New model accurately predicts how coasts will be impacted by storms and sea-level rise

July 7 2021, by Alan Williams

The beach at Perranporth in North Cornwall (UK) has already been dramatically affected by the effects of extreme storms and sea-level rise. Credit: University of Plymouth

Coastal communities across the world are increasingly facing up to the huge threats posed by a combination of extreme storms and predicted rises in sea levels as a result of global climate change.

However, scientists at the University of Plymouth have developed a simple algorithm-based model which accurately predicts how coastlines could be affected and—as a result—enables communities to identify the

actions they might need to take in order to adapt.

The Forecasting Coastal Evolution (ForCE) model has the potential to be a game-changing advance in coastal evolution science, allowing adaptations in the shoreline to be predicted over timescales of anything from days to decades and beyond.

This broad range of timescales means that the model is capable of predicting both the short-term impact of violent storm or storm sequences (over days to years), as well as predicting the much longer-term evolution of the coast due to forecasted rising sea levels (decades).

The computer model uses past and present beach measurements, and data showing the physical properties of the coast, to forecast how they might evolve in the future and assess the resilience of our coastlines to erosion and flooding.

Unlike previous simple models of its kind that attempt forecasts on similar timescales, ForCE also considers other key factors like tidal, surge and global sea-level rise data to assess how beaches might be impacted by predicted climate change.

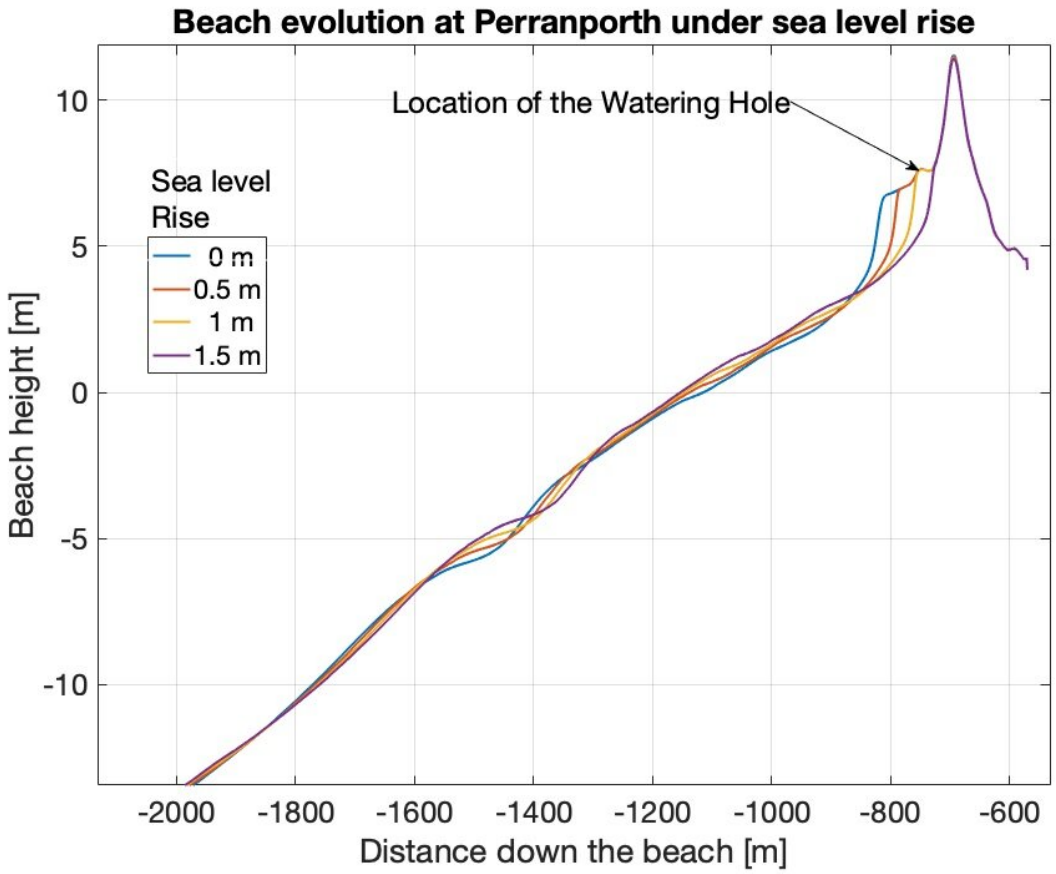
Beach sediments form our frontline of defence against coastal erosion and flooding, preventing damage to our valuable coastal infrastructure. So coastal managers are rightly concerned about monitoring the volume of beach sediment on our beaches.

The new ForCE model opens the door for managers to keeping track of the 'health' of our beaches without leaving their office and to predict how this might change in a future of rising sea level and changing waves.

Model predictions have shown to be more than 80% accurate in current tests, based on measurements of beach change at Perranporth, on the

north coast of Cornwall in South West England.

It has also been show to accurately predict the formation and location of offshore sand bars in response to extreme storms, and how beaches recover in the months and years after storm events.



This charts show how the projected rise in sea level over the next 60 years could affect the beach at Perranporth in North Cornwall (UK). Credit: Mark Davidson, University of Plymouth

As such, researchers say it could provide an early warning for coastal

erosion and potential overtopping, but its stability and efficiency suggests it could forecast coastal evolution over much longer timescales.

The study, published in Coastal Engineering, highlights that the increasing threats posed by sea level rise and coastal squeeze has meant that tracking the morphological evolution of sedimentary coasts is of substantial and increasing societal importance.

Dr. Mark Davidson, Associate Professor in Coastal Processes, developed the ForCE model having previously pioneered a traffic light system based on the severity of approaching storms to highlight the level of action required to protect particular beaches.

He said: "Top level coastal managers around the world have recognised a real need to assess the resilience of our coastlines in a climate of changing waves and sea level. However, until now they have not had the essential tools that are required to make this assessment. We hope that our work with the ForCE model will be a significant step towards providing this new and essential capability."

The University of Plymouth is one of the world's leading authorities in coastal engineering and change in the face of extreme storms and sea-level rise.

Researchers from the University's Coastal Processes Research Group have examined their effects everywhere from the coasts of South West England to remote islands in the Pacific Ocean.

They have shown the winter storms of 2013/14 were the most energetic to hit the Atlantic coast of western Europe since records began in 1948, and demonstrated that five years after those storms, many beaches had still not fully recovered.

Case study

Researchers from the University of Plymouth have been carrying out beach measurements at Perranporth in North Cornwall for more than a decade. Recently, this has been done as part of the £4million BLUE-coast project, funded by the Natural Environment Research Council, which aims to address the importance of sediment budgets and their role in coastal recovery.

Surveys have shown that following extreme storms, such as those which hit the UK in 2013/14, beaches recovered to some degree in the summer months but that recovery was largely wiped out in the following winters. That has created a situation where high water shorelines are further landward at sites such as Perranporth.

Sea level is presently forecast to rise by about 0.5m over the next 100 years. However, there is large uncertainty attached to this and it could easily be more than 1m over the same time-frame. If the latter proves to be true, prominent structures on the coastline—such as the Watering Hole bar—will be under severe threat within the next 60 years.

More information: Mark Davidson, Forecasting coastal evolution on time-scales of days to decades, *Coastal Engineering* (2021). DOI: 10.1016/j.coastaleng.2021.103928

Provided by University of Plymouth