

Experts: The sea level is rising, and coastal cities better be ready

Aaron Orlowski, Orange County Register, 4-23-16

On Balboa Island, during especially high tides, water from the bay burbles up through cracks in the sidewalk and laps at the top of 80-year-old sea walls, which loom several feet above lower-lying walkways.

It's an occasional nuisance. But scientists say that within the lifetime of people now being born, such flooding, exacerbated by ever higher tides and storm surges, will become increasingly common in several Orange County coastal communities as sea levels rise as much as several feet.

How much damage those areas will suffer – and how much increased costs cities will face – depends in part on how much planning and preparation officials pursue, beginning now, experts say.

Low-elevation coastal areas such as Balboa, the Newport Peninsula, Sunset Beach and Seal Beach will feel the effects first. It won't hit all at once, but gradually, over decades, according to researchers, as ankle-deep floods become knee-deep, waist-deep and eventually strong enough to wash away cars and make some homes unlivable.

“Something that wouldn't have been a big flood previously will become a much more significant flood,” said Timu Gallien, who researches sea level rise at Scripps Institution of Oceanography in San Diego.

Most coastal Orange County cities are beginning to act by incorporating sea level rise projections into planning documents and general plan updates, but many scientists and officials warn it's too little and coming too slowly.

The current pace of progress on defensive and preparation measures is disconcerting, some experts and officials say, given the scientific consensus that human-generated, heat-trapping gases such as carbon dioxide will ensure such communities at some point will have to confront rising oceans.

And it can take years to prepare flood studies that provide detailed information on neighborhood-level vulnerabilities. Sea walls, dikes and beach sand replenishment projects cost millions of dollars and are extremely time-consuming to plan, approve and build. A National Climate Assessment in 2014 concluded that sea level rise damages to unprepared coastal communities would cost four to 10 times more than adapting and preparing.

“I don't think anybody is ahead of the curve the way we're going,” said Lesley Ewing, a senior coastal engineer at the California Coastal Commission.

For official sea level rise projections in California, the Coastal Commission relied on a 2012 National Research Council consensus report of the best science at the time. It forecast seas south of Mendocino would rise between 1.5 and 5.5 feet by 2100, depending on the worldwide steps taken to slow emissions of planet-warming gases.

A 2013 United Nations panel forecast seas would rise globally more than three feet by 2100, an estimate many scientists thought was too conservative. New studies projecting varying rates of sea level rise are frequently published by teams of scientists, such as a groundbreaking study published in the journal *Nature* this month that doubled U.N. estimates by accounting for major melting of ice sheets in Greenland and Antarctica.

Another study, published last month by a team of scientists from UC Irvine and other institutions, found that many Greenland glaciers were at greater risk of melting from below the sea surface than previously thought because of new calculations of the depth of warm ocean water. Quicker glacial melt rates would cause seas to rise faster.

In Newport Beach, a city expected to face some of the most severe consequences, officials recently settled on a \$2 million compromise plan to raise sea walls protecting flood-prone areas by nine inches, after some homeowners objected to higher walls that could interfere with their bay views, said Bob Stein, the assistant city engineer, during a walking tour around the island.

Generally, residents are skeptical about official sea level rise projections, he said.

And the current, periodic flooding isn't seen as harbinger of worse things to come by some Balboa Island residents. "It's not that big, really and truly, you just walk around a puddle," said Ann Roberson, a lifelong Balboa Island resident, standing next to the sea wall on a recent day. "I just don't see it as a big issue."

Huntington Beach, the other city in Orange County most threatened by sea level rise, has convened a task force to work on a coastal resiliency plan that will go into the city's general plan update in the coming years. Seal Beach and Dana Point also are taking preliminary steps to assess whether rising seas will affect homes, businesses and roads.

Two cities in Orange County – San Clemente and Newport Beach – have gotten financial help from the Coastal Commission, which regulates land use on the California coast, to determine their vulnerability to ocean level increases and begin planning for corrective measures.

One problem is that little is known about where and how water from higher sea levels will actually arrive on specific streets and in specific neighborhoods. That's because most sea level rise forecasts are global in scale and rely on what scientists call a "bathtub" model. Water levels are overlaid on topographic maps of the coastlines and uniformly raised around the world.

But that's not how the oceans actually work. Sea levels in different places are influenced by a host of regional and local factors, as well as short- and long-term oceanographic trends.

The tides alone cause sea levels to rise and fall as much as five feet every day and large storms can bring water levels up nearly two feet. Waves can be six feet or more. Seasonal patterns like El Niño can add half a foot, while yearslong climate patterns can suppress them and Greenland and Antarctic glaciers can pull sea levels higher nearby.

The imprecise localized information on when and how sea level changes may affect coastal areas stands in contrast to the confidence scientists have that oceans will rise. The lack of the former shouldn't prevent cities from beginning to plan for the latter, said Ewing, the Coastal Commission engineer.

"We don't need to be waiting for the next best tool. We need to be starting to plan for sea level issues now and as new tools develop, they can improve planning operations," Ewing said. "It's going to be so much better in 50 years if we have planned for sea level rise that's happening, than if we blindly stumble into it and are constantly surprised by the damages."

In terms of detailed forecasts of potential problems, Newport Beach should be ahead of many other cities in the years to come. UC Irvine scientists studying the city are developing some of the most advanced flood mapping tools in the country and testing different ways of disseminating flood risk information to residents. The research also includes two communities on each side of U.S.-Mexican border.

To create the future maps and models, the scientists several years ago painstakingly documented the location and size of storm drains, sea walls and other infrastructure that influence flooding patterns.

Many areas of the Newport Peninsula are below the level of bayside sea walls and susceptible to flooding, especially when rainstorms combine with rising seas. Drains that ferry water from curbside gutters to the ocean get closed when ocean water levels are especially high to prevent water from traveling backward through the pipes to the streets. That causes rainwater to pond on streets with nowhere to go.

Flooding patterns in Newport illustrate a key point about sea level rise, scientists say. The threat isn't just persistently higher sea levels, per se, but worsening flood damage that will become more commonplace when severe storms hit the coast in the coming decades.

Managing those floods will strain city budgets as they spend more on sending crews to build sand berms and pump trucks to drain flooded streets, experts warn. Those increased costs will be the first sign of sea level rise, said Brett Sanders, a UCI professor who is leading the team that's creating the hyper-local flood maps for Newport Beach. Such computer models eventually will be able to simulate flooding down to individual houses, a potentially powerful tool for educating communities about the risks ahead, Sanders said.

"That's more likely to help people appreciate it, when you bring the scale down to everyday life," he said.

The UCI team's models will be able to show exactly where water would be a few inches or a few feet deep under different scenarios, he said. "People are eager to know what that difference is," Sanders said. The answer could determine responses, such as when and where residents may want to remove cars to avoid damage during the strongest storms.

The UCI team surveyed residents door to door in Newport, and found that people were highly aware of flooding, but ranked their preparedness low. They weren't preoccupied or concerned with potential flooding, said Kimberly Serrano, the project manager for the UCI mapping team.

The first, enhanced defenses against rising sea levels, she said, should be natural mitigation methods, such as planting oyster beds and mangrove forests that can weaken the strongest tides and slow the advance of waves. Building engineered sea walls and tide gates would come next, followed eventually by pulling back development.

"It's a hard conversation," Serrano said.

California and the Pacific Coast haven't suffered major storms comparable to Superstorm Sandy and Hurricane Katrina on the East and Gulf coasts, Serrano said. "In our collective memory there hasn't been a recent disaster to galvanize us," Serrano said.

But sea levels could become a major issue in California sooner than many think, researchers say.

In the last few decades, prevailing wind currents have suppressed ocean levels in Southern California by displacing warmer water with cooler, denser water. Those currents have already started to shift.

Plus, the sheer gravitational mass of the enormous ice sheets in Greenland and Antarctica draws ocean water to the poles, depressing sea levels in places such as California. When those ice sheets melt, that water will redistribute.

“The further you are from the ice sheets, the more sea level rise you’ll get when they melt,” said Patrick Barnard, a Santa Cruz-based coastal geologist with the U.S. Geological Survey, who is leading a climate change impacts team there.

It’s not just low-lying Orange County areas that could be at risk over the coming several decades. Cities with bluff-top roads and houses, such as Dana Point, Laguna Beach and San Clemente, are likely to face increased erosion threats, scientists warn.

Normally, stretches of sandy beach protect the cliffs beyond from the worst wave impacts. But as sea levels rise, waves will break closer to the cliff toe.

Assuming sea levels rise three feet by 2100, cliffs will erode twice as fast in Southern California, according to Patrick Limber, who studies cliff erosion at USGS in Santa Cruz.

To prevent erosion, coastal engineers and officials often coat cliffs in concrete or build sea walls in front of them, a process called “armoring.” But, ultimately, armoring causes the beach, not replenished by cliff erosion, to disappear, washed away on coastal currents. It’s better, Limber said, to nourish beaches with sand from offshore or elsewhere and make them wider so waves don’t reach sea cliffs.

“The hazard of coastal erosion is only going to get worse as we go through the 21st century. A lot of people are just not aware of that,” Limber said.

In the same way that the rarest, strongest storms will herald the worst impacts of sea level rise, the danger with failing cliffs is that even though the danger builds gradually, the damage crashes down all at once. “You can’t predict when it’s going to happen,” he said.