

# Close relationship between past warming and sea-level rise

June 22 2009

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Scientists from the National Oceanography Centre, Southampton, along with colleagues from Tuebingen and Bristol have reconstructed sea-level fluctuations over the last 520,000 years. Comparison of this record with data on global climate and CO<sub>2</sub> levels from Antarctic ice cores suggests that even stabilization at today's CO<sub>2</sub> levels may commit us to much greater sea-level rise over the next couple of millennia than previously thought.

In a paper in *Nature Geoscience*, a team from the National Oceanography Centre, Southampton (NOCS), along with colleagues from Tübingen (Germany) and Bristol presents a novel continuous reconstruction of sea level fluctuations over the last 520 thousand years. Comparison of this record with data on [global climate](#) and carbon dioxide (CO<sub>2</sub>) levels from Antarctic ice cores suggests that even stabilisation at today's CO<sub>2</sub> levels may commit us to sea-level rise over the next couple of millennia, to a level much higher than long-term projections from the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).

Little is known about the total amount of possible sea-level rise in equilibrium with a given amount of global warming. This is because the melting of ice sheets is slow, even when temperature rises rapidly. As a consequence, current predictions of sea-level rise for the next century consider only the amount of ice sheet melt that will occur until that time. The total amount of ice sheet melting that will occur over millennia, given the current climate trends, remains poorly understood.

The new record reveals a systematic equilibrium relationship between [global temperature](#) and CO<sub>2</sub> concentrations and sea-level changes over the last five glacial cycles. Projection of this relationship to today's CO<sub>2</sub> concentrations results in a sea-level at 25 (±5) metres above the present. This is in close agreement with independent sea-level data from the Middle Pliocene epoch, 3-3.5 million years ago, when atmospheric CO<sub>2</sub> concentrations were similar to the present-day value. This suggests that the identified relationship accurately records the fundamental long-term equilibrium behaviour of the climate system over the last 3.5 Million years.

Lead author Professor Eelco Rohling of the University of Southampton's School of Ocean and Earth Science based at NOCS, said: "Let's assume that our observed natural relationship between CO<sub>2</sub> and temperature, and sea level, offers a reasonable 'model' for a future with sustained global warming. Then our result gives a statistically sound expectation of a potential total long-term sea-level rise. Even if we would curb all CO<sub>2</sub> emissions today, and stabilise at the modern level (387 parts per million by volume), then our natural relationship suggests that sea level would continue to rise to about 25 m above the present. That is, it would rise to a level similar to that measured for the Middle Pliocene."

Project partners Professor Michal Kucera (University of Tübingen) and Dr Mark Siddall (University of Bristol), add: "We emphasise that such equilibration of sea level would take several thousands of years. But one still has to worry about the large difference between the inferred high equilibrium sea level and the level where sea level actually stands today. Recent geological history shows that times with similarly strong disequilibria commonly saw pulses of very rapid sea-level adjustment, at rates of 1-2 metres per century or higher."

The new study's projection of long-term sea-level change, based on the natural relationship of the last 0.5 to 3.5 million years, differs

considerably from the IPCC's model-based long-term projection of +7 m. The discrepancy cannot be easily explained, and new work is needed to ensure that the 'gap is closed'.

The observed relationships from the recent geological past can form a test-bed or reality-check for models, to help them achieve improved future projections.

More information: The paper 'Antarctic temperature and global [sea level](#) closely coupled over the past five glacial cycles' is published by *Nature Geoscience*, on 21 June 2009.

Source: National Oceanography Centre, Southampton

Citation: Close relationship between past warming and sea-level rise (2009, June 22) retrieved 19 April 2024 from <https://phys.org/news/2009-06-relationship-sea-level.html>

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