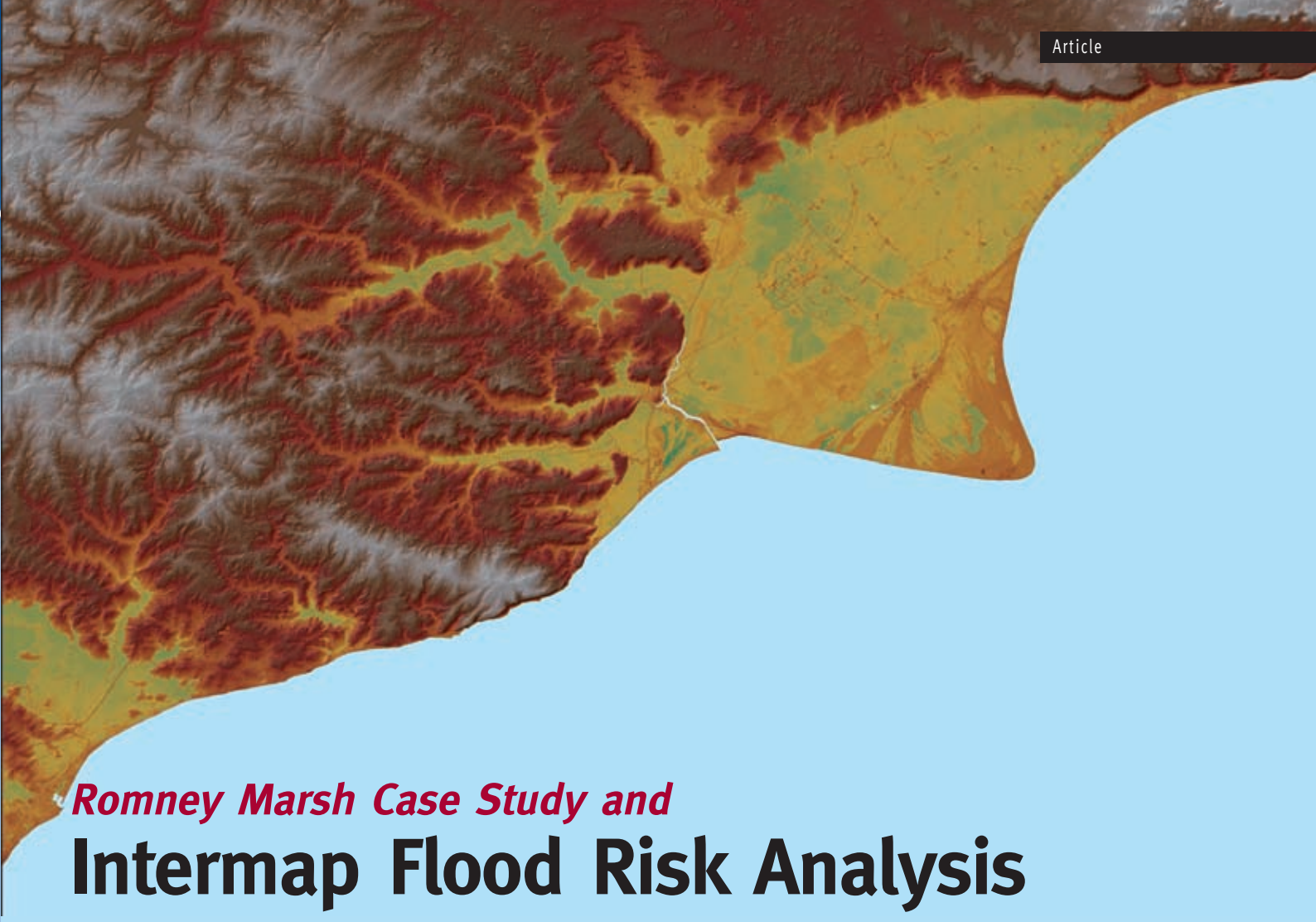


Romney Marsh Case Study and

Intermap Flood Risk Analysis

Insurers face their biggest UK flood bill in 20 years, with claims set to top 2 billion pounds after intense rain left swathes of central, northern and southern England under water. The bill from flooding across the central counties of Worcestershire, Gloucestershire and Herefordshire is likely to run into hundreds of millions of pounds, which comes on top of an estimated bill of 1.5 billion pounds from earlier flooding in June that hit central and northern England and caused chaos in the cities of Sheffield and Hull.

By Kevin Thomas

This unprecedented catastrophe comes in the wake of an attack on the UK Environment Agency's flood and costal defence budget by The National Audit Office (NAO) in early June, which slammed the EA's £176m budget as too focused on reactive repairs and lower-priority defence systems.

The writing was already on the wall. Seven years earlier, the autumn floods of 2000 in Britain marked the wettest autumn since records began in the 1700s; river catchments were saturated, and unable to hold water, which ran straight into the rivers. Of the 1.8 million premises at risk of flooding in the UK, about 9,000 were flooded: some on several occasions. Fortunately, then, as is not the case in 2007, there was no loss of life directly attributable to the flooding. Subsequently, that year, Intermap Technologies collected, processed, and archived 230,000 square kilometres of detailed digital mapping for all of England, Scotland, and Wales.

Intermap's NextMap Britain programme began with a pilot project undertaken in 1999 /2000. Willis Consulting, a flood risk consultant to the insurance industry, hired Intermap to acquire elevation data in the River Thames drainage basin for use in a new flood risk analysis system.

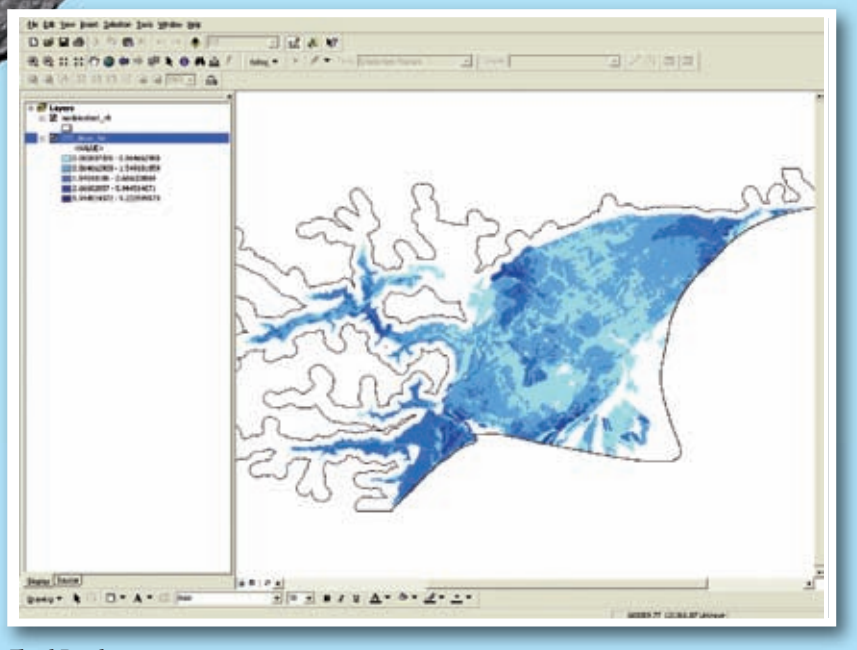
The 340 kilometre long River Thames is unique in that its regime changes from tidal (susceptible to storm surge) to non-tidal (susceptible only to rainfall induced flooding). Flood modelling has to consider this dual regime. There are 1.4 million residential and 100,000 commercial properties in the immediate vicinity of the river, with a population of approximately three million people.

Intermap's proprietary IFSAR system (Interferometric Synthetic Aperture Radar) was used to collect approximately 22,000 km² of Digital Elevation Models (DEM) and image data in support of the project.

Subsequently, every insurer with commercial or residential property portfolios in the Thames basin made use of the risk analysis system. The traditional method of assessing a flood risk by postal code has been rendered obsolete by this new technology that actually provides an address-specific (rooftop) flood risk assessment. Fortunately, on this occasion, the South East of England, home to the low lands of the Thames Estuary, was spared the travesty of relentless rain and flood risk. In the event, home owners and insurers would likely have been better prepared than middle England. It is this preparedness that is increasingly critical in the knowledge that "one hundred year events" are proving to be ever more frequent and with greater environmental impact.

Marsh Attack!

A good case in point lies some 50 miles south of the Capital, an area known as Romney Marsh in the Dungeness Peninsular with a costal focus between Folkestone and Cliff End on the English



Flood Depth

Channel. Here, in 2005 the local authority implemented a '100 year' flood risk management and coastal defence strategy using Intermap height data.

Most of the land behind this line of the British south coast is barely above sea level and some areas are well below, requiring a criss-cross of water dykes to drain the fertile farmland. It has provided an excellent wetland environment for an abundance of flora and fauna, as well as to the shingle habitats, which are arguably the most extensive in Europe. These habitats are recognised as protected, at an international level.

The Marsh has never been densely populated but the extent of the low lying area results in over 15,000 homes and businesses - including two of Britain's Nuclear Power Stations and the nearby Lydd Airport all being potentially within floodable areas.

Further, a long history of settlement has resulted in the presence of a surprising number of medieval churches and numerous other valuable features such as the unique fresh water and shingle habitats, and tourist attractions such as the Romney, Hythe and Dymchurch miniature railway.

The extensive coastline and sparse development creates an environment attractive for holidaying, resulting in the many holiday parks situated around the peninsula's coast. There is also the Royal Military Canal, which stretches for 28 miles hugging the old cliff line that borders Romney Marsh from Hythe in the north east to Cliff End. The canal was built as a third line of defence against Napoleon, after the British Royal Navy patrolling the English Channel, and a line of 74 Martello Towers were also built along the south coast. Today, it is used to manage water levels across much of the Marsh, and is integral to the area's flood protection.

1.4 million residential and 100,000 commercial properties in the immediate vicinity of the river Thames, with a population of approximately three million people.

In the recent UK government commission report 'Foresight Futures', the ecosystems of coastal marshes are highlighted as driven by both sea-level rise and flood-management policy. Coastal grazing marsh appears to be the most threatened coastal habitat as intertidal losses of salt-marsh and mudflat are likely to be offset by coastal realignment or abandonment of grazing marsh.

The flood risk management project was run by the Halcrow Group on behalf of the UK Environment Agency, focusing on developing a flood risk management and coastal defence strategy which would take into account anticipated climate change and sea level rise. The area is currently defended from flooding by a combination of man-made coastal and fluvial defences and very effective natural defences such as the sand dunes and shingle ridges.

Such a large low-lying area is potentially under threat from inundation from any part of the coast, or indeed from fluvial sources such as the River Rother, which outfalls at Rye.

Halcrow used Intermap's NEXTMap Britain Digital Terrain Model (DTM) supplied through the Environment Agency to identify what would happen if a defence were to fail in a particular place to better identify the risks.

Using Tuflow modelling software, it can be seen where and how far flood waters would flow in the event of a defence being overtopped or breached. Particular assets can then be identified in a particular area, such as houses, and business premises and in the case of the Dungeness Peninsular, the power stations and Lydd airport, and thereby estimate the likely damages of such a flood.

This estimate can then be used in a cost benefit analysis to appraise the economic justification for providing or improving flood defences. There are many complicated socio-economic factors to be considered and there is always a delicate balance between the cost of building more elaborate defences against the potential damage caused by a flood. The flood modelling also allows us to consider the potential impacts of inundation upon the valuable natural environment of the area.

The Halcrow Group used a NEXTMap DTM to calculate many different scenarios; for example flooding associated with extreme surge and storm events, both for present day and in the future including consideration of climate change. The implications of possible defence failure can also be calculated, by creating a hole in the defence line imposed onto the Digital Terrain Model.

The group looked at the areas with underlying OS mapping, and existing environmental datasets, but for a strategic study of this nature, they did not need to gather more detailed data such as ortho photos. Some LiDAR data was used to perform some QA of the NEXTMap DTM to establish that the data is suitable for use on this study.

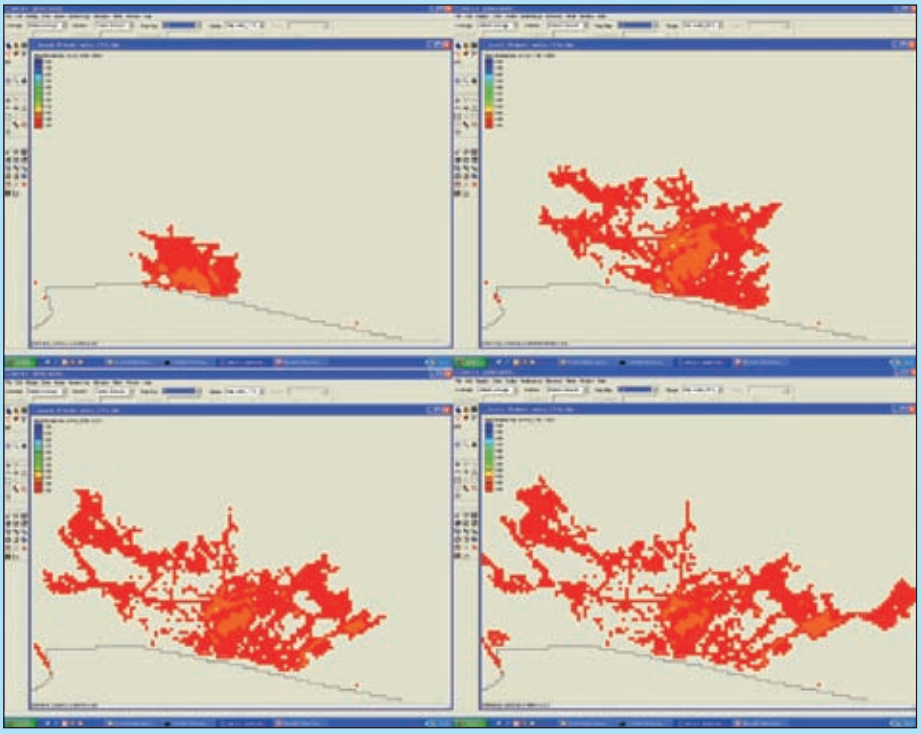
Romney Marsh

For the purposes of this project The Halcrow Group took the NEXTMap 5 meter data and gridded it up to 50 meters. This was done as the computational time involved running the Tuflow model for the full flood risk area using the denser 5m data would have been huge. Over the centuries, many smaller defences and dykes have been put in place which affect the way the water would flow in particular areas. The 5 meter data picks up many of these, but these are partially lost in gridding to 50 meters. At the back of the Dungeness peninsular for example is the Royal Military Canal, which is raised above the surrounding land.

The first step was to load the DTM and then overlay the height of the existing flood defences along the coast, many of which are not correctly represented in the DTM as their crest is narrower than 5 meters. The same was done for the banks and ditches around the Marsh areas. After this, a time series of water level data was run (to represent a tidal curve) against the edge of the defences and then run the model over different periods of time. When the height of the water exceeds the height of the defences, Tuflow calculates the volume of water that goes over that defence and uses hydraulic calculations to spread it across the DTM.

The model calculates water inputs and movements for every minute of the simulated period and creates outputs every thirty minutes, so it is possible to see how the flood waters propagate as the tide ebbs and flows. These can be run as animations over time which can be very useful when illustrating the potential flooding risks to stakeholders.

The review and understanding of potential flooding risks is then used to identify the potential social and environmental impacts of the various potential flood management options. The strategy then goes on to use the outputs from these appraisals to identify the preferred management approach for the next 100 years – or sooner.



Official Warning

One of the most important warnings to local and central governments in the UK to develop effective flood risk management strategies came from a group of experts commissioned to look at the risks by the Chief Scientific Adviser, Sir David King, under the Government's Foresight Programme, in 2004. Their report, Future Flooding, said that unless precautions were taken, more severe floods brought about by climate change could massively increase the number of people and the amount of property at risk.

Amidst all the news of communities being overwhelmed by water in June and July, one very significant announcement, from the Prime Minister, Gordon Brown and the Secretary of State for the Environment, Hilary Benn, was that the Government is setting up an independent inquiry to look at the flood events of June and July. Its report will be immensely important and may prove a milestone in terms of the British public's appreciation of the reality of climate change. It will doubtless focus on the key problem in terms of flood response - but it may also take a view of the disaster in terms of global warming, and may well come to the conclusion that we are already witnessing the future.

Kevin Thomas is Vice President, Marketing at Intermap Technologies. For more information on Intermap: www.intermap.com.