RMetS briefing paper

How climate change is affecting sea levels

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Why is sea level rise important?

Sea level rise increases the frequency and severity of storm surges and coastal flooding, causing serious damage to critical infrastructure and leading to the displacement of coastal communities around the world. Globally, more than 600 million people live in low-lying coastal areas at less than 10m elevation, and the population of these regions is expected to exceed 1 billion by 2050 (Neumann *et al*., 2015). In the United Kingdom, current annual damages from coastal flooding are estimated at over £500 million per year (Edwards, 2017), and costs of damage are likely to increase under projections of future sea level rise.

How much and how fast is sea level rising?

Since 1900, global mean sea level (GMSL) has risen by approximately 20cm (Church *et al*., 2013). The rate of sea level rise has increased throughout the twentieth and early twenty-first centuries, and it is currently rising at about 3.6cm per decade (Oppenheimer *et al*., 2019). Sea level rise varies locally from the global average, however, as a result of multiple factors, including changes in ocean temperature and circulation, gravitational effects and vertical land movement. Once vertical land movement is taken into account, regional mean sea level around the United Kingdom has risen by approximately 1.4cm per decade since 1900 (Kendon *et al*., 2018).

What causes sea level to rise?

Increasing global surface temperatures, resulting from human emissions of greenhouse gases (GHGs), cause the sea level to rise through two main processes (Church *et al*., 2013). First, the ocean warms up along with the surface temperature, causing the ocean to expand as it warms and therefore increasing sea level. Second, water that is currently stored on land in the form of ice is added to the oceans as glaciers and ice sheets melt, further increasing sea level.

How much will sea level rise in future?

The Intergovernmental Panel on Climate Change (IPCC) projected, in its recent Special Report on the Ocean and Cryosphere in a Changing Climate, that GMSL rise by 2100 will likely lie within the ranges of 29–59cm or 61–110cm (relative to 1986–2005) for a low- or high-emissions scenario, respectively (Oppenheimer *et al*., 2019). In addition, the IPCC Special Report on Global Warming of 1.5°C stated that GMSL rise by 2100 will likely be around 10cm less in a 1.5°C warmer world when compared with a 2°C warmer world (Hoegh-Guldberg *et al*., 2018). The latest regional projections for the United Kingdom were published in the UKCP18 report, with 2100 ranges of 8–49cm (low-emissions scenario) or 30–90cm (high-emissions scenario) for Edinburgh and 29–70cm (low) or 53–115cm (high) for London (Palmer *et al*., 2018). The largest source of uncertainty in all these projections is currently associated with quantifying the additional sea level rise contribution due to instabilities of the West Antarctic Ice Sheet, which remains the subject of ongoing research.

Beyond 2100, sea level will continue to rise for many centuries, even if GHG emissions are reduced to net zero in line with the 2015 Paris Agreement targets to limit global warming to 1.5°C or 2°C. However, the magnitude and the rate of this committed long-term sea level rise depend strongly on near-term emissions reductions in the coming decades. The sooner net-zero or net-negative GHG emissions are achieved, the more the rate of long-term sea level rise can be limited. If GHG emissions are left unchecked, the rate of sea level rise will further accelerate.

Acknowledgements

This paper was developed in collaboration with the Royal Meteorological Society's Climate Science Communications Group. The Society thanks Matt Palmer, Jonathan Gregory and Tamsin Edwards for reviewing the paper.

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doi:10.1002/wea.3716