

INFORMED DECISIONS ON CATASTROPHE RISK

Current Flood Insurance Policy and Potential Improvements

Researchers from the Wharton Risk Center, Princeton University, MIT, and NOAA Geophysical Fluid Dynamic Laboratory are undertaking a multi-year collaborative National Science Foundation project on hurricane risk assessment and management. This issue brief summarizes points raised during a workshop related to the project held at the Wharton Risk Center on June 9, 2016, attended by project scientists, economists, FEMA policymakers and other federal advisors.

Recent disasters, including Hurricane Sandy in 2012, underscore the significant vulnerability of the United States to hurricanes.

The impacts of storms may worsen because of coastal development coupled with sea level rise and possibly more intense hurricanes.

A well-designed insurance program can play an important role in linking investment in loss reduction measures and financial protection should a disaster occur.

- This NSF project will establish a framework for assessing hurricane hazards, estimate how these hazards may evolve in the future, and will develop engineering and policy strategies for reducing losses from related disasters.
- An important component of the project is better estimating the coastal flood risk and how to address this risk in the design of the National Flood Insurance Program (NFIP).

Measures to improve resilience to floods:

- Improve accuracy of flood maps
- Improve communication on flood risk, potential damage and the roles of mitigation and insurance
- Provide elevation certification for at-risk structures
- Investments in loss-reduction measures such as elevating houses
- Provide vouchers and/or other financial aid for homeowners to purchase flood insurance and undertake loss-reduction measures that will also address affordability issues
- Government acquisition of at-risk properties for open space and flood buffer zones

- Insurance premiums should reflect risk to communicate to floodplain residents the degree of the hazard they face.
- Under the NFIP today, many homeowners residing in the floodplain pay a subsidized premium due to equity and affordability considerations.
- Risk-based insurance premiums could motivate homeowners to invest in cost-effective loss reduction measures through a reduction in the price of insurance.
- FEMA flood maps on which NFIP premiums are based may not accurately reflect the current risk and do not account for future climate change and sea level rise.

Improving Flood Maps

- Flood risk maps should be based on structure-specific flood elevation and frequency determinations.
- Anticipating future risk (e.g., impacts of climate change) needs to be part of the mapping process.
- Risk classifications should be modernized using geospatial data.

Affordability of Flood Insurance

- **Two key questions**
 - Who should receive financial assistance (e.g., income-based; housing costs in relation to income)?
 - What form(s) of assistance are appropriate (e.g., vouchers, low-interest loans, mitigation grants, tax credits)?
- **Reducing risk-based premiums and future losses through cost-effective mitigation measures**
 - Where feasible, houses should be elevated to 1 foot above base flood elevation (BFE) or the optimal level based on cost-benefit analysis, taking sea level rise into account.
 - Other risk reduction measures: moving habitable areas to higher floors; raising electrical outlets; making sure the grading in the yard directs water away from the building.
- **Linking means-tested assistance with mitigation**
 - Means-tested assistance coupled with a low-interest loan should encourage homeowners to insure and fortify their home against flood hazards.
 - The annual cost of a loan is likely to be less than the reduction in the risk-rated insurance premium if the loss reduction measure is cost-effective.

Risk Communication

- Inform policyholders that their insurance premiums are subsidized and what the premium would cost if pricing was risk-based.
- Inform homeowners that FEMA disaster aid is largely designated for repairing infrastructure and public facilities, not damage to homeowners' property and contents.
- Inform homeowners that risks may increase with sea level rise and more intense hurricanes.
- Inform homeowners that changes in flood risk could increase the costs of insurance premiums.
- Inform homeowners who are not required to carry flood insurance policies that purchasing coverage will protect them financially following the next flood.
- Inform homeowners how various flood mitigation activities would lower their flood risk and insurance premiums.
- Restrict financial assistance to those who currently reside in flood prone areas so as not to encourage people to move into harm's way.

Role of the Public Sector

- The Stafford Act disincentivizes state and local governments to invest in loss-reduction measures.
 - Federal government should incentivize state and local governments to make decisions for the safety of their citizens, such as preventing further coastal development.
 - State and local governments should provide the federal government with insights on what they are doing to inform policy and practice of cost-effective flood risk management.
- Design guidelines for community planners to convey the message that retreat instead of rebuilding is the preferred option under many circumstances.
- Incentivize or require homeowners to purchase flood insurance coverage and invest in cost-effective mitigation measures.
- Provide researchers with anonymized census data to help determine criteria for addressing affordability issues. Data needed:
 - household income/wealth
 - percentage of household income spent on insurance, mitigation and mortgage
 - cost to invest in loss reduction measures
 - resulting benefits (e.g., lower annual losses, changes in property values)

About the NSF Hazard SEES Project EAR-1520683

This project will demonstrate a tropical cyclone (TC) risk assessment and management framework with applications to NJ, NY, NC, and FL in the U.S., and Shanghai in China. We will compare the hazards, vulnerability, and risk, as well as existing and potential risk management strategies for the coastal cities in our study. We will use these case studies to propose engineering and policy strategies to build resilient and sustainable coastal communities. To contribute to sustainability – defined in the Hazards SEES program as human needs being met equitably and without sacrificing the ability of the future generations to meet their needs – we will apply these quantifications of climate change impact on TC hazards and damage to coastal mega-cities around the world and inform decision-makers about the likely consequences of continued greenhouse gas emissions on the global scale.

Principal Investigator: Ning Lin, Assistant Professor of Civil and Environmental Engineering, Princeton University. Her research integrates science, engineering, and policy to study tropical cyclones and associated weather extremes (e.g., strong winds, heavy rainfall, and storm surge), how they change with climate, and how their impact on society can be mitigated.

Kerry Emanuel, Professor of Atmospheric Science, MIT. Expertise includes tropical meteorology and hurricane physics. He leads the research on statistical-deterministic TC modeling.

Tom Knutson, NOAA/Geophysical Fluid Dynamic Laboratory (GFDL), Climatologist, Leader of Climate Impacts and Extremes Group; Co-Chair of World Meteorological Organization Expert Team on Climate Change Impacts on Tropical Cyclones.

Howard Kunreuther, James G. Dinan Professor, Wharton School; co-director of the Wharton Risk Management and Decision Processes Center. He has a long-standing interest in ways that society can better manage low-probability, high-consequence events related to technological and natural hazards. He leads the research on U.S. National Flood Insurance Program analysis.

Guy Nordenson, Professor of Structural Engineering and Architecture, Princeton University. Expertise includes urban resiliency and coastal engineering design. He leads the research on flood mitigation design and analysis.

Michael Oppenheimer, Professor of Geosciences and International Affairs, Princeton University; Director of the Program in Science, Technology and Environmental Policy (STEP) at Princeton's Woodrow Wilson School of International Affairs. He leads the research to incorporate sea level rise into the flood risk analysis to inform policy analysis and engineering design.

James A. Smith, Professor and Chair of Civil and Environmental Engineering, Princeton University. He leads the research on WRF modeling and rainfall and inland flooding analysis.

Gabriel Vecchi, NOAA Geophysical Fluid Dynamic Laboratory (GFDL), Oceanographer, Head of Climate Variations and Predictability Group; Princeton University. His expertise includes ocean atmosphere coupling and climate change and variability. He co-leads the research on dynamic statistical TC modeling and GFDL-WRF TC hazards modeling.



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INFORMED DECISIONS ON CATASTROPHE RISKS issue briefs are published by the Wharton Risk Management and Decision Processes Center of the University of Pennsylvania. For additional information, contact Carol Heller, hellerc@wharton.upenn.edu or 215-898-5688.

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About the Wharton Risk Center

Established in 1985, the **Wharton Risk Management and Decision Processes Center** develops and promotes effective corporate and public policies for dealing with catastrophic events. The Risk Center research team – over 70 faculty, fellows and doctoral students – investigate how individuals and organizations make choices under conditions of risk and uncertainty under various regulatory and market conditions, and the effectiveness of strategies such as alternative risk financing, incentive systems, insurance, regulation, and public-private collaborations at a national and international scale. The Center actively engages multiple viewpoints, including top representatives from industry, government, international organizations, interest groups and academia. More information is available at <https://riskcenter.wharton.upenn.edu>.