

U.S. threatened by more frequent flooding

September 11 2017



Blue sky, calm weather and streets flooded: This combination is characteristic for nuisance floodings. Credit: Shimon Wdowinski/University of Miami

The East Coast of the United States is threatened by more frequent flooding in the future. This is shown by a recent study by the

Universities of Bonn, South Florida, and Rhode Island. According to this, the states of Virginia, North Carolina, and South Carolina are most at risk. Their coastal regions are being immersed by up to three millimeters per year – among other things, due to human intervention. The work is published in the journal *Scientific Reports* by the Nature Publishing Group.

Cities such as Miami on the East Coast of the USA are being affected by flooding more and more frequently. The causes are often not hurricanes with devastating rainfall such as Katrina, or the recent hurricanes Harvey or Irma. On the contrary: flooding even occurs on sunny, relatively calm days. It causes damage to houses and roads and disrupts traffic, yet does not cost any people their lives. It is thus also known as 'nuisance flooding'.

And this nuisance is set to occur much more frequently in the future. At least researchers from the Universities of Bonn, South Florida, and Rhode Island are convinced of this. The international team evaluated data from the East Coast of America, including GPS and satellite measurements. These show that large parts of the [coastal region](#) are slowly yet steadily sinking into the Atlantic Ocean.

"There are primarily two reasons for this phenomenon," explains Makan A. Karegar from the University of South Florida, currently a guest researcher at the Institute of Geodesy and Geoinformation at the University of Bonn. "During the last ice age around 20,000 years ago, large parts of Canada were covered by an ice sheet. This tremendous mass pressed down on the continent." Some areas of the earth's mantle were thus pressed sideways under the ice, causing the coastal regions that were free of ice to be raised. "When the ice sheet then melted, this process was reversed," explains Karegar. "The East Coast has thus been sinking back down for the last few thousand years."

This geological effect explains the submerging of the coastal regions, but only in part. In the last decade, the area between 32 and 38 degrees latitude has been sinking more quickly than in the previous millennia – in some cases, by more than three millimeters a year. The melting of the [ice sheet](#) is responsible for a maximum of a third of this.

The researchers assume that it is caused by the significant use of groundwater in the corresponding region. Water allows the land mass to swell up to some degree – similar to carbon dioxide bubbles in cake mix. "When groundwater is removed, the [land mass](#) can be compressed more greatly," says Karegar. "It practically collapses into itself and thus sinks even more."

"Depending on the distance from the sea, the creation of reservoirs can also contribute to the sinking or even the raising of the coastal [region](#)," says Prof. Jürgen Kusche from the Institute of Geodesy and Geoinformation. "This effect was taken into account with the help of [satellite measurements](#), which were evaluated in our working group."

60 centimeters in 300 years

Many cities on the East Coast of America were founded at the end of the 16th or start of the 17th centuries. The researchers have calculated that these cities lie at least 45 centimeters lower today than back then, solely due to the glacier effect. In recent years, they have even been sinking much more rapidly in some places due to the removal of groundwater. A further factor is the rising sea level due to global warming, an effect that now also totals more than three millimeters per year and is responsible for another 15 centimeters of submerged land.

This increase is set to gain much more momentum in the future. "Even if the removal of groundwater is reduced, the number of floods will thus continue to increase," predicts Karegar. "The sums of money that need

to be spent to rectify the damage associated with this will also increase significantly. One should, therefore, assume that the USA has a vested interest in combatting climate change with all its resources."

More information: Makan A. Karegar et al. Nuisance Flooding and Relative Sea-Level Rise: the Importance of Present-Day Land Motion, *Scientific Reports* (2017). DOI: [10.1038/s41598-017-11544-y](https://doi.org/10.1038/s41598-017-11544-y)

Provided by University of Bonn

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