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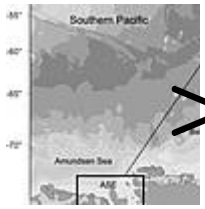
Rising sea level

Expedition to Antarctica's Glaciers

Results expected to improve forecasts for the rising global sea level

[02. February 2017] **How has the West Antarctic Ice Sheet changed in response to alternating warm and cold time periods? And what does it mean for the sea level – today and tomorrow? Pursuing answers to these key questions, 50 researchers on board the Alfred Wegener Institute's research vessel Polarstern are going to depart from Punta Arenas (Chile) on 6 February 2017, bound for the Amundsen Sea – the region of the Antarctic currently characterised by the most massive and rapid loss of ice. In the course of the expedition, the seafloor drill rig MARUM-MeBo70 will be used in the Antarctic for the first time.**





Rifts in the Larsen Ice Shelf and the Brunt Ice Shelf, which is home to the UK's Halley Research Station, are being closely observed. Though the loss of ice mass is dramatic in these regions of Antarctica's Atlantic sector, it's progressing even faster in the continent's Pacific sector: in the Amundsen Sea. Accordingly, this is the destination of the latest expedition of the research vessel Polarstern, which will investigate changes in the ice sheet and their contributions to sea-level changes in the past, helping us to better forecast future changes.


Iceberg near Pine Island (Photo: Jan Grobys)

Between 1901 and 2010, the global sea level rose by 19 centimetres. Projections for the future call for a rise of anywhere between 26 and 82 centimetres by the end of the century. These scenarios still contain a great deal of uncertainty, and the latest models show that the sea level might indeed rise by an additional metre. Prognoses for sea-level rises are important, because they provide the basis for potentially adapting to and minimising the impacts of climate change, e.g. with the help of coastal protection measures.

Although today's computer models are now capable of depicting the relationship between ice and the ocean, there is still a lack of data on the

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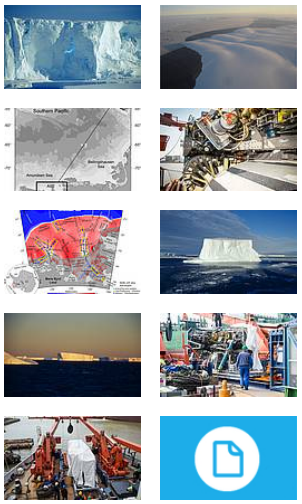

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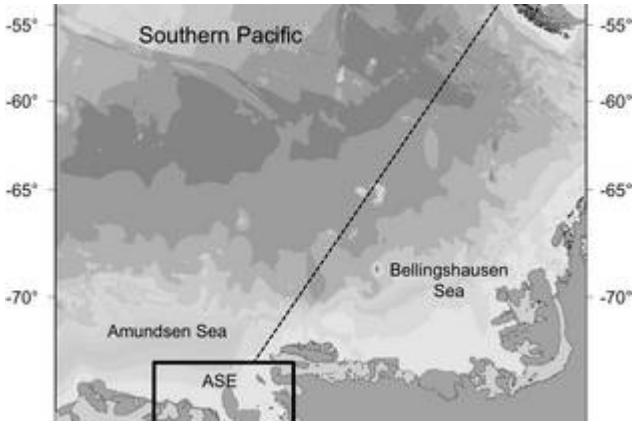
behaviour of the West Antarctic Ice Sheet. "That's exactly why we want to explore how the ice sheet has advanced and retreated in the past, including the spatial and chronological variability and the rate," explains Dr Karsten Gohl from the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI). "Particularly in the Amundsen Sea region, we've observed an unusually rapid retreat over the past few decades, which many believe to be the first step in a complete collapse of the West Antarctic Ice Sheet," reports Gohl, the chief-scientist of the Polarstern expedition.



Planned track of Polarstern during expedition PS104 (Photo: Karsten Gohl)

The Amundsen Sea lies in the Pacific sector of the Antarctic, where two major glaciers – Pine Island Glacier and Thwaites Glacier – discharge into the ocean, transporting a tremendous mass of ice from the West Antarctic Ice Sheet. A typical characteristic of the West Antarctic Ice Sheet is that a major portion of its base rests on the continent below sea level. Today, comparatively warm seawater is circulating over the continental shelf of the Amundsen Sea, producing tangible reactions in both the grounding zone of the continental ice and the floating ice shelf: as the ocean warms, the ice shelf begins to melt from below and the grounding zone moves farther inland. The glaciers retreat with a result that, where there was once an ice sheet that was hundreds of metres thick, now there is open water covered by only a thin layer of seasonal sea-ice.

Geoscientists take advantage of precisely such changes in the ice sheet movements: with the help of sediment cores from the now open water continental shelf, they hope to determine when in Earth's history and to what extent the Amundsen Sea was covered with ice or was free of ice. The information they need is found in the remains of single-celled algae (foraminifera and diatoms), which sink to the seafloor as sediments when they die. To unlock the secrets these sediments hold, the seafloor drill device MeBo70, provided by the University of Bremen's Center for Marine Environmental Sciences (MARUM), will be used in the Antarctic for the first time. The device can drill sediment cores of up to 70 metres in length. Subsequent analyses of the cores – like determining the species and ages of the fossil algae – will yield essential information on past water temperatures and the history of ice cover in the Amundsen Sea.


Test installation of MeBo (Photo: Thomas Ronge)

"We plan to collect samples from epochs of the Earth's history with similar climatic conditions to those we expect to see in the next 100 to 200 years," says Gohl. Accordingly, one drill target is the last interglacial before the current one, which was roughly 125,000

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The Alfred Wegener Institute pursues research in the polar regions and the oceans of mid and high latitudes. As one of the 18 centres of the Helmholtz Association it coordinates polar research in Germany and provides ships like the research icebreaker Polarstern and stations for the international scientific community.

years ago. As another past time period, the Pliocene is also of considerable interest: three to five million years ago, the temperature was two to three degrees higher than it was just before the industrial revolution, and the carbon dioxide concentration in the atmosphere, 400 parts per million, was roughly the same as it is today.

Thanks to uplift and sinking processes of the Antarctic continent as well as erosion, geological layers with greatly varying ages can be found near the surface of the ocean floor of the Amundsen Sea. During the expedition, the MeBo will be used to drill sediment cores from as many as nine different sites. “In addition, we will conduct geophysical measurements between the drilling locations, which will allow us to link the samples from the drill sites and to portray historical changes in the ice cover of the Amundsen Sea as a grid,” explains Gohl. “We hope the drilling technique and measurements will work smoothly despite the harsh conditions in the Antarctic, so that when we return to Punta Arenas on 19 March, it won’t be empty-handed, but with several hundred metres of sediment cores,” says the expedition leader. Once the ship has returned, the samples and data will be analysed in the laboratories. Geoscientists and climate modellers at the AWI as well as researchers from partner institutes MARUM, the British Antarctic Survey, German and British universities can’t wait to get their hands on the new data.

Background: Facts and figures on the rising sea level

Between 1901 and 2010, the global sea level rose by 19 centimetres, the equivalent of 1.7 millimetres per year. For the period between 1993 and 2010, the scientific community estimates a rise of 3.2 millimetres per year (IPCC 2013).

It is considered highly probable that Greenland’s glacier contributed between 1.4 and 4.3 metres to the sea-level height in the last interglacial. In the IPCC’s Fifth Assessment Report, the currently available data only allows researchers to postulate with a medium degree of confidence that the West Antarctic Ice Sheet also contributed.

Compared to the years 1986 to 2005, projections for the period from 2081 to 2100 call for a sea-level rise of between 0.26 and 0.55 metres, or of between 0.45 and 0.82 metres – depending on the scenario and model used (these figures are likely, i.e. in the IPCC’s vocabulary they are listed with a “medium degree of confidence”).

(Source: IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.; download: http://ar5-syr.ipcc.ch/)

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