Sea level (including effects on coastal habitats)

What is the issue?

Sea-level rise (SLR) can cause flooding, coastal erosion and the loss of coastal regions. It reduces the return period for extreme water levels and threatens existing coastal ecosystems. Future impacts from SLR will be felt most keenly on low-lying coastlines with high population densities and relatively small tidal ranges (Kundzewicz *et al.*, 2001). Decisions on adaptation measures (e.g. coastal defence or re-alignment) will affect coastal communities and ecosystems.

What has happened and how confident?

Over the 20th century global average sea level rose at an average of 1.7 mm/yr. The rate of SLR varied from -0.3 mm/yr to 2.8 mm/yr along European coasts depending on the region.

Tide-gauge and satellite data-sets indicate an accelerated trend in SLR since about 1990 (Nerem *et al.*, 2006; Church and White, 2006; Rahmstorf, 2007). In 2008, the EEA reported this increased rate in the satellite data as 3.1 mm/yr during the previous 15 years. At present it is unclear whether this higher rate is part of a continual long-term acceleration in the rate of rise or is associated with shorter time-scale variability of the climate and sea-level system.

What might happen?

The UN Intergovernmental Panel on Climate Change projects in its Fourth Assessment report an overall level of rise during the 21st century of 0.18–0.59 m above the 1980–2000 level, but with large uncertainties attached to the upper limit associated with ice-sheet dynamics. Thermal expansion is the largest component in the IPCC projection, contributing 70–75 % for all scenarios. Glaciers, ice caps and the Greenland ice sheet are also projected to contribute to sea-level rise but with high uncertainty (IPCC, 2007a).

Average rates of 1.6±0.8 m per century of sea-level rise during the last inter-glacial (Rohling *et al.*, 2008) may give an insight to rises that cannot be discounted in the coming century, but there is no evidence to suggest this is currently happening.

SLR projections for Arctic coasts based on SRES scenarios indicate an increased risk of flooding and coastal erosion after 2050, but always lower than the risk in the North Sea (Johansson *et al*., 2004, Meier *et al*., 2004, 2006; Nicholls, 2004; EEA, 2008).

An additional 1.6 million people living in Europe's coastal zones could experience coastal flooding by 2080 (EEA, 2008).

Are there any OSPAR regional differences?

Change in absolute sea level is seen locally through changes in the sea level relative to the land. Land-level is responding to the millennial time-scale change of glaciation where land that was covered by ice is now rising. Relative sea-level rise is lesser in those areas experiencing isostatic uplift. The rate of uplift is not constant and some areas traditionally thought to be at low risk of significant changes in relative sea-level may be within range of SLR (Smith *et al*., 2000).

In Northern Europe, the removal of the great Eurasian ice sheets at the end of the last glacial period has led to a post-glacial ‘rebound’ of the land. Fennoscandia and Denmark were at the centre of the former ice mass, here the isostatic post-glacial rebound means that Sweden and Finland are subject to uplift at a rate that is leading to relative falls of sea level (Doody *et al*., 2004).

By contrast, beyond the edge of the former Eurasian ice masses, in the North Sea between Norway and Great Britain and extending through the north-western Netherlands and northern Germany, the collapse of the glacial ‘forebulge’, and re-filling of the ocean basins when the ice sheets melted mean that subsidence is apparent (Lowe *et al*., 2009).

In Iceland, melting of the four major ice caps since 1890 is leading to glacio-isostatic uplift of land in the centre and south-east of the country (Lund and Arnadottir, 2009). In Greenland, the response of the Greenland ice sheet to glacio-isostatic adjustment (both since the last glacial and through present-day wastage) largely leads to falling sea levels, particularly in the south-east where present day ice-loss is greatest and sea level could be falling at rates as high as a few mm per year (Fleming *et al*., 2009).

➥ *Go to the full QSR assessment report on impacts of climate change (publication number 463/2009)*

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