After the flood: Harnessing the power of mud

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Mudflat and marsh at Abbots Hall, Essex. Credit: Dr Iris Moller

(Phys.org)—On the 60th anniversary of the 'big flood' that devastated the coastline of eastern England, new research shows that integrating 'natural' sea defences such as salt marshes with sea walls is a more sustainable and effective method of flood prevention.

Sixty years ago tonight, a storm surge in the North Sea caused catastrophic flooding on the coast of eastern England. The 'big flood' of 1953 inundated more than 65,000 hectares of land, damaged 24,000

houses and around 200 important industrial premises, resulting in 307 deaths in the immediate flooding phase.

In the aftermath, sea defences were developed and major protection schemes were implemented – the eventual construction of the Thames Barrier being the most conspicuous example. Warning services and emergency responses to flooding became coordinated at a national level, something which hadn't existed in 1953.

But many of these reinforcements will reach the end of their design life in the next decade. Experts analysing storm surge height and wave activity believe the flood to be a once every 50 year event – it will happen again, they say, it is only a question of when.

Environmental changes and possible sea-level rises hadn't been properly anticipated when protection schemes commenced, and UK coastal populations have risen by up to 90% in certain areas since 1953 – many designated as high flood risk.

"Such contexts call for more research into complexities of storm surge dynamics, strengthening of coastal planning policy and a more nuanced approach to coastal engineering," said Dr Tom Spencer, Director of the Cambridge Coastal Research Unit (CCRU) from the Department of Geography.

The CCRU are currently researching the effectiveness of the natural flood defences offered by coastal ecosystems such as salt marshes and mud flats. They suggest a 'hybrid engineering' approach, combining sea walls with natural ecosystems. Such ecosystems not only provide flood protection but store carbon, filter pollutants and increase biodiversity. Over recent years, these important habitats have become "squeezed out" by rising sea levels and hard sea defences.

The research is part of a six year programme involving 14 other institutions, funded by the Natural Environment Research Council. The teams are focusing on the marshlands of the Essex coast and Morecambe Bay.

"We already know that some of the Essex marshes regularly reduce the energy of waves by up to 90% over a distance of 80 metres or so," said Dr Iris Möller, Lecturer in Physical Geography at Fitzwilliam College and co-investigator on the project.

"Hard defences are expensive and doomed to fail or incur ever-increasing costs. A key priority is the need to restore a natural coastal 'buffer' zone, free from human occupation and compatible with the 'inbuilt' ability of the coast to respond dynamically to environmental change – such as sea level rise or more frequent storms."

The researchers say they now have the technology to accurately measure wave depth and energy across marshes and mud flats, providing engineers and policy makers with the information they need to show the effectiveness of ecosystem-inclusive sea defence systems.

By installing a total of 42 wave recording devices at marshes in Essex and Morecambe Bay, with measurements controlled by solar-powered data logging systems, the team can track wave level and pressure variations as water moves across mud and vegetation. This information is continuously streamed back to Cambridge via mobile phone networks.

The team are finding that the mud and plants of the marshes naturally dissipate the ferocity of waves from storms, whereas just seawalls can alter the shape of the coast artificially, causing greater erosion through energy redistribution.

The Cambridge wave research is part of the Coastal Biodiversity and

Ecosystem Services Sustainability project, looking at the range of benefits natural ecosystems can provide – from carbon stores to pollution sinks as well as wave buffers – and how they can integrate with traditional flooding engineering.

"It is important to understand the value of varied habitats that make up the landscape of the UK," said Professor David Paterson, project leader from the University of St. Andrews. "Coastal systems are some of the most sensitive to pressures of climate change".

Adds Spencer: "It's vital that we also investigate the role of ecosystems in coastal risk reduction and how, through 'hybrid engineering', both types of approach to coastal defence can be brought together to reduce risks and provide a long-term and robust response to the threat of catastrophic coastal flooding."

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