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Global Temperature Report: December 2019

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

December Temperatures (preliminary)

Global composite temp.: +0.56 C (+1.01 °F) above seasonal average

Northern Hemisphere.: +0.61 C (+1.10°F) above seasonal average

Southern Hemisphere.: +0.50 C (+0.90°F) above seasonal average

Tropics.: +0.58 C (+1.04°F) above seasonal average

November Temperatures (final)

Global composite temp.: +0.55 C (+0.99 °F) above seasonal average

Northern Hemisphere.: +0.56 C (+1.01°F) above seasonal average

Southern Hemisphere.: +0.54 C (+0.97°F) above seasonal average

Tropics.: +0.55 C (+0.99°F) above seasonal average

Notes on data released January 3, 2019 (v6.0), completing 41 calendar years

The year 2019 ended with December following November's example of producing record warmth in the 41+ years of satellite observations. The globally-averaged, bulk-layer atmospheric temperature anomaly of +0.56°C (+1.01°F) was almost exactly the same as measured in November and higher than the second-place December of +0.47 °C in 2015. As noted last month, November and December are characterized by generally lower variability than other months, so that the record departure of +0.56 °C for December is still less in magnitude than record values for other months such as January through May.

For the calendar year as a whole, 2019 was quite warm at +0.44 °C (+0.79 °F), slightly below the second-place year of 1998 (+0.48 °C) and below the warmest year of 2016 (+0.53 °C). Since 1998 and 2019 are separated by only +0.04 °C, it could be argued that they actually tied for second place. The warmth in 2019 came, in part, from the modest El Niño that carried into mid-year as seen in the tropical warmth over the Pacific Ocean (see annual map). For the year as a whole, very warm air covered Alaska and its surroundings, Eastern Europe, eastern Asia, central South America eastward through South Africa to southern Australia as well as portions of the Arctic. Pakistan, parts of the southern oceans and western US through central Canada were cooler than average. The overall 41+ year trend continues at +0.13 °C per decade.

Calendar Year Global, Bulk Atmospheric Temperature departures from 1981-2010 average.

Year	Temp		Year	Temp
1979	-0.21			
1980	-0.04		2000	-0.02
1981	-0.11		2001	0.12
1982	-0.30		2002	0.22
1983	-0.04		2003	0.19
1984	-0.24		2004	0.08
1985	-0.36		2005	0.20
1986	-0.22		2006	0.11
1987	0.05		2007	0.16
1988	0.04		2008	-0.10
1989	-0.21		2009	0.09
1990	0.01		2010	0.33
1991	0.02		2011	0.02
1992	-0.28		2012	0.05
1993	-0.20		2013	0.14
1994	-0.06		2014	0.18
1995	0.07		2015	0.28
1996	-0.01		2016	0.53
1997	-0.01		2017	0.40
1998	0.48		2018	0.23
1999	-0.02		2019	0.44

The conterminous U.S. as a whole experienced a warmer-than-average December (+0.92°C, +1.64 °F). It was a little cooler than this average in Alaska, so that the 49-state area's temperature departure was +0.85 °C (+1.53 °F). 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.

Globally, locations with sustained warmer-than-average temperatures for the month appeared over most of Europe and western Russia, Japan, Antarctica, the Australian Bight, eastern North America and southeastern Pacific Ocean. The globe's warmest spot was near the village of Kopu in Estonia (+3.8 °C, +6.8 °F).

The planet's coldest departure from average this month was -3.3 °C (-6.0 °F) in the South Pacific Ocean. Other areas of cooler than average temperatures occurred over portions of the mid-latitude southern oceans, Greenland/No. Atlantic and eastern Asia.

With this report we now begin the 42nd year of atmospheric temperature data monitored by several satellites beginning with TIROS-N in late 1978. Our first complete month was December 1978, so December 2019 is our 42nd to evaluate.

Spoiler Alert first published March 2019: As noted over the past several months in this report, the drifting of satellites NOAA-18 and NOAA-19, whose temperature errors were somewhat compensating each other, will be addressed in this updated version of data released from March 2019 onward. As we normally do in these situations we have decided to terminate ingestion of NOAA-18 observations as of 1 Jan 2017 because the corrections for its significant drift were no longer applicable. We have also applied the drift corrections for NOAA-19 now that it has started to drift far enough from its previous rather stable orbit. These actions will eliminate extra warming from NOAA-18 and extra cooling from NOAA-19. The net effect is to introduce slight changes from 2009 forward (when NOAA-19 began) with the largest impact on annual, global anomalies in 2017 of 0.02 °C. The 2018 global anomaly changed by only 0.003°C, from +0.228°C to +0.225°C. These changes reduce the global trend by -0.0007 °C/decade (i.e. 7 ten-thousandths of a degree) and therefore does not affect the conclusions one might draw from the dataset. The v6.0 methodology is unchanged as we normally stop ingesting satellites as they age and apply the v6.0 diurnal corrections as they drift.

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. Research Associate Rob Junod assists 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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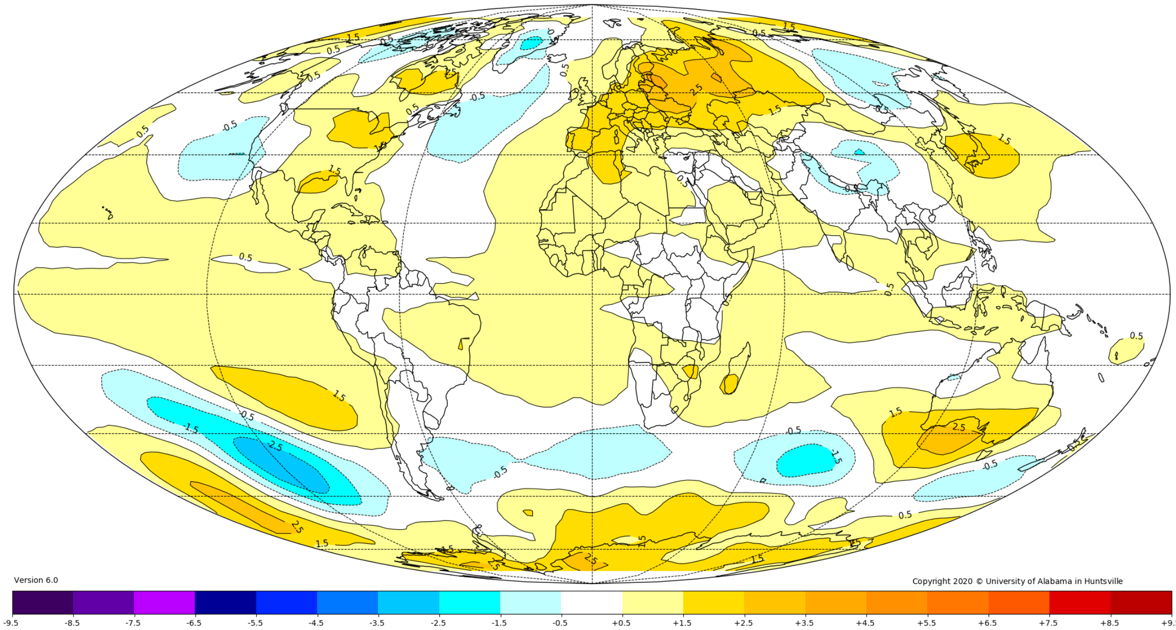
DECEMBER 2019
LAYER =LT LOWER TROPOSPHERE



Monthly Anomaly in $^\circ$C
Broken lines outline areas that were cooler than seasonal norms; solid lines outline areas that were warmer than seasonal norms. Each contour represents one degree Celsius, starting at -0.5 and +0.5 degrees C.

DECEMBER 2019
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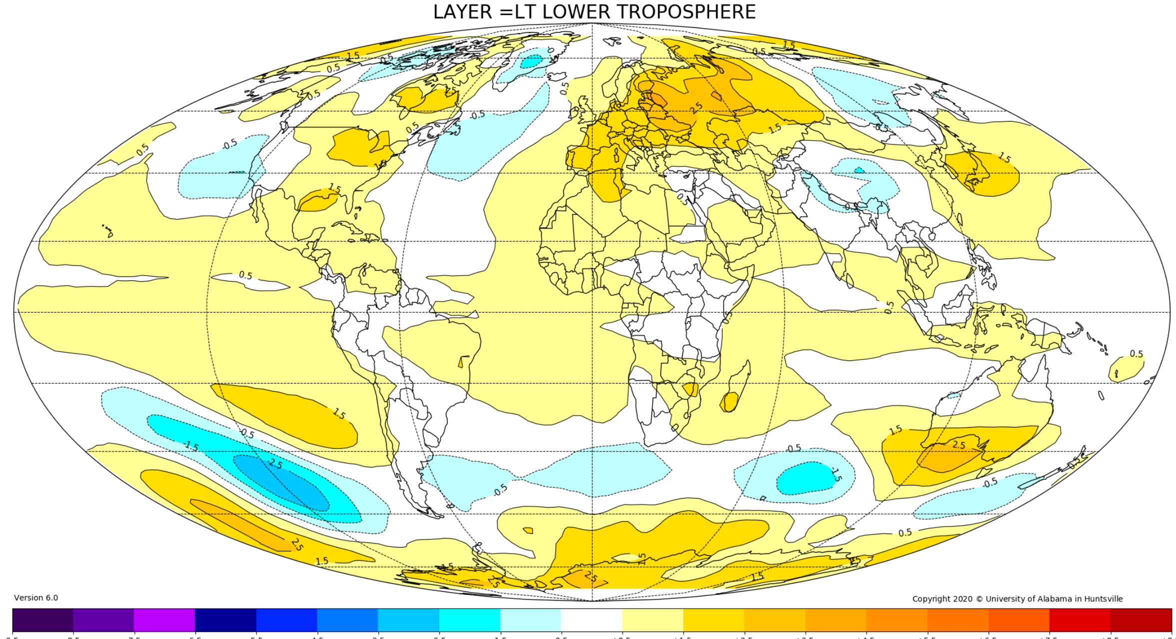

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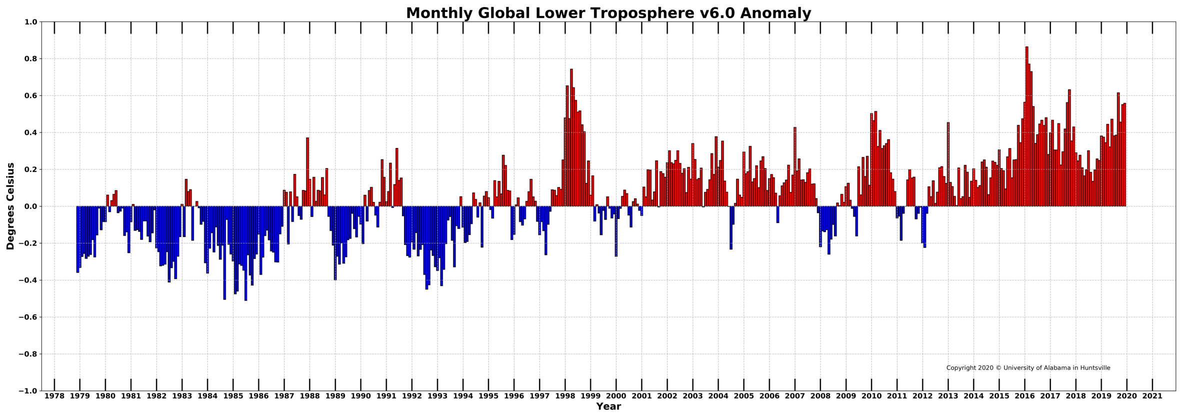

December 1978 to December 2019