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THE CAUSE OF GLOBAL WARMING

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By Vincent Gray

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THE CAUSE OF GLOBAL WARMING

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About the Author

Vincent Gray is a Climate Consultant from Wellington, New Zealand. He has a Ph.D in Chemistry from Cambridge University, UK and has had a long career in research laboratories in UK, France, Canada, China and New Zealand, in colloid science, petroleum, plastics, timber, building, forensic science and coal. He has published over 100 scientific and technical papers. He is an expert reviewer for the Intergovernmental Panel on Climate Change, and recently submitted 97 pages of comments on their draft of "Climate Change 2001". He participated in a recent "Skeptics Summit" in Washington DC which gave a seminar in the Capitol Building on "What's Wrong with UN Climate Science".

THE CAUSE OF GLOBAL WARMING

THE CAUSE OF GLOBAL WARMING

EXECUTIVE SUMMARY

Three of the four methods of measuring global temperature show no signs of global warming:

- Proxy measurements (tree rings, sediments etc) for the past 1000 years
- Weather balloons (radiosondes) for the past 44 years
- Satellites (MSU Units) for the past 21 years.

The fourth method, surface measurement at weather stations, gives an averaged mean global rise of a mere 0.6°C over 140 years, but is intermittent and irregular. Individual records are highly variable, regional, and sometimes, particularly in remote areas, show no change, or even a fall in temperature.

It is concluded that temperature measurements carried out away from human influence show no evidence of global warming.

The small and irregular rise shown by many surface stations must therefore be caused by changes in their thermal environment over long periods of time, such as better heating, larger buildings, darkening of surfaces, sealing of roads, increases in vehicles and aircraft, increased shielding from the atmosphere and deterioration of painted surfaces.

1. INTRODUCTION

The federal government has committed this country to compliance with the Kyoto accords, a set of protocols signed in 1997 that bind signatories to significant reductions in the level of emissions of what have been called "greenhouse gases." The remedy most often suggested to bring Canada into compliance is a sharp increase in taxes on the consumption of fossil fuels. By some measures, those “green” taxes would have to double to discourage consumption enough to ensure compliance.

The scientific claims behind the theory of man-made global warming, a theory that has stimulated the desire for such corrective measures have been in dispute since they were first made, in 1978. Another warning that these doubts are valid was received in August 2000, when James Hansen, a NASA scientist at the Goddard Space Center and the "father of climate change theory," recanted his position that carbon dioxide pollution was causing worldwide warming. It is questionable public policy to double carbon taxes in a cold, energy-dependent country like Canada if this theory is not true.

To present another view on global warming, the Frontier Centre for Public Policy is pleased to publish the text of a paper first delivered in November by Climatologist Dr. Vincent Gray to the Wellington Branch of the New Zealand Royal Society. It suggests that global temperature change may not even be a reality at all, but rather a false conclusion based on temperature readings that have been skewed by human activity. The stations that monitor the temperature in cities have moved closer to humans as cities have expanded, and many rural stations have been closed down. That explains why there has been no recorded increase in the measure of atmospheric temperatures, only a spike in the data on surface temperatures. Dr. Gray verifies his thesis by examining the surface temperature variation in remote stations, which conform to the data on atmospheric readings.

The idea that humans are causing the world to heat up and risking disaster by doing so has a powerful hold on the public perception. It is reinforced by media reporting which finds verification for it in every weather event. It is being taught to schoolchildren as scientific truth. Dr. Gray offers a rebuttal to this widespread perception.

1. THE MEASUREMENT OF GLOBAL TEMPERATURE

On June 23rd 1988 Dr James Hansen of the Goddard Institute of Space Studies, New York told the US Senate that he had devised a method for calculating the average temperature of the earth's surface by amalgamating the many thousands of temperature measurements collected by weather stations (Hansen and Lebedeff 1987). His method can be illustrated by Figure 1, (from Karl 1998) which shows global temperature changes from 1901 to 1996 Red dots show a temperature rise and blue dots a temperature fall, with the area of the dot indicating the size of the rise or fall (in °C/100 yr)

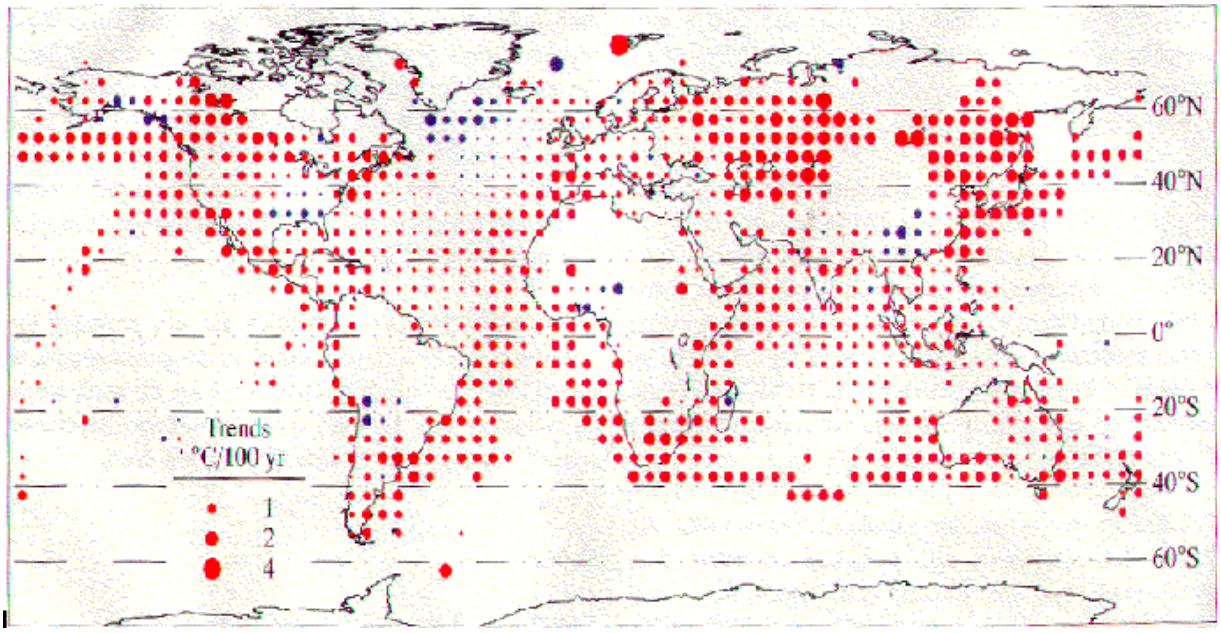

Figure 1. Global temperature changes 1901-1996 for individual 5°x5° grids (Karl 1998)

The method involves dividing the world into 5°x5° latitude/longitude boxes on a Mercator map. In each box, the average temperature for each month of each year is calculated from records of all the weather stations that are regarded as reliable. This figure is then subtracted from the average monthly temperature for the same box for a reference period (currently 1961-1990). The result is the *Temperature Anomaly* for that box for that year. The average of all these can then be made for the whole year for each box, and then for the globe, or for the Northern or Southern Hemispheres. A current version of annual anomalies for the Northern and Southern Hemispheres, and for the globe since 1860 is given in Figure 2 (IPCC1996 plus updates). Until a record based on the amalgamation of surface readings was published in 1987 the idea of "global warming" did not, and could not exist. This record remains to this day the only evidence for "global warming".

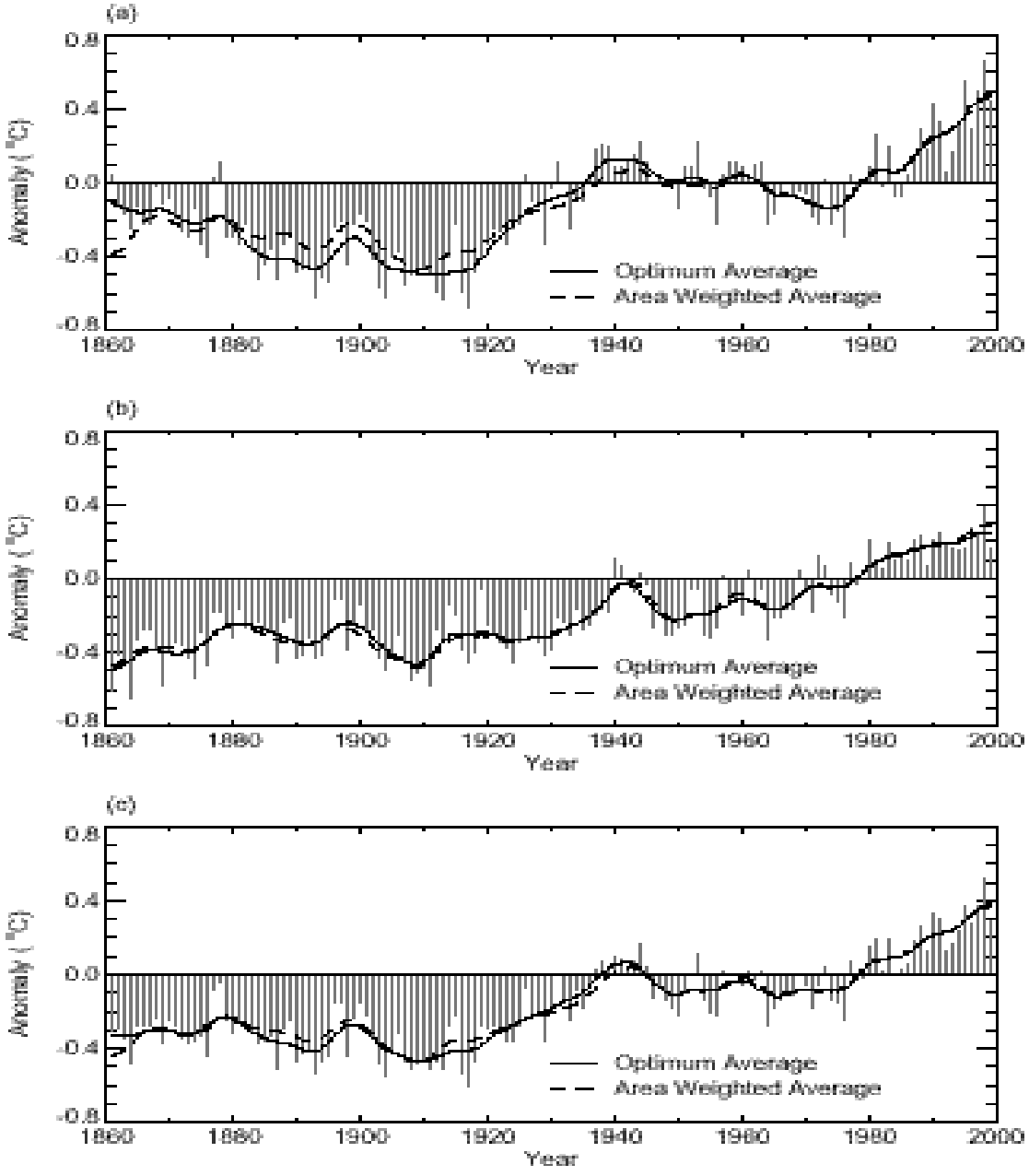

Figure 2. Combined annual land-surface air and sea surface temperature anomalies (°C) for (a) Northern Hemisphere, (b) Southern Hemisphere, (c) for Globe (University of East Anglia, IPCC 1996, updated)

The overall global rise is considered to be 0.6°C ±0.2°C over 140 years. It is difficult to understand why this very small rise is regarded as important. All of us endure fluctuations of more than this amount as a routine. It is an amount that is hardly noticeable, and would make very little difference to any biological system over such a long period. Much greater variability occurs over short distances or times.

Yet it has taken on tremendous significance. The nations of the world have regarded it as indicative of a potential future disaster and are busy taking economically damaging measures which they believe may avert it.

The record passes through several phases of different behaviour.

- From 1860 to 1910 there was a slight fall of about 0.15°C
- From 1910 to 1940 there was a rise of about 0.5°C
- From 1940 to 1975 there was a fall of about 0.15°C
- From 1975 to 2000 there was a rise of about 0.5°C

There is an obvious explanation for these sequences, related to the increase in human population, the growth in the number and size of buildings, and the increased use of energy over the period.

From 1860 to 1910 the system was becoming established in the large industrial cities and spreading over the globe. Equipment was being moved from the sides and roofs of buildings to protected enclosures, leading to a slight fall in the average.

From 1910 to 1940 the cities expanded, together with their energy use. Thermometers still suffered from an upwards bias because of the shrinkage of the thermometer glass. The First World War closed many stations which were rebuilt with better facilities, still mainly in large cities.

From 1940 to 1975 many stations were moved to airports and others were set up in rural areas, so causing an average fall in temperature.

From 1975 to 2000 airports expanded to become "heat islands" and better heating took place everywhere.

This explanation is confirmed if there is no global warming for temperature measurements taken remote from human habitation.

There are only minor differences between the two Hemispheres. Since 1975 the Northern Hemisphere has warmed more then the Southern Hemisphere.

The fluctuating behaviour of the record is incompatible with any explanation involving a steady climate change and it is not possible to establish any particular trend. The use of linear regression to characterise the overall sequence, or any part of it, is no guide to its future course.

Monthly Individual land-surface station data are available from the US sources (Goddard Institute of Space Studies, at http://www.giss.nasa.gov) and the Global Historical Climate Network, GHCN (http://www.ncdc.noaa.gov). Charts of annual means for the whole world can be downloaded from the GISS site, and for the USA from GHCN.

Monthly gridded anomaly figures are available also from these sources, as well as from the University of East Anglia Climate Research Unit (http://www.cru.uea.ac.uk).

Annual and hemispherical anomalies are available from all of these sources, but it is significant that the US have never recognised the reliability of the sea-surface temperatures that have been incorporated into the global and hemispherical annual anomalies by the British team (Folland and Parker 1995) which depends on "calibration" with surface sites. The IPCC (1990, 1996) have favoured the British series despite this doubt. There are also significant differences between the amalgamated annual records of the three authorities which raise doubt on the reliability of all of them.

The monthly recorded and gridded anomaly figures are too voluminous for easy individual study. It proved to be possible to obtain from NCDC/NOAA the annual gridded mean anomalies which formed the basis of Figure 1, plus the calculated temperature changes 1901-1996 which are plotted in Figure 1.The annual mean figures form the basis for the annual discrepancies of Figure 2.

Examination of this dataset reveals the following information:

- Only 46% of the earth's surface is covered by the boxes (938 out of 2592 boxes) in Figure 1 (60% of the Northern Hemisphere and 31% of the Southern hemisphere). This includes the sea surface temperature readings, which are regarded as unreliable by the US investigators. The land-based boxes (217) cover only 14% of the earth's surface (11% in the Northern Hemisphere and 3.8% in the Southern Hemisphere).

- There are gaps in most of the annual records for the boxes that are filled. The dataset consists only of records where there was a minimum of 72 out of the possible 96 readings. This means that there may be as many as 24 missing readings in some boxes. Many of these gaps were between 1914 and 1919. 51% of the 938 boxes have one or more missing readings over this period, and 23% are missing four or five annual readings. There must have been considerable disruption and discontinuity as a result.

- The 1901-1996 temperature change was obtained by subtracting the average of the first five readings from the average of the last five readings. The maximum change was therefore from 1902 to 1995. Not all readings began in 1901. One box began as late as 1925. Not all readings began in 1901. One box began as late as 1925.

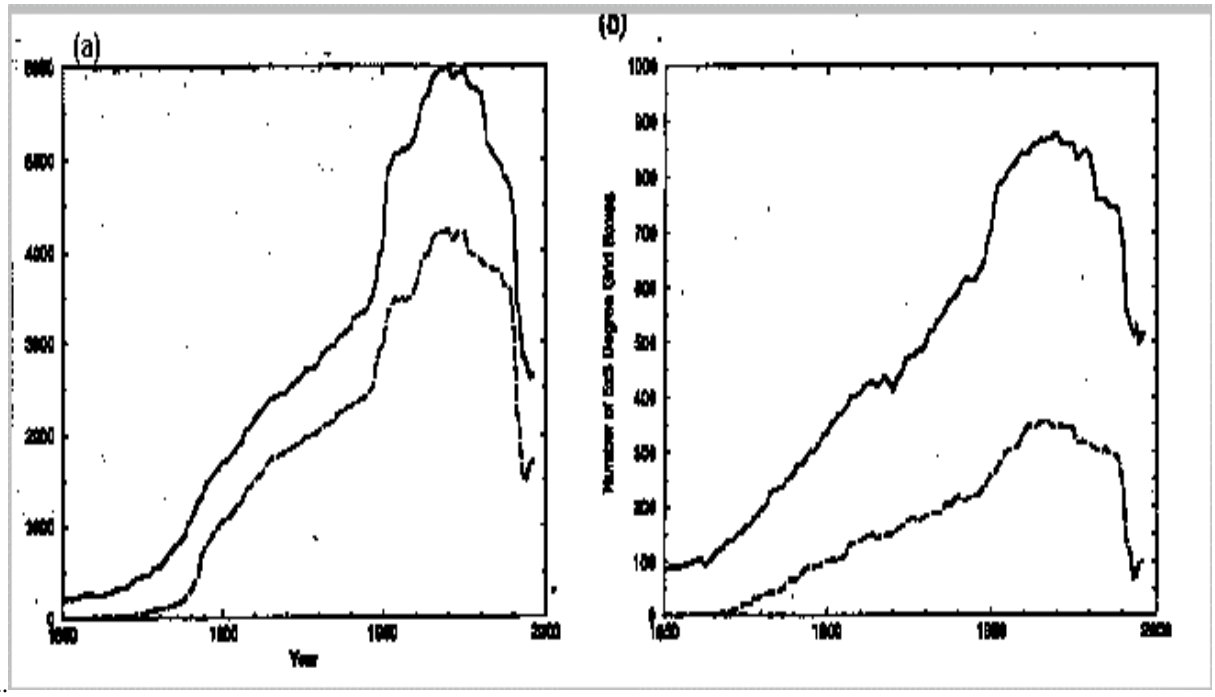

Figure 3 (a) Number of stations measuring temperature (upper curve) and maximum and minimum temperature (lower curve); **3(b)**, numbers of grid boxes giving mean temperature (upper curve) and maximum and minimum temperatures (lower curve), in The Global Historical Climate Network (Peterson & Vose 1997)

Besides the irregular behaviour of the mean temperature, it is evident from Figure 1 that there is pronounced regional irregularity. Several regions (Southeast United States, Bolivia, Alaska, Central Africa, Tibet, the Greenland Sea, Tananarive, Tombuktou) fell in temperature between 1901 and 1996. The greatest increase was over 4°C on Svalbard, close to a fall of 2°C in the neighbouring ocean (see Figure 18 below).

Although some reference boxes had many measurement stations, notably in Europe and the USA, other regions, notably Russia/USSR, depended on only one or two stations in each box. Over the 1900-1996 period there were huge gaps in coverage in the Pacific, Indian and Antarctic Oceans, Central Asia, Africa and South America, Arabia, Western Australia, Antarctica and the Arctic, so that the quoted averages may not be representative.

As is shown by Figure 3, the number of stations and boxes varied considerably over the years. In 1900 there were 1800, in 1970 there were 6000, and in 1996, 2,600 (Peterson and Vose 1997). Many stations were closed between 1980 and 2000, mainly in rural areas, so increasing the average temperature.

It is evident that the recorded temperature changes showed considerable regional variability which must surely be mainly associated with purely local changes related to proximity to human habitation.

This can be tested by comparing the combined surface measurements with the three other methods of measuring mean global temperature changes.

2. COMPARISON OF SURFACE TEMPERATURE WITH PROXY TEMPERATURE

Mann et al (1999) have recently compared the combined surface temperature record for the Northern Hemisphere with "proxy" temperature calculations for the past 1000 years. These have mainly been from the width of tree rings, but also from ice cores, marine sediments and coral growth (Figure 4.)

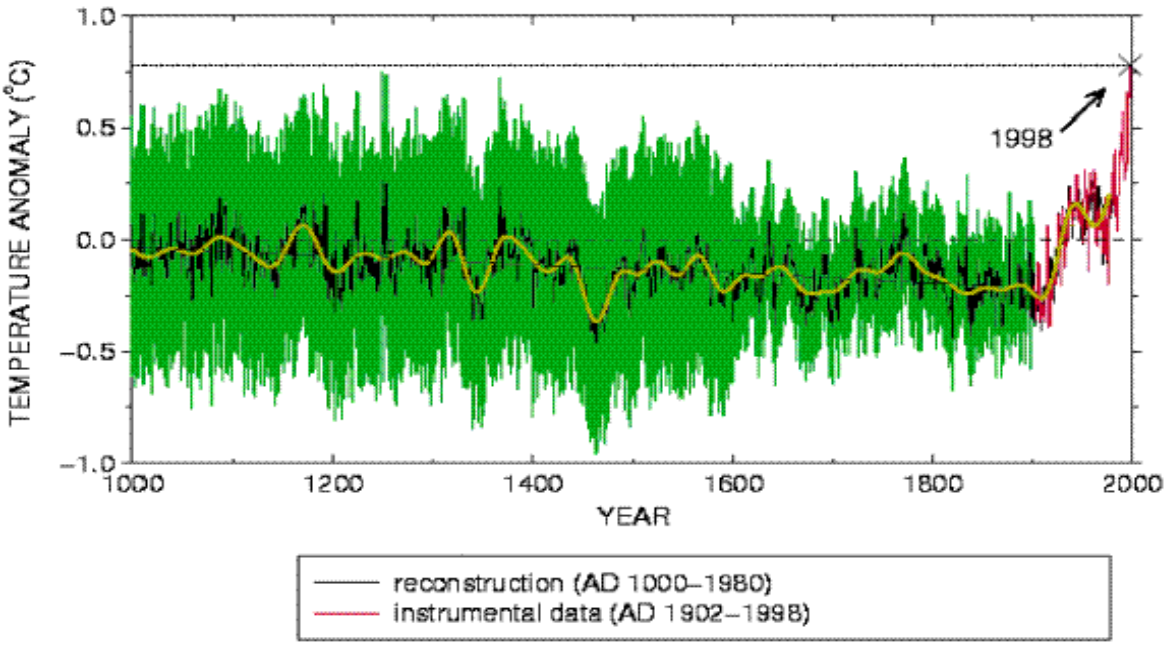

Figure 4. Millennial Northern Hemisphere temperature reconstruction (solid) and instrumental data (dotted) from AD 100-1998 (Mann et al 1999). Two standard errors are shown.

Since the proxy measurements were all from remote areas and most of the surface measurements were close to buildings, this comparison confirms the likelihood that the increase in the amalgamated surface readings is due to their proximity to human habitation. The statistical comparison is somewhat dubious however, since the proxy measurements do not appear to take proper account of the well established Medieval Warm Period and Little Ice Age which are featured in other studies.

The conclusion that the rise in the amalgamated surface measurements is caused by proximity to human habitation is confirmed if the proxy measurements are continued to the present day.

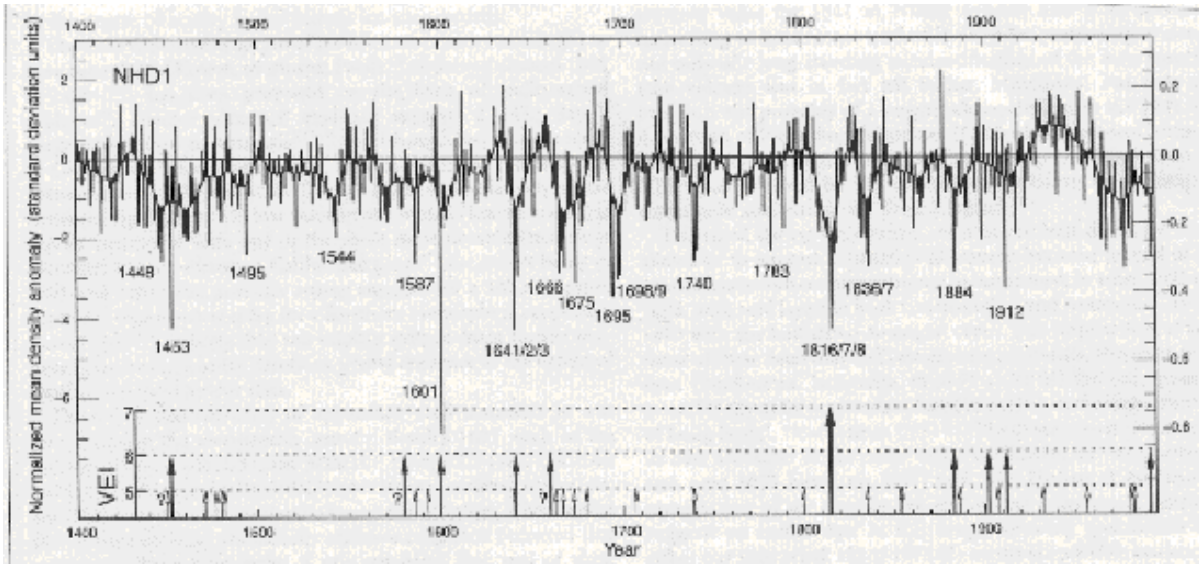

Figure 5. Northern hemisphere tree-ring density chronologies, referred to 1881-1960 period. Extreme low values can be associated with volcanic events. (from Briffa et al 1998)

Figure 5 which shows Northern Hemisphere tree ring density since 1400 shows no evidence of warming for the Northern hemisphere since then, and indic ates a recent fall rather than a rise.

Figure 6 goes back much further, more than 2000 years, and shows a slight recent warming which cannot be considered as exceptional. A slight increase in tree-ring thickness recently is to be expected because of the increased atmospheric concentration of carbon dioxide

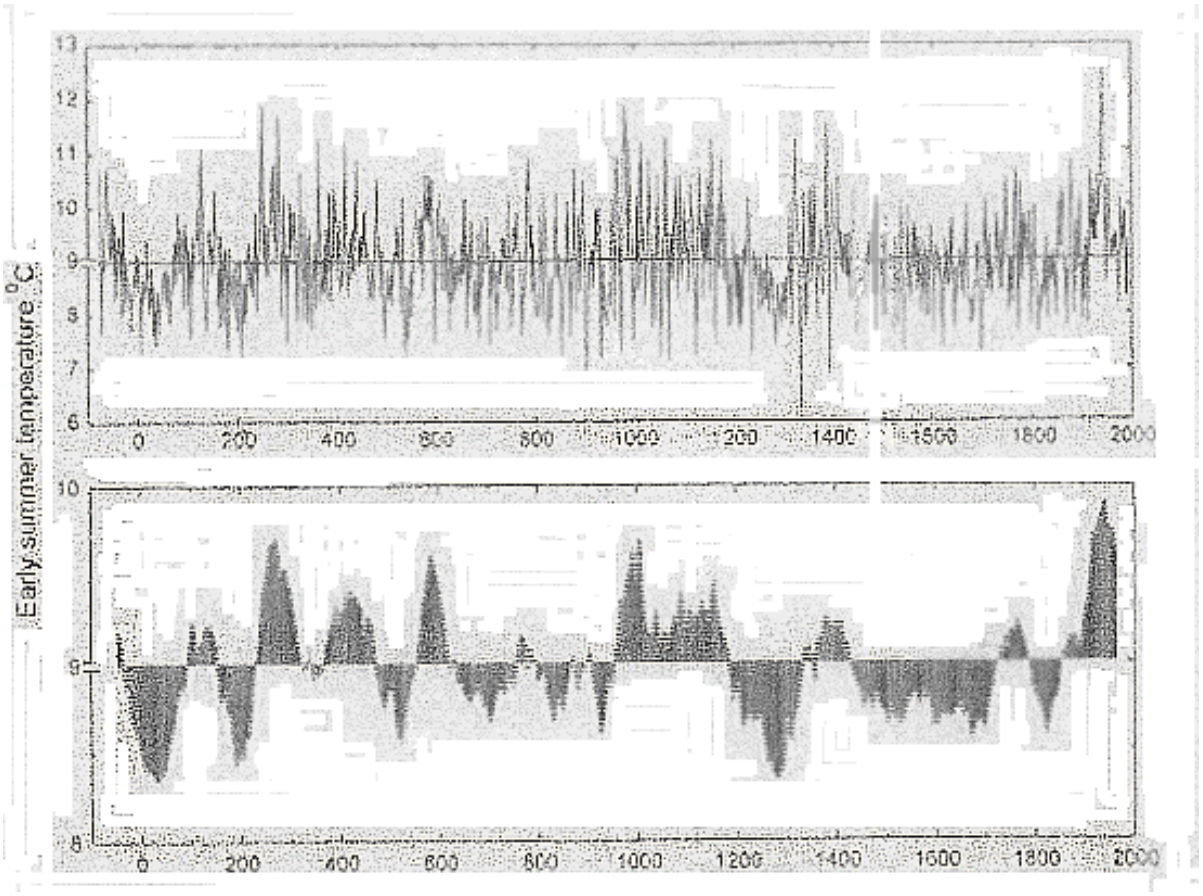

Figure 6. Reconstructed early summer temperature history in Northern Siberia (top) and a 57-year smoothed version of the same data (bottom) (Naurzbaev and Vaganov 2000)

To conclude: the proxy temperature measurements confirm that there has been no global warming in locations far from human habitation.

To further explore the contrast between sites close and remote from human activity, let us examine other records of global temperature change.

3. GLOBAL TEMPERATURE FROM WEATHER BALLOONS

Weather balloons (radiosondes) have been measuring temperature in the lower atmosphere since 1956. There are three sets of records which agree fairly well.

Figure 7 shows the temperature record of weather balloons (HadRT2.0 T2LT) of Parker et al (1997, updated). It is plotted together with the satellite (MSU) measurements which closely agree and are discussed below.

It will be seen that the readings fell below zero between 1960 and 1980, but rose again to the level of 1956 until the present day. These results have been interpreted as showing a temperature rise, but the fluctuations are likely to be due to natural variability. The overall change over the 1956-2000 period is surely zero.

Similar remarks apply to the results of Angell (1999). He tries to argue that the top series in Figure 8 show a rise similar to that of the surface measurements; but in fact they actually show no rise at all since 1956, but fluctuations down and then up.

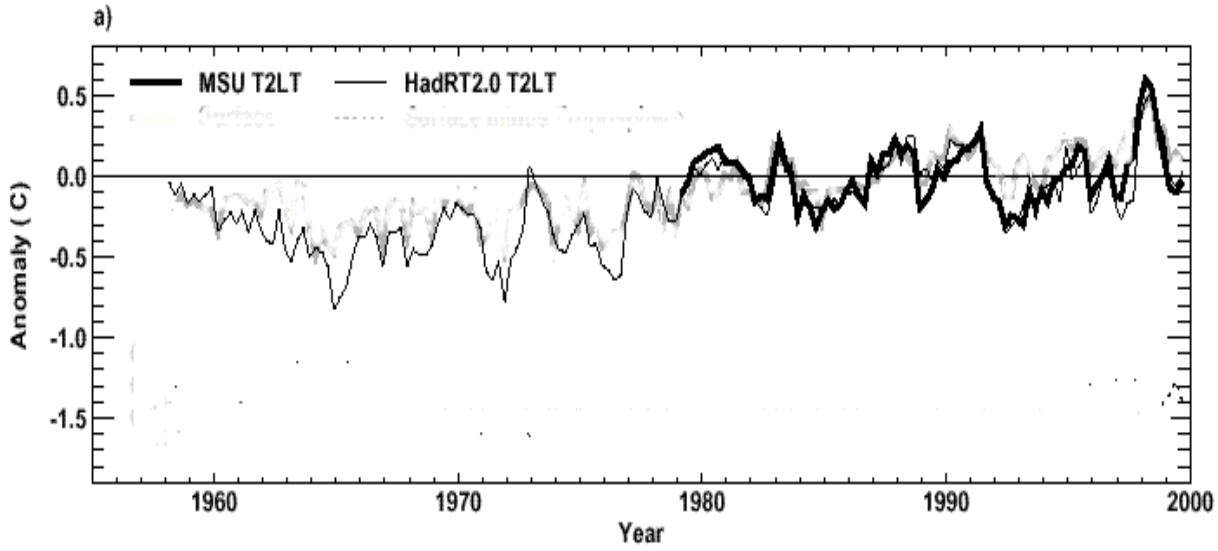

Figure 7. Weather balloon (radiosonde) temperature anomalies in lower atmosphere from 1956, with satellite (MSU readings, from 1979. (Parker et al 1997)

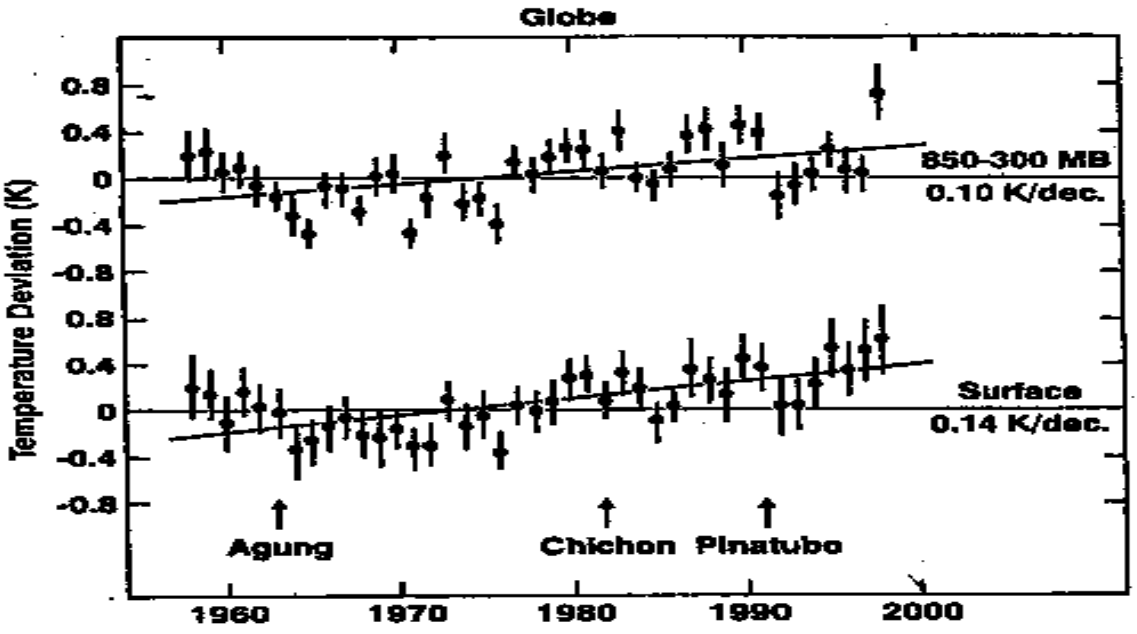

Figure 8. Weather balloon (radiosonde) temperature measurements (top) compared with surface measurements (bottom); from Angell (1999)

4. GLOBAL TEMPERATURE FROM SATELLITES

The most reliable global temperature measurements, since 1979, are those made by NASA satellites, using Microwave Sounder Units (MSUs). The temperature of various levels in the atmosphere is measured from the microwave absorption of oxygen, which is sensitive to temperature change. Measurements have a greater accuracy than the surface measurements (Christy and Goodridge 1977). They not only provide the only genuine global average, but they are able to supply a temperature record for any designated region on the earth's surface.

The latest MSU satellite record for the lower atmosphere is shown n Figure 9. It will be seen that it shows no overall warming since 1979. The exceptionally high figure for 1998, which was also evident in the weather balloon and surface records, was thought by some to indicate an overall rise in the satellite record. It has, however been evident from subsequent measurements that it represented an exceptionally high, but temporary departure from a zero trend, attributed to the El Niño event of 1998. The subsequent measurements indicate the complete absence of any positive trend.

Figure 12 gives a comparison between the weather balloon, satellite, and two different surface measurements, for the period from 1979 to 2000.

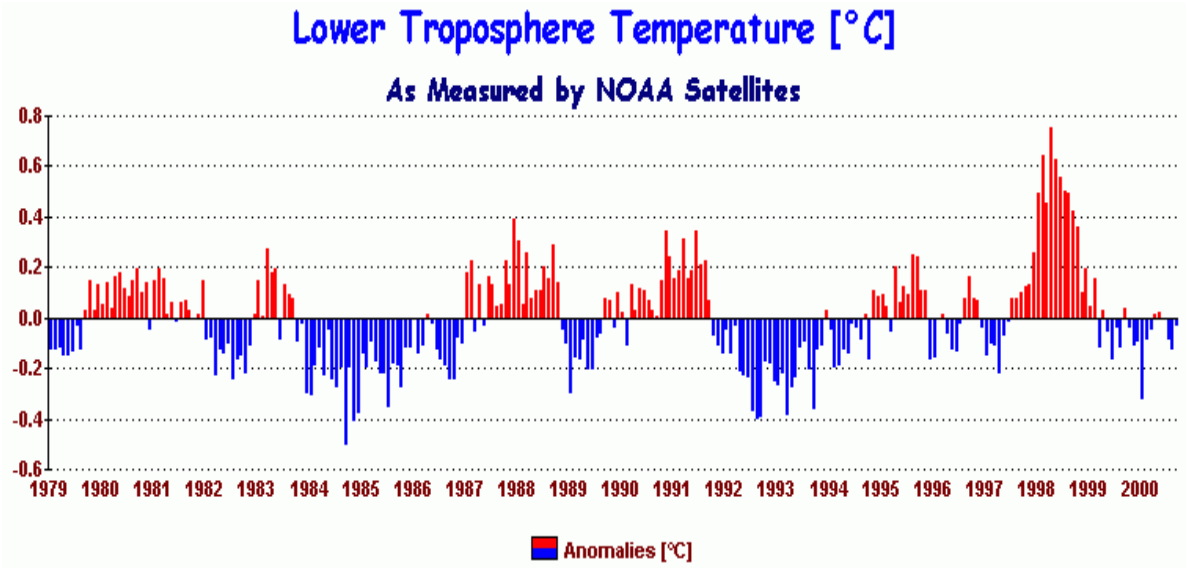

Figure 9. Global monthly temperature anomalies in the lower atmosphere as measured by MSU units on NASA satellites.

It will be noted that the four sets of measurements show a close agreement with temperature fluctuations from year to year. They all show rises in 1981, 1984, 1987, 1996 and 1998. They all show falls in 1983, 1986, 1990, 1997 and 2000. This shows that all four measurements are responsive to exactly the same influences in the climate. However, the surface measurements show a steady trend upwards which is not seen in the balloon and MSU measurements. This trend must be attributable to some influence on the surface itself, an influence not present in the lower atmosphere.

The very high transient temperature rise in 1998 should be noted. It is recorded by all the methods, and it is being argued as evidence of permanent global warming, as its effects were widespread.
However, it is clear from the weather balloon and MSU measurements that it was a transient effect which has now subsided, and both of these measurements have now returned to their baseline. The fact that the surface record has also fallen, but not to its original level is evidence that these measurements are subject to an upward bias not present in the balloon and satellite measurements.

The 1998 temperature surge is attributable to an unusually large Southern Oscillation (El Niño), not to an overall warming trend.

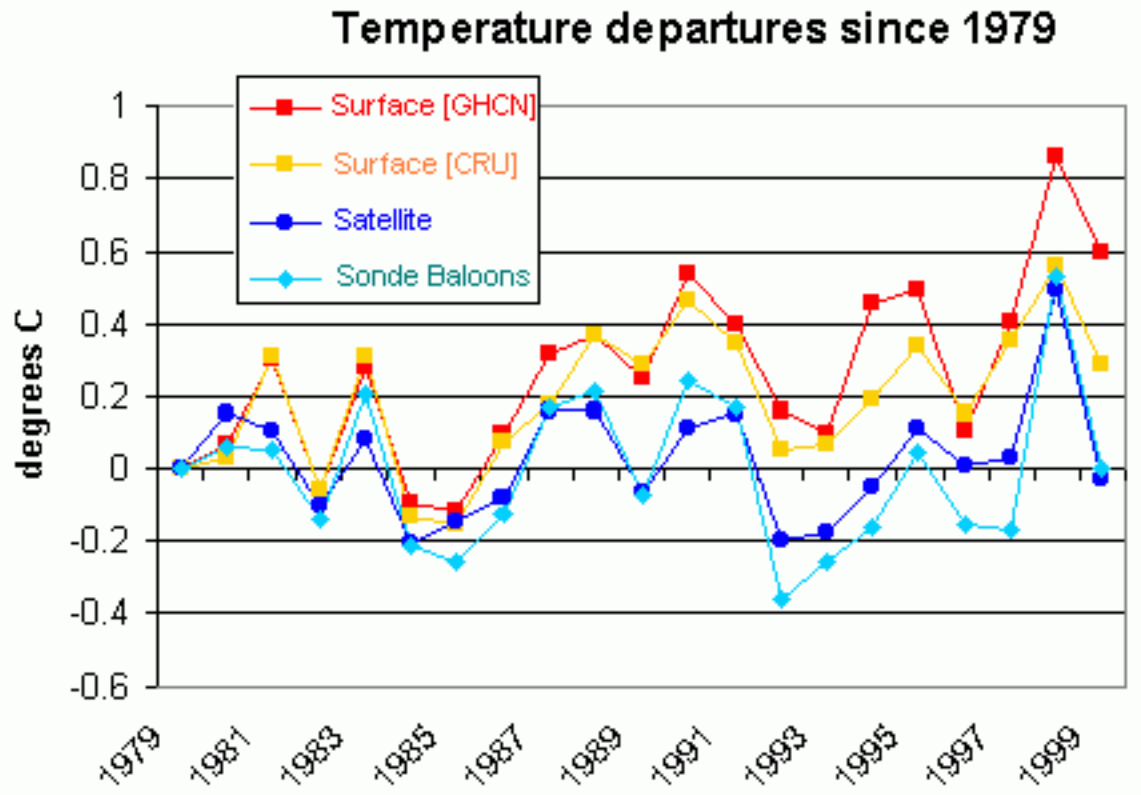

Figure 10 Comparison between annual global temperature anomalies for two sets of surface measurements (GHCN and CRU), weather balloons and satellite (MSU) measurements.

6. SURFACE TEMPERATURE FROM REMOTE SITES

Now, it so happens that there are many surface records from remote sites that do not show evidence of warming. Selections are given in Figures 11 to 20.

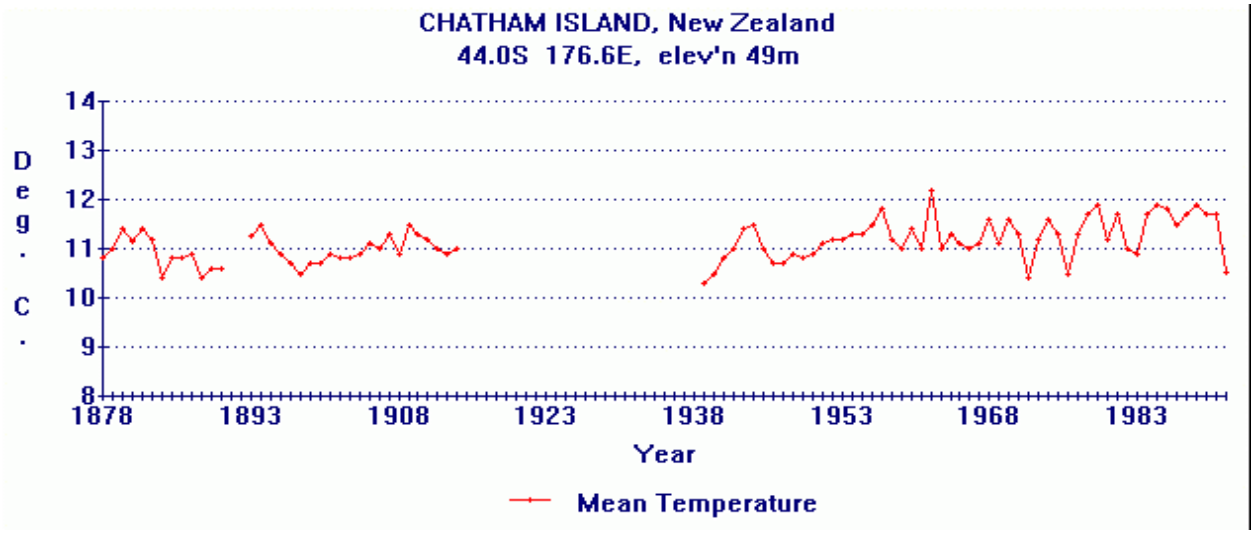

Figure 11 Surface temperature record for Chatham Islands, New Zealand.

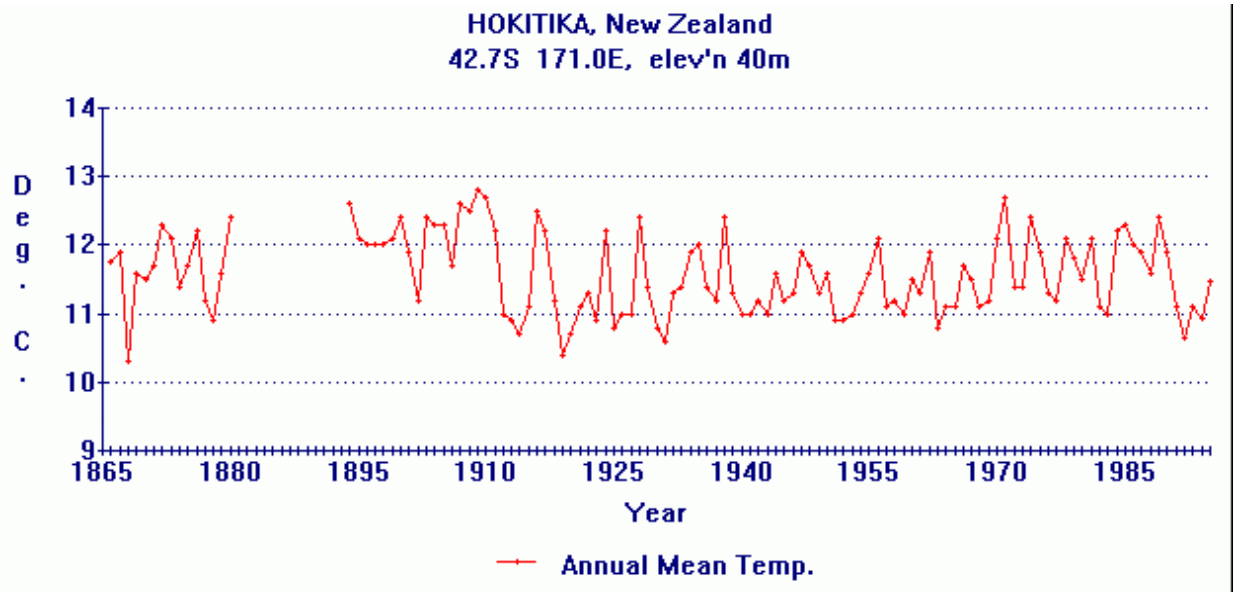

Figure 12 Surface temperature record for Hokitika, New Zealand

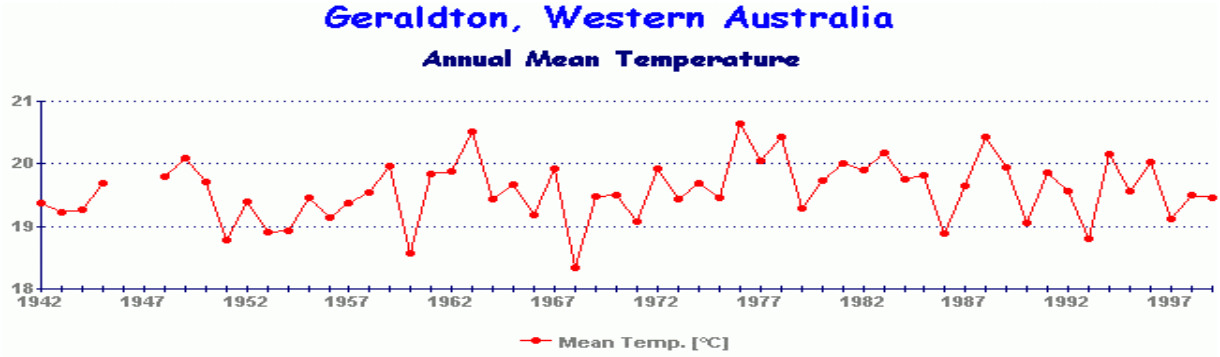

Figure 13 Surface record for Geraldton, Western Australia

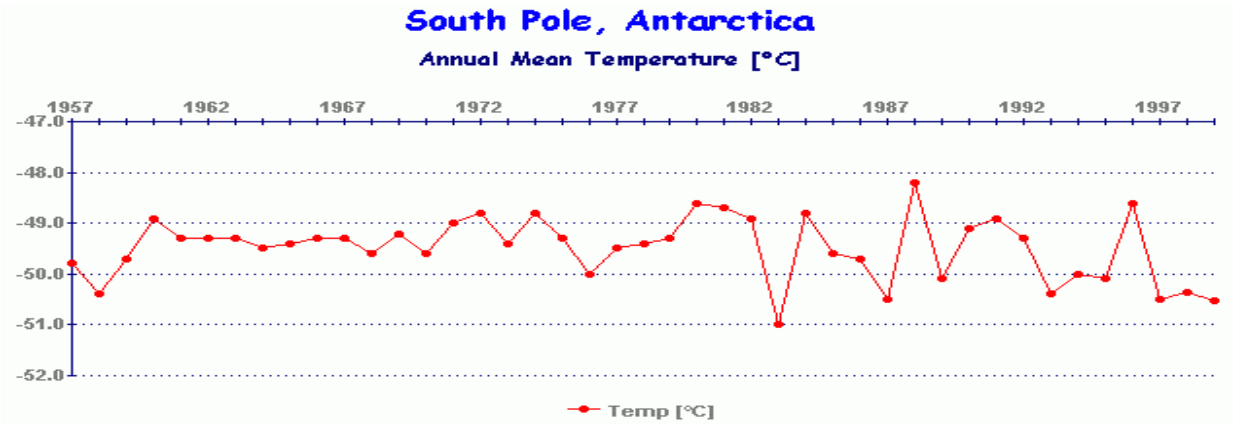

Figure 14 Surface record for South Pole

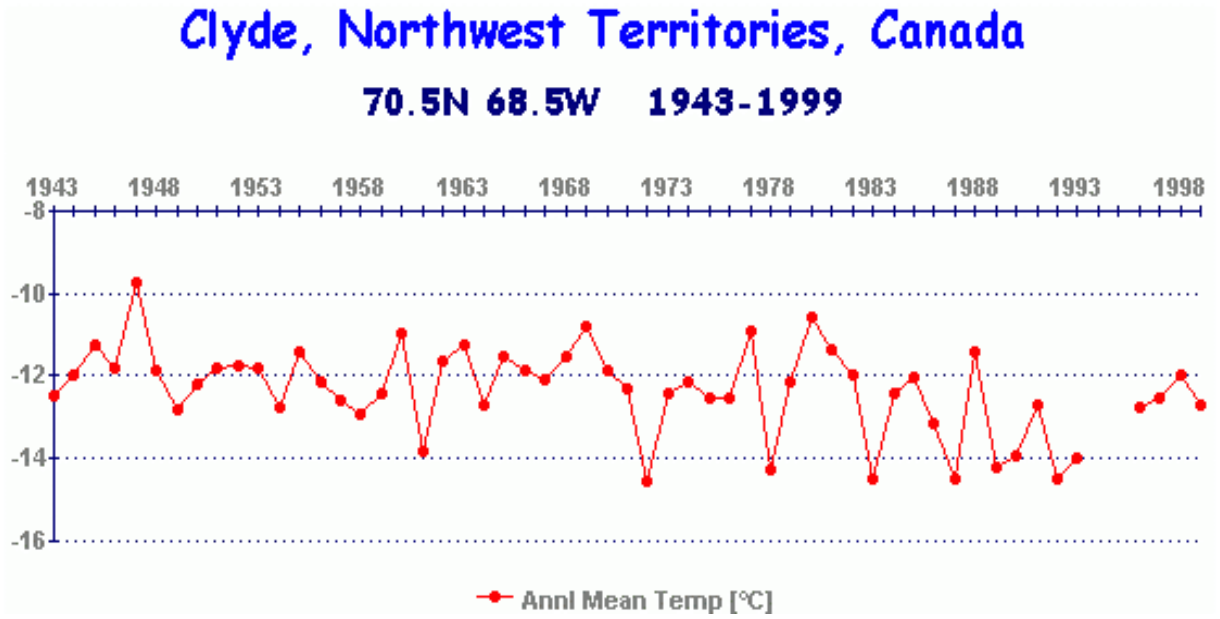

Figure 15. Surface record for Clyde, Northern Territories, Canada

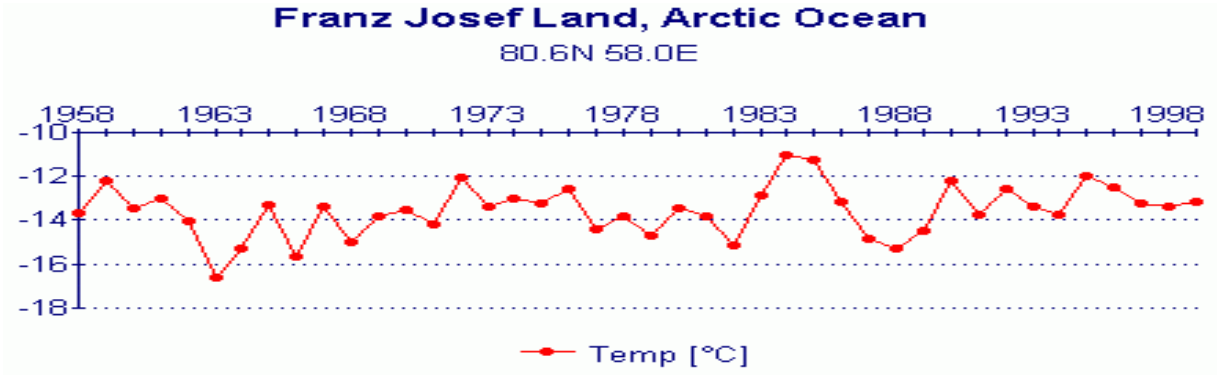

Figure 16. Surface record for Franz Josef Land, Arctic Ocean

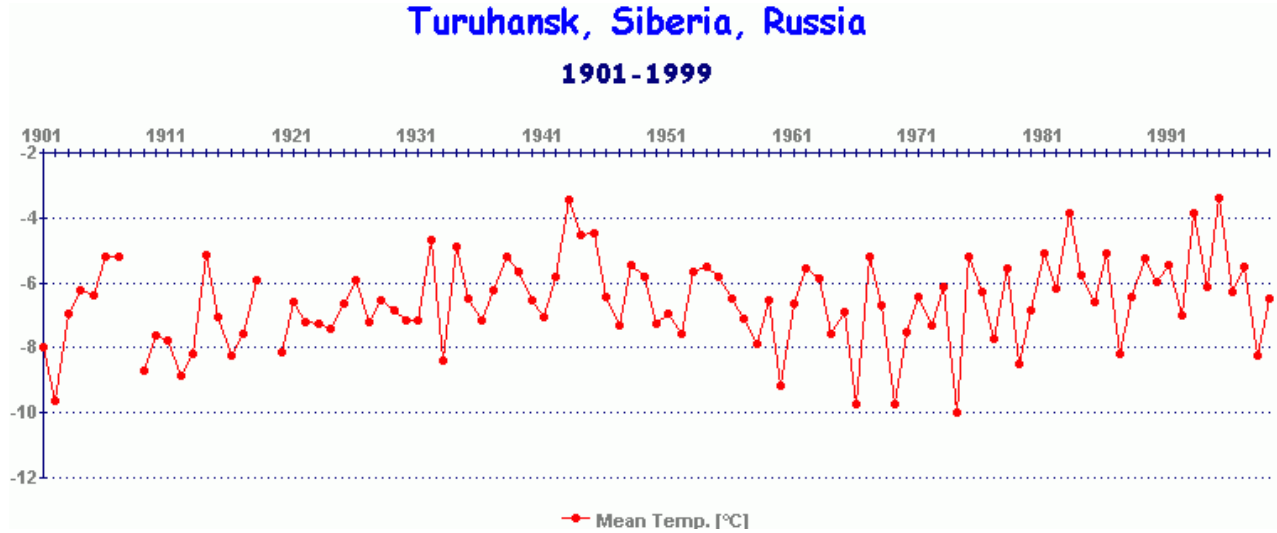

Figure 17. Surface record for Turahansk. Siberia

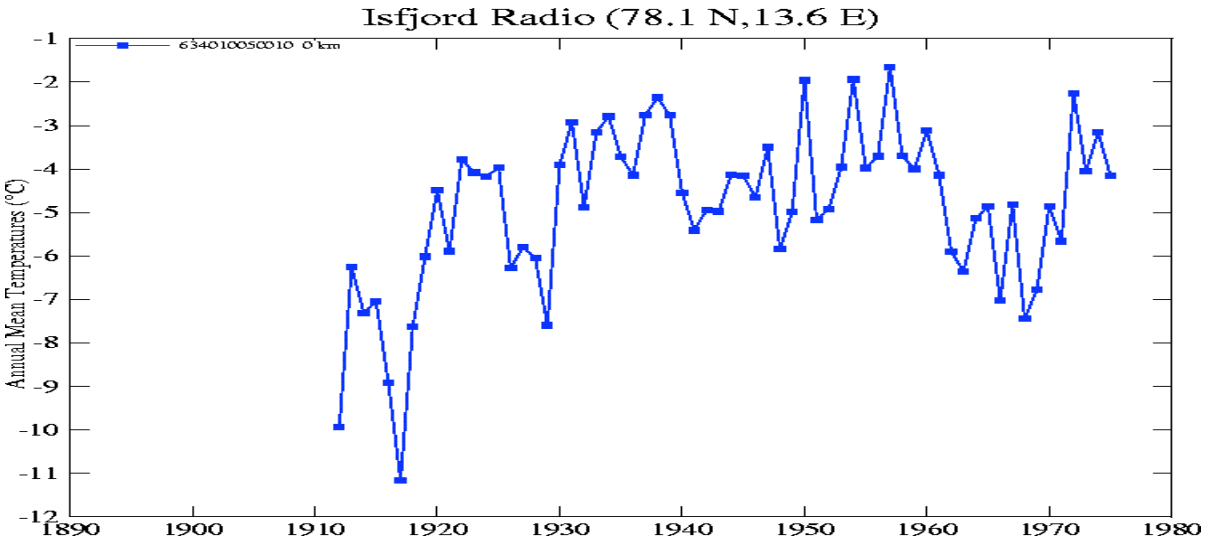

Figure 18 Surface record for Isfjord Radio, Svalbard

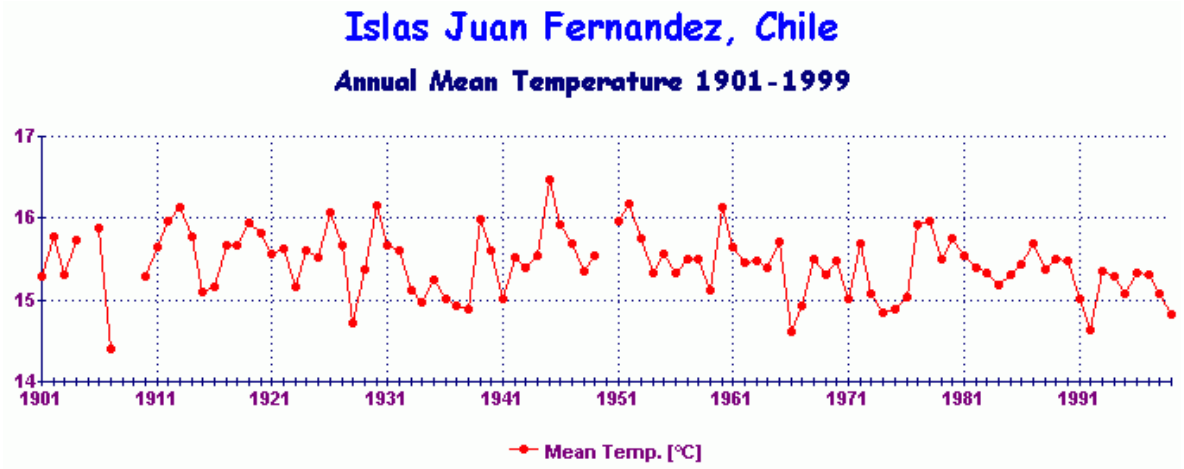

Figure 19. Surface record for Islas Juan Fernandez, Chile

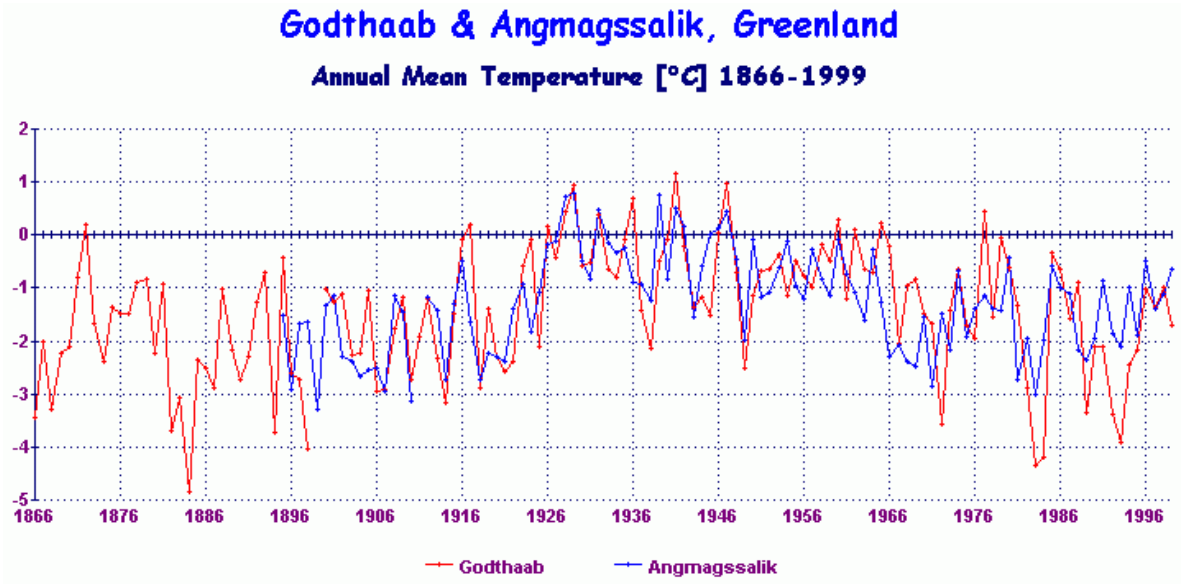

Figure 20. Surface record for Godthaab and Anmgssalik, Greenland

It will be seen that many surface records in remote parts of the world show no signs of warming for the past century. There is some emphasis here of records from the Arctic, as there are persistent false claims that there is warming in the Arctic region, which are contradicted by all available measurements.

The record from Isfjord Radio, Svalbard (Figure 20) is of particular interest, as it illustrates some of the problems in making use of surface records. This record is used by all three surface compilations (GHCN, CRU and GISS), and it is the basis for the large red dot in Figure 1, indicating a temperature rise of 4.1°C between 1901 and 1996. The actual record, which starts in 1910, shows a rise in annual mean temperature from -11.5°C to -4.2°C between 1917 and 1923, an increase of 7.3°C in only 6 years. Yet we are complaining of a mere rise of 0.8°C in 160 years! The inhabitants of Svalbard must have been devastated. Extreme fluctuations in annual mean recorded temperatures are to be found in many Russian/Siberian records, both in the surface and the MSU records.

7. GLOBAL WARMING ONLY HAPPENS CLOSE TO HUMANS

The evidence is overwhelming that temperature records from places remote from human habitation show no evidence of warming. These remote places include forests, ice cores and other proxy measurements, measurements by weather balloons, measurements by satellite (the only truly global measurements) and surface measurements in places where human influence is minimal. It only remains, therefore to characterise the human influence around weather stations in more detail.

Figure 21 shows the equipment currently used for the measurement of surface temperature in many weather stations worldwide. It shows the Stevenson screen, a device invented by Robert Stevenson, the Scottish lighthouse engineer and father of the author Robert Louis, in the early 1800s, and has been little changed since. It consists of a wooden box with louvred sides and ventilated roof, painted white, with a front lowering door.

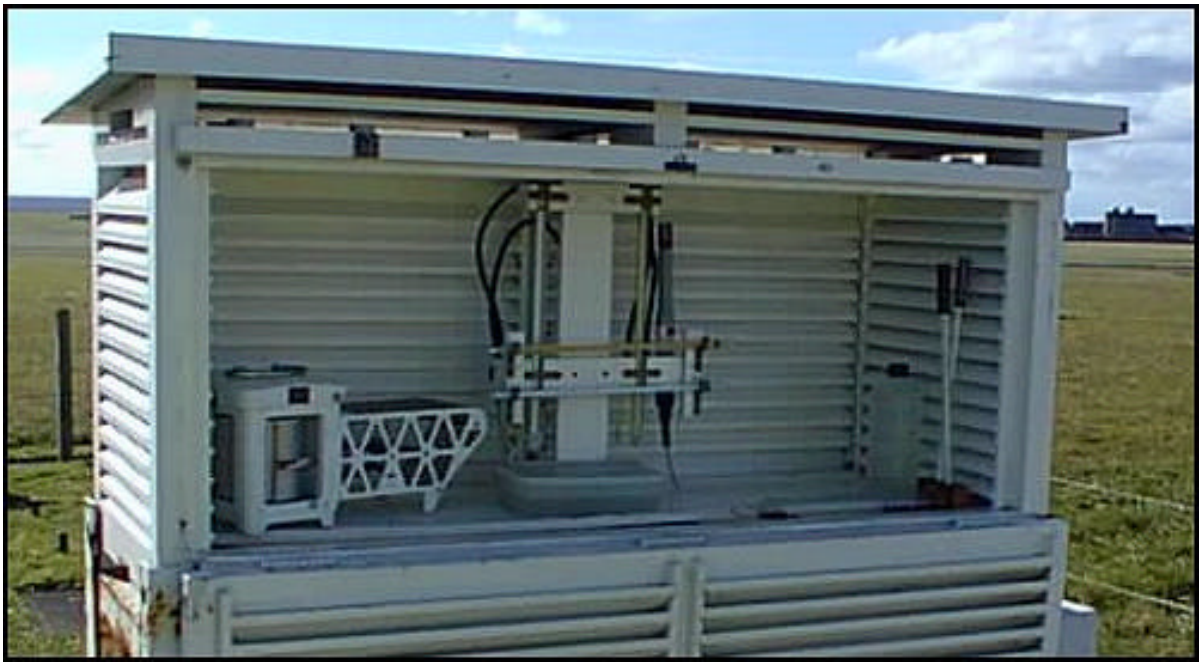

Figure 21 Surface temperature measuring equipment in current use at the Isle of Man airport, in a Stevenson screen.

Temperatures are measured, in this case, by mercury-in-glass thermometers. Heat transfer to the thermometer takes place by the conventional three mechanisms, conduction, convection and radiation. The conductivity of air is low, so transfer by conduction will be small provided there is air circulation within the screen. However, there will be calm days when the air temperature within the screen, rather than that outside, has an important influence. With good ventilation, convection exchanges heat with the thermometers.

The air entering the box, will however, not necessarily be representative of the outside background climate. If it comes over mountains, open fields or the ocean it might approximate to that background. If it comes from a large urban area it will have exchanged heat with the buildings and other heated surfaces. At an airport it will have been in contact with large aircraft. The effect of “heat islands” and “urbanisation” on

weather station readings has long been recognised and many studies have attempted to account for it by comparing measurements in "urban" and "rural" stations, defined rather crudely by differences in population. The three sets of amalgamated surface readings from the University of East Anglia (UEA), Goddard Institute of Space Studies (GISS) and Global Historical Climate Network (GHCN) all make corrections for "urbanisation" based on comparing "urban" and "rural" sites within a grid box, and reducing the "urban" increase to correspond to the "rural" behaviour. The actual corrections are very small in each case. The system only works for boxes with many weather stations. Areas with only a few boxes in a square, or recent figures where trends are not clear, cannot be corrected. Also there is no recognition of the fact that even so-called "rural" sites, defined, sometimes, as below 10,000 population, are also subject to local convective heating of incoming air. Airports, usually classified as "rural" are often heat islands.

The air entering the Stevenson screen will have a component that has exchanged heat with local building surfaces, ground surfaces, roads, vehicles and aircraft. The example in Figure 22 appears to have an open field behind it, but the circulating air will undergo a sudden temperature rise every time an aircraft is near.

Besides convection, the thermometer exchanges heat by radiation. The caption to this picture from the Internet stated that the white paint on the screen prevents heating effects from the sun's radiation. This is not true. White paint absorbs between 30 and 50% of the sun's radiation. The screen will become hot in the sun, and on a calm day, without the ventilation in the roof space, it will dominate the temperature inside. Any deterioration in the paint, such as a loss of gloss or accumulation of dust, will increase the temperature of the screen in the daytime without influencing radiation emission at night.

White paint emits 95% of infrared radiation, so the temperature of the box will be conveyed to the thermometer from the internal surfaces. On a calm day this will be the main influence. The sun's radiation will also heat local buildings and roads, particularly those that are dark in colour, and this heat will supply radiated heat to the screen and continue to do so, and affect convected air, when the sun has gone. All surfaces will cool by radiation overnight, again depending on their infrared emissivity, which for most surfaces, including those painted white, is 95%.

Changes in the heating of neighbouring buildings, darkening of their surfaces, or of ground surfaces (such as by sealing of roads) and increases in number and size of vehicles and aircraft, will all contribute to an upwards temperature bias. An increase in shelter, such as by growth of neighbouring trees, will increase the influence of local convective interchange and of radiation. The composite atmosphere in the screen is a characteristic of the local microclimate, suitable for local weather records and prediction. But it does not measure the local background climate and if the measurements are used to judge changes of surface temperature over many years, then any changes in the surrounding environment will alter (and usually increase) their influence on the record.

In Figure 22 measurements are made by opening the box. This causes a sudden change in air circulation and radiation and thus a drop in temperature. Many weather stations have recently installed automatic measuring equipment which does not involve opening the box for the measurement. This will mean another upwards bias in the record.

Weather stations do not measure the temperature of the background local climate. They measure a mixture of background climate and thermal properties of the local environment. It is the changes in these local thermal properties over long periods of time that are responsible for the observed "global warming".

An indication of the relative importance of these sources of upwards bias may be obtained from

Figure 22, which shows the regional temperature increase from 1976 to 1999 during the winter months, December, January and February which showed most of the temperature rises during this period.

It will be seen that most of the temperature rises over this period took place in the USA, Europe and Russia, all places with cold winters. The implication, surely, is that the rise resulted predominantly from better heating in the buildings surrounding the weather equipment during a period of improved living standards. Note that there were falls in temperature in the Arctic and Antarctic.

8. CONCLUSION

Global temperature measurements remote from human habitation and activity show no evidence of a warming during the last century. Such sites include "proxy" measurements such as tree rings, marine sediments and ice cores, weather balloons and satellite measurements in the lower atmosphere, and many surface sites where human influence is minimal. The small average and highly irregular individual warming displayed by surface measurements is therefore caused by changes in the thermal environment of individual measurement stations over long periods of time, and not by changes in the background climate.

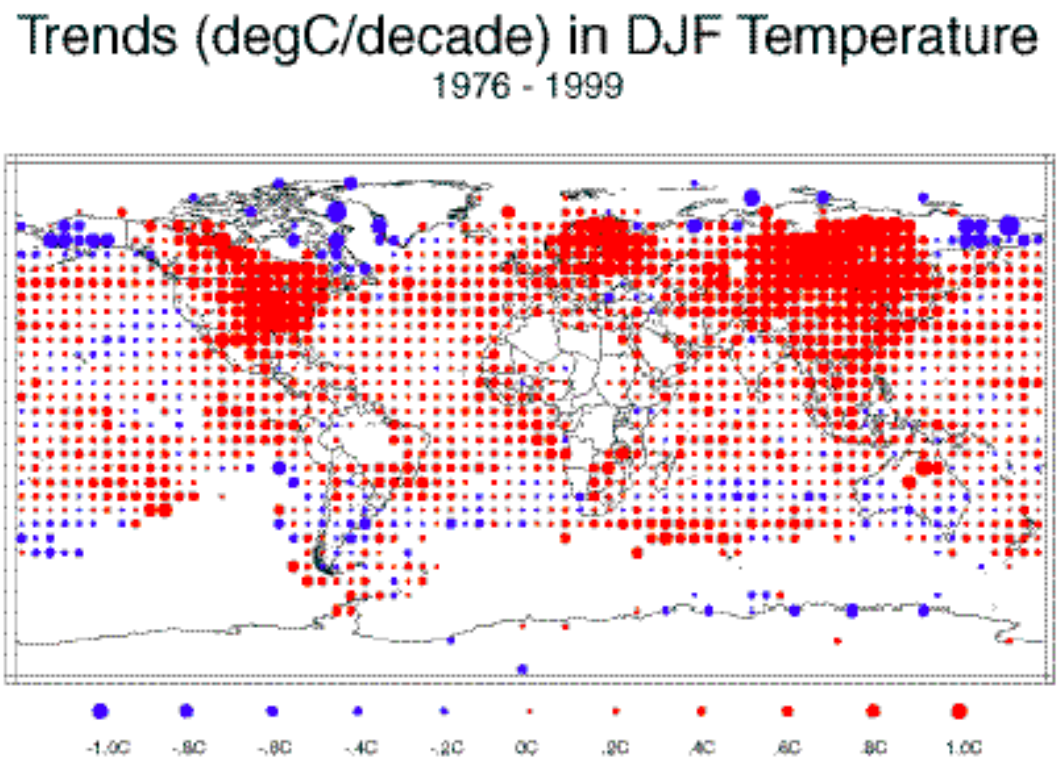

Figure 22 Temperature rises in 5°x5° latitude/longitude grids from 1976 to 1999 in the winter months December January and February (IPCC 2000 Draft)

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