Stabilization of ozone hole and changing wind patterns has driven regional cooling phase in Antarctic Peninsula

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This picture is from the SW Antarctic Peninsula region. Credit: Vincent van Zeijst/ Wikipeidia / CC BY-SA 3.0

The rapid warming of the Antarctic Peninsula, which occurred from the

early-1950s to the late 1990s, has paused. Stabilisation of the ozone hole along with natural climate variability were significant in bringing about the change. Together these influences have now caused the peninsula to enter a temporary cooling phase. Temperatures remain higher than measured during the middle of the 20th Century and glacial retreat is still taking place. However, scientists predict that if greenhouse gas concentrations continue to rise at the current rate, temperatures will increase across the Antarctic Peninsula by several degrees Centigrade by the end of this century.

Reporting this week in the journal *Nature* researchers from British Antarctic Survey (BAS) describe how the stabilisation of the ozone hole and changing wind patterns has driven a regional cooling phase that is temporarily masking the warming influence of greenhouse gases.

Lead author, Professor John Turner of British Antarctic Survey says: "The Antarctic Peninsula is one of the most challenging places on Earth on which to identify the causes of decade-to-decade temperature changes. The Antarctic Peninsula climate system shows large natural variations, which can overwhelm the signals of human-induced global warming. In recent years, there has been an international research effort to explain what's happening in the region and to understand the implications for the Antarctic environment and future sea-level rise.

"Our study highlights the complexity and difficulty of attributing effect to cause. The ozone hole, sea-ice and westerly winds have been significant in influencing regional climate change in recent years. Even in a generally warming world, over the next couple of decades, temperatures in this region may go up or down, but our models predict that in the longer term greenhouse gases will lead to an increase in temperatures by the end of the 21st Century."

A wide range of climate data was analysed for this study, including

atmospheric circulation fields, sea-ice records, ocean surface temperatures and meteorological observations from six Antarctic Peninsula research stations with near-continuous records extending back to the 1950s.

During the Twentieth Century, Antarctic Peninsula temperatures increased by up to 0.5? C per decade, helping to trigger the dramatic collapse of ice shelves and causing many glaciers to retreat. Whilst there was a decrease in sea ice extent around the Antarctic Peninsula towards the end of the last century it has been increasing in recent years, particularly in the north-east of the region. The cold easterly winds observed in the 21st Century have had a greater impact on the region because the sea ice has prevented ocean heat from entering the atmosphere.

To set their observations in a longer-term context, the research team looked at a 2,000 year climate reconstruction using the chemical signals in ice cores. As previously reported, analysis suggests that peninsula warming over the whole twentieth century was unusual, but not unprecedented in the context of the past 2,000 years. The reconstruction shows a warming starting in the 1920s, which is consistent with the warming trends recorded by the meteorological stations. The ice core records also reveal periods of warming and cooling over the last several centuries that were comparable to those observed in the post-1950s instrumental record. This highlights the large natural variability of temperatures in this region of Antarctica that has influenced more recent climate changes.

Dr Robert Mulvaney, is a leading ice core researcher at British Antarctic Survey. He says:

"Meteorological observations from the Antarctic Peninsula research stations only cover the last 60 years or so. If we are to get a better idea of

the long-term trend we need to look back in time. The ice core record helps us see how the climate evolves over the longer term. We can also look at the levels of carbon dioxide and other chemicals that were in the atmosphere and compare them with observations from today."

In the last month, the levels of the greenhouse gas carbon dioxide (CO2) in the atmosphere above Antarctica rose past the 400 parts per million milestone, contrasting with the pre-industrial level of 280 parts per million recorded in Antarctic ice cores. Climate model simulations predict that if greenhouse gas concentrations continue to increase at currently projected rates their warming effect will dominate over natural variability (and the cooling effect associated with recovering ozone levels) and there will be a warming of several degrees across the region by the end of this century.

More information: John Turner et al, Absence of 21st century warming on Antarctic Peninsula consistent with natural variability, *Nature* (2016). DOI: 10.1038/nature18645

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