The Future of Coasts: Changing Flood Risk for Coastal Communities in the Developing World

Globally, more than 600 million people live in low-elevation coastal areas that face an increasing risk of flooding from sea level rise caused by climate change. The areas at most significant risk include two-thirds of cities with populations over five million and regions that conduct the vast majority of global trade. These areas, especially in the developing world, are projected to grow rapidly in the coming decades.

Our climate crisis is here and will remain with us for decades to come. The accumulated heating of the earth system due to fossil burning to date is largely absorbed by the oceans, and this stored heat expands the ocean volume, leading to increased based height for tides. When high tides inundate the city, the condition is referred to as “sunny day” flooding, but the saline waters corrode infrastructure and wreak havoc on daily routines. The danger ahead for many coastal cities in the developing world is the combination of increasing high tide intrusions coupled with heavy precipitation storm events.

Expensive large-scale mitigation infrastructure in response to increasing flooding takes decades to plan and implement. The resettlement of large coastal urban centers presents social justice challenges, especially in developing countries. If not undertaken with the utmost diligence and careful planning, these solutions may exacerbate the impacts of climate change and sea level rise on those who already suffer the most.

RESEARCH QUESTIONS

Through this MIT Grand Challenge, we aim to answer the following questions to guide short-term flood response and long-term adaptation processes.

1. How will flooding recurrence increase decade by decade and street by street?
2. What is the value of the damage to economic, social, and ecosystem services caused by the increased flooding, and what investments will be needed to develop protective infrastructure and mitigation measures?
3. Will people have to move their homes and jobs, and will increases in episodic flooding result in irreversible population and livelihood displacements?
4. Will patterns of flooding in coastal urban areas increase the social and economic inequities in these communities?
5. What tools do communities and government stakeholders need to effectively collaborate to respond to increased flooding, build resilience, and chart long-term adaptation pathways?

STRUCTURE

The project will include a cross-sectoral partner network of local and regional governments, non-governmental community organizations, disaster management agencies, multilateral aid organizations, and universities.

We will begin with six pilot locations with a focus on South and Southeast Asia, Africa, and South America.

Pilot Locations

METHODOLOGY

This interdisciplinary project, The Future of Coasts, will develop detailed risk maps for coastal cities in developing countries using recently available, very high-resolution remote-sensing data from space-borne instruments, tide predictions, and regional storm characteristics. Utilizing these datasets, we aim to produce street-by-street risk maps that will provide local decision-makers and stakeholders with a way to estimate present and future flood risks. With the model of future tides and probabilistic precipitation events, we will be able to forecast future inundation risks by flooding, including decadal changes with various climate-change and sea-level rise projections, and an increase in the likelihood of sunny-day flooding.

Working closely with local partners, we will use the Environment, Human Vulnerability, Policy Decisions and Earth Observation Technology (EVDT) framework and develop toolkits to explore short-term emergency response, as well as long-term mitigation and adaptation options to help people in six pilot locations (Asia, South America, and Africa) cope with the increased risk of disastrous flooding. To encourage the use and adoption of the risk information, we will establish two-way conversations with community stakeholders by developing new coordination methods. These spatial models, tools, and maps of increasing flood risk will enable local decision-makers and stakeholders to go beyond conventional cost-benefit analysis to assess future displacements, migrations, and vulnerabilities specific to a settlement's social, economic, and ecological system. Our work with local decision-makers and community stakeholders to develop these collaborative tools for collective actionable planning and mitigation scenarios is called The Future of Coasts.

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