Climate4you update March 2011

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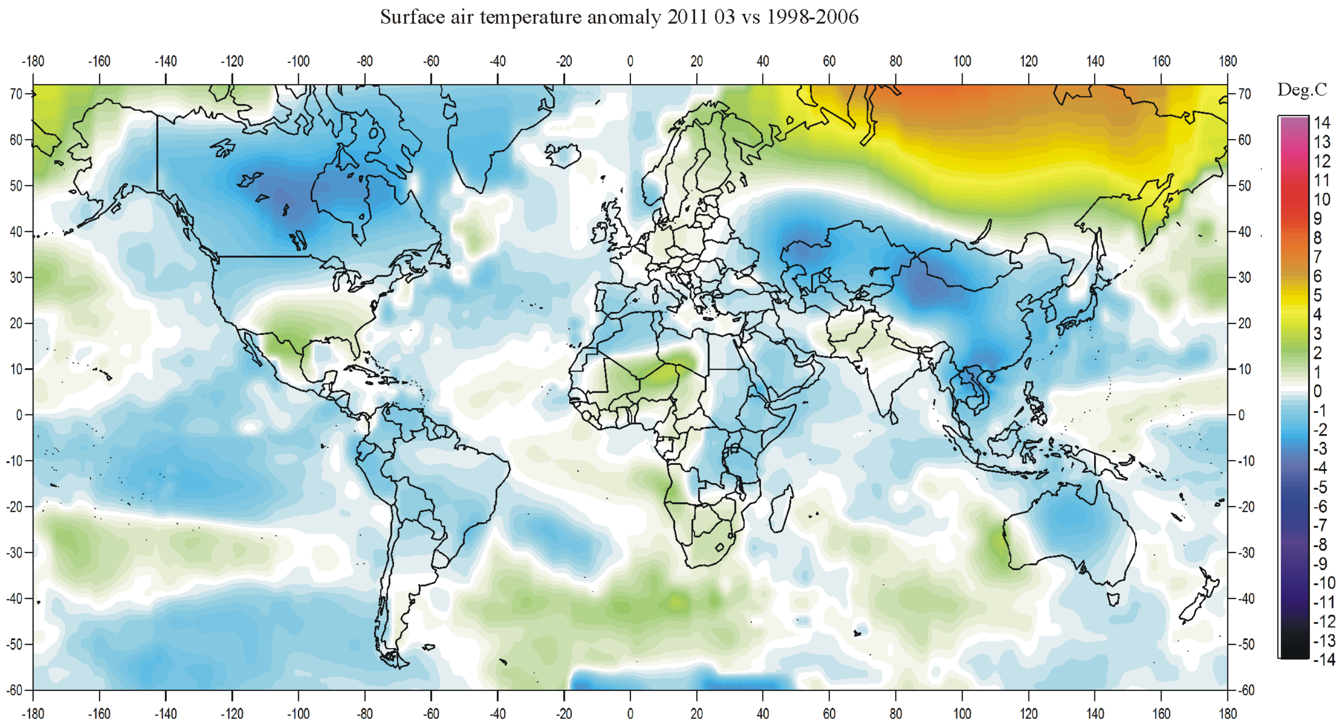
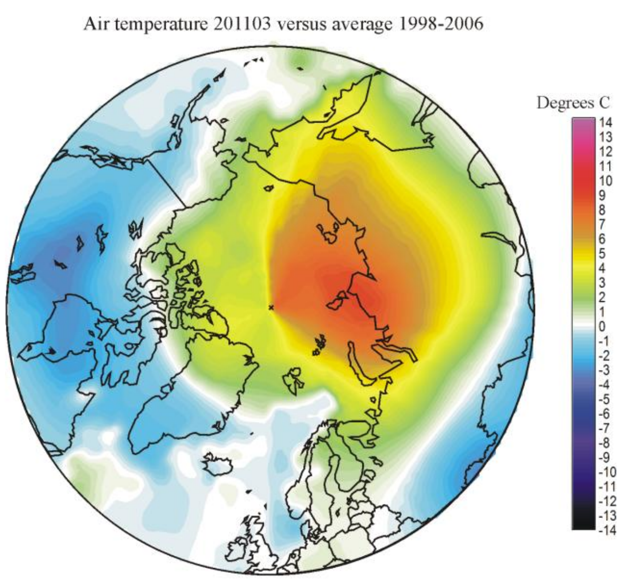
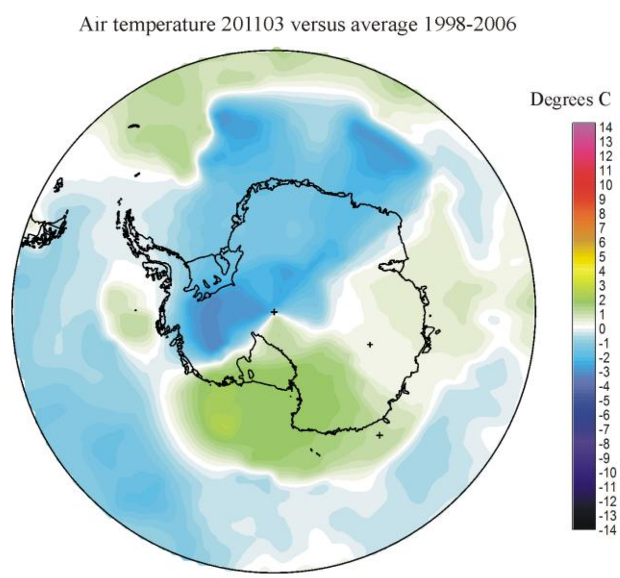
March 2011 global surface air temperature overview







March 2011 surface air temperature compared to the average 1998-2006. Green.yellow-red colours indicate areas with higher temperature than the 1998-2006 average, while blue colours indicate lower than average temperatures. Data source: Goddard Institute for Space Studies (GISS)

Comments to the March 2011 global surface air temperature overview

General: This newsletter contains graphs showing a selection of key meteorological variables for March 2011. All temperatures are given in degrees Celsius.

In the above maps showing the geographical pattern of surface air temperatures, the period 1998-2006 is used as reference period. The reason for comparing with this recent period instead of the official WMO 'normal' period 1961-1990, is that the latter period is affected by the relatively cold period 1945-1980. Almost any comparison with such a low average value will therefore appear as high or warm, and it will be difficult to decide if modern surface air temperatures are increasing or decreasing. Comparing with a more recent period overcomes this problem. In addition to this consideration, the recent temperature development suggests that the time window 1998-2006 may roughly represent a global temperature peak. If so, negative temperature anomalies will gradually become more and more widespread as time goes on. However, if positive anomalies instead gradually become more widespread, this reference period only represented a temperature plateau.

In the other diagrams in this newsletter the thin line represents the monthly global average value, and the thick line indicate a simple running average, in most cases a simple moving 37-month average, almost corresponding to three years. The 37-month average is calculated from values covering a range from 18 month before to 18 months after, with equal weight for every month.

The year 1979 has been chosen as starting point in several of the diagrams, as this roughly corresponds to both the beginning of satellite observations and the onset of the late 20th century warming period. Several of the records, however, have a much longer history, which may be inspected on www.Climate4you.com.

Most diagrams shown in this newsletter are also available for download on www.climate4you.com

Global surface air temperatures March 2011 in general was near the 1998-2006 average, but on a rising trend compared to the previous months. According to satellite measurements, however, the trend is still towards lower temperatures. These recent developments are detailed in several of the temperature diagrams shown below in this newsletter.

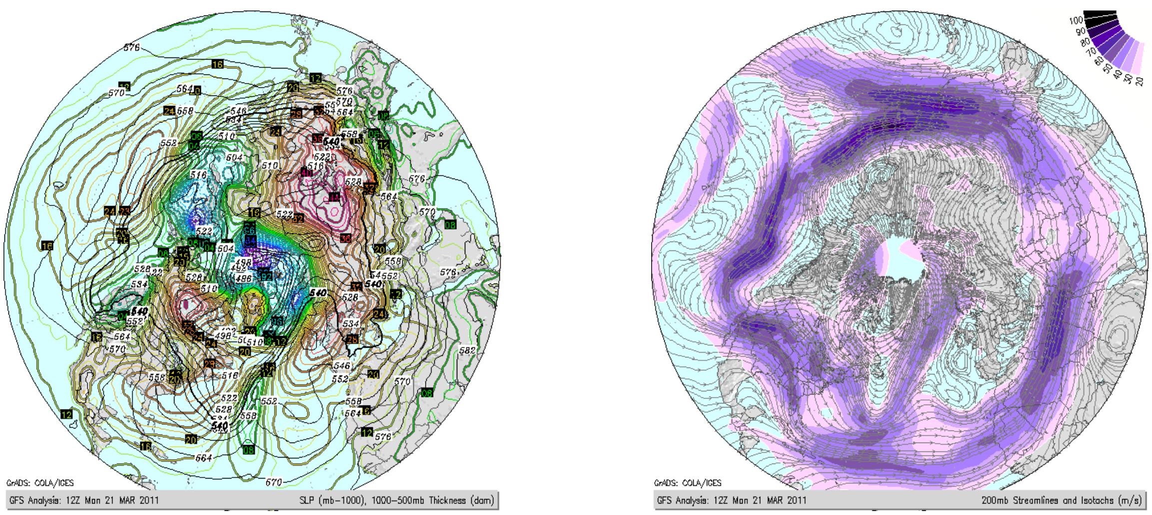
The Northern Hemisphere was characterised by high regional variability. A zone of below average temperatures extended from China, across Mongolia, southern Russia, the Mediterranean, the North Atlantic, northern USA and Canada, into SE Alaska. Above average temperatures especially characterised northern Russia and most of Siberia. This positive anomaly and its extension across the Arctic Ocean is the main reason for the increasing global temperature displayed by all surface records (GISS, NCDC and HadCRUT3) for March 2011.

The Southern Hemisphere in general was close to or slightly below average 1998-2006 conditions. Most of South America and Africa south of Equator experienced below average March temperatures. Most of South America and Australia experienced temperatures below average. On the whole, Africa had temperatures close to average. There were no major warm anomalies in the Southern Hemisphere in March 2011.

Near Equator temperatures conditions were still influenced by the still ongoing La Nina situation. Relatively low temperatures characterised most of the Equatorial regions in the Pacific and Indian Ocean. The Equatorial Atlantic was close to average conditions. Because of the huge areas represented by these regions at low latitudes, the cooling effect on the global average temperature is still felt, but in March to a reduced degree compared to the previous months. The present La Nina situation is presumably coming to an end within few months.

The Arctic was characterized by big contrasts as to the surface air temperature. Most areas experienced above average 1998-2006 temperatures, but especially in northern Siberia. With the exception of the northernmost areas, both Canada and Greenland had below average temperatures in March 2011.

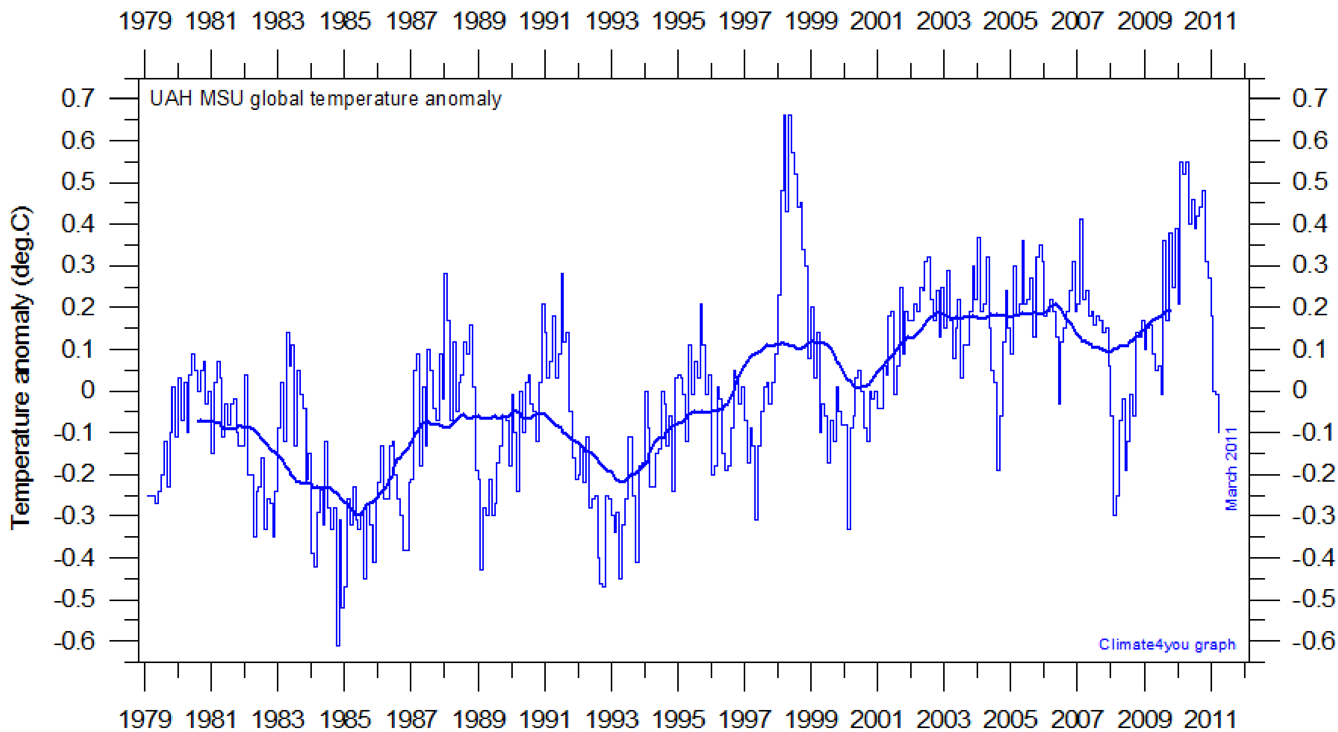
As mentioned above, this Arctic positive temperature anomaly is the main reason for increasing global surface temperatures in March. Presumably a contributing reason for this temperature anomaly is low surface air pressure along the Russian-Siberian arctic coast in much of March 2011, associated with a northerly track of the jet stream in the Atlantic Arctic sector (see example diagrams from 21 March 2011 below). This meteorological situation is likely to bring relatively warm air masses into this part of the Arctic.



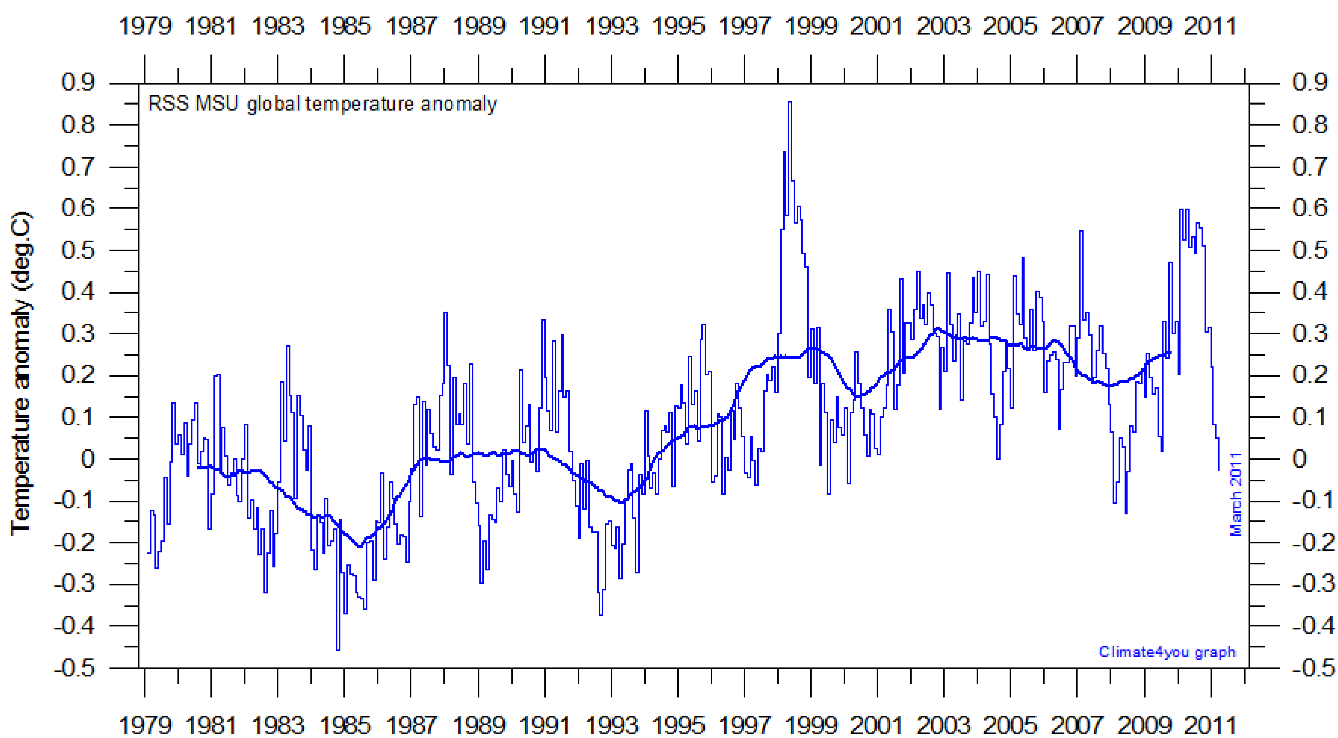
21 March 2011. Northern Hemisphere sea level pressure and 1000-1500 millibar thickness (left; blue areas show areas of relatively low surface air pressure, and red areas signify areas of relatively high air pressure), and Northern Hemisphere air flow speed and -direction at the 200 milibar level (right; deep purple shading indicates high wind speed).

Also the Antarctic displayed contrast in temperature anomalies. Most of the continent experienced below average temperatures, but at the same time large areas in East Antarctic had above normal temperatures, especially around Ross Sea.

Lower troposphere temperature from satellites, updated to March 2011

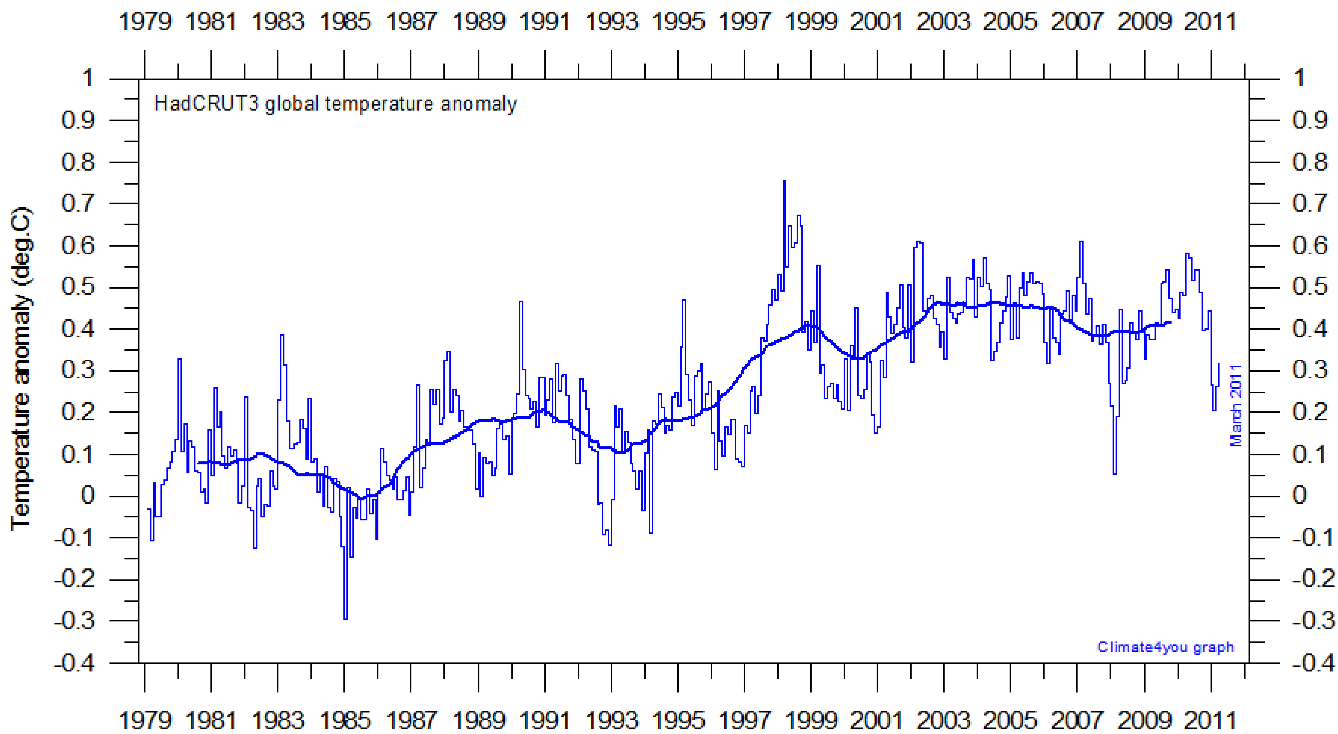


Global monthly average lower troposphere temperature (thin line) since 1979 according to [University of Alabama](#) at Huntsville, USA. The thick line is the simple running 37 month average.

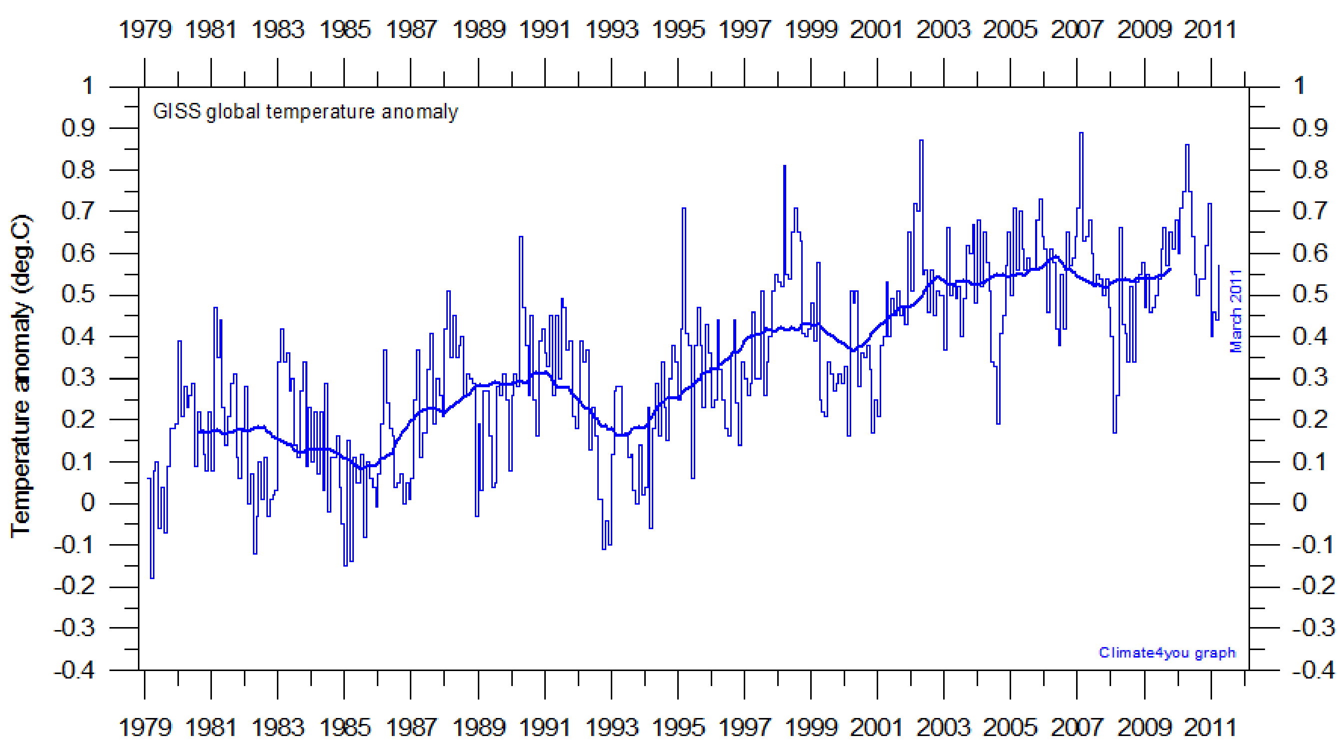


Global monthly average lower troposphere temperature (thin line) since 1979 according to according to [Remote Sensing Systems](#) (RSS), USA. The thick line is the simple running 37 month average.

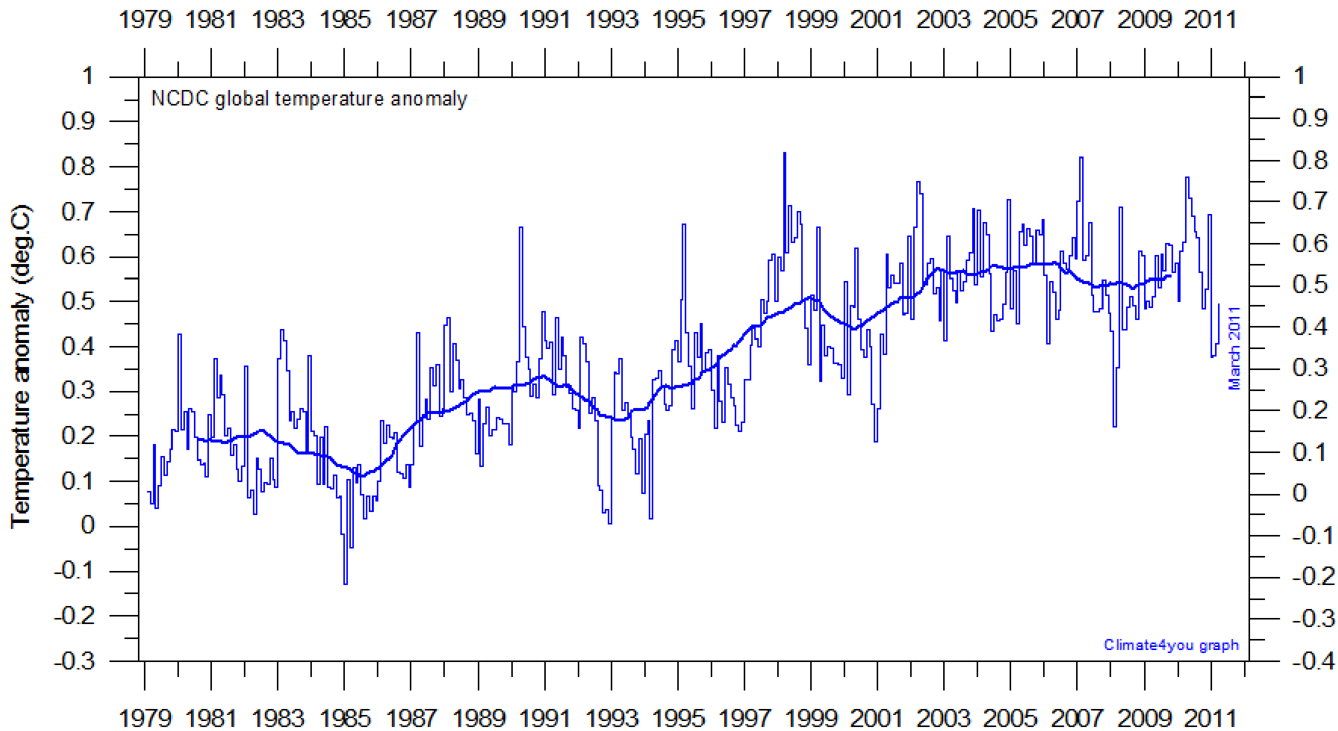
Global surface air temperature, updated to March 2011



Global monthly average surface air temperature (thin line) since 1979 according to according to the Hadley Centre for Climate Prediction and Research and the University of East Anglia's Climatic Research Unit (CRU), UK. The thick line is the simple running 37 month average.

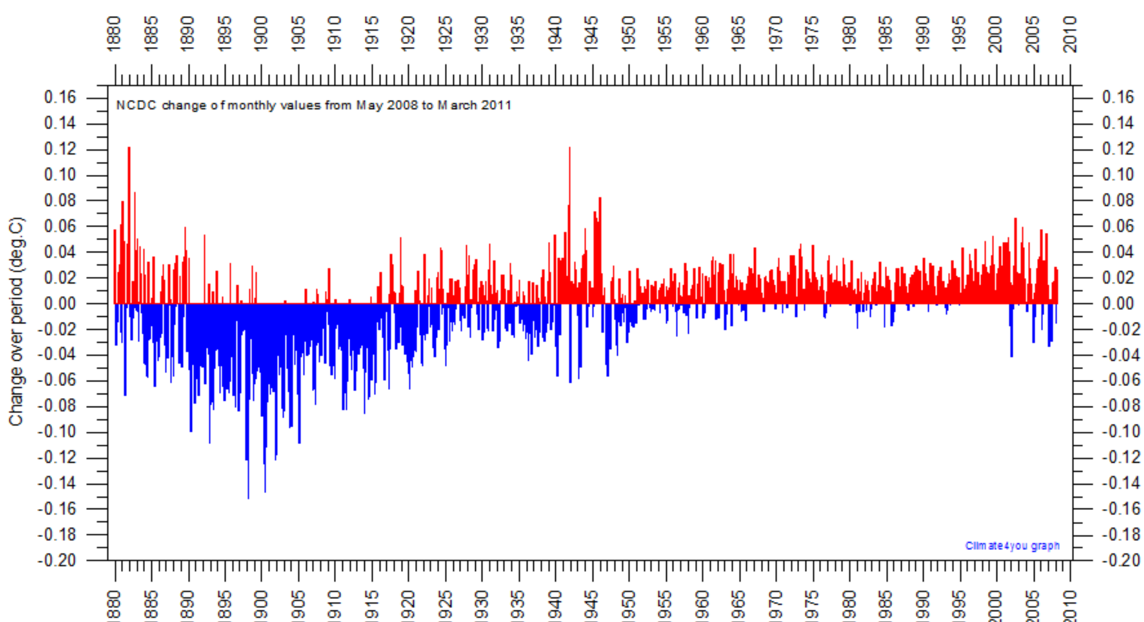


Global monthly average surface air temperature (thin line) since 1979 according to according to the Goddard Institute for Space Studies (GISS), at Columbia University, New York City, USA. The thick line is the simple running 37 month average.

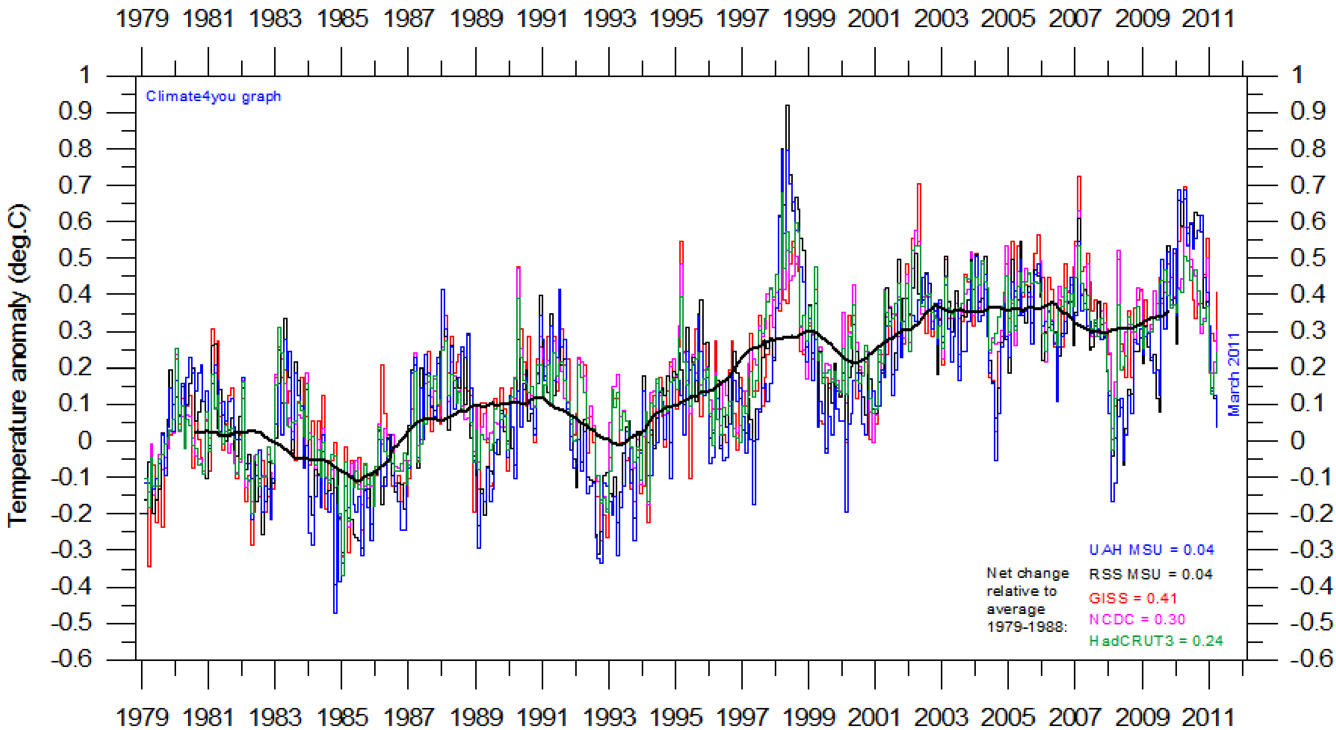


Global monthly average surface air temperature since 1979 according to according to the [National Climatic Data Center](#) (NCDC), USA. The thick line is the simple running 37 month average.

Some readers have noted that the above temperature estimates display changes when one compare with previous issues of this newsletter, not only for the most recent months, but actually for all months back to the beginning of the record. As an example, the net change of the NCDC record since 17 May 2008 is shown below. By this administrative effort the apparent global temperature increase since 1900 has been enhanced about 0.1°C, or about 14% of the total increase recorded since 1900 by NCDC. The interested reader may find more on this lack of temporal stability on www.climate4you (go to: Global Temperature and then Temporal Stability).



All in one, updated to March 2011

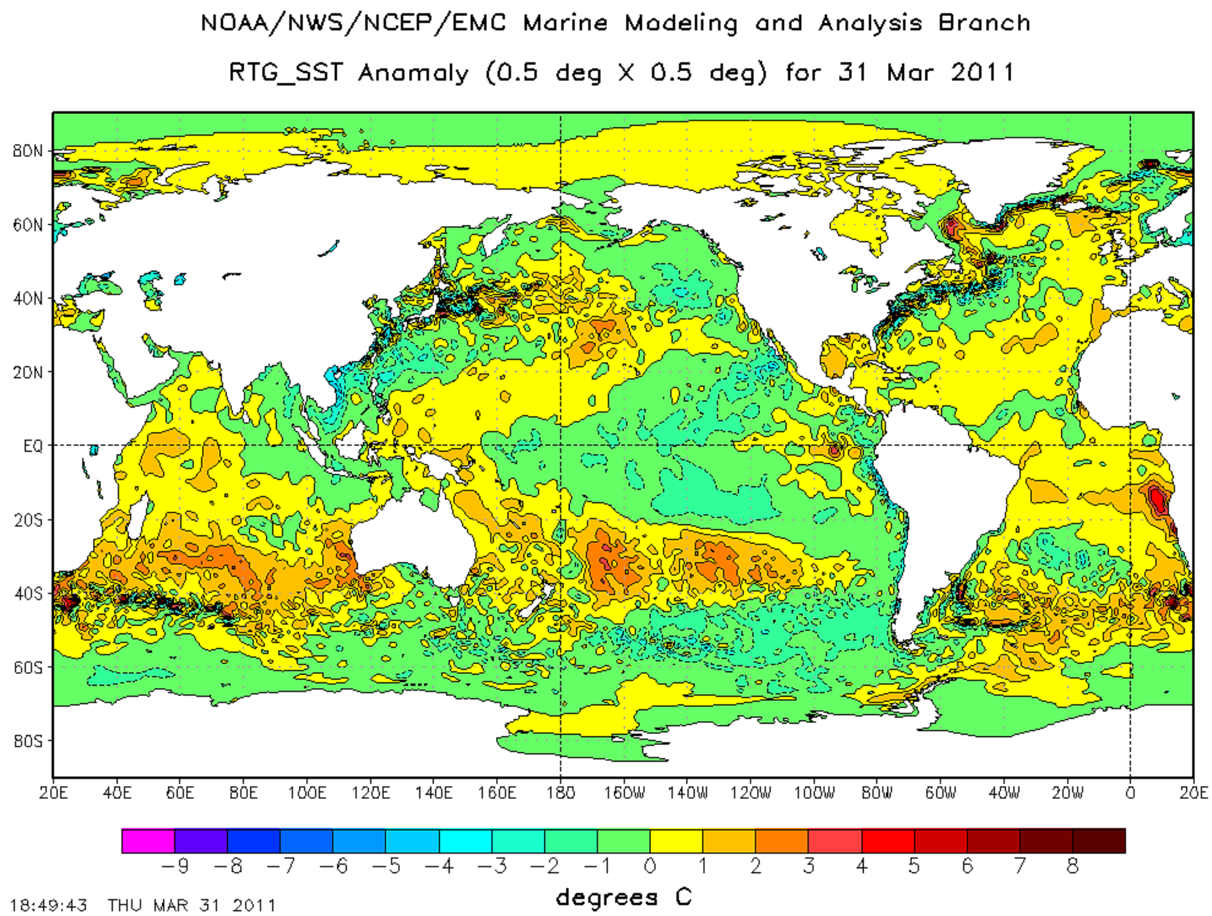


Superimposed plot of all five global monthly temperature estimates shown above. As the base period differs for the different temperature estimates, they have all been normalised by comparing to the average value of their initial 120 months (10 years) from January 1979 to December 1988. The heavy black line represents the simple running 37 month (c. 3 year) mean of the average of all five temperature records. The numbers shown in the lower right corner represent the temperature anomaly relative to the above mentioned 10 yr average.

It should be kept in mind that satellite- and surface-based temperature estimates are derived from different types of measurements, and that comparing them directly as done in the diagram above therefore in principle is problematical. However, as both types of estimate often are discussed together, the above diagram may nevertheless be of some interest. In fact, the different types of temperature estimates appear to agree quite well as to the overall temperature variations on a 2-3 year scale, although on a short time scale there may be considerable differences. This is exemplified by March 2011, where surface and satellite temperatures are showing opposing developments.

All five global temperature estimates presently show stagnation, at least since 2002. There has been no increase in global air temperature since 1998, which was affected by the oceanographic El Niño event. This does not exclude the possibility that global temperatures will begin to increase again later. On the other hand, it also remain a possibility that Earth just now is passing a temperature peak, and that global temperatures will begin to decrease within the coming years. Time will show which of these possibilities is correct.

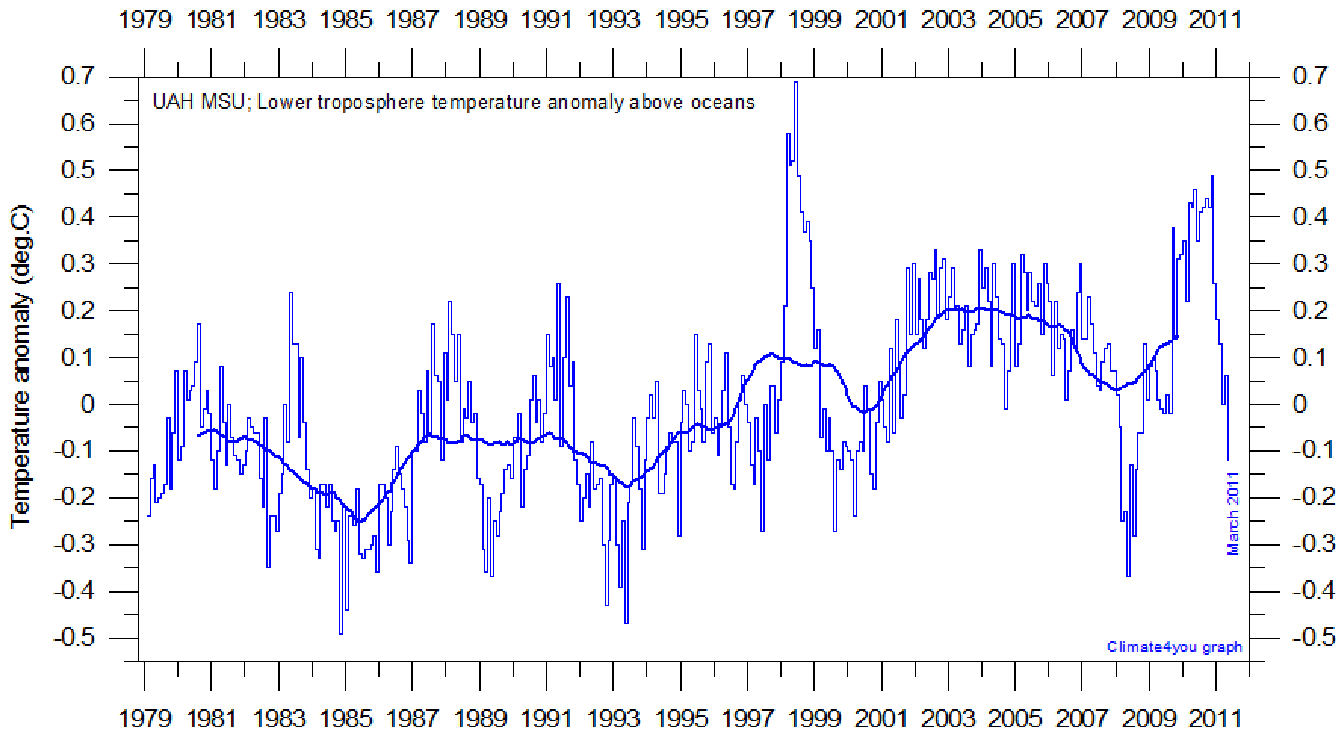
Global sea surface temperature, updated to end of March 2011



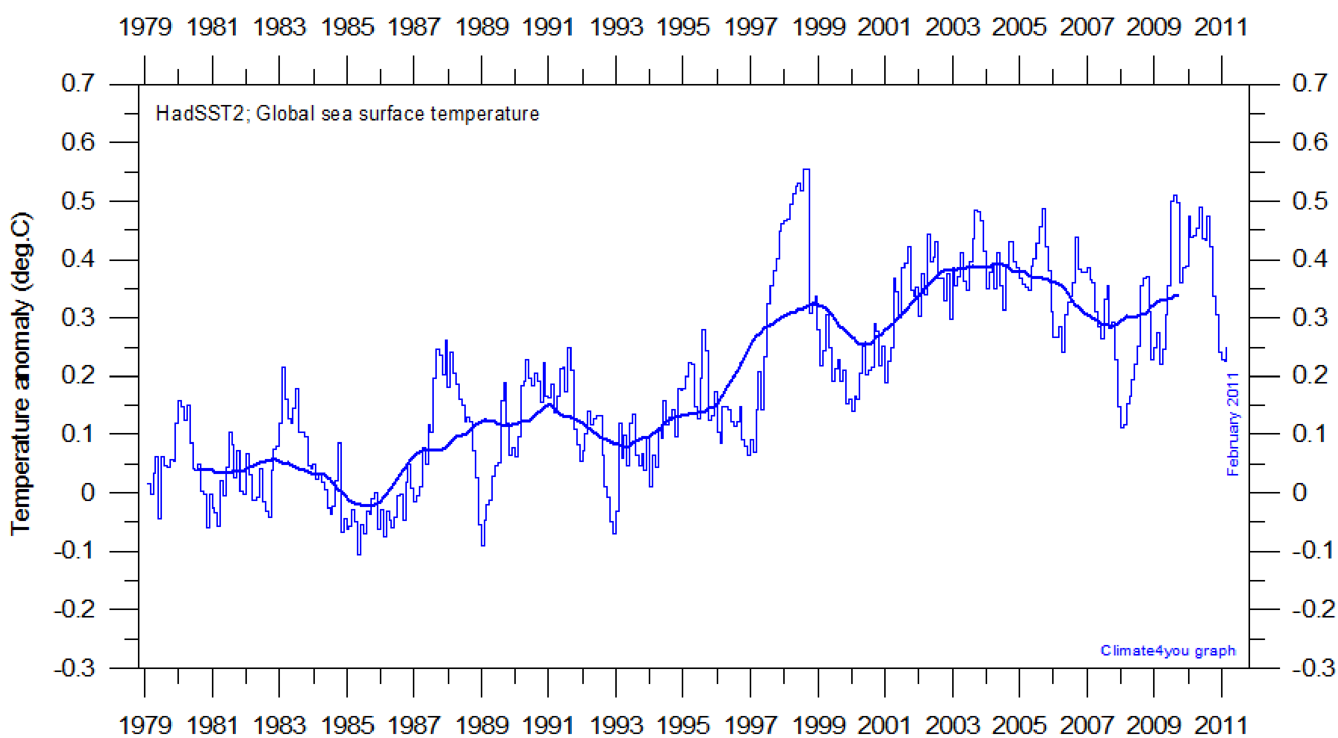
Sea surface temperature anomaly at 31 March 2011. Map source: National Centers for Environmental Prediction (NOAA).

The relative cold surface water dominating the Equator in the Pacific Ocean represents a La Niña situation and affects the temperature of the atmosphere above. Because of the large surface areas involved (being near Equator) this natural cyclic development is at the moment affecting the global atmospheric temperature towards relatively low temperatures.

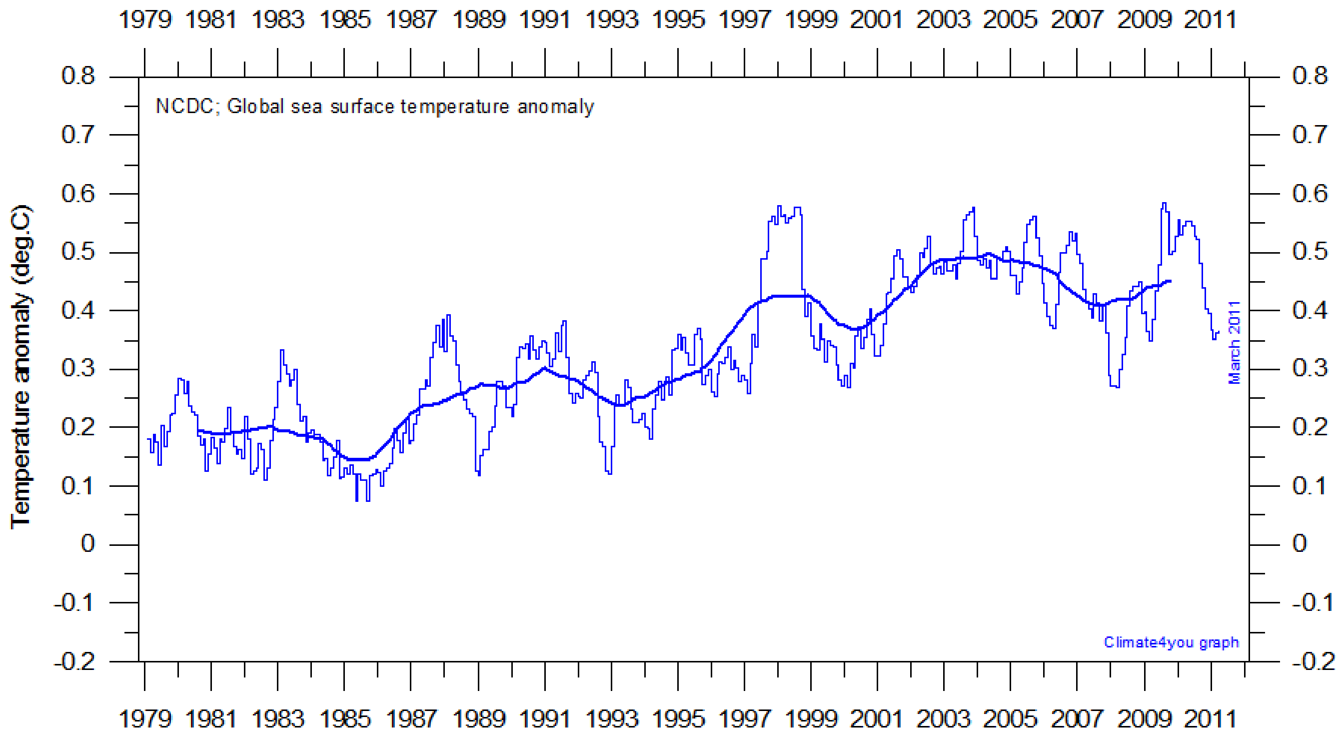
However, the significance of any such cooling seen in surface air temperatures should not be over stated. Whenever Earth experiences cold La Niña or warm El Niño episodes major heat exchanges takes place between the Pacific Ocean and the atmosphere above, eventually showing up in estimates of the global air temperature. This does not, however, reflect similar changes in the total heat content of the atmosphere-ocean system. In fact, net changes may be small, as it mainly reflects a redistribution of energy. What matters is the overall development when seen over some years.



Global monthly average lower troposphere temperature over oceans (thin line) since 1979 according to [University of Alabama](#) at Huntsville, USA. The thick line is the simple running 37 month average.

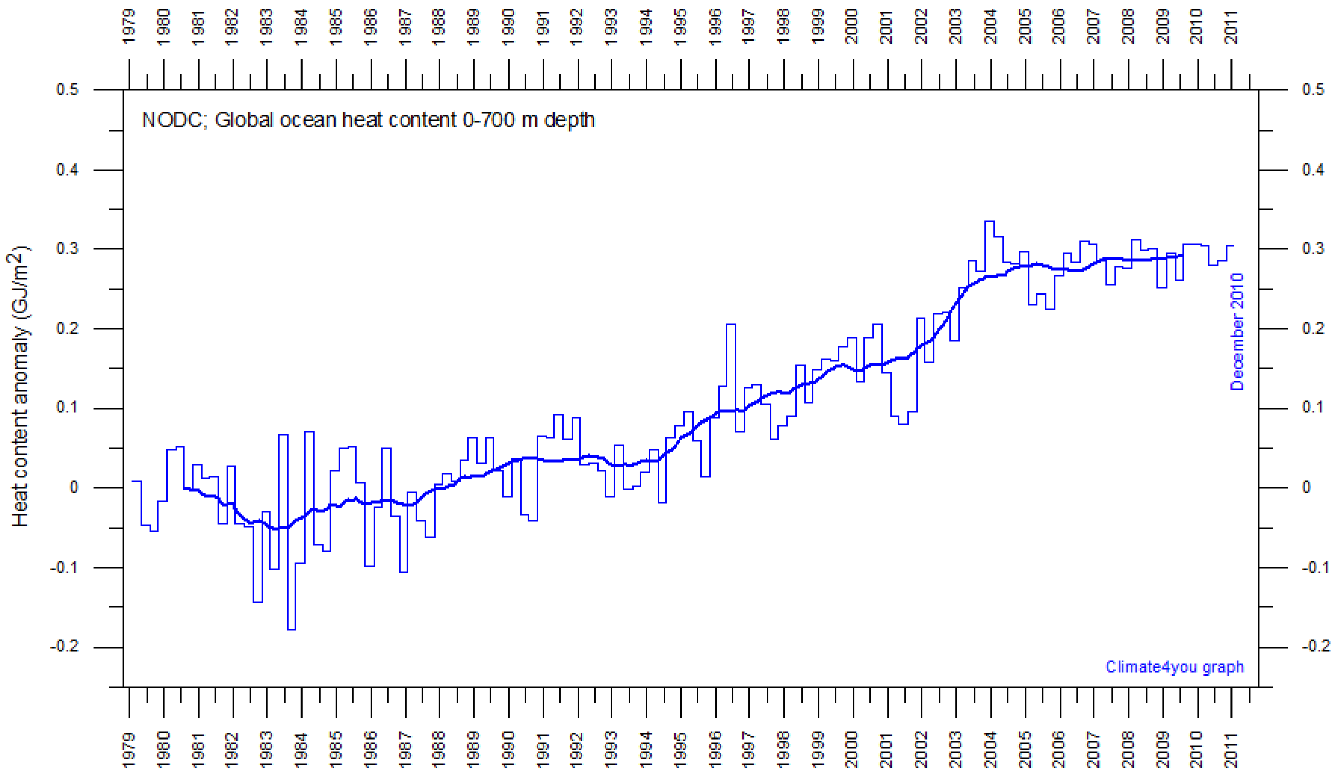


Global monthly average sea surface temperature since 1979 according to University of East Anglia's [Climatic Research Unit](#) ([CRU](#)), UK. Base period: 1961-1990. The thick line is the simple running 37 month average. Please note that this diagram is not updated beyond February 2011.

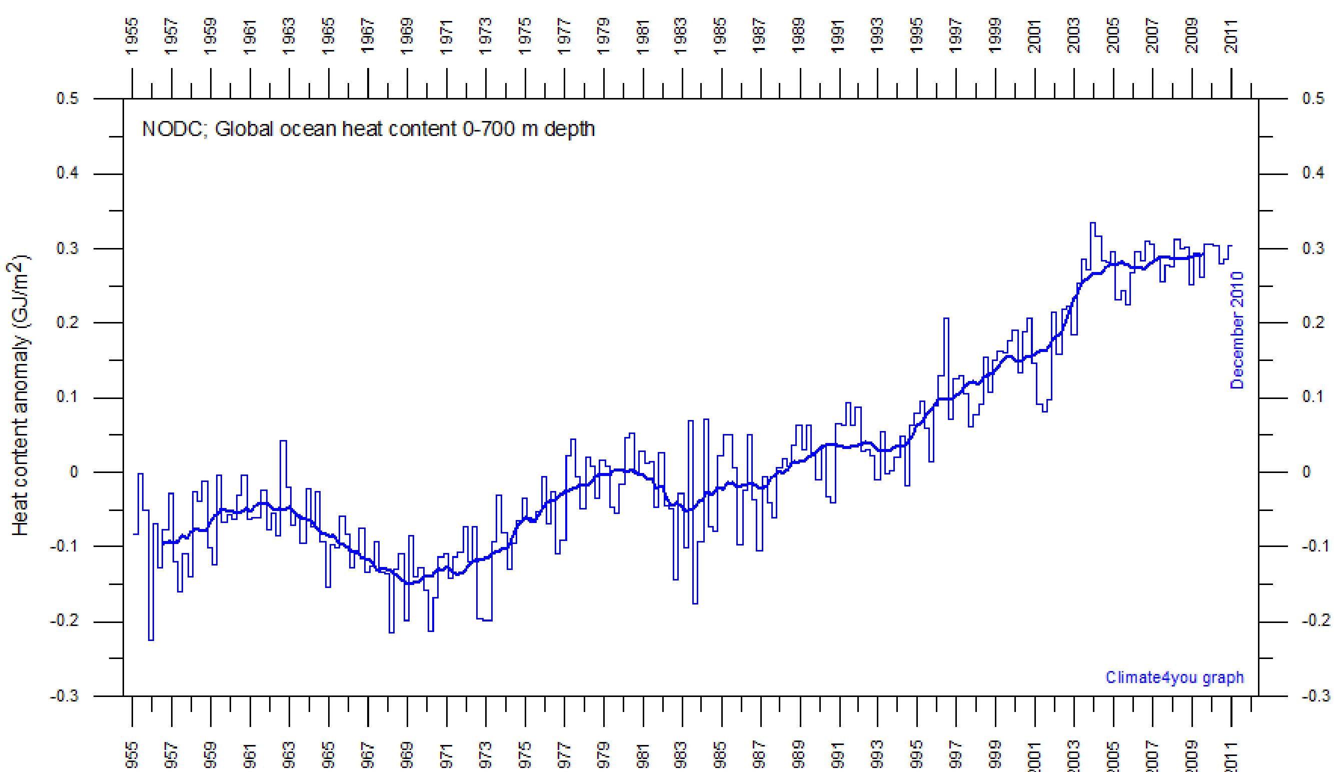


Global monthly average sea surface temperature since 1979 according to the [National Climatic Data Center](#) (NCDC), USA. Base period: 1901-2000. The thick line is the simple running 37 month average.

Global ocean heat content, updated to December 2010

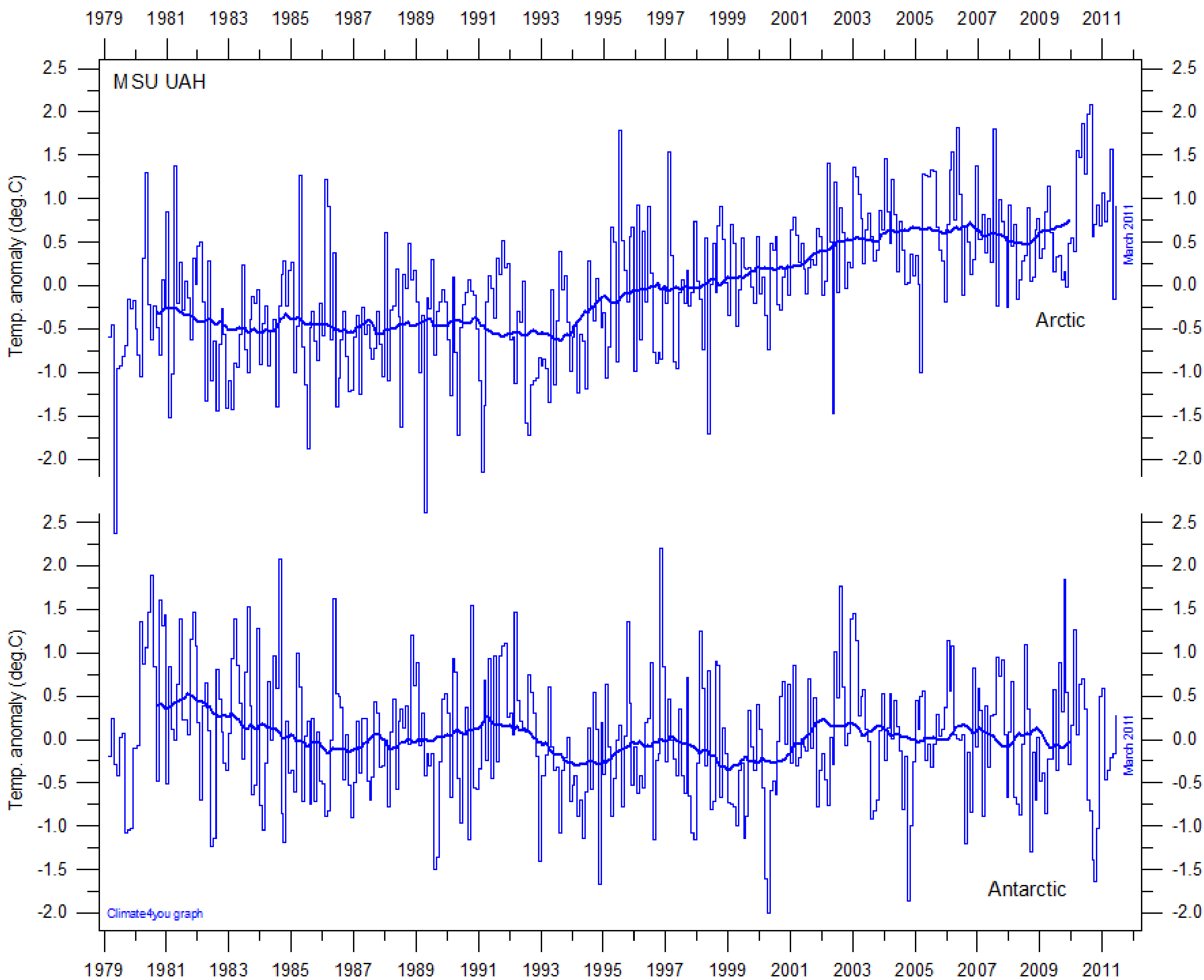


Global monthly heat content anomaly (GJ/m2) in the uppermost 700 m of the oceans since January 1979. Data source: National Oceanographic Data Center(NODC).



Global monthly heat content anomaly (GJ/m2) in the uppermost 700 m of the oceans since January 1955. Data source: National Oceanographic Data Center(NODC).

[Arctic and Antarctic lower troposphere temperature, updated to March 2011]()



Global monthly average lower troposphere temperature since 1979 for the North Pole and South Pole regions, based on satellite observations ([University of Alabama]() at Huntsville, USA). The thick line is the simple running 37 month average, nearly corresponding to a running 3 yr average.

Arctic and Antarctic surface air temperature, updated to February 2011

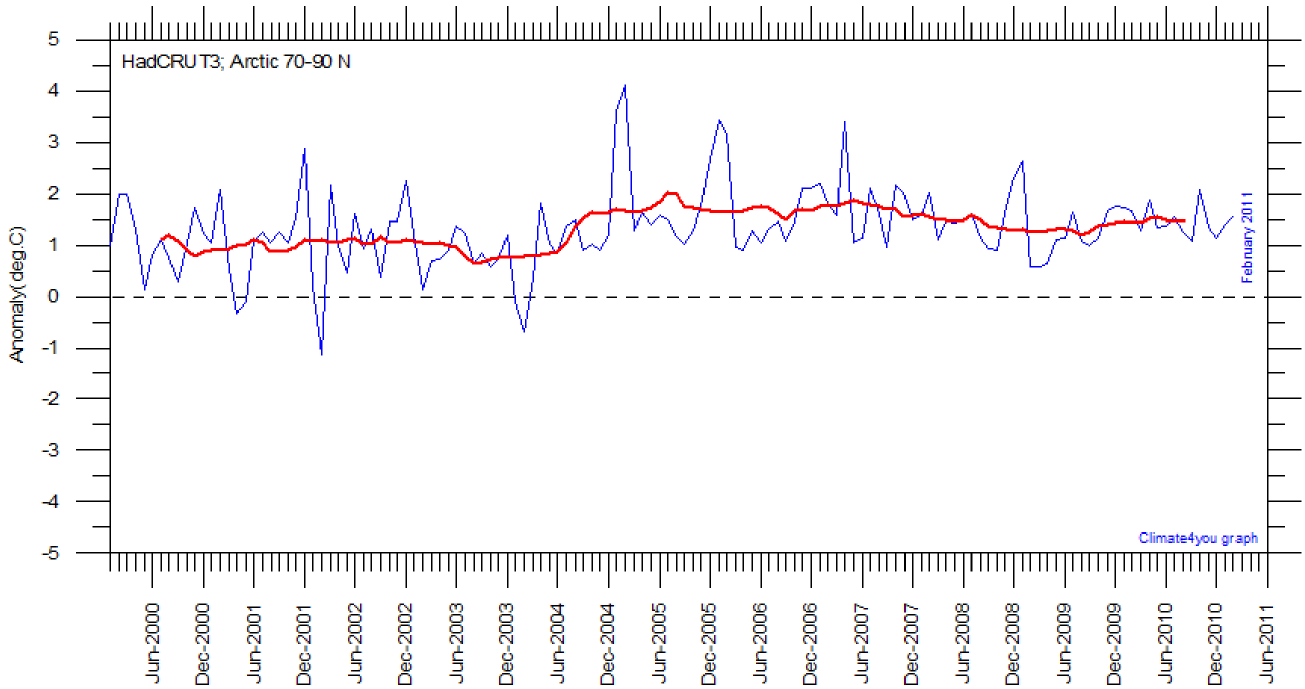


Diagram showing Arctic monthly surface air temperature anomaly 70-90°N since January 2000, in relation to the WMO reference "normal" period 1961-1990. The thin blue line shows the monthly temperature anomaly, while the thicker red line shows the running 13 month average. Data provided by the Hadley Centre for Climate Prediction and Research and the University of East Anglia's Climatic Research Unit (CRU), UK.

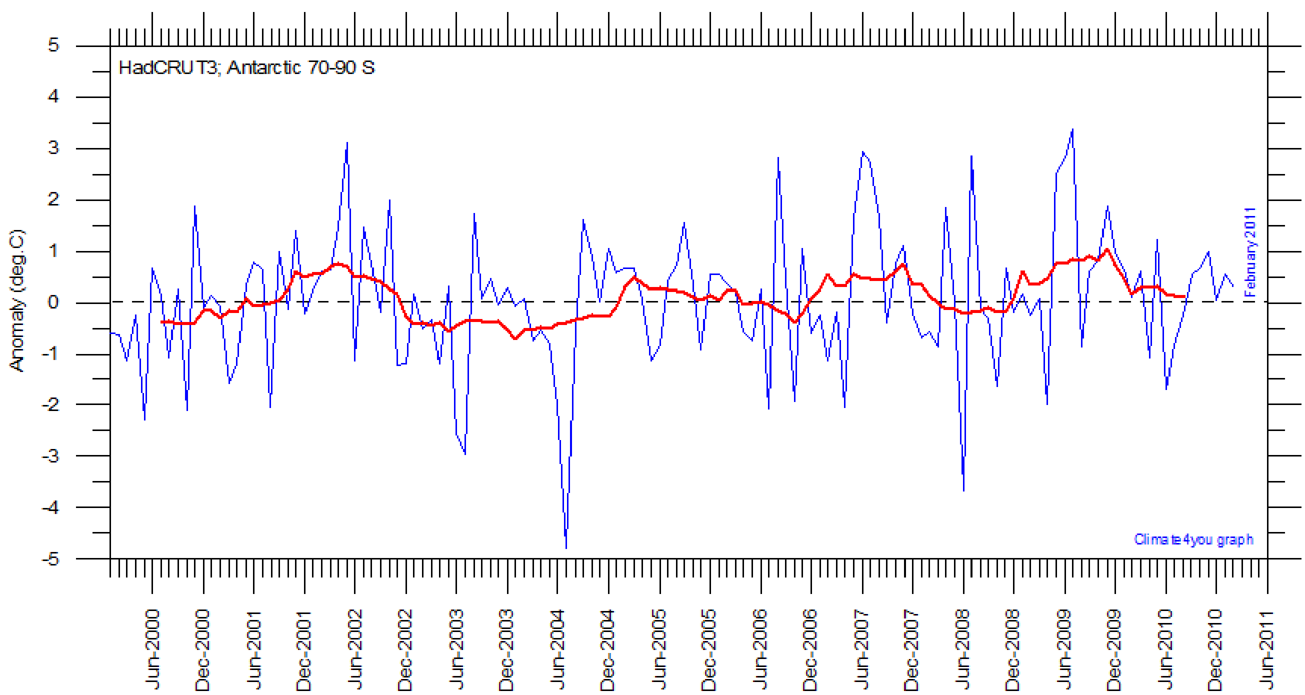


Diagram showing Antarctic monthly surface air temperature anomaly 70-90°S since January 2000, in relation to the WMO reference "normal" period 1961-1990. The thin blue line shows the monthly temperature anomaly, while the thicker red line shows the running 13 month average. Data provided by the Hadley Centre for Climate Prediction and Research and the University of East Anglia's Climatic Research Unit (CRU), UK.

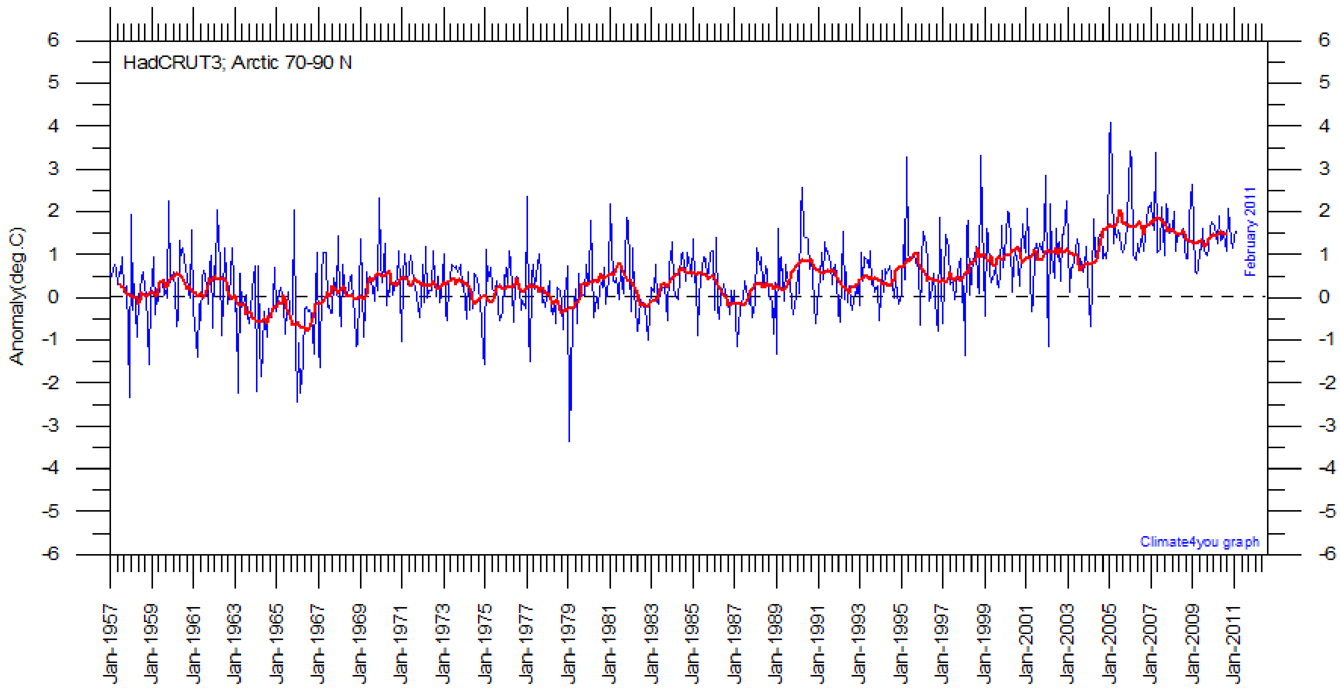


Diagram showing Arctic monthly surface air temperature anomaly 70-90^{o}N since January 1957, in relation to the WMO reference "normal" period 1961-1990. The year 1957 has been chosen as starting year, to ensure easy comparison with the maximum length of the realistic Antarctic temperature record shown below. The thin blue line shows the monthly temperature anomaly, while the thicker red line shows the running 13 month average. Data provided by the Hadley Centre for Climate Prediction and Research and the University of East Anglia's [Climatic Research Unit] ([CRU]), UK.

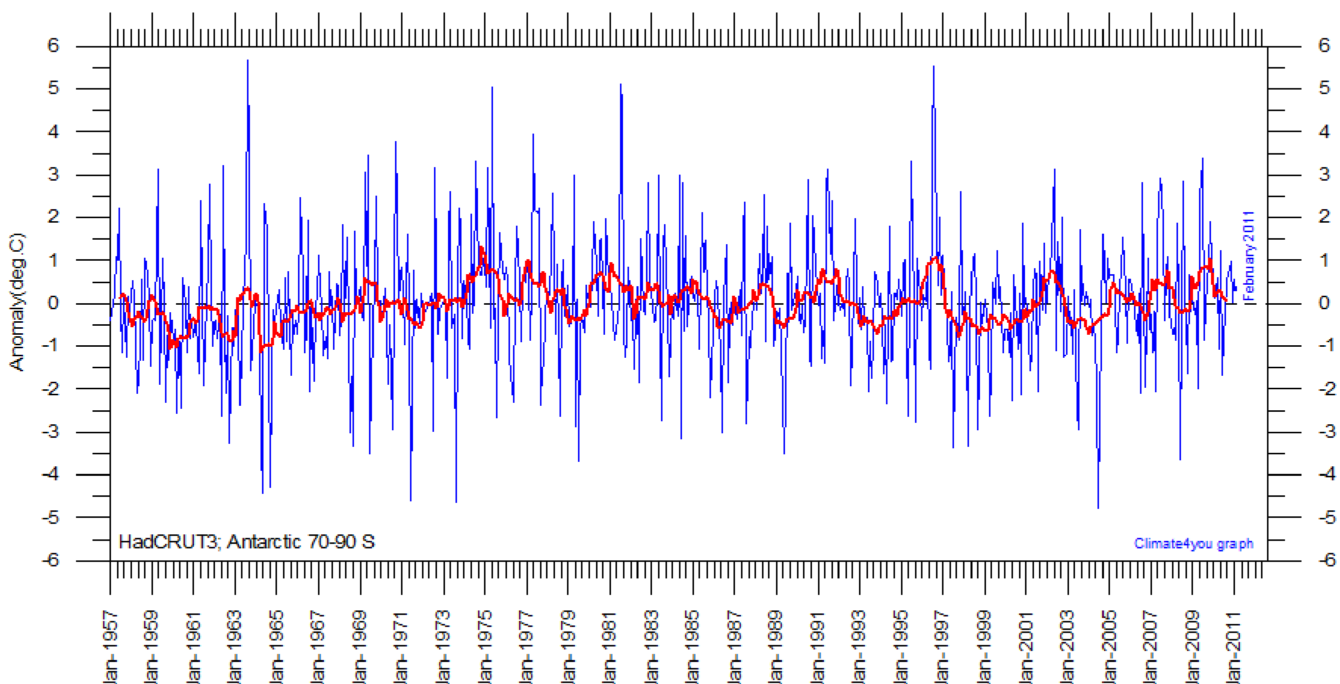


Diagram showing Antarctic monthly surface air temperature anomaly 70-90^{o}S since January 1957, in relation to the WMO reference "normal" period 1961-1990. The year 1957 was an international geophysical year, and several meteorological stations were established in the Antarctic because of this. Before 1957, the meteorological coverage of the Antarctic continent is poor. The thin blue line shows the monthly temperature anomaly, while the thicker red line shows the running 13 month average. Data provided by the Hadley Centre for Climate Prediction and Research and the University of East Anglia's [Climatic Research Unit] ([CRU]), UK.

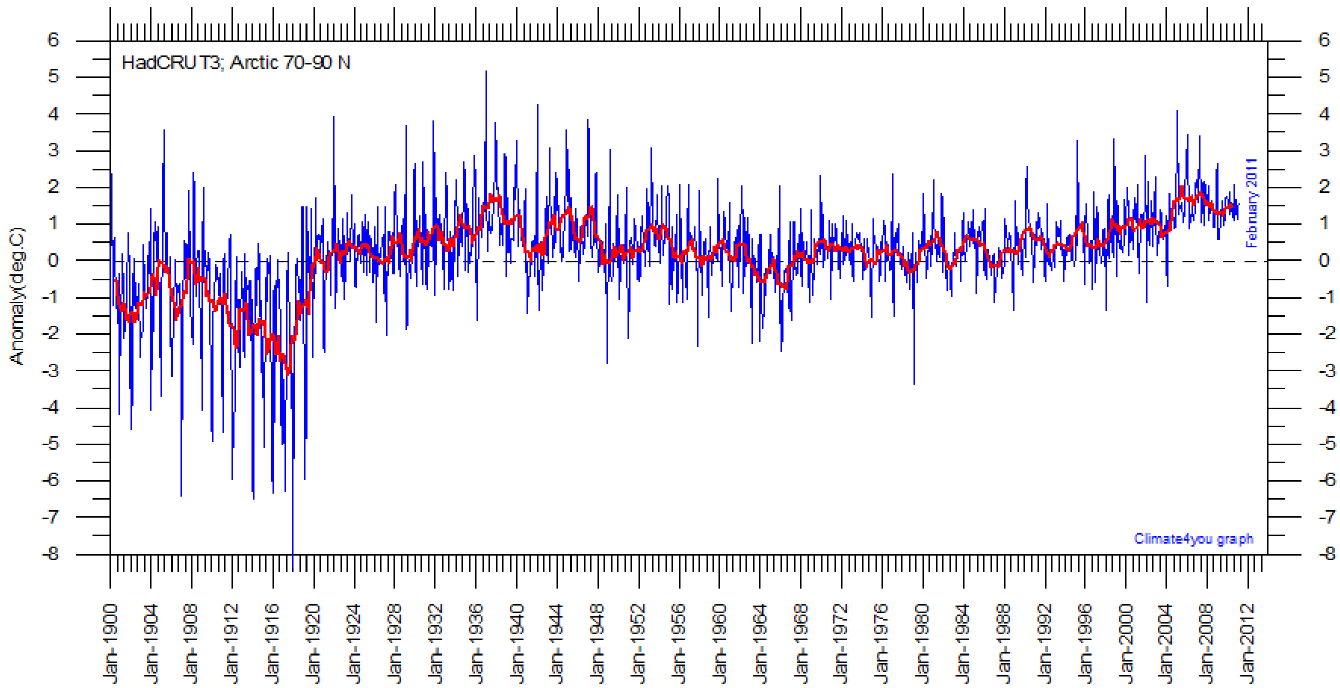


Diagram showing Arctic monthly surface air temperature anomaly 70-90°N since January 1900, in relation to the WMO reference "normal" period 1961-1990. The thin blue line shows the monthly temperature anomaly, while the thicker red line shows the running 13 month average. In general, the range of monthly temperature variations decreases throughout the first 30-50 years of the record, reflecting the increasing number of meteorological stations north of 70°N over time. Especially the period from about 1930 saw the establishment of many new Arctic meteorological stations, first in Russia and Siberia, and following the 2nd World War, also in North America. Because of the relatively small number of stations before 1930, details in the early part of the Arctic temperature record should not be over interpreted. The rapid Arctic warming around 1920 is, however, clearly visible, and is also documented by other sources of information. The period since 2000 is warm, about as warm as the period 1930-1940. Data provided by the Hadley Centre for Climate Prediction and Research and the University of East Anglia's Climatic Research Unit (CRU), UK

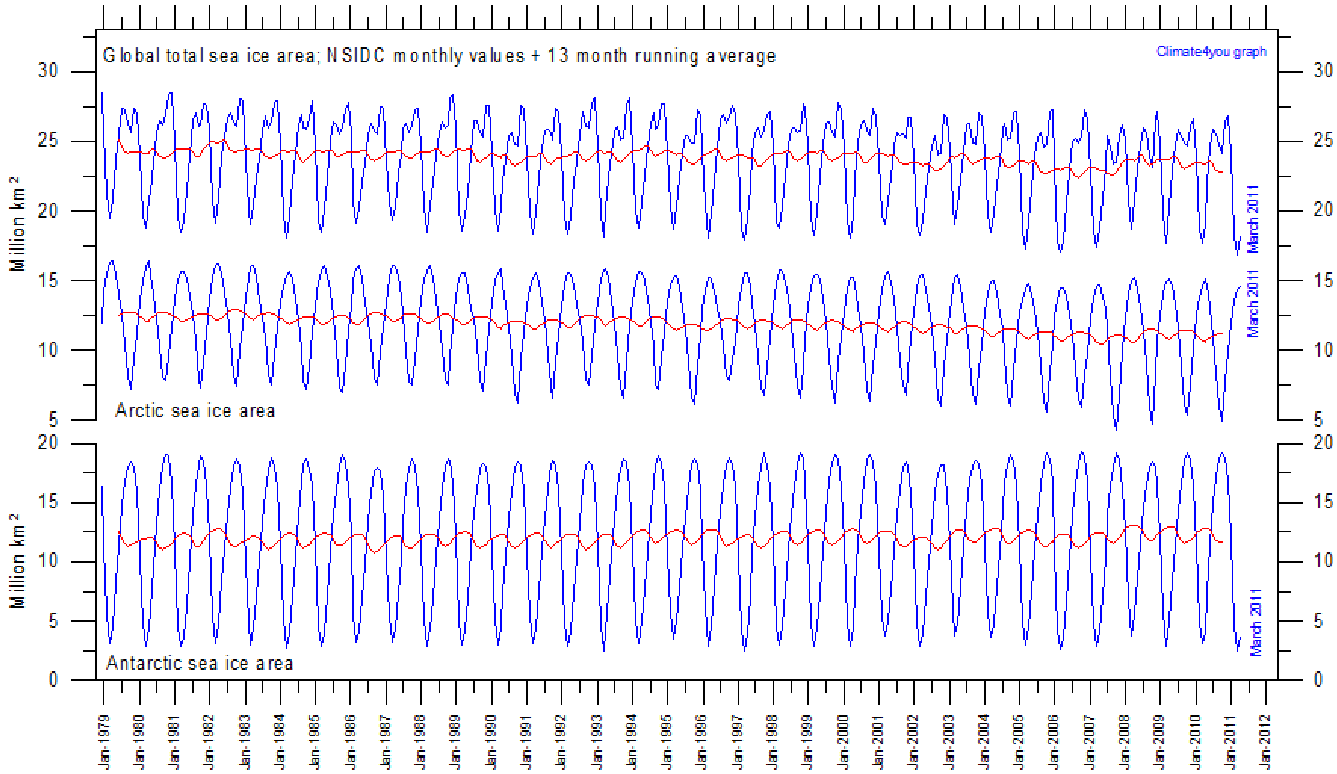
In general, the Arctic temperature record appears to be less variable than the Antarctic record, presumably at least partly due to the higher number of meteorological stations north of 70°N, compared to the number of stations south of 70°S.

As data coverage is sparse in the Polar Regions, the procedure of Gillet et al. 2008 has been followed, giving equal weight to data in each 5°x5° grid cell when calculating means, with no weighting by the areas of the grid dells.

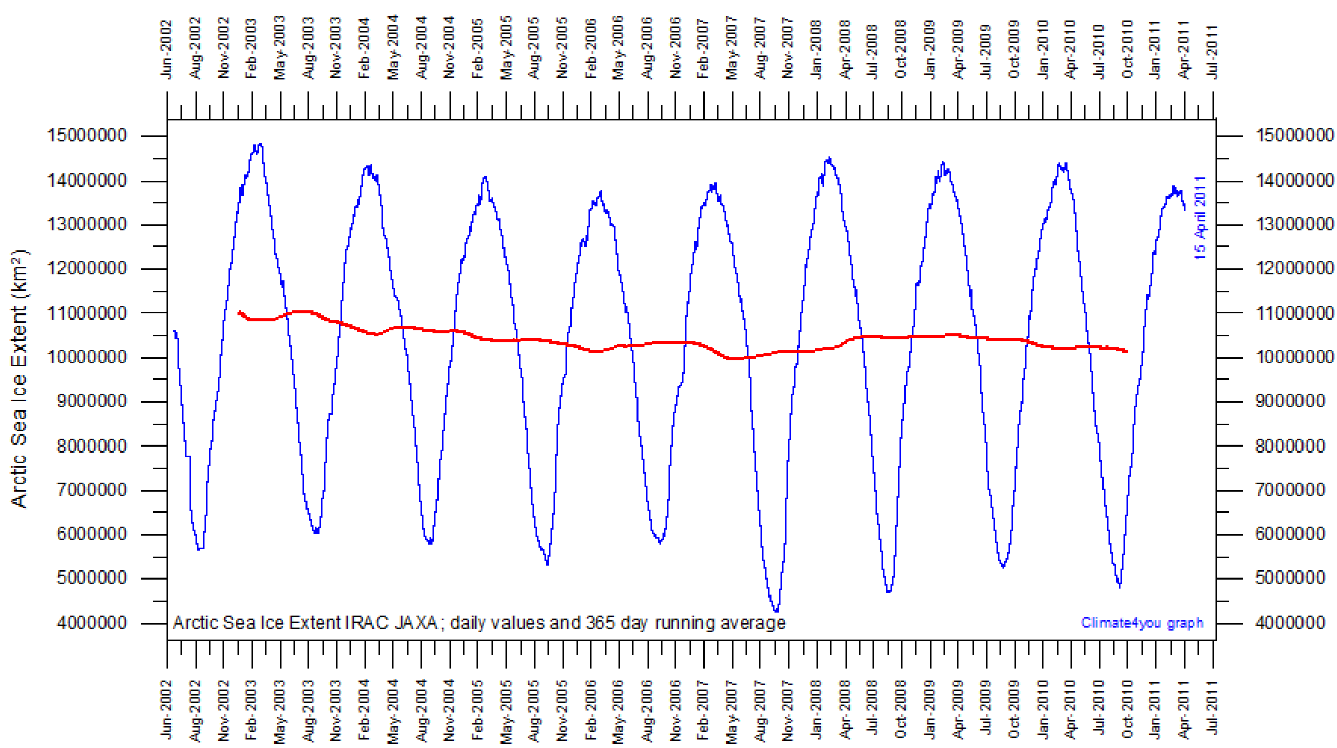
Literature:

Gillett, N.P., Stone, D.A., Stott, P.A., Nozawa, T., Karpechko, A.Y.U., Hegerl, G.C., Wehner, M.F. and Jones, P.D. 2008. Attribution of polar warming to human influence. *Nature Geoscience* 1, 750-754.

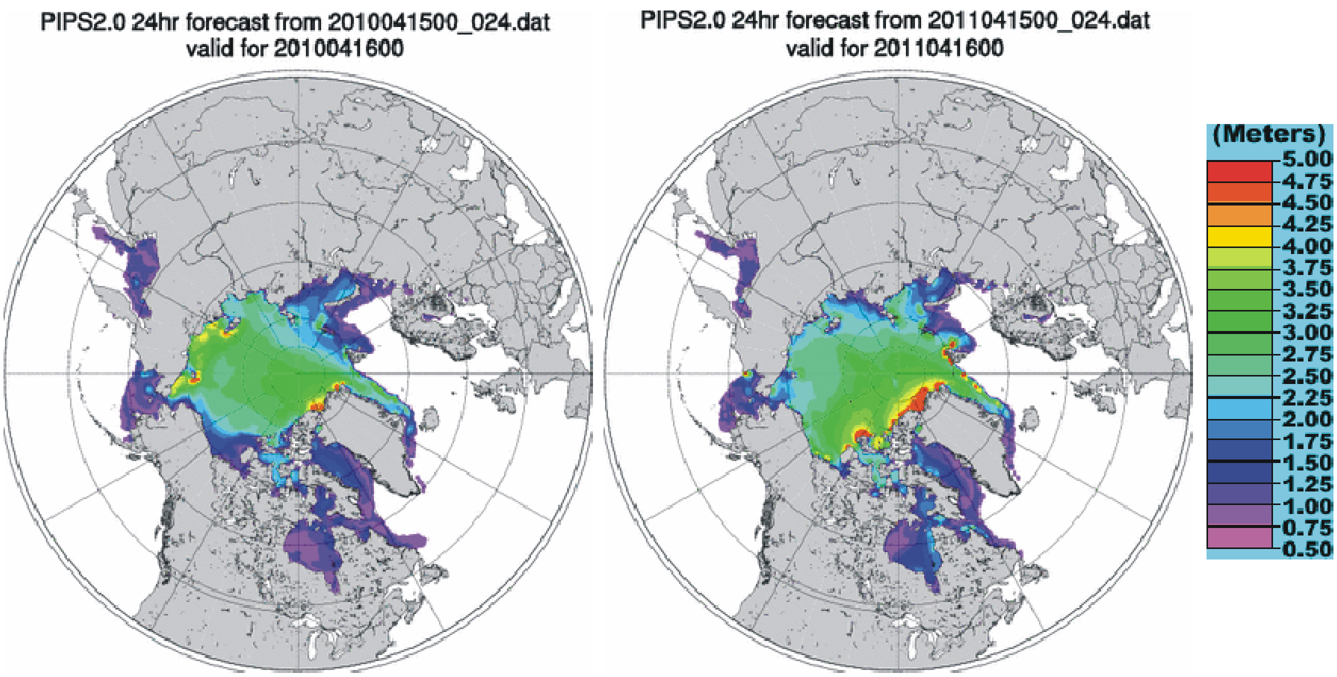
[Arctic and Antarctic sea ice, updated to March 2011]



Graphs showing monthly Antarctic, Arctic and global sea ice extent since November 1978, according to the [National Snow and Ice data Center] (NSIDC).

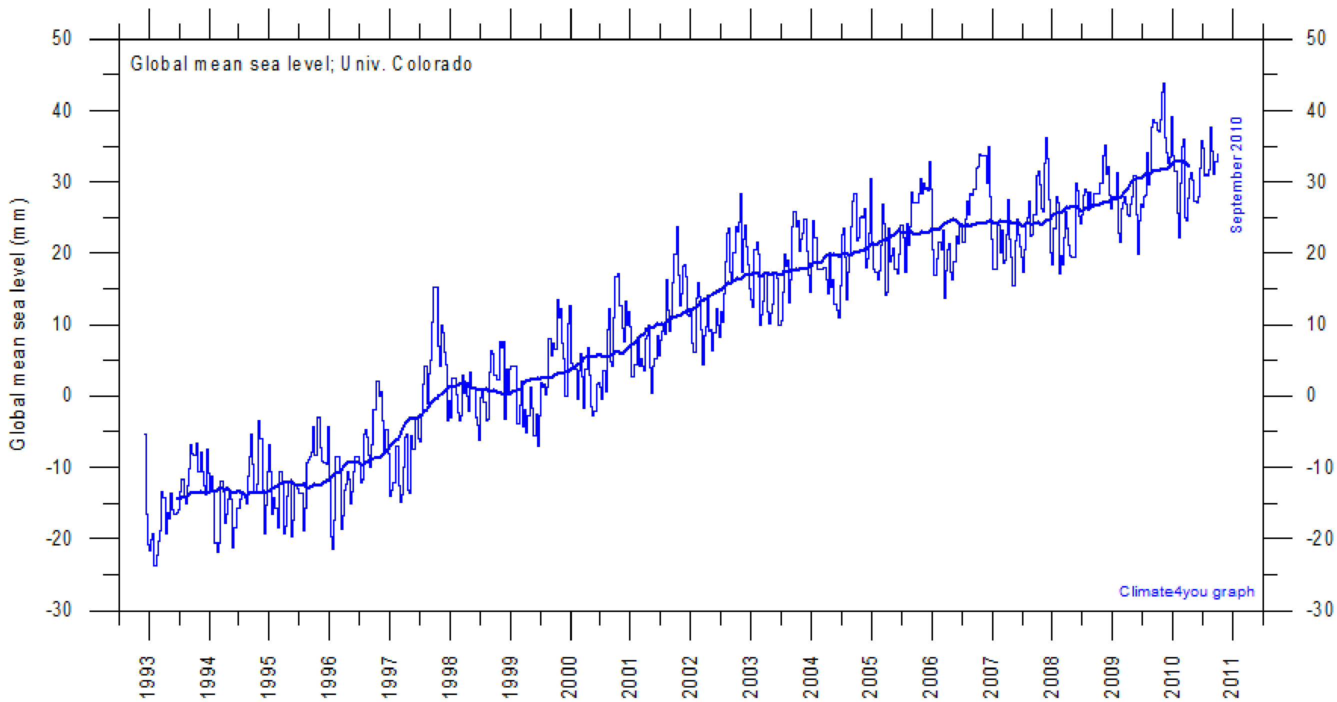


Graph showing daily Arctic sea ice extent since June 2002, to 15/04 2011, by courtesy of [Japan Aerospace Exploration Agency] (JAXA).

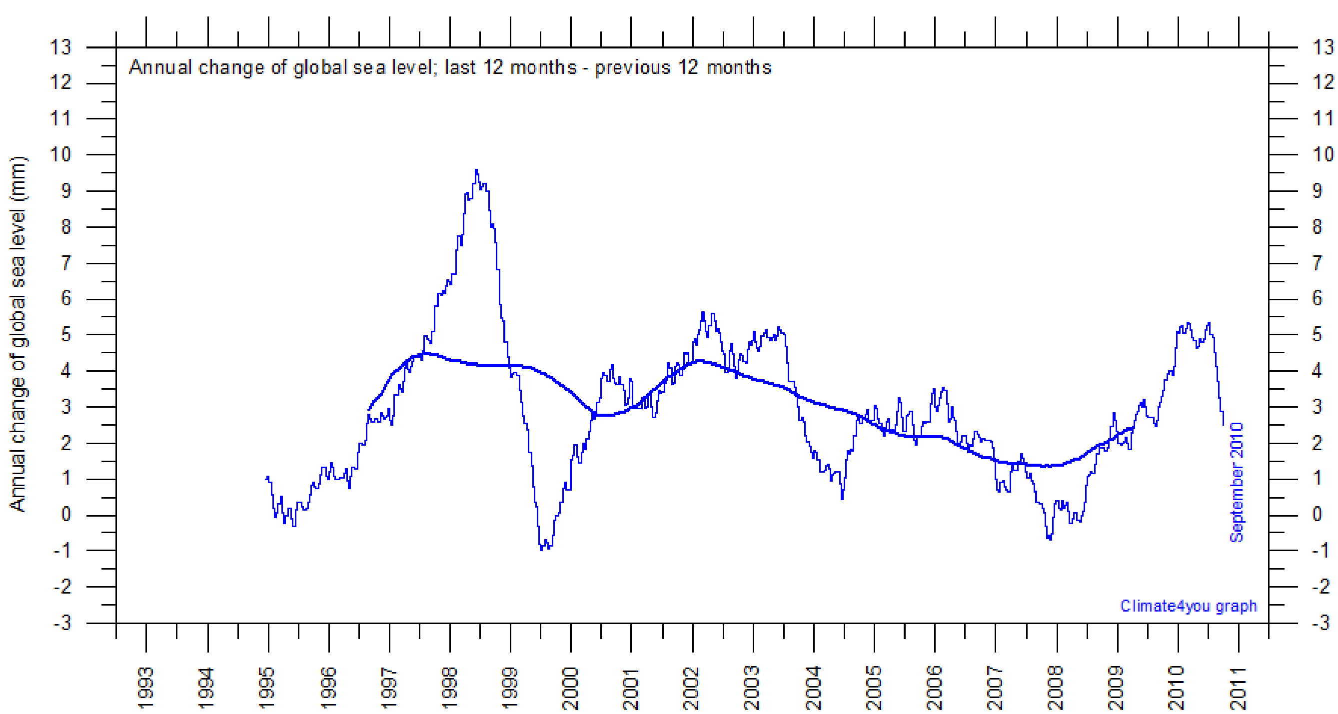


Northern hemisphere sea ice thickness on 15 April 2010 (left) and 2011 (right), according to the Naval Oceanographic Office *(NAVO). Thickness values are calculated by the Polar Ice Prediction System (PIPS 2.0), based on the Special Sensor Microwave Image (SSM/I) to initialize the calculation. Thickness scale (m) is shown to the right.*

Global sea level, updated to September 2010

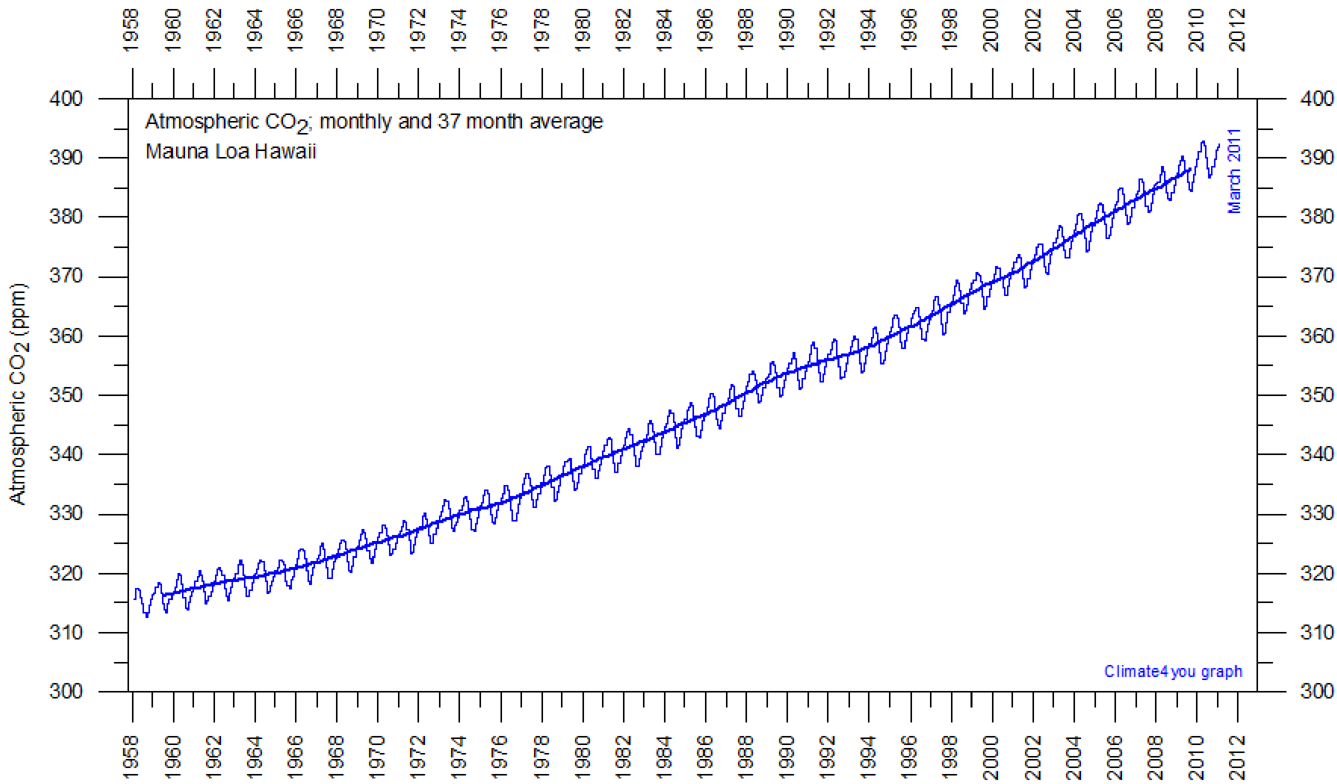


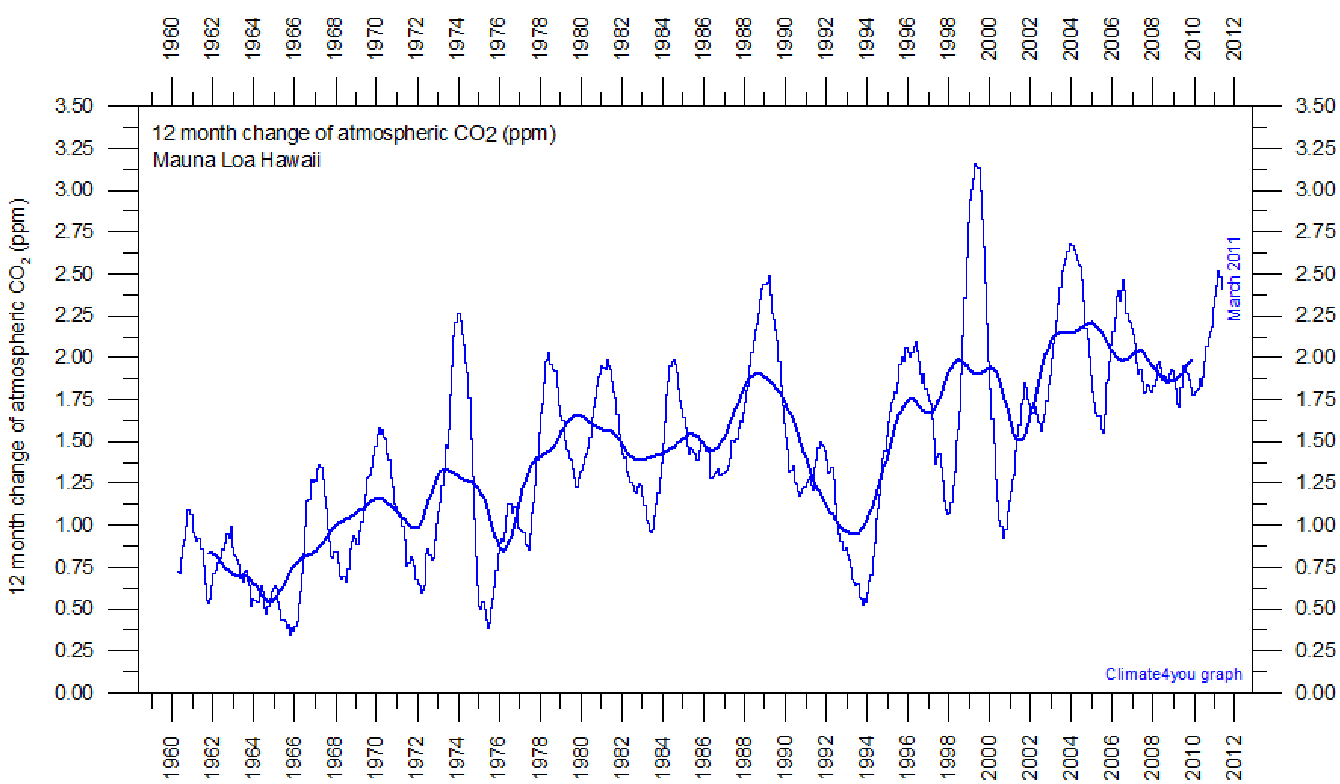
Globa lmonthly sea level since late 1992 according to the Colorado Center for Astrodynamics Research at [University of Colorado at Boulder](), USA. The thick line is the simple running 37 observation average, nearly corresponding to a running 3 yr average.



Annual change of global sea level since late 1992 according to the Colorado Center for Astrodynamics Research at [University of Colorado at Boulder](), USA. The thick line is the simple running 3 yr average.

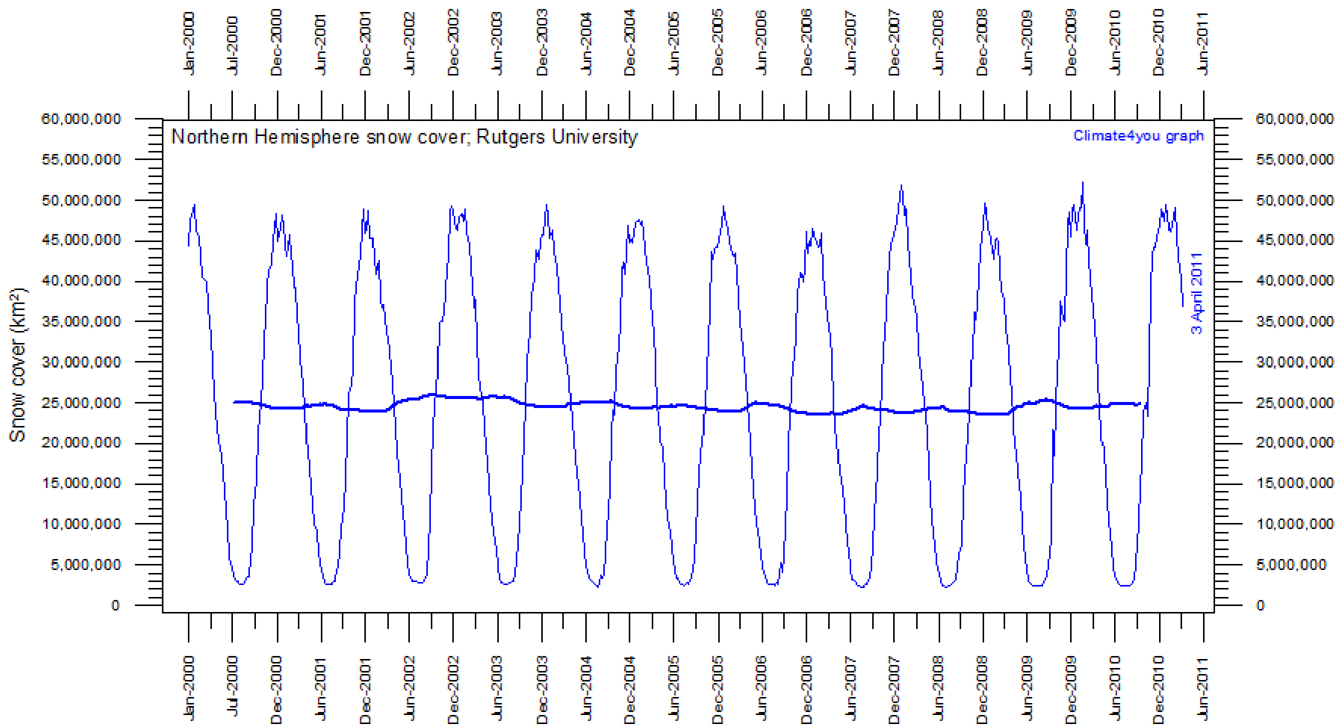
Atmospheric CO_2, updated to March 2011



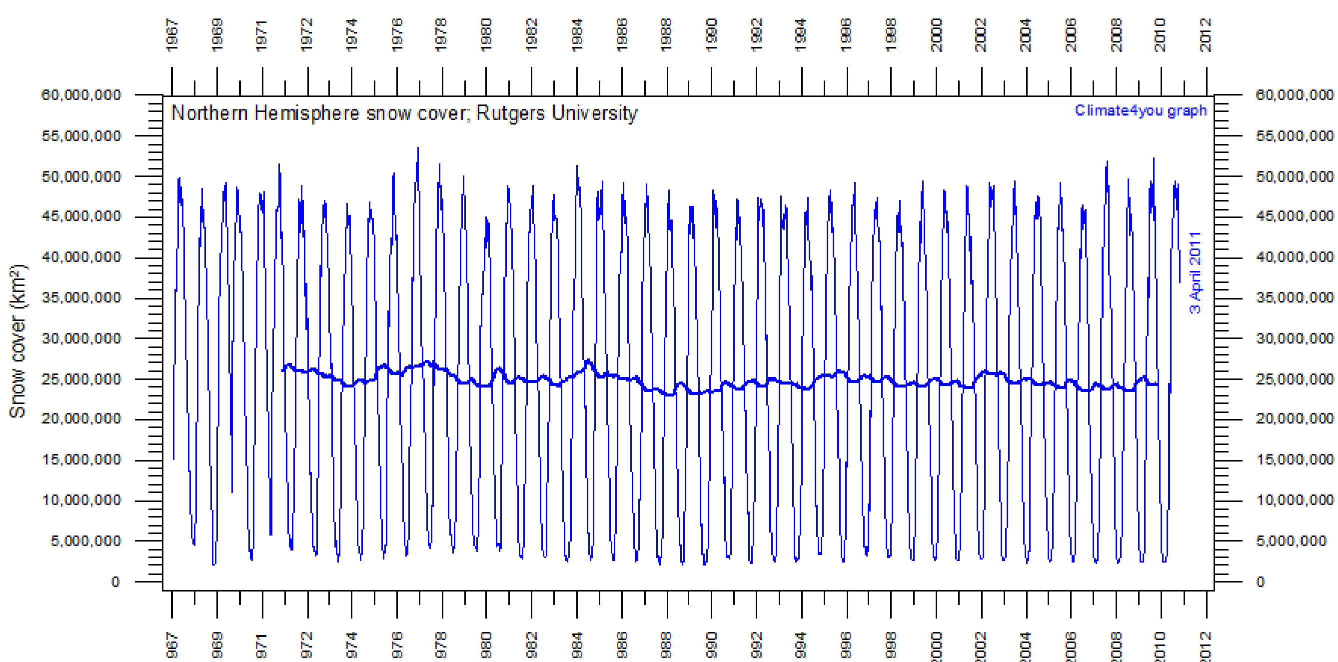


Monthly amount of atmospheric CO_2 (above) and annual growth rate (below; average last 12 months minus average preceding 12 months) of atmospheric CO_2 since 1959, according to data provided by the [Mauna Loa Observatory](), Hawaii, USA. The thick line is the simple running 37 observation average, nearly corresponding to a running 3 yr average.

Northern Hemisphere weekly snow cover, updated to late March 2011

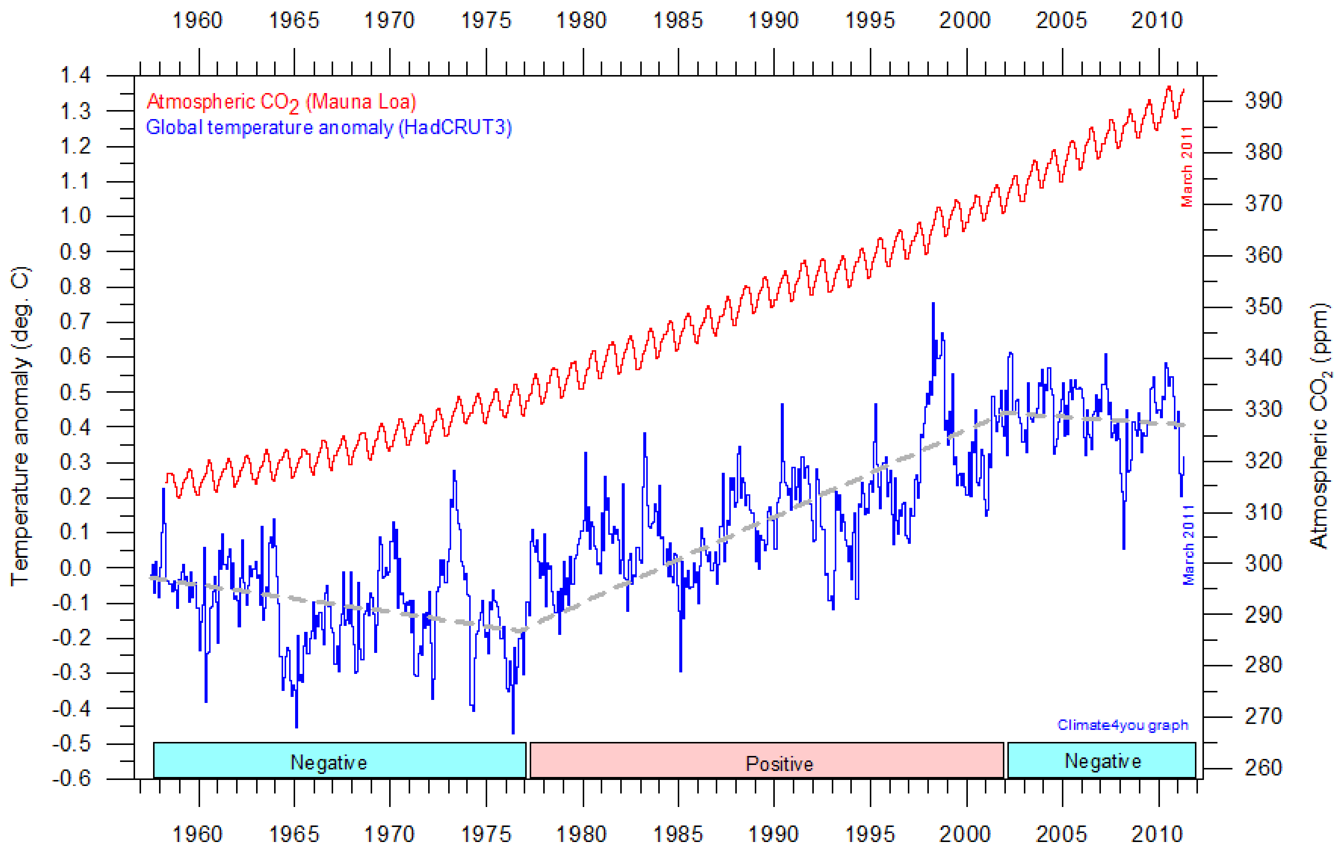


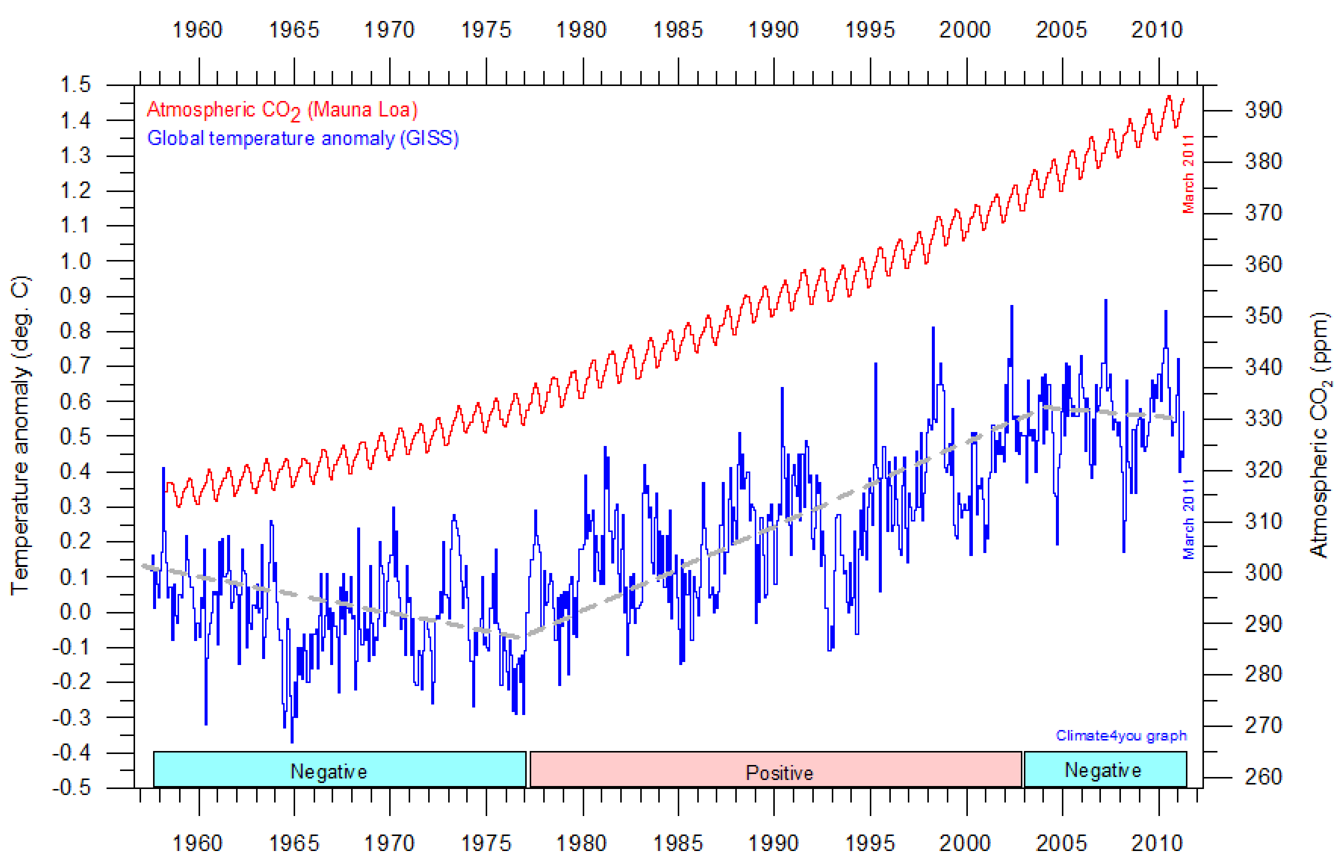
Northern hemisphere weekly snow cover since January 2000 according to Rutgers University Global Snow Laboratory. The thin line is the weekly data, and the thick line is the running 53 week average (approximately 1 year).

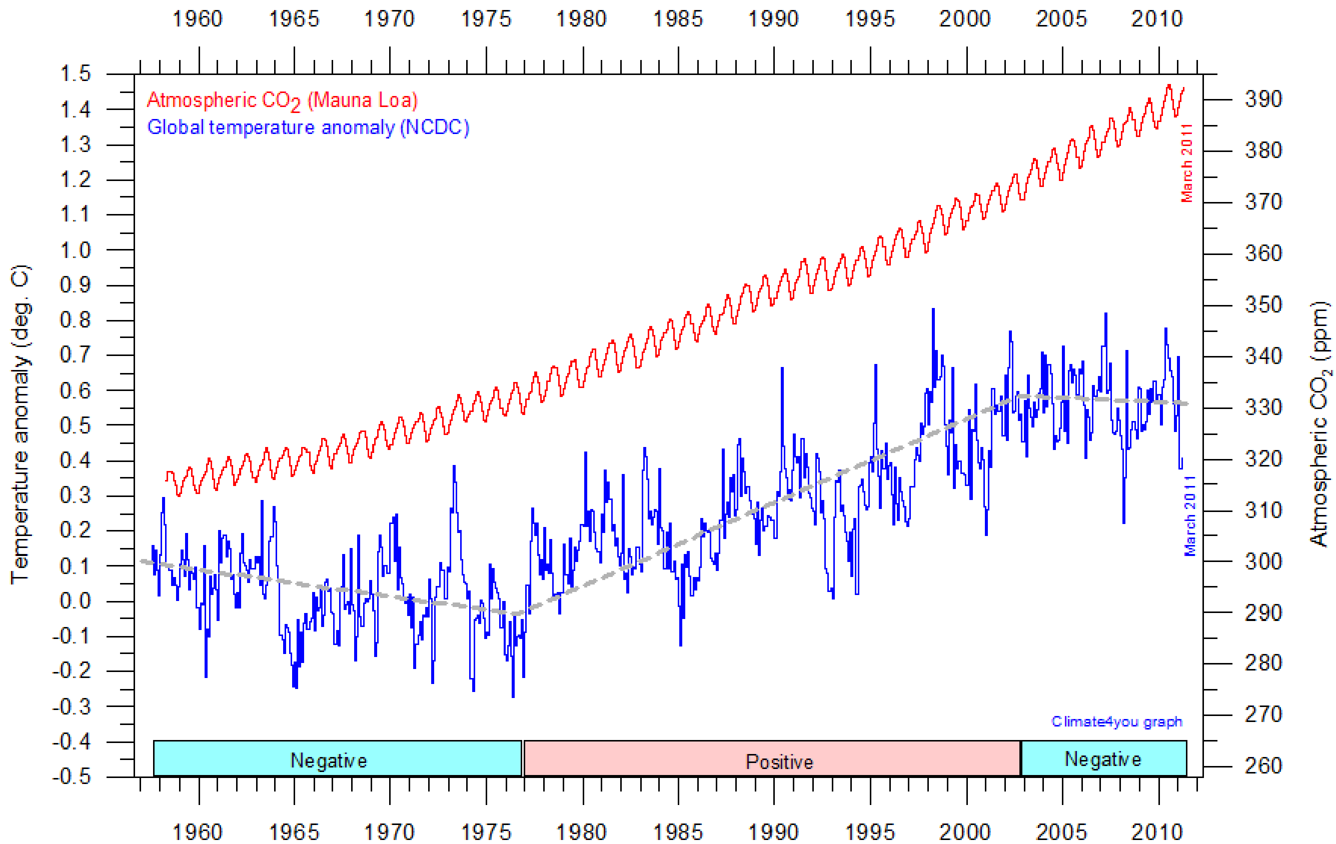


Northern hemisphere weekly snow cover since October 1966 according to Rutgers University Global Snow Laboratory. The thin line is the weekly data, and the thick line is the running 53 week average (approximately 1 year). The running average is not calculated before 1971 because of some data irregularities in this early period.

Global surface air temperature and atmospheric CO_2, updated to March 2011







Diagrams showing HadCRUT3, GISS, and NCDC monthly global surface air temperature estimates (blue) and the monthly atmospheric CO_2 content (red) according to the [Mauna Loa Observatory](), Hawaii. The Mauna Loa data series begins in March 1958, and 1958 has therefore been chosen as starting year for the diagrams. Reconstructions of past atmospheric CO_2 concentrations (before 1958) are not incorporated in this diagram, as such past CO_2 values are derived by other means (ice cores, stomata, or older measurements using different methodology, and therefore are not directly comparable with modern atmospheric measurements. The dotted grey line indicates the approximate linear temperature trend, and the boxes in the lower part of the diagram indicate the relation between atmospheric CO_2 and global surface air temperature, negative or positive.

Most climate models assume the greenhouse gas carbon dioxide CO_2 to influence significantly upon global temperature. Thus, it is relevant to compare the different global temperature records with measurements of atmospheric CO_2, as shown in the diagrams above. Any comparison, however, should not be made on a monthly or annual basis, but for a longer time period, as other effects (oceanographic, clouds, volcanic, etc.) may well override the potential influence of CO_2 on short time scales such as just a few years.

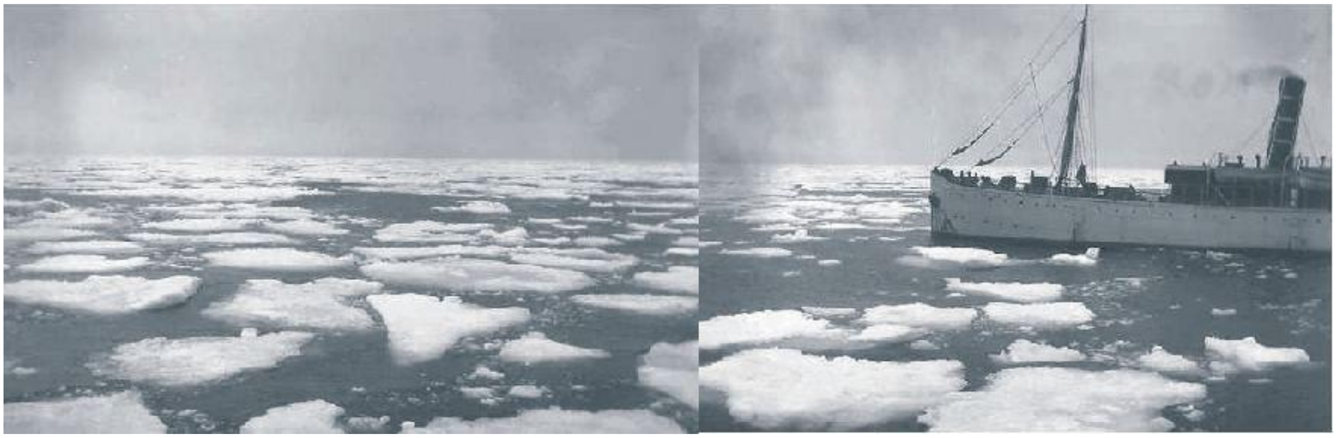
It is of cause equally inappropriate to present new meteorological record values, whether daily, monthly or annual, as support for the hypothesis ascribing high importance of atmospheric CO_2 for global temperatures. Any such short-period meteorological record value may well be the result of other phenomena than atmospheric CO_2.

What exactly defines the critical length of a relevant time period to consider for evaluating the alleged high importance of CO_2 remains elusive, and is still a topic for debate. The critical period length must, however, be inversely proportional to the importance of CO_2 on the global temperature, including feedback effects, such as assumed by most climate models. So if the effect of CO_2 is strong, the length of the critical period is short, and vice versa.

After about 10 years of global temperature increase following global cooling 1940-1978, IPCC was established in 1988. Presumably, several scientists interested in climate then felt intuitively that their empirical and theoretical understanding of climate dynamics was sufficient to conclude about the high importance of CO_2 for global temperature. However, for obtaining public and political support for the CO_2-hyphotesis the 10 year warming period leading up to 1988 in all likelihood was important. Had the global temperature instead been decreasing, public support for the hypothesis would have been difficult to obtain. Adopting this approach as to critical time length, the varying relation (positive or negative) between global temperature and atmospheric CO_2 has been indicated in the lower panels of the three diagrams above.

Climate and history; one example among many

1909-1917: Difficult sea ice conditions around Spitsbergen

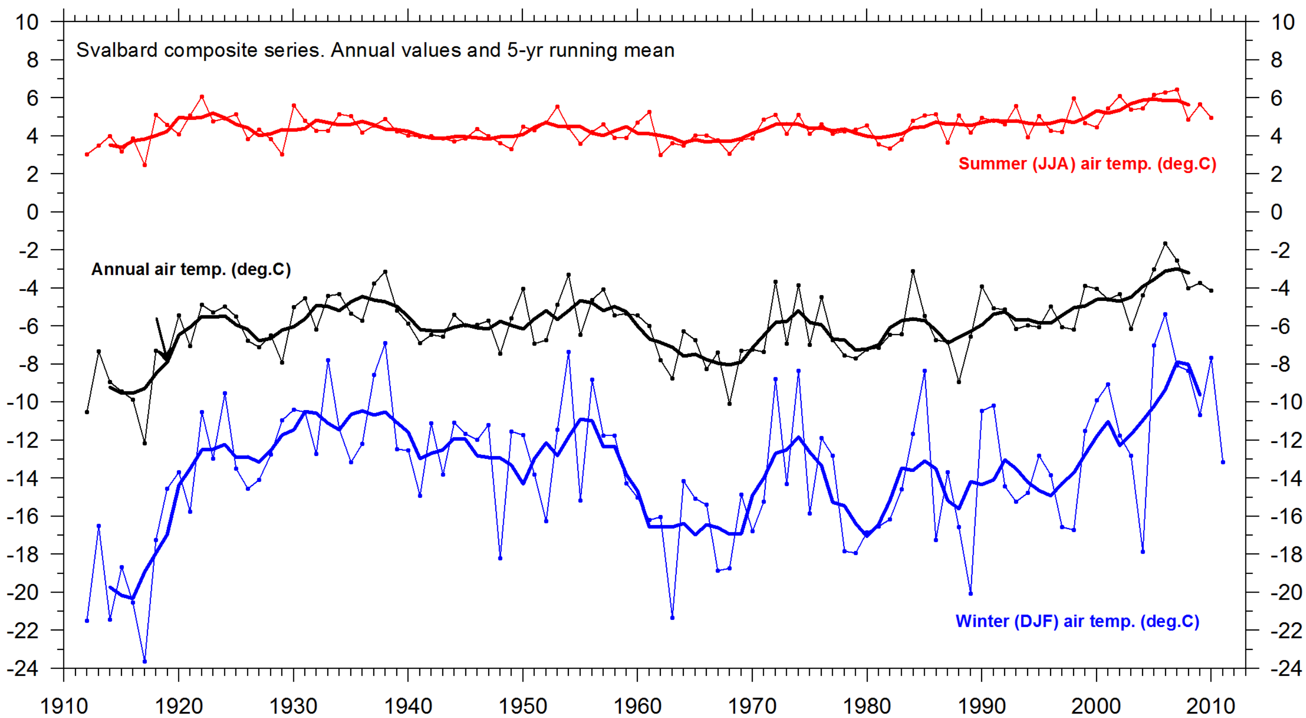


Steamship Neptun in pack ice at Spitsbergen, summer 1909. Picture source: Anders Beer Wilse, Norsk Folkemuseum.

In connection with a detailed description of the Swedish mining and exploration activities (coal) in Spitsbergen (Svalbard, 78^{o}N), Hoel (1966) provides information on summer sailing conditions in the main fjords and along the west coast of Spitsbergen:

- July 7, 1909: The Billefjord is blocked by ice. First ship makes it to Pyramiden in innermost Billefjord July 12.
- September 1910: Geological expedition lead by Ernest Mansfield (The Northern Exploration Co., Ltd., London) find Kongsfjorden blocked by ice, and instead seeks emergency harbour in Braganzavågen, Van Milenfjorden. Here sea ice makes it impossible to leave the fjord and begin the return journey before early October.
- August 11, 1912: Braganzavågen in Van Mijenfjorden is closed by ice. Also Bellsund is blocked by ice.
- July 1915: An expedition lead by Birger Johnsson finds the west coast of Spitsbergen blocked by sea ice. Westerly winds keep the ice in a state of compression. The winter sea ice in the fjords is beginning to break up, but the ice along the west coast fills the mouth of the fjords, and keeps the winter ice in place. Several vessels have to return to Tromsø in northern Norway without reaching the coast of Spitsbergen. The Birger Johnsson expedition for several weeks attempts landing on Spitsbergen, and is forced to give up on August 17.

- July-August 1917: Difficult sea ice conditions in Van Milenfjorden made it impossible for the steamship D/S Amsterdam to reach Braganzavågen, innermost Van Mijenfjord, before early August.



The Svalbard temperature record 1912-2010, showing the mean annual air temperature (MAAT), the average summer temperature (JJA), and the average winter temperature (DJF). Thin lines show annual values, and thick lines show the simple moving 5 yr average. The linear MAAT increase 1912-2010 is 0.23°C per decade.

The above descriptions refer to conditions around the time when systematically meteorological conditions were initiated in Svalbard (78°N). The Svalbard temperature record (diagram above) is characterised by a rapid post Little Ice Age warming around 1920, a warm period lasting until around 1955, a relatively cold period lasting to about 1995, and a renewed warming lasting at least until 2006. A number of shorter variations are apparently superimposed on this generalised pattern of change. The overall variations displayed by the mean annual air temperature are mainly derived from winter temperature variations, while the summer temperature only shows relatively small variations.

Before 1912 only scattered temperature records are known from Svalbard and it is entirely possible that the very cold initial period 1912-1917 represents a temperature minimum following a previous period with somewhat higher temperatures. If so, the linear trend of 0.23°C per decade calculated for the entire MAAT record 1912-2010 would indicate an unrealistic high overall temperature increase, as it begins on low and ends on a high note. See Førland et al. 1997 for further information on the Svalbard temperature record.

References:

Førland, E. J., Hanssen-Bauer, I. and Nordli, P. Ø. 1997. *Climate statistics & longterm series of temperature and precipitation at Svalbard and Jan Mayen*. Det Norske Meteorologiske Institutt, Report No. 21/97 klima.

Hoel, A. 1966. *Svalbard. Svalbards historie 1596-1965*. Sverre Kildahls Boktrykkeri, Oslo, 1024 pp.

All the above diagrams with supplementary information, including links to data sources and previous issues of this newsletter, are available on www.climate4you.com

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