**Lily Kraft**
**Research Agenda**

My research broadly aims to investigate and quantify the relationship between the hydrologic and socio-economic factors associated with flooding through the lens of insured flood losses from the National Flood Insurance Program (NFIP) through the Federal Emergency Management Agency (FEMA). Additionally, I seek to understand how climate change will influence both the severity of flooding and the associated damages to communities. To this end, I have outlined three main objectives targeted at addressing these themes. My first objective is to quantify the economic impacts of flooding to vulnerable communities. Specifically, I seek to answer key questions regarding which communities are most vulnerable (and potentially disproportionately exposed to flooding). Additionally, my research will focus on identifying disparities in federal disaster aid across communities. Secondly, my objective is to investigate the relationship between publicly available data and insured loss information; that is, I will assess the value of incorporating various sources of hydrologic data as flood loss model predictors to assess their effect on model skill. My final objective is to assess the magnitude of future flood impacts under climate change. I am interested to further evaluate how an increase in flood hazard and changes in insurance policy uptake will influence insured flood losses.

**Research Area 1: Evaluating and quantifying flood impacts to vulnerable communities**

A main objective of my research is to identify and quantify the economic impacts of flooding to vulnerable communities, such as racial and ethnic minority groups and low-income populations. Previously, I have conducted studies investigating the federal aid distribution across communities in the Midwest following the 2019 flood (Kraft et al., 2023), finding that those with lower income living in mobile homes were less likely to receive aid than those with higher income living in single family homes. My ongoing work focuses on another historically marginalized community, federally recognized tribal nations. Tribal communities across the United States have been historically underrepresented when considering national flood risk. Often, FEMA has not developed flood maps for these tribal nations, and therefore their true flood risk is unknown. By leveraging local hydrologic data such as flood ratio or inundation mapping, we can infer the flood conditions in both the tribal communities and nearby non-tribal communities and compare reported damages in relation to the flood severity. By linking this to available flood insurance policy data, we can quantify any discrepancies in available federal aid between the tribal and non-tribal communities. This work has implications for the future of flood disaster aid and ensuring equitable access for vulnerable communities.

**Research Area 2: Statistical modeling of flood losses leveraging publicly available hydrologic data**

Cities across Iowa, such as Davenport, Waterloo, and Cedar Rapids, have been economically impacted by major flood events, such as the 2008 or 2019 floods. As such, there is interest in understanding the factors influencing the location and amount of insurance claims. To achieve this, I can develop statistical models, which are conditioned on hydrologic information related to historical storms, to quantify flood insurance claims. One downside of hydrologic modeling is reliance on irregular or low-resolution data, because many regions have not developed comprehensive flood maps. However, by conducting analyses in Iowa, I can incorporate more granular hydrologic information for assessing impacts by adapting inundation maps developed

for the Iowa Flood Information System (IFIS) at the University of Iowa IIHR-Hydroscience & Engineering. By matching historical streamgauge discharge records to corresponding flood maps, we can estimate the inundation levels for flood events and incorporate average flood depth as a predictor into the model. From there, I can perform sensitivity analyses comparing the skill of the models either incorporating flood ratio or inundation depths. I will additionally investigate the effect of climate change and increasing flood severity on future flood insurance claims and claim amounts for select cities within Iowa. This work has implications for the development of future statistical modeling frameworks utilizing publicly available data and for the flood insurance industry within the Midwest.

**Research Area 3: Quantifying the magnitude and extent of future flood impacts on insured losses under climate change.**

Climate change is projected to have a substantial impact on the magnitude and duration of precipitation, likely contributing to severe flooding. In addition, rapid urbanization will expose more communities to flood conditions, which will place additional strain on federal assistance programs. To investigate these factors, I can focus on modeling insurance claims and claim amounts in cities, such as Houston, Texas, well-known for its rapid population expansion and frequent flooding. Using previously developed statistical models, I can investigate the effects of increasing flood hazard (representing climate change-driven conditions) and changes in flood insurance policy uptake (representing population growth) on projected insurance claims and claim amounts.

**Reference:**

Kraft, L. L., Villarini, G., & Czajkowski, J. (2023). Characterizing the 2019 Midwest Flood: A Hydrologic and Socio-Economic Perspective. *Weather, Climate, and Society*. https://doi.org/https://doi.org/10.1175/WCAS-D-22-0065.1