

# **First comprehensive review of the state of Antarctica's climate**

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The first comprehensive review of the state of Antarctica's climate and its relationship to the global climate system is published this week by the Scientific Committee on Antarctic Research (SCAR). The review - Antarctic Climate Change and the Environment - presents the latest research from the icy continent, identifies areas for future scientific research, and addresses the urgent questions that policy makers have about Antarctic melting, sea-level rise and biodiversity.

Based on the latest evidence from 100 world-leading scientists from 13 countries, the review focuses on the impact and consequences of rapid warming of the Antarctic Peninsula and the Southern Ocean; rapid ice loss in parts of Antarctica and the increase in sea ice around the continent; the impact of climate change on Antarctica's plants and animals; the unprecedented increase in carbon dioxide levels; the connections between human-induced global change and natural variability; and the extraordinary finding that the ozone hole has shielded most of Antarctica from global warming.

Dr. Colin Summerhayes, Executive Director of the Scientific Committee on Antarctic Research said, "Antarctica is an unrivalled source of information about our planet. This review describes what we know now and illustrates how human activity is driving rapid climate change. By integrating this multidisciplinary evidence into a single source we will help scientists and policy makers understand the distinction between environmental changes linked to the Earth's natural cycles, and those that are human induced. The work is particularly important because it puts

Antarctic climate change into context and reveals the impact on the rest of the planet."

Professor John Turner of British Antarctic Survey is the lead editor of the review. He said,

"For me the most astonishing evidence is the way that one man-made environmental impact - the ozone hole - has shielded most of Antarctica from another - global warming. Understanding the complexities surrounding these issues is a challenge for scientists - and communicating these in a meaningful way to society and to policymakers is essential. There is no doubt that our world is changing and human activity is accelerating global change. This review is a major step forward in making sure that the latest and best evidence is available in one place. It sets the scene for future Antarctic Research and provides the knowledge that we all need to help us live with environmental change."

A summary of the report's findings are detailed in the following 10 key points:

1. Hole in ozone layer has shielded most of Antarctica from global warming

The ozone hole has delayed the impact of greenhouse gas increases on the climate of the continent. Consequently south polar winds (the polar vortex), have intensified and affected Antarctic weather patterns.

Westerly winds over the Southern Ocean that surrounds Antarctica have increased by around 15%. The stronger winds have effectively isolated Antarctica from the warming elsewhere on the planet. As a result during the past 30 years there has been little change in surface temperature over much of the vast Antarctic continent, although West Antarctica has warmed slightly. An important exception is the eastern coast of the

Antarctic Peninsula, which has seen rapid summer warming. This warming is caused by stronger westerly winds bringing warm, wet air into the region from the ocean.

## 2. Warming of the Southern Ocean will cause changes in Antarctic ecosystem

The largest ocean current on Earth (the Antarctic Circumpolar Current) has warmed faster than the global ocean as a whole. The Southern Ocean is one of the major sinks of atmospheric CO<sub>2</sub>, but increasing westerly winds have affected the ocean's ability to absorb CO<sub>2</sub> by causing the upwelling of CO<sub>2</sub> rich water. If temperatures continue to rise 'alien' species may migrate into the region, competing with and replacing original Antarctic inhabitants. Key species in the food chain like planktonic snails could suffer from ocean acidification. Changes in the food regime are likely to decrease the rich Antarctic seabed biodiversity.

## 3. Rapid increase in plant communities across Antarctic Peninsula

Rapid warming has been seen along the western Antarctic Peninsula, along with a switch from snowfall to rain during summer, resulting in expansion of plant, animal and microbial communities in newly available land. Humans have also inadvertently introduced 'alien' organisms such as grasses, flies and bacteria.

## 4. Rapid ice loss in parts of the Antarctic

The West Antarctic Ice Sheet has significantly thinned particularly around the Amundsen Sea Embayment as a result of warmer ocean temperatures. Regional warming caused by intensification of the westerly winds (due to the ozone hole) is melting ice shelves along the eastern Antarctic Peninsula (e.g. Larsen B Ice Shelf). Overall, 90% of the Peninsula's glaciers have retreated in recent decades. However, the

bulk of the Antarctic ice sheet has shown little change.

#### 5. 10% increase in sea ice around the Antarctic

Since 1980 there has been a 10% increase in Antarctic sea ice extent, particularly in the Ross Sea region, as a result of the stronger winds around the continent (due to the ozone hole). In contrast, regional sea ice has decreased west of the Antarctic Peninsula due to changes in local atmospheric circulation and this has also been linked with the very rapid warming seen over land on the west coast of the Peninsula.

#### 6. Carbon dioxide levels increasing at fastest pace in 800,000 years

Atmospheric concentrations of CO<sub>2</sub> and CH<sub>4</sub> are at higher levels than experienced in the last 800,000 years and are increasing at rates unlikely to have been seen in the (geologically) recent past. Antarctica was warmer in the last interglacial (130,000 years ago) and sea levels were higher, but the contribution of West Antarctica to that rise is currently unknown. Small-scale climate variability over the last 11,000 years has caused rapid ice loss, shifts in ocean and atmospheric circulation and enhanced biological production, showing that Antarctica is highly sensitive to even minor climate changes. Studies of sediments under recently lost ice shelves suggest ice shelf loss in some regions is unprecedented during this time scale.

#### 7. Sea ice loss directly affecting krill levels and penguin colonisation

Loss of sea ice west of the Antarctic Peninsula has caused changes in algal growth. This loss of sea ice has also caused a shift from large to smaller species. Stocks of krill have declined significantly. In some areas Adélie penguin populations have declined due to reduced sea ice and prey species (on the northern [Antarctic Peninsula](#)), but they have remained stable or increased elsewhere (Ross Sea and East Antarctica).

Historical exploitation of seals and whales has changed the ecosystem, reducing scientists' ability to fully understand the impacts of [climate change](#) on krill and other species.

#### 8. Antarctica predicted to warm by around 3°C over this century

Over this century the [ozone hole](#) is expected to heal, allowing the full effects of greenhouse gas increases to be felt across the Antarctic. Models suggest that the net effect will be continued slow strengthening of winds across the Southern Ocean, while [sea ice](#) will decrease by a third, resulting in increased phytoplankton productivity. The predicted warming of about 3°C across the continent is not enough to melt the main ice sheet and an increase in snowfall there should offset sea level rise by a few centimetres.

#### 9. West Antarctic ice loss could contribute to 1.4 m sea level rise

Loss of ice from the West [Antarctic ice](#) sheet is likely to contribute some tens of centimetres to global sea level by 2100. This will contribute to a projected total [sea level rise](#) of up to 1.4 metres (and possibly higher) by 2100.

#### 10. Improved modelling of polar processes required for accurate predictions

Climate variability in the Polar Regions is larger than in other parts of the world, yet these remote regions are sparsely sampled. These areas need to be monitored in much greater detail in order to detect change, to improve understanding of the processes at work, and to distinguish between natural climate variability and variability caused by human influences. A detailed understanding of past climate is also crucial for understanding this distinction, as is a significant refinement of currently crude climate models.

Scientific Committee on Antarctic Research (SCAR) is the main body dealing with the international co-ordination of scientific research in Antarctica and the Southern Ocean. Formed with 12 member countries in 1958 to continue activities begun during the International Geophysical Year of 1957 - 58, it is an interdisciplinary committee of the International Council for Science (ICSU) and now has 35 Member countries. SCAR played a leading role in the recently completed International Polar Year (2007 - 2008).

British Antarctic Survey (BAS), a component of the Natural Environment Research Council, delivers world-leading interdisciplinary research in the Polar Regions. Its skilled science and support staff based in Cambridge, Antarctica and the Arctic, work together to deliver research that underpins a productive economy and contributes to a sustainable world. Its numerous national and international collaborations, leadership role in Antarctic affairs and excellent infrastructure help ensure that the UK maintains a world leading position. BAS has over 450 staff and operates five research stations, two Royal Research Ships and five aircraft in and around Antarctica.

More information: Key findings from the review are highlighted in 85 key points, which you can see in full at:

[www.antarctica.ac.uk/met/SCAR\\_ssg\\_ps/ACCE.htm](http://www.antarctica.ac.uk/met/SCAR_ssg_ps/ACCE.htm)

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