Met Office

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Met Office Hadley Centre Climate Briefing Note

# Global sea level rise – the latest evidence

- Observations show sea levels are rising at an accelerating rate and human influence is the dominant cause.
- Climate projections show sea level will continue to rise for several centuries under all emissions scenarios, but reducing emissions slows the rate of increase.
- Potential future sea level rise under high emissions scenarios has been revised upwards in the last decade.
- Rising sea levels mean coastal flood events (e.g. associated with storm surges) will become more common and adaptation is needed.

## What has already happened to global sea levels?

Up-to-date observations show sea levels are not only rising, but also that the rate of that rise is accelerating[1,2] (see Figure 1). Melt from glaciers and ice sheets is now the largest contribution to total sea level rise, exceeding that of thermal expansion associated with ocean warming. The Intergovernmental Panel on Climate Change's (IPCC) Special Report on Oceans, Cryosphere and Climate Change (SROCC) concludes the evidence for human influence on sea level rise has increased since its 5th Assessment Report (AR5) published in 2013[3] – citing it now as the 'dominant cause' of sea level rise since 1970.

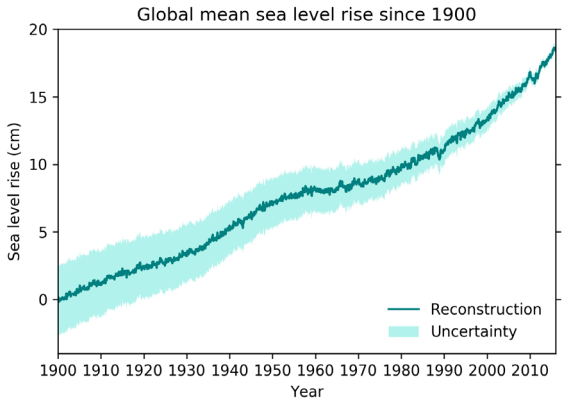


**Figure 1:** Observed global mean sea level rise based from the tide gauge reconstruction of Dangendorf et al (2019). Note the acceleration in the rate of sea level rise over the record, which is particularly clear after 1960.

## What will happen in future?

Climate projections presented in SROCC show sea level will continue to rise for several centuries under all emissions scenarios[4]. Under high emissions scenarios, 21st century projections of sea level rise have been revised upwards since AR5 owing to an increase in the projected loss of ice from the Antarctic ice sheet (Figure 2a). These revised projections show good agreement with independent work carried out at the Met Office for UKCP18[5].

[1] Daangendorf, S. et al (2019), Nature Climate Change: Persistent acceleration in global sea-level rise since the 1960s.

[2] Nerem, R. S., et al (2018), Proceedings of the National Academy of Sciences of the United States of America: Climate-change–driven accelerated sea-level rise detected in the altimeter era.

[3] Church, J. A., et al (2013): Sea Level Change. In Climate Change 2013: The Physical Science Basis. Contribution of Working Group 1 to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

[4] The lowest emissions scenario considered is RCP2.6, which is typically above 1.5C of warming

[5] Palmer, M. et al., 2018: UKCP18 Marine Report, 133pp.

The SROCC includes sea level rise projections beyond 2100 which highlight the long-term commitment to change, as well as the large uncertainties associated with looking at multi-century timescales (Figure 2b). Again, independent methods developed for UKCP18 show projections that are broadly consistent with those presented in SROCC at 2300. The extended projections highlight the potential for continued sea level rise in the coming centuries and the impact of reduced greenhouse gas emissions in mitigating long-term commitment.

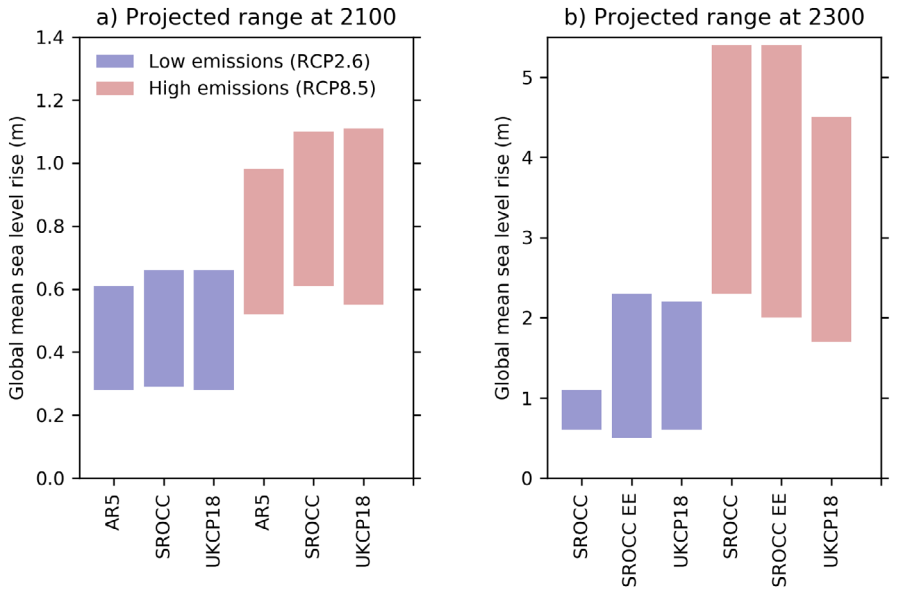


**Figure 2:** Projected ranges of sea level rise under low emissions (RCP2.6) and high emissions (RCP8.5) scenarios at: a) 2100 and then extended to b) 2300. The different reports are labelled as follows: "AR5" = IPCC 5th Assessment Report; "SROCC" = IPCC Special Report on Oceans and Cryosphere in a Changing Climate; "UKCP18" = UKCP18 Marine Projections Report. "SROCC EE" indicates projections based on expert elicitation study of Bamber et al (2019)[6]. All projections are presented relative to a baseline period of 1986-2005.

## What are the risks associated with sea level rise?

The SROCC links future sea level rise and increased coastal flood risk, finding that "Extreme sea level events that are historically rare (once per century in the recent past) are projected to occur frequently (at least once per year) at many locations by 2050 in all RCP scenarios, especially in tropical regions". Without adaptation measures, this will result in increased occurrence of severe flooding and other associated disruption. The report also notes the challenges of identifying effective adaptation strategies, as ecosystem-based approaches may become compromised under high emissions scenarios.

## What updates to the science can we expect?

A new set of state-of-the-art climate models, known as CMIP6 models, have been developed. These have more detail than ever before and their results are likely to provide updates on the potential range of sea level rise we could see. These models will contribute to the evidence base for the IPCC's next major report, AR6, which is due to be published from 2021. As well as the new models, this report will look at a new set of future emissions scenarios (called Shared Socioeconomic Pathways (SSPs)), which include a lower emissions scenario than was assessed in SROCC and AR5.

## How is the Met Office helping to advance our understanding of sea-level rise?

On century and longer timescales, a major uncertainty in sea level rise projections is the response of ice sheets. To address this research need, the Met Office is working with UK partners to develop representation of ice sheets in the UK Earth System Model (UKESM) and represent the feedbacks that take place between land, ice, ocean and atmosphere. These interactions are especially important in Antarctica where the ocean plays a key role in the melting of ice shelves, which could lead to accelerated global sea level rise. Sea level projections based on UKESM simulations with fully-coupled ice sheets for both Greenland and Antarctica should be available in the coming years.

Understanding the full range of potential sea level rise in the 21st Century is vital for those making adaptation and mitigation decisions for coastal communities. New work led by the Met Office will explore expert evidenced-based opinion to deliver a revised set of sea level rise upper estimates expressed as a function of confidence, enabling planners to choose appropriate values for their level of risk aversion.

[6] Bamber, J. L. et al (2019), Proceedings of the National Academy of Sciences: Ice sheet contributions to future sea-level rise from structured expert judgment.