Report: Rising Seas Stretch Risk Zones

Annual coastal flood risk projected to expand this century onto land now home to nearly 100 million

Higher ground is vanishing along the world's coasts.

As seas rise, land once safely above the tideline is slipping below annual flood risk levels, exposing residents to escalating threats. New elevation data, maps, and analysis document how, by the end of this century, risk zones will extend higher and further inland, into areas where 93 million people live today.

That estimate comes from Climate Central's updated analysis of global elevations and coastal flood risk projections – based on the most recent IPCC medium-to-high emissions scenario – applied to population data to determine the number of people who live in areas expected to experience increased coastal flooding because of sea level rise. The elevation data beneath the analysis represent an extensive, March 2024 update to CoastalDEM, Climate Central's AI-driven digital elevation model. CoastalDEM is the lowest-error global dataset of coastal land heights, as evaluated against a global ground-truth dataset.

Biggest potential impacts

In some countries, the encroachment of coastal flood risk by the end of the century will sharply increase the numbers and proportions of residents potentially exposed to harm, disruption, and losses during storms.

China, for example, has approximately 52 million people living within the annual flood risk zone, where coastal floods are expected to occur at least once-per-year on average by 2030. That risk expands by 2100 to land where an additional 29 million now live.

In Vietnam, where 18 million people live within the 2030 annual flood risk zone, rising seas are expected to threaten land now home to an additional 7 million with at least once-per-year coastal flood risks by 2100. At that point, the annual flood risk zone would cover an area where 30% of the population lives today.

In Bangladesh, nearly 10 million live on land that is currently above the annual flood risk zone, but expected to fall into the zone by the end of the century. In India, annual flood risk by 2100 will expand onto land where more than 8 million live. In Indonesia, land home to more than 6 million will shift into the annual flood risk zone by 2100. In Japan, land home to nearly 5 million will shift into the zone by 2100. These shifts will force large communities to adapt to more severe and more frequent threats from coastal flooding.

Table 1: Countries with the most residents on land projected to experience at least annual coastal flooding by 2100

country	population in 2030 annual coastal flood risk zone	population in 2100 annual coastal flood risk zone	percentage increase
China	52.5 million	81.7 million	56%
Bangladesh	20.4 million	30.4 million	49%
Vietnam	18.3 million	25.6 million	40%
India	15.7 million	24.2 million	55%
Thailand	16.1 million	17.7 million	10%
Indonesia	10.4 million	16.8 million	61%
Japan	7.9 million	12.7 million	60%

Even where fewer people live on vulnerable land, rising seas dramatically increase countries' potential exposure to coastal flooding. In Sri Lanka, the land expected to shift into the annual coastal flood zone by 2100 is home to more than 350,000 people. That approaches three times the potential exposure Sri Lanka is expected to face in 2030, when annual coastal flood risk is projected across land now home to 131,000.

In the Philippines, land projected below the annual flood risk level by 2100 is home to 10.6 million people, significantly increasing the 2030 estimate of 5.8 million whose homes face annual flood risk.

While fewer in Egypt – slightly more than 2 million – live within the 2030 annual coastal flood risk zone, the country's exposure jumps to more than 4 million by the end of the century. In Malaysia, where 2.4 million live within the 2030 risk zone, the increase is only slightly less: by 2100 annual coastal flood risk will extend to land where roughly 4 million live today.

Even in the United States, where less than 1% of the population – roughly 2 million people – live on land at risk of annual coastal flooding by 2030, the expansion of the risk zone extends the threat to land where 3.4 million now live. (The U.S. is one of a handful of countries that makes even higher-quality lidar-based elevation data available for analyses like this. Comparisons indicate that analyses based on those data align with these findings.)

Table 2: Select high-population countries with large increases in residents on land projected to experience at least annual coastal flooding by 2100

country	population in 2030 annual coastal flood risk zone	population in 2100 annual coastal flood risk zone	percentage increase
Philippines	5.8 million	10.6 million	81%
Myanmar	6.6 million	9.4 million	41%
Nigeria	3.8 million	5.7 million	50%
Egypt	2.2 million	4.0 million	88%
Malaysia	2.4 million	3.9 million	65%
United States	2.0 million	3.4 million	73%
Brazil	1.3 million	2.1 million	68%

A lack of source data kept previous versions of Climate Central's coastal risk screening tools from assessing projections above 60 degrees north latitude. But the most recent version of CoastalDEM supports analyses to the poles, which enables Climate Central's first full assessment of population exposure to rising seas and coastal flooding in Arctic stakeholder nations, including Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden, and the United States.

Along the shores of the Scandinavian Peninsula, roughly 300,000 people in Finland, Norway, and Sweden live on land expected to experience at least annual coastal flooding by 2030. At the end of the century, that number is projected to grow by 15% to 345,000.

The risks in this region highlight a challenge that governments will increasingly face in the coming years: deciding on policies to protect people and property from rising seas when affected populations are relatively small and remote. Those decisions may be required long before land falls beneath the tideline, as coastal floods occur more frequently and reach higher and farther inland, intensifying impacts on local communities and economies.

Table 3: Number of residents on land falling into annual flood risk zones in Arctic nations

country	population in 2030 annual coastal flood risk zone	population in 2100 annual coastal flood risk zone	percentage increase
Russia	310,000	469,000	52%
Denmark	137,000	224,000	63%
Canada	295,000	325,000	10%
Sweden	126,000	153,000	21%
Norway	140,000	153,00	9%
Finland	35,000	41,000	14%
Iceland	16,700	17,300	4%

This analysis is based on elevation data from Climate Central's CoastalDEM version 3.1, released in March 2024, global coastal flood modeling from COAST-RP and Tebaldi et al., global population estimates from WorldPop (2010), and 2021 sea level rise projections from IPCC, based on medium-to-high emissions scenario SSP3-7.0. Map-based visualizations of projected risk zones are openly available to the public through Climate Central's Coastal Risk Screening Tool. Additional background and technical details on elevation data are available in a technical white paper evaluating error in CoastalDEM, as well as other global elevation datasets covering coastal areas.