Exponent®
Engineering & Scientific Consulting

Erick R. Velasco-Reyes, Ph.D.

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Professional Profile

Erick R. Velasco-Reyes, Ph.D., is a coastal and multi-hazard risk scientist at Exponent with over 10 years assessing coastal flooding, hurricane storm surge, tsunami, and erosion hazards to buildings, ports, infrastructure, and the natural environment. He specializes in hydrodynamic and sediment-transport modeling, fragility-based vulnerability assessment, climate risk, and disaster risk management, supporting insurance, litigation, and regulatory matters involving coastal and natural-hazard damage.

Dr. Velasco-Reyes has led and contributed to projects spanning over a decade of research, consulting and disaster response practice involving natural hazard modeling, infrastructure damage assessment, coastal flood risk evaluation, and climate vulnerability analysis, providing expert analysis and consulting for research institutions, government agencies, NGOs, and port authorities. His work encompasses probabilistic hazard characterization, hydrodynamic simulation, fragility-based vulnerability assessment, and cascading risk analysis, with expertise in coastal flooding, storm surge, tsunami, and erosion impacts on buildings, ports, and lifeline systems.

He has served clients in infrastructure, energy and utilities, transportation (ports and maritime), NGOs and government and public-sector planning, addressing challenges including coastal property damage from storms and flooding, port and waterfront infrastructure failure, science-based support for regulatory and planning decisions in flood-prone areas, and climate adaptation planning. His consulting experience spans flood simulation and inundation mapping, storm and tsunami surge, wave impact analysis, shoreline erosion and sediment transport assessment, earthquake and tsunami hazard evaluation, and climate risk and multi-hazard cascading failure analysis.

Dr. Velasco-Reyes's consulting approach integrates physics-based numerical modeling (e.g., Delft3D, ADCIRC, GeoCLAW, SFINCS, HEC-RAS), probabilistic and Bayesian uncertainty quantification, fragility curve application, GIS-based geospatial analysis, and high-performance computing to deliver rigorous, defensible, and decision-ready conclusions. He translates complex multi-hazard analyses into clear risk metrics, actionable recommendations, and visual decision-support products accessible to both technical and non-technical stakeholders. His methods support forensic, physics-based damage-causation analysis — attributing coastal flood, storm-surge, and erosion damage to specific physical mechanisms — for expert investigation, insurance, and litigation contexts.

Before joining Exponent, Dr. Velasco-Reyes served as a Postdoctoral Scholar at Oregon State University, where he led multi-institution research on coastal infrastructure resilience, hurricane storm surge modeling, and tsunami-induced sediment transport. Previously, he directed disaster risk management programs at the Colombian Red Cross, advised the Colombian government on national tsunami risk reduction, and coordinated international emergency response operations including the 2016 Ecuador earthquake. He earned his Ph.D. and M.Sc. in Earth Science from Tohoku University (Japan) and his B.Sc. in Geology from the National University of Colombia. He also served as a member within the Colombian Red Cross Search and Rescue (SAR) team, directing multiple field operations.

Dr. Velasco-Reyes has published peer-reviewed articles on tsunami hazard, coastal morphodynamics, climate risk modeling, and disaster response optimization in journals including *Communications Earth & Environment*, *Coastal Engineering*, and *Progress in Earth and Planetary Science*. He has secured competitive research funding from NSF-funded CoPes Hub, the Cascadia Lifelines Program, and the NSF-funded Cascadia Region Earthquake Science Center (CRESCENT). His work on catastrophe and climate-risk model design — including "Rethinking Uncertainty: Why Disaster and Climate Risk Models Must Move Beyond Logic Trees" (with a Marsh expert) and commentary for the Actuaries Institute of Australia — engages directly with the insurance and actuarial community.

Areas of Expertise

- Coastal flood, storm surge, hurricane, tropical cyclone, tsunami & multi-hazard modeling
- Hydrodynamic & morphodynamic simulation (Delft3D, SFINCS, GeoClaw, ADCIRC, SWAN, HEC-RAS)
- Coastal geology, structural geology, sedimentology & geomorphology
- Seismic risk
- Fragility & vulnerability analysis
- Catastrophe & probabilistic risk modeling
- Bayesian inference, time-series analysis & uncertainty quantification
- Climate risk assessment & adaptation planning
- GIS / geospatial analysis (ArcGIS Pro, QGIS)
- Python
- High-performance computing
- Stakeholder engagement & risk communication

Academic Credentials & Professional Honors

Ph.D., Earth Sciences, Tohoku University, 2024

M.Sc., Earth Sciences, Tohoku University, 2020

B.Sc., Geology, National University of Colombia, 2015

Monbukagakusho (MEXT) Scholarship for postgraduate studies. Japanese Government Ministry of Education, Culture, Sports, Science and Technology. Awarded through university recommendation.

Prior Experience

Postdoctoral Scholar, Oregon State University — Sep 2024 – May 2026

Tsunami Risk Consultant, National Unit for Disaster Risk Management (UNGRD), Colombia — Mar 2021 – Aug 2021

Disaster Modeling Consultant, National University of Colombia — Feb 2021 – May 2021

Disaster Risk Management Director, Colombian Red Cross, Bogota — Jun 2020 – May 2021

Disaster Risk Management Consultant, Colombian Red Cross, Bogota — Mar 2018 – Apr 2020

Emergency Response Coordinator, Colombian Red Cross, Bogota — Feb 2016 – Jan 2017

Professional Affiliations

American Society of Civil Engineers (ASCE)

Coasts, Oceans, Ports, and Rivers Institute (COPRI/ASCE)

Japanese Geoscience Union (JpGU)

Publications

Cox D, Amini M, Hubbard K, Kaihatu J, Kennedy A, Velasco-Reyes E, Sanderson D. Modeling of hurricane surge and waves in the built environment: hurricane Ian. Workshop #3 Report, National Institute of Standards and Technology 2026; Gaithersburg, MD, NIST NWIRP GCR 1-3.

Velasco-Reyes E, Cox D, Barbosa A. Modeling building-aware overland flow and dynamic collapse during hurricane surge. Coastal Engineering 2026.

Velasco-Reyes E, Cox D, Barbosa A. Modeling tsunami-induced sediment transport and erosion with implications for coastal infrastructure vulnerabilities. Journal of Geophysical Research: Earth Surface, in review, 2026.

Velasco-Reyes E, Pui A. Rethinking uncertainty: why disaster and climate risk models must move beyond logic trees. SSRN 2026.

Sanchez Escobar RE, Ferrer JJ, Velasco-Reyes ER, Mas E. Tsunami–sediment interactions amplify coastal hazard and reshape inundation dynamics in Tumaco Bay, Colombia. EGUsphere, preprint 2025.

Velasco-Reyes E, Feddersen M, Pui A. Why a manga-predicted earthquake scared tourists and what it reveals about climate and risk communication. Actuaries Digital, Actuaries Institute of Australia 2025.

Velasco-Reyes E, Sugawara D, Adriano B. Tracing the sources of paleotsunamis using Bayesian frameworks. Communications Earth & Environment 2024; 5:478.

Velasco-Reyes ER, Hernández-Pérez GJ, Osorio-Ramírez C. Data-driven demand localization for effective disaster response. Applied Computer Sciences in Engineering (Communications in Computer and Information Science 2024; 2222:232–244.

Velasco-Reyes ER, Goto K, Sugawara D, Nishimura Y, Shinohara T, Chiba T. Paleotsunami history of Hachinohe, northern Japan: a multiproxy analysis and numerical modeling approach. Progress in Earth and Planetary Science 2022; 9:19.

Project Experience

Damage Causation & Vulnerability Analysis

- Reconstructed the failure mechanism by which tsunami-induced scour (erosion of soil around a structure's base) undermined foundations and drove progressive structural collapse.
- Applied fragility curves (damage-probability curves) and damage functions to translate hazard intensity (flood depth, surge velocity, wave forces) into infrastructure performance metrics for buildings.

- Quantified seismic-structural vulnerability using probabilistic hazard assessment and collapse modeling to estimate search-and-rescue demand following large-scale earthquake scenarios; results optimized emergency resource pre-positioning and reduced projected response times.
- Quantified financial exposure to large-scale seismic events to inform disaster-risk-financing and loss-mitigation strategies for government agencies.

Hurricane, Storm Surge & Coastal Flood Risk

- Developed building-aware overland-flow and dynamic-collapse frameworks for hurricane storm surge, attributing structural damage to specific flow depths, velocities, and impact forces to improve damage prediction.
- Modeled hurricane overland flow and inland surge propagation using Delft3D and SFINCS for a NIST technical report on Hurricane Ian, characterizing how coastal flooding moves inland and loads buildings and infrastructure.
- Modeled hurricane storm surge and coastal flooding using Delft3D and SFINCS hydrodynamic (water-flow) simulations for a multi-community coastal resilience assessment; results quantified inundation depths, flood extents, velocities and forces over 50+ assets.
- Simulated shoreline change and extreme-event-induced erosion using Delft3D coupled morphodynamic (shoreline and seabed change) models to investigate drivers of sediment loss at a port facility; identified scour mechanisms that increased infrastructure vulnerability estimates, reshaping risk mitigation priorities.

Tsunami Hazard & Risk Assessment

- Designed high-resolution tsunami inundation (flooding) models using Delft3D and GeoClaw to characterize hazard intensity (flow depth, velocity, momentum flux — the force the flow exerts on structures), erosion, and sedimentation across Pacific Northwest port complexes and coastal cities; outputs enabled critical infrastructure exposure assessments and relocation decision-making.
- Developed a Bayesian source-inversion methodology to reconstruct paleotsunami sources, improving inputs for catastrophe and risk modeling.
- Developed a reduced-order Early-Warning system methodology for the Colombian Tsunami Authority – DIMAR, to improve the modeling of far-field tsunamis.

Climate Risk Assessment & Adaptation Planning

- Assessed how climate change shifts coastal flood frequency, storm intensity, and erosion through 2100 to inform forward-looking exposure and adaptation-investment decisions for portfolios of coastal assets.
- Led the Bogotá chapter of the Colombian Red Cross to accreditation as a Green Climate Fund partner, expanding access to international climate financing for adaptation projects.

Disaster Response, Emergency Management & Risk Communication

- Co-led international emergency response operations including deployment to the 2016 Pedernales, Ecuador earthquake (M7.8) integrating real-time risk assessment with resource allocation and crisis coordination.

- Directed multi-disciplinary disaster risk reduction programs and community resilience initiatives at the Colombian Red Cross overseeing teams of 15+ professionals and large-scale assessment projects across multiple regions.
- Translated complex multi-hazard modeling outputs into risk communication products, decision-relevant visualizations, and adaptation recommendations for diverse stakeholder audiences including port authorities, emergency managers, insurers, and community planners; increased stakeholder comprehension and buy-in for risk reduction investments.
- Designed and administered an IRB-approved stakeholder survey of Pacific Rim port authorities and operators to capture operational priorities and resilience needs, aligning hazard and infrastructure-vulnerability modeling with real-world decision-making across ports.

Additional Education & Training

ICS-700: National Incident Management System (NIMS), FEMA, Issued Feb 2025

ICS-200: Basic Incident Command System for Initial Response, FEMA, Issued Feb 2025

ICS-100: Introduction to the Incident Command System, FEMA, Issued Jan 2025

Research Grants

Towards a Multi-Hazard Coastal Solutions Sandbox: Integrating Physics-Based Modeling and Real-Time Visualization Using Game-Engine Technologies. **Gaulke Center for Marine Innovation and Technology Pilot Project.** *Oregon State University. $50,000. Jan 2026*

Multi-institution research on lifeline infrastructure resilience in the Pacific Northwest, focusing on integrated hazard and vulnerability assessment for critical systems. **Cascadia Lifelines Program (CLiP) Research Grant.** *Oregon State University. $68,000. Nov 2025*

Tsunami-Induced Scour and Its Role in Port Stability and Cascading Events across Oregon-Washington Ports. **NSF Cascadia CoPes Hub Pilot Project.** *Oregon State University. $41,000. Aug 2025*

Tsunami Morphodynamics and Their Role in Hazard, Risk and Resilience Modulation and Environmental Impact in Newport. **CRESCENT Seed Grant Program.** *Cascadia Region Earthquake Science Center. $30,000. Jun 2025*

Peer Reviews

Cambridge Prisms: Coastal Futures, reviewer

Scientific Reports, reviewer

Coastal Engineering Journal, reviewer

Journal of the Franklin Institute, reviewer

Springer Nature Computer Science, reviewer