

A family evacuated in Whitstable, Kent, during the 'Great Storm' of 1953. These floods killed 307 people in eastern England and were the catalyst for the construction of the Thames Barrier.



Canterbury City Council 2015

A century of UK coastal flooding

Ivan Haigh and Elizabeth Bradshaw describe SurgeWatch, a new database of coastal floods that's set to revolutionise our understanding of how and why these destructive events happen – and of how to limit the damage.

Coastal floods, caused by high sea levels, are a serious global hazard. In the last decade we have witnessed major events including two of the most costly natural disasters in US history: Hurricanes Katrina (in 2005) and Sandy (in 2012). Coastal flooding from these two events killed thousands of people and caused damage worth hundreds of billions of dollars.

In 2008 Cyclone Nargis generated a 5m storm surge along the coast of southern Myanmar, sweeping seawater 50km inland and killing a staggering 130,000 people. In 2013, Typhoon Haiyan swept across the central Philippines, killing 8,000 people and destroying a million homes; much of the damage was due to high sea levels.

During the winter of 2013/14, an unusually severe sequence of coastal flooding occurred in the UK. Over this period storms repeatedly subjected large areas of the coast to enormous stress and caused extensive damage.

These events are a reminder of the ever-present risks facing coastal communities; risks that will increase over the coming century as sea levels rise and coastal populations continue to grow. To plan effectively for the future, we need better information on the occurrence, causes and consequences of coastal flooding.

What causes coastal flooding?

Coastal flooding happens because of a combination of high tides, storm surges and waves. A storm surge is a temporary large-scale rise in sea level caused by strong winds pushing water towards the coast where it 'piles up', and by low pressure at the centre of storms – this 'pulls' the sea surface up by about 1cm for every millibar that air pressure drops. Often, the worst coastal flooding occurs when the peak storm surge coincides with high spring tide. Storms can also produce large waves, which can overtop coastal defences and cause erosion.

A long history of flooding in the UK

The UK coastline has been subject to terrible floods throughout history. Records suggest that coastal floods killed 100,000 people in the UK in 1099, with similar death tolls in 1421 and 1446. Up to 2,000 people drowned around the Bristol Channel in 1607, the greatest loss of life from a natural catastrophe in the UK in the last 500 years.

In 1703 a severe storm washed away the lowest street of houses in the village of Brighthelmstone (today's Brighton). Daniel Defoe, the author of *Robinson Crusoe*, wrote an interesting account of the events in *The Storm*. He described the aftermath of the flood as 'the very picture of desolation' and wrote that 'it looked as if an enemy had sacked' the towns affected.

The worst natural disaster to affect the UK in modern times was the 'Big Flood' of early 1953. 307 people were killed in South-east England and 24,000 fled their homes, while almost 2,000 lives were lost in the Netherlands and Belgium. This was the driving force for the creation of the Thames Storm Surge Barrier and other flood defence schemes around the country. It also led to the establishment of the UK Coastal Monitoring and Forecasting Service. Today, this provides warnings of impending high sea levels, helping people prepare for flooding emergencies.

2013/14 storm surge season

Over the winter of 2013/14, these flood defence and forecasting services were tested on a national scale when storms and floods relentlessly hit the UK coast, triggering intense media coverage and public attention. On several occasions the government assembled the Cobra crisis committee.

Particular events stand out. First, the storm on 5-6 December 2013 that generated what was widely referred to as 'the biggest storm surge for 60 years' and flooded 2,800 homes and 1,000 businesses. Second, the storm in early February that destroyed the Dawlish railway in Devon. Third, the dramatic 'Valentine's Day Storm', which placed the south coast under severe flood alert.

The fact that the damage was so limited during these storms, compared to the tragedy of 1953, is thanks to significant government investment in coastal defences, flood forecasting, sea-level monitoring and improved communications. However, 2.5 million people and £150 billion of assets are still at risk from coastal flooding in the UK today.

On top of this there is currently no nationwide system in place to record which high sea levels caused coastal flooding, and to record information on how often this happens and what the consequences are. This limits our ability to understand coastal flood risks and makes it difficult to assess how unusual 2013/14 really was.

SurgeWatch: A new coastal flooding database

This led a team of scientists from the University of Southampton, National Oceanography Centre, and the British Oceanographic Data Centre to create a 100-year database of coastal flooding in the UK, called SurgeWatch. We compiled data on the 96 largest events over this period, with information on the storm that generated each event, the high water levels recorded during the events and the severity of coastal flooding.

We also developed a website (www.surgewatch.org) to make the information freely and easily accessible to a wide range of users including scientists, coastal engineers, managers and planners.

We are aiming to expand the database and are appealing for the help of the general public. Do you have any photographs of coastal flooding from recent or past events which you are willing to share? Photos can be easily uploaded to www.surgewatch.org/contribute-photos. We want to investigate these in order to improve understanding of exactly which areas were flooded and to what water depth.

Please don't put yourself at risk to take photos, though.

Preventing future flooding

Coastal flooding remains a threat to life and economic assets in the UK and we hope SurgeWatch will provide crucial information to help prevent it in future. The database has let us identify which historic storms resulted in the worst coastal flooding over the last century, and we have mapped the specific paths of the storms responsible.

What is particularly clear is that coastal flooding 'clusters'. You get seasons and even decades of calm, with relatively few floods, and other periods when they occur in rapid succession. 2013/14 was a particularly unusual season, in that seven out of the 96 events in the 100-year database occurred during this period; no other season has had so many large floods in the last century. Two of the events in 2013/14 (5–6 December 2013 and 3 January 2014) rank in the top ten for sea-level height. Both also rank highly in terms of spatial footprints – that is, they struck very long stretches of the UK coast.

Now that we know more accurately which seasons and decades had the most coastal flooding, we are examining properties of the North Atlantic the year before, such as the temperature of the sea surface, to see if this gives any clues to how stormy the following season may be. If there are links that show the ocean contributes to storm clustering, we may be able to develop seasonal predictions that could supplement the short-term forecasting provided by the UK Coastal Monitoring and Forecasting Service. If we can give coastal communities more warning, perhaps the losses of life and property they suffer from flooding can continue to fall even as sea levels rise.

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