WINTER TEMPERATURE TRENDS IN ANTARCTICA

HOT TAKES

1 There has been no warming over the entire East Antarctic land mass, comprising 80% of the continent.

2 Ice cores show the slight warming over West Antarctica is not unprecedented. It is natural.

3 There is no evidence for Antarctic warming caused by increasing CO_2.

Winter temperature trends across Antarctica are a good test of global warming theory[1] for three reasons. Firstly, the environment is completely pristine meaning that the temperature records are devoid of human warming caused by urban development and land use changes. These localised man-made warming effects plague many thermometer records elsewhere. Second, solar influences are minimal because the sun lies below the horizon for long periods over winter. Third, because of the intense cold, the atmosphere is very dry. Theoretically, this should enhance the relative greenhouse role of CO_2 by minimising water vapour, its main competitor. However it is found there is *no evidence* for Antarctic warming caused by increasing CO_2. This is despite the fact that, over the same 60 year period since 1959 that widespread ground-based temperature measurements have been available from across the continent, CO_2 has increased by almost a third throughout the global atmosphere, from around 316 parts per million (ppm) to nearly 412 ppm today.

Antarctica is the coldest place on Earth. The lowest surface temperature ever directly recorded on Earth is –89.2°C, which was at the Russian Vostok Station on 21 July 1983. The mean (average) winter temperature at Vostok is –66.6°C, while at the South Pole, Scott–Amundsen Base has a mean winter maximum of –55.3°C, and mean winter minimum of –62.2°C. Even at the most northerly station in Antarctica, Esperanza, the mean maximum winter temperature is –5.7°C and the mean winter minimum is –14.1°C. At Australia's Mawson Station, the hottest-ever summer day reached 10.6°C in January 1974, while the temperature in winter dropped to –36°C more than once.

History and Geography of Weather Stations at Antarctica

The oldest record of ground-based thermometer records began at Esperanza in 1945 at the very northern tip of the Antarctic Peninsula. A few more stations commenced recording temperatures in the 1950s, including the Australian Bureau of Meteorology (BoM) installation at the Mawson research station where measurements commenced in early 1954. It was not until 1959 that the number of stations in Antarctica reached double figures.

The majority of stations are on the coast, with a cluster on the Antarctic Peninsula. Only four stations are in the interior on the main Antarctic Plateau. Regional variability was tested by charting the individual temperature time series based on six different regions, as shown in Figure 1. The station sites vary in terrain, altitude, latitude, wind direction, distance from the coast, susceptibility to coastal ocean currents, cloud cover, and precipitation.

Figure 1: Location of Antarctic stations with temperature data used in this study[2]

Regional Variation in Winter Temperature Trends

Due to its remoteness, the observational time frame for Antarctic temperature measurements is relatively short compared to most other regions. Nevertheless regional differences in winter temperature trends can be detected between West and East Antarctica.

Figure 2 summarises trends in the winter temperature anomalies from individual Antarctic stations, loosely grouped into six of the geographic regions whose localities are shown in Figure 1. Warming is clearly evident along the Antarctic Peninsula and in the Victoria Land region of West Antarctica. However in East Antarctica there is no long term warming on time frames relevant to climate change over the whole of the observational record.

The most notable thing about the geographically grouped temperature series in all six of the charts in Figures 2a and 2b is that the grouped temperature records move up and down in synchrony. This is because the records at each station are affected by the same regional weather patterns.

Figure 2a: Antarctic winter anomalies grouped by region[2]

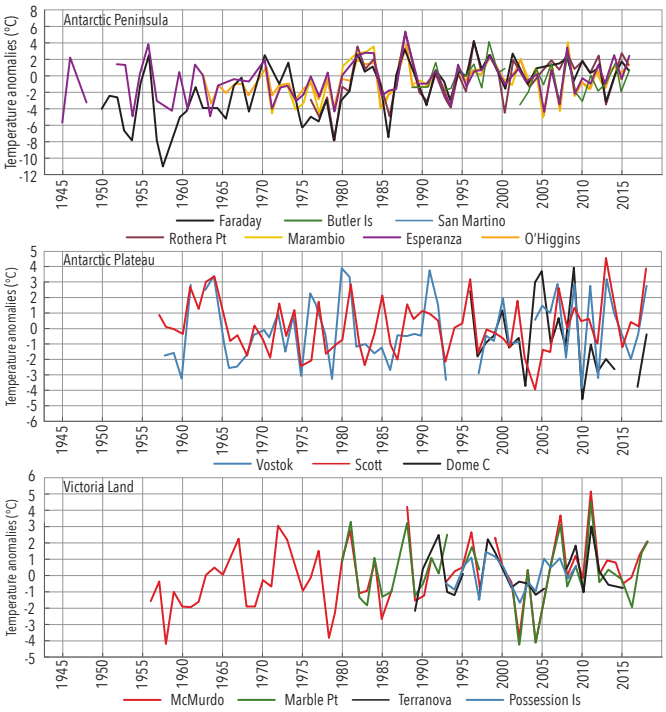
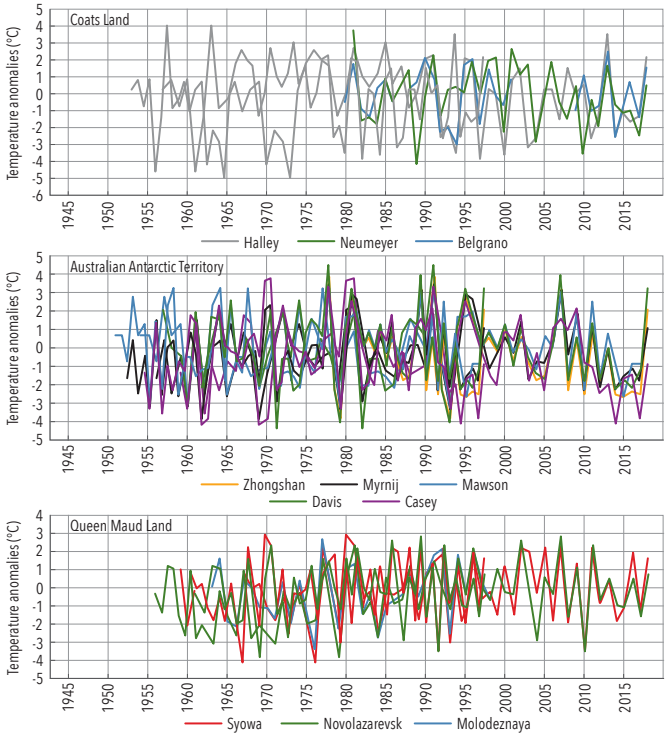


Figure 2b: Antarctic winter anomalies grouped by region continued



Anomalies calculated from 1981 – 2010 means.

Conclusion

According to climate models, amplified warming should be greatest over the polar regions[3]. However there are considerable differences in physical geography between the two hemispheres. The climate in Antarctica is very different to the Arctic because of the combined climatic effects of the surrounding Southern Ocean and the persistent ice sheet.

The absence of warming over the main East Antarctic continent shows there is no evidence increasing CO_2 is having an effect. In the case of West Antarctica it is well documented that the slight warming along the Antarctic Peninsula and Victoria Land is driven by changes in the flow of 'warm' circumpolar water moving along the adjacent coastline[4]. This is linked to natural variability in the giant Antarctic Circumpolar Current, and winds.

A temperature reconstruction based on ice core analysis at West Antarctica shows recent warming there cannot be distinguished from natural variability over the last 2,000 years[5]. Since the observed warming is also only localised, as evidenced by its absence over East Antarctica, it cannot be attributed to increasing CO_2. CO_2 cannot cause localised warming differences because it is globally evenly distributed.

SEE ALSO

FACT SHEET #2: Climate Change in the Polar Regions: A Perspective
FACT SHEET #6: Monitoring Temperatures and Sea Ice with Satellites
FACT SHEET #8: No Evidence of Warming at Mawson, Antarctica

Information in this fact sheet has been drawn from *Climate Change: The Facts* 2020 (IPA 2020), Chapter 7, by Ken Stewart. Fact Sheet series general editor: Dr Arthur Day

1. Global warming theory is fundamentally about the role of CO_2 in reducing the ability of the Earth to cool itself. This is because CO_2 affects how efficiently the climate system cools through infrared (heat) radiation to outer space. Most of the radiation that actually escapes into space is emitted from the atmosphere and not from the surface but the question remains how big is the effect of extra CO_2, and is it dangerous if the effect is too small to even directly detect?
2. Source: Schmidt, G., GHCN V3 unadjusted dataset, viewed 4 March 2019, https://data.giss.nasa.gov/gistemp/stdata/
3. Collins et al. 2013, *Long-term Climate Change: Projections, Commitments and Irreversibility*: https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_Chapter12_FINAL.pdf
4. Kekesi, A 2005, NASA/Goddard Space Flight Center Scientific Visualization Studio. https://svs.gsfc.nasa.gov/vis/a000000/a003100/a003188/index.html
   Hellmer et al. 2012, 'Twentyfirst-century warming of a large Antarctic ice-shelf cavity by a redirected coastal current', *Nature*, vol. 485, pp. 225–228.
   Spence et al. 2007, 'Localised rapid warming of West Antarctic subsurface waters by remote winds', *Nature Climate Change*, vol. 7, pp. 595–603.
5. Steig et al. 2013, 'Recent climate and ice-sheet changes in West Antarctica compared with the past 2,000 years', *Nature Geoscience*, vol. 6, pp. 372-375.

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