Study examines increasing likelihood of extreme sea levels

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A family is evacuated during the great storm of 1953. Credit: Canterbury City Council

Scientists at the University of Southampton are warning that future coastal impact studies must take account of extreme sea levels – a phenomenon expected to occur more frequently as rising waters combine with high tides and storm surges to potentially devastating effect.

A new study published today in *Nature Communications* – led by the University of Central Florida and involving experts from Southampton,

Germany and the Netherlands – suggests that extreme events currently expected to happen on average once every 100 years could, in vulnerable coastlines around the world, occur every decade or even every year by 2050.

As sea levels continue to rise because of global warming, much less intense and far more frequent moderate storms could cause as much damage to vulnerable coastal communities in the future as currently only occurs during rare extreme storms.

Densely populated coastal regions of the USA and large parts of Australia and Europe, including the UK, are thought to be particularly at risk from these future extreme sea levels.

The researchers suggest that vulnerable communities can protect themselves by creating or upgrading infrastructure such as dykes, pumping systems and barriers. New building regulations or flood zones to prevent new infrastructure from being built in high-risk areas could also help mitigate the effects of future extreme sea levels.

Researchers used an extensive new global tide gauge database (gesla.org) and state-of-the-art statistical models to quantify for the first time how ongoing processes such as rising sea levels and different analysing techniques could affect future predictions of extreme sea levels, which lead to coastal flooding and erosion.

Using a representative sample of 20 different statistical methods for predicting extreme sea levels, they focused on better estimating the uncertainty that accompanies any prediction to give a more accurate range of possible future conditions.

Study co-author Dr Ivan Haigh, Associate Professor in Coastal Oceanography at the University of Southampton, said: "It is particularly

important to better estimate uncertainties in future predictions of extreme sea levels to provide the best possible guidance for designing flood defence upgrades. Our new results have, for the first time, considered all of the main uncertainties in future predictions of extreme sea levels globally.

This improves our confidence in what extreme sea levels might look like in coming decades and helps us to identify hotspot areas of major concern, where significant upgrades to flood protection and other measures are urgently needed."

The research was carried out to make data about extreme events part of the ongoing research and planning required to help at-risk communities prepare for conditions that may be dramatically different in the not-too-distant future.

Lead author Thomas Wahl, an assistant professor at the University of Central Florida, added: "Storm surges globally lead to considerable loss of life and billions of dollars of damages each year, and yet we still have limited understanding of the likelihood and associated uncertainties of these extreme events both today and in the future."

Robert Nicholls, a Professor in Coastal Engineering at the University of Southampton, also involved in the study, said: "In the UK, the damage we have seen from recent storm events has been limited compared to the tragedy of January 1953, during which 307 people were killed along the UK's North Sea coast, and this is thanks to significant Government investment in coastal defences, flood forecasting and sea level monitoring.

"Our study has shown that extreme sea levels will increase dramatically in coming decades. It is therefore vital we continue to invest in defences, forecasting and monitoring."

More information: T. Wahl et al. Understanding extreme sea levels for broad-scale coastal impact and adaptation analysis, *Nature Communications* (2017). DOI: 10.1038/ncomms16075