

Study predicts sea level rise may take economic toll on California coast

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This is a map showing the areas likely to be affected by upland erosion at Ocean Beach, San Francisco, following a range of sea level rise scenarios. The map shows Ocean Beach between Sloat Boulevard to the south and Lincoln Way to the north. This forecast was part of a new state-commissioned study conducted by economists at San Francisco State University examining the economic impact of sea level rise in California.

California beach towns could face hefty economic losses caused by sea level rise in the next century, according to a new state-commissioned study conducted by economists at San Francisco State University. The study forecasts the economic impact of sea level rise on five communities: Ocean Beach in San Francisco; Venice Beach and Malibu

in Los Angeles; Carpinteria in Santa Barbara County; and Torrey Pines State Reserve in San Diego County.

Funded by the California Department of Boating and Waterways, the study examines the cost of coastal storm damage and erosion, both of which are expected to increase as sea levels rise. It also forecasts the economic impact of sea level rise on tourism and [natural habitats](#), as beaches that have been narrowed by erosion lose their appeal to visitors and their ability to sustain wildlife.

The results suggest that visitor hotspots like Venice Beach could lose up to \$440 million in tourism revenue between now and 2100 if sea levels rise by 4.6 feet (1.4 meters), a projection specific to the California coast, based on recent scientific studies. At San Francisco's Ocean Beach, accelerated erosion could cause up to \$540 million worth of damage.

"Sea level rise will send reverberations throughout local and state economies," said Philip King, associate professor of economics at San Francisco State University. "We also found that the economic risks and responses to a changing coastline will vary greatly over time and from beach to beach."

The findings suggest that the cost and type of damage will vary depending on a community's economy, geography and local decisions about land use. For example, if sea level rises by 4.6 feet, Malibu beaches could lose almost \$500 million in accumulated tourism revenue between now and 2100. Revenue losses would be much smaller at San Francisco's windswept Ocean Beach (\$82 million), which attracts fewer visitors per year.

In addition to mean sea level rise, the study estimated the economic impact of more extreme flooding. Coastlines are already at risk of low-probability coastal storms -- like 100-year floods -- but higher sea levels

are expected to extend the depth and reach of these floods, increasing the damage to homes, businesses and public infrastructure.

"In California, our coastline is one of our most valuable natural resources," King said. "More than 80 percent of Californians live in coastal communities, and California's beaches support local economies and critical natural species."

King and co-authors Aaron McGregor and Justin Whittet hope the findings will inform local planning efforts to evaluate and respond to sea level rise. "Understanding the kind of impact sea level rise will have is important for deciding what adaptive action to take," King said.

"Seawalls have become the de facto policy for dealing with erosion and sea level rise but our findings suggest that other policies such as beach nourishment or where possible, allowing the coastline to retreat, could be more cost effective."

King and colleagues conducted their analysis primarily using secondary data, an approach which allowed them to calculate the economic impact of sea level rise at a fraction of the cost and time taken to complete the more commonly used shoreline hazard assessments.

Below is a summary of the key findings:

Ocean Beach (north of Sloat Boulevard), San Francisco County

Based on a sea level rise estimate of 4.6 feet (1.4 meters) by 2100, Ocean Beach could lose:

- \$19.6 million in damages caused by a 100-year coastal flood

damaging homes and contents. This is an increase of 200 percent from the present day risk of a 100-year flood, which is \$6.5 million

- \$82 million in tourism spending and local and state tax revenue losses (accumulated between now and 2100) caused by a narrower, eroded beach attracting fewer visitors
- \$16.5 million in habitat and recreation losses, caused by erosion reducing the beach area by 92 percent (53 acres lost). Ocean Beach provides a habitat for native species such as the Western Snowy Plover, a bird that is federally listed as a threatened species
- \$540 million caused by land, buildings and infrastructure being lost or damaged by erosion and subsidence

Venice Beach, Los Angeles County

Based on a sea level rise estimate of 4.6 feet (1.4 meters) by 2100, Venice Beach could lose:

- \$51.6 million in damages caused by a 100-year coastal flood damaging homes, commercial buildings and contents
- \$439.6 million in tourism spending and local and state tax revenue losses (accumulated between now and 2100) caused by a narrower, eroded beach attracting fewer visitors
- \$38.6 million in habitat and recreation losses, caused by erosion reducing the beach area by 16 percent

Zuma Beach and Broad Beach, Malibu, Los Angeles County

Based on a sea level rise estimate of 4.6 feet (1.4 meters) by 2100, Zuma Beach and Broad Beach could lose:

- \$28.5 million in damage caused by a 100-year coastal flood damaging homes, commercial buildings and contents
- \$498.7 million in tourism spending and local and state tax revenue losses (accumulated between now and 2100) caused by narrower, eroded beaches attracting fewer visitors
- \$102.3 million in habitat and recreation losses caused by erosion reducing the beach area

Carpinteria City and State Beach, Santa Barbara County

Based on a [sea level](#) rise estimate of 4.6 feet (1.4 meters) by 2100, Carpinteria City and State Beach could lose:

- \$10.7 million in damages caused by a 100-year coastal flood, damaging homes and contents, and commercial structures
- \$164.7 million in tourism spending and local and state tax revenue losses (accumulated between now and 2100) caused by a narrower, eroded beach attracting fewer visitors
- \$31.3 million in habitat and recreation losses caused by erosion reducing the beach area
- \$300,000 caused by upland areas being lost or damaged by erosion and subsidence

Torrey Pines City and State Beach, San Diego County

Based on a [sea level rise](#) estimate of 4.6 feet (1.4 meters) by 2100, Torrey Pines City and State Beach could lose:

- \$5 million in damages caused by a 100-year coastal flood, including damage to homes and contents, cars and roads
- \$99 million in tourism spending and local and state tax revenue losses (accumulated between now and 2100) caused by a narrower, eroded beach attracting fewer visitors

- \$20.2 million in habitat and recreation losses caused by erosion reducing the beach area by 100 percent
- \$348.7 million caused by land, road and railway lines being lost or damaged by erosion and subsidence, including damage to the Los Angeles-San Diego-San Luis Obispo (LOSSAN) Rail Corridor

Provided by San Francisco State University

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