Ice

Oct. 31, 2015

NASA Study: Mass Gains of Antarctic Ice Sheet Greater than Losses

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A new NASA study says that an increase in Antarctic snow accumulation that began 10,000 years ago is currently adding enough ice to the continent to outweigh the increased losses from its thinning glaciers.

The research challenges the conclusions of other studies, including the Intergovernmental Panel on Climate Change's (IPCC) 2013 report, which says that Antarctica is overall losing land ice.

According to the new analysis of satellite data, the Antarctic ice sheet showed a net gain of 112 billion tons of ice a year from 1992 to 2001. That net gain slowed to 82 billion tons of ice per year between 2003 and 2008.

"We're essentially in agreement with other studies that show an increase in ice discharge in the Antarctic Peninsula and the Thwaites and Pine Island region of West Antarctica," said Jay Zwally, a glaciologist with NASA Goddard Space Flight Center in Greenbelt, Maryland, and lead author of the study, which was published on Oct. 30 in the *Journal of Glaciology*. "Our main disagreement is for East Antarctica and the interior of West Antarctica – there, we see an ice gain that exceeds the losses in the other areas." Zwally added that his team "measured small height changes over large areas, as well as the large changes observed over smaller areas."

Scientists calculate how much the ice sheet is growing or shrinking from the changes in surface height that are measured by the satellite altimeters. In locations where the amount of new snowfall accumulating on an ice sheet is not equal to the ice flow downward and outward to the ocean, the surface height changes and the ice-sheet mass grows or shrinks.

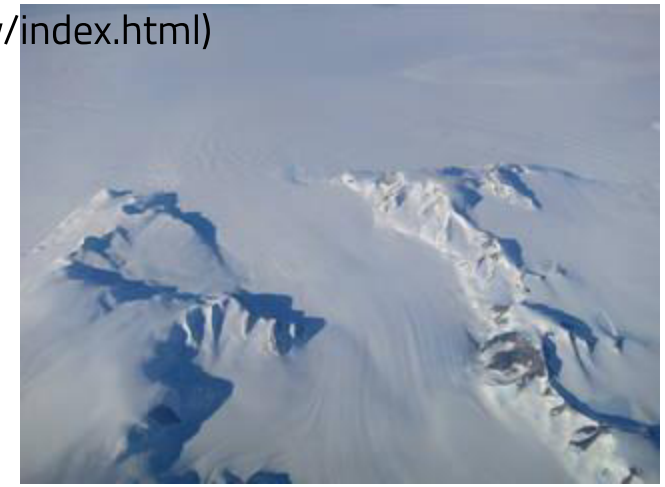
But it might only take a few decades for Antarctica's growth to reverse, according to Zwally. "If the losses of the Antarctic Peninsula and parts of West Antarctica continue to increase at the same rate they've been increasing for the last two decades, the losses will catch up with the long-term gain in East Antarctica in 20 or 30 years -- I don't think there will be enough snowfall increase to offset these losses."

The study analyzed changes in the surface height of the Antarctic ice sheet measured by radar altimeters on two European Space Agency European Remote Sensing (ERS) satellites, spanning from 1992 to 2001, and by the laser altimeter on NASA's Ice, Cloud, and land Elevation Satellite (ICESat) from 2003 to 2008.

Zwally said that while other scientists have assumed that the gains in elevation seen in East Antarctica are due to recent increases in snow accumulation, his team used meteorological data beginning in 1979 to show that the snowfall in East Antarctica actually decreased by 11 billion tons per year during both the ERS and ICESat periods. They also used information on snow accumulation for tens of thousands of years, derived by other scientists from ice cores, to conclude that East Antarctica has been thickening for a very long time.

“At the end of the last Ice Age, the air became warmer and carried more moisture across the continent, doubling the amount of snow dropped on the ice sheet,” Zwally said.

The extra snowfall that began 10,000 years ago has been slowly accumulating on the ice sheet and compacting into solid ice over millennia, thickening the ice in East Antarctica and the interior of West Antarctica by an average of 0.7 inches (1.7 centimeters) per year. This small thickening, sustained over thousands of years and spread over the vast expanse of these sectors of Antarctica, corresponds to a very large gain of ice – enough to outweigh the losses from fast-flowing glaciers in other parts of the continent and reduce global sea level rise.



(/web/20151101124608mp_/http://www.nasa.gov/sites/default/files/thumbnails/image/antarctic_peninsula.jpg)

A new NASA study says that Antarctica is overall accumulating ice. Still, areas of the continent, like the Antarctic Peninsula photographed above, have increased their mass loss in the last decades.

Credits: NASA's Operation IceBridge

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Zwally’s team calculated that the mass gain from the thickening of East Antarctica remained steady from 1992 to 2008 at 200 billion tons per year, while the ice losses from the coastal regions of West Antarctica and the Antarctic Peninsula increased by 65 billion tons per year.

“The good news is that Antarctica is not currently contributing to sea level rise, but is taking 0.23 millimeters per year away,” Zwally said. “But this is also bad news. If the 0.27 millimeters per year of sea level rise attributed to Antarctica in the IPCC report is not really coming from Antarctica, there must be some other contribution to sea level rise that is not accounted for.”

“The new study highlights the difficulties of measuring the small changes in ice height happening in East Antarctica,” said Ben Smith, a glaciologist with the University of Washington in Seattle who was not involved in Zwally’s study.

"Doing altimetry accurately for very large areas is extraordinarily difficult, and there are measurements of snow accumulation that need to be done independently to understand what’s happening in these places,” Smith said.

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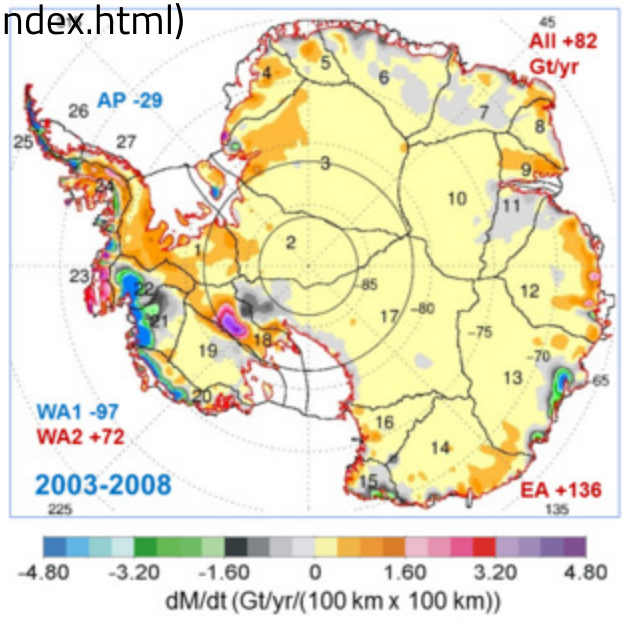
To help accurately measure changes in Antarctica, NASA is developing the successor to the [illegible] mission, ICESat-2, which is scheduled to launch in 2018. "ICESat-2 will measure changes in the ice sheet within the thickness of a No. 2 pencil," said Tom Neumann, a glaciologist at Goddard and deputy project scientist for ICESat-2. "It will contribute to solving the problem of Antarctica's mass balance by providing a long-term record of elevation changes."

Related Link

- **Learn more about this study**



(/web/20151101124608mp_/http://www.nasa.gov/sitdmdt-map.png)
Map showing the rates of mass changes from ICESat 2003-2008 over Antarctica. Sums are for all of Antarctica: East Antarctica (EA, 2-17); interior West Antarctica (WA2, 1, 18, 19, and 23); coastal West Antarctica (WA1, 20-21); and the Antarctic Peninsula (24-27). A gigaton (Gt) corresponds to a billion metric tons, or 1.1 billion U.S. tons.
Credits: Jay Zwally/ Journal of Glaciology
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Maria-José Viñas (mailto:maria-jose.vinasgarcia@nasa.gov?subject=RE%20MASS%20GAINS%20OF%20ANTARCTIC%20ICE%20SHEET%20GREATER%20THAN%20LOSSES)
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Dec. 14, 2018

Snow over Antarctica Buffered Sea Level Rise during Last Century

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A new NASA-led study has determined that an increase in snowfall accumulation over Antarctica during the 20th century mitigated sea level rise by 0.4 inches. However, Antarctica's additional ice mass gained from snowfall makes up for just about a third of its current ice loss.

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Dec. 12, 2018

ICESat-2 Reveals Profile of Ice Sheets, Sea Ice, Forests

Less than three months into its mission, NASA's Ice, Cloud and land Elevation Satellite-2, or ICESat-2, is already exceeding scientists' expectations. The satellite is measuring the height of sea ice to within an inch, tracing the terrain of previously unmapped Antarctic valleys, surveying remote ice sheets, and peering through forest canopies and shallow coastal waters.

With each pass of the ICESat-2 satellite, the mission is adding to datasets tracking Earth's rapidly changing ice. Researchers are ready to use the information to study sea level rise resulting from melting ice sheets and glaciers, and to improve sea ice and climate forecasts.

"ICESat-2 is going to be a fantastic tool for research and discovery, both for cryospheric sciences and other disciplines," said Tom Neumann, ICESat-2 project scientist at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

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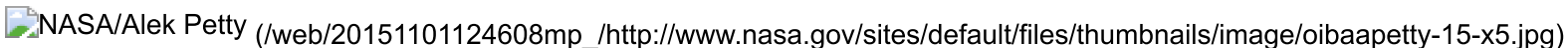
Wintertime Arctic Sea Ice Growth Slows Long-term Decline: NASA

New NASA research has found that increases in the rate at which Arctic sea ice grows in the winter may have partially slowed down the decline of the Arctic sea ice cover.

As temperatures in the Arctic have warmed at double the pace of the rest of the planet, the expanse of frozen seawater that blankets the Arctic Ocean and neighboring seas has shrunk and thinned over the past three decades. The end-of-summer Arctic sea ice extent has almost halved since the early 1980s. A recent NASA study found that since 1958, the Arctic sea ice cover has lost on average around two-thirds of its thickness and now 70 percent of the sea ice cap is made of seasonal ice, or ice that forms and melts within a single year.



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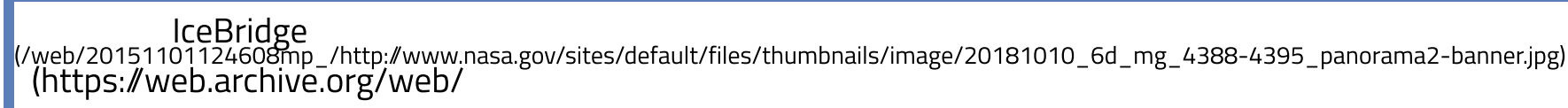

Oct. 13, 2018

Operation IceBridge, ICESat-2 Join Forces To Survey Antarctica

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NASA's decade-long airborne survey of polar ice, Operation IceBridge, is once again probing Antarctica. But this year is different: it is the first time the IceBridge team and instruments survey the frozen continent while NASA's newest satellite mission, the Ice, Cloud and land Elevation Satellite-2 (ICESat-2), studies it from space.

After successfully flying over the Bailey Ice Stream and Slessor Glacier in East Antarctica on Oct. 10, IceBridge will spend the next five weeks measuring changes in Antarctic sea and land ice while precisely flying under orbits of ICESat-2 to compare measurements.

IceBridge began flying in 2009 to maintain continuity of laser-altimetry measurements between NASA's ICESat missions. The original ICESat

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Oct. 4, 2018

ICESat-2 Laser Fires for 1st Time, Measures Antarctic Height

The laser instrument that launched into orbit last month aboard NASA's Ice, Cloud and land Elevation Satellite-2 (ICESat-2) fired for the first time Sept. 30. With each of its 10,000 pulses per second, the instrument is sending 300 trillion green photons of light to the ground and measuring the travel time of the few that return: the method behind ICESat-2's mission to monitor Earth's changing ice. By the morning of Oct. 3, the satellite returned its first height measurements across the Antarctic ice sheet.

"We were all waiting with bated breath for the lasers to turn on and to see those first photons return," said Donya Douglas-Bradshaw, the project manager for ICESat-2's sole instrument, called the Advanced Topographic Laser Altimeter System, or ATLAS. "Seeing everything work together in

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Sept. 28, 2018

2018 Arctic Summertime Sea Ice Minimum Extent Tied for Sixth Lowest on Record

Arctic sea ice likely reached its 2018 lowest extent on Sept. 19 and again on Sept. 23, according to NASA and the NASA-supported National Snow and Ice Data Center (NSIDC) at the University of Colorado Boulder. Analysis of satellite data by NSIDC and NASA showed that, at 1.77 million square miles (4.59 million square kilometers), 2018 effectively tied with 2008 and 2010 for the sixth lowest summertime minimum extent in the satellite record.

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ICESat-2

Aug. 29, 2018

Counting on NASA's ICESat-2

NASA is about to launch the agency's most advanced laser instrument of its kind into space. The Ice, Cloud and land Elevation Satellite-2, or ICESat-2, will provide critical observations of how ice sheets, glaciers and sea ice are changing, leading to insights into how those changes impact people where they live.

Launch is scheduled for Sept. 15, and as we count down the days, we're counting up 10 things you should know about ICESat-2:

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Earth

Aug. 18, 2018

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Unexpected Future Boost of Methane Possible from Arctic Permafrost

New NASA-funded research has discovered that Arctic permafrost's expected gradual thawing and the associated release of greenhouse gases to the atmosphere may actually be sped up by instances of a relatively little known process called abrupt thawing. Abrupt thawing takes place under a certain type of Arctic lake, known as a thermokarst lake that forms as permafrost thaws.

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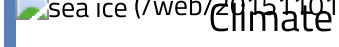

Climate

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Aug. 31, 2017

NASA Scientists Seek to Improve Sea Ice Predictions

Sea ice in the Arctic Ocean is in a downward spiral, with summer minimum extents about 40 percent smaller than in the 1980s. But predicting how much sea ice is going to behave in a particular year is tricky. There are still many unknowns about the conditions of the sea ice cover, to say nothing of the difficulties of forecasting weather and ocean behavior over seasonal timescales.

NASA researchers are working to improve their forecasts of the size of the Arctic sea ice cover at the end of the summer melt season — but the goal is not just to have a better prediction of sea ice coverage. The challenge of making summer sea ice forecasts allows scientists to test their understanding of the processes that control seasonal sea ice growth and retreat, and to fine-tune computer models that represent connections among the ice, atmosphere and ocean.

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