Researcher estimates future sea level rise by looking to the past

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(PhysOrg.com) -- Boston University College of Arts & Sciences Paleoclimatologist Maureen Raymo and colleagues have published findings that should help scientists better estimate the level of sea level rise during a period of high atmospheric carbon dioxide levels 3 million years ago. That geologic era, known as the mid-Pliocene climate optimum, saw much higher global temperatures that may have been caused by elevated levels of carbon dioxide—an analogy for the type of climate we are causing through human addition of greenhouse gases to the atmosphere.

During the mid-Pliocene climate optimum, sea levels were anywhere between 15 and 100 feet higher than at present because water that is now locked up in glaciers as ice circulated freely through the oceans. Raymo and her colleagues published their findings in the current edition of *Nature Geoscience* in a paper titled "Departures from eustasy in Pliocene sea-level records." The paper provides an improved model for interpreting geologic evidence of ancient shorelines.

The team's findings add to the scientific body of knowledge about mid-Pliocene sea levels. By understanding the extent of sea level rise 3 million years ago, scientists like Raymo hope to more accurately predict just how high the seas will rise in the coming decades and centuries due to global warming.

Through their project, titled PLIOMAX (Pliocene maximum sea level project), Raymo and her colleagues have shared data with a larger community of geoscientists involved in studying similar so-called "high stand deposits" around the world. The accumulated data should shed light on the extent to which we can expect the Greenland Ice Sheet, West Antarctic Ice Sheet, and East Antarctic Ice Sheet to melt due to increasing levels of atmospheric carbon dioxide.

Raymo is a Research Professor in the Department of Earth Science in BU's College of Arts & Sciences. She is also a member of BU's Climate and Earth History Research Group. She received her Ph.D. from Columbia University in 1989 and has recently accepted a position to return to Columbia University.

Raymo studies the causes of climate change over Earth's history, in particular the role played by the global carbon cycle and Earth's orbital variations around the Sun. Most of her work has been based on data collected from deep-sea sediment and microfossils recovered using the research vessel JOIDES Resolution. She has used the stable isotopes of oxygen and carbon to study past ocean circulation and ice volume history and is well known for her proposal that the cooling of global climate over the last 40 million years was caused primarily by enhanced chemical weathering and consumption of atmospheric CO2 in the mountainous regions of the world, especially in the Himalayas.

Founded in 1839, Boston University is an internationally recognized institution of higher education and research. With more than 30,000 students, it is the fourth largest independent university in the United States. BU contains 17 colleges and schools along with a number of multi-disciplinary centers and institutes which are central to the school's research and teaching mission.

More information: Departures from eustasy in Pliocene sea-level records, *Nature Geoscience* 4, 328–332 (2011) doi:10.1038/ngeo1118

Abstract

Proxy data suggest that atmospheric CO2 levels during the middle of the Pliocene epoch (about 3 Myr ago) were similar to today, leading to the use of this interval as a potential analogue for future climate change. Estimates for mid-Pliocene sea levels range from 10 to 40 m above present, and a value of +25 m is often adopted in numerical climate model simulations. A eustatic change of such magnitude implies the complete deglaciation of the West Antarctic and Greenland ice sheets, and significant loss of mass in the East Antarctic ice sheet. However, the effects of glacial isostatic adjustments have not been accounted for in Pliocene sea-level reconstructions. Here we numerically model these effects on Pliocene shoreline features using a gravitationally self-consistent treatment of post-glacial sea-level change. We find that the predicted modern elevation of Pliocene shoreline features can deviate significantly from the eustatic signal, even in the absence of subsequent tectonically-driven movements of the Earth's surface. In our simulations, this non-eustatic sea-level change, at individual locations, is caused primarily by residual isostatic adjustments associated with late Pleistocene glaciation. We conclude that a combination of model results and field observations can help to better constrain sea level in the past, and hence lend insight into the stability of ice sheets under varying climate conditions.

Provided by Boston University