WCRP World Climate Research Programme | CliC Climate and Cryosphere

2025

WCRP Status Brief

Current understanding of global sea-level rise

Sea level is currently rising by 4.7 mm a year and accelerating. It will keep rising for centuries under all emission scenarios.



Stormy seas at Dawlish, UK. Photo: @Moorefam via iStock (2025).

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ABOUT THE WCRP STATUS BRIEFS

WCRP Status Briefs explain, in non-technical language, where important and emerging climate science stands and what it means for society. They are written for decision-makers and the wider public.

This brief was produced by the **Climate and the Cryosphere (CliC) Project**, a core project of the World Climate Research Programme (WCRP), which coordinates fundamental climate research with all nations and across disciplines. More about who is behind this brief on page 7.

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AT A GLANCE

WCRP Status Brief

Current understanding of global sea-level rise

Sea level is rising faster. What we decide now sets the pace for centuries.

4.7 mm / year

Current rate of sea-level rise (average of the last 10 years)

1 billion people

hit by coastal hazards from sea-level rise by the end of the century

0.5 m by 2100

is unavoidable, even on a pathway consistent with the Paris Agreement

2 m by 2100

cannot be ruled out under high emissions, with rapid and irreversible West Antarctic ice loss

KEY POLICY-RELEVANT MESSAGES

WHAT WE KNOW

1. **Sea-level rise is accelerating** globally and **will continue for centuries** under all emission scenarios.
2. **Minimum estimates** of sea-level rise can be made with high confidence and planned for.
3. **There is deep uncertainty in the maximum** levels of sea-level rise that will need to be planned for.

WHAT TO DO

4. **Decisions made today on mitigation matter**: they set the timing and scale of future impacts.
5. **Deep reduction in greenhouse gas emissions** in line with the Paris Agreement 1.5°C target can avoid tipping points that would yield rapid, irreversible sea-level rise of several metres.
6. **Sustained engagement between policy-makers and scientists** is critical to turn sea-level knowledge into action.

TOP RESEARCH PRIORITIES

More in the full brief, page 6

1. Improve ice-sheet models and observations.
2. Deliver the Ice Sheet Model Intercomparison Project 7 (ISMIP7) for the IPCC Seventh Assessment Report.
3. Build consistent, actionable information with the people who use it.

IMPACTS

Why does sea-level rise matter?

1 billion
people living on the coast will be impacted by the end of the century.

4–72 million
people will need to migrate between 2020 and 2100.

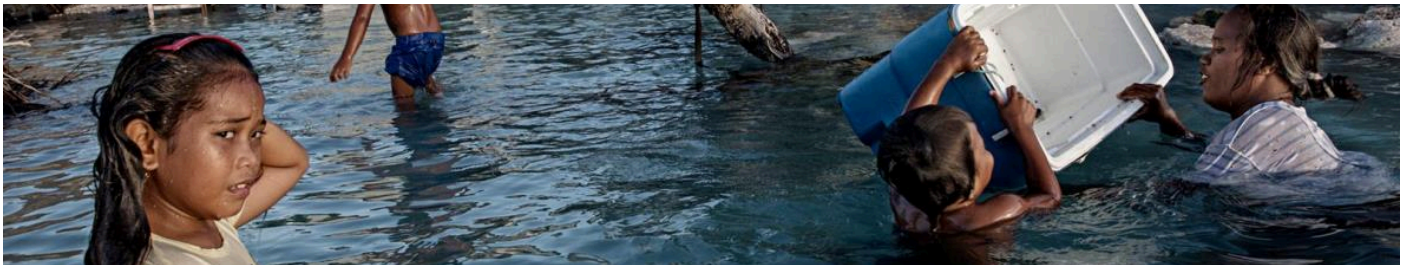
15 million
estimated to be displaced in Bangladesh alone by 2050.

THE RISKS

- Sea-level rise (SLR) affects coastal communities, infrastructure and ecosystems through permanent inundation of the lowest-lying areas and by increasing the frequency of flooding.
- Flooding brings wider impacts on the coastal environment: erosion, groundwater inundation, and salinisation of aquifers and floodplains.
- Coastal hazards and their impacts are **already occurring worldwide**. Near-term risks are projected to **escalate well before 2050**.
- How society copes beyond 2050 depends on its ability to anticipate and adapt and to curtail the acceleration of SLR. That ability depends on access to context-specific risk information and strategies tailored to local environmental, cultural and social settings, together with near-term and ongoing commitment to emissions mitigation.
- There are **hard limits to adaptation**, because SLR may become irreversible this century.
- Coastal inundation already threatens **habitability and sovereignty** for some small island developing states. Tuvalu and Fiji are already implementing relocation or managed retreat from the coast, or exploring new visions of a digital community.[1]

THE CONSEQUENCES

- It is estimated that between **4 and 72 million people** will need to migrate between 2020 and 2100, with a net land loss of 2,800 to 490,000 km².[2]
- The greatest numbers are in **Bangladesh, India and Vietnam**, but many are affected elsewhere. In Bangladesh alone, an estimated 15 million will be displaced by 2050.[3]
- Across the shared socio-economic pathways (SSPs) considered in the IPCC Sixth Assessment Report (AR6), the greatest estimated migration is under the high mid-range SSP3-7.0 scenario, because of population and economic differences between scenarios.[2]



Some small island and developing states are already near the limits of adaptation. Source: greenstories.co.in/kiribati-slowly-drowning.

OBSERVATIONS

How much and how fast is sea level rising?

Global mean sea-level rise, millimetres



2024 is a single year, shown against the longer-term average rates. Sources: references 4 and 5.

- Sea-level rise (SLR) depends almost equally on two contributors, both highly sensitive to climate change: the expansion of ocean waters as they warm, and meltwater from land ice (the Antarctic and Greenland ice sheets and thousands of smaller mountain glaciers).
- SLR is **accelerating**, due to faster land-ice loss and recent exceptional atmospheric and ocean warming.
- Tide-gauge records for 1970–2023, extended forward to 2050, support the mid-range IPCC AR6 projections of sea-level change by 2050. They show how useful real-world observations are for checking and narrowing model projections.[6]
- The likely range of global SLR by 2100, across all climate scenarios, is **0.4–1 m** ("likely" means about a two-in-three chance; Fig. 1, page 5).

SEA LEVEL WILL NOT RISE EVENLY

- The global average is often quoted, but rates will **differ between regions**, depending on which polar ice sheets melt fastest, shifts in Earth's gravitational field, axis of rotation and surface shape, and regional ocean and atmospheric dynamics.[7]
- Examples: in the western equatorial Pacific, rates of SLR are up to 20 mm a year due to regional ocean heating, against a global average of 4.7 mm a year. Along the US coastline, SLR could be up to 20% above the global average if the West Antarctic Ice Sheet melted dramatically.
- Local land subsidence can add to SLR. Causes include tectonics, groundwater and fluid extraction, and compaction from the weight of industrialisation.[8] Adaptation decision thresholds may be **brought forward by decades**.[9]

WHY FLOODING BECOMES MORE FREQUENT

- SLR raises the baseline water level, so even moderate storm surges, high tides and waves reach further inland and overtop defences that were once adequate.
- The effect is often **exponential**. Small amounts of SLR greatly increase the chance of a previously rare flood, quickly turning nuisance flooding into a chronic hazard.
- Future SLR combined with storm surge and heavy rainfall will increase compound flood risks.

FOR MANY COASTLINES

20–40 cm

of SLR is enough to turn a **one-in-100-year flood** into an **annual event**.

UNCERTAINTY

Is future sea-level rise uncertain?

The minimum can be planned for. The maximum is deeply uncertain.

- Despite recent advances in ice-sheet modelling, **deep uncertainty remains** about how accelerating ice loss from the Antarctic Ice Sheets will affect the high end of projections, especially beyond 2100. Processes at the ice margins and their feedbacks with the climate system are not yet well understood or represented.[10,11]
- This includes potential runaway processes such as marine ice cliff instability: very tall ice cliffs at the coast collapsing under their own weight, exposing taller cliffs behind so that retreat feeds itself.
- Scientists cannot yet discount some **low-probability but potentially catastrophic** scenarios that go well beyond the upper likely range of the high-emissions IPCC scenario (~102 cm by 2100).[12] For this reason IPCC AR6 stated that **2 m by 2100 cannot be ruled out**.
- Better models, forcing datasets and observations are urgently needed (see Research priorities, page 6).
- Until around 2070, differences between the forcing datasets of different climate models dominate uncertainty in global and regional projections.[13] After that, uncertainty depends on the emissions pathway and Antarctic ice-sheet melting processes.
- A recent study indicates that warming needs to be stabilised **well below 1.5°C** above pre-industrial to avoid damaging, multi-metre sea-level rise over the next few centuries.[14]
- Vertical land movement can be as fast as global sea-level rise. Its direction can offset or exacerbate the local change in relative sea level. These processes are poorly represented in the projections used for local coastal hazard and risk assessments.

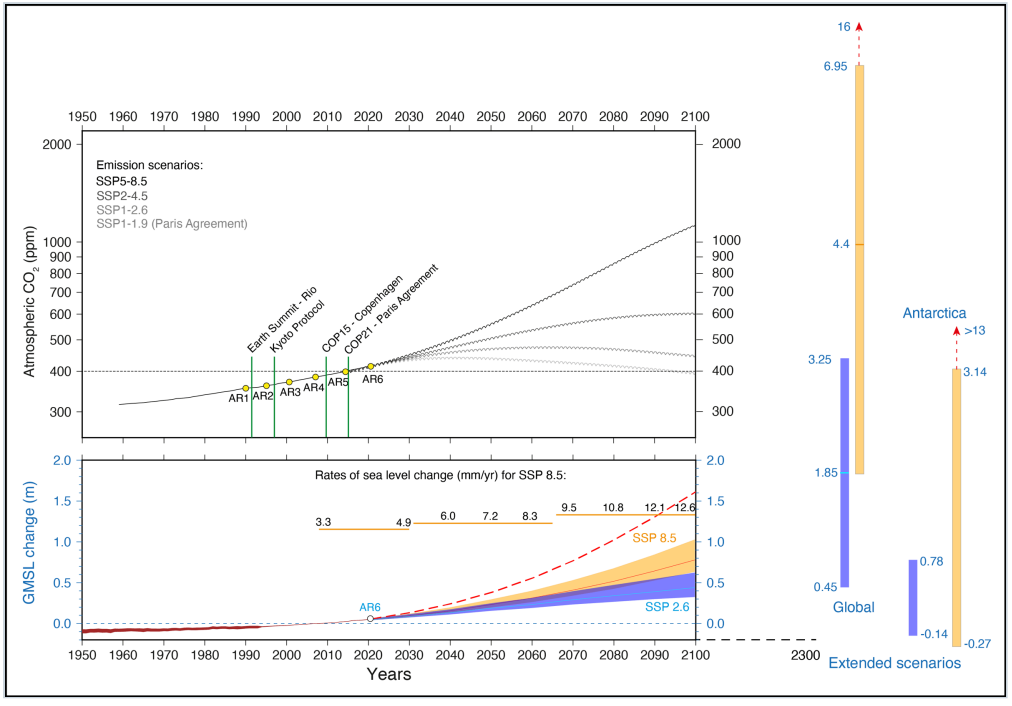


Fig. 1. Observed and projected CO_2 (top) and global mean sea level (bottom). Blue: low emissions (SSP1-2.6, consistent with Paris). Orange: unabated emissions (SSP5-8.5). Red dashed: low-confidence, high-impact case with rapid Antarctic ice loss. Shading is the likely range (a two-in-three chance; 17th–83rd percentile); bars on the right extend to 2300. Modified from Colleoni et al.[15]

PAST WARMING, PAST SEAS

up to
+9 m
at 1.5°C of warming, 125,000 years ago, over centuries.

up to
+20 m
at 2.5°C of warming, 3 million years ago, over centuries.

WHAT COMES NEXT

Research priorities

Better models, better data, and closer work with the people who use them.

1 Improve models and observations

Further improvements to ice-sheet models and their forcing datasets (for example ocean circulation) are urgently needed, together with enhanced observations and a better understanding of the key rate-determining processes.[10,16]

2 Deliver ISMIP7

The ice-sheet modelling community is gearing up for the Ice Sheet Model Intercomparison Project 7 (ISMIP7), a WCRP CliC-sponsored project that will contribute to the IPCC Seventh Assessment Report (AR7) cycle. It promises further advances in climate and ice-sheet projections and so less uncertainty about future sea-level change.

3 Consistent, actionable information

Practitioners and users of sea-level data are asking for consistency in actionable information to support decision-making and planning for coastal resilience.[17]

4 Researchers and users together

Researchers and users need to work together more effectively on providing and communicating sea-level science, and on understanding uncertainty from global to local scales.

On the horizon: understanding the impacts of rising seas is increasingly important. WCRP itself is developing a sea-level-focused activity to bring the various aspects of sea-level research and impacts together, and is establishing a **Task Team on Sea Level**.



A flooded coastal village in Malaysia. Photo: Pok Rie, Pexels.

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WHO IS BEHIND THIS BRIEF

PREPARED BY

CliC Climate and Cryosphere

CliC is the focal point for climate science on the cryosphere: ice sheets, glaciers, snow, permafrost and sea ice. It promotes research and international cooperation, and shows policy makers and the public why it matters.

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