2025 Coastal Flooding Technical Workshop
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Speaker Abstracts

Erfan Amini
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Co-Authors: Reza Marsooli, Philip Orton, Muhammad Hajj

A Street-Scale Model for Evaluating Compound Flooding in Hoboken-Jersey City under Climate Change Scenarios

Urban coastal regions face increasing threats from compound flooding driven by elevated sea levels and intensified rainfall, both of which are exacerbated by climate change. This study investigates these risks in the densely populated Hoboken-Jersey City area of New Jersey using the Super-Fast INundation of CoastS (SFINCS) model, a reduced-complexity hydrodynamic model. With a high spatial resolution of 1.5 meters, the model captures the detailed urban landscape, simulating flooding from combined storm tides and extreme rainfall. A spatially varied infiltration rate, based on the land cover maps, is applied as a calibration parameter to approximate the performance of surface and subsurface drainage systems without explicitly modeling underground stormwater infrastructure. The model is validated against data from post-tropical cyclone Ida, utilizing rainfall records, tide gauge observations, and crowdsourced flood reports and imagery. Validation results show the model's ability to accurately replicate flood extent, depth, and timing across the study area. To evaluate the effectiveness of current flood management measures, numerical experiments were conducted under future climate scenarios incorporating sea level rise projections and increased rainfall intensity. The findings reveal potential changes in flood dynamics, including extent, depth, and duration. These insights are critical for urban flood risk assessment and can guide the development of adaptive flood management strategies, enhancing resilience in vulnerable coastal communities.

Amanda Archer
Coastal Training Program Coordinator, Jacques Cousteau National Estuarine Research Reserve

Co-Author: Devon Haines, NJDEP

Coastal Flooding Community Engagement and Research via MyCoast: New Jersey

The MyCoast: New Jersey application allows people to collect local flood information and data through the power of community science. This web and app-based platform gives users tools to share photos and stories which help document impacts of flooding due to increased precipitation, storms, or high tides and changes to the environment over time. This use of personally provided visual science and storytelling pairs users' lived experiences with weather and tide data, adding the "where, when, and how often" communities are flooding. With over 1,300 users and 6,200 reports, each of the MyCoast NJ community science tools collect community-derived information aimed at improving state and local decision-making processes, providing content for outreach and education materials to local organizations, and supplying data to ground-truth flood model outputs. Community users state that My Coast NJ allows them to see changes to their environment over time and can be used to gain support for resilience efforts and funding requests. The New Jersey Coastal Management Program (NJCMP) and Rutgers University's Department of Marine and Coastal Sciences, and the Jacques Cousteau National Estuarine Research Reserve (JC NERR) have partnered for several years to provide MyCoast NJ to the state. This session will provide an overview of how practitioners and researchers can use MyCoast NJ as a community science learning experience in their own flood-related projects.

Raychel Bahnick
Water Engineer, Arcadis

Protecting the Financial District and Seaport Neighborhoods from Future Sea Level Rise and Storm Surge

"Protecting the Financial District and Seaport Neighborhoods from Future Sea Level Rise and Storm Surge" will present details of the hydrodynamic modeling approach taken for the FiDi and Seaport Climate Resilience Plan Project. The FiDi and Seaport Climate Resilience Plan Project is a comprehensive approach to combat tidal flooding and coastal storms in Lower Manhattan. The Plan aims to fortify the region against the impact of rising sea levels and storm surge to 2100.

The integration of climate resilience infrastructure plays a pivotal role in ensuring public waterfront access, development of resilient maritime facilities to support vital operations, including ferries and historic ships, and flood protection for future generations. This is large scale multi-disciplinary planning and engineering project that requires extensive computational modeling at every stage. The talk will discuss the advanced hydrodynamic modeling methods, and the tools utilized such as Delft3D, ADCIRC, and SWAN 2D for both wave and hydrodynamic modeling.

DanaRose Brown
Coastal Engineer, USACE NY District

Co-Authors: Karen Baumert; Reegan McCaulley

The Challenges of Managing Coastal Storm Risk in a Low-Lying Area Impacted by Frequent Flooding

The USACE New York District is currently undertaking the Spring Creek South (SCS), New York, Coastal Storm Risk Management Feasibility Study to manage coastal storm risk in the communities of Hamilton Beach, Howard Beach, Old Howard Beach, and Lindenwood on the northern shore of Jamaica Bay. This area has been studied extensively in the past by State, City, and Federal agencies; however, features from these studies have not been implemented. These communities are densely populated and low-lying, especially Hamilton Beach, which contains many structures located at or below +5 ft NAVD88. Considering future sea level change (SLC), the possibility of daily high tide flooding in this area exists under the USACE High SLC scenario by 2085. The study area is also highly vulnerable to low-frequency, high intensity storm events, with inundation expected to occur throughout the majority of the study area during a 2% (50-year) annual exceedance probability (AEP) event.

This presentation will discuss the considerations for managing flood risk in a low-lying area, including the challenges of designing structures to combat high water levels during low-frequency events in an area with limited availability of high ground tie-ins, and managing property accessibility for high-frequency events throughout the period of analysis. Tools and approaches to be discussed include water level mapping for various AEP events and SLC; the metrics to evaluate the feasibility of measures such as flood gates, flood walls, elevations, and buyouts to manage the risk of coastal flooding; and the implications of these defending, accommodating, and retreating strategies.

Nick Brown
Coastal Scientist, HDR

Coastal Adaptation: Strategic Realignment and Managed Retreat

New Jersey's coastal communities, like many in the United States, have pushed the limits of waterfront development. The coastal adaptation and protection toolbox is broad consisting of grey methods including shoreline stabilization using sheet piles or riprap and implementing flood water pumping stations, or nature-based solutions such as beach nourishment and marsh restoration. While these are often successful and, in many areas, can be long-term solutions, in areas that are too close to the water, other non-structural strategies may need applied. Coastal managers have historically been hesitant to use the strategies of strategic realignment, where carefully selected properties are removed and to allow for the preferred solutions to be implemented, or retreat, where large-scale community movement can occur, often without planned removal of structures to implement better protection strategies. This presentation will review the tools of strategic realignment and managed retreat, how they can be implemented into long-term planning to mitigate coastal flooding and examine case studies of where these methods have been and are being implemented.

Elissa Commins
Township Engineer, Township of Brick, and New Jersey Association of Floodplain Managers

Co-Author: Christopher Crane PE, CFM - NJAFM President

Navigating New Coastal Flood Regulations

NJDEP Inland Flood Protection Rules went into effect summer 2023, new Flood Disclosure Laws went into effect March 2024, and NJDEP's proposed coastal flood rules will be released summer 2024. All of these impact municipal governance, construction, development, and real estate values in municipalities across the State. We hope to provide some tools to help navigate the new regulations.

Doug Gaffney
Technical Director, AtkinsRealis

Lessons Learned Using CitySimulator to Evaluate Climate Vulnerabilities

Through a Resilient Florida Grant from the Florida DEP, AtkinsRéalis used our CitySimulator tool to evaluate vulnerabilities to climate influenced flooding in Clearwater, FL. Results are helping prioritize adaptation initiatives.

Communities and public agencies are often confronted with challenges in selecting and prioritizing competing projects due to limited resources and diverse stakeholder interests, along with the complexity of scientifically predicting which initiatives will yield equitable community benefits and effectively reduce the climate risks. Technology serves as a pivotal conduit between resilience planning and implementation strategies. Resilience planning aims to prepare communities for adverse events, such as coastal flooding, ensuring they can recover swiftly and efficiently. However, translating these plans into actionable strategies has historically faced numerous challenges, including data scarcity, stakeholder coordination, and financial planning. Platforms such as CitySimulator can disseminate vital information swiftly, identify and prioritize projects, and develop funding and implementation strategies. These platforms can also be extended to model disaster scenarios, enabling planners and communities to visualize potential impacts and rehearse response strategies, thus enhancing preparedness.

This presentation will provide strategies and a case study on how technology platforms are changing resilience planning and implementation by offering robust data analysis, fostering stakeholder collaboration, and enabling evaluation of pre- and post-disaster investment scenarios. By leveraging these technological tools, communities can transform resilience plans into practical, actionable strategies that enhance their ability to withstand and recover from adverse events.

Hazards considered included storm surge, sunny day tidal flooding, precipitation and heat waves. Assets considered included building stock, critical assets, and the road system. Key metrics included disrupted commute trips, storm damage, flood depths within buildings and overtopping roads. Adaptation and mitigation solutions includes elevating homes, buyout programs, seawall elevation, tree planting, and elevating roads.

Alireza Gharagozlou
Taylor Engineering

Co-authors: Chris Bender, Jeff Lillycrop, T. Chris Massey, Tahirih Lackey, Kevin Dugan, Travis Kuennen

WaterWorks OnDemand: Advancing Coastal Engineering and Hazard Analysis through Cloud-Based Workflows

Coastal regions are increasingly vulnerable to both short-term weather events, such as storms, and long-term hazards like sea level rise. Climate change continues to amplify the frequency and intensity of these events, creating a need for more advanced tools for prediction and analysis. Addressing these challenges requires the seamless integration of diverse datasets and computational models.

The WaterWorks OnDemand (WWOD) platform, developed as part of the U.S. Army Corps of Engineers (USACE) Model Modernization (Model Mod) initiative, is advancing coastal hazard modeling through cloud-based workflows. Model Mod, launched in 2022 under the Coastal and Hydraulics Laboratory's (CHL) Numerical Technology Modernization Strategy (NTMS), is a collaborative effort involving CHL, Woolpert, Taylor Engineering, and Jackson State University (JSU).

WWOD enhances coastal engineers' capabilities by streamlining model setup, optimizing computational resources, accelerating result generation, and enabling automated visualization. It also provides educational resources, fostering collaboration and knowledge-sharing among students and professionals. This presentation highlights WWOD's role in advancing coastal hazard analysis. Key topics include the integration of coastal models into the platform, workflows for data collection and model execution, post-processing tools, and case studies showcasing practical applications. Attendees will gain insight into how WWOD supports efficient project design, addresses knowledge gaps, and builds a framework for tackling coastal challenges in the face of climate change.

Chris Huch
Hazard Mitigation Specialist, Black & Veatch Corporation

Prevent Secondary Disasters: Substantial Damage Planning

Coastal areas are particularly prone to disaster events. Hurricanes and nor'easters can bring severe winds and flooding that result in widespread major damages. Municipalities that are members of the National Flood Insurance Program (NFIP) are required to enforce substantial damage requirements. This involves identifying structures that incur damages greater than 50% of their pre-event value and ensuring that during the rebuilding process, the structure is brought up to modern building code standards. However, when disaster strikes, chaos often follows. Municipal staff capabilities are stretched beyond their limits. While done with the best of intentions, the desire to get people back home quickly can sometimes leads to missing critical steps and overlooking standard procedures. However, when FEMA audits a community following a major disaster event, substantial damage violations are quickly uncovered. Recent hurricane events in Florida have made headlines months later as FEMA has found substantial damage violations. Homes were repaired without substantial damage inspections and are built back to their pre-event status, instead of higher modern standards that would keep them safe in the future. When this occurs, FEMA may be forced to revoke Community Rating System discounts, leading to dramatic increases in flood insurance costs for citizens, or remove the municipality from the NFIP entirely, leaving residents without flood insurance. Substantial Damage Response Plans provide an opportunity to set standard procedures to follow after disaster events, making sure NFIP standards are met, and preventing loss of flood insurance coverage.

Holly Josephs
PhD Student, Rutgers University

Co-authors: Avin Laali, Fahed Chickh-Alchabab

Enhancing Flood Damage Predictions Using NFIP and LIDAR Data: A Case Study Assessing HAZUS Accuracy During Hurricane Ida

Accurate building damage predictions are essential for flood risk management, policymaking, and disaster mitigation, yet obtaining datasets for validation remains a significant challenge. This study addresses this gap by proposing a methodology for leveraging localized National Flood Insurance Program (NFIP) data, HECRAS simulated floods, and first floor elevations extracted from LiDAR scans to evaluate and enhance the accuracy of damages predicted by HAZUS, FEMA's standard damage prediction tool. While HAZUS is widely used, its reliability is heavily influenced by the specificity and accuracy of input data, such as flood parameters and building characteristics. A Level 3 HAZUS analysis, which incorporates user-specified flood and building data, was conducted for Manville, NJ, during Hurricane Ida as a case study. The analysis predicted damages for 189 structures, which were then compared to actual damages reported by NFIP. Results revealed that HAZUS underpredicted damages by an average of 13 percentage points. Discrepancies stemmed from limitations in default depth-damage curves and challenges in fully localizing building-level attributes. This study demonstrates a novel methodology for integrating granular data into HAZUS to improve and evaluate prediction accuracy. By showcasing the potential of localized NFIP data and advanced modeling techniques, this work provides valuable insights for enhancing flood damage prediction tools and informing data-driven disaster preparedness and resilience strategies.

Shima Kasaei
PhD Candidate, Stevens Institute of Technology

Co-Authors: Philip Orton, David Ralston, John Warner, Thomas Wahl

Influence of rainfall on 100-year coastal floods in an urban environment

Severe coastal and pluvial flooding are both becoming more prevalent due to climate change and urbanization in coastal zones. The co-occurrence of these flood drivers is generally assumed to exacerbate the resulting flood impacts, a result referred to as compound flooding. However, few observational or modeling studies have investigated the circumstances under which this occurs. To improve flood risk management and infrastructure design, it is essential to understand the potential compound effects of extreme coastal storms. Existing FEMA and National Hurricane Center flood risk mapping in coastal flood zones neglects the potential compounding effects of pluvial and fluvial flood drivers. Here we evaluate the implicit hypothesis of FEMA flood maps, which is that rainfall has a negligible impact on a 100-year coastal flood in terms of the flood depth and flooded area. The Coupled Ocean-Atmosphere-Wave-Sediment Transport (COAWST) model is applied, a community model capable of capturing multiple storm-induced hazards including waves, erosion, wind, storm surge and rainfall. A scenario-based strategy is adopted starting from a 100-year coastal flood including wave effects, then integrating real rainfall data from historical tropical cyclones. Simulations for Jamaica Bay in New York City assess differences of the flood extent and depth to understand the influence of pluvial compounding. We also

evaluate the probability of these compound coastal-pluvial scenarios using historical data and copula modeling. Results show a moderate probability of an increase in the flooded area due to the pluvial driver which may influence emergency management strategies, such as evacuation plans, shelter arrangements, and related preparedness measures.

Benjamin Komita
Coastal Engineer, HDR

Utilizing drone photogrammetry to simply visualize coastal flood risk

Coastal flood risk management relies heavily on accurate elevation data to predict flood extents and inform mitigation strategies. This presentation explores the use of drone photogrammetry and aerial elevation data as a powerful tool for visualizing and assessing coastal flood risks. By utilizing drones equipped with advanced photogrammetric cameras, we can create precise 3D point-cloud models that detail variations in coastal elevation, including critical features such as shorelines, floodplains, topography, and infrastructure. These models enable a more accurate understanding of how rising sea levels and storm surges will interact with the landscape, revealing areas of vulnerability. The ability to quickly collect and process elevation data allows for simple yet detailed visualizations of accurate site-specific flooding scenarios under different conditions. We will highlight how drone-derived elevation data can be utilized by coastal stakeholders to evaluate existing site conditions, inform repairs, and guide future flood resiliency upgrades; this approach provides decision-makers with a cost-effective, scalable, and highly precise method for assessing flood risk. Through this innovative technology, we can improve flood resilience and better protect coastal communities from the escalating threat of climate-related flooding.

Laura Lemke-Verderame
Assistant Vice President, Catastrophe Risk Management, Guy Carpenter

Co-Authors: Pelayo Menendez, Roberto Guidotti, Dag Lohmann, Michael W. Beck, Guillermo Franco

Reduction in Insurance Premiums Attributable to Nature-Based Solutions

Coastal risks have increased due to sea level rise, more frequent and intense storms, and new urban development. As part of their risk management plan, communities may consider solutions that target mitigating risk (e.g. infrastructure), as well as those that target transferring risk (e.g. insurance). Any risk mitigation efforts should have an impact on risk transfer, affecting how much coverage to purchase and the associated cost. There is growing interest from the insurance industry to support the restoration and maintenance of natural defenses (e.g. beach/dunes, wetlands, coral reefs, mangroves) which decrease event losses while providing other ecological benefits. It is difficult to assess, however, the impact that natural defenses have on insurance premiums due to limitations in the risk models commonly used by the industry. This work aims to address this obstacle using complementary data sets and modeling results from nature-related studies in order to quantify potential premium savings, starting first with an example in the Philippines, a country invested in preserving its mangrove forests that act as a natural barrier to waves and storm surge during tropical cyclones. We design and price parametric insurance mechanisms considering both the presence and loss of mangroves, and we identify both the geographic scale and target insurance layers for which the greatest reduction in premiums is achieved. We expect that the explicit evaluation of premium savings, such as that performed in this study, will provide further encouragement for conservation and motivate similar investigations in other geographies.

Owen MacNeill
Senior Account Executive, ForeRunner

Flooding Tools for More Effective Decision-Making

Effectively managing data, processes, and documentation is critical for successful floodplain management, leading to better compliance and a safer community. However, prioritizing this can be challenging due to the complexity of flood risk information and competing tasks faced by floodplain managers. Compounding this is the increasing complexity of maps, shifts in insurance, and residents seeking more detailed information about individual properties. It can be difficult to manage nuanced data and even harder to keep track of it for internal recordkeeping and programs like the CRS.

Using a case study of Forerunner's work with Manasquan, New Jersey, this session will outline how the community uses technology to streamline floodplain management. We'll discuss how software like Forerunner can help communities pull together disparate maps, datasets and documentation, and mobilize information for a variety of different use cases for community stakeholders. We'll explore how using digital workflows can ensure faster response time to resident requests, better compliance enforcement, and stronger data continuity. The presentation will also include suggestions on how other communities might be able to leverage data to strengthen their floodplain management programs.

Sara Margolis and Mat Mampara
Senior Planner/Project Manager, Dewberry

Bringing Resilience into Business as Usual at the New Jersey Turnpike Authority

Severe weather events' growing frequency and severity demand that transportation agencies and asset owners' approach to infrastructure evolve. ""Maintaining a state of good repair"" has expanded beyond maintenance to include preparing and adapting systems to withstand climate change and disruptive events like flooding. Transportation agencies must integrate climate and future conditions into their operations, project delivery, and asset management to support safe, reliable, and efficient networks.

The New Jersey Turnpike Authority (Authority) has systematically started targeted efforts to integrate resilience into operations. Implementing resilience thinking into a transportation agency necessitates strategic, holistic and analytical strategies. We'll unpack the use of tools and processes to support decision-making, like the flood exposure visualization tool, vulnerability assessments, and the development of standard operating procedures (SOPs) to allow Authority staff and design consultants to integrate resilience considerations as part of any project.

While exposure highlights whether an asset or system is in an area experiencing the direct effects of climate hazards, vulnerability is the degree to which an asset or system is susceptible to, or unable to cope with adverse effects of climate change or extreme weather events, based on exposure and sensitivity to climate and weather effects, and adaptive capacity. Understanding and addressing both elements are crucial for infrastructure owners to develop effective flood risk management strategies, enhance resilience, and minimize potential damages and disruptions. By integrating vulnerability assessments with exposure analyses, infrastructure owners can prioritize interventions, allocate resources more effectively, and implement adaptive measures to mitigate flood risks comprehensively.

Alison Miskiman
Resilience Planning Lead, Black & Veatch

Charleston's Integrated Water Plan - Creating Space for Equity

As coastal communities continue to face combination flooding with sea level rise at the helm, the City of Charleston is working to create a blueprint to resiliency. Encompassing the historic Downtown Peninsula, as well as surrounding islands and inlands, Charleston is in a unique position to demonstrate this comprehensive approach. Through adaptive water management, coastal and civil engineering, nature-based design, and community planning fields, the City is working to realize its vision of living with water.

By fostering fluency and building capacity in equity and adaptation planning, communities can better anticipate and address the diverse challenges posed by climate change, ultimately enhancing their resilience and ability to thrive, now and in the future. The team created space in the planning process to focus on equity by bringing together a dedicated Equity Working Group. The work group elevated equity topics to the forefront and included equity as a key factor driving investment through project scoring and selection criteria. To date, several projects are moving from the planning phase to implementation. The Water Plan continues to provide a guiding vision on how the City embraces water, transforms threats to assets, preserves the City's character, and addresses equity and long-standing environmental injustices.

Norah Morton
High School Researcher

Evaluation of the Performance of Breakwater Designs at a Coastal Marsh Shoreline Using a Smartphone-Based Wave Intensity Sensor (WILSON)

Coastal wetlands, vital for wildlife habitat and natural flood defense, are critically threatened by sea level rise and eroding damage from wakes and waves created by recreational boating. Scientists, engineers, and coastal communities have partnered to test various "living shoreline" structures intended to reduce wave impacts on marsh. Comparing the efficacy of various breakwaters in reducing wave heights, I created a novel cost-effective wave action device, the **W**ave **I**ntensity **L**ogging **S**ensor **O**f **N**ora or "WILSON" and deployed it to compare three breakwaters protecting adjacent areas of the Intracoastal Waterway in New Jersey: Breakwater 1 (interlocking concrete blocks), Breakwater 2 (triangular concrete structures), and Breakwater 3 (geosynthetic tubes). The WILSON included an anchor, a float, and an iPhone operating SensorLog acceleration data collection. In 2024, I collected data from four units simultaneously, monitored boat and wave activity by a camera, and compared open water to individual breakwaters. Mean isolated-wave heights were reduced 57% by Breakwater 1, 21% by Breakwater 2, and only 11% by Breakwater 3, ($p<.001$) Breakwaters ⅔ insignificant from open water. In 1 hour intervals of ambient waves, Breakwater 1 reduced wave height 84%, Breakwater 2 reduced wave height 70%, Breakwater 3 51% (not significant) and waves were reduced 21% across Open Water (no breakwater) ($p \approx 0.001$). This constructed a reproducible method to collect wave data in a cost-effective manner accessible to students, teachers, or researchers. These studies can help inform coastal resilience infrastructure decisions and contribute to protection of both natural habitats and adjacent coastal communities.

Ambika Nair
Community Development Analyst, Federal Reserve Bank of New York

Co-Author: Claire Kramer-Mills

Flood Risk and Basement Housing in New York City: The Impact of Extreme Weather on Vulnerable Housing Stock

Hurricane Ida, which struck New York in early September 2021, exposed the region's vulnerability to extreme rainfall and inland flooding. Most acutely, it was responsible for the deaths of eleven people in their basement homes, highlighting specific risks to inhabitants of low-lying units in the face of extreme weather. The intersection of natural hazards, severe housing shortages, and public safety raises the importance of identifying which neighborhoods contain the highest shares of flood-prone basement dwellings.

This research brief measures the significance of the basement housing stock in New York City, particularly for low-income and immigrant populations. It examines the flood exposure of basements using climate risk data from the Federal Emergency Management Agency and First Street Foundation that incorporate flood risk from coastal, river-driven (fluvial), and rainfall-driven (pluvial) flooding. The brief focuses on the basement structures that are most likely to be in residential buildings, using the New York City Primary Land Use Tax Lot Output Database. The method for identifying basement housing adopts and modifies a data filtering process from Citizens' Housing and Planning Council and divide basements into flood-prone and viable categories.

The analysis finds that basements in select census tracts are at high risk of flooding, affecting an estimated ten percent of low-income and immigrant New Yorkers. However, estimates of the census tracts with highly flood-prone versus less flood-prone basement housing stock indicate that nearby and neighboring affordable and less-storm vulnerable neighborhoods could be future sites of safe dwellings.

Lynn Needle
Founder/Artistic Director and Adjunct Faculty Modern Dance/Improvisation, Art of Motion Dance Theatre, AOMDT.org and Bergen Community College

Co-authors: The cast of artists includes musicians, dancers, live mermaid and surfers

The POSEIDON PROJECT: An Aquatic Myth

The Poseidon Project: An Aquatic Myth conceived by Lynn Needle was the recipient of a Coastal Art Project Grant from NOAA, NJDEP, NJCMP, NJSCA and Monmouth Arts to draw attention to Coastal Hazards and Fragility. TPP was born as a passion project having lost her family home to Hurricane Sandy. The immersive, multi-media one act featured 3D upcycled installations by Thai artist Poramit Thantapalit, live music featuring piano, by Steinway pianist, Carolyn Enger, percussion by Teddy Gibbons and violin by Francesco Osto. Eight mythical hybrid dance sections featuring Poseidon, Sea Gods and Goddesses and local surfers who led a procession to the sea with a live mermaid were performed by AOMDT in a site specific amphitheater and later at Gallery Bergen at Bergen Community College and Connecticut College in New London, CT. The live music and dance immersive event educated audiences on coastal hazards through the performing arts.

Lukasz Niemoczynski
Hydrologist, USGS

Co-Authors: Thomas Suro, Michal Niemoczynski, Anna Boetsma

Moderate Flood Level Scenarios: Synthetic Storm-Driven Flood-Inundation Maps for Coastal Communities in 10 New Jersey Counties

The U.S. Geological Survey (USGS), in cooperation with the New Jersey Department of Environmental Protection (NJDEP) and the New Jersey Office of Emergency Management (NJOEM), created digital flood-inundation maps for 10 coastal counties. The maps depict extent and depth estimates of coastal flooding corresponding to selected tidal elevations recorded by 25 real-time USGS tide gages located within the study area. The flood-inundation maps can be accessed through the USGS Interagency Flood Risk Management (InFRM) Flood Decision Support Toolbox (FDST).

Previously published modeled data were utilized from the coupled ADCIRC-SWAN model. Simulated tropical storm events were selected based on parameters including landfall location or closest approach location, maximum wind speed, central pressure, and radii of winds. Two storm events were selected per tide gage providing two "scenarios" and accompanying inundation-map libraries for each gage.

The availability of these maps to visualize potential inundation for selected water levels along with real-time water level data available online from USGS tide gages, coastal impact statements, and forecasted tide elevations from the National Weather Service (NWS) will provide emergency management personnel and residents with a link between numeric and text warning information and images of estimated inundation extents in their community. User selected display of inundation allows early response activities to NWS forecasted water level elevations or mitigation planning such as building elevations, early traffic pattern changes because of neighborhood building inundation levels, improved understanding about when major road access is affected, as well as for post-flood recovery efforts.

Philip Orton
Research Associate Professor, Stevens Institute of Technology

Co-Authors: Ziyu Chen, Nickitas Georgas, Mahmoud Ayyad, Laura Kerr, Jessica Kuonen, Hannah Burnett, Muhammad Hajj

The Stevens Flood Advisory System: User Applications and Forecast Assessment

Ensemble forecasts are increasingly relied on due to the utility of probabilistic measures for emergency preparation and response. The Stevens Flood Advisory System (SFAS) is an ensemble coastal water level forecast system forced by an ensemble of global atmospheric forecasts. The website for SFAS provides time series of central forecast water levels and 5th and 95th percentiles to represent uncertainty. We surveyed users of SFAS and assessed two years of forecasts for the Mid-Atlantic/New York Bight region. The survey with 301 responses revealed that common response activities by government and residential users included closing flood gates or storm surge barriers, moving cars to higher elevation, closing roads, preparing facilities to accommodate floodwaters, and triggering emergency management activities.

The accuracy of the central forecast and the spread of the uncertainty estimates for the full SFAS ensemble were compared to results of NOAA's probabilistic forecast system, Probabilistic Extratropical Storm Surge (P-ETSS). Assessing the probabilistic forecast spread, about 80-90% of the time, observed water levels are within the spread (5th-to-95th percentile), whereas P-ETSS forecasts have a far lower value. A low bias is identified in SFAS and P-ETSS central forecasts during surge/blowout events and shown to be related to bias in wind forecasts. This could be partially due to the resolution-dependent bias of coarse-resolution met forcing. A new mini-ensemble of high-resolution and control members is shown to improve the central forecasts and it is proposed for future use while utilizing the full ensemble spread for uncertainty.

Dan Rizza
Project Manager, Climate Central

Climate Central's Tools for Assessing, Communicating, and Responding to Sea Level Rise and Coastal Flood Risk

With the sea projected to rise 1.4 feet above 2000 levels by 2050 (STAP 2019) and dramatically increase flood risks to New Jersey's 7 million coastal residents (NOAA 2024), it is more imperative than ever that coastal stakeholders have the resources they need to analyze, communicate, and adapt to the risks posed by sea level rise and coastal flooding.

For the past decade, Climate Central has provided publicly available online tools, maps, reports, and visualizations, grounded in peer-reviewed research and informed by the needs of coastal stakeholders. These resources have been shared by the news media tens of thousands of times, used by over ten million people, and featured at the UN climate conference.

Coastal Risk Finder is a forthcoming interactive web tool that allows users to customize their sea level rise and coastal flood scenario, learn who and what is at risk, and share localized maps, statistics, and graphics. The tool also provides resources for adapting to coastal flood risks and curated lists of coastal resilience efforts in each state.

Additionally, Climate Central's cutting-edge FloodVision technology can capture video, elevation, and spatial data with vehicle-mounted sensors to produce entry-floor elevation data and photorealistic visualizations of flooding for any location the FloodRover vehicle can drive by. These visualizations are powerful tools for communication.

This presentation will demo Climate Central's latest tools, provide examples of how coastal stakeholders use them, and seek feedback from the audience to inform the continuous improvement of our tools.

Hugh Roarty
Research Project Manager, Rutgers University

Co-Author: Tim Stolarz

Impact of Surface Current Measurements on NY Harbor Water Levels

Coastal flooding in urban areas such as New York Harbor poses significant risks to infrastructure, ecosystems, and human populations. Accurate predictions of flooding events are crucial for effective mitigation and response strategies. High-Frequency (HF) radar systems have been operating in NY harbor for the past two decades and provide surface currents in real time, offer a valuable tool for improving coastal flood forecasting. By providing continuous and spatially extensive data on ocean surface currents, HF radar systems enhance our understanding of how wind, tides, and storm surges interact to influence water levels.

In New York Harbor, integrating HF radar-derived surface current data into hydrodynamic models improves their accuracy by capturing the complex circulation patterns of the estuarine and nearshore environment. These systems enable better resolution of eddies, outflows, and water mass movement that contribute to localized flooding. During extreme weather events such as hurricanes or nor'easters, real-time HF radar data allow for rapid assessment of conditions, enhancing storm surge predictions and emergency planning efforts.

Additionally, HF radar data support long-term analyses of sea-level rise and its impact on flood risk, informing adaptation strategies. Studies in New York Harbor demonstrate the potential of HF radar to complement traditional monitoring systems, providing a high-resolution understanding of water dynamics that informs coastal resilience initiatives. As climate change amplifies flood risks, leveraging HF radar technology is essential for proactive and adaptive management of vulnerable coastal areas like New York Harbor.

Michael Spina
Senior Landscape Architect, HDR

Co-Author: Barbara Barnes, PLA

Fireplace Neck: Tidal Wetland Hydrologic Connectivity Improvements

Fireplace Neck appears to be a well-established functioning marsh system in the Town of Brookhaven, NY. The approximately 108 acre New York State Department of Environmental Conservation property is dominated by low marsh habitat. However, forty years ago, this same complex was primarily high marsh. Fireplace Neck is a grid ditched marsh exhibiting water logging, changes in marsh vegetation over time, and an increase of invasive species cover. It is showing signs of habitat degradation as high marsh transitions to low marsh and eventually to mudflat and open water. Over the last 100 years substantial changes to site hydrology occurred through the implementation of extensive ditching, to support salt hay farming and later mosquito control. These interventions, exacerbated by other influences like sea-level rise and modified sediment sources, has altered site hydrology and vegetation patterns resulting in slowly degrading marsh function.

While many restoration projects complete extensive site re-grading, importation of fill material to raise grades, and replanting, the goal of this project was to identify smaller scale restoration techniques that could be implemented to limit further degradation and encourage tidal hydrology. Increasing circulation reduces the high salinity levels and low dissolved oxygen levels seen in mudflat areas, allowing for revegetation of these areas. This work was accomplished by widening existing tidal channels, removing vegetation growth from primary ditches, installing runnels, and adding and removing ditch plugs to better size the drainage area to the widened channels. Work was completed in 2023 and early monitoring showed positive results.

Isabelle Stinnette
Senior Scientist for Ecological Restoration, NY-NJ Harbor & Estuary Program; Hudson River Foundation

Aquatic Connectivity through Climate-Ready Infrastructure

The New York – New Jersey Harbor and Estuary Program's (HEP) project, addresses two of our region's pressing issues: habitat loss and flooding. For five years, HEP has worked to find and assess poorly performing bridges and culverts in coastal New Jersey. Communities are exposed to flood risks due to undersized stream crossing transportation infrastructure. Flood risk can be reduced if local decision-makers are informed of current infrastructure conditions to proactively plan and implement restoration strategies on the highest priority structures. In many cases, towns do not have the resources to complete a thorough inventory and hydraulic capacity assessment of their existing infrastructure. Often, replacement of a damaged culvert ends up being executed because of a failure during an emergency. At times these emergency projects result in the replacement of a culvert with the same undersized or incompatible structure. Further, with the precipitation increases that we are experiencing with climate change, structures that were once adequate are no longer able to handle flows. HEP's project identifies at-risk infrastructure using a model developed by the Cornell Water Resources Institute, and prioritizes structure upgrades with more appropriate infrastructure that also increases habitat value for fish and other aquatic life.

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BICC Site Sediment Cover System in the Hudson River Coastal Flood Plain

The Former BICC Cables Site resides along the Hudson River in Yonkers, New York. The Site was used to manufacture lead-jacketed cables and historical operations resulted in remaining poly-chlorinated biphenyl (PCB) sediment contamination. A Sediment Cover System (SCS) was selected as the required remedial technology to address the remaining PCB-impacted sediments after unsuccessful dredge attempts using multiple techniques. This sediment remediation was required to protect natural resources from contamination and flood risk. The NYSDEC and the USEPA approved the SCS after the RP demonstrated that dredging was not technologically or economically feasible. The SCS was designed, permitted, and constructed based on the super storm Sandy coastal flood elevation observations. The SCS, a robust engineering control (EC), withstands the velocities, wave energies, and tidal flooding events. A hydraulic model was developed to study SCS armoring technologies to protect the EC and comply with regulatory requirements.

The installed 24,500 square foot Multi-Layer SCS provides active treatment and containment of the sediments. EC hydrographic mapping and hydraulic modeling efforts were performed to develop a constructible and viable solution.

A state-of-the-art EC Remote Sensing System was installed on the SCS for routine, precise measurements of the EC. Each routine data set is compared to previous sets to identify variances which may indicate excessive settlement or a potential integrity breach. PS&S performed successful EC monitoring and reporting events annually since 2017. These routine monitoring events documented that the EC is stable and remains protective of human health and the environment.

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Using Numerical Modeling to Assess the Contribution of Shelf Seiches to Coastal Flooding Along the U.S. East Coast

Coastal flooding can cause substantial damage to densely populated coastal areas, critical transportation networks, and other essential infrastructure. Severe coastal flooding often occurs due to a primary storm surge, which gets the worst when the surge coincides with high tide. However, not only the primary storm surge but also a "resurgence" of water levels has caused severe coastal flooding when combined with high tides. These rapid fluctuations in water levels can occur hours or even days after storms have passed and the winds have subsided, which leads to subjectivity and failure to take precautions against flood warnings. Our data analysis results indicate that the New York Harbor (NYH) region is one location of significant historical resurgence events. Following a storm with strong onshore winds, an abrupt relaxation or change in wind direction can cause the storm surge to be released from the coast as a free wave. This free wave then oscillates across the shelf, forming a standing wave. In this study, we evaluate the potential for seiches and enhanced water levels along U.S. East Coasts in response to wind events from various directions. Using the Regional Ocean Modeling System (ROMS), we conducted idealized wind experiments to investigate the spatially varying resonant behavior and the role of shelf and coastal geometry in trapping energy from shelf seiches. This research will support coastal management and protection and based on that, develop policies and plans to reduce risks, minimize damage, and enhance preparedness.

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Dredging with Nature: The Strategic Sediment Pulse Hydrodynamic Dredging Approach to Marsh Nourishment Applied to Tidal Flood Control Channels

Four of the five most flood-prone counties in the United States are in New Jersey: Atlantic, Bergen, Cape May, and Ocean. These counties are particularly vulnerable due to their geographical locations and proximity to waterways. Similarly, the San Francisco Bay area faces high dredging costs and stringent permitting restrictions, which hinder local flood agencies from maintaining necessary flood protection levels.

To address these challenges, Marin County Flood Control, in collaboration with the USACE San Francisco District, has proposed an innovative dredging approach. This method uses advanced hydrodynamic dredging technology to mobilize sediments during periods of increased wave and tidal energy, facilitating sediment transport into the bay and enhancing ecological benefits. This approach is more cost-effective and environmentally friendly, reducing greenhouse gas emissions.

The proposed approach leverages advanced hydrodynamic dredging technology from Europe and the East Coast to mobilize sediments during periods of increased wave and tidal energy events. This method facilitates the transport of sediments into the bay, where recent geomorphic studies have indicated a higher likelihood of marsh nourishment. Unlike traditional dredging, this approach ensures that the vast majority of the sediments are retained within the overall Bay system, enhancing ecological benefits.

This innovative methodology could also be applied in many areas of New Jersey to help maintain flood control channels more effectively and affordably, ensuring better flood protection for the vulnerable counties.

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Flood Mitigation in Seaside Heights

The New Jersey coastline is experiencing impacts of sea level rise (SLR) at rates that surpass the global average, resulting in increasingly frequent 'sunny day' flooding, and exacerbated impacts from rain fall events and storm surge. In particular, a waterfront neighborhood located in Seaside Heights, Ocean County, is experiencing regular flooding that inundates the street and becomes trapped due to the local topography. The neighborhood is on the Inward Thorofare, north of Rt. 37 and east of Harbor Island in Barnegat Bay. ACT Engineers was contracted by the township to conduct a study of the area and chart a course for resiliency of the neighborhood. The lowest spot elevation in is approximately 1.3ft NAVD-88; the water level at high tide regularly surpasses this elevation. When rainfall and runoff pool in the street, regardless of overtopping of the bulkhead, the current gravity-based drainage system is unable to release the flood water to the bay.

In order to design an effective flood mitigation system, the first steps included collecting detailed topo-bathy data and gathering information on typical tides, rainfall, and reported flooding. This information was utilized as a base for hydrographic modeling and stormwater calculations. These models indicate the behavior of runoff and are used to determine necessary specifications for the mitigation plans to upgrade the drainage, including alterations to the bulkheads, constructing a pump station, and adding check valves on outflows. The project goal is to design effective mitigation, without over-engineering, so that the aesthetics of the coastal neighborhood are preserved.
