

# U.S. sea-level report cards: 2020 again trends toward acceleration

January 26 2021, by David Malmquist

---



Coastal flooding is of growing concern across Tidewater Virginia and in other coastal areas worldwide. Credit: J.D. Loftis/VIMS

The annual update of their sea level "report cards" by researchers at William & Mary's Virginia Institute of Marine Science adds further evidence of an accelerating rate of sea-level rise at nearly all tidal stations along the U.S. coastline.

The team's web-based report cards project [sea level](#) to the year 2050 based on an ongoing analysis of tide-gauge records for 32 localities along the U.S. coast from Maine to Alaska. The analysis now includes 52 years

of water-level observations, from January 1969 through December 2020. The interactive charts are available online at [www.vims.edu/sealevelreportcards](http://www.vims.edu/sealevelreportcards).

The project's founder, VIMS emeritus professor John Boon, says "The year-to-year trends are becoming very informative. The 2020 report cards continue a clear trend toward acceleration in rates of sea-level rise at 27 of our 28 tide-gauge stations along the continental U.S. coastline." The one continental outlier—in [Crescent City, California](#)—joins four [Alaskan stations](#) as sites where coastal uplift makes it appear sea level is falling relative to land.

VIMS marine scientist Molly Mitchell says "Seeing acceleration at so many of our stations suggests that—when we look at the multiple sea-level scenarios that NOAA puts out based on global models—we may be moving towards the higher projections." Mitchell has partnered with Boon to generate the report cards each year since 2017.

"Acceleration can be a game changer in terms of impacts and planning, so we really need to pay heed to these patterns," says Boon. "We have increasing evidence from the tide-gauge records that these higher sea-level curves need to be seriously considered in resilience-planning efforts," adds Mitchell.

Boon says the report cards add value by providing sea-level projections that are updated more frequently than those issued by NOAA or other agencies. Boon and colleagues also use a statistical approach that includes evidence for the recent acceleration in the rate of sea-level change at many U.S. tide-gauge stations, and stress their use of relative sea-level measurements—changes in water level relative to the land surface on which people live and work. The relative sea-level rise in Virginia and other East and Gulf coast areas is due to both rising water and sinking land.

## East Coast Trends

Sea-level rise has now been accelerating at all [U.S. East Coast stations since 2014](#). Prior to that year, stations south of Cape Hatteras had recorded little or no acceleration. "Today," says Boon, "sea level is accelerating faster at many of these southern stations than at some stations further north considered to be sea level rise 'hot spots' not long ago."

"Rates of sea-level rise in [Norfolk, Virginia](#) are still the highest along the Atlantic Coast at 5.4 millimeters per year," says Mitchell. "However, acceleration at stations in North Carolina, South Carolina, and Georgia indicate that we should be watching sea-level patterns in those states very closely." Some studies indicate that the "hot spot" of sea-level rise in the mid-Atlantic is moving southward, and that stations south of Cape Hatteras will see greater sea-level rise by 2050 than their histories suggest.

## Gulf Coast Trends

Most Gulf Coast stations witnessed an upturn in acceleration rates beginning around 2014, and all nine of them have experienced increased acceleration during the last three years. At Grand Isle, Louisiana and Galveston, Texas, these trends marked a transition from deceleration to acceleration. At others, including Pensacola, Florida and Rockport, Texas, sea level has been accelerating since 2004 but trending faster in recent years.

Texas and Louisiana stations continue to show the highest rates of rise in the country. [Rockport](#) has the second highest annual rise rate (7.1 mm/year in 2020), and the highest projected sea-level rise for 2050 at 0.82 meters (2.69 ft) above mean sea level in 1992, the midpoint of the

most recent National Tidal Datum Epoch. Grand Isle flips the tables, with the highest annual rise rate (8.1 mm/year in 2020), and the second highest projected sea-level rise for 2050 at 0.58 meters (1.9 ft) above 1992 levels. [Galveston](#) places third in both measures, with an annual rise rate of 6.6 mm/year in 2020, and a projected rise in 2050 sea level of 0.57 meters (1.87 ft).

Mitchell and Boon attribute the extreme rise rates and sharp contrast in acceleration among the Gulf Coast stations in part to their location within a sedimentary basin with a [complex history of water and mineral extraction](#). Pumping of groundwater and oil can cause land subsidence, which contributes to relative sea-level rise.

## West Coast Trends

With the exception of Alaska and Crescent City, California—where plate movements and post-glacial rebound generate pronounced coastal uplift—[U.S. West Coast stations](#) had been essentially neutral since at least 2004, with relative sea level neither rising nor falling at significant rates. That is no longer the case, as most stations have experienced acceleration since 2017. "Upward trends in acceleration presage positive and increasing sea-level rise rates at most stations along the continental west coast," says Boon. "Rise rates had been near zero for some time, but nascent acceleration is beginning to cause them to pop."

"Although sea level has been rising very slowly along the West Coast," adds Mitchell, "models have been predicting that it will start to rise faster. The report cards from the past five years support this idea." Scientists suggest that the speed-up is due to a shift in wind patterns associated with the Pacific Decadal Oscillation, an El Niño-like pattern of climate variability.

## Overall Trends

Previous work by Boon, Mitchell, and VIMS colleague Derek Loftis suggests the current acceleration in rates of sea-level rise began around 2013 or 2014, likely associated with ocean dynamics and ice-sheet loss. In 2020, rates of sea-level rise accelerated at all 21 of the report-card stations along the U.S. [East](#) and Gulf coasts, and at 7 of the 8 monitored stations along the U.S. [West Coast](#) excluding [Alaska](#). All four stations monitored in Alaska show relative sea level falling at increasingly rapid rates. This is due to various processes causing rapid uplift of the coast, tide gauges rising along with the land they rest on.

## Notable 2020 findings

The 2020 report cards show an accelerating rate of sea-level rise at 27 of the 32 monitored stations. [Rockport, Texas](#) recorded the highest acceleration rate in 2020, with a value of 0.262 mm/yr<sup>2</sup>. The next highest rates of acceleration were observed at [Pensacola, FL](#) (0.24 mm/yr<sup>2</sup>); Wilmington, NC (0.238 mm/yr<sup>2</sup>); Cedar Key, FL (0.21 mm/yr<sup>2</sup>); [Naples, FL](#) (0.199 mm/yr<sup>2</sup>); [Eastport, ME](#) (0.195 mm/yr<sup>2</sup>); [Charleston, SC](#) (0.181 mm/yr<sup>2</sup>); [Portland, ME](#) (0.166 mm/yr<sup>2</sup>); [Boston, MA](#) (0.165 mm/yr<sup>2</sup>); and [Port Isabel, TX](#) (0.16 mm/yr<sup>2</sup>). Significant acceleration in rates of sea-level rise at these widely distributed localities hints at global drivers, with climate change the obvious suspect. [NOAA recently reported](#) that 2020 was tied with 2016 as the warmest year on record.

Boon and Mitchell note that acceleration at these and other locations sharply increases their quadratic, "best-estimate" sea-level projections for 2050, despite in several cases a relatively low 2020 rise rate. For instance, [Eastport, Maine](#) had a rise rate of only 2.02 mm in 2020, but sea level there is projected to rise 0.41 m (1.3 feet) above 1992 levels by 2050. That 2050 projection is on par with the 0.51-m projection for

[Norfolk, Virginia](#) (1.67 ft), even though the latter's 2020 rise rate was 5.39 mm/yr, almost three times higher than in Eastport.

The VIMS team stresses that sea level will also experience short-term variations in the future just as it does today. Thus, coastal residents and planners in Virginia and other areas likely to experience significant sea-level increases by 2050 must also account for storm surges and other transient forces raising sea level even higher than the projected mean rise value. [The 95% confidence bands](#) placed about the projected quadratic curve in VIMS' sea-level report cards are a further reminder that average sea level in any given month can deviate from the projected annual mean by as much as 20 centimeters (8 inches).

## **The value of an annual, localized report card**

Because long-term changes in sea level are typically on the order of a few millimeters per year, researchers have traditionally felt little need to issue frequent forecasts of sea-level changes. Moreover, many sea-level projections are global in scope, with a forecast horizon of 2100—far enough off to allow for readily discernible linear change. An example is the United Nation's [oft-reported projection of 65 centimeters \(2.1 feet\)](#) of absolute sea-level rise by the end of this century.

The VIMS team has purposefully taken a more localized and timely approach, one designed to add maximum value for coastal residents, businesses, and governments.

Says Boon, "Our report cards show what sea level has been doing recently, what's happening now at your locality. Numerous studies show that local rates of sea-level rise and acceleration differ substantially from the global rates published by the IPCC and NOAA—a key result because local rates of relative sea-level rise give a direct indication of the extent to which homes, buildings, and roads are at risk of flooding."



The team's decision to use a subset of available tide-gauge data runs counter to the traditional approach taken by NOAA, the agency that operates [the nation's official network of tidal stations](#). "NOAA should be commended for their care in ensuring the continuity, consistency, and availability of the nation's long-term tidal datasets," says Boon. "But at the same time, a longer record isn't always better, especially when there's evidence of recent non-linear changes in the rate of sea-level rise like we see along the U.S. East Coast."

An earlier analysis by Boon showed that this acceleration began in 1987, at the center of a 36-year sliding window beginning in 1969—thus setting the start date for the VIMS report cards. This is decades after many U.S. tide-gauge stations began operation but within a span where many more stations now have complete or nearly complete records. Given recent evidence of ongoing warming, it makes sense in a nationwide, comparative study of sea-level change to analyze only those observations made over the same period of time.

Mitchell explains further, "If you cross a threshold in terms of something like sea-level rise, what came before—say a tide-gauge record that began in 1900—is biased in terms of seeing where you're going. We think ice sheets are melting faster today, and if that's true then the previous 90 years of data won't accurately predict the future."

The difference between the linear rates used in NOAA's sea-level forecasts and the non-linear, accelerating rates used in VIMS' report cards can lead to sharply different forecasts of our sea-level future. Extending NOAA's linear sea-level projections to mid-century for the tide gauge in Norfolk, Virginia indicates that sea level here will be 0.3 meters (11.4 inches) higher by 2050, while the VIMS forecast—using a non-linear, accelerating rate—is 0.51 meters, or 20.1 inches. That extra 21 centimeters (8.6 inches) of sea-level rise would have major implications for the low-lying region.

Provided by The College of William & Mary

Citation: U.S. sea-level report cards: 2020 again trends toward acceleration (2021, January 26)  
retrieved 16 August 2024 from <https://phys.org/news/2021-01-sea-level-cards-trends.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.