Flood Loss Estimates Impacted by Spatial Aggregation of Inputs

Objective

- Economic losses from flood damage over broad spatial scales are important for informing adaptation and mitigation decisions
- Prior studies have relied on geographically coarse input data, leaving estimates subject to unquantified aggregation bias
- We assess losses' sensitivity to the spatial resolution of hazards and affected structures in a Massachusetts case study

Approach

- Benchmark property-level losses are computed using hazard exposure and structure characteristics data for 1.3 M single family homes
- The benchmark is evaluated against three spatial aggregation procedures: low-resolution structures but high-resolution hazard exposures, low-resolution structures and hazards, and aggregate structures and hazard filtering out properties not at risk
- We characterize the resulting bias, pinpoint its origins, and compare its effects with those of other uncertainties in flood loss estimation

Impact

- The three aggregation procedures can give rise to large overall biases
- Higher resolution hazards reduce overall bias, but inaccurately reflect the spatial distribution of losses due to aggregation's impact on correlations between the tails of the hazard and asset distributions
- Effective flood risk management may need to rely on methods for decision-making under uncertainty to inform robust mitigation and adaptation

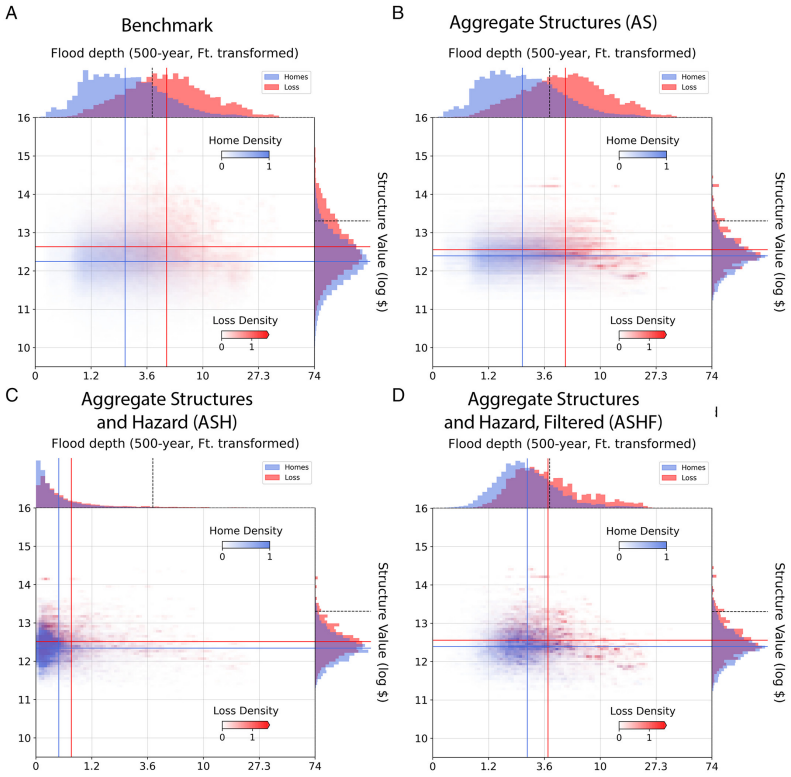

Figure: Marginal and joint distributions of flood depth and structure value of single-family homes across our four estimation procedures: (A) benchmark, (B) aggregate structures, (C) aggregate structures and hazard, (D) aggregate structures and hazard, filtering properties not exposed to risk. Horizontal axes show flood hazard transformed with the inverse hyperbolic sine function. Vertical axes show the logarithm of structure values. Histograms show marginal distributions of hazard (top) and structure value (left) when single-family homes are weighted equally (blue) or by their estimated loss (red). Joint distributions are visualized using a 2D kernel density estimator that weights each home equally (blue) or by its estimated loss (red). Vertical and horizontal lines mark the unweighted (blue) and loss-weighted (red) means of each distribution.

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Pollack, Adam B., IS Wing, and C Nolte. 2022. "Aggregation Bias and Its Drivers in Large-scale Flood Loss Estimation: A Massachusetts Case Study." Journal of Flood Risk Management, August. https://doi.org/10.1111/jfr3.12851.