Spatial and Temporal Variation of Hydrological Risk in Rural and Urban Environmental Justice Communities

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The compounding effects of climate change are inextricably linked to social vulnerabilities, poverty, race, and systemic injustices. The intersection between climate change and risk manifests as geospatial environmental hazards such as flooding, which have been projected to increase over the next 30 years in the continental United states. These climate-driven increases suggest that even modest increases in flood hazards have the potential to impact traditionally marginalized communities vulnerable to flooding. Compositional characteristics such as social status and identity have been shown to be linked to increased mortality, and slower economic and physical recovery after flooding (e.g., Hurricane Harvey and Hurricane Ida). These patterns demonstrate that higher clustering of minorities and low socioeconomic status people face unequal social consequences of climate-related disasters. While continental-scale flood models have shown heightened hazard susceptibility, multiple dimensions of social characteristics—including spatial and temporal scales of social class and status—are needed to understand the granular differences between zip codes. To examine the relationship between spatial and temporal social and geographic scales, we compared the spatial clustering from 2010 to 2019 for two different indices of social vulnerability: Social Vulnerability Index (SVI) of the Centers for Disease Control and Prevention and the Environment Justice Index (EJ) of the Massachusetts Executive Office of Energy and Environmental Affair. Between 2010 and 2019 in Massachusetts, we evaluate whether greater flood protections exist in urban communities (average 2019 population: 244,422) vs rural communities (average population: 8,310) and if flood risks change over time for minority populations. The results of this study demonstrate that current hydrologic extremes are disproportionately contained within block groups of vulnerable populations (e.g., 40.5% of vulnerable block groups intersect with the 500-year flood area and 20.7% for the 100-year flood area for Lawrence for example) and that social vulnerability to flood risk is increasing in rural areas with higher amounts of EJ block groups, while decreasing in urban areas with diversifying EJ block groups. Furthermore, the increased detail provided in EJI census block group scale (as compared to SVI census tract scale) demonstrated distinct zones that would require increased disaster management planning and prioritization.