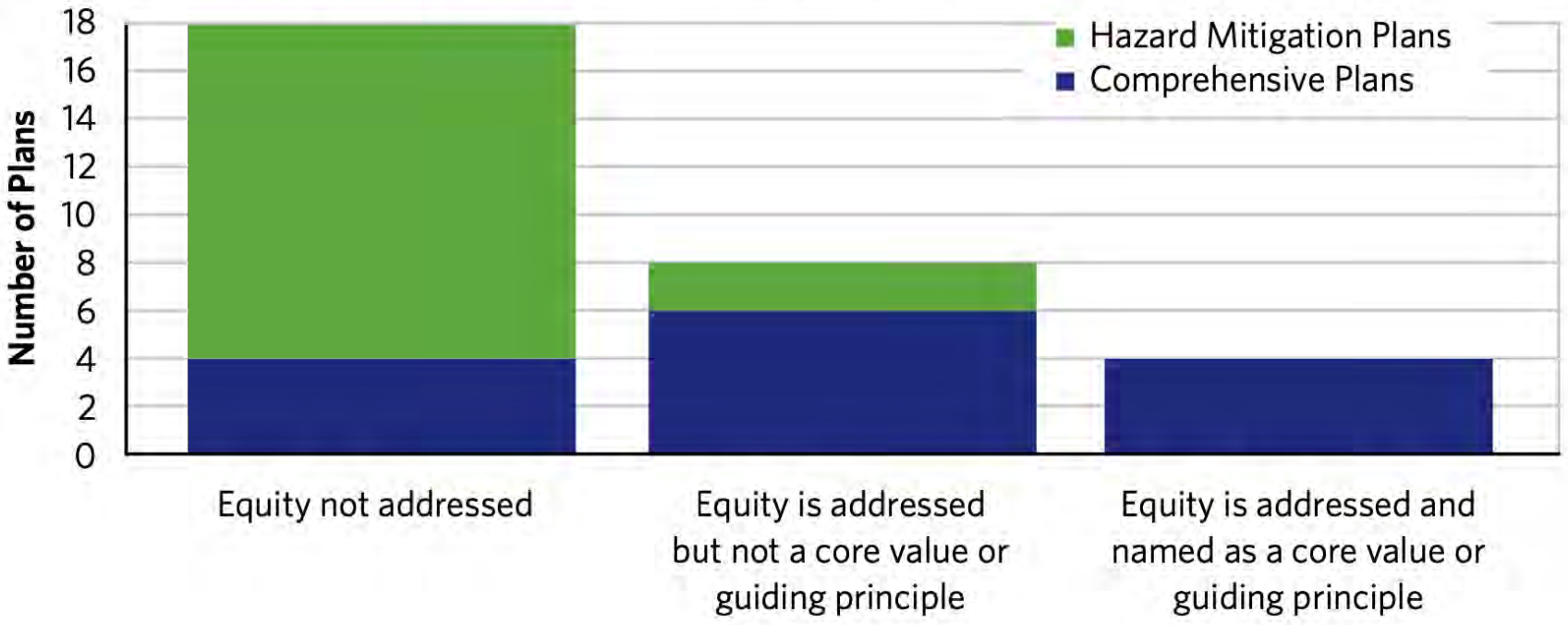
Key Findings: Plan Evaluation

Mitigation plans less likely than comp plans to integrate equity as a core value or to include equity-supporting goals

Figure 9. Extent to which equity is addressed in sampled plans



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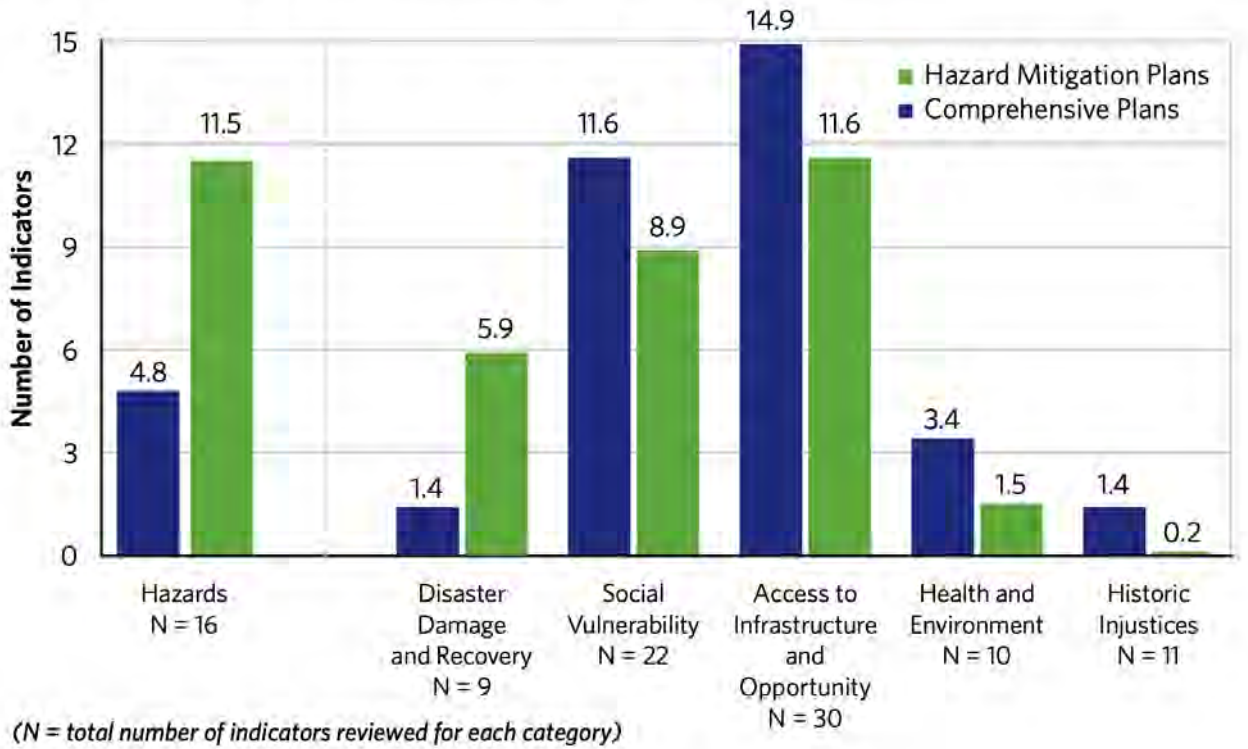
Key Findings: Plan Evaluation

Mitigation plans address more hazards, comp plans include more indicators that can be used to assess equity

Figure 10. Equity Fact Base: Mean number of indicators that could be used to assess equity in comprehensive plans and hazard mitigation plans by category



(N = total number of indicators reviewed for each category)

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KEY FINDINGS: Community Voice

- There is little formalized attention to the ways that demographic and socioeconomic factors affect residents' abilities to prepare for, respond to, and recover from disaster
- Current focus of social vulnerability assessment in hazard mitigation and disaster response is on populations with access and functional needs
- Differences in hazard mitigation or disaster outcomes between various population groups in our four NC case study sites are not currently being tracked or evaluated
- Common practices that local agencies in our case sites use to increase disaster communication and support to socially vulnerable populations include:

Translation | **Multiple modes of engagement** | **Partnerships** | **Targeted support**

Next Steps

- Deeper dive into interview data
- Integrating findings across 3 components of study
- Sharing out results and recommendations

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Thank you!

Contact Fern Hickey at fern@unc.edu

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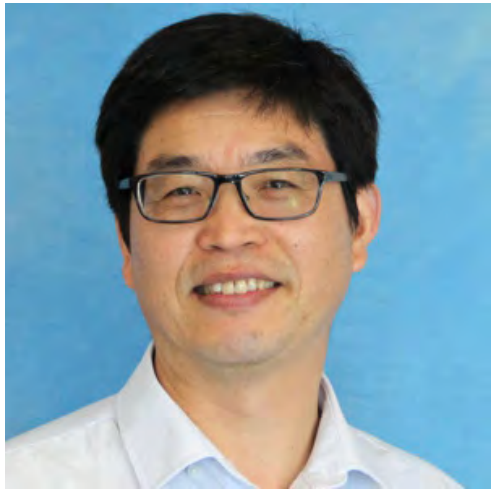

Conghe Song

Professor and Chair, Department of Geography and Environment

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Climate Impacts on People's Livelihoods and the Ecosystem Services

Conghe Song

Professor and Chair

Dept. of Geography & Environment

At UNC-Chapel Hill

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Climate Impact on Cropland Abandonment

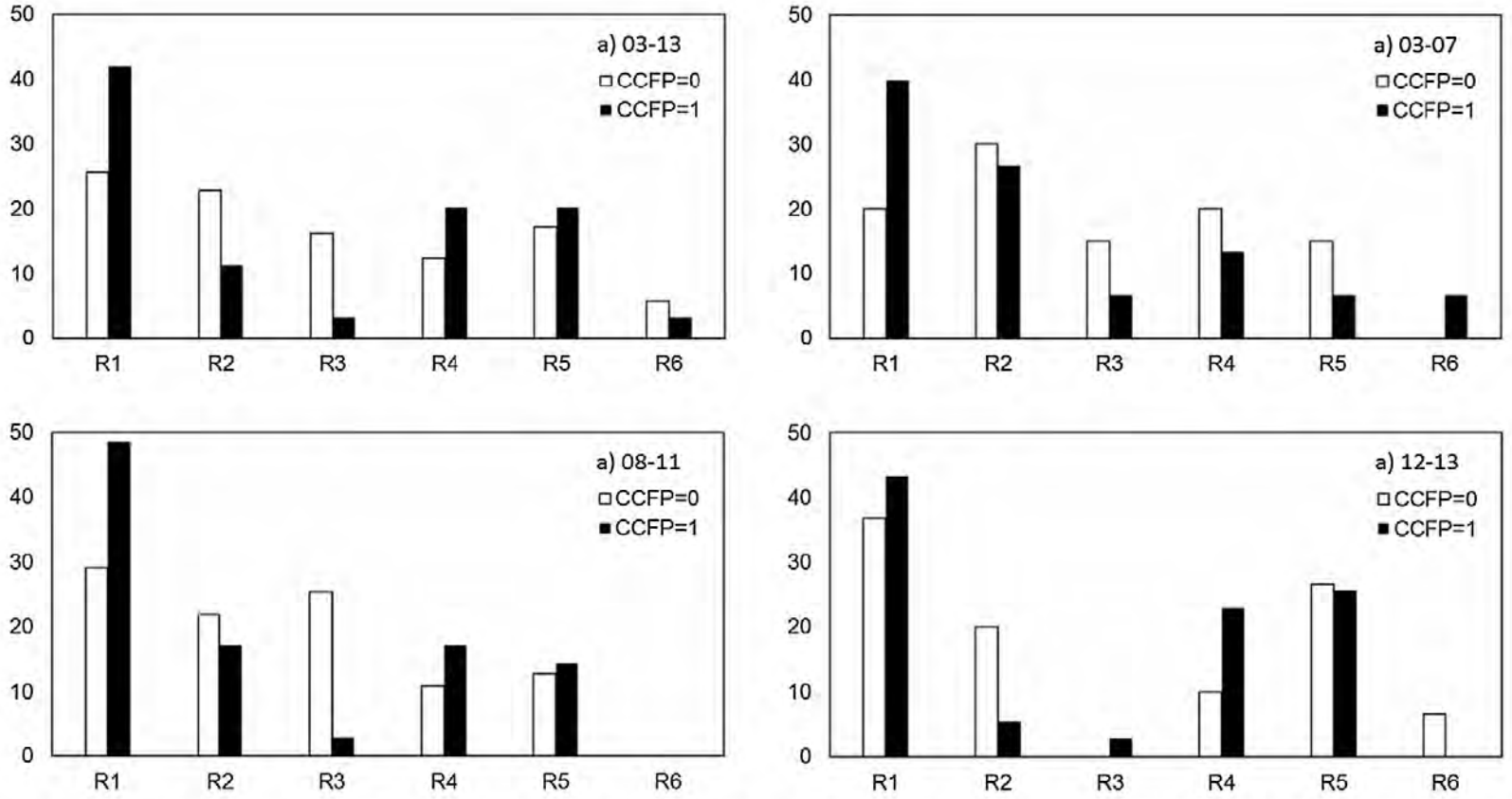

Fig. 3. Reasons of cropland abandonment for CCFP-participating households and non-participants during a) the entire time period (2003–2013), b) 2003–2007, c) 2008–2011, and d) 2012–2013.

Notes: Y-axis represents percentage of each reason of cropland abandonment provided by the respondents. X-axis represents category of the responses: R1, lack of labor due to migration or aging; R2, crop raiding by wildlife; R3, too far away from the house; R4, not worthwhile for cropping due to high opportunity costs of forgoing employment alternatives; R5, lack of reliable water supply for crop growth; R6, frequent natural disasters such as flooding, drought, insects, and disease.

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Climate Impacts on Irrigation Water Supply

Reason of decreased water	Pyuthan	Salyan	Total
Construction activities	2 (4.5%)	1 (1.2%)	3 (2.4%)
Damage of irrigation canals (or spring)	1 (2.3%)	5 (6.0%)	6 (4.7%)
Decreased in forest	2 (4.5%)	1 (1.2%)	3 (2.4%)
Decreasing rainfall	23 (52.3%)	51 (61.4%)	74 (58.3%)
Don't know	3 (6.8%)	1 (1.2%)	4 (3.1%)
Increased population	0 (0.0%)	4 (4.8%)	4 (3.1%)
Increasing pine forest cover	3 (6.8%)	4 (4.8%)	7 (5.5%)
More branches of canal	0 (0.0%)	3 (3.6%)	3 (2.4%)
More used for drinking	2 (4.5%)	4 (4.8%)	6 (4.7%)
Shrinkage of water source	5 (11.4%)	7 (8.4%)	12 (9.4%)
Poor management	3 (6.8%)	2 (2.4%)	5 (3.9%)
Total	44	83	127

Based on a survey of 992 households in spring 2023, 127 households irrigate crops and nearly 60% of them think decreasing rainfall is the primary reason for decreasing water availability for irrigation.

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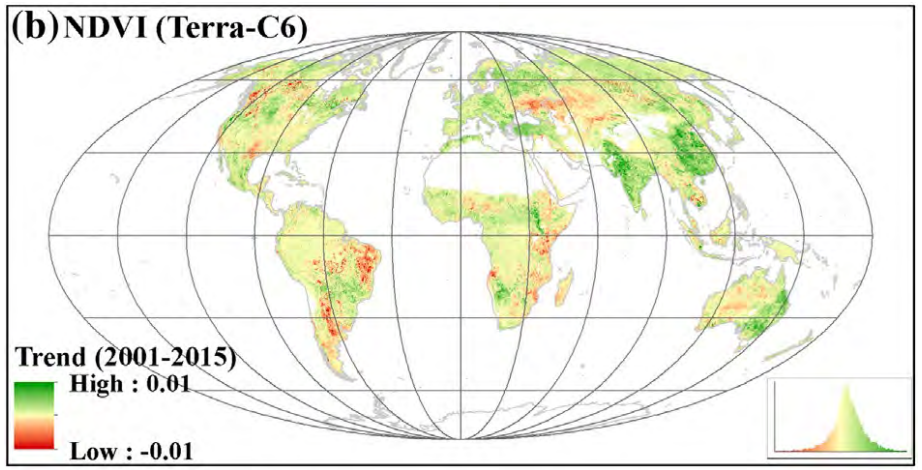
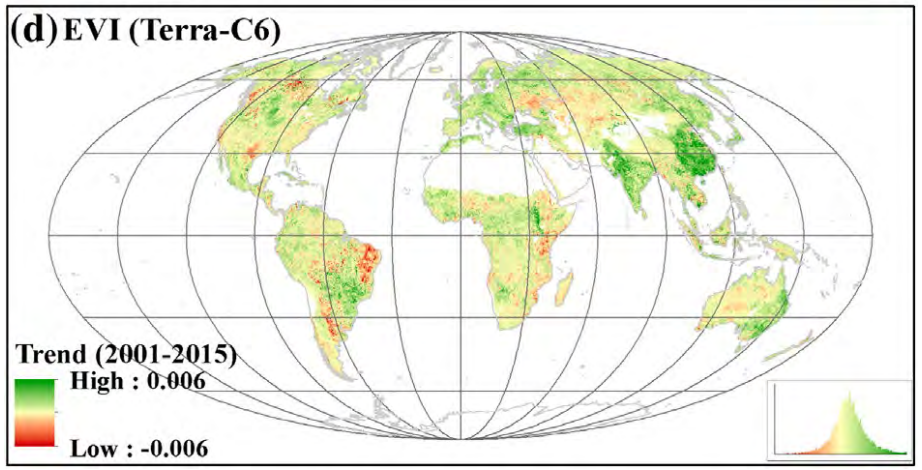
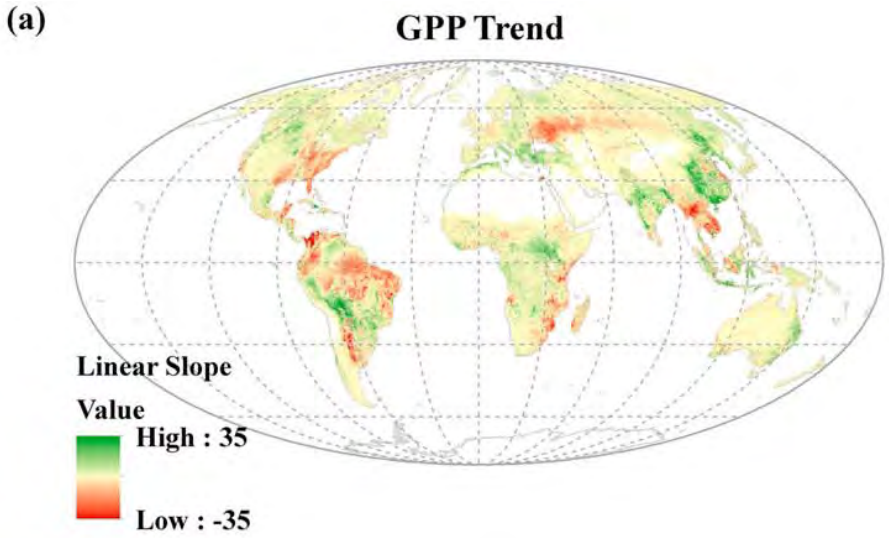
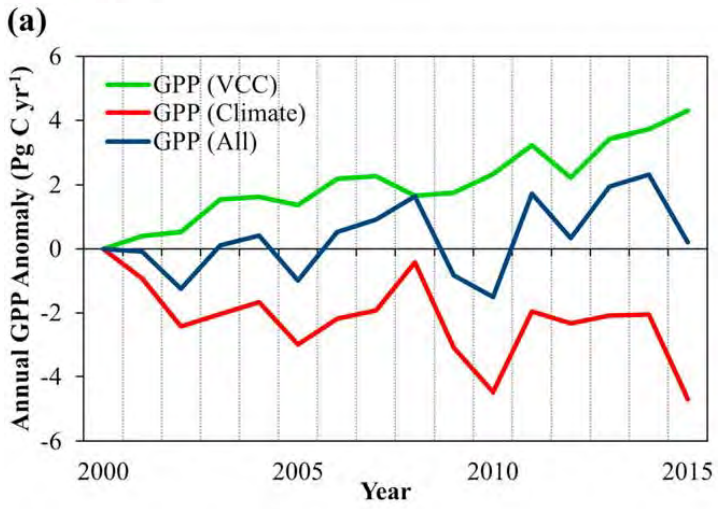
Climate Change and Vegetation Interact to Affect Ecosystem Services









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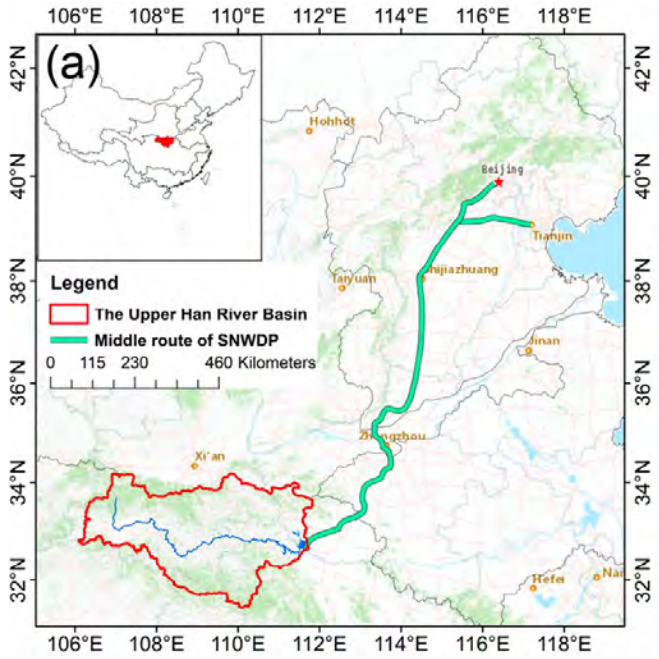
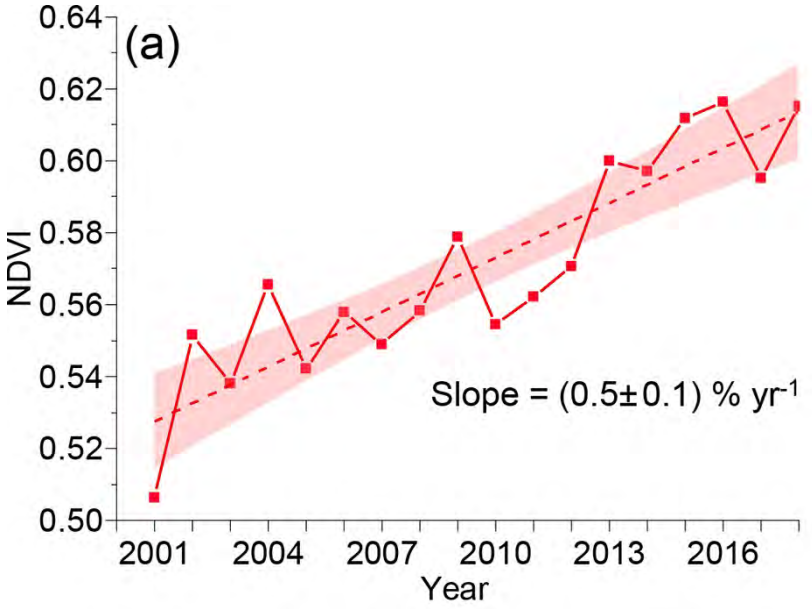
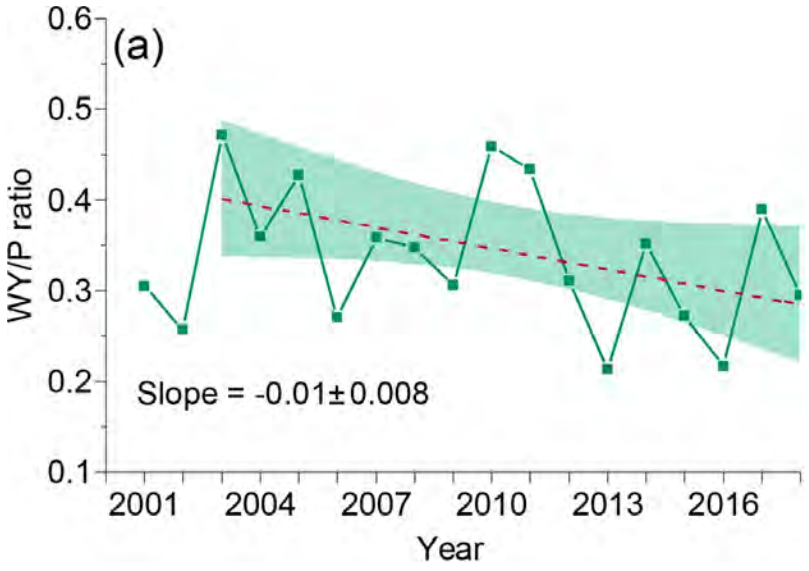
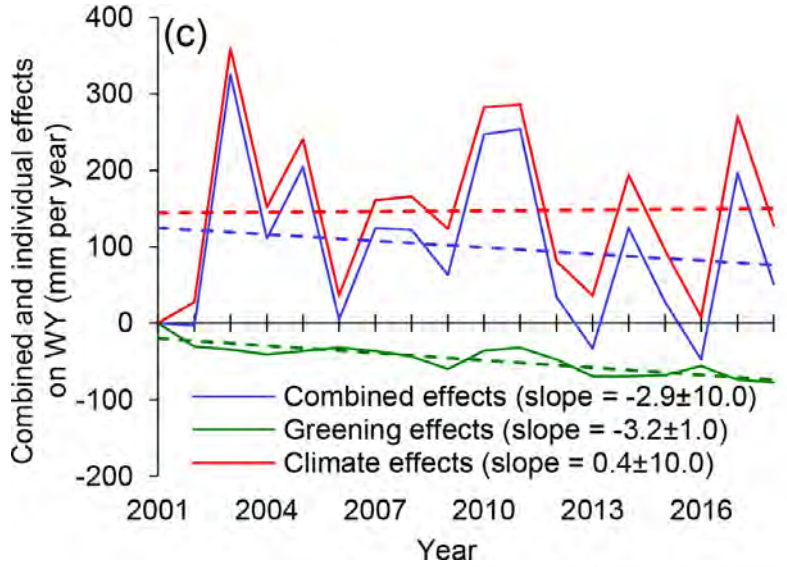
Climate Change Interacts with Vegetation Change to Affect Freshwater Availability









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