National Institute of Environmental Health Sciences

134.

Effects of Flood Risk and Climate Change on Census Tract-Level Health Outcomes

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Background

Floods have been linked to various health outcomes such as mental disorders and chronic diseases. This is likely due to psychosocial and post-traumatic stress caused by natural disasters and inadequate responses to them[1].

Objective

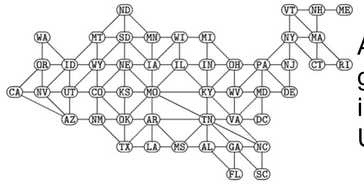
- Estimate the effect of flood risk at a given census tract on the prevalence of coronary heart disease (CHD) among adults.
- We focus on 7 states in the Southeastern U.S.: North Carolina, South Carolina, Tennessee, Georgia, Alabama, Mississippi, and Florida.

Data

Flood Risk[2] (12 covariates)	- Average risk score (1 to 10) - Percent of properties with given risk score
Social Vulnerability Index[3] (16 covariates)	- Percentage of the population below poverty, unemployed, without high school diploma, aged 65 or over, aged 17 or younger, with disability, in single-parent households, with minority status, with poor English, in multi-unit structures, in mobile homes, in crowded quarters, without vehicle, in group quarters, or are uninsured. - Per Capita Income
Air Pollution Concentrations[4] (6 covariates)	- Concentrations of six pollutants from a land use regression model made by the Center for Air, Climate and Energy Solutions: CO, NO2, O3, PM10, PM2.5, SO2
CDC Prevalence[5] (1 covariate, 1 response)	- Prevalence of current smoking among adults - Prevalence of coronary heart disease among adults

Methods

We fit a Bayesian hierarchical model (BHM) where the CHD prevalence at a census tract is a linear function of several flood risk measures, SVIs, air pollution concentrations, and smoking prevalence in the tract. To account for the spatial correlation among census tracts, we use a latent Gaussian conditional autoregressive (CAR) model[6].



Adjacency graph of states in contiguous US[7]

Discussion

Flood risk variables that are associated with significant increases in CHD prevalence, under the 5% level:

- Percent of properties with risk score 2
- Percent of properties with risk score 6
- Percent of properties with risk score 8
- Percent of properties with risk score 10

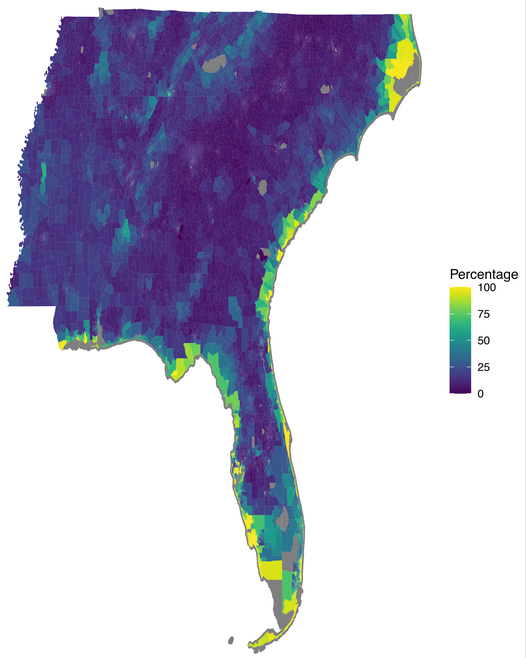
Many of the SVIs and air pollutants are associated with significant increases in CHD prevalence. These covariates are associated with especially large increases in CHD prevalence:

- Percentage of the population 65 or over
- PM2.5 concentration
- Smoking prevalence

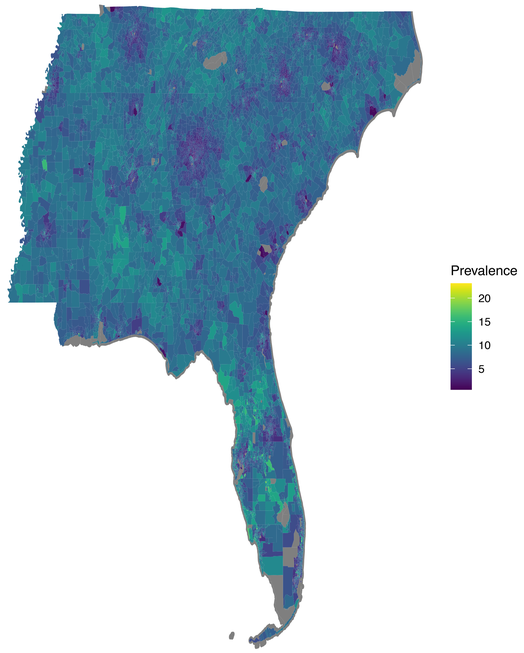
Future Directions

- Incorporate other flood risk measures derived from 3-meter level raster data.
- Implement more complex BHMs that include measurement error and multiple response variables.

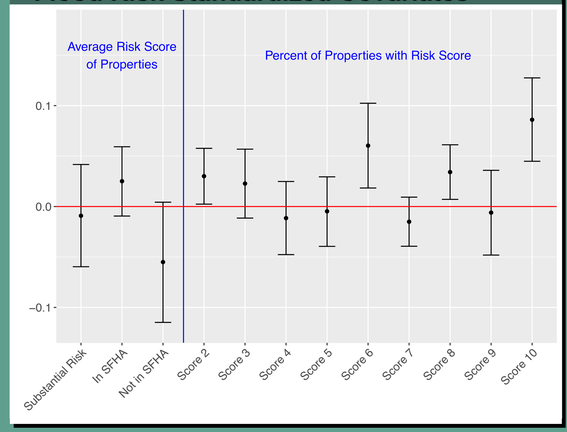
Percent of Properties with Any Risk of Flooding in each Census Tract



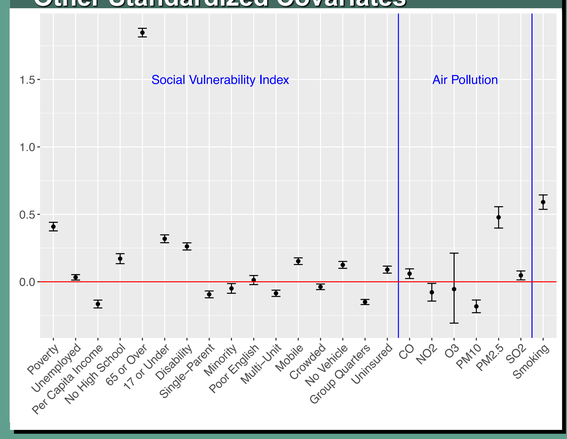
Census Tract CHD Prevalence



95% Credible Intervals of Coefficients for Flood Risk Standardized Covariates



95% Credible Intervals of Coefficients for Other Standardized Covariates



References

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[2]First Street. First street foundation flood risk summary statistics. https://registry.opendata.aws/fsf-flood-risk/, May 2021.

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[4]Sun-Young Kim, Matthew Bechle, Steve Hankey, Lianne Sheppard, Adam A. Szpiro, and Julian D. Marshall. Concentrations of criteria pollutants in the contiguous U.S., 1979 – 2015: Role of prediction model parsimony in integrated empirical geographic regression. PLoS ONE, 15(2), 2020.

[5]Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, and Division of Population Health. PLACES: Local data for better health, census tract data 2020 release. https://chronicdata.cdc.gov/500-Cities-Places/PLACES-Local-Data-for-Better-Health-Census-Tract-D/cwsq-ngmh, January 2021.

[6]Alexandra M. Schmidt and Widemberg S. Nobre. Conditional autoregressive (CAR) model. Wiley StatsRef: Statistics Reference Online, 2018.

[7]https://mathworld.wolfram.com/ContiguousUSAGraph.html

Acknowledgments

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