World Meteorological Organization
Organisation météorologique mondiale
Secrétariat
7 bis, avenue de la Paix – Case postale 2300 – CH 1211 Genève 2 – Suisse
Tél.: +41 (0) 22 730 81 11 – Fax: +41 (0) 22 730 81 81
wmo@wmo.int – www.wmo.int

Weather • Climate • Water
Temps • Climat • Eau

Global Features

Overview

The year 2014 is on track to be the warmest, or one of the warmest years on record. The near-surface oceans have been particularly warm. Arctic sea ice extent was once again below its long term mean and this year's minimum extent was the sixth lowest on record. Antarctic sea ice extent reached a record high. The year has been marked by flooding around the world. Other extreme events during the first 10 months of 2014 have included droughts, heavy snow falls and a below-average number of tropical storms globally.

Global temperatures

Based on an average of three leading global data sets[1] for January to October, a preliminary estimate concludes that the global average temperature in 2014 was 0.57 ± 0.10 °C[2] (1.03 ± 0.18 °F) above the 1961-1990 average of 14.00°C (57.2 °F). This is 0.09°C (0.16 °F) above the average temperature of the past 10 years (2004-2013), which in turn was 0.48 °C (0.86 °F) above the 1961-1990 average.

If November and December maintain the same global temperature anomaly value, the best estimate for 2014 according to this measure would place it as the warmest year on record. The year, however, is not yet over. Comparing January to October 2014 to the same period in earlier years, 2014 is so far tied for warmest with 2010. It is important to note that differences

[1] Produced by NOAA NCDC, NASA GISS and the Met Office and Climatic Research Unit at the University of East Anglia (UK).
[2] The uncertainty is that estimated for the HadCRUT.4.3.0.0 data set. Estimates produced for the MLOST data set at ±0.12 °C are comparable. NASA GISS do not produce uncertainty estimates for individual years, but the uncertainty of annual averages from 1950-2008 is estimated to be ±0.05 °C.
ftp://ftp.ncdc.noaa.gov/pub/data/mlost/operational/products/aravg.ann.land_ocean.90S.90N.v3.5.4.201409.asc and Hansen et al. (2010)

in the rankings of the warmest years are a matter of only a few hundredths of a degree, and that different data sets show slightly different rankings.

Global average temperatures are also estimated using reanalysis systems, which use a weather forecasting system to combine many sources of data to provide a more complete picture of global temperatures. According to data from the reanalysis produced by the European Centre for Medium-Range Weather Forecasts, the January to October combined land and ocean global average temperature would place 2014 as third or fourth highest for this dataset, which runs from 1958.

Based on these lines of evidence it is most likely that 2014 is currently one of the four warmest years on record, but there is a possibility that the final rank will lie outside this range. Global temperatures and their estimated uncertainties are shown in Figure1.

The average temperature for January to October 2014 was above the long-term mean for most land areas. Air temperatures averaged over land were 0.86 ± 0.23 °C above the 1961-1990 average, nominally the fourth or fifth warmest on record. Global-average sea-surface temperatures (SSTs) for the period January to October 2014 were around 0.45 ± 0.05 °C[3] above the 1961-1990 average, warmer than any previous year in the record.

During the year (to early November 2014), SST anomalies in the tropical Pacific increased and approached El Niño thresholds, but did not exceed them for any sustained period. Despite above-average temperatures in the east, there was no sustained signal that the atmospheric side of a typical El Niño cycle was at work so far this year. Although the conditions in 2014 did not yet meet the criteria for a typical El Niño, certain weather patterns normally associated with El Niño have been observed.

Oceans

Sea-surface temperatures in the western tropical Pacific Ocean were unusually high during 2014, which might have inhibited the atmospheric feedbacks necessary to initiate and maintain an El Niño. Sea-surface temperatures were also much warmer than average across the north and north-east Pacific as well as the polar and subtropical North Atlantic, southwest Pacific, parts of the South Atlantic and in much of the Indian Ocean. Below-average SSTs, were recorded in the Southern Ocean, to the south of Greenland and parts of the east Pacific

[3] Based on the ERSST data set used in NCDC and GISTEMP. It also ranks warmest in HadSST.3.1.1.0, with an anomaly of 0.48 ± 0.10 °C.

around 20° south of the equator. Global-average SSTs for the period January to October 2014 were around 0.45 ± 0.05 °C above the 1961-1990 average, warmer than any previous year in the record. SSTs were particularly high in the Northern Hemisphere from June to October.

The majority of the energy that accumulates in the climate system is taken up by the oceans. Therefore, the heat content of the oceans is a key measure for understanding the climate system. Ocean heat content anomalies for January to June 2014 have been estimated down to depths of 700m and 2000m, the latter depth now being routinely measured by Argo floats. In 2014, the ocean heat content anomalies estimated[4] for both layers were approximately equal to, or higher than, in 2013 and higher than any earlier year in the record (from 1955 for measurements down to 700m and from 2005 for measurements down to 2000m) (Figure 9).

Sea-level is another key measure of the climate system. Thermal expansion of the ocean water and addition of fresh water from the melting of ice sheets and glaciers are the main contributions to the global mean sea-level rise. Ocean dynamics, large-scale climate patterns like ENSO, and gravitational effects from melting of ice sheets may create regional patterns of sea level. Short-scale variations in local sea level are affected by tides and storms. In early 2014, global-average measured sea-level reached a record high for the time of year[5], close to what would be expected given the average rate of change of 3.2 ± 0.4 mm/yr over the satellite altimetric record (1993 to 2014) (Figure 8).

Antarctic and Arctic sea ice

Arctic sea-ice extent[6] reaches a maximum in March and the minimum is in September. According to the U.S. National Snow and Ice Data Center, in 2014, the annual maximum daily extent of 14.91 million km^2 was recorded on 21 March, and the annual minimum extent of 5.02 million km^2 on 17 September (Figure 7). This daily minimum was the sixth lowest on record. The monthly average extent for September (Figure 6) was also the sixth lowest on average, 1.24 million km^2 below the 1981-2010 average and 1.65 million km^2 above the record-low extent recorded in September 2012.

Antarctic daily sea ice extents remained at record high levels for much of 2014. Maximum daily Antarctic sea-ice extent is usually observed in September or October. For 2014, a

[4] http://www.nodc.noaa.gov/OC5/3M_HEAT_CONTENT/
[5] http://www.cmar.csiro.au/sealevel/sl_hist_last_15.html
[6] http://nsidc.org/arcticseaicenews/2014/10/2014-melt-season-in-review/
http://nsidc.org/arcticseaicenews/2014/04/
http://nsidc.org/arcticseaicenews/2014/10/2014-melt-season-in-review/

maximum daily extent of 20.11 million km^2 was reached on 22 September, 0.56 million km^2 higher than the previous record set on 1 October 2013. 2014 is the third year in a row to set a new Antarctic sea-ice extent record (Figure 5).

The Arctic and Antarctic are quite different environments for sea ice. While Antarctic sea ice forms around the edges of a land mass, Arctic sea ice is found in an ocean that is partially encircled by land. This difference leads to quite different ice dynamics. The IPCC AR5 says that there is low confidence in the scientific understanding of the observed long-term increase in Antarctic sea ice extent since 1979. Two explanations for the long-term increase have been offered. The first is that there has been a strengthening of the prevailing westerly winds. The second is that a freshening of the near-surface water due partly to the melting of ice shelves has provided conditions conducive to ice growth. At shorter time scales, month to month variations in weather are an important factor[7].

Regional Features

Regional Temperatures, Heat Waves and Cold Spells

In Africa during the first ten months of 2014, temperatures were near-to or above average almost everywhere where long-term records are available. The average anomaly across the continent was higher than the long-term mean, but lower than the record value for 2010. There were notable heatwaves in South Africa between 16 and 18 January when four highest temperature records were broken. A heatwave affected Tunisia between 18 and 22 September. Morocco was unusually warm in October with an average temperature of more than 3 °C above normal.

February was very warm in European Russia, the Arctic and also in the far north-east of Russia. In Kolyma, Chukotka and Kamchatka, anomalies reached 10 °C making it the region’s second warmest February. Spring in Russia was the warmest on record (anomaly of 3.12 °C, records begin in 1936) with temperatures in the north and east more than 5 °C above average for the season. Each of the spring months was much warmer than average. In April, ice break up began on the River Ob in Siberia two weeks earlier than normal, the earliest it has happened in the last 100 years. In July, many low minimum temperature records were broken in the east of European Russia, the Urals and Western Siberia. During the summer,

[7] http://nsidc.org/arcticseaicenews/2014/07/melting-in-the-north-freezing-in-the-south/
http://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter10_FINAL.pdf (Section 10.5.1)

China was cooler than average over the Yangtze River Basin and Northwest China. In contrast, Hong Kong experienced an unusually hot summer, breaking records for June and July monthly-averaged temperature (records began 1884). August in Russia was the warmest on record. It was also ranked the second warmest August for Armenia since 1961 (with a temperature anomaly of 3.5 °C). A cold wave occurred in European Russian in the second half of October. Minimum temperature records were set in many areas.

In South America, temperatures were above average across much of the continent (Figure 2). Temperatures were particularly high in the south of Brazil and in northern Argentina. In Argentina the average temperature anomaly for the year to October would place it second highest on record. In October, the town of Las Lomitas, near the northern border, recorded four consecutive days with maximum temperatures between 43.4 °C and 45.6 °C. The heatwave also affected southern Brazil, Bolivia and Paraguay. Monthly average temperatures in the region were the warmest on record for October.

In North America, temperatures between January and October 2014 were below average across the eastern U.S. and Canada. In the U.S., the most notable cooler-than-average temperatures were observed across the Mid-West and the Mississippi River Basin where seven states had one of their ten coldest January-October periods on record. The persistent cold during the winter led to 91% of the Great Lakes being frozen at the beginning of March, the second largest ice cover since records began in 1973. Continued cold weather meant that nearly two thirds of the Great Lakes remained frozen into early April and Lake Superior was not completely ice free until early June[8]. In contrast, the west of the continent from Alaska, through Canada, down to California was much warmer than average. In the USA, eight states had a top-ten warm January to October. California was record warm for January to October 2014.

For Australia, January to October has been the fifth warmest such period on record (records begin in 1910) with warmth particularly notable across southern Australia. As in 2013, there were a number of significant and widespread warm spells[9]. From 13 to 18 January, southeast Australia experienced very high temperatures and a number of records were set early in the period. Melbourne had four consecutive days warmer than 41 °C, Adelaide five days over 42 °C and Canberra four days over 39 °C. In May, a number of North Island locations in New

[8] http://coastwatch.glerl.noaa.gov/statistic/statistic.html
[9] See http://www.bom.gov.au/climate/current/special-statements.shtml and http://www.bom.gov.au/climate/mwr/ for summaries of individual events.

Zealand observed record or near-record low minimum temperatures for the month. The New Zealand seven-station series recorded its warmest June[10]. A cold outbreak affecting Australia at the end of July and into the first few days of August was one of the most significant for over a decade with severe frosts and associated crop damage across south-eastern Australia.

Throughout Europe, temperatures for the first ten months of the year were above average with anomalies exceeding 2°C in central Europe and parts of Scandinavia. The average temperature anomaly across Europe[11] for January to September was warmer than any previous equivalent period and higher than any full-year average. January to October was the warmest such period on record for the United Kingdom (records start in 1910) and for Central England (for which records go back to 1659). January to September was the warmest such period for France (records start in 1900), Denmark (records start in 1874) and the Netherlands (records start in 1706)[12], and the third warmest for Spain (records start in 1961).

January 2014 was the warmest January in France since 1900 and the third warmest in both Portugal (since 1931) and Spain (since 1961). The same weather pattern that brought colder-than-average conditions to the U.S. and Canada in February and March, led to exceptionally warm conditions over Europe. New daily record maximum temperatures for the month of February were reported for 25 stations in Turkey. Parts of Sweden experienced their warmest March since 1859[13]. In Slovakia it was the warmest March on record[14] and in Austria, Poland and Belarus, it was the second warmest March on record. April was also warm. It was the second warmest April for Spain and overall the second warmest spring for Denmark in 141 years. Some coastal stations in Norway broke record monthly temperatures, including the Utsira lighthouse (Rogaland) record which had stood since 1894. The boreal summer of 2014 was warmer than average in many European countries. Norway had its warmest July on record with an anomaly of 4.3°C, 1°C warmer than the previous record[15]. In Denmark, July was the second warmest since 1874.

Notable events in the regions

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[10] http://www.niwa.co.nz/climate/nzcu/new-zealand-climate-update-181-july-2014/current-climate-june-2014

[11] From CRUTEM4, Europe defined either as 25°W-45°E 35°-75°N or as 25°W-30°E 35°-70°N plus Turkey, 30°-45°E 35°-40°N (as used by EEA).

[12] http://www.knmi.nl/cms/content/121129/2014_waarschijnlijk_record_warm

[13] http://www.dwd.de/bvbw/generator/DWDWWW/Content/Oeffentlichkeit/KU/KU2/KU23/rcc-cm/products/Berichte/monthly__ravi__bulletin/bulletin__2014__02,templateId=raw,property=publicationFile.pdf/bulletin_2014_02.pdf

[14] http://www.shmu.sk/sk/?page=2049&id=521

[15] http://met.no/Klima/Klimastatistikk/Varet_i_Norge/2014/juli_2014/

Drought

- The North-West Province of South Africa was declared to be in a state of drought disaster on 5 September 2013. The drought continued into January 2014. In the North-West Province, farmers lost more than 50% of their crops at an estimated loss of about R2 billion. This led to 23,000 farmers in the province applying for drought relief. The drought was considered by agriculturalists to be the worst since 1933. Rainfall totals during February 2012 to January 2014 were also exceptionally low in parts of Namibia, southern Angola and Zambia.

- There was severe drought in northern China due to a lack of precipitation during the summer. The precipitation in the southern part of Northeast China and parts of the Yellow River basin and Huaihe River basin did not reach half of the summer average.

- The Indian summer monsoon rainfall ended up 12% below normal for the country and season as a whole, which is considered to be a deficient monsoon.

- Parts of eastern and some areas of central Brazil are in a state of severe drought with severe water deficits extending back more than two years. São Paulo city has been particularly badly affected with a severe shortage of stored water in the Cantareira reservoir that supplies the population of over 11 million people.

- As of 14 November 2014, large areas of the western U.S. are still in drought with areas of California, Nevada and Texas having received less than 40% of the 1961-1990 average rainfall and suffering exceptional drought, the most severe category used by the U.S. Drought Monitoring Service. Canada experienced dry conditions at the start of 2014 with many regions only receiving 50-70% of the baseline average in the west and north between January and April.

- At the start of the year, northeast New South Wales and southeast Queensland had long-term rainfall deficiencies. Since the end of the 2011-12 La Niña, many of the eastern parts of the country have had below-average-rainfall, and drought conditions have affected inland Queensland for the past two years. Significant rainfall deficits developed in parts of southeastern Australia from late winter 2014. March in New Zealand saw some stations experiencing one of their three driest months of March on record.

- During September, parts of western Europe experienced drier than average conditions. The United Kingdom had its driest September on record. At the start of September, some stations in south-east Spain had recorded their lowest total precipitation during the agricultural year (1 September 2013 – 31 August 2014).

Floods

- In March, parts of South Africa experienced severe floods. The floods in the North-West caused an estimated R100 millions of damages; the estimated cost of damage to infrastructure in the City of Tshwane at R124 million and the Johannesburg Roads agency estimate the costs of repairs at R37 million. Heavy rains also affected Mozambique in March. On 26 March, in Pemba City (in the north-east of the country), 587.8 mm of rain was recorded over four consecutive days, with 175.8 mm falling on just one day, a record for that station. Flooding affected over 4000 families and destroyed over 3000 houses.

- Intense rainfall in the beginning of February in south Rift Valley, caused flash floods where 10 people perished in Kajiado (in the southern Rift Valley).The early part of the 2014 "Short Rains" which fall between October and December were characterised by short, but intense rainfalls. On 17 October, Nairobi experienced heavy rainfall and severe flooding.

- In late November, between the 21 and 24 November, heavy rain in southern Morocco caused severe flooding with significant infrastructure damages and loss of around 30 lives. At Guelmim, 126mm of rain fell in four days. The monthly average for November is 17mm and the average for the year is 120mm. Agadir, Sidi-ifni and Tiznit also recorded high rainfall in this period.

- In September, heavy rains caused severe flooding in northern Pakistan and India. 250 people were drowned and over 100,000 were displaced. From 13 to 25 August, heavy rain in the north of Bangladesh caused flooding that affected 2.8 million and displaced more than 57,000 families including 31,000 whose homes had been totally destroyed by the floods[16]. In Assam, in the north east of India, there was severe flooding during the last two weeks of September. Around one million people in 25,000 villages were affected as well as widespread damage to crops and property.

[16] http://reliefweb.int/disaster/fl-2014-000117-bgd

- In Russia, in late May and early June, more than twice the monthly average precipitation fell in the Altai, Khakassia and Tuva republics. Heavy rains caused widespread flooding between the end of May and June. In total more than 70,000 people were affected by flooding and over 41,000 people had to be temporarily rehomed.

- In Japan, from 30 July to 26 August, heavy rainfall events were observed throughout the country. The heavy rains were associated with a southward shift and meandering of the jet stream and two typhoons: Nakri and Halong. The monthly precipitation over the Pacific side of western Japan for August 2014 was 301% of normal, which was the highest since 1946 when collection of the area-averaged data began.

- Buenos Aires and north eastern provinces of Argentina were severely affected by flooding. In February, many stations in northern and central Argentina reported record rainfall totals for the month. Cordoba Observatorio (which opened in 1873) recorded 213 mm, exceeding the previous record of 191.5 mm set in 2012. In another long series at San Luis Aero (1874-2014), the February total was a record at 278.6 mm[17]. In May and June, precipitation totals in excess of 250% of the long term average were recorded in Paraguay, southern Bolivia and parts of south east Brazil. The heavy rain led to flooding on the Parana River which particularly affected Paraguay[18] where more than 200,000 people were affected.

- On 29 and 30 April, torrential rain fell across the Southeast, Mid-Atlantic and Northeast of United States causing significant flash flooding. The Gulf Coast of Alabama and northwest Florida bore the brunt of the heavy rains. At the Pensacola Regional Airport, in Florida, the two-day precipitation total was 519.9 mm, with 395 mm of the total falling on the 29th, breaking both one-day and two-day precipitation records; local records date back to 1879.

- Twelve major Atlantic storms affected the United Kingdom through the winter 2013/2014 and the UK winter rainfall was the wettest on record with 177% of the long term average. It was also the wettest winter in the near 250-year England and Wales precipitation series from 1766. In Brittany (in western France), it was the wettest February on record (far

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[17] http://www.smn.gov.ar/serviciosclimaticos/hidro/archivo/informeprecipitaciones-febrero2014.pdf
[18] http://reliefweb.int/map/paraguay/11-june-2014-paraguay-floods and http://vosocc.unocha.org/rss/vo_2842cw6o.html

ahead of February 1990, the second wettest) and in Spain January-February precipitation was 48% above average.

- In May, floods in Serbia, Bosnia-Herzegovina and Croatia affected more than two million people[19] . There were 79 related deaths and around 137,000 people were displaced. Flooding also affected Romania, Bulgaria and Slovakia (with record daily May rainfall at some stations in Slovakia[20]). In June, August and September, heavy rains again caused flooding in Bulgaria. In September, southern parts of the Balkan Peninsula received over 250% of the monthly average rainfall and, in parts of Turkey, over 500% of normal.
- July and August were very wet in France with the two-month total being the highest on record (records begin 1959). September saw flooding in the south of France. Between 16 and 20 September, in Hérault, the south of Aveyron (départements in southern France), more than 400mm was recorded. This is three to four times the normal monthly average for September and caused severe flooding and mudslides.

Heavy snowfalls

- The Pacific side of northern and eastern Japan experienced two heavy snowfall events in February. Some parts of the Tohoku region and Kanto/Koshin region experienced record-breaking snowfalls from 14 to 15 February. Northern Japan was hit by further snow falls from 15 to 19 February. New records for maximum snow depth were set at 18 stations in northern Japan and in the Kanto/Koshin region. In Tokyo, the maximum snow depth of 27 cm was the joint eighth highest since 1875. According to the Cabinet Office, the event in mid-February claimed 26 lives across the country and had a heavy socio-economic impact.
- Exceptional cold in the U.S. in mid-November triggered a lake-effect snow storm in Buffalo, New York. Several locations accumulated more than 127 cm of snow in a 24-hour period, most likely exceeding the state-wide all-time snowfall accumulation (124.5 cm set in Watertown, NY during 14-15 November 1900) pending a review from the State Climate Extremes Committee. Over the course of the entire event, which lasted several days, some locations received over 170 cm of total snowfall. The event has caused at least 12 fatalities.

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[19] http://reliefweb.int/disaster/ff-2014-000059-srb
[20] http://www.shmu.sk/sk/?page=2049&id=528

Tropical cyclones

Globally, for 2014 so far (to 13 November), 72 tropical storms – storms where wind speeds equalled or exceeded 17.5m/s (63 km/hr) – have been recorded. This is below the 1981-2010 average of 89 storms. Tropical storms tend to form over the oceans and there is no simple connection between the total number of storms and the number of storms that make landfall in inhabited areas. The year is not yet complete, but the number of storms already exceeds the 67 storms recorded in 2010, the lowest total in the modern satellite era.

- In 2014, in the North Atlantic basin there were eight named storms[21], which is below the 1981-2010 average of twelve storms. Of these storms, six became hurricanes and two became major hurricanes (wind speeds exceeding 49m/s or 177 km/hr). Hurricane Arthur was the first hurricane to make landfall in the contiguous U.S. since August 2012.
- The Eastern North Pacific basin saw above average hurricane activity in 2014. In all, Twenty named storms formed between 22 May and the end of October[22], somewhat higher than the long-term average. Of these twenty storms, fourteen became hurricanes and nine of those became major hurricanes. Tropical storm Iselle made landfall on Hawaii's Big Island on 7 August, with maximum sustained winds of 27m/s (96 km/hr). This was the strongest tropical cyclone on record to make landfall on the Big Island and was the first tropical cyclone to make landfall anywhere in Hawaii since hurricane Iniki in 1992. Hurricane Odile severely affected Baja California, Mexico.
- In the Western North Pacific basin, twenty named tropical cyclones formed between 18 January and 20 November, slightly below the 1981-2010 average of twenty four storms (to the end of November). Ten of the cyclones reached typhoon intensity. Typhoons Nakri and Halong, contributed to the high precipitation totals recorded in western Japan in August. Typhoon Rammasun made landfall in the eastern Philippines on 15 July 2014. Rammasun displaced half a million people and killed around 100 people[23]. 100,000 houses were destroyed and a further 400,000 were damaged. Rammasun also made landfall on China’s Hainan island on 18 July causing 46 deaths and destroying 37,000 houses.

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[21] http://www.nhc.noaa.gov/text/MIATWSAT.shtml
[22] http://www.nhc.noaa.gov/text/MIATWSEP.shtml
[23] http://reliefweb.int/disaster/tc-2014-000092-phl

- The North Indian Ocean basin recorded three storms, slightly below the 1981-2010 average of four storms. Two of these storms – Hud Hud and Nilofar – became very severe cyclonic storms. On 12 October, Hud Hud crossed the east coast of India around Visakhapatnam with maximum sustained wind speeds of 47-50 m/s (170-180 km/hr).
- In the South West Indian Ocean basin, a total of eight storms formed between the start of the year and the middle of April. La Réunion and, to a lesser extent, Mauritius were affected by tropical cyclone Bejisa, the first cyclone of 2014 in that basin, and tropical cyclone Edilson in February. Tropical cyclone Hellen went through a process of rapid intensification and subsequent rapid decay in late March that was unlike anything previously seen in the basin. For the full season which started in 2013, nine storms formed, equal to the long-term average.
- The Australian basin experienced a slightly-below-average number of tropical storms in 2014. Eight tropical storms formed and of these, four made landfall as cyclones over Australia and one other as a tropical low. The most intense tropical cyclone to make landfall over Australia in the 2013-2014 season was severe tropical cyclone Ita which made landfall as a category 4 cyclone. The storm caused extensive damage to banana and sugar crops in the region. Ita also affected the Solomon Islands[24], with heavy rain causing flash flooding in the capital Honiara and across Guadalcanal Province. Almost 10% of the country's population was affected and at least 22 people were killed.
- In the South West Pacific basin, six storms formed in addition to those counted in the Australian region. The combined total of ten storms is slightly below the long-term average of twelve storms. Tropical Cyclone Ian made landfall in northern Tonga on 11 January. On the affected islands, around 50% of buildings were destroyed[25].

Greenhouse gases and ozone depleting substances

The latest analysis of observations by the WMO Global Atmosphere Watch Programme shows that atmospheric levels of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) reached new highs in 2013. Data for 2014 have not yet been processed.

[24] http://www.unocha.org/top-stories/all-stories/solomon-islands-worst-flooding-history
[25] http://www.unocha.org/top-stories/all-stories/tonga-tropical-cyclone-ian-strikes-tiny-pacific-nation

Globally-averaged atmospheric levels of CO_2 reached 396.0 ± 0.1 parts per million (ppm), approximately 142% of the pre-industrial average[26]. The increase from 2012 to 2013 was 2.9 ppm which is the largest year to year increase between 1984 and 2013. The overall increase in atmospheric CO_2 from 2003 to 2013 corresponds to around 45% of the CO_2 emitted by human activities. The remaining 55% is absorbed by the oceans and the terrestrial biosphere.

CH_4 concentrations in the atmosphere reached a new high of 1824 ± 2 parts per billion (ppb) in 2013. That is approximately 253% of the pre-industrial level[27]. Global concentrations of N_2O reached 325.9 ± 0.1 ppb which is 121% of the pre-industrial level[28].

NOAA's Annual Greenhouse Gas Index shows that from 1990 to 2013, radiative forcing by long-lived greenhouse gases increased by 34%. CO_2 alone accounted for 80% of the increase. The increase since pre-industrial times in the total radiative forcing by all long-lived greenhouse gases reached +2.9 Wm^{-2} in 2013 which corresponds to a CO_2-equivalent mixing ratio of 478 ppm.

Thanks to the Montreal Protocol, the use of ozone depleting gases, such as chlorofluorocarbons and halons, has been phased out. However, these compounds breakdown only slowly and will remain in the atmosphere for many decades. There is still enough chlorine and bromine present in the atmosphere to cause complete destruction of ozone at certain altitudes in Antarctica during the August to December ozone season. Because the abundance of ozone depleting gases changes only slowly, the size of the ozone hole in any particular year is largely determined by meteorological conditions. Conditions during the winter and spring of 2014 were similar to those observed in 2013. Analyses carried out at NASA and KNMI both show that the maximum area of the ozone hole in 2014 (24.06 million km^2 on 11 September and 23.0 million km^2 on 16 September, respectively) was similar to that of 2013 (24.01 million km^2 on 16 September and 23.1 million km^2 on 15 September, respectively).

[26] Pre-industrial CO2 concentration was 278 ± 2 ppm according to AR5 WG1 Section 2.2.1.1.1.
[27] Pre industrial CH4 concentration was 722 ± 25 ppb according to IPCC AR5 WG1 Section 2.2.1.1.2
[28] Pre industrial N2O concentration was 270 ± 7 ppb according to IPCC AR5 WG1 Section 2.2.1.1.3

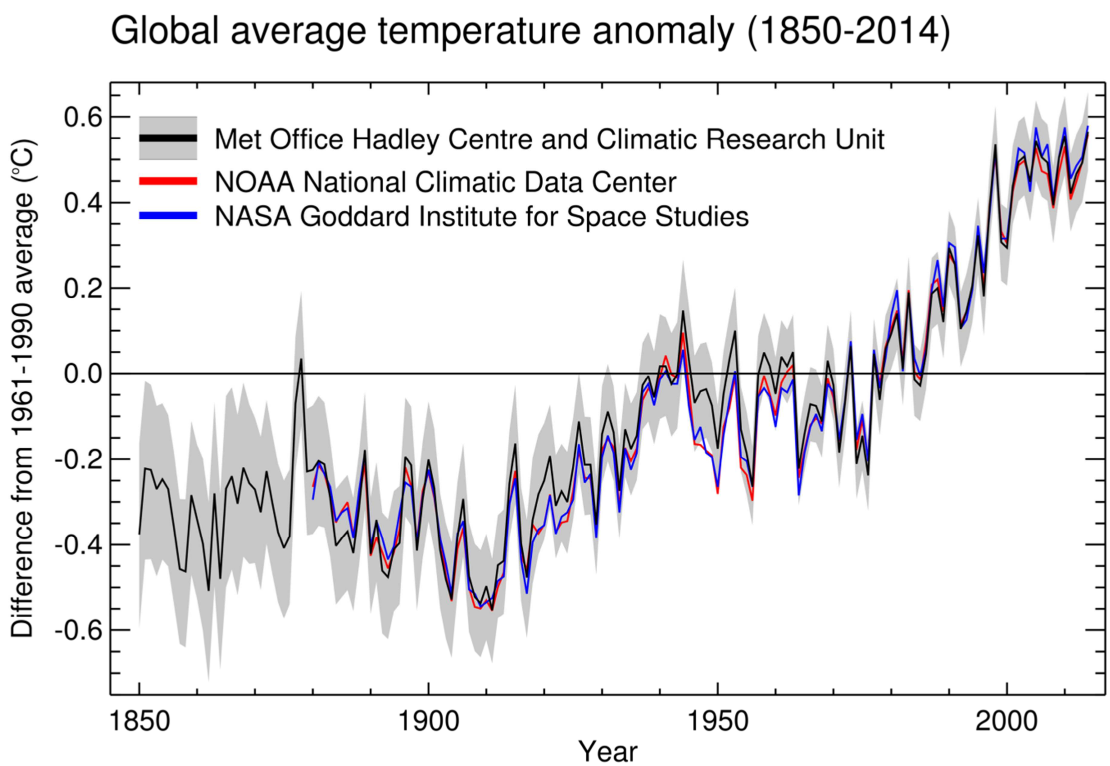

Figure 1: Global annual average temperature anomalies (relative to 1961-1990) for 1850-2013. The January to October average is shown for 2014. The black line and shaded area (which represent the median and 95% uncertainty range respectively) are from the HadCRUT.4.3.0.0 data set (produced in collaboration between the Met Office Hadley Centre and the Climatic Research Unit at the University of East Anglia). The blue line is from the GISTEMP analysis produced by the National Aeronautic and Space Administration Goddard Institute for Space Studies (NASA GISS). The red line is the Merged Land Ocean Surface Temperature data set (MLOST) produced by the National Atmospheric and Oceanic Administration National Climatic Data Center (NOAA NCDC).

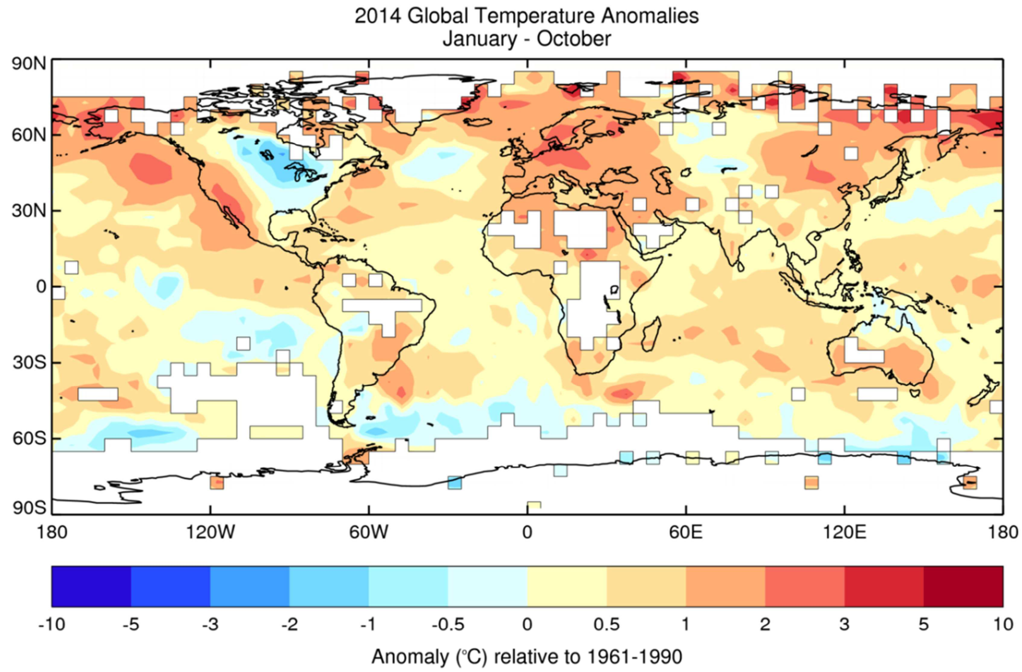

Figure 2: January to October 2014 average air temperature anomalies over land and sea-surface temperature anomalies over the oceans (relative to the 1961-1990 average) from the HadCRUT.4.3.0.0 data set. A grid cell average is calculated if there is at least one month of data for each quarter: January-March, April-June, July-September, October.

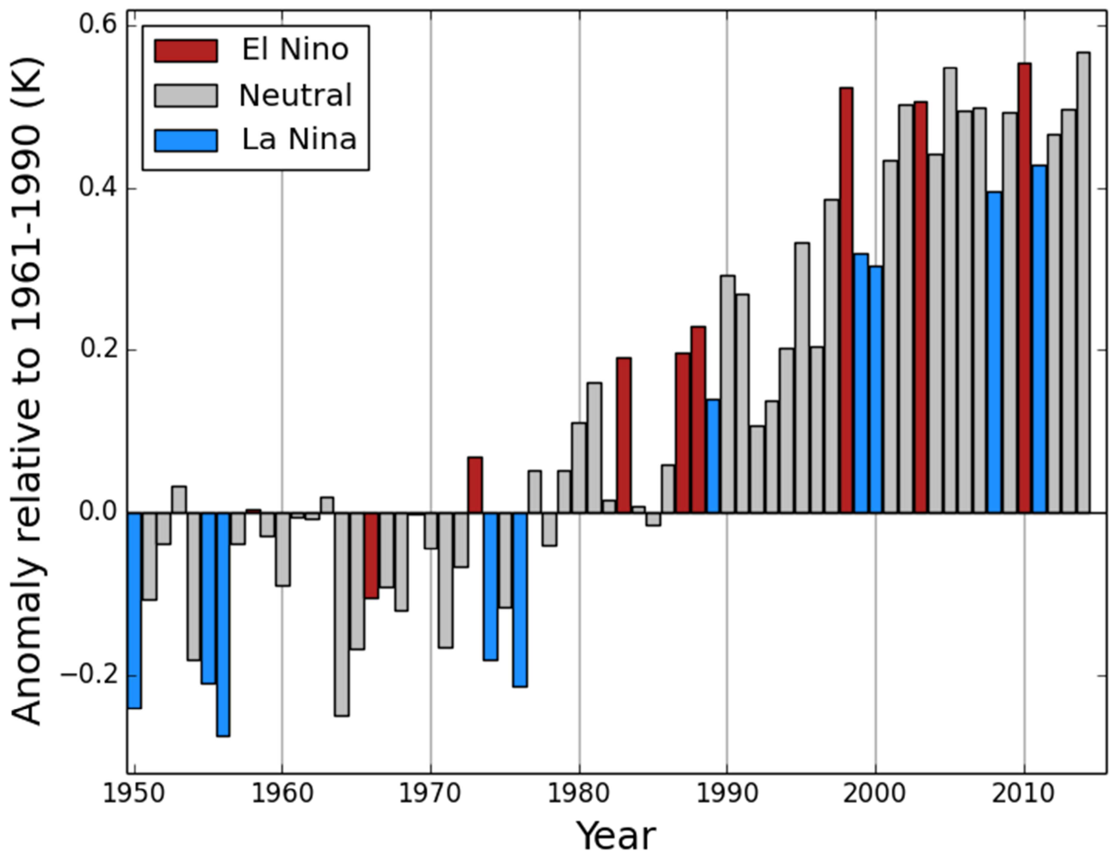

Figure 3: Global annual average temperature anomalies (relative to the 1961-1990 average) for 1950-2013, based on an average of the three data sets (GISTEMP, MLOST and HadCRUT.4.3.0.0). The January to October average is shown for 2014. The colouring of the bars indicates whether a year was classified as an El Niño year (red), an ENSO neutral year (grey) or a La Niña year (blue).

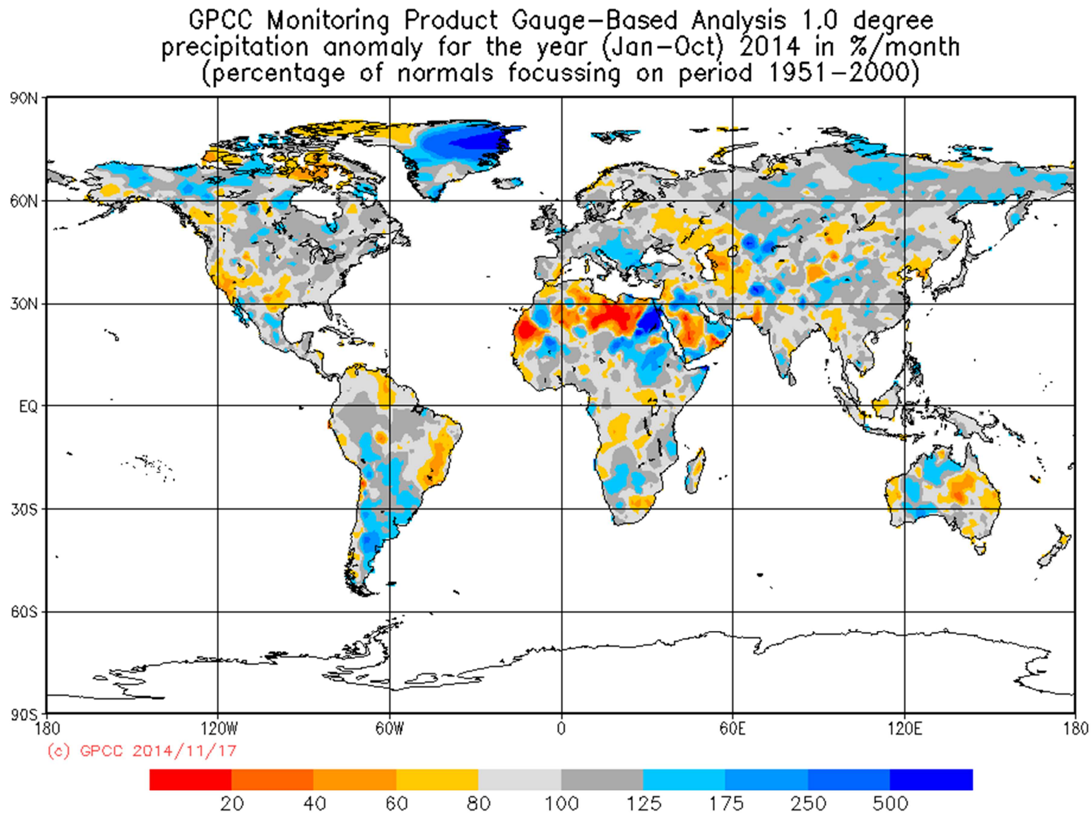

Figure 4: January to October 2014 precipitation totals expressed as a percentage of the 1951-2000 average. Data are from the Global Precipitation Climatology Centre (GPCC). A longer base line period is used than for temperature because precipitation anomalies are more variable than temperature anomalies.

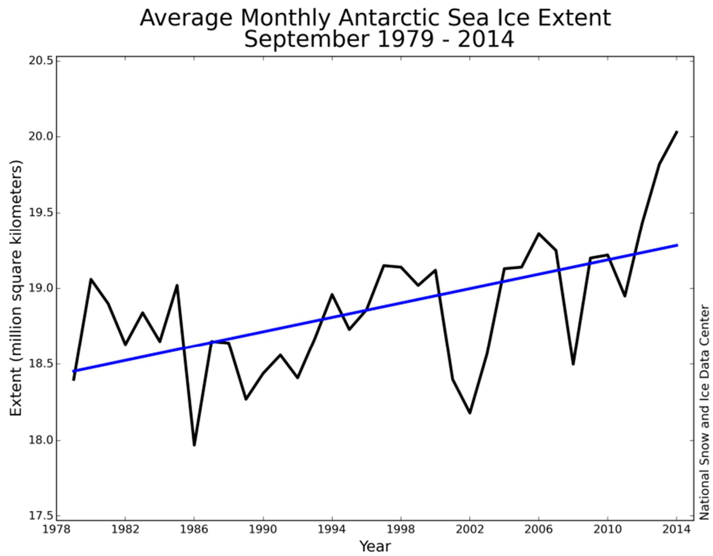

Figure 5: September Antarctic sea ice extent 1979-2014 measured in millions of square kilometres. Diagram is provided by the National Snow and Ice Data Center (NSIDC).

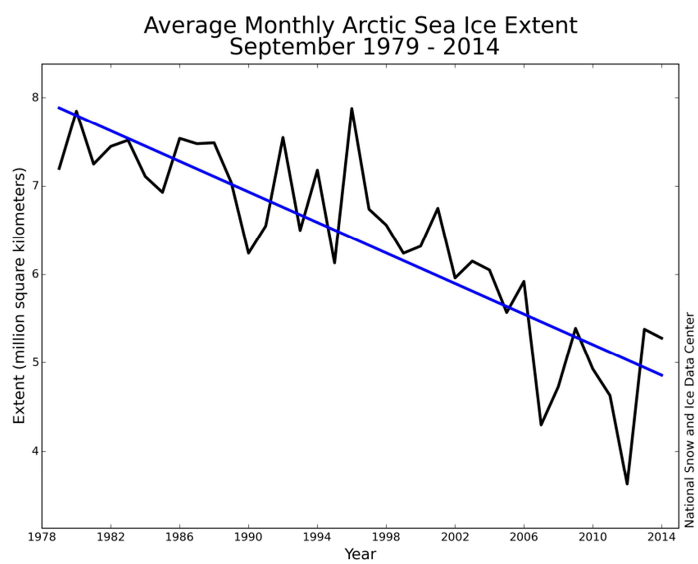

Figure 6: September Arctic sea ice extent 1979-2014 measured in millions of square kilometres. Diagram is provided by the National Snow and Ice Data Center (NSIDC).

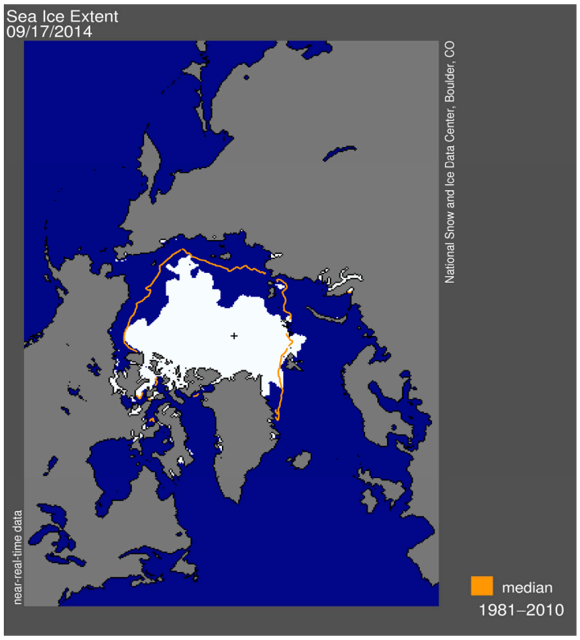

Figure 7. Arctic sea ice extent for September 17, 2014 was 5.02 million square kilometers (1.94 million square miles). The orange line shows the 1981 to 2010 average extent for that day. The black cross indicates the geographic North Pole. Credit: National Snow and Ice Data Center

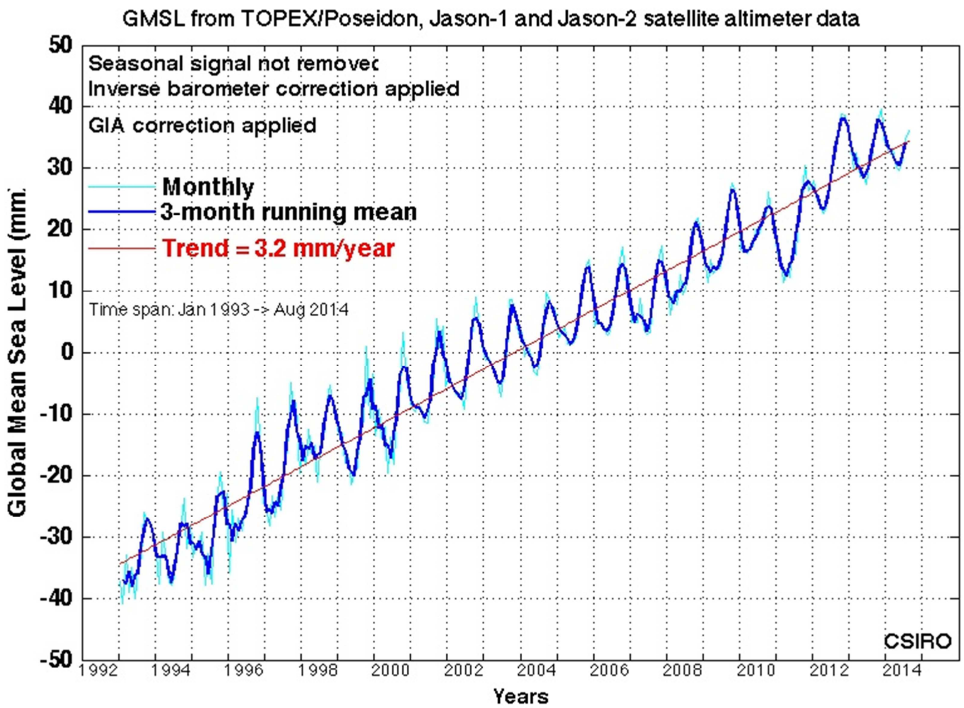

Figure 8: Global mean sea level as measured by the TOPEX/Poseidon, Jason-1 and Jason-2 altimeters. http://www.cmar.csiro.au/sealevel/sl_hist_last_15.html. Image provided by CSIRO.

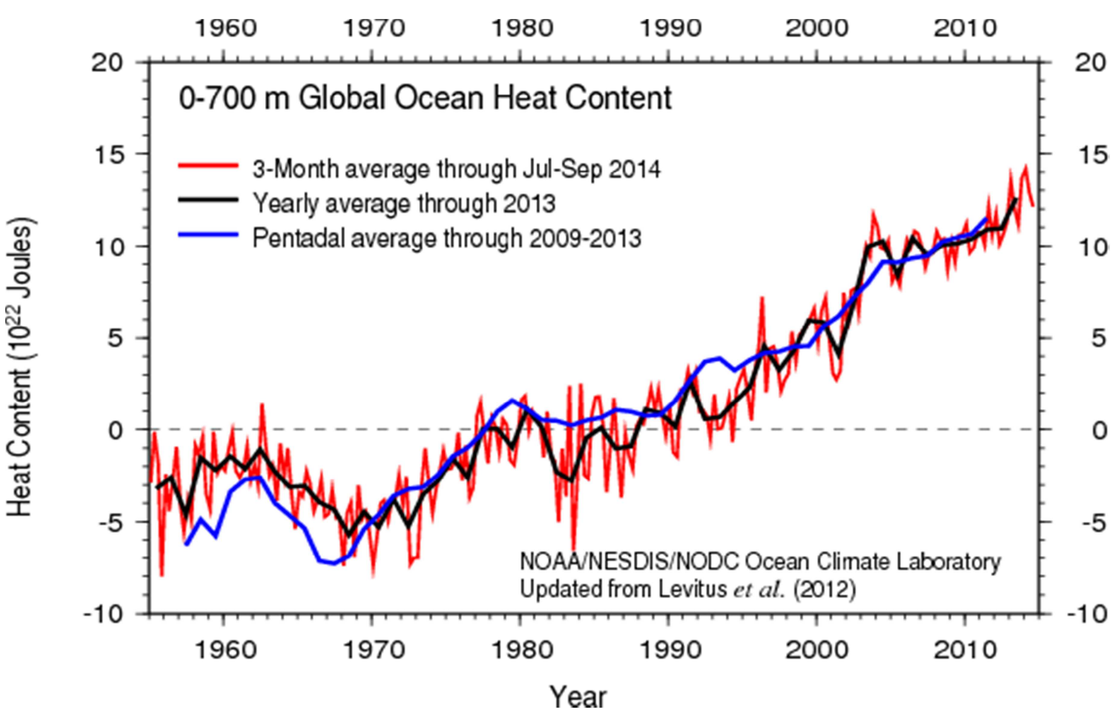

Figure 9: Global ocean heat content anomaly for the 0-700m layer from 1955 to 2014. The red line shows the three month average to July – September 2014. The black line shows the annual average to 2013 and the blue line shows the pentadal average. Figure is from NOAA/NESDIS/NODC http://www.nodc.noaa.gov/OC5/3M_HEAT_CONTENT/