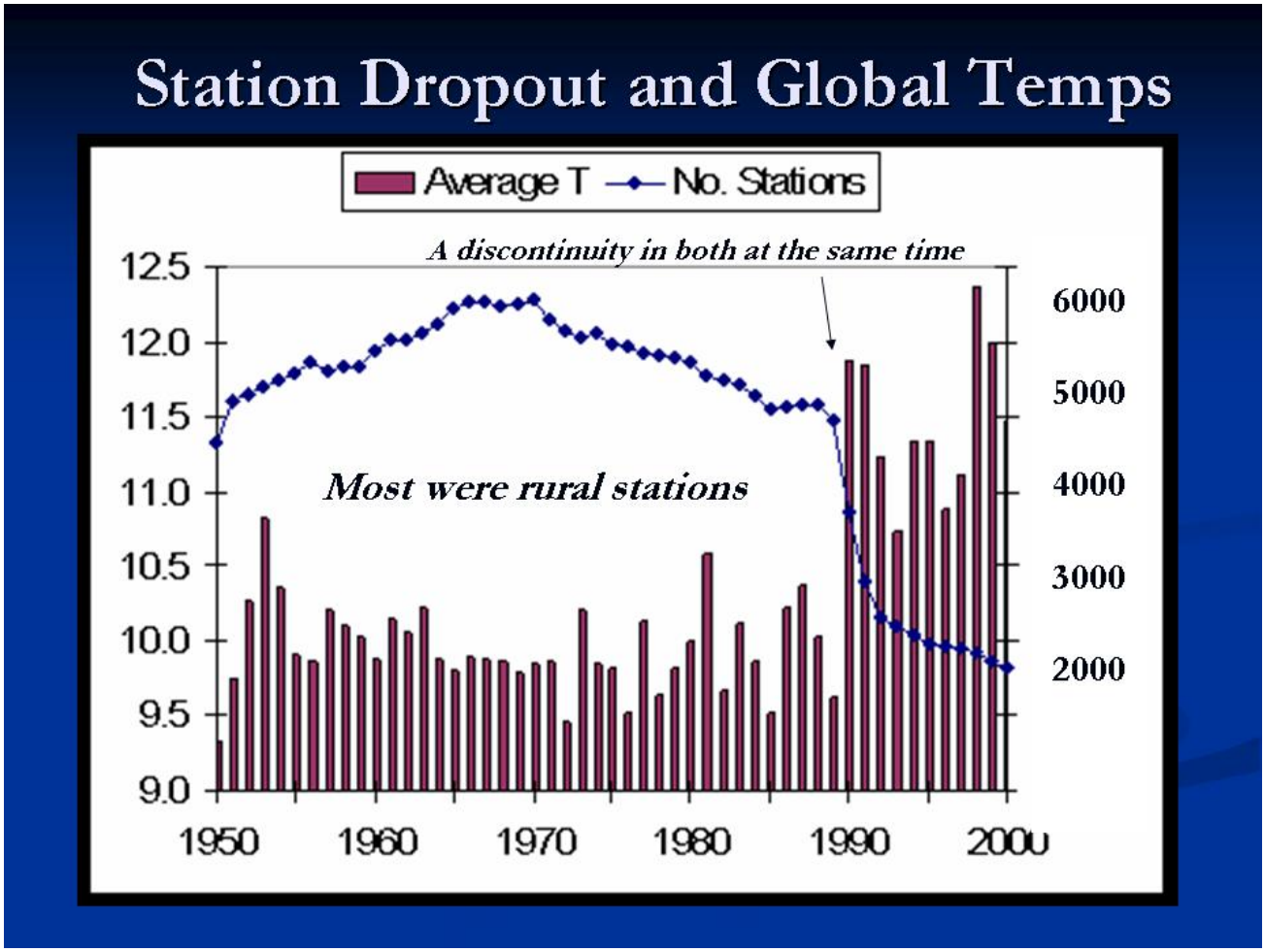
GLOBAL DATA ISSUES

Though there has clearly been some global warming in recent decades, the global data is seriously compromised by urbanization and other local factors (land-use /land-cover, improper siting, station dropout and missing data) and thus overestimates the warming. The NCDC US data is more stable and continuous than the rest of the world's, and therefore more likely to more accurately represent the climate change picture. And what does it show? That changes are cyclical in nature with a smaller rise over time, some of which may be man made and some natural.

The global data bases all suffer from:

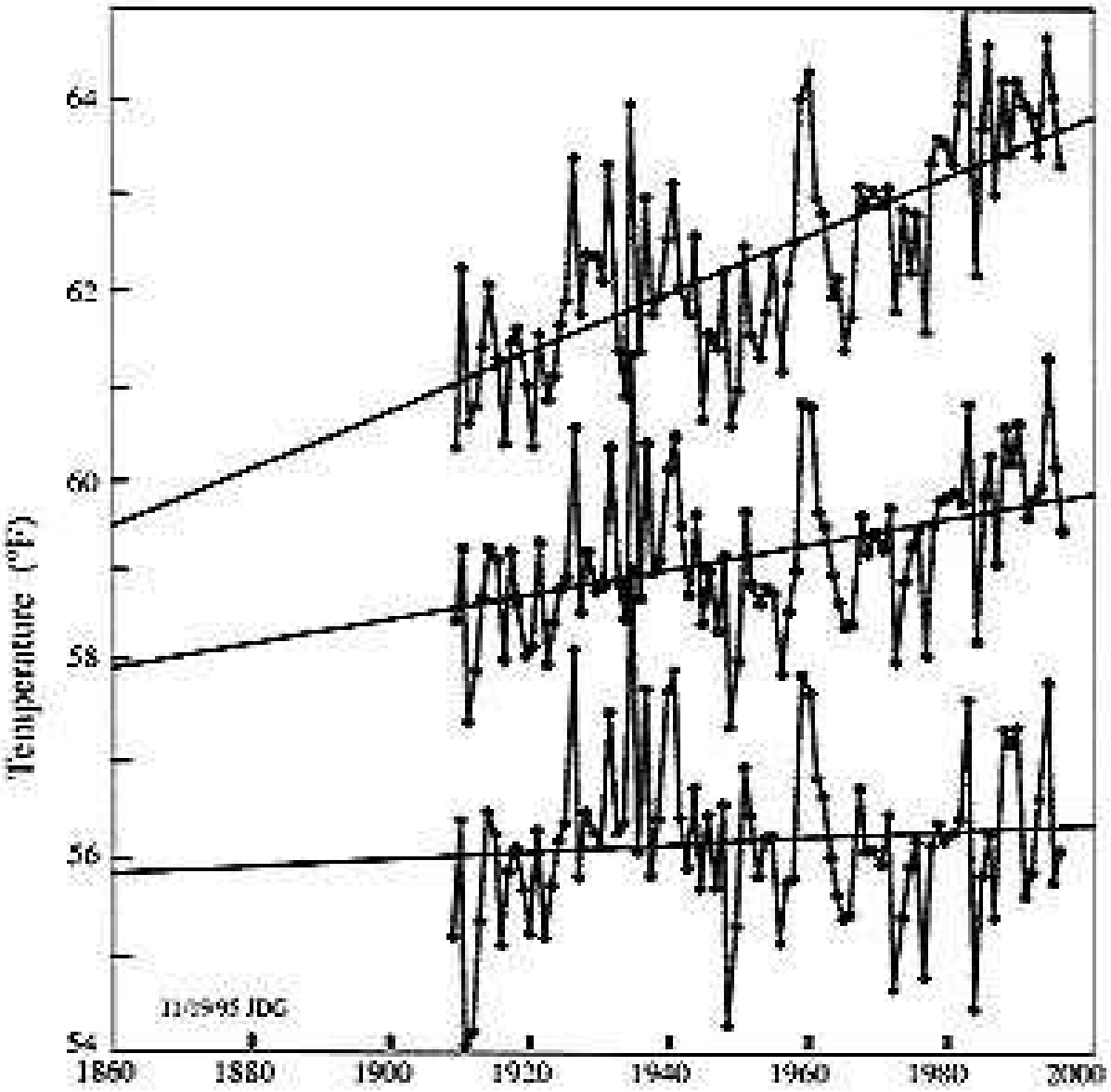
(1) Station drop-out -- from a peak of 6,000 stations in 1970 to 2,000 today. Many of the stations that were dropped were rural. Note the sudden dropout was timed with sudden rise in temperatures, suggesting changing station distribution may have played a role.



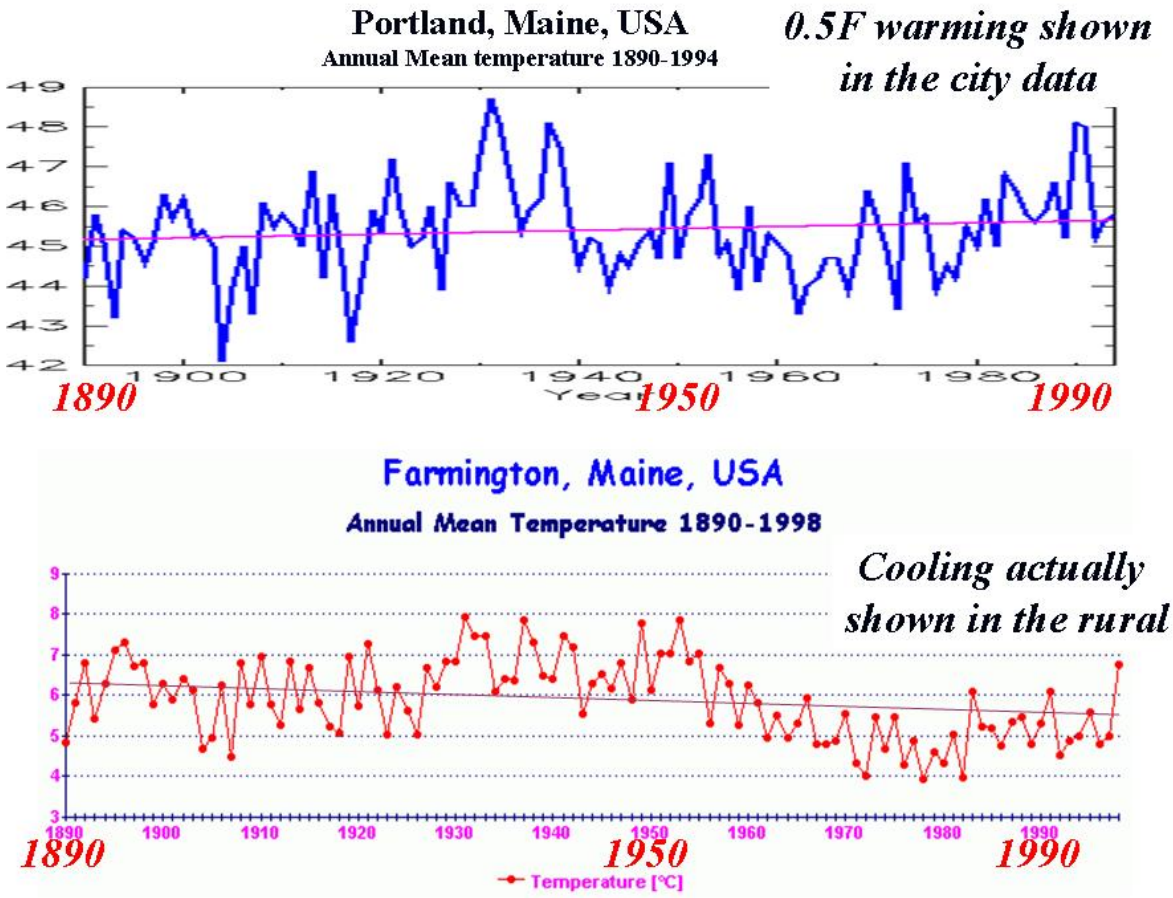
See the dropout visually here:
http://climate.geog.udel.edu/~climate/html_pages/Ghcn2_images/air_loc.mpg

This dropout of mostly smaller towns and reporting sites, introduces a warm bias to the data.

(2) Insufficient adjustment for urbanization. The population of the world has increased four fold from 1.5 billion to 6 billion during the 20th century. More and more areas are urbanized. Airports once rural, find the cities grow around them. Goodrich has shown a large difference for California counties with large populations (over 1 million (a 4F warming since 1910) versus countes with less than 100,000 polulation (no warming).



In Maine Portland has shown a half degree warming while rural Farmington actual a half degree cooling in the century since 1895.



The site CO2 Science features a site per week with no warming since 1930 and the FSU web site has a an excellent display of cities with focus on southeast region showing the same. http://gis.coaps.fsu.edu/httpdocs/climstudy.php

Oke (the winner of the American Meteorological Society Helmut Landsberg award in 2007 for his pioneer work in urbanization), in 1973 showed how even cities with 1000 population could have a significant warming relative to urban areas (2 degrees Celsius). The global data bases do not consider an area a city and adjust for urbanization until the population exceed 100,000. This introduces a warm bias into the data bases. For more see section on URBAN HEAT ISLAND.

(3) Land use changes and improper siting

In addition to questions about urban adjustment, land use changes and siting may be an issue. In a BAMS 2005 paper, Pielke and Davey noted issues with siting with the majority of 57 coop stations (10 which were part of the USHCN network for climate assessment. In many cases, the temperature sensors did not meet the WMO 1996 requirements for proper siting. Though Peterson responded in 2006 Examination of potential biases in air temperature caused by poor station locations. Bull. Amer. Meteor. Soc., 87, 1073-1089 that he can adjust poorly sited stations of this type, Pielke et al. (Pielke Sr., R.A, J. Nielsen-Gammon, C. Davey, J. Angel, O. Bliss, M. Cai, N. Doesken,

S. Fall, K. Gallo, R. Hale, K.G. Hubbard, H. Li, X. Lin, , D. Niyogi, and S. Raman, 2006: Documentation of bias associated with surface temperature measurement sites, submiteed to BAMS that no value is added from such sites. In addition, for locations where these poorly sited locations are the only data used to construct a grid area average in the global temperature trend data base, their use will introduce spatially unrepresentative data into the analyses.

This was also found and documented in separate assessments for several other states in the Pacific Northwest, Southeast and Northeast conducted by NOAA teams of state climatologists. Also Taylor et al. (2002) noted how some of the adjustments made to USHCN in 1999 accentuated the recent warming from the late 1960s on.

Examples of shelters whose siting does not meet WMO standards. Land use changes such as building construction, paving parking lots right up to the shelter, increase in height of vegetation blocking the proper ventilation needed, or placing the shelter on the roof of a building. Each of these lead to a warm bias. (photos from John Daly and Roger Peilke Sr)

This has been confirmed by numerous peer review papers in recent years (Kalney and Cai "Impact of Urbanization and Land-use Change on Climate", Nature. 2003, de laat and Maurellis ("Evidence for influence of anthropogenic surface processes on lower tropospheric and surface temperature trends" in the International Journal of Climatology

2006, and Pielke, Microclimate exposures of surface-based weather stations - implications for the assessment of long-term temperature trends.BAMS 2005, etc).

A recently updated version of the paper by McKitrick, R and P. J. Michaels (2004). "*A Test of Corrections for Extraneous Signals in Gridded Surface Temperature Data" Climate Research"*, concluded interestingly:

"The standard interpretation of global climate data requires that non-climatic effects, such as urbanization and other land surface effects, or data quality problems due to inhomogeneities in the temperature series, do not bias the large-scale trends. Although these effects are known to be real at the local level, it is assumed by the IPCC and others that they have been accounted for in the production of climate data sets, and their overall effects are negligible or non-existent. Our empirical model embeds this assumption as a null hypothesis, and it is rejected at very high confidence levels.

These results are consistent with previous findings showing that non-climatic factors, such as those related to land use change and variations in data quality, likely add up to a net warming bias in climate data, suggesting a possible overstatement of the rate of global warming. They also provide support for attribution of some observed climate changes in recent decades to land surface modifications rather than greenhouse gas emissions, a factor not currently evaluated in studies that attempt to attribute the causes of global warming"

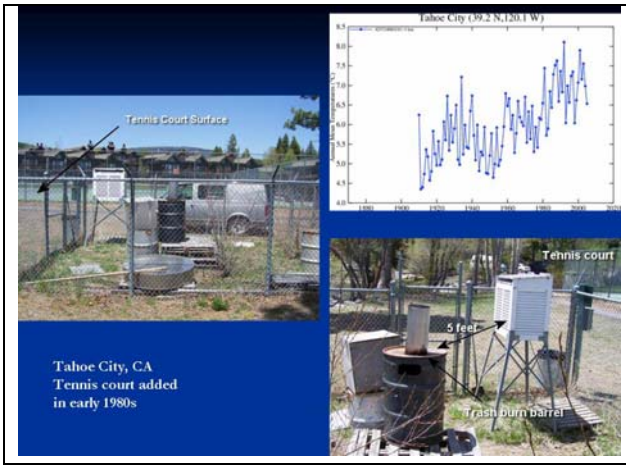
The papers estimated as much as 50% of the warming may be due to improper adjustment for these factors.

A study by Roger Pielke Sr. of Colorado State University, *"Unresolved Issues with the Assessment of Multi-Decadal Global Land Surface Temperature Trends*," which demonstrates the errors in the measurement of surface temperatures with a bias toward warming has been submitted to *Journal of Geophysical Research*.

A major conclusion of the study is that as a climate metric to diagnose climate system heat changes (i.e., 'global warming'), the surface temperature trend, especially if it includes the trend in nighttime temperature, is not the most suitable climate metric. As reported in Pielke [BAMS 2003], the assessment of climate heat system changes should be performed using the more robust metric of ocean heat content changes rather than surface temperature trends. If temperature trends are to be retained in order to estimate large scale (including a global average), the maximum temperature is a more appropriate metric than using the mean daily average temperature. Pielke's work has been confirmed by the work of FSU at http://gis.coaps.fsu.edu/httpdocs/climstudy.php. They show virtually no warming for maximum temperatures and warming for minimum temperatures only near urban center airports.

	
USHCN Station Hopkinsville, KY (Pielke et al 2006)	*Max/Min sensor near John Martin Reservoir, CO (Davey 2005)*

Anthony Watts took up the gauntlet and set up a web site, http://surfacestations.org and national group of volunteers to do the job the government did not seem inclined to or was not willing to fund. This network of volunteers went to climate stations and photographed them from multiple angles and evaluated their quality using the governments own established criteria.

	
Tahoe California climate station which was surrounded by a tennis court in early 1980s. Note the trash burn barrel also close to shelter	Other examples of poorly sited climate stations in the USHCN network as documented by Watts at surface staions.org

As of 10/10/07, Watts team had evaluated 34.5% of the 1221 station network surveyed, with 421 stations surveyed so far, 800 to go. At last count 70% were rated as poor or very poorly sited.

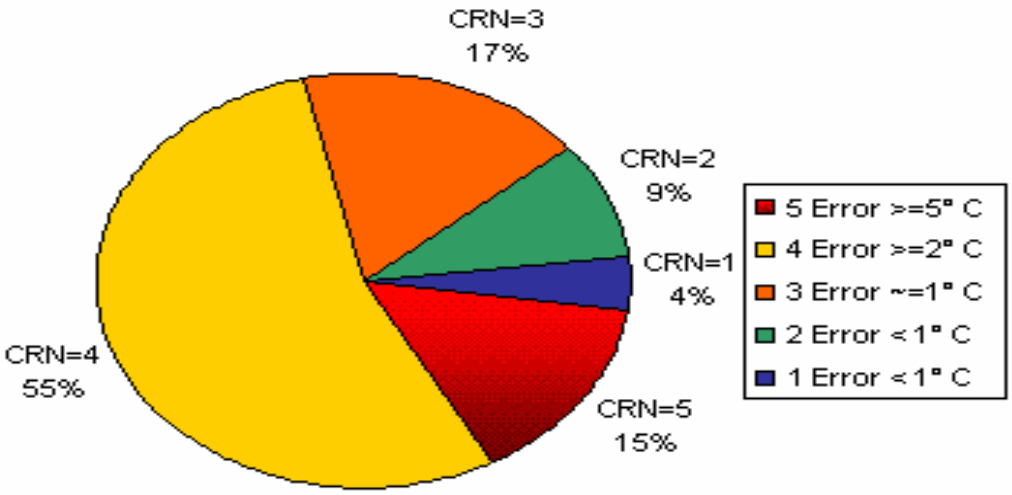
USHCN Site Evaluation Criteria:

- Borrowed from US CRN site criteria
- Reference: U. S. CLIMATE REFERENCE NETWORK SITE INFORMATION HANDBOOK 01/15/03
- Simple, suitable for visual analysis
- Distance based steps 10m, 30m, 100m
- Simple 1-5 category rating

surfacestations.org
A resource for climate station records and surveys

As of 9/12/07 with 33% of USHCN surveyed

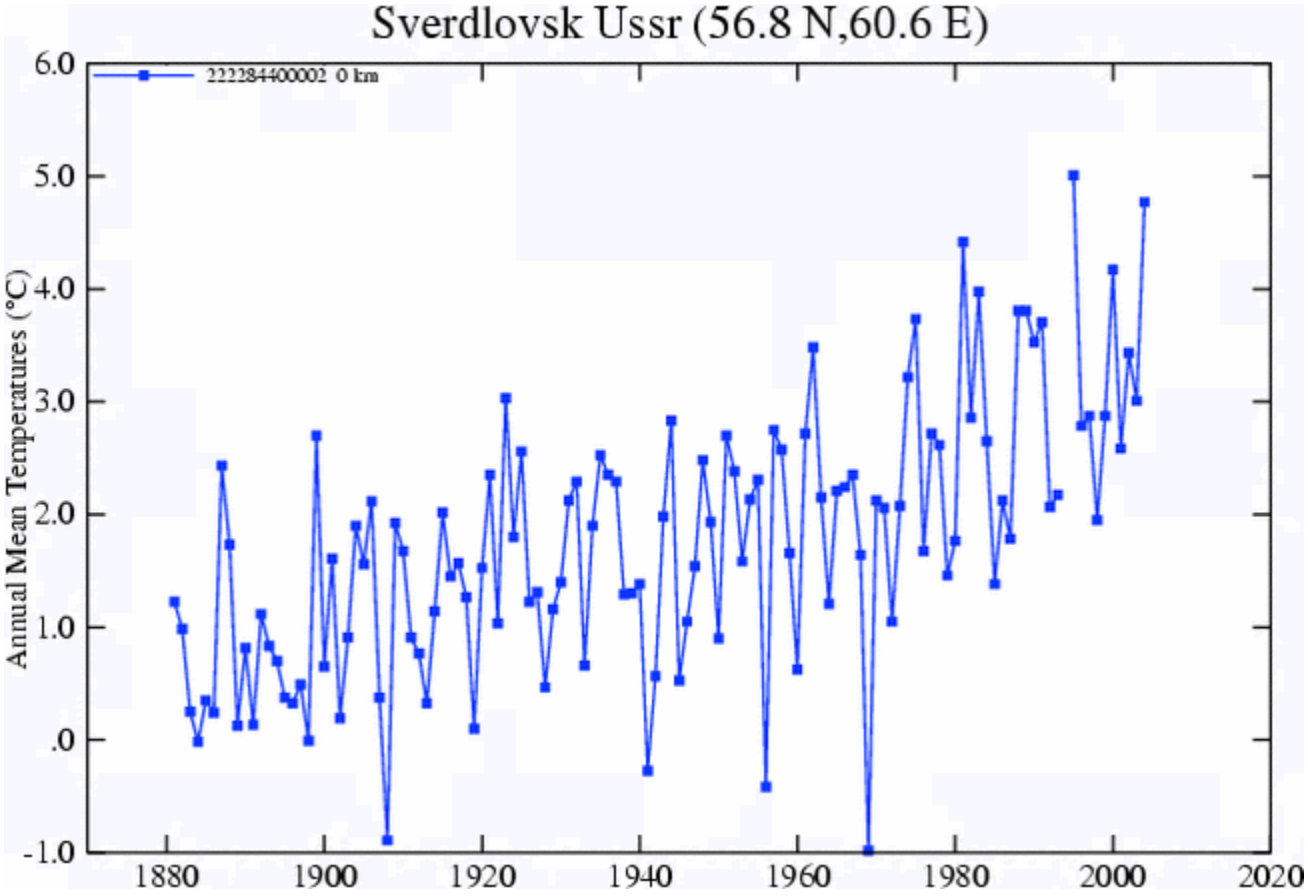
CRN Site Quality Rating

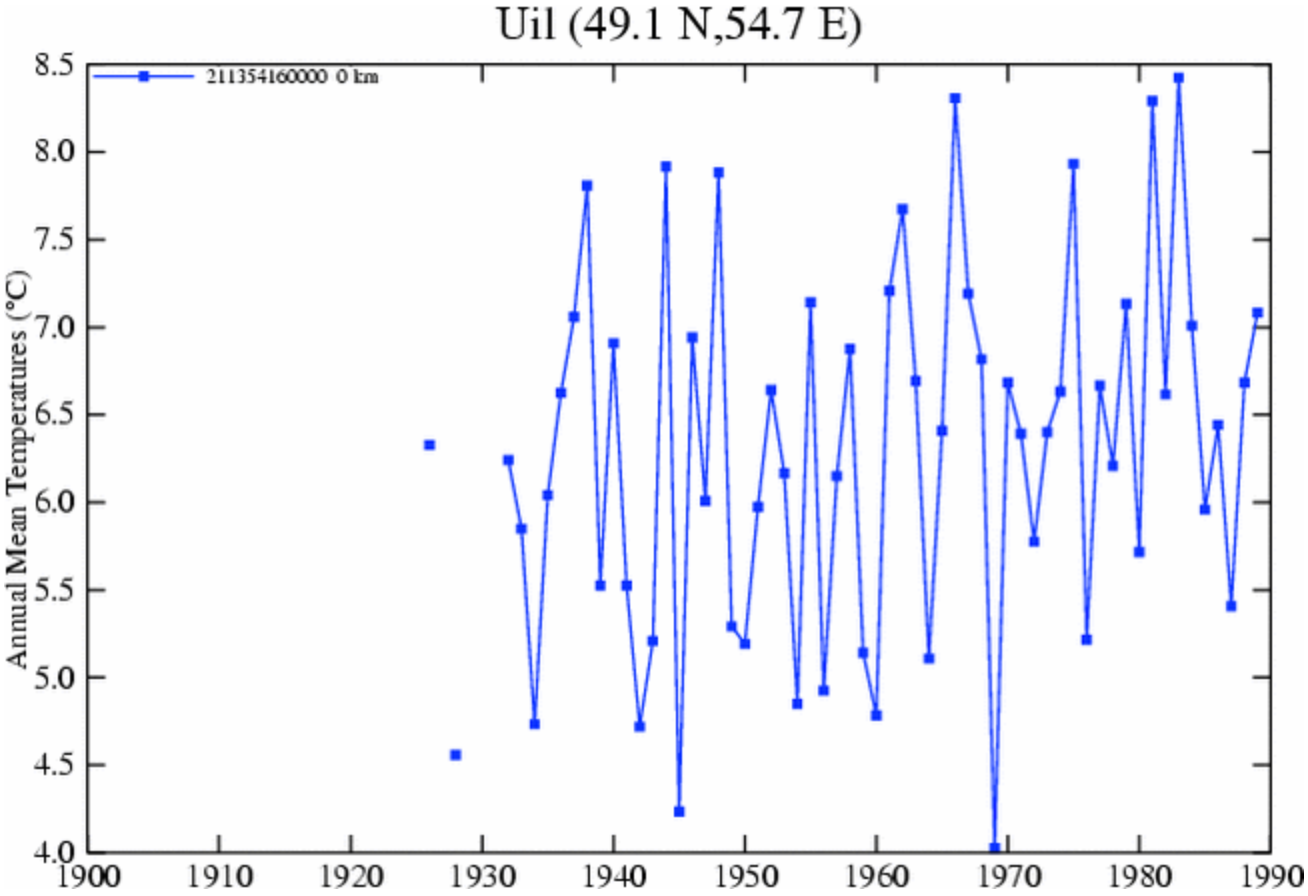


(C) 2007 Anthony Watts and www.surfacestations.org

(4) Questionable handling of missing data.

As one example, one of the cities that survived the big drop-out in station number in 1990 was the Russian city of Sverdlovsk. It has a population of 1,211,000 and as expected shows a rise, mainly due to urbanization. It becomes obvious that inadequate correction has been made for urbanization, if you compare it to a nearby rural location UIL which follows.





Note in the table below from downloaded GISS data how even for this large city, Sverdlovsk, the data record is incomplete. Notice the many missing months in the data,

SVERDLOVSK

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1987	-18.6	-8.3	-5.5	0.9	14.9	20	19.3	16.2	8.6	2.1	-11.2	-11.5
1988	-12.7	-9.6	-2.6	4.8	10.3	19.5	22.6	18.3	9.7	3.9	-7	-9.9
1989	-15.1	-9.6	-0.3	1.5	11.9	21.4	22.8	14.2	10.2	2.8	-4.2	-10.2
1990	-14.2	-6.8	0.1	5.3	9.6	999.9	19	16.4	999.9	1.2	-5	-8.3
1991	999.9	-12.6	-7.1	9.2	15.5	999.9	17.6	13.6	10.6	7.2	-3.6	-13.6
1992	-12	-9.2	-4.1	1.8	10.1	14	16.3	13.8	10.9	2.1	-5.3	999.9
1993	-8.9	-11.8	-6	3.2	10.8	17.9	18.6	16.5	5.8	2.4	-13.2	-9.9
1994	-10.2	-17.2	999.9	999.9	11.4	999.9	999.9	14.9	11	6.6	-7	-14
1995	-10.2	-4.2	-0.6	10.7	13	17	999.9	16.9	999.9	3.9	-3.7	-12.7
1996	-14.1	-11.2	-3.9	0.6	12.2	19.1	19.2	999.9	7.1	1.9	-2.3	-10.2
1997	-18.4	-9.4	-2.1	6.2	12	16.7	15.9	14	11.2	5.9	-7.3	-14.7
1998	-11	-14.8	-3.3	-1.4	11.8	18.5	21.6	17.6	8.3	3.5	-12.7	-7.1
1999	-12.6	-7.8	-8.6	4.8	9	15.1	20.2	15.6	9.3	7	-10.4	-6.4
2000	-12.9	-6.9	-1.7	7.2	8.3	19.1	20.5	999.9	8.9	2.3	-6.5	-12.2
2001	-12.1	-14.9	-3.4	6.8	13	14.6	17.9	999.9	10.7	0.6	-4.6	-12.3
2002	-9.2	-4.2	-1	3	9.3	14	19	13.1	11.1	2.1	-3.7	-18.5

2003	-10.7	-13.2	-3.9	4.9	12.7	14.8	19.2	20.6	11.2	5.2	-6.2	-5.4
2004	-9.2	-9.3	-3.5	0.1	15	17	21.4	999.9	999.9	999.9	999.9	999.9

Ross McKitrick shows how the number of missing data points increased rapidly after 1990, about the same time as the number of stations dropped by 2/3rds/.

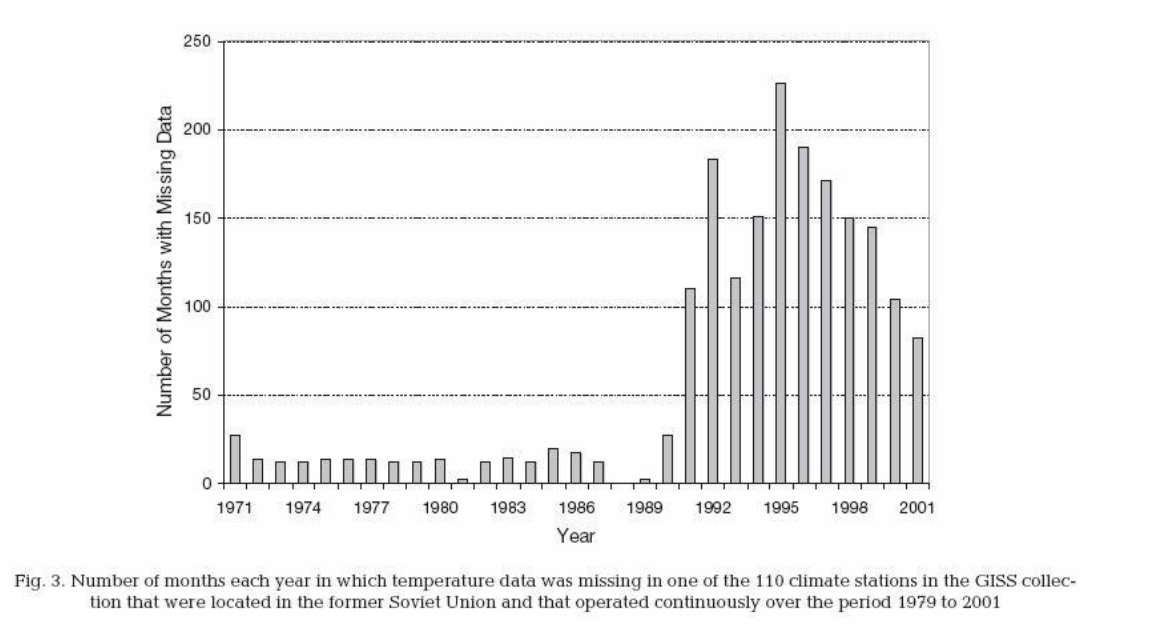
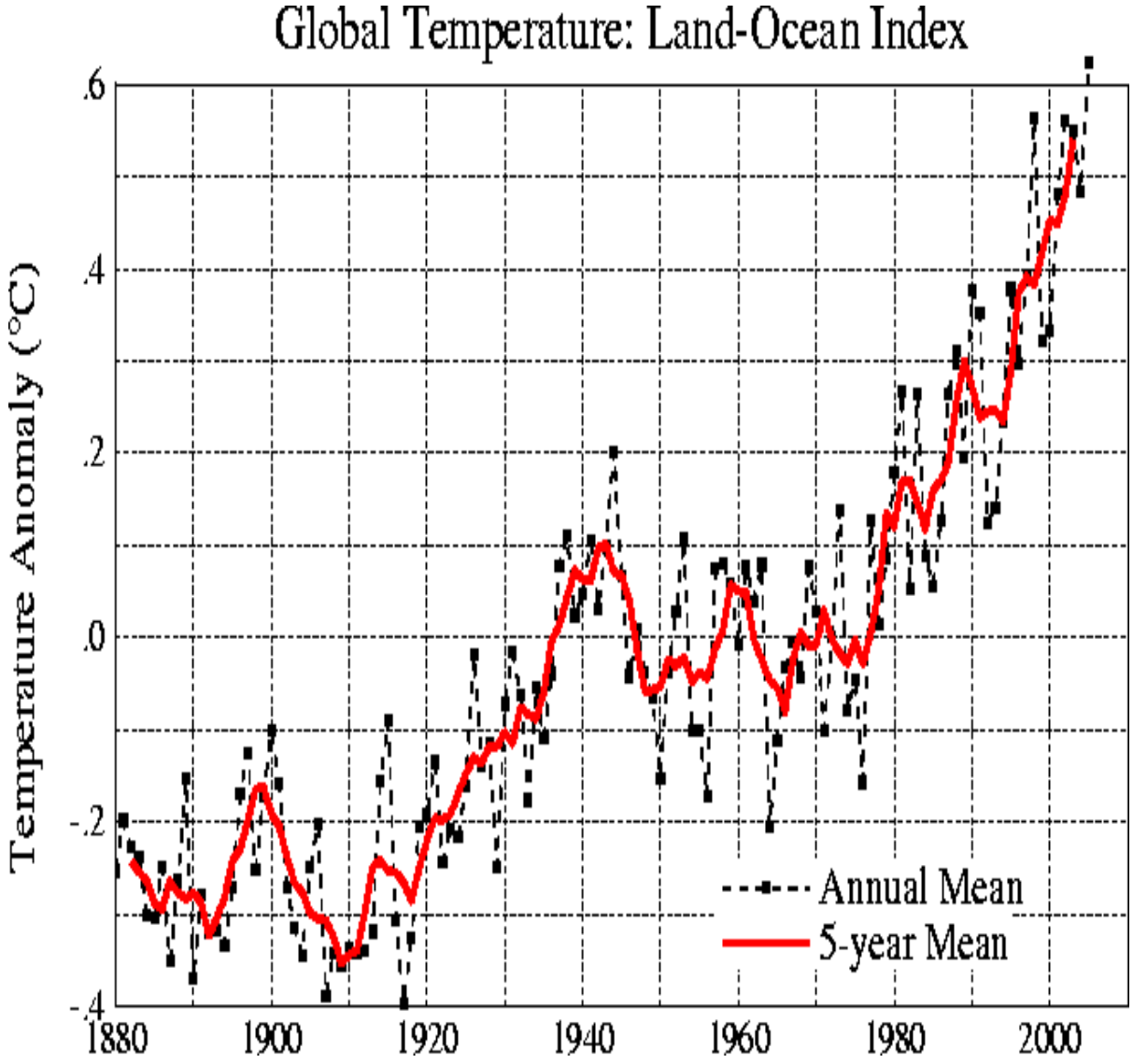
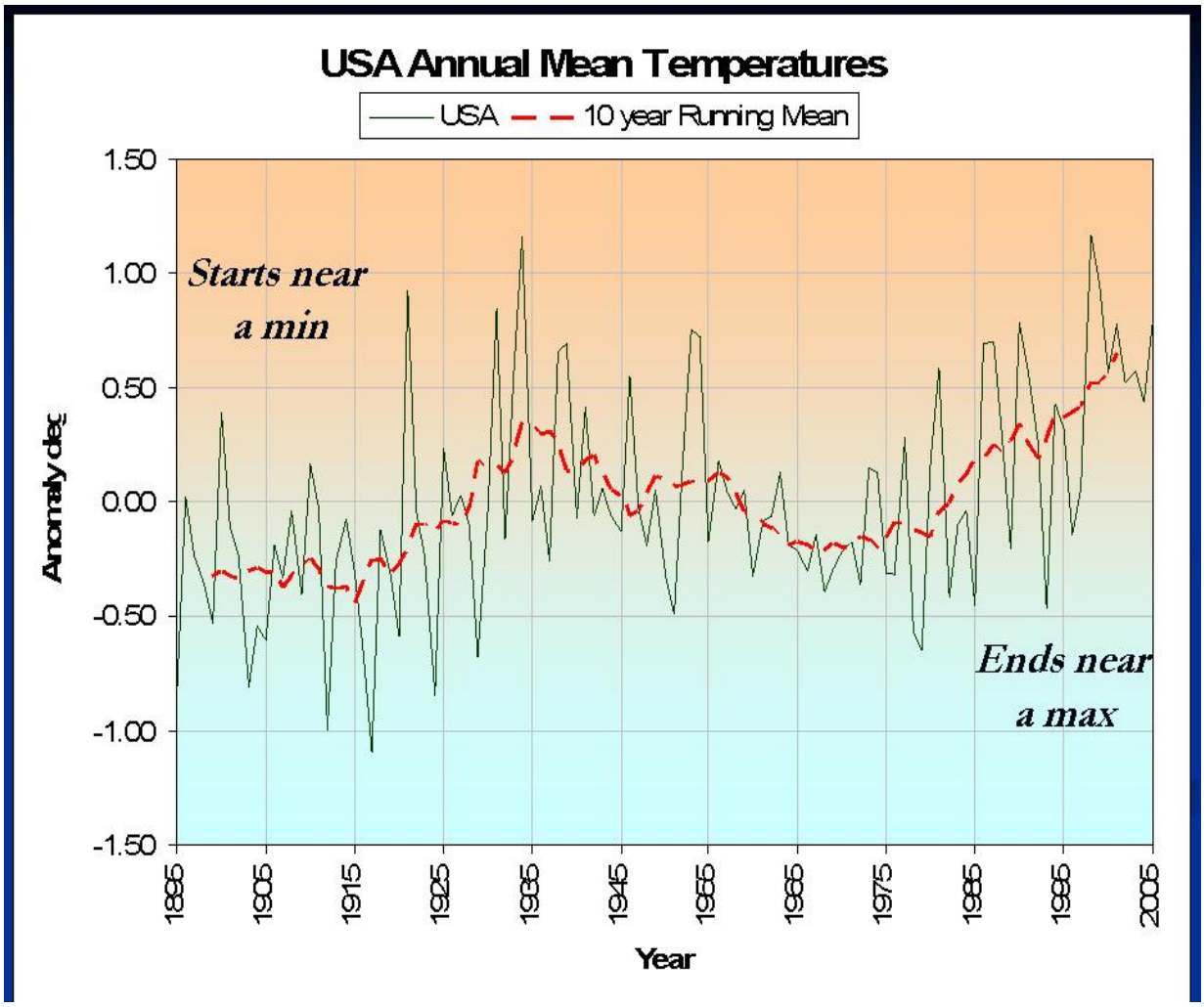


Fig. 3. Number of months each year in which temperature data was missing in one of the 110 climate stations in the GISS collection that were located in the former Soviet Union and that operated continuously over the period 1979 to 2001

GISS chooses to deal with this by taking the average anomaly for the year and applying it to the station for that month. A better approach might have been to do a station distance weighted anomaly adjustment, but even there, given the sparcity of rural stations, a contamination from urbanization may still show up. This is the approach employed by NCDC to deal with missing data.

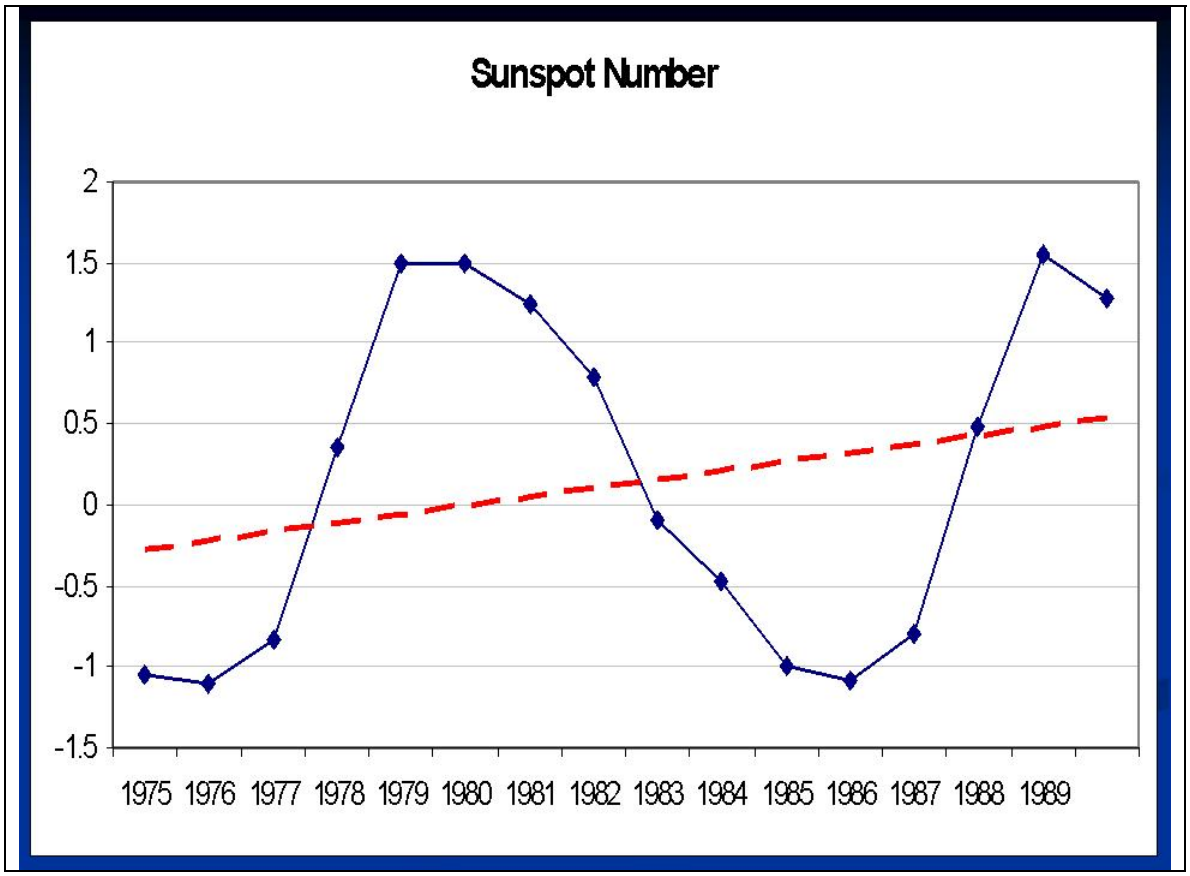
These factors may be responsible for most of the discrepancy between the US data where there was no station dropout and missing data and probably a better adjustment for urbanization and for which there is virtually no change since 1930 and the global data base which has all these issues and ‘accelerated’ global warming.


Global Temperature: Land-Ocean Index
Temperature Anomaly (°C)
.6
.4
.2
.0
-.2
-.4
1880
1900
1920
1940
1960
1980
2000
Annual Mean
5-year Mean



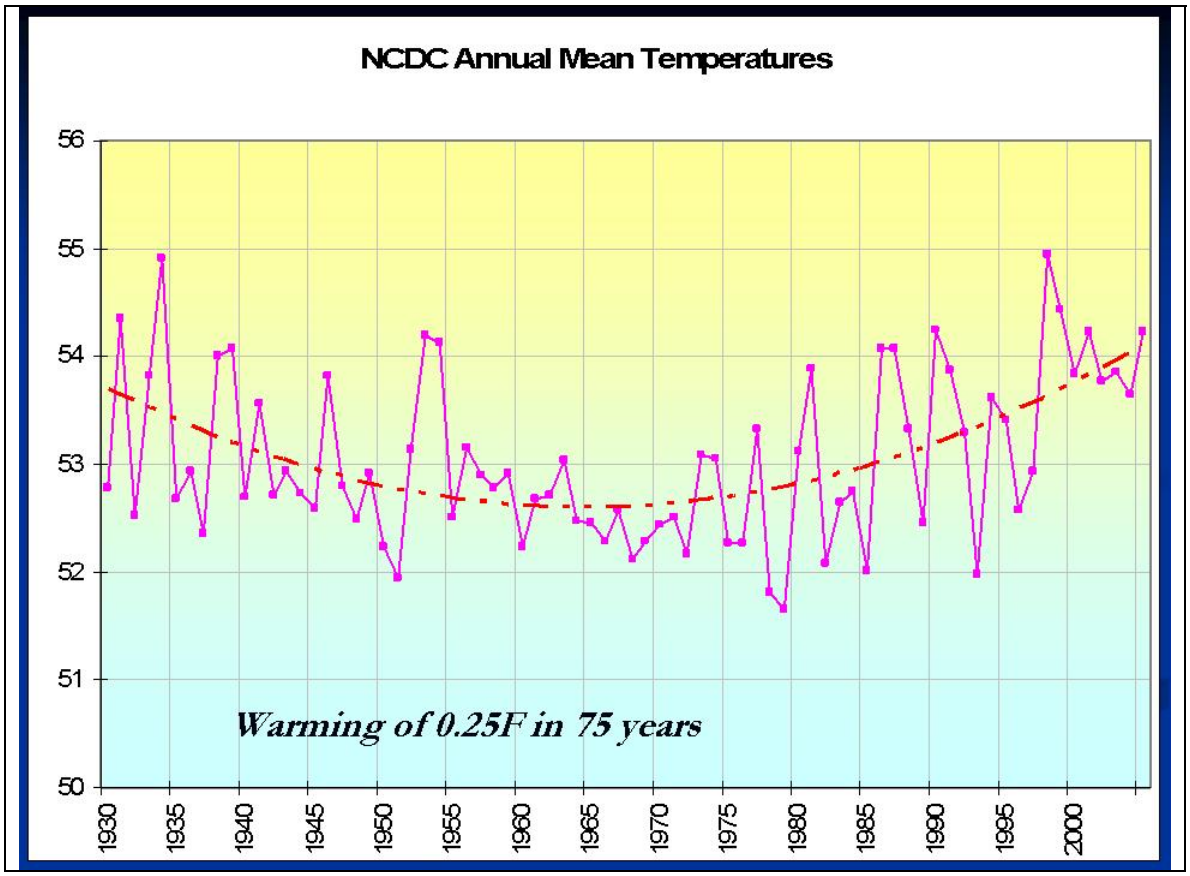
TRENDS IN CYCLICAL PATTERNS

When you are dealing with cycles, you can't use simple linear trendlines. For example it would be ludicrous for me to do a trendline from the solar minimum of cycle 21 to solar maximum of cycle 22, a pattern not unlike that of the last 135 years temperatures-wise in the US HCN database.

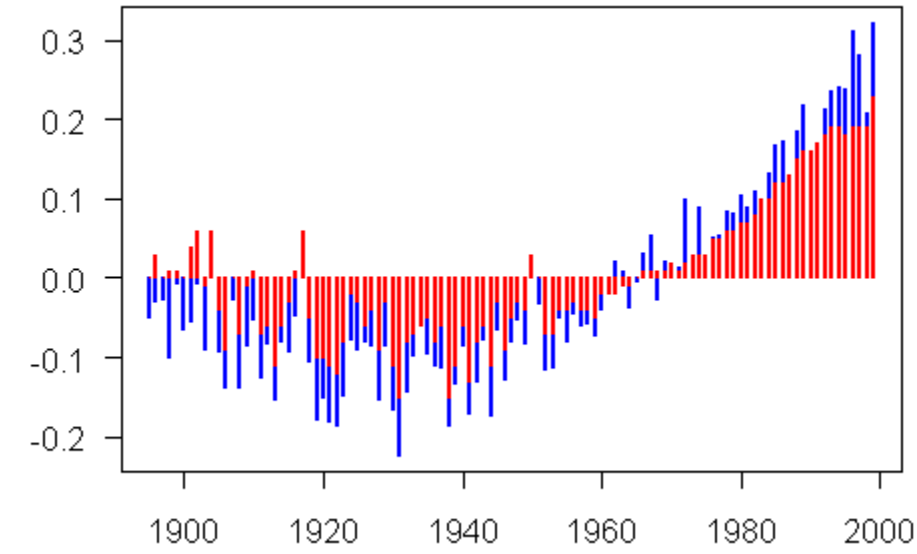


That approach would suggest an increasingly active sun, which was not the case as both cycles were about the same magnitude. Yet we do that with the temperatures since the 1890s (or the last leg up since the 1970s). Solar scientists measure cycle changes by looking the differences max to max or min to min. We need to do the same for temperatures.

The US HCN data change min to min and max to max is about 0.25 degrees F in 75 years, less than half the amount generally quoted by GISS, UKMO, NCDC for the global.



Taylor et al. (2002) noted how some of the adjustments made to USHCN in 1999 accentuated the recent warming from the late 1960s on. Stephen McIntyre on Climate Audit has shown how the GISS US data used above has been altered in 2006/07, and as a result is more in line with the global data. This was done by altering the adjustments made to the raw data such that the 1920s and 1930s cooled while the 1990s warmed. The differences are significant



Difference between updated GISS 2007 data and 2000 version (red) and the NOAA NCDC 2000 and GISSS 2007 data (blue). Positive values indicate an adjustment upwards and negative downwards. The adjustments had the effect of creating a net warming since 1930 that was not there in the 2000 version. (chart from McIntyre)

HELP IS ON THE WAY – NOAA'S NERON NETWORK

With pressure from scientists like Ken Crawford (Oklahoma mesonet) and Roger Pielke Sr., NOAA is proceeding to build a network of observing stations properly sited. Unfortunately this process is slow. Nearly 100 sites are now operating in New England, western NYS and Alabama (where they worked with John Christy on 10 station network). The equipment and effort is expensive and only $4 million per year and since $1million brings just 20 stations, will mean it will take more than a decade to have a network comparable to USHCN. Of course these stations will not have history to work with but will be able to better detect year to year changes and comparing those changes to USHCN and the GHCN data may be helpful in validating their trends. For more see http://www.isos.noaa.gov/

Conclusion

If indeed there is even a small warm bias introduced by siting, land-use change, inhomogeneity and other issues discussed herein, the climate today may be no warmer than 70 years ago. These issues also add to the difficulty of comparing temperatures today to those over the past 1300 years, as the IPCC claims to be able to do.

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Experts on station data:

Roger Pielke Sr.
CIRES
University of Colorado at Boulder
Boulder, CO 80309-0216
pielkesr@cires.colorado.edu

NCDC
ncdc.info@noaa.gov

Ken Crawford
Oklahoma Climate Survey
ocs@ou.edu

George Taylor
Oregon State Climatologists
taylor@coas.oregonstate.edu

Anthony Watts
http://wattsupwiththat.wordpress.com/
http://surfacestations.org

THE DATA SETS AND DOCUMENTATIONS

USHCN

http://lwf.ncdc.noaa.gov/oa/climate/research/cag3/explain.html

http://gis.coaps.fsu.edu/httpdocs/climstudy.php

http://www.co2science.org/scripts/CO2ScienceB2C/data/ushcn/ushcn.jsp
(pick a state, site and start with 1930)

GHCN

http://www.ncdc.noaa.gov/oa/climate/research/ghcn/ghcn.html

NASA GISS

http://data.giss.nasa.gov/gistemp/station_data/

HADLEY CRU

http://www.cru.uea.ac.uk/cru/data/temperature/