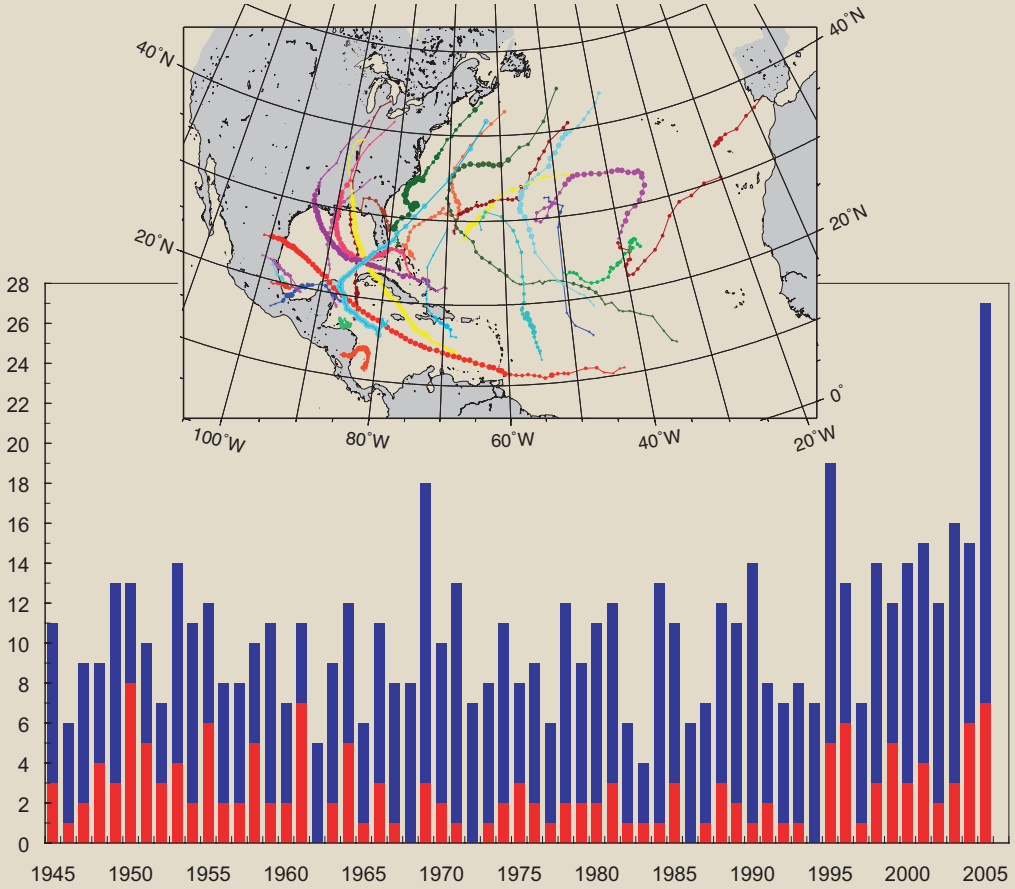
WMO STATEMENT ON THE STATUS OF THE GLOBAL CLIMATE IN 2005



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Weather • Climate • Water

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Front cover: *Top: Tracks of the hurricanes in the 2005 North Atlantic hurricane season. (*Source*: National Climatic Data Center, NOAA, United States)*

*Bottom: Annual number of named storms (blue) and major hurricanes (red) in the North Atlantic Ocean for the period 1945-2005. (*Source*: National Climatic Data Center, NOAA, United States)*

Back cover: *Left: Mean total ozone (in Dobson units) over the southern hemisphere during September 2005 based on ground-based measurements. (*Source*: World Ozone and Ultraviolet Radiation Data Centre, Environment Canada)*

*Right: Accumulated precipitation anomalies (departures in millimetres from a 1979-2000 base period) during the 2005 May to August season for Europe. Green indicates areas that received above normal precipitation during the period while pink depicts those regions that were drier than normal. Areas in white show regions where departures are within +/- 25 mm of the average seasonal value. Precipitation values are obtained by merging rain-gauge observations and satellite-derived precipitation estimates. (*Source*: Climate Prediction Center, NOAA, United States)*

NOTE

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This statement is a summary of the information provided by the Hadley Centre of The Met Office, United Kingdom, the Climatic Research Unit, University of East Anglia, United Kingdom; and the National Climatic Data Center and the Climate Prediction Center of the National Oceanic and Atmospheric Administration (NOAA), United States. Other contributors were from the following WMO Member countries: Argentina, Australia, Canada, China, Fiji, France, Germany, India, Japan, Mauritius, Morocco, New Zealand, Norway and Sweden, as well as the International Research Institute for Climate and Society, United States, the IGAD Climate Prediction and Applications Centre in Nairobi and the AGRHYMET Regional Centre in Niamey.

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FOREWORD

The World Meteorological Organization (WMO), through the Commission for Climatology and in cooperation with its Members, has issued annual statements on the status of the global climate for the past 12 years. The statement for 2005 describes extreme weather and climate events and provides a historical perspective on the variability and trends of surface temperatures that have occurred since the nineteenth century. The statements complement the periodic assessments of the WMO/UNEP sponsored Intergovernmental Panel on Climate Change (IPCC) and are intended to provide credible scientific information on climate and its variability.

The year 2005 was most likely one of the two warmest years on record since 1850. The 2005 hurricane season saw some of the most destructive hurricanes on record, which claimed more than 3 000 lives in Central America and the United States. Disastrous floods and landslides due to extreme precipitation events were also reported worldwide. Prolonged drought conditions continued to affect parts of Africa, Australia and the western United States. In 2005, western parts of Europe were also under the grip of a severe drought. Arctic sea ice during September 2005 was the lowest on record and below the average for the fourth consecutive year. The ozone hole in 2005 was the third largest recorded after 2000 and 2003. In December, central Europe and central and eastern parts of Asia experienced significantly colder than average temperatures.

The impacts of climate variability and climate change, especially extreme events on human and natural systems, pose numerous challenges to sustainable development. In 2005, damages and casualties caused by extreme weather and climate events were high and alarming. The economic impact of natural disasters has shown a marked upward trend over the last several decades. The least developed countries are more affected by these hazards. The adequate integration of risk assessment and early warnings, with prevention and mitigation measures, can prevent natural hazards from becoming disasters. The role of WMO and the National Meteorological and Hydrological Services (NMHSs) is therefore fundamental in the identification, assessment and monitoring of risks and the provision of early warnings. In the longer term, climate changes could result in increased frequency of some extreme events such as heatwaves, droughts and floods. For sustainable development, there is a need for a better monitoring and understanding of the climate system as well as the further development of capabilities for predicting natural climate variability and human-induced climate change.

A major challenge for the meteorological and hydrological communities is to work towards a major reduction of the fatality rate associated with natural disasters. Enhanced weather, climate and hydrological services are being implemented to contribute to reducing the adverse human, social and economic impacts of natural disasters and extreme weather and climate events. Through its Programmes, WMO contributes actively to the timely provision of authoritative climate statements, assessments and reviews for the benefit of humankind in the twenty-first century.

(M. Jarraud)
Secretary-General

GLOBAL TEMPERATURES DURING 2005

The analyses made by various leading centres indicate that the global mean surface temperature in 2005 was 0.47°C to 0.58°C above the 1961-1990 annual average of 14°C. This places 2005 as one of the two warmest years in the temperature record since 1850. (The year 1998 had annual surface temperatures averaging 0.52°C* above the same 30-year mean.) The last 10 years, 1996-2005, with the exception of 1996 and 2000, are the warmest years on record.

The latest improved analysis of global temperature made by the Hadley Centre, The Met Office, UK, marks the year as the second warmest (0.47°C above average). Based on similar improved temperature analyses, but different methodology, the National Climatic Data Center, NOAA, United States, ranks 2005 as the warmest year (0.52°C above the 1961-1990 annual average). The analysis of the Goddard Institute of Space Studies, United States, also ranks the year as the warmest (0.58°C above the 1951-1980 annual average). All the temperature values have uncertainties, which arise mainly from gaps in data coverage. The sizes of the uncertainties are such that the global average temperature for 2005 is statistically indistinguishable from that of 1998. Based on the Hadley Centre analyses, averaged separately for both hemispheres, surface temperatures in 2005 for the northern hemisphere (0.65°C above the 1961-1990 average) were the warmest and for the southern hemisphere (0.28°C above the 1961-1990 average) were the fifth warmest in the instrumental record from 1850 to the present.

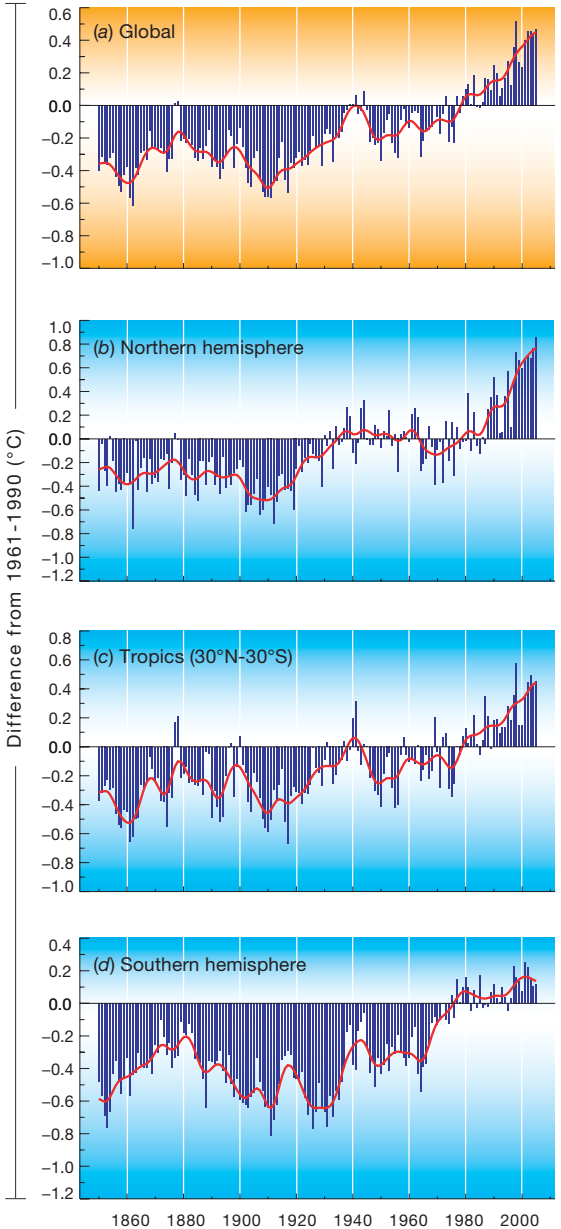


Figure 1 — Combined annual land (near surface) and sea surface temperature anomalies from 1861-2005 (departures in degrees Celsius from the average in the 1961-1990 base period) for: (a) the globe; (b) the northern hemisphere; (c) the Tropics (30°N-30°S); and (d) the southern hemisphere. The solid red curves have had sub-decadal timescale variations smoothed with a binomial filter. Anomalies (in degrees Celsius) for 2005 are: (a) +0.47; (b) +0.65; (c) +0.45; and (d) +0.28. (Sources: *Hadley Centre, The Met Office, UK, and Climatic Research Unit, University of East Anglia, UK)*

NOTE: There are some differences in annual anomalies between the present and earlier WMO statements. In this new analysis, more quality-improved, sea surface temperature and land station data have been used.

*This value is based on the new temperature analysis of the Hadley Centre, UK, introduced for the first time this year. In the earlier temperature analysis, the temperature anomaly value for 1998 was +0.54°C.

Since the beginning of the twentieth century, the global average surface temperature has increased by about 0.6°C. However, this increase has not been continuous and has risen sharply since 1976.

Areas of significant warmth were widespread with large areas of Africa, Australia, Brazil, the Russian Federation, Scandinavia, Canada, China and the south-west United States showing significantly above average temperatures. Much of the North Atlantic and south-west Pacific Oceans were also significantly warm, as was the Gulf of Alaska. Sea surface temperatures in the North Atlantic in 2005 were the warmest on record.

REGIONAL TEMPERATURE ANOMALIES

Large portions of the northern hemisphere experienced warm conditions in 2005 that exceeded 90 per cent of the annual temperatures recorded in the 1961-1990 period (the 90th percentile). Parts of the North Atlantic and Indian Oceans had warm temperatures exceeding the 98th percentile. Only a few small areas in the southern hemisphere experienced temperatures below the 10th percentile.

The large-scale climate phenomenon El Niño can contribute to above average warmth, as was the case with the extremely strong 1997/1998 episode. A weak El Niño episode that developed in mid-2004 continued through the beginning of 2005, but sea surface temperatures in the central and east central equatorial Pacific decreased early in the year and the episode ended by late February. The record warmth in 2005 is notable as there was little influence of the El Niño event on the 2005 global temperatures.

For Australia, 2005 was the hottest year since records commenced in 1910, with about 95 per cent of the continent experiencing above average mean temperatures. The previous annual temperature record was set in 1998. The nationwide maximum temperature anomaly in April was +3.11°C, the largest anomaly recorded for any month since 1950. During the January-May period, the hottest maximum temperatures on record exacerbated the exceptionally dry conditions.

In India, Pakistan and Bangladesh, extremely harsh heatwaves in May and June brought maximum temperatures of between 45°C and 50°C. The maximum temperatures over these regions were 5°C to 6°C above the long-term average. The delayed south-west monsoon rains allowed the heatwave to persist into June, claiming at least 400 lives in India.

A severe heatwave gripped the south-western United States from early to mid-July, setting up numerous temperature records.

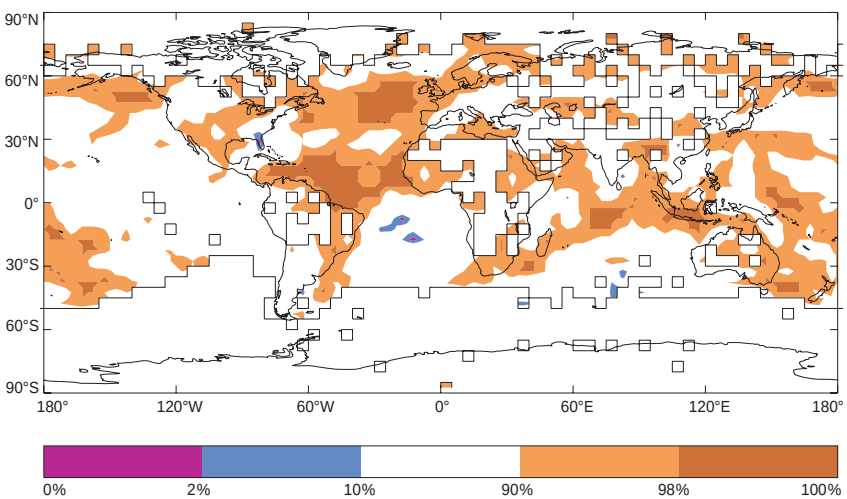


Figure 2 — Global annual temperature anomaly percentiles for 2005 based on a gamma distribution for the 1961-1990 base period, calculated in five-degree grid boxes. Orange and red indicate regions where the temperature anomalies were estimated to be within the highest (warm) 10 and 2 per cent, respectively, of the climatological occurrences. Blue and purple indicate the lowest (cold) 10 and 2 per cent of occurrences, respectively. Note that grid areas without sufficient data for analysis are left blank. (Source: Hadley Centre, The Met Office, UK)

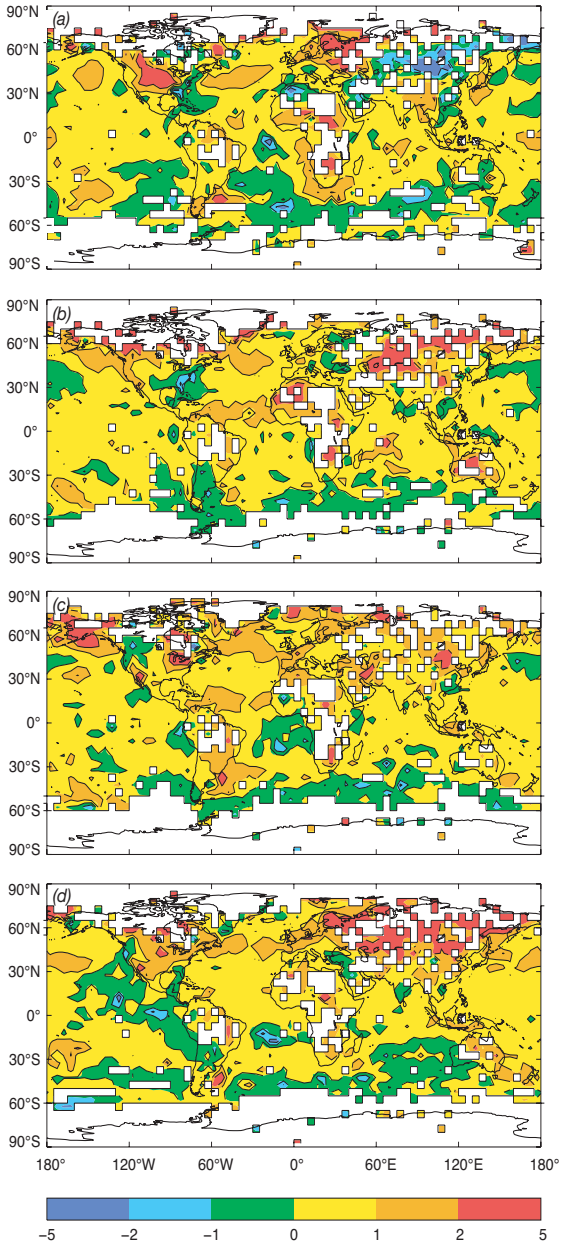


Figure 3 — Global surface temperature anomalies (departures in degrees Celsius from the average in the 1961-1990 base period) for three-month periods: (a) December 2004-February 2005; (b) March-May 2005; (c) June-August 2005; and (d) September-November 2005. (Sources: Hadley Centre, The Met Office, UK, and Climatic Research Unit, University of East Anglia, UK)

Central Canada experienced its warmest and most humid summer on record. In 2005, the number of hot days in Toronto was more than twice its average value. In China, the 2005 summer seasonal temperature was one of the warmest since 1951. Severe heatwave conditions also affected much of southern Europe and North Africa during July. In Algeria, the heatwave in July pushed temperatures as high as 50°C and claimed more than a dozen lives.

Extremely cold temperatures affected much of the Balkan region during the first half of February. In Morocco, a cold wave in January dropped temperatures to as low as -14°C. In Sevlievo, Bulgaria, a 50-year temperature record was broken with temperatures reaching as low as -34°C. During December, much of Japan, the Korean peninsula, China, Mongolia and parts of the eastern Russian Federation experienced significantly colder than average temperatures. A series of winter storms brought below normal temperatures over parts of Central Europe in December.

PROLONGED DROUGHT IN SOME REGIONS

Long-term drought continued in parts of the Greater Horn of Africa, including southern Somalia, eastern Kenya, south-eastern Ethiopia, north-eastern United Republic of Tanzania and Djibouti. Both the long (March-June) and short (October-December) rainy seasons brought below normal precipitation over this region. Over 11 million people in Ethiopia, Djibouti, Somalia and Kenya were at risk of starvation due to the effects of recent droughts. Sporadic rainfall during the 2004/2005 rainy season caused serious shortfalls in the cereal harvest

in Zimbabwe, Malawi, Angola and Mozambique. At least 5 million people in Malawi were threatened with hunger arising from the worst drought in a decade.

Multi-month drought conditions also affected much of western Europe during July, August and September. During the period October 2004 to June 2005, rainfall was less than half the normal in areas of the United Kingdom, France, Spain and Portugal. Neighbouring Spain and Portugal experienced the worst drought conditions since the late 1940s, with 97 per cent of Portugal affected by severe to extreme drought. The dry conditions also aggravated wildfires in the region.

The long-term hydrological drought continued for southern and eastern Australia, but eased slightly in the second half of the year. The period January to May was exceptionally dry for much of Australia, with 44 per cent of the continent experiencing rainfall in the lowest 10 per cent of the recorded totals. During this period, Australia received an average of only 168 mm of rainfall, the second lowest January-May total since records commenced in 1900.

Across the United States, moderate to severe drought persisted throughout parts of the Pacific North-West eastward into the northern Rocky Mountains. At the end of winter, moderate to extreme drought affected 72 per cent of the Pacific North-West. Below normal rainfall beginning in December 2004 caused severe drought conditions over southern parts of Brazil, where corn and soybean crops were severely damaged. In Brazil, the southernmost state of Rio Grande do Sul, which is one of the country's most prolific agricultural states, was the worst affected.

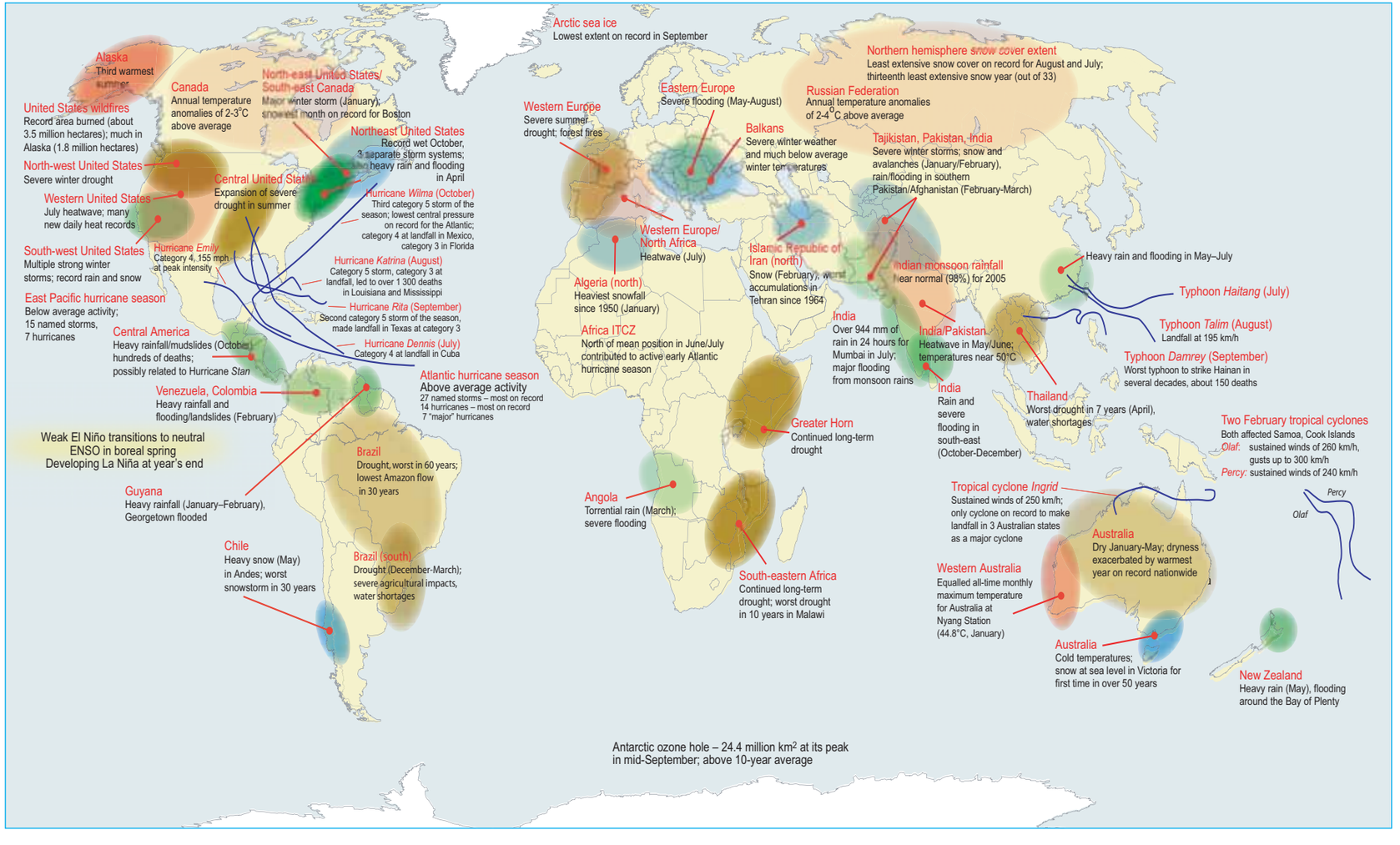


*Figure 4 — Significant climatic anomalies and events in 2005. The average global temperature was the second warmest on record. There has been a rise in global temperature greater than 0.6°C since 1900. (*Source*: National Climatic Data Center, NOAA, United States)*

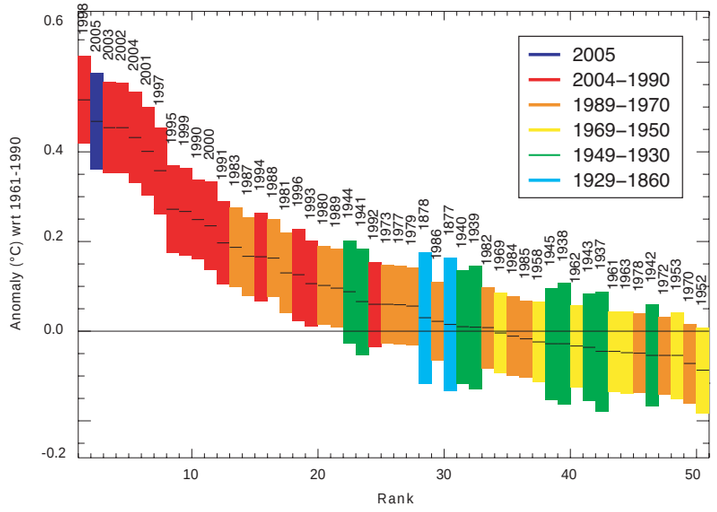


Figure 5 — Global ranked surface temperatures showing the last 50 warmest years. The size of the bars indicates the uncertainty associated with each year. Values are HadCRUT3 temperature values. (Sources: Hadley Centre, The Met Office, UK, and Climatic Research Unit, University of East Anglia, UK)

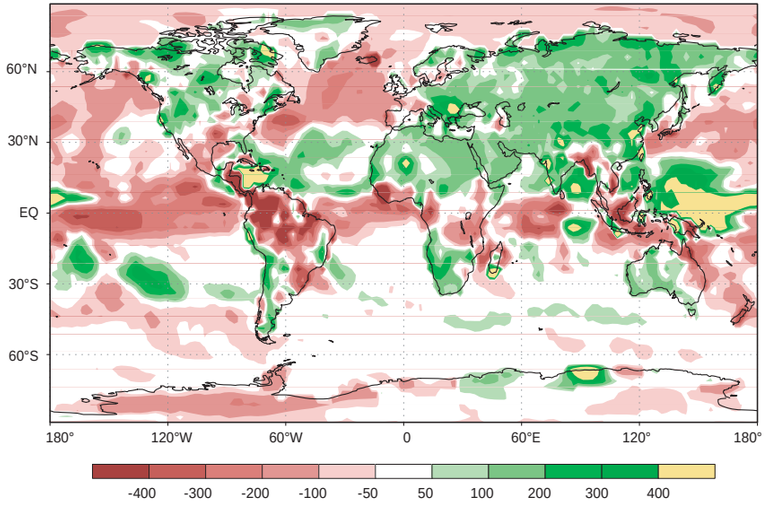


Figure 6 — Annual precipitation anomalies (departures in millimetres from a 1979-2000 base period) for 2005. Green and yellow indicate areas that received above normal precipitation for the calendar year 2005 as a whole while pink and red depict those regions of the world that were drier than normal. Areas in white show regions where departures are within +/- 50 mm of the average annual value. Precipitation values are obtained by merging rain-gauge observations and satellite-derived precipitation estimates. (Source: Climate Prediction Center, NOAA, United States)

The state of Amazonas experienced the worst drought in nearly 60 years, resulting in record low water levels in the Amazon River. In October, drought conditions extended further south into neighbouring Paraguay. By the end of the year, drought affected much of the central United States from the southern Great Plains to the western Great Lakes. Parts of Illinois, Arkansas, Oklahoma and Texas had the driest March-December in the 111-year record.

RAINFALL AND FLOODING

Global precipitation in 2005 was near the 1961-1990 average. Wetter than average conditions prevailed over Central America, eastern parts of Europe, India, China and Canada. Drier than average conditions were widespread across eastern Australia, Brazil, parts of Western Europe, Central Africa, and the Mississippi valley and southern Great Plains region in the United States.

The south-west monsoon during June-September brought unprecedented heavy rain and widespread massive flooding to parts of western and southern India, affecting more than 20 million people and resulting in more than1 800 deaths. On 27 July, Mumbai recorded unprecedented heavy rainfall of 944 mm in the previous 24 hours, which is an all-time 24-hour rainfall record for the city. The devastating floods in Mumbai caused economic losses of about US$ 3.5 million.

Heavy rainfall continued unabated in south-eastern parts of India, during the north-east monsoon season of October-December. The associated devastating floods affected more than 2 million people with at least 300 fatalities and caused considerable adverse socio-economic impacts. The north-east monsoon also produced extremely heavy rainfall in parts of the Malay Peninsula, Sri Lanka, the central Philippines, Thailand and Viet Nam. In Thailand, at least 52 deaths were attributed to one of the worst floods in nearly 30 years. In Viet Nam, flooding claimed at least 69 lives and caused damage to property.

During the third week of June, consecutive heavy rainstorms in parts of Fujian, Guangdong and Guangxi provinces in southern China killed at least 170 people and affected about 21 million people. Heavy rainfall across southern China continued into July, with floods affecting the upper reaches of the Huaihe River Basin. Across northern China, heavy rainfall during late September to early October produced extensive flooding in the Hanjiang River and the Weihe River basins, affecting about 5.52 million people.

Persistent heavy rains during the period May-August led to destructive flooding in Eastern Europe, particularly in Romania, Bulgaria, Hungary and The former Yugoslav Republic of Macedonia, causing damage to property, infrastructure and agriculture. Torrential rainfall in mid-August also flooded sections of Switzerland, Austria and southern Germany and the Czech Republic. The hardest hit area was Romania where 66 flood-related fatalities and losses of at least US$ 1.9 million in damage were reported. During April and May, floods and landslides were widespread in southern parts of the Russian Federation, affecting more than 4 000 people. In the first week of January, a severe winter storm affected parts of Sweden and neighbouring countries including Denmark and Latvia, causing an

Tropical cyclones and global warming

In terms of overall hurricane activity (number and intensity of storms), the 2005 Atlantic hurricane season has been clearly the most active season on record. The season brought an unprecedented 27 named tropical storms that caused devastating losses across Central America, the Caribbean and the United States. Of the named storms, 14 were hurricanes, 7 of those "major" hurricanes (category 3 or higher on the Saffir-Simpson scale). On average, 10 named storms develop in the Atlantic Basin, 6 of which are hurricanes. The 2005 hurricane season broke the previous record for the most named storms (21 in 1933) and hurricanes (12 in 1969), and ties the season record for major hurricanes, first set in 1950. In Central America and the Caribbean region, the most damage occurred from Hurricanes *Dennis*, *Emily*, *Stan*, *Wilma* and *Beta*. In the United States, 7 storms including 4 hurricanes made landfall. Hurricane *Katrina* was the deadliest hurricane to hit the United States since 1928. The storm killed over 1300 people, mostly in the southern states of Louisiana and Mississippi, and produced widespread devastation along the central Gulf coast of the United States. Hurricane *Wilma* was the most intense Atlantic hurricane ever recorded. The first tropical cyclone on record to strike the Iberian Peninsula since 1851 was *Vince*.

Conversely, in the eastern North Pacific, activity was below average. During the year, 15 named storms developed, compared with the average of 16, and there were also fewer strong storms. Of those 15 storms, 7 reached hurricane strength and 2 reached "major" status. In the North-West Pacific, 23 named storms developed, whereas the average is 27; 13 reached typhoon intensity. Typhoon *Talim* crossed south-eastern China and caused serious damage, including at least 150 deaths. In early September, typhoon *Nabi* caused severe damage and brought a record heavy precipitation of 1321 mm in three days in western Japan. Typhoon *Longwang*, which caused flash floods, was responsible for at least 80 deaths in south-east China. The south-west Indian and south-west Pacific Ocean cyclone season was also active with a near-average number of named storms. Tropical cyclone *Ingrid*, which lasted from 5 to 16 March, was the first cyclone recorded to reach category 5 intensity off the coast of three different Australian states, Queensland, Northern Territory and Western Australia.

There is speculation that, because of the link between higher ocean temperatures and hurricanes, the increased hurricane activity in the North Atlantic is possibly linked to global warming. There is no indication of a long-term trend in the global annual frequency of tropical cyclones. Since 1995, there has been a marked increase in the annual number of tropical storms in the Atlantic Basin, largely in response to the active phase of the multi-decadal signal. Climate models suggest that global warming will result in more intense hurricanes, as increasing sea surface temperatures provide energy for storm intensification. Global data indicate a 30-year trend toward more intense hurricanes in the North Pacific, Indian, South-West Pacific and North Atlantic Oceans. However, the attribution of long-term trends in frequency and/or intensity to global warming requires a longer global data record. Similarly, the attribution of a single event such as Hurricane *Katrina*, regardless of how extreme, is fundamentally impossible.

economic loss of about US$ 2.3 billion for the forest industry.

An onslaught of winter storms in early January brought exceptionally heavy rain, snow and flooding to the south-western United States. Los Angeles, California, experienced its second wettest rainfall season on record. In January, a major winter snowstorm affected areas of the north-eastern United States with more than 30 cm of snow accumulation. Record rainfall occurred in the north-east United States in the autumn of 2005, with three storm systems affecting the region. Across Canada, 2005 was the wettest year on record. In June, three major rain events in southern Alberta produced the costliest natural disaster in the province's history. Calgary experienced its wettest month ever covering 125 years of record.

Heavy rains in January and February caused massive flooding in Guyana's capital, Georgetown, and surrounding areas affecting more than 290 000 people. In February, at least two weeks of heavy rainfall in Colombia and Venezuela caused river flooding and landslides that resulted in the deaths of at least 80 people. Across Costa Rica and Panama, heavy rains in January caused flooding that was responsible for displacing more than 35 000 people. In October, Hurricane *Stan* caused flooding and mudslides over portions of Mexico, Nicaragua, Honduras and El Salvador, leading to the deaths of hundreds of people.

Cold weather and heavy snowfall that began in January continued in February over south-west Asia, causing avalanches. In parts of Tajikistan, two metres of snow accumulated in two weeks. During February, sections of northern Pakistan and neighbouring areas of northern India received heavy snowfall, described as the worst in two decades. In India, at least 230 people died as a result of the extreme winter weather. In Pakistan's north-west province, 360 deaths in February were attributed to flooding, landslides and avalanches. Heavy rains during March also caused flooding in parts of western Pakistan and Afghanistan, resulting in more than 200 fatalities. In December, record-breaking heavy snowfall occurred in parts of Japan, claiming at least 80 lives. A record maximum snowfall of 58 cm was recorded at Akita in December.

In New Zealand, the Bay of Plenty floods in May were most disastrous, with unprecedented heavy rainfall causing widespread damage in parts of Tauranga. It was one of the wettest years on record in parts of the Bay of Plenty and Hawke's Bay. In the South Pacific, heavy rains and high storm surges owing to tropical cyclones *Olaf* and *Percy* impacted the coastal areas of Samoa, American Samoa, Cook Islands and Manua Islands, causing coastal flooding and displacing thousands of people.

ANTARCTIC OZONE HOLE

In 2005, the size of the Antarctic ozone hole was close to 2003 values and well above the 1995-2004 average. The maximum size of the Antarctic ozone hole, 24.4 million km^2, was reached in the third week of September. The ozone hole in 2005 dissipated earlier than usual, in mid-November. Based on satellite observations, the ozone hole of 2005 ranks as the third largest ever recorded after 2000 and 2003. This year, greater ozone depletion took

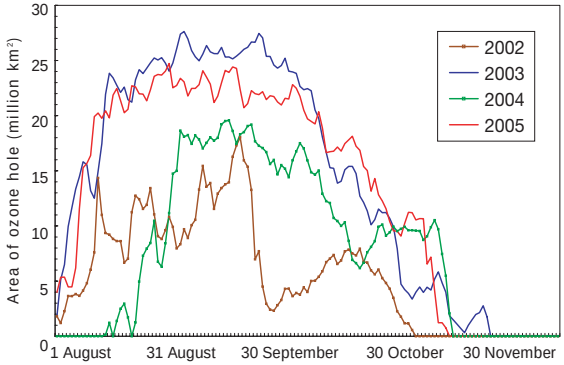


Figure 7 (right) — Daily size of the Antarctic ozone hole (in million square km) from 1 August to 30 November for the period 2002-2005 using total ozone observations from NOAA's solar back-scatter ultraviolet (SBUV/2) instrument on board its polar-orbiting satellites. (Source: Climate Prediction Center, NOAA, United States)

place in the Arctic. During the spring of 2005, in large portions of the Arctic region, average values of total ozone were 30-45 per cent lower than comparable values during the early 1980s.

ARCTIC SEA-ICE

Typically, September is the month with the least sea-ice extent in the Arctic. By the end of September 2005, the Arctic sea-ice extent dropped far below the average for the fourth consecutive year. It was about 20 per cent less than the 1979-2004 average, the lowest extent ever observed during the satellite record since 1979. Satellite information suggests a general decline of 8 per cent in the end of September

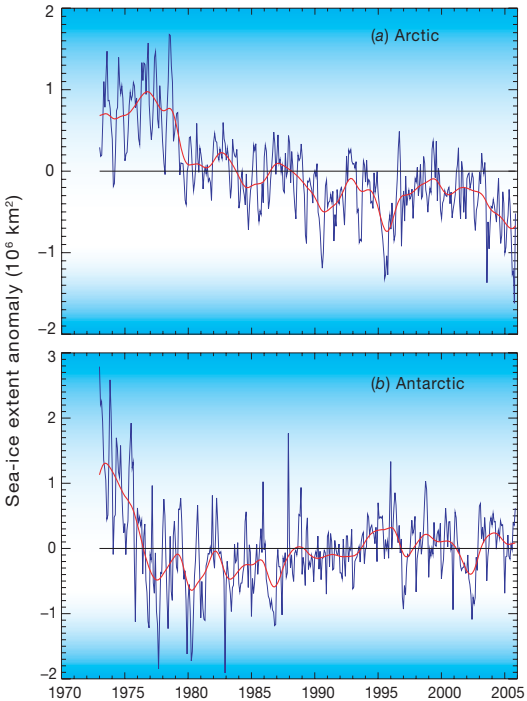
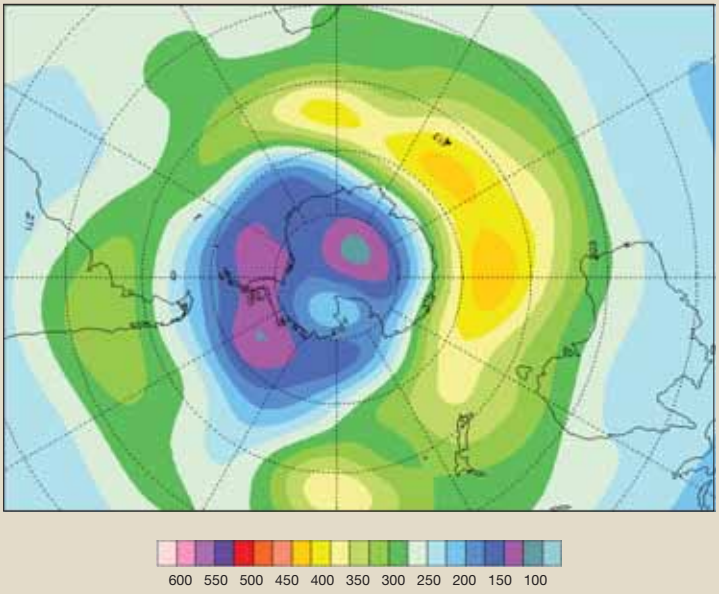
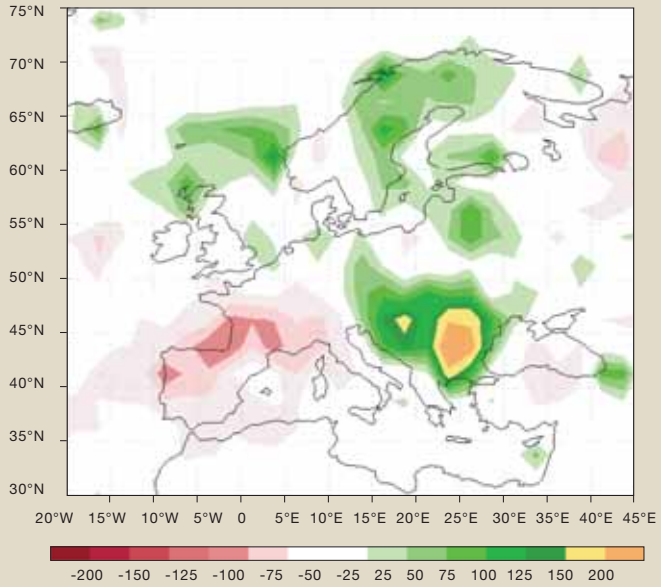


Figure 8 (far right) — Monthly sea-ice extent anomalies for 1973-2005 (departures in millions of square km from the average in the 1973-2005 base period) for (a) the Arctic and (b) the Antarctic. The values are derived from satellite passive microwave sounder data. (Source: Hadley Centre, The Met Office, UK)

Arctic sea-ice extent over the last 25 years. Warmer than average Arctic temperatures and an early arrival of the sea-ice melt season are the main causes for the intensification of the sea-ice decline in 2005.





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