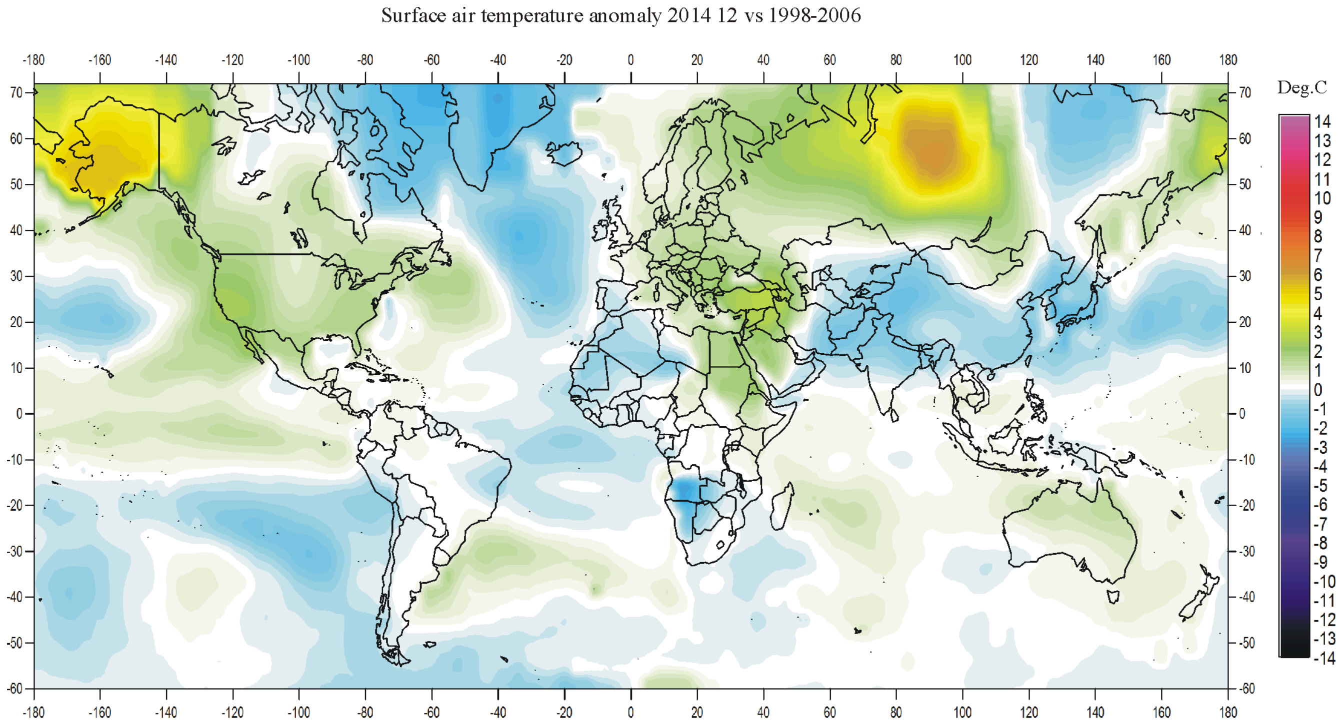
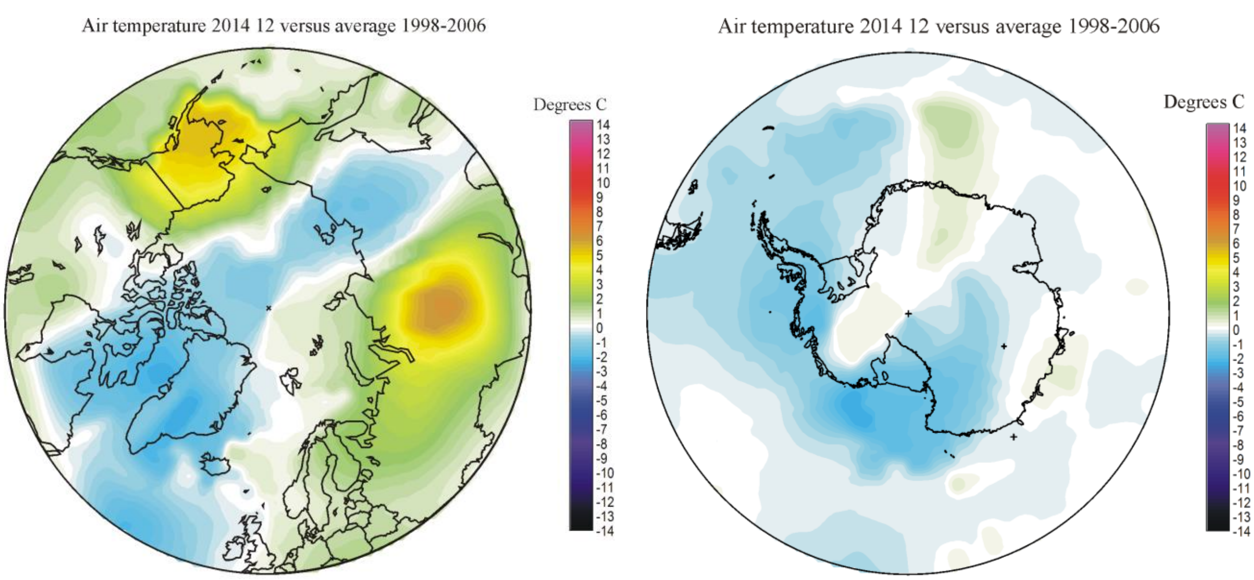
Climate4you update December 2014

Contents:

All diagrams in this newsletter as well as links to the original data are available on www.climate4you.com

December 2014 global surface air temperature overview





December 2014 surface air temperature compared to the 1998-2006 average. 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 December 2014 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 cold period 1945-1980. Most comparisons with such a low average value will therefore appear as 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 the above consideration, the recent temperature development suggests that the time window 1998-2006 may roughly represent a global temperature peak (see, e.g., p. 4-6). However, it might be argued that the time interval 1999-2006 or 2000-2006 would better represent a possible temperature peak period. However, by starting in 1999 (or 2000) the cold La Niña period 1999-2000 would result in a unrealistic low reference temperature by excluding the previous warm El Niño in 1998. These two opposite phenomena must be considered together to obtain a representative reference average, and this why the year 1998 is included in the adopted reference period.

Finally, the GISS temperature data used for preparing the above diagrams show a pronounced temporal instability for data before 1998 (see p. 7). Any comparison with the WMO 'normal' period 1961-1990 is therefore influenced by monthly changing values for the so-called 'normal' period, which is therefore not suited as reference.

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 greater detail on www.Climate4you.com.

December 2014 global surface air temperatures

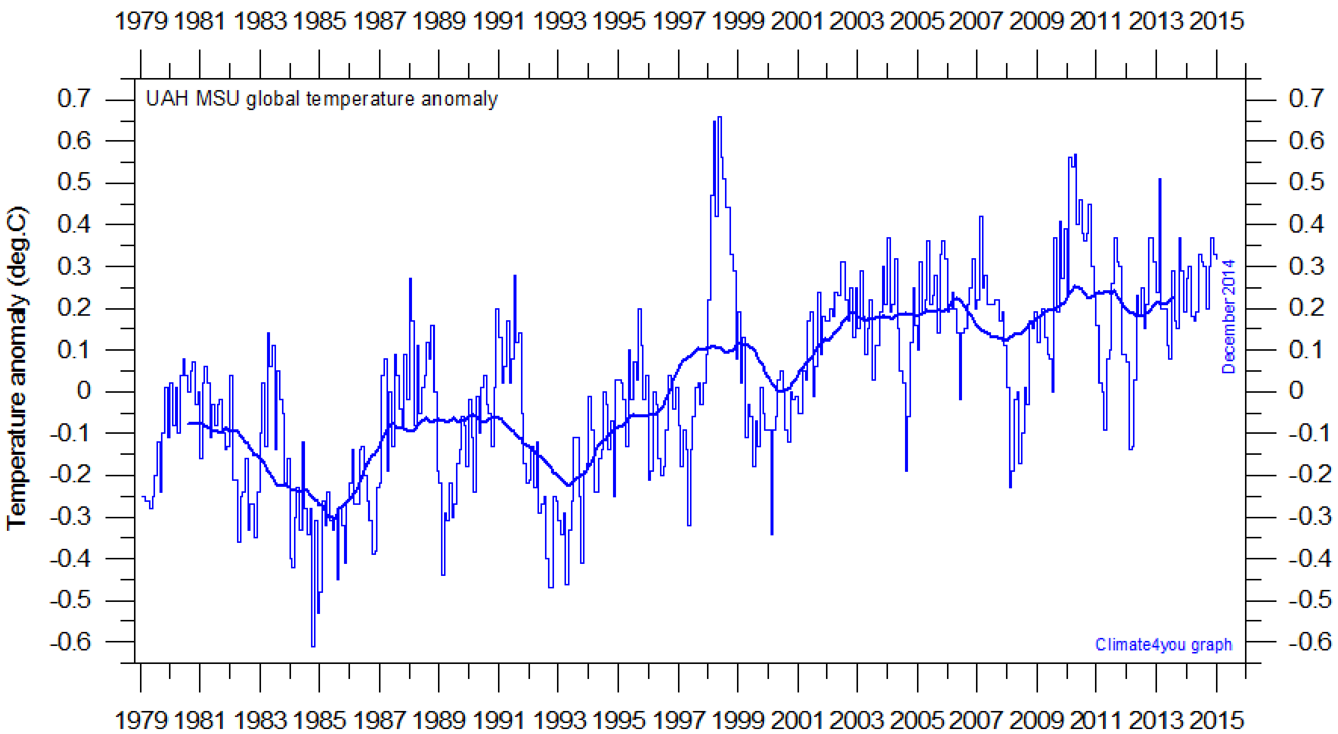
General: In general, the global air temperature was near the 1998-2006 average.

The Northern Hemisphere was characterised by marked regional air temperature contrasts. Alaska and western Siberia had relatively high temperatures. Most of North Atlantic with Greenland and parts of Siberia had below average temperatures. The Arctic was relatively cold in the central Canada – Siberia region, while the Alaska and NW Russia sectors were relatively warm.

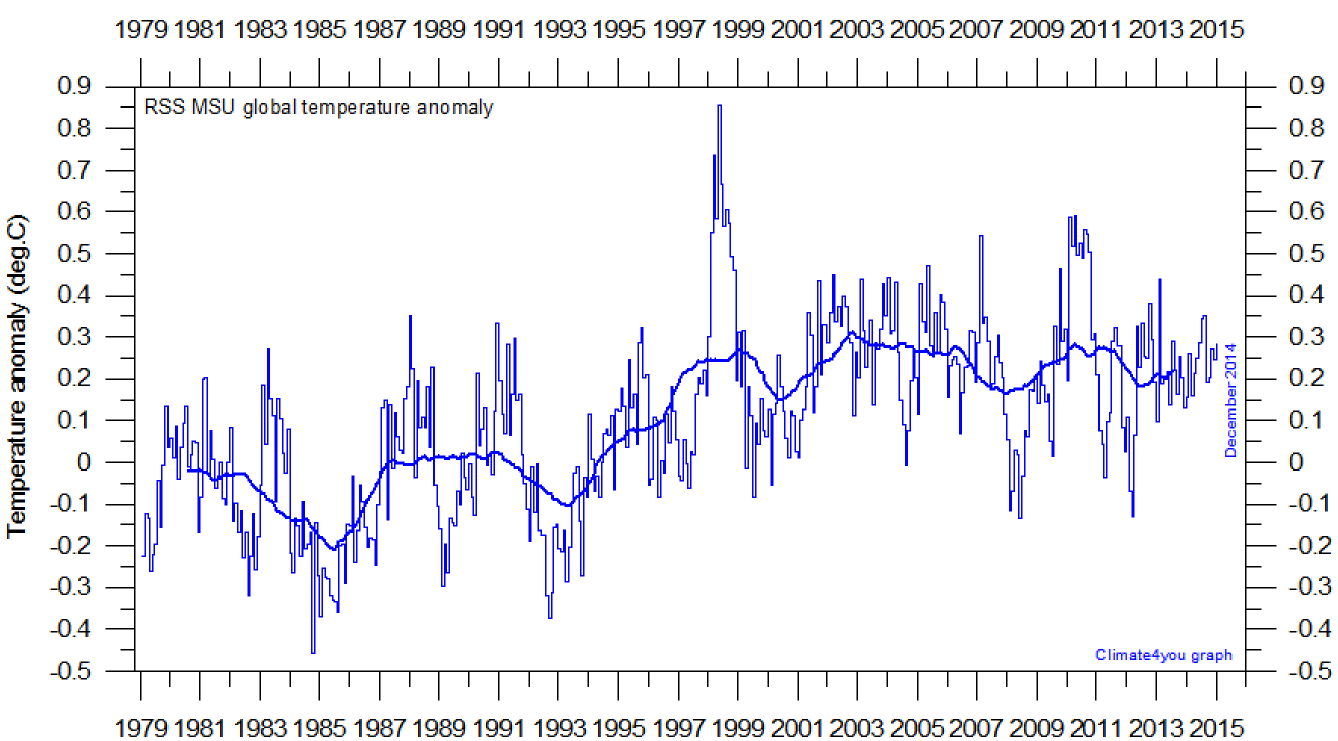
Near the Equator temperatures conditions were generally somewhat above the 1998-2006 average in the Pacific sector, but below average in the Atlantic-Africa sector.

The Southern Hemisphere temperatures were mainly near or below average 1998-2006 conditions. Northern Australia had slightly higher than average temperatures. The Antarctic was mainly at or below average 1998-2006 temperature.

Lower troposphere temperature from satellites, updated to December 2014

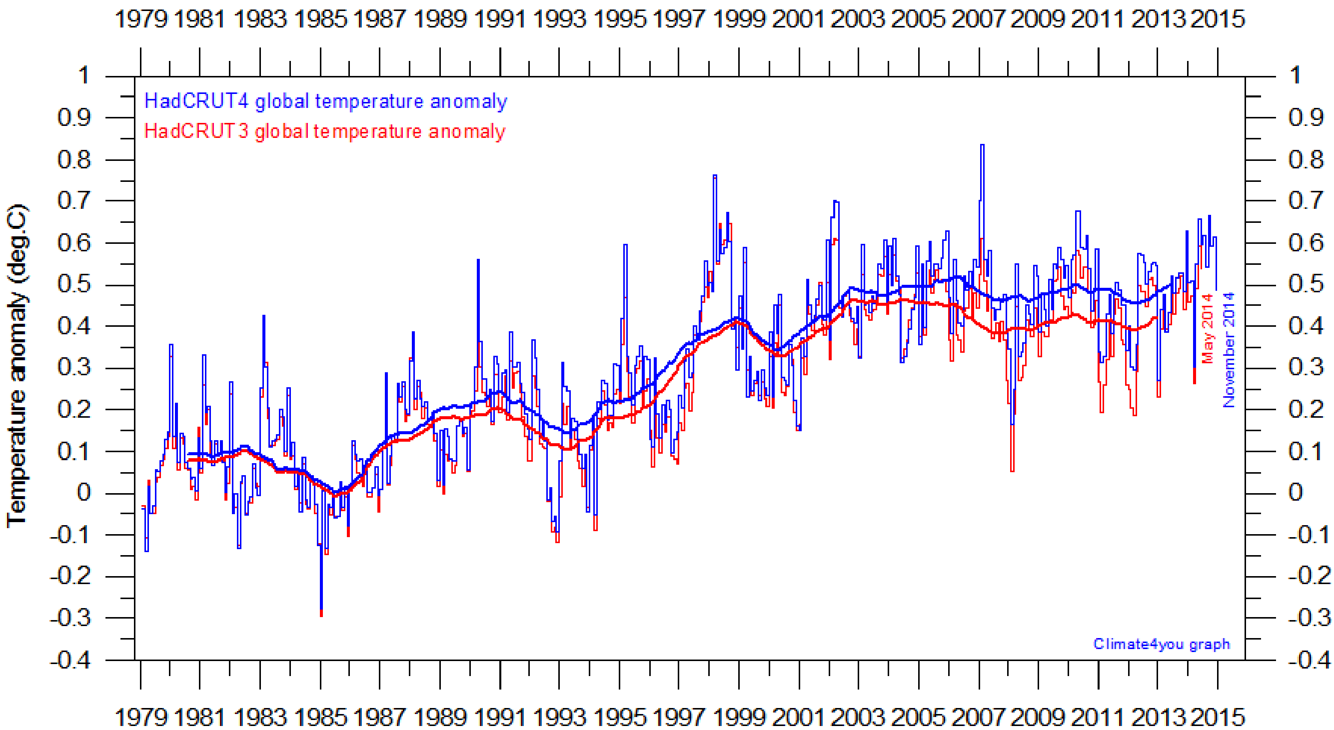


Global monthly average lower troposphere temperature (thin line) since 1979 according to University of Alabama at Huntsville, USA. The thick line is the simple running 37-month average.

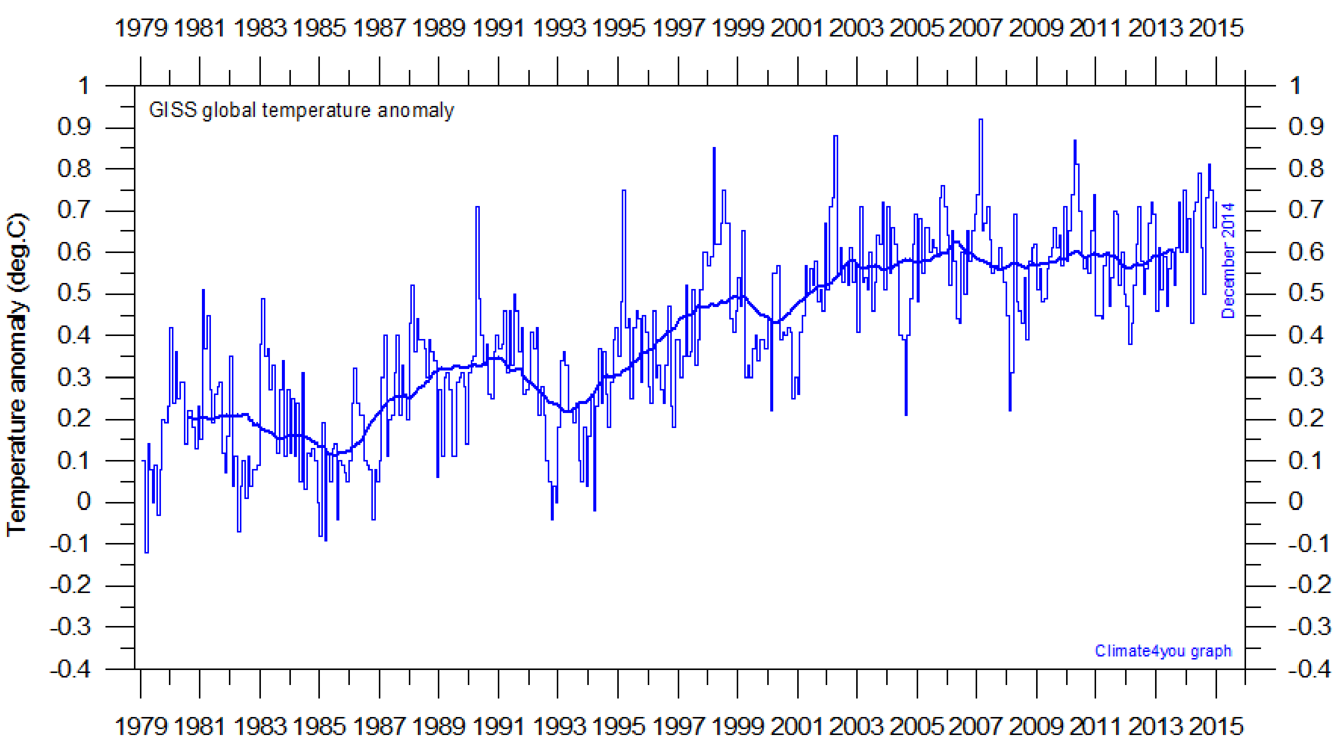


Global monthly average lower troposphere temperature (thin line) since 1979 according to according to Remote Sensing Systems (RSS), USA. The thick line is the simple running 37-month average.

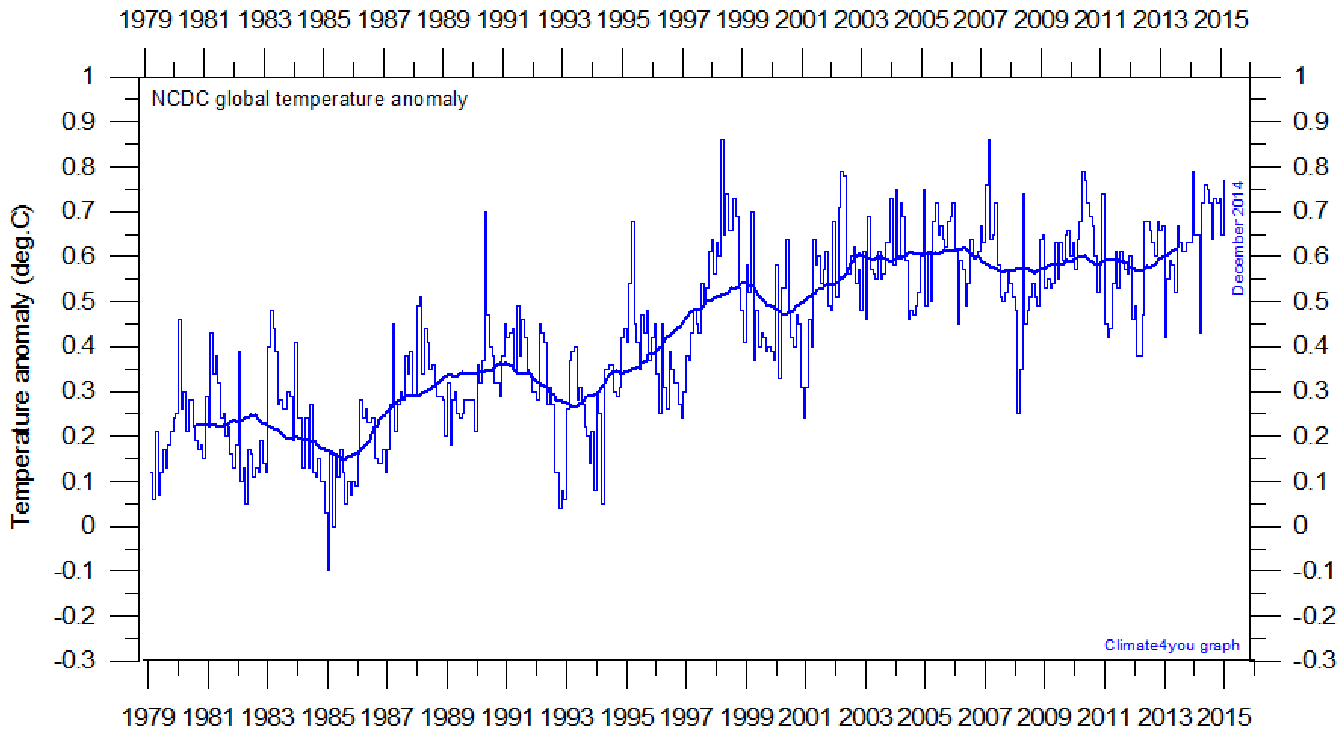
Global surface air temperature, updated to December 2014



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. Version HadCRUT4 (blue) is now replacing HadCRUT3 (red). Please note that this diagram is not yet updated beyond November 2014.



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, more than 100 years ago. Presumably this reflects recognition of errors, changes in the averaging procedure, and the influence of other unknown phenomena.

None of the temperature records are entirely 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 NCDC global surface temperature record for January 1915 and January 2000, illustrating how the difference between the early and late part of the temperature records gradually is growing by administrative adjustments.

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

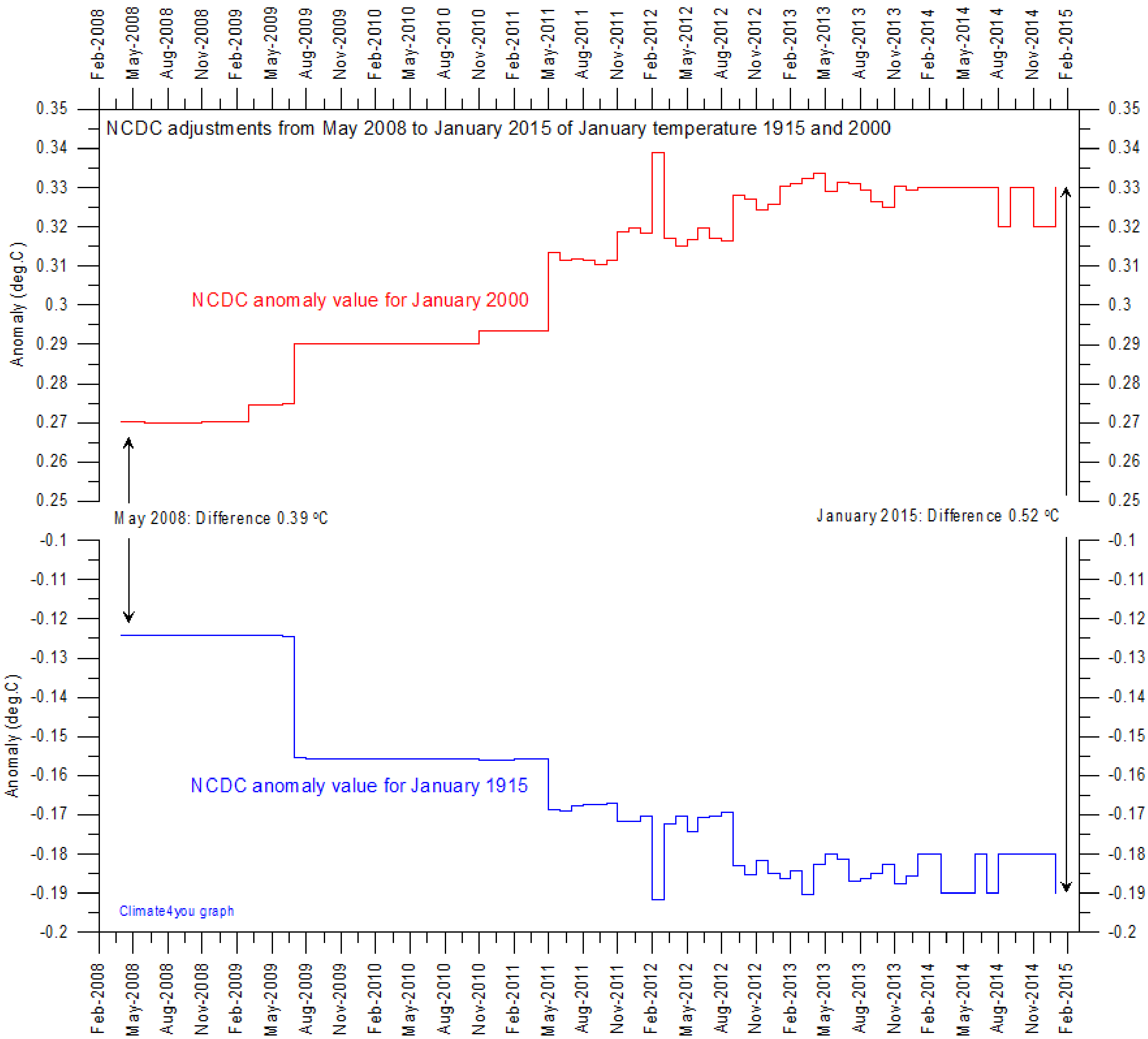


Diagram showing the adjustment made since May 2008 by the [National Climatic Data Center](#) (NCDC) in the anomaly values for the two months January 1915 and January 2000.

Note: The administrative upsurge of the temperature increase between January 1915 and January 2000 has grown from 0.39 (May 2008) to 0.52 ^{o}C (January 2015), representing an about 33% administrative temperature increase over this period.

Global air temperature linear trends updated to November 2014

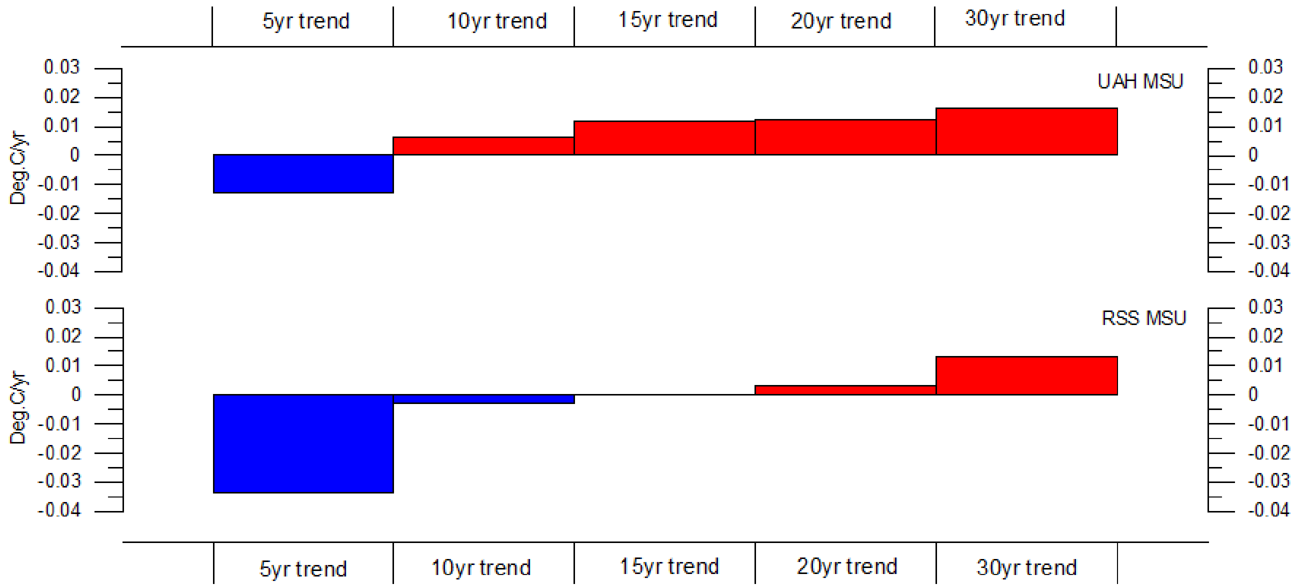


Diagram showing the latest 5, 10, 20 and 30 yr linear annual global temperature trend, calculated as the slope of the linear regression line through the data points, for two satellite-based temperature estimates (UAH MSU and RSS MSU). Last month included in analysis: November 2014.

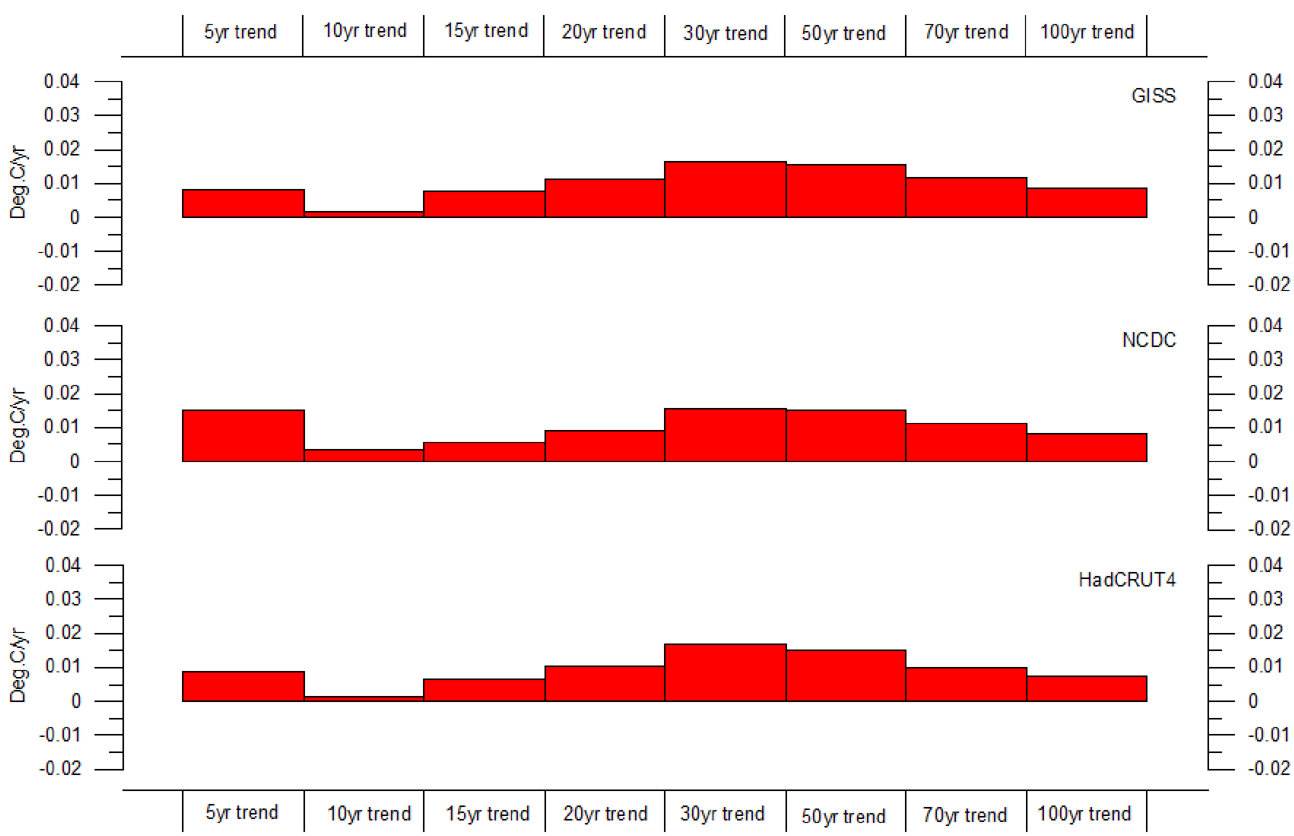
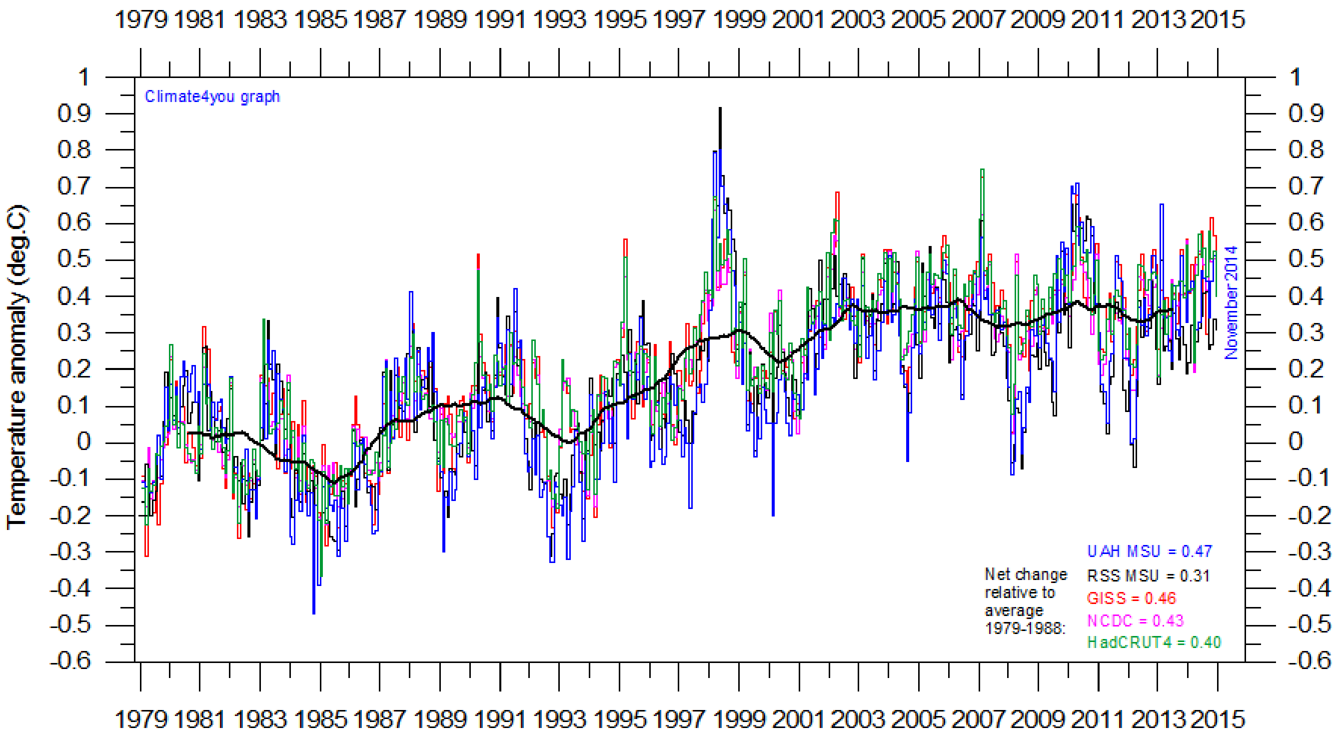


Diagram showing the latest 5, 10, 20, 30, 50, 70 and 100 year linear annual global temperature trend, calculated as the slope of the linear regression line through the data points, for three surface-based temperature estimates (GISS, NCDC and HadCRUT4). Last month included in all analyses: November 2014.

[All in one, updated to November 2014]

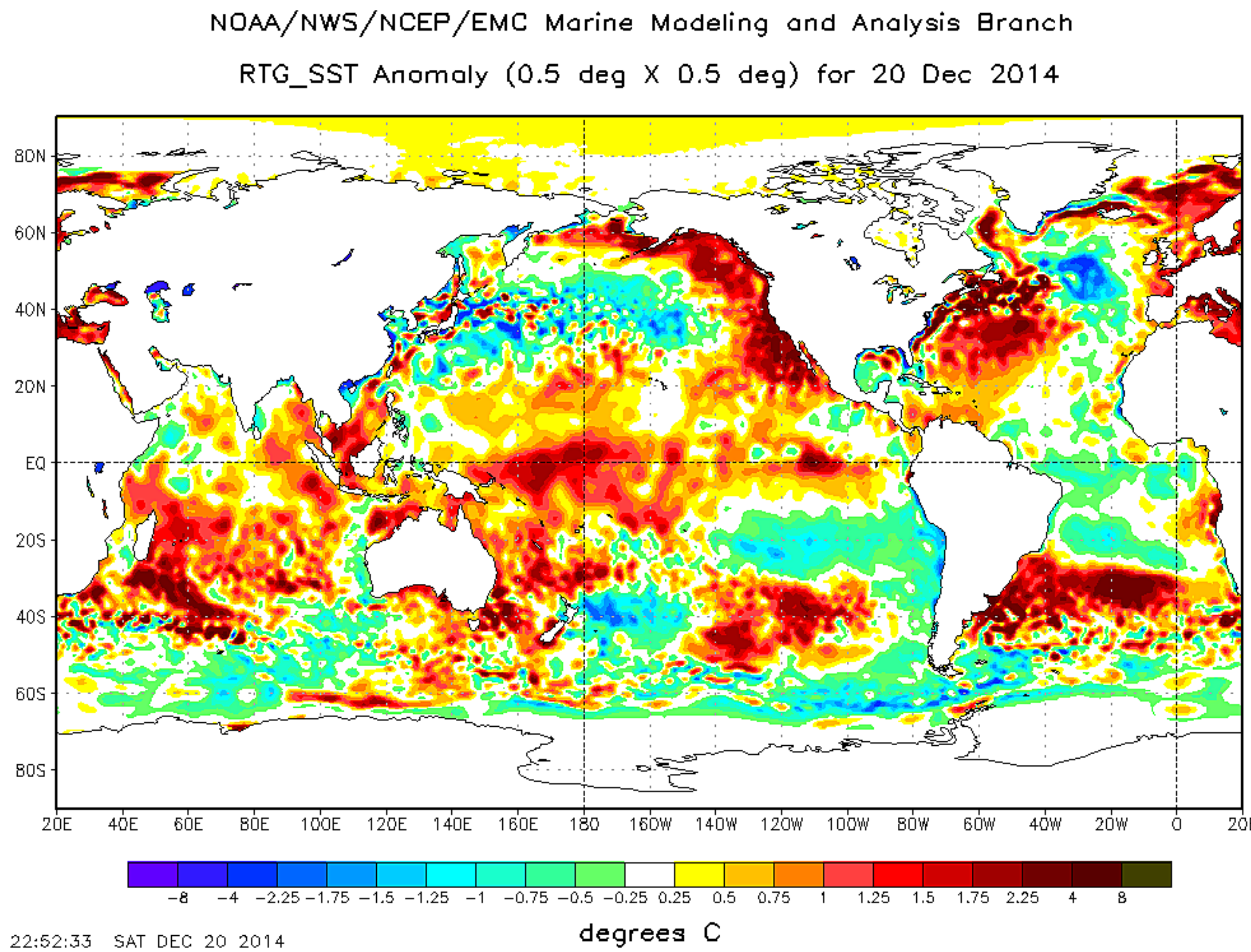


Superimposed plot of all five global monthly temperature estimates. As the base period differs for the individual temperature estimates, they have all been normalised by comparing with the average value of the initial 120 months (10 years) from January 1979 to December 1988. The heavy black line represents 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 may be somewhat 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 during the coming years. Time will show which of these two possibilities is correct.

Global sea surface temperature, updated to December 2014



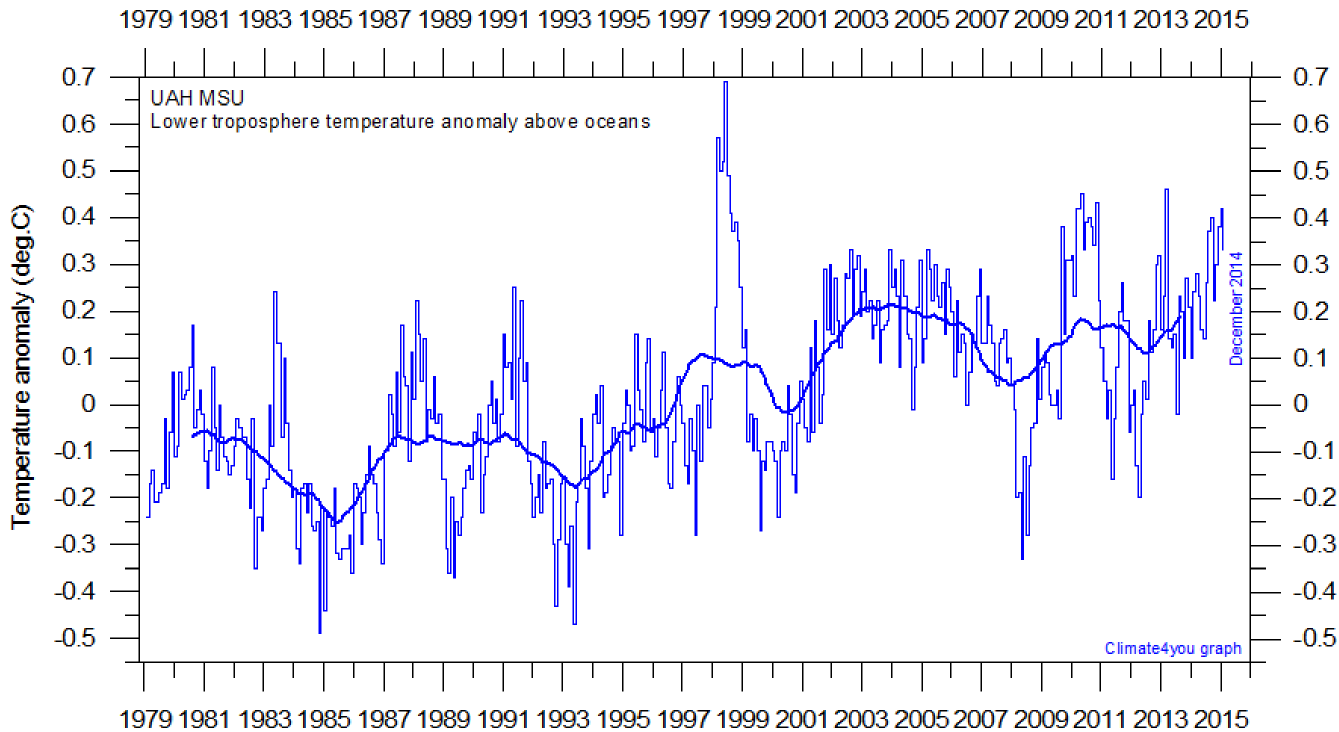
Sea surface temperature anomaly on 20 December 2014. Map source: National Centers for Environmental Prediction (NOAA).

Because of the large surface areas near Equator, the temperature of the surface water in these regions is especially important for the global atmospheric temperature (p.4-6).

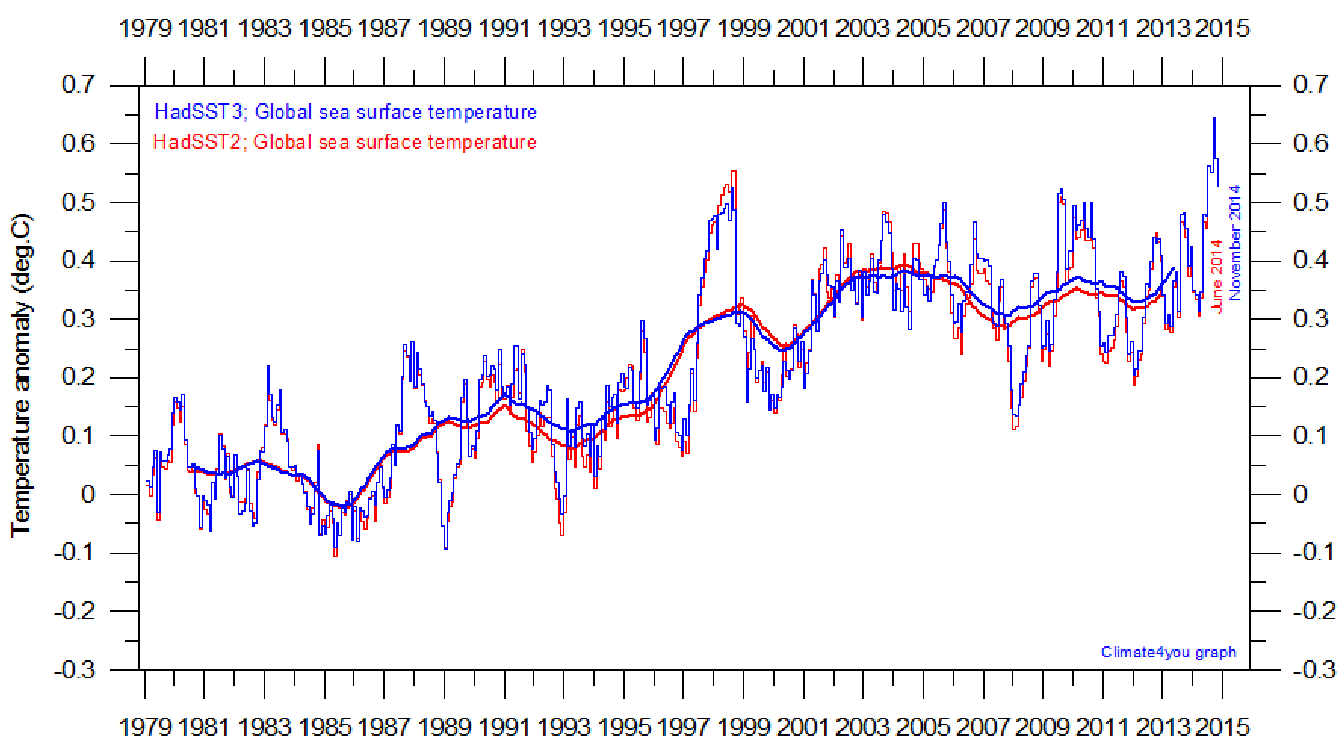
Relatively warm water is dominating the Pacific Ocean and Indian Ocean near the Equator, and is influencing global air temperatures now and in the months to come.

The significance of any such short-term cooling or warming reflected 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.

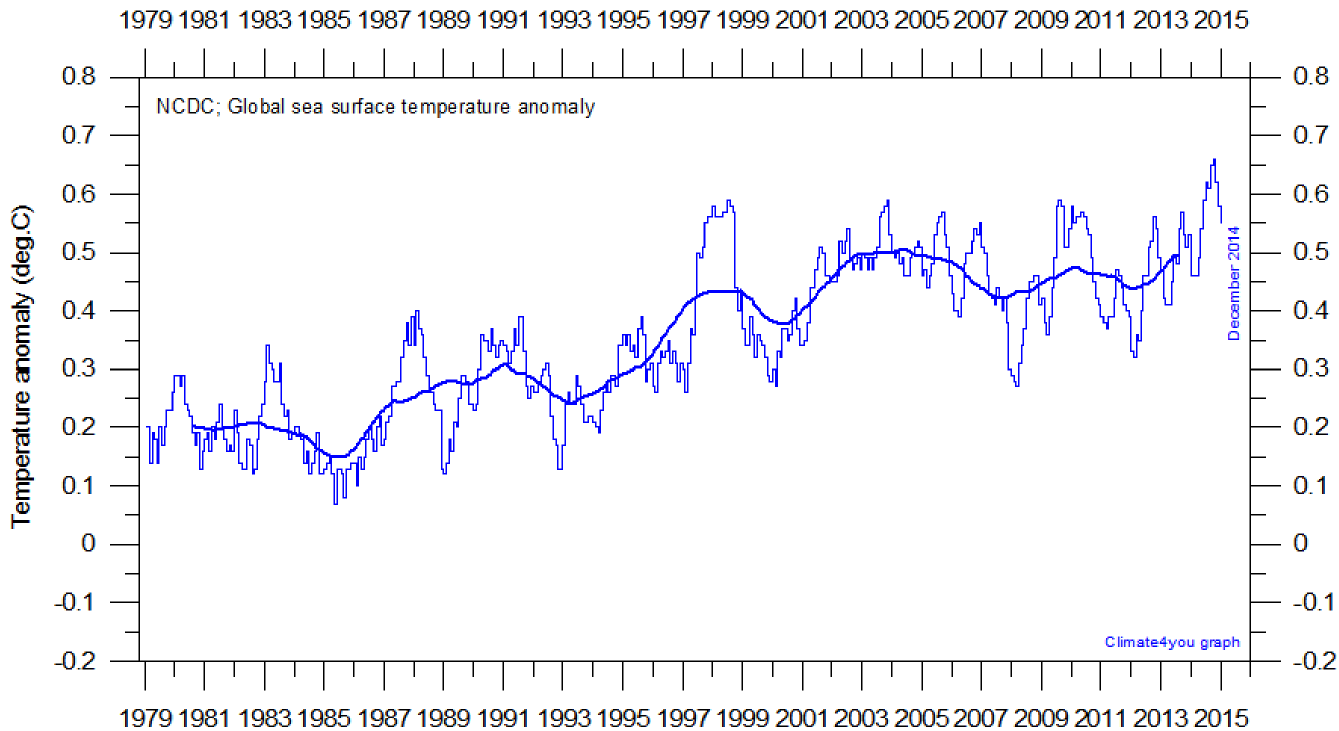
However, this does not reflect similar changes in the total heat content of the atmosphere-ocean system. In fact, global net changes can be small and such heat exchanges may mainly reflect redistribution of energy between ocean and atmosphere. What matters is the overall temperature development when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

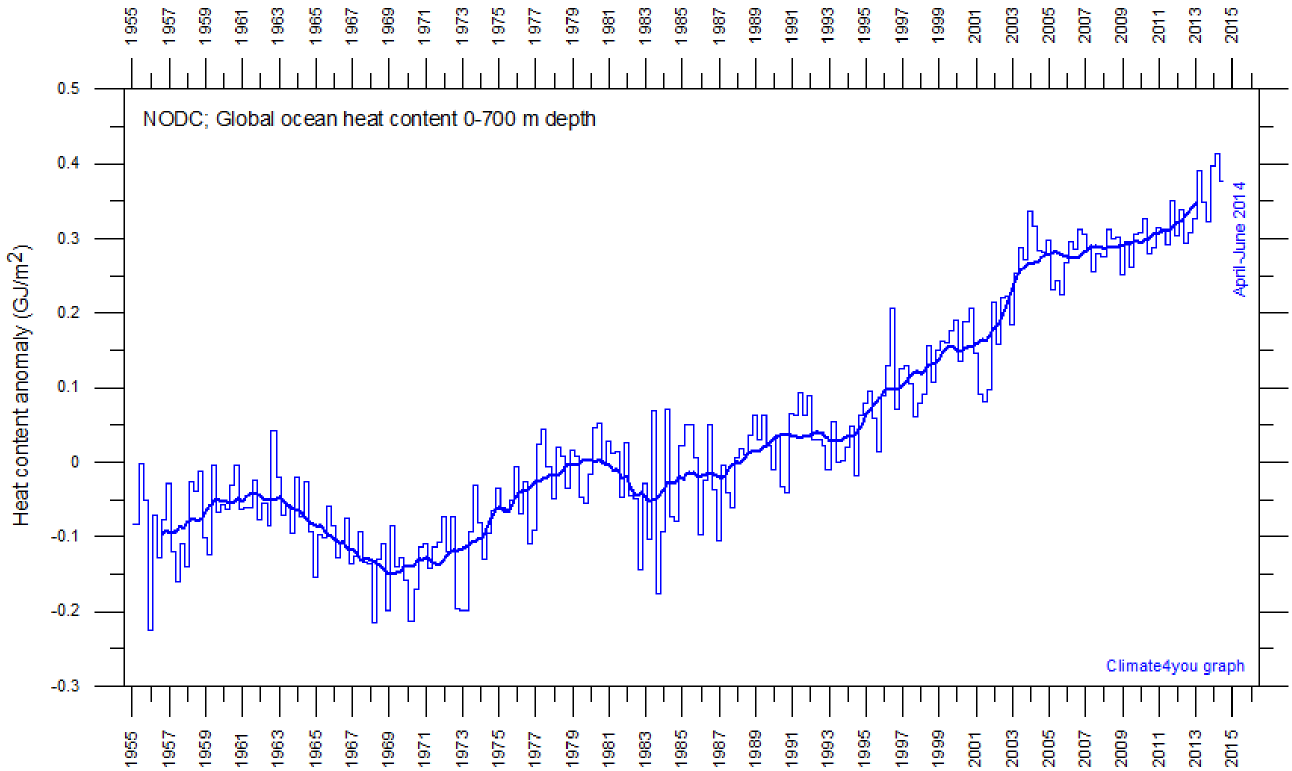


Global monthly average sea surface temperature since 1979 according to University of East Anglia's [Climatic Research Unit](#) ([CRU](#)), UK. Base period: 1961-1990. The thick line is the simple running 37-month average. Please note that this diagram is not updated beyond November 2014.

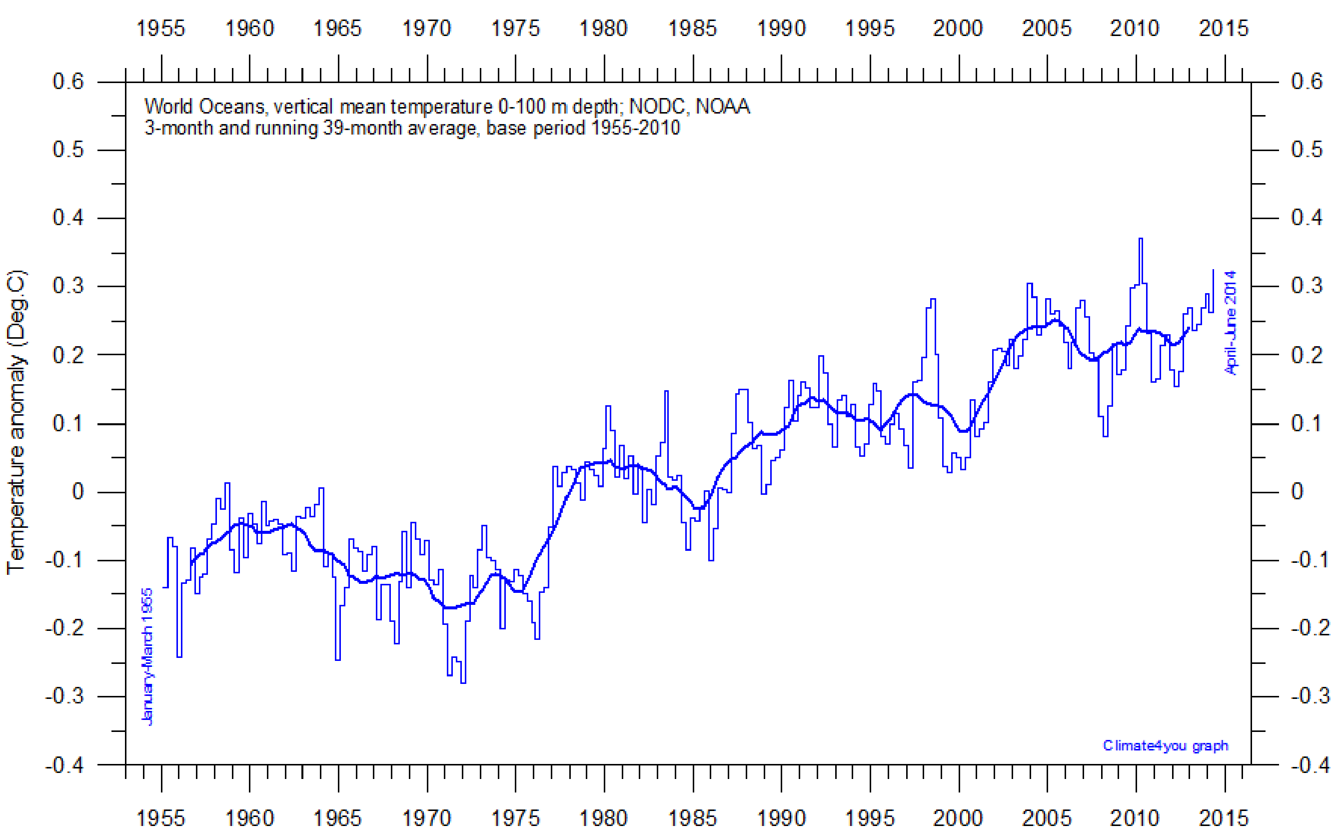


Global monthly average sea surface temperature since 1979 according to the [National Climatic Data Center](#) (NCDC), USA. Base period: 1901-2000. The thick line is the simple running 37-month average.

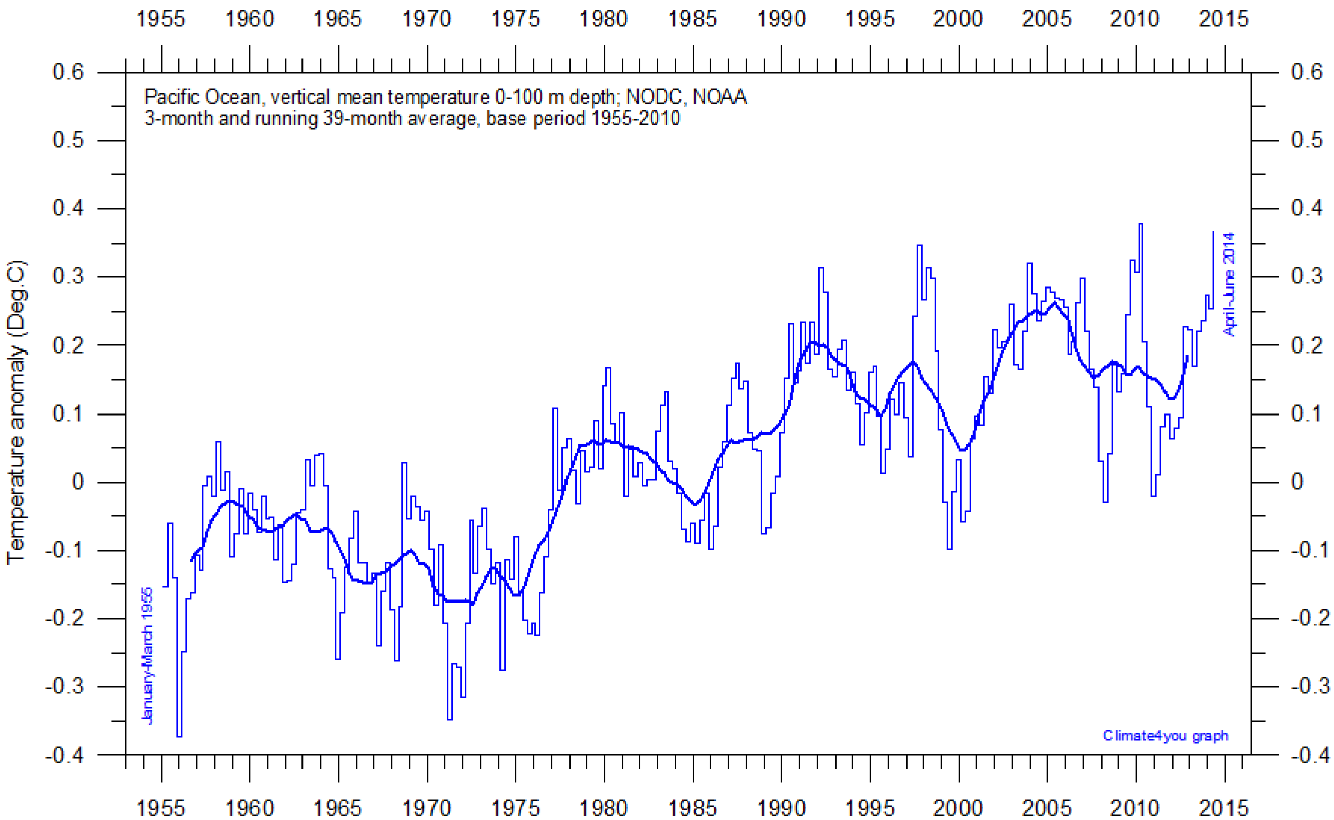
Ocean heat content uppermost 100 and 700 m, updated to June 2014



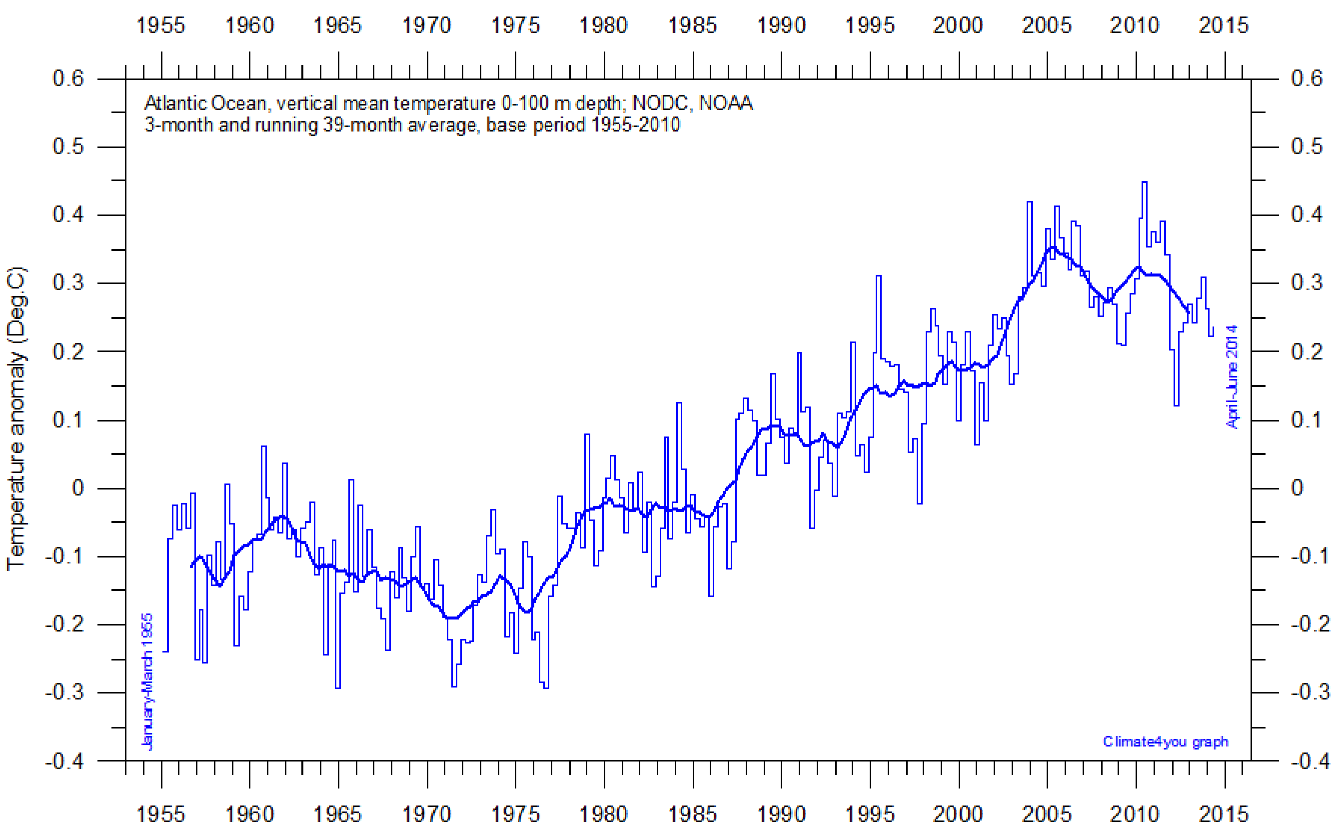
Global monthly heat content anomaly (GJ/m2) in the uppermost 700 m of the oceans since January 1955. Data source: National Oceanographic Data Center(NODC).



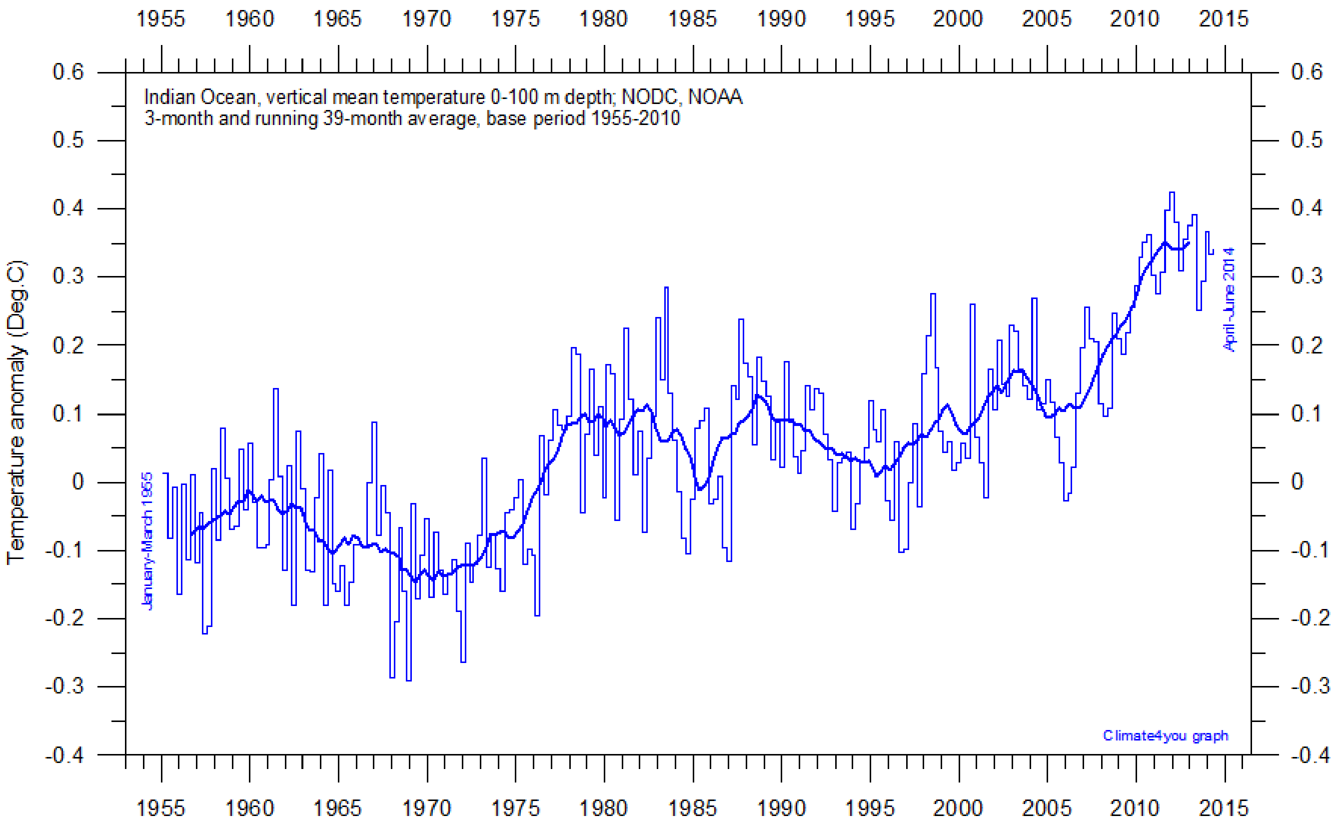
World Oceans vertical average temperature 0-100 m depth since 1955. The thin line indicate 3-month values, and the thick line represents the simple running 39-month (c. 3 year) average. Data source: [NOAA National Oceanographic Data Center] (NODC). Base period 1955-2010.



Pacific Ocean vertical average temperature 0-100 m depth since 1955. The thin line indicate 3-month values, and the thick line represents the simple running 39-month (c. 3 year) average. Data source: [NOAA National Oceanographic Data Center]() (NODC). Base period 1955-2010.

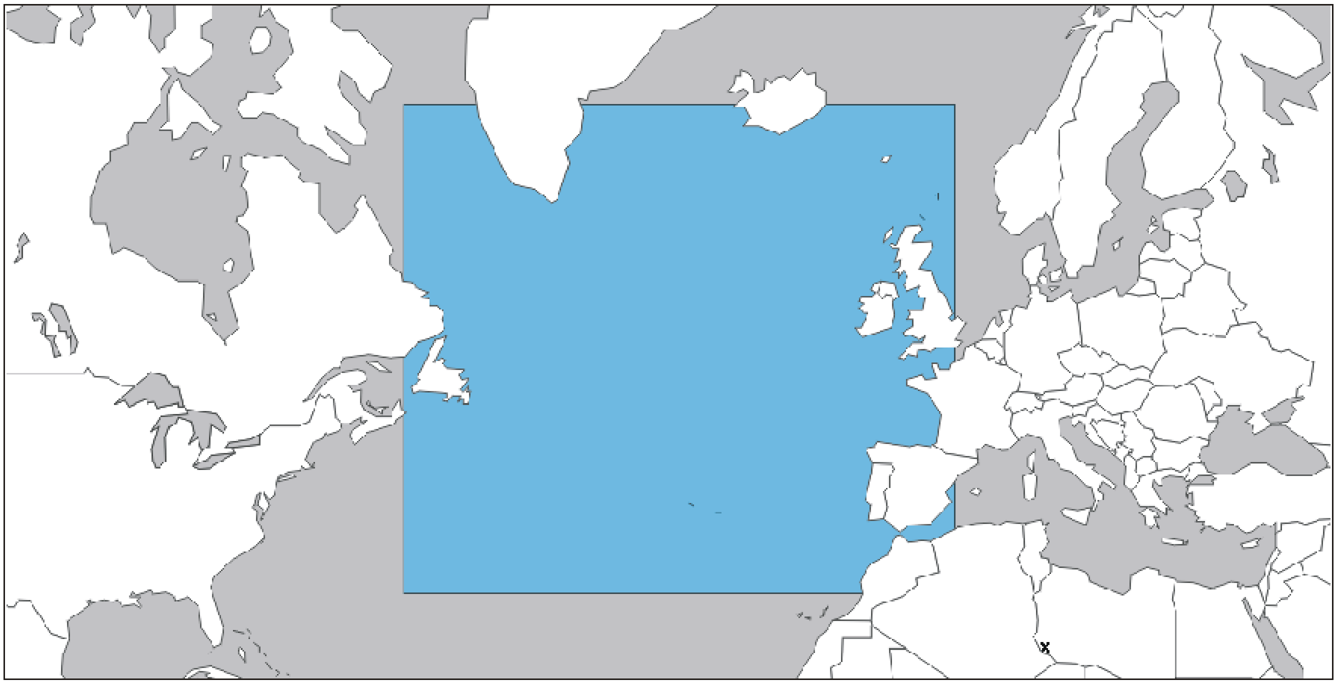


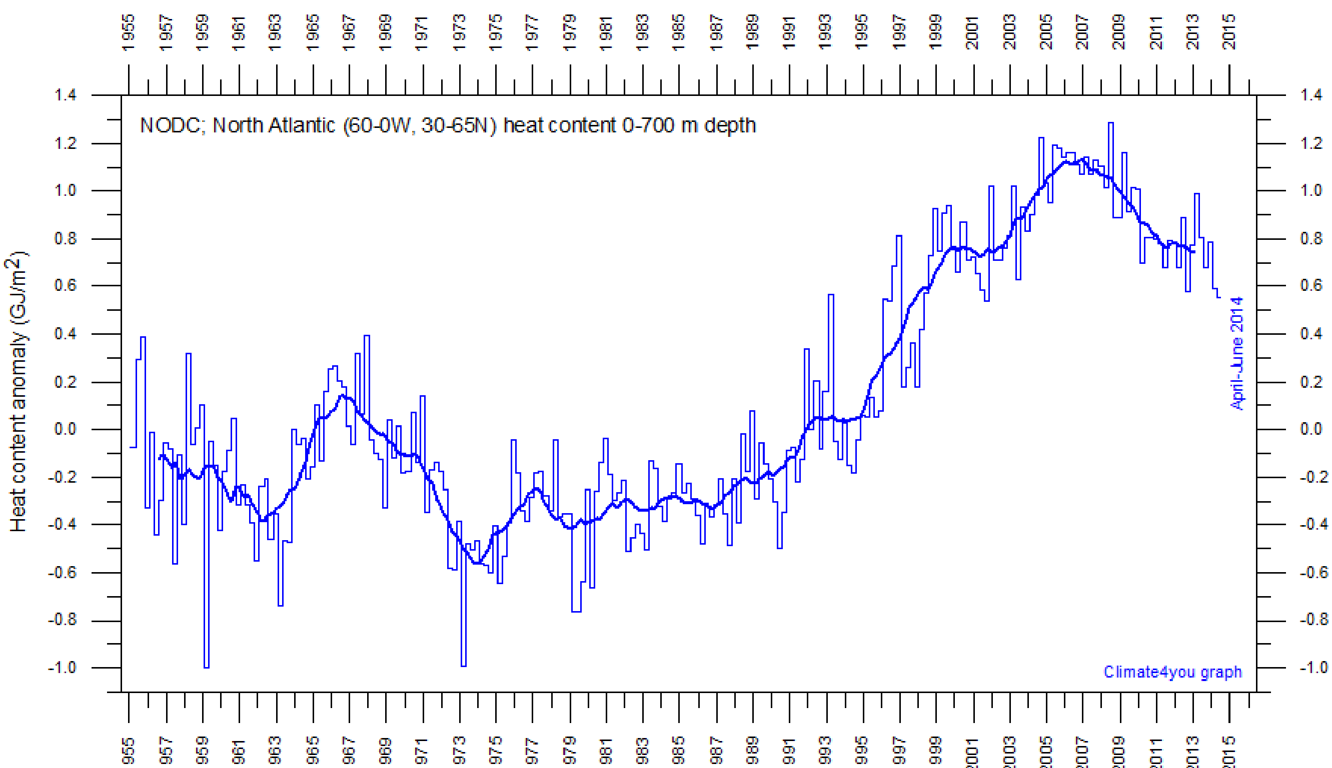
Atlantic Ocean vertical average temperature 0-100 m depth since 1955. The thin line indicate 3-month values, and the thick line represents the simple running 39-month (c. 3 year) average. Data source: [NOAA National Oceanographic Data Center]() (NODC). Base period 1955-2010.



Indian Ocean vertical average temperature 0-100 m depth since 1955. The thin line indicate 3-month values, and the thick line represents the simple running 39-month (c. 3 year) average. Data source: NOAA National Oceanographic Data Center (NODC). Base period 1955-2010.

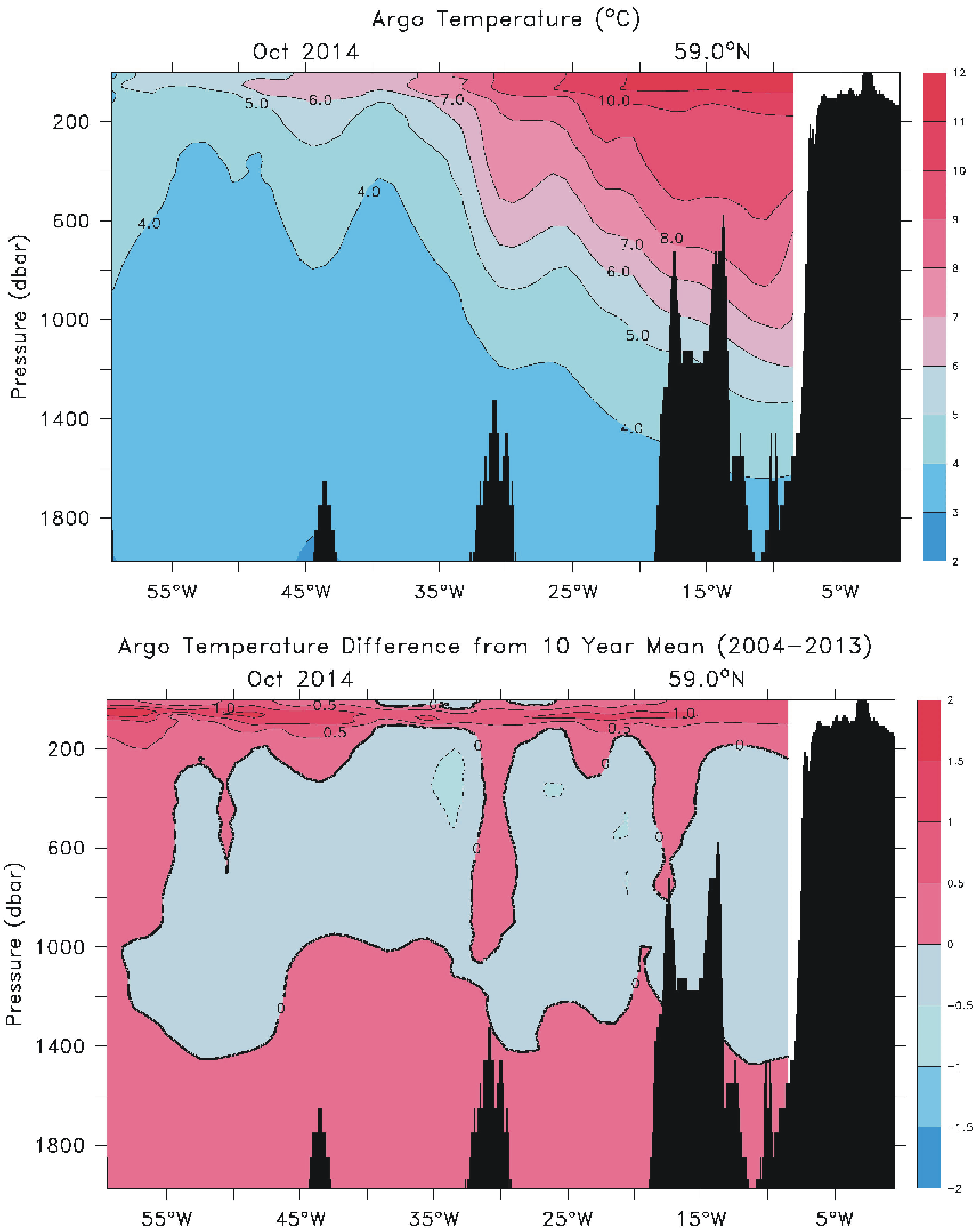
North Atlantic heat content uppermost 700 m, updated to June 2014





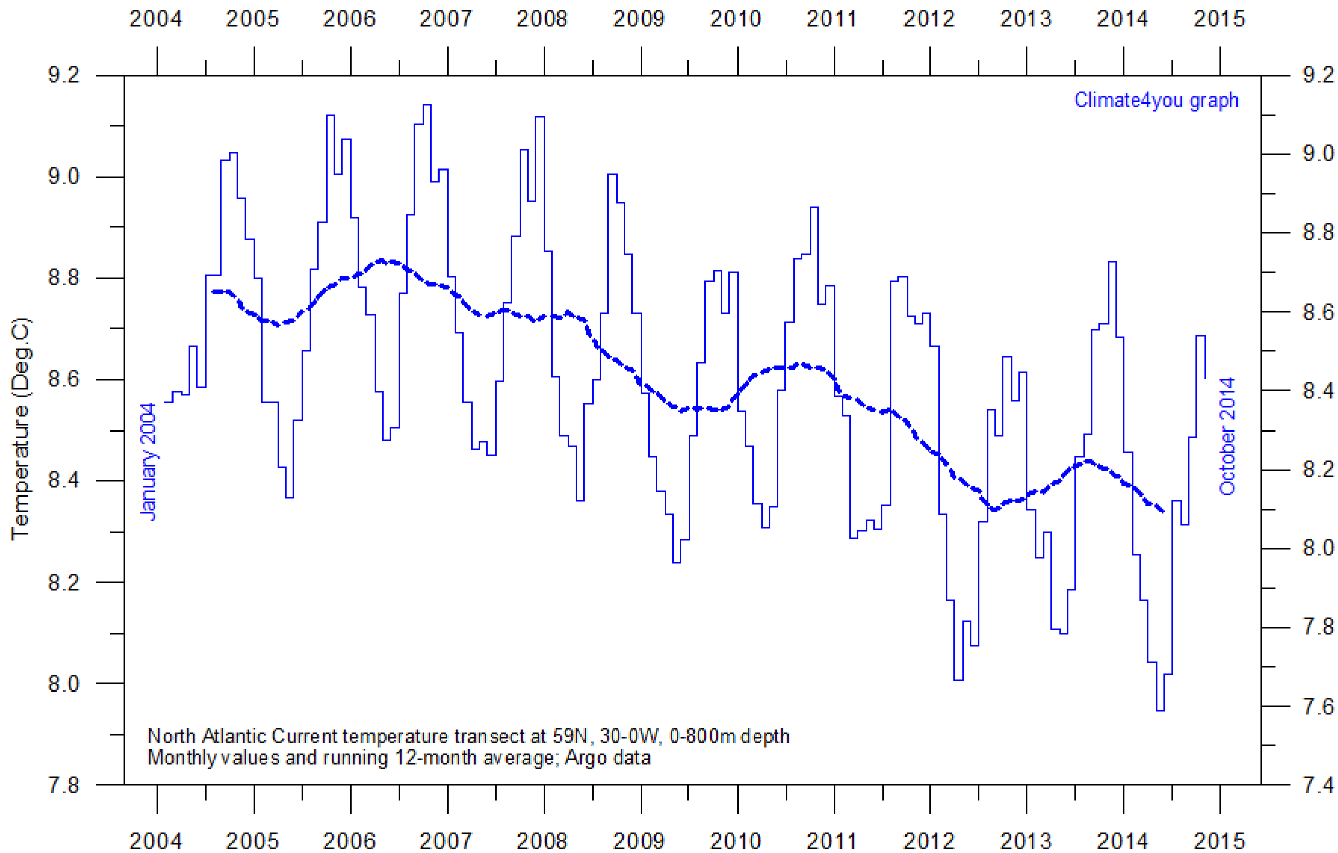
Global monthly heat content anomaly (GJ/m2) in the uppermost 700 m of the North Atlantic (60-0W, 30-65N; see map above) *ocean since January 1955. The thin line indicates monthly values, and the thick line represents the simple running 37 month (c. 3 year) average. Data source: [National Oceanographic Data Center](#) (NODC).*

North Atlantic sea temperatures along 59N, updated to October 2014



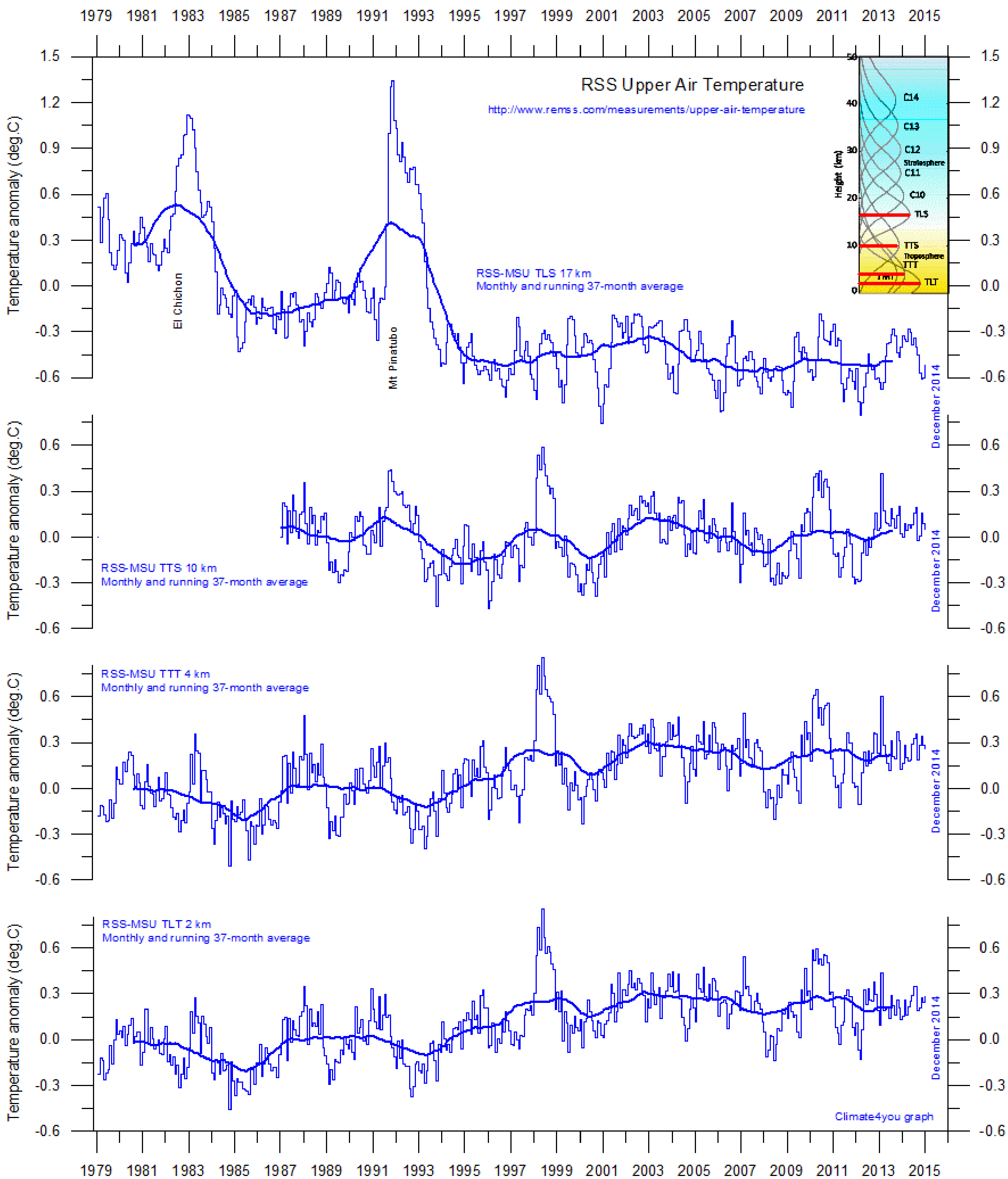
Depth-temperature diagram along 59 N across the North Atlantic, extending from northern Labrador in the west to northern Scotland in the east, using Argo-data. The uppermost panel shows the temperature, and the lower diagram shows the temperature anomaly, using the monthly average temperature 2004-2013 as reference. Source: Global Marine Argo Atlas.

North Atlantic sea temperatures 30-0W at 59N, updated to October 2014



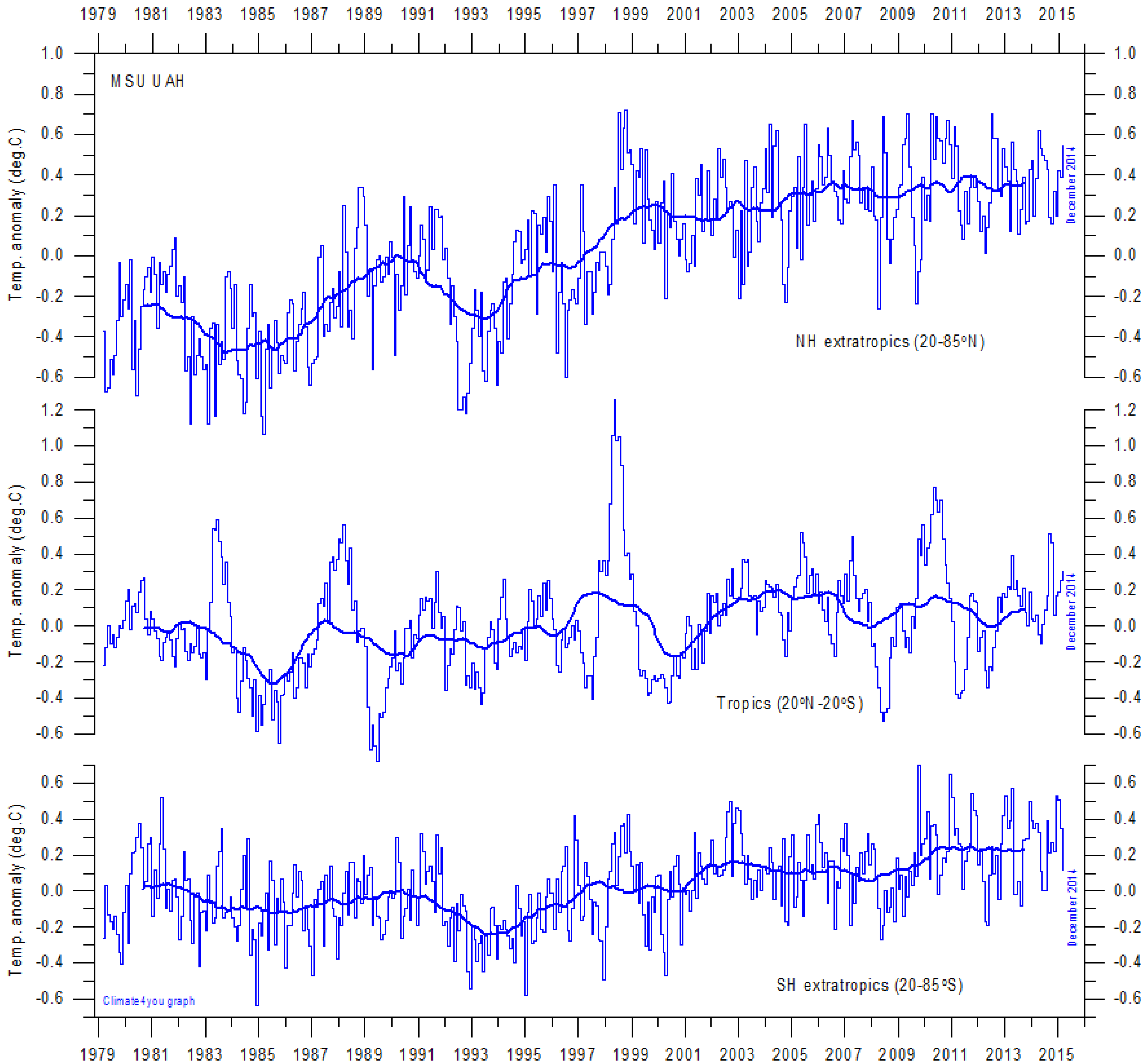
Average temperature along 59 N, 30-0W, 0-800m depth, corresponding to the main part of the North Atlantic Current, using Argo-data. Source: Global Marine Argo Atlas. Additional information can be found in: Roemmich, D. and J. Gilson, 2009. The 2004-2008 mean and annual cycle of temperature, salinity, and steric height in the global ocean from the Argo Program. Progress in Oceanography, 82, 81-100.

[Troposphere and stratosphere temperatures from satellites, updated to December 2014]



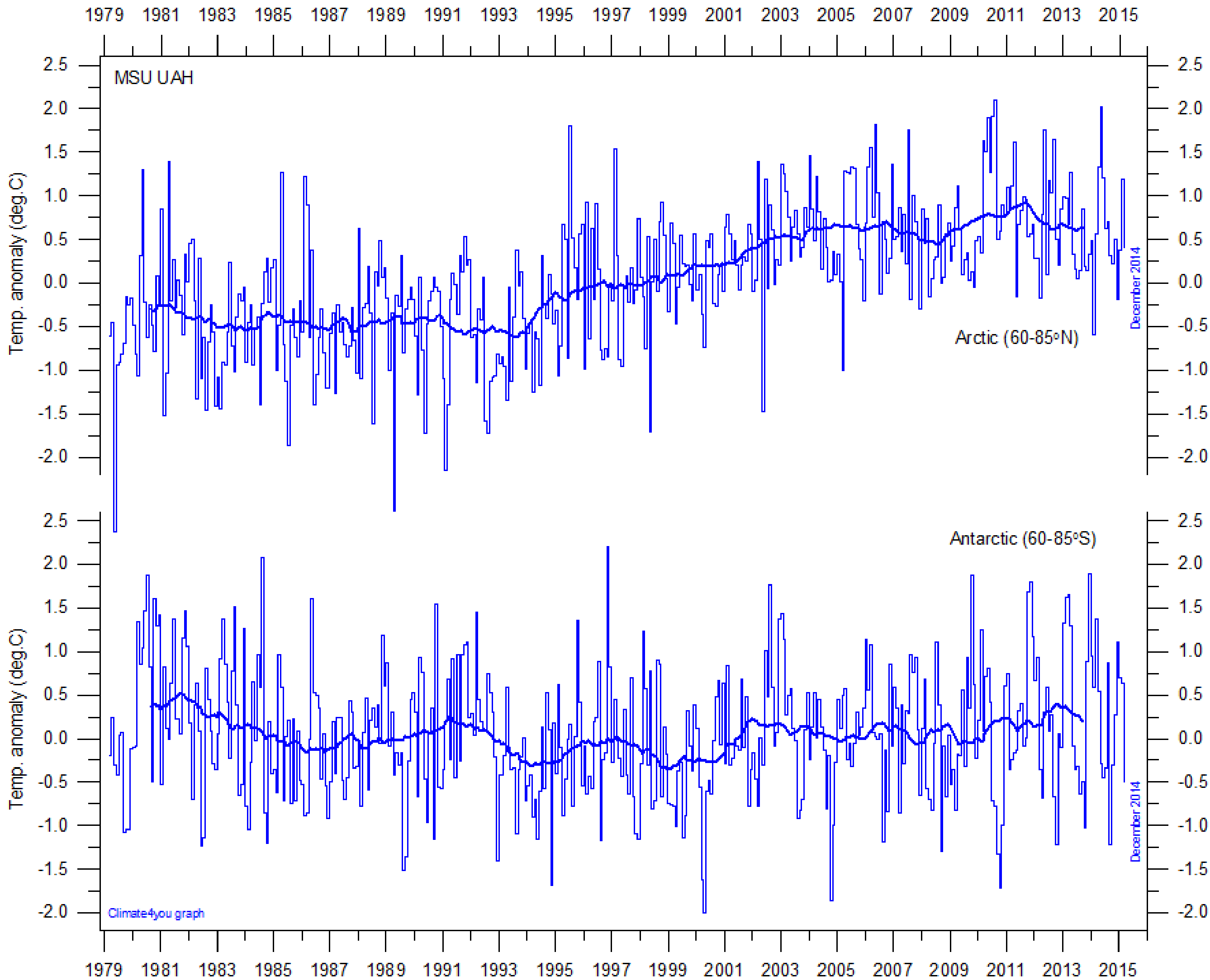
Global monthly average temperature in different altitudes according to [Remote Sensing Systems] (RSS). The thin lines represent the monthly average, and the thick line the simple running 37 month average, nearly corresponding to a running 3 yr average.

Zonal lower troposphere temperatures from satellites, updated to December 2014



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 December 2014



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 November 2014]

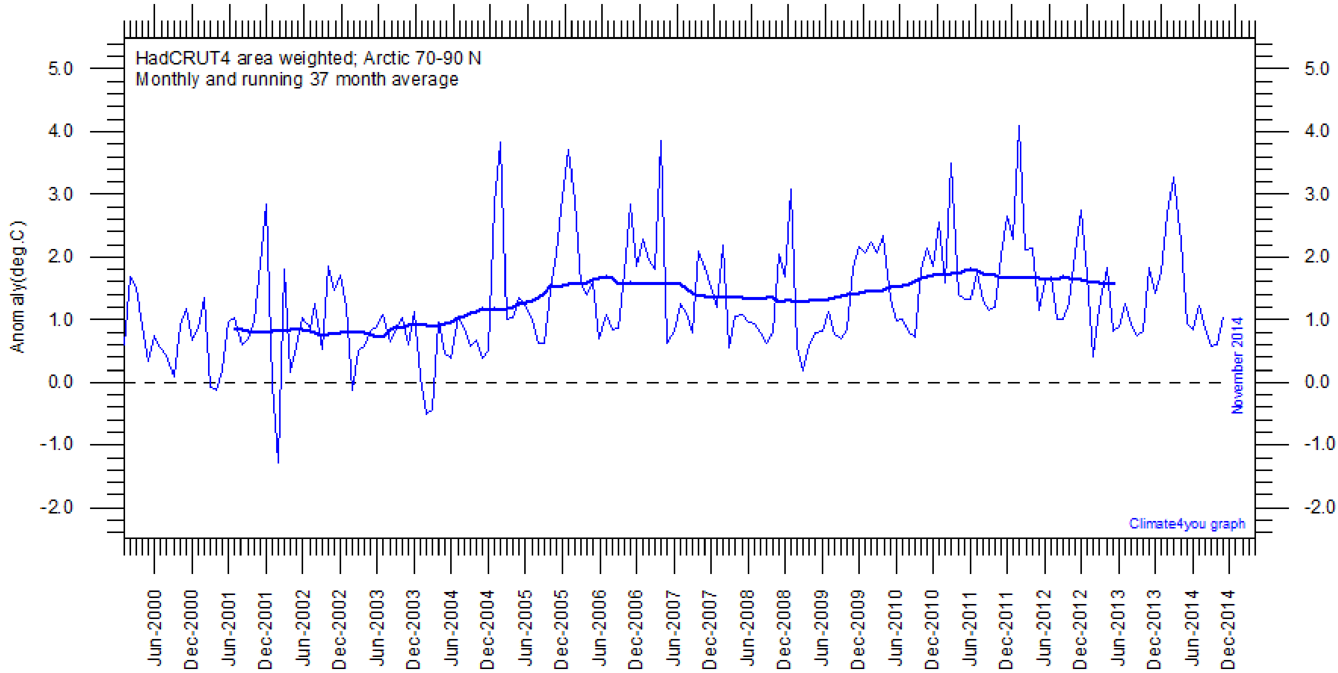


Diagram showing area weighted Arctic (70-90°N) monthly surface air temperature anomalies ([HadCRUT4]) since January 2000, in relation to the WMO [normal period] 1961-1990. The thin blue line shows the monthly temperature anomaly, while the thicker red line shows the running 37 month (c.3 yr) average.

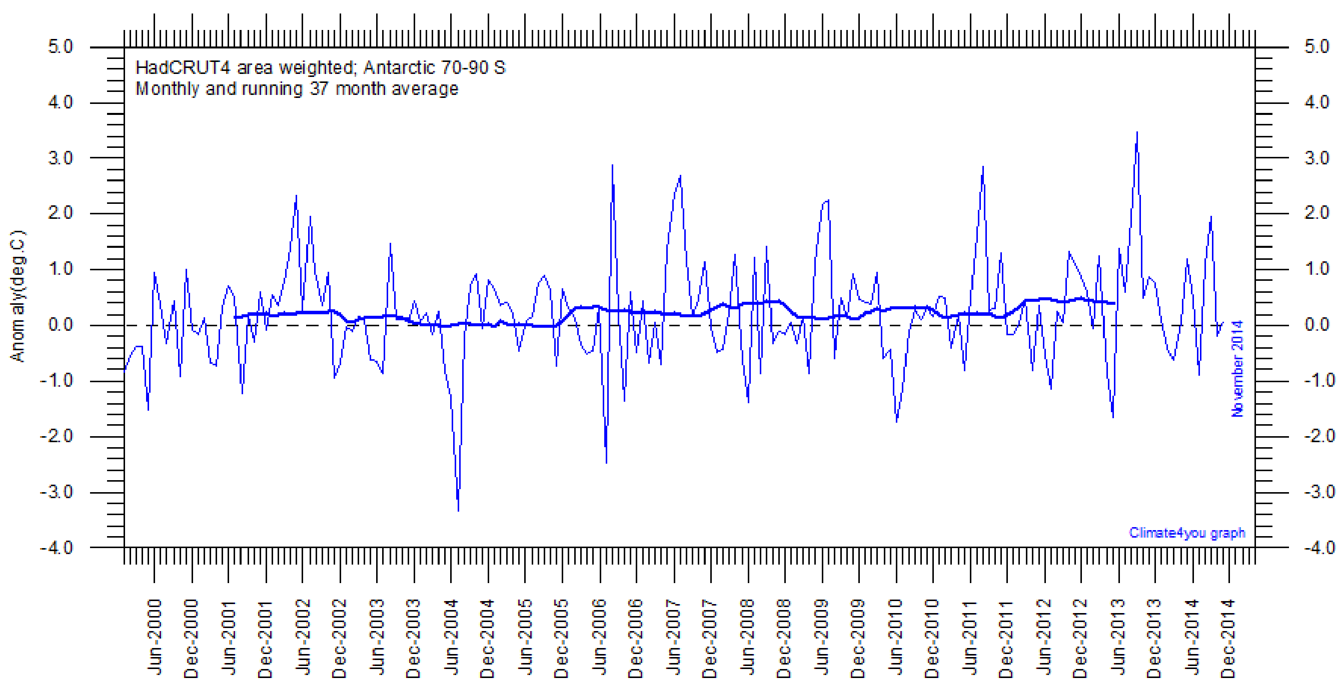


Diagram showing area weighted Antarctic (70-90°N) monthly surface air temperature anomalies ([HadCRUT4]) since January 2000, in relation to the WMO [normal period] 1961-1990. The thin blue line shows the monthly temperature anomaly, while the thicker red line shows the running 37 month (c.3 yr) average.

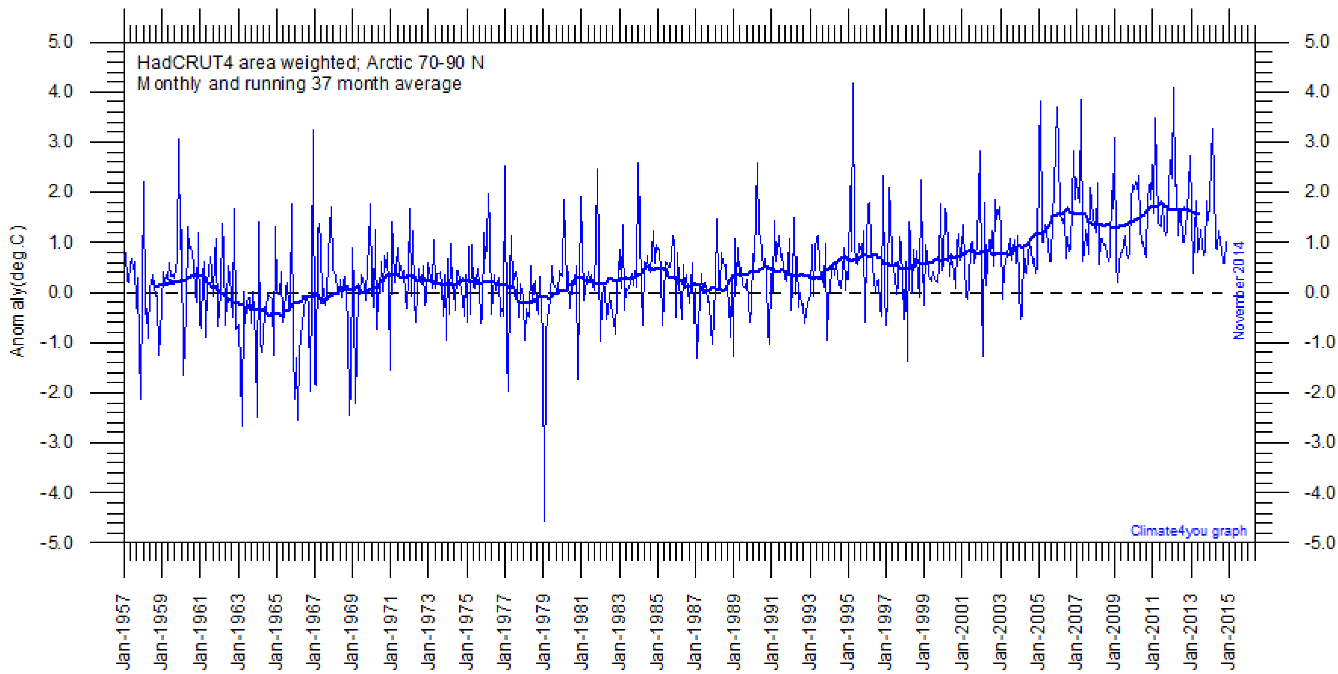


Diagram showing area weighted Arctic (70-90°N) monthly surface air temperature anomalies ([HadCRUT4]) since January 1957, in relation to the WMO [normal period] 1961-1990. The thin blue line shows the monthly temperature anomaly, while the thicker red line shows the running 37 month (c.3 yr) average.

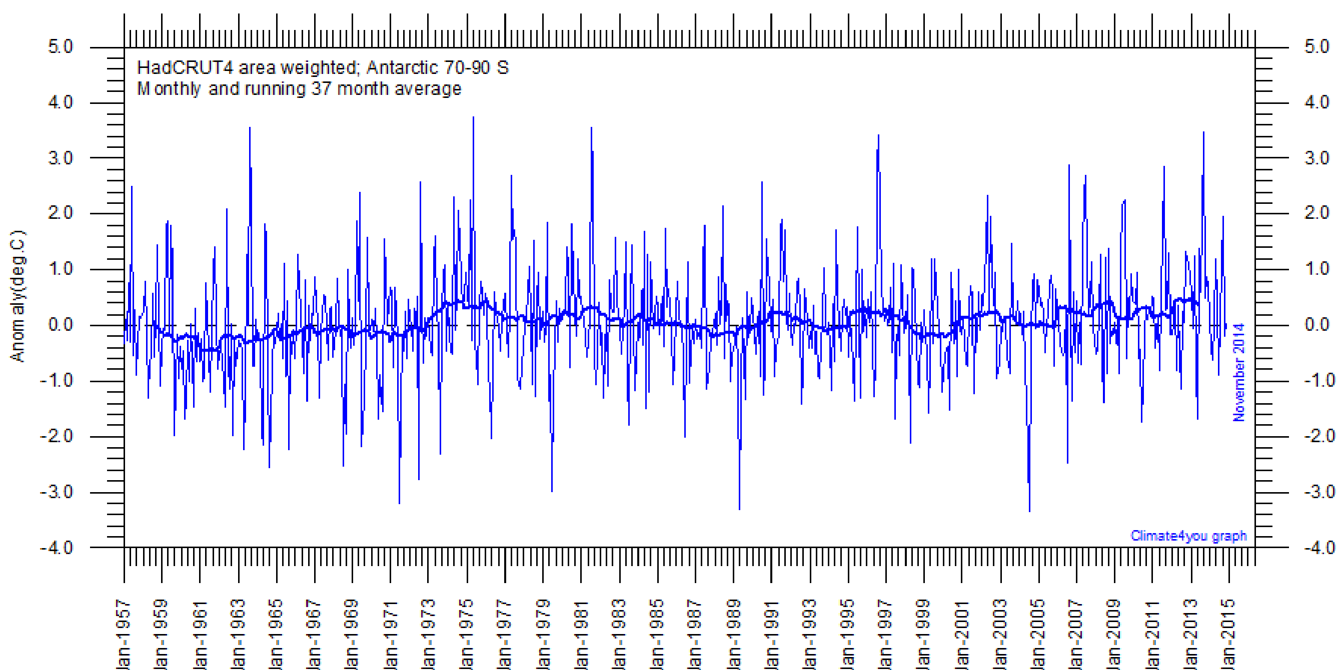


Diagram showing area weighted Antarctic (70-90°N) monthly surface air temperature anomalies ([HadCRUT4]) since January 1957, in relation to the WMO [normal period] 1961-1990. The thin blue line shows the monthly temperature anomaly, while the thicker red line shows the running 37 month (c.3 yr) average.

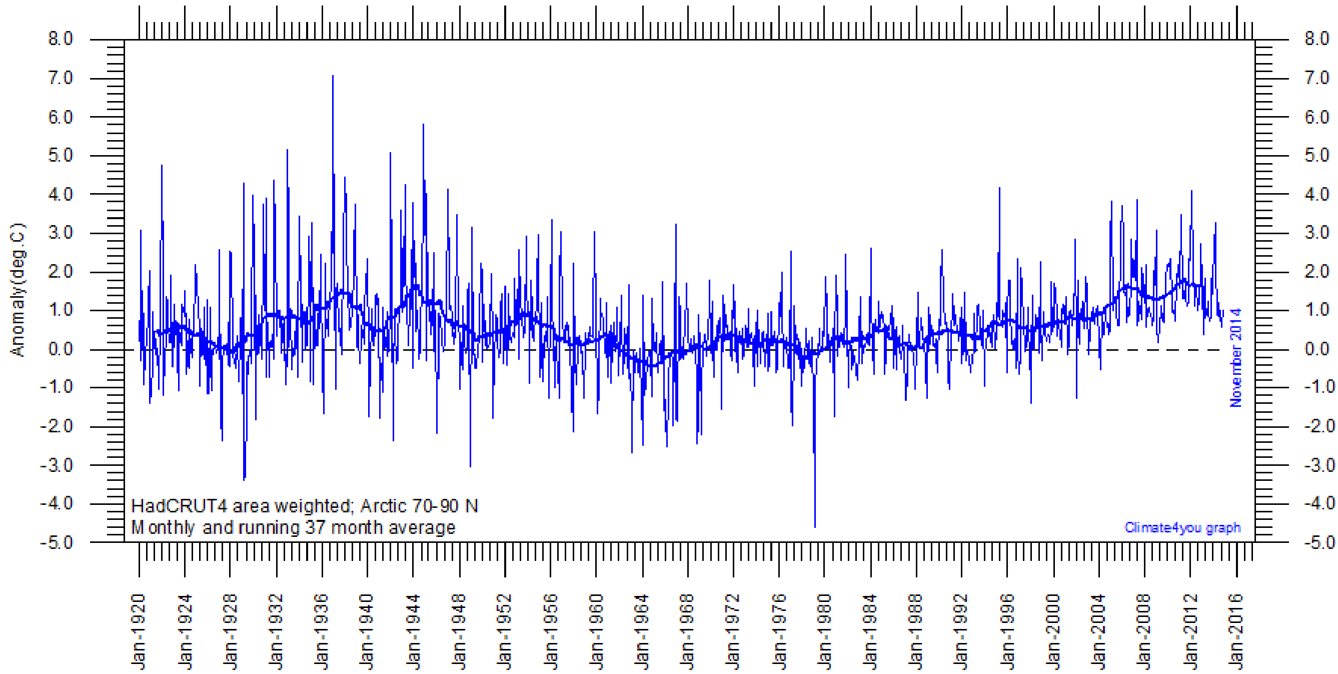


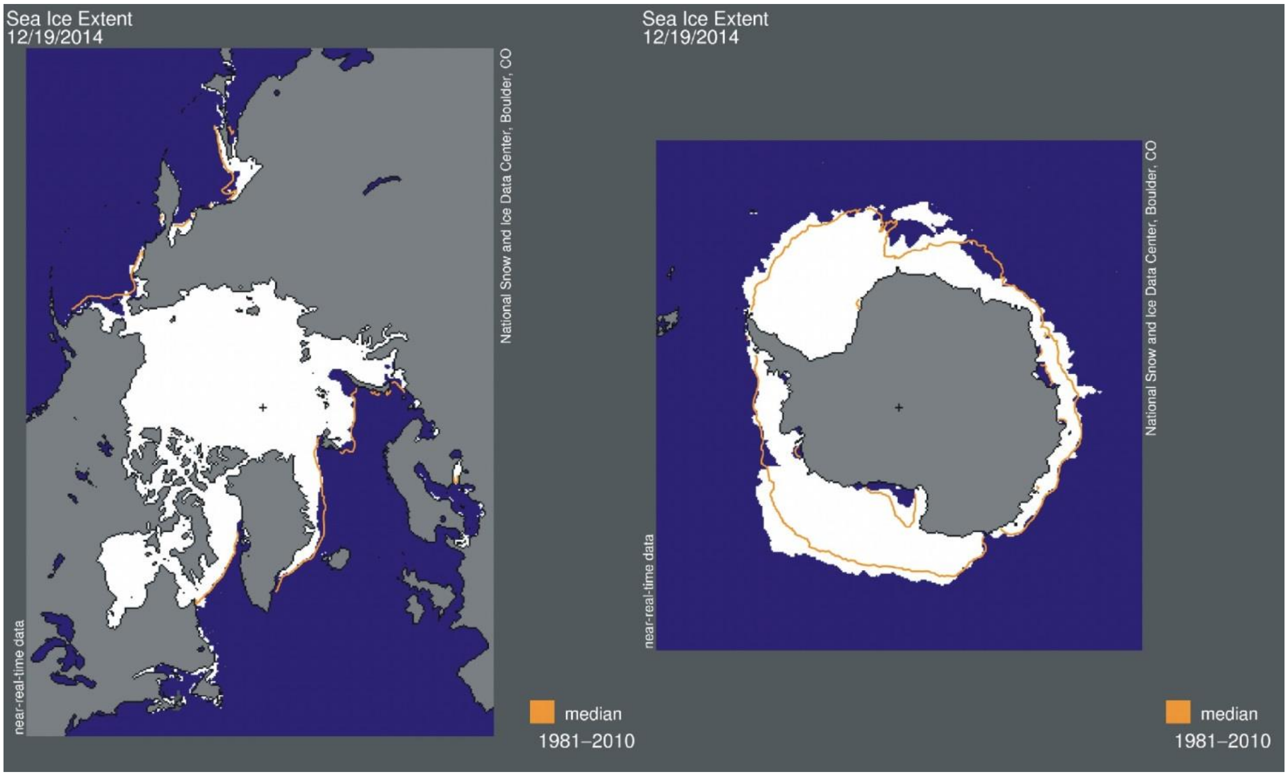
Diagram showing area-weighted Arctic (70-90°N) monthly surface air temperature anomalies ([HadCRUT4]) since January 1920, in relation to the WMO [normal period] 1961-1990. The thin blue line shows the monthly temperature anomaly, while the thicker red line shows the running 37 month (c.3 yr) average. Because of the relatively small number of Arctic stations before 1930, month-to-month variations in the early part of the temperature record are larger than later. 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. The period since 2000 is warm, about as warm as the period 1930-1940.

As the HadCRUT4 data series has improved high latitude coverage data coverage (compared to the HadCRUT3 series) the individual 5°x5° grid cells has been weighted according to their surface area. This is in contrast to Gillet et al. 2008 which calculated a simple average, with no consideration to the surface area represented by the individual 5°x5° grid cells.

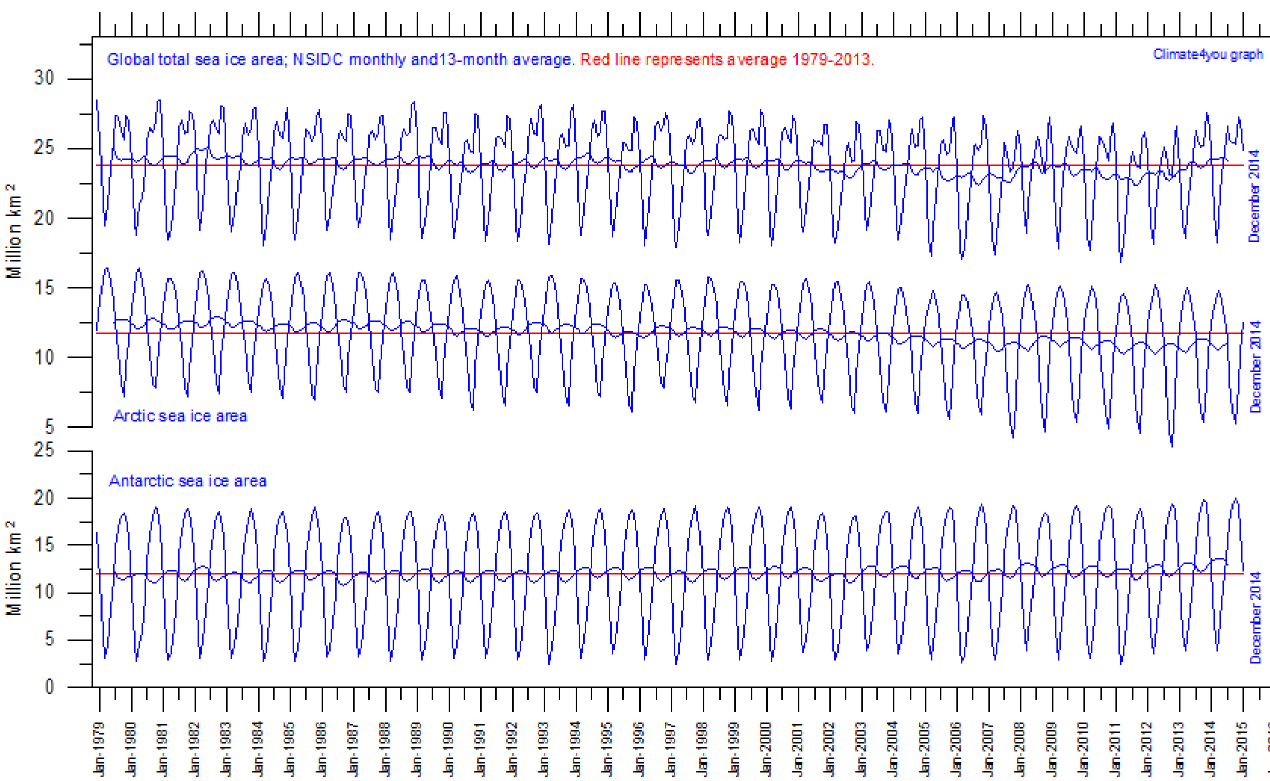
Literature:

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.

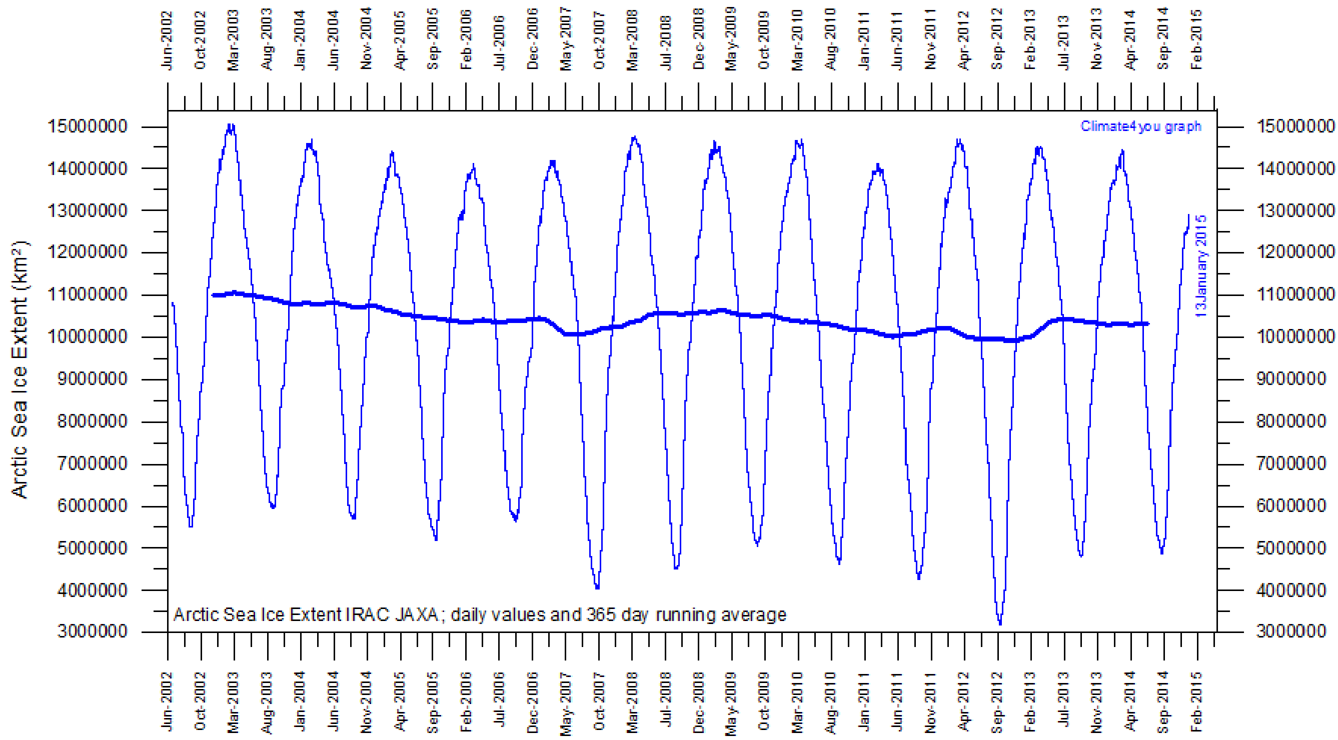
[Arctic and Antarctic sea ice, updated to December 2014]



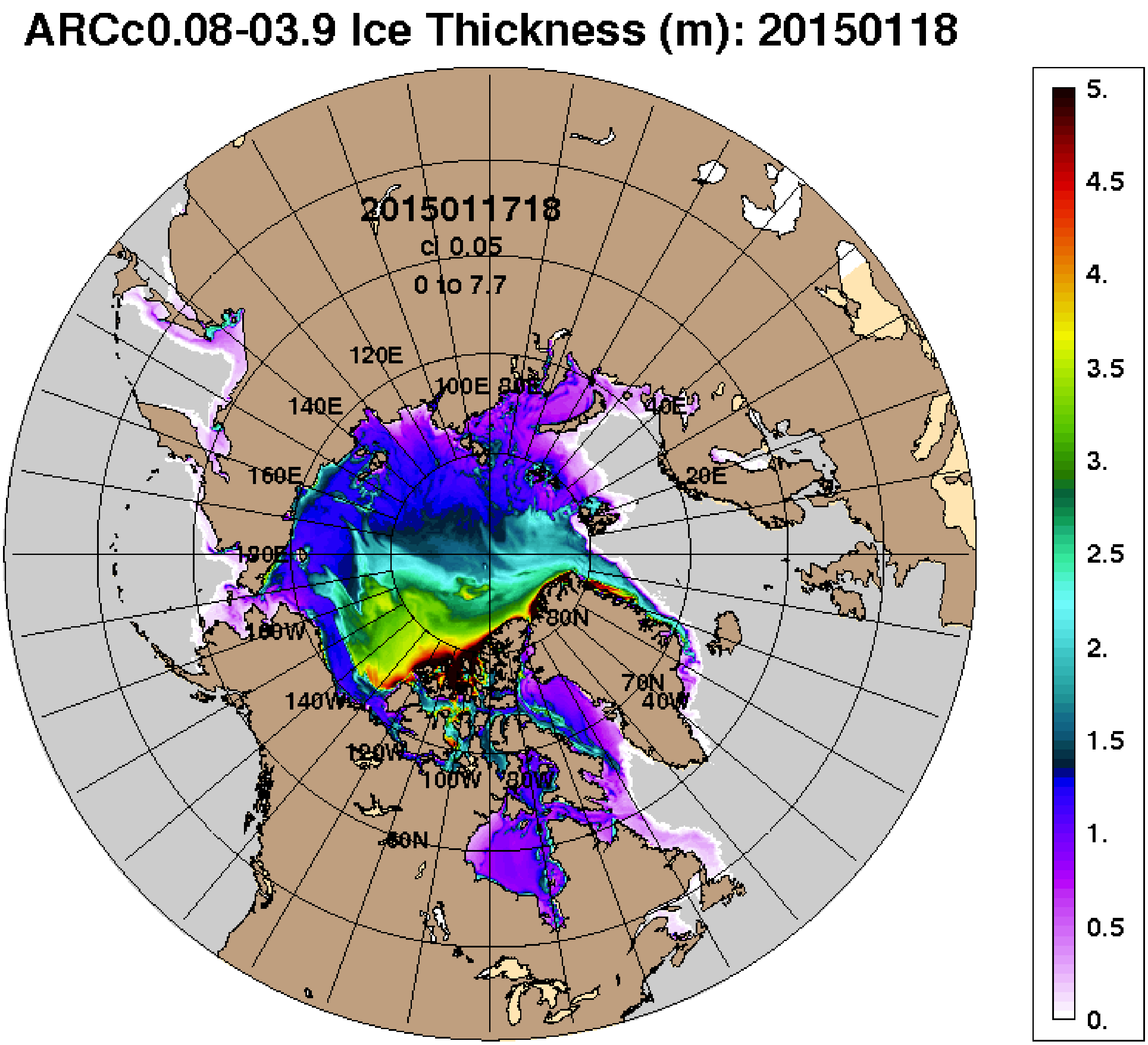
Sea ice extent 19 December 2014. The 'normal' or average limit of sea ice (orange line) is defined as 15% sea ice cover, according to the average of satellite observations 1981-2010 (both years inclusive). Sea ice may therefore well be encountered outside and open water areas inside the limit shown in the diagrams above. Map source: National Snow and Ice Data Center *(NSIDC).*



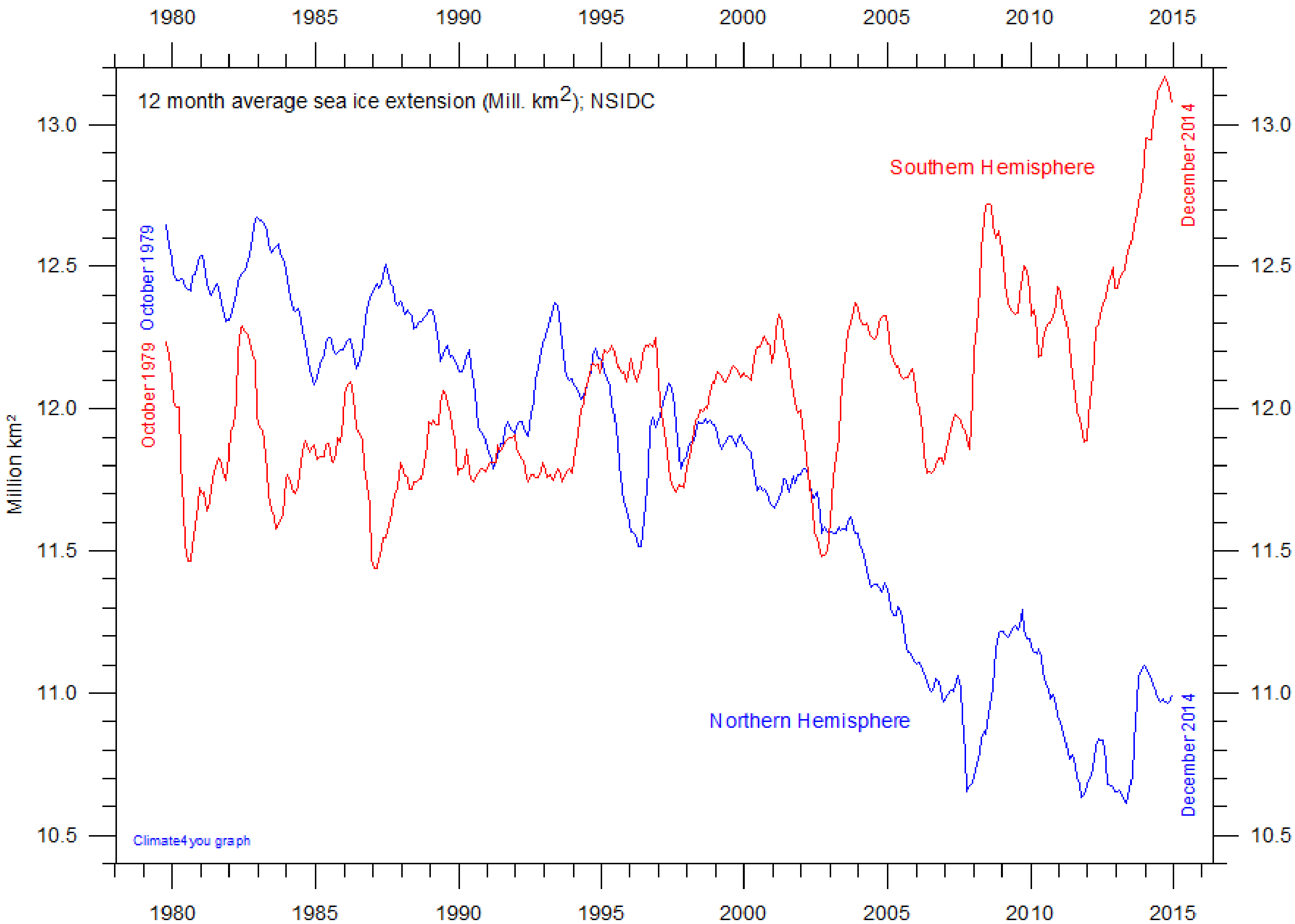
Graphs showing monthly Antarctic, Arctic and global sea ice extent since November 1978, according to the [National Snow and Ice data Center] (NSIDC).



Graph showing daily Arctic sea ice extent since June 2002, to 13 January 2015, by courtesy of [Japan Aerospace Exploration Agency](#) (JAXA).

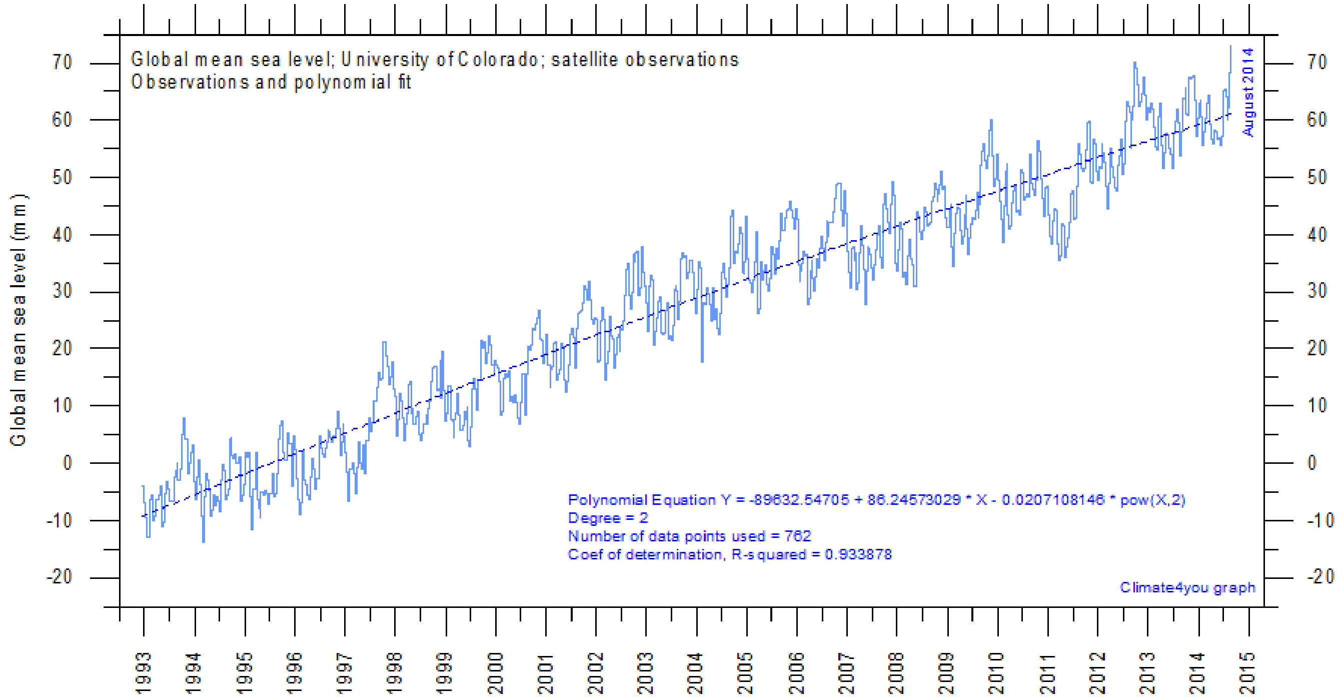


Northern hemisphere sea ice extension and thickness on 18 January 2015 according to the [Arctic Cap Nowcast/Forecast System](#) (ACNFS), US Naval Research Laboratory. Thickness scale (m) to the right.

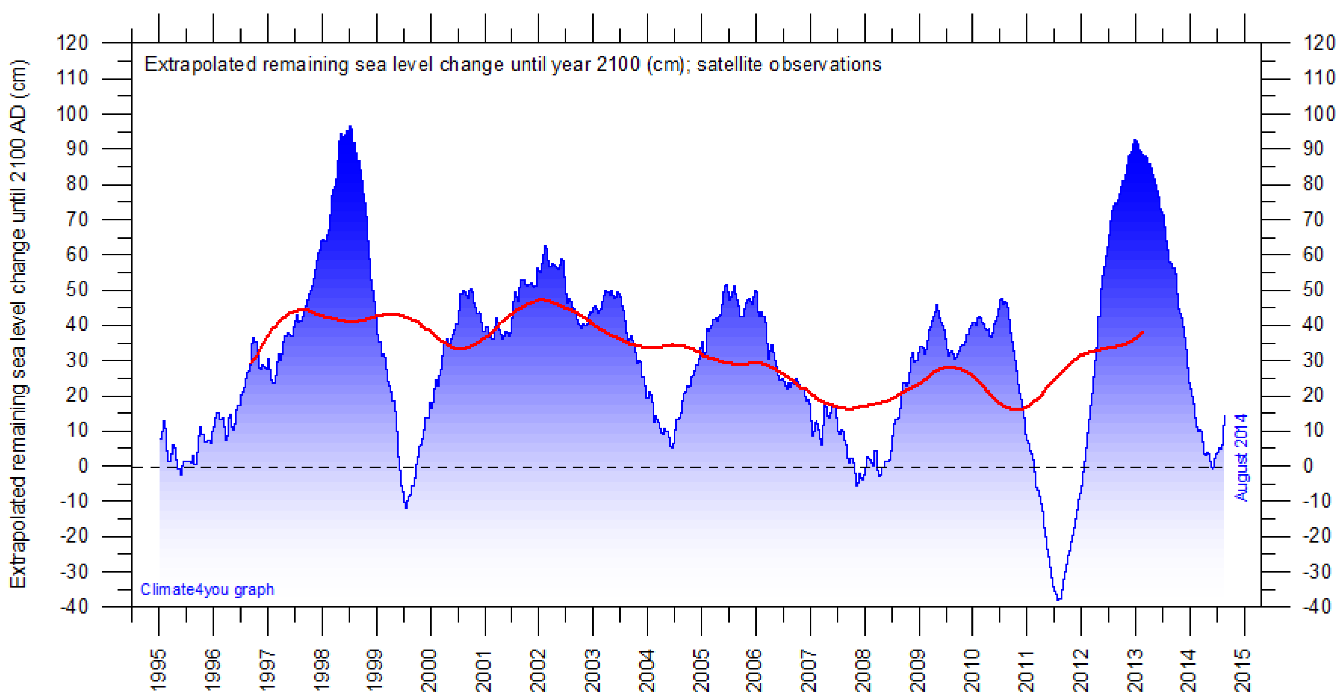


12 month running average sea ice extension in both hemispheres since 1979, the satellite-era. The October 1979 value represents the monthly average of November 1978 - October 1979, the November 1979 value represents the average of December 1978 - November 1979, etc. Last month included in the 12-month calculations: December 2014. Data source: National Snow and Ice Data Center (NSIDC).

Global sea level, updated to August 2014

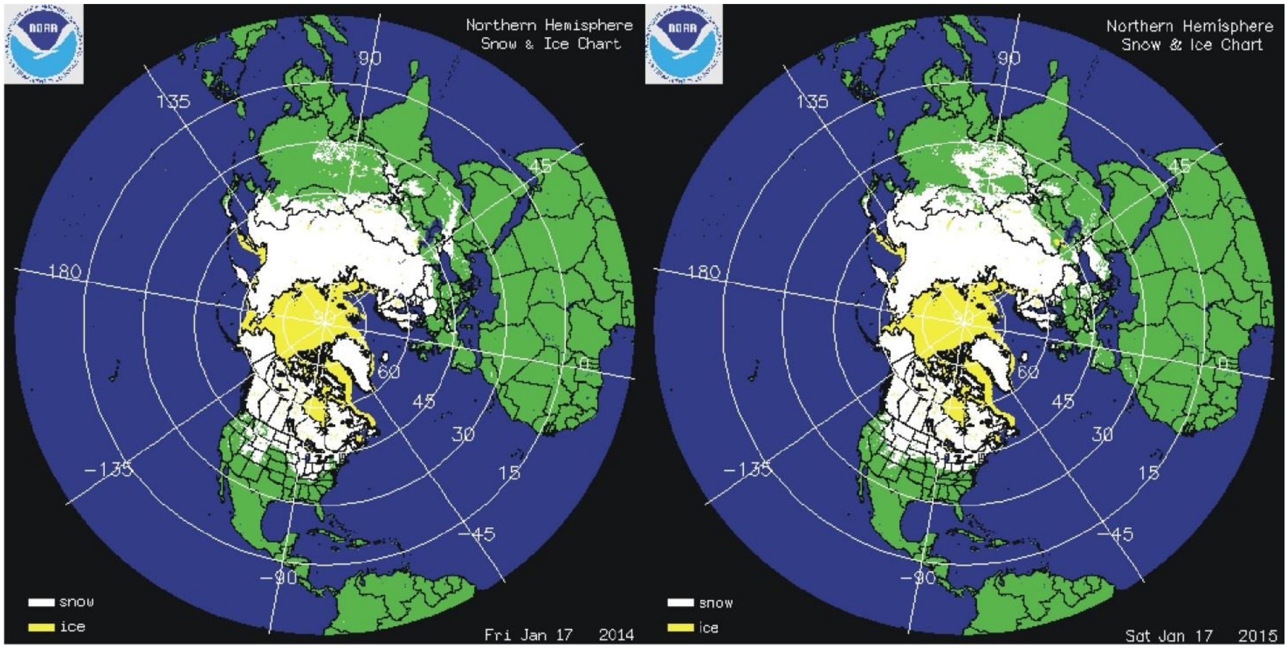


Global sea level (thin line) since late 1992 according to the Colorado Center for Astrodynamics Research at University of Colorado at Boulder. The thick stippled line represents a two-degree polynomium. The polynomium suggests the rate of the ongoing global sea level rise to be slowly decreasing. Time is shown along the x-axis as fractions of calendar years.

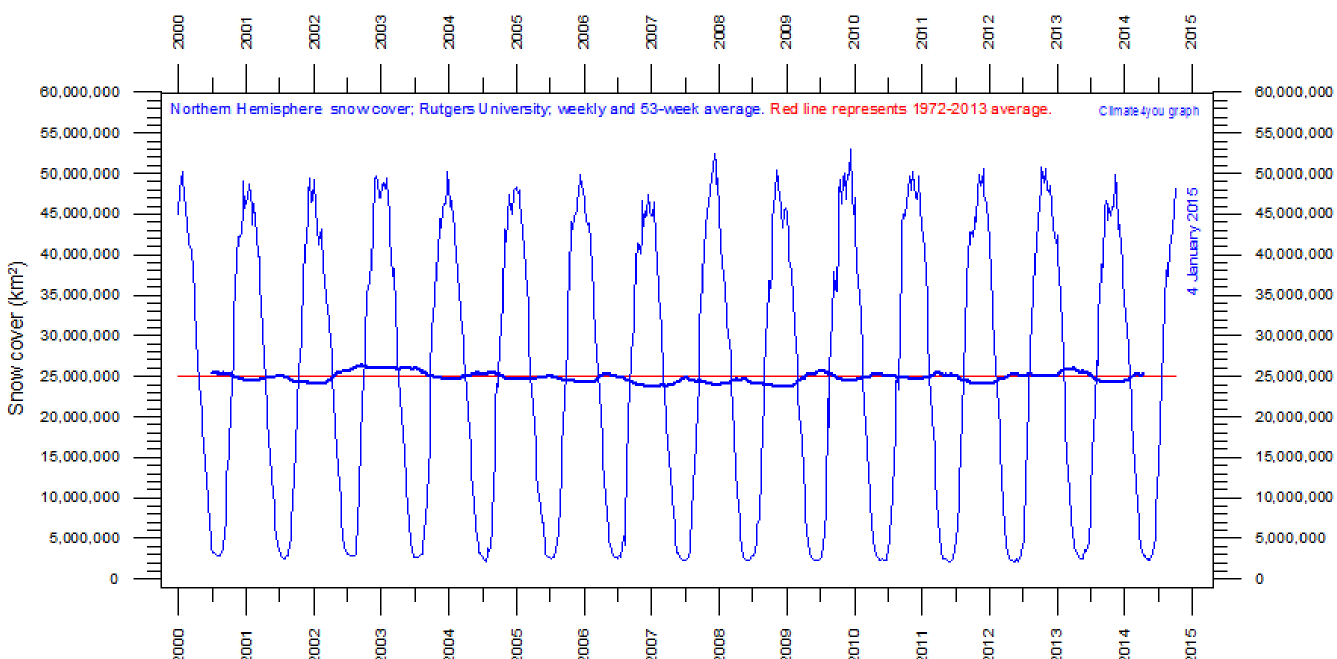


Forecasted change of global sea level until year 2100, based on simple extrapolation of measurements done by the Colorado Center for Astrodynamics Research at [University of Colorado at Boulder](), USA. The thick line is the simple running 3 yr average forecast for sea level change until year 2100. Based on this (thick line), the present simple empirical forecast of sea level change until 2100 is about +38 cm.

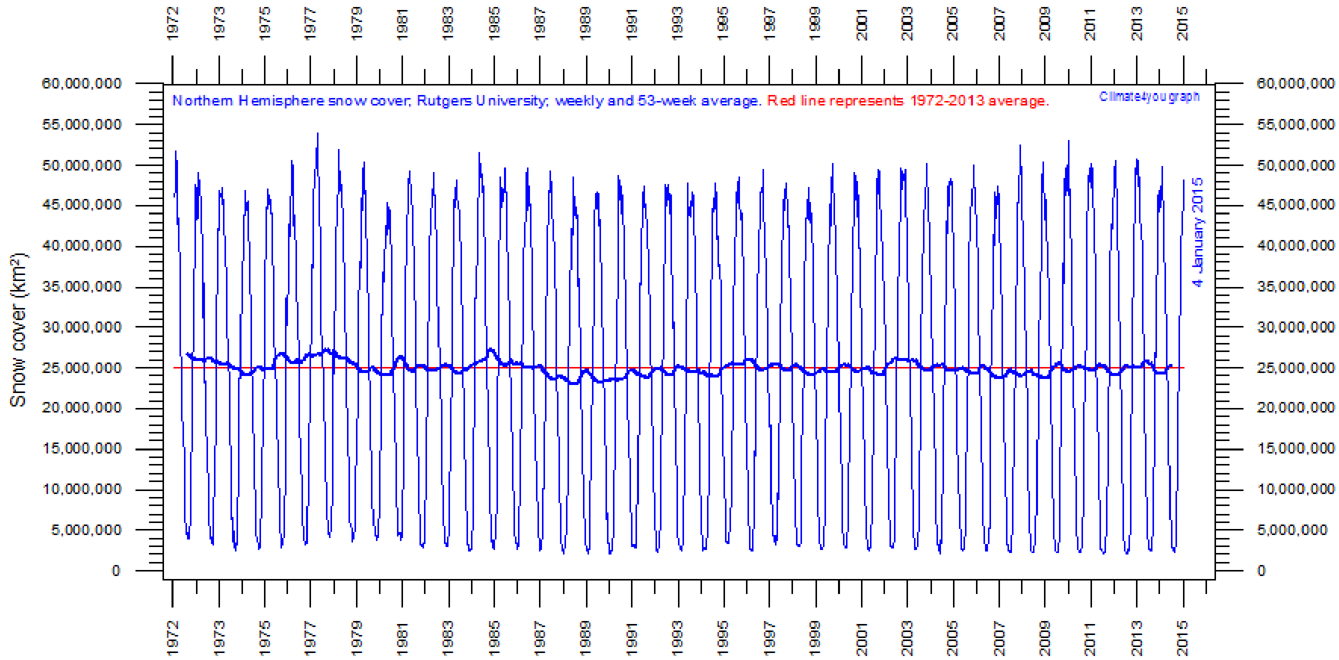
Northern Hemisphere weekly snow cover, updated to early January 2015



Northern hemisphere snow cover (white) and sea ice (yellow) 17 January 2014 (left) and 2015 (right). Map source: [National Ice Center](#) (NIC).

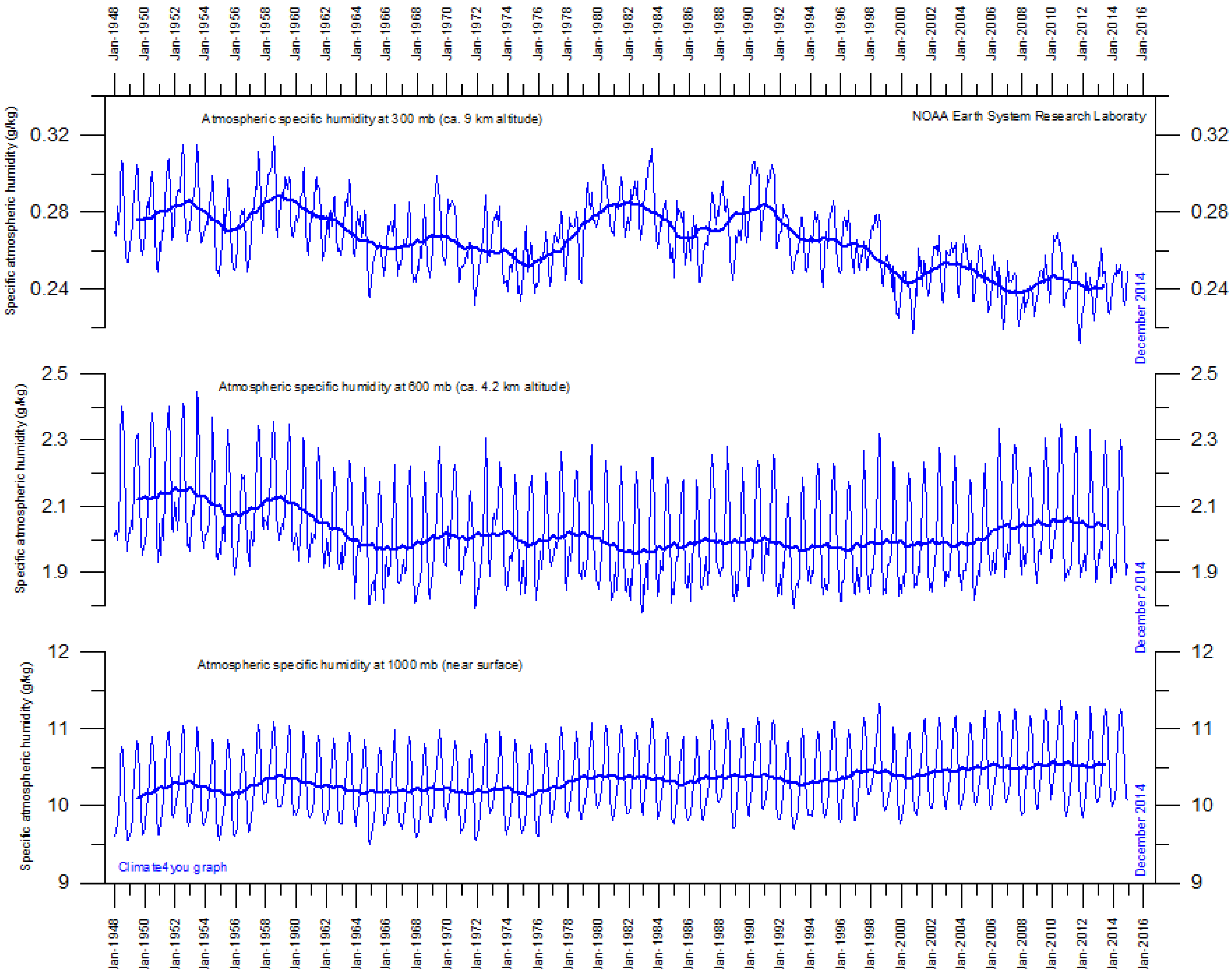


Northern hemisphere weekly snow cover since January 2000 according to Rutgers University Global Snow Laboratory. The thin blue line is the weekly data, and the thick blue line is the running 53-week average (approximately 1 year). The horizontal red line is the 1972-2013 average.



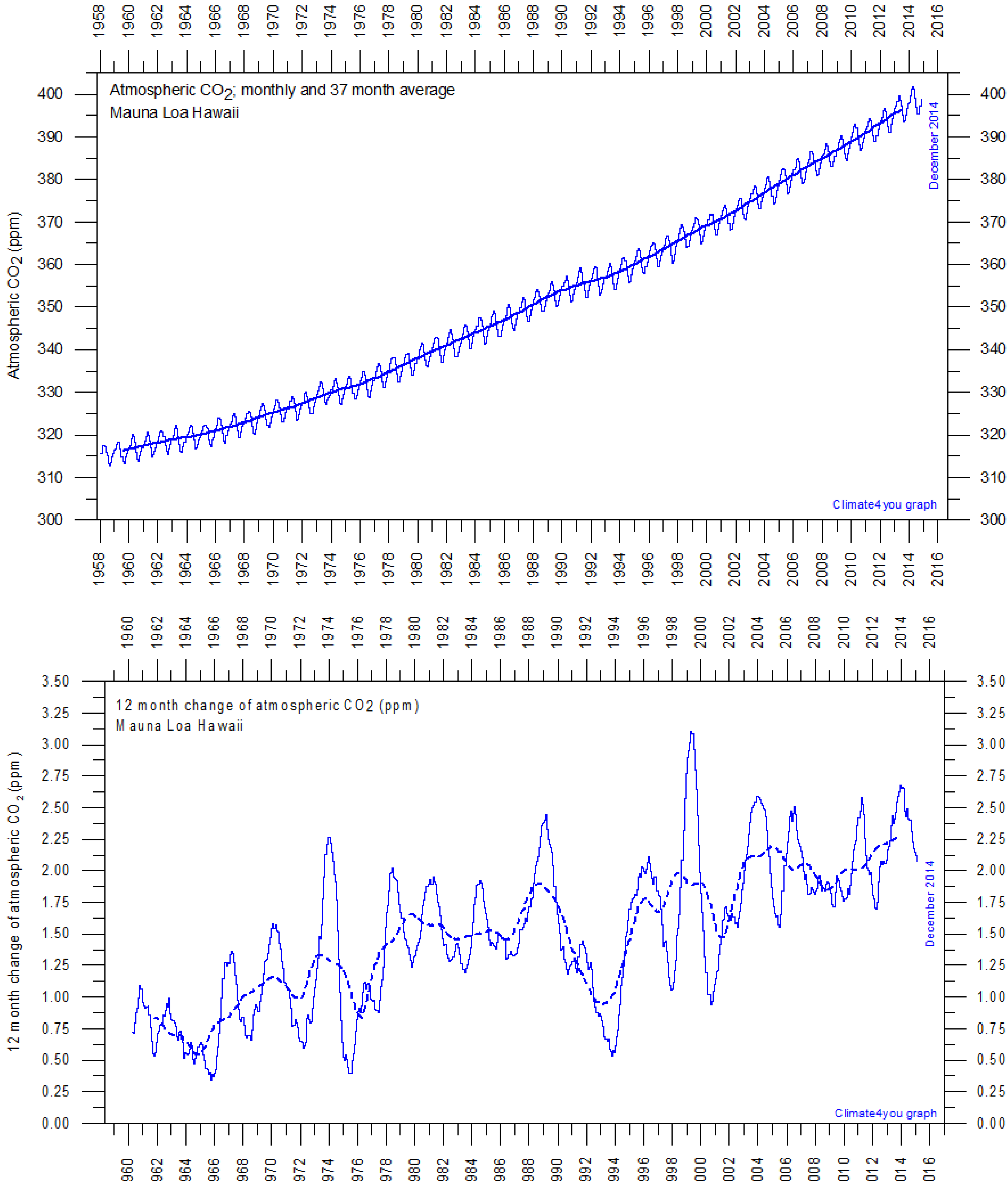
Northern hemisphere weekly snow cover since January 1972 according to Rutgers University Global Snow Laboratory. The thin blue line is the weekly data, and the thick blue line is the running 53-week average (approximately 1 year). The horizontal red line is the 1972-2013 average.

Atmospheric specific humidity, updated to December 2014



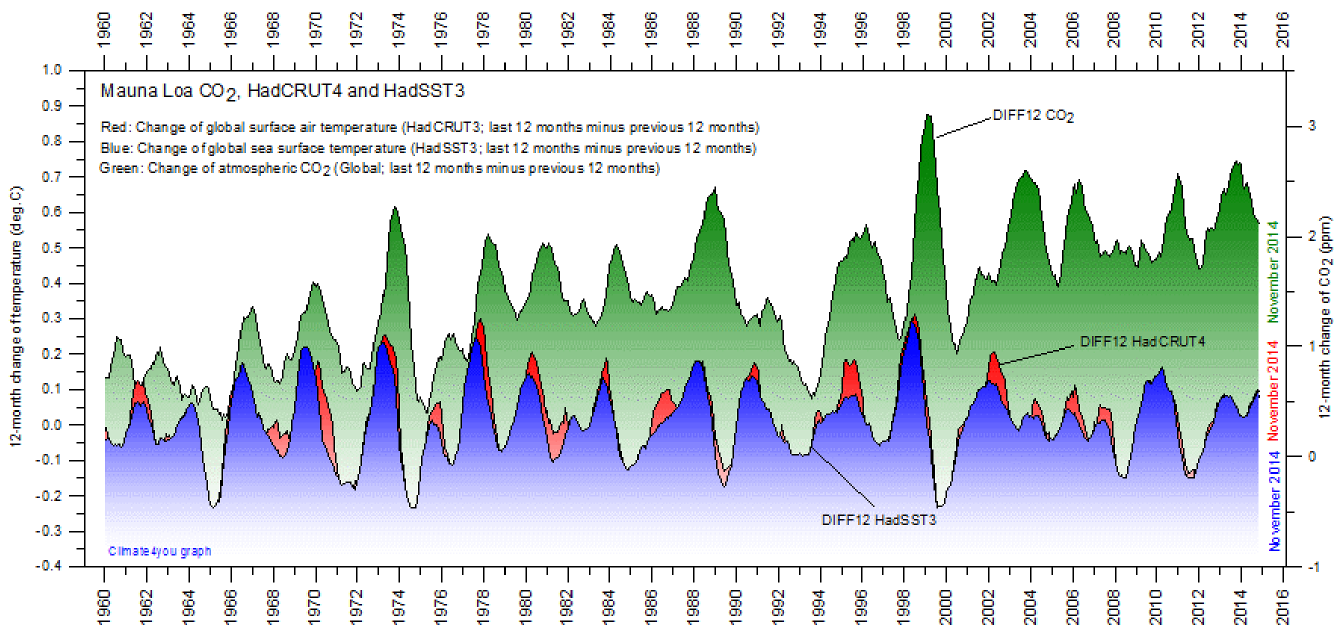
Specific atmospheric humidity (g/kg) at three different altitudes in the lower part of the atmosphere (the Troposphere) since January 1948 (Kalnay et al. 1996). The thin blue lines shows monthly values, while the thick blue lines show the running 37-month average (about 3 years). Data source: Earth System Research Laboratory (NOAA).

Atmospheric CO_2, updated to December 2014



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

The phase relation between atmospheric CO_2 and global temperature, updated to November 2014

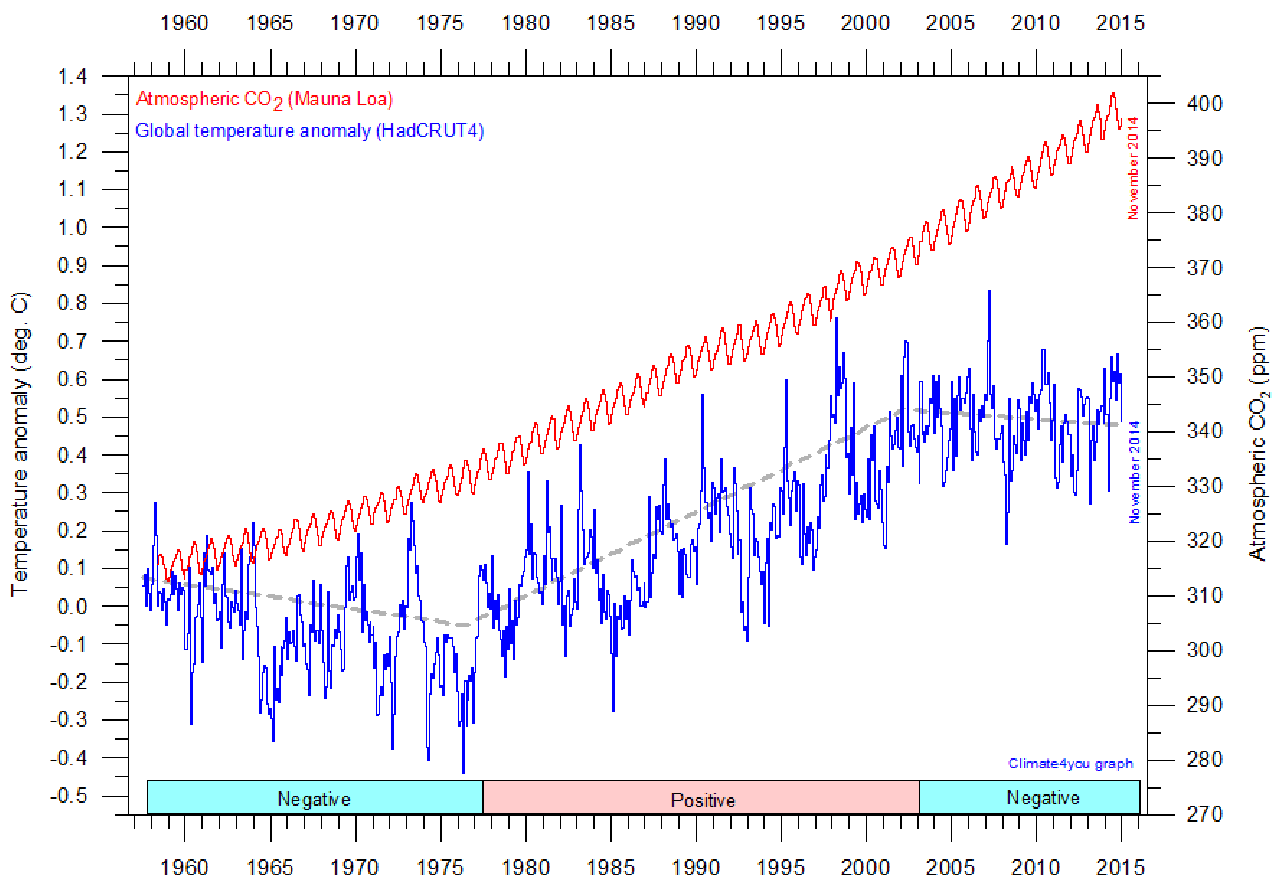


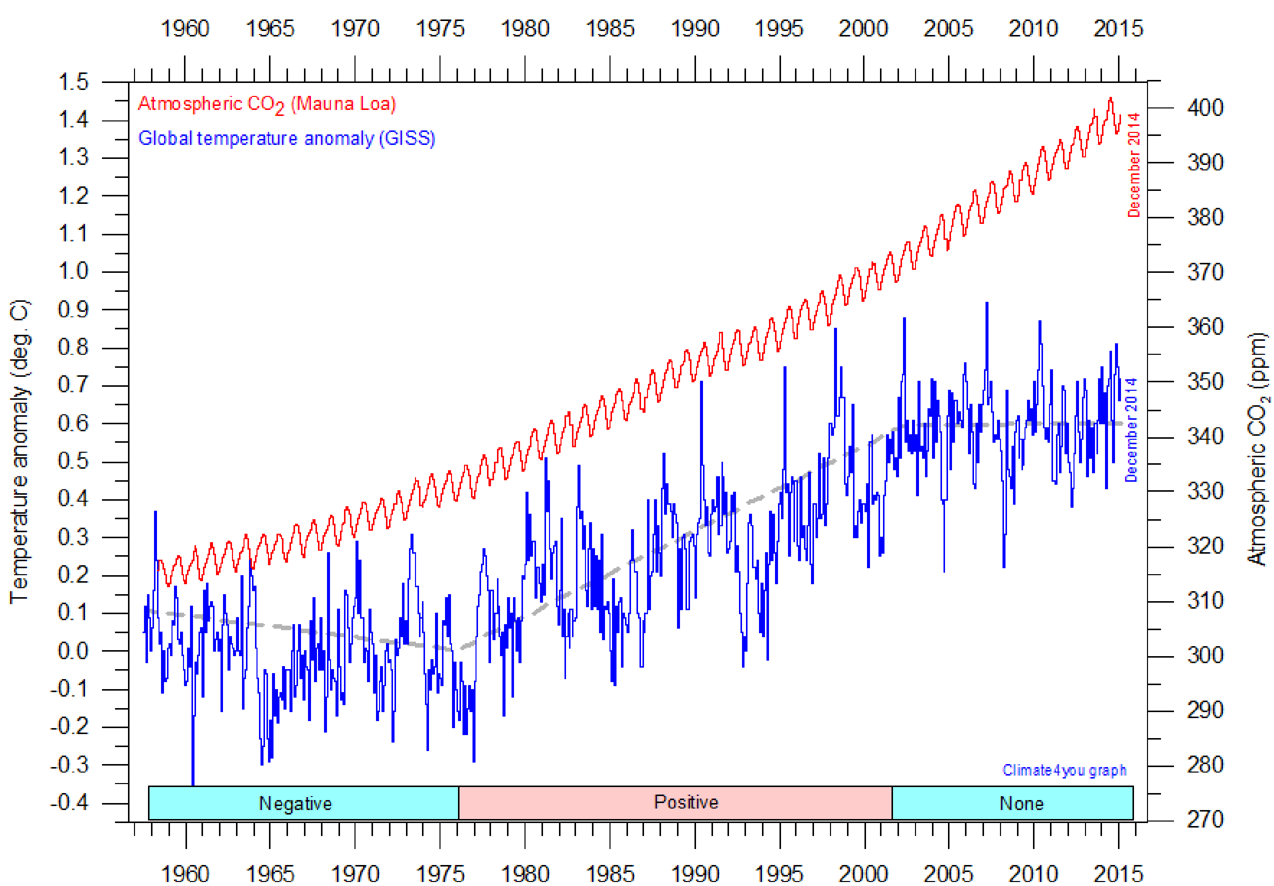
12-month change of global atmospheric CO_2 concentration (Mauna Loa; green), global sea surface temperature (HadSST3; blue) and global surface air temperature (HadCRUT4; red dotted). All graphs are showing monthly values of DIFF12, the difference between the average of the last 12 month and the average for the previous 12 months for each data series.

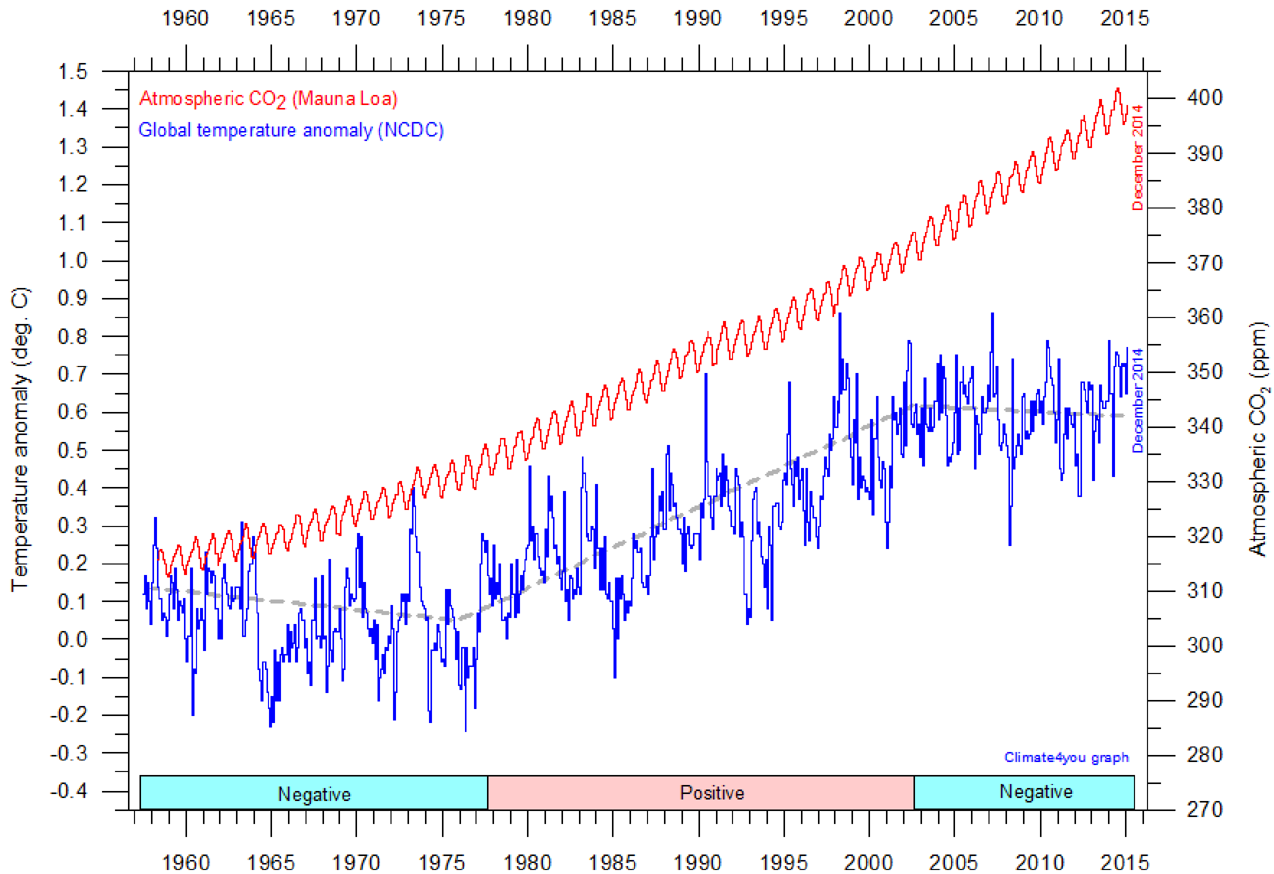
References:

Humlum, O., Stordahl, K. and Solheim, J-E. 2012. The phase relation between atmospheric carbon dioxide and global temperature. Global and Planetary Change, August 30, 2012. http://www.sciencedirect.com/science/article/pii/S0921818112001658?v=s5

Global surface air temperature and atmospheric CO_2, updated to December 2014







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 was therefore 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 is not yet updated beyond November 2014.

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 meteorological record value may well be the result of other phenomena.

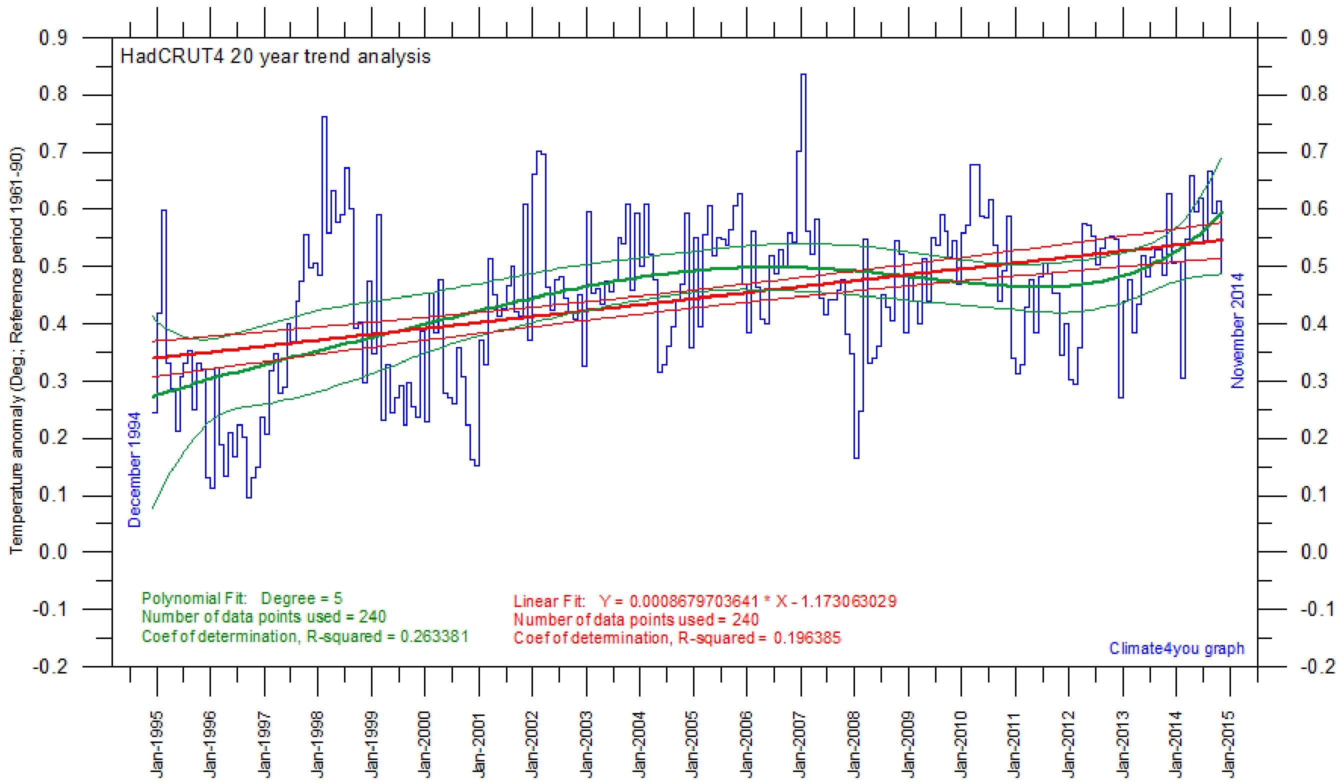
What exactly defines the critical length of a relevant time period to consider for evaluating the alleged importance of CO_2 remains elusive, and is still a topic for discussion. However, the critical period length must be inversely proportional to the temperature sensitivity of CO_2, including feedback 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 CO_2 has been indicated in the lower panels of the diagrams above.

Last 20 year monthly surface air temperature changes, updated to November 2014



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). Please note that the linear regression is done by month, not year.

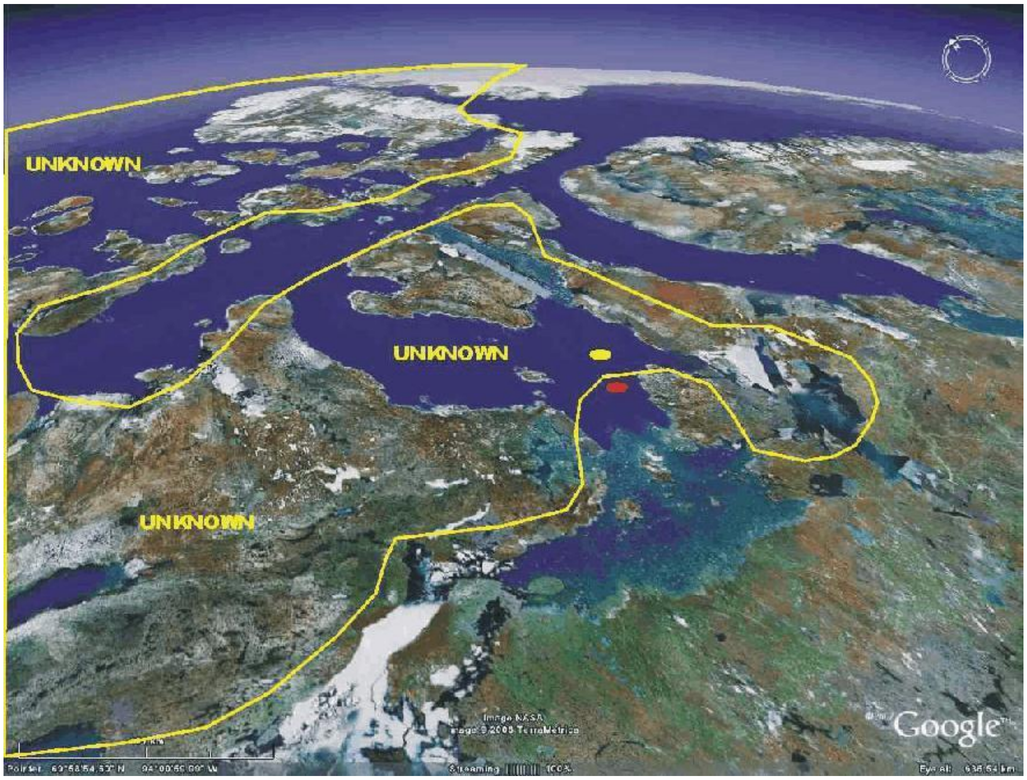
It is quite often debated if the global surface air temperature still increases, or if the temperature has levelled out during the last 15-18 years. The above diagram may be useful in this context, and demonstrates the differences between two often used statistical approaches to determine recent temperature trends. Please also note that such fits only attempt to describe the past, and usually have limited predictive power. In addition, before using any linear trend (or other) analysis of time series a proper statistical model should be chosen, based on statistical justification.

For temperature time series there is no *a priori* physical reason why the long-term trend should be linear in time. In fact, climatic time series often have trends for which a straight line is not a good approximation, as can clearly be seen from several of the diagrams in the present report.

For an excellent description of problems often encountered by analyses of temperature time series analyses please see Keenan, D.J. 2014: Statistical Analyses of Surface Temperatures in the IPCC Fifth Assessment Report.

Climate and history; one example among many

1845-1848: The Franklin Expedition to the Northwest Passage



Satellite picture showing the central parts of the Northwest Passage, as it was known in 1845, when the Franklin Expedition sailed. Direction of view is towards northeast. The yellow dot shows where Erebus and Terror were beset 1846. The red dot shows where they were abandoned April 1848. King Williams Island is seen shortly southeast of the red dot. Greenland is seen in the far distance near the horizon. Picture source: Google Earth.

In September 1843 James Clark Ross returned triumphantly with *HMS Erebus* and *HMS Terror* from a brilliant three-year voyage of exploration in Antarctic seas, during which the Ross Sea and the Ross Ice Shelf were discovered and named. Their arrival offered Sir John Barrow, 1st Baronet and second secretary to the Admiralty in London, a last opportunity, before his retirement in 1845 aged eighty, to mount the decisive expedition to find the Northwest Passage.

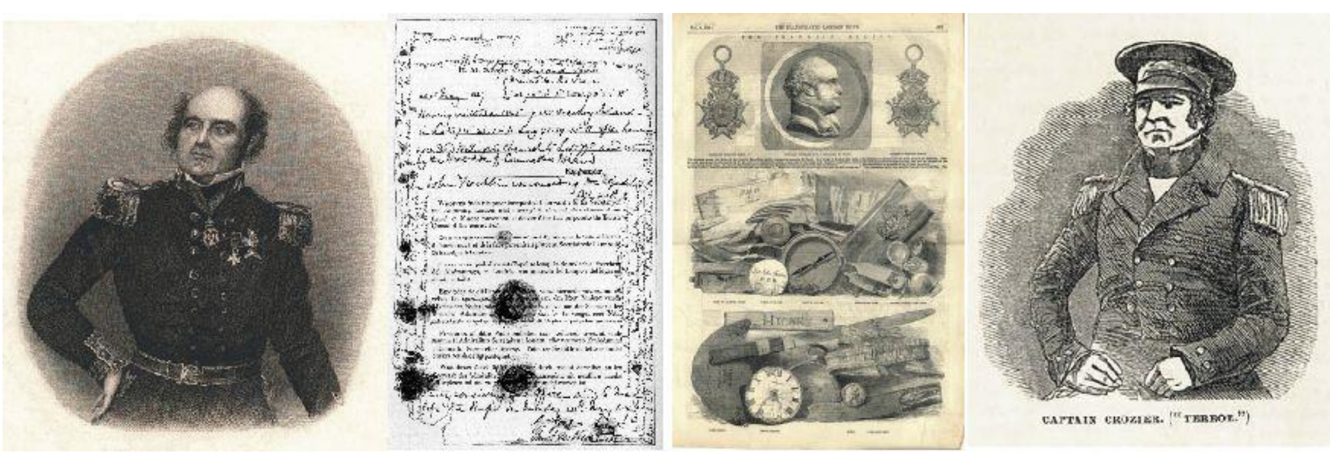
The Royal British Navy therefore decided to send a well-equipped Arctic expedition to complete the charting of the Northwest Passage. After Sir James Ross declined an offer to command the expedition because of his age (45), an invitation was extended to Sir John Franklin, who accepted despite his age (59). Sir John had previous experience from the Arctic, and had mapped a significant part of the northern coastline of Canada. In 1819-22 he led a disastrous overland expedition into the Northwest Territories of Canada along the Coppermine River, losing 11 of the 20 men in his party from starvation.

The new British expedition with John Franklin in command was ordered to gather magnetic data in the Canadian Arctic and to complete a crossing of the Northwest Passage, which by then had already been partly charted from both the east and west, but had never been entirely navigated.

The expedition was provided with the two sturdy navy ships, *HMS Erebus* and *HMS Terror*, just returned from their Antarctic journey. Both ships were built as so-called bomb vessels. Bomb vessels were strongly built in order to withstand the enormous recoil of their 3 ton mortars, and this made them suited to Arctic service. Both ships were equipped with converted railway twenty-horsepower steam engines that enabled the ships to make 4 knots on their own power, and also provided a novel heating device for the comfort of the crew. In addition, a mechanism that enabled the iron rudder and propeller to be drawn into iron wells to protect them from damage when in thick ice. Iron plating was added to their hulls. The expedition brought three years preserved or tinned preserved food supplies with them. The quality of the canned soups and meat have since been reason for concern, and may have contributed to the sad outcome of the expedition. Captain James Fitzjames, was given command of HMS Erebus while Captain Francis Crozier was named executive commander and commander of HMS Terror.

Being well acquainted with Erebus and Terror from his Antarctic expedition, James Ross thought that the two ships were too big for the planned operation, and was convinced the expedition would fail. No one, and least of all Franklin himself, listened to Ross.

The Franklin Expedition set sail May 19, 1845, with a crew of 24 officers and 110 men. The ships first travelled north to Aberdeen for additional supplies. From Scotland, the then ships sailed to West Greenland. After initially misjudging the location of the small town Godhavn (Qeqertarssuag), Disko Island, central West Greenland, the expedition turned back and finally harboured at Godhavn to prepare for the rest of their voyage. Five crew members were sent home on two accompanying ships, reducing the final expedition crew size to 129. The expedition was last seen by Europeans on July 26, 1845, when the Peterhead whaler *Enterprise* encountered Terror and Erebus moored to an iceberg in Melville Bay.



Sir John Franklin (left). The note found by McClintock in May 1859 in a cairn south of Back Bay, King William Island, describing the fate of the Franklin Expedition until April 1848 (centre left). Relics of Franklin's expedition brought back by John Rae in 1854 (centre right). Captain Crozier of the Terror, Franklin's second in command (right).

The remaining part of the summer 1845 was used exploring the Wellington Channel northwest of Devon Island. The Wellington channel was found to be blocked by thick, old ice. Late September 1845 the expedition found a safe winter harbor on the south coast of Beechey Island. The following summer 1846 the expedition sailed south west of Summerset Island, towards King William Island (at that time believed to represent an peninsula extending from south), to explore the southern of the two alleged channels which were supposed to represent the final leg of the Northwest Passage.

Presumably John Franklin was aware of the contemporary notion of the sea east of King Williams Island being a closed bay, wherefore he decided to force his way through thick ice along the west coast of King Williams Island. This proved to be a fatal misjudgment, as this region usually is covered with multiyear sea ice, transported by the prevailing wind down the McClintock Channel, and therefore in a continuous state of compression. During the Little Ice Age the ice conditions most likely were worse than is typically seen today. Had Franklin instead sailed east of King Williams Island, which in reality is not a closed bay and only covered by seasonal ice (as observed by John Rae in 1854), he might well have been successful in navigating the entire Northwest Passage.

Terror and Erebus were rapidly beset in the thick ice in the southern part of McClintock Channel. Their twenty-horsepower steam engines were no match for meter-thick sea ice. Not surprisingly, the multiyear ice did not melt the following summer 1847, and both ships had to be abandoned in April 1848. Sir John Franklin himself died in June 1847. A desperate attempt to walk and sail to safety in the south with smaller boats was attempted, but in vain. No members of the expedition survived.

A number of rescue expeditions were organized. The German geographer August Petermann in 1852 proposed that a search expedition should be send northwards through '*the wide opening*' between Spitsbergen and Novaya Zemlya which '*probably offers the easiest and most advantageous entrance into the open, navigable Polar Sea, and perhaps the best route for the search after Sir John Frankli*n' (Brown 1858).

In 1854, the Hudson's Bay Company doctor John Rae became the first to collect evidence and information from local Inuit’s pointing to the fate of the Franklin expedition. Most rescue expeditions were searching elsewhere than the region near King Williams Island, as it was not believed that the lost navigators would be found anywhere near the coast of the continent. It was reasoned that if Franklin’s ships had iced up anywhere near the western shore of Boothia Peninsula and had to be abandoned, the crews would certainly have followed the example of Sir John Ross and Sir James Ross in 1832 and would have retreated toward Fury Beach on the east coast of Somerset Island. There, where Sir Edward Parry had wrecked *MHS Fury* in 1825, they would not only have found a large depot of provisions and fuel, but would also have been in a position to attract the attention of whaling ships, just as John and James Ross had done previously. Furthermore, to travel south with a view to reaching some tiny Hudson’s Bay Company fur-trading outpost would involve a much longer journey with a far smaller chance of success.

Captain Leopold McClintock commanded one of the rescue expeditions and later in a book published about his voyage wrote (McGoogan 2001):

Had Sir John Franklin known that a channel existed eastward of King William Land (so named by Sir John Ross), I do not think he would have risked the besetment of his ships in such very heavy ice to the westward of it; but had he attempted the northwest passage by the eastern route, he would probably have carried his ships safely through to Behring’s Straits. But Franklin was furnished with charts which indicated no passage to the eastward of King William’s Land, and made that land (since discovered by Rae to be an island) a peninsula attached to the continent of North America; and he consequently had but one course open to him, and that the one he adopted.

In many respects John Rae can be said to have discovered the final link in the only Northwest Passage navigable by nineteenth-century ships. The final link in the passage therefore rightfully carries his name: Rae Strait. Half a century later, when Roald Amundsen in 1903-06 became the first to navigate the entire Northwest Passage, he did so by sailing his small 47-ton ship called the *Gjøa* through the channel discovered by John Rae in 1854.

References:

Brown, J. 1858. *The North-West Passage, and the Plans for the Search for Sir John Franklin. A Review*. London: E. Stanford.

McGoogan, K. 2002. *Fatal Passage. The untold story of Scotsman John Rae, the Arctic adventurer who discovered the fate of Franklin.* Bantam Books, London, 328 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

Yours sincerely,

Ole Humlum (Ole.Humlum@geo.uio.no)

January 20, 2015.