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## CALIFORNIA'S CHANGING CLIMATE

# Under water by 2100? Risk of the rising sea

## SCIENTISTS SEEK WAYS TO AVERT A CREEPING CATASTROPHE IN BAY AREA

By Mike Taugher  
MediaNews

The seas have been rising for 18,000 years, but the pace has quickened.

At the Golden Gate Bridge, the Pacific Ocean crept seven inches higher during the past century, as global warming melted glaciers and expanded ocean waters.

Californians are taking notice. In one of the first efforts of its kind in the state, officials are starting to address the threats rising seas pose to the Bay Area.

One of the first steps was to compile maps that show what would happen if the sea level rose three feet -- the upper limit for what might occur by 2100, according to computer models of climate used by the state.

The maps show a dramatic level of inundation: San Francisco and Oakland international airports would be under water, along with Foster City, parts of Redwood City and virtually all the bay wetlands, many of which have been restored at great public expense as habitat for wildlife.

Also at risk are railroad tracks running through Alviso, highways, buildings, and public works projects, such as the East Bay Municipal Utility District sewage-treatment plant in Oakland.

"There are some areas that are extremely vulnerable," said Leslie Lacko, a coastal planner for the San Francisco Bay Conservation and Development Commission.

According to a 1990 study, a three-foot rise in sea level would threaten \$48 billion in real estate, roads and pipes around San Francisco Bay.

"We have a lot of infrastructure that is very vulnerable to a little bit of sea level rise," said the study's author, Peter Gleick, president of the Pacific Institute in Oakland. "We're going to have to spend a lot of money to protect them."

The issue is already having an effect on flood insurance rates. They're going up around the country, in part because of natural hazards that could be worsened by warming, according to Evan Mills, a staff scientist at Lawrence Berkeley Laboratory.

As sea levels continue to rise, he said, "The demand will go up, I am sure."

Recent climate models suggest a sea level rise of four to 36 inches by 2100, although that range will reportedly narrow when a major report from an international team of climate scientists is released on Tuesday.

On the other hand, a recent study in the journal *Science* suggests that since 1990, the seas have been rising in accordance with the worst-case scenario. Stefan Rahmstorf of the Potsdam Institute for Climate Impact Research in Germany argues that climate models may underestimate how fast the seas will rise because they don't take into account some of the complexities of glacier behavior.

## Surprises feared

While any rise is likely to be gradual and could be modest, especially if greenhouse gas emissions are curtailed, scientists worry that there will be catastrophic surprises, such as huge ice sheets sliding into the oceans.

Even a relatively modest increase could spell trouble.

Raise sea level 18 inches, and salty ocean water would flow deep into the Sacramento-San Joaquin River Delta, intruding into the drinking water supply for 23 million Californians.

"A foot and a half would be huge," said John Andrew, chief of special planning for the state Department of Water Resources.

A rise of just one foot would put tremendous pressure on the levees that protect the delta's fresh water supply. High

tides that now come once a century would come once a decade; levees that are designed to withstand 100-year events could crumble and break.

A 2005 study estimated a two-in-three chance of catastrophic levee failures in the delta by 2050, partly because of added pressure on levees from a rising sea level.

Flooding from storms, especially during high tides, would be much more widespread.

Take, for example, a powerful storm in February 1998 that struck during a tide that was about two feet higher than normal.

Waves splashed over the San Francisco Embarcadero, as much as four feet of water washed over U.S. Highway 101 in Marin County and hundreds of people fled their homes around the bay, according to the U.S. Geological Survey.

The storm occurred during a massive El Niño event, part of a natural climate cycle that has not been linked to global warming. But it dramatically illustrated how rising seas and high tides can combine to intensify the effects of storms.

“If we have that same El Niño and that same high tide in 20 years, the damage would be much more extreme,” said Amy Luers, California climate manager for the advocacy group Union of Concerned Scientists.

“We have developed our society to manage our existing weather and existing extremes,” she said. “What global warming is doing is making those more challenging.”

Rising seas will also flood coastal areas and nibble away at beaches and cliffs, threatening houses from the Bay Area to San Diego.

In some places, such as Monterey and La Jolla, the bluffs are sturdy, said Mark Johnsson, a geologist at the California Coastal Commission. But other real estate with prime ocean views is more vulnerable to erosion, including Sand City and Marina in Monterey County and Pacifica just south of San Francisco.

Like the San Francisco Bay Conservation and Development Commission, the state Coastal Commission is in the early stages of considering how California might deal with the consequences of a rise in sea level along the rest of the coast. It could, for example, require bluff-top houses to be set farther back.

## Sea wall dilemma

The issue could pit regulators trying to protect the long-term health of beaches and wetlands against property owners' desires for stunning vistas.

Property owners would often rather build sea walls to prevent erosion than give up their views.

But regulators say those walls actually jeopardize beaches. The problem, Johnsson said, is that they disrupt natural processes that maintain beaches by cutting away the bluffs and releasing new sand.

“Sea walls protect property, but they inevitably destroy beaches in the long run in this environment of rising sea level,” he said. Even so, he said, regulators have little legal authority to reject applications from property owners who want to build them.

Lacko of the BCDC said that while sea walls seem to be an obvious solution to the threat of flooding around the bay, they would destroy wetlands and turn a living bay into nothing more than a “giant reflecting pool.”

As Susanne Moser, a geographer at the National Center for Atmospheric Research in Boulder, Colo., put it: “Do we really want an America behind sea walls?”

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