Radiocarbon dates of tiny fossilized marine animals found in Antarctica's seabed sediments offer new clues about the recent rapid ice loss from the West Antarctic Ice Sheet and help scientists make better future predictions about sea-level rise. This region of the icy continent is thought to be vulnerable to regional climate warming and changes in ocean circulation. Reporting this month in the journal Geology a team of researchers from British Antarctic Survey (BAS), the Alfred Wegener Institute for Polar and Marine Research (AWI) and the University of Tromsø presents a timeline for ice loss and glacier retreat in the Amundsen Sea region of West Antarctica.

The team concludes that the rapid changes observed by satellites over the last 20 years at Pine Island and Thwaites glaciers may well be exceptional and are unlikely to have happened more than three or four times in the last 10,000 years.

Lying on the Pacific Ocean side of the Transantarctic Mountains, West Antarctica comprises the Antarctic Peninsula (with Graham Land and Palmer Land) and Ellsworth Land, Marie Byrd Land and King Edward VII Land, offshore islands such as Adelaide Island, and ice shelves, notably the Filchner-Ronne Ice Shelf on the Weddell Sea, and the Ross Ice Shelf on the Ross Sea. West Antarctica is separated from the main land mass of the continent by the icy waters of the Ross Sea and Weddell Sea, and resembles a giant peninsula that stretches roughly from the South Pole towards the southern tip of South America.

The team studied the average rate of glacial retreat since the end of the last Ice Age around 12,000 years ago. Their work centered on Pine Island and Thwaites glaciers, which drain ice from the West Antarctic Ice Sheet into Pine Island Bay.

Lead author Dr Claus-Dieter Hillenbrand from BAS says, "As snow and ice builds up on the vast

Antarctic Ice Sheet, the ice flows from the centre of the continent through glaciers towards the sea where it often forms floating ice shelves and eventually breaks off as icebergs. The floating ice shelves hold back the ice on land. A critical issue for us is to understand how the grounding line — the position where the ice sitting on land (glaciers) begins to float (ice shelves) — has retreated landward over time. Satellite data are available only for the last 20 years and show that since 1992 the Pine Island and Thwaites glaciers have experienced significant thinning (melting), flow acceleration and rapid landward retreat of their grounding lines, with that of Pine Island Glacier having retreated up to 25 km. It's possible that the grounding lines may retreat even further inland over coming decades. Our study has revealed that episodes of fast glacier retreat similar to that observed over recent decades can only have occurred very rarely during the previous 10,000 years."

The investigation was carried out in 2010 during an expedition on-board the German research ship RV Polarstern. The science team used gravity corers up to ten meters long to extract mud from the sea floor of the continental shelf in the Amundsen Sea.

Co-author Dr Gerhard Kuhn from AWI explains, "It was important to get a better understanding of the rapid retreat that we see in the satellite data. As coring targets we selected three relatively shallow undersea ridges that lie within 110 kilometers of the current grounding line and flank a deep glacial valley which was carved into the sea bed by the glaciers during past ice sheet advances. These locations gave us the best chance to collect the tiny skeletons and shells of animals made of calcium carbonate. Such calcareous microfossils are critical for using the radiocarbon technique to determine the age of the sediments, but they are normally extremely rare on the Antarctic continental shelf."

Co-author Dr James Smith, also from BAS, adds,
"First we determined the distance between the core locations and the modern position of the grounding line. Then by dating the type of sediment material deposited at a core site in the open ocean (after the grounding line had moved further landward), we were able to calculate the average rate of glacier retreat over time."

This new research will be used to improve the accuracy of computer models that are essential to predict future ice loss in the Amundsen Sea sector of the West Antarctic Ice Sheet and its likely contribution to global sea-level rise. Over the last two decades the melting of West Antarctic glaciers has contributed significantly to sea-level rise (recent studies have suggested that continued melting would raise global sea level by up to 0.3 mm a year).