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Global Temperature Report: December 2023

Global climate trend since Dec. 1 1978: +0.14 C per decade

December Temperatures (preliminary)

Global composite temp: +0.83 C (+1.49°F) above the seasonal average

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

Southern Hemisphere: +0.73 C (+1.31°F) above seasonal average

Tropics: +1.08 C (+1.94°F) above seasonal average

November Temperatures (final)

Global composite temp: +0.91 C (+1.64°F) above the seasonal average

Northern Hemisphere: +1.01 C (+1.82°F) above seasonal average

Southern Hemisphere: +0.82 C (+1.48°F) above seasonal average

Tropics: +1.03 C (+1.85°F) above seasonal average

Notes on data released January 4, 2024 (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.]

Though down slightly from November's anomaly, the global atmospheric temperature departure for December ended the calendar year with the sixth-straight monthly record high at +0.83 °C (+1.49 °F). And, as calendar year values go, 2023 was the warmest of the 45-year record with an average of +0.51 °C (+0.92 °F) outdoing 2016 which finished that year at +0.39 °C (+0.70 °F). This

calendar year was also warmer than any other 12-month period which before 2023 was Dec 2015 to Nov 2016 at +0.41 °C (+0.73 °F). Because early 2023 was much cooler than now, we can expect further 12-month records over the next few months.

This major warm El Niño episode, a periodic warming of the tropical Pacific Ocean waters, remains strong and thus is keeping the atmosphere very warm as well. The tropical average temperature anomaly of +1.08 °C is the warmest December in the tropics in the 45-year satellite record. A value of 1.15°C in Feb 1998 still holds the record as the warmest tropical anomaly, but since El Niños often peak around Feb, there is a good chance that a new tropical record will be set in 2024. See NOAA's excellent updates here.
https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/lanina/enso_evolution-status-fcsts-web.pdf.

It is tempting to think that the global temperature peaked in October at +0.93 °C and that it is now on the decline, but changes of a tenth of a degree are very common and changes of more than 0.20 °C happen every few months. So, thinking we have reached the peak warming of this El Niño is not a good bet to make at this point.

The planet's warmest spot in December occurred over northeast Manitoba, Canada at +5.8 °C (+10.4°F) which was the center of a large warm region covering all of Canada and the northern conterminous US. The tropical Pacific displayed the familiar El Niño pattern of double warm regions on either side of the Intertropical Convergence Zone. Northern Africa eastward to China was well above average.

With a reading of -2.7°C (-4.9°F), the coolest departure from average could be found over southern Finland. Cooler than average temperatures extended in patches from Greenland eastward all the way to Alaska and the northeastern Pacific Ocean.

The conterminous US was above average at +1.26°C (+2.27°F), due mainly to the northern and western areas. It was cooler than average in the SE. Alaska was cooler than average, so with Alaska, the 49-state average was lowered to +0.92 °C (+1.66°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.]

2023

The year 2023 actually began with a La Niña-induced global anomaly of -0.04 °C but rose virtually every month to a peak in Oct (+0.93 °C) as La Niña became El Niño. The powerful El Niño reached the threshold to be classified as El Niño in May, about 6 months earlier in the year than usual and has grown to be one of the strongest as those seen in 1997-98 and 2015-16.

Attached are maps of the global anomalies in 2023 and the trend since Dec 1978. Notice on the map of trends that virtually all of the land north of 60°S indicates a magnitude above +0.15

°C/decade whereas most of the oceans are cooler than +0.15 °C/decade. A few spots on land warmed at a rate of as much as +0.35 °C/decade.

As noted above, the calendar year anomaly of +0.51 °C (+0.92°F) represents the warmest of the past 45 years as monitored by microwave sensors on polar-orbiting satellites. The global tropospheric temperature trend starting in 1979 is +0.14 °C per decade which is influenced by many factors operating on differing time scales. If we remove the influence of the early volcanic cooling episodes (El Chichon 1982, Mt. Pinatubo 1991) the background climate-trend is about +0.1 °C per decade and could represent the warming effect of the extra greenhouse gases that are being added to the atmosphere as human development progresses (see Christy and McNider 2017 for details of this type of analysis).

With temperatures so warm at the present, it is very likely 2024 will be well above average too, even though NOAA's various forecasting tools suggest this El Niño will end mid-year.

Background notes.

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.

A note about the global temperature trend. For several years, 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.

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

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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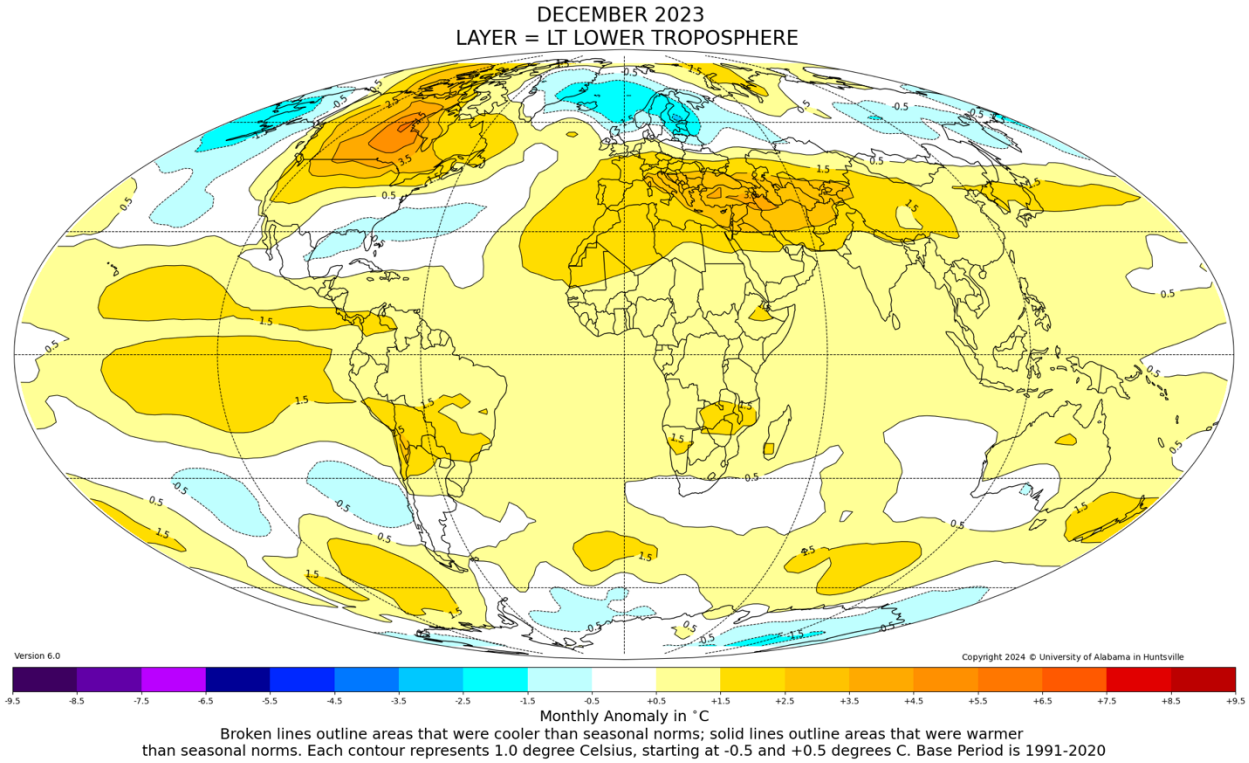

Figure. Lower tropospheric temperature anomalies for December 2023

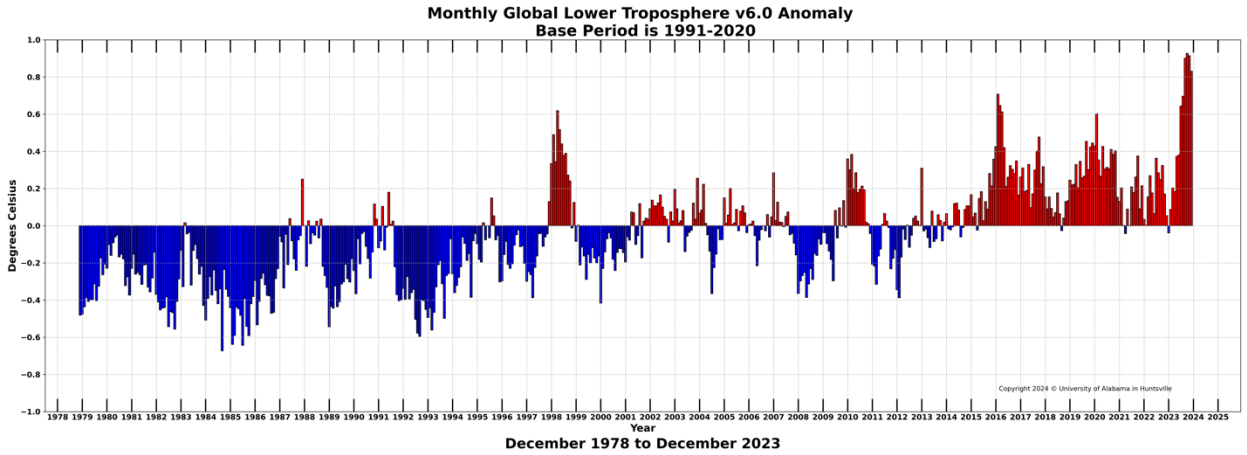

Figure. Bar chart of global monthly lower tropospheric temperature anomalies.

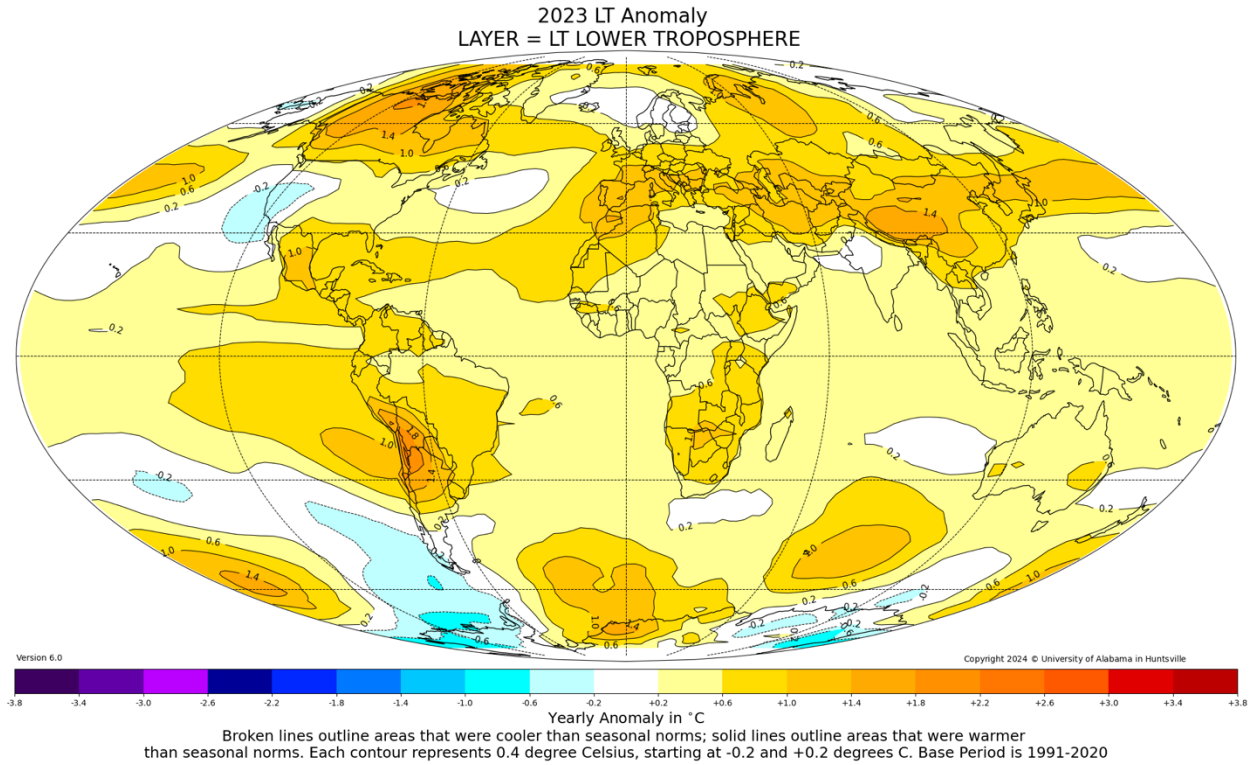

Figure. Lower tropospheric temperature anomalies for 2023.

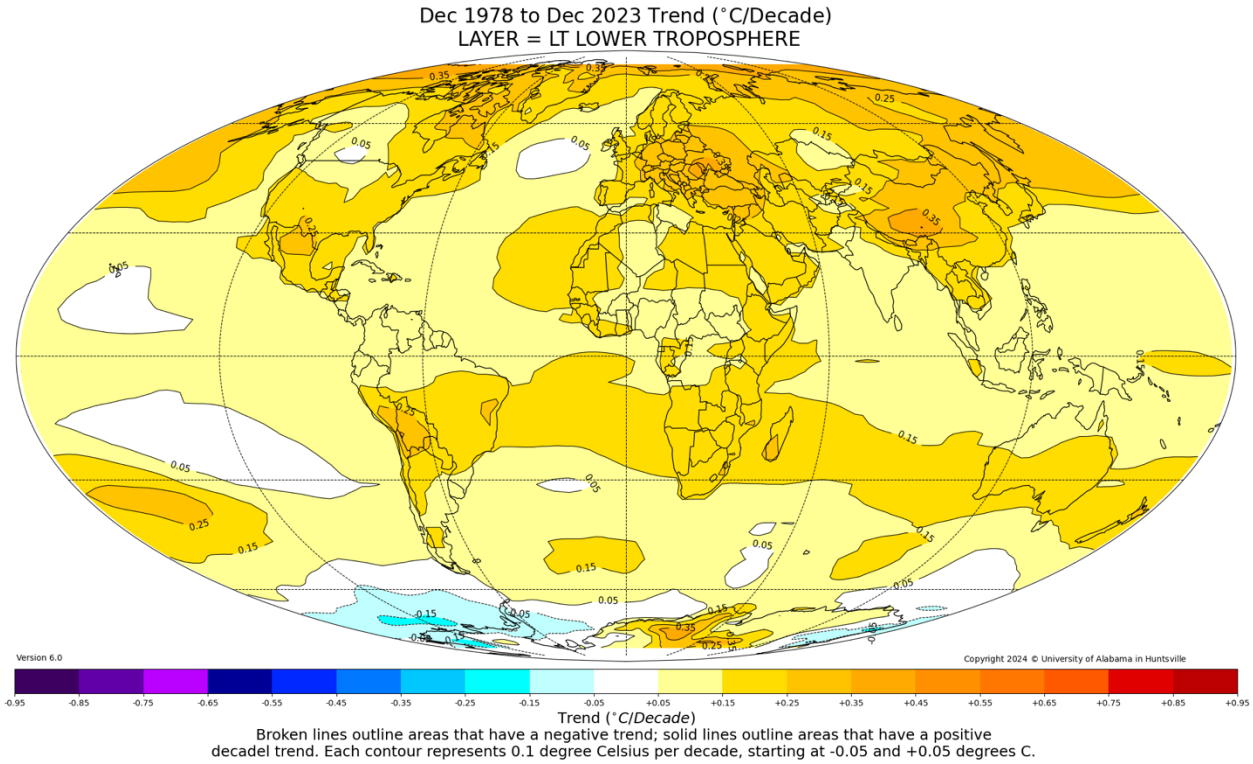

Figure. Decadal trend (°C/decade) of lower tropospheric temperature anomalies for Dec 1978 through Dec 2023.