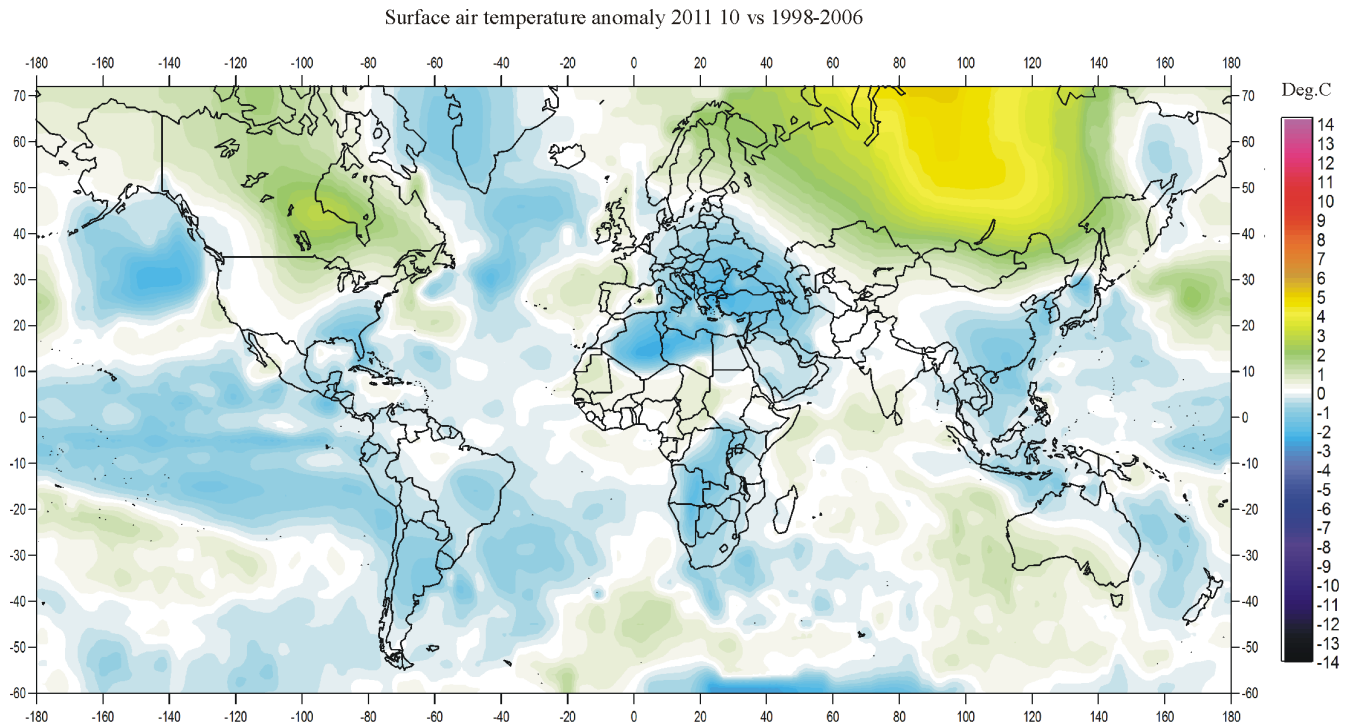


Climate4you update October 2011

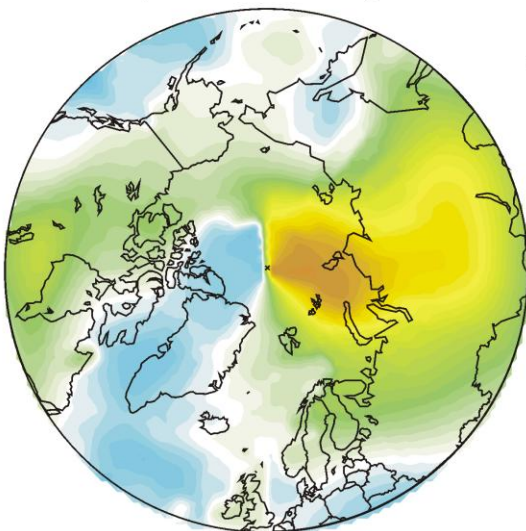
www.climate4you.com

October 2011 global surface air temperature overview

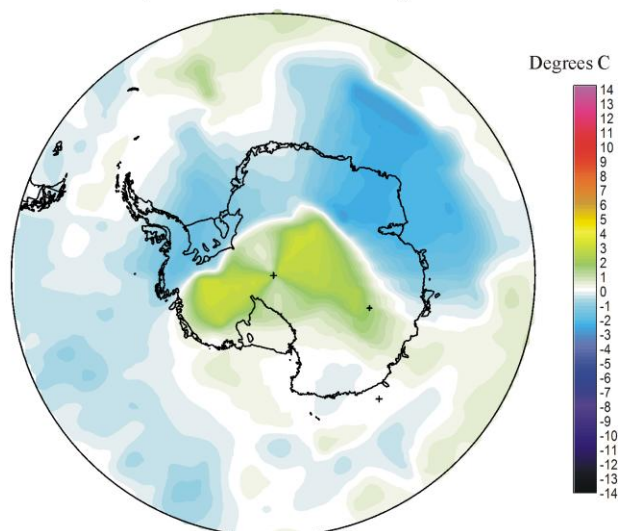


1

Air temperature 201110 versus average 1998-2006



Air temperature 201110 versus average 1998-2006



October 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](http://www.giss.nasa.gov) (GISS)

Comments to the October 2011 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.

2

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.

The average global surface air temperatures October 2011:

The Northern Hemisphere was characterised by high regional variability. Warmer than 1998-2006 average temperatures extended across most of northern Russia, most of Siberia and Canada. A prominent hotspot existed over northern Siberia and adjoining parts of the Arctic Ocean.

The Southern Hemisphere in general was close to or slightly below average 1998-2006 conditions. Most of South America, southern Africa and Indonesia had below average temperatures. Australia in general was to average.

Near Equator temperatures conditions were in general below average 1998-2006 conditions.

The Arctic was characterized by a high variability of average surface air temperatures. Most of Siberia and Russia had above average temperatures, and only eastern Siberia saw below average temperature. Also most of Alaska and the Canadian Arctic sector had above average temperature. Only Greenland had below average temperature in October. The marked thermal contrast near the North Pole is a mathematical artefact, derived from the GISS interpolation procedure, and should be ignored.

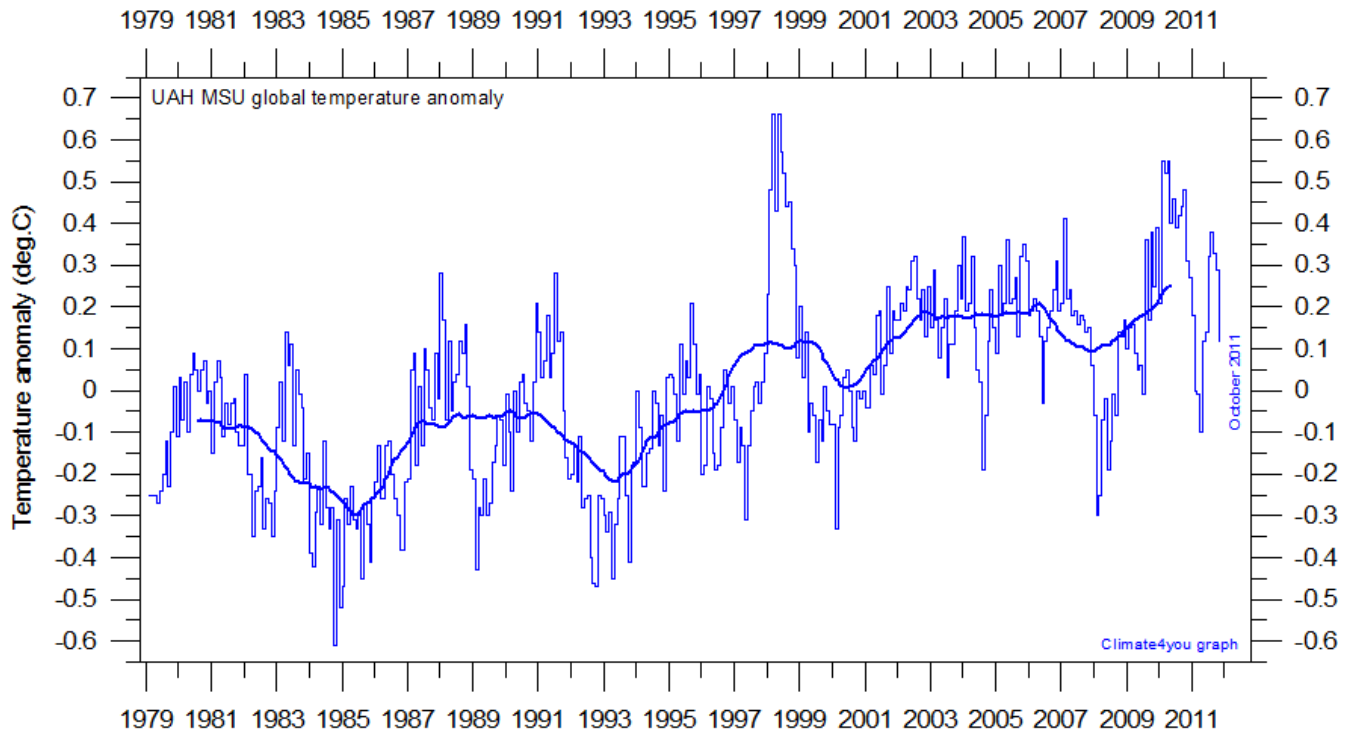
Most of the Antarctic continent experienced below average temperatures. Only the central part of the continent experienced above average temperatures.

The global oceanic heat content has now for several years been almost stable, at least since 2003/2004 (page 10).

The global sea level is not doing very much, either, since 2009 (page 17).

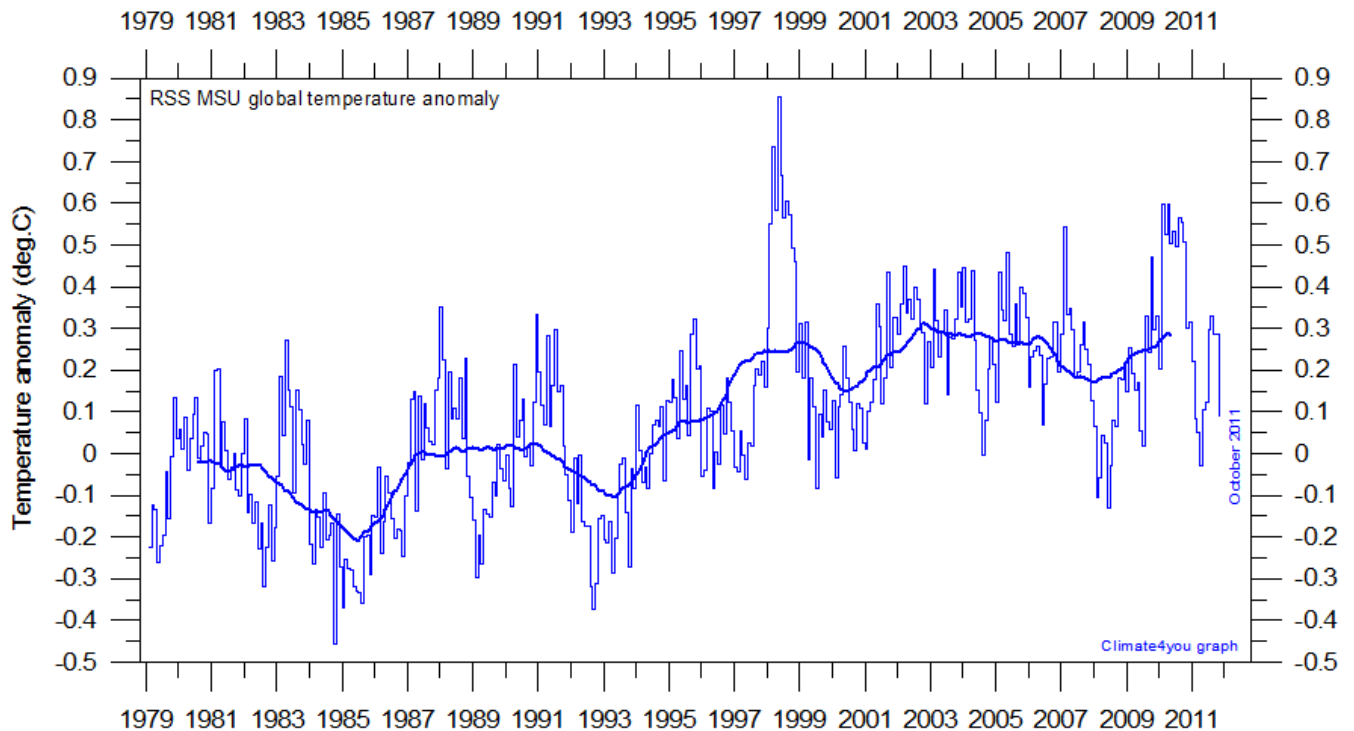
Most diagrams shown in this newsletter are also available for download on www.climate4you.com

Lower troposphere temperature from satellites, updated to October 2011



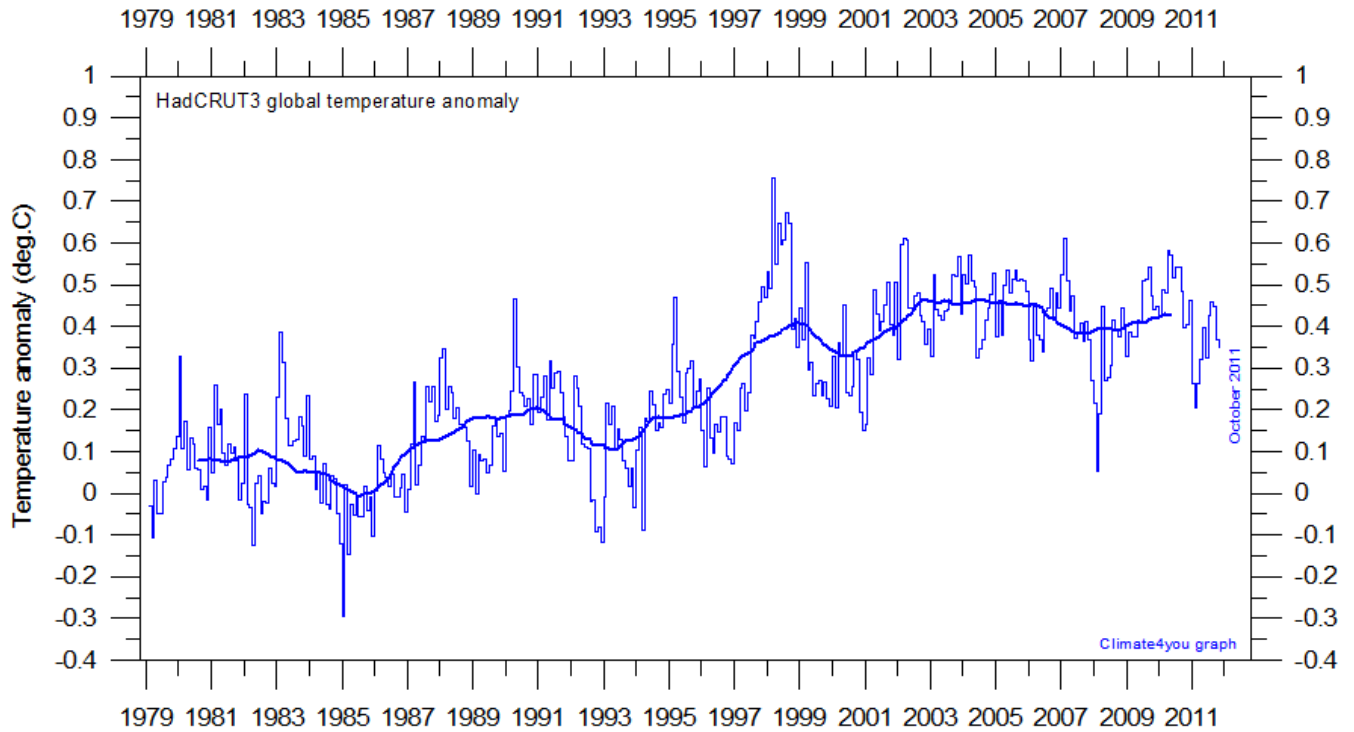
Global monthly average lower troposphere temperature (thin line) since 1979 according to [University of Alabama](#) at Huntsville, USA. The thick line is the simple running 37 month average.

3



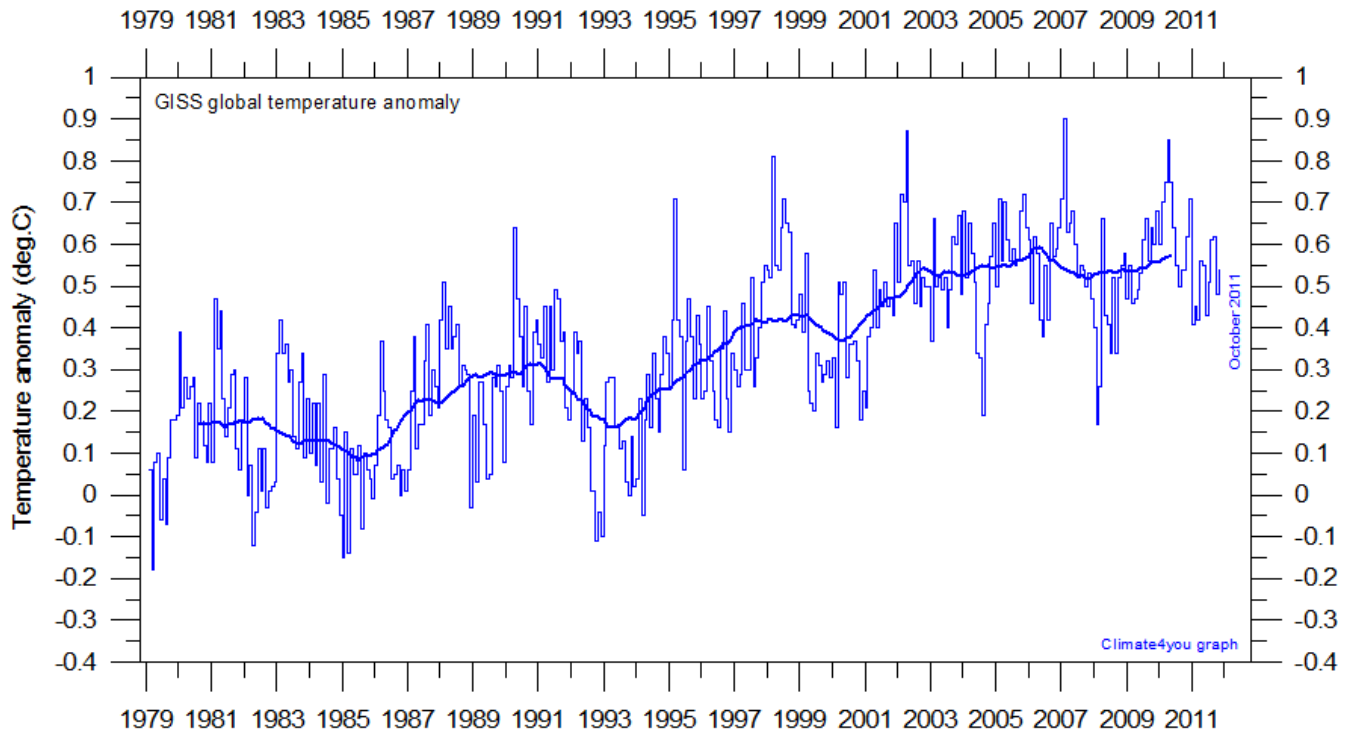
Global monthly average lower troposphere temperature (thin line) since 1979 according to according to [Remote Sensing Systems](#) (RSS), USA. The thick line is the simple running 37 month average.

Global surface air temperature, updated to October 2011

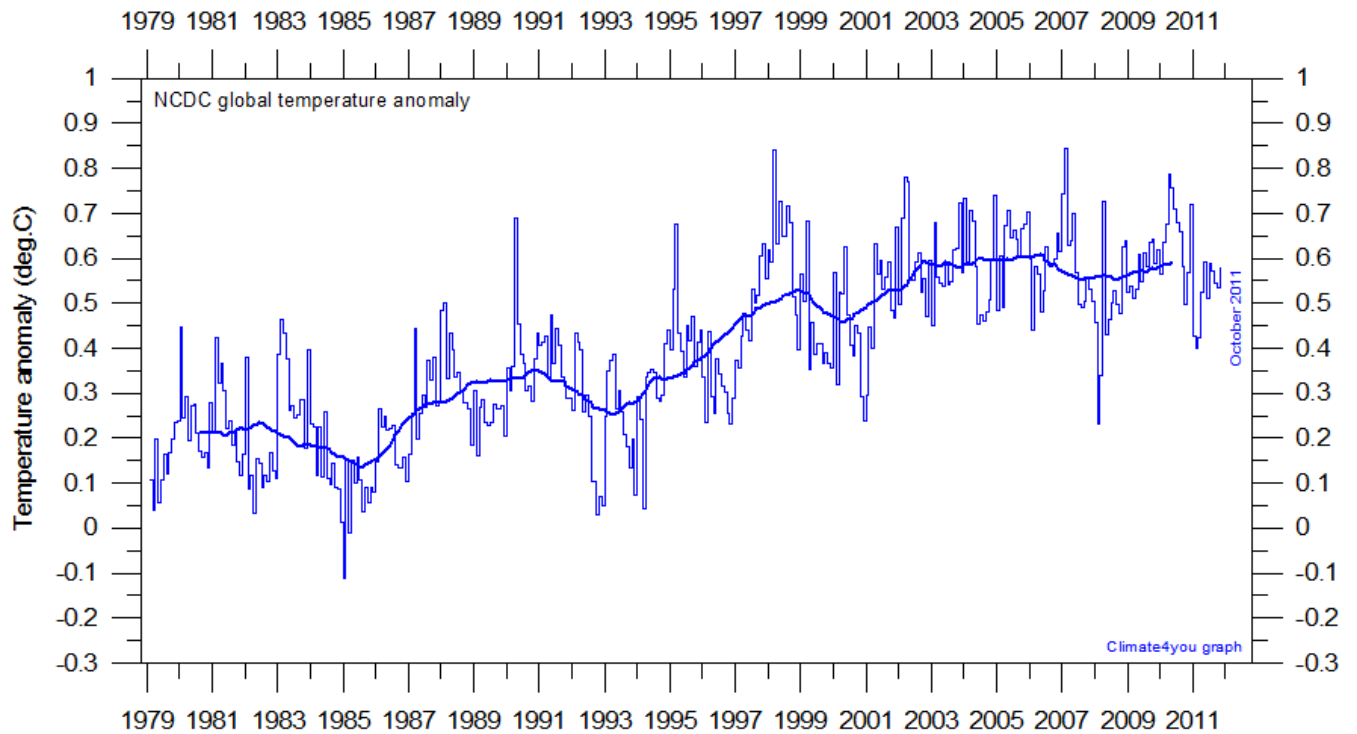


4

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.

5

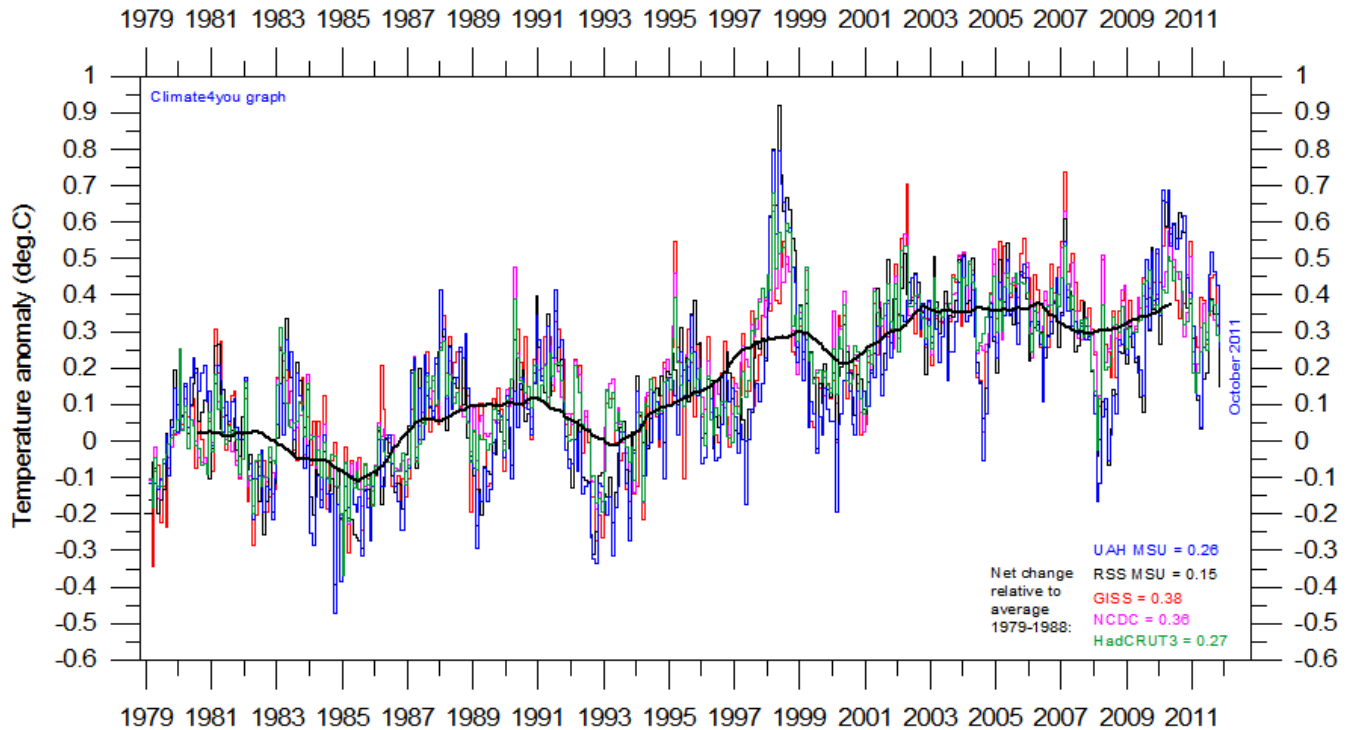
A note on data record stability:

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 additional data being added, but actually for all months back to the very beginning of the records. Presumably this reflects recognition of errors and changes in the averaging procedure followed.

The most stable temperature record over time of the five global records shown above is the HadCRUT3 series.

The interested reader may find more on the issue of temporal stability (or lack of this) on www.climate4you (go to: *Global Temperature*, followed by *Temporal Stability*).

All in one, updated to October 2011



6

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 1979-1988 average.

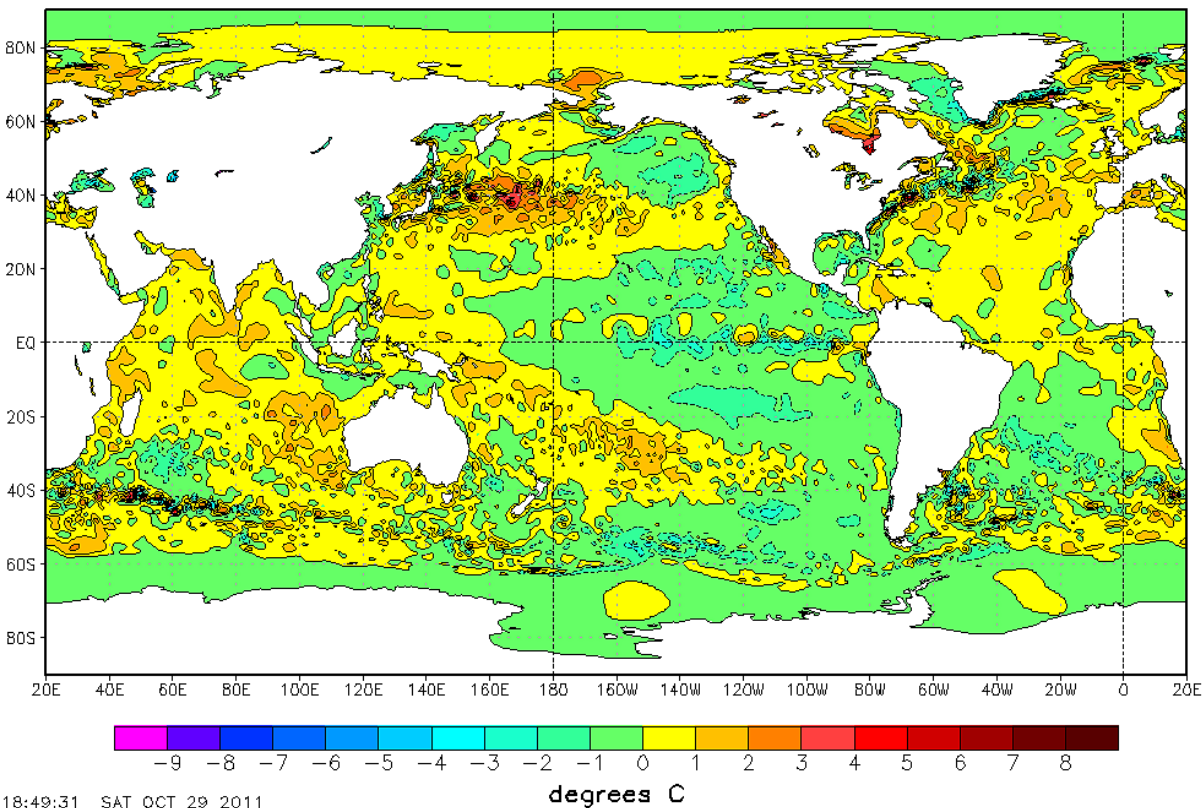
It should be kept in mind that satellite- and surface-based temperature estimates are derived from different types of measurements, and that comparing them directly as done in the diagram above therefore in principle may be problematical. However, as both types of estimate often are discussed together, 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 may be considerable differences between the individual records.

All five global temperature estimates presently show 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 the end of October 2011

NOAA/NWS/NCEP/EMC Marine Modeling and Analysis Branch

RTG_SST Anomaly (0.5 deg X 0.5 deg) for 29 Oct 2011



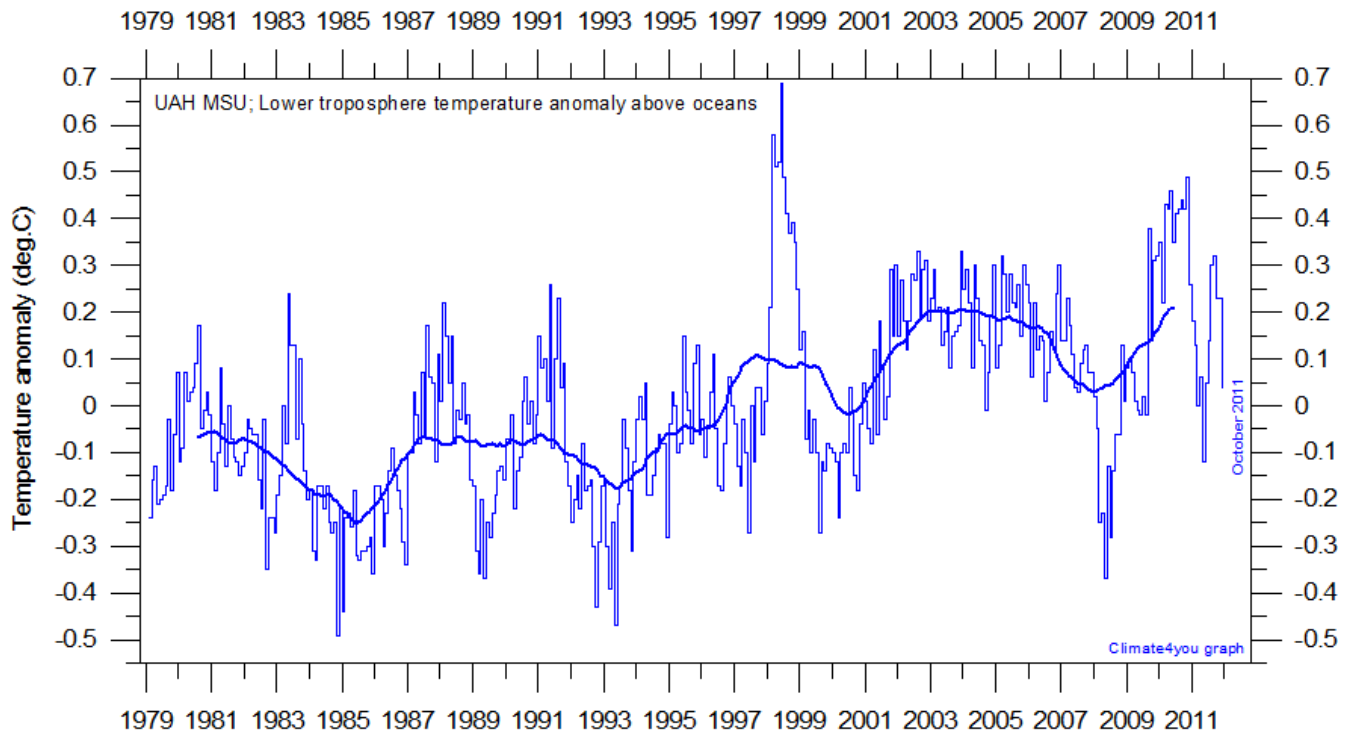
7

Sea surface temperature anomaly at 29 October 2011. Map source: National Centers for Environmental Prediction (NOAA).

Relative cold surface water dominates the regions near Equator, especially in the eastern Pacific Ocean, and represents remnants of the previous La Niña, fading away in the spring 2011. Apparently a new El Niño is not going to materialise, and surface temperatures are dropping. Because of the large surface areas involved near Equator, the relatively cold surface water in these regions affects the global atmospheric temperature.

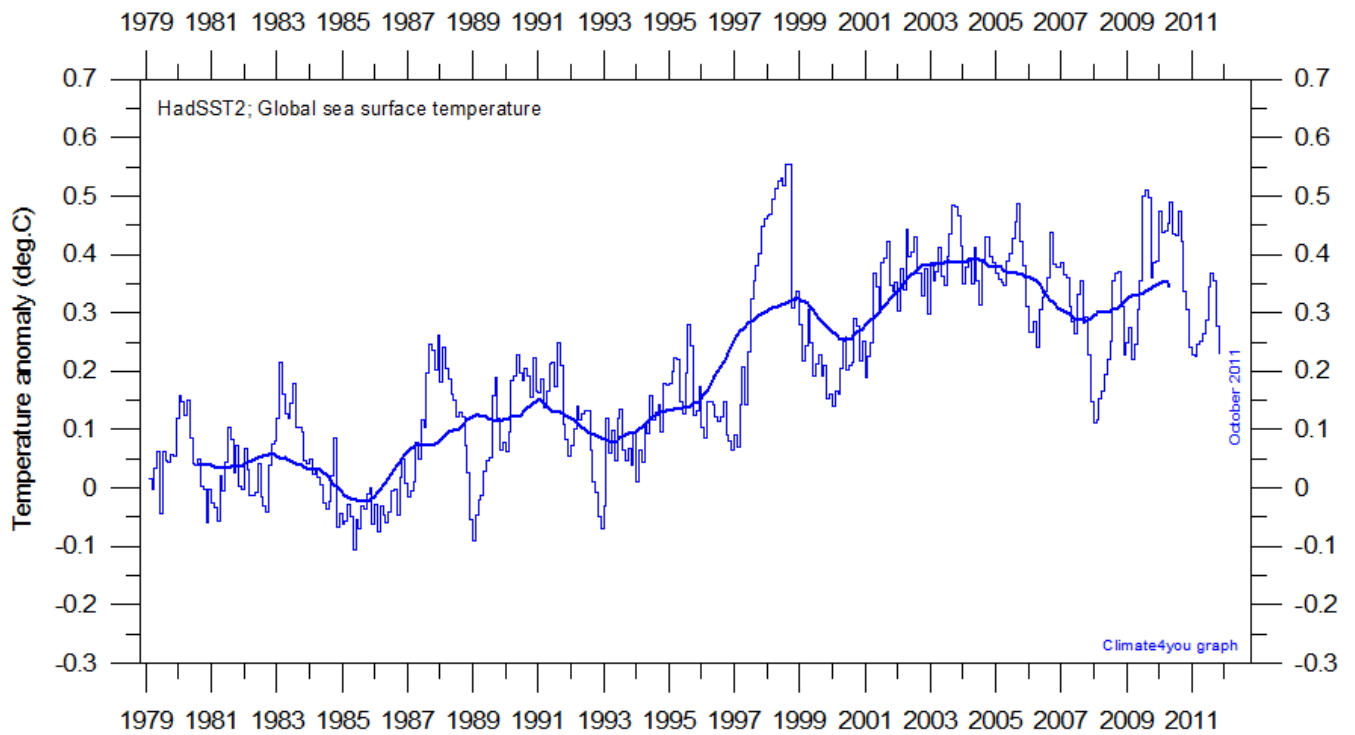
The significance of any warming or cooling seen in surface air temperatures should not be over stated.

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 the above heat exchange mainly reflects a redistribution of energy between ocean and atmosphere. What matters is the overall temperature development when seen over a number of years.

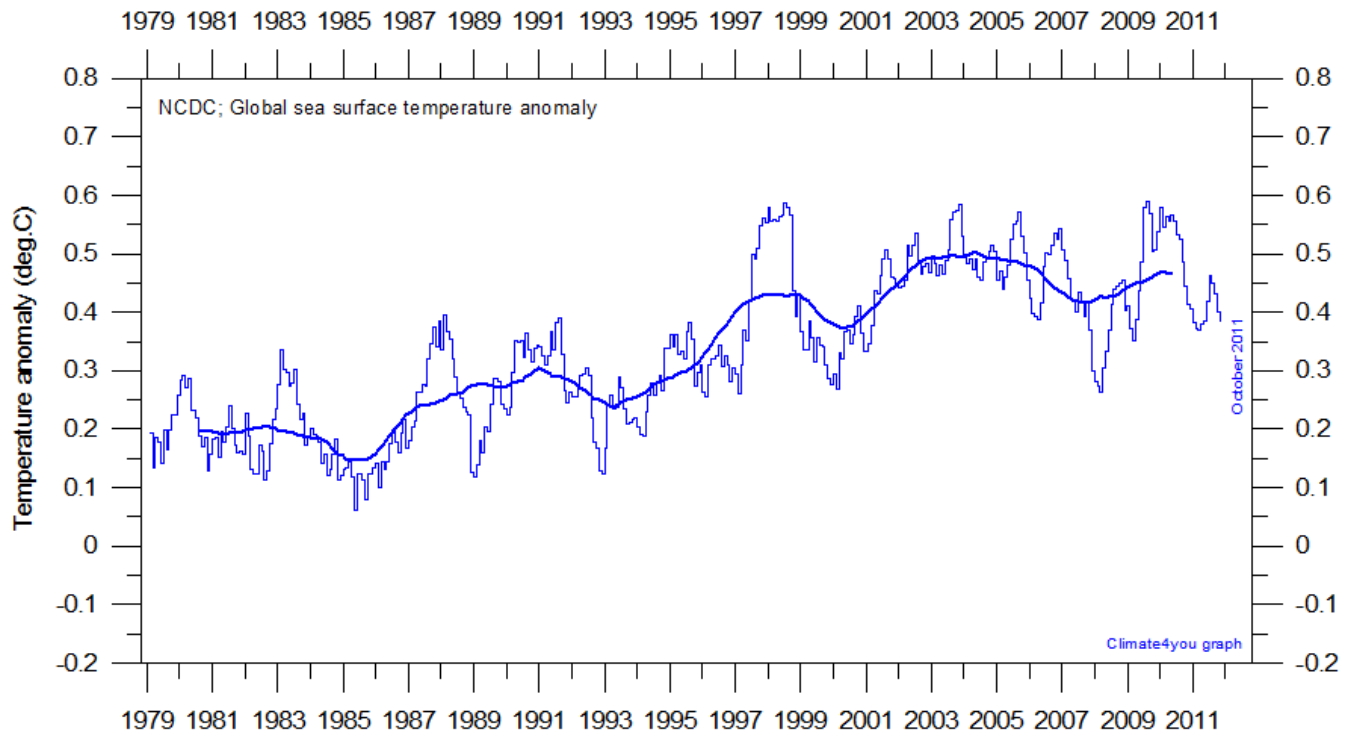


Global monthly average lower troposphere temperature over oceans (thin line) since 1979 according to [University of Alabama](#) at Huntsville, USA. The thick line is the simple running 37 month average.

8

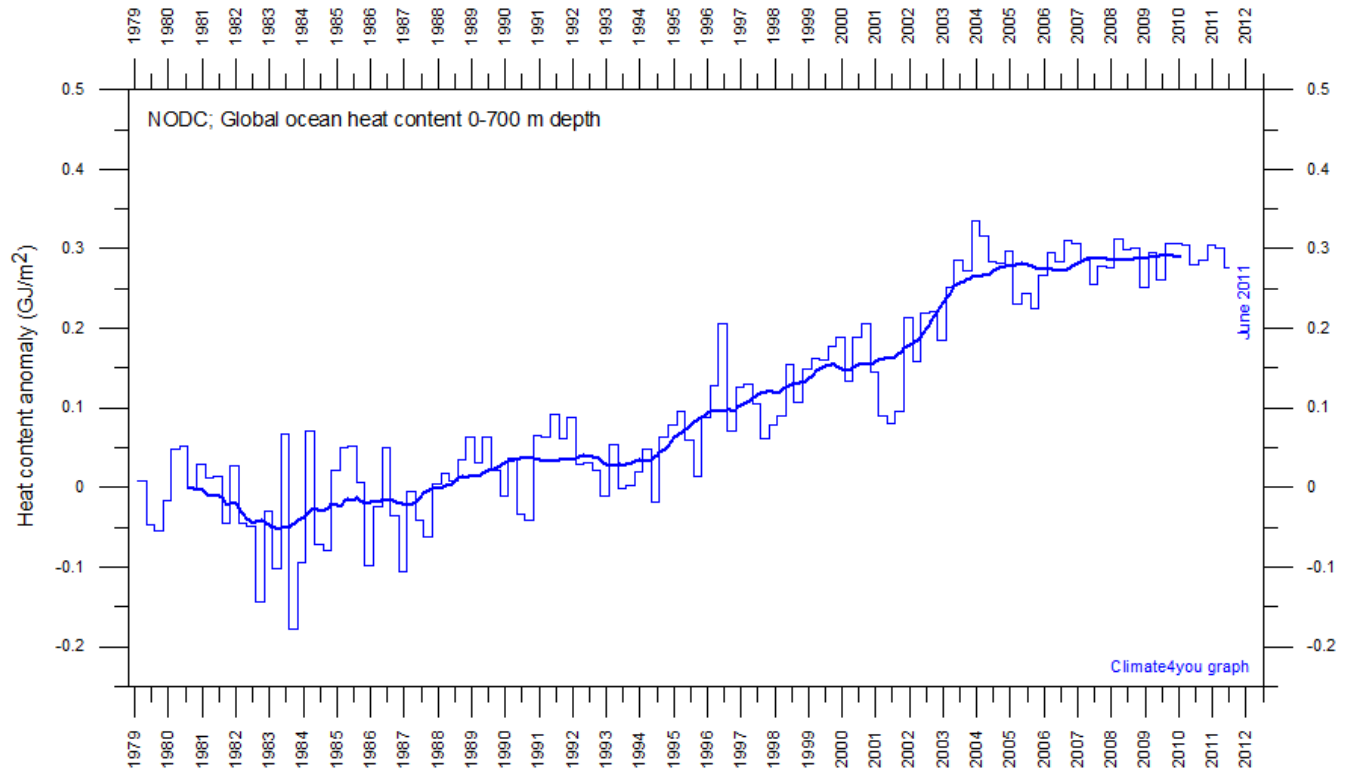


Global monthly average sea surface temperature since 1979 according to University of East Anglia's [Climatic Research Unit \(CRU\)](#), UK. Base period: 1961-1990. The thick line is the simple running 37 month average.



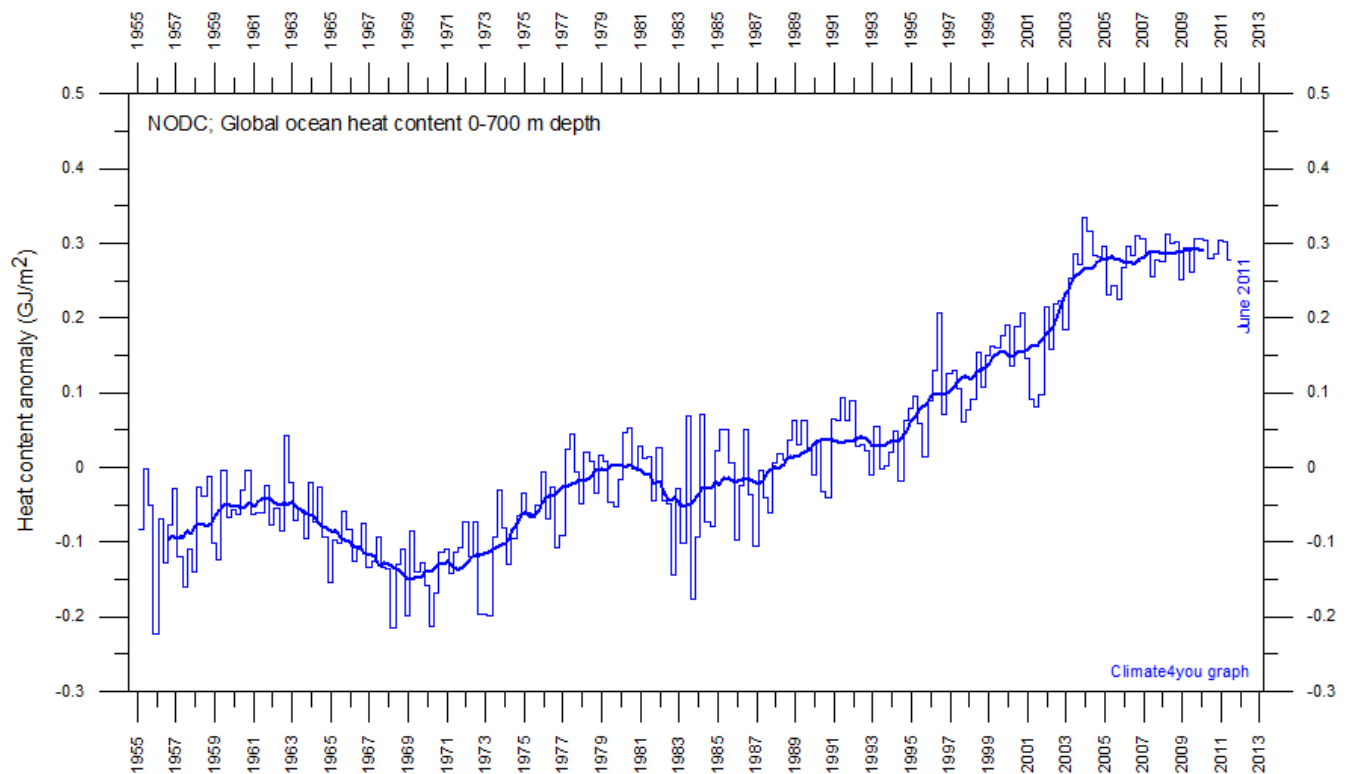
Global monthly average sea surface temperature since 1979 according to the [National Climatic Data Center \(NCDC\)](#), USA. Base period: 1901-2000. The thick line is the simple running 37 month average.

Global ocean heat content, updated to June 2011



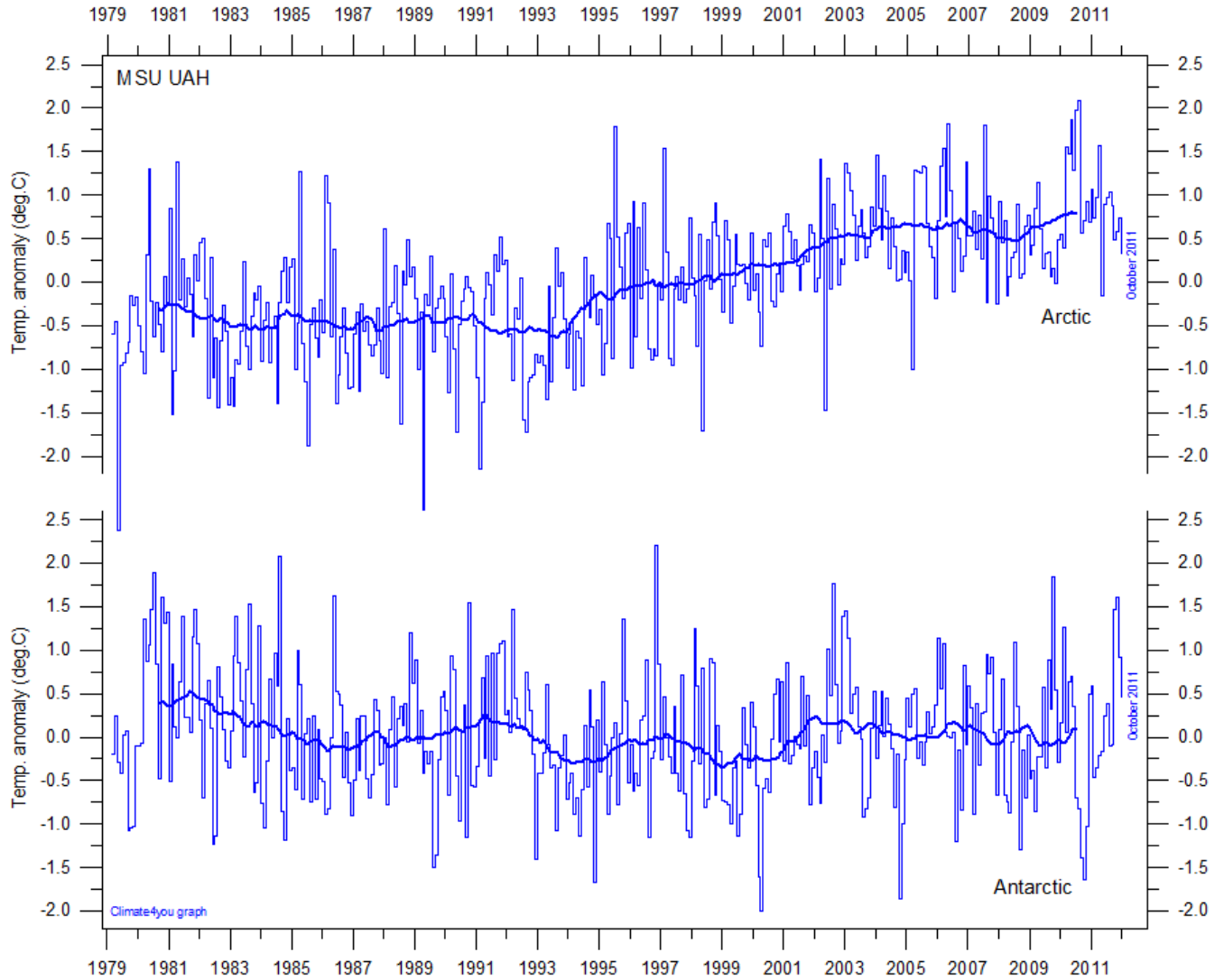
Global monthly heat content anomaly (GJ/m^2) in the uppermost 700 m of the oceans since January 1979. Data source: National Oceanographic Data Center(NODC).

10



Global monthly heat content anomaly (GJ/m^2) 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 October 2011



Global monthly average lower troposphere temperature since 1979 for the North Pole and South Pole regions, based on satellite observations ([University of Alabama](http://www.ua.edu) 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 September 2011

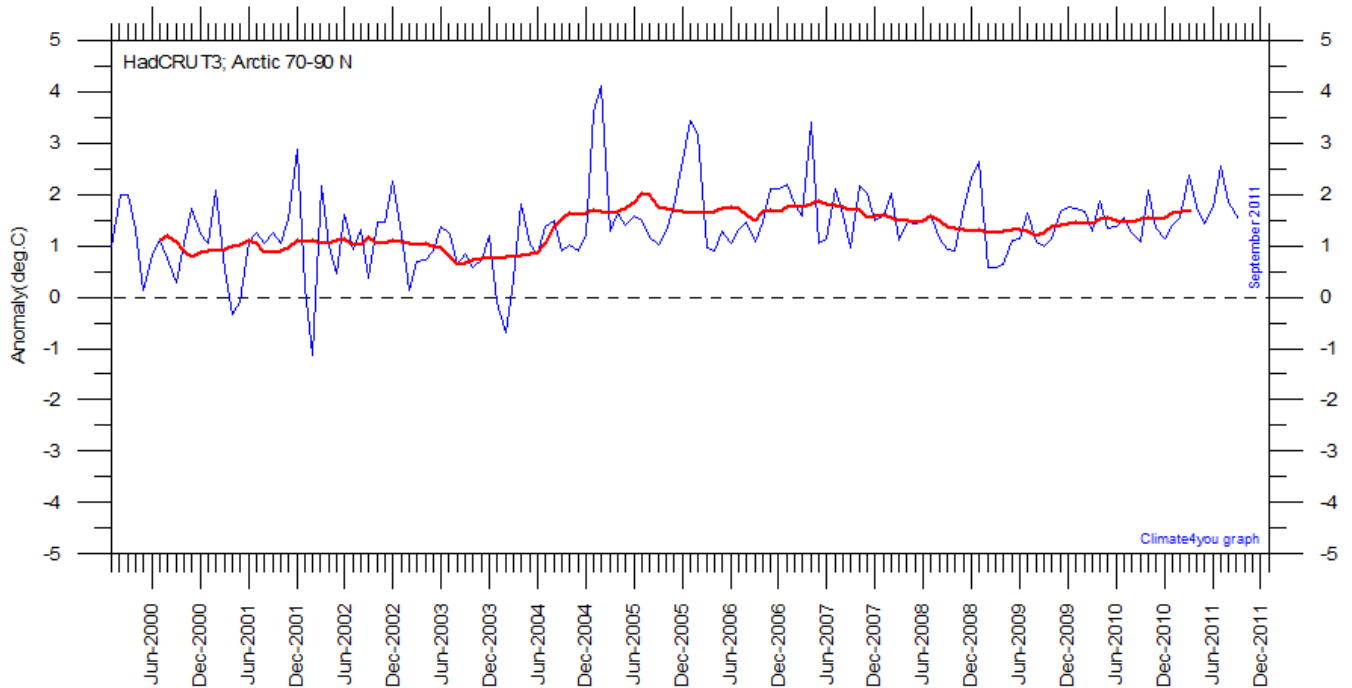


Diagram showing Arctic monthly surface air temperature anomaly 70-90°N since January 2000, in relation to the WMO reference “normal” period 1961-1990. The thin blue line shows the monthly temperature anomaly, while the thicker red line shows the running 13 month average. Data provided by the Hadley Centre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

12

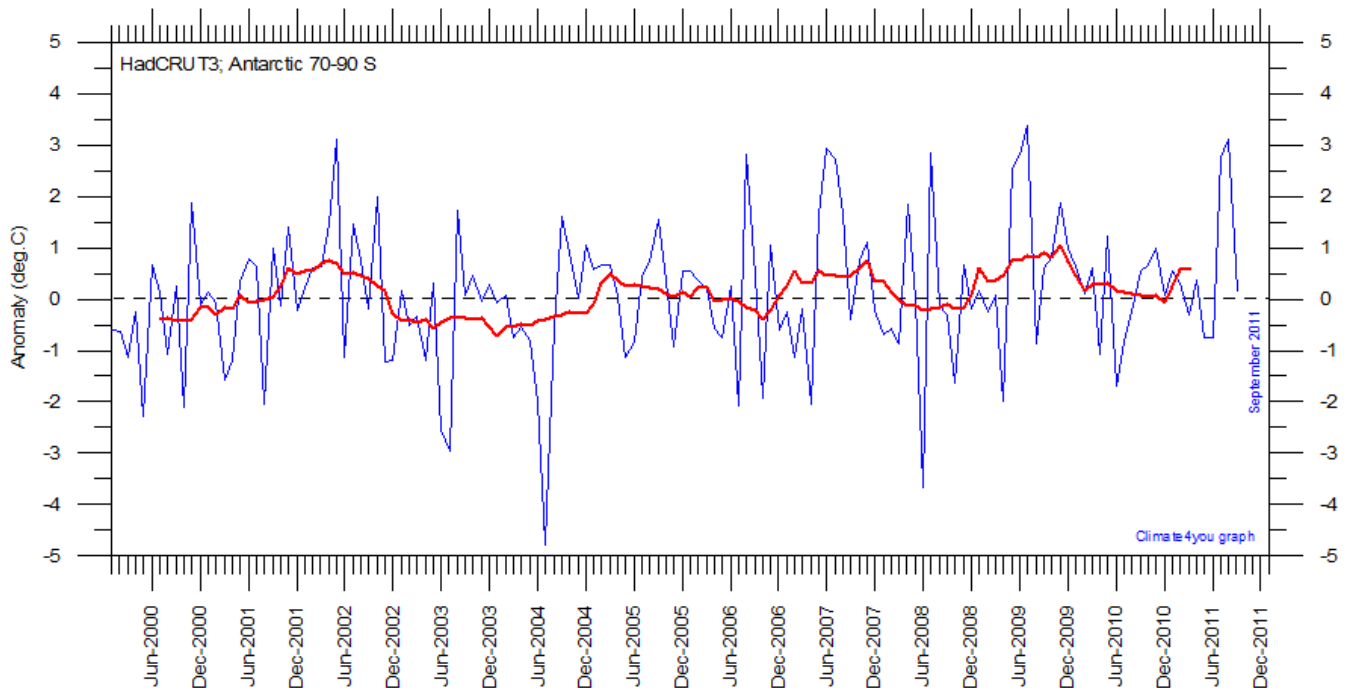


Diagram showing Antarctic monthly surface air temperature anomaly 70-90°S since January 2000, in relation to the WMO reference “normal” period 1961-1990. The thin blue line shows the monthly temperature anomaly, while the thicker red line shows the running 13 month average. Data provided by the Hadley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

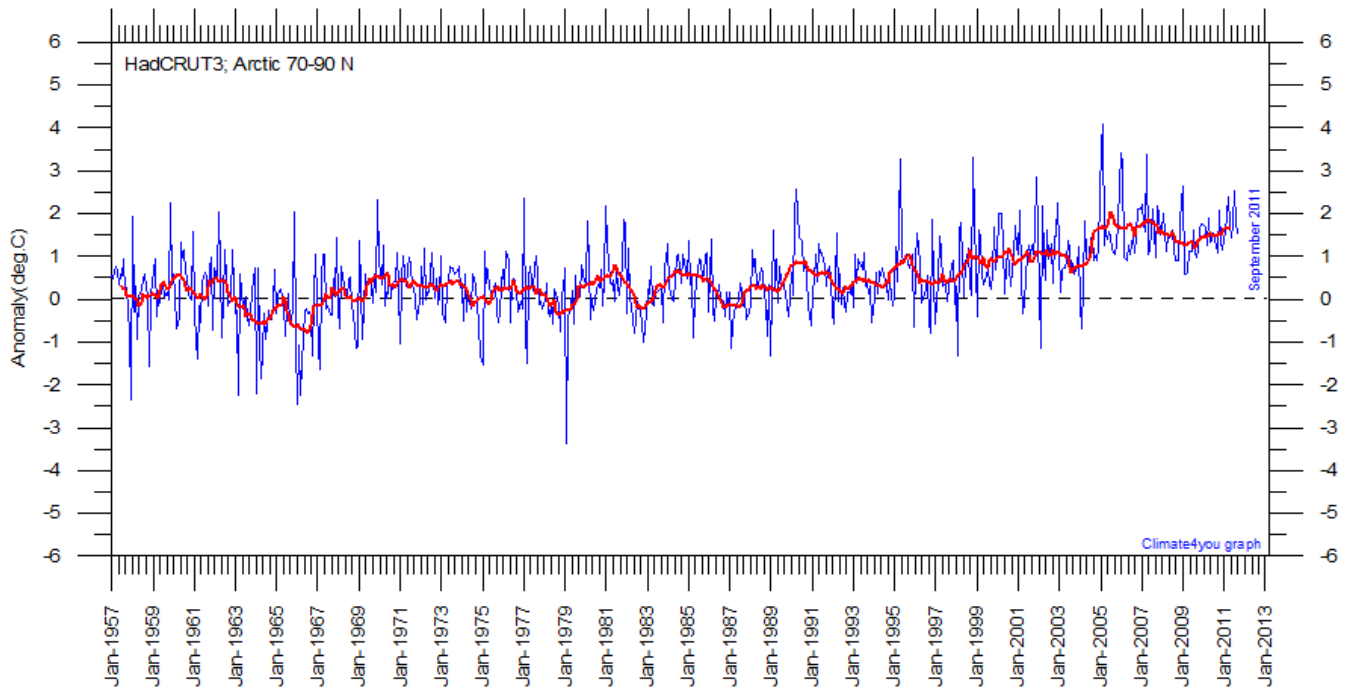


Diagram showing Arctic monthly surface air temperature anomaly 70-90°N since January 1957, in relation to the WMO reference “normal” period 1961-1990. The year 1957 has been chosen as starting year, to ensure easy comparison with the maximum length of the realistic Antarctic temperature record shown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

13

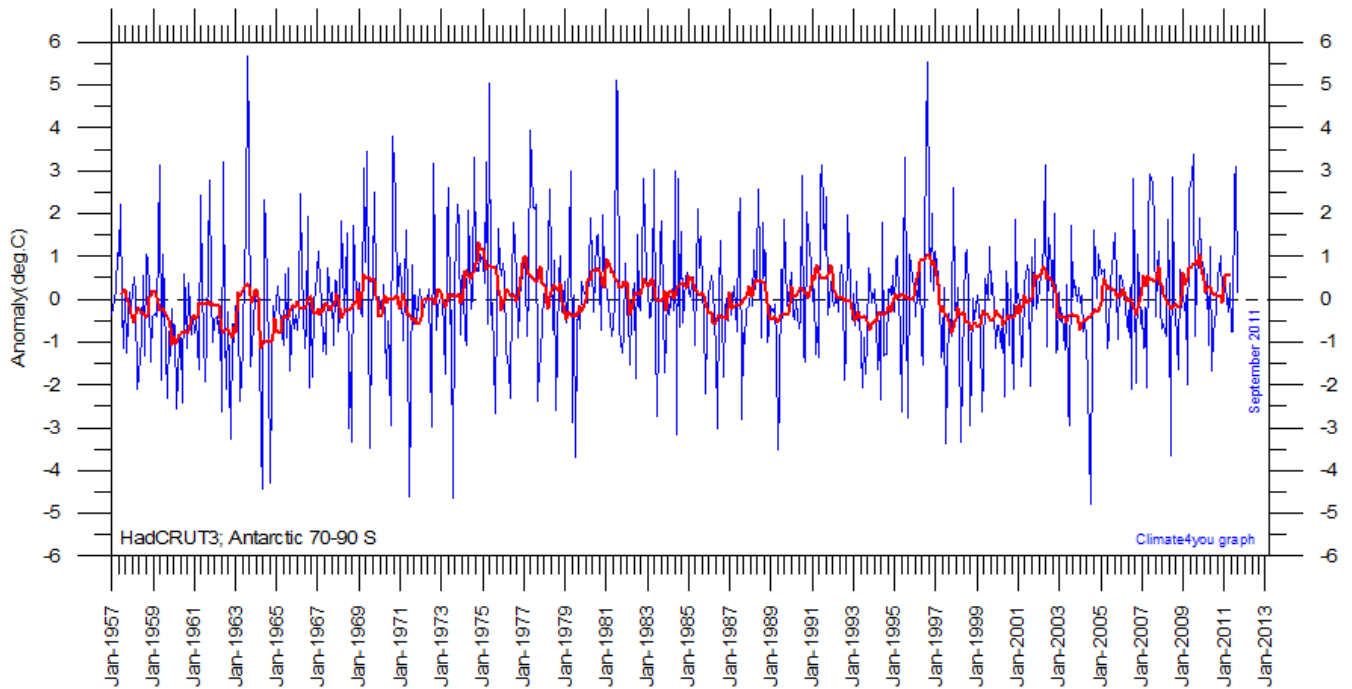


Diagram showing Antarctic monthly surface air temperature anomaly 70-90°S since January 1957, in relation to the WMO reference “normal” period 1961-1990. The year 1957 was an international geophysical year, and several meteorological stations were established in the Antarctic because of this. Before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

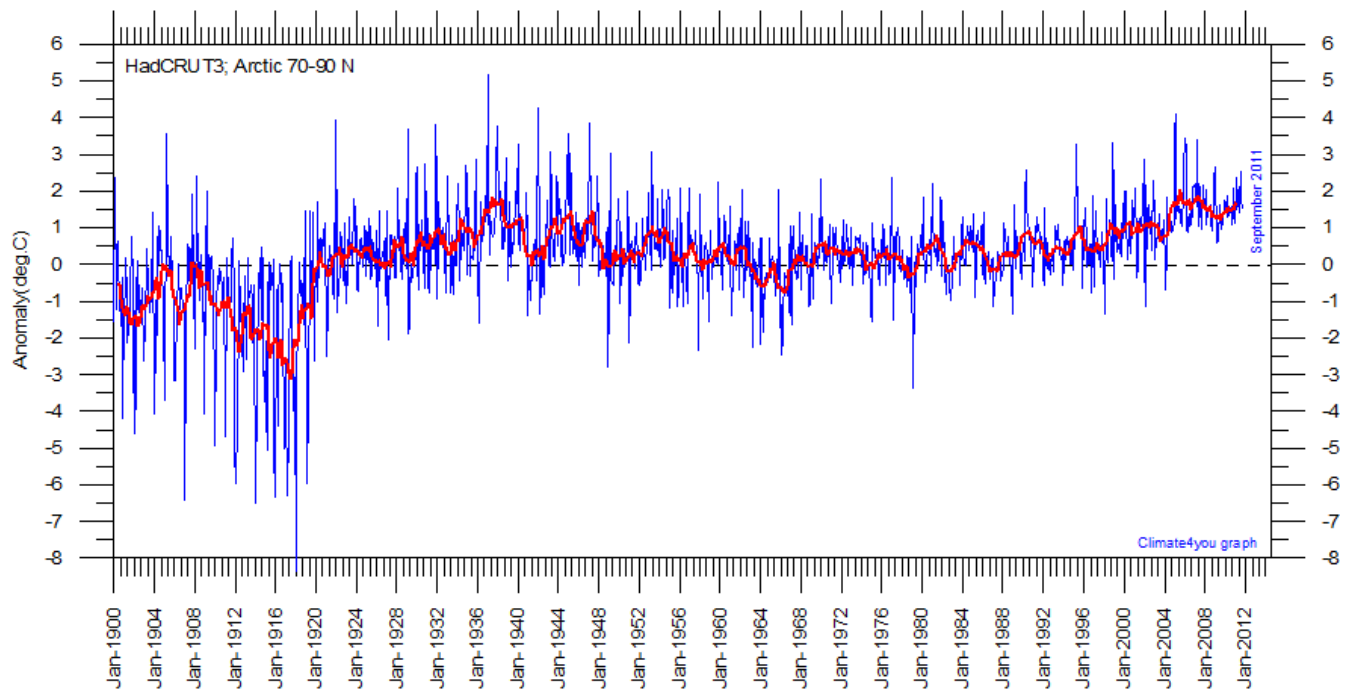


Diagram showing Arctic monthly surface air temperature anomaly 70-90°N since January 1900, in relation to the WMO reference “normal” period 1961-1990. The thin blue line shows the monthly temperature anomaly, while the thicker red line shows the running 13 month average. In general, the range of monthly 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.

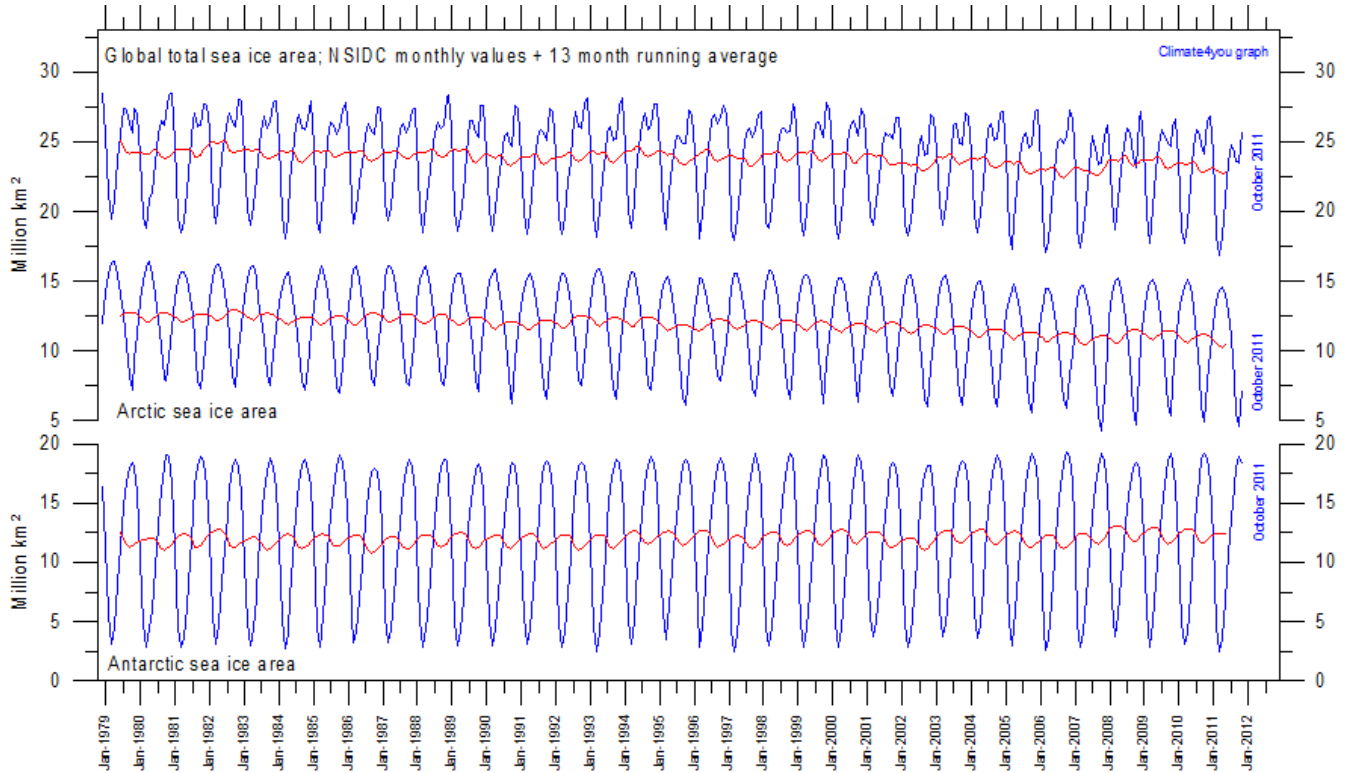
As data coverage is sparse in the Polar Regions, the procedure of Gillett et al. 2008 has been followed, giving equal weight to data in each 5°x5° grid cell when

calculating means, with no weighting by the surface areas of the individual grid cells.

Literature:

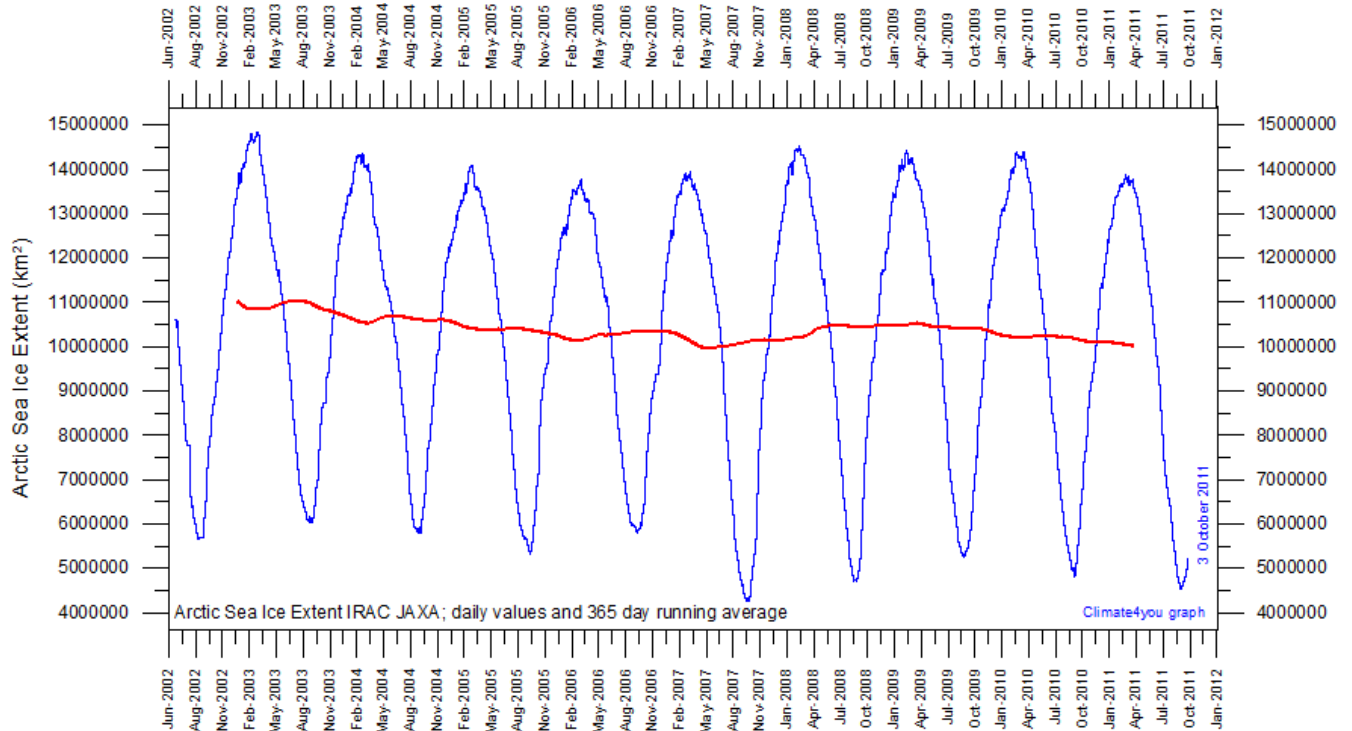
Gillett, N.P., Stone, D.A., Stott, P.A., Nozawa, T., Karpechko, A.Y.U., Hegerl, G.C., Wehner, M.F. and Jones, P.D. 2008. Attribution of polar warming to human influence. *Nature Geoscience* 1, 750-754.

Arctic and Antarctic sea ice, updated to October 2011



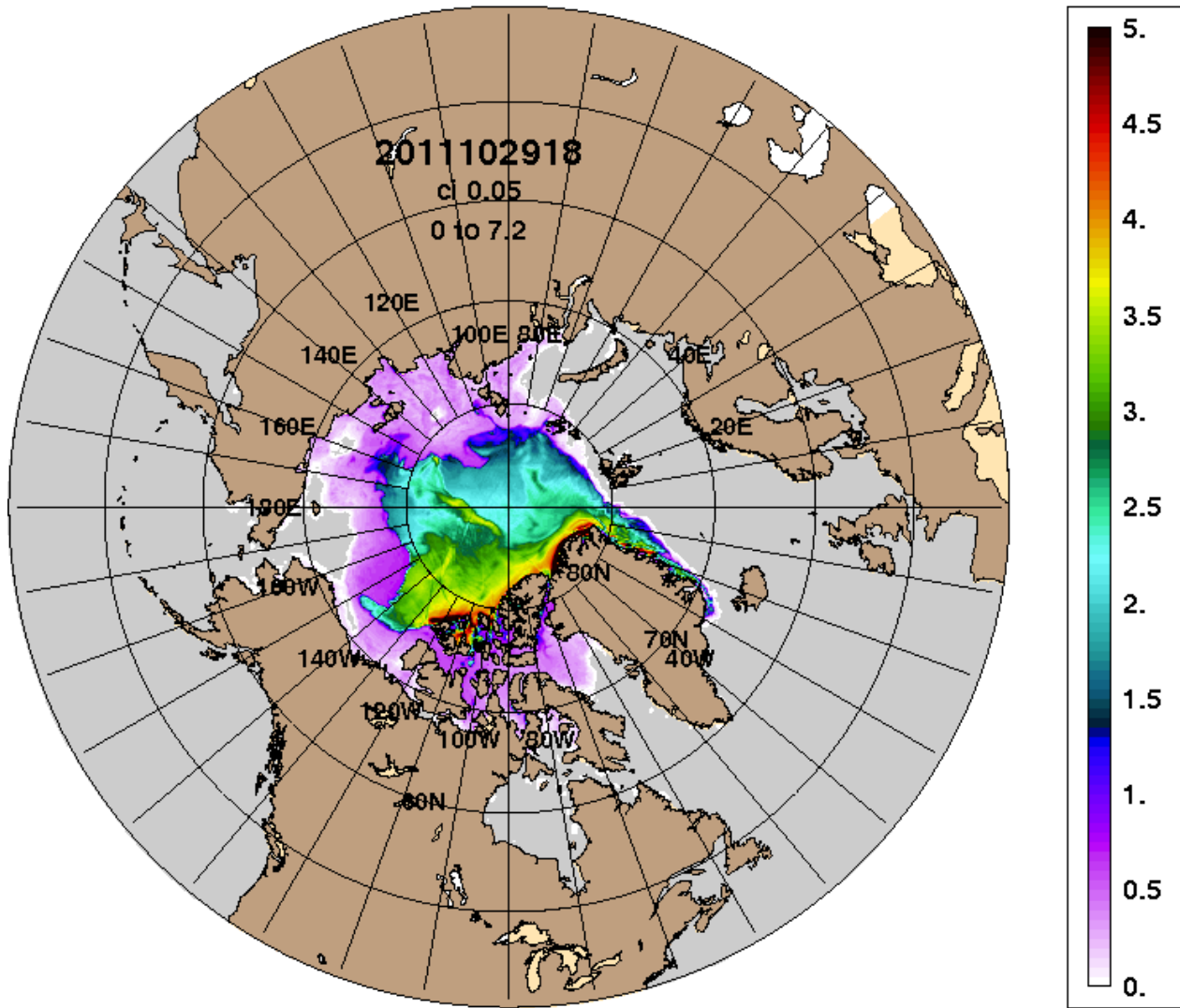
Graphs showing monthly Antarctic, Arctic and global sea ice extent since November 1978, according to the [National Snow and Ice data Center \(NSIDC\)](#).

15



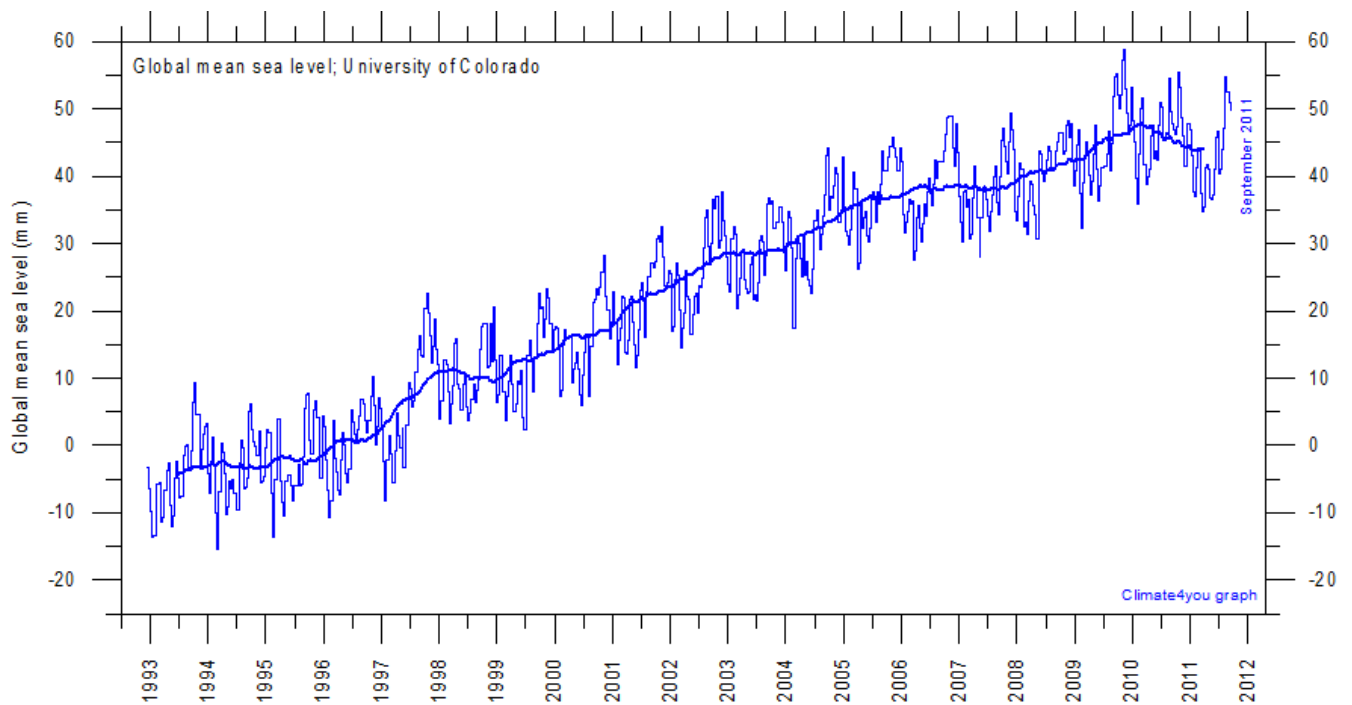
Graph showing daily Arctic sea ice extent since June 2002, to October 3, 2011, by courtesy of [Japan Aerospace Exploration Agency \(JAXA\)](#). Please note that this diagram is not updated beyond 3 October 2011 due to the suspension of AMSR-E observation.

ARCc0.08-03.5 Ice Thickness: 20111030



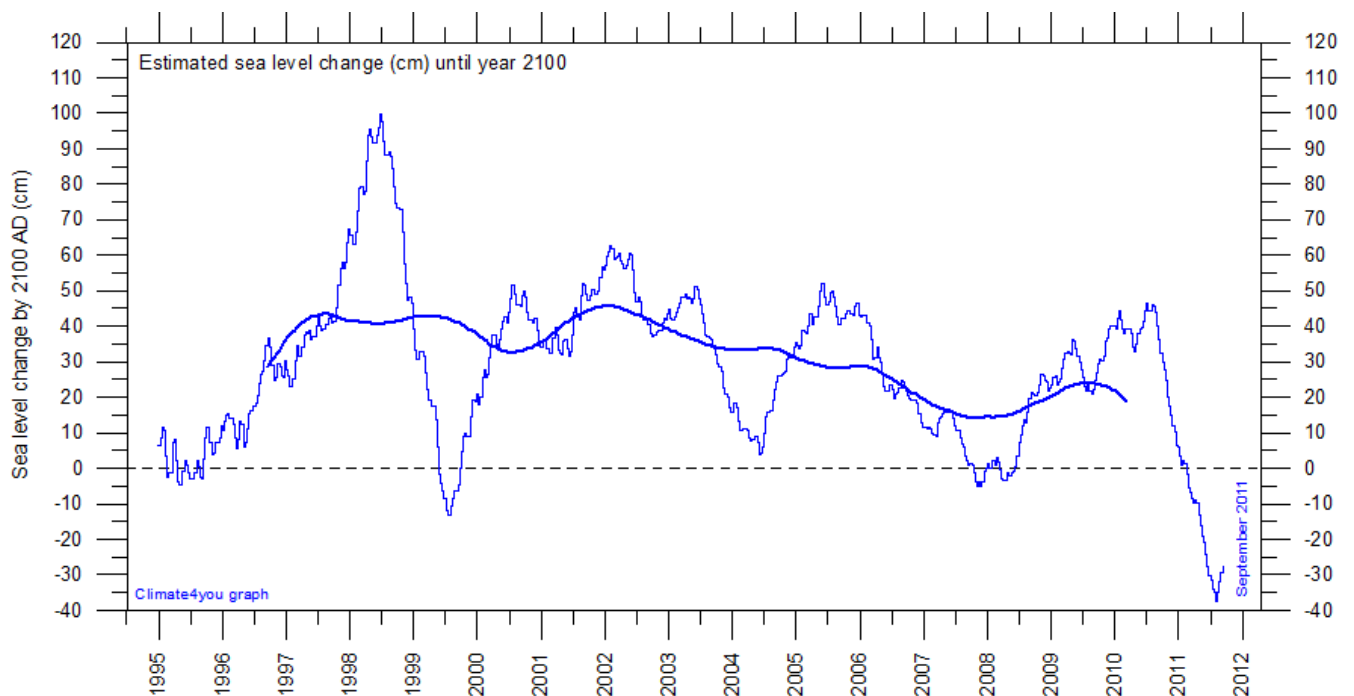
Northern hemisphere sea ice thickness on 30 October 2011 according to the [Arctic Cap Nowcast/Forecast System \(ACNFS\)](#), US Naval Research Laboratory. Thickness scale (m) is shown to the right.

Global sea level, updated to September 2011



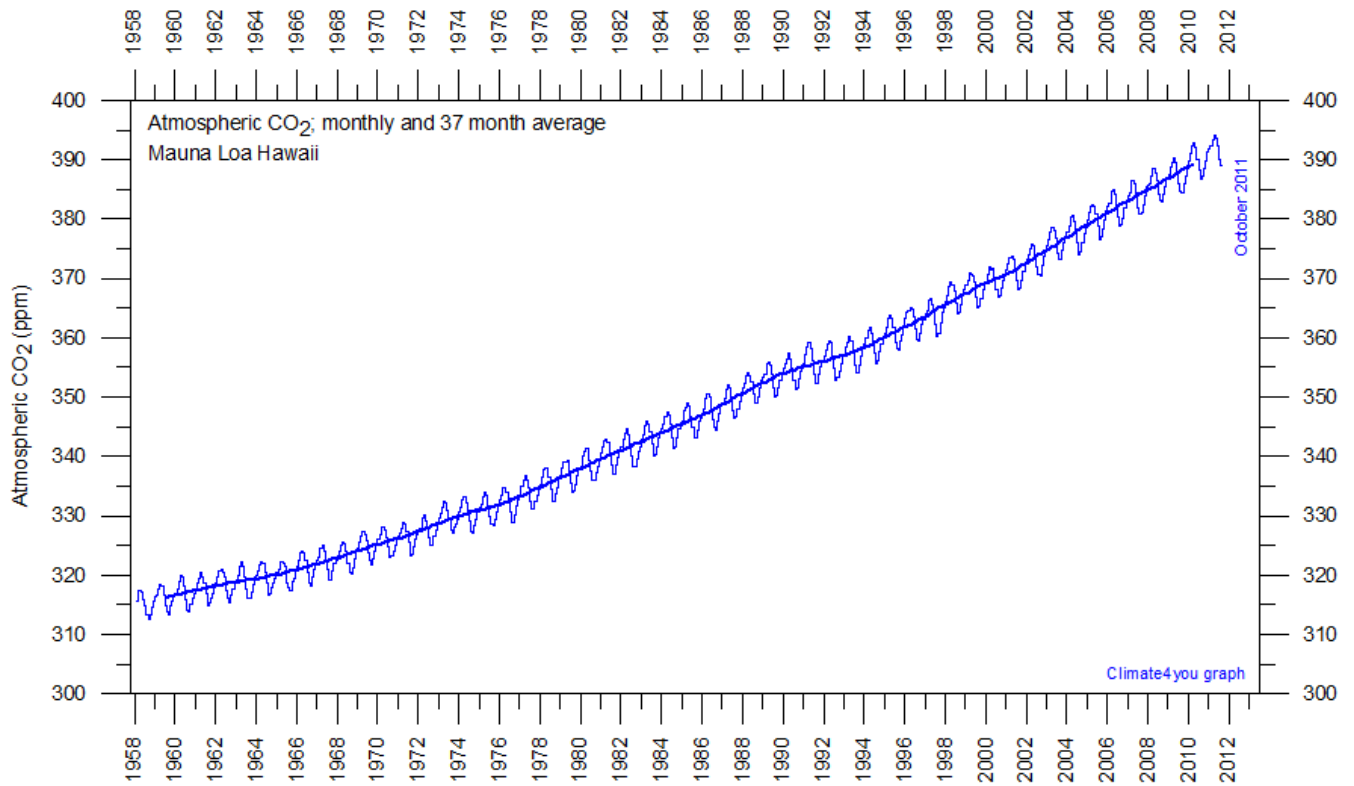
Global monthly sea level since late 1992 according to the Colorado Center for Astroynamics Research at [University of Colorado at Boulder](#), USA. The thick line is the simple running 37 observation average, nearly corresponding to a running 3 yr average.

17

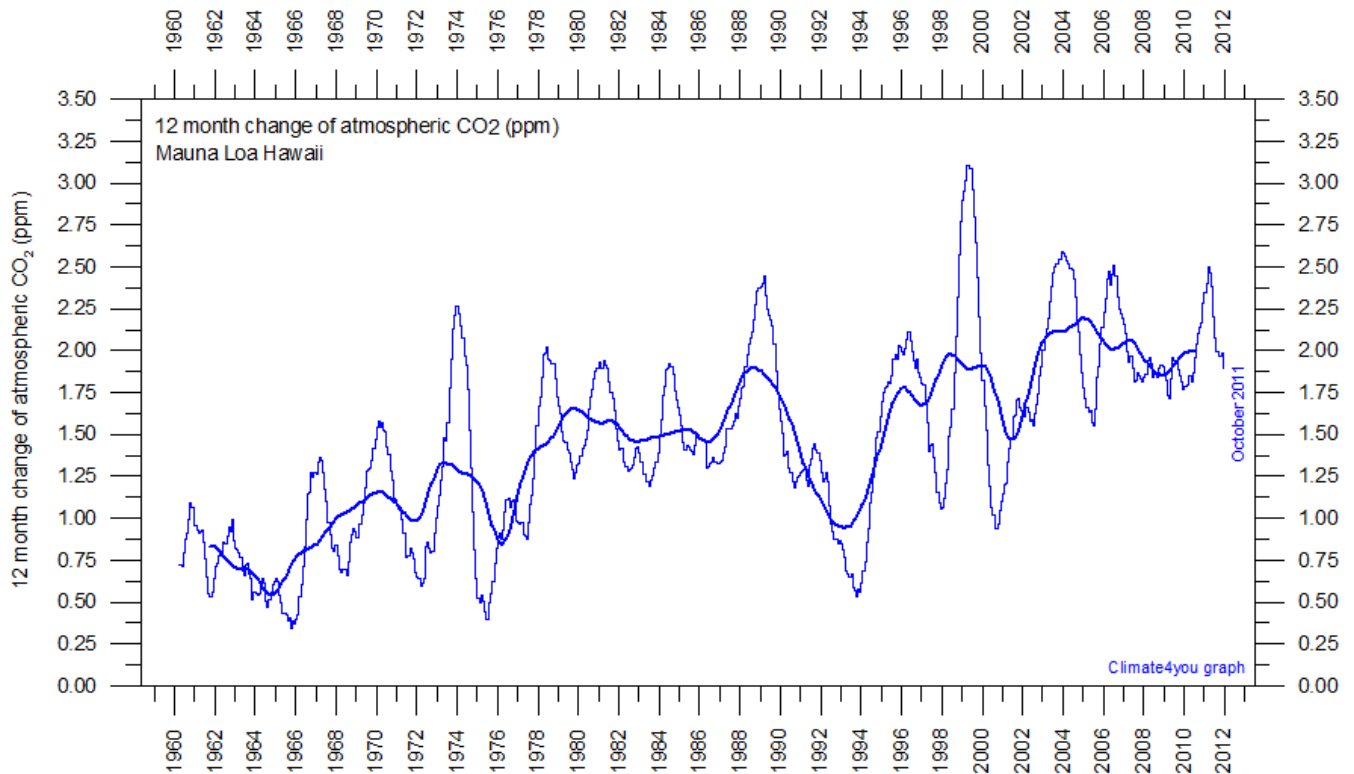


Forecasted change of global sea level until year 2100, based on simple extrapolation of measurements done by the Colorado Center for Astroynamics Research at [University of Colorado at Boulder](#), USA. The thick line is the simple running 3 yr average forecast for sea level change until year 2100. Based on this (thick line), the present empirical forecast of sea level change until 2100 is about +20 cm.

Atmospheric CO₂, updated to October 2011

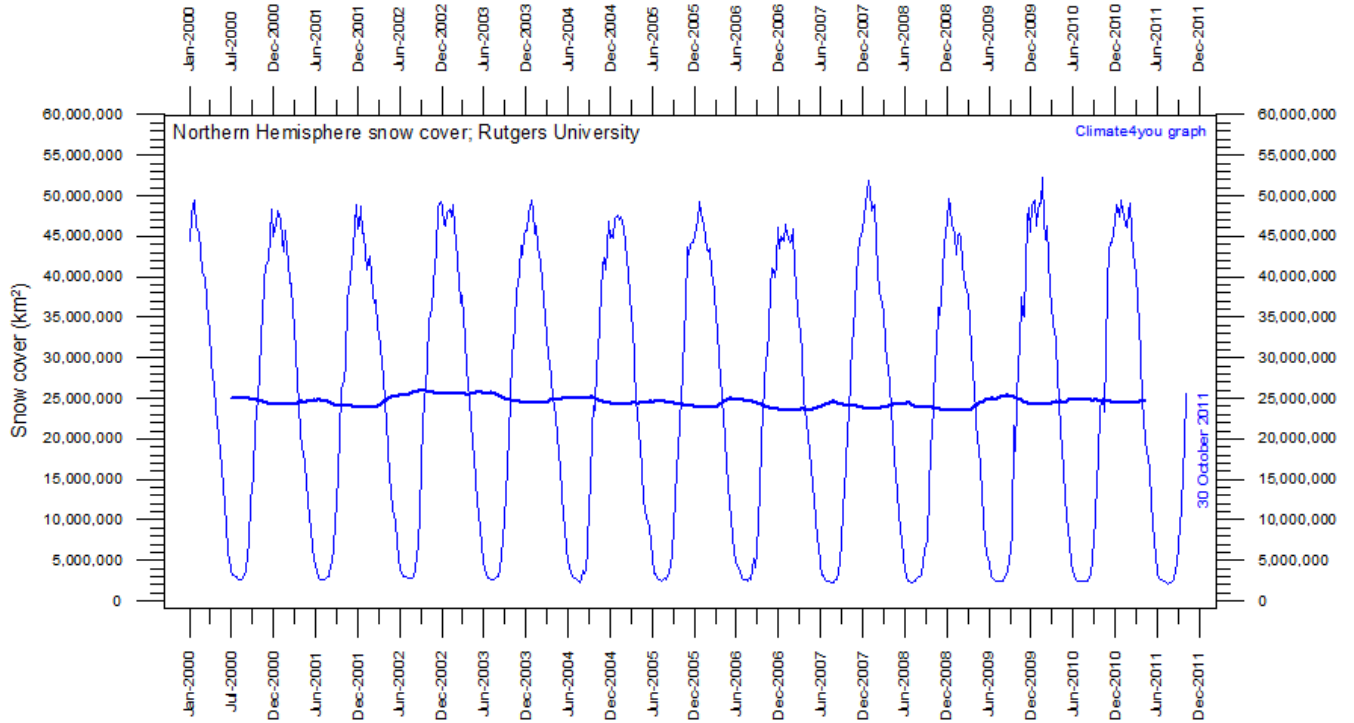


18



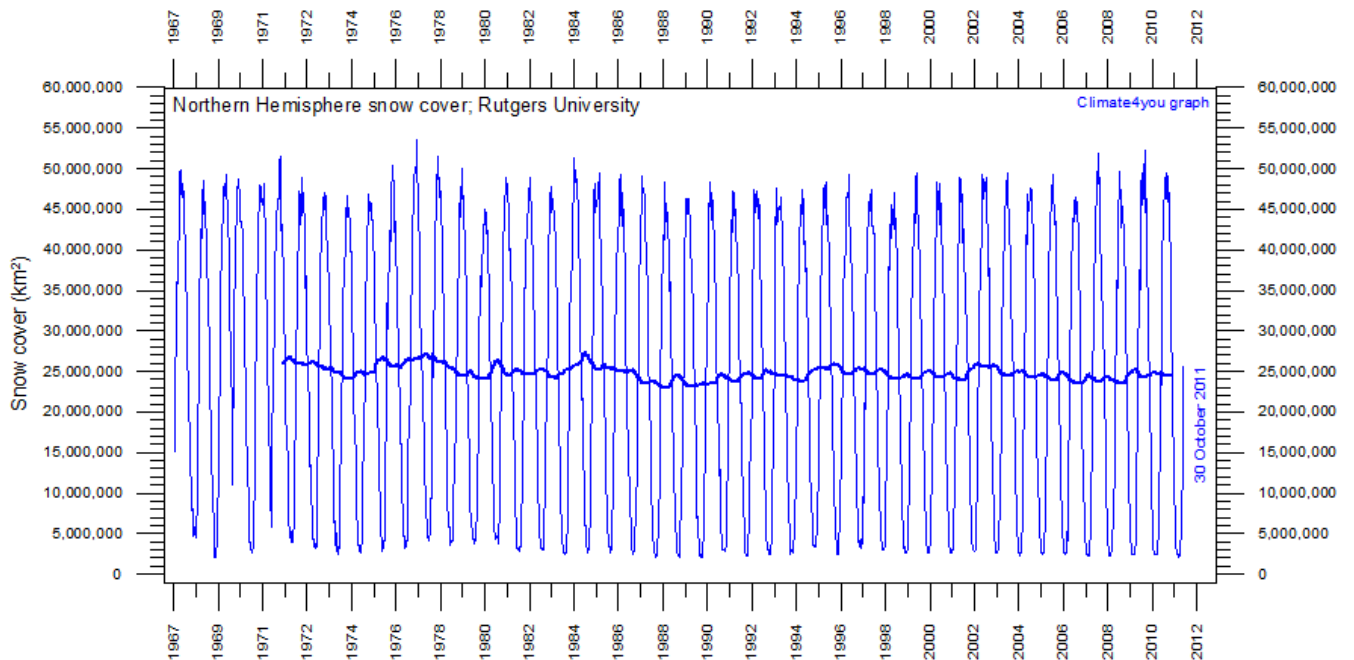
Monthly amount of atmospheric CO₂ (above) and annual growth rate (below; average last 12 months minus average preceding 12 months) of atmospheric CO₂ since 1959, according to data provided by the [Mauna Loa Observatory](#), Hawaii, USA. The thick line is the simple running 37 observation average, nearly corresponding to a running 3 yr average.

Northern Hemisphere weekly snow cover, updated to the end of October 2011



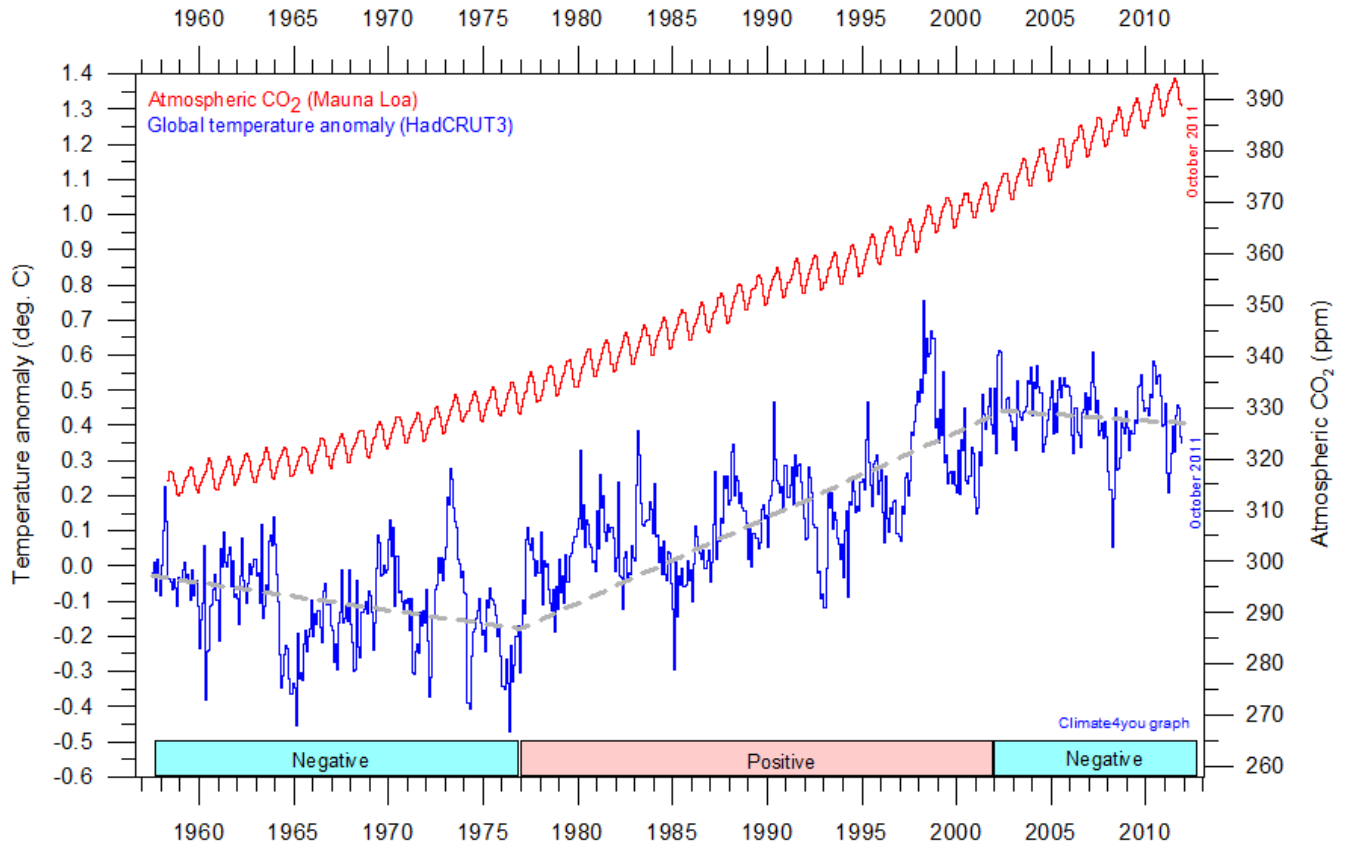
Northern hemisphere weekly snow cover since January 2000 according to Rutgers University Global Snow Laboratory. The thin line is the weekly data, and the thick line is the running 53 week average (approximately 1 year).

19

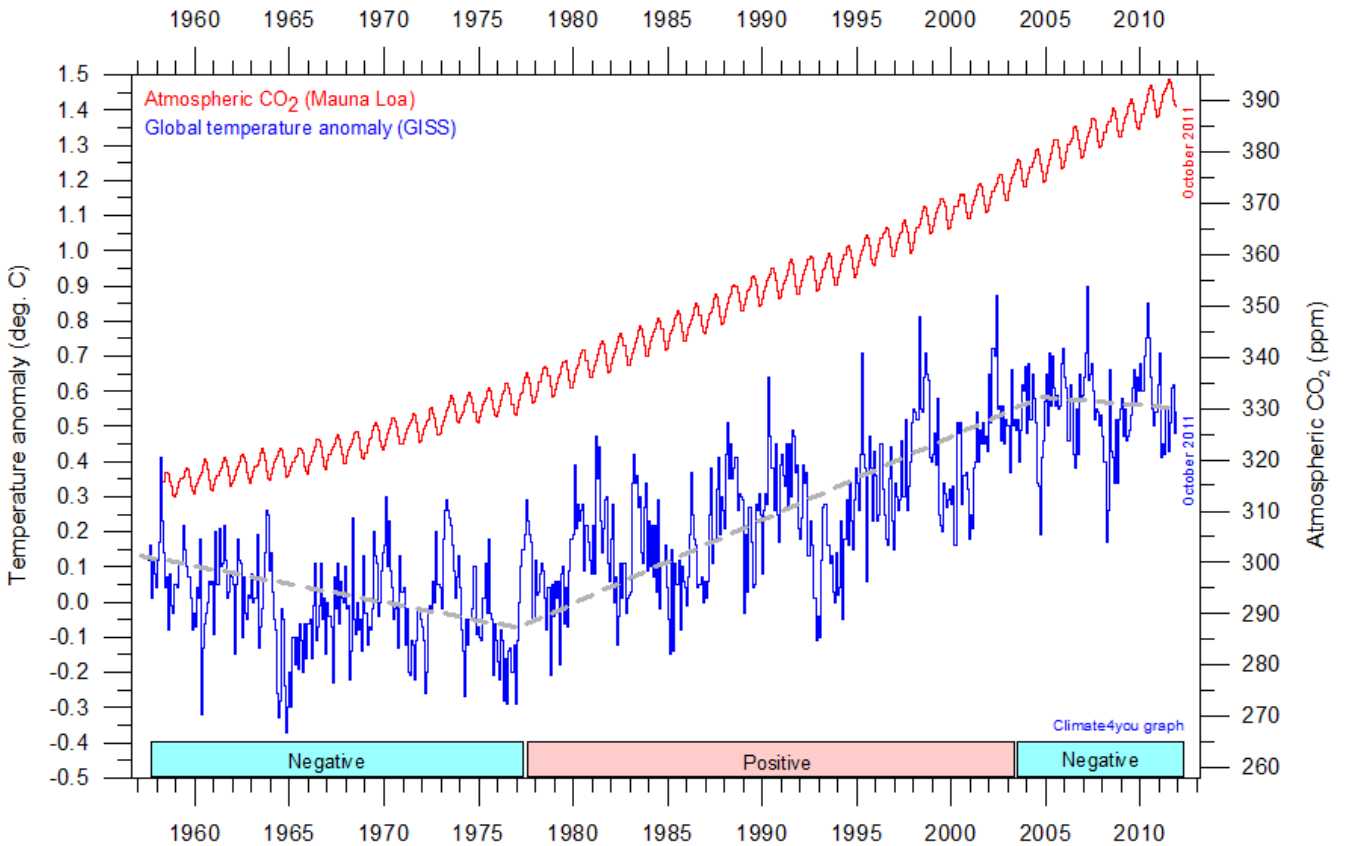


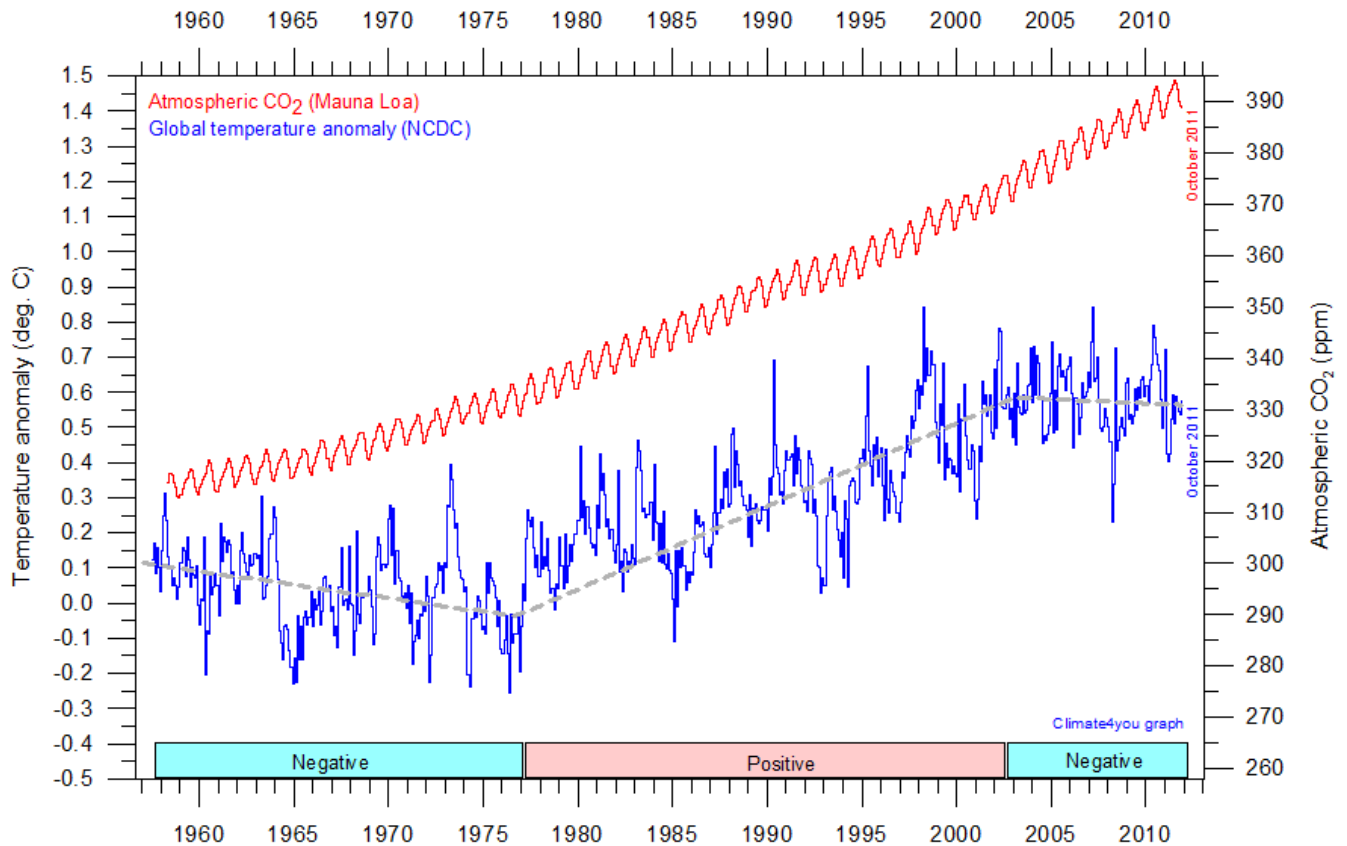
Northern hemisphere weekly snow cover since October 1966 according to Rutgers University Global Snow Laboratory. The thin line is the weekly data, and the thick line is the running 53 week average (approximately 1 year). The running average is not calculated before 1971 because of some data irregularities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

Global surface air temperature and atmospheric CO₂, updated to October 2011



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Diagrams showing HadCRUT3, GISS, and NCDC monthly global surface air temperature estimates (blue) and the monthly atmospheric CO₂ 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 CO₂ concentrations (before 1958) are not incorporated in this diagram, as such past CO₂ 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 CO₂ and global surface air temperature, negative or positive.

Most climate models assume the greenhouse gas carbon dioxide CO₂ to influence significantly upon global temperature. Thus, it is relevant to compare the different global temperature records with measurements of atmospheric CO₂, 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 CO₂ 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

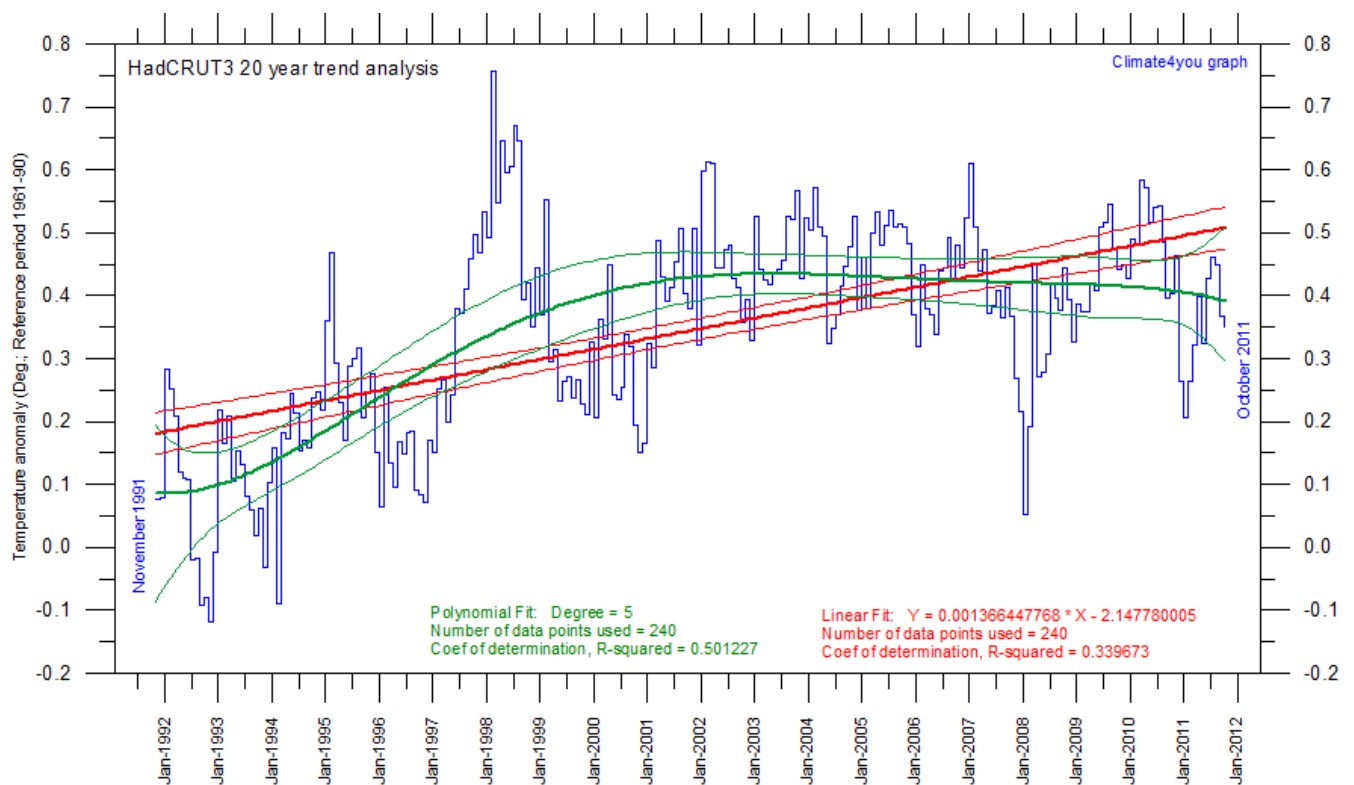
ascribing high importance of atmospheric CO₂ for global temperatures. Any such short-period meteorological record value may well be the result of other phenomena than atmospheric CO₂.

What exactly defines the critical length of a relevant time period to consider for evaluating the alleged high importance of CO₂ remains elusive. However, the length of the critical period must be inversely proportional to the importance of CO₂ on the global temperature, including possible feedback effects. So if the net effect of CO₂ 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 in 1988 felt intuitively that their empirical and theoretical understanding of climate dynamics was sufficient to conclude about the high importance of CO₂ for global temperature. However, for obtaining public and political support for the CO₂-hypothesis the 10 year warming period

leading up to 1988 in all likelihood was important. Had the global temperature instead been decreasing, political and public support for the CO₂-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 CO₂ has been indicated in the lower panels of the three diagrams above.

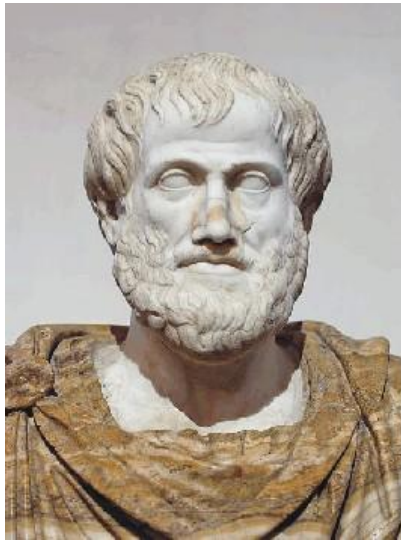
Last 20 year surface temperature changes, updated to October 2011



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. Last month included in analysis: October 2011.

From time to time it is debated if the global surface temperature is increasing, or if the temperature has leveled out during the last 10-15 years. The above diagram may be useful in this context. If nothing else, it demonstrates the differences between two different statistical approaches to determine recent temperature trends.

384-322 BC; Aristotle's views on weather and climate



Marble bust of Aristotle (left). Roman copy after a Greek bronze original by [Lysippus](#) c. 330 BC. Geocentric celestial spheres (center); Peter Apian's *Cosmographia* (Antwerp, 1539). Right picture: Plato (left) and Aristotle (right), a detail of [The School of Athens](#), a fresco by [Raphael](#). Aristotle gestures to the earth, representing his belief in knowledge through empirical observation and experience, while holding a copy of his [Nicomachean Ethics](#) in his hand, whilst Plato gestures to the heavens, representing his belief in [The Forms](#).

Aristotle (384-322 BC) was a Greek philosopher, a student of [Plato](#) and later teacher of [Alexander the Great](#). Aristotle is one of the most important founding figures in Western philosophy, and his views on the physical sciences profoundly shaped medieval scholarship, and their influence extended well into the Renaissance, although they were ultimately replaced by Newtonian physics. Much of the summary below is adopted from different sources in [Wikipedia](#) and from [Rasmussen 2010](#), from where additional information is available.

Aristotle was born in Stageira in 384 BC, about 55 km east of the modern-day city Thessalonika. His father Nicomachus was the personal physician to [King Amyntas of Macedon](#). Aristotle was trained and educated as a member of the aristocracy. At about the age of eighteen, he went to Athens to continue his education at [Plato's Academy](#). Aristotle remained at the academy for nearly twenty years before quitting Athens in 348/47 BC, and traveling to Asia Minor, where he studied botany and

zoology. In 343 BC Aristotle was invited by [Philip II of Macedon](#) to become the tutor to his son [Alexander the Great](#). Aristotle was appointed as the head of the royal academy of Macedon and gave lessons not only to Alexander, but also to two other future kings: [Ptolemy](#) and [Cassander](#). By 335 BC he had returned to Athens, establishing his own school there known as the [Lyceum](#), where he conducted courses at for the next twelve years. It is during this period in Athens from 335 to 323 BC when Aristotle is believed to have composed many of his works.

Aristotle studied almost every subject possible at the time, and made significant contributions to most of them. In physical science, Aristotle studied anatomy, astronomy, embryology, geography, geology, meteorology, physics and zoology. In philosophy, he wrote on aesthetics, ethics, government, metaphysics, politics, economics, psychology, rhetoric and theology. He also studied education, foreign customs, literature and poetry.

His combined works constitute a virtual encyclopedia of Greek knowledge. It has been suggested that Aristotle was probably the last person to know everything there was to be known in his own time. Like his teacher Plato, Aristotle's philosophy was aiming at the universal. Aristotle, however, found the universal in particular things, which he called the essence of things. Aristotle's method is both inductive and deductive, while Plato's is essentially deductive from a priori principles.

In 350 BC Aristotle wrote a treatise entitled '[Meteorologica](#)', which probably is the first attempt ever to make a comprehensive about the earth sciences, including [meteorology](#). '[Meteorologica](#)' consists of four books, including early accounts of water evaporation, weather phenomena, and earthquakes, and was considered a benchmark publication for more than 2000 years. Interesting enough, Aristotle expected clouds to consist of water. In chapter (part) nine in his first book, he directly states that '*air condensing into water is cloud*'.

In '[Meteorologica](#)' Aristotle presents a number of interesting interpretations concerning different phenomena related to the Earth, atmosphere, clouds weather, climate and climate change effects:

Earth, Sun and atmosphere

- *The earth is surrounded by water, just as that is by the sphere of air, and that again by the sphere called that of fire.*
- *...four bodies are fire, air, water, earth.*
- *Fire occupies the highest place among them all, earth the lowest, and two elements correspond to these in their relation to one another, air being nearest to fire, water to earth.*
- *...the motion of these latter bodies [of four] being of two kinds: either from the centre or to the centre.*
- *Fire, air, water, earth, we assert, originate from one another, and each of them exists potentially in each, as all things do that can be resolved into a common and ultimate substrate.*
- *The efficient and chief and first cause is the circle in which the sun moves. For the sun as it approaches or recedes, obviously causes dissipation and condensation and so gives rise to generation and destruction.*

Clouds and rain

- *Now the earth remains but the moisture surrounding it is made to evaporate by the sun's rays and the other heat from above, and rises. But when the heat which was raising it leaves it, in part dispersing to the higher region, in part quenched through rising so far into the upper air, then the vapour cools because its heat is gone and because the place is cold, and condenses again and turns from air into water. And after the water has formed it falls down again to the earth.*
- *Since water is generated from air, and air from water, why are clouds not formed in the upper air? They ought to form there the more, the further from the earth and the colder that region is. For it is neither appreciably near to the heat of the stars, nor to the rays reflected from the earth. It is these that dissolve any formation by their heat and so prevent clouds from forming near the earth. For clouds gather at the point where the reflected rays disperse in the infinity of space and are lost. To explain this we must suppose either that it is not all air which water is generated, or, if it is produced from all air alike, that what immediately surrounds the earth is not mere air, but a sort of vapour, and that its vaporous nature is the reason why it condenses back to water again.*
- *However, it may well be that the formation of clouds in that upper region is also prevented by the circular motion. For the air round the earth is necessarily all of it in motion, except that which is cut off inside the circumference which makes the earth a complete sphere. In the case of winds it is actually observable that they originate in marshy districts of the earth; and they do not seem to blow above the level of the highest mountains. It is the revolution of the heaven which carries the air with it and causes its circular motion, fire being continuous with the upper element and air with fire. Thus its motion is a second reason why that air is not condensed into water.*
- *The exhalation of water is vapour: air condensing into water is cloud. Mist is what is left over when a cloud condenses into water, and is therefore rather a sign of fine weather than of rain; for mist might be called a barren cloud. So we get a circular process that follows the course of the sun. For according as the sun moves to this side or that, the moisture in this process rises or falls. We must think of it as a river flowing up and down in a circle and made up partly*

of air, partly of water. When the sun is near, the stream of vapour flows upwards; when it recedes, the stream of water flows down: and the order of sequence, at all events, in this process always remains the same. So if 'Oceanus' had some secret meaning in early writers, perhaps they may have meant this river that flows in a circle about the earth.

- *So the moisture is always raised by the heat and descends to the earth again when it gets cold. These processes and, in some cases, their varieties are distinguished by special names. When the water falls in small drops it is called a drizzle; when the drops are larger it is rain.*

Water vapour, dew and hoar-frost

- *Some of the vapour that is formed by day does not rise high because the ratio of the fire that is raising it to the water that is being raised is small*
- *Both dew and hoar-frost are found when the sky is clear and there is no wind. For the vapour could not be raised unless the sky were clear, and if a wind were blowing it could not condense.*
- *...hoar-frost is not found on mountains contributes to prove that these phenomena occur because the vapour does not rise high. One reason for this is that it rises from hollow and watery places, so that the heat that is raising it, bearing as it were too heavy a burden cannot lift it to a great height but soon lets it fall again.*

Weather

- *When there is a great quantity of exhalation and it is rare and is squeezed out in the cloud itself we get a thunderbolt.*
- *So the whirlwind originates in the failure of an incipient hurricane to escape from its cloud: it is due to the resistance which generates the eddy, and it consists in the spiral which descends to the earth and drags with it the cloud which it cannot shake off. It moves things by its wind in the direction in which it is blowing in a straight line, and whirls round by its circular motion and forcibly snatches up whatever it meets.*

Climate change effects:

- *So it is clear, since there will be no end to time and the world is eternal, that neither the Tanais nor the Nile has always been flowing, but that the region whence they flow was once dry: for their effect may be fulfilled, but time cannot. And this will be equally true of all other rivers. But if rivers come into existence and perish and the same parts of the earth were not always moist, the sea must needs change correspondingly. And if the sea is always advancing in one place and receding in another it is clear that the same parts of the whole earth are not always either sea or land, but that all this changes in course of time.*

Aristotle's writings were never to influence directly on practical meteorology. For many centuries people relied instead on a number of weather rules of thumb, sometimes blended with the assumption of a certain degree of divine interference. One of Aristotle's students, Theophrastus (371-287 BC) succeeded him as a director of the Lyceum in Athens. He took over the philosophy of Aristotle in parts reshaping, commenting, and developing it in an original way. His thinking leads to empiricism by means of observation, collection, and classification.

Theophrastus was years the director of the Lyceum around 35 years and he was a teacher of up to 2000 students. Today he is often considered the "father of botany". In addition, he probably was the first in Europe to discover Sunspots (although observed also independently and much earlier in China). However, he also continued Aristotle's work on meteorology, formulating about 80 weather rules, based entirely on observations. This indicates that empirical meteorology already at this time had reached an advanced stage in Greek science ([Rasmussen 2010](#)).

Later, much of the scientific knowledge acquired and formulated by Aristotle and his students was sadly ignored and forgotten in Europe, and it was not before 1000-1100 AD that it was rediscovered by European scientist, after surviving among Arabian scientists. By this, with a delay of at least 1300 years, the theories and explanations set forth by Aristotle were to gain huge impact on the later European scientific development.

References:

Rasmussen, E.A. 2010. *Vejret gennem 5000 år (Weather through 5000 years). Meteorologiens historie*. Aarhus Universitetsforlag, Århus, Denmark, 367 pp, ISBN 978 87 7934 300 9.

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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