



The Antarctic Peninsula's retreating ice shelves

The breakout in March 2008 of the Wilkins Ice Shelf on the Antarctic Peninsula is the latest drama in a region that has experienced unprecedented warming over the last 50 years. In the past 30 years around ten floating ice shelves retreated, in some cases very little of their original area remains. The changes give us clues about the impact of climate change across Antarctica in the coming centuries.

What are ice shelves?

Ice shelves are the floating extensions of a grounded ice sheet. Although a few small ice shelves exist in the Arctic, most occupy bays around the coast of Antarctica. They were once thought to be permanent features of the Antarctic landscape. The largest ice shelf, the Ronne-Filchner, covers an area slightly smaller than Spain. Over many decades, ice shelves find their natural size when the amount of snow falling on the surface, and the amount ice delivered by glaciers, balances the rate of ice loss through melting and iceberg calving. A change in any of these factors will cause an ice shelf to change its size to find a new equilibrium.

What is happening to Antarctic Peninsula ice shelves?

The long mountainous landmass known as the Antarctic Peninsula has always been warmer than the interior of the Antarctic continent. Each summer produces significant amounts of meltwater on the Antarctic Peninsula's ice shelves. Each shelf can tolerate only so much meltwater before they weaken and begin to retreat – scientists call this the 'limit of viability'.

As the climate on the Antarctic Peninsula has warmed – by 3°C over the last 50 years – the limit of viability for ice shelves has moved southwards. Ice shelves that used to be stable are now retreating.

How much ice has been lost?

Since the 1950s, a total of 28,000km² of ice shelf has been lost from around the Antarctic Peninsula. In volume, this is the equivalent of the UK domestic water requirement for more than 1,000 years.

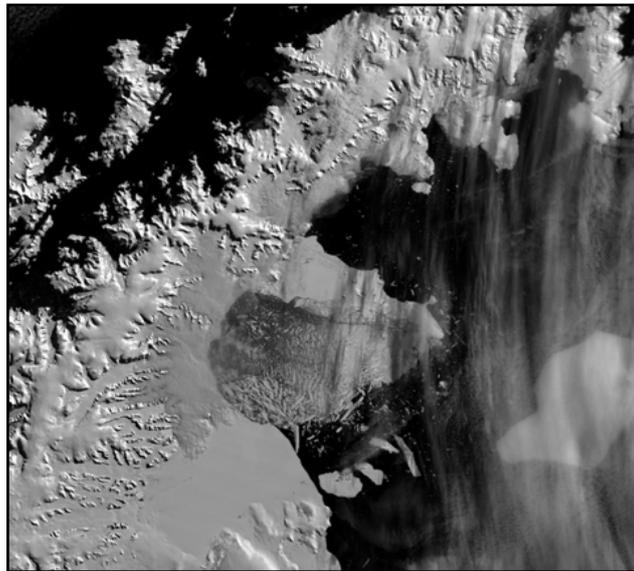
Retreat and collapse?

For some ice shelves, loss of area has occurred progressively over

several decades. For others there have been dramatic episodes of collapse. Some progress in determining the exact mechanisms responsible is now being made.

Does this ice loss affect sea level?

The loss of ice from ice shelves has very little direct impact on sea level, but in several places the acceleration of glaciers draining ice from the grounded ice sheet has been reported as a consequence of ice-shelf retreat. Overall, this and other effects are leading to the northern Antarctic Peninsula to contribute 0.16mm per year to global sea-level rise.



▲ Satellite image of the 2002 break-up of the Larsen B Ice Shelf

When did we first make the link with climate change?

In 1991, the Wordie Ice Shelf was the first ice shelf to be shown to be retreating. However, it was in 1996, after the retreat of the Prince Gustav and the dramatic break-up of the Larsen A ice shelves, that BAS first presented evidence that these events were caused by climate change.

Have ice shelves been lost before?

Sea-bed sediment cores indicate that before their recent loss, some ice shelves were present continuously for at least 10,000 years. This suggests that the current ice-shelf retreat, and climate warming, are unprecedented on this timescale and are not solely part of a natural cycle of change.

What does the future hold for Antarctic ice shelves?

Although stable through most of the 20th Century, Wilkins Ice Shelf has been in retreat since around 1990. Substantial collapse events occurred in 1998 and 2008, and now only the southern portion of the ice shelf remains. To date, Wilkins Ice Shelf was the largest and most southerly ice shelf to retreat, but in future Larsen C, which is currently stable, may also begin to retreat in the coming decades.

FACTFILE

- **George VI Ice Shelf** – This ice shelf is unusual in that it is constrained within a narrow channel and loses most of its mass to melting, rather than iceberg calving. This suggests that this ice shelf may be most sensitive to changes in ocean conditions, and less sensitive than its neighbours to atmospheric change.
- **Larsen A Ice Shelf** – The final-stage collapse of Larsen A in 1995 was a dramatic event that filled the headlines worldwide. The rapidity of the break-up, which occurred in a matter of weeks and left an armada of small icebergs in the Weddell Sea, was unprecedented.
- **Larsen B Ice Shelf** – The progression of retreat on this ice shelf was broadly similar to that which occurred on its neighbour Larsen A, but its final collapse did

not occur until 2002.

- **Larsen C Ice Shelf** – To date, this ice shelf has not shown evidence of climate-driven retreat, but UK and US field parties, supported by the British Antarctic Survey, continue to monitor it to understand more fully its state and likely vulnerability to future change.
- **Prince Gustav Ice Shelf** – This ice shelf retreated progressively through the late-20th century. In 1995, it finally collapsed, leaving open water between James Ross Island and the main Antarctic Peninsula.
- **Wilkins Ice Shelf** – The largest and mostly southerly ice shelf to have retreated has currently lost around one third of its original area.

ICE SHELF CHANGES ON THE ANTARCTIC PENINSULA (1950 to 2008)

