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## ODU Professor Co-Authors Study of the Sources of Sea Level Rise Since 1900

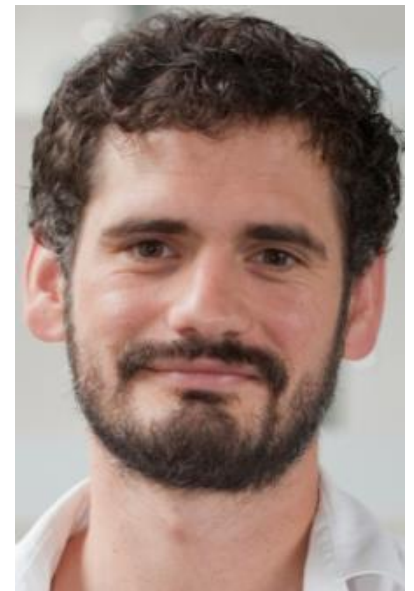
October 16, 2020

By Tiffany Whitfield

Sönke Dangendorf, an assistant professor of ocean, earth and atmospheric sciences at Old Dominion University, is a co-author of a paper recently published in the scientific journal *Nature* that examines sea level rise since 1900.

Scientists from across the globe used new datasets and developed novel techniques to fill in the gaps from a century ago for the study, titled "The Causes of Sea Level Rise Since 1900."

In addition to scientists from NASA's Jet Propulsion Laboratory in Southern California (JPL) and ODU, the project involved researchers from Caltech, Université Catholique de Louvain in Belgium, University of Siegen in Germany, the National Oceanography Centre in the United Kingdom, Courant Institute in New York, Chinese Academy of Sciences and Academia Sinica in Taiwan.



Sönke Dangendorf

Lead researcher Thomas Frederikse, a postdoctoral fellow at JPL led the international team that developed a framework that pulls together historic measurements along with improved estimates from satellite data helped the multi-disciplinary scientists better interpret the known contributors to sea level rise from 1900 to 2018, ultimately providing a new validation benchmark for models that are used to predict rising seas in the future.

"Tide-gauge data was the primary way to measure sea level before 1992, but sea level change isn't uniform around the globe, so there were uncertainties in the historic estimates," Dangendorf said. "Also, measuring each of the factors that contribute to global mean sea levels was very difficult, so it was hard to gain an accurate picture."

The researchers found that estimates of global sea level variations based on tide-gauge observations had slightly overestimated global sea levels before the 1970s. They also found that mountain glacier meltwater was adding more water to the oceans than previously realized but that the relative contribution of glaciers to sea level rise is slowly decreasing. At the same time the

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contribution of the Antarctic and Greenland ice sheets has been accelerating over the last two decades. The team discovered that glacier and Greenland ice sheet mass loss explain the increased rate of sea level rise before 1940.

The latest satellite observations came from the pair of NASA/German Aerospace Center (DLR) Gravity Recovery and Climate Experiment (GRACE) satellites that operated from 2002-2017, and their successor pair, NASA/German Research Centre for Geosciences (GFZ) GRACE Follow-On (launched in 2018). Additional data from a series of TOPEX/Jason satellites - a joint effort of NASA and the French space agency Centre National d'Etudes Spatiales - that have operated continuously since 1992 were included in the analysis to enhance tide-gauge data.

The new study also found that during the 1970s, when dam construction was at its peak, sea level rise slowed to a crawl. Dams create reservoirs that store freshwater that would normally flow straight into the sea which, for instance, helped to prevent flooding.

"That was one of the biggest surprises for me," Frederikse said. "We impounded so much freshwater humanity nearly brought sea level rise to a halt."

The study showed that on average sea levels have risen 1.6 millimeters (0.063 inches) per year between 1900 and 2018. It also demonstrated that sea levels are now rising at a faster rate than at any time in the 20th century.

Collecting satellite observations helped to better interpret the data about how regional ocean salinity changes and thermal expansion affects some parts of the world more than others. Up-and-down movements of Earth's crust influence the regional and global level of the oceans as well, so these aspects were included in the team's analysis.

"That was a problem," Frederikse said. "How could we trust projections of future sea level change without fully understanding what factors are driving the changes that we have seen in the past?"

But over the past two decades, scientists have been "flooded" with satellite data, added Dangendorf, which has helped them precisely track the physical processes that affect sea levels.

"With the GRACE and GRACE-FO data we can effectively back-extrapolate the relationship between these observations and how much sea level rises at a particular place," said Felix Landerer, project scientist at JPL for GRACE-FO and a coauthor of the study. "All observations together give us a pretty accurate idea of what contributed to sea level change since 1900, and by how much."