NCCOS NATIONAL CENTERS FOR COASTAL OCEAN SCIENCE

NOAA'S NATIONAL CENTERS FOR COASTAL OCEAN SCIENCE FY23 EFFECTS OF SEA LEVEL RISE (ESLR) PROGRAM AWARDS AND COASTAL RESILIENCE FUNDING

Multi-objective assessment of flood adaptation options in LA County

Institutions: University of California, Irvine, University of Miami
Project Period: September 2023 - August 2025
Location: California
FY23 Funding: $499,999

Project Summary: Climate change is intensifying flood risks in Los Angeles County, CA with unequal impacts across socioeconomic and racial demographics. LA County is home to 10 million people and a $712 billion per year economy that faces flood risks 20 times greater than suggested by federally defined floodplains. This risk disproportionately impacts Black, Hispanic, and disadvantaged communities. There is a need for transformative flood infrastructure that simultaneously reduces flood risk, captures more stormwater, builds climate resilience across the region, and advances equity. This project will evaluate the social, economic, and environmental benefits, costs, and tradeoffs of different nature-based solutions approaches to manage flood risk at a high resolution that can inform project specific decision making. Management approaches will be framed in terms of how benefits are geographically distributed to underserved communities, empowering more equitable flood risk management in LA County. Learn more.

Promoting innovative transformational coastal adaptation in collaboration with underserved communities

Institutions: George Mason University, The Nature Conservancy, Resources for the Future, Maryland Department of Natural Resources
Project Period: September 2023 - August 2025
Location: Maryland
FY23 Funding: $499,993

Project Summary: The Chesapeake Bay region has one of the highest rates of relative sea level rise in the U.S. Nature based solutions can have a mitigating effect on local sea level rise impacts, but barriers to implementation exist, including performance uncertainty, policy and permitting challenges, and funding structures that favor traditional infrastructure. This project will combine existing model frameworks with a cost-benefit and ecosystem services analysis to evaluate different land management actions, flood mitigation designs, and policy options under climate scenarios. Researchers will work closely with local stakeholders to: 1) facilitate informed decision-making at the community level, 2) communicate complicated modeling concepts in digestible formats, 3) generate project concepts that meaningfully incorporate community resilience goals, and 4) align community goals with government flood adaptation planning. The team will provide capacity to communities applying for restoration and flood mitigation project funding, including providing technical analysis of the effectiveness of multiple coastal management actions over short- and long-term planning horizons. Learn more.

A cost-benefit analysis of green-gray infrastructure for sea-level rise adaptation in the Pacific Northwest, incorporating externalities and ecosystem co-benefits

Institutions: Oregon State University, Pacific Northwest National Laboratory
Project Period: September 2023 - August 2025
Location: Washington, Oregon
FY23 Funding: $500,000

Project Summary: Coastal communities have typically responded to sea level rise and flood hazards through construction of gray infrastructure such as levees and seawalls, which often have negative consequences, such as decreased environmental quality and enhanced flood risk in other regions. Green infrastructure is an increasingly popular alternative because it can also provide ecosystem co-benefits such as carbon sequestration and increased fish habitat, but it may also be costly. This project addresses the tradeoffs between gray and green infrastructure approaches for flood risk reduction by applying a cost-benefit analysis framework to two estuaries in the Pacific Northwest (Coos Bay, Oregon and Grays River, Washington), which represent a range of fluvial to coastal flood risks. To evaluate the spectrum of gray to green options, the team will use previously calibrated hydrodynamic flood models in both estuaries. They will couple flood models with FEMA's HAZUS-MH software to quantify estimated flood losses for both green and gray infrastructure options across multiple sea level rise and coastal storm scenarios. By understanding the relative costs and benefits of different

flood reduction strategies, coastal communities can more easily incorporate and prioritize alternative management scenarios, like green infrastructure, into broader decision-making processes. Project outputs will include actionable information that communities can use when applying for funding for coastal resilience projects (e.g. inundation maps, cost-benefit analysis, and ecosystem service evaluation for a range of green-to-gray infrastructure). Learn more.

Understanding the impact of sea-level rise on coral reef and mangrove interactions and the resulting coastal flooding hazards to inform nature-based features**

Institutions: USGS, University of California Santa Cruz
Project Period: September 2023 - August 2025
Location: U.S. Virgin Islands
FY23 Funding: $324,767

Project Summary: The tropics are dominated by thousands of coral reef-lined islands with shoreline mangrove forests, and they are expected to experience disproportionately greater sea level rise impacts in the future. Coral reefs and mangroves together provide an effective first line of defense against sea level rise and the increased flooding and wave risk brought on by rising water. However, there is limited understanding of how these two ecosystems may co-evolve with sea level rise, and what this will mean for the coastal protection they provide. This project uses existing models to assess the vulnerability and potential nature-based solutions (NBS) approaches for two locations in the U.S. Virgin Islands (USVI). Researchers will model flooding hazards under a range of sea level rise scenarios and NBS approaches across the green-to-gray-infrastructure spectrum. The flooding characteristics from the simulations with coral reef and mangrove NBS will be compared to simulations with only traditional flood mitigation features, like seawalls, to understand NBS performance in flood mitigation. Coastal managers and communities can use this information to inform the design of current and future management decisions, and support applications to programs that fund resilience project implementation. This approach will be transferable and applicable to many tropical coral reef-lined islands and locations in the USVI. Learn more.

Informing Coastal Adaptation and Management through the Coastal Dynamics of Sea Level Rise (iCAM-CDSLR)**

Institutions: University of Georgia, USGS, Embry-Riddle Aeronautical University
Project Period: September 2023 - August 2025
Location: Florida, Alabama, Mississippi, Louisiana, Texas
FY23 Funding: $500,000

Project Summary: Gulf coast resource managers and decision-makers are increasingly exploring how to improve community resilience in the face of extreme storms and sea level rise, particularly with nature-based infrastructure. This project will evaluate flood hazard mitigation and the socioeconomic and ecological benefits of flood mitigation projects for present and future climate change conditions. With direct support from local stakeholders, existing models will be combined with traditional and contemporary approaches in natural resource economics to evaluate mitigation project outcomes regarding efficiency, equity, environmental sustainability, and socio-economic resiliency. Outputs will be tailored based on community needs. Learn more.

Coastal resilience through actionable science: Evaluation of adaptation strategies to mitigate surface-subsurface flooding in coastal communities**

Institutions: University of Texas at Arlington, University of Arkansas
Project Period: September 2023 - August 2025
Location: California
FY23 Funding: $499,973

Project Summary: Coastal flooding associated with sea level rise and more intense storm events poses a serious risk to California communities and the infrastructure upon which they rely. As communities and other coastal stakeholders nationwide engage in adaptation planning to mitigate the impacts of flooding, developing site-specific modeling is critical for evaluating the efficacy of proposed projects and policies to improve outcomes for residents and the built and natural environments. This project will implement a mature, coupled groundwater-surface water modeling system to evaluate the performance of proposed shoreline adaptation actions and to inform the design and implementation of flood mitigation strategies that enhance coastal resilience. Researchers will test nature-based, conventional, and hybrid mitigation strategies across a range of sea level rise and storm scenarios. Given the high resolution and

broad coverage of the models, they can be applied within a single community or across a planning corridor to capture interactions between multiple standalone or phased projects along neighboring or proximate shorelines. This will allow for the assessment of the cumulative impacts of proposed projects on regional flood exposure. Project outputs will provide coastal managers and other partners with locally relevant guidance on the hydrologic, socioeconomic, and ecological implications of sea level rise and the degree to which proposed management solutions achieve priorities related to resiliency and equity. Outputs will be co-developed with community partners to support applications for federal funding to design and implement flood mitigation or restoration activities. Learn more.

Using ESLR funded datasets and tools to evaluate alternative backshore management options along US Pacific Northwest Coastlines**

Institutions: Oregon State University
Project Period: September 2023 - August 2025
Location: Washington, Oregon
FY23 Funding: $500,000

Project Summary: In the Pacific Northwest, nature-based solutions (NBS), such as those provided by beaches and dunes, provide ecosystem services that help mitigate the effects of sea level rise and extreme storms. There is interest in managing backshore land use to optimize coastal protection while considering other ecosystem services. However, given the enormous alongshore variability along the Pacific Northwest coast, the ecosystem service tradeoffs of backshore environments are complex and multifaceted. Coastal managers need comprehensive assessments of the tradeoffs of different management options to make informed, effective decisions. This project will assess the biophysical and economic values of a variety of backshore management options, including vegetated foredunes, habitat restoration areas, graded foredunes, dynamic cobble revetments, and shoreline armoring, in Clatsop and Tillamook counties, Oregon. This will help towns, state parks, and other public and private landowners understand the conditions that maximize protection and other ecosystem services under different backshore management options. Results will support community efforts to produce updated beach and dune management plans, and inform applications for resilience project implementation funds. Learn more.

Quantification and optimization of Nature-based solutions for mitigating coastal vulnerability and risk**

Institutions: University of Rhode Island, Penn State University
Project Period: September 2023 - August 2025
Location: Rhode Island
FY23 Funding: $360,425

Project Summary: Coastal communities are facing increasing flood risk and erosion from nor'easters, hurricanes, and sea level rise. In Charlestown, Rhode Island, long term cultural, economic, and environmental resilience depends on coastal beach-barrier-lagoon systems that help protect communities from flooding while supporting vibrant ecosystems. Maintaining the protective and ecological functions of these beach-barrier-lagoon systems under sea level rise, while preserving other local ecosystem services (e.g. tourism, boating, aquaculture), is a challenge. This project will assess and optimize the short- and long-term performance of different nature-based solutions (NBS) in reducing the coastal vulnerability while preserving key ecosystem functions and services necessary for nearby communities. NBS along the gray-to-green-solution spectrum will be simulated using a suite of numerical models and performance will be evaluated according to relevant hazard and vulnerability metrics. Results will help local decision makers and communities decide which management actions to prioritize to enhance coastal resilience, and can be used to support funding applications for flood mitigation or restoration activities. Learn more.

CIROH: Defining nationally consistent coastal flood severity thresholds

Institutions: University of Alabama
Location: Nationwide
FY23 Funding: $177,642

Project Summary: The exposure to coastal flooding is increasing due to sea level rise, population growth, and the ever-increasing land intensification in the low-lying coastal regions. A monitoring system that helps planners and managers understand the spatio-temporal patterns of flooding to design flood mitigation plans is essential. NOAA's National Weather Service (NWS) has minor, moderate and major flood height severity thresholds established for dozens of NOAA tide gauges along the U.S. coastline. Despite the importance of flooding thresholds in spatio-temporal monitoring of coastal floods, such information is available only in places where installed tide gauges are

accompanied with long enough monitoring systems. There are numerous instances of the same flood category (e.g. minor) with very different impacts that range from inconsequential/no flooding to widespread and damaging flooding. To avoid under- or over- estimating impacts in public weather communications, and to contextualize changes in current risk profiles due to sea level rise, a more consistent definition of minor, moderate and major coastal flooding and associated impacts is needed. This project will use a machine learning framework to explore cause and effect relationships between physical data (e.g., local elevation profiles, rainfall, water level, and wave data time series) with chronologies of archived NWS advisory/warning guidance, available damage reports and other quantifiable impacts, to produce spatially relevant and consistent flood threshold metrics for U.S. coastlines. By providing sensible metrics and communicable information on coastal flood risk across time and space, results will support decision making to enhance coastal resilience.

CIROH: Supporting equitable nature-based solutions for flood mitigation

Institutions: University of Alabama, University of Hawaii at Manoa Water Resources Research Center, University of Hawai'i Sea Grant
Location: Hawaii
FY23 Funding: $498,819

Project Summary: Nature-based solutions (NBS) harness the power of natural processes in natural or engineered landscapes to deliver multiple benefits, including reducing the impacts of flooding for downstream communities and building social-ecological resilience to climate change. Across Hawai'i, community groups are managing and restoring landscapes to mitigate floods and gain other benefits, including through biocultural approaches that emphasize the mutual restoration of ecosystems and culture. This project will: 1) Identify and document local flood risk perception, flood communication needs, and the range of NBS currently practiced and desired by communities across Hawai'i; and 2) Co-produce research around social-ecological resilience to flooding with two frontline communities, including through participatory mapping of future and desired NBS to support climate adaptation. Results will support future efforts to include local management and knowledge into flood modeling, communication, and response. This work will also set the stage for long-term CIROH collaborations through building relationships and co-producing research agendas with frontline communities.

CIROH: Development of Adjusted Digital Elevation Models (DEMs) to support a marsh model testbed for retrospective analysis at Grand Bay, MS and Plum Island Estuary, MA

Institutions: University of Alabama and The Water Institute of the Gulf
Location: Mississippi, Massachusetts
FY23 Funding: $284,879

Project Summary: Marsh ecosystems provide numerous services to coastal communities, yet they are increasingly vulnerable to degradation and loss due to climate change, reductions in sediment loading, and other environmental changes. Projected sea level rise further threatens these ecosystems and the critical functions they provide. Natural resource managers need specific, localized predictions of marsh vulnerability to sea level rise in order to target restoration and resilience efforts. To first evaluate the fidelity of contemporary, process-based marsh models there is a critical need for marsh model retrospective analyses. Such an approach requires historic digital elevation models (DEMs) of marsh bathymetry, which may benefit from correction using coring techniques and field measurements that estimate accretion rates over different timescales. These DEMs are not currently available for most study sites of interest, but the necessary historic data exists for their development at sites of interest, including the Grand Bay National Estuarine Research Reserve (GBNERR) in MS and Plum Island Estuary (PIE) in MA. This project will develop adjusted, historic Digital Elevation Models of marsh bathymetry at both of these sites that can be used to validate and parameterize models that predict sea level rise impacts to coastal ecosystems, providing decision makers and natural resource managers with the data they need to improve marsh resilience.

***Funding for five of these ESLR projects was awarded as part of President Biden's Investing in America agenda under the Inflation Reduction Act (IRA), allowing NOAA to help communities prepare for, adapt to and build resilience to changing climate conditions.*