The world's largest ice sheet has started to melt along its coastal fringes, raising fears that global sea levels will rise faster than scientists expected.

The East Antarctic ice sheet, which makes up three-quarters of the continent's 14,000 sq km, is losing around 57bn tonnes of ice a year into surrounding waters, according to a satellite survey of the region.

Scientists had thought the ice sheet was reasonably stable, but measurements taken from Nasa's gravity recovery and climate experiment (Grace) show that it started to lose ice steadily from 2006.

The measurements suggest the polar continent could soon contribute more to global sea level rises than Greenland, which is shedding more than 250bn tonnes of ice a year, adding 0.7mm to annual sea level rises.

Satellite data from the whole of Antarctica show the region is now losing around 190bn tonnes of ice a year. Uncertainties in the measurements mean the true ice loss could be between 113bn and 267bn tonnes.

"If the current trend continues or gets worse, Antarctica could become the largest contributor to sea level rises in the world. It could start to lose more ice than Greenland within a few years," said Jianli Chen, of the University of Texas at Austin.

Chen's team used data from the Nasa mission to see how Earth's gravitational pull varied month to month between April 2002 and January 2009. Measurements taken over the south pole reflect changes in the mass of the Antarctic ice sheets.

The survey confirmed the West Antarctic ice sheet is melting rapidly with the loss of around 132bn tonnes of ice a year, but revealed unexpected melting in the larger East Antarctic ice sheet.

The scientists used a computer model to take account of ongoing movements in the Earth's surface caused by the retreat of glaciers at the end of the last ice age. Uncertainties in the model gave the scientists only a broad estimate of ice loss in the East Antarctic ice sheet of between 5bn and 109bn tonnes a year.

Chen said that warmer ocean waters may have triggered the melting by seeping under the ice sheet and making it slide more easily over the rock it rests on.

Writing in the journal Nature Geoscience, Chen's team reports that Wilkes Land on the East Antarctic ice sheet was stable until 2006, but has since begun to lose ice. Another region on the ice sheet, Enderby Land, was thickening until 2006, but has since started to melt. "We're seeing these kinds of climate change effects all around the world now," Chen said.