Flood Risk and Housing Market Dynamics Across CONUS Coastal Communities

Sandeep Poudel¹, James Knighton¹, Rebecca Elliot², Richard Anyah¹, Zbigniew Grabowski¹

1 Department of Natural Resources and the Environment, University of Connecticut, Storrs, CT, USA
2 Department of Sociology, London School of Economics and Political Science, London, UK

1. Introduction

- Flood Risk = Hazard x Exposure x Vulnerability
- Human-flood systems are shaped by complex interactions between these risk components (e.g., levee & adaptation effect), and this study explores:
  2. How the system will respond to climate risks (2021-2100) under high (SSP585) and low (SSP245) climate change emission scenarios?

2. Methods

- Calibration of SE model on historical data using DDS algorithm
- SE Model with Optimized Parameters
- Projection of L, A, D & HP up to 2100 under different climate change scenarios
- Precipitation from 4 CMIP6 GCMs
- Storm Surge by Monte-Carlo simulation of gumbel parameters from CoDEC data
- Sea Level Rise from NOAA

- We calibrated SE models across CONUS Coastal tracts & used model parameters to explore historical human-flood dynamics across regions (Fig.1) and demographics (Fig.2)
- Next, we forecasted National Flood Insurance Program Loss and policy purchases to 2100 across coastal states (Fig.3) & different social vulnerability groups (Fig.4)
- Finally, we tested the effects of raising levees on mitigating forecasted flood risk by increasing existing surge threshold by +1, +2, & +∞ (Fig.5)

3. Results

- Pacific: Less flood-exposure, more sensitive National Flood Insurance Program (NFIP) participation & housing market
- Gulf & Atlantic: More flood-exposure, less sensitive NFIP participation & housing market

- Flood losses across CONUS coastal communities is forecasted increase between 25% (SSP245) & 130% (SSP585) above historical levels, with largest increases across Atlantic coast
- Number of properties covered by NFIP to increase from 10% during historical record to 13% (SSP245) & 16% (SSP585)
- The gap between loss claims paid by NFIP & uptake of insurance policies continue to widen

4. Conclusions

- Strong regional and demographic variation in human-flood dynamics across CONUS
- Rising flood loss with modest flood insurance purchases under climate change, with disproportionate impacts to socially vulnerable communities
- Levees can reduce some catastrophic storm-surge losses & stabilize housing market but won’t eliminate flood risks entirely

Fig 1. Distribution of SE model parameters across CONUS states

Fig 2. Spearman’s ranked correlation of census variables indicating social vulnerability and SE model parameters

Fig 3. Average flood loss and insurance policy purchases for historical and forecasted period across coastal CONUS states (SSP585)

Fig 4. Historical and forecasted flood loss and insurance policy purchases among different social vulnerability groups across CONUS coastline (SSP585)

Fig 5. Flood loss and housing value for existing and increased surge threshold levels by +1, +2, +∞ m