



This is the print version of the [Skeptical Science](http://sks.to/antarctica) article '[Antarctica is gaining ice](http://sks.to/antarctica)', which can be found at <http://sks.to/antarctica>.

Is Antarctica losing or gaining ice?

What The Science Says:

Satellites measure Antarctica is gaining sea ice but losing land ice at an accelerating rate which has implications for sea level rise.

Climate Myth: Antarctica is gaining ice

"[Ice] is expanding in much of Antarctica, contrary to the widespread public belief that global warming is melting the continental ice cap." ([Greg Roberts, The Australian](#))

Update Nov. 7 2015

A study published by Jay Zwally and his team on Oct. 30 (Zwally et al. 2015) has suggested that **until 2008** there might have been a bigger increase in ice on East Antarctica than there is a decrease in the west, meaning that total Antarctic land ice is increasing. While their results for the Antarctic Peninsula and much of West Antarctica agree with other research, the study disagrees with many other techniques. We will update this discussion once more studies address this issue. Until then here are links to some recently published takes on the study:

[A controversial NASA study says Antarctica is gaining ice. Here's why you should be skeptical](#) - Chris Mooney (Nov. 5)

[NASA Scientist Warned Deniers Would Distort His Antarctic Ice Study — That's Exactly What They Did](#) - Media Matters (Nov.4)

[More on Antarctic Ice Melt](#) - ClimateCrocks (Nov. 3)

[Is Antarctica Gaining or Losing Ice? Hint: Losing.](#) - Phil Plait (Nov. 3)

[Q&A: Is Antarctica gaining or losing ice?](#) - Carbon Brief (Nov. 3)

[Just Because Antarctica Might Be Gaining Ice Doesn't Mean Climate Change Isn't Happening](#) - Vice (Nov. 2)

Skeptic arguments that Antarctica is gaining ice frequently hinge on an error of omission, namely ignoring the **difference between land ice and sea ice**.

In glaciology and particularly with respect to Antarctic ice, *not all things are created equal*. Let us consider the following differences. **Antarctic land ice** is the ice which has accumulated over thousands of years on the Antarctica landmass itself through snowfall. This land ice therefore is actually stored ocean water that once fell as precipitation. *Sea ice in Antarctica is quite different* as it is ice which forms in salt water primarily during the winter months. When land ice melts and flows into the oceans global sea levels rise on average; when sea ice melts sea levels do not change measurably.

In Antarctica, sea ice grows quite extensively during winter but nearly completely melts away during the summer (Figure 1). That is where the important difference between Antarctic and Arctic sea ice exists as much of the Arctic's sea ice lasts all the year round. During the winter months it increases and before decreasing during the summer months, but an ice cover does in fact remain in the North which includes quite a bit of ice from previous years (Figure 1). Essentially Arctic sea ice is more important for the earth's energy balance because *when it increasingly melts, more sunlight is absorbed by the oceans* whereas Antarctic sea ice normally

melts each summer leaving the earth's energy balance largely unchanged.

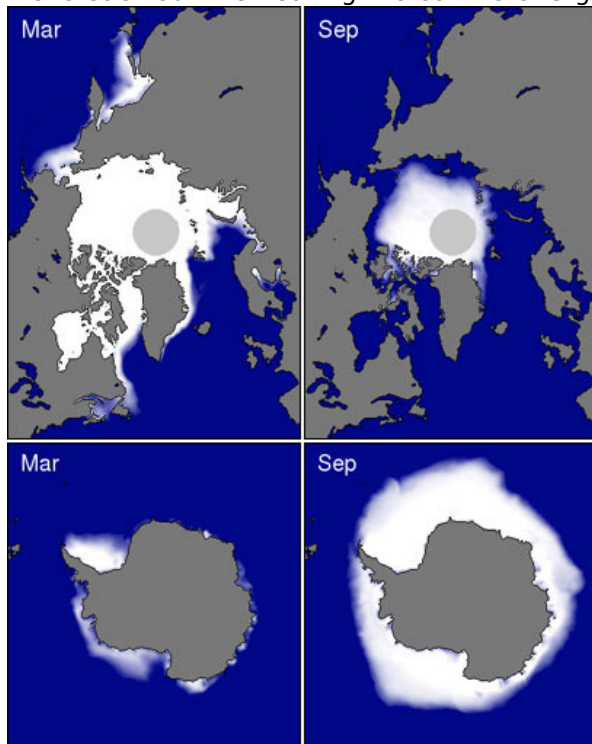


Figure 1: Coverage of sea ice in both the Arctic (Top) and Antarctica (Bottom) for both summer minimums and winter maximums

Source: [National Snow and Ice Data Center](#)

One must also be careful how you interpret trends in Antarctic sea ice. Currently this ice is increasing overall and has been for years but *is this the smoking gun against climate change?*

Not quite. Antarctic sea ice is gaining because of many different reasons but the most accepted recent explanations are listed below:

i) Ozone levels over Antarctica have dropped causing stratospheric cooling and increasing winds which lead to more areas of open water that can be frozen ([Gillet 2003](#), [Thompson 2002](#), [Turner 2009](#)).

and

ii) The Southern Ocean is freshening because of increased rain and snowfall as well as an increase in meltwater coming from the edges of Antarctica's land ice ([Zhang 2007](#), [Bintanga et al. 2013](#)). Together, these change the composition of the different layers in the ocean there causing less mixing between warm and cold layers and thus less melted sea and coastal land ice.

All the sea ice talk aside, it is quite clear that really when it comes to Antarctic ice and sea levels, sea ice is not the most important thing to measure. In Antarctica, the largest and most important ice mass is the land ice of the West Antarctic and East Antarctic ice sheets.

Therefore, how is Antarctic land ice doing?

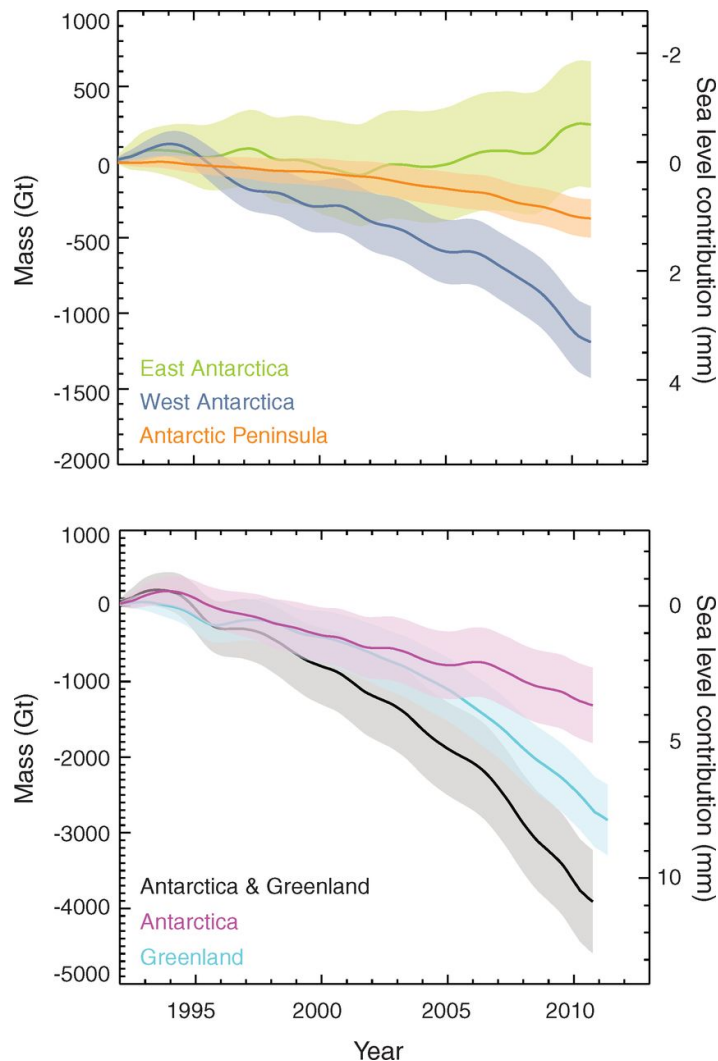


Figure 2: Estimates of total Antarctic land ice changes and approximate sea level contributions using a combination of [different measurement techniques](#) (Shepherd, 2012). Shaded areas represent the estimate uncertainty (1-sigma).

Estimates of recent changes in Antarctic land ice (Figure 2, bottom panel) show an *increasing contribution to sea level with time*, although not as fast a rate or acceleration as Greenland. Between 1992 and 2011, the Antarctic Ice Sheets overall lost 1350 giga-tonnes (Gt) or 1,350,000,000 tonnes into the oceans, at an average rate of 70 Gt per year. Because a reduction in mass of 360 Gt/year represents an annual global-average sea level rise of 1 mm, these estimates equate to an increase in global-average sea levels by 0.19 mm/yr.

There is variation between regions within Antarctica (Figure 2, top panel), with the West Antarctic Ice Sheet and the Antarctic Peninsula Ice Sheet losing ice mass, and with an increasing rate. The East Antarctic Ice Sheet is growing slightly over this period but not enough to offset the other losses. There are of course uncertainties in the estimation methods but independent data from multiple measurement techniques (explained [here](#)) all show the same thing, Antarctica is losing land ice as a whole, and these losses are accelerating quickly.

Basic rebuttal written by mattking

Update July 2015:

Here is the relevant lecture-video from [Denial101x - Making Sense of Climate Science Denial](#)



Skeptical Science explains the science of global warming and examines climate misinformation through the lens of peer-reviewed research. The website won the Australian Museum 2011 Eureka Prize for the Advancement of Climate Change Knowledge. Members of the Skeptical Science team have authored peer-reviewed papers, a [college textbook on climate change](#) and the book [Climate Change Denial: Heads in the Sand](#). Skeptical Science content has been used in university courses, textbooks, government reports on climate change, television documentaries and numerous books.



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