



WMO Provisional Statement on Status of the Climate in 2013

Global Temperatures in 2013

A preliminary assessment of global temperatures during the first nine months of 2013 indicates that this year will likely be among the 10 warmest years since global records began in 1850. For the year to date, January–September 2013 ties with 2003 as the seventh warmest such period on record, with a global land and ocean surface temperature that was $0.48^{\circ}\text{C} \pm 0.12^{\circ}\text{C}$ ($0.86^{\circ}\text{F} \pm 0.22^{\circ}\text{F}$) above the 1961–1990 average and equal to the most recent 2001–2010 decadal average. This is also higher than both 2011 and 2012, which were 0.44°C and 0.46°C above average, respectively, when La Niña conditions had a cooling influence over the global temperature.

Neither La Niña nor El Niño conditions were present during the 2013 period to date; ENSO-neutral conditions have prevailed since April 2012, with September marking the 17th consecutive month with these conditions, the longest stretch of neutral conditions since 1992–1994, when similar conditions prevailed for 26 consecutive months according to NOAA's Climate Prediction Center.

The warmest complete year on record is 2010 with a temperature anomaly of $+0.56 \pm 0.09^{\circ}\text{C}$, closely followed by 2005 and 1998 with global temperature anomalies of $+0.55 \pm 0.09^{\circ}\text{C}$ and $+0.52 \pm 0.09^{\circ}\text{C}$, respectively. El Niño conditions dominated the early periods of 2010 and 1998. Weak El Niño-type conditions extended as well from 2004 to the first half of 2005. Currently, it is expected that ENSO-neutral conditions will continue through the remainder of 2013.

Global average temperatures for 2013 are also estimated using data from reanalysis which uses a Numerical Weather Prediction model to optimally combine observations and are typically consistent with the observations. According to reanalysis data from the European Centre for Medium-Range Weather Forecasts (ECMWF), the January–September 2013 global land and ocean temperature anomaly is the seventh highest for this period, with records dating back to 1958.

With ENSO-neutral conditions prevailing and exceptional warmth observed around the oceans south of Australia and the equatorial western Pacific Ocean, the global ocean surface temperature for January–September 2013 was the highest since 2010, tying with 2004 as the sixth warmest on record, at 0.35°C above the 1961–1990 average and close to the most recent 2001–2010 average.

Across the world's land surfaces, the January–September global temperature was 0.80°C above the 1961–1990 average and close to the 2001–2010 average. This ties with 2012 as the sixth warmest for the period on record although geographically the anomalous warmth was distributed differently around the world. In contrast with 2012, when the United States, in particular, observed record high annual temperatures, the warmth in 2013 was most extreme on the other side of the world in Australia.

The Arctic Oscillation was a major driver of weather patterns during early 2013 across the Northern Hemisphere, bringing cooler-than-average spring temperatures to much of Europe, the south-east United States, north-west Russia, and parts of Japan. The Arctic region in contrast was considerably warmer than average, along with much of central and northern Africa, the eastern Mediterranean, southern Russia, and much of China. This so-called warm Arctic-cold continents pattern is characteristic of the negative phase of the Arctic Oscillation, which had several exceptionally negative values during the first half of spring. During March 2013, the most negative Arctic Oscillation on record for this month and the most negative since the record value of February 2010 repeatedly contributed to frigid polar air outbreaks to parts of Europe and the south-east United States. A similar pressure pattern with high pressure over Greenland and low pressure to the south re-emerged in late spring, once again causing cold Arctic air to flow to western and central Europe.

Arctic Sea Ice

Arctic sea ice acts as an insulator between the ocean and polar atmosphere and helps modulate global climate. In response to rising air temperatures, sea ice melt creates a positive feedback loop: as sea ice has a bright surface, up to 70 per cent of the incoming solar radiation is reflected back into the atmosphere — even more when sea ice is snow covered. Melting sea ice exposes the dark ocean surface. Instead of reflecting 70 per cent of the sunlight, the ocean absorbs 90 per cent of the sunlight. As a consequence, the ocean heats up and Arctic temperatures rise further, and hence more ice melts. The decline of sea ice in the Arctic Ocean in the past three decades is largely attributed to global warming.

The Arctic sea ice expands during the Northern Hemisphere cold season, reaching a maximum areal extent in March, and then melts during the Northern Hemisphere warm season, reaching a minimum in September. In 2013, during the growth season, Arctic sea ice extent reached its annual maximum on 15 March at 15.13 million square kilometers according to the National Snow and Ice Data Center (NSIDC). This was approximately 0.5 million square kilometers below the 1981–2010 March annual maximum average and the sixth smallest maximum sea ice extent since satellite records began in 1979. During the entire 2012/13 growth season, Arctic sea ice extent grew by a record-large 11.7 million square kilometers. This growth can be explained by the large variation in the sea ice extent from the record small sea ice extent at the end the melt season in September 2012 to the large amounts of first-year ice forming through the growing season ending in March 2013. According to the University of Colorado-Boulder (USA), for the peak in March, ice four years of age and older has decreased from 18 per cent of the ice cover in 1984 to 3 per cent in 2013. In March 1984, 56 per cent of the peak ice pack was composed of first-year ice. In March 2013, first-year ice comprised 78 per cent of total ice cover. Overall, March Arctic sea ice extent is decreasing at an average rate of 2.6 per cent per decade.

The Arctic reached its lowest sea ice extent in its annual cycle on 13 September, at 5.10 million square kilometers, marking the sixth smallest extent on record. This value was 18 per cent, or nearly 1.1 million square kilometers, below the 1981–2010 average minimum and notably higher than the record low of 3.41 million square kilometers, recorded last year on 16 September 2012. During June–August 2013, lower-than-average pressure dominated over much of the Arctic Ocean, which limited heat transport from the south and brought more cloud cover, contributing to lower temperatures

compared to the previous year. The winds associated with the low pressure also caused the ice cover to spread out and cover a larger area. Thus the summer melt was less than the past three years. Since the beginning of satellite measurements, the decade 2001–2010 has seen the greatest average annual melting of Arctic sea ice on record and all seven of the lowest Arctic sea ice extents have occurred in the last seven years, since 2007. September Arctic sea ice extent is decreasing at an average rate of 13.7 per cent per decade. It is also noted that while the minimum September 2013 extent was larger than the record low in September 2012, estimates by the University of Washington (USA) Polar Science Center show that the total minimum ice volume in the Arctic Ocean in 2013 was higher than in 2010, 2011, and 2012 but lower than in 2007 and well below the 1979–2012 average.

Greenland Ice Sheet

Ice sheets contain approximately 70 per cent of the planet's frozen water. If the Greenland Ice Sheet melted, scientists estimate that sea level would rise about six meters. Recent studies using a combination of techniques confirmed the mass of ice in the Greenland Ice Sheet has begun to decline since mid-1900s. At higher elevations, an increase in winter snow accumulation has partially offset the melt. However, the decline continues to outpace accumulation because warmer temperatures have led to increased melt and faster glacier movement at the island's edges. The decade of 2001–2010 experienced accelerated melting of the Greenland ice sheet and can be described as the period in which the trend towards mass loss resulted in consistently negative mass balance for Greenland, with the largest losses observed in 2007 and 2008. 2012 set a new record for Greenland surface melt. In 2013, the overall state of Greenland ice sheet shows a surface melt not as dramatic as in 2012, with mild melt duration in the summer season.

The estimated area of Greenland where the surface ice is melting reached a peak in late July with 44 per cent of surface melt, coinciding with a period of very warm weather. During this period, strong southerly winds brought record warmth to southwestern Greenland. On 30 July, Maniisq recorded a temperature of 25.9°C, the highest air temperature ever observed in Greenland.

Antarctic Sea Ice

In the Southern Hemisphere, Antarctic sea ice expands during the cold season, reaching a maximum sea ice extent in September, and then melts during the warm season, reaching a minimum sea ice extent in February / March.

For the second year in a row, Antarctic sea ice extent reached a record maximum sea ice extent. On 22 September 2013, sea ice extent was 19.47 million square kilometers according to NSIDC. This is approximately 30,000 kilometers larger than the previous record set in 2012, and is 2.6 per cent higher than the 1981–2010 average.

September Antarctic sea ice extent is increasing at an average rate of 1.1 per cent per decade. The changes in the atmospheric circulation observed in the past three decades, which resulted in changes in the prevailing winds around Antarctica, are considered by scientists as factors related to this increase. However, it is possible that this increase is due to a combination of factors that also include effects of changing ocean circulation.

Antarctica differs from the Arctic in that the Arctic is comprised of water surrounded by land. Conversely, the Antarctic is comprised of land surrounded by open ocean water.

Annular wind patterns and circumpolar ocean currents tend to isolate Antarctica from global weather patterns, keeping it cold.

Sea Level Rise

Global sea level reached a new record high during March 2013. Sea level has been rising at an average rate of 3.2 ± 0.4 mm/yr with inter-annual variability since altimeter satellite measurements began in 1993. This is close to the observed rate of about 3 mm/yr of the most recent decade of 2001–2010 and double the observed 20th century trend of 1.6 mm/yr.

2012 State of the Greenhouse Gases in the Atmosphere

The globally averaged mole fractions of carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) reached new highs in 2012. The globally averaged CO₂ mole fraction in 2012 reached 393.1 ± 0.1 ppm, marking a 41 per cent increase relative to the pre-industrial level of 278 ppm. The annual increase from 2011 to 2012 was 2.2 ppm. More information on other GHG components are available in the WMO Greenhouse Gas bulletin.³

Regional Temperatures

During the first nine months of 2013, above average temperatures were present across most of the world's land areas, perhaps most notably in Australia, along with ocean waters to the south and south-east of Australia, as well much of northern North America, the northeastern Pacific Ocean and part of the coastal north-east Atlantic, northeastern South America, northern Africa, and much of Eurasia. Cooler-than-average temperatures were scattered across a concentrated region of North America, central South America and the eastern Pacific Ocean waters off the coast of Ecuador, a small region of northern Russia, and parts of northeastern Asia.

Temperatures across North America were above average during 2013, but overall more moderate than 2012, which brought record heat to much of the continent. It was warmer than average during winter for both Canada and the United States. However, the contiguous United States observed its coolest spring since 1996 and first cooler-than-average season overall since winter 2010/11. Canada was above average for the spring and summer was the 8th warmest on record, continuing its yearly warmth. Temperatures in the United States rebounded during the summer and Alaska having its 2nd warmest summer on record. The warmth continued into September in the United States, with a monthly temperature that was the 6th warmest since records began in 1895. It was a record warm summer for Mexico, with anomalous warmth throughout the period; June was 7th warmest, while July and August were both record warm for their respective months.

In South America, temperatures were near to above average for the January–September period. This includes Argentina, which had more moderate temperatures compared with record warmth in 2012, but also some notable extreme temperature shifts over short time periods. In some instances during August and September, minimum and maximum daily temperature records were broken at the same location within a few days. Across other regions of South America, temperatures were below average in central and northern Chile and above average over the northern half of South America, particularly northeastern Brazil and a region along the Colombia-Venezuela border.

Across the African continent, Kenya observed above-average maximum temperatures during January, February, and August. Several daily maximum records were broken for these months at various locations, including Wajir, Mombasa, Mandera, and Dagoretti Corner (Nairobi). The average January temperature at Wajir was the highest recorded in the past half century. Mauritius had temperatures 2–3°C above average for prolonged periods during January and February. Summer temperatures 2.2°C above average contributed to one of the 10 warmest January–August periods in Tunisia since 1950. Temperatures were 2°C or more above average during March–September over northern Africa in Morocco, Tunisia, and Libya.

Many regions across Europe were warmer than average at the start of 2013. Reykjavik, Iceland recorded its warmest January since 1987 and the north-east of the country had its warmest January–February on record. However, spring brought extremely cold conditions affecting a large swath of Europe. In most of European Russia, March was colder than February for the first time since 1957. In the north of this region, it was the coldest March in the past half century, as temperatures were 8–10°C below average in some areas. France had its coolest spring since 1986 and the Netherlands recorded its coolest spring for more than 40 years. Spring brought the United Kingdom its coolest March since 1962 and the coolest month of any month since December 2010, along with the coolest April and May since 1989 and 1996, respectively.

In contrast to parts of Europe mentioned above, along the western Greenland coast, Pituffik/Thule Air Force Base had its record warmest March, and Norway and Sweden each observed one of their warmest months of May since their national records began. Warmer-than-average spring conditions were reported in southern and eastern parts of Europe. Croatia, Montenegro, Hungary, Moldova, and Latvia had warmer-than-average temperatures in April and May. Spring temperatures were also well above average for a large part of Russia; April was one of the 10 warmest months of April for all of Russia since records began in 1891. In Chukotka, northern Asia Russia, April temperature anomalies reached +9°C in places. Central and southern European Russia observed its 2nd warmest May on record. This is the second consecutive year that late spring temperatures were more typical of summer.

Summer was very hot over many European countries, as Spain had its 5th warmest July and the United Kingdom its 3rd warmest. Austria had its 2nd warmest, tied with 1983 and behind 2006, since records began in 1767. It was also one of the 10 warmest summers for Montenegro. South and west Bosnia and Herzegovina had its warmest first 10-day period of August on record.

The beginning of autumn was also anomalously warm over Europe, as Norway, Finland, and Spain all reported above-average temperatures for September. Anomalous warmth was also present in north-east Greenland, where Danmarkshavn and Daneborg had record high temperatures for the month. September also started off warm in Switzerland, where Genève-Cointrin had its first September day above 30°C since 1987.

Northern East Asia had a cold period during its 2012/13 winter season, associated with negative Arctic Oscillation conditions and blocking patterns around eastern Siberia. During this period, most of Siberia was 2–3°C below average, making this one of the coldest winters for the region in the 21st century. Record-low temperatures were recorded in Siberia, Yakutia, Kolyma, and Chukotka, as well as the Arctic coast. In April, the Republic of Korea observed its 4th coldest April on record.

South Asia experienced above-average temperatures during the beginning of the year. Thailand had a February monthly temperature more than 1°C above average. Hong Kong experienced its 4th warmest February on record. During March and April many daily maximum temperature records were broken, with some locations exceeding 40°C. March temperatures were 2–4°C above average in most of China, and 4–6°C above normal in central and northwestern parts of the country.

Summer was extremely hot in many parts of Asia. The northwestern Pacific High and the Tibetan High were enhanced during July and August, contributing to Japan's hottest summer on record. The heat was also present across China during August, as the country saw its warmest August on record (tied with 2006). The Republic of Korea observed its 4th warmest July and warmest August, contributing to a record-high summer temperature.

In the South-west Pacific, Australia started off the year with extreme warmth. January 2013 was the hottest month ever observed in the country. Monthly maximum temperature anomalies reached +5°C in north-west New South Wales. Widespread heat across the continent contributed to this record, rather than extreme heat at individual locations. The extreme warmth combined with a warmer-than-average December and February to give the country its hottest summer (December–February) on record. Warmer-than-average temperatures continued through the year as Australia observed its 3rd warmest winter (June–August) on record followed by its record warmest September. Temperatures for September were 2.75°C above average, the highest monthly temperature departure ever recorded in Australia. The country recorded its all-time warmest 12-month period during September 2012–August 2013, only to see the record broken the following two consecutive months, making November 2012–October 2013 the current warmest 12-month period on record. January–October 2013 is also the warmest such period for Australia, at 1.32°C above average and 0.24°C higher than the previous record warmest such period in 2005. This is also much higher than the 2001–2010 average temperature anomaly of +0.48°C. The anomalous warmth was also present during austral winter in New Zealand, which experienced its 4th warmest July and record warmest August. These warm months contributed to the country's warmest winter on record.

Regional Precipitation assessment

As is typical in a given year, precipitation patterns and anomalies in 2013 varied greatly by region due to differing weather and large-scale climate patterns. It is also worth noting that in arid places and desert areas, small variations in the annual total precipitations relative to the very low normal averages can easily bring an apparent high increase or decrease in the anomaly percentages. This preliminary assessment covers January–October 2013.

For the first 10 months of 2013, below-average conditions were notable across the western United States, where rainfall deficit conditions in central North America during 2012 migrated, bringing record dry conditions to California. Conversely, parts of Mexico experienced above-average rainfall, due to high precipitation amounts associated with tropical cyclone activity both from the North Atlantic and East North Pacific hurricane basins.

In South America, much-below-average rainfall was recorded in northeastern Brazil, where parts of the region were experiencing their worst drought in the past half century in early 2013. It was also dry along much of the continental western coast, much of Argentina, and western Brazil near the Bolivian border. Near to above-average precipitation was recorded across parts of Brazil, Bolivia, and part of southeastern Argentina.

In southern Africa, Botswana and Namibia experienced a large rainfall deficit, causing their worst droughts in years during 2013. An active tropical cyclone season brought heavy precipitation to other locations, contributing to above-average January–October rainfall for southern Madagascar and most of Mozambique. An active West-African summer monsoon season (July–September) brought average to above-average rainfall over most of central and western parts of the Sahel. Northern Mali and central Niger experienced well-above-average rainfall. Conversely, much of the coastal Gulf of Guinea had average to below-average precipitation. Southern Sudan and Somalia had below-average rainfall, while above-average conditions were present across parts of northern Africa.

Most of Europe saw average to above-average precipitation for the January–October period; however, below-average precipitation conditions prevailed in parts of northern Europe, including southern Sweden. Farther to the south east, well-below-average rainfall dominated parts of western Asia, including most of Iran, parts of Afghanistan, and Turkmenistan. These conditions expanded to most parts of the Middle East and Turkey.

Large areas in south west Asia including India, Pakistan, and western China experienced above-average rainfall due to an active Indian monsoon, which was one of the longest on record. Far eastern Asia, including eastern Russia, northeastern China, and Japan, experienced near to above-average rainfall conditions. On the other hand, eastern and northern China into southern Mongolia recorded near to below-average rainfall.

Parts of Australia had drier-than-average conditions in January–October, particularly in the interior stretching northward and in far western Australia. The western half of Queensland had well-below-average rainfall in its 2012/13 summer wet season and, with no significant winter rain, was well below normal for the year to date. Small areas, mainly along sections of the eastern and southern coasts and part of Western Australia, saw higher-than-average precipitation.

2013: A variety of climate extremes

Many different notable climate anomalies and events were observed across the globe throughout 2013.

Major heat waves and extreme high temperatures

Heat built over southwestern Western Australia during the last week of December 2012 and then traveled eastward, leading to one of Australia's most extreme heat waves on record to start off 2013. On 7 January a new national area-averaged daily maximum temperature of 40.30°C was set. Moomba, South Australia, reached 49.6°C, the highest temperature recorded in the state since 1960. Hobart recorded its all-time high temperature of 41.8°C on 4 January while Sydney recorded its hottest temperature ever of 45.8°C on 18 January. There were also other significant heat waves March, May, and late August and September. The annual number of record high temperatures in Australia

has doubled since 1960, with 2001–2010 seeing the highest number on record among the past five decades.

Vioolsdrif, South Africa soared to 47.3°C on 4 March. This was the hottest March temperature ever measured anywhere in Africa. In West Africa, the temperature in Navrongo, Ghana reached 43.0°C on 6 March, the warm est temperature ever measured in Ghana for any month.

In the pre-monsoon month of May, Pakistan saw its most severe heat wave in decades. The temperature reached 51°C on Larkana, southern Sindh province, on 19 May, the highest May temperature in that city since 1998. Damages to cotton crops and rice paddies were reported and more than 100 people died.

Austria experienced an extended heat wave during 20 July–10 August, with a new national record high temperature of 40.5°C set in Lower German-Altenburg on 8 August. This was the first date a temperature above 40°C was ever measured in Austria.

Summer (daily mean temperature $\geq 10^{\circ}\text{C}$) was exceptionally long or record long in most of Lapland in northern Finland. This period lasted from 17 May–20 September and was as long as the average summer in southern Finland; only summer 2001 ended later (21 September).

A persistent heat wave occurred from the beginning of July to the end of August across most of southern China. It was one of the most severe on record with respect to its geographical extent, duration, and intensity, as more than 300 stations exceeded a daily maximum temperature of 40°C during the period. Forty-four people perished due to the heat.

On 12 August, Ekawasaki station in Shimanto-city, Kochi Prefecture recorded a temperature of 41.0°C, the highest temperature ever observed in Japan.

Major Drought and Wildfires

For the second consecutive year, northeastern Brazil experienced severe drought conditions. This follows the decade of 2001–2010, when large parts of the Amazon Basin saw prolonged drought. This year's drought is considered to be the worst in the past 50 years. According to a NOAA-led assessment⁴, deficits exceeding 300 mm occurred in some regions during the onset (September–November), mature phase (December 2012–February 2013), and decay phase (March–May) of the annual South American monsoon. The Brazilian Plateau, the core monsoon region in South America experienced its largest rainfall deficit since records began in 1979. The government provided food assistance to the affected population in five of the nine north-east states. Hydro-power supplies were threatened as dams in the north-east ended December 2012 at just 32 percent of capacity, below the 34 percent considered sufficient to guarantee electricity supplies. Damages are estimated to exceed \$8 billion US dollars.

Drier-than-normal weather conditions since late 2012 resulted in severe drought conditions in the northern Republic of Marshall Islands and led to critical shortages of safe drinking water and damages to food crops. On 6 May 2013, the Republic of Marshall Islands Cabinet declared a state of disaster for the drought. More than 5,700 people were living in drought-affected atolls. Water tanks were depleted and

groundwater was rendered unsafe for human consumption due to high salinity levels in several of these atolls.

With little significant rainfall in northern and eastern parts of New Zealand since October 2012, by early 2013 the country was suffering its worst drought in decades. A drought zone was declared over the entire North Island and parts of the South Island. Measures of soil moisture deficit were at their highest levels since the 1970s and parts of the North Island were the driest in the past 70 years, receiving between a third and a half of average rainfall levels during the summer.

Following nearly three decades of low seasonal rainfall and a second consecutive year of failed rains, in much of 2013, the southern African countries of Angola and Namibia were gripped by one of the worst droughts in the past 30 years. According to OCHA, as of August, more than 778,000 people — about one-third of the population— were either severely or moderately food insecure in northern Namibia, including an estimated 109,000 children under the age of five at risk of acute malnutrition. An estimated 1.5 million people in southern Angola were food insecure.

In the western United States, the Black Forest Fire started on 11 June near Colorado Springs, Colorado. The fire burned 5,780 ha before being contained on 20 June 2013. Very hot conditions, combined with strong winds and drought, contributed to the rapid growth of the fire. The fire destroyed over 500 homes and was the most destructive wildfire in Colorado history, surpassing the Waldo Canyon Fire from just last year. Nearly 40,000 people were evacuated as the wildfire grew rapidly out of control. At least two people were killed. To the south west, the Yarnell Hill Fire was ignited by lightning on 18 June, near Prescott, Arizona, burning around 3,400 ha. The fire grew quickly and spread in an unpredictable manner due to gusty winds from a nearby thunderstorm and the rugged terrain. Nineteen firefighters perished as they battled the blaze, making it the most deadly wildfire in the United States since 1991.

During July and August, southern China experienced severe drought conditions. Zhejiang, Jiangxi, Anhui, Hunan, Hubei, Guizhou and Chongqing provinces received 135.2 mm during 1 July–21 August, just 48 per cent of average precipitation. An estimated 78 million people were impacted and more than 8 million ha of farm lands were affected. Direct economic losses are estimated to be about \$7.7 billion US dollars.

Extreme Precipitation and Floods

In January, a tropical low caused major flooding along much of the east coast of Queensland and northern New South Wales in Australia. In Queensland five people were killed and 8,000 residents were forced to evacuate as floods reached record heights. The Burnett River catchment had the most severe flooding, receiving nearly 70 per cent rainfall above the previous record. Bundaberg had its highest flood on record, with many residential areas being inundated. Farther south in northern New South Wales, the Clarence River at Grafton also reached record flood height.

Floods hit various regions across Africa in 2013. In the south east, Mozambique experienced severe flooding during 12–31 January that killed at least 113 people and displaced 185,000 residents, while heavy rainfall during March–April led to flooding that damaged crops and displaced thousands of people throughout parts of southern Somalia and eastern Kenya. During August, heavy rains in Sudan caused severe damages. An estimated 500,000 people were impacted throughout the country and nearly 36,000

homes were destroyed. Khartoum province, West Kordofan, and White Nile were the most affected areas. On 28 August, torrential rains led to flash floods in Bamako, Mali in West Africa. At least 37 people were killed and more than 100 homes were swept away as the Niger River overflowed its banks, bringing down bridges and submerging entire streets. In North Africa, heavy precipitation in a 3-h period on 17 September in Marrakech, Morocco killed two people, collapsed 10 homes, and rendered many districts impassable.

On 2 April in Argentina, the city of La Plata, near Buenos Aires, received about 300 mm of rainfall in just three hours. The torrential downpour led to flash floods that resulted in more than 50 fatalities. It is one of the worst climate disasters in Argentina's history.

On 2 May, 32.8 mm of rain fell over Schaffhausen, Switzerland in a 10-minute period, resulting in severe flooding, the 2nd most intense short-term rain event in the country. The Swiss record is held by Locarno-Monti in the Ticino with a 10-minute total of 33.6 mm (29 August 2003).

Extreme precipitation in the Alpine region and in Germany, Poland, Czech Republic, Austria, and Switzerland caused the most intense and extended flooding in Danube and Elbe river catchments since at least 1950 as more than 400 mm of rain fell in some localized areas on 29 May–3 June, an event with a return period of more than 100 years. Austria observed its wettest May–June since records began in 1858. Some rivers reached historical record heights. Passau/SE-Germany saw its highest water level since 1501. Twenty-five people were killed in Germany, Austria, and the Czech Republic as a result of the floods.

The Southwest Asian monsoon season had an early onset of 16 June over all of India and brought the worst flooding and devastation in the past half century to regions near the India-Nepal border. Twenty districts in Nepal and several districts in the Indian states of Uttarakhand, Himachal Pradesh, and Uttar Pradesh were affected. The monsoon arrived 15 days early in Uttarakhand, with constant rain during 15–18 June. Northwest India received nearly double its average June rainfall. The flooding occurred during the peak tourist and pilgrimage season. Thousands of people were killed and many more remain missing.

From the end of July to mid-August 2013, unusually heavy rain fell near the Amur River, which marks the border between China and Russia. The river reached a record 100.56 m, surpassing the previous record set in 1984, as heavy flooding hit parts of the region. The Songhuajiang and Liaohe River Basins in northeast China saw their heaviest floods since 1998. Nankouqian Township measured 449 mm of rain — half its average annual total — in a single day on 16 August. Heavy flooding was also reported in eastern Russia. More than 140 towns were affected by their worst flooding in 120 years. Over 74,000 houses were flooded, 1,200 roads were washed away, and 71 bridges were destroyed. In China there were direct economic losses of about \$1.8 billion US dollars and 102 casualties. In the Amur region of the Russian Federation, economic losses were estimated at \$500 million US dollars.

In the United States during 9–16 September, a cut-off low pressure system situated over the Great Basin pumped deep tropical moisture into the Colorado Front Range, resulting in record-breaking precipitation. In Boulder, Colorado 231 mm fell of rain on 12 September, setting a new 24-hour precipitation record for the city. Boulder also broke its monthly and annual precipitation records due to the event. Streams and rivers

approached and exceeded record levels with widespread flooding reported. Wildfires earlier in the summer left much of the land charred, contributing to the massive runoff.

Snow and Extreme Cold

In Spain, heavy snowfall was observed on 18–20 January in high elevations in the north of Navarra, with accumulations of more than 300 mm (equivalent water thickness) in 3–4 days. This is a very rare event in the region.

During 22–24 March, 20 cm or more of snow fell widely across northern parts of the United Kingdom, especially across higher elevations, with blizzard conditions and significant drifting. This was the region's most significant late winter snow event since 1979 and snow remained on the ground until early April. Thousands of homes lost power, hundreds of schools were closed, and transportation was majorly disrupted.

During 1–10 April, average snow depth in eastern Latvia was 40 cm, 10 times higher than normal and the 2nd highest on record for the period. This was the thickest snow cover throughout winter; Latvia typically experiences the thickest snow cover during the last 10-day period in February. On 25–26 September, several regions in Estonia received their earliest snowfall since 1961.

In Kenya, a minimum temperature of 5.7°C observed at Eldoret Meteorological Station in the North Rift on 16 July, the lowest recorded in July at the station over the past decade.

Tropical Cyclones

As of early November 2013, the 2013 global tropical cyclone activity was near the 1981–2010 average of 89 storms, with a total of 86 storms in the year to date⁵ (wind speeds equal to or greater than 63 km/h).

In the North Atlantic, with the season officially ending on 30 November, there have been a total of 12 named storms, similar to the 1981–2010 average of 12 storms, but below the recent active decade of 2001–2010, which saw an average of 15 storms per year. This was the first season since 2002 that no hurricane formed during June–August. Only two storms (Humberto and Ingrid) reached hurricane status (average is six), both in September and both reaching Category 1 status on the Saffir Simpson Hurricane Wind Scale (SSHWS); no storms attained major intensity (minimum wind speed 178 km/h; average is three). With respect to the Accumulated Cyclone Energy (ACE), which measures the intensity and duration of tropical storms and hurricanes, the North Atlantic 2013 hurricane season was just 30 percent of average as of the end of September. This makes 2013 the quietest season since 1994 and fifth lowest in terms of ACE since 1950.

Following well-below average hurricane activity in 2012 with just 11 named storms, the Eastern North Pacific basin had above-average hurricane activity in 2013. There were a total of 17 storms, eight of which intensified to hurricane status, and one (Raymond) became a major hurricane. The 1981–2010 average number of named storms in this basin is 17, although the most recent decade of 2001–2010 was slightly below this

average. For only the fifth time since reliable records began in 1949 (also 1956, 1984, 1992, and 2012), two tropical cyclones formed early in May.

Two tropical cyclones from two separate basins (Ingrid in the North Atlantic and Manuel in the Eastern North Pacific) struck Mexico nearly simultaneously on 15 September, an unusual event that last occurred in 1958. Large amounts of rain combined with orographical precipitation enhancement over Mexico's mountainous regions led to major flooding and landslides. In total, 24 of Mexico's 31 states were impacted by the storms. Tens of thousands of residents were displaced and some 22,000 homes were damaged in Guerrero state, the state hardest hit by the storms. Heavy rain temporarily isolated the resort town of Acapulco.

As of early November, the Western North Pacific typhoon season recorded a total of 30 storms, above the 1981–2010 average of 26 and also well above the most recent decadal (2001–2010) average of 23, making this the most active season since 2004. Of these storms, 13 strengthened into typhoons. Several of these storms still caused considerable damage in the region.

Typhoon Usagi (Odette) was one of the strongest cyclones globally in 2013. According to the RSMC Tokyo, the storm had 10-min maximum sustained winds of 204 km/h with a minimum central pressure of 910hPa. The storm struck the northernmost Philippines on 21 September, affecting almost 48,000 people and causing severe agriculture damage in the region. Usagi intensified seasonal monsoon rains, leading to flooding and landslides that killed 30 people. Northward in Taiwan-Province of China, an estimated 3,400 people were forced to evacuate due to the heavy rains and flooding. Typhoon Usagi made a final landfall in southern China near Hong Kong on 22 September. In mainland China, 25 people were killed by impacts from Usagi. Heavy monsoon rains enhanced by the typhoon also killed at least 36 people in Vietnam and Cambodia.

The North Indian Ocean recorded a below-average season with only two tropical cyclones compared with the 1981–2010 average of four; however, one of these storms (Phailin) evolved into a Very Severe Cyclonic Storm in the Bay of Bengal on 11 October, tying with Usagi and Francisco (both in the Western North Pacific basin) as one of three Category 5 storms on the SSHWS of 2013 to date. It was the second Category 5 cyclone to form anywhere around the globe in 2013 and the second strongest for the year to date, behind Usagi, with an ACE Index value of 17.5. Phailin also became the strongest storm in the North Indian basin since the Odisha Super Cyclone in 1999. Odisha made landfall in roughly the same region as Phailin, killing almost 10,000 people. Vastly improved early warning systems and preparedness for Phailin are largely credited with avoiding the major humanitarian disaster that occurred with Odisha. More than 1.1 million residents in Odisha and Andhra Pradesh states were evacuated ahead of the storm, one of the largest such evacuations in the history of India. The storm crossed over Odisha and adjoining north coastal Andhra Pradesh on 12 October with sustained winds of 200–210 km/h and central pressure of 940 hPa. However, damage was still extensive, as at least 200 mm of rain fell over the region in conjunction with a storm surge of more than three meters. An estimated 39 people were killed by the storm, hundreds of thousands of homes and thousands of educational facilities were damaged or destroyed, and more than three million trees were uprooted.

The Southwest Indian Ocean 2012/13 tropical cyclone season observed 10 tropical storms. This is close to the long-term 1981–2010 average and 2001–2010 average of

nine tropical storms. Seven of these storms reached cyclone status, with three becoming intense cyclones, well above the average of four and one, respectively. Anais developed into an intense tropical cyclone on 14 October 2012, the earliest known intense tropical cyclone on record in the season for this basin, impacting Madagascar on 19 October.

The 2012/13 tropical cyclone season in the Southwest Pacific (from 120°W to 135°E) was well below average, with five named tropical storms occurring compared to the 1981–2010 average of 12 and also compared to the 2001–2010 decadal average of 10. Four of these storms attained severe tropical cyclone status, which is similar to the 1981–2010 average. Severe Tropical Cyclone Evan, which formed in December 2012, was the strongest storm in the basin during the season, reaching Category 4 intensity. The storm impacted several populated areas, with the largest impacts on Samoa, Wallis and Fatuna, and Fiji. Ten people were killed and damages in Samoa and Fiji alone totaled over \$300 million US dollars.

The Australian basin (from 90°E to 160°E) recorded a near-average 2012/13 cyclone season, with 10 tropical cyclones compared with the 1981–2010 average of 11 and the most recent decadal average of nine. Four of these storms became severe tropical cyclones. The strongest cyclone of the season was Rusty, near Pardoo, east of Port Hedland, on 27 February. The impact was associated with disruption to industry with likely financial impact exceeding \$100 million US dollars. The remnants of Oswald caused major flood damage in eastern Queensland and northeastern New South Wales.

Extra-Tropical Cyclones and Storms

During 4–6 August, intense thunderstorms hit France, Germany, and Austria. Extremely large hailstones fell, including one near Reutlingen, Baden-Württemberg, Germany with a diameter of 14 cm and a weight of 360 g. Wind gusts as high as 111 km/h were reported, as trees were felled. Lightning and flooding also caused major damage.

An extra-tropical cyclone, Storm Depression Christian, struck the United Kingdom on 28 October, brought on by a fast-moving Atlantic depression. The storm brought widespread wind gusts that reached 111–129 km/h across south-east England and as high as 159 km/h at Isle of Wight. This was the strongest autumn storm to hit the region since 2002. This storm happened earlier than a comparable Storm Kyrill, which impacted central Europe on 18–19 January 2007 with same magnitude of high wind gusts. The storm moved across western and northern Europe and further into the Baltic states. At least 14 people were killed and hundreds of thousands of homes lost electricity. Most of the damage was due to trees felled by the high winds.

In the United States, a rare EF-5 tornado, the strongest category of the EF scale, struck Moore, Oklahoma on 20 May, leading to 20 fatalities and destroying thousands of homes and businesses. An EF-3 touched down near El Reno, Oklahoma on 31 May. This tornado had a path width of approximately 4.2 km, the widest tornado ever observed in the United States. There were 29 fatalities and damages were estimated at more than \$4 billion US dollars.

On 19 June, an EF-3 tornado occurred in the Côte d'Or region in northeastern France. It had a path length of 14 km and was embedded in a microburst. This was the strongest tornado in France since 2008.

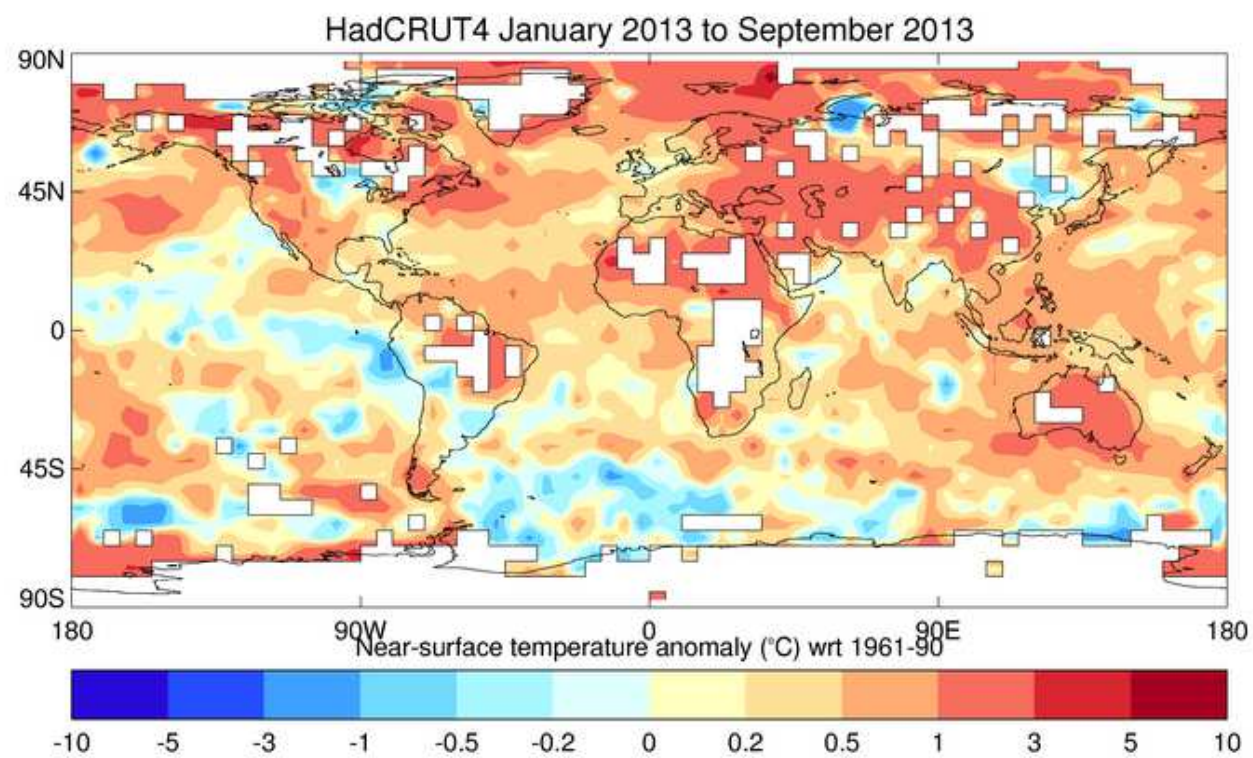
¹ The global land and ocean temperature anomaly is the average of the three main global datasets from NOAA NCDC, NASA GISS, and UK Met Office.

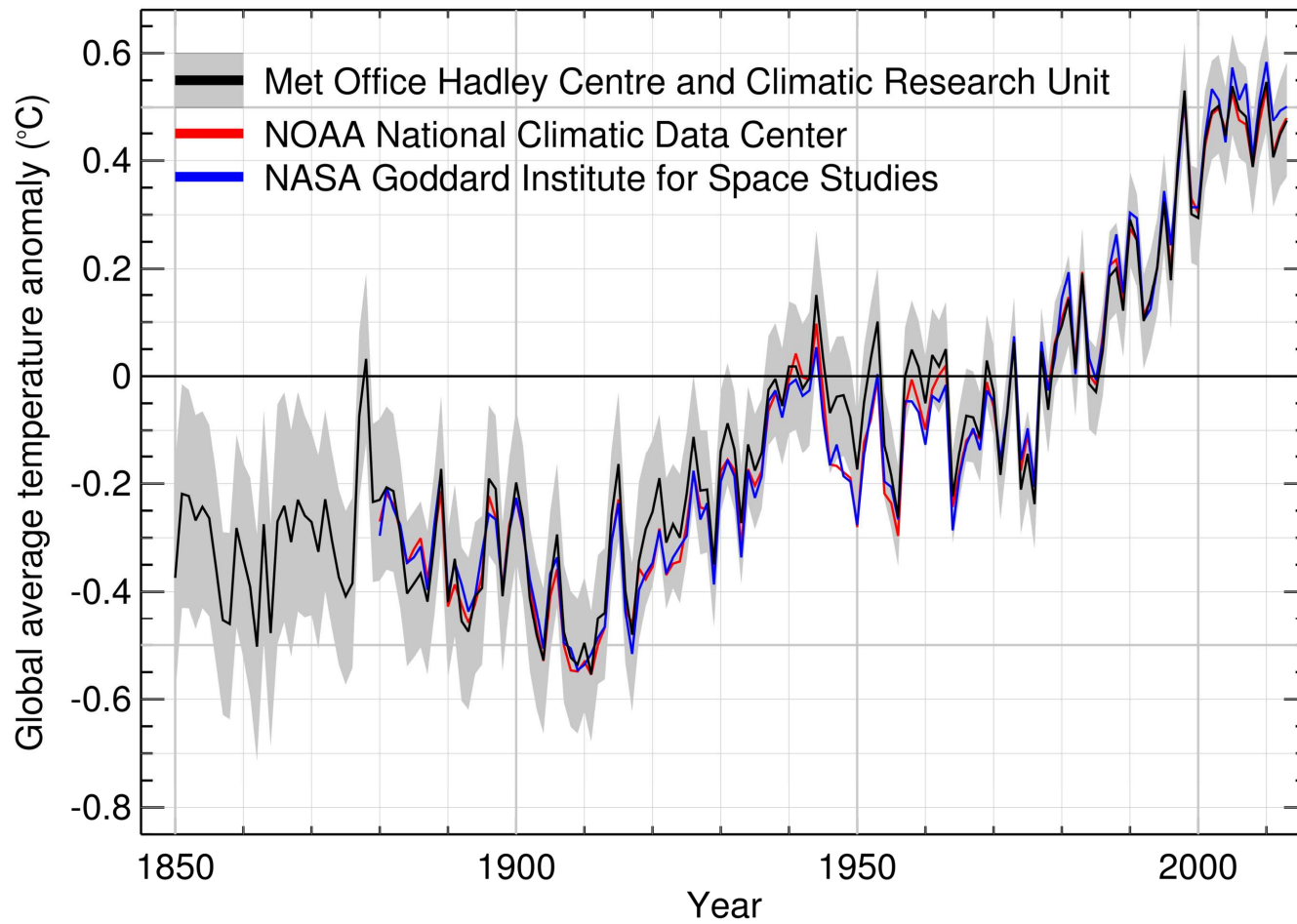
² Uncertainty value has been calculated from the UK Met Office dataset only.

³ WMO released its annual Greenhouse Gas Bulletin on 6 November 2013. It is available at WMO Global Atmosphere Watch Programme Web page: <http://www.wmo.int/gaw>.

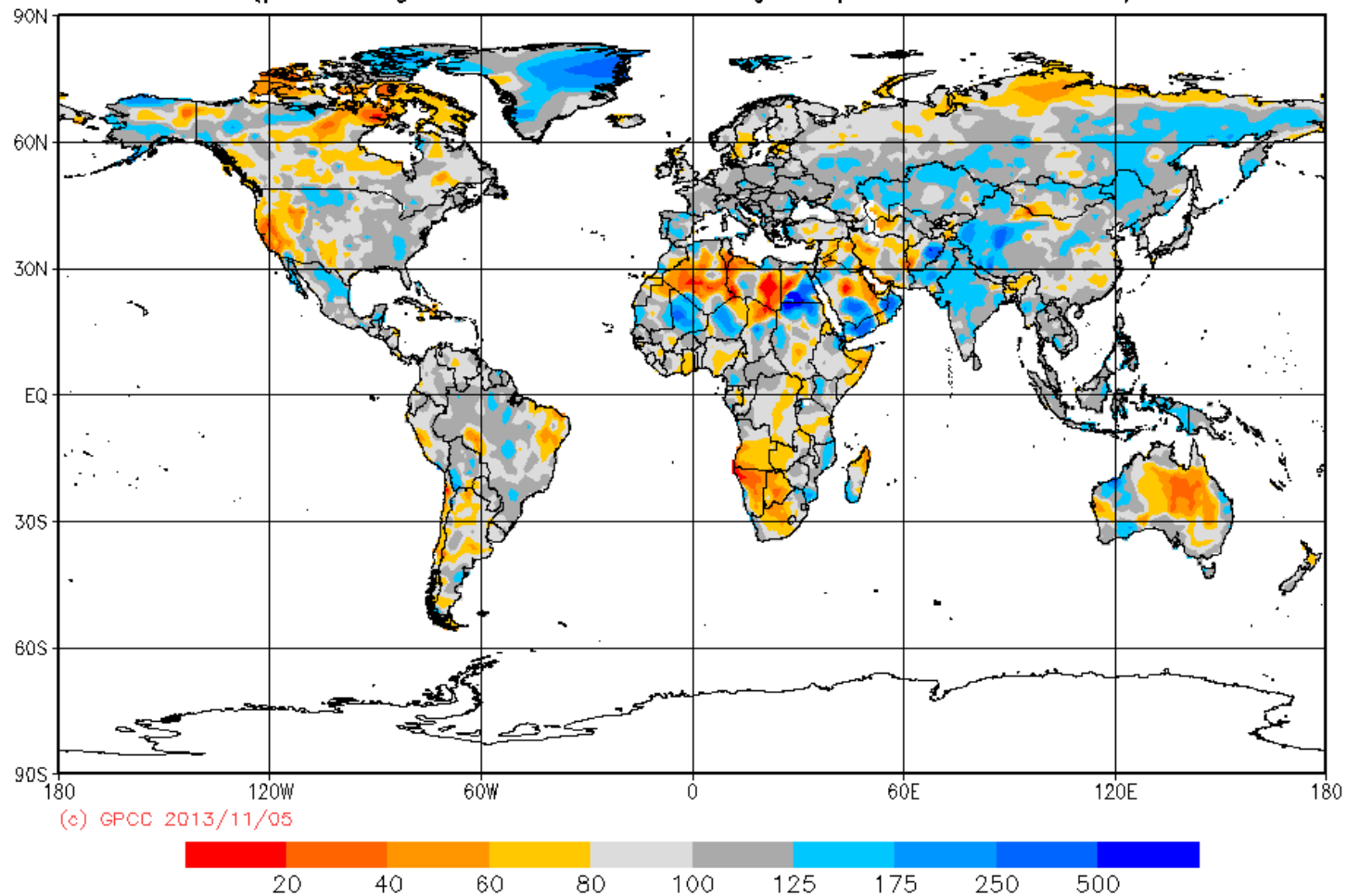
⁴ The study was conducted by NOAA Climate Prediction Center, in collaboration with Instituto Nacional de Meteorologia (INMET) and Centro de Previsão de Tempo e Estudos Climáticos (CPTEC).

⁵ It is noted that the season is still ongoing in some basins and tropical cyclones may form outside of their formal seasons as well.





GPCC Monitoring Product Gauge-Based Analysis 1.0 degree
precipitation anomaly for the year (Jan-Oct) 2013 in %/month
(percentage of normals focussing on period 1951-2000)



Average Monthly Arctic Sea Ice Extent September 1979 - 2013

