British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

SCIENCE BRIEFING

Antarctica and climate change

It is widely accepted that climate change as a result of human activity is real, happening now and will have an impact on everyone and everything on the Earth. Antarctica, and the Southern Ocean that surrounds it, affects the whole planet through its influence on the Earth's climate system. Understanding Antarctica's role in climate change is not only a huge scientific challenge but also an urgent priority for society

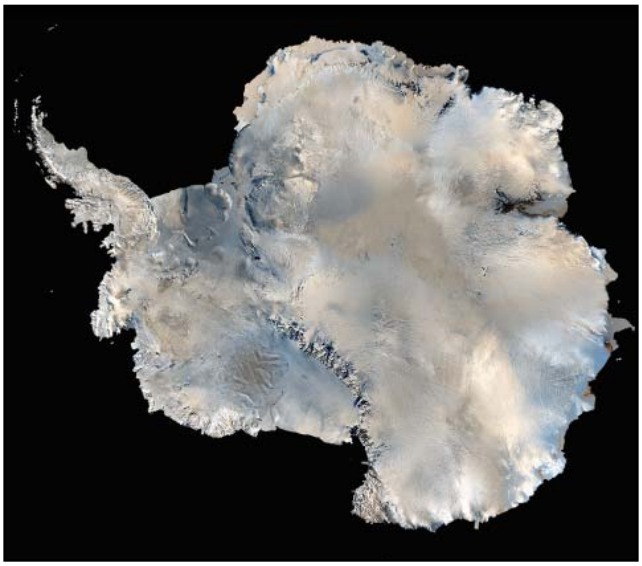
What makes Antarctica so important?

The vast, ice-covered polar regions are like a global thermostat that regulates the Earth's climate system. The whiteness of the ice sheets helps cool the atmosphere by reflecting heat from the Sun; the darkness of the polar oceans absorbs heat from the Sun. Ice cold, salty water at the surface drops into the deep oceans to drive the ocean currents that carry heat around the globe. The Southern Ocean that surrounds Antarctica is a natural 'sink' that absorbs the greenhouse gas carbon dioxide from the atmosphere.

Scientists know that the Antarctic ice sheet has grown and shrunk over geological history. Recent analysis of Antarctic ice cores reveals that during the past 800,000 years the Earth experienced eight glacial cycles (each with an ice age and a warm period). Understanding this natural rhythm helps scientists get a better picture of what's happening to the Earth's climate today and what might happen in the future.

So is Antarctica really melting?

The majority of long-term measurements from Antarctic research stations show no significant warming or cooling trends, and temperatures over most of the continent have been relatively stable over the past few decades. The effects of the ozone hole have shielded much of the Antarctic continent from the impact of 'global warming'.



▲ *Antarctica is vital for understanding climate change*

Does the ozone hole warm Antarctica?

We now know that the Antarctic ozone hole has had a profound effect on the Antarctic climate that extends far beyond increasing the levels of ultra-violet radiation. As stratospheric ozone amounts have fallen, temperatures above the continent have also dropped. This creates a bigger temperature difference between the tropics and the Antarctic which affects global weather patterns. For example, since 1980 the strength of winds over the Southern Ocean have increased by about 15%. Consequently the Antarctic has become more isolated from warm maritime air.

What about reports about Antarctica melting?

It is a very different story on the Antarctic Peninsula – the long mountainous landmass that projects from the main continent. Climate records from the west coast of the Antarctic Peninsula show that temperatures in this region have risen by nearly 3°C during the past 50 years – about 10 times the global average – a rise only matched in Alaska and Siberia. British Antarctic Survey research has shown also that nearsurface sea temperatures to the west of the Peninsula have risen by over 1°C over a similar period. It is now accepted that the waters of the Antarctic Circumpolar Current are warming more rapidly than the global ocean as a whole.

Is human activity warming Antarctica?

At present it is not known if the large temperature increase seen on the western side of the Antarctic Peninsula is a result of human activity or natural variations in climate. Volcanic dust in the atmosphere, variations in energy from the Sun, variations in the Earth's orbit around the Sun, and changes in ocean circulation all affect the climate.

But the eastern side of the Antarctic Peninsula is very sensitive to climate change. Stronger westerly winds in the northern Antarctic Peninsula, driven principally by human-induced climate change, were responsible for the marked regional summer warming that led to the well-publicised retreat and collapse of the northern Larsen Ice Shelf. In October 2006, the first direct evidence linking human activity to the collapse of northern Antarctic Peninsula ice shelves was reported in the *Journal of Climate*.

What's the evidence?

The ozone hole and global warming have changed Antarctic weather patterns such that strengthened westerly winds force warm air eastward over the natural barrier created by the Antarctic Peninsula's 2km-high mountain chain. On summer days when this happens temperatures in the north-east Peninsula warm by around 5°C, creating the conditions that allowed the drainage of melt-water into crevasses on the Larsen Ice Shelf, a key process that led to its break-up in 2002.

What next?

It is important that society and political leaders have access to the best scientific evidence and understanding of the likely scale and impact of global climate change. Attributing observed changes to either natural environmental events or to human activity requires reliable observations of past and present climate. A great deal of international effort is focused on using and improving sophisticated climate models that will analyse results of experiments and help determine future change.

FACTFILE

- Since the start of the Industrial Revolution the amount of greenhouse gases entering the atmosphere has increased beyond that caused by natural events.
- There is growing evidence that a large part of the recently observed, rapid change is driven by human activity.
- The lowest temperature ever recorded in Antarctica was -89°C.
- The temperature in the Antarctic Peninsula has risen by almost 3°C in the past 50 years causing some of the smaller ice shelves to melt.
- Around 30 countries operate Antarctic research stations where scientists study global environmental issues like climate change, ozone depletion and sustainable management of marine life.