NATHAN GELDNER, PH.D.

Applied Mathematician

Nathan Geldner, Ph.D., is focused on the design and analysis of probabilistic, statistical, and simulation models of environmental risk with applications in public policy and decision support under uncertainty. His experience is principally in surge and wave-driven as well as compound flooding from tropical cyclones, but he's also interested in application domains ranging from more directly related climate and meteorological hazards such as inland pluvial flooding and water resource management to more diverse areas such as environmental health, emissions policy, and ecological management.

Nathan's previous work includes creating methods improvements for Louisiana's 2023 Coastal Master Plan as well as probabilistic model development for the Louisiana Watershed Initiative, addressing coastal surge and wave-driven risk modeling and joint surge/riverine flood hazard modeling respectively. He also has experience working with decision-making under deep uncertainty, a family of methodological frameworks for tackling hard problems of public policy when there is uncertainty of what the future holds and analysts can't confidently put probability distributions to the problem.

Nathan believes it is crucial that applied research tackling complex environmental challenges addresses not only the questions being asked by decision makers, but also questions of equity to help ensure that the work protects the people who need it most.

PROFESSIONAL EXPERIENCE

2023–Present: Applied Mathematician, The Water Institute

2018–2023: Research Assistant, Purdue University

2016–2018: ORISE Statistics Fellow, Centers for Disease Control and Prevention, Tobacco and Volatiles Branch

2015–2016: Project Manager, Harvey Mudd College NOAA Clinic Team

June 2015–August 2015: Undergraduate Researcher, UCLA Applied Mathematics REU 2015

ORGANIZATION ROLE

Applied Mathematician

PROJECT ROLE / FOCUS AREAS

Statistical analysis

Environmental risk modeling

Compound flood modeling

Decision support under uncertainty

EDUCATION

Ph.D., Industrial Engineering, Purdue University, 2023

BS, Mathematics, Harvey Mudd College, 2016.

PROFESSIONAL MEMBERSHIPS

Society of Risk Analysis

Decision Making under Deep Uncertainty (DMDU) Society

SELECTED PROJECTS

Advances in Coastal Flood Risk Analysis. *Ph.D. Thesis. (2018–2023).* The first chapter extends the JPM-OS statistical model of surge- and wave-driven coastal flooding to account for rainfall and riverine dynamics via Monte Carlo sampling of rainfall and riverine drivers and k-means clustering of hydrologic and surge features. The second chapter attempts to optimize the net present value of adaptive and static, structural and nonstructural protection measures in the Larose to Golden Meadow protection system in a multi-objective sense across many sea level rise trajectories in order to quantify the value of adaptivity in protection planning. The third chapter investigations the extent to which traditional benefit-cost analysis harms socioeconomically disadvantaged communities and the extent to which an alternative risk measure may mitigate those harms, ultimately proposing the use of hybrid metrics with favorable tradeoffs.

Coastal Compound Flood Hazard Modeling for the Louisiana Watershed Initiative. *(2021–Present).* Ongoing methods development for probabilistic modeling of coastal compound flood hazard.

Model Improvements for the 2023 Louisiana Coastal Master Plan. *Coastal Protection and Restoration Authority. (2019–2021)* Assisted a multi-agency team in making various improvements to the risk modeling component of the Coastal Master Plan, including updates to accommodate an expanded suite of synthetic storms, development of a building-level coastwide structure inventory, and changes to levee fragility modeling.

SELECTED PUBLICATIONS

1. Geldner, N., Johnson, D., Doss-Gollin, J., & Keller, K. (In review). Efficient flood risk mitigation and intersectional equity implications: A case study in New Orleans. *Nature Communications*.
2. Johnson, D., Geldner, N., Liu, J., Baldos, U., & Hertel, T. (2023). Reducing U.S. biofuels requirements mitigates short-term impacts of global population and income growth on agricultural environmental outcomes. *Energy Policy*, *175*.
3. Johnson, D., Wang, J., Geldner, N., & Zehr, A. (2022). Rapid, risk-based levee design framework for greater risk reduction at lower costthan standards-based design. *Journal of Flood Risk Management*, *15*(2).
4. Johnson, D., Fischbach, J., Geldner, N., Wilson, M., & Stelzner, C. (2021). *Coastal Louisiana Risk Assessment (CLARA) Model Summary report*. Coastal Protection and Restoration Authority.
5. Johnson, D., & Geldner, N. (2019). Contemporary decision methods for agricultural, environmental, and resource management and policy. *Annual Review of Resource Economics*, *11*, 19–41.
6. Bagchi, P., Geldner, N., deCastro, B., De Jesus, V., Park, S., & Blount, B. (2018). Crotonaldehyde exposure in U.S. tobacco smokers and nonsmokers: NHANES 2005-2006 and 2011-2012. *Environmental Research*.

SELECTED PRESENTATIONS

1. 2023, Efficient Nonstructural Flood Risk Mitigation and Intersectional Equity Implications / State of the Coast Conference, Geldner, N., Johnson, D., Doss-Gollin, J., Keller, K.

2. 2023, Coastal Compound Flooding for the Louisiana Watershed Initiative – The Extended Joint Probability Method with Optimal Sampling / State of the Coast Conference

3. 2021, Coastal Master Plan – Risk Assessment: Social Vulnerability and other Metrics / State of the Coast Conference, Geldner, N., Johnson, D., Fischbach, J., Wilson, M., Stelzner, C.

4. 2021, Multi-Objective Optimization of Tradeoffs and Synergies Between Structural and Nonstructural Coastal Protection Projects / Society for Risk Analysis Annual Meeting, Geldner, N., Wang, J., Zehr, A., Johnson, D.