NEWS RELEASE

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Global sea level very likely to rise between 0.5 and 1.9 metres by 2100 under a high-emissions scenario, finds NTU Singapore-led study using new projection method

An interdisciplinary team of researchers from **Nanyang Technological University, Singapore (NTU Singapore)**, and **Delft University of Technology (TU Delft)**, The Netherlands, has projected that if the rate of global CO2 emissions continues to increase and reaches a high emission scenario, sea levels would as a result *very likely* rise between 0.5 and 1.9 metres by 2100. The high end of this projection's range is 90 centimetres higher than the latest United Nations' global projection of 0.6 to 1.0 metres[1].

The *very likely* range (90 per cent probability for the event to occur), reported by the NTU team in the scientific journal *Earth's Future*, complements sea-level rise projections reported by the United Nation's Intergovernmental Panel on Climate Change (IPCC), which only assessed the probability of projections up to a *likely* range (66 per cent probability).

Current sea-level projections rely on a range of methods to model climate processes. Some include well-understood phenomena like glacier melting, while others incorporate more uncertain events, such as abrupt ice shelf collapse.

As a result, these models produce varying projections, making it difficult to estimate reliable extreme sea-level rise. This ambiguity in projections from different methods has prevented the IPCC from providing *very likely* ranges for sea-level projections - a valuable standard in managing risk.

To overcome this challenge and to address the uncertainties in current sea-level rise projections, NTU researchers developed a new, improved projection method known

[1] Projection based on the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report. The IPCC is a United Nations body that provides authoritative scientific assessments on climate change. https://www.ipcc.ch/report/ar6/wg1/chapter/chapter-9/

as the **"fusion" approach**. This approach combines the strengths of existing models with expert opinions, offering a clearer, more reliable picture of future sea-level rise.

Lead author of the study, **Dr Benjamin Grandey**, Senior Research Fellow at NTU's **School of Physical and Mathematical Sciences (SPMS)**, said, "Our new approach tackles a key issue in sea-level science: different methods of projecting sea-level rise often produce widely varying results. By combining these different approaches into a single fusion projection, we can estimate the uncertainty associated with future sea-level rise and quantify the *very likely* range of sea-level rise."

The research team believes their new method fills a critical gap for reliable information, complementing the IPCC's latest report.

The fusion approach: Combining strengths of existing models

The interdisciplinary NTU team of physicists and climate scientists created the fusion model by integrating statistical methods with expert judgments. They used data from established projections presented in the IPCC's Sixth Assessment Report, which simulate potential future scenarios under different emissions pathways.

The researchers combined different classes of projections reported in the IPCC report. They incorporated both 'medium confidence' and 'low confidence' projections, supplemented by expert assessments, to account for poorly understood extreme processes, such as sudden shifts in ice sheet behaviour. A weighting system was applied, prioritising more reliable medium-confidence data while still including lower-confidence projections to address uncertainties.

Projections based on this fusion approach suggest that under a **low-emissions scenario**, global mean sea levels are *very likely* to rise between **0.3 and 1.0 metres** by 2100. The IPCC's *likely* range projected global mean sea level to rise by 0.3 to 0.6 metres.

Under a **high-emissions scenario**, the NTU fusion model projects global mean sea level will *very likely* rise between **0.5 and 1.9 metres** by 2100. The IPCC *likely* range projected a rise between 0.6 to 1.0 metres.

The broader ranges indicated by the NTU model suggest that **previous estimates may have understated the potential for extreme outcomes**, with levels possibly rising to 90 cm higher than the upper end of the IPCC's *likely* range under a high-emissions pathway.

Current emissions trends suggest that the world is on a trajectory between the low-emissions and high-emissions scenarios.

“Our new *very likely* projections highlight just how large the uncertainties are when it comes to sea-level rise,” said Dr Grandey. “The high-end projection of 1.9 metres underscores the need for decision-makers to plan for critical infrastructure accordingly. More importantly, these results emphasise the importance of climate mitigation through reducing greenhouse gas emissions.”

Co-author, **Professor Benjamin Horton, Director, Earth Observatory of Singapore at NTU**, said, “This NTU research represents a significant breakthrough in sea-level science. By estimating the probability of the most extreme outcomes, it underscores the severe impacts of sea-level rise on coastal communities, infrastructure, and ecosystems, emphasising the urgent need to address the climate crisis.”

Why the new projection method matters

Accurate projections of sea-level rise are essential for preparing for climate change. The NTU team believes that their new method provides valuable, actionable information for urban planners and governments, helping them plan and implement measures to protect vulnerable communities, especially in extreme sea-level rise scenarios.

Co-author, **Professor Chew Lock Yue** from NTU **School of SPMS**, said, “By appropriately combining the best available knowledge of sea-level information at different confidence levels into a single fused probability distribution, we have developed a novel way to project the full uncertainty range of future sea-level rise.”

Co-author, **Associate Professor Justin Dauwels**, **Signal Processing Systems (SPS), Department of Microelectronics at TU Delft**, said, “Our new method for projecting the full uncertainty range of future sea-level rise can also be applied for other climate projections and beyond, including coastal flooding risk assessments, infrastructure vulnerability analysis, and economic impact forecasts.”

This study exemplifies NTU’s commitment to advancing climate science research and supporting global sustainability efforts and is supported by the National Research Foundation, Singapore, and National Environment Agency, Singapore under the National Sea Level Programme Funding Initiative (Award No. USS-IF-2020-3).

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Notes to Editor:

Paper titled “Fusion of Probabilistic Projections of Sea-Level Rise” published online in *Earth’s Future*, 11 December 2024
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About Nanyang Technological University, Singapore

A research-intensive public university, Nanyang Technological University, Singapore (NTU Singapore) has 35,000 undergraduate and postgraduate students in the Business, Computing & Data Science, Engineering, Humanities, Arts, & Social Sciences, Medicine, Science, and Graduate colleges.

NTU is also home to world-renowned autonomous institutes – the National Institute of Education, S Rajaratnam School of International Studies and Singapore Centre for Environmental Life Sciences Engineering – and various leading research centres such as the Earth Observatory of Singapore, Nanyang Environment & Water Research Institute and Energy Research Institute @ NTU (ERI@N).

Under the NTU Smart Campus vision, the University harnesses the power of digital technology and tech-enabled solutions to support better learning and living experiences, the discovery of new knowledge, and the sustainability of resources.

Ranked amongst the world's top universities, the University's main campus is also frequently listed among the world's most beautiful. Known for its sustainability, NTU has achieved 100% Green Mark Platinum certification for all its eligible building projects. Apart from its main campus, NTU also has a medical campus in Novena, Singapore's healthcare district.

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