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## **Global Temperature Report: September 2023**

Global climate trend since Dec. 1 1978: +0.14 C per decade [see note at end]

### **September Temperatures (preliminary)**

Global composite temp: +0.90 C (+1.62°F) above the seasonal average

Northern Hemisphere: +0.94 C (+1.69°F) above seasonal average

Southern Hemisphere: +0.86 C (+1.55°F) above seasonal average

Tropics: +0.93 C (+1.67°F) above seasonal average

### **August Temperatures (final)**

Global composite temp: +0.70 C (+1.26°F) above the seasonal average

Northern Hemisphere: +0.88 C (+1.58°F) above seasonal average

Southern Hemisphere: +0.51 C (+0.92°F) above seasonal average

Tropics: +0.86 C (+1.55°F) above seasonal average

### **Notes on data released October 5, 2023 (v6.0, with 1991-2020 reference base)**

[Please note that we provide these data out of our own initiative, and are only able to produce these updates at times convenient to our working schedules.]

The global atmospheric temperature anomaly jumped in September to +0.90°C (+1.62°F) above the 30-year average, setting a new anomaly record for the 45-year satellite era. This month's departure easily outdistanced Feb 2016 when the temperature peaked then at +0.71 °C (+1.28 °F). This makes three months in a row that the previous temperature record was superseded as

the current El Niño came on in force earlier than is typical, warming up the atmosphere in these mid-year (and already warm) months. Though the tropics this month were warmer than any other September, the early-year months of Jan-Apr still hold the records for the largest departures from average in this equatorial belt. Besides the global record for departure from average, this month produced record departures for all months for the global land and ocean separately, NH land, and SH land and ocean.

As discussed in the past two months, July still represents the warmest global “absolute” monthly temperature (since July is already on average the hottest month each year) with a temperature 266.06 K. Because September is on average cooler than July, the absolute temperature this month was cooler too at 265.54 K even though the anomaly was larger (+0.90 K vs. +0.64 K). These very warm global atmospheric temperatures are expected to continue with the ongoing El Niño event through at least the boreal winter in 2024 since the tropical Pacific seawater temperatures are still warmer than average, especially for this time of year, though the tropical water temperatures appeared to have leveled off in the past two months. See NOAA’s updates here. [https://www.cpc.ncep.noaa.gov/products/analysis\\_monitoring/lanina/enso\\_evolution-status-fcsts-web.pdf](https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/lanina/enso_evolution-status-fcsts-web.pdf).

An interesting question at this point is, “When will the El Niño and its warming influence peak?” Since it began 4-5 months earlier than usual, will it peak earlier as well, or will it continue to maintain its strength until the typical peak in Feb-Apr? We will have to wait and see.

The planet’s warmest spot in September occurred over northern Poland at +4.1 °C (+7.5°F). Warmer than average conditions were pervasive in the tropical belt with exceptionally warm regions in Europe through western Russia, NW Canada, middle South America, southern Australia and the North Pacific Ocean.

With a reading of -2.0°C (-3.7°F), the coolest departure from average could be found over southern Chile. Cooler than average regions were few and far between but included the far North Atlantic, southern Chile, and Kazakhstan.

Unlike the globe as a whole, the conterminous US was only slightly above average at +0.40°C (+0.72°F), with the West being relatively cool. Alaska was even cooler than the lower 48, so with Alaska, the 49-state average was +0.29 °C (+0.52°F). [We don’t include Hawaii in the US results because its land area is less than that of one satellite grid square, so it would have virtually no impact on the overall national results.]

A note about the global temperature trend. For several years now, the trend has been extremely close to +0.135 °C/decade. This past July, the threshold of 0.135 was crossed at +0.1352 °C/decade. The global trend is now +0.14 °C/decade by rounding up.

\*In the July 2023 GTR we reported the February 2016 anomaly as +0.70 °C. As the intercalibrations between satellites are recalculated with each month’s new data, there is the

possibility of tiny changes in the base annual cycle ( $< 0.01$  °C), and thus the anomalies calculated therefrom. This is the reason for the February 2016 value being  $+0.71$  °C this month.

### **Background notes.**

**New Reference Base Jan 2021 and forward.** As noted in the Jan 2021 GTR, the situation comes around every 10 years when the reference period or “30-year normal” that we use to calculate the departures is redefined. With that, we have averaged the absolute temperatures over the period 1991-2020, in accordance with the World Meteorological Organization’s guidelines, and use this as the new base period. This allows the anomalies to relate more closely to the experience of the average person, i.e. the climate of the last 30 years. Due to the rising trend of global and regional temperatures, the new normals are a little warmer than before, i.e. the global average temperature for Januaries for 1991-2020 is  $0.14$  °C warmer than the average for Januaries during 1981-2010. So, the new departures from this now warmer average will appear to be cooler, but this is an artifact of simply applying a new base period. It is important to remember that changes over time periods, such as a trend value or the relative difference of one year to the next, will not change. Think about it this way, all we’ve done is to take the *entire* time series and shifted it down a little.

**To-Do List:** There has been a delay in our ability to utilize and merge the new generation of microwave sensors (ATMS) on the NPP and JPSS satellites. As of now, the calibration equations applied by the agency have changed at least twice, so that the data stream contains inhomogeneities which obviously impact the type of measurements we seek. We are hoping this is resolved soon with a dataset that is built with a single, consistent set of calibration equations. In addition, the current non-drifting satellite operated by the Europeans, MetOP-B, has not yet been adjusted or “neutralized” for its seasonal peculiarities related to its unique equatorial crossing time (0930). While these MetOP-B peculiarities do not affect the long-term global trend, they do introduce error within a particular year in specific locations over land.

As part of an ongoing joint project between UAH, NOAA and NASA, Christy and Dr. Roy Spencer, an ESSC principal scientist, use data gathered by advanced microwave sounding units on NOAA, NASA and European satellites to produce temperature readings for almost all regions of the Earth. This includes remote desert, ocean and rain forest areas where reliable climate data are not otherwise available. Drs. Danny Braswell and Rob Junod assist in the preparation of these reports.

The satellite-based instruments measure the temperature of the atmosphere from the surface up to an altitude of about eight kilometers above sea level. Once the monthly temperature data are collected and processed, they are placed in a "public" computer file for immediate access by atmospheric scientists in the U.S. and abroad.

The complete version 6 lower troposphere dataset is available here:

[http://www.nsstc.uah.edu/data/msu/v6.0/tlt/uahncdc\\_lt\\_6.0.txt](http://www.nsstc.uah.edu/data/msu/v6.0/tlt/uahncdc_lt_6.0.txt)

Archived color maps of local temperature anomalies are available on-line at:

<http://nsstc.uah.edu/climate/>

Neither Christy nor Spencer receives any research support or funding from oil, coal or industrial companies or organizations, or from any private or special interest groups. All of their climate research funding comes from federal and state grants or contracts.

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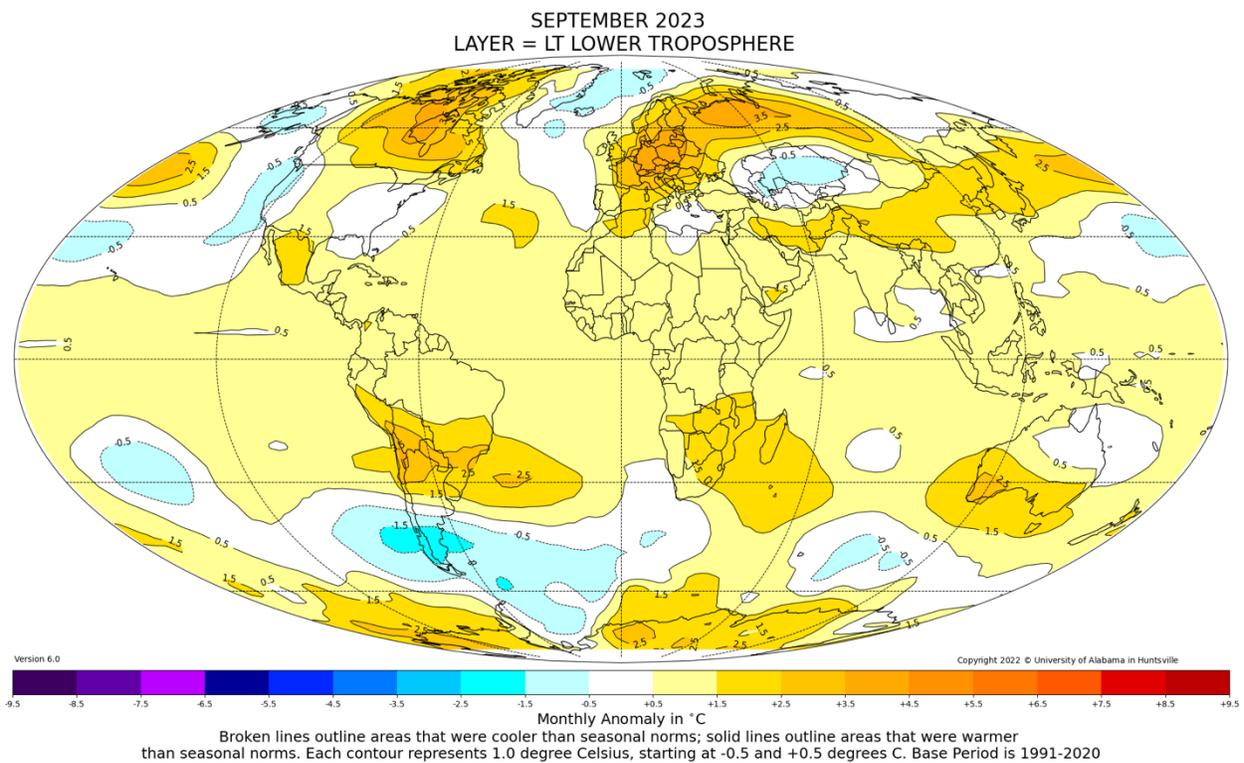


Figure. Lower tropospheric temperature anomalies for September 2023

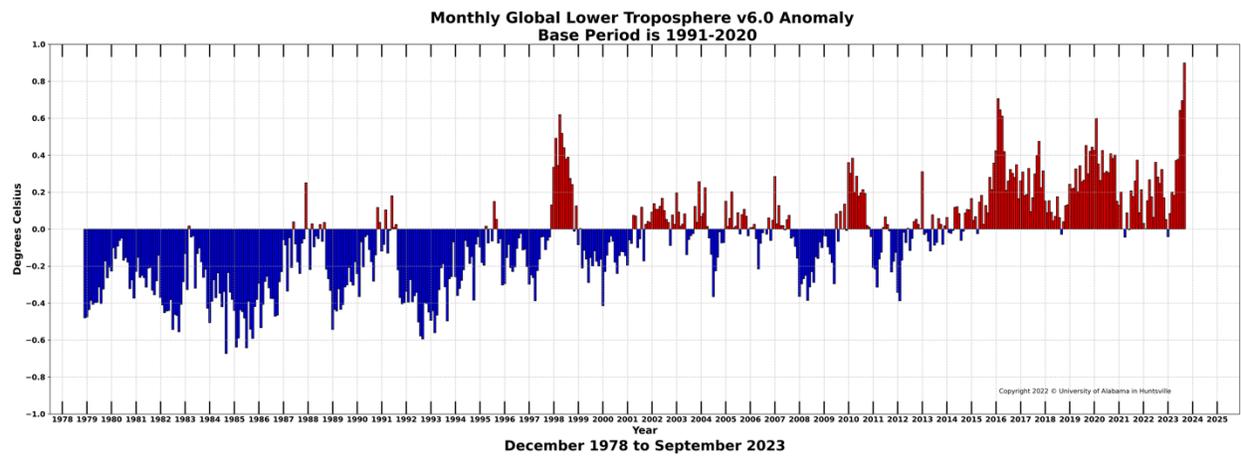


Figure. Bar chart of global monthly lower tropospheric temperature anomalies.