Climate4you update October 2012

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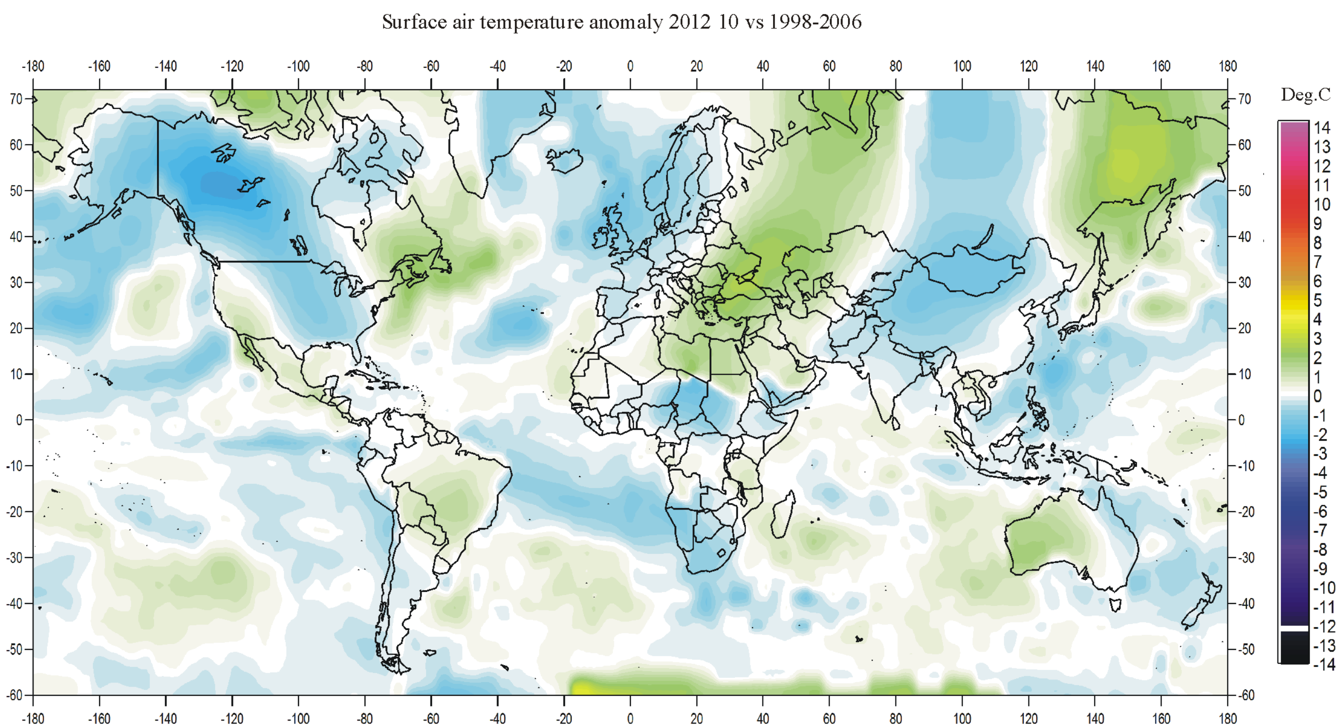
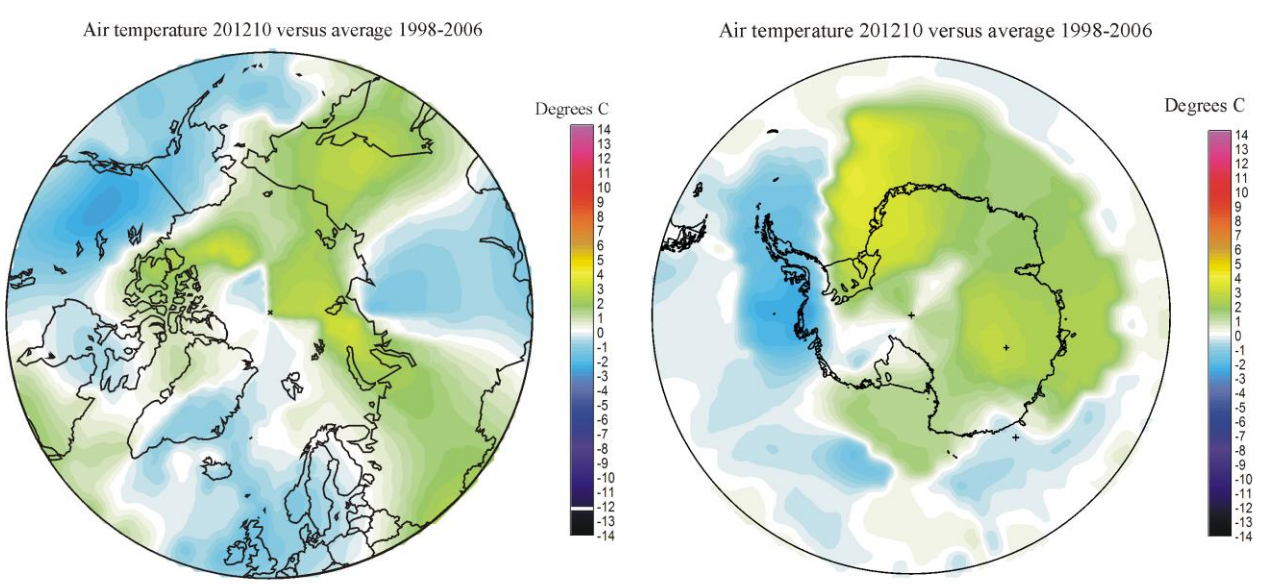
October 2012 global surface air temperature overview





October 2012 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 October 2012 global surface air temperature overview

General: This newsletter contains graphs showing a selection of key meteorological variables for the past month. *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 and where modern surface air temperatures are increasing or decreasing at the moment. 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, nearly corresponding to a three year average. 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 many diagrams, as this roughly corresponds to both the beginning of satellite observations and the onset of the late 20th century warming period. However, several of the records have a much longer record length, which may be inspected in grater detail on www.Climate4you.com.

October 2012 global surface air temperatures

General: Global air temperatures again were close to average for the period 1998-2006.

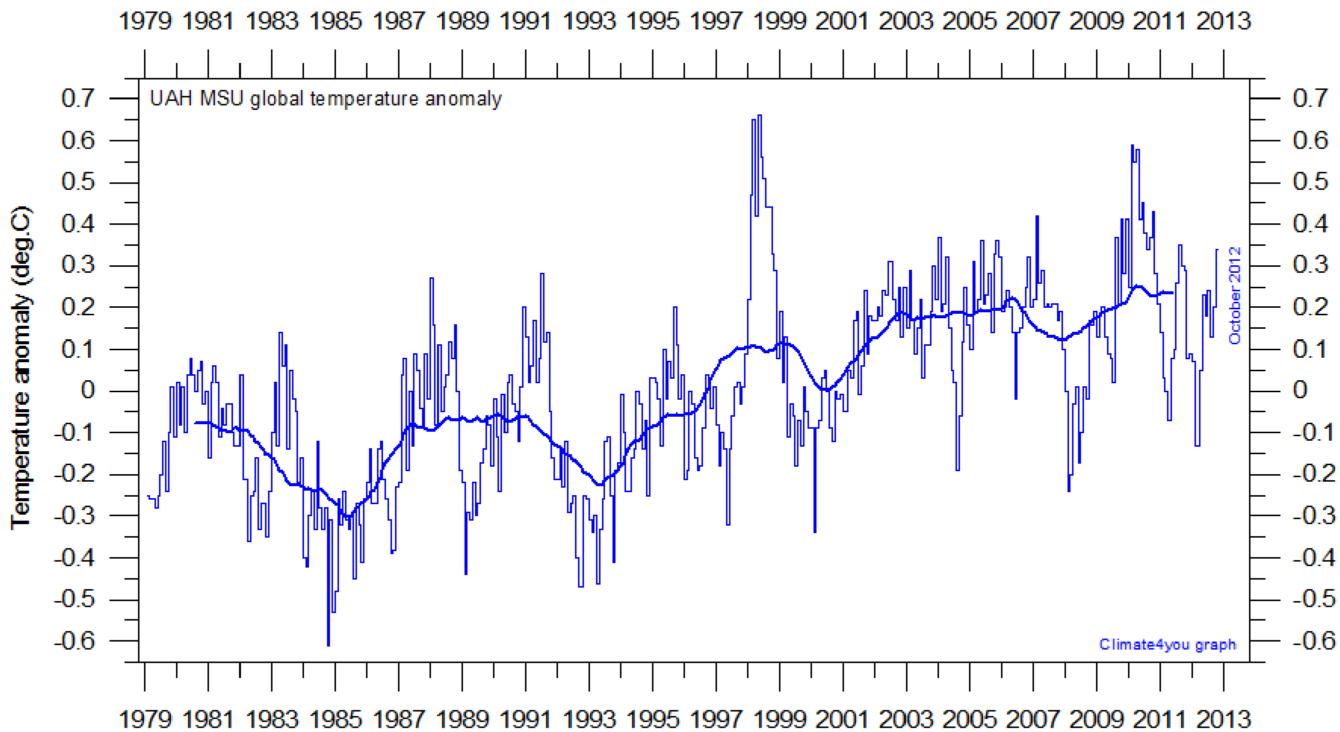
The Northern Hemisphere was characterised by regional variability. Most of North America, NW Europe, eastern Siberia and China were relatively cold, more or less like in September 2012. Russia and eastern Siberia were relative warm. The marked limits between warm and cold areas over the Arctic Ocean are an artefact derived from the GISS interpolation technique and should be ignored.

Near Equator temperatures conditions were near average, but with the region from India to Indonesia being relatively cold. Relatively cold areas also extended across northern central Africa, while Brazil was relatively warm.

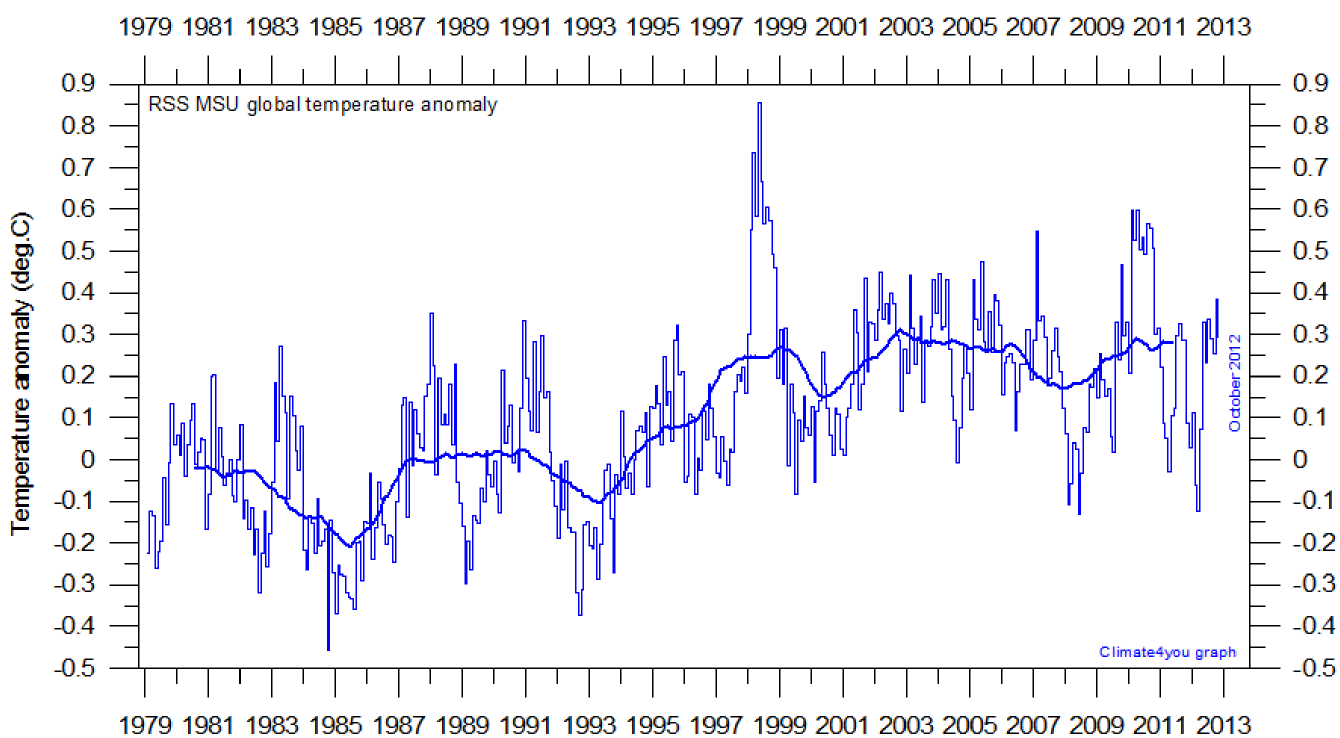
The Southern Hemisphere was at or below average 1998-2006 conditions. Much of the South Atlabtic and South Africa was cold. Western Australia was relatively warm. New Zealand was below below average 1998-2006 conditions. The Antarctic continent again this month experienced large contrasts. Most of the continent was relatively warm, while the Peninsula and parts of West Antarctica were relatively ciold.

The global oceanic heat content has been rather stable since 2003/2004 (page 11).

Lower troposphere temperature from satellites, updated to Ocyober 2012

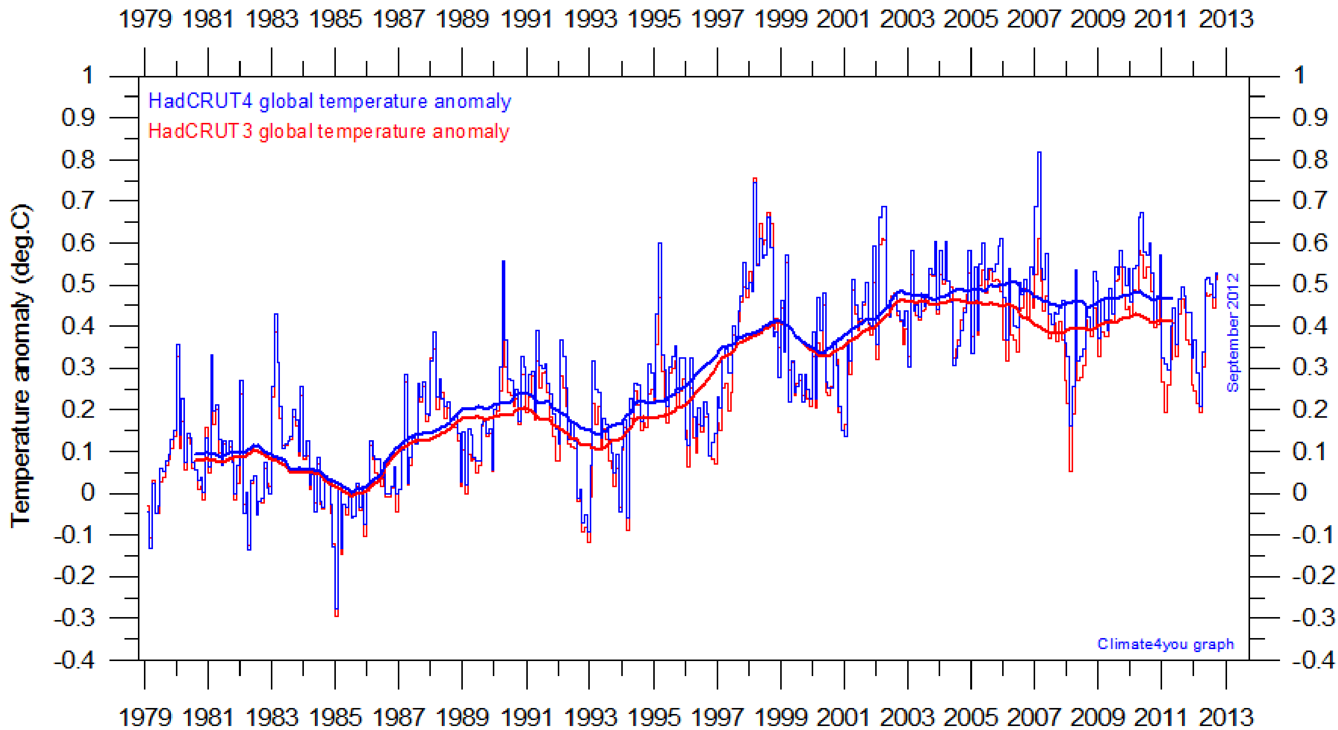


Global monthly average lower troposphere temperature (thin line) since 1979 according to University of Alabama at Huntsville, USA. The thick line is the simple running 37 month average.

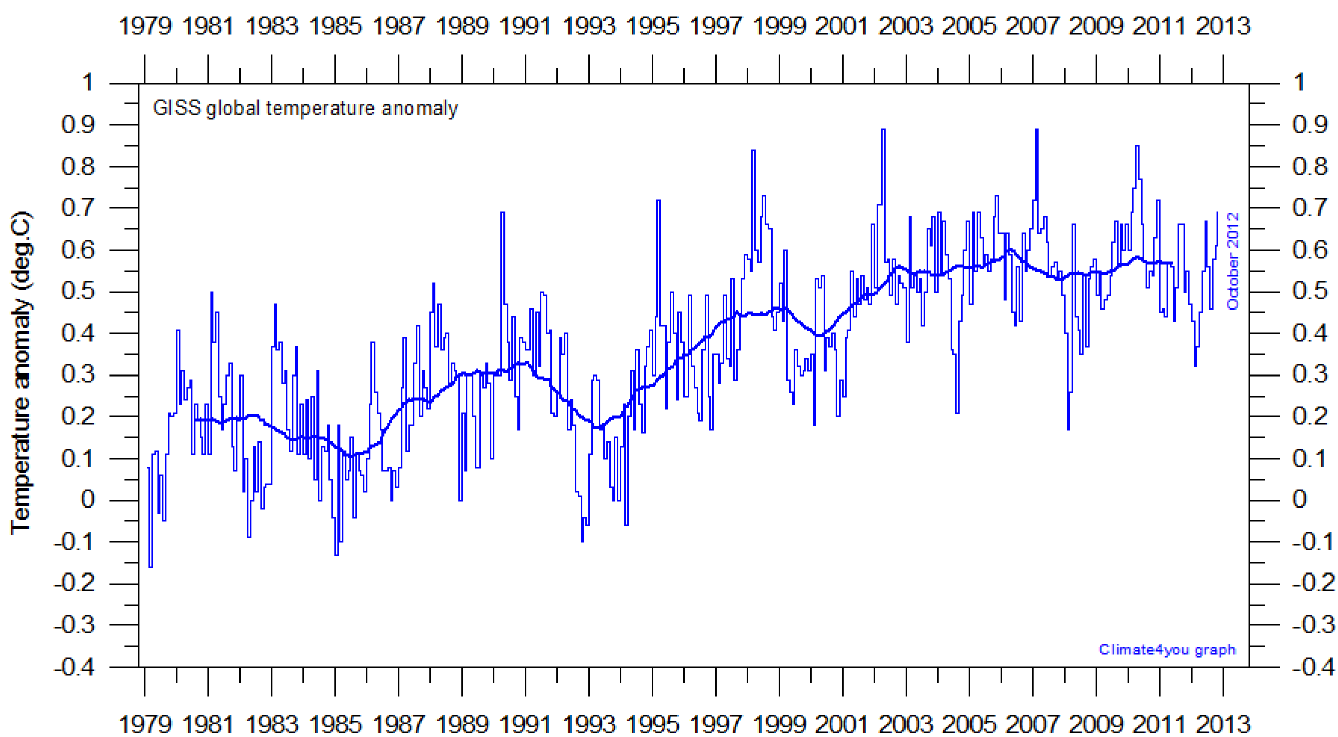


Global monthly average lower troposphere temperature (thin line) since 1979 according to according to Remote Sensing Systems (RSS), USA. The thick line is the simple running 37 month average.

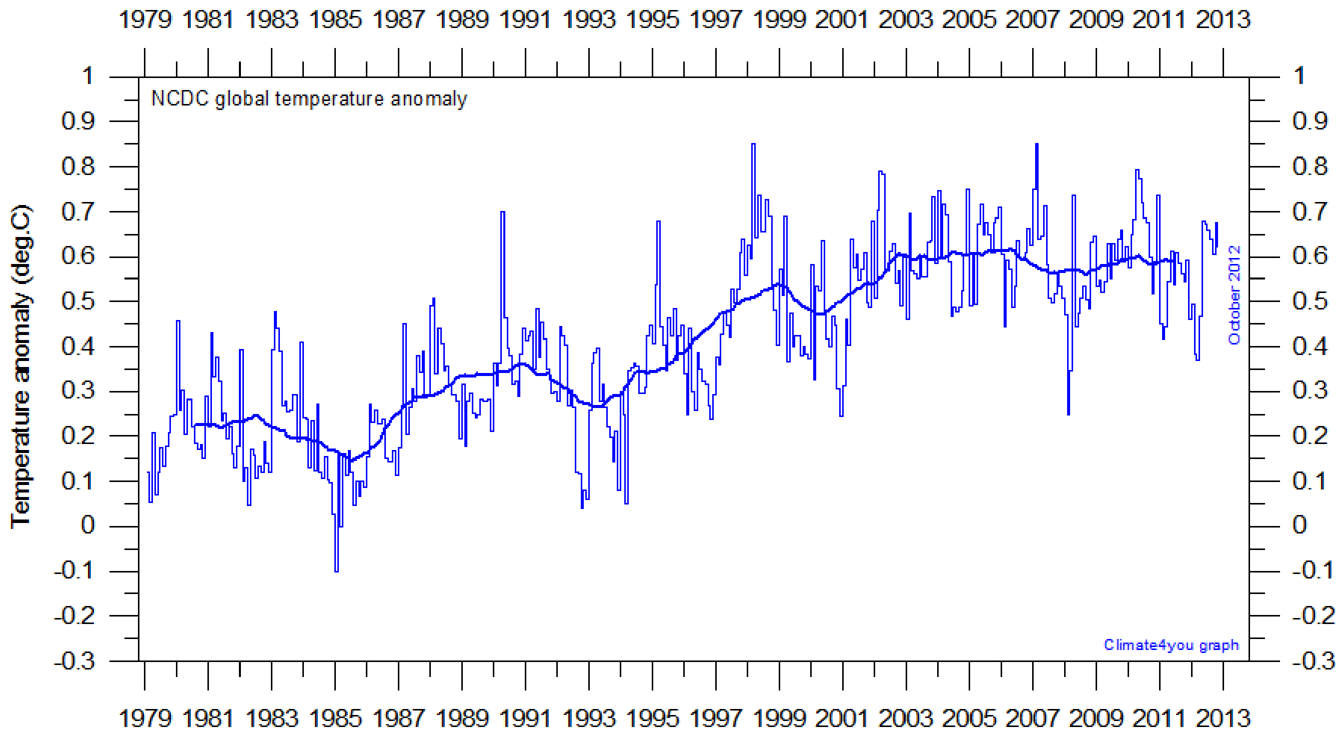
Global surface air temperature, updated to October 2012



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. Please note that this diagram has not been updated beyond September 2012. Version HadCRUT4 (blue) is now replacing HadCRUT3 (red).



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.

A note on data record stability:

All the above temperature estimates display changes when one compare with previous monthly data sets, not only for the most recent months as a result of supplementary data being added, but actually for all months back to the very beginning of the records. Presumably this reflects recognition of errors, changes in the averaging procedure, and the influence of other phenomena.

None of the temperature records are stable over time (since 2008). The two surface air temperature records, NCDC and GISS, show apparent systematic changes over time. This is exemplified the diagram on the following page showing the changes since May 2008 in the GISS global surface temperature record for August 1935 and August 2006.

You can find more on the issue of temporal stability (or lack of this) on [www.climate4you](#) (go to: *Global Temperature*, followed by *Temporal Stability*).

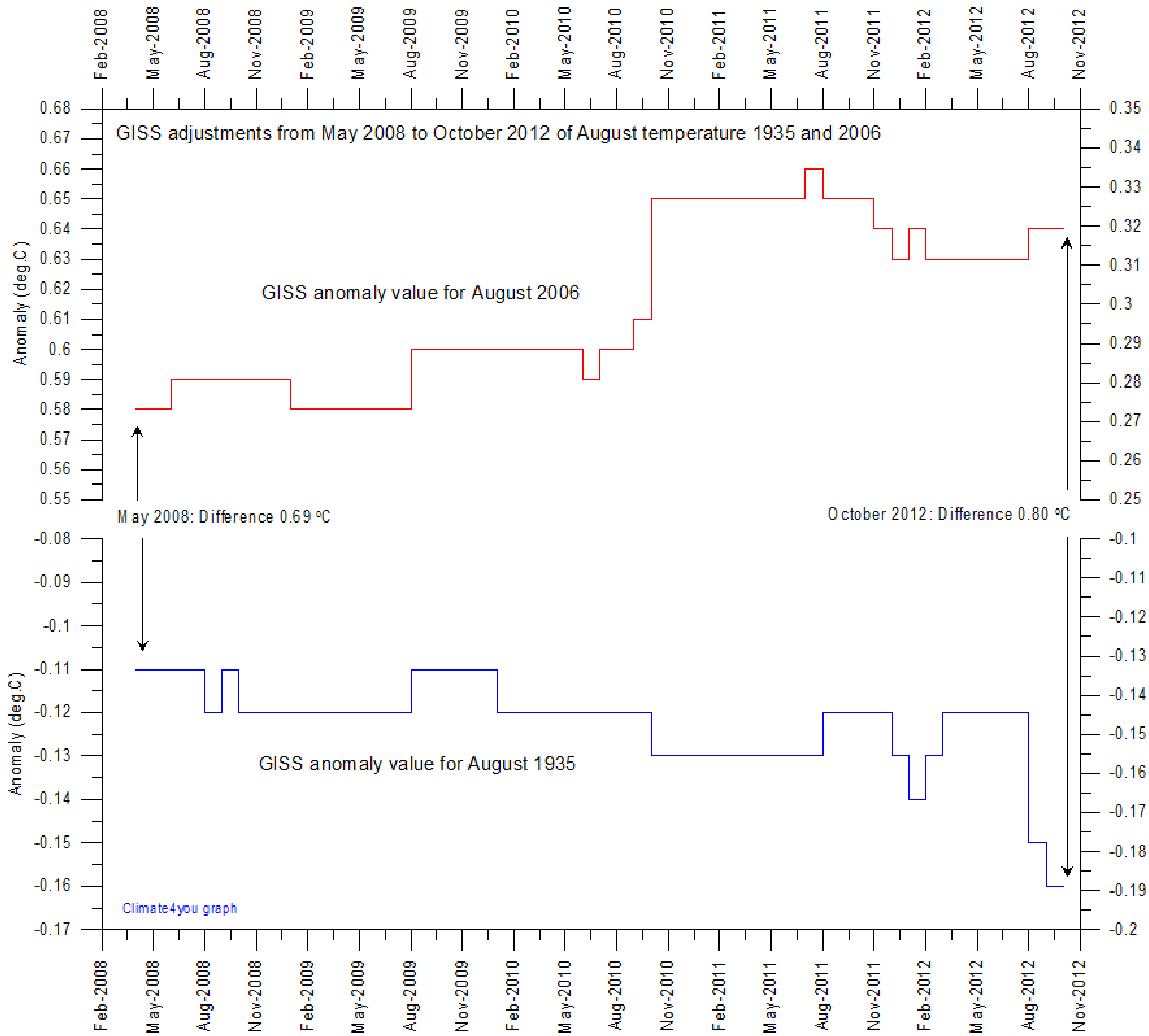
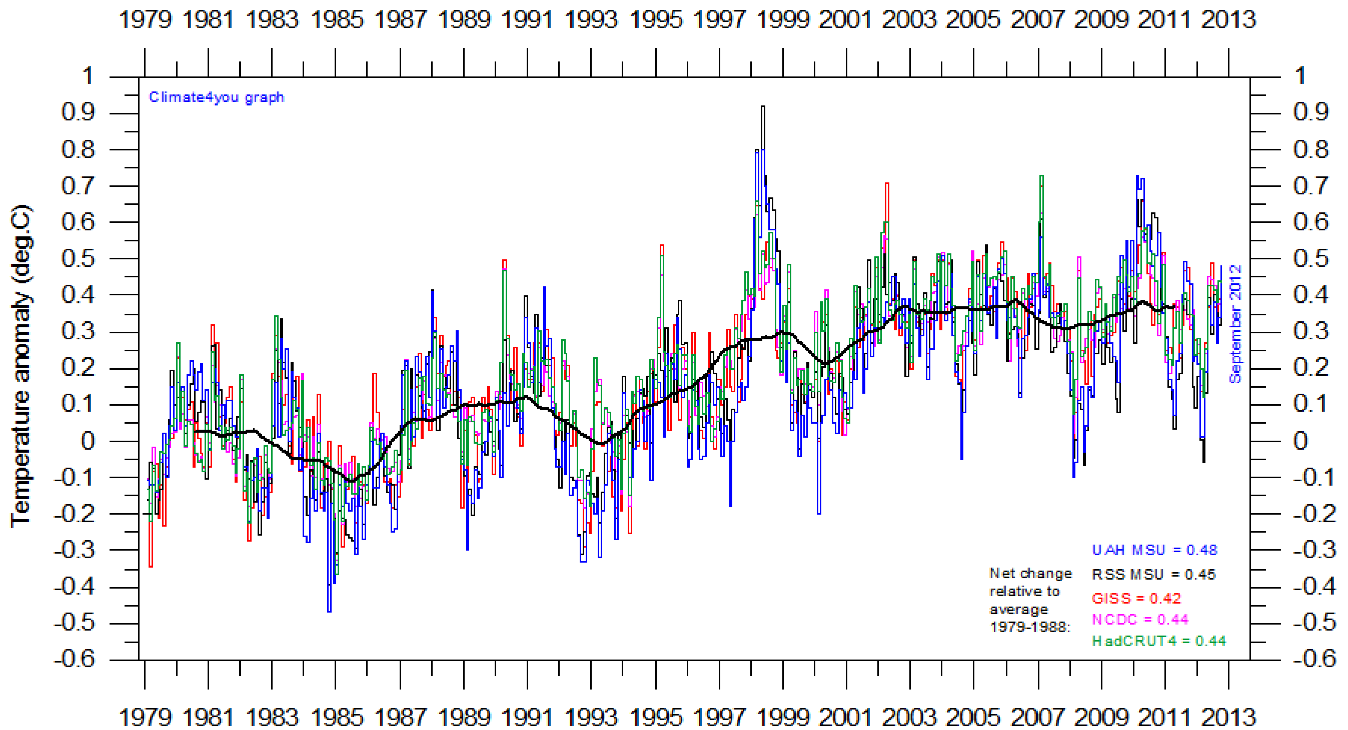


Diagram showing the adjustment made since May 2008 by the [Goddard Institute for Space Studies](#) (GISS) in anomaly values for the months August 1935 and August 2006.

All in one, updated to September 2012

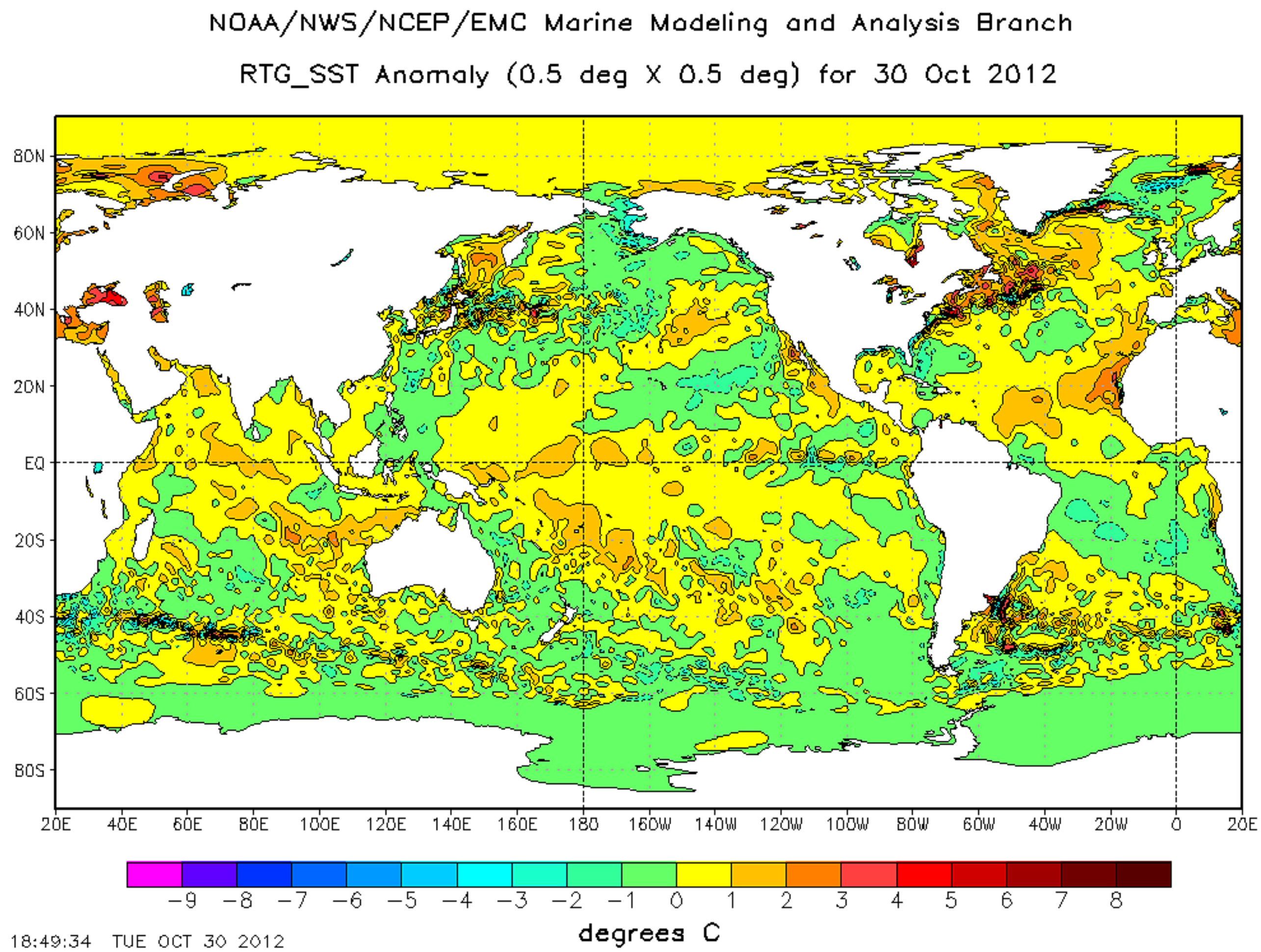


Superimposed plot of all five global monthly temperature estimates. As the base period differs for the individual temperature estimates, they have all been normalised by comparing with the average value of the initial 120 months (10 years) from January 1979 to December 1988. The heavy black line represents 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 individual 1979-1988 averages.

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 may be 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 shorter time scale there are often considerable differences between the individual records.

All five global temperature estimates presently show an overall stagnation, at least since 2002. There has been no increase in global air temperature since 1998, which however was affected by the oceanographic El Niño event. This stagnation 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 two possibilities is correct.

[Global sea surface temperature, updated to October 2012]



Sea surface temperature anomaly at 30 October 2012. Map source: National Centers for Environmental Prediction (NOAA).

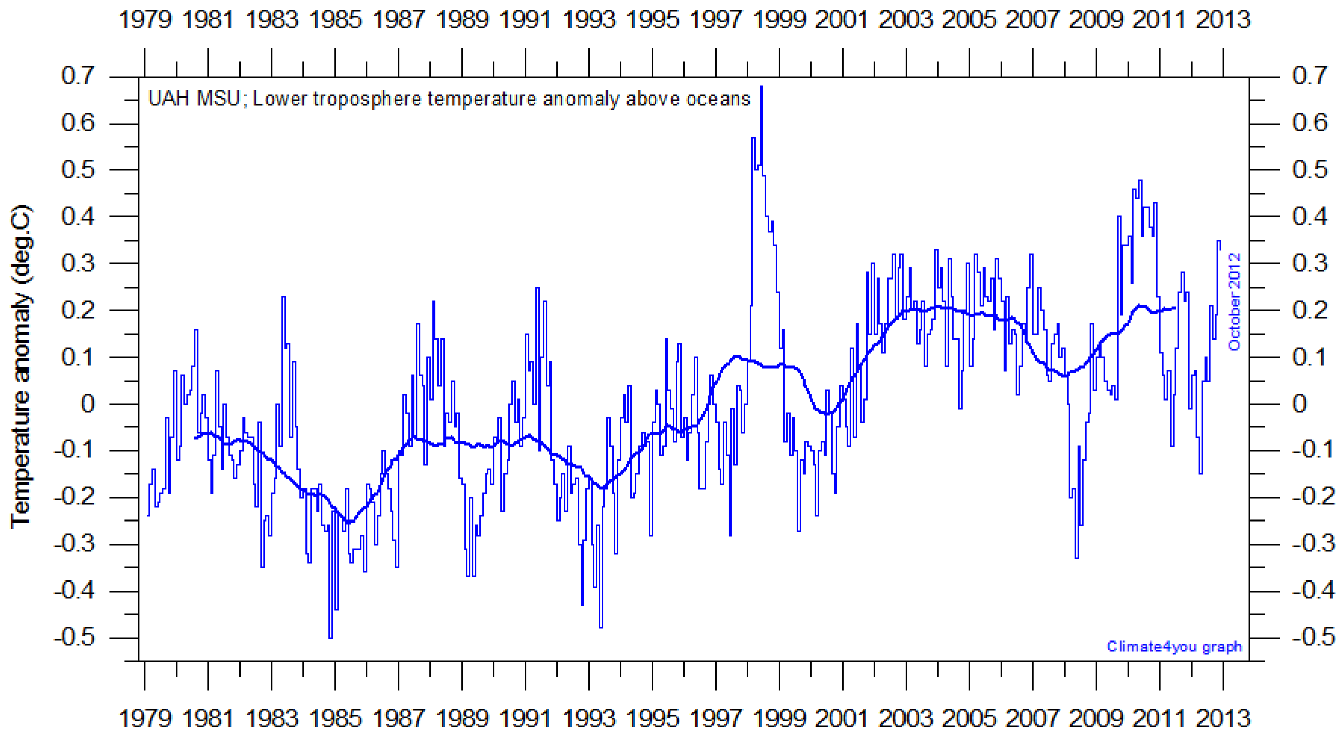
A clear ocean surface temperature asymmetry is apparent between the two hemispheres, with relatively warm conditions in the northern hemisphere, and relatively cold conditions in the southern hemisphere.

The ocean regions near the Equator are dominated by relative warm sea surface water, and the ongoing El Niño episode in the Pacific is still developing.

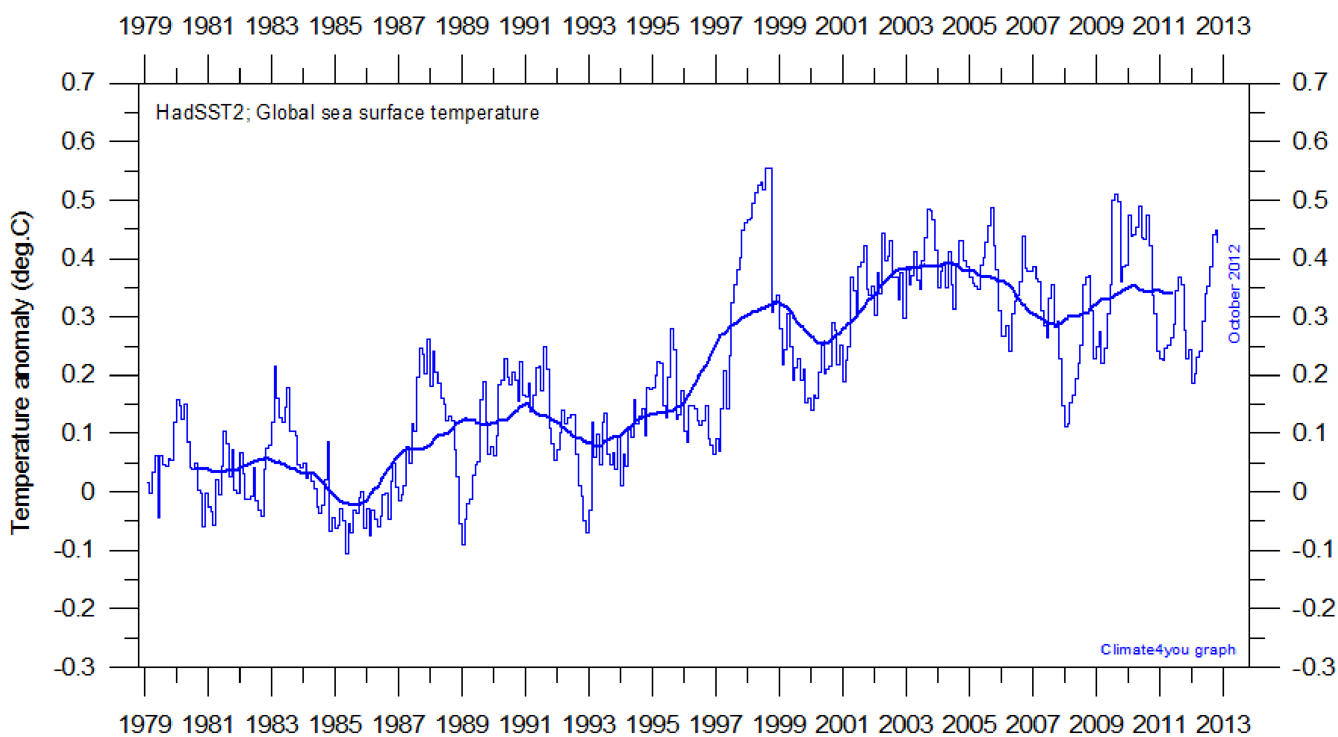
Because of the large surface areas involved especially near Equator, the temperature of the surface water in these regions clearly affects the global atmospheric temperature (p.3-5).

The significance of any such short-term warming or cooling seen in air temperatures should not be over stated. Whenever Earth experiences cold La Niña or warm El Niño episodes (Pacific Ocean) major heat exchanges takes place between the Pacific Ocean and the atmosphere above, eventually showing up in estimates of the global air temperature.

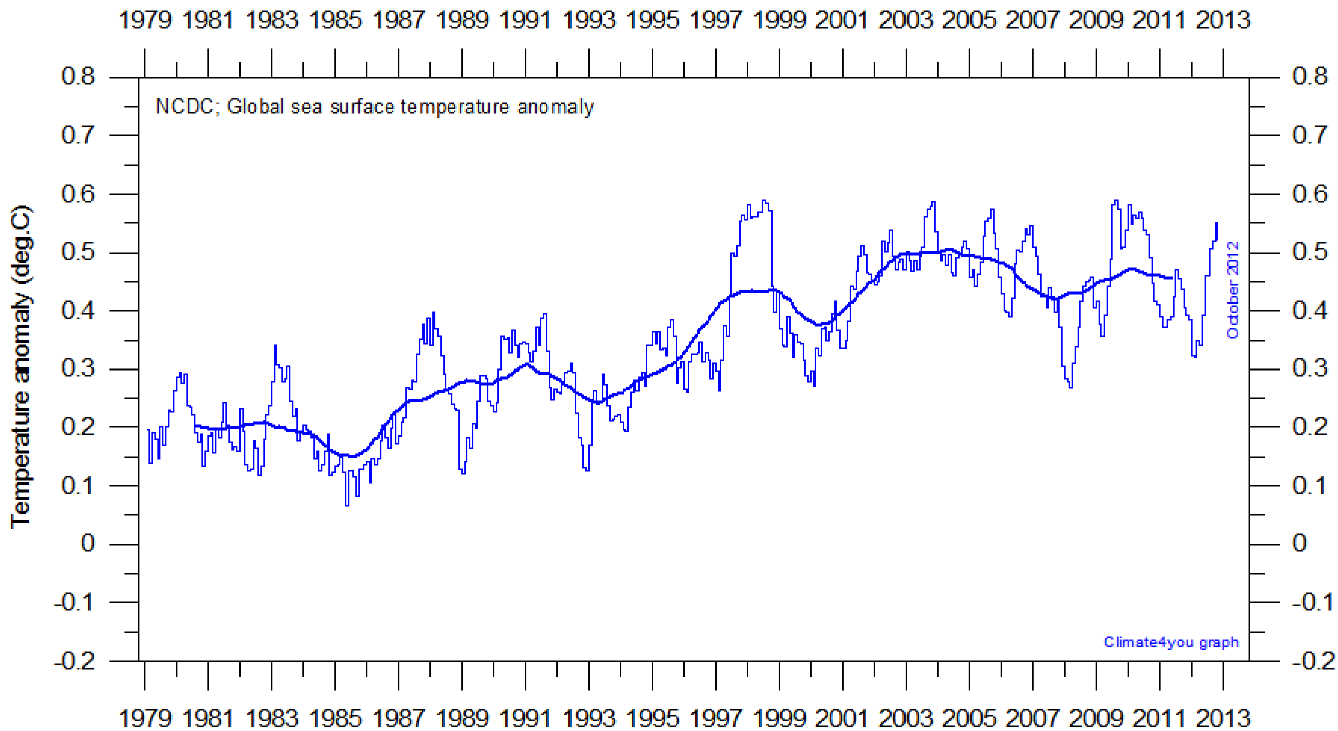
However, this does not reflect similar changes in the total heat content of the atmosphere-ocean system. In fact, net changes may be small, as heat exchanges as the above mainly reflect redistribution of energy between ocean and atmosphere. What matters is the overall temperature development when seen over a number of 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.

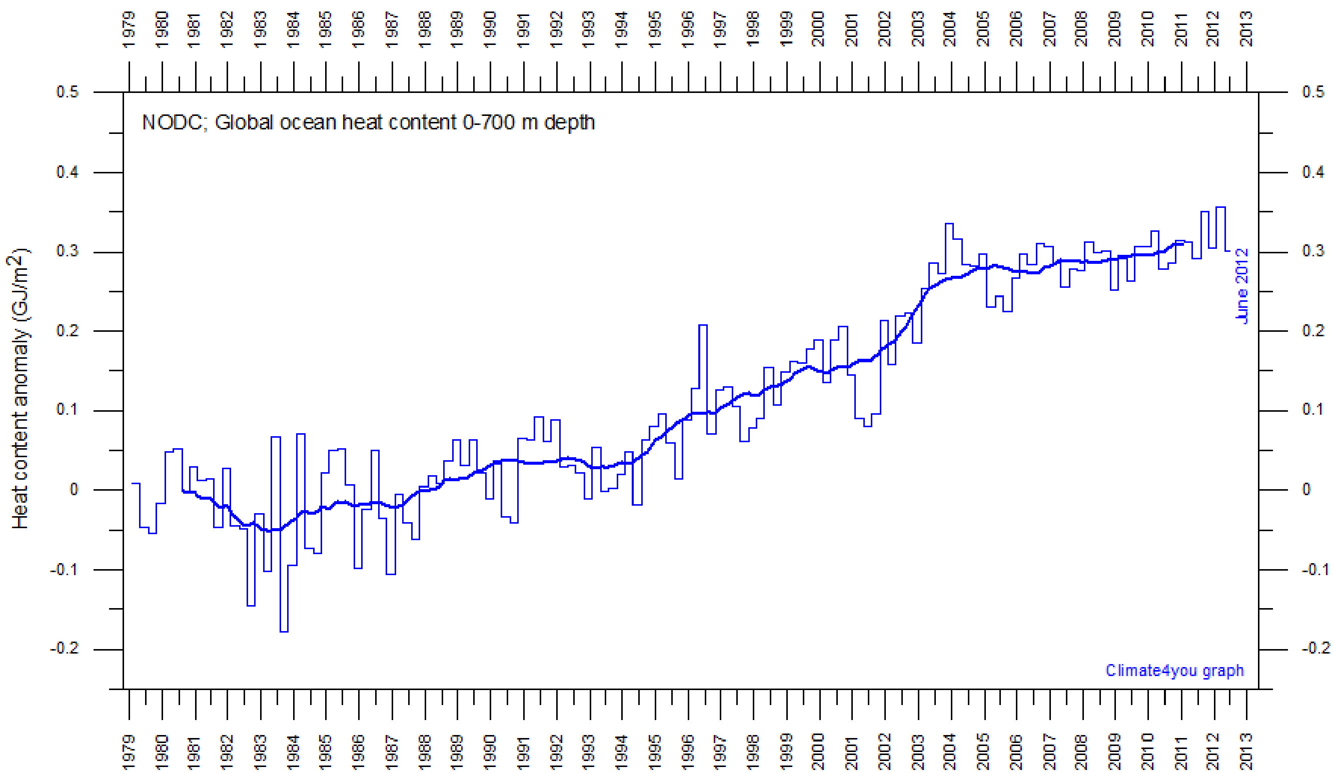


Global monthly average sea surface temperature since 1979 according to University of East Anglia's [Climatic Research Unit]() ([CRU]()), UK. Base period: 1961-1990. The thick line is the simple running 37 month average.

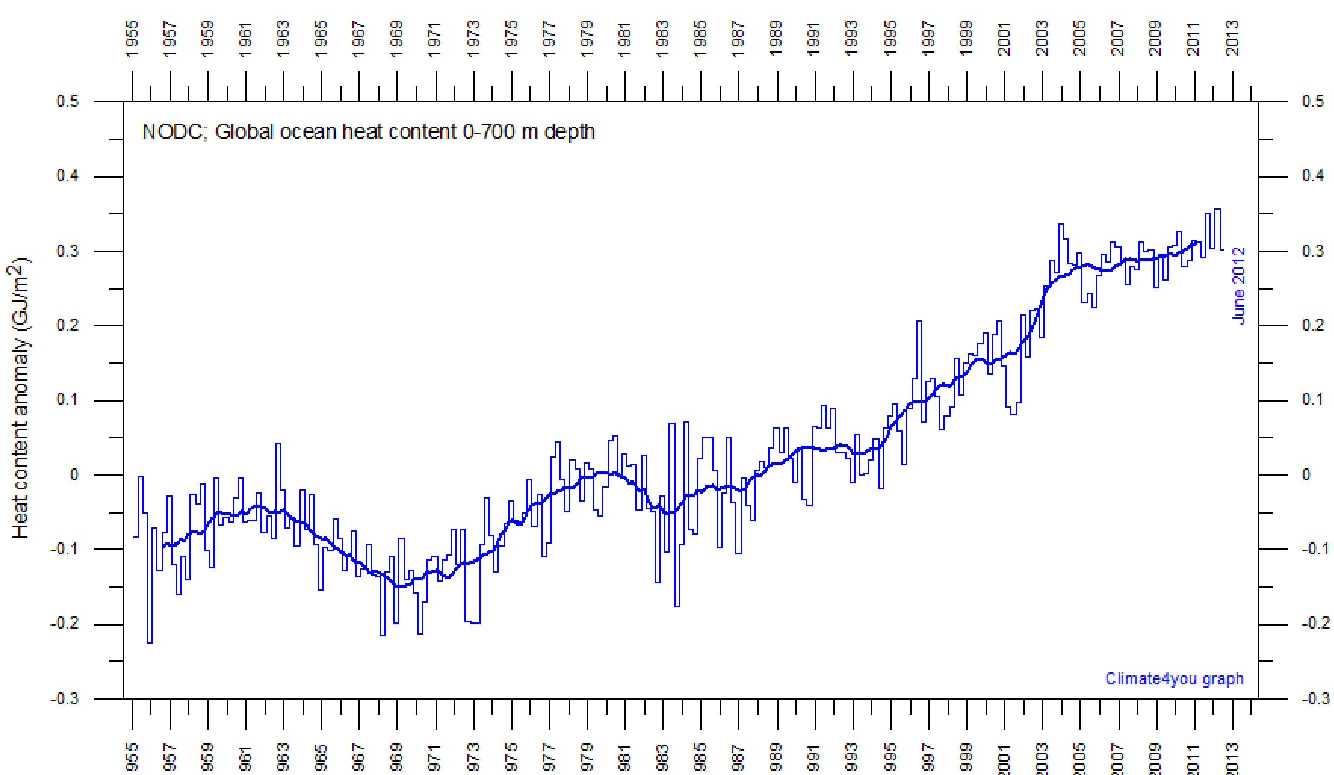


Global monthly average sea surface temperature since 1979 according to the [National Climatic Data Center](#) (NCDC), USA. Base period: 1901-2000. The thick line is the simple running 37 month average.

Global ocean heat content, updated to June 2012

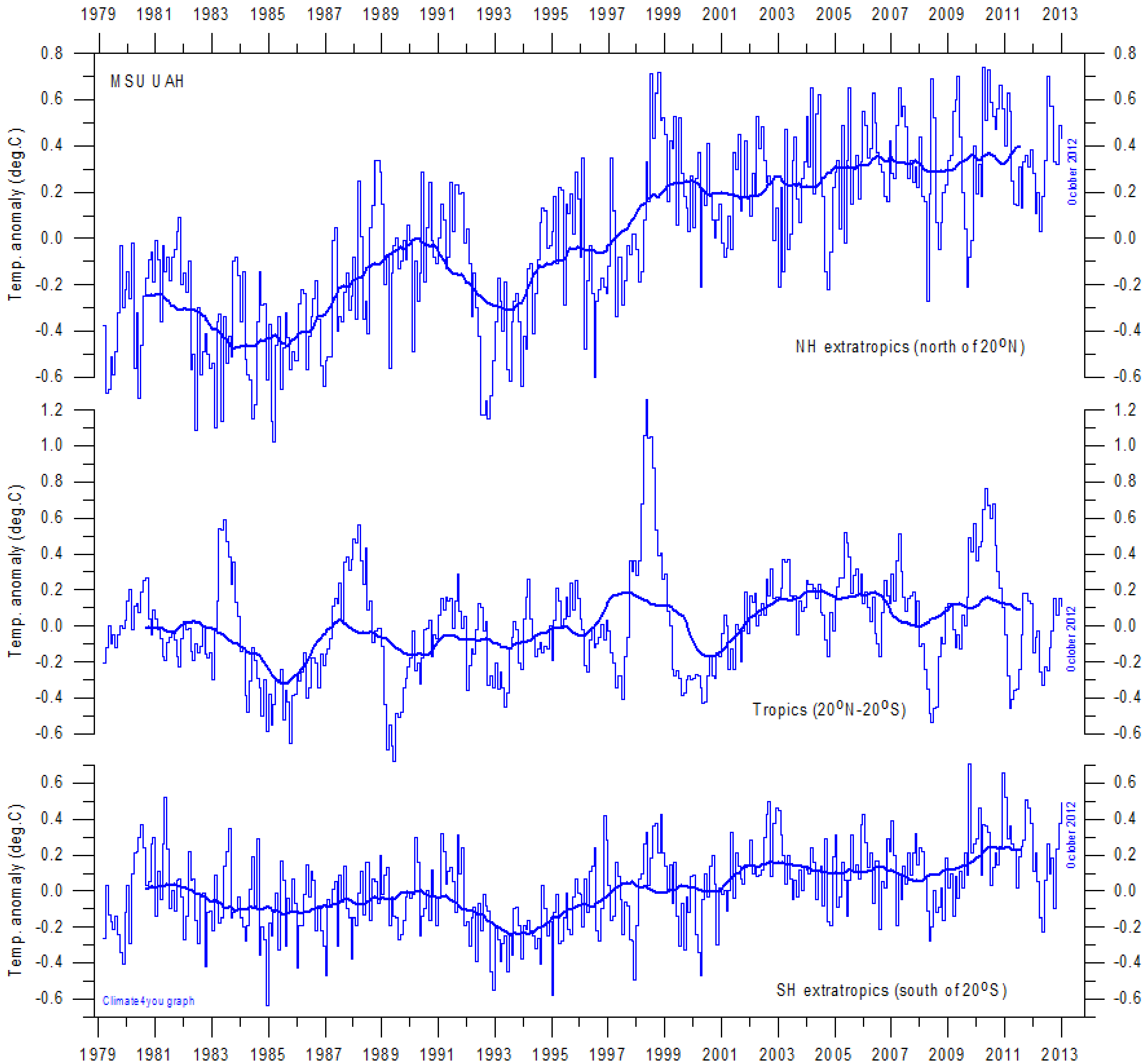


Global monthly heat content anomaly (GJ/m2) in the uppermost 700 m of the oceans since January 1979. Data source: National Oceanographic Data Center(NODC).



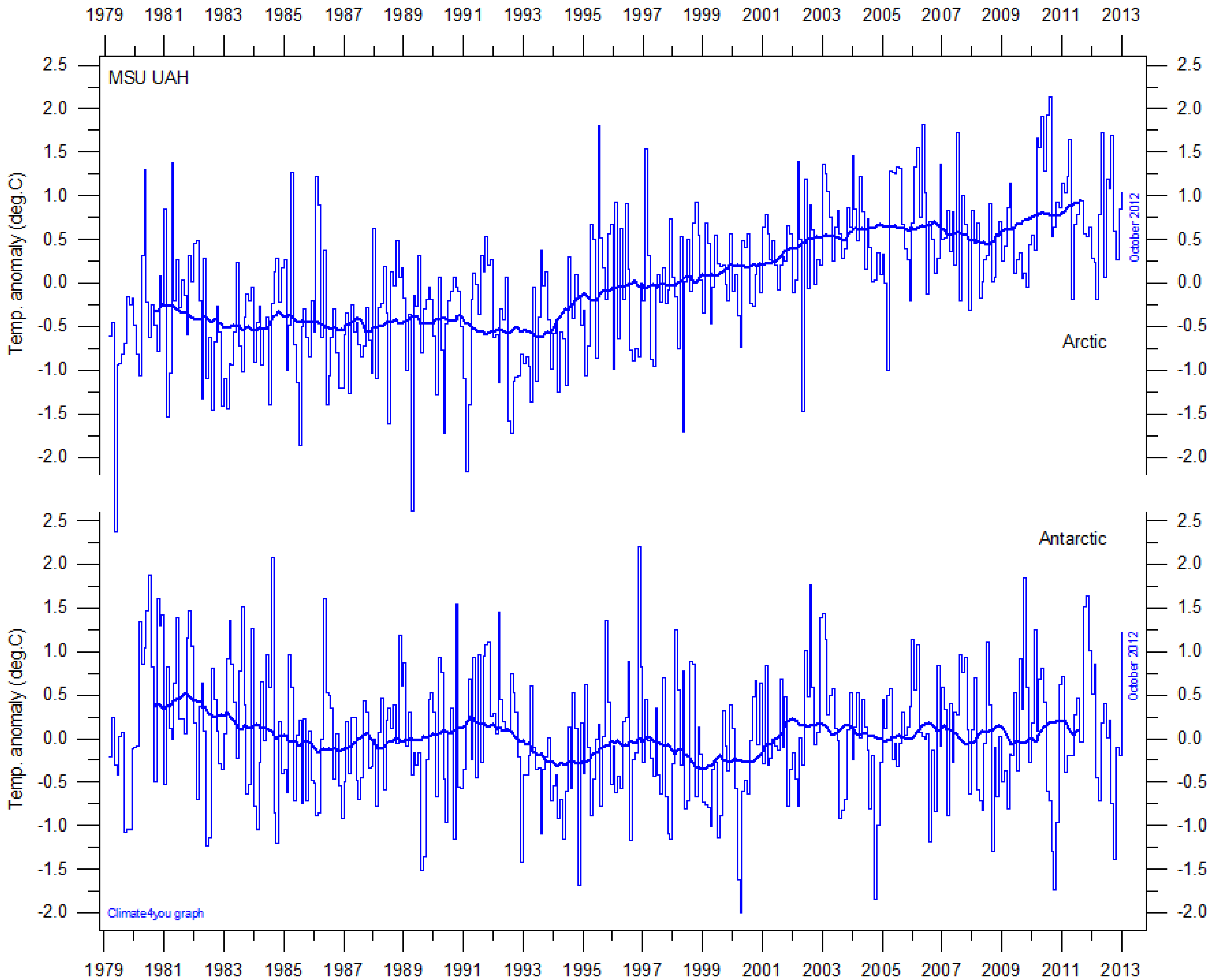
Global monthly heat content anomaly (GJ/m2) in the uppermost 700 m of the oceans since January 1955. Data source: National Oceanographic Data Center(NODC).

Zonal air temperatures, updated to October 2012



Global monthly average lower troposphere temperature since 1979 for the tropics and the northern and southern extratropics, according to [University of Alabama](#) at Huntsville, USA. Thin lines show the monthly temperature. Thick lines represent the simple running 37 month average, nearly corresponding to a running 3 yr average. Reference period 1981-2010.

Arctic and Antarctic lower troposphere temperature, updated to October 2012



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). Thin lines show the monthly temperature. 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 September 2012

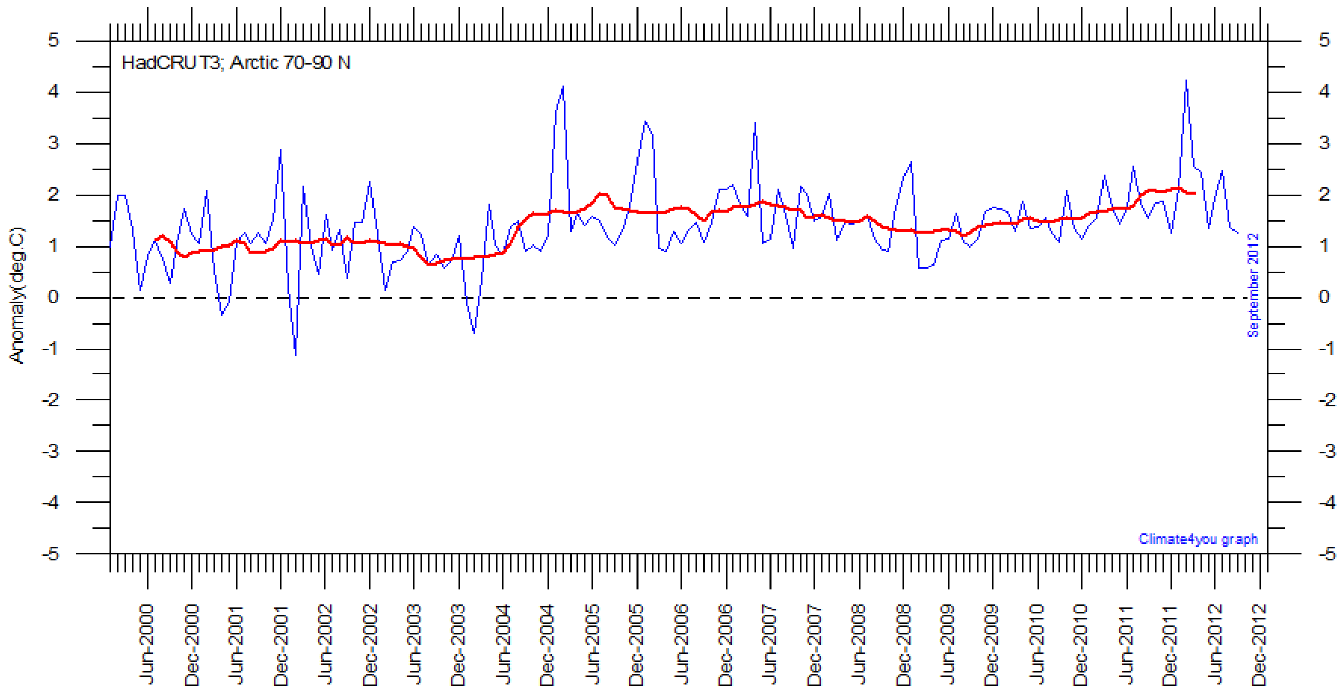


Diagram showing Arctic monthly surface air temperature anomaly 70-90°N since January 2000, in relation to the WMO reference "normal" period 1961-1990. The thin blue line shows the monthly temperature anomaly, while the thicker red line shows the running 13 month average. Data provided by the Hadley Centre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

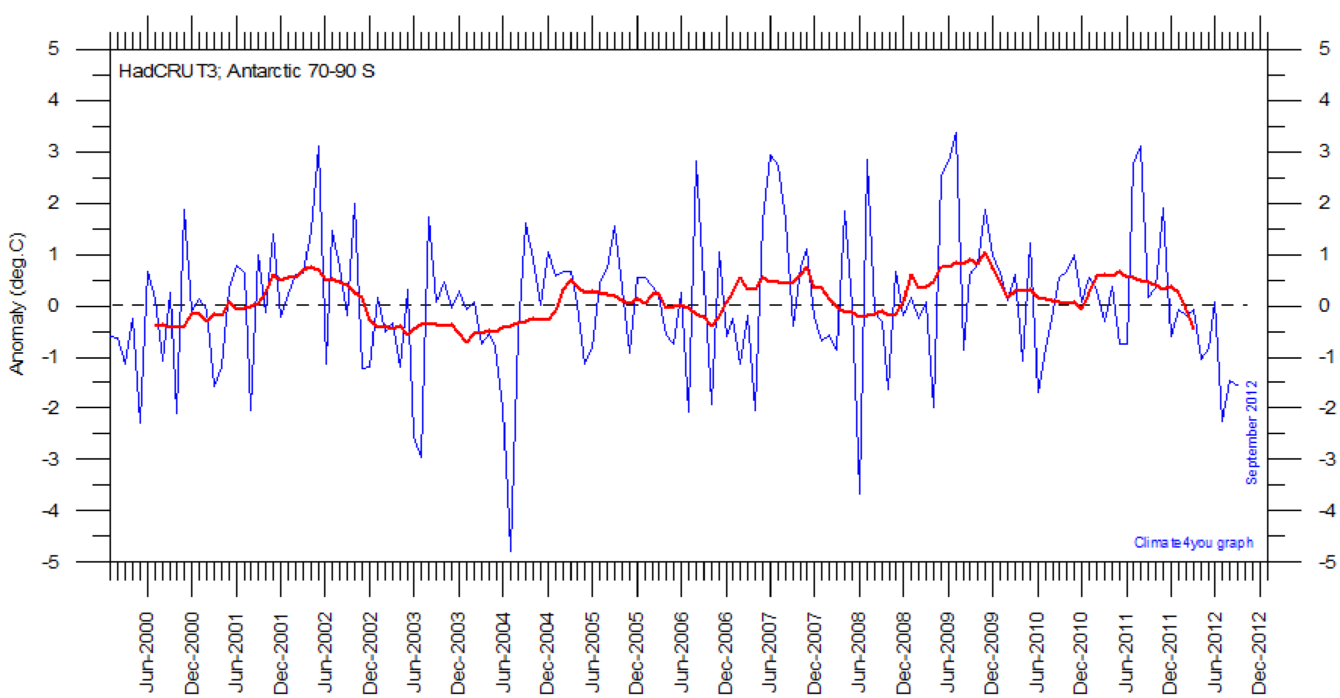


Diagram showing Antarctic monthly surface air temperature anomaly 70-90°S since January 2000, in relation to the WMO reference "normal" period 1961-1990. The thin blue line shows the monthly temperature anomaly, while the thicker red line shows the running 13 month average. Data provided by the Hadley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

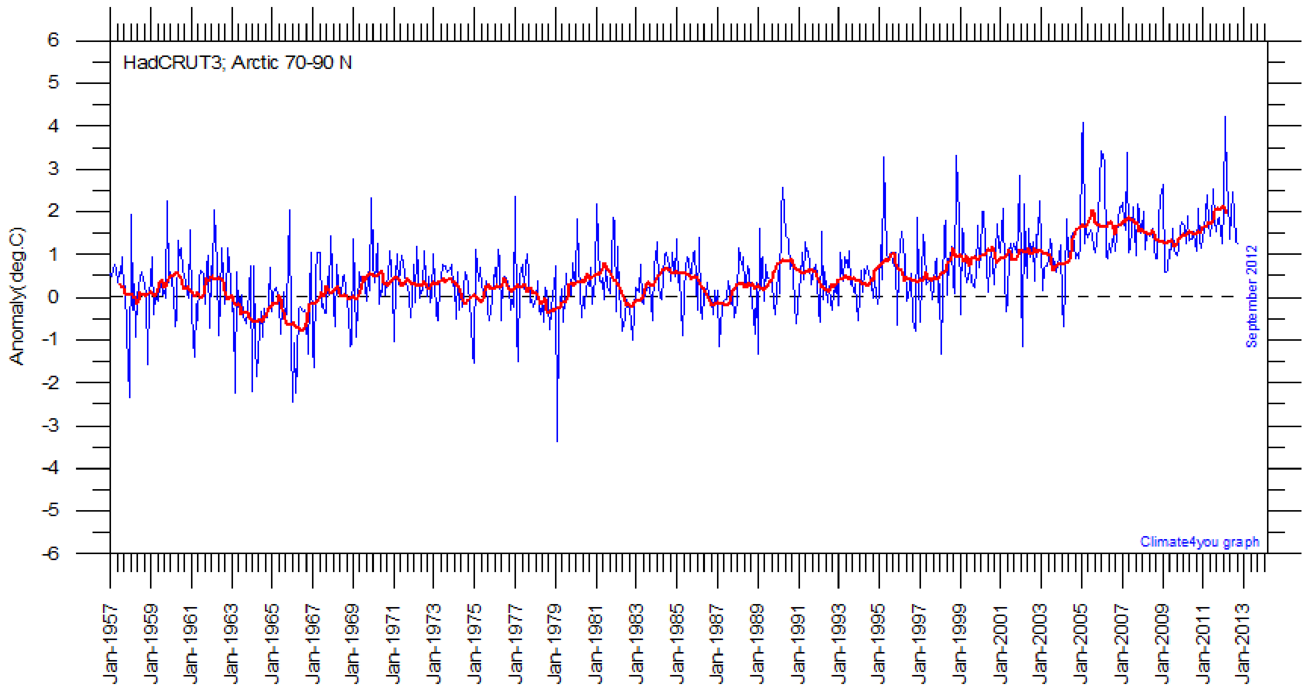


Diagram showing Arctic monthly surface air temperature anomaly 70-90°N since January 1957, in relation to the WMO reference "normal" period 1961-1990. The year 1957 has been chosen as starting year, to ensure easy comparison with the maximum length of the realistic Antarctic temperature record shown 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) ([CRU]), UK.

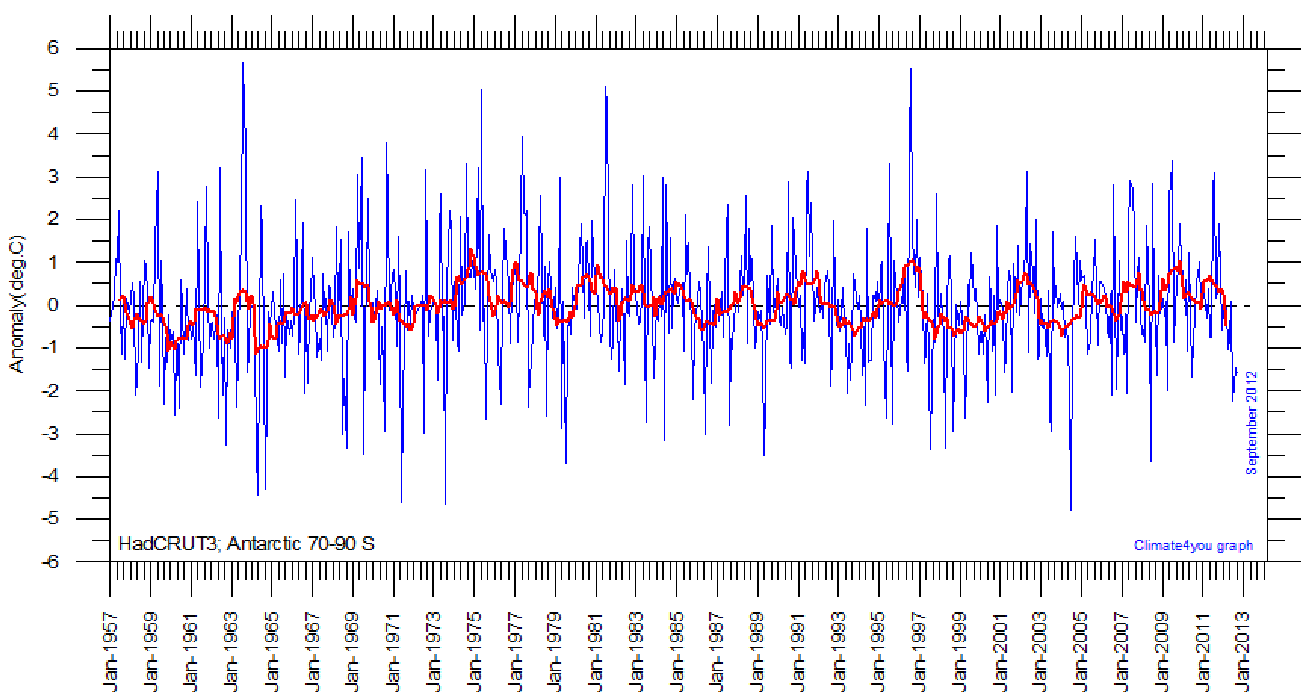


Diagram showing Antarctic monthly surface air temperature anomaly 70-90°S since January 1957, in relation to the WMO reference "normal" period 1961-1990. The year 1957 was an international geophysical year, and several meteorological stations were established in the Antarctic because of this. Before 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.

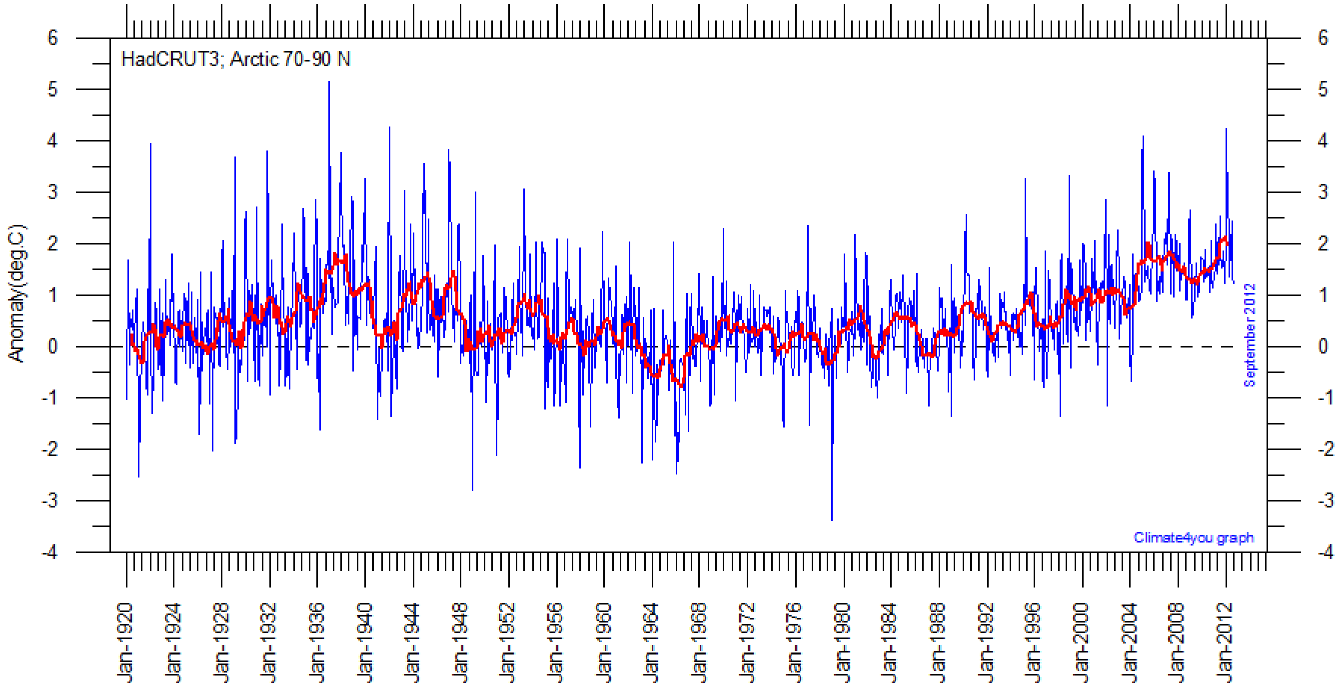


Diagram showing Arctic monthly surface air temperature anomaly 70-90°N since January 1920, in relation to the WMO reference "normal" period 1961-1990. The thin blue line shows the monthly temperature anomaly, while the thicker red line shows the running 13 month average. In general, the range of monthly 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, month-to-month variations in the early part of the Arctic temperature record are larger than later. 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

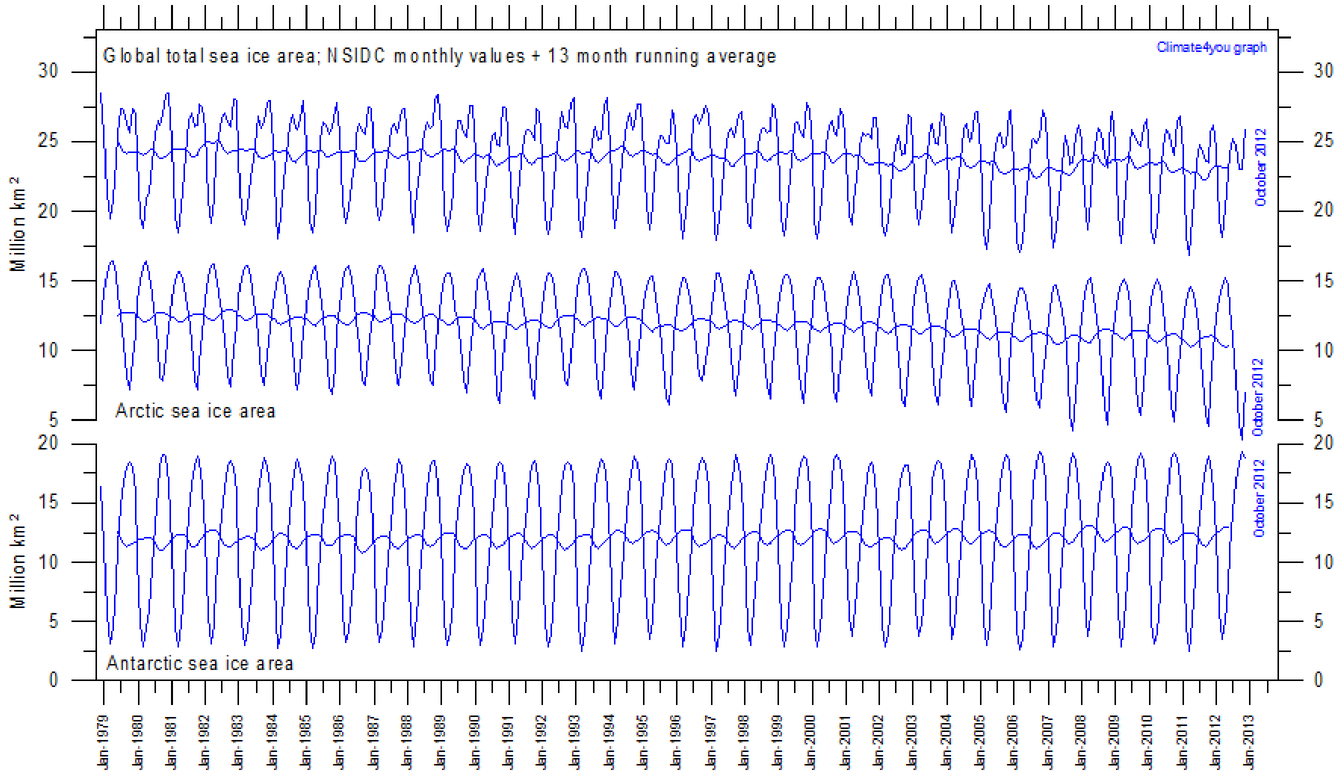
In general, the Arctic temperature record appears to be less variable than the Antarctic record, presumably at least partly due to the higher number of meteorological stations north of 70°N, compared to the number of stations south of 70°S.

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 surface areas of the individual grid dells.

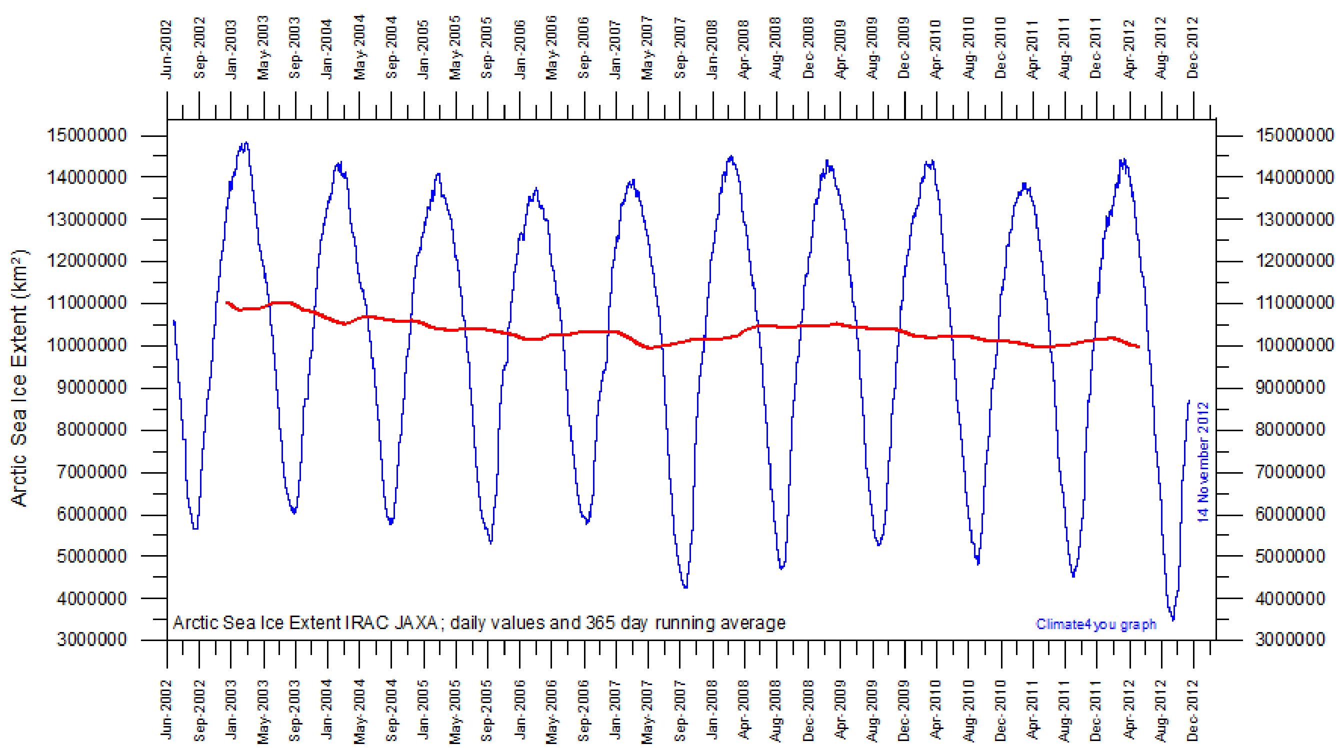
Literature:

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.

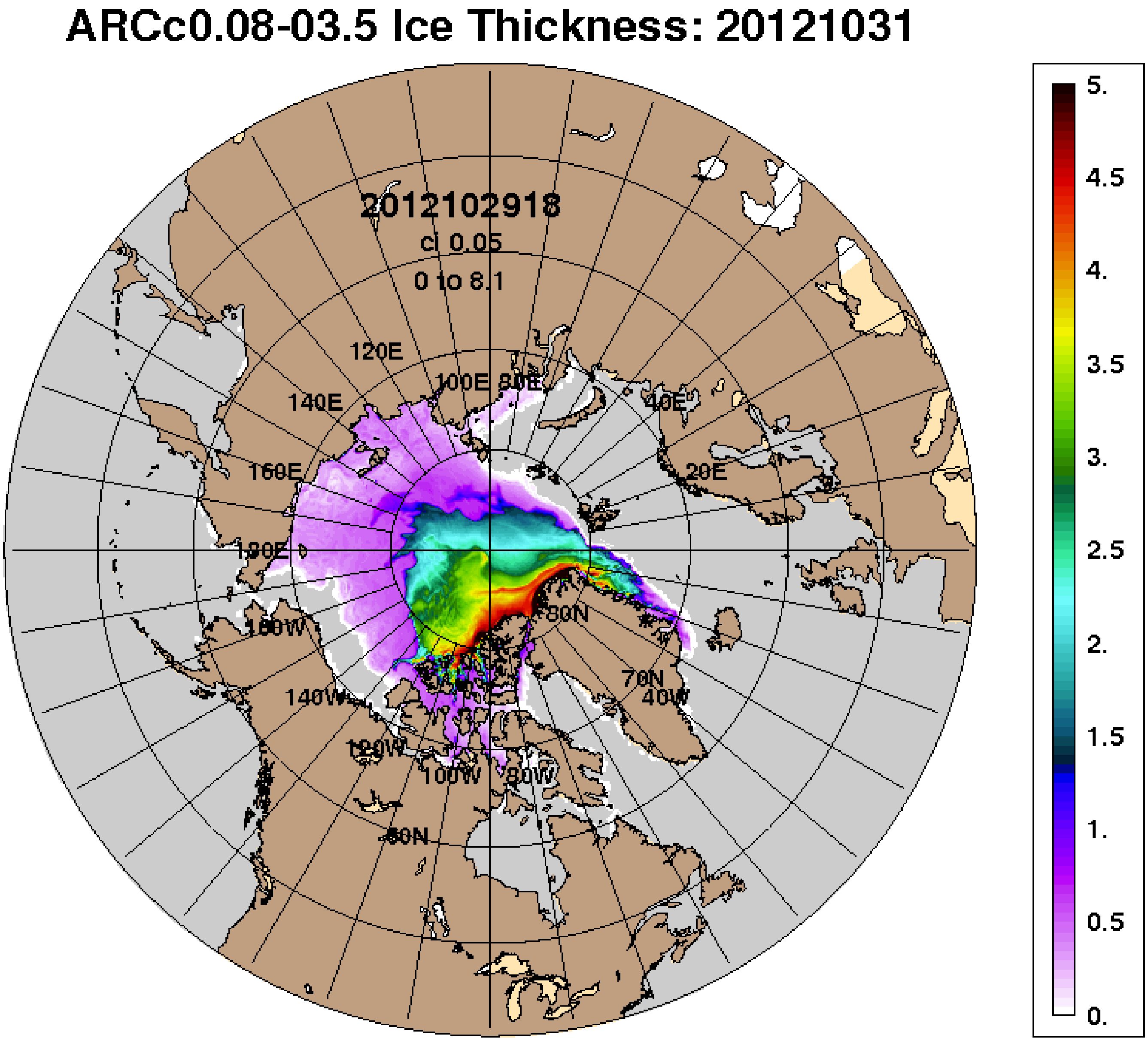
Arctic and Antarctic sea ice, updated to October 2012



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

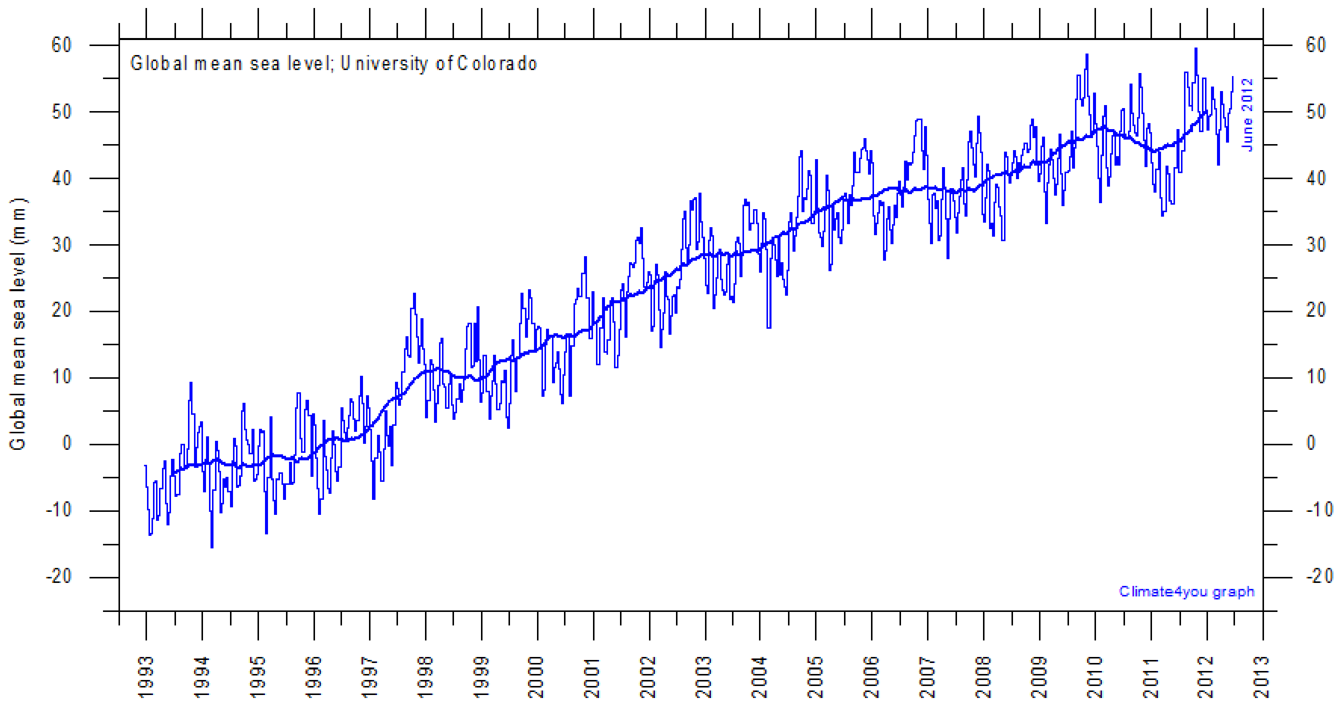


Graph showing daily Arctic sea ice extent since June 2002, to November 14, 2012, by courtesy of Japan Aerospace Exploration Agency (JAXA).

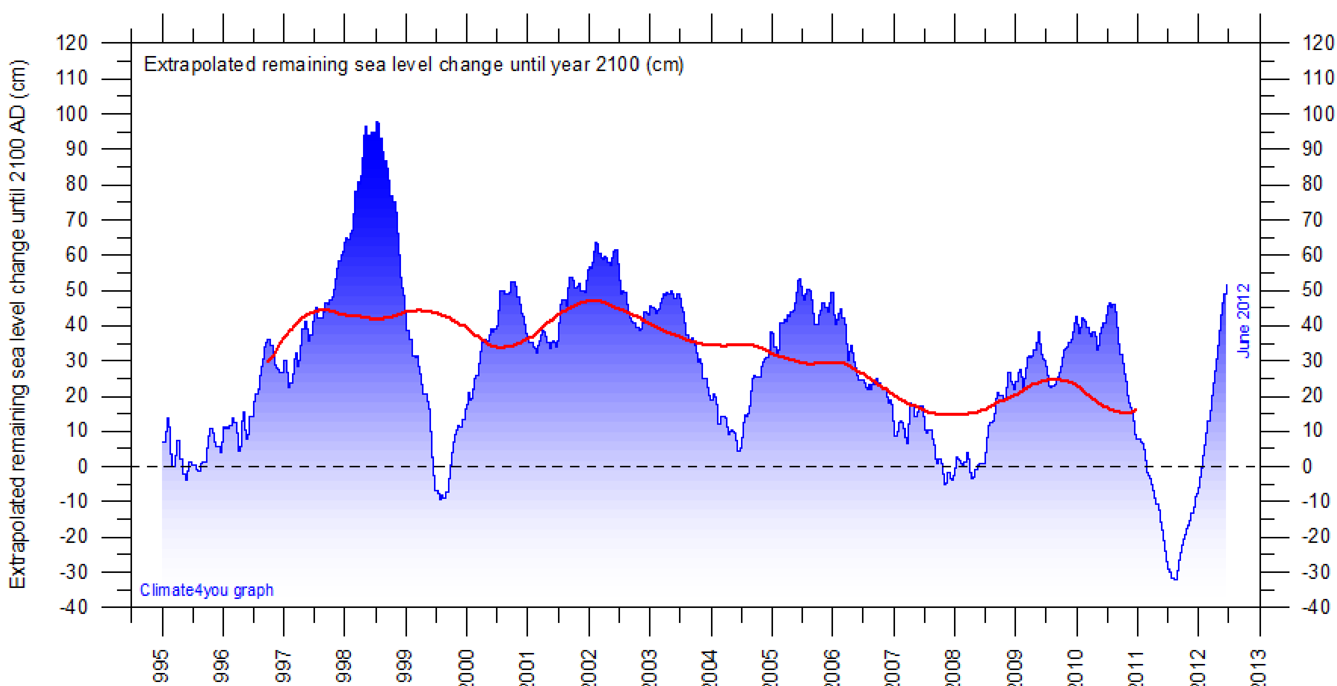


Northern hemisphere sea ice extension and thickness on 31 October 2012 according to the [*Arctic Cap Nowcast/Forecast System*]() *(ACNFS), US Naval Research Laboratory. Thickness scale (m) is shown to the right.*

Global sea level, updated to June 2012

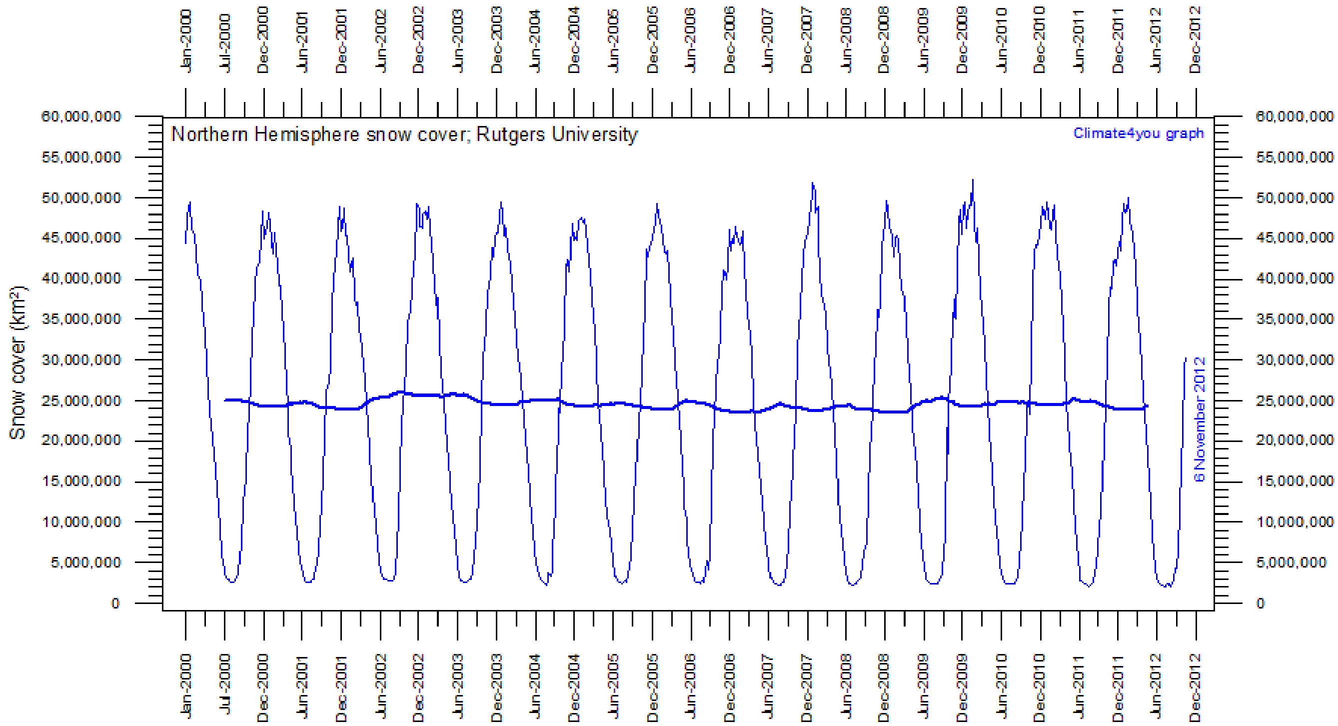


Globa lmonthly sea level since late 1992 according to the Colorado Center for Astrodynamics Research at University of Colorado at Boulder, USA. The thick line is the simple running 37 observation average, nearly corresponding to a running 3 yr average.

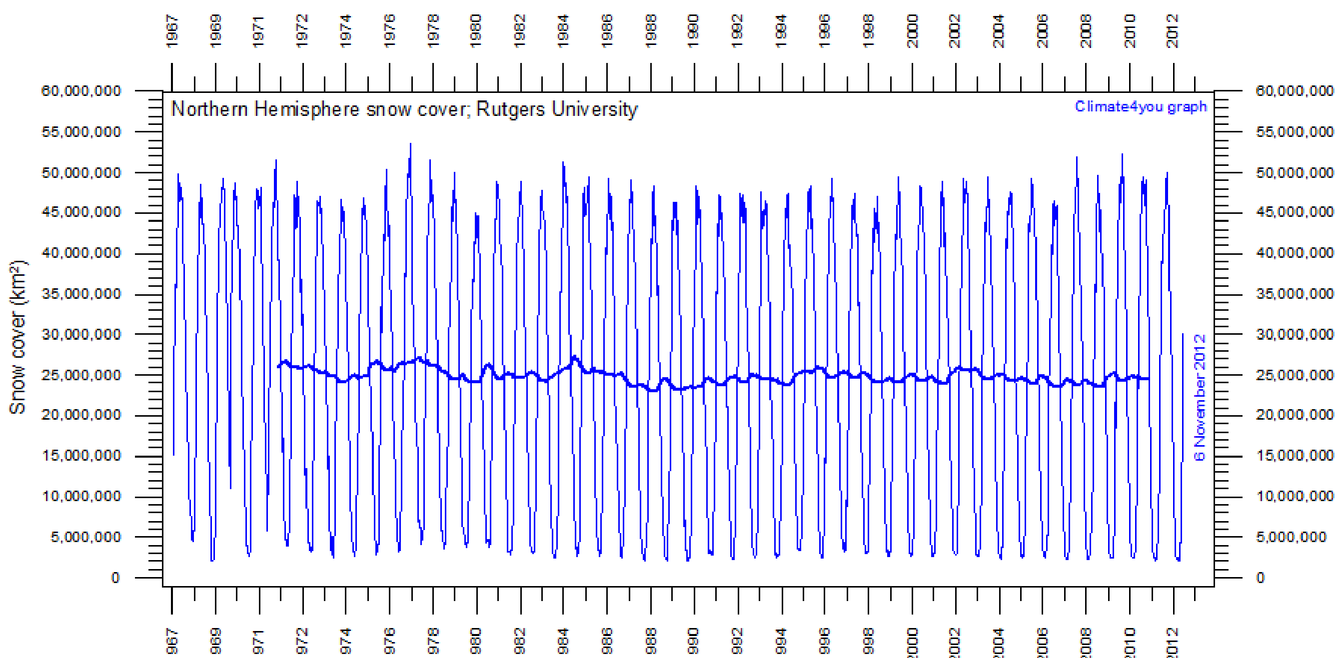


Forecasted change of global sea level until year 2100, based on simple extrapolation of measurements done by the Colorado Center for Astrodynamics Research at University of Colorado at Boulder, USA. The thick line is the simple running 3 yr average forecast for sea level change until year 2100. Based on this (thick line), the present simple empirical forecast of sea level change until 2100 is about +17 cm.

Northern Hemisphere weekly snow cover, updated to early November 2012

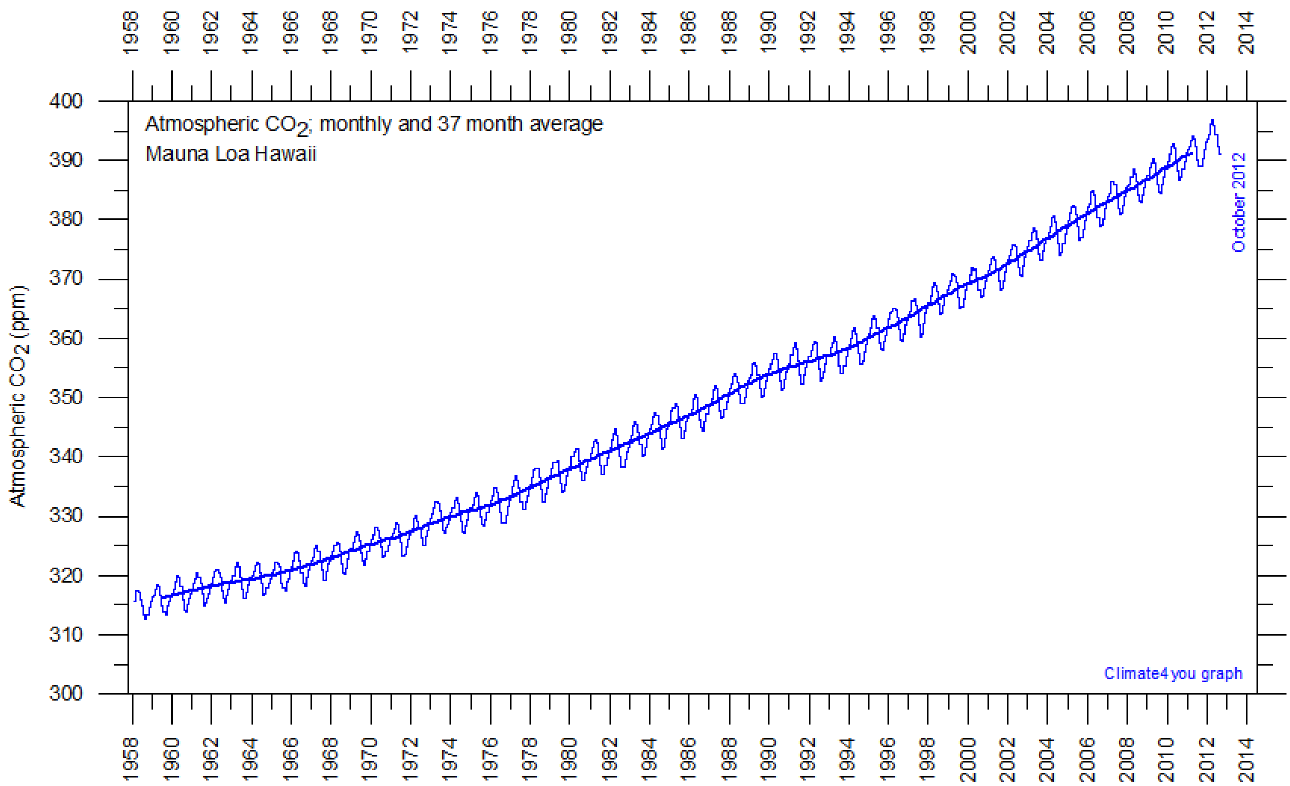


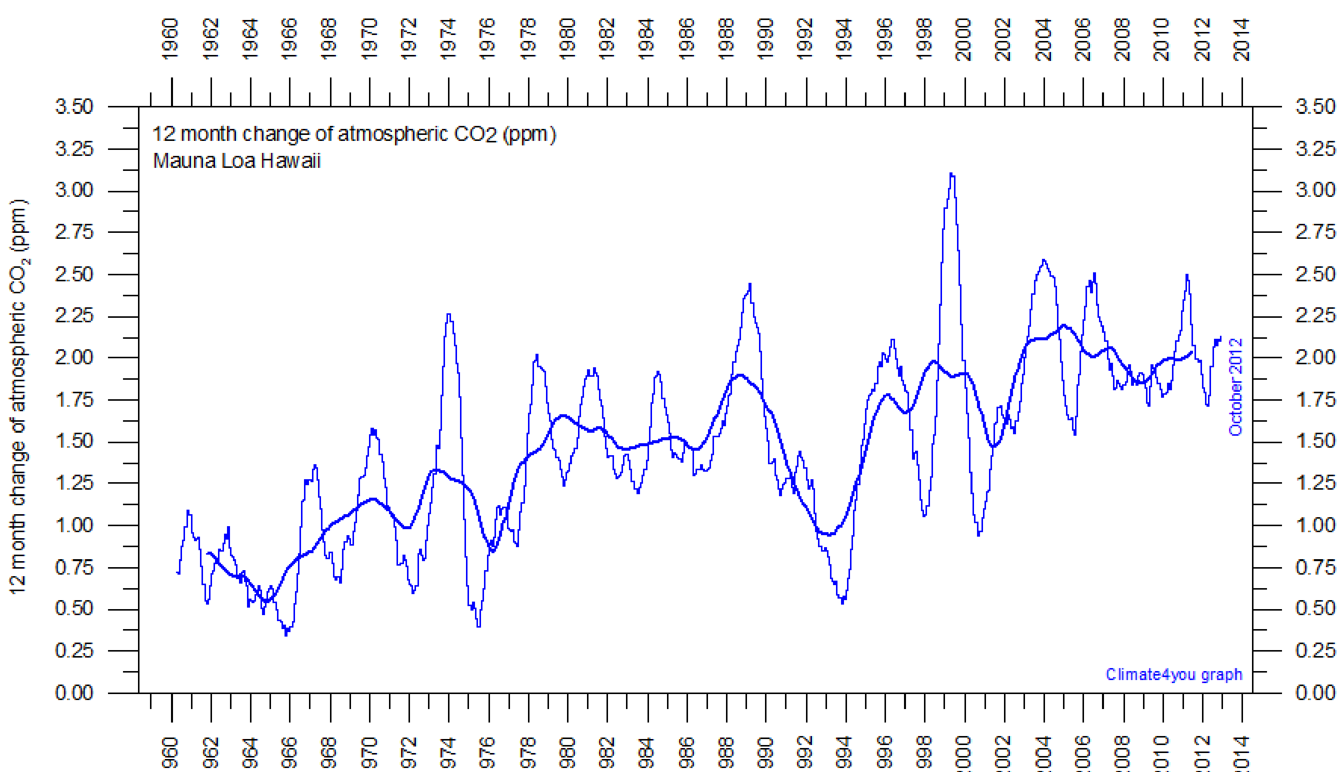
Northern hemisphere weekly snow cover since January 2000 according to Rutgers University Global Snow Laboratory. The thin line represents the weekly data, and the thick line is the running 53 week average (approximately 1 year).



Northern hemisphere weekly snow cover since October 1966 according to Rutgers University Global Snow Laboratory. The thin line represents 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 data gaps in this early period.

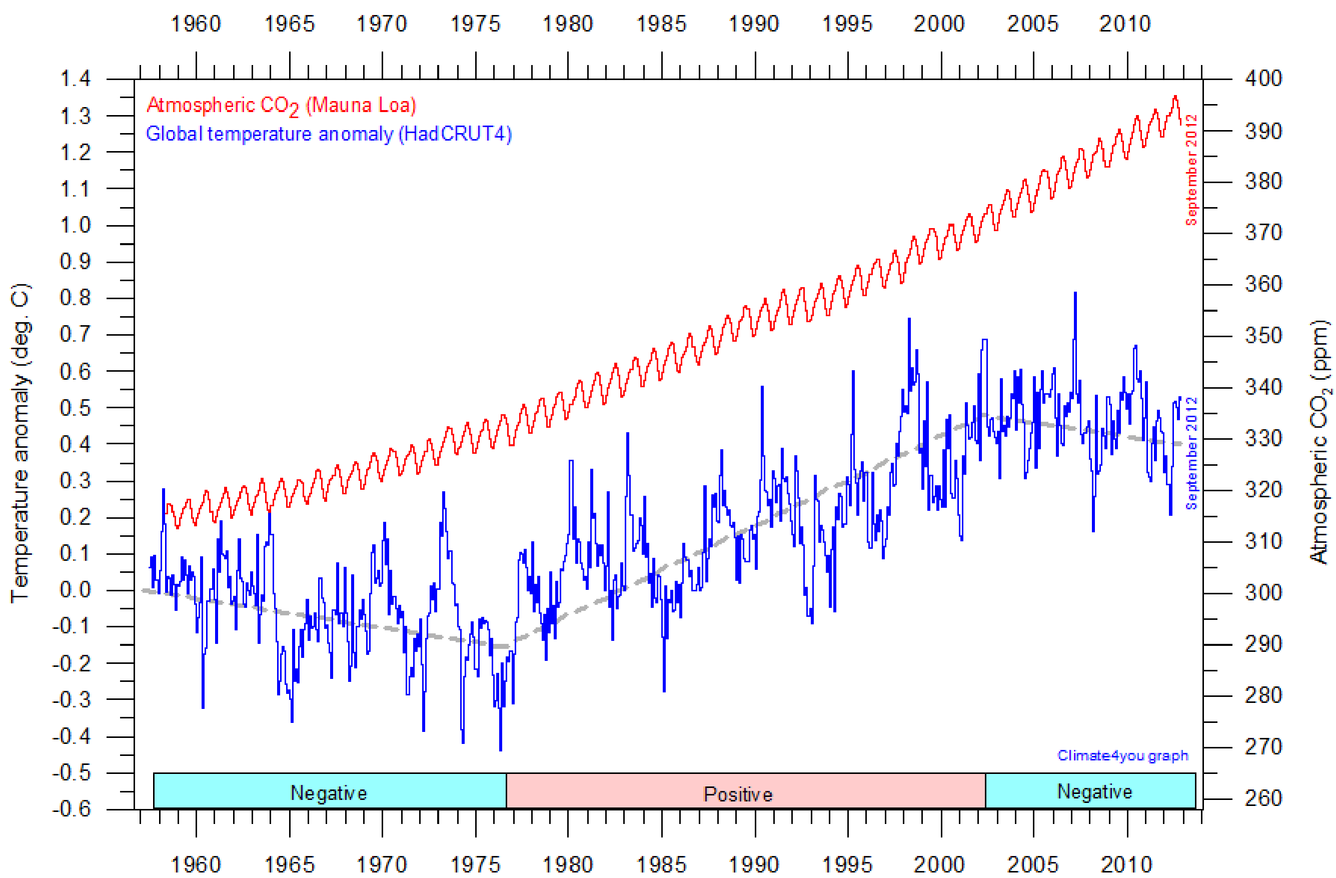
Atmospheric CO_2, updated to October 2012

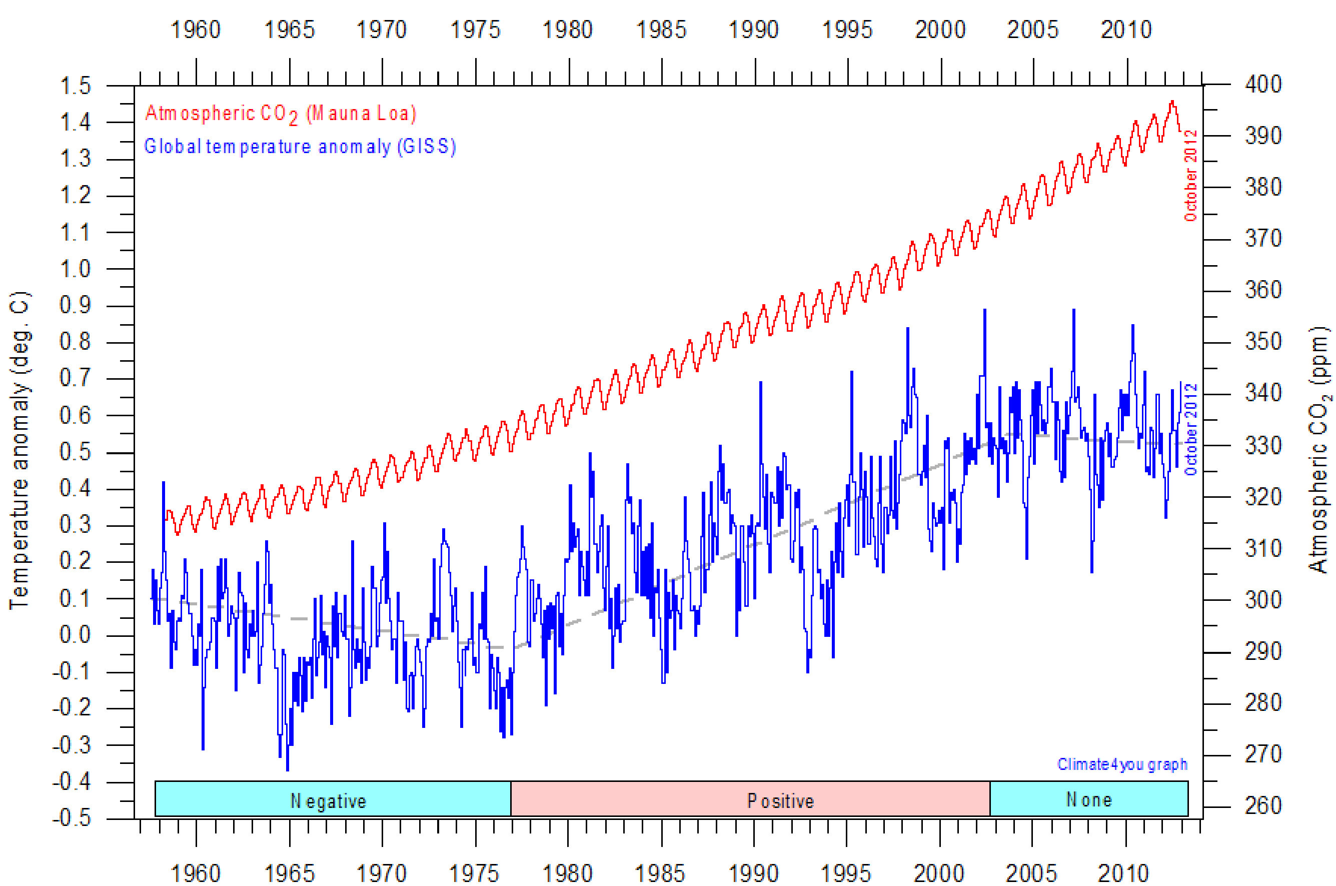


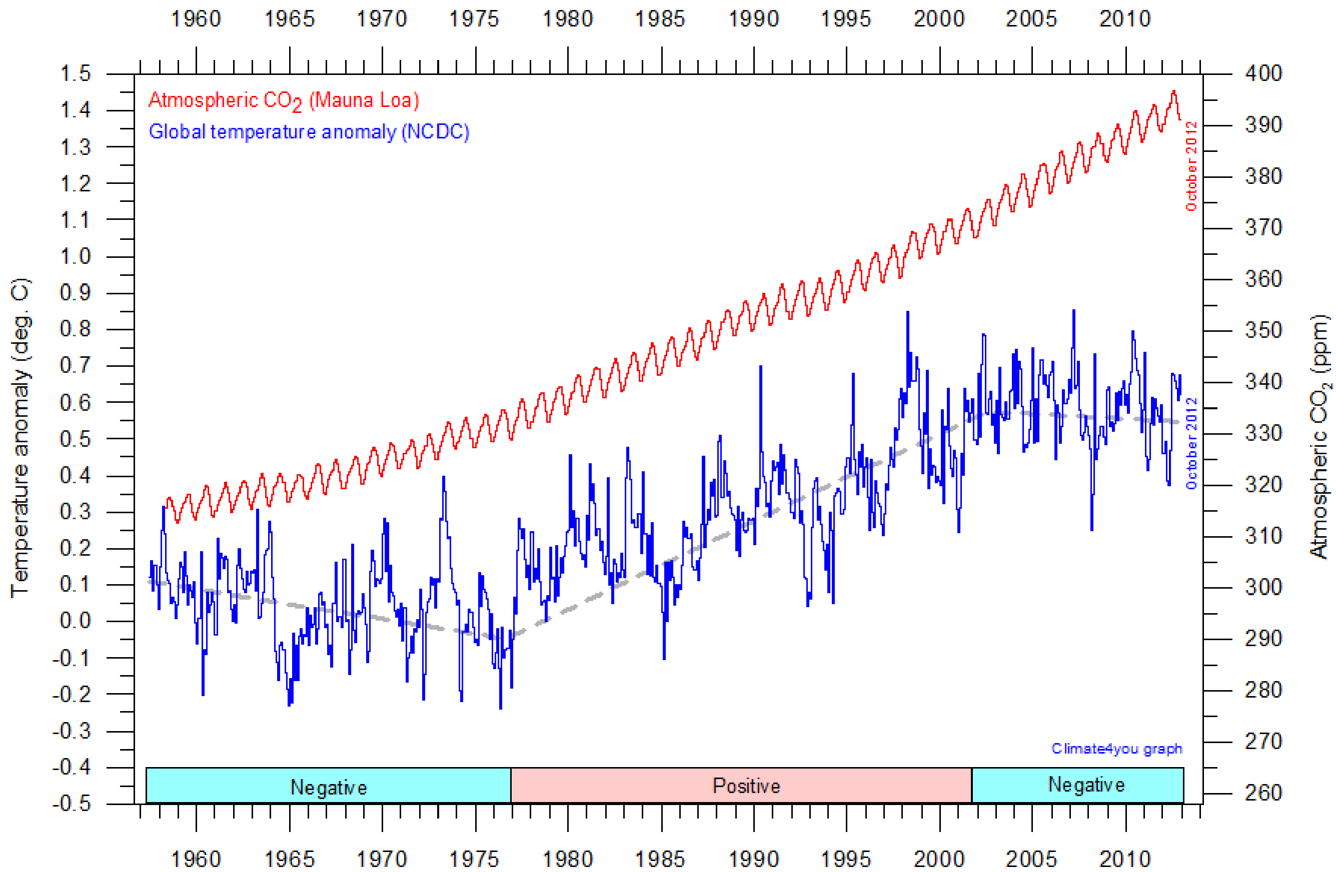


Monthly amount of atmospheric CO_2 (above) and annual growth rate (below; average last 12 months minus average preceding 12 months) of atmospheric CO_2 since 1959, according to data provided by the [Mauna Loa Observatory](), Hawaii, USA. The thick line is the simple running 37 observation average, nearly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

Global surface air temperature and atmospheric CO_2, updated to October 2012







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 direct 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. Please note that the HadCRUT4 diagram has not yet been updated beyond September 2012.

Most climate models assume the greenhouse gas carbon dioxide CO_2 to influence significantly upon global temperature. It is therefore relevant to compare different 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, 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.

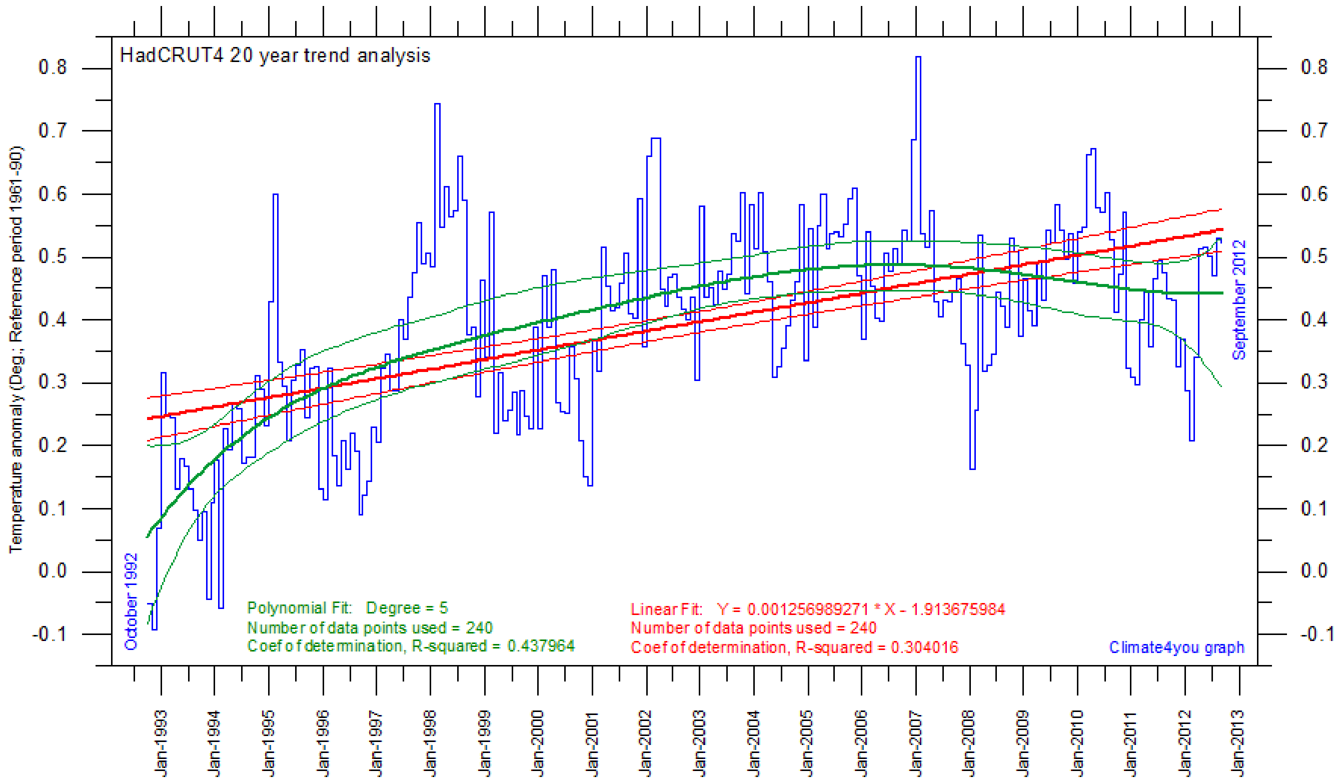
What exactly defines the critical length of a relevant time period to consider for evaluating the alleged importance of CO_2 remains elusive, and is still a topic for discussion. However, the critical period length must be inversely proportional to the temperature sensitivity of CO_2, including feedback effects. If the net temperature effect of atmospheric CO_2 is strong, the critical time period will be short, and vice versa.

However, past climate research history provides some clues as to what has traditionally been considered the relevant length of period over which to compare temperature and atmospheric CO_2. After about 10 years of concurrent global temperature- and CO_2-increase, IPCC was established in 1988. 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, politic support for the hypothesis would have been difficult to obtain.

Based on the previous 10 years of concurrent temperature- and CO_2-increase, many climate scientists in 1988 presumably felt that their understanding of climate dynamics was sufficient to conclude about the importance of CO_2 for global temperature changes. From this it may safely be concluded that 10 years was considered a period long enough to demonstrate the effect of increasing atmospheric CO_2 on global temperatures.

Adopting this approach as to critical time length (at least 10 years), the varying relation (positive or negative) between global temperature and atmospheric CO2 has been indicated in the lower panels of the diagrams above.

Last 20 year surface temperature changes, updated to September 2012



Last 20 years global monthly average surface air temperature according to Hadley CRUT, a cooperative effort between the Hadley Centre for Climate Prediction and Research and the University of East Anglia's Climatic Research Unit (CRU), UK. The thin blue line represents the monthly values. The thick red line is the linear fit, with 95% confidence intervals indicated by the two thin red lines. The thick green line represents a 5-degree polynomial fit, with 95% confidence intervals indicated by the two thin green lines. A few key statistics is given in the lower part of the diagram (note that the linear trend is the monthly trend)..

From time to time it is debated if the global surface temperature is increasing, or if the temperature has levelled out during the last 10-15 years. The above diagram may be useful in this context, and it clearly demonstrates the differences between two often used statistical approaches to determine recent temperature trends. Please also note that such fits only attempt to describe the past, and usually have limited predictive power.

1588: The Spanish Armada destroyed by storm

King Philip II of Spain (left). The Spanish Armada assembling at Lisboa, Portugal, in May 1588 (centre). Queen Elizabeth I of England (right).

King Philip II ruled Spain from 1556 to 1598. He was not only King of Spain, but also King of Portugal, King of Naples, Ruler of the Spanish Netherlands, and Duke of Milan.

King Philip II initially had sought an alliance with the Kingdom of England by marriage with the Catholic Queen Mary I of England. By this marriage Philip became king consort during the lifetime of Queen Mary I. At the same time, he also received the Kingdom of Neaples and the title of King of Jerusalem. When Queen Mary I died in 1558, Philip may have been inclined to marry her younger half-sister, Queen Elizabeth I of England. Elizabeth, who was a Protestant, was inclined to venture into such a marriage.

King Philip II at the same time had an ongoing conflict with Dutch rebels. The Dutch rebel leader William I, Prince of Orange, was outlawed by Philip and assassinated in 1584 after Philip had offered a reward of 25,000 crowns to anyone who killed him. The Dutch resistance forces however continued to fight on, using their substantial naval resources to plunder Spanish ships and blockade the Spanish-controlled southern provinces. When England provided support for the Dutch rebels, King Philip II saw an opportunity to invade England and to return the country to Catholicism.

The large Spanish army standing in the Netherlands fighting the Dutch resistance forces was in a fine position to do the job. However, just like Adolf Hitler in the summer of 1940, he first had to solve the problem of transporting the army across the Channel to England. Presumably, the British Navy would not sit back passive and see this happen. Therefore, first the British Navy had to be neutralized before attempting to ferry the Spanish Army across the sea to England. The

Royal Spanish Navy was large and powerful, and should be able to do the job.

The Spanish Armada, also known as the Invincible Armada, was assembled during the spring of 1588. In total 130 ships with 30,000 on board were under command of the Duke of Sidonia, Medina Sidonia. The fleet set sail on 28 May 1588 with 22 warships of the Spanish Royal Navy and 108 converted merchant vessels. The intension was to sail north to the English Channel. Here the fleet should anchor off the coast of Flanders, where the Duke of Parma would stand ready with his army to be transported across the Channel to the south-east of England.

The English fleet under command of Sir Francis Drake was assembled at Plymouth, awaiting news of Spanish sea movements. The Spanish Armada was, however, delayed by adverse weather and did not reach Cornwall in SW England before July 19.

During the period 20-26 July 1588 a number of naval battles took place in the Channel region between the Spanish Armada and the English Navy, none of which were decisive. A major problem for the Armada was the lack of secure harbors, where their large ships could obtain supplies of water and other provisions. After all, they had already been at sea for two months. Also the lack of good lines of communication between Philip II and his two commanders at land and sea, respectively, contributed to the awkward situation for the Spanish fleet.

On the evening of July 27 the Armada was anchored off Calais in a defensive formation. At midnight between 27 and 28 July the English Navy attacked by launching eight fireships drifting with the south-westerly winds. The Armada had to lift anchor in a hurry, and in the now increasing rising south-westerly wind the fleet was not able to recover its defensive formation. To make things worse, during their narrow escape from the English fireships, many Spanish ships had been forced to cut their anchor to get under sail rapidly. Under these circumstances, the Spanish Admiral, the Duke of Sidonia, was understandingly reluctant to sail further east owing to the danger from the shoals off Flanders, where the Dutch rebels had removed all sea-marks.

In the shallow waters, the smaller English ships had superior maneuverability, and closed in for battle while maintaining a position to windward (upwind). Having the windward position enabled the English ships to fire damaging broadsides into the heeling enemy ships below the water-line. Eleven Spanish ships were lost or damaged during the following battle.

The next day the wind turned southerly, enabling Medina Sidonia to sail the Armada north into the North Sea, where there was wider space for his big ships to operate efficiently. The English fleet pursued in an attempt to prevent the enemy from returning to escort the Spanish Army across the Channel to England. On August 12 both fleets were at the latitude of the Firth of Forth, off the east coast of Scotland. Now the Spanish ships, being at sea for a prolonged period, were suffering from both thirst and exhaustion. In this situation, Medina Sidonia decided that the most prudent decision would be to chart a course home to Spain, along the exposed west coast of Scotland and Ireland. In addition, the wind was beginning to pick up from the south-east, which would make crossing back to the English Channel in the North Sea difficult and time-consuming. The wind was increasing as the result of an approaching storm from the west.

The Spanish Armada being attacked by English fireships in the night between 27 and 28 July 1588. Oil painting by Philippe-Jacques de Loutherbourg (left). Route taken by the Spanish Armada May-August 1588 (centre). Spanish ship wrecked on the west coast of Ireland August 1588, Illustration from the Art Gallery Illustrated (right).

Off the coasts of Scotland and Ireland the Spanish fleet ran into a very strong storm (in modern times not usual at these latitudes in mid August) with fierce winds from westerly and later north-westerly direction. Probably the storm centre was passing shortly south of the Armada, which the navigated into the dangerous NW-quadrant of the storm, with strong north-westerly winds behind the storm centre.

With great skill the Spanish ships long attempted to fight the storm, but due to their construction they were not able to cross efficiently against the wind. Many of the ships slowly drove off course and away from the safety of the open sea. Many anchors had been abandoned during the forced escape from the English fireships off Calais, and the ships were consequently incapable of securing shelter as they reached the west coast of Ireland. Instead they were in great numbers driven on to the rocky coast. In the end, only 67 Spanish ships and around 10,000 men survived and made it back to Spain.

From an official English political point of view the outcome was a major triumph for the English Navy and for Sir Francis Drake. In reality it was a climate-induced disaster for Spain and King Philip II, who rightfully complained that he had sent his ships to fight the English, not the elements. The immediate political effect was the survival of the Kingdom of England and the gradual transfer of world sea dominance to the British Navy: *Rule Britannia, Britannia rules the waves*.

From a meteorological point of view the strong westerly and north-westerly winds suggest a major storm centre travelling across England, in response to a relatively southerly position of the Polar Jet Stream in August 1588. Presumably the meteorological situation was much alike that bringing about the wet, windy and cold summer of 2007 to NW Europe.

This British newborn naval sea dominance was going to be the backbone in the developing British Empire over the centuries to follow, and was to last without interruption until the 2nd World War. After having rebuild their fleet after the Japanese attack on the US naval base at Pearl Harbour (December 1941), the US navy around 1944 became the leading naval power.

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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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