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[https://doi.org/10.5194/tc-17-2059-2023](#)  
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Research paper | 16 May 2023

## Change in Antarctic ice shelf area from 2009 to 2019

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### Abstract

Antarctic ice shelves provide buttressing support to the ice sheet, stabilising the flow of grounded ice and its contribution to global sea levels. Over the past 50 years, satellite observations have shown ice shelves collapse, thin, and retreat; however, there are few measurements of the Antarctic-wide change in ice shelf area. Here, we use MODIS (Moderate Resolution Imaging Spectroradiometer) satellite data to measure the change in ice shelf calving front position and area on 34 ice shelves in Antarctica from 2009 to 2019. Over the last decade, a reduction in the area on the Antarctic Peninsula (6693 km<sup>2</sup>) and West Antarctica (5563 km<sup>2</sup>) has been outweighed by area growth in East Antarctica (3532 km<sup>2</sup>) and the large Ross and Ronne–Filchner ice shelves (14 028 km<sup>2</sup>). The largest retreat was observed on the Larsen C Ice Shelf, where 5917 km<sup>2</sup> of ice was lost during an individual calving event in 2017, and the largest area increase was observed on Ronne Ice Shelf in East Antarctica, where a gradual advance over the past decade (535 km<sup>2</sup> yr<sup>-1</sup>) led to a 5889 km<sup>2</sup> area gain from 2009 to 2019. Overall, the Antarctic ice shelf area has grown by 5305 km<sup>2</sup> since 2009, with 18 ice shelves retreating and 16 larger shelves growing in area. Our observations show that Antarctic ice shelves gained 661 Gt of ice mass over the past decade, whereas the steady-state approach would estimate substantial ice loss over the same period, demonstrating the importance of using time-variable calving flux observations to measure change.

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Competing interests

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Financial support

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