State of the Climate
Global Analysis
June 2010

National Oceanic and Atmospheric Administration

National Climatic Data Center

Contents of this Section:

Global Highlights

- The combined global land and ocean average surface temperature for June 2010 was the warmest on record at 16.2°C (61.1°F), which is 0.68°C (1.22°F) above the 20th century average of 15.5°C (59.9°F). The previous record for June was set in 2005.
- June 2010 was the fourth consecutive warmest month on record (March, April, and May 2010 were also the warmest on record). This was the 304th consecutive month with a global temperature above the 20th century average. The last month with below-average temperature was February 1985.
- The June worldwide averaged land surface temperature was 1.07°C (1.93°F) above the 20th century average of 13.3°C (55.9°F)—the warmest on record.
- It was the warmest April–June (three-month period) on record for the global land and ocean temperature and the land-only temperature. The three-month period was the second warmest for the world's oceans, behind 1998.
- It was the warmest June and April–June on record for the Northern Hemisphere as a whole and all land areas of the Northern Hemisphere.
- It was the warmest January–June on record for the global land and ocean temperature. The worldwide land on average had its second warmest

January–June, behind 2007. The worldwide averaged ocean temperature was the second warmest January–June, behind 1998.

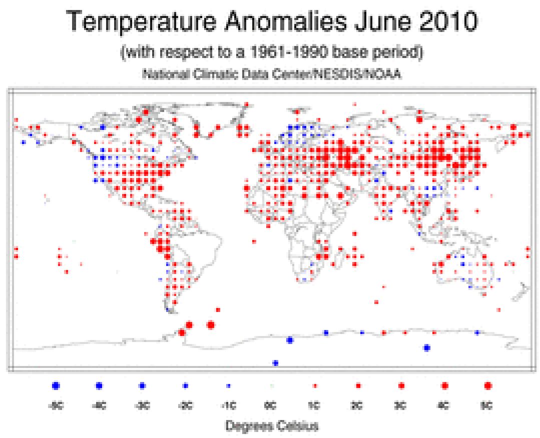
- Sea surface temperature (SST) anomalies in the central and eastern equatorial Pacific Ocean continued to decrease during June 2010. According to NOAA's Climate Prediction Center, La Niña conditions are likely to develop during the Northern Hemisphere summer 2010.

Please Note: The data presented in this report are preliminary. Ranks and anomalies may change as more complete data are received and processed. Effective with the **July 2009** State of the Climate Report, NCDC transitioned to the new version (version 3b) of the extended reconstructed sea surface temperature (ERSST) dataset. ERSST.v3b is an improved extended SST reconstruction over version 2. For more information about the differences between ERSST.v3b and ERSST.v2 and to access the most current data, please visit NCDC's Global Surface Temperature Anomalies page.

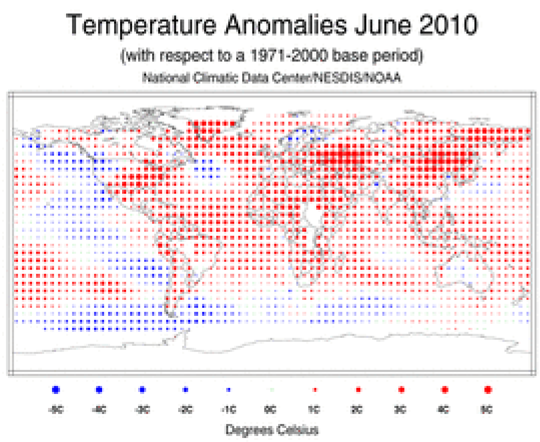
Introduction

Temperature anomalies for June 2010 are shown on the dot maps below. The dot map on the left provides a spatial representation of anomalies calculated from the Global Historical Climatology Network (GHCN) dataset of land surface stations using a 1961–1990 base period. The dot map on the right is a product of a merged land surface and sea surface temperature (SST) anomaly analysis developed by Smith et al. (2008). For the merged land surface and SST analysis, temperature anomalies with respect to the 1971–2000 average for land and ocean are analyzed separately and then merged to form the global analysis. For more information, please visit NCDC's Global Surface Temperature Anomalies page.

June



June Land Surface Temperature
Anomalies in degrees Celsius



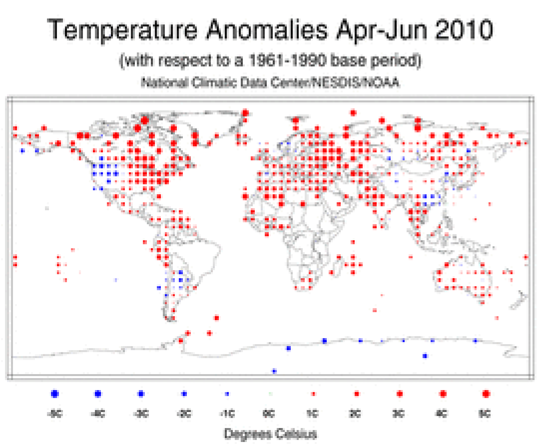
June Blended Land and Sea Surface
Temperature Anomalies in degrees Celsius

Warmer-than-average conditions dominated the globe during June 2010, with the most prominent warmth in Mexico, northern Africa, and most of Europe, Asia, South America, and the contiguous U.S. Cooler-than-average conditions were present across Scandinavia, southeastern China, and the northwestern contiguous U.S. The world land surface temperature June 2010 anomaly of 1.07°C (1.93°F) was the warmest on record, surpassing the previous June record set in 2005 by 0.12°C (0.22°F). The anomalous warm conditions that affected large portions of each inhabited continent also contributed to the warmest June worldwide land and ocean surface temperature since records began in 1880. The previous June record was set in 2005. Separately, the worldwide ocean surface temperatures during June 2010 were 0.54°C (0.97°F) above the 20th century average—the fourth warmest June on record. Warmer-than-average conditions were present across most of the Atlantic, Indian, and the western Pacific oceans. Meanwhile, cooler-than-average conditions were present across the eastern and equatorial Pacific Ocean, the southern oceans, and a small region in the northwestern Atlantic Ocean. Sea surface temperature (SST) anomalies were below average across the eastern and central equatorial Pacific, as temperatures continued to decrease during June 2010. SST anomalies in the Niño 3.4 region decreased to -0.43°C (-0.77°F), a cooling of 0.34°C (0.61°F) compared to May's anomaly. According to NOAA's Climate Prediction Center (CPC), La Niña conditions are likely to develop during the Northern Hemisphere summer 2010 as SSTs continue to decrease across the equatorial Pacific Ocean.

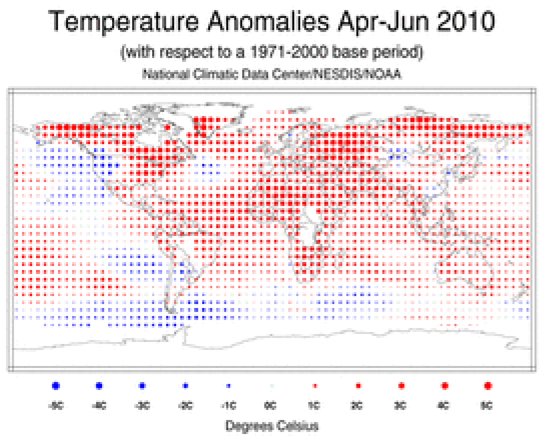
The June 2010 average temperature across China was 20.5°C (68.9°F), which is 1.0°C (1.8°F) above the 1971–2000 average. According to the Beijing Climate Center (BCC), Inner Mongolia, Heilongjiang, and Jilin (northeastern China) experienced their warmest June since national records began in 1951. Meanwhile, Guizhou (southern China) had its coolest June on record. On June 9th–11th and again on June 23rd–28th, northeastern China was engulfed by heat waves that brought scorching temperatures to the area. Heilongjiang and Jilin set new maximum number of hot days (defined as daily maximum temperatures greater or equal to 35°C [95°F]) records (BCC).

Spain's meteorological office (Agencia Estatal de Meteorología) reported that the country experienced normal-to-slightly above average temperatures during June 2010. Overall, Spain's nationwide average temperature was 0.4°C (0.7°F) above the 1971–2000 average—the coolest June since 1997.

Three-month (April–June)



April–June Land Surface Temperature Anomalies in degrees Celsius

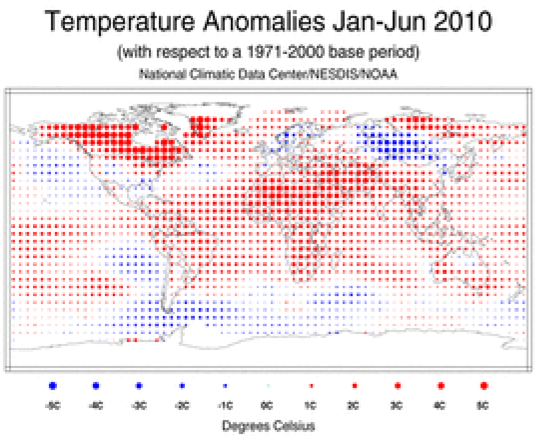


April–June Blended Land and Sea Surface
Temperature Anomalies in degrees Celsius

June 2010 was the fourth consecutive month with reported warmest averaged global land and ocean temperature on record (March, April, and May 2010 were also the warmest on record). When averaging the last three months, the combined global land and ocean surface temperature during April–June 2010 (three-month period) ranked as the warmest April–June on record, with an anomaly of 0.70°C (1.26°F) above the 20th century average. The previous April–June record was set in 1998, which had an anomaly of 0.66°C (1.19°F) above the 20th century average.

During this three-month period, warmer-than-average temperatures enveloped much of world's land surface, with the most notable warm anomalies in Canada, the eastern half of the contiguous U.S., northern Africa, and western Asia. The worldwide land surface temperature during April–June 2010 was 1.12°C (2.02°F) above the 20th century average—the warmest on record. This value surpassed the previous record of 1.02°C (1.84°F) set in 2005. Meanwhile, warmer-than-average temperatures were present across much of the world's oceans, with the exception of cooler-than-average conditions across parts of the southern oceans, the northeastern and southeastern Pacific Ocean, and the northeastern Atlantic Ocean. The worldwide average ocean surface temperature had an anomaly of 0.54°C (0.97°F) above the 20th century average—the second warmest April–June on record, behind 1998.

Year-to-date (January–June)



The January–June 2010 map of temperature anomalies shows that for the first half of the year anomalous warm temperatures were present over much of the world, with the exception of cooler-than-average conditions across the higher-latitude southern oceans, the northern Pacific Ocean, along the western South American coast, Mongolia, northeastern China, the south central and southeastern U.S., central Russia, and parts of Scandinavia. The combined global average land and ocean surface temperature for January–June period was the warmest such period on record. This value is 0.68°C (1.22°F) above the 20th century average. Separately, the average worldwide land surface temperature ranked as the second warmest on record, behind 2007, while the worldwide average ocean surface temperature ranked as the second warmest January–June on record—behind 1998.

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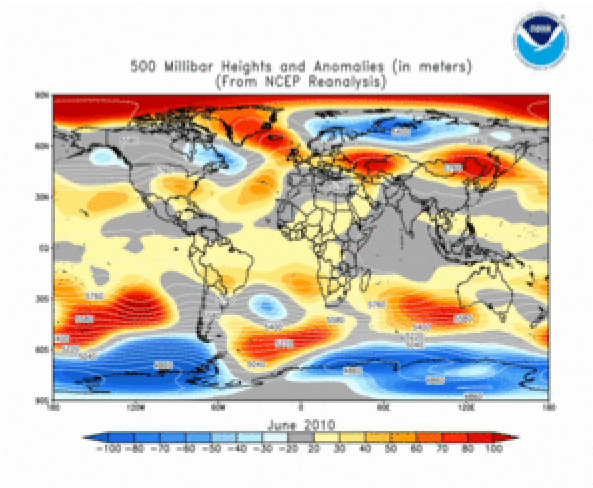
The average position of the upper-level ridges of high pressure and troughs of low pressure (depicted by positive and negative 500-millibar height anomalies on the 

June 2010 map, respectively) are generally reflected by areas of positive and negative temperature anomalies at the surface, respectively. For other Global products, please see the Climate Monitoring Global Products page.

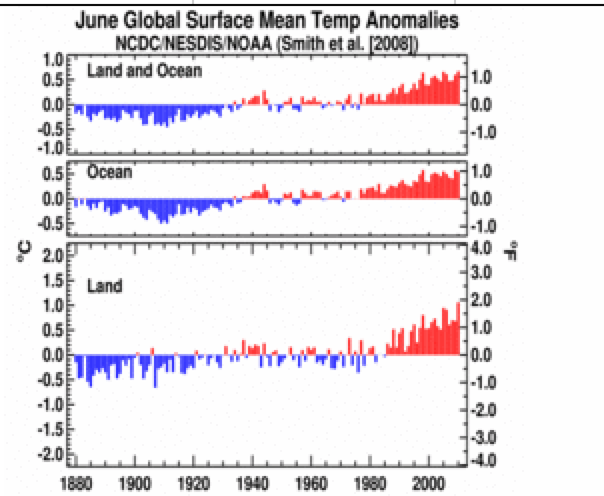
Images of sea surface temperature conditions are available for all weeks during 2009 from the weekly SST page.

Temperature Rankings and Graphics

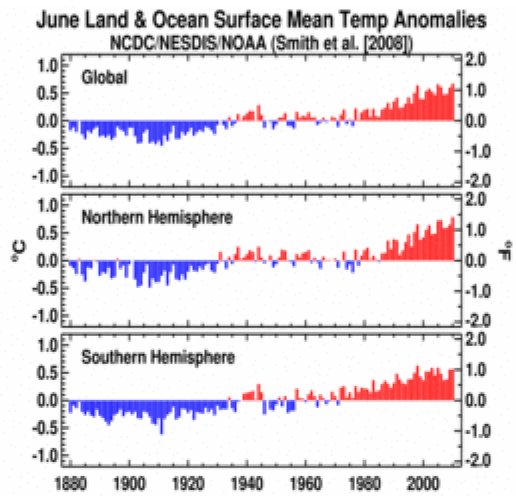
Current Month | Year-to-date

June	Anomaly	Rank (out of 131 years)	Warmest/Next Warmest Year on Record
Global			
Land	+1.07°C (+1.93°F)	1st warmest	2005 (+0.95°C/1.71°F)
Ocean	+0.54°C (+0.97°F)	4th warmest	1998 (+0.58°C/1.04°F)
Land and Ocean	+0.68°C (+1.22°F)	1st warmest	2005 (+0.66°C/1.19°F)
Northern Hemisphere			

Land	+1.22°C (+2.20°F)	1st warmest	2006 (+1.11°C/2.00°F)
Ocean	+0.54°C (+0.97°F)	4th warmest	2009 (+0.62°C/1.12°F)
Land and Ocean	+0.79°C (+1.42°F)	1st warmest	2006 (+0.73°C/1.31°F)
Southern Hemisphere			
Land	+0.66°C (+1.19°F)	5th warmest	2005 (+1.03°C/1.85°F)
Ocean	+0.55°C (+0.99°F)	2nd warmest	1998 (+0.60°C/1.08°F)
Land and Ocean	+0.56°C (+1.01°F)	4th warmest	1998 (+0.63°C/1.13°F)



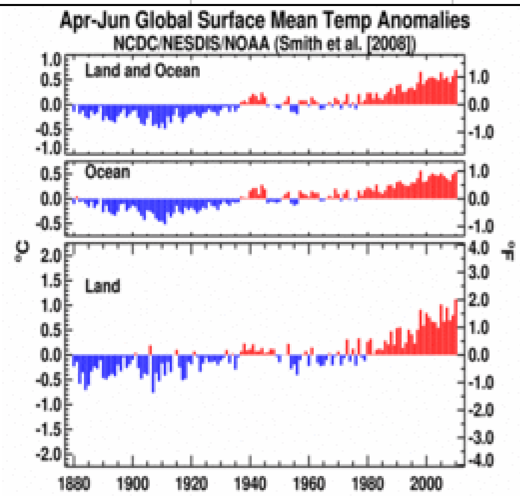
June Global Land and Ocean plot



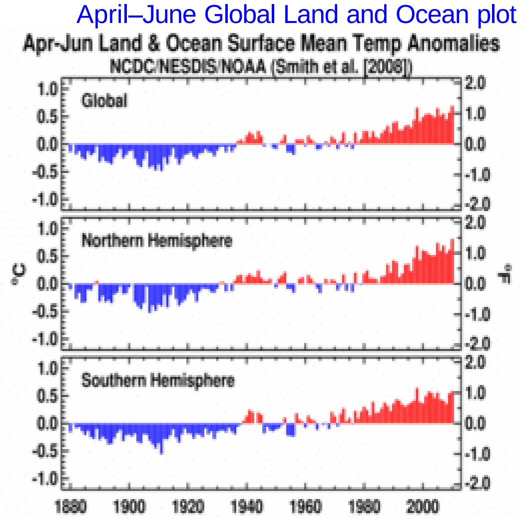
June Global Hemisphere plot

April - June	Anomaly	Rank (out of 131 years)	Warmest/Next Warmest Year on Record
Global			
Land	+1.12°C (+2.02°F)	1st warmest	2005 (+1.02°C/1.84°F)
Ocean	+0.54°C (+0.97°F)	2nd warmest	1998 (+0.56°C/1.01°F)
Land and Ocean	+0.70°C (+1.26°F)	1st warmest	1998 (+0.66°C/1.19°F)
Northern Hemisphere			
Land	+1.25°C (+2.25°F)	1st warmest	2007 (+1.16°C/2.09°F)
Ocean	+0.55°C (+0.99°F)	2nd warmest	2005 (+0.56°C/1.01°F)
Land and Ocean	+0.81°C (+1.46°F)	1st warmest	2005 (+0.74°C/1.33°F)
Southern Hemisphere			

Land	+0.78°C (+1.40°F)	3rd warmest	2005 (+0.98°C/1.76°F)
Ocean	+0.56°C (+1.01°F)	2nd warmest	1998 (+0.61°C/1.10°F)
Land and Ocean	+0.58°C (+1.04°F)	2nd warmest	1998 (+0.64°C/1.15°F)



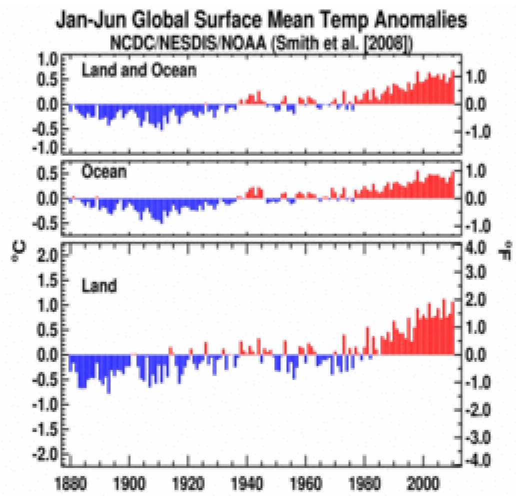
April–June Global Land and Ocean plot



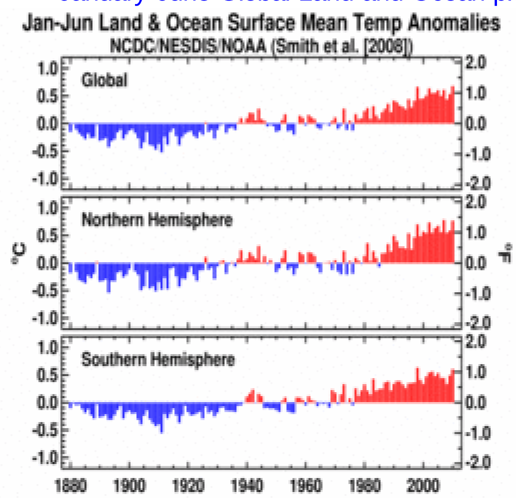
April–June Global Hemisphere plot

January - June	Anomaly	Rank (out of 131 years)	Warmest/Next Warmest Year on Record
Global			

Land	+1.07°C (+1.93°F)	2nd warmest	2007 (+1.12°C/2.02°F)
Ocean	+0.54°C (+0.97°F)	2nd warmest	1998 (+0.56°C/1.01°F)
Land and Ocean	+0.68°C (+1.22°F)	1st warmest	1998 (+0.66°C/1.19°F)
Northern Hemisphere			
Land	+1.15°C (+2.07°F)	3rd warmest	2007 (+1.34°C/2.41°F)
Ocean	+0.53°C (+0.95°F)	1st warmest	1998 (+0.52°C/0.94°F)
Land and Ocean	+0.77°C (+1.39°F)	2nd warmest	2007 (+0.78°C/1.40°F)
Southern Hemisphere			
Land	+0.86°C (+1.55°F)	2nd warmest	2005 (+0.90°C/1.62°F)
Ocean	+0.56°C (+1.01°F)	2nd warmest	1998 (+0.60°C/1.08°F)
Land and Ocean	+0.60°C (+1.08°F)	2nd warmest	1998 (+0.63°C/1.13°F)



January-June Global Land and Ocean plot



January-June Global Hemisphere plot

The most current data may be accessed via the Global Surface Temperature Anomalies page.

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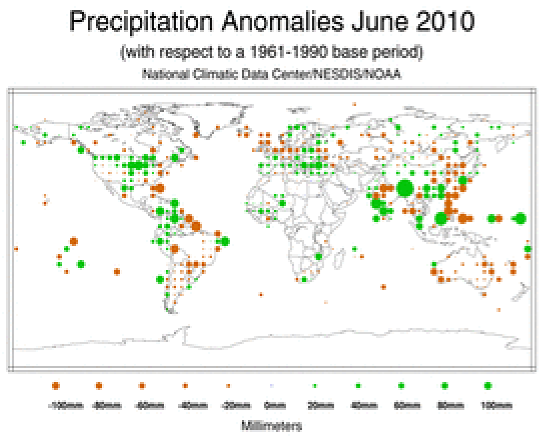
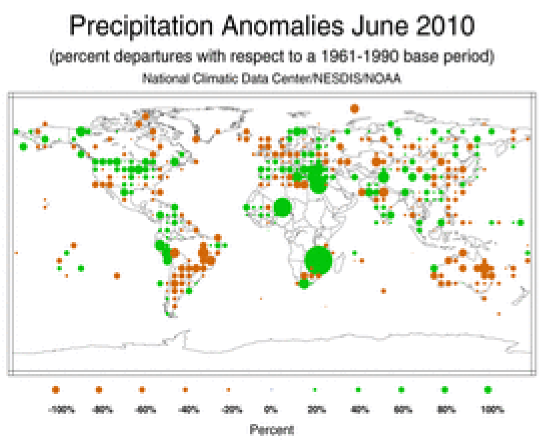
Precipitation

The maps below represent anomaly values based on the GHCN dataset of land surface stations using a base period of 1961–1990. Precipitation anomalies on a month-to-month basis are often highly variable across the globe and even within regions. The areas with the wettest anomalies during June 2010 included southern India, southern China, southern Europe, the midwestern contiguous U.S., and parts of northwestern South America. The driest anomalies were present across northern India and across parts eastern Asia, northeastern South America, and Australia.



June 2010 Precipitation Anomalies in Millimeters



June 2010 Precipitation Percent Departures

According to the Beijing Climate Center (BCC), the provinces of Guizhou, Fujian, and Qinghai had above-average precipitation during June 2010, ranking as the second wettest June since national records began in 1951. The BCC also reported that ten provinces in southern China were affected by storms that brought heavy rainfall across the area—resulting in record breaking daily rainfall in some places of Jiangxi and Fujian. The copious rainfall prompted floods that killed nearly 200 people. Meanwhile, the province of Jiangsu had its driest June on record, while Shanxi had its second driest on record. Overall, the monthly averaged precipitation in China during June 2010, 95.0 mm (3.7 inches), was near the 1971–2000 average.

According to the German Meteorological Service (Deutscher Wetterdienst), the monthly averaged precipitation across Germany was 48.8 mm (1.9 inches), which is 35.8 mm (1.4 inches) below average. The nationally-averaged precipitation value ranks as the seventh driest June since 1901.

Most of Australia experienced below-average precipitation during June 2010, according to Australia's Bureau of Meteorology (BoM). The monthly averaged precipitation for June 2010 was 11.2 mm (0.4 inch), which is 52 percent below the 1961–1990 average—the fourth driest June since national records began in 1900 and the driest June since 1984. The BoM reported that all states and territories experienced drier-than-average conditions, with less than five percent of the country receiving its mean monthly precipitation for June.

According to New Zealand's National Institute of Water and Atmospheric Research (NIWA), June 2010 was a very wet month in most regions of the country, with Marlborough and parts of Waikato and Bay of Plenty receiving double their average June rainfall. NIWA reported that Whakatane and Blenheim had their wettest June since records began in 1952 and 1927, respectively.

The first six months of 2010 were the second driest on record and the driest since 1929 for the United Kingdom as a whole, according to the United Kingdom Met Office. The average rainfall during January–June 2010 was 362.5 mm (14.3 inches), which is 86.8 mm (3.4 inches) above January–June 1929. The January–June long-term average is 511.7 mm (20.1 inches).

Additional details on flooding and drought can also be found on the June 2010 Global Hazards page.

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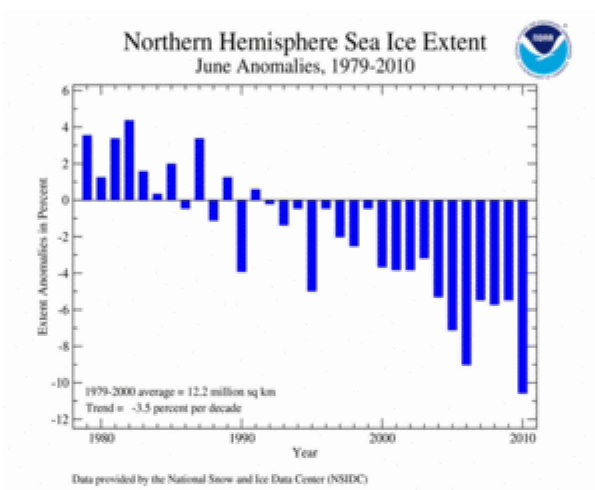
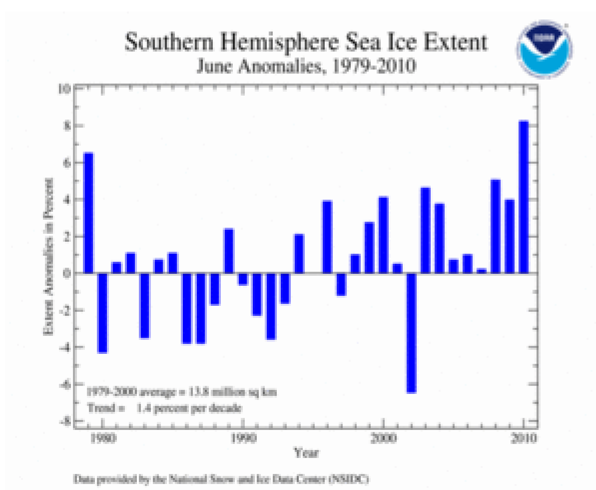
Sea Ice Extent



June's Northern Hemisphere
Sea Ice Extent plot

Arctic sea ice continued its annual decline, typically reaching a September minimum. Similar to May 2010, the Arctic sea ice continued to decline at a record rapid rate—the fastest measured for June (more than 50 percent greater than average). The previous record for the fastest decline rate in June was set in 1999. According to the National Snow and Ice Data Center (NSIDC), June 2010 Arctic sea ice extent was 10.9 million square kilometers (10.6 percent or 1.29 million square kilometers below the 1979–2000 average), resulting in the lowest June sea ice extent since records began in 1979—the previous June record low was set in 2006. This was also the 19th consecutive June with below-average Arctic sea ice extent. It was reported that sea ice was below average everywhere with the exception of the East Greenland Sea, where sea ice extent was near average. June Arctic sea ice extent has decreased at an average rate of 3.5 percent per decade. Of note, the Arctic dipole (DA) anomaly—an atmospheric pressure pattern—was present during June 2010 (similar to 2007—which had record low September sea ice extent).

According to the NSIDC, the DA contributed to the record low sea ice extent observed in September 2007. One of the DA's characteristics is an unusual high pressure over the northern Beaufort Sea (located north of Alaska and northern Canada) and an unusual low pressure over Kara Sea (located north of Siberia). The imbalance in pressure causes winds to blow from the south along the Siberian coast, moving the ice away from the coast, favoring melt. Northerly winds in the Fram Strait region help move the ice out of the Arctic Ocean into the warmer ocean waters of the northern Atlantic. The DA may also favor the import of warm ocean waters from the northern Pacific that will accelerate ice melt.



June's Southern Hemisphere
Sea Ice Extent plot

As the Arctic sea ice extent contracts (during the Northern Hemisphere warm season), the Antarctic sea ice extent expands (during the Southern Hemisphere cold season). During June 2010, the Southern Hemisphere sea ice extent reached its largest extent on record for June, 8.3 percent above the 1979–2000 average. This is the eighth consecutive June with above-average Southern Hemisphere sea ice extent. Southern Hemisphere sea ice extent for June has increased at an average rate of 1.4 percent per decade.

For further information on the Northern and Southern Hemisphere snow and ice conditions, please visit the NSIDC News page, provided by NOAA's National Snow and Ice Data Center (NSIDC).

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Troposphere

Temperatures above the Earth's surface are measured within the lower troposphere, middle troposphere, and stratosphere using in-situ balloon-borne instruments (radiosondes) and polar-orbiting satellites (NOAA's TIROS-N). The radiosonde and satellite records have been adjusted to remove time-dependent biases (artificialities caused by changes in radiosonde instruments and measurement practices as well as changes in satellite instruments and orbital features through time). Global averages from radiosonde data are available from 1958 to present, while satellite measurements date back to 1979.

Lower Troposphere

Current Month | Year-to-date

These temperatures are for the lowest 8 km (5 miles) of the atmosphere. Information on the University of Alabama in Huntsville (UAH) and Remote Sensing Systems (RSS) sources of troposphere data is available.

June	Anomaly	Rank (out of 32 years)	Warmest (or Next Warmest) Year on Record	Trend
UAH	+0.44°C/+0.79°F	2nd warmest	1998 (+0.57°C/+1.03°F)	+0.10°C/decade

low-trop				
RSS low-trop	+0.54°C/+0.96°F	2nd warmest	1998 (+0.57°C/+1.02°F)	+0.14°C/decade

January-June	Anomaly	Rank (out of 32 years)	Warmest (or Next Warmest) Year on Record	Trend
UAH low-trop	+0.56°C/+1.01°F	2nd warmest	1998 (+0.64°C/+1.15°F)	+0.13°C/decade
RSS low-trop	+0.59°C/+1.06°F	2nd warmest	1998 (+0.66°C/+1.19°F)	+0.16°C/decade

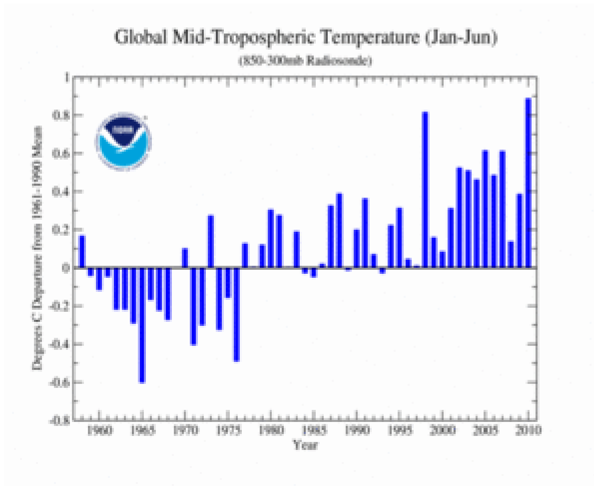
Mid-troposphere

Current Month | Year-to-date

These temperatures are for the atmospheric layer centered in the mid-troposphere (approximately 3–10 km [2–6 miles] above the Earth's surface), which also includes a portion of the lower stratosphere. (The Microwave Sounding Unit [MSU] channel used to measure mid-tropospheric temperatures receives about 25 percent of its signal above 10 km [6 miles].) Because the stratosphere has cooled due to increasing greenhouse gases in the troposphere and losses of ozone in the stratosphere, the stratospheric contribution to the tropospheric average, as measured from satellites, may create an artificial component of cooling to the mid-troposphere temperatures. The University of Washington (UW) versions of the UAH and RSS analyses attempt to remove the stratospheric influence from the mid-troposphere measurements, and as a result the UW versions tend to have a larger warming trend than either the UAH or RSS versions. For additional information, please see NCDC's Microwave Sounding Unit page.

The radiosonde data used in this global analysis were developed using the Lanzante, Klein, Seidel (2003) ("LKS") bias-adjusted dataset and the First Difference Method (Free et al. 2004) (RATPAC). Additional details are available.

Satellite data have been adjusted by the Global Hydrology and Climate Center at the University of Alabama in Huntsville (UAH). An independent analysis is also performed by Remote Sensing Systems (RSS) and a third analysis has been performed by Dr. Qiang Fu of the University of Washington (UW) (Fu et al. 2004) to remove the influence of the stratosphere on the mid-troposphere value. Global averages from radiosonde data are available from 1958 to present, while satellite measurements began in 1979.



RATPAC January-June plot

Radiosonde measurements indicate that, for the January-June year-to-date period, temperatures in the mid-troposphere were 0.89°C (1.60°F) above average, resulting in the warmest January–June (out of 53 years) since global radiosonde measurements began in 1958. Meanwhile, satellite analyses of the January–June year-to-date period for the middle troposphere were second warmest in the 32-year satellite record, behind 1998.

The global mid-troposphere temperatures were above average during June 2010. As shown in the table below, satellite measurements for June 2010 ranked second warmest on record for all sources.

June	Anomaly	Rank (out of 32 years)	Warmest (or Next Warmest) Year on Record	Trend
UAH	+0.35°C/+0.63°F	2nd warmest	1998 (+0.52°C/+0.94°F)	+0.03°C/decade

mid-trop				
RSS mid-trop	+0.37°C/+0.67°F	2nd warmest	1998 (+0.56°C/+1.00°F)	+0.07°C/decade
UW-UAH mid-trop	+0.45°C/+0.80°F	2nd warmest	1998 (+0.64°C/+1.15°F)	+0.08°C/decade
UW-RSS mid-trop	+0.46°C/+0.82°F	2nd warmest	1998 (+0.66°C/+1.19°F)	+0.12°C/decade

January–June	Anomaly	Rank (out of 32 years)	Warmest (or Next Warmest) Year on Record	Trend
UAH mid-trop	+0.40°C/+0.72°F	2nd warmest	1998 (+0.59°C/+1.06°F)	+0.04°C/decade
RSS mid-trop	+0.46°C/+0.83°F	2nd warmest	1998 (+0.62°C/+1.12°F)	+0.09°C/decade
UW-UAH mid-trop	+0.51°C/+0.92°F	2nd warmest	1998 (+0.71°C/+1.28°F)	+0.09°C/decade
UW-RSS mid-trop	+0.57°C/+1.03°F	2nd warmest	1998 (+0.73°C/+1.31°F)	+0.15°C/decade
RATPAC*	+0.89°C/+1.60°F	warmest	1998 (+0.82°C/+1.48°F)	+0.15°C/decade

*RATPAC's rank is based on records that began in 1958 (53 years).

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Stratosphere

Current Month

The table below summarizes stratospheric conditions for June 2010. On average, the stratosphere is located approximately 16–23 km (10–14 miles) above the Earth's surface. Over the last decade, stratospheric temperatures have been below average in part due to the depletion of ozone. The large positive anomaly in 1982 was caused by the volcanic eruption of El Chichon in Mexico, and the sharp jump in temperature in 1991 was a result of the eruption of Mt. Pinatubo in the Philippines. In both cases the temperatures returned to pre-eruption levels within two years.

June	Anomaly	Rank (out of 32 years)	Coolest Year on Record
UAH stratosphere	-0.33°C (-0.59°F)	13th coolest	1996 (-0.69°C/-1.24°F)
RSS stratosphere	-0.23°C (-0.41°F)	13th coolest	1996 (-0.61°C/-1.10°F)

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For additional details on precipitation and temperatures in June, see the Global Hazards page.

References

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