P5.1 Climate Change in the Subantarctic:

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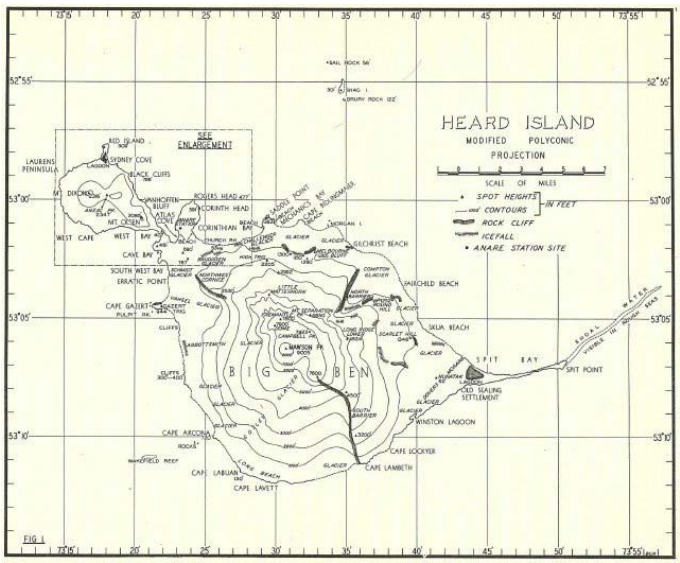
1. INTRODUCTION

1.1 *Location*

Heard Island, at 53°6′ S and 72°31′ E, about 480 km (300 mi) southeast of the Kerguelen Islands and about 4,000 km (2,500 mi) southwest of Perth, is about 910 sq km (350 sq mi) in size. Bleak and mountainous, it is dominated by a dormant volcano, Big Ben, about 2,740 m (8,990 ft) high.



Source: Map of Heard Island. ANARE Reports, Series D, Meteorology, Volume 1, Heard and Macquarie Islands, 1948.

Source: Big Ben. Photo by K. Gooley.

1.2 *History*

Heard Island was discovered in 1833 by the English sealer and explorer, Peter Kemp, on a voyage from Kerguelen Island to the Antarctic. However, Kemp did not publish his discovery and the island takes its name from John Heard, an American merchant captain who rediscovered it independently in 1853.

The territory was transferred from the UK to Australia at the end of 1947. Three scientific expeditions called in at the island in 1874, 1902 and 1929, but it wasn't until the establishment of a research station by the 1947 Australian National Antarctic Research Expedition of 1947 that any systematic observations of the meteorology of the island were recorded. There was a station at Atlas Cove from 1947 to 1955, but the island is now uninhabited and is visited only occasionally by scientists.

The island was continuously occupied for just over seven years, and manual weather observations were taken at Atlas Cove on the western side of the island during this period. These observations greatly assisted in the analysis of southern ocean weather systems.

Source: Photo by David Eastman. © Australian Antarctic Division

2. COMPARISON WITH MARION ISLAND

2.1 *Background*

In a recent paper (Climate Change in the Sub-Antarctic: An Illustration from Marion Island Smith V.R. Climatic Change, Volume 52, Number 3, February 2002 , pp. 345-357(13)) whose title inspired that of the current work, Smith (2002) analysed data from Marion Island, which is located approximately half-way between Heard Island and South Africa.

Smith found that between 1969 and 1999, annual mean surface air temperature at the island increased by 1.2 ° C and noted that warming had occurred in all months except June.

2.2 *Purpose*

The purpose of the current paper is to take the opportunity to examine the temperature data from the sites on Heard Island, in order to find out what these data might be able to contribute towards our understanding of global climate change.

3. CLIMATE

3.1 *Atlas Cove*

At present, there are two automatic weather stations on Heard Island. One of these sites is located very near the old Atlas Cove site at latitude 53°01'08"S longitude 73°23'30"E and at an altitude of just 3.0m, and has provided an almost continuous stream of data since 1997.

Atlas Cove experiences a cold, wet and windy climate. Between 1948 and 1954, the annual mean minimum and maximum temperatures were respectively –0.7°C and +2.9°C, while, on average, the year's mildest day had a maximum temperature of only 12.2°C.

However, extremes of cold were rare. On average, the year's coldest night had a minimum temperature of -8.0°C.

Mean annual rainfall totalled 1353mm, while sunshine averaged only a gloomy 1.4 hours per day. The mean wind speed was a gusty 25 knots.

An illustration from Heard Island.

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Source: Atlas Cove and Azorella Peninsula. Photo by L. Williams

3.2 *The Spit*

The other site is located at The Spit on the eastern side of the island at latitude 53°06'30"S longitude 73°43'21"E and at an altitude of 12.0m, and has also provided an almost continuous stream of data since 1997.

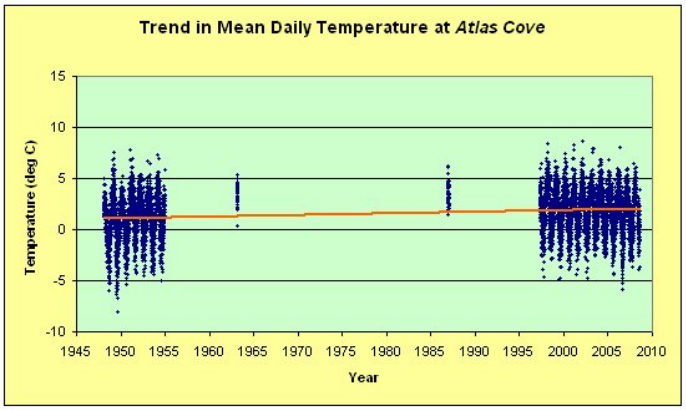
Undoubtedly on account of the föhn effect, the mean temperature at The Spit (2.37°C) has, since 1997, been slightly milder than that at Atlas Cove (1.92°C), this effect being illustrated by the fact that whilst an extreme maximum temperature of 15.8°C has been recorded at Atlas Cove an extreme maximum temperature of 21.6°C has been recorded at The Spit.

Source: On a rare sunny day, a view of the *The Spit* (background). Photo by N. Gremmen.

4. DATA ANALYSIS

4.1 *Trend at Atlas Cove*

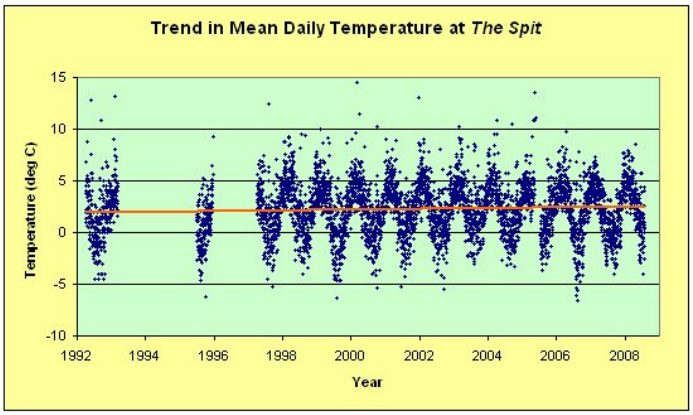
The linear trend in mean daily temperature at Atlas Cove since 1948 is at a rate of +1.46°C per 100 years; with the 95% lower confidence limit being +1.26°C per 100 years (the 95% upper confidence limit is +1.66°C per 100 years).



4.2 *Trend at The Spit*

The trend in mean daily temperature at The Spit since 1992 is at a rate of +3.66°C per 100 years, but the relatively short period, that the data is sourced from, suggests that there is far greater uncertainty about this trend (than the trend derived from the Atlas Cove data).

This uncertainty is reflected in the 95% lower confidence limit being considerably less than the trend, being +1.93°C per 100 years, and in the 95% upper confidence limit being considerably more than the trend, being +5.39°C per 100 years.



5. CONCLUDING REMARKS

In closing, one notes that the data indicate an upward trend in temperature at both Heard Island sites. However, one also notes that whilst there is confidence in the magnitude of the trend suggested by data from the Atlas Cove site, but that there is less confidence in the magnitude of the trend suggested by data from The Spit. Furthermore, one realises that the suggested confidence limits related to the trend from the two stations don't overlap.

In the light of these observations, one may reasonably conclude that what the Heard Island data informs us about climate change in the region is that we can be confident that there has been an overall warming over the past six decades. However, one can be less confident about the magnitude of the rate of that warming.

Nevertheless, it may be reasonable to suggest that the rate of warming in the region probably lies between the upper confidence limit of the Atlas Cove trend, that is, +1.66°C per 100 years and the lower confidence limit of the trend at The Spit, that is, +1.93°C per 100 years.