Antarctica is Cooling

By Ken Gregory

In a story featured on the cover of Nature, January 22, 2009, Steig et al, including Michael Mann, creator of the "hockey stick", report to have found "significant warming" that "extends well beyond the Antarctic Peninsula to cover most of West Antarctica."

Several scientists have been analyzing the paper, led by Steve McIntyre of Climate Audit. The analysis to date shows that the paper is not holding up to rigorous scrutiny.

The Antarctic Peninsula, which represents about 5% of the continent, has been warming about 1.1 ^{o}C/decade. Lower troposphere satellite and surface station measurement across the rest of the continent shows cooling over the last 30 years.

Most weather station data is from the peninsula and the coast with very little data from the interior of Antarctica. There are only 30 weather stations with data prior to 1980. Some automated weather stations (AWS) were added in the 1980's, but many stations have large gaps in their records or record data for only a few years.

The Steig 2009 paper also utilized infrared satellite data which measures the infrared emissions from the ice/ground, but this data is available only since 1982. This is not the same as the lower troposphere satellite temperature data, which measures the air temperature. The authors have refused to provide any of the satellite data that they used as inputs. (This behaviour would not be tolerated in any other branch of science.)

The Steig 2009 paper attempts to make a continent wide temperature reconstruction using the surface station data and the infrared satellite data. They use a statistical technique to fill in the missing surface measurements. Kevin Trenberth of the National Center for Atmospheric Research, said in an e-mail: "It is hard to make data where none exist."

There are several standard area-weighting algorithms that could be used to assign temperature trends to a gridded area. The Antarctic Peninsula has 35% of the surface stations but less than 5% of the continental land area. A reasonable technique to weight the station temperature trends would be to define a grid pattern over the continent and average the station trends within each grid. If a grid on the peninsula encompasses six stations, the trends of these stations would be averaged for that grid. An adjacent grid might have only one station. The continent trend would be the area weighted trends of all the grid cells. This technique ensures that a group of stations in a small area does not have a disproportionate influence on the total area.

Steig 2009 did not use an area weighted technique, but instead used an algorithm called RegEM to infill the missing surface data. The algorithm uses covariance, or how much one station's data is different from another station's data, to assign weighting of a pattern in the data. It does not have any input for the actual station locations. This means that the temperature trend of a station on the peninsula could be applied to an area thousands of

kilometers away.

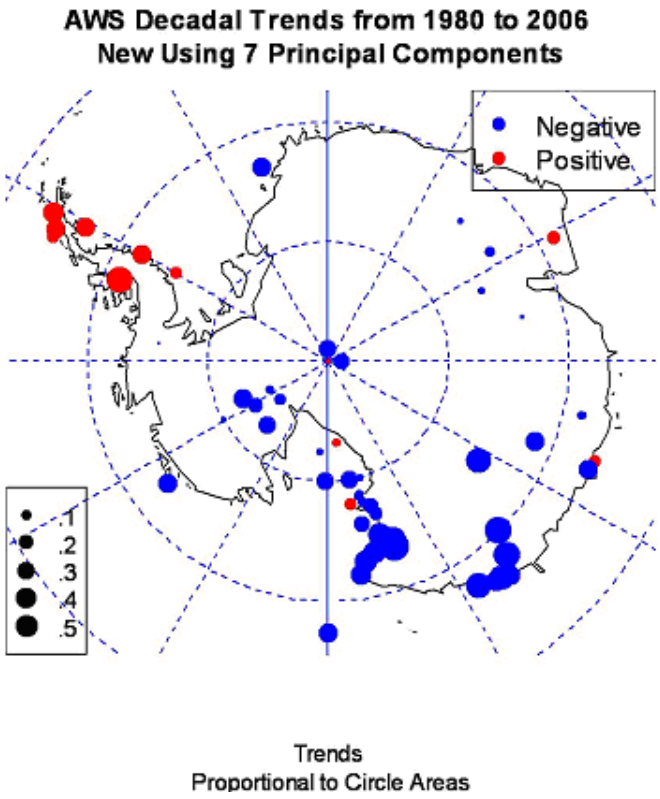
An analysis of the Steig 2009 paper by Jeff C and Jeff Id titled “Steig’s Antarctic Heartburn”, Feb 28, 2009 at http://wattsupwiththat.com shows that the algorithm takes the peninsula climactic pattern and “smears it over a large region that lacks adequate data of its own.” RegEM uses Principal Component Analysis (PCA) to replace the actual station data with a simplified dataset for its covariance analysis. It is like data compression for a picture. Steig's paper uses only three principal components (PC), or only three types of variations of the temperature patterns between station datasets. Steve McIntyre has shown that the choice of three PCs yields the maximum temperature trend for the Antarctica reconstruction. Any other number would yield less warming.

McIntyre compared the correlations between stations to the distances between stations. The correlations drops with distance because you would expect stations thousands of kilometers apart should be less similar than stations next to each other.

If the RegEM technique works correctly, the infilled (made-up) data should show a similar pattern to the real data. But the infilled data shows no similar decline of correlation with distance. Many stations show almost perfect correlation for stations 3000 km apart!

Steig 2009 also generated a satellite reconstruction, also from only three PCs of the satellite data. It shows exactly the same problem as the station data reconstruction; almost perfect correlation at points up to 3000 kilometer distance, which of course, is nonsense.

Jeff and Jeff used RegEM to generate a reconstruction using seven PCs with the same input data. This recovers the lost data with three PCs, so the correlation decay with distance between stations using seven PCs is similar to that seen with the real station data. Clearly, limiting the reconstruction to three PCs resulted in spurious correlations, making the Steig 2009 analysis useless. Using seven PCs (more of the original data), the warming is limited to the peninsula and the rest of Antarctica shows cooling as shown below. The map is from Jeff and Jeff’s article. The blue circles represent cooling trends from 1980 to 2006 where the trends are proportional to the circle areas.



The Steig 2009 paper shows a total Antarctica warming trend from 1957 to 2006 of +0.14 ^{o}C/decade. However the analysis shows warming to 1979, but a slight cooling trend from 1980 to 2006 (when there were automated weather stations) of -0.06 ^{o}C /decade.

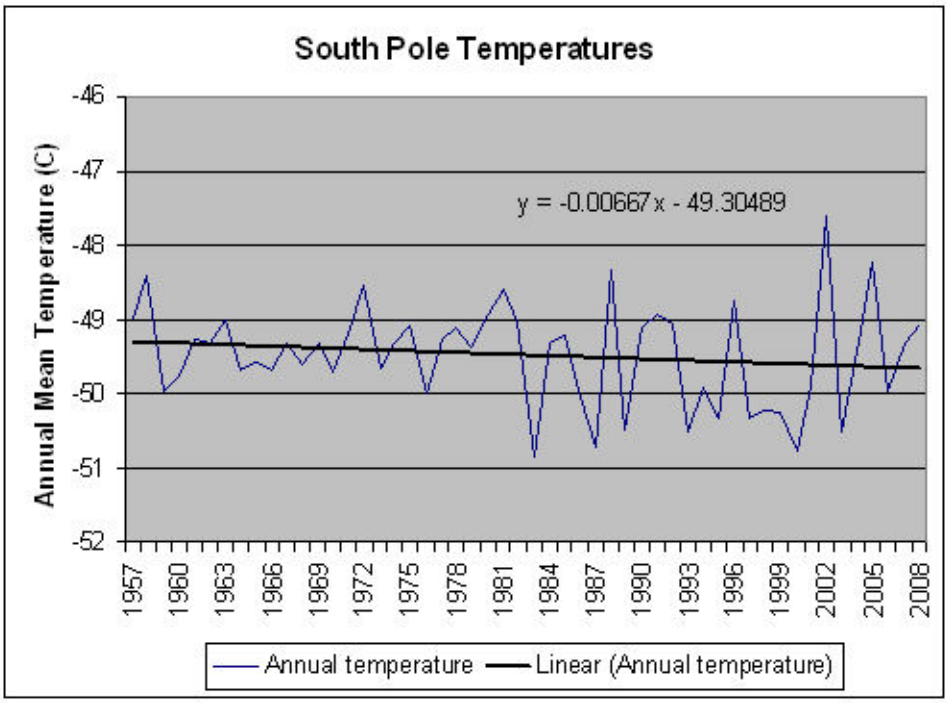
According the Jeff and Jeff's analysis, using the Steig 2009 technique but with seven PCs, the cooling trend of the continent increases to -0.20 ^{o}C/decade since 1980. The cooling trend increases further when applying the seven PCs to weighted grid cells to -0.21 ^{o}C/decade.

Jeff and Jeff conclude that "The trends from the AWS reconstruction clearly have blended into distant stations creating an artificially high warming result. The RegEM methodology also appears to have blended warming that occurred decades ago into more recent years to present a misleading picture of continuous warming."

The cooling trend of Antarctica agrees with the Sun-cosmic ray theory of climate change, which says when the Sun is more active, there are less cosmic rays to seed clouds, causing Antarctica to cool as the very white ice is more reflective than clouds, while the rest of the planet warms where clouds are more reflective than the ground, even in the Arctic. In contrast, the CO_2 greenhouse theory predicts that the coolest part of the planet, Antarctica, should show the most warming due to the very low water vapour content in the air.

The Jeff and Jeff analysis agrees with the usual interpretation of individual station data and lower troposphere temperature data that the peninsula is warming and the rest of Antarctica is cooling.

Here is a graph of the Amundsen-Scot weather station located at the South Pole. It shows a cooling trend from 1957 to 2008 of 0.067 ^{o}C/decade.



A detailed discussion of these issues by Jeff C and Jeff Id is here.

Another issue with the Steig 2009 paper is the “Trouble with Harry”. Steve McIntyre noticed that one station called Harry AWS had an extreme warming trend from 1979 - 2003 of 0.81 ^{o}C. But the station was installed in November 1994, so where did the data from 1979 to October 1994 come from? It was found that the Harry data used in the study was actually a splice of another station called Gill onto the Harry station data. Gill is an unrelated station located on the Ross Ice Sheet. McIntyre says: "Considered by itself, Gill has a slightly negative trend from 1987 to 2002. The big trend in "New Harry" arises entirely from the impact of splicing the two data sets together. It's a mess." The temperature trends given above are calculated after correcting the Harry station data.

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