Machine learning highlights ways to improve flood mitigation

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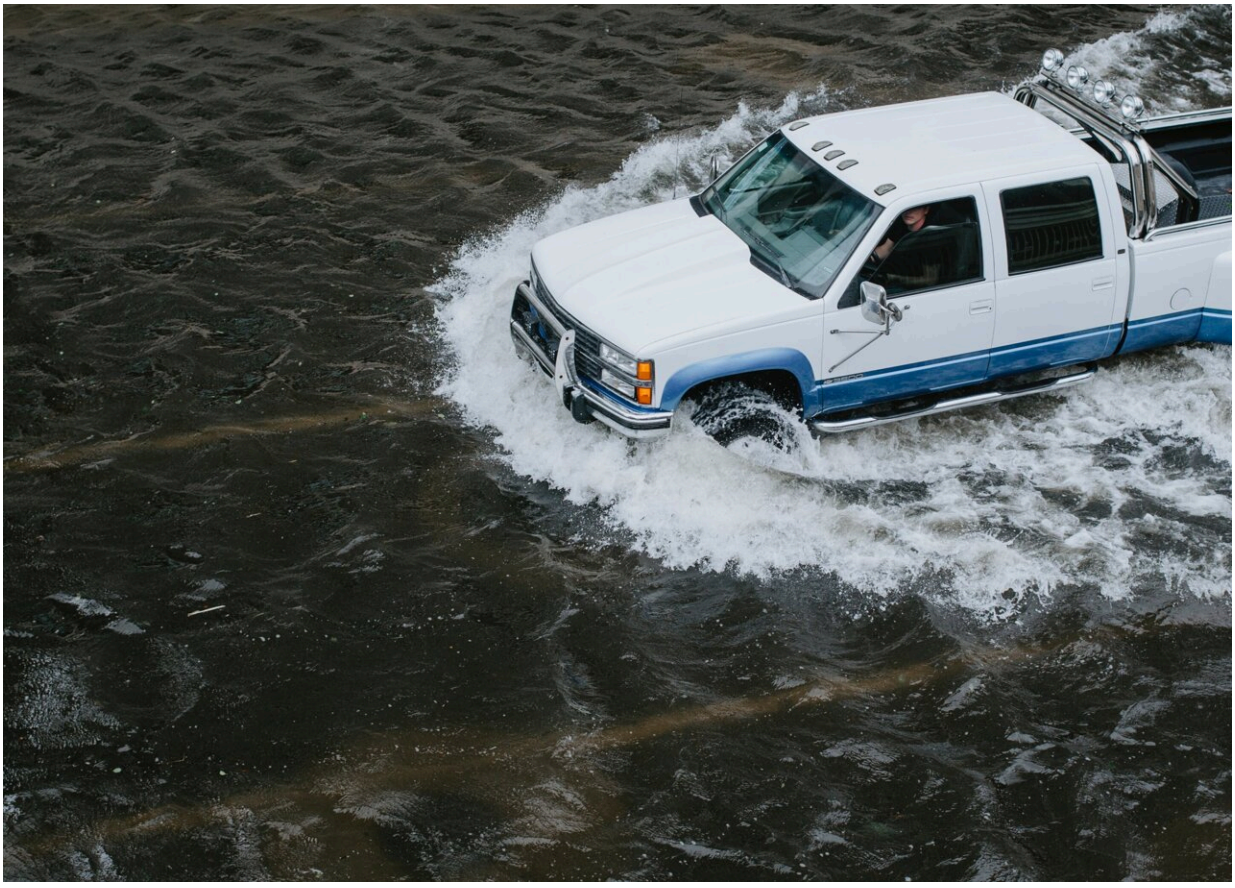

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Flooding in the United States costs communities more than $32 billion each year. As climate change drives increasingly severe and erratic storm

events, experts project that figure to rise in coming years: Forecasts estimate that flood risk will increase by more than 26% by 2050. Because of socioeconomic inequalities in flood risk mitigation, flooding disproportionately affects metropolitan areas with larger populations of Black, Indigenous, and People of Color (BIPOC) residents.

Against this backdrop, Nadja Veigel and colleagues apply interpretable machine learning to better understand the efficacy of flood resilience strategies. To build the machine learning model, the team selected 400 behavioral and socioeconomic variables that affect disaster response and mitigation. These included both bottom-up, household-level efforts (e.g., insurance or property improvements) and top-down policy measures such as community-level policies.

The authors used open-access flood insurance data from the National Flood Insurance Program and the U.S. Census Bureau's American Community Survey. Their findings are published in the journal *Earth's Future*.

The results showed that most households acquire flood insurance in response to severe flood events. Thus, residents of communities not regularly or heavily exposed to damaging flooding are more likely to be uninsured. The authors also note that high resident turnover in cities often limits knowledge of flood history, weakening mitigation and preparation efforts. Urban areas also typically see lower insurance adoption.

In contrast, community-level policies like the National Flood Insurance Program's Community Rating System (CRS) offer a more proactive approach. The CRS encourages insurance adoption by lowering premiums for communities that undertake mitigation and floodplain management measures. The authors suggest that the system could more effectively address flood risk inequality by targeting underserved, at-risk

communities.

The research underscores previous findings that vulnerable groups are systematically more exposed to floods and could benefit from increased resilience. The data show that top-down approaches, such as the CRS, offer proactive flood solutions that help address structural inequalities in risk. Although flood insurance remains a critical strategy in managing risk, it is often a reactive approach that provides limited relief when not accompanied by community-level efforts.

More information: Nadja Veigel et al, Interpretable Machine Learning Reveals Potential to Overcome Reactive Flood Adaptation in the Continental US, *Earth's Future* (2023). DOI: 10.1029/2023EF003571

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