

Assessing the future impact of coastal change

Scottish Natural Heritage

The Challenge

- Gain an accurate understanding of the threats to Scotland's coastline from climate change

The Benefits

- Firm evidence on which to make projections about future coastal changes
- Insight into risks, allowing businesses to make better decisions about the placement of assets
- Greater public awareness of climate change
- Improved public sector collaboration on initiatives relating to coastal change



The Scottish Government, Scottish Natural Heritage and the University of Glasgow have collaborated in a ground-breaking project to map the potential future impacts of climate change on Scotland's coastline. Conducted using Esri's ArcGIS platform, the study helps government bodies, businesses and communities recognise erosion risks and improve their resilience to coastal change.

The Challenge

While Scotland is renowned for its spectacular coastal cliffs and scenic rocky coves, 19% of the country's 21,000 km of shoreline is formed of beaches, sand dunes and saltmarshes. Government and university experts are concerned about the potential long-term implications of climate change on these soft landforms, because they are highly susceptible to erosion, as well as accretion from the build-up of sediments along the coast.

The Scottish Government recognises the importance of the likely future impacts of climate change on Scotland's soft coastal landscapes and joined forces with Scottish Natural Heritage (SNH) and the University of Glasgow to undertake the country's first ever National Coastal Change Assessment. However, before researchers could begin to assess future risks, they first needed to understand what changes had taken place in the last 120 years, where they had occurred and the pace at which these changes had happened.

The Solution

With funding from Scotland's Centre of Expertise for Waters (CREW), researchers used Esri's ArcGIS Desktop to analyse geo-rectified historical maps from the 1890s and 1970s alongside modern maps and LiDAR surfaces. They used over a million data points in the soft, erodible sections of the Scottish shoreline and built up a fully interactive map, enabling them to not only depict a century of coastal change, but also calculate the rate of change for every 10 metres of the soft coast. The analysis showed an increase in erosion extent of 39%, a fall in extent of accretion of 22% and a doubling of erosion rates, above historic baseline levels.

Using this evidence base, the researchers then performed sophisticated spatial analysis to identify areas likely to experience future change. They highlighted the areas of anticipated future erosion in dark red on the map and included a ten metre erosion influence area, which together includes more than 50 buildings, 5 km of roads, 2 km of railway and 2 km of water pipes that may be threatened by erosion by 2050. Over £340m of assets are at risk if erosion continues, however, in total, £13bn of assets are protected by 'natural defences'.

Finally, the project team used Esri's ArcGIS Online platform to share its insight into coastal erosion via an accessible web map that everyone can easily view, interrogate and understand. Called [DynamicCoast.com](https://dynamiccoast.com), it enables people to browse every beach in Scotland, zoom in to view potential erosion risks at any location, using any device, whether they are at home, at work or standing on a beach. Lachlan Renwick, GIS Services Manager at Scottish Natural Heritage says, "If we had been doing this project five years ago, before ArcGIS Online, we wouldn't have been able to be as responsive to the original vision of the project and share our coastal change insight with everyone."

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ArcGIS Online displays the shoreline position at Montrose (Angus) in 1901, 1982 and 2011 and the likely future erosion by 2050, assuming recent rates continue.

The Benefits

Firm evidence of climate change along Scotland's coast

Using ArcGIS Desktop, researchers have gained tangible evidence about climate change, which they can use to make secure judgements about the future. “As scientists, we are all inherently cautious about making future predictions, yet as advisors we need to give advice to help the Scottish Government, businesses and citizens prepare for the future,” says Dr Alistair Rennie, Dynamic Coast Project Manager, Scottish Government. “The GIS-led research approach we developed gives us accurate, statistical evidence and allows us to provide objective recommendations with confidence.”

Improved resilience to climate change

By accessing DynamicCoast.com, the public and organisations can now easily find out how the continuance of past coastal changes may impact their property and assets and, as a result, make better informed decisions to reduce their longer term risks and costs. For instance, electricity suppliers can use the information to plan the installation of new electricity cables with more confidence, to avoid those areas where their condition and safety may be jeopardised by erosion or changing sea levels in the future. The University of Glasgow’s Prof. Jim Hansom, Principal Researcher for Dynamic Coast, says: “Ultimately the information in DynamicCoast.com helps Scotland, its businesses and communities become more resilient to climate change.”

Greater public awareness of coastal change

As the data is displayed on simple-to-use, interactive maps via ArcGIS Online, people with absolutely no prior experience of GIS can easily understand the implications of continued erosion and climate change on the areas of coastline where they live, work or visit. “For many climate change is a vague and distant topic, but everyone can now see for the first time, precisely how much change has happened and what the future impacts may be on the specific beaches they love,” Renwick says.

A collaborative response to the challenges of coastal change

The versatility of the ArcGIS platform, and the breadth of the analysis available, is the cornerstone of future collaboration between government bodies in Scotland and will lead to more joined-up responses to the challenges of coastal change. Organisations like SNH, SEPA, Historic Environment Scotland and Local Authorities can work more effectively together to assess the implications for threatened sites of historical and environmental interest and put strategies in place to protect and preserve them for future generations.

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