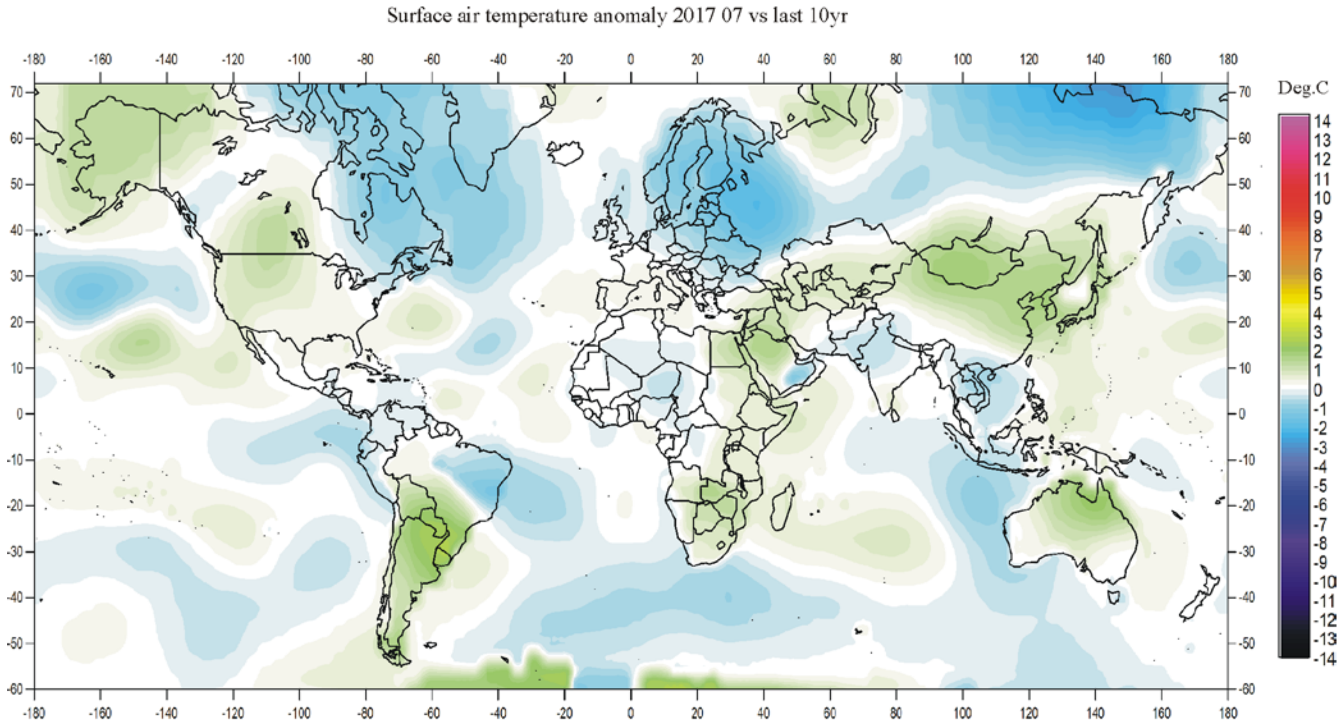
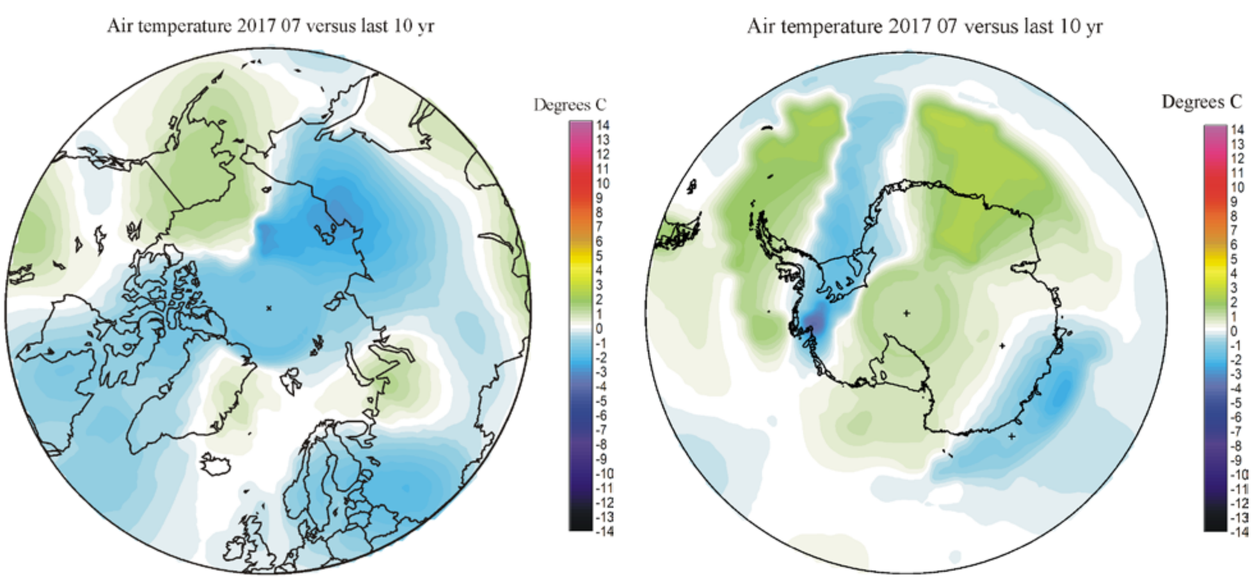
Climate4you update July 2017

Contents:

[July 2017 global surface air temperature overview]





July 2017 surface air temperature compared to the average of the last 10 years. Green-yellow-red colours indicate areas with higher temperature than the 10-year average, while blue colours indicate lower than average temperatures. Data source: [Goddard Institute for Space Studies] (GISS) using ERSST_v4 ocean surface temperatures. Please note that both polar regions appear to be affected by an error in the GISS interpolation (see more next page).

Comments to the July 2017 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 last previous 10 years are used as reference period*.

The rationale 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 this time period will automatically appear as warm, and it will be difficult to decide if modern surface air temperatures are increasing or decreasing. Comparing instead with the last previous 10 years overcomes this problem and displays the modern dynamics of ongoing change.

In addition, the GISS temperature data used for preparing the above diagrams display distinct temporal instability for data before the turn of the century (see p. 7). Any comparison with the WMO 'normal' period 1961-1990 is therefore influenced by ongoing monthly mainly administrative changes, and not suited as reference. Comparing with the last previous 10 years is more useful.

The different air temperature records have been divided into three quality classes, QC1, QC2 and QC3, respectively, as described on page 7.

In many diagrams shown 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 given to all individual months.

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 data series have a much longer record length, which may be inspected in greater detail on www.climate4you.com.

July 2017 global surface air temperatures

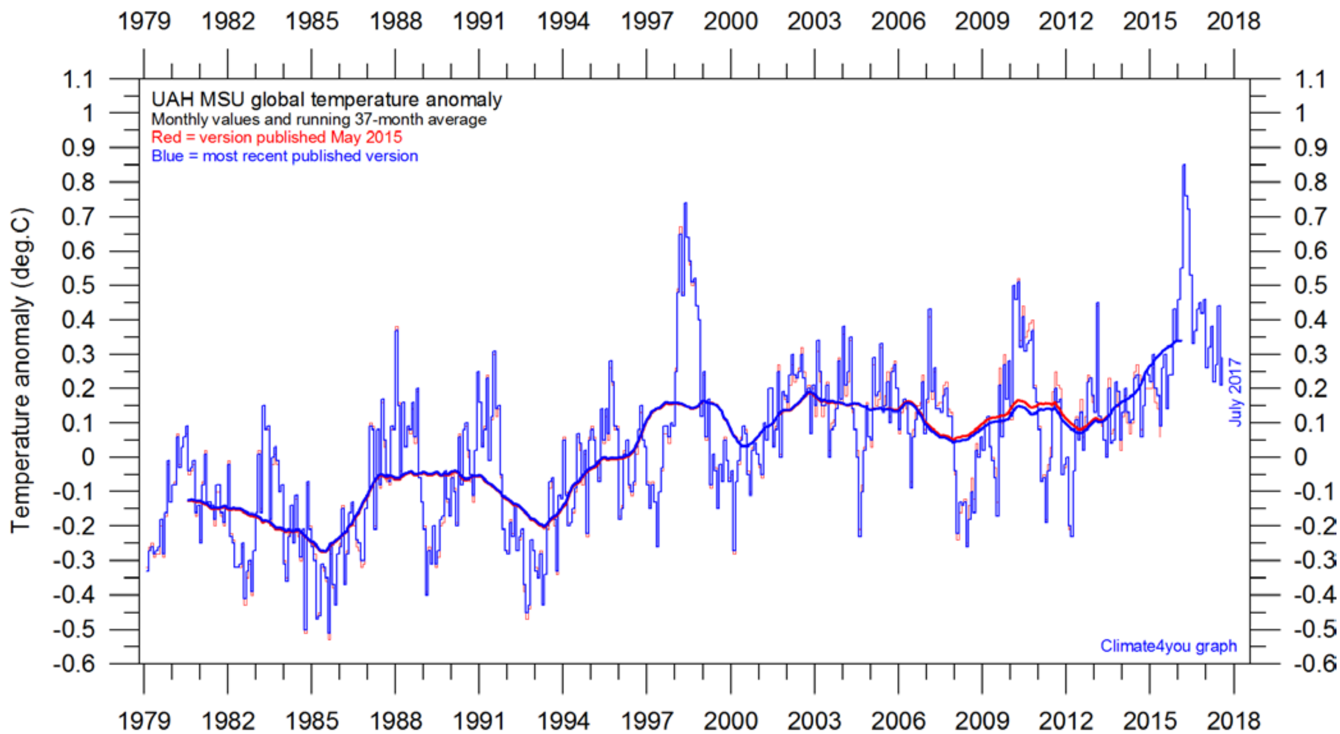
General: For July 2017 GISS supplied 15965 interpolated surface air data points; all are used to produce the diagrams on page 2. For July, the average global temperature anomaly was somewhat higher than in June (see p.6).

The Northern Hemisphere was, as usual, characterised by regional differences. Alaska and parts of northern Russia were relatively warm, while NE Canada, Greenland, Europe and Siberia were relatively cold. In the central Arctic region surface air temperatures were below average, although the interpolated GISS temperature data north of 80^o N still appears to be affected by an interpolation artefact.

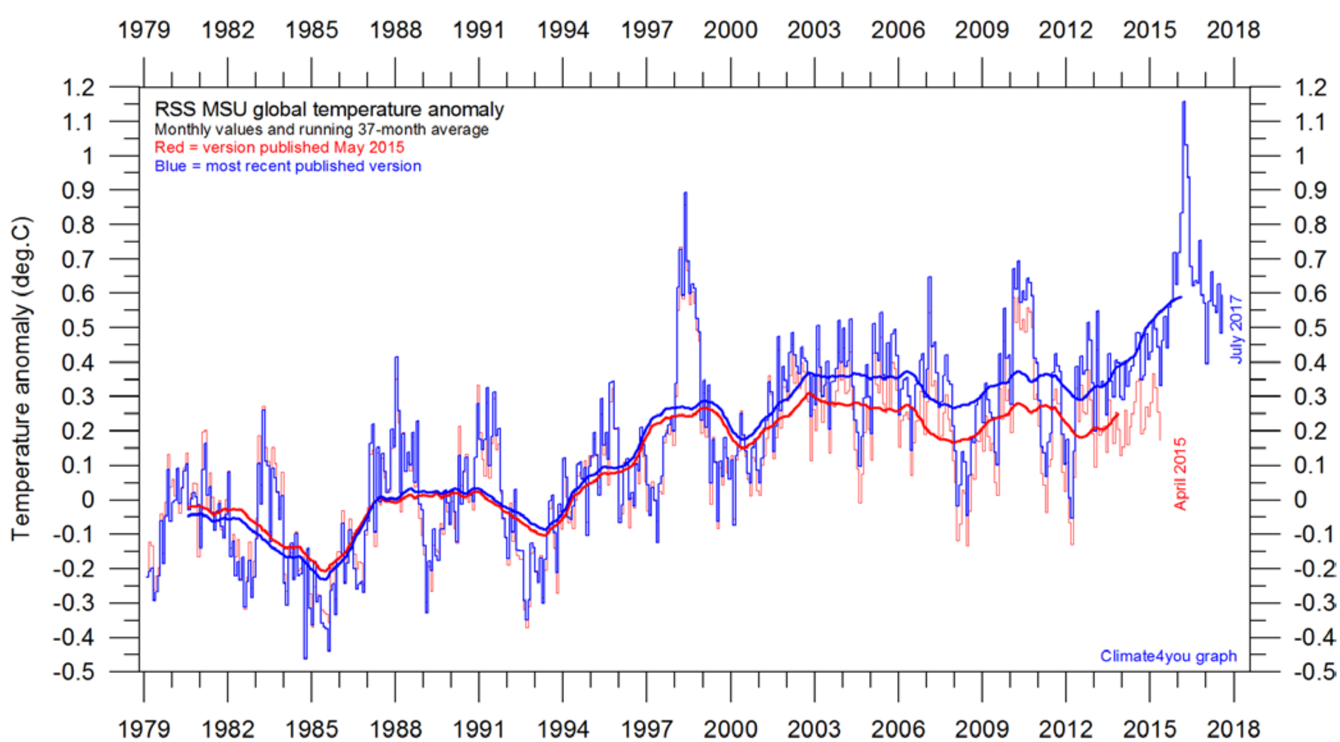
Near the Equator temperatures were, on average, near the 10-year average, but with regional differences.

The Southern Hemisphere temperatures were near the previous 10-year average. Most of the major land areas, South America, Africa and Australia had relatively warm conditions, while most of the oceans had relatively cold conditions. In the Antarctic, most regions had temperatures above average, although some had below average temperatures compared to the previous 10 years. The Antarctic temperature pattern appears to be affected by an interpolation artefact south of 80^{o}S.

Temperature quality class 1: Lower troposphere temperature from satellites, updated to July 2017

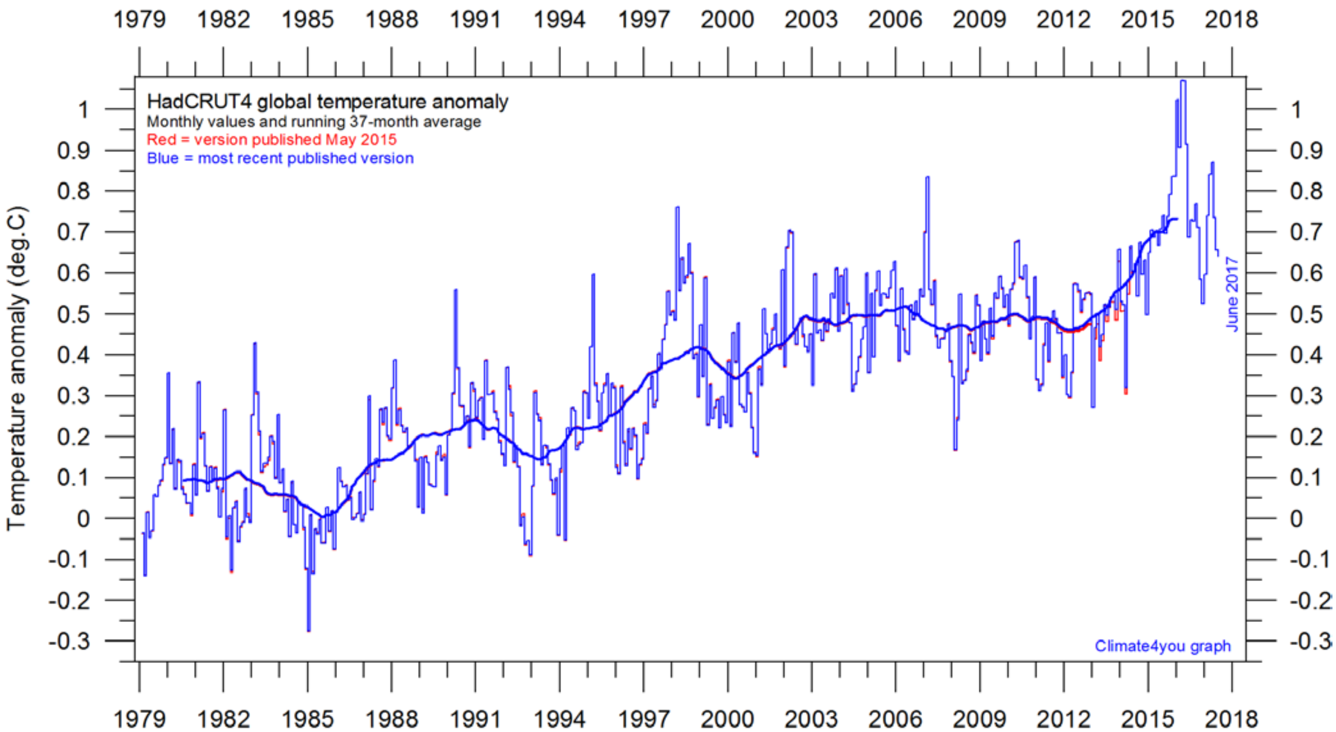


Global monthly average lower troposphere temperature (thin line) since 1979 according to [University of Alabama](#) at Huntsville, USA. The thick line is the simple running 37-month average.



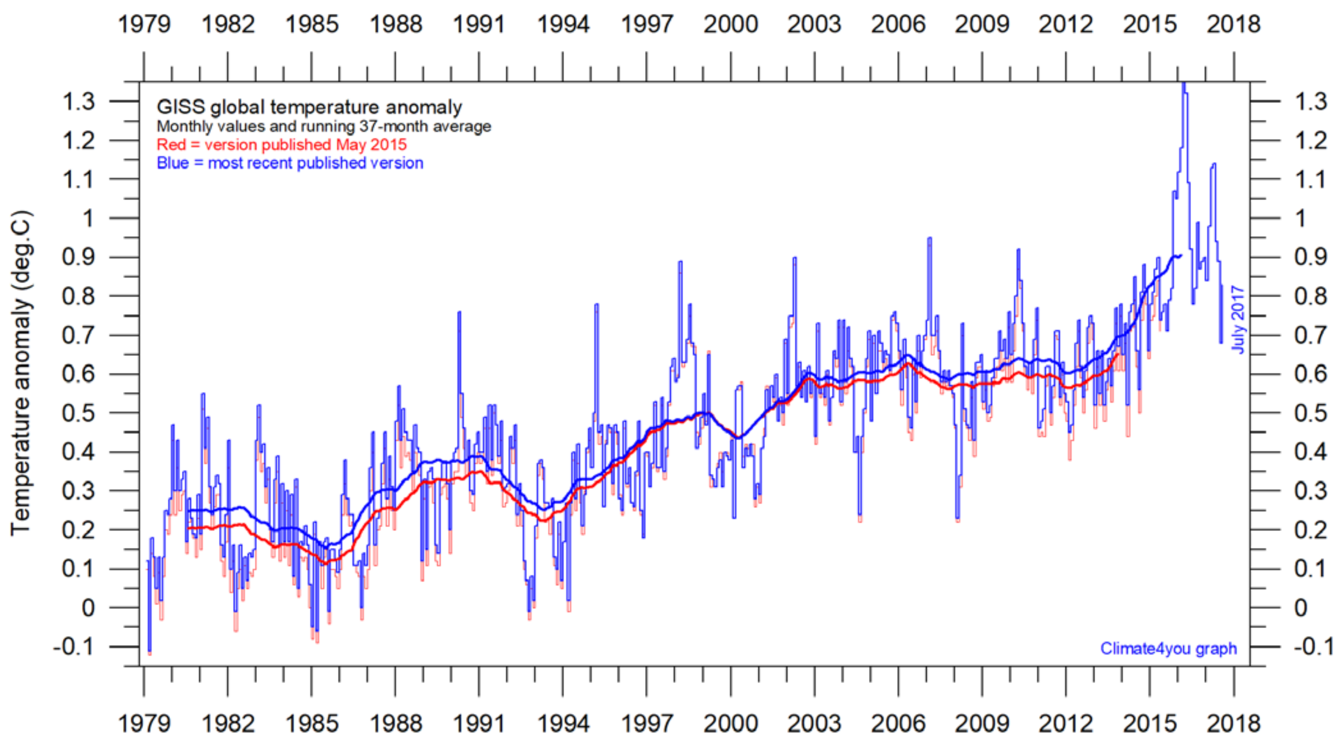
Global monthly average lower troposphere temperature (thin line) since 1979 according to according to [Remote Sensing Systems](#) (RSS), USA. The thick line is the simple running 37-month average.

Temperature quality class 2: HadCRUT global surface air temperature, updated to June 2017

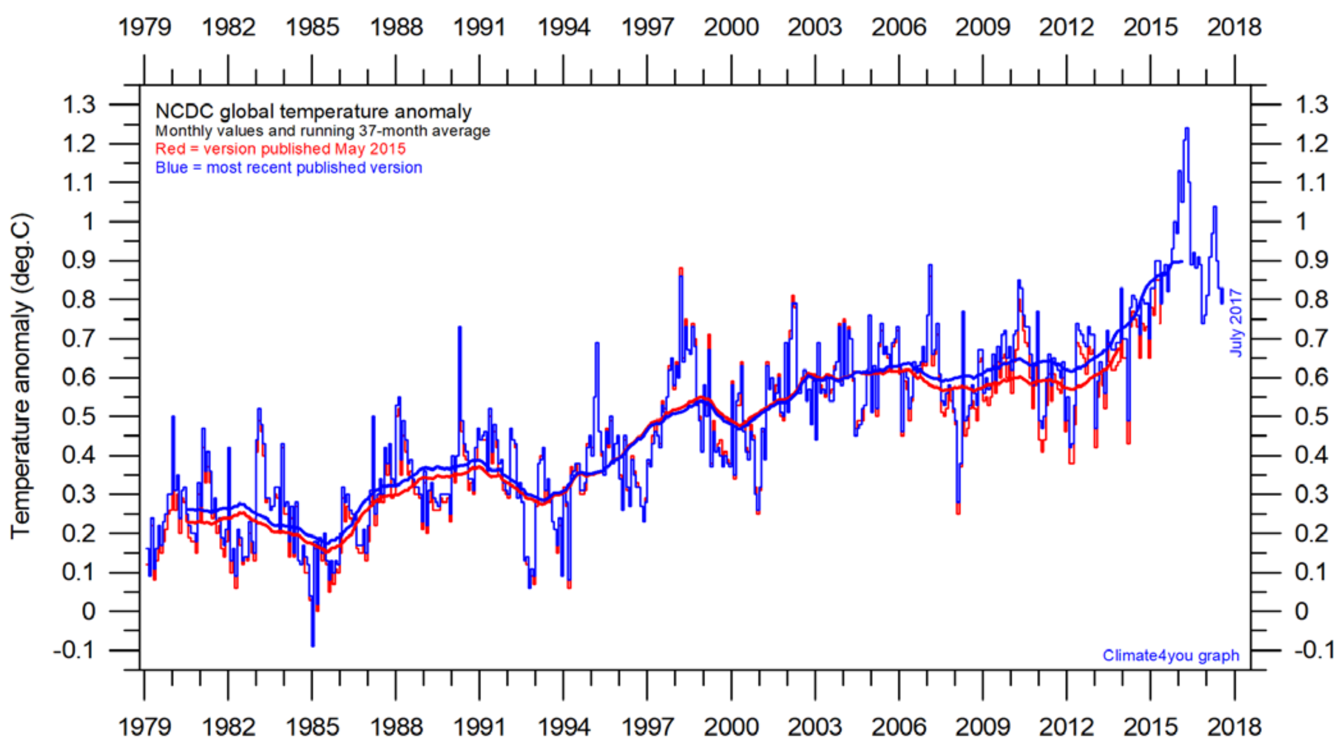


Global monthly average surface air temperature (thin line) since 1979 according to according to the Hadley Centre for Climate Prediction and Research and the University of East Anglia's [Climatic Research Unit](#) ([CRU](#)), UK. The thick line is the simple running 37-month average.

Temperature quality class 3: GISS and NCDC global surface air temperature, updated to July 2017



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, using ERSST_v4 ocean surface temperatures. 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 and -quality:

All temperature diagrams shown above have 1979 as starting year. This roughly marks the beginning of the recent period of global warming, after termination of the previous period of global cooling from about 1940. In addition, the year 1979 also represents the starting date for the satellite-based global temperature estimates (UAH and RSS). For the three surface air temperature records (HadCRUT, NCDC and GISS), they begin much earlier (in 1850 and 1880), as can be inspected on www.climate4you.com.

For all three surface air temperature records, but especially NCDC and GISS, administrative changes to anomaly values are quite often introduced, even for observations many years back in time. Some changes may be due to the delayed addition of new station data, while others probably have their origin in a change of technique to calculate average values. It is clearly impossible to evaluate the validity of such administrative changes for the outside user of these records; it is only possible to note that such changes appear very often (se example diagram next page).

In addition, the three surface records represent a blend of sea surface data collected by moving ships or by other means, plus data from land stations of partly unknown quality and unknown degree of representativeness for their region. Many of the land stations have also moved geographically during their existence, and their instrumentation changed, and they are influenced by changes in their surroundings (vegetation, buildings, etc.).

The satellite temperature records also have their problems, but these are generally of a more technical nature and therefore correctable. In addition, the temperature sampling by satellites is more regular and complete on a global basis than that represented by the surface records. Also important is that the sensors on satellites measure temperature directly by emitted radiation, while most surface temperature measurements are indirect, using electronic resistance.

Everybody interested in climate science should gratefully acknowledge the efforts put into maintaining the different temperature databases referred to in the present newsletter. At the same time, however, it is also important to realise that all temperature records cannot be of equal scientific quality. The simple fact that they to some degree differ shows that they cannot all be correct.

On this background, and for practical reasons, Climate4you operates with three quality classes (1-3) for global temperature records, with 1 representing the highest quality level:

Quality class 1: The satellite records (UAH and RSS).

Quality class 2: The HadCRUT surface record.

Quality class 3: The NCDC and GISS surface records.

The main reason for discriminating between the three surface records is the following:

While both NCDC and GISS often experience quite large administrative changes (see example on p.8), and therefore essentially are unstable temperature records, the changes introduced to HadCRUT are fewer and smaller. For obvious reasons, as the past does not change, any record undergoing continuing changes cannot describe the past correctly all the time.

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

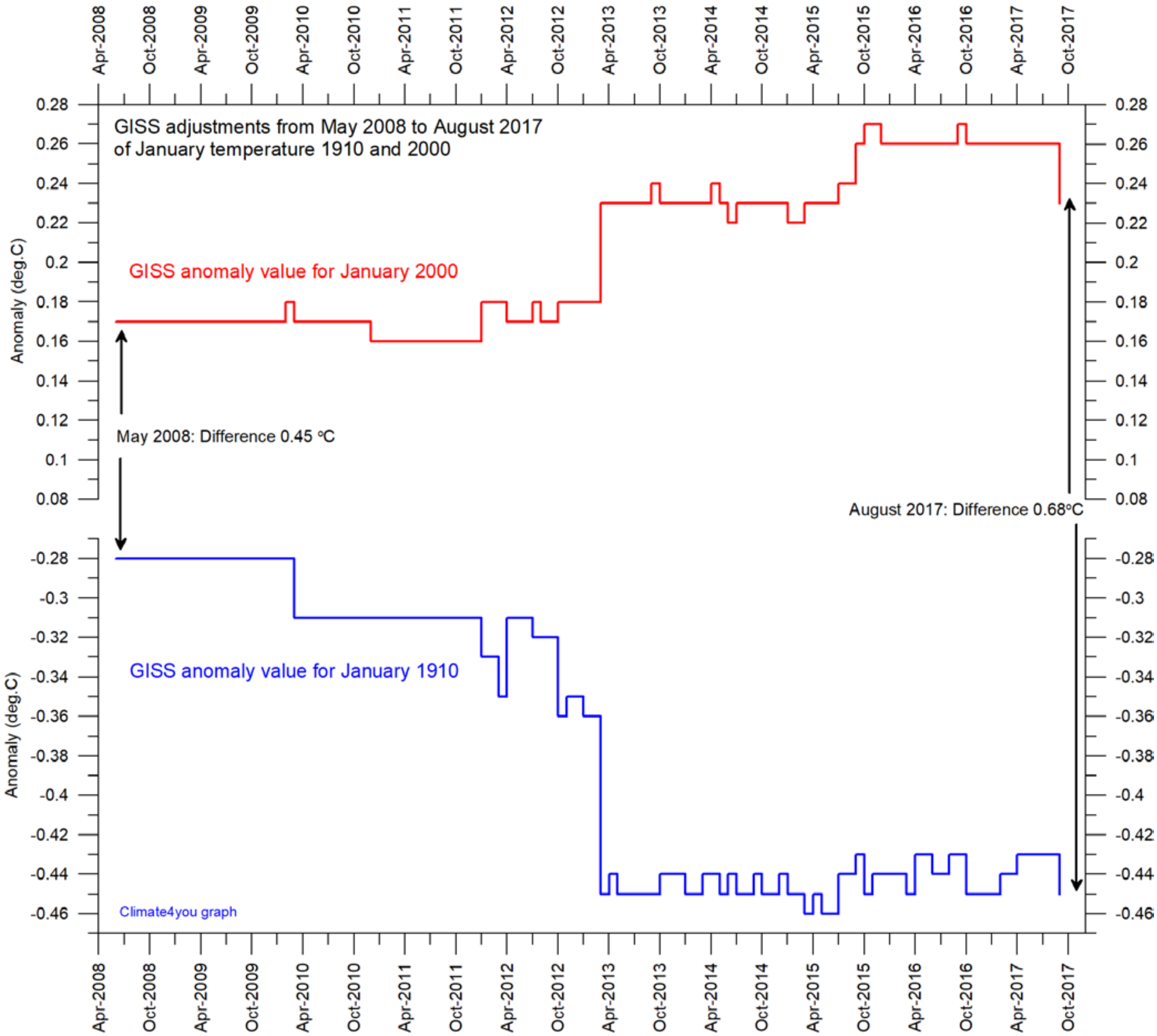
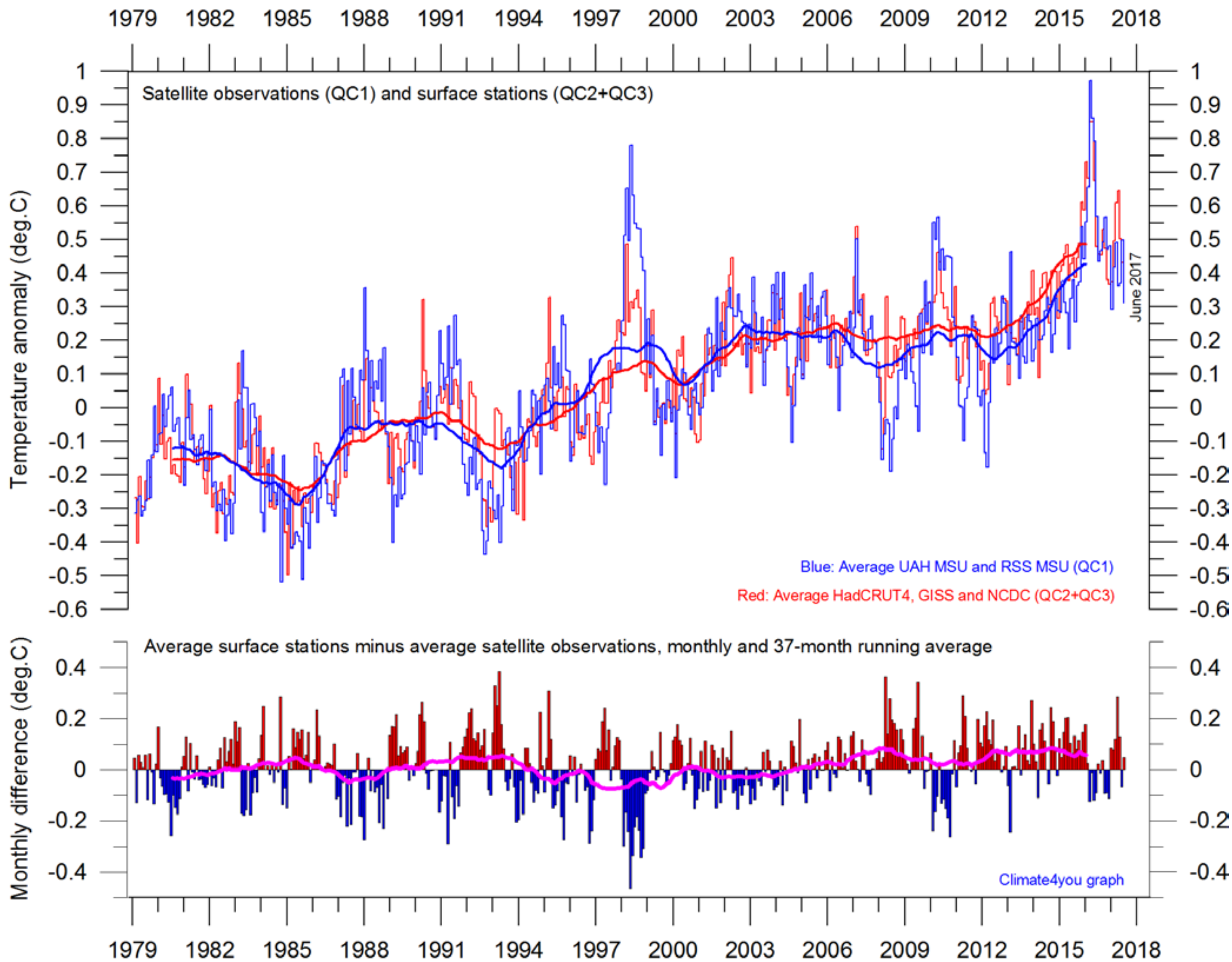


Diagram showing the adjustment made since May 2008 by the [Goddard Institute for Space Studies](#) (GISS), USA, in anomaly values for the months January 1910 and January 2000.

<u>Note:</u> The administrative upsurge of the temperature increase from January 1915 to January 2000 has grown from 0.45 (reported May 2008) to 0.68°C (reported August 2017). This represents an about 51% administrative temperature increase over this period, meaning that more than half of the reported (by GISS) global temperature increase from January 1910 to January 2000 is due to administrative changes of the original data since May 2008.

Comparing global surface air temperature and lower troposphere satellite temperatures; updated to June 2017



Plot showing the average of monthly global surface air temperature estimates (HadCRUT4, GISS and NCDC) and satellite-based temperature estimates (RSS MSU and UAH MSU). The thin lines indicate the monthly value, while the thick lines represent the simple running 37-month average, nearly corresponding to a running 3-yr average. The lower panel shows the monthly difference between average surface air temperature and satellite temperatures. As the base period differs for the different temperature estimates, they have all been normalised by comparing to the average value of 30 years from January 1979 to December 2008.

NOTE: Since about 2003, the average global surface air temperature is steadily drifting away in positive direction from the average satellite temperature, meaning that the surface records show warming in relation to the troposphere records. The reason(s) for this is not entirely clear, but can presumably at least partly be explained by the recurrent administrative adjustments made to the surface records (see p. 7-8).

Global air temperature linear trends updated to June 2017

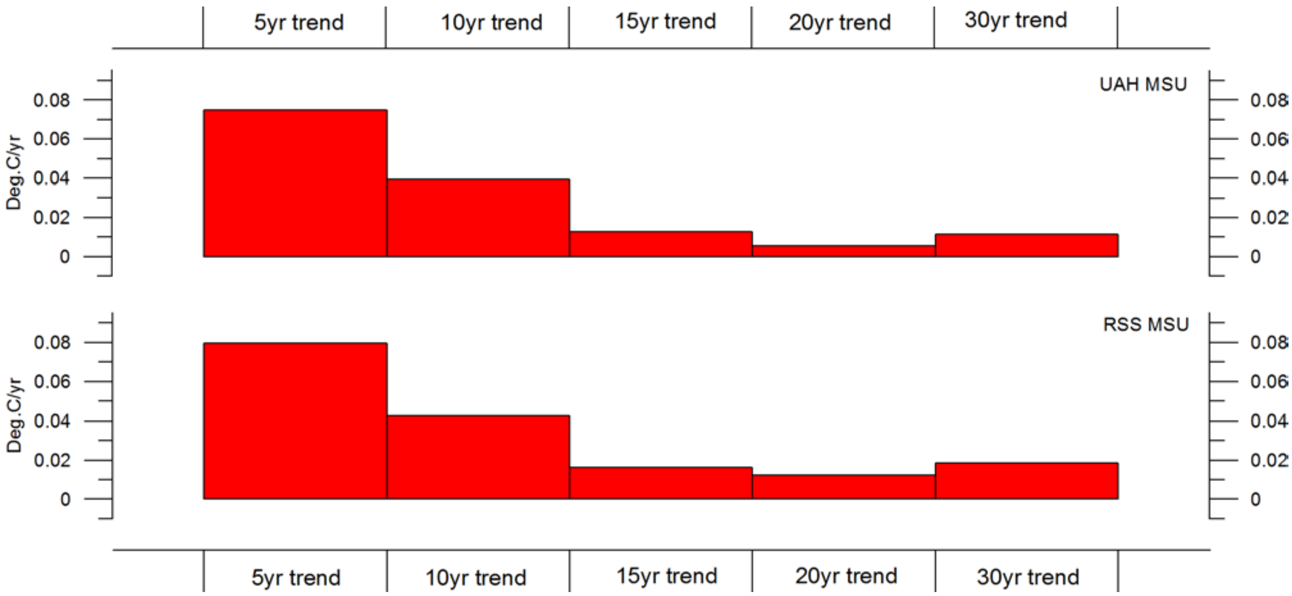


Diagram showing the latest 5, 10, 20 and 30-yr linear annual global temperature trend, calculated as the slope of the linear regression line through the data points, for two satellite-based temperature estimates (UAH MSU and RSS MSU).

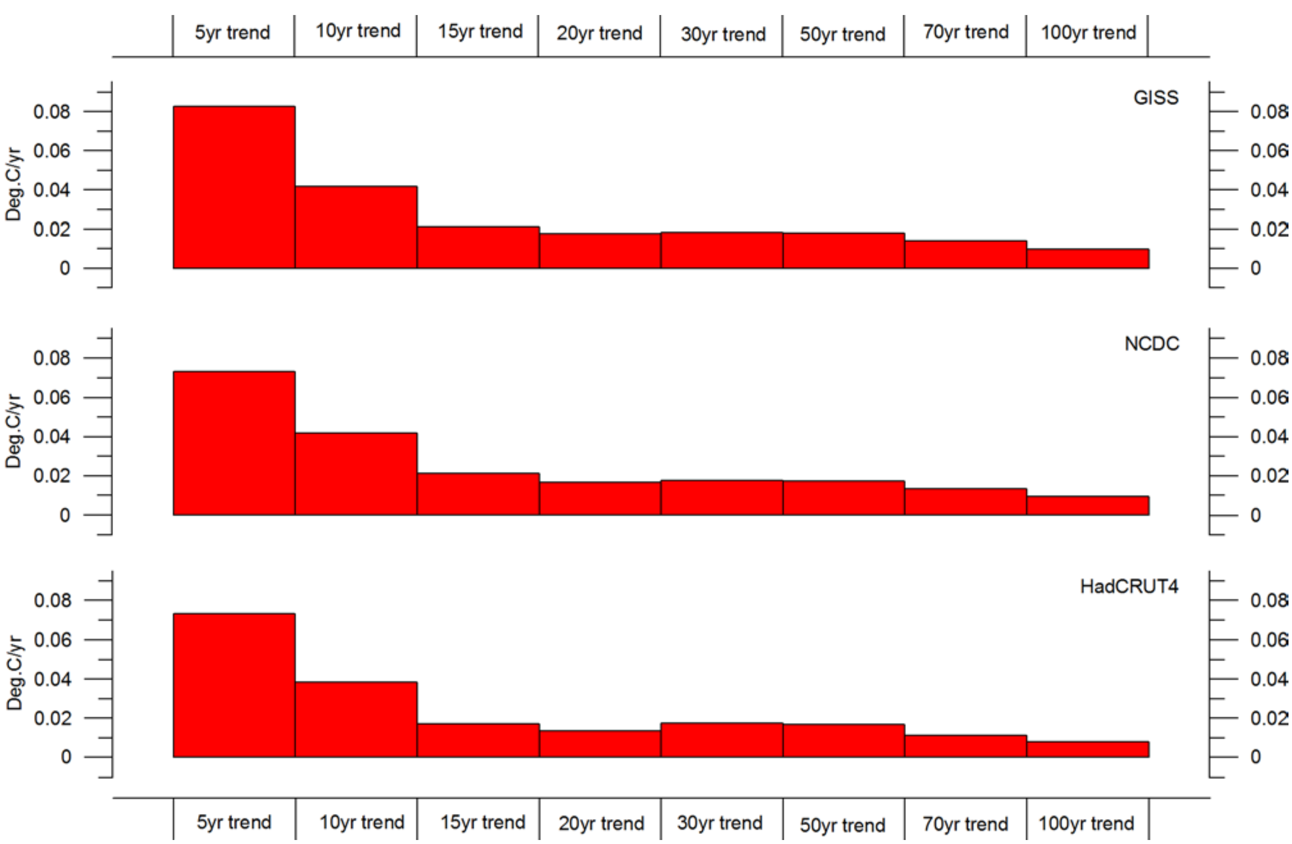
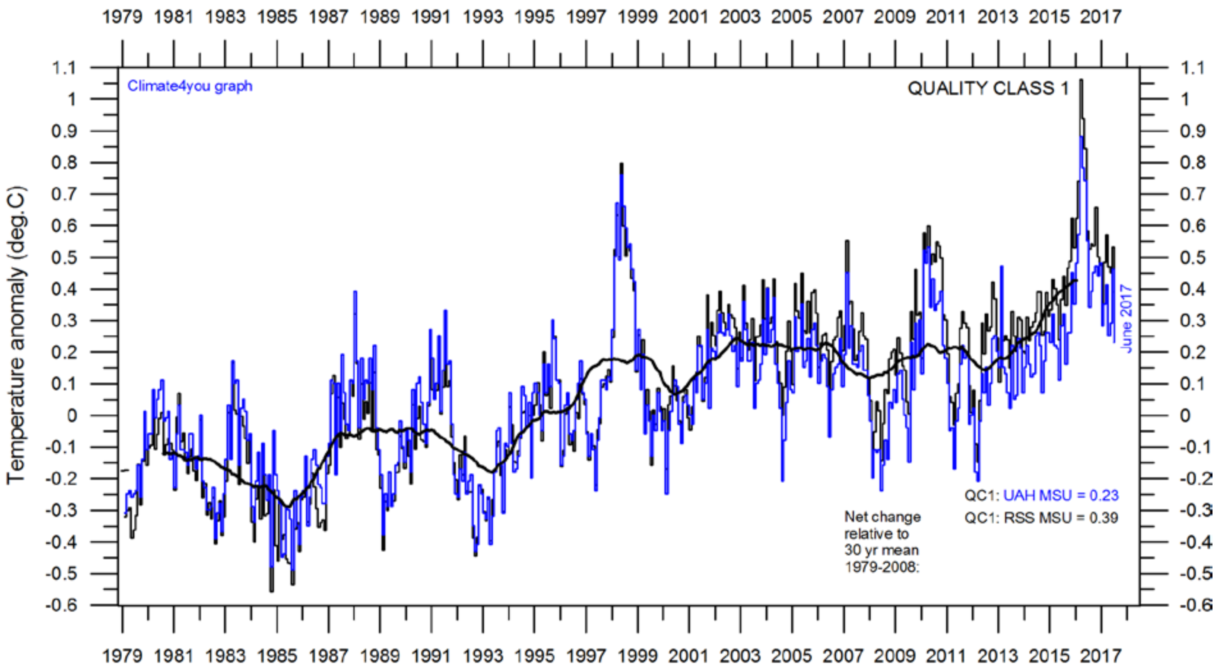
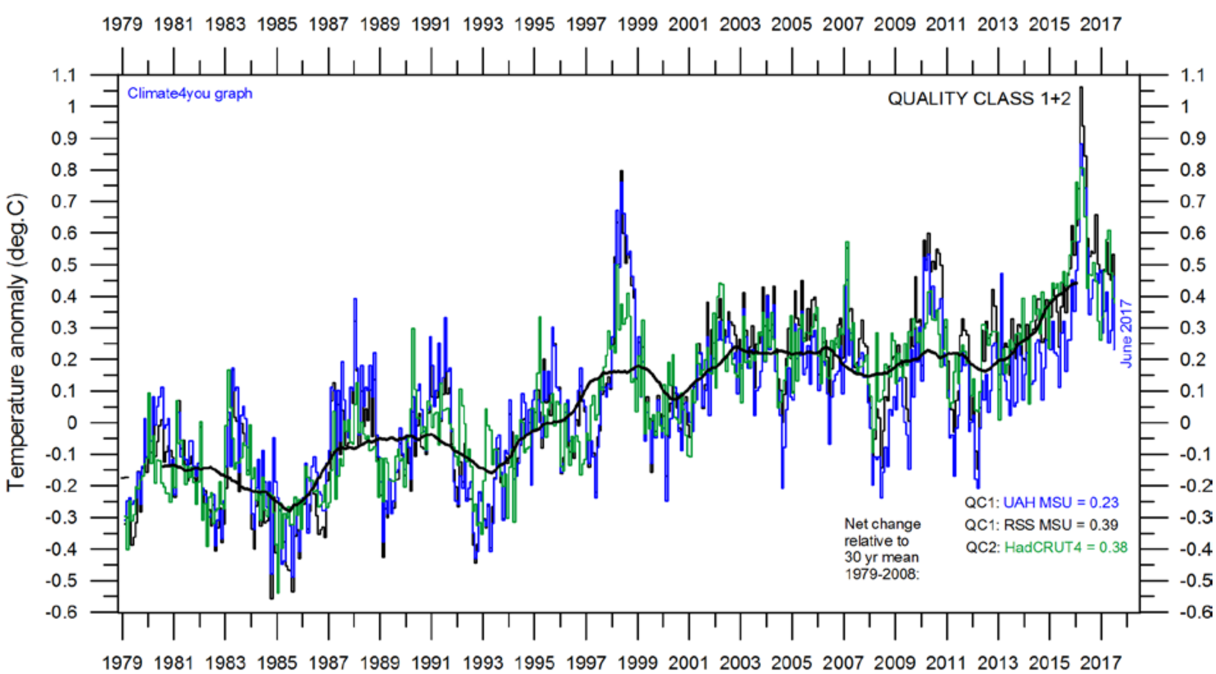


Diagram showing the latest 5, 10, 20, 30, 50, 70 and 100-year linear annual global temperature trend, calculated as the slope of the linear regression line through the data points, for three surface-based temperature estimates (GISS, NCDC and HadCRUT4).

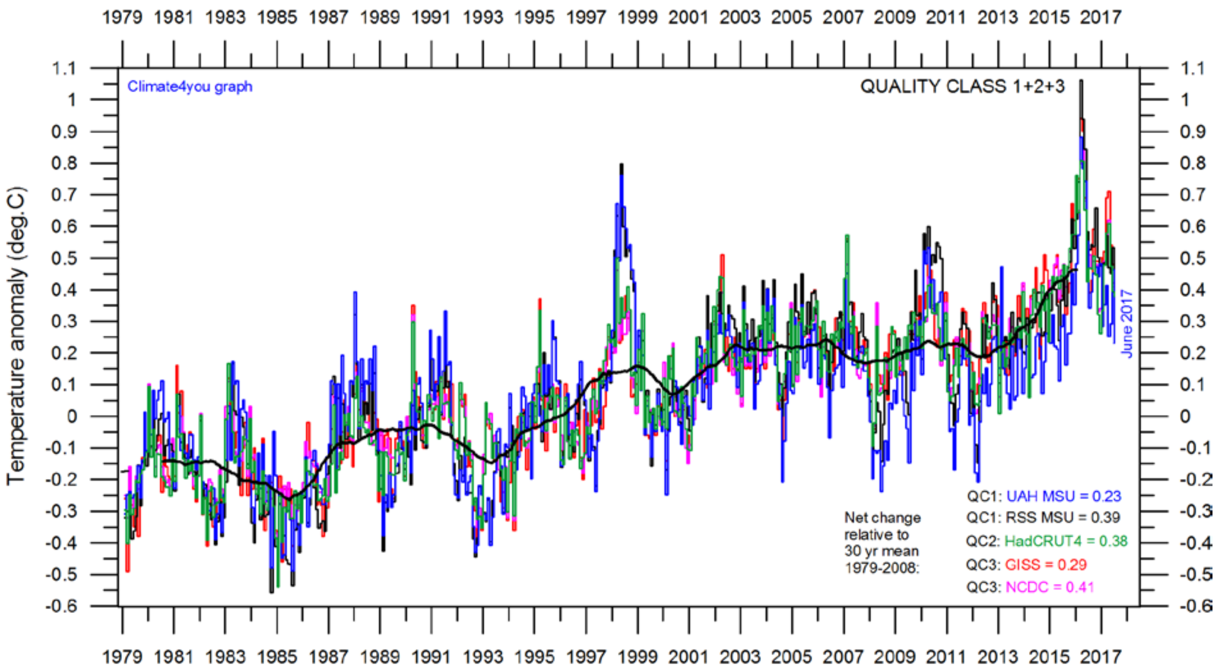
All in one, Quality Class 1, 2 and 3; updated to June 2017



Superimposed plot of Quality Class 1 (UAH and RSS) 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 (30 years) from January 1979 to December 2008. The heavy black line represents the simple running 37 month (c. 3 year) mean of the average of both temperature records. The numbers shown in the lower right corner represent the temperature anomaly relative to the individual 1979-2008 averages.



Superimposed plot of Quality Class 1 and 2 (UAH, RSS and HadCRUT4) 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 (30 years) from January 1979 to December 2008. The heavy black line represents the simple running 37 month (c. 3 year) mean of the average of all three temperature records. The numbers shown in the lower right corner represent the temperature anomaly relative to the individual 1979-2008 averages.



Superimposed plot of Quality Class 1, 2 and 3 global monthly temperature estimates (UAH, RSS, HadCRUT4, GISS and NCDC). 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 (30 years) from January 1979 to December 2008. 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 1979-2008 averages.

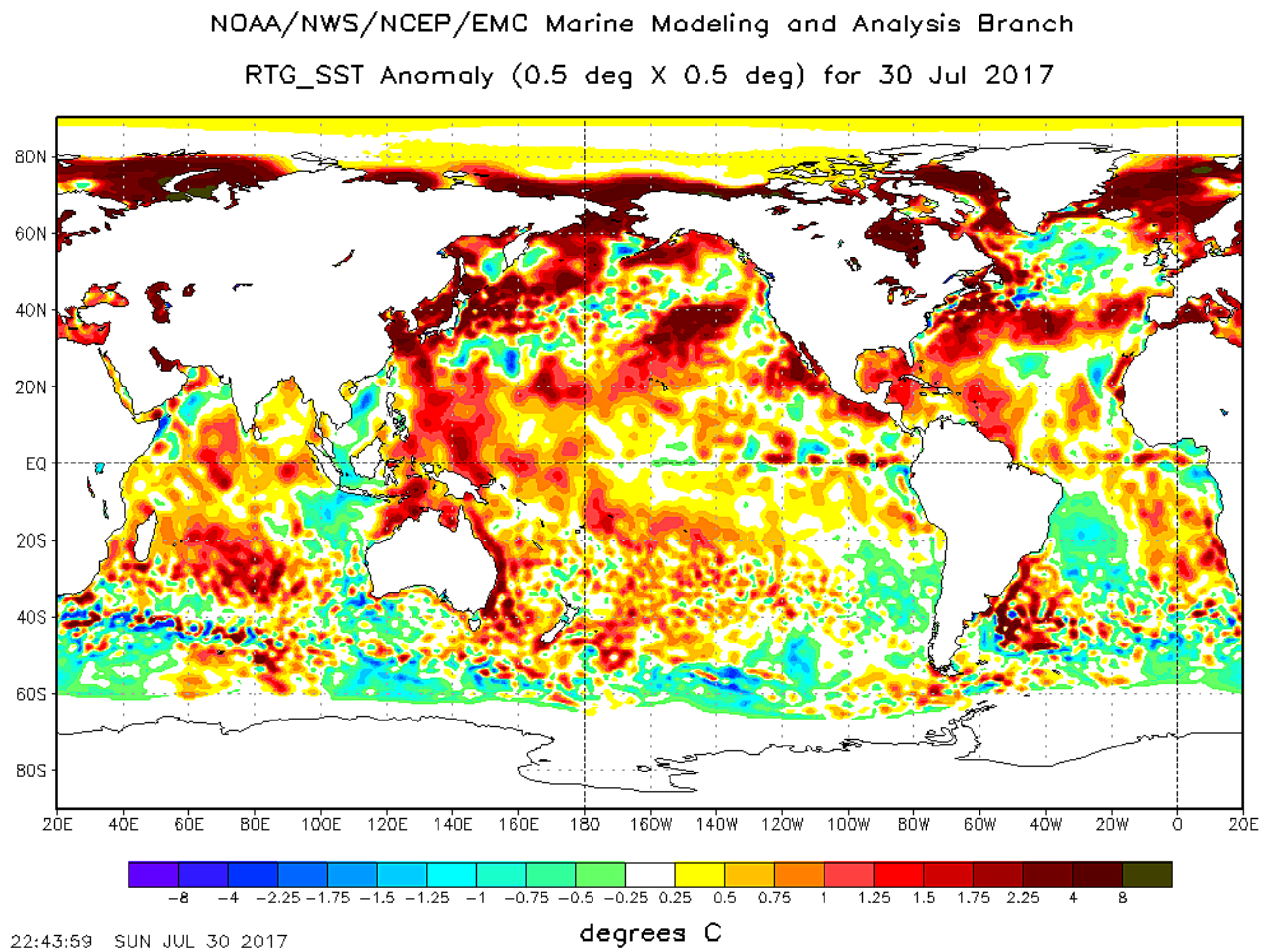
Please see notes on page 7 relating to the above three quality classes.

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 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. However, since about 2003 the surface records are consistently drifting towards higher temperatures than the satellite records (see p. 9).

The average of all five global temperature estimates presently shows an overall stagnation, at least since 2002-2003. There has been no real increase in global air temperature since 1998, which however was affected by the oceanographic El Niño event. Also, the recent (2015-16) El Niño event is probably a relatively short-lived spike on a longer development. Neither has there been a temperature decrease since 2002-2003.

The present temperature stagnation does not exclude the possibility that global temperatures will begin to increase again later. On the other hand, it also remains 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 possibilities is correct.

Global sea surface temperature, updated to July 2017



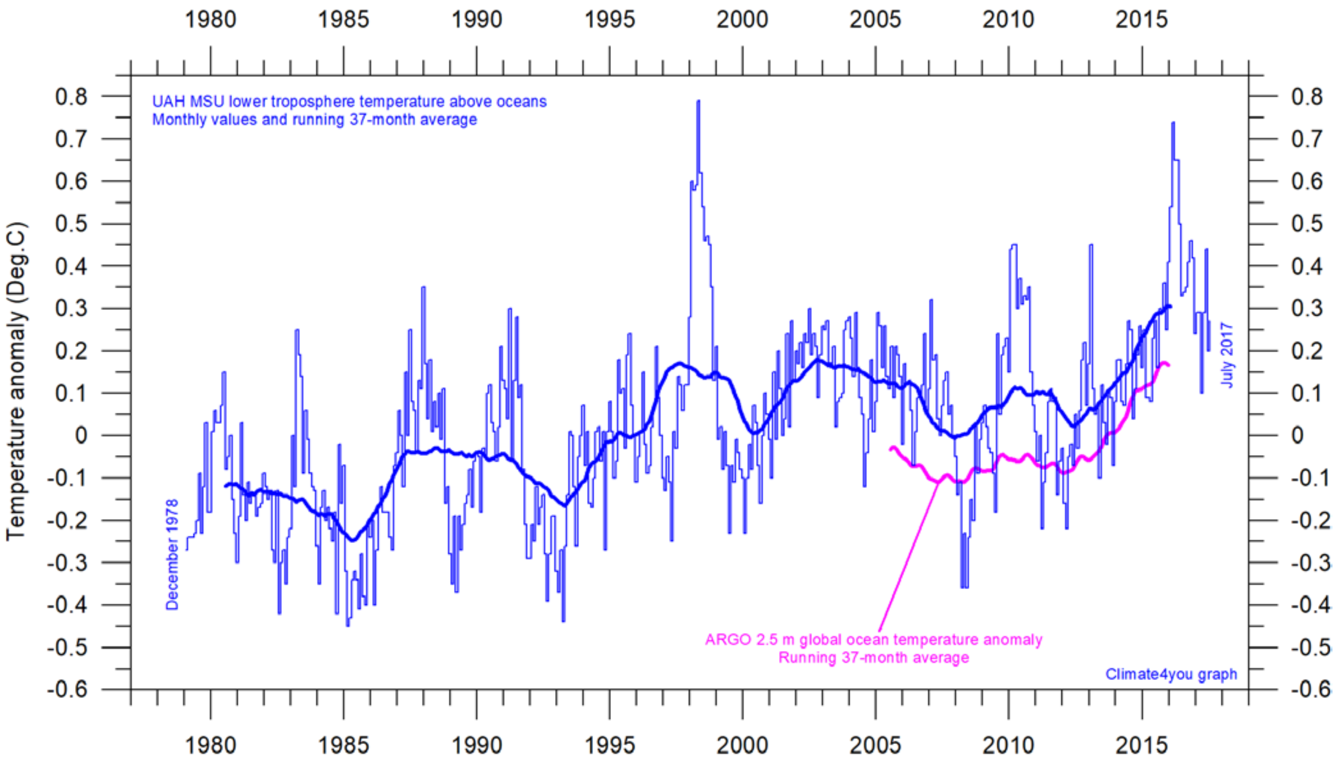
Sea surface temperature anomaly on 30 July 2017. Map source: National Centers for Environmental Prediction (NOAA).

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).

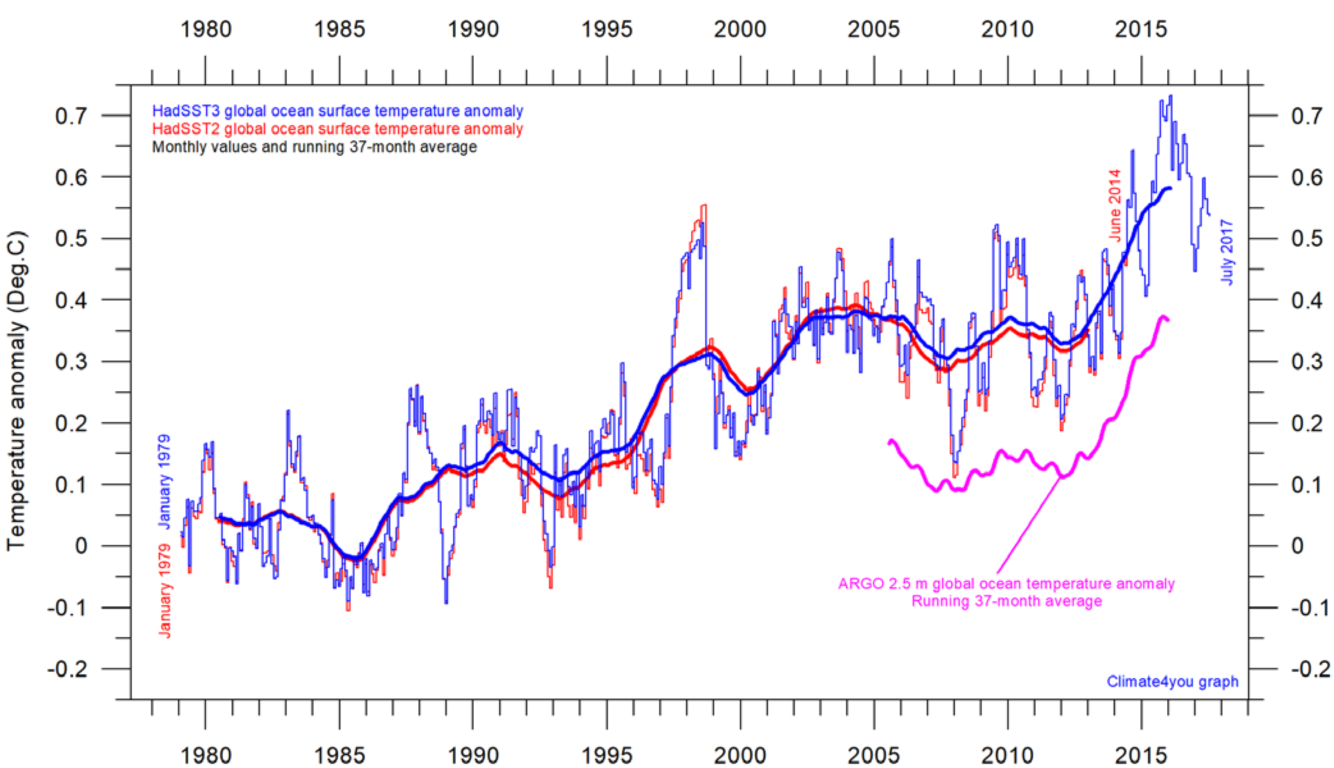
Relatively warm water is still dominating much of the oceans near the Equator, and is influencing global air temperatures now and in the months to come.

The significance of any short-term cooling or warming reflected in air temperatures should not be overstated. 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.

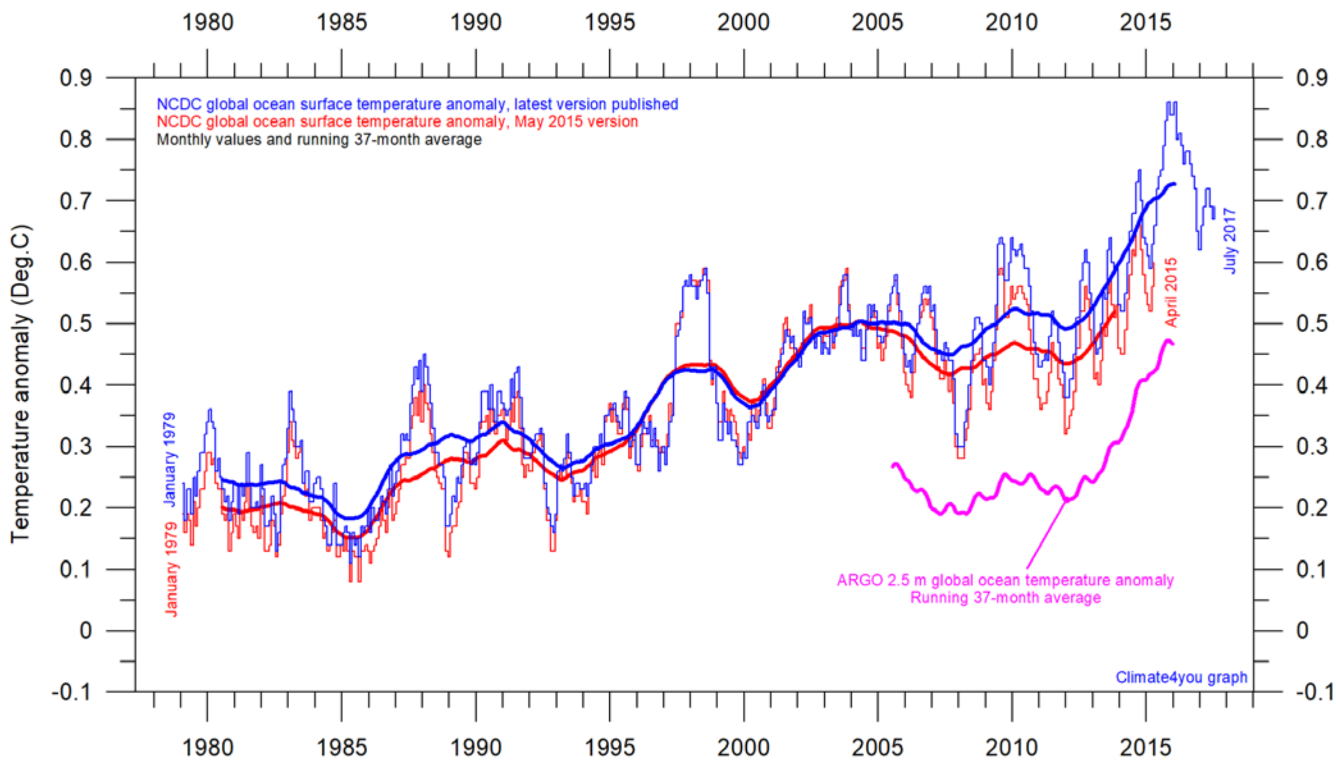
However, this does not reflect similar changes in the total heat content of the atmosphere-ocean system. In fact, global net changes can be small and such heat exchanges may mainly reflect redistribution of energy between ocean and atmosphere. What matters is the overall temperature development when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



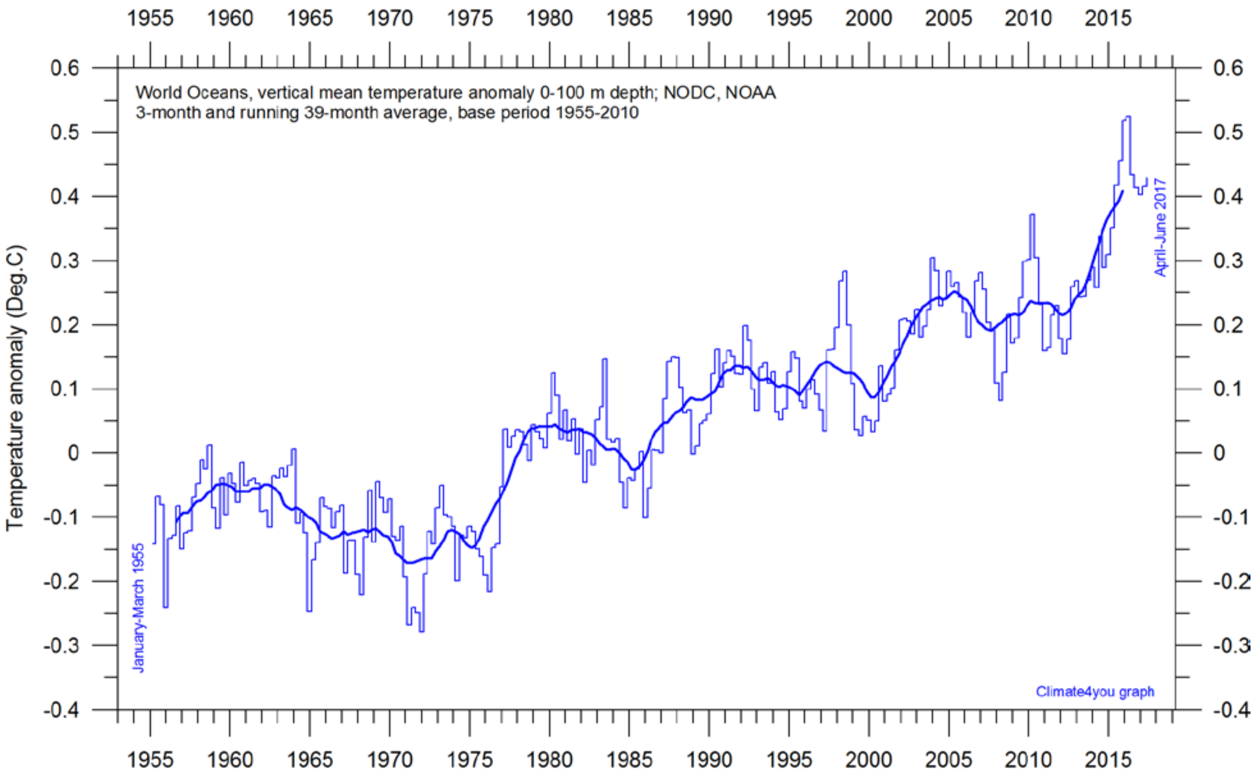
Global monthly average sea surface temperature since 1979 according to University of East Anglia's [Climatic Research Unit](#) ([CRU](#)), UK. Base period: 1961-1990. The thick line is the simple running 37-month average. Insert: Argo global ocean temperature anomaly from floats.



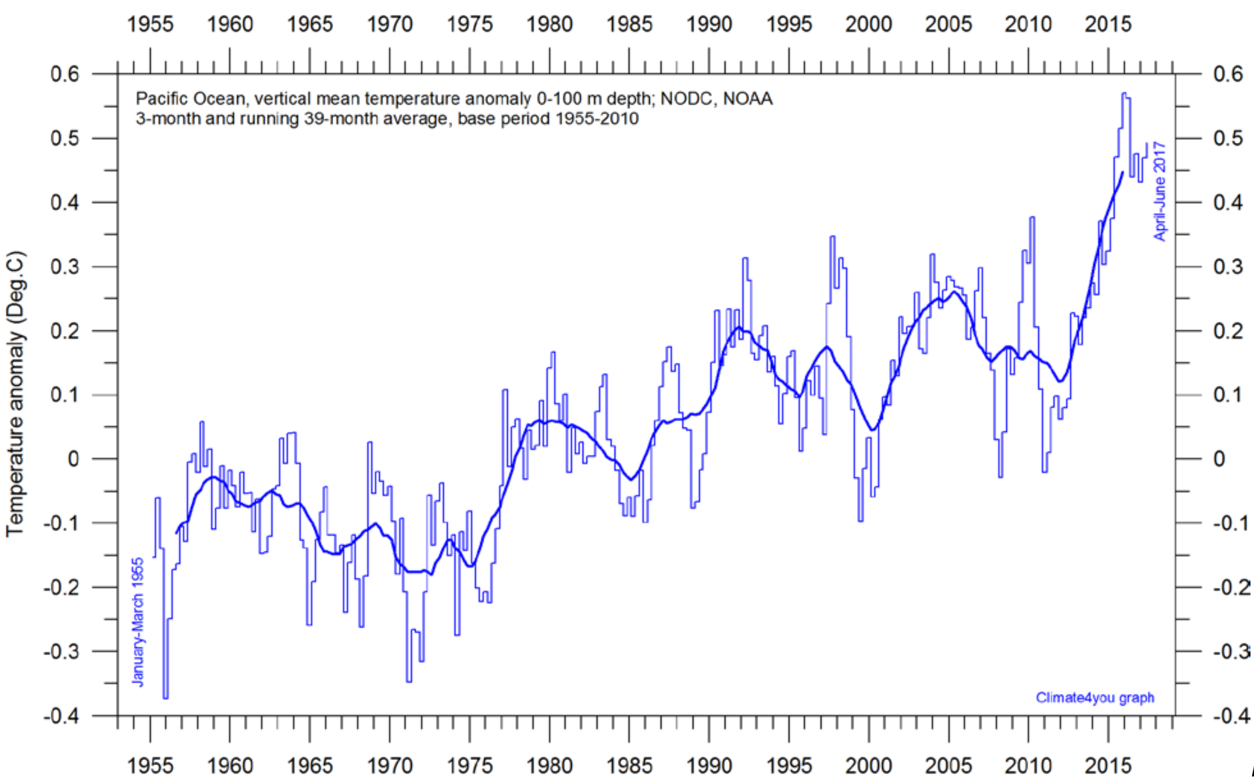
Global monthly average sea surface temperature since 1979 according to the [National Climatic Data Center](#) (NCDC), USA. Base period: 1901-2000. The thick line is the simple running 37-month average. Insert: Argo global ocean temperature anomaly from floats.

June 18, 2015: *NCDC has introduced a number of rather large administrative changes to their sea surface temperature record. The overall result is to produce a record giving the impression of a continuous temperature increase, also in the 21st century. As the oceans cover about 71% of the entire surface of planet Earth, the effect of this administrative change is clearly seen in the NCDC record for global surface air temperature (p. 6).*

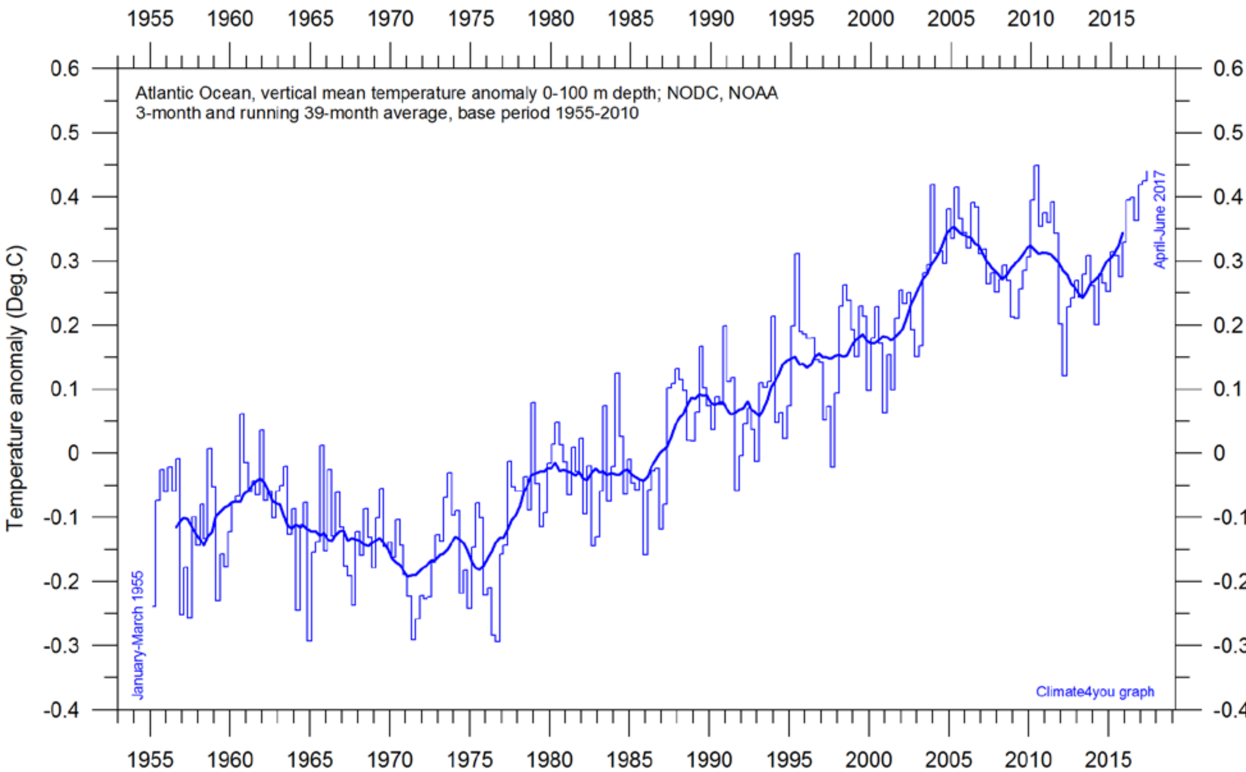
Ocean temperature in uppermost 100 m, updated to June 2017



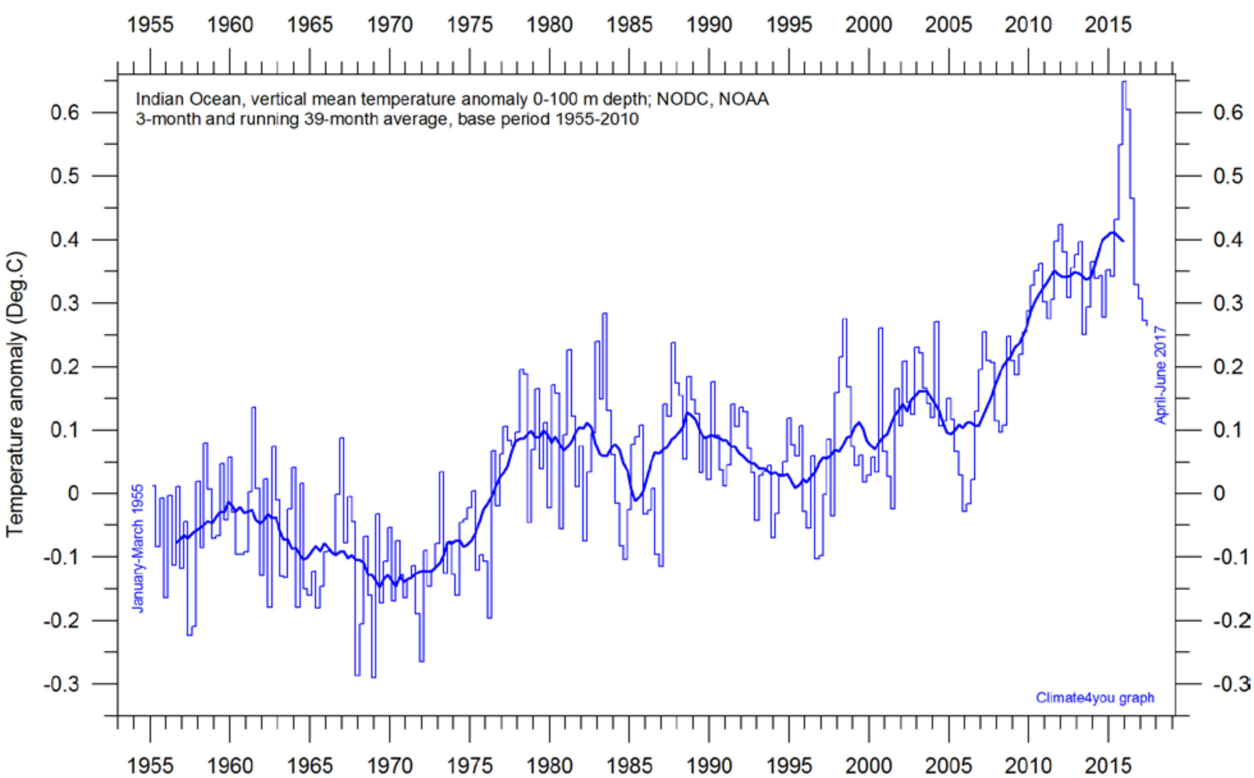
World Oceans vertical average temperature 0-100 m depth since 1955. The thin line indicates 3-month values, and the thick line represents the simple running 39-month (c. 3 year) average. Data source: [NOAA National Oceanographic Data Center] (NODC). Base period 1955-2010.



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.

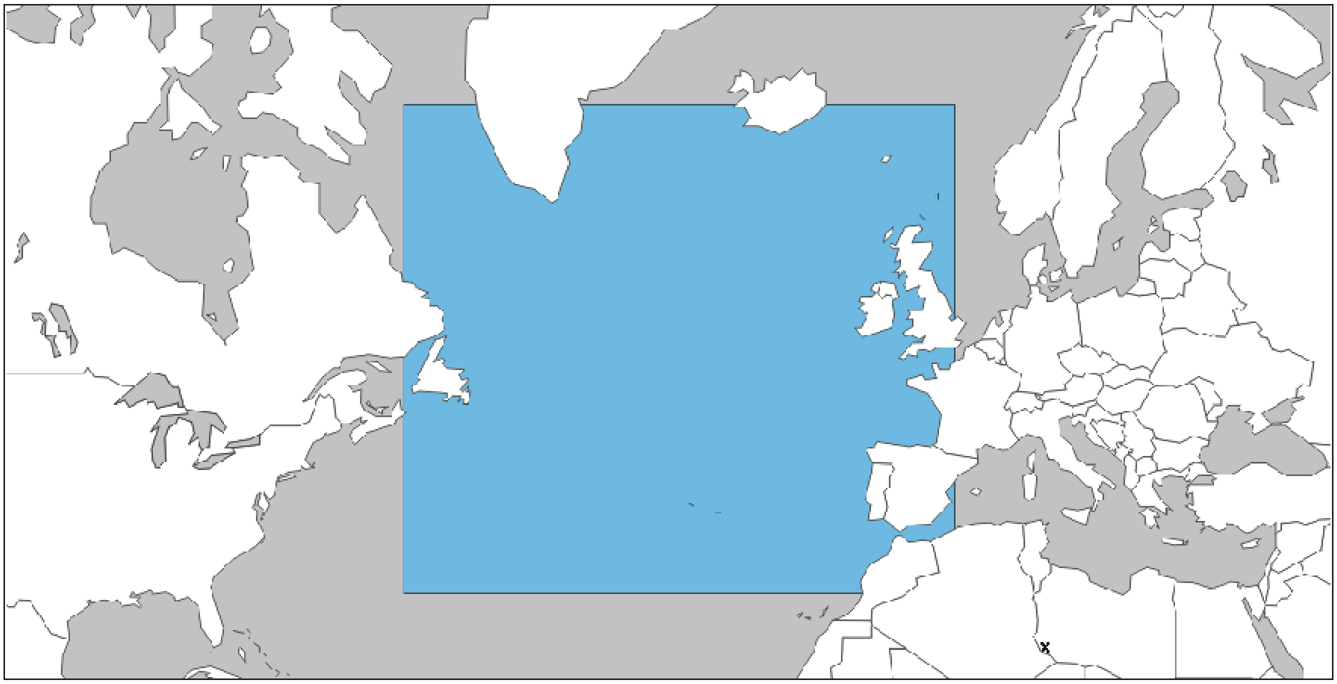


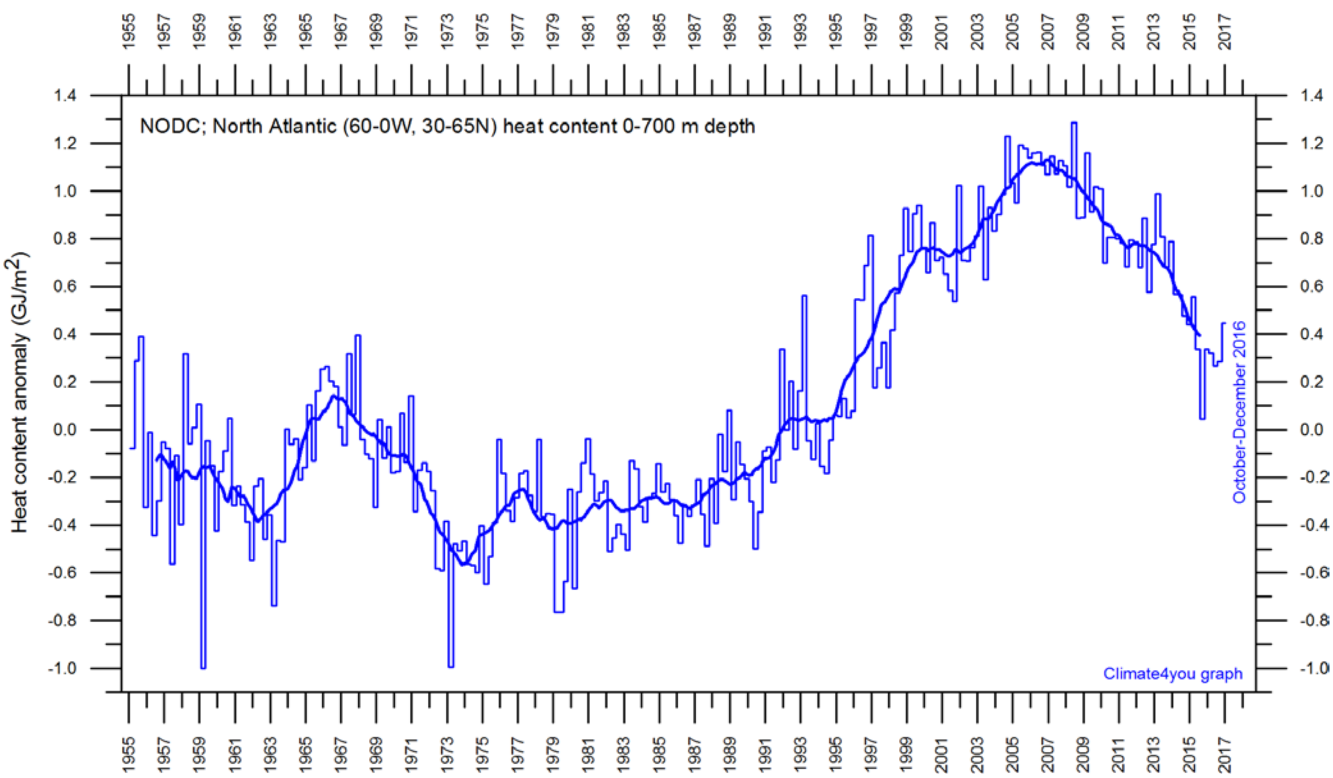
Atlantic Ocean vertical average temperature 0-100 m depth since 1955. The thin line indicate 3-month values, and the thick line represents the simple running 39-month (c. 3 year) average. Data source: [NOAA National Oceanographic Data Center]() (NODC). Base period 1955-2010.



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.

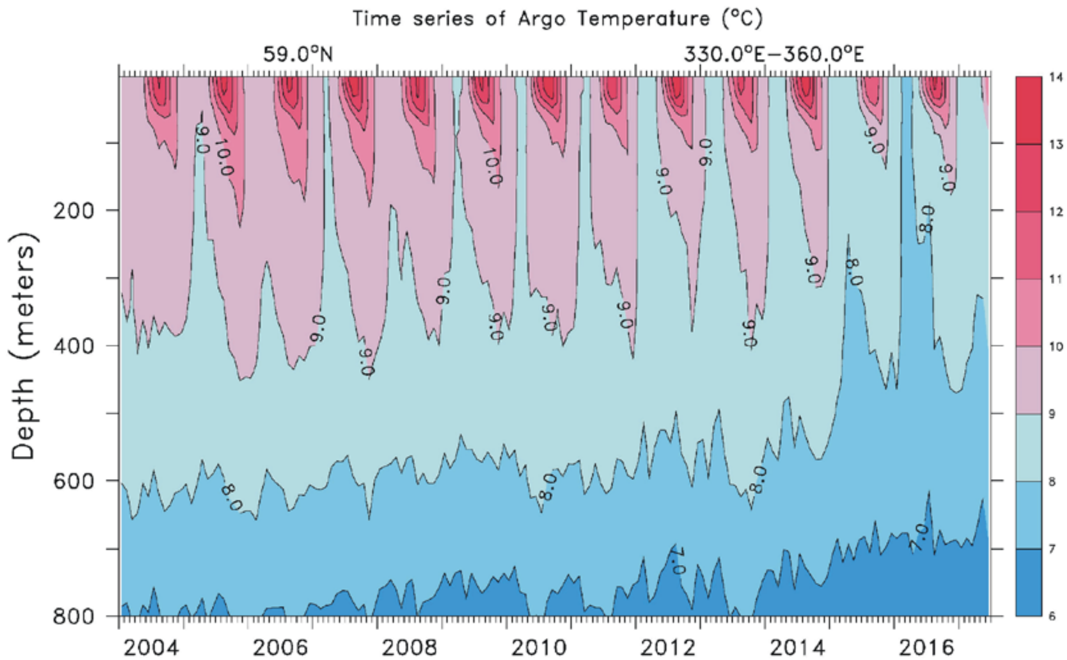
North Atlantic heat content uppermost 700 m, updated to December 2016



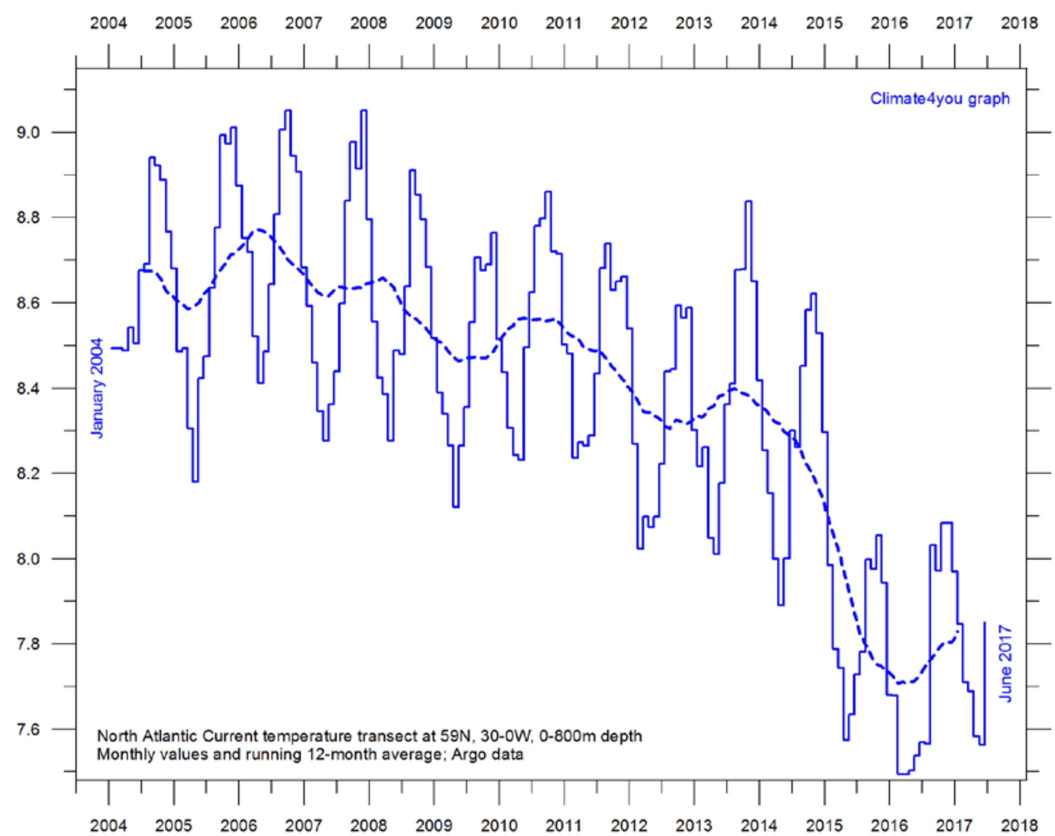


Global monthly heat content anomaly (GJ/m2) in the uppermost 700 m of the North Atlantic (60-0W, 30-65N; see map above) *ocean since January 1955. The thin line indicates monthly values, and the thick line represents the simple running 37 month (c. 3 year) average. Data source: [National Oceanographic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

North Atlantic temperatures 0-800 m depth along 59°N, 30-0W, updated to June 2017

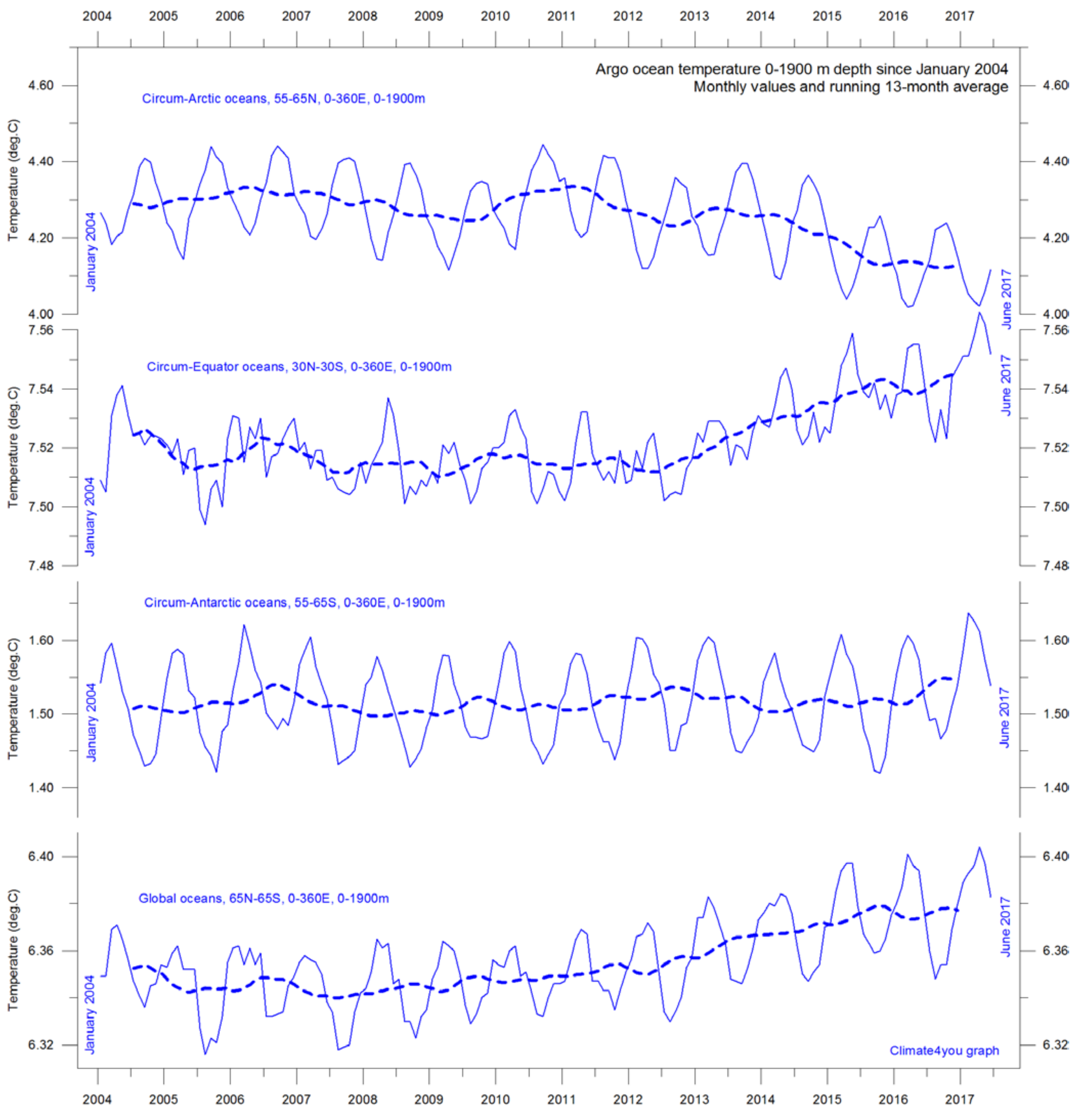


Time series depth-temperature diagram along 59 N across the North Atlantic Current from 30°W to 0°W, from surface to 800 m depth. Source: Global Marine Argo Atlas. See also the diagram below.



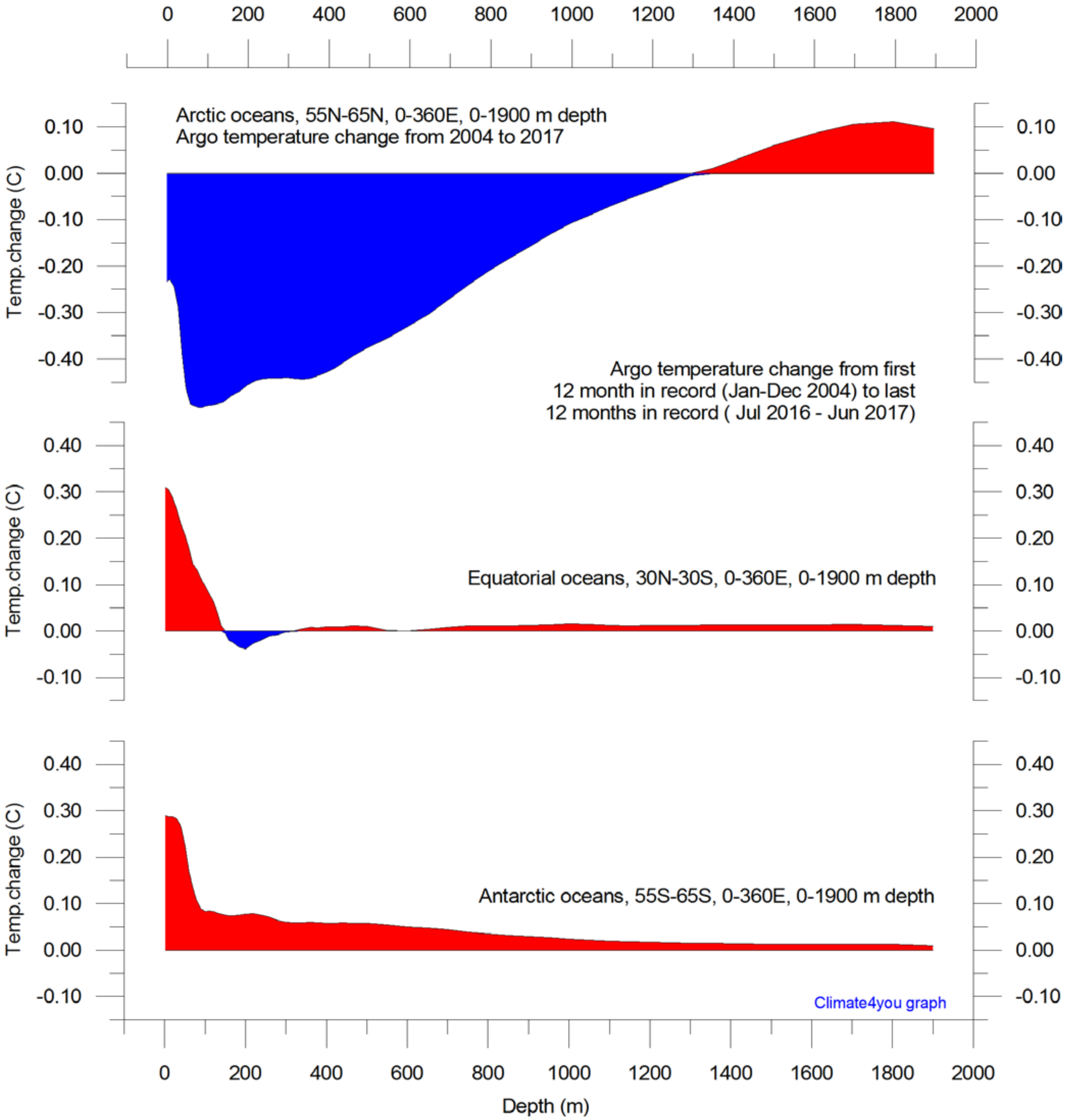
Average temperature along 59 N, 30-0W, 0-800m depth, corresponding to the main part of the North Atlantic Current, using Argo-data. Source: Global Marine Argo Atlas. Additional information can be found in: Roemmich, D. and J. Gilson, 2009. The 2004-2008 mean and annual cycle of temperature, salinity,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

Global ocean temperature 0-1900 m depth summary, updated to June 2017



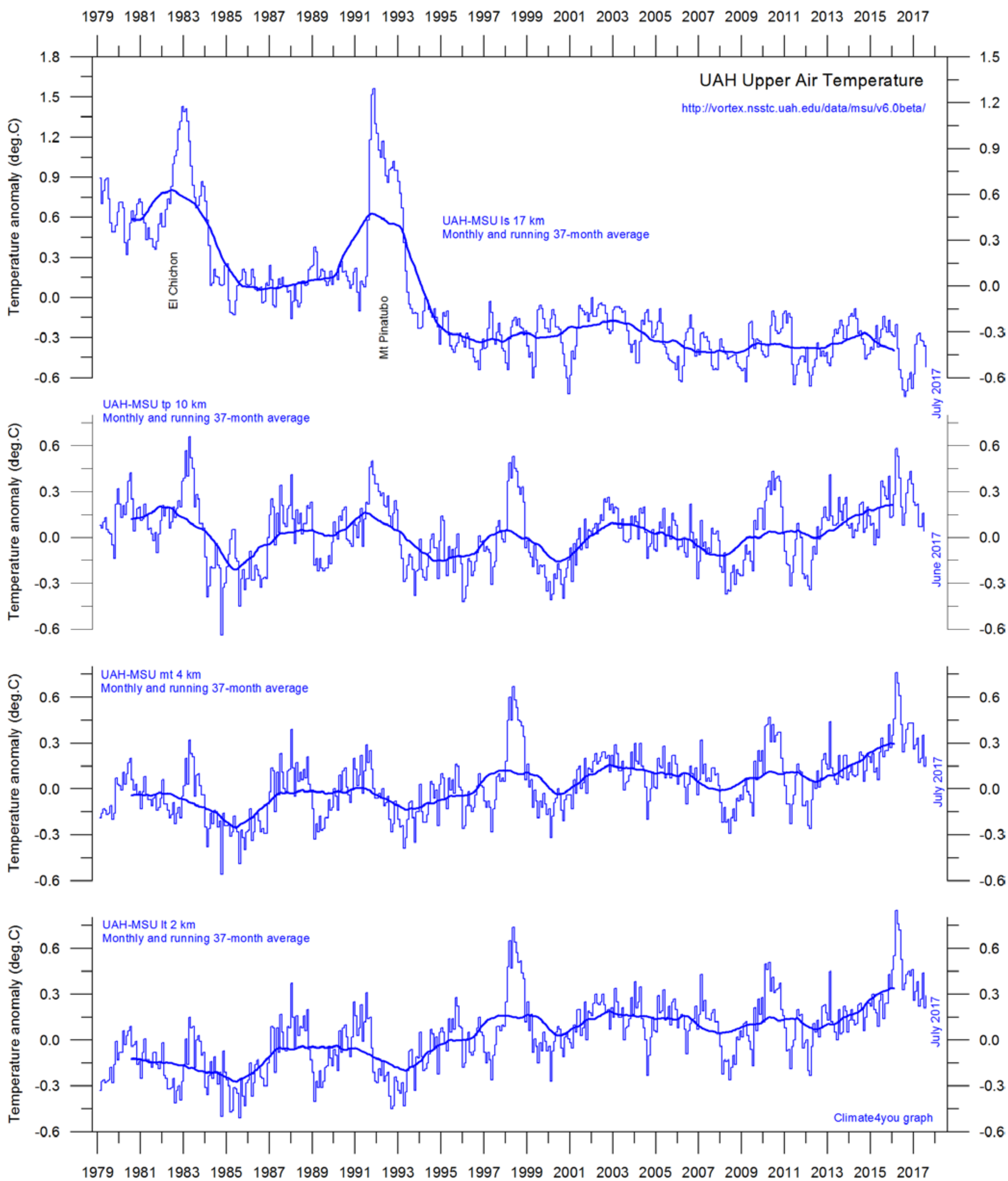
Summary of average temperature in uppermost 1900 m in different parts of the global oceans, using Argo-data. Source: Global Marine Argo Atlas. Additional information can be found in: Roemmich, D. and J. Gilson, 2009. The 2004-2008 mean and annual cycle of temperature, salinity, and steric height in the global ocean from the Argo Program. Progress in Oceanography, 82, 81-100.

Global ocean net temperature change since 2004 at different depths, updated to June 2017



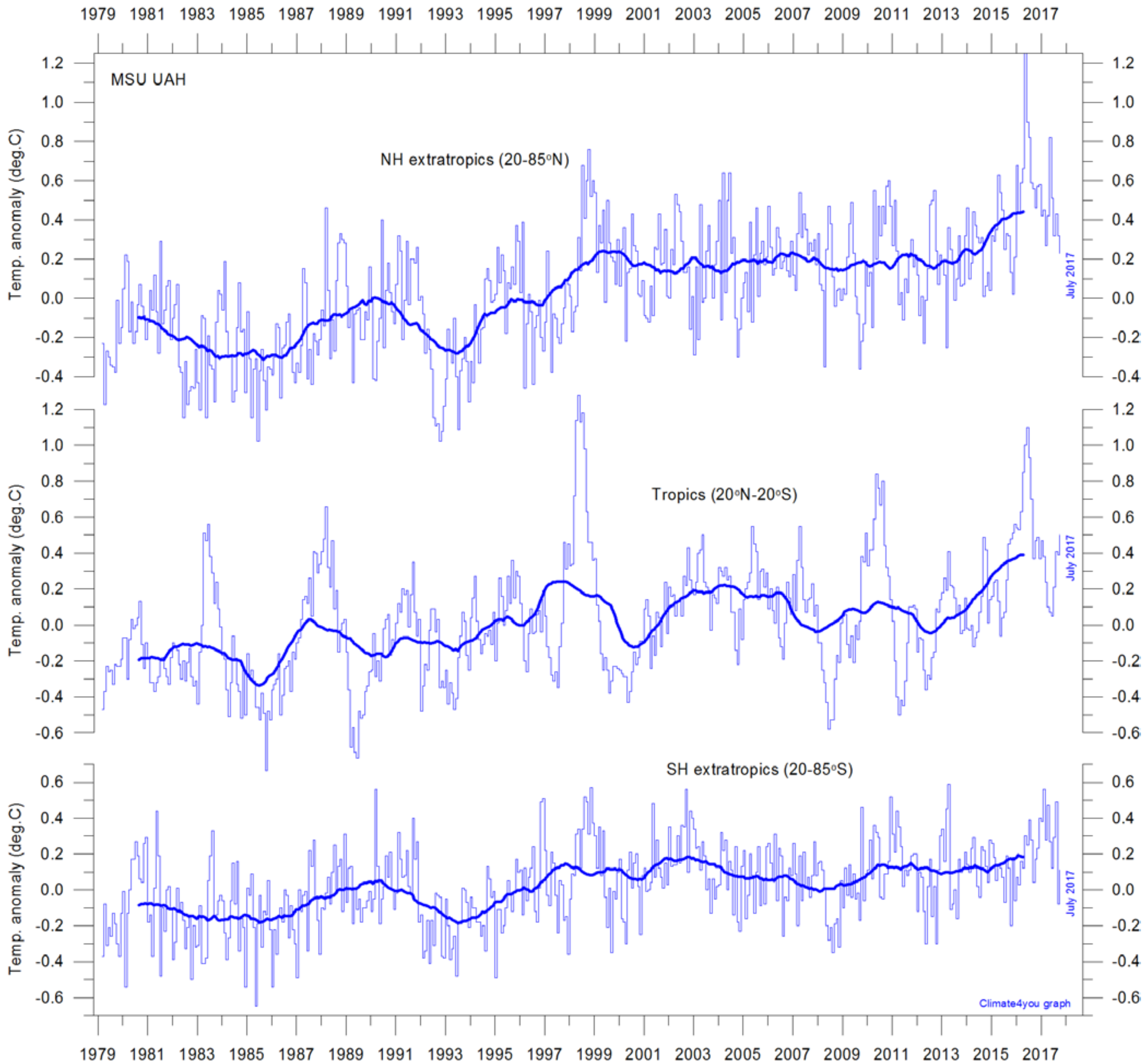
Net temperature change since 2004 from surface to 1900 m depth in different parts of the global oceans, using Argo-data. Source: Global Marine Argo Atlas. Additional information can be found in: Roemmich, D. and J. Gilson, 2009. The 2004-2008 mean and annual cycle of temperature, salinity, and steric height in the global ocean from the Argo Program. Progress in Oceanography, 82, 81-100. Please note that due to the spherical form of Earth, northern and southern latitudes represent only small ocean volumes, compared to latitudes near the Equator.

Troposphere and stratosphere temperatures from satellites, updated to July 2017



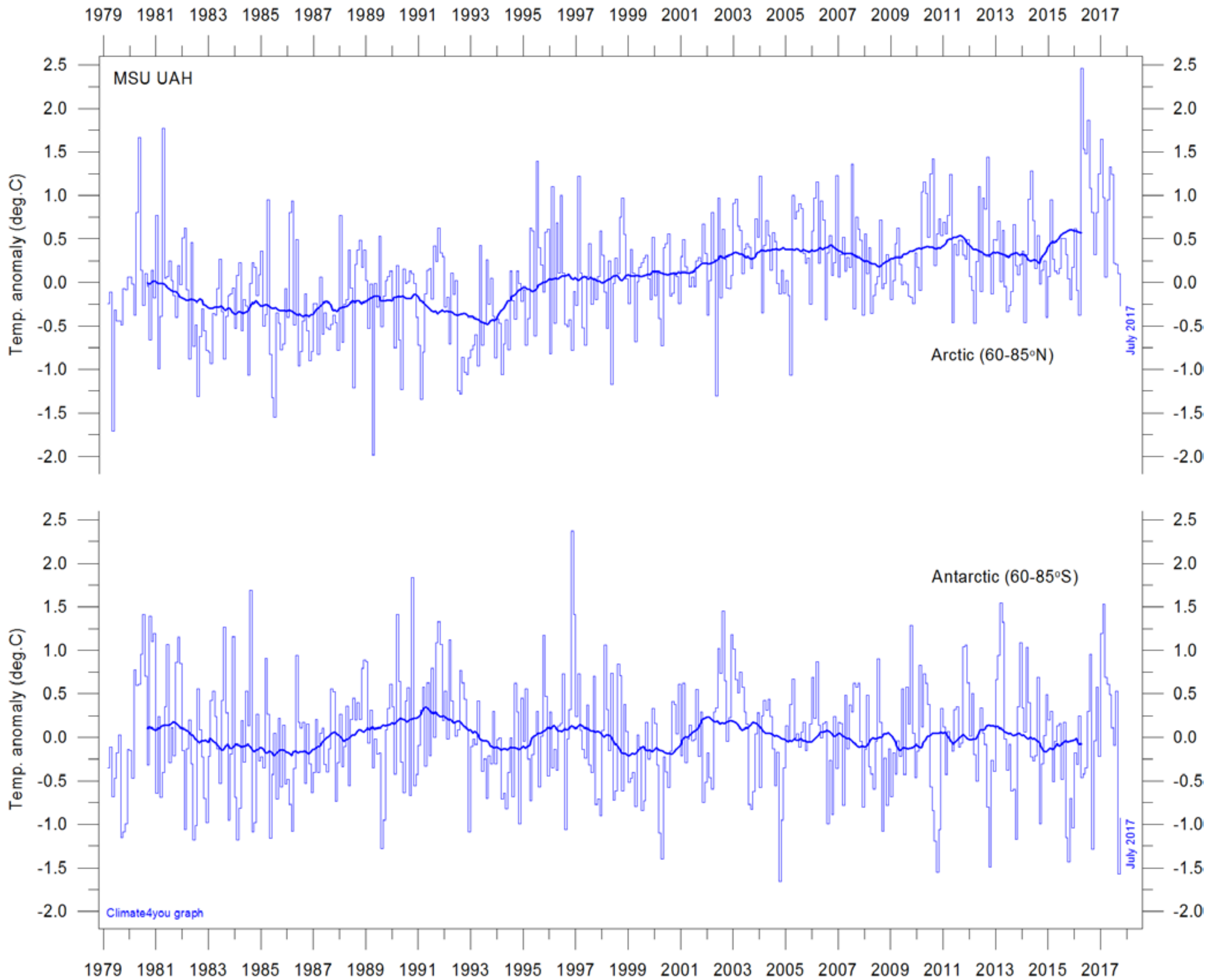
Global monthly average temperature in different according to University of Alabama at Huntsville, USA. The thin lines represent the monthly average, and the thick line the simple running 37 month average, nearly corresponding to a running 3 year average.

Zonal lower troposphere temperatures from satellites, updated to July 2017



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-year average. Reference period 1981-2010.

Arctic and Antarctic lower troposphere temperature, updated to July 2017



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-year average. Reference period 1981-2010.

Arctic and Antarctic surface air temperature, updated to June 2017

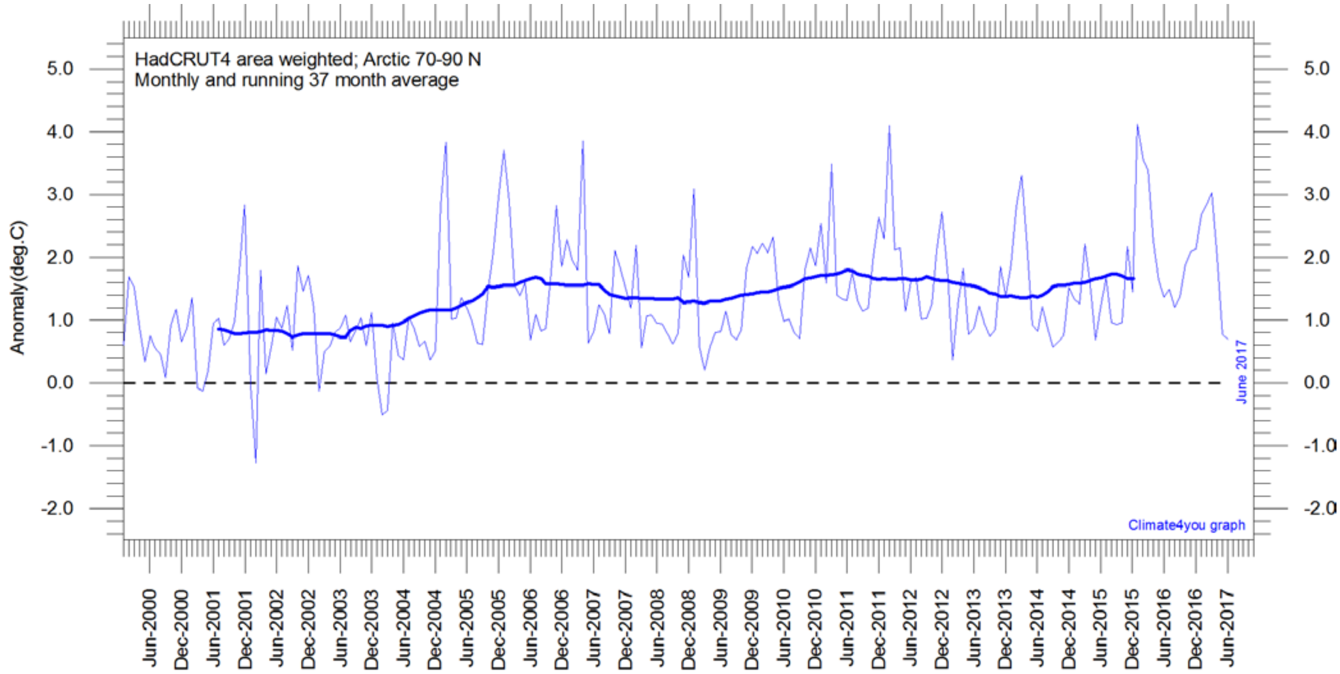


Diagram showing area weighted Arctic (70-90°N) monthly surface air temperature anomalies (HadCRUT4) since January 2000, in relation to the WMO normal period 1961-1990. The thin line shows the monthly temperature anomaly, while the thicker line shows the running 37-month (c. 3 year) average.

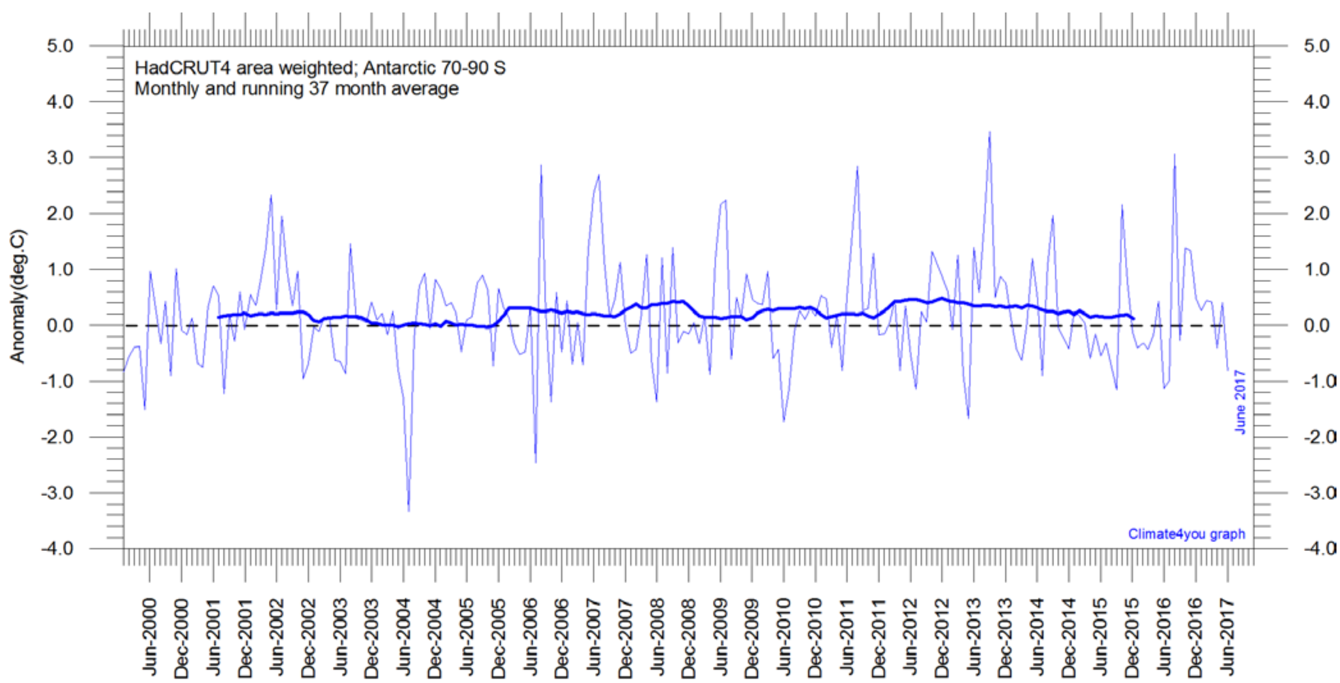


Diagram showing area weighted Antarctic (70-90°N) monthly surface air temperature anomalies (HadCRUT4) since January 2000, in relation to the WMO normal period 1961-1990. The thin line shows the monthly temperature anomaly, while the thicker line shows the running 37-month (c. 3 year) average.

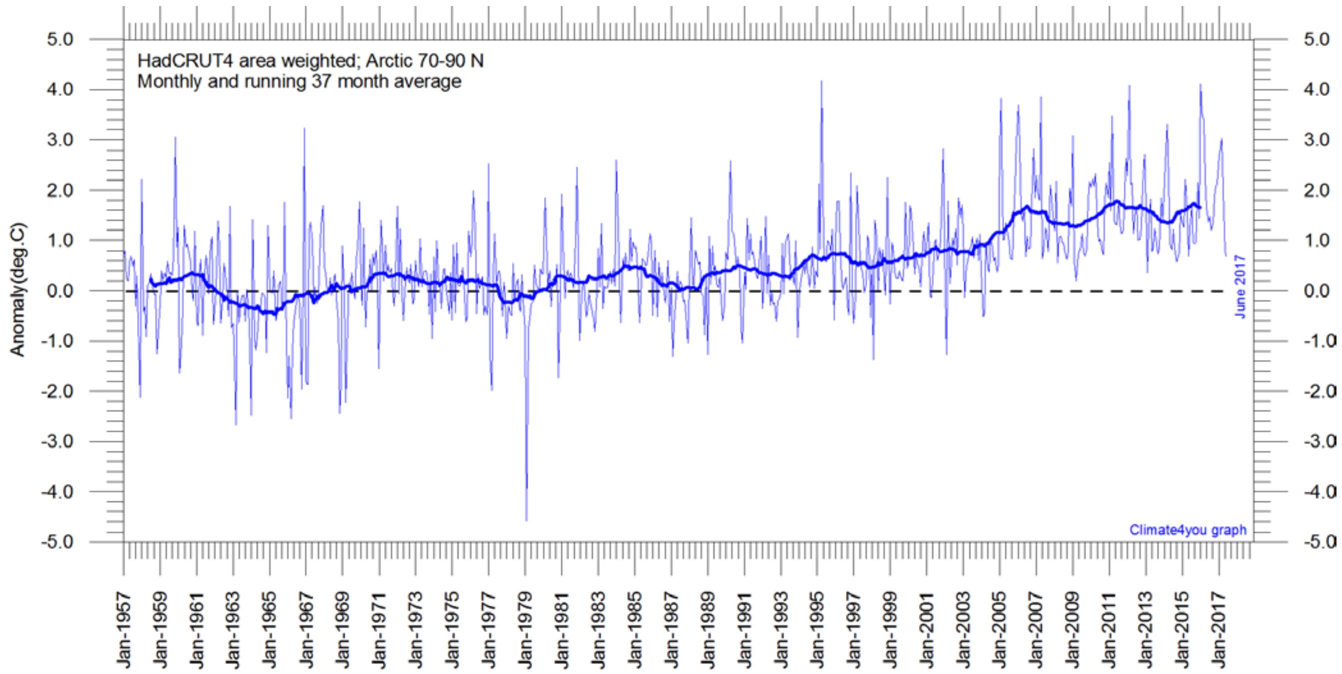


Diagram showing area weighted Arctic (70-90°N) monthly surface air temperature anomalies ([HadCRUT4]) since January 1957, in relation to the WMO [normal period] 1961-1990. The thin line shows the monthly temperature anomaly, while the thicker line shows the running 37-month (c. 3 year) average.

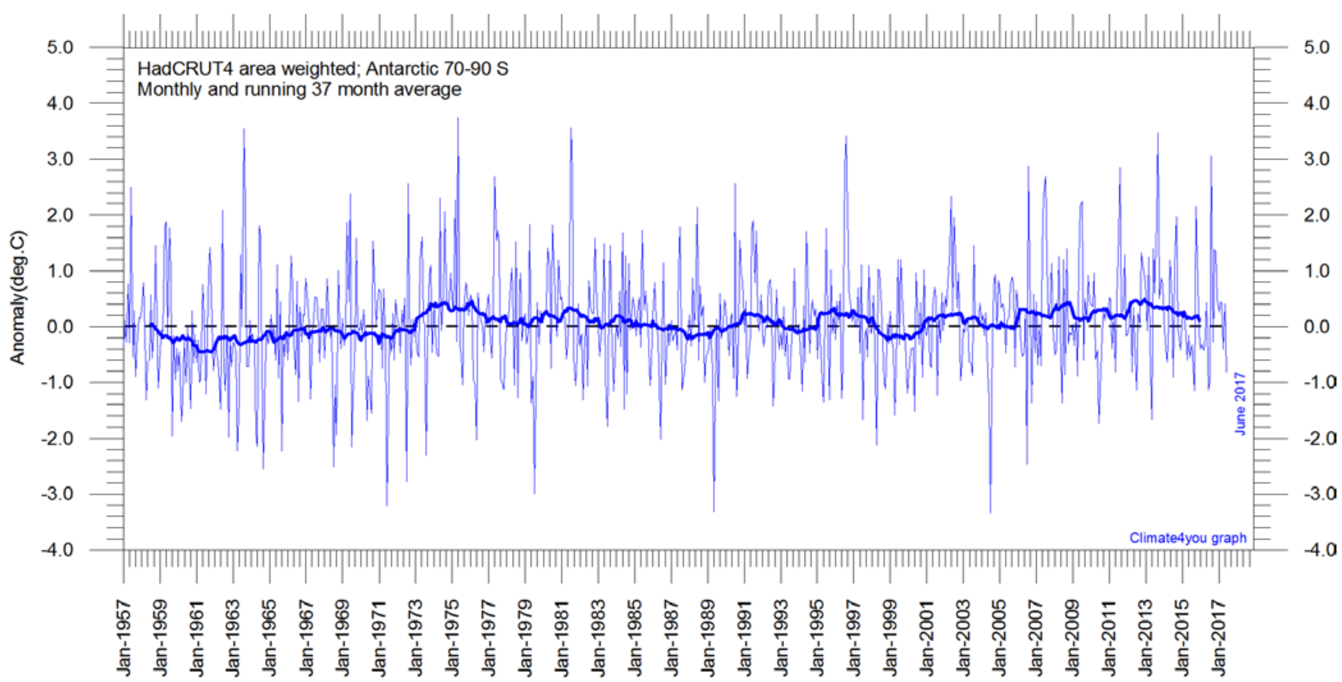


Diagram showing area weighted Antarctic (70-90°N) monthly surface air temperature anomalies ([HadCRUT4]) since January 1957, in relation to the WMO [normal period] 1961-1990. The thin line shows the monthly temperature anomaly, while the thicker line shows the running 37-month (c. 3 year) average.

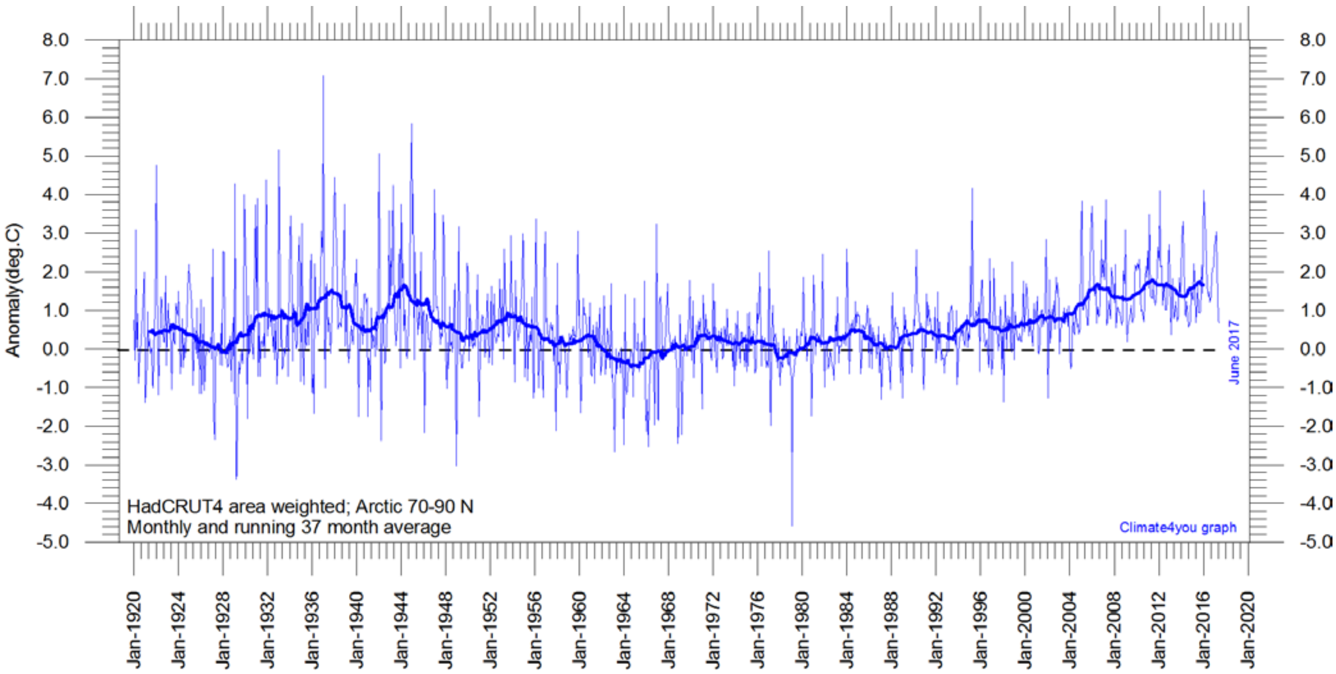


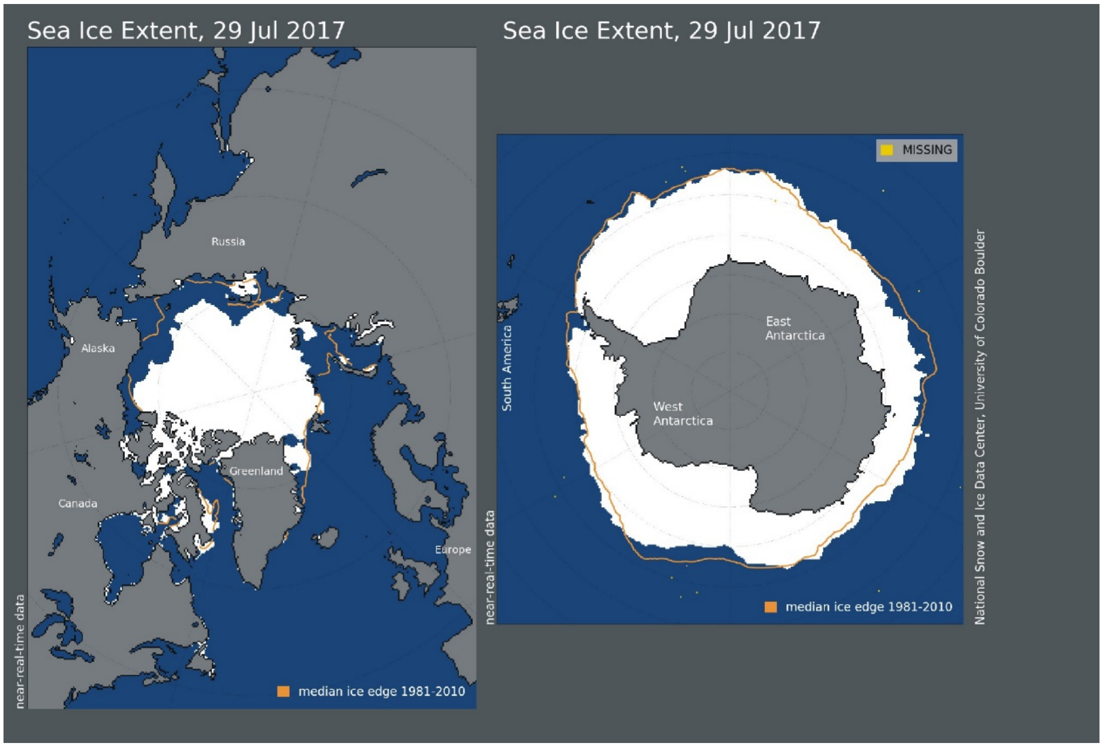
Diagram showing area-weighted Arctic (70-90°N) monthly surface air temperature anomalies (HadCRUT4) since January 1920, in relation to the WMO normal period 1961-1990. The thin line shows the monthly temperature anomaly, while the thicker line shows the running 37-month (c. 3 year) average. Because of 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 contrasts with Gillet et al. 2008 which calculated a simple average, with no consideration to the surface area represented by the individual 5°x5° grid cells.

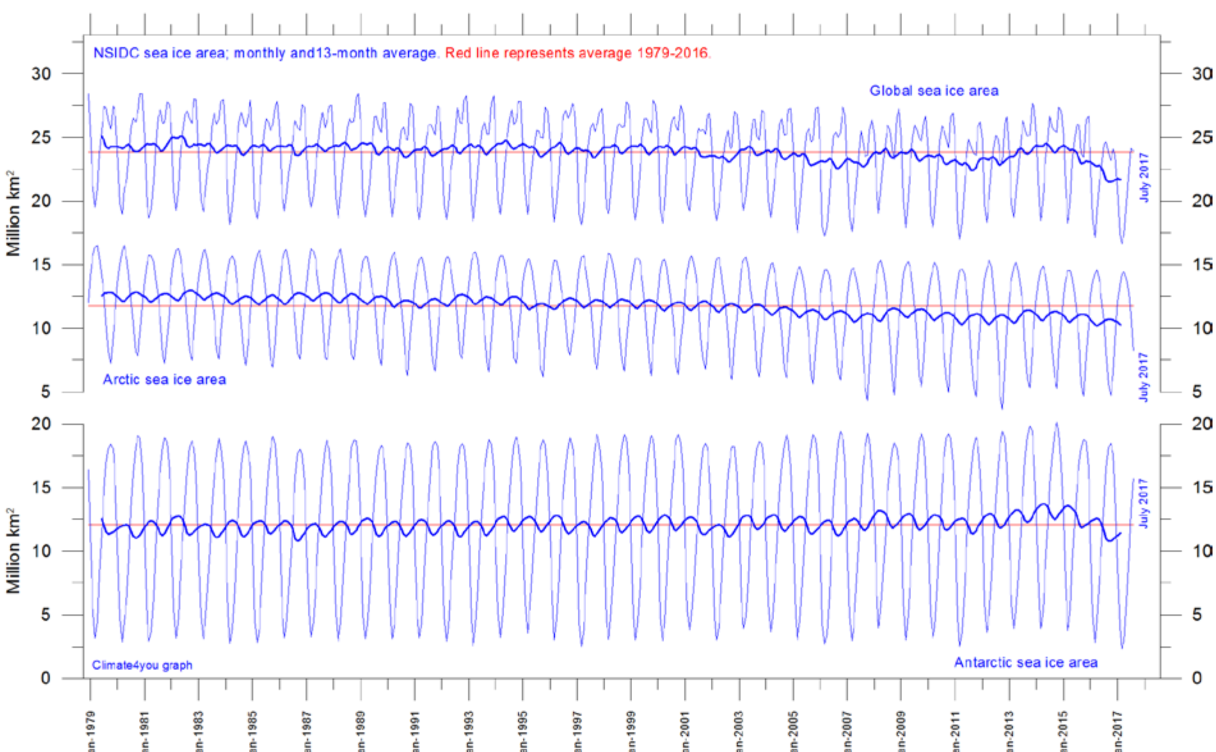
Literature:

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 July 2017



Sea ice extent 29 July 2017. The median 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).

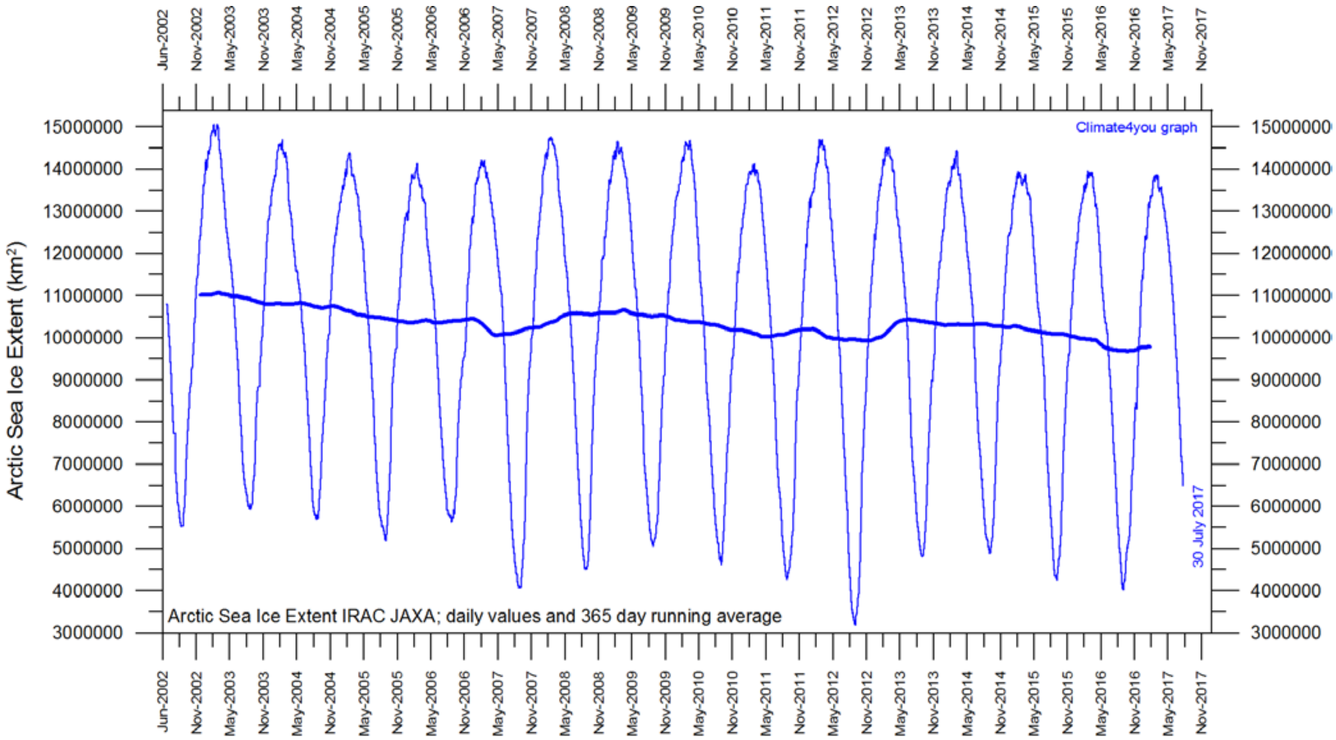
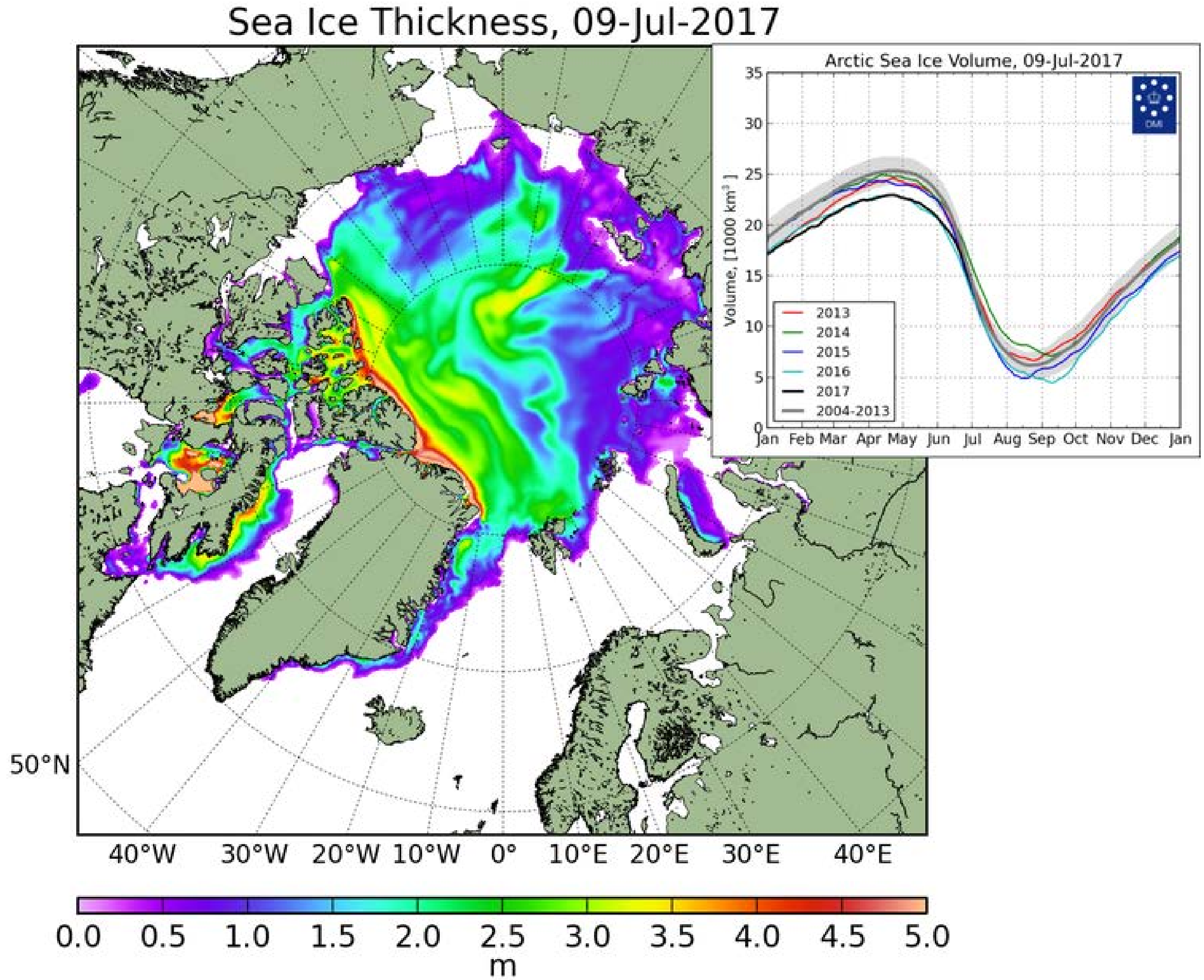
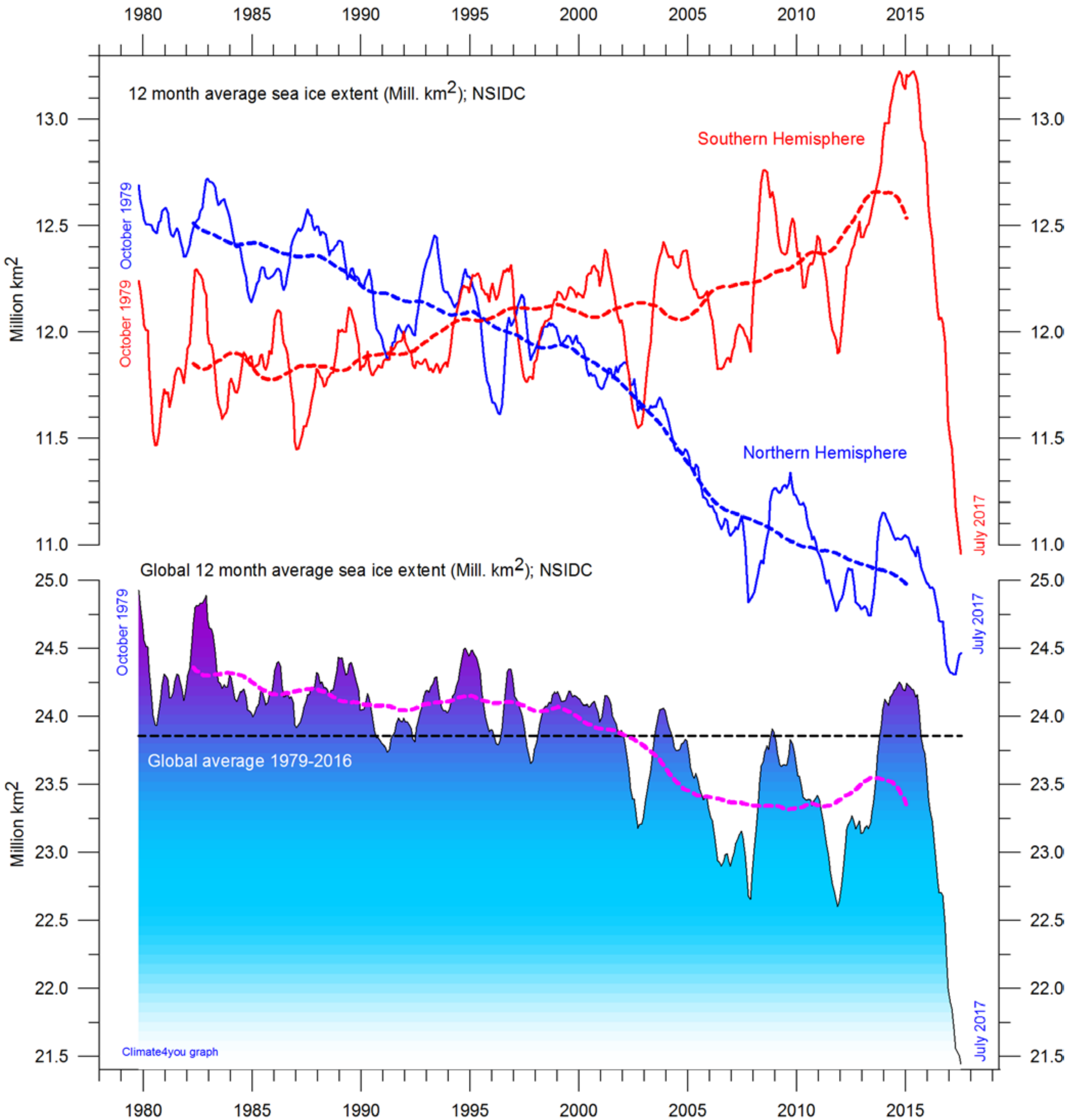


Diagram showing daily Arctic sea ice extent since June 2002, to 30 July 2017, by courtesy of Japan Aerospace Exploration Agency (JAXA).



Diagrams showing Arctic sea ice extent 9 July 2017 and the seasonal cycles of the calculated total arctic sea ice volume, according to [The Danish Meteorological Institute (DMI)](). The mean sea ice volume and standard deviation for the period 2004-2013 are shown by grey shading.



12 month running average sea ice extension, global and in both hemispheres since 1979, the satellite-era. The October 1979 value represents the monthly 12-month average of November 1978 - October 1979, the November 1979 value represents the average of December 1978 - November 1979, etc. The stippled lines represent a 61-month (ca. 5 years) average. Data source: National Snow and Ice Data Center (NSIDC).

Sea level in general

Global (or eustatic) sea-level change is measured relative to an idealised reference level, the geoid, which is a mathematical model of planet Earth's surface (Carter et al. 2014). Global sea-level is a function of the volume of the ocean basins and the volume of water they contain. Changes in global sea-level are caused by – but not limited to - four main mechanisms:

1. Changes in local and regional air pressure and wind, and tidal changes introduced by the Moon.
2. Changes in ocean basin volume by tectonic (geological) forces.
3. Changes in ocean water density caused by variations in currents, water temperature and salinity.
4. Changes in the volume of water caused by changes in the mass balance of terrestrial glaciers.

In addition to these there are other mechanisms influencing sea-level; such as storage of ground water, storage in lakes and rivers, evaporation, etc.

Mechanism 1 is controlling sea-level at many sites on a time scale from months to several years. As an example, many coastal stations show a pronounced annual variation reflecting seasonal changes in air pressures and wind speed. Longer-term climatic changes playing out over decades or centuries will also affect measurements of sea-level changes. Hansen et al. (2011, 2015) provide excellent analyses of sea-level changes caused by recurrent changes of the orbit of the Moon and other phenomena.

Mechanism 2 – with the important exception of earthquakes and tsunamis - typically operates over long (geological) time scales, and is not significant on human time scales. It may relate to variations in the sea-floor spreading rate, causing volume changes in mid-ocean mountain ridges, and to the slowly changing configuration of land and oceans. Another effect may be the slow rise of basins due to isostatic offloading by deglaciation after an ice age. The floor of the Baltic Sea and the Hudson Bay are presently rising, causing a slow net transfer of water from these basins into the adjoining oceans. Slow changes of very big glaciers (ice sheets) and movements in the mantle will affect the gravity field and thereby the vertical position of the ocean surface. Any increase of the total water mass as well as sediment deposition into oceans increase the load on their bottom, generating sinking by viscoelastic flow in the mantle below. The mantle flow is directed towards the surrounding land areas, which will rise, thereby partly compensating for the initial sea level increase induced by the increased water mass in the ocean.

Mechanism 3 (temperature-driven expansion) only affects the uppermost part of the oceans on human time scales. Usually, temperature-driven changes in density are more important than salinity-driven changes. Seawater is characterised by a relatively small coefficient of expansion, but the effect should however not be overlooked, especially when interpreting satellite altimetry data. Temperature-driven expansion of a column of seawater will not affect the total mass of water within the column considered, and will therefore not affect the potential at the top of the water column. Temperature-driven ocean water expansion will therefore not in itself lead to lateral displacement of water, but only lift the ocean surface locally. Near the coast, where people are living, the depth of water approaches zero, so no temperature-driven expansion will take place here (Mörner 2015). Mechanism 3 is for that reason not important for coastal regions.

Mechanism 4 (changes in glacier mass balance) is an important driver for global sea-level changes along coasts, for human time scales. Volume changes of floating glaciers – ice shelves – has no influence on the global sea-level, just like volume changes of floating sea ice has no influence. Only the mass-balance of grounded or land-based glaciers is important for the global sea-level along coasts.

Summing up: Mechanism 1 and 4 are the most important for understanding sea-level changes along coasts.

References:

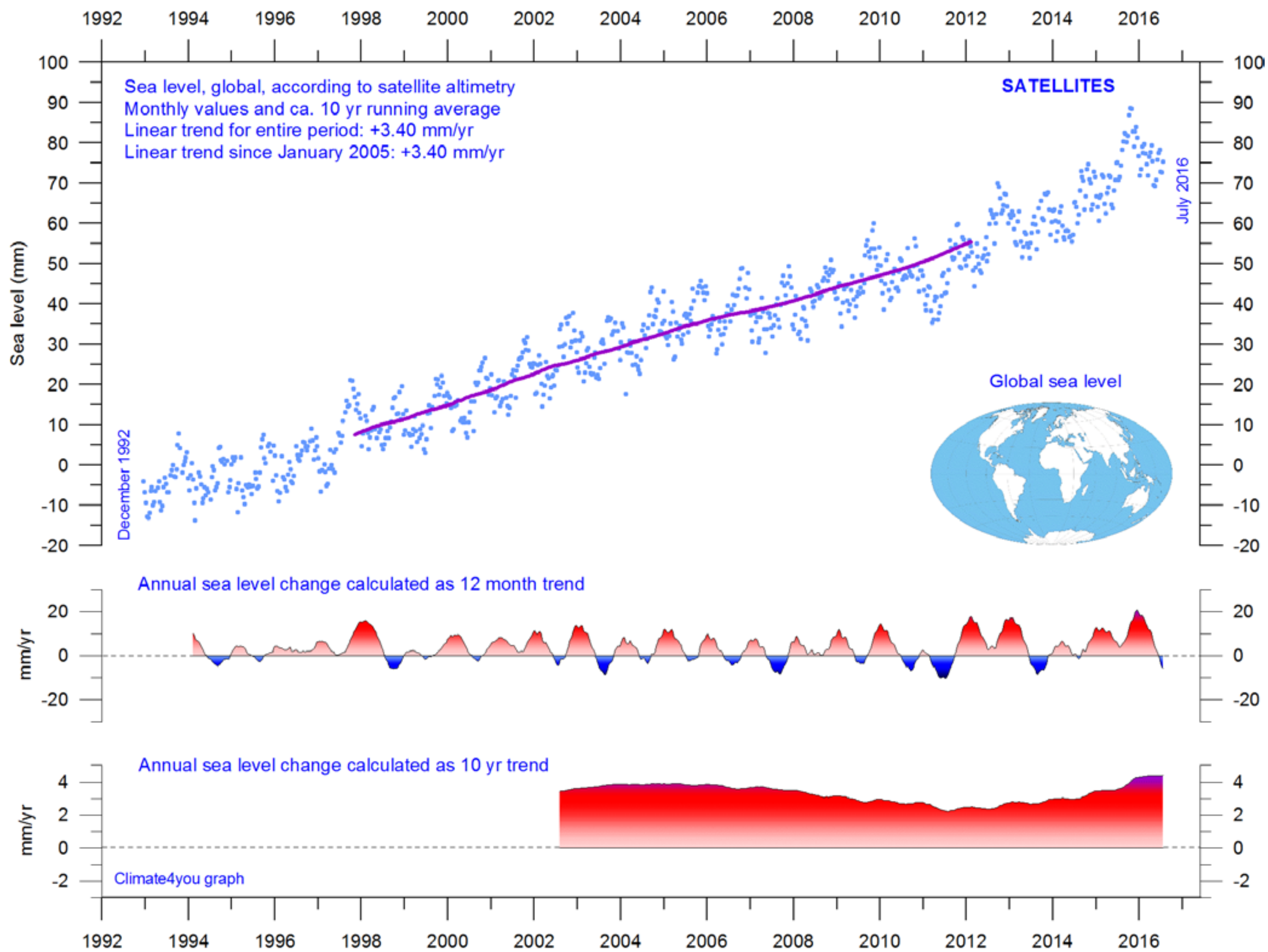
Carter R.M., de Lange W., Hansen, J.M., Humlum O., Idso C., Kear, D., Legates, D., Mörner, N.A., Ollier C., Singer F. & Soon W. 2014. Commentary and Analysis on the Whitehead& Associates 2014 NSW Sea-Level Report. Policy Brief, NIPCC, 24. September 2014, 44 pp. http://climatechangereconsidered.org/wp-content/uploads/2014/09/NIPCC-Report-on-NSW-Coastal-SL-9z-corrected.pdf

Hansen, J.-M., Aagaard, T. and Binderup, M. 2011. Absolute sea levels and isostatic changes of the eastern North Sea to central Baltic region during the last 900 years. Boreas, 10.1111/j.1502-3885.2011.00229.x. ISSN 0300–9483.

Hansen, J.-M., Aagaard, T. and Huijpers, A. 2015. Sea-Level Forcing by Synchronization of 56- and 74-YearOscillations with the Moon's Nodal Tide on the Northwest European Shelf (Eastern North Sea to Central Baltic Sea). Journ. Coastal Research, 16 pp.

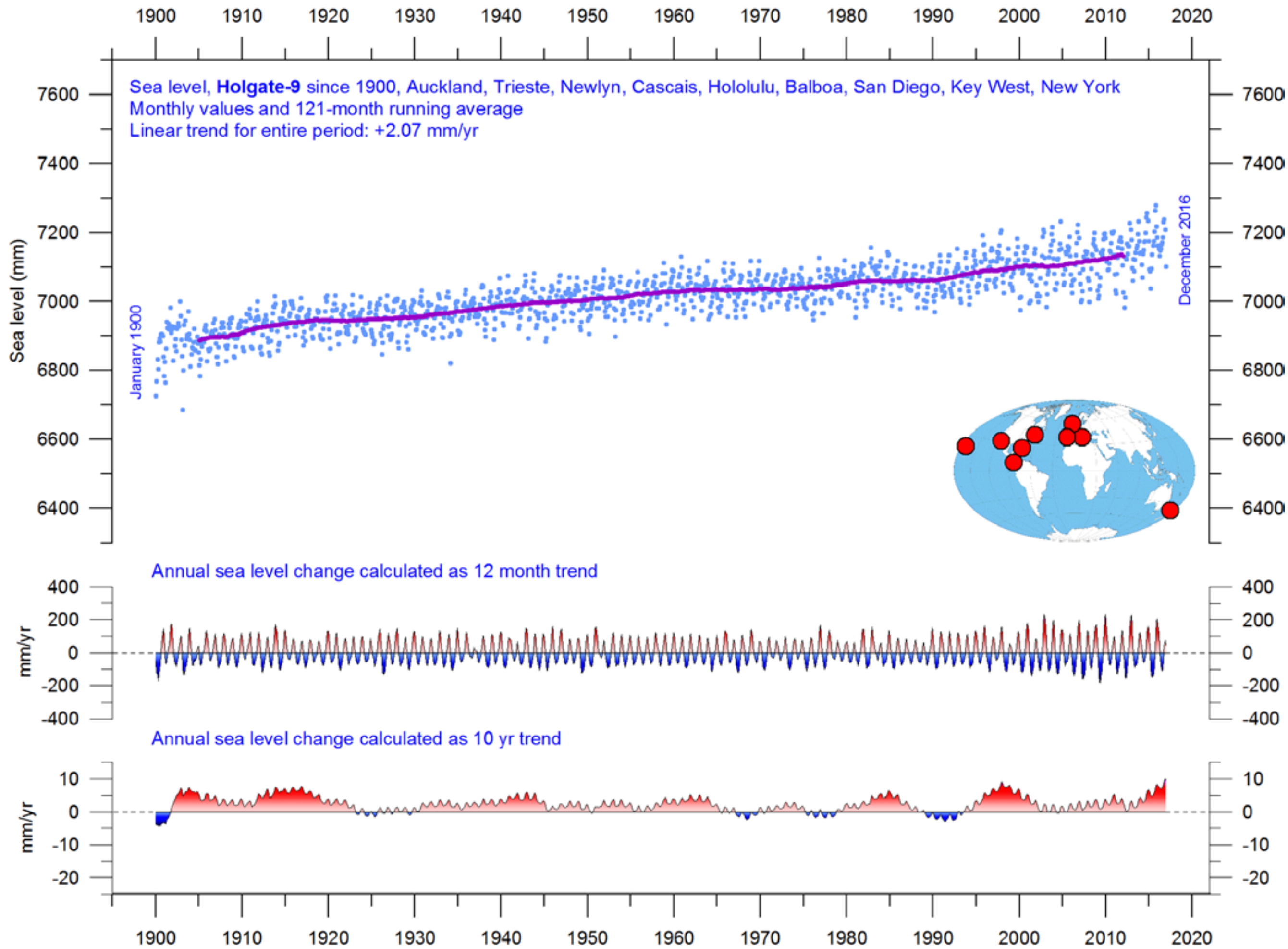
Mörner, Nils-Axel 2015. Sea Level Changes as recorded in nature itself. Journal of Engineering Research and Applications, Vol.5, 1, 124-129.

[Global sea level from satellite altimetry, updated to July 2016](#)



Global sea level since December 1992 according to the Colorado Center for Astrodynamics Research at University of Colorado at Boulder. The blue dots are the individual observations, and the purple line represents the running 121-month (ca. 10 year) average. The two lower panels show the annual sea level change, calculated for 1 and 10 year time windows, respectively. These values are plotted at the end of the interval considered. Data from the TOPEX/Poseidon mission have been used before 2002, and data from the Jason-1 mission (satellite launched December 2001) after 2002.

Global sea level from tide-gauges, updated to December 2016

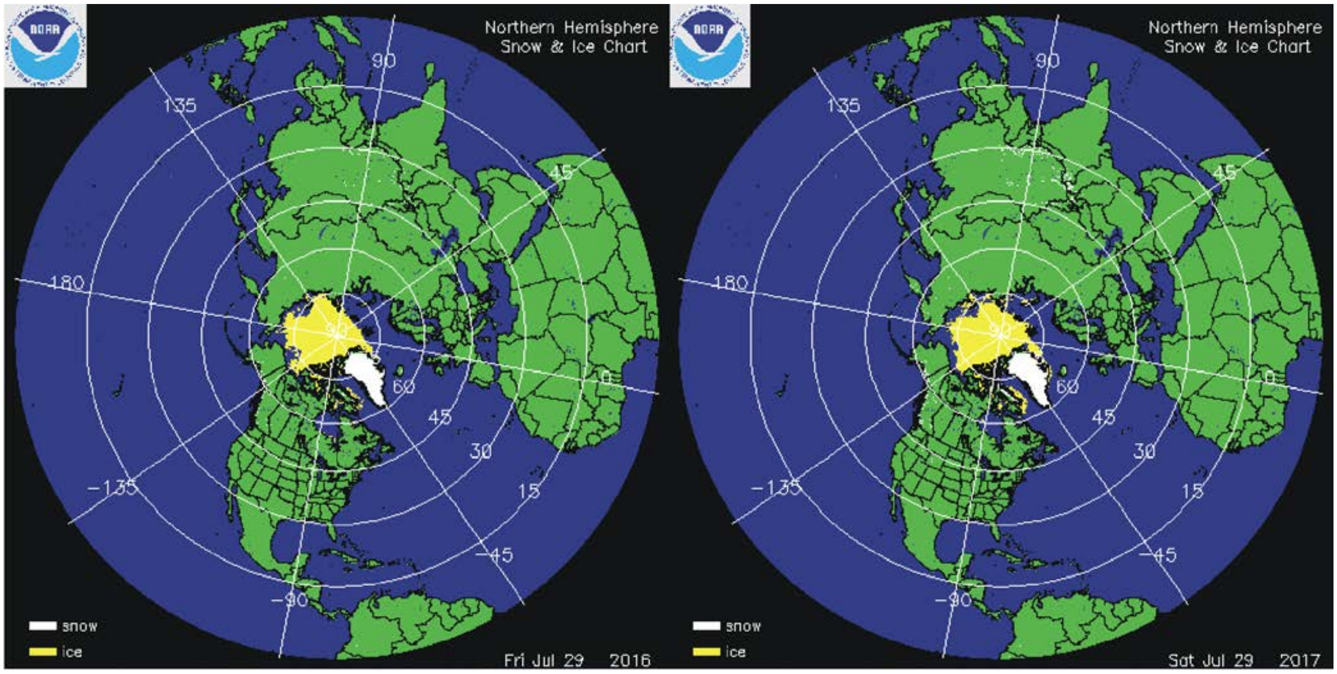


Holgate-9 monthly tide gauge data from PSMSL Data Explorer. Holgate (2007) suggested the nine stations listed in the diagram to capture the variability found in a larger number of stations over the last half century studied previously. For that reason average values of the Holgate-9 group of tide gauge stations are interesting to follow. The blue dots are the individual average monthly observations, and the purple line represents the running 121-month (ca. 10 yr) average. The two lower panels show the annual sea level change, calculated for 1 and 10 yr time windows, respectively. These values are plotted at the end of the interval considered.

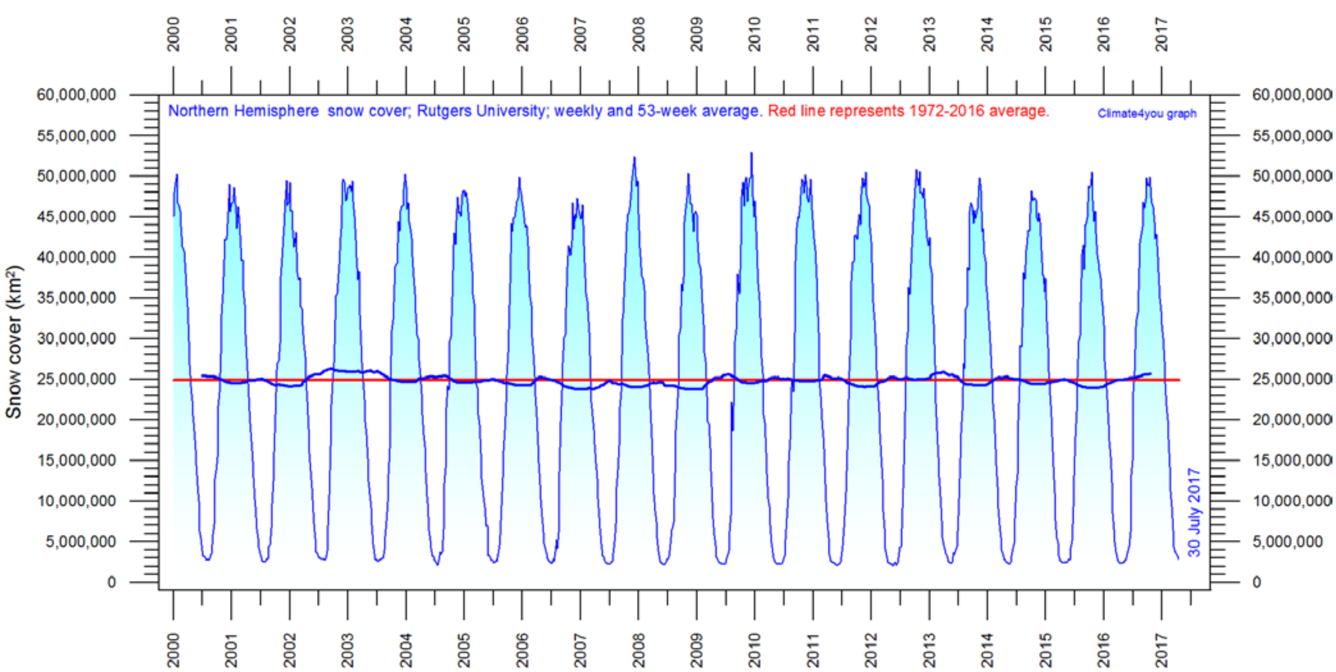
Reference:

Holgate, S.J. 2007. On the decadal rates of sea level change during the twentieth century. Geophys. Res. Letters, 34, L01602, doi:10.1029/2006GL028492

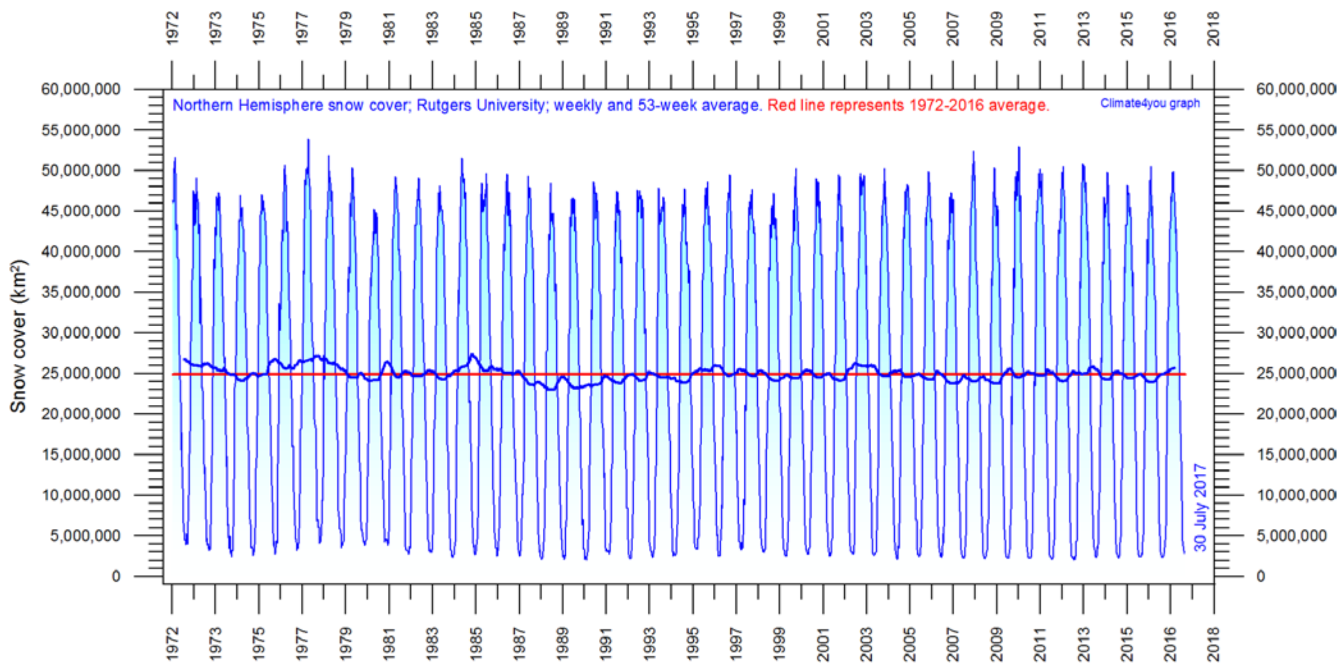
[Northern Hemisphere weekly snow cover, updated to July 2017]



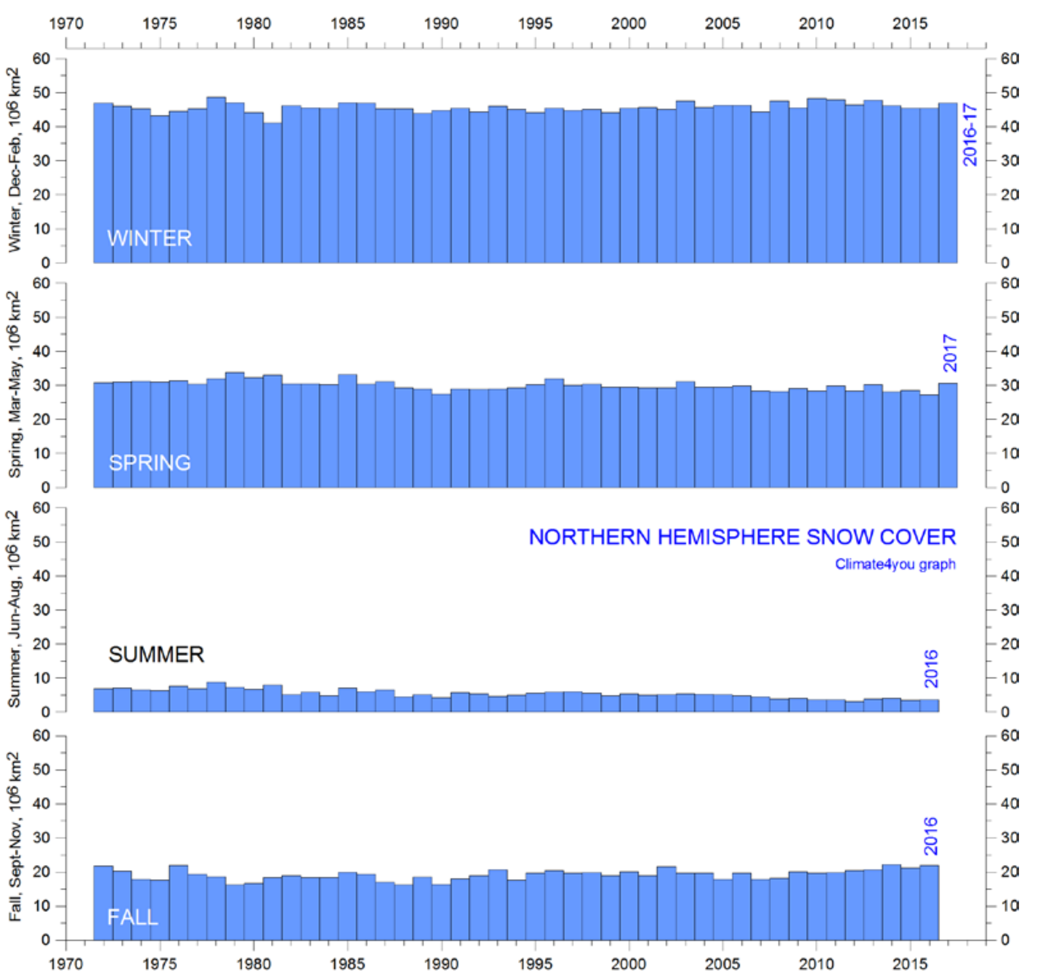
Northern hemisphere snow cover (white) and sea ice (yellow) 29 July 2016 (left) and 2017 (right). Map source: [National Ice Center](NIC).



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 1972-2016 average.

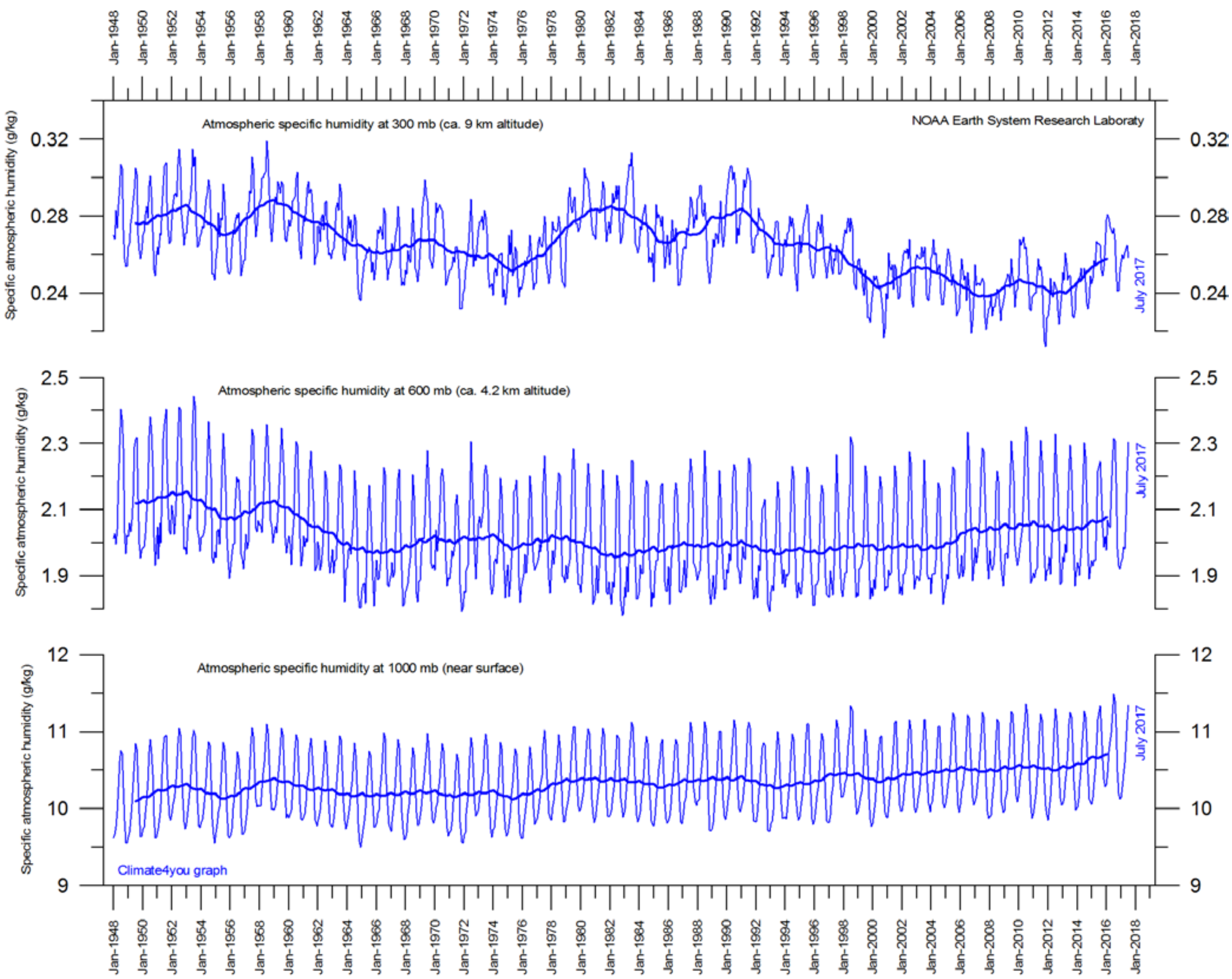


Northern hemisphere weekly snow cover since January 1972 according to Rutgers University Global Snow Laboratory. The thin blue line is the weekly data, and the thick blue line is the running 53-week average (approximately 1 year). The horizontal red line is the 1972-2016 average.



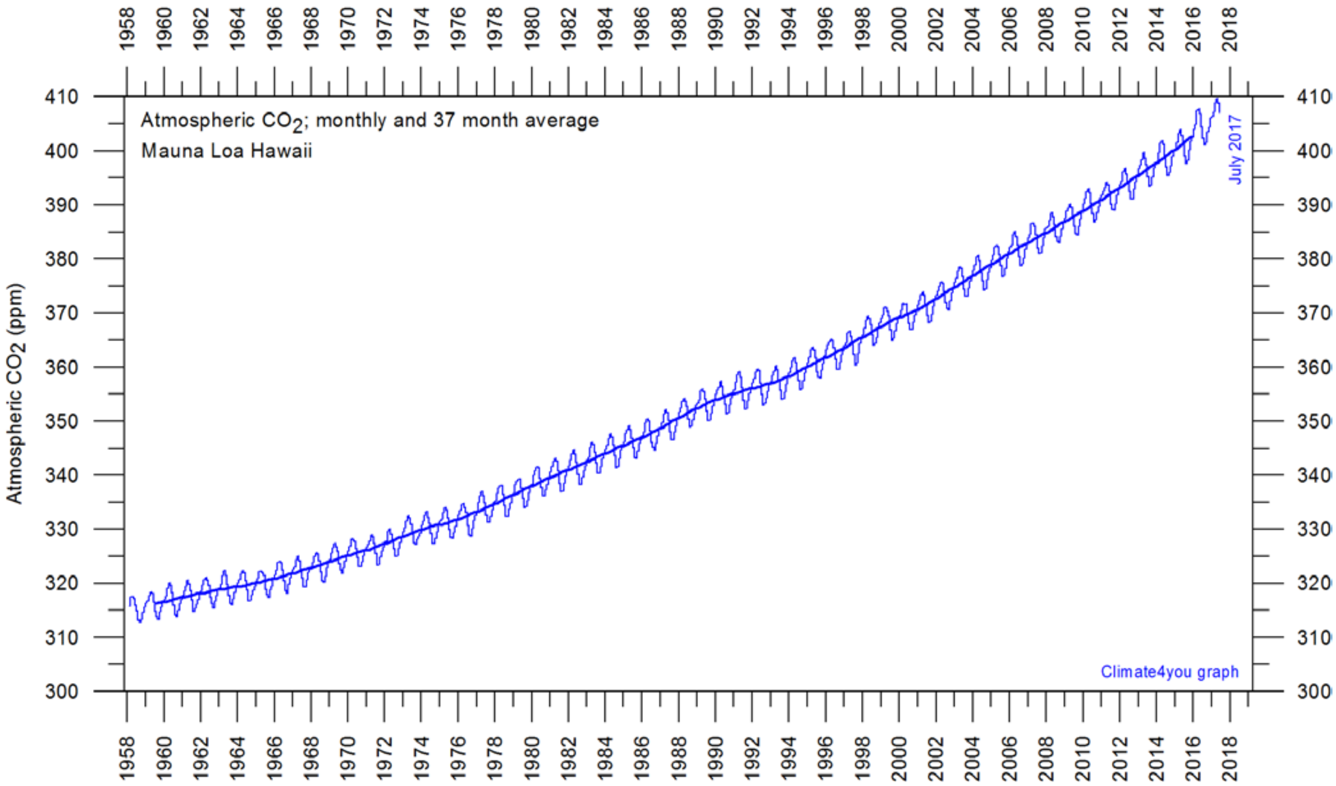
Northern hemisphere seasonal snow cover since January 1972 according to Rutgers University Global Snow Laboratory.

Atmospheric specific humidity, updated to July 2017

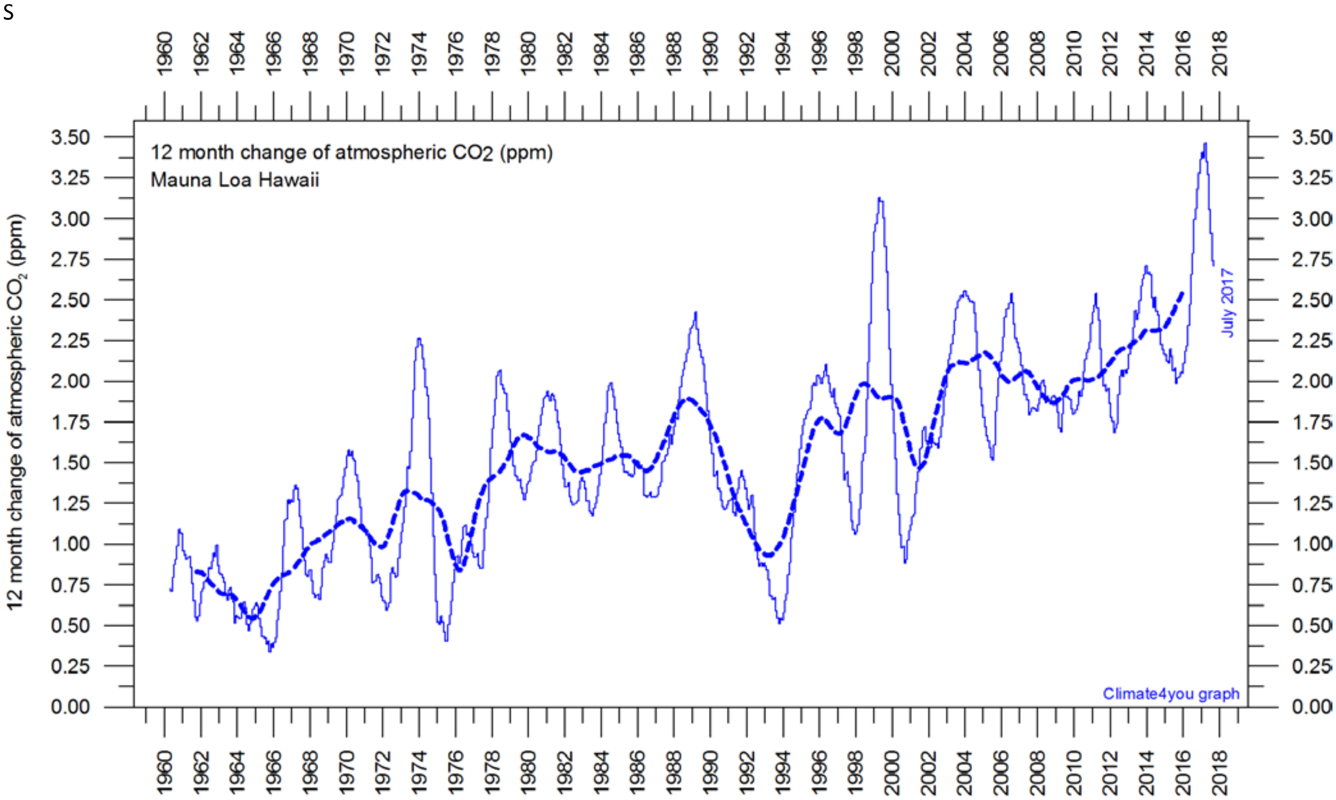


Specific atmospheric humidity (g/kg) at three different altitudes in the lower part of the atmosphere (the Troposphere) since January 1948 (Kalnay et al. 1996). The thin blue lines shows monthly values, while the thick blue lines show the running 37-month average (about 3 years). Data source: Earth System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

Atmospheric CO_2, updated to July 2017

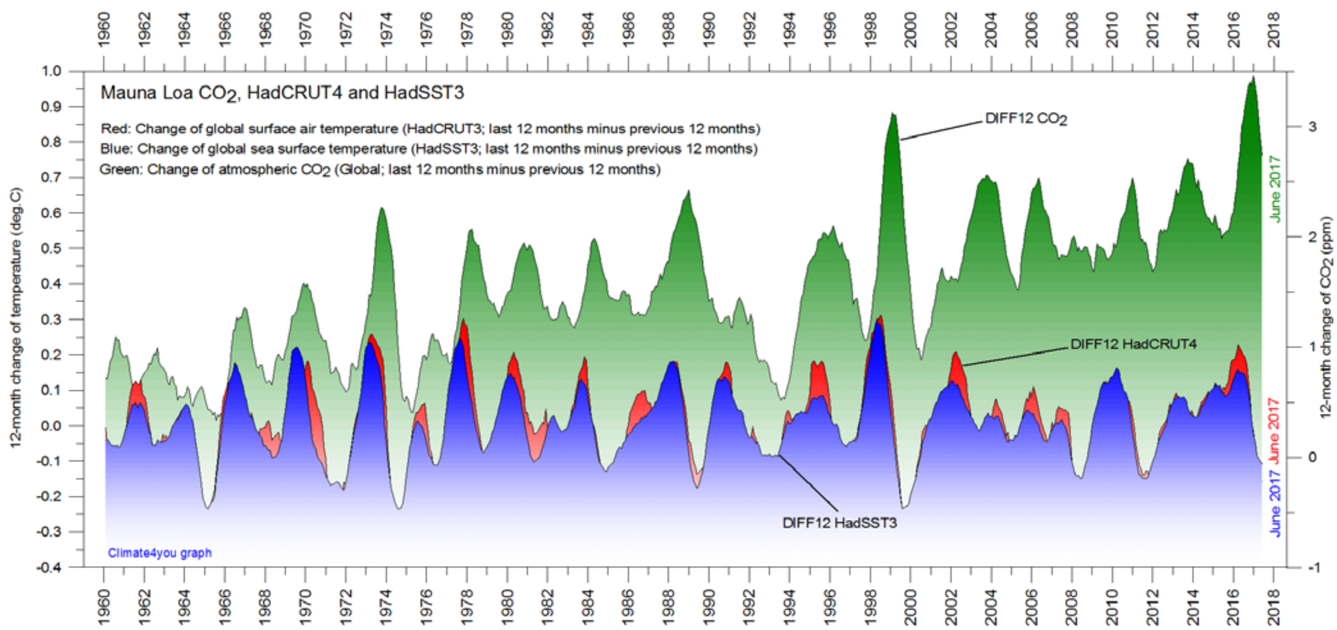


S



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-year average.

The phase relation between atmospheric CO_2 and global temperature, updated to June 2017

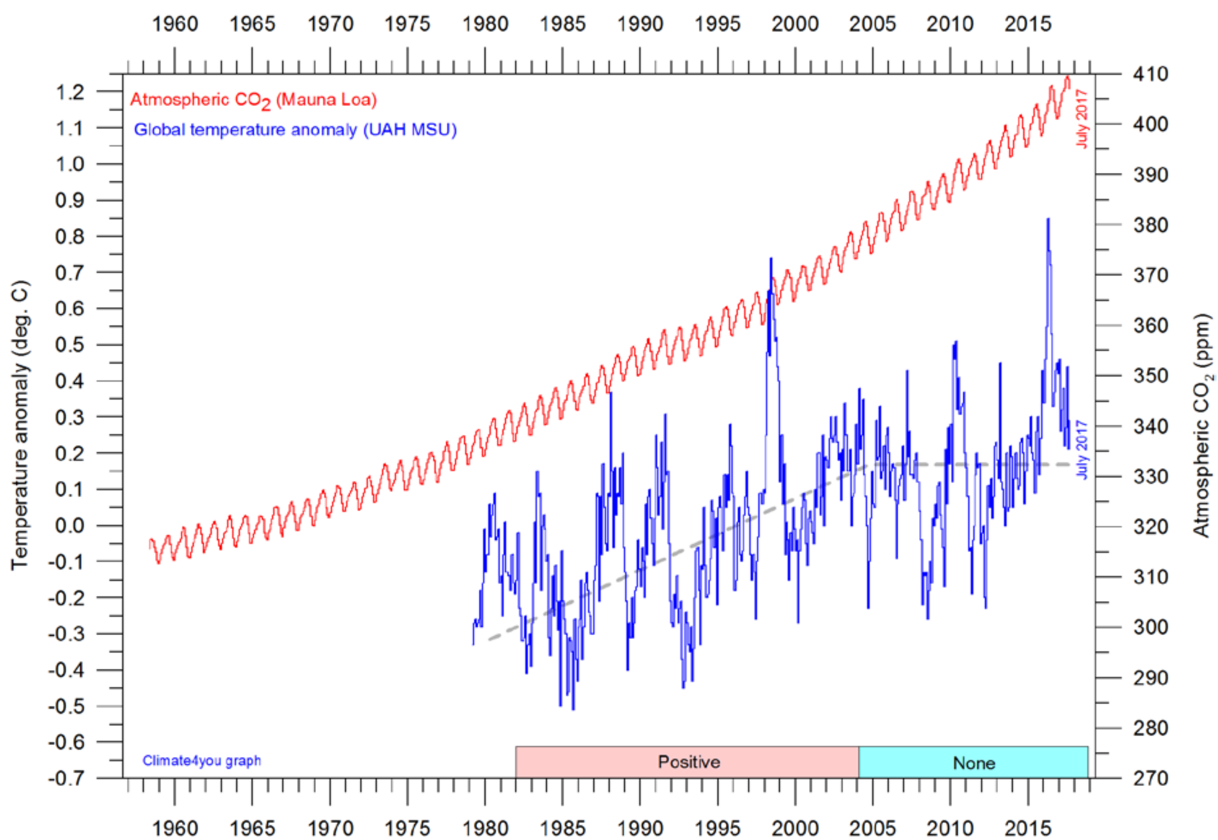


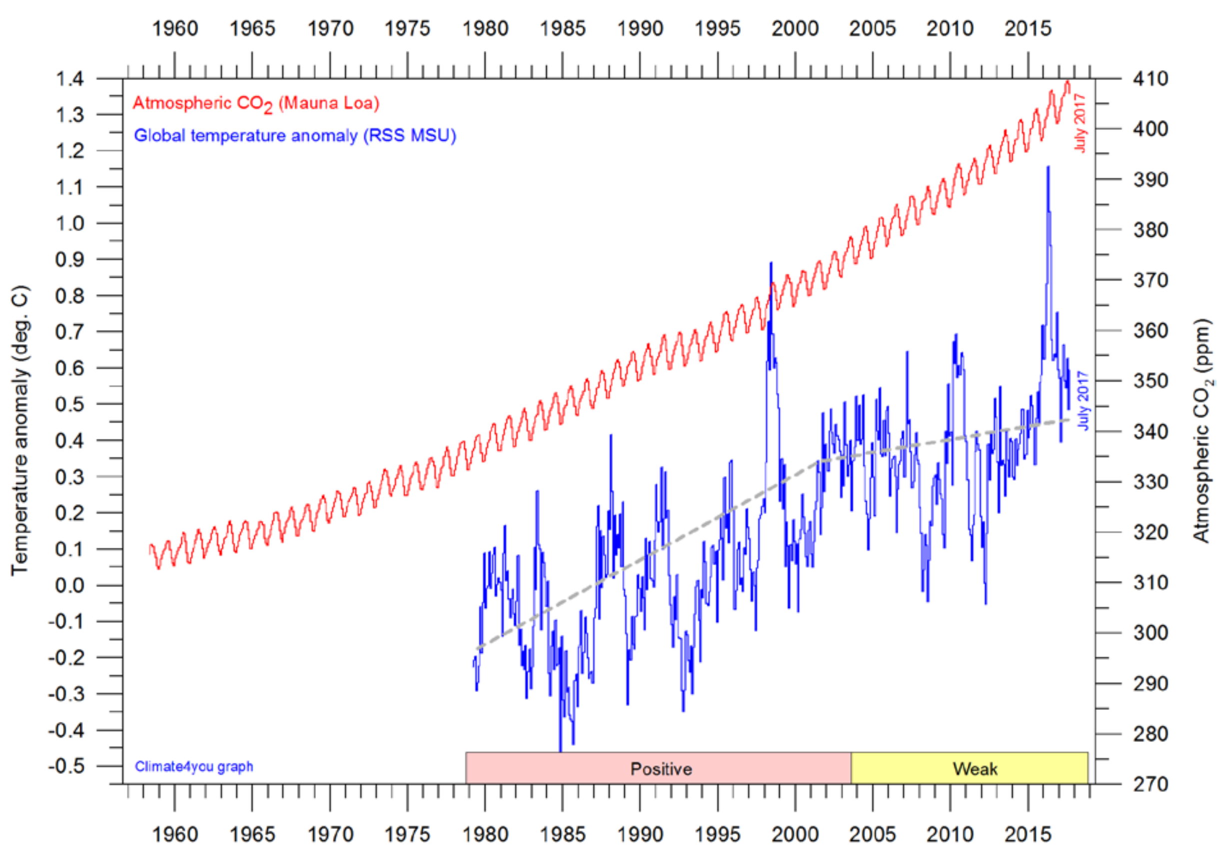
12-month change of global atmospheric CO_2 concentration (Mauna Loa; green), global sea surface temperature (HadSST3; blue) and global surface air temperature (HadCRUT4; red dotted). All graphs are showing monthly values of DIFF12, the difference between the average of the last 12 month and the average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

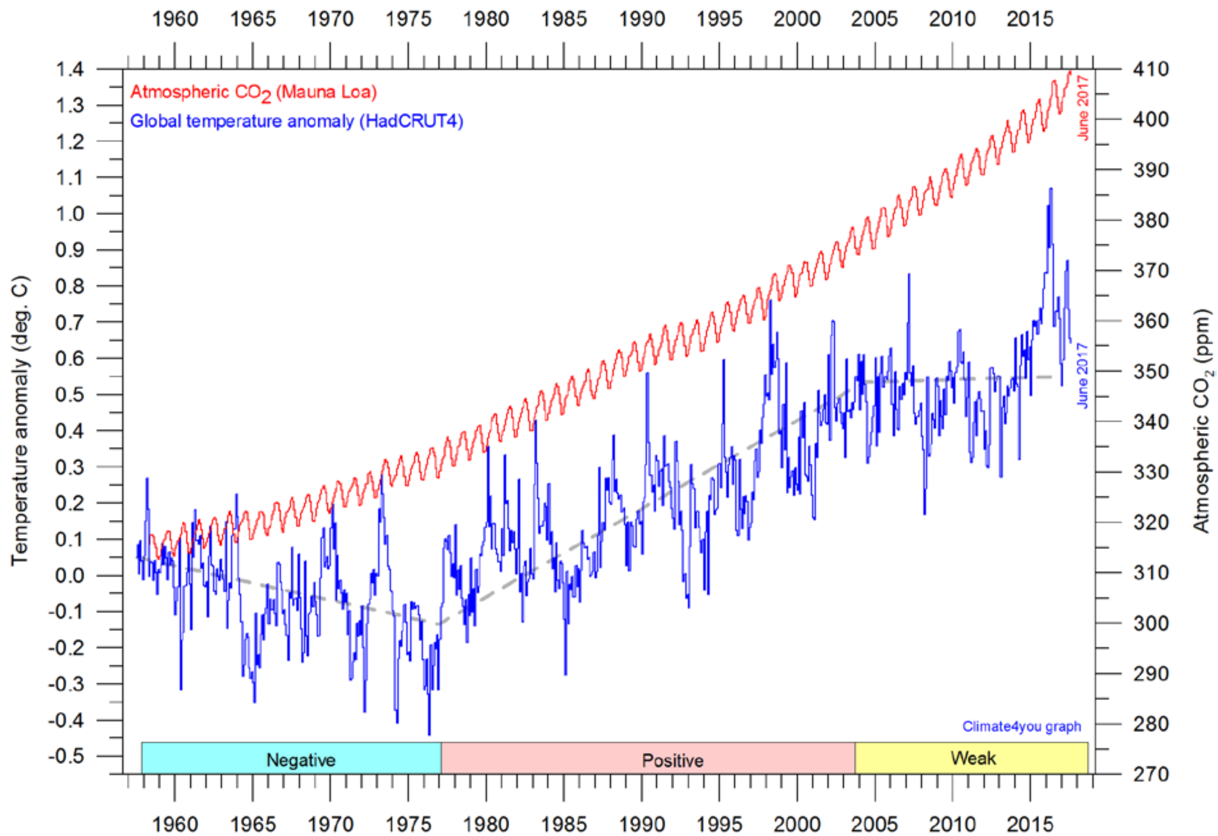
References:

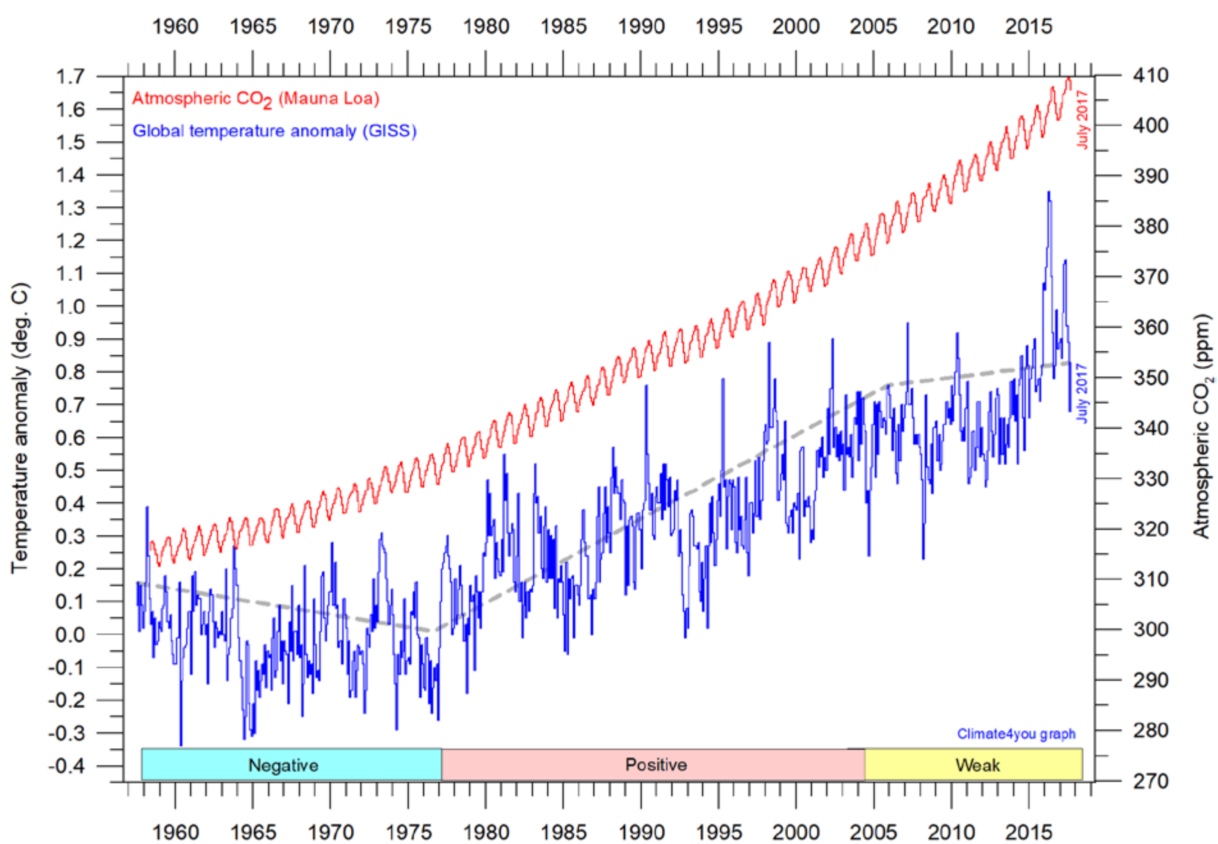
Humlum, O., Stordahl, K. and Solheim, J-E. 2012. The phase relation between atmospheric carbon dioxide and global temperature. Global and Planetary Change, August 30, 2012. http://www.sciencedirect.com/science/article/pii/S0921818112001658?v=s5

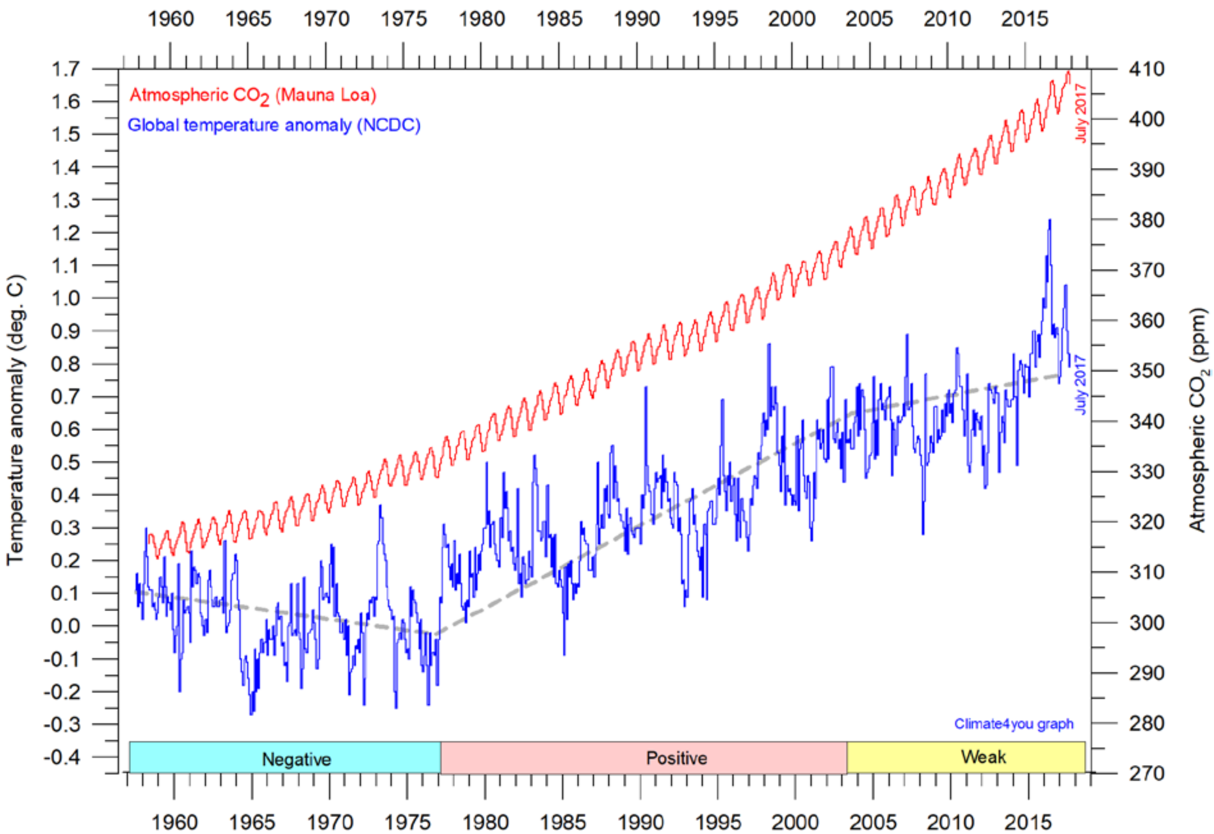
Global air temperature and atmospheric CO_2, updated to July 2017






Atmospheric CO2 (Mauna Loa)
Global temperature anomaly (HadCRUT4)
June 2017
June 2017
Temperature anomaly (deg. C)
Atmospheric CO2 (ppm)
Climate4you graph
Negative
Positive
Weak


Atmospheric CO2 (Mauna Loa)
Global temperature anomaly (GISS)
July 2017
July 2017
Temperature anomaly (deg. C)
Atmospheric CO2 (ppm)
Climate4you graph
Negative
Positive
Weak



Diagrams showing UAH, RSS, HadCRUT4, GISS, and NCDC monthly global 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 (p.41) is not yet updated beyond June 2017.

Most climate models are programmed to give the greenhouse gas carbon dioxide CO_2 significant influence on 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 represents a theme for discussion. However, the length of the critical period 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.

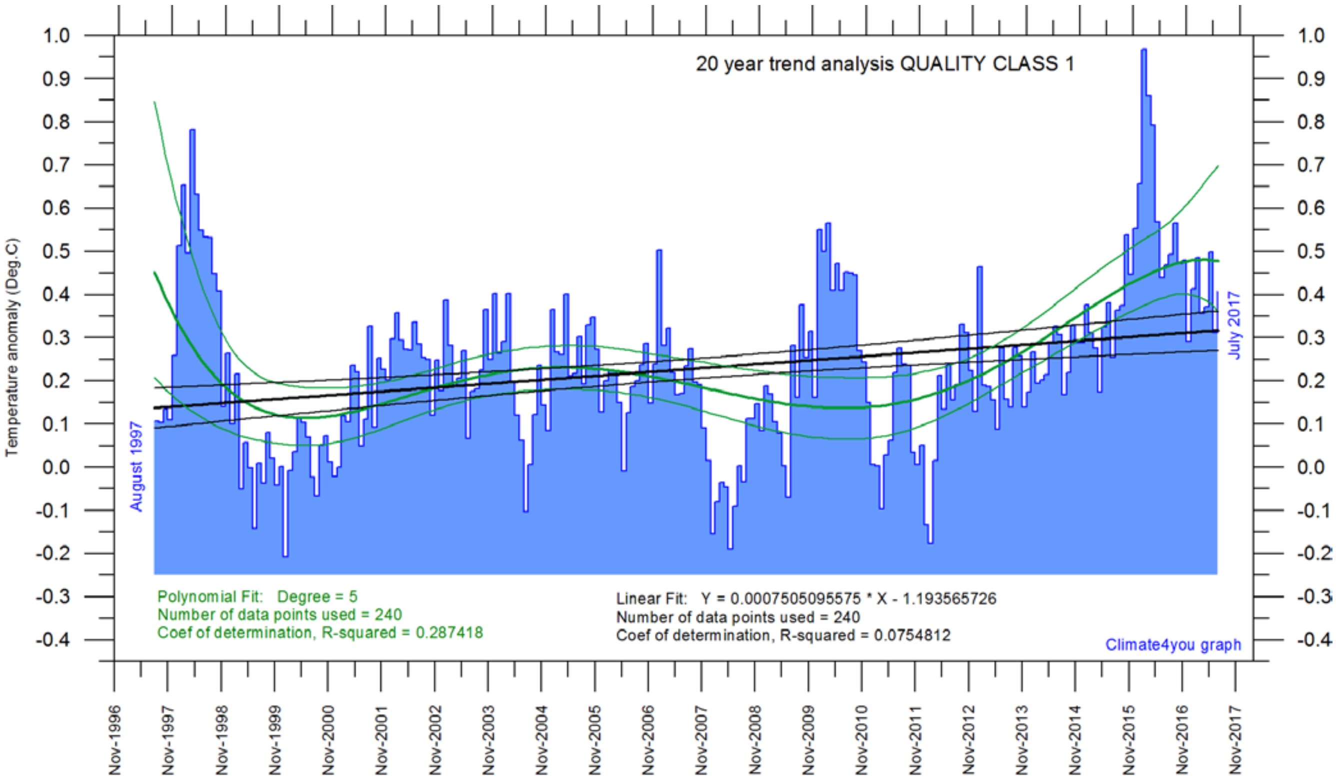
However, past climate research history provides some clues as to what has traditionally been considered the relevant length of period over which to compare temperature and atmospheric

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 likely 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.

Latest 20-year QC1 global monthly air temperature changes, updated to July 2017



Last 20 years' global monthly average air temperature according to Quality Class 1 (UAH and RSS; see p.10) global monthly temperature estimates. The thin blue line represents the monthly values. The thick black line is the linear fit, with 95% confidence intervals indicated by the two thin black 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 are given in the lower part of the diagram (please note that the linear trend is the monthly trend).

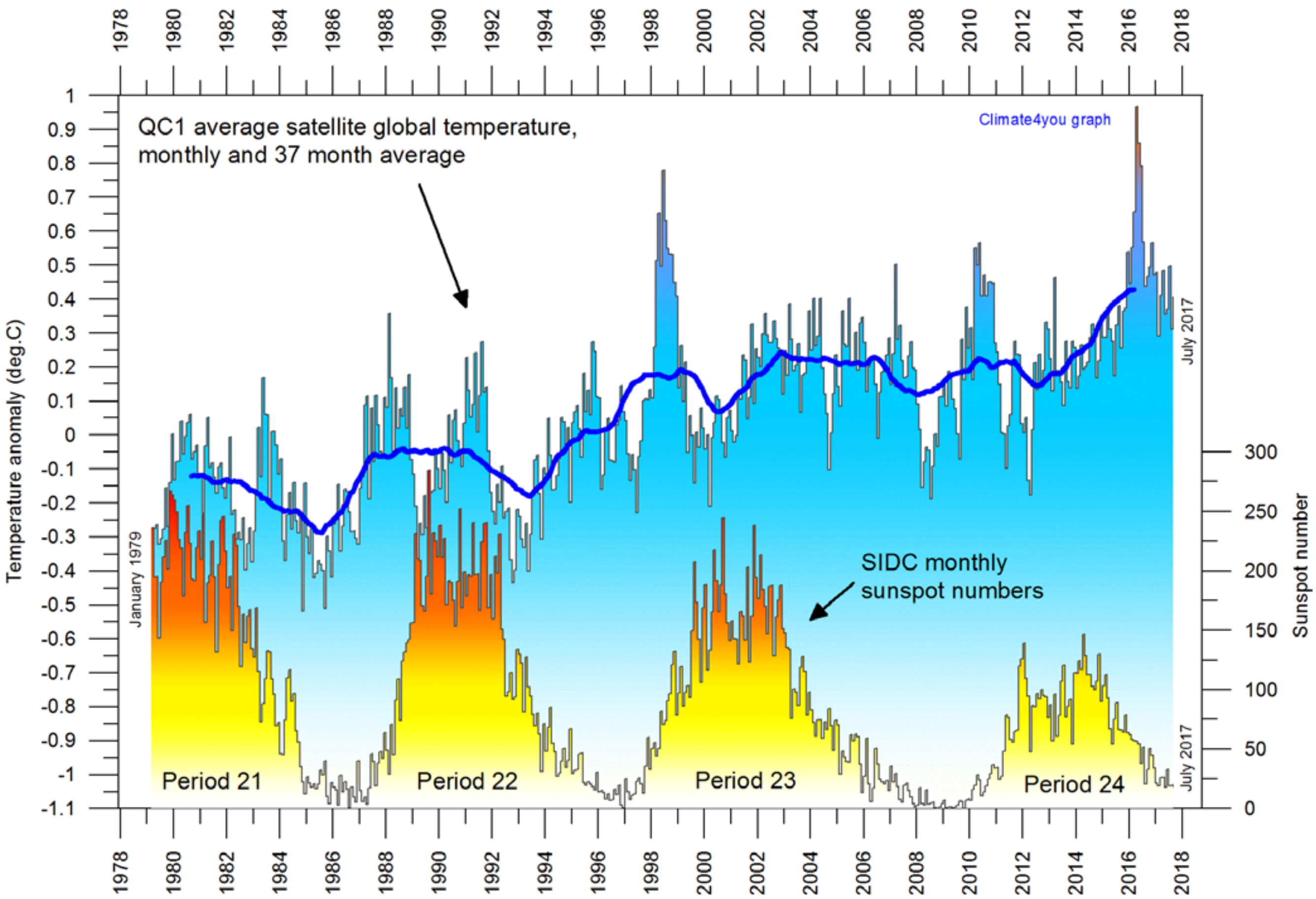
In the ongoing climate debate the question if the global surface air temperature still increases, or if the temperature has levelled out during the last 15-18 years, is often put forward.

The diagram above 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](#).

Sunspot activity and QC1 average satellite global air temperature, updated to July 2017



Variation of global monthly air temperature according to Quality Class 1 (UAH and RSS; see p.4) and observed sunspot number as provided by the Solar Influences Data Analysis Center (SIDC), since 1979. The thin lines represent the monthly values, while the thick line is the simple running 37-month average, nearly corresponding to a running 3-year average. The asymmetrical temperature 'bump' around 1998 is influenced by the oceanographic El Niño phenomenon in 1998, as is the case also for 2015-16.

1813-14: A cold winter makes the invasion of France difficult

Napoleon and his staff are returning towards Soissons after the battle of Laon 9 March 1814, painting by Meissonier.

The catastrophic outcome of the Russian campaign 1812 sealed Napoleon's fate. Not only did it cost him 300,000 of his best French soldiers (today this would compare to a loss of 700,000 men), but it also punctured the aura of superiority and being invincible that has been surrounding Napoleon's person. Few saw this more clearly than the German patriots in Prussia, who had been suffering under the humiliation of French dominion. On 28 February 1813, an alliance was concluded between Russia and Prussia, and two weeks the latter declared war on France.

However, in astonishingly short time Napoleon managed to raise a new army of 200,000 men, and rapidly regained his old self-confidence. In April 1813, he launches a huge counteroffensive with his new army into the Prussian heartland towards Dresden. His strategy was to retake Berlin and relieve Danzig, thus rescuing the no less than 150,000 French troops surrounded along the lower Vistula. At this time, some minor German princes still supported him.

At Lützen Napoleon defeated the combined Russo-Prussian force on 2 May and once again at Bautzen 20 May, but all to no avail. Sweden joined the coalition against Napoleon and Britain contributed money. And as Napoleon's enemies grew in strength, his remaining allies began to waver. On 12 August Austria declared war on France. Napoleon responded by defeating a combined Russian-Austrian army 26 August outside Dresden. On 16 October 1813 Napoleon faced the combined forces of the new coalition at Leipzig, being outnumbered by two to one. Napoleon nevertheless held his ground for long, but finally had to fell back across the Rhine early November 1813.

In the spring of 1814 Napoleon fought his perhaps most brilliant campaign against the invading armies on French soil. In January 1814, the Prussian army under the generals Blücher and Gneisenau crossed the river Meuse and penetrated 120 km into French territory.

During a fierce winter blizzard, Napoleon attempted to work his way around the Prussian's rear, nearly capturing Blücher and Gneisenau, and forcing their army to retreat towards La Rothiére (Harvey 2006). The allies had great trouble concentrating one big army to face and defeat Napoleon, as the very cold winter 1813-1814 made it extremely difficult to keep any big army supplied on French soil during the winter. The allied armies therefore remained separated and vulnerable.

However, this development and other French victories were unable to do more than delay the evitable end. Paris capitulated 31 March 1814, and Napoleon was forced to abdicate on 6 April, less than 18 months after leaving Moscow. He was exiled to the island of Elba off the Italian coast. One year later, on 1 March 1815, he landed in France and took power once again. On 18 June 1815, he was defeated at Waterloo by a combined British and Russian army under Wellington. Even at this final confrontation, Napoleon proved himself to be an outstanding general. The outcome of the battle was, in a phrase used by the Duke of Wellington in describing his victory at Waterloo, "the nearest run thing you ever saw in your life" (Massie 2005). Napoleon was exiled to St. Helena in the southern part of the Atlantic Ocean, where he died 5 May 1821.

France, a state at least as powerful as Britain before the industrial revolution, was crippled politically and economically for decades after 1815. For long, it remained a largely agrarian country, and its own industrial revolution was seriously postponed. In total, France was considerably worse off economically and more backward politically in 1816 than in 1788. The French industrial revolution had been limited to military-related manufacturing, which was not particularly efficient. While Britain was undergoing a significant industrial revolution during this period, France in many respects fell way behind, and ceased to be a major economic and political rival to Britain until the late 20th century.

In Europe, most nations in 1816 were far less progressive and democratic than in 1788. The Napoleon period and its final outcome had set the clock back, not forward, except in one respect: the expansion of the role of the central state, fuelled by the military imperative. This was a legacy that was to last well into the 20th century.

REFERENCES

Harvey, R. 2006. *The Wars of Wars. The epic struggle between Britain and France 1789-1815*. Constable & Robinson Ltd., London, 962 pp.

Massie, R.K. 2005. *Castles of Steel. Britain, Germany and the winning of the great war at sea*. Pimlico, Random House UK Limited, London. 865 pp.

*****

All diagrams in this report, along with any supplementary information, including links to data sources and previous issues of this newsletter, are freely available for download on www.climate4you.com

Yours sincerely,

Ole Humlum (Ole.Humlum@unis.no)

August 19, 2017.