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Meeting report: Emerging technologies for monitoring the coastal zone

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There is a growing recognition of the value of monitoring coastal processes for nature conservation and coastal defence management purposes, particularly in light of future climate change impacts. Allied to the need for effective coastal monitoring is a realisation that new technologies can make a significant contribution to monitoring programmes both in terms of accuracy and cost efficiency. ICE's 'Emerging technologies for monitoring the coastal zone' conference, as reported in this paper, reviewed a variety of innovative technologies to assess how they may best be used in future coastal monitoring programmes.

A one-day conference organised by the Maritime Board was held as part of the Oceanology International exhibition at Excel, London. The conference brought together practitioners in the field of coastal monitoring and the scientists and engineers who are developing the technologies likely to be used to monitor coastal processes in the future.

A number of innovative local and regional coastal monitoring programmes are already delivering good-quality data to a variety of users in the UK and elsewhere (Dr Travis Mason and Dr John Howarth showed regional examples later in the conference). The managers of these programmes are interested in new technologies in terms of the potential benefits for data coverage, data quality and cost.

The conference began with John Goudie [Department for the Environment, Food and Rural Affairs (DEFRA)] stressing the need for a coordinated approach to coastal monitoring, and the importance of expanding the use of coastal data across a range of applications including, for example, coastal erosion risk assessments. Although monitoring is often well synthesised at a local and regional level, the need for a national coastal monitoring programme requires further investigation. The aim of such a programme would be to provide a consistent approach to data collection and analysis that is underpinned with an understanding of risk to people and the natural environment.

The use of Light Detection and Ranging (LiDAR) formed the basis of a number of presentations, with Crispin Hambridge (Environment Agency (EA)) firstly highlighting the substantial quantities of remotely-sensed data held by the EA. For example, 70 000 km^2 of LiDAR covering much of England and Wales is available, with multispectral satellite data also obtained for coastal monitoring purposes.

Trevor Burton from BKS Surveys showed low-level, high-resolution LiDAR and aerial photography collected from helicopters. He noted that although wet sand can prove an impenetrable surface for topographic modelling of this kind (due to absorption of the laser pulse by water), most other coastal surfaces are suitable for LiDAR survey with constantly improving degrees of accuracy.

Some terrestrial sources of LiDAR error were described by Chris Longmire (Canterbury City Council), who compared relative accuracies of beach profile topography derived from real-time kinematic global positioning system (GPS) and other survey methods. Again, the speed of LiDAR data acquisition over large areas is an advantage over in situ surveying, although GPS is still regarded as the best survey method for detailed beach surveys.

Chris Howlett (UK Hydrographic Office) explained how a blue-green laser LiDAR system has been used to measure seabed levels through clear shallow water. Although the resolution of this system cannot record the detailed seabed features of conventional bathymetric surveys, it can survey shallow water depths far faster than the narrow swath of a vessel-towed multibeam system. Coastal bathymetry was one of many uses of video cameras mounted in numbers on a coastline, as shown by Dr Mark Davidson of Plymouth University. Using the theory of photogrammetry, Dr Davidson explained that anything within the camera's field of view could potentially be quantified, including the impact of storms on coastal stability, identification of erosion hotspots, and high water exceedence curves.

New technologies used for high-resolution coastal mapping and shallow seismic profiling were the subjects of presentations by Dr Peter Balson (British Geological Survey) and Dr Justin Dix (National Oceanography Centre), respectively. Peter Balson showed how a laser scanner mounted on a stationary platform on a beach can quantify minute cliff movement in specific geological layers, or model beach topography if mounted on a cliff that allows a sufficient swath of the survey area. Justin Dix

exhibited an innovative surface-towed frame measuring pitch and roll of a sub-bottom profiler that allows three-dimensional mapping of features at sub-metre scales in coastal environments.

The nearshore wave recording network, which forms part of the strategic regional coastal monitoring programme for south-east England, was described by Dr Travis Mason (Channel Coast Observatory). Wave parameters from these buoys and fixed recorders have been used to verify the UK Meteorological Office wave model. The wave data (together with other coastal data collected as part of the programme) are freely available through the website (www.channelcoast.org), with further expansion of the wave network planned shortly. Furthermore, a national network of wave buoys providing online data is available from Wavenet at www.cefas.co.uk/wavenet. Dr David Woolf (National Oceanography Centre) then explained how satellites offer the potential for offshore wave monitoring. Although data resolution and frequency are limited to satellite tracks, such information has been used to improve predictions of wave models, and often shows good correlation with wave buoys.

Case studies demonstrating a combination of many of the previously described monitoring principles and techniques were presented by Graham Birch (Network Rail) and Dr John Howarth (Proudman Oceanographic Laboratory). Graham Birch presented work conducted on the Dover to Folkestone coastal rail link, which has been subjected to landslides over the last century, including details of the use of satellite interferometry to record ground movements. Monitoring of the Irish Sea and surrounding coastline using ferry-mounted sensors, high-frequency radar, satellite imagery and physical models, for example, have allowed Dr Howarth and his team to assimilate a detailed hydrodynamic and oceanographic understanding of this region. Such data are provided to researchers, coastal managers and the general public through the programme's website (http://cobs.pol.ac.uk/).

Fola Ogunyoye (Royal Haskoning) concluded the conference by underlining the importance of being clear as to the purpose of collecting coastal data before embarking on a monitoring campaign. Although many data sets are eventually used for multiple purposes, time and money can be saved by considering the exact requirements of a project before large (and sometimes unnecessary) data sets are collected.

Throughout the day there were lively and informed discussion sessions on both the papers presented at the conference and on the wider issues of coastal monitoring. It was clear that there is a growing recognition of the importance of monitoring natural processes in the coastal zone primarily for coastal defence and nature conservation purposes. Further, the range of techniques available is constantly expanding and provides coastal managers with a variety of options to employ, depending on the nature of the data required, the specifics of the site itself and the budget that is available.

More information on the topics discussed can be found at the websites given in Table 1.

BKS Surveys	http://www.bks.co.uk/
British Geological Survey	http://www.bgs.ac.uk/
Channel Coast Observatory	http://www.channelcoast.org
DEFRA	http://www.defra.gov.uk/
Environment Agency	http://www.environment-agency.gov.uk/
Liverpool Bay Coastal Observatory	http://cobs.pol.ac.uk/
National Oceanography Centre	http://www.noc.soton.ac.uk/
Network Rail	http://www.networkrail.co.uk/
Plymouth University	http://www.plymouth.ac.uk/
UK Hydrographic Office	http://www.ukho.gov.uk/
Wavenet	www.cefas.co.uk/wavenet/

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