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A Numerically-integrated Approach for Residential Flood Loss Estimation at the Community Level

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Evaluating average annual loss (AAL) is an essential component of assessing and minimizing future flood risk. A robust method for quantifying flood AAL is needed to provide valuable information for stakeholder decision-making. Several recent studies suggest that the numerical integration method can provide meaningful AAL estimates since this technique includes the full loss□exceedance probability of flood. While past research focuses on applying the numerical integration method on a single, one-family residential house, calculations across space are necessary for assessing community vulnerability. This research develops a computational framework in MATLAB for integrating across the full loss-exceedance probability curve through space to evaluate flood AAL for multiple single-family homes, including loss to the structure, content, and time spent in refurbishing it (i.e., use), over a case-study census block in Jefferson Parish, Louisiana, USA. To further inform flood mitigation planning, the AAL is also calculated for one, two, three, and four feet of freeboard and separately for each owner-occupant type of residence (i.e., homeowner, landlord, and tenant). Although previous studies provided essential information related to the structure and content loss for one type for ownership-occupant type (homeowner), the wider scope of this study allows for consideration of the use loss and the remaining ownership-occupant types. Results show that individual building AAL varies within a community because of its building attributes. Besides, results highlight the difference of AALs by owner-occupant type, with homeowners generally bearing the highest total AAL and tenants incurring the lowest total AALs. A simple elevation of only one foot can decrease the AAL by as much as 90 percent. A sensitivity analysis underscores the importance of using the exact values of the base flood elevation (BFE) compared to rounding to the nearest integer and excluding damage lower than first flood height (FFH) in the depth-damage functions (DDFs). Expanding the application of the numerical integration method to a broad-scale study area may enhance validity and accuracy as compensating errors are likely to make bulk estimates more reasonable, which might augment its utility at the community level. In general, such techniques improve resilience to flood, the costliest natural hazard, by assisting in better understanding of risk with and without mitigation efforts.