Microsoft

AI for Earth Grantee Profile
HighTide Intelligence
Sea level rise risk to population

Summary

Sea levels are rising and the impact on coastal communities will be far reaching. Though most communities are aware and conceptually understand what it could mean to local infrastructure, very few are focusing on addressing the inevitable challenges this will bring to individuals. HighTide Intelligence is quantifying the financial impact of climate-driven flooding with the goal of preparing people and cities to understand the risks and measures required to adapt to changing climates.

Implementing risk mitigation measures for sea level rise

According to the National Ocean Service, a department of the National Oceanic and Atmospheric Administration (NOAA), global sea level has been rising at an increasing rate, currently about one-eighth of an inch per year. The overall effect at the local level can vary quite a bit due to various factors such as subsidence and erosion, ocean currents, and flood control measures. Changes near the coastlines specifically include changes in tides which affect the regional rise. High-density coastal communities account for nearly 40 percent of the US population, making sea level rise a serious concern for the nation.

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Along the coast of California, specifically the San Francisco Bay Area, many communities have elevations close to current sea level. A rise in the sea level leading to coastal flooding would be devastating to many communities but particularly to those who live in socioeconomically disadvantaged areas. Many households could face financial ruin with the burden of continual flood-repair costs. Scientists have researched the effects of sea level rise on coastal areas and how to mitigate the rise, but not much emphasis has been placed on adapting to the inevitable change sea level rise will require.

Using actionable data to mitigate risks

Adrian Santiago Tate, Arnav Mariwala, and Avery Bick, co-founders of HighTide Intelligence, are passionate about mitigating these risks through adaptation for individuals, not only the lower income households but for all communities in the Bay Area and across the country. As graduate students in environmental engineering at Stanford University, Tate, Mariwala, and Bick joined the Future Bay Initiative program, which focuses on collaboration and co-learning, with students teaching in teamwork with the community and local government groups. It was in the Future Bay course that they began working on a project studying sea level rise risk, producing useful and actionable data for the community.

"The main thing we got from that feedback was that it's great to have these models that look at damage from flooding, but people seem to be more interested in the cascading impacts from flooding," Bick says. "I think that wasn't getting as much attention in the Bay." This interest is what lead the trio, along with student Alex Miltenberger, to create a risk framework they dubbed SURF: the Stanford Urban Risk Framework. What began as a methodology developed in the classroom with community input turned into a Python framework to measure sea level rise risk and how it affects income across different brackets.
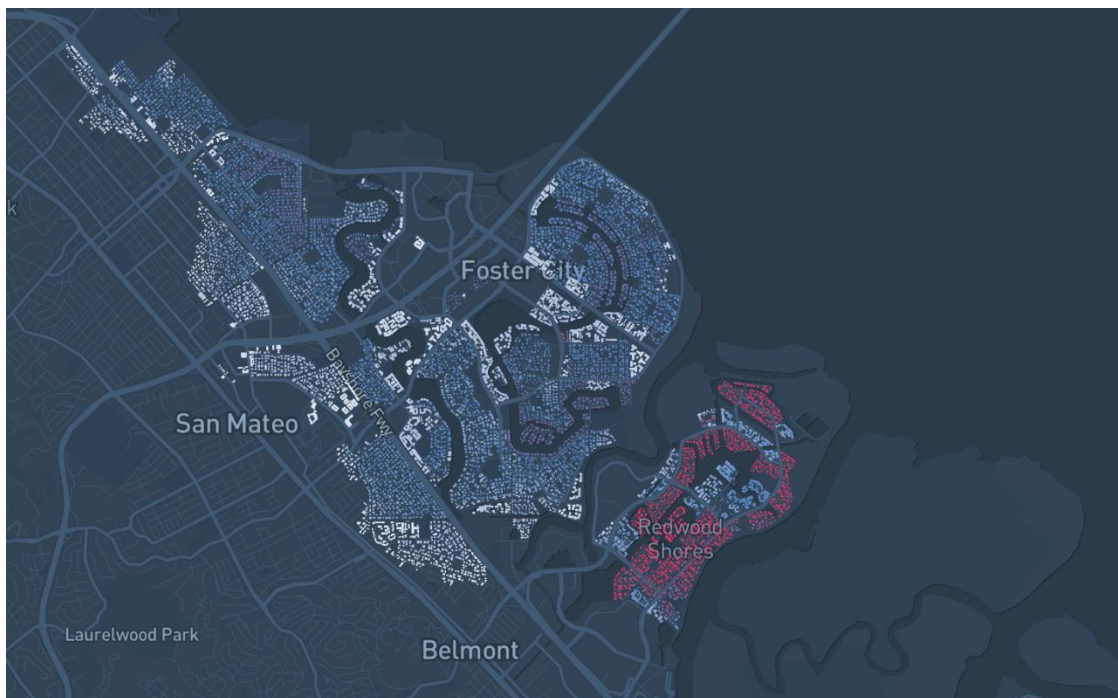
Several coastal communities in San Mateo county in the San Francisco Bay area have inequity risks larger than 50%, highlighting the need for immediate policy intervention. Source

The team wanted to take this analysis a step further, to not only look at the impact to infrastructure, but specifically how coastal flooding will affect the people who live in these communities and what could be done

now to help mitigate it. They are researching how resilient people are to the financial shock of potentially losing access to their work and income stream. The housing crisis and income inequality in the Bay Area is substantial, and the team are currently focused on how lower-income groups are less resilient to the shock and how that can exacerbate the inequality and further dislocate those groups. For example, Bick says, "Lower-income groups may not lose as much financially in terms of dollar amount, but the percent of income lost will be much greater than a higher-income group." In a paper the SURF team co-wrote with others, *Rising seas, rising inequity? Communities at risk in the San Francisco Bay Area and implications for adaptation policy*, they state that though the study's analysis is specific to the San Francisco Bay Area, its "granular, household-level perspective is transferable to other urban centers to identify the specific challenges that different communities face and design appropriate adaptation interventions."

Scaling sea level rise research with cloud computing

In order to understand the risks and raise awareness for local communities, HighTide Intelligence uses a number of datasets to get the layers of information required for analysis. These include the NOAA [Our Coast, Our Future](#) flood maps for California, [Microsoft Open Street Maps](#) and building footprint data, and additional data from the US Bureau of Labor Statistics, Bureau of Economic Analysis, and US Census. Running the datasets and completing their analysis takes a significant amount of computing power, which now HighTide can access thanks in part to a Microsoft AI for Earth grant gained in unusual fashion: through a hackathon.

The SURF team members (Bick, Mariwala, Tate, and Miltenberger) participated in the [Stanford Big Earth Water Hackathon](#) as a way to "build a team around a previously limited-scope project and get real experience with software development." The grand prize for the hackathon winner included a Microsoft AI for Earth grant for $5,000 of Microsoft Azure cloud computing credits—one of the key reasons they joined the hackathon. The AI for Earth grant helped Bick, Mariwala and Tate launch HighTide Intelligence as a way to further their research and expand their model nationally.

"Creating a flood risk platform like ours would have been much more difficult without the Azure credits."—Arnav Mariwala, co-founder, HighTide

Mariwala explains the value that the AI for Earth grant and Azure have brought to HighTide. "Having access to Azure resources enabled us to build an interactive product that allows users to visualize their flood risk and analyze how different factors—a property's replacement value, or a range of carbon emissions scenarios, for example—would affect their flood risk," says Mariwala. "It has been very helpful in allowing us to streamline our workflow as we work on scaling our platform to the entire United States. Now, instead of having to crunch

large datasets offline on a region-by-region basis, we're able to efficiently set up pipelines and allow users to interact with the results easily. Creating a flood risk platform like ours would have been much more difficult without the Azure credits and consultations that we received from the Hackathon and subsequent grants."

Looking forward

HighTide Intelligence is currently building out a predictive mapping and analytics platform that evaluates climate flooding impacts in built environments, starting in California and scaling to urban areas around the world. Their goal is to provide high-resolution, near-real time data on climate impacts to businesses and investment funds that can ensure more resilient communities and cities in the future.

About HighTide Intelligence

What started out as research for the Future Bay Initiative course at Stanford turned into a hackathon-winning team called Stanford Urban Risk Framework or SURF. The SURF team used their methodology as a basis to create their startup HighTide Intelligence. HighTide is building a platform to map and predict the impacts of climate-driven flooding in built environments around the world. Using proprietary physical and data science models with high-resolution property and flooding data, HighTide is able to predict the dollar value impact of flooding for individual buildings, and scale up to cities and portfolios. Their product is currently focused on applications for investors and enterprises in California and will soon scale to high-risk urban areas in the continental United States.

About Arnav Mariwala

Arnav Mariwala is the co-founder and CEO of HighTide Intelligence. He graduated from Stanford University with a B.S. in Physics and M.S. in Geophysics. At Stanford, he conducted research on using natural ecosystems to protect coastlines from hurricanes and flooding, and developed a strong passion for sustainable energy and climate adaptation through leading the Stanford Energy Club. Outside of Stanford, he completed internships with Cyclotron Road and Congressman Bill Foster, and a project with Dr. Varun Sivaram on research into the future of solar energy. Arnav grew up in Mumbai, India, where he saw the impacts of chronic flooding firsthand, and enjoys sailing, hiking, and reading about history.

Arnav Mariwala, co-founder and CEO, HighTide Intelligence [photo courtesy Mariwala]

About Adrian Santiago Tate

Adrian Santiago Tate is the co-founder and CTO of HighTide Intelligence. He graduated from Stanford University with an M.S. in Geophysics and Virginia Tech with a B.S. in Civil Engineering. At Stanford, he published research on the long-term impacts of sea-level rise in the San Francisco Bay Area and protecting coastlines from tsunamis using mitigation parks. Outside of Stanford, he completed internships with the US Army Corps of Engineers and Fugro Group. Adrian grew up under sea level in the Netherlands, where he realized the importance of adapting to rising sea levels and is an avid surfer.

Adrian Santiago Tate, co-founder and CTO, HighTide Intelligence [photo courtesy Tate]

About Avery Bick

Avery Bick believes in building technology that supports sustainability and equity in climate adaptation. He completed his M.S. in Environmental Engineering at Stanford University, where he published research and assisted in teaching courses on sustainable cities. Through his multifaceted experiences as an engineer, educator, and artist he has honed the skills to build models that explore the interactions between society and the environment. A co-founder of High Tide Intelligence, Bick now serves as a scientific advisor to HighTide and is not currently involved actively with the company.

Resources

Websites
HighTide Intelligence site

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