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Global Temperature Report: Dec 2022 and Annual 2022

Global climate trend since Dec. 1 1978: +0.13 C per decade

December Temperatures (preliminary)

Global composite temp.: +0.05 C (+0.09°F) above the seasonal average

Northern Hemisphere: +0.13 C (+0.23 °F) above seasonal average

Southern Hemisphere: -0.03 C (-0.05 °F) below seasonal average

Tropics: -0.35 °C (-0.63°F) below seasonal average

November Temperatures (final)

Global composite temp.: +0.17 C (+0.31°F) above the seasonal average

Northern Hemisphere: +0.21 C (+0.36 °F) above seasonal average

Southern Hemisphere: +0.13 C (+0.23 °F) above seasonal average

Tropics: -0.16 °C (-0.29°F) below seasonal average

Notes on data released January 3, 2023 (v6.0, with 1991-2020 reference base)

The global atmospheric temperature departure-from-average in December fell from November down to +0.05 °C (+0.09 °F), just above the long-term average. The drop was most evident over the tropics, down 0.19 °C (34°F) to -0.35 °C (-0.63 °F) as the third year of the La Niña phase is impacting temperatures there. The tropical value essentially tied with Jun 2022 as the coolest departure since April 2012.

Calculating calendar year anomalies is popular given the interest in climate issues today. The average of the daily global anomalies for the year 2022 was +0.17 °C (+0.31 °F), up a little from +0.14 °C in 2021 and down from +0.36 °C in 2020. The warmest calendar year was +0.39 °C in 2016, the year of the major El Niño warm phase. At -0.50 °C, 1985 still holds the 43-year record low value.

2022 ended up as the 7th warmest of the past 43 years, but given the error probabilities we would say 2022 was likely the 6th to 9th warmest. This is remarkable for a La Niña year and indicates not only a positive temperature trend over the period, but the exceptional warmth in the northern midlatitudes this year. Indeed, the temperature departure for the area poleward of 20°N latitude averaged +0.42 °C (+0.76°F) above the 30-year average. The tropics came in at -11 °C (-0.20°F) below the average.

The overall trend since Dec 1978 is stuck, as it has been for several years, about halfway between +0.13 and +0.14 °C per decade. As noted last month, the splitting of hairs as to whether to report +0.13 or +0.14 is not important as the estimate of the error range of these observations is ± 0.04 °C/decade.

The latest values of various El Niño/La Niña indices indicate the La Niña (cold phase of the cycle) continues and is predicted to continue through the NH winter, though its demise is forecast to occur late next NH spring. The impact of the colder-than-average tropical Pacific Ocean surface temperatures induces a complex response in the atmospheric temperatures we report here, but in a very simple sense, cooler water will warm the atmosphere less than usual, causing it to be cooler than average (note the tropical atmospheric temperature in Dec was -0.35 °C). The latest on the evolution of La Niña and its anticipated diminishment in 2023 is provided by NOAA here: https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/lanina/enso_evolution-status-fcsts-web.pdf.

The planet's warmest spot in December, in terms of the monthly departure from average, occurred over the Arctic Ocean near the Dateline at +4.8 °C (+8.7 °F). The map indicates the wavy nature of these departures with hot spots in the North Pacific, NE Canada, middle Europe and SE China.

With a reading of -3.4 °C (-6.2°F) the coolest departure from average could be found over Northern Alberta. The impact on the atmospheric temperature of the cool tropical Pacific waters is evident. Western Canada, as noted was chilly and negative departures falling in between the hot spots noted above.

For 2022 as a whole, the warmest region was in the Tibetan area (+1.5 °C, +2.7 °F) and the coldest in the South Pacific Ocean near Tatakoto (French Polynesia) thanks to the strong La Niña. In terms of the trends, the most rapidly warming regions are found over mid and high latitude regions of the northern hemisphere, especially from China through the North

Pacific, the Arctic and back toward Eastern Europe and Northern Russia. Since the climate of the last 2.5 years has been under the influence of the cool La Niña, the subtropical regions that straddle the equator in the eastern tropical Pacific show little trend at all. In general Antarctica and the bordering ocean is not participating in the general rise seen elsewhere.

The conterminous US was a bit below average in December (-0.21 °C, -0.38 °F). However, Alaska was so much warmer that the mean, that the 49-state average climbed into positive territory at +0.08 °C (+0.14°F). For the Year, the conterminous US averaged +0.22 °C (+0.40°F). The warmest year for the lower 48 was 2015 at +0.59 °C and the coolest -0.72 °C thanks in part to the cooling of the Mt. Pinatubo volcanic aerosols. [We don't include Hawaii in the US results because its land area is less than that of a satellite grid square, so it would have virtually no impact on the overall national results.]

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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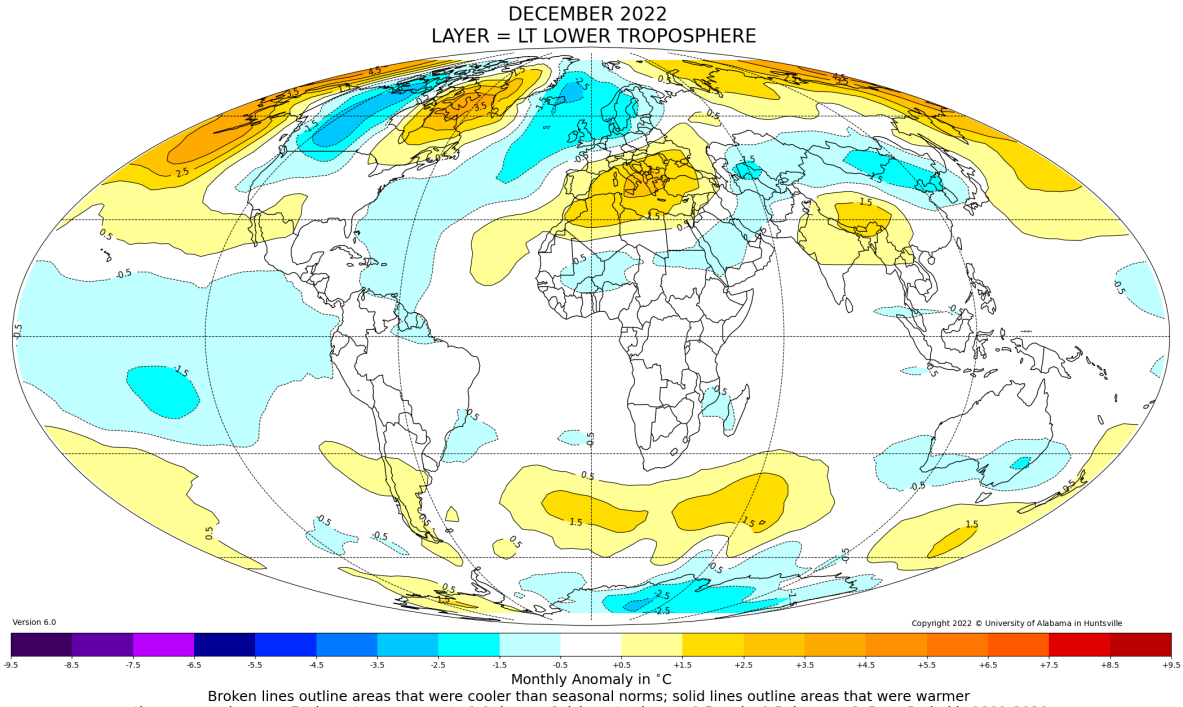

Figure. Lower tropospheric temperature anomalies for December 2022

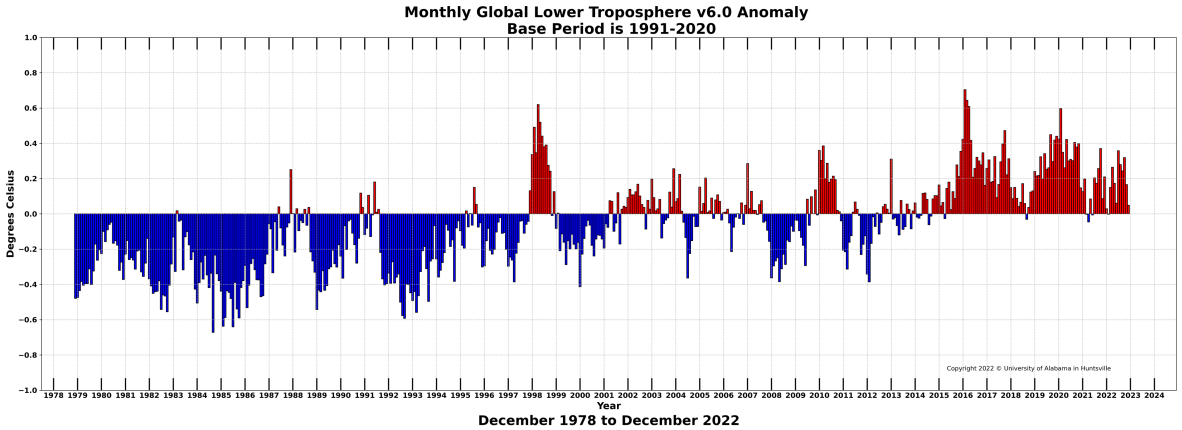

Figure. Bar chart of global monthly lower tropospheric temperature anomalies.

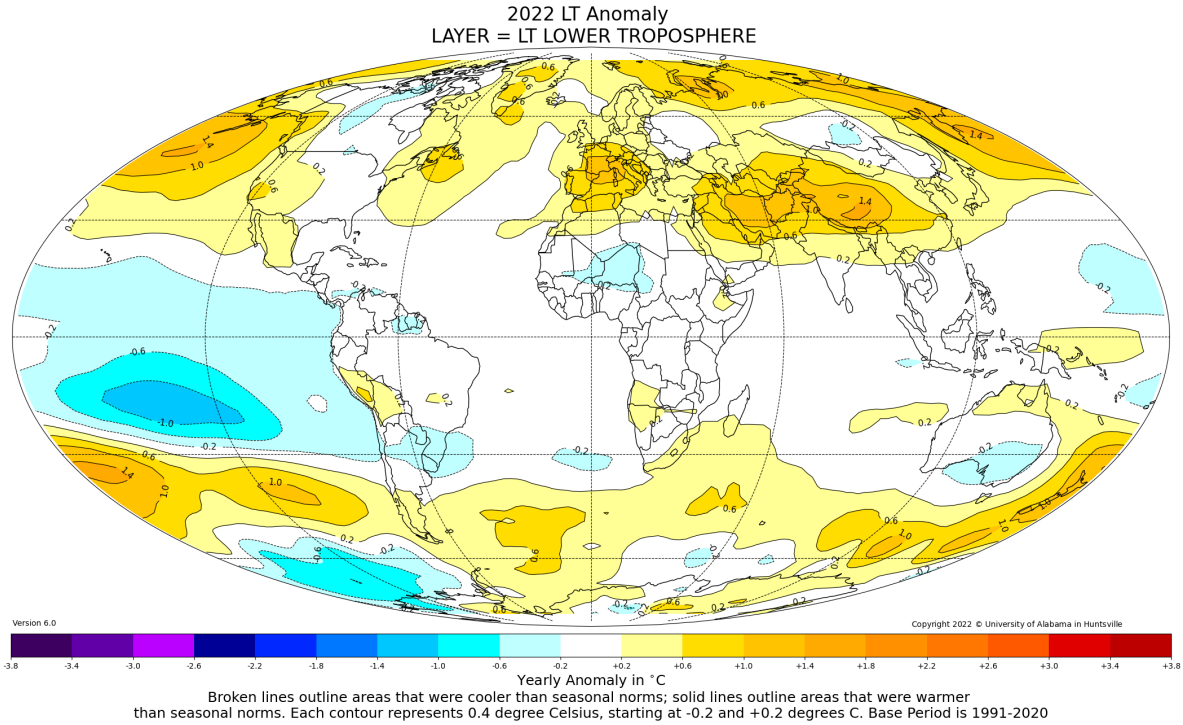

Figure. Lower tropospheric temperature anomalies for the years 2022

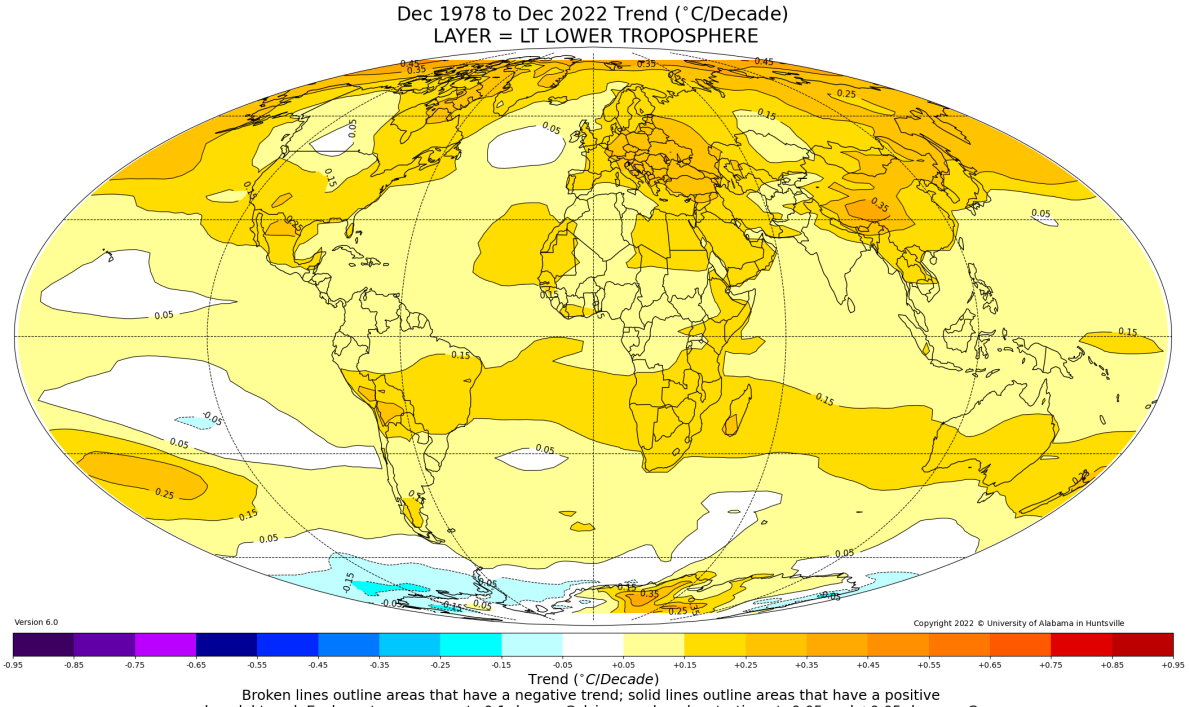

Figure. 43-year grid point trends of the lower tropospheric temperature, Dec 1978 to Dec 2022 (°C per decade.)