

# 'King tides' are rising, so groups span globe to monitor it

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The tide watchers start patrolling whenever the celestial forces align. From coast to coast, hundreds of tide watchers come out with their cameras to record the latest "king tides," brief episodes of tidal flooding that could become the norm, with expected sea level rise.

King tides are a colloquial term for the highest tides of the year. They occur when the moon is closest to the earth at moments when the sun, moon and Earth are in alignment, increasing the gravitational forces at play.

A decade ago, few had heard of "king tides," much less waded through them in galoshes. Now, Miami regularly floods. So does Myrtle Beach, Charleston and other U.S. cities. And more than ever, groups of citizens are out there photographing the results, uploading the pics and debating what the future will bring.

"Coastal flooding is our new normal," said Daniel J. Burger, who coordinates the King Tides Initiative for the South Carolina Department of Health & Environmental Control. "What we are doing is leveraging the capacity of interested citizens to document a very dynamic coastline."

King tides have always been part of the world's seasonal tidal variations. One just finished up along the coast of the Carolinas. In California, another one is expected Jan. 1 and 2, followed by one a few days later in

Washington state.

Depending on a coast's topography, king tides can increase the elevation of a high [tide](#) by a foot or more. Much depends on other natural forces at work. Offshore winds, for instance, can push a king tide higher. So can river runoff from recent rainfall, which gets backed up by the incoming tide.

Some cities are already experiencing ever higher king tides, also known as "sunny day" flooding. From 1970 to 2014, the annual number of sunny day floods in Charleston increased from two to 14.

In 2016, the city experienced a record of 50 tidal flood days, according to a study this year by the National Oceanic and Atmospheric Administration. Savannah, Ga., also set a record with 38 tidal flood days, as did Key West with 14 days.

Over the last century, sea level has risen about a foot in Charleston. That's one reason sunny day flooding has increased there and in other parts of the Carolinas, Virginia and Florida. With expected [sea level rise](#) in coming decades—caused by melting of the ice sheets and expansion of warming ocean waters—Charleston could see 180 days of sunny-day flooding by 2045. That means that current king tides could become the normal high tides.

As sea levels and tides rise, coastal cities face hard choices about preventing inundation. These include building expensive sea walls, elevating streets and retrofitting sewage treatment plants and other infrastructure. Natural habitats are also at risk. In Morro Bay, which sits roughly halfway between Los Angeles and San Francisco, coastal managers fear loss of salt marshes and possibly eelgrasses, essential parts of the marine food web.

Citizen environmental monitoring has a long history, most notably with the Audubon Society's Christmas bird count. For king tides, the monitoring effort started in Australia in 2009, then spread quickly to North America and other parts of the world.

California started one of the United States' first king tide programs, a collaboration between agencies and non-profit groups. "We wanted to give people a way to bring climate change home and see what it would look like," said Marina Psaros, a founder of the program. More than 20,000 people now receive the group's emails.

At a typical king tide event, volunteers are urged to fan out along a stretch of coastline and photograph impacts to beaches, roads and other locations. The photographs are then uploaded to a set of websites, or shared on Twitter or other social media.

As participation has increased, the resulting photographs are proving helpful to planners and flood-control agencies. According to Burger, South Carolina is using the photographs to gauge whether king tide flooding was lower or higher than forecasts had predicted.

Yet protocols vary in archiving the photographs. Some images online include no information on time and location. In South Carolina, managers have developed a "MyCoast" app where photographs are time stamped with geolocation data.

Some science educators have quickly recognized king tides as a potential teaching tool. In South Carolina, teacher Merrie Koester launched a project for students at Charleston Development Academy to explore flooding in and around the charter school, due to king tides, storm runoff and nearby development replacing marshes.

The students ended up producing a hip-hop video about king tides and

the flooding. They also collaborated on a public presentation, which included an explanation of what causes king tides.

"A king tide takes place at full or new moon when the moon comes the closest it will ever be to the Earth," said one of the students, Tonisha Forrest, in the video. "The closer it is, the harder its gravitational pull on the Earth's water, and the higher the high tide."

Koester said her students never heard about king tides before the project launched. Now they want to share what they learned.

"These kids are already coming up with ideas for hip-hop public service announcements," she said. "Those could help in warning about future flood events."

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## KING TIDE PROJECT ORGANIZERS

Worldwide: King Tides Project

California: King Tides Project

Florida: Tampa Bay Estuary Program King Tides

North Carolina: King Tides Project

South Carolina: King Tides Initiative

Washington state: Witness King Tides

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