The coastal environment

Sustaining coastal resources

Using geoscience to monitor and combat coastal hazards

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Coasts, and estuaries in particular, are some of the most complex environments on Earth. Their physical, chemical and biological settings are continually altering through exposure to forcing factors, such as waves, tides and seasonal cycles, and to changing irregular influences such as weather patterns or land-use in river catchments. Coasts and their adjoining shelf seas are also very important to society. Their landforms, such as coral reefs and sand spits, provide physical protection for areas vulnerable to marine coastal flooding and erosion. They are increasingly important economically, not only for ports, communication and transport, but also for the raw materials they provide for industry such as aggregates. They provide fishing grounds and nursery sites for fish breeding or aquaculture, and are one of the primary resources of an expanding tourism industry.

Many of man's economic activities have had serious negative impacts on the sustainability of coastal resources and the health of coastal environments. Some, such as over-fishing, coral mining or inappropriate sand and gravel dredging, are easy to identify. Others are less obvious, but they pose a much greater threat to society.

A direct effect of man's activities is the problem of coastal pollution. Litter and domestic sewage are easily recognised, but far more hazardous to coastal environments is the invisible threat posed by chemical pollutants. These are either inorganic substances (such as heavy metals) or organic complexes (such as oils, pesticides or fertilizers) that are absorbed by animals and plants. These pollutants may affect communities directly, for instance through the consumption of poisoned fish, or indirectly, by causing the destruction of fish stocks, or coastal ecosystems. Coastal pollution problems are likely to intensify with the growth of coastal megacities, and the increasing use of agrichemicals in river catchments.

Fish trap in Jakarta Bay, Indonesia. Fishing industries are commonly affected by coastal pollution.

Many physical coastal problems, such as erosion or siltation, result from the tendency for coasts to develop equilibrium states between physical form, sediment supply and tidal or wave energies. Whilst most of these physical problems are thus natural, some may be exacerbated by man's activities. For instance, localised erosion is commonly caused by man cutting-off the supply of sediments to a coast, such as on the Nile delta, where sediment supply to the coast has been minimal since the building of the Aswan Dam. Of greater concern is the increase in pressures on our coasts caused by global warming. This is likely to have been influenced by atmospheric build-ups of CO_2 caused by man burning fossil fuels. Global warming is predicted to bring with it sea level rise (the Intergovernmental Panel on Climate Change forecasts a rise of at least half a metre by the year 2050) along with greater storminess. These pressures are likely to greatly increase the future hazards of coastal erosion, siltation and flooding.

Society needs to recognise the value of its coastal resources and decide which need to be protected. It must aim to ensure that usage or exploitation of these is done in a sustainable fashion by developing appropriate policy, legislation and education, based on sound scientific principles. There is a need to assess, not only the resources themselves, but also the processes that affect them and the pressures these impose.

The application of geoscience has a major part to play in coastal resource and hazard management, especially because it gives a long-term perspective of coastal issues, that is largely unaffected by tidal or seasonal variability. BGS coastal geoscience expertise and information are being used by coastal zone managers in many ways. For instance, they have been used to quantify coastal aggregate, water or habitat resources, calibrate hydrodynamic models, assess (and monitor) the threat of coastal erosion, pollution and flooding, and predict coastal and estuarine response to sea level rise or increased storminess.