



International “State of the Climate” report confirms record-high greenhouse gases, global temperatures, global sea level, and ocean heat in 2024

Contact

Rachel Thomas-Medwid, rthomas@ametsoc.org

Katie Pflaumer, kpflaumer@ametsoc.org

14 August, 2025

According to the **35th annual [State of the Climate report](#)**, greenhouse gas concentrations, the global temperature across land and oceans, global sea level, and ocean heat content all reached record highs in 2024, and glaciers lost the most ice of any year on record.

The international review of the world’s climate, published by the [Bulletin of the American Meteorological Society](#) (BAMS), is based this year on contributions from 589 scientists in 58 countries. For decades, the State of the Climate has provided the **most comprehensive annual update on Earth’s climate** — illuminating not only key indicators like global CO₂ but also notable weather events, regional phenomena, and other data collected by environmental monitoring stations and instruments located on land, water, and ice, as well as in space.

“The State of the Climate report is an annual scientific landmark,” says American Meteorological Society President David J. Stensrud. “It is a truly global effort, in which hundreds of researchers from universities, government agencies, and more come together to provide a careful, rigorously peer-reviewed report on our planet’s climate. High-quality observations and findings from all over the world are incorporated, underscoring the vital importance of observations to monitor, and climate science to understand, our environment. The results affirm the reality of our changing climate, with 2024 global temperatures reaching record highs.”

Notable findings from the international report include:

- **Earth’s greenhouse gas concentrations were the highest on record.** Carbon dioxide (CO₂), methane, and nitrous oxide — Earth’s major atmospheric greenhouse gases — once again reached record-high concentrations in 2024. The globally averaged CO₂ level reached 422.8±0.1 parts per million, a 52% increase from the pre-industrial level of ~278 ppm. Annual growth in global mean CO₂ has increased from 0.6±0.1 ppm yr⁻¹ in the early 1960s to an average of 2.4 ppm yr⁻¹ during 2011–20. The growth from 2023 to 2024 was 3.4 ppm, equal with 2015/16 as the highest in the record since the 1960s.
- **Record temperatures were notable across the globe.** A new annual global surface temperature record was set for the second year in a row, with records dating back as far as the mid-1800s. A range of scientific analyses indicate that the annual global surface temperature was 1.13 to 1.30



degrees F (0.63 to 0.72 degrees C) above the 1991–2020 average. A strong El Niño that began in mid-2023 and ended in boreal spring 2024 contributed to the record warmth. The last time two consecutive years reached a new global surface temperature record was in 2015 and 2016, when a strong El Niño developed during the latter half of 2015 and dissipated by May 2016. All six major global temperature datasets used for analysis in the report agree that the last 10 years (2015–24) were the 10 warmest on record.

- **The water cycle continued to intensify.** Higher global temperatures impacted the water cycle. Water evaporation from land in the Northern Hemisphere reached one of the highest annual values on record. The global atmosphere contained the largest amount of water vapor on record, with over one-fifth of the globe recording their highest values in 2024. This far exceeded 2023, where only one-tenth of the globe experienced record-high values of total column water vapor. Precipitation was globally high; 2024 was the third-wettest year since records began in 1983. Extreme rainfall, as characterized by the annual maximum daily rainfall over land, was the wettest on record. In April, Dubai in the United Arab Emirates recorded 9.8 in (250 mm) of rain in 24 hours — nearly three times its annual average.
- **El Niño conditions contributed to record-high sea surface temperatures.** Strong El Niño conditions in the equatorial Pacific Ocean that emerged by the end of 2023 continued into early 2024, with neutral conditions returning in boreal spring. Daily globally averaged sea surface temperatures were at record-high levels from the beginning of 2024 until late June. The mean annual global sea surface temperature in 2024 was a record high, surpassing the previous record of 2023 by 0.11 of a degree F (0.06 of a degree C). Approximately 91% of the ocean surface experienced at least one marine heatwave in 2023, which is defined as sea surface temperatures in the warmest 10% of all recorded data in a particular location for at least five days. Only 26% of the ocean surface experienced at least one marine cold spell. The ocean experienced a record-high global average of 100 marine heatwave days and a new record low of nine marine cold spell days.
- **Ocean heat and global sea level were the highest on record.** Over the past half-century, the oceans have stored more than 90% of the excess energy trapped in Earth's system by greenhouse gases and other factors. The global ocean heat content, measured from the ocean's surface to a depth of 2000 m (approximately 6561 ft), continued to increase, and reached new record highs in 2024. Global mean sea level was a record high for the 13th consecutive year, reaching about 4.0 in (105.8 mm) above the average for 1993 when satellite altimetry measurements began. Warming oceans have contributed an average of 1.5 ± 0.3 mm to the rise per year since 2005, while melt from ice sheets and glaciers have contributed an average of 2.1 ± 0.4 mm during that same period.
- **The Arctic saw near-record warmth.** The Arctic had its second-warmest year in the 125-year record, with autumn (October to December) having been record warm. During the summer, an intense August heatwave brought all-time record-high temperatures to parts of the northwest North American Arctic, and record-high August monthly mean temperatures at Svalbard Airport reached more than 52°F (11°C). In September, temperatures above 86°F (30°C) were observed in Norway, marking the latest time of the year in the observational record that such high temperatures have occurred there. During the 2023/24 snow season, there were large differences in how long snow remained on the ground, from the shortest to date in the twenty-first century over parts of Canada to at or near the longest in this century in parts of the Nordic and Asian Arctic. The Arctic maximum sea ice extent in 2024 was the second smallest in the 46-year satellite record, while the minimum sea ice extent was the sixth smallest.
- **Antarctica saw continued low sea ice.** Following record lows in 2023, net sea ice extent was larger than last year but continued to be well below average during much of 2024. The Antarctic daily minimum and maximum sea ice extents for the year were each the second lowest on record behind 2023, marking a continuation of low and record-low sea ice extent since 2016.

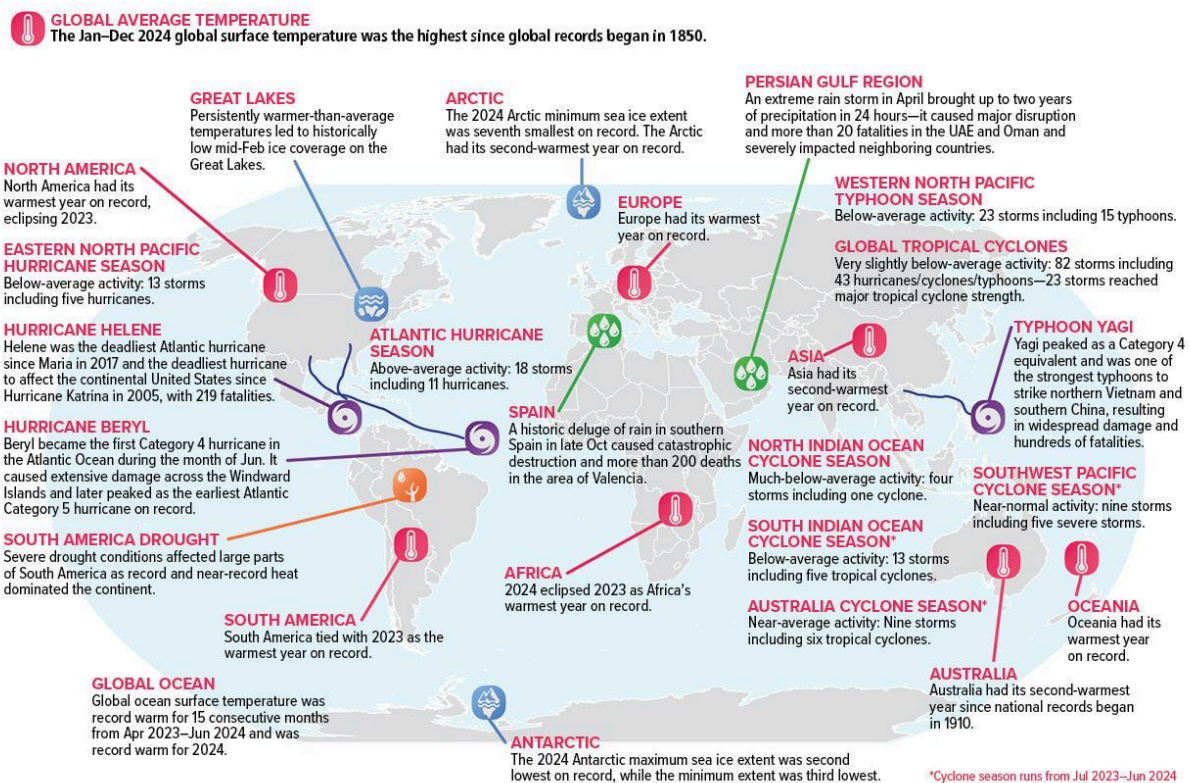
AMS



American Meteorological Society

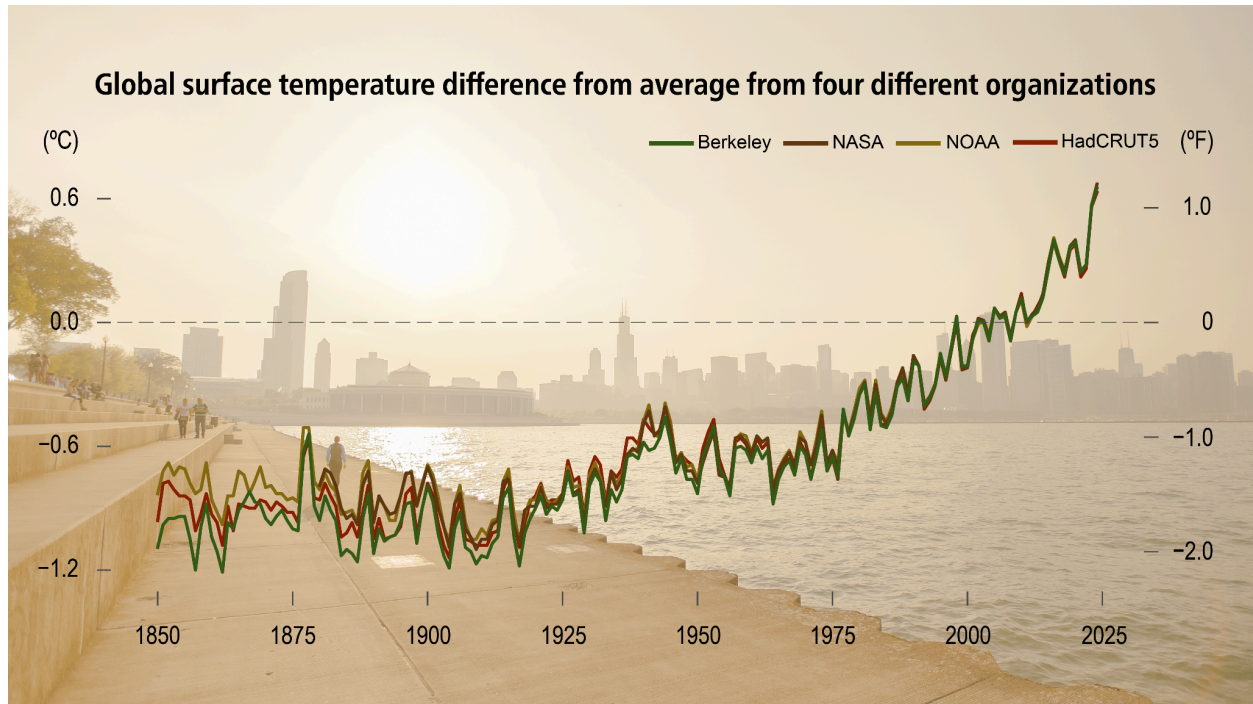
- **Glaciers around the world continued to melt.** For the second consecutive year, all 58 global reference glaciers across five continents lost mass in 2024, resulting in the greatest average ice loss in the 55-year record. In South America, Venezuela became the first Andes country to register the loss of all glaciers. In Colombia, the Conejeras Glacier was declared extinct, joining the list of glaciers that have disappeared in recent years.
- **Tropical cyclone activity was below average, but storms still set records around the globe.** A total of 82 named tropical cyclones were observed during the Northern and Southern Hemispheres' storm seasons, below the 1991–2020 average of 87 and equal to the number recorded in 2023. Many storms made landfall and some caused major damage. Hurricane Helene brought destruction from Florida to the southern Appalachian Mountains. The storm caused devastating record flooding that contributed to over 200 deaths, the most in the United States since Hurricane Katrina in 2005. Hurricane Milton impacted Florida's Gulf Coast just 12 days after Helene affected the region, marking the shortest time between major (Category 3 or higher) hurricane landfalls in Florida. In the northwest Pacific basin, Super Typhoon Yagi became one of the most destructive storms to affect China and Vietnam in recent years, causing more than 800 fatalities.

Selected Significant Climate Anomalies and Events: Annual 2024



Please note: Material provided in this map was compiled from NOAA's State of the Climate Reports. For more information please visit: <https://www.ncei.noaa.gov/access/monitoring/monthly-report/global/>

Geographical distribution of selected notable climate anomalies and events in 2024. (Fig. 1.1 in [The State of the Climate in 2024](#).)



Global surface temperature difference from average from four different organizations. The four datasets include: Berkeley, NASA, NOAA, and HadCRUT5, with Celsius temperature depicted on the left-hand side and Fahrenheit on the right-hand side. Credit: NOAA NCEI and UK Met Office.

The State of the Climate report is a peer-reviewed series published annually as a special supplement to the *Bulletin of the American Meteorological Society*. The journal makes the [full report openly available online](#).

About the American Meteorological Society

The American Meteorological Society (www.ametsoc.org) advances the atmospheric and related sciences, technologies, applications, and services for the benefit of society. Founded in 1919, AMS has a membership of around 12,000 professionals, students, and weather enthusiasts. AMS publishes 12 scientific journals in the atmospheric and related oceanic and hydrologic sciences; sponsors more than 12 conferences annually; and offers numerous programs and services to the weather, water, and climate community.