

## DOCKETED

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*Comment Received From: Gene Nelson, Ph.D.*

*Submitted On: 1/19/2016*

*Docket Number: 15-IEPR-01*

## **Climate Change Impacts on California Energy Supply and Demand**

Global warming, which is being exacerbated by the massive natural gas leak at the Aliso Canyon Storage Field (ACSF) well "Standard Sesnon 25" (SS-25,) is impacting California energy supply and demand. Methane, which strongly absorbs in the infrared frequencies, has a GHG effect about 70 times that of CO<sub>2</sub> over a 20 year time frame. Eventually, atmospheric methane is oxidized to CO<sub>2</sub> and water, leading to less intense effects over longer time frames. In early December, 2015, the SS-25 leak was releasing as much methane as 25% of the baseline value of all methane leaks in California.

California hydroelectric generation is showing a negative trend during the interval from 1983 to present, per the California Energy Almanac. This trend is coupled to global warming, as rising temperatures tend to diminish California rainfall and snowpack. A graph of California hydroelectric generation is shown in the first figure. Hydroelectric generation, which is concentrated in northern California, is down from a peak of 59,244 GWh in 1983 to the 2014 nadir of 14,041 GWh. With an annual average of 32,434 GWh, the 2014 total is 18,393 GWh below average. To put that figure in perspective, that shortage is approximately equal to the annual electric production of Diablo Canyon Power Plant (DCPP.)

Given the record California drought that continued through 2015, 2015 hydropower statistics should be comparable to 2014.

As temperatures rise, the demand for air conditioning increases, further straining the California energy infrastructure.

While there has been considerable media attention devoted to the possibility of an El Nino event bringing much-needed rain to California, California central coast reservoir levels remain parched and the NOAA statewide precipitation figures for the past 90 days preceding 18 January 2016 show that a drought persists throughout the state. (See the 17 January 2016 article, "Reservoirs remain unchanged after rainfall" and the slide from the NOAA El Nino presentation dated 18 January 2016.)

To gain some insight into the coupling between rising greenhouse gas (GHG) levels and increased temperature, a set of four figures have been reproduced from a pair of detailed NOAA online publications,

NOAA Global Climate Analysis - November 2015

<https://www.ncdc.noaa.gov/sotc/global/201511>

The NOAA Annual Greenhouse Gas Index (AGGI) - Updated Spring, 2015

<http://www.esrl.noaa.gov/gmd/aggi/aggi.html>

A figure showing the rising atmospheric levels of methane is shown, followed by an overview of the rising CO<sub>2</sub> levels between 1958-2016 and a detail for the last five years. Rising CO<sub>2</sub> concentrations means rising global temperatures, as is shown by the November, 2015 world-wide climate anomalies and the land and ocean temperature percentiles. While methane's atmospheric concentration is much lower than the carbon dioxide level, the AGGI graphic shows that during the study period, methane is about 1/6 of the GHG index.

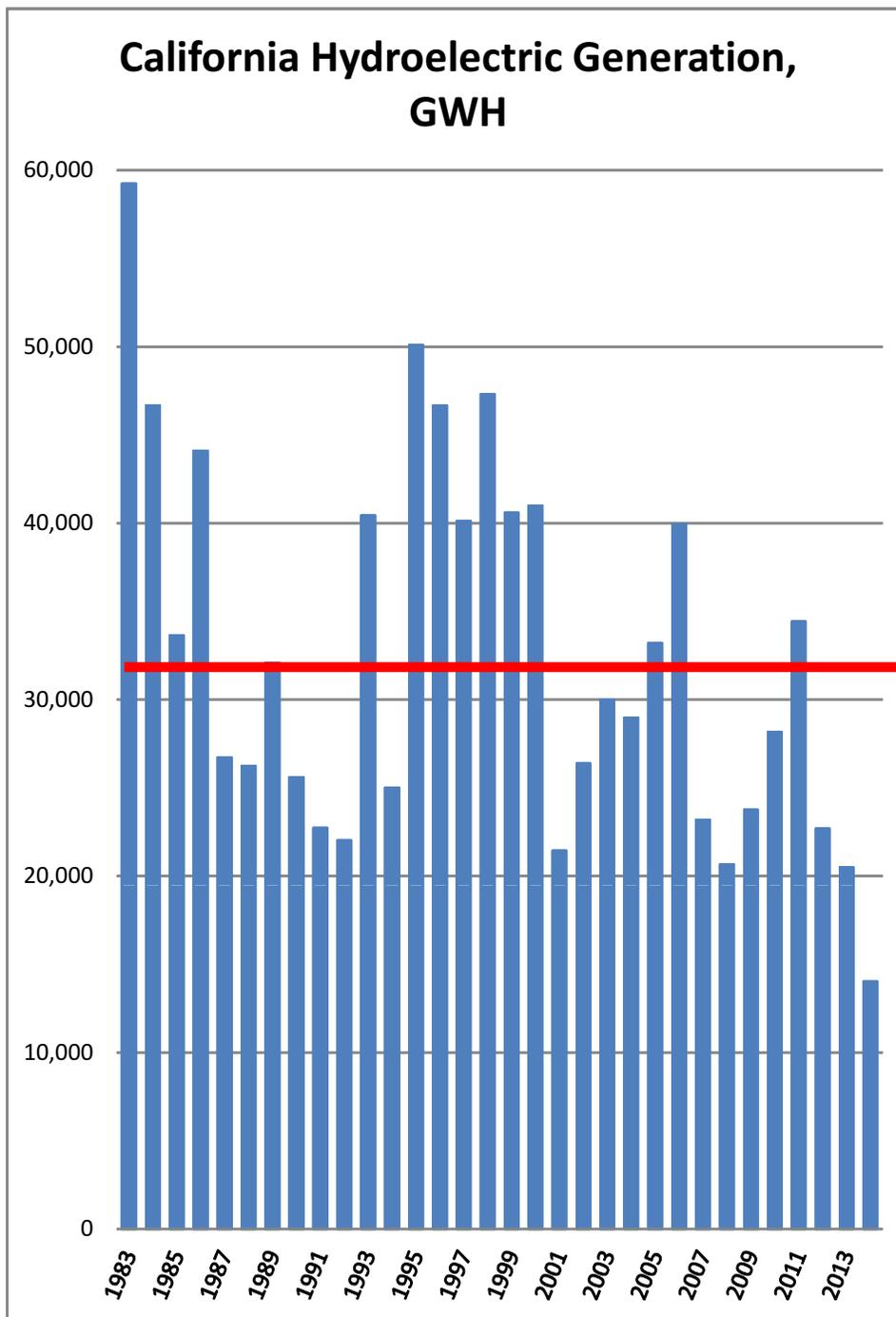
In order to implement meaningful GHG reductions in California, the use of reliable, abundant, reasonably-priced nuclear power should be strongly encouraged in California.

Finally, Alex Whittington, a sophomore chemical engineering and chemistry student at Louisiana State University at Lafayette should be commended for his attached 12 January 2016 article in the student paper, "Wimpy winter

comes to end, 2015 hottest year on record" regarding the warm winter in his state. His article alerted me to the valuable NOAA resources that I utilized in this docket entry.

*Additional submitted attachment is included below.*

Year	Hydro-electric GWH
1983	59,244
1984	46,687
1985	33,639
1986	44,117
1987	26,727
1988	26,259
1989	32,096
1990	25,612
1991	22,728
1992	22,033
1993	40,440
1994	25,024
1995	50,089
1996	46,660
1997	40,122
1998	47,326
1999	40,593
2000	41,001
2001	21,449
2002	26,395
2003	29,984
2004	28,992
2005	33,210
2006	39,979
2007	23,204
2008	20,676
2009	23,767
2010	28,166
2011	34,437
2012	22,693
2013	20,506
2014	14,041
<b>Average</b>	<b>32,434</b>



Average,  
1983-2014

Sources: [http://energyalmanac.ca.gov/electricity/electricity\\_generation.html](http://energyalmanac.ca.gov/electricity/electricity_generation.html)  
[http://energyalmanac.ca.gov/electricity/electricity\\_generation.html#pre2000](http://energyalmanac.ca.gov/electricity/electricity_generation.html#pre2000)  
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# Reservoirs remain unchanged after rainfall

Kenny Lindberg [klindberg@leecentralcoastnews.com](mailto:klindberg@leecentralcoastnews.com)

Jan 17, 2016

[http://santamariatimes.com/news/local/features/el\\_nino/reservoirs-remain-unchanged-after-rainfall/article\\_d875a850-a209-5aea-af13-8f824ea15fe1.html](http://santamariatimes.com/news/local/features/el_nino/reservoirs-remain-unchanged-after-rainfall/article_d875a850-a209-5aea-af13-8f824ea15fe1.html)

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- Len Wood, Staff

Visitors to Cachuma Lake walk down stairs and, then, a long path to reach the water and boats Friday. Recent rains have had little impact on the level of the water reservoir.



- Len Wood, Staff

Cachuma Lake naturalist Rosie Bishop talks to visitors Friday before a tour of the reservoir to see the wildlife that live there. They are standing on the boat launch ramp used when the lake is full. Recent rains have had little impact on the water level.

While rainfall has certainly drenched Santa Barbara County in periods this winter, the runoff has not produced any major impacts on reservoirs, as capacity levels have remained virtually unchanged.

“We typically need 10 to 15 inches until we get any runoff,” said Tom Fayram, the county’s deputy director of water resources. “We’re still a long way from that.”

The heaviest rainfall this winter occurred during the week of Jan. 3, when four separate storms hit the region in a span of roughly five days.

“We need a couple more of those storms to get some runoff,” Fayram said. “We definitely need more rain to get to that point.”

Runoff increases dramatically with one strong storm, rather than many small storms, Fayram said. For example, a rain event with 10 inches in one day would produce more runoff than five storms with 2 inches each.

“It all depends on how fast it comes,” he said.

The county's most heavily used reservoir is Cachuma, which has a storage capacity of 193,305 acre-feet. Currently, it's at 14.7 percent of capacity with 28,399 acre-feet, according to Friday's county rainfall and reservoir summary. An acre-foot of water equals about 326,000 gallons.

Jameson Reservoir is at 15-percent capacity, while Gibraltar is at 9.6 percent. Both of those have storage capacities just over 5,000 acre-feet.

Twitchell Reservoir, near Santa Maria, has the county's largest storage capacity at 194,971 acre-feet, but the reservoir is well below capacity at 0.2 percent or 475 acre-feet.

But one month of heavy rainfall could make a huge difference, Fayram said.

In December 2004, water levels reached 78,000 acre-feet at Cachuma. A month later, water spilled over after heavy rainfall in January 2005.

With meteorologists predicting heavy rainfall this winter as a result of El Nino, history very well could repeat itself, Fayram said.

"It's absolutely possible. If we get into that pattern in February or March, we could absolutely fill it."

But so far, the winter hasn't produced much rainfall. In fact, the countywide average rainfall percentage is at 77 percent, which means this winter has produced less rainfall than an average winter.

Santa Maria is typically not impacted by the water levels at the reservoirs as the city relies on groundwater. Instead, the reservoir mostly impacts the Santa Ynez Valley and most of South County.

The next significant weather system is predicted by both AccuWeather and The Weather Channel to occur sometime toward the end of the month. The National Weather Service could not confirm that claim, since they do not provide forecasts more than seven days in advance.

**Kenny Lindberg** covers Santa Barbara County for Lee Central Coast Newspapers. Follow him on [Twitter](#).

## Reservoir summary

Reservoir	Maximum storage	Current storage	Current pct.
Cachuma	193,305	28,399	14.7
Gibraltar	5,246	506	9.6
Jameson	5,144	744	15
Twitchell	194,971	475	0.2

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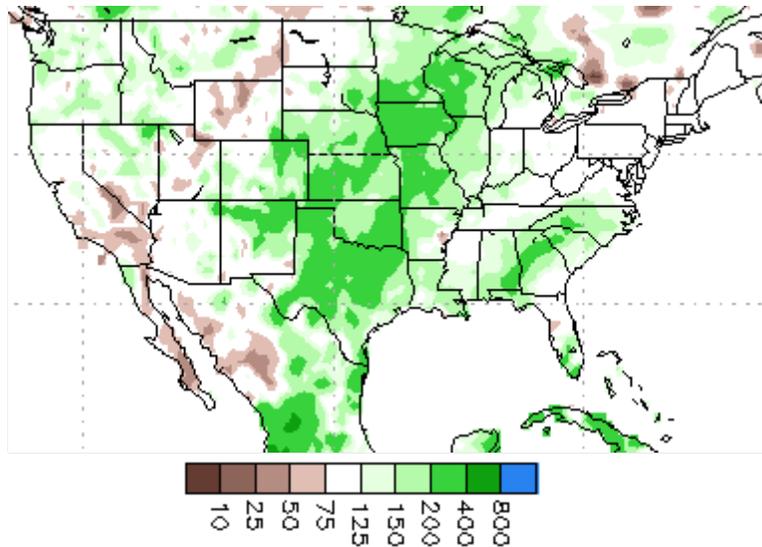
# U.S. Temperature and Precipitation Departures During the Last 90 Days

[http://www.cpc.ncep.noaa.gov/products/analysis\\_monitoring/lanina/enso\\_evolution-status-fcsts-web.pdf](http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/lanina/enso_evolution-status-fcsts-web.pdf) Archived 01 19 16 by Gene A. Nelson, Ph.D.  
El Nino Southern Oscillation - Evolution, condition and status 18 January 2016 Page 30 of 32

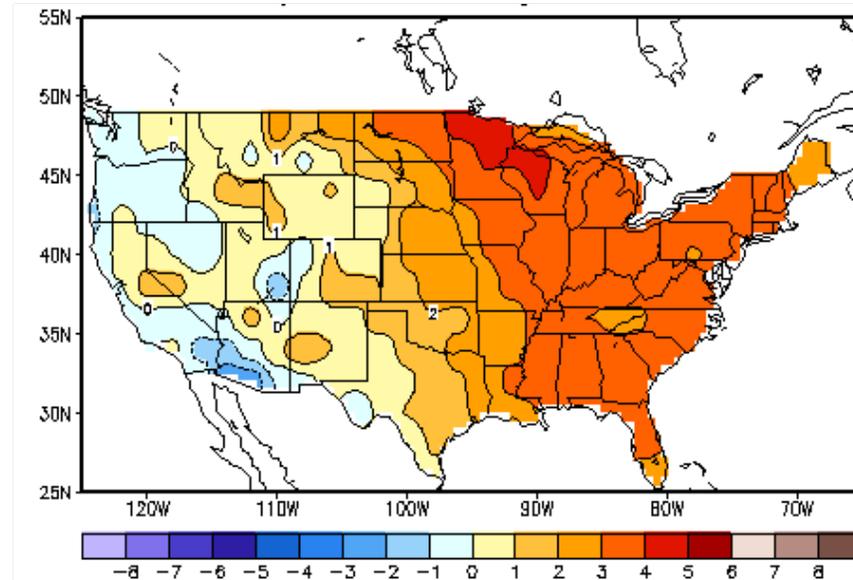
End Date: 17 January 2016

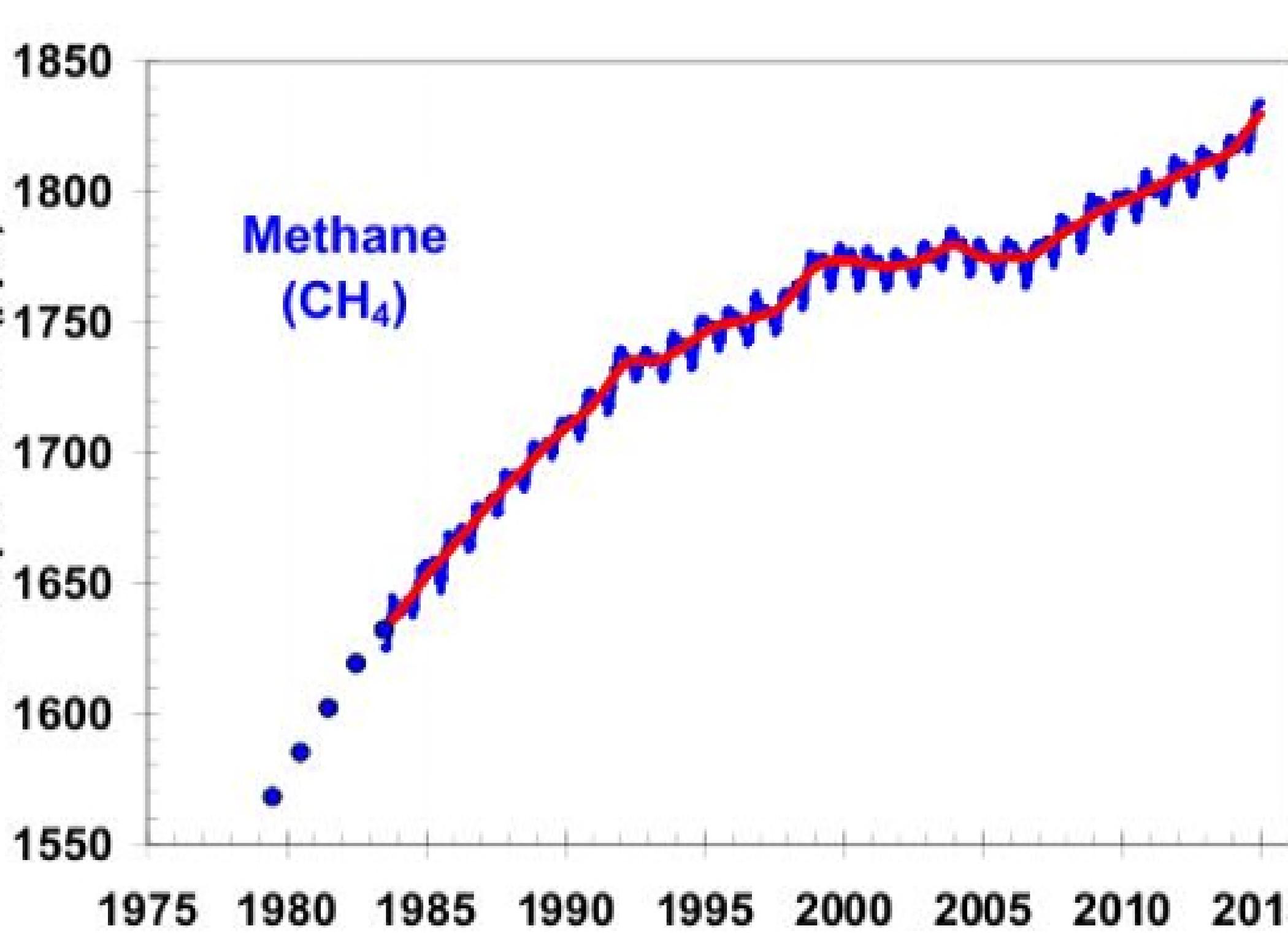
Note the significant **precipitation deficit** for California during the last 90 days. - GN

Percent of Average Precipitation

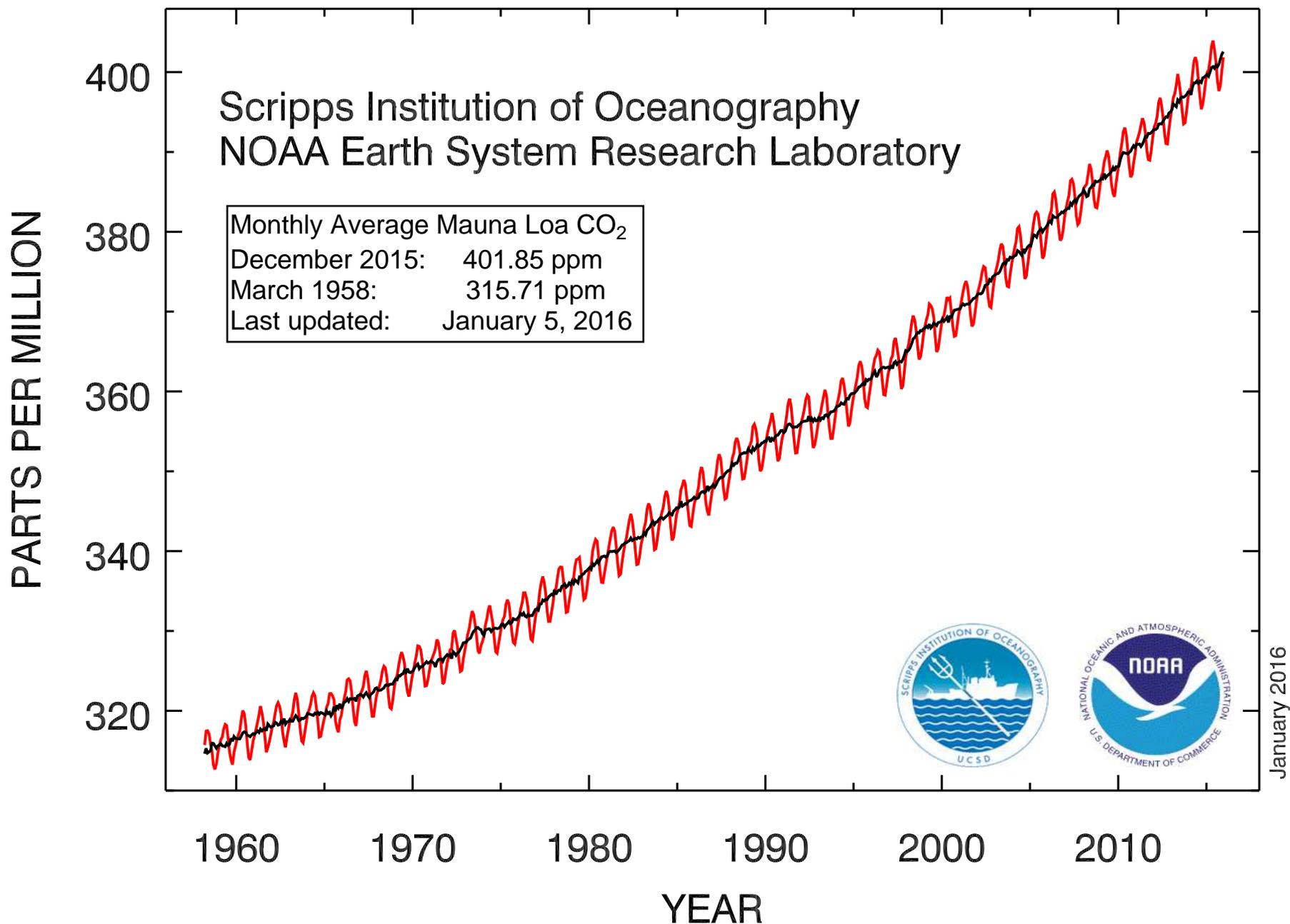


Temperature Departures (degree C)

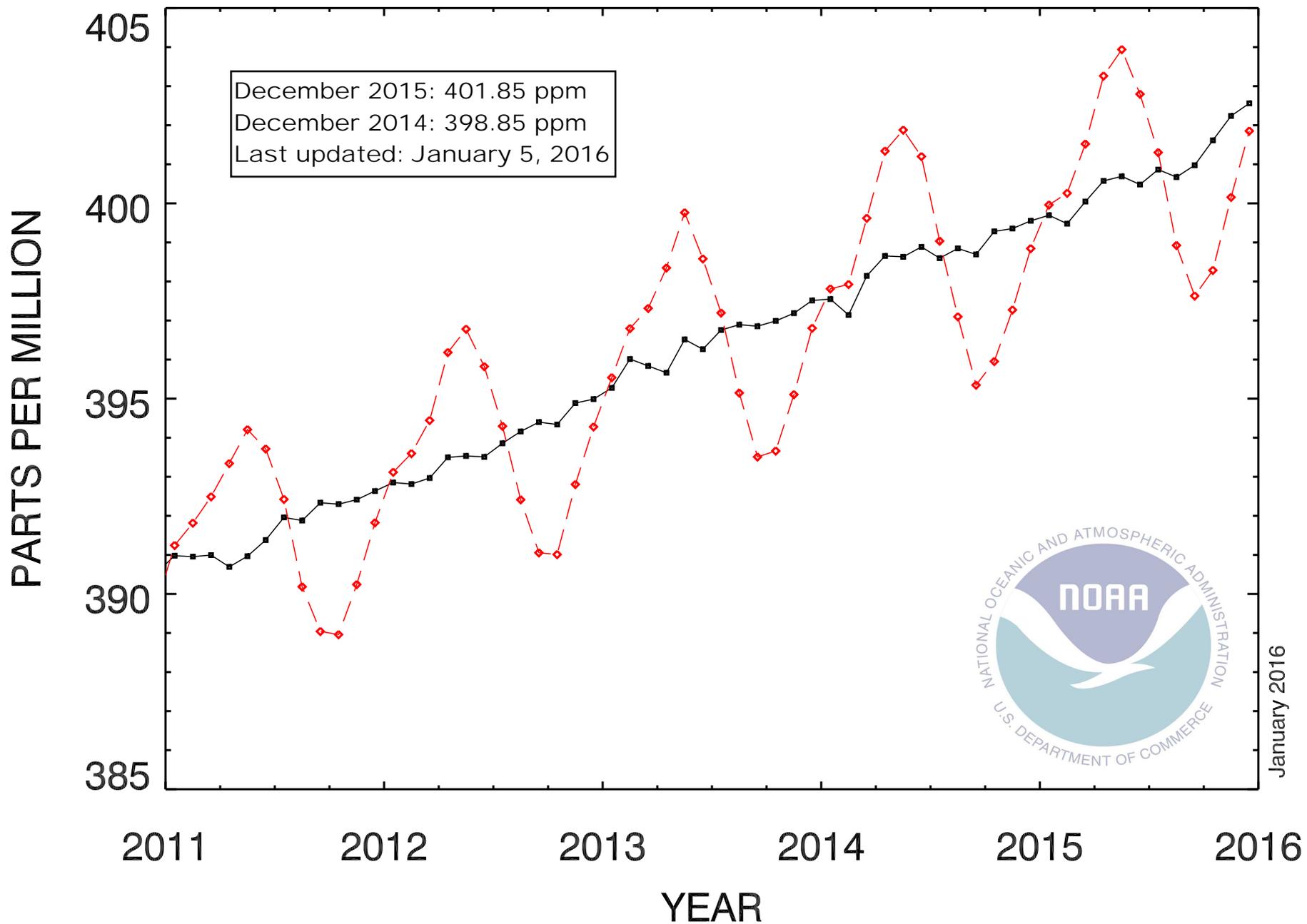




# Atmospheric CO<sub>2</sub> at Mauna Loa Observatory



# RECENT MONTHLY MEAN CO<sub>2</sub> AT MAUNA LOA



# Selected Significant Climate Anomalies and Events

## November 2015

### GLOBAL AVERAGE TEMPERATURE

November 2015 average global land and ocean temperature was the highest for November since records began in 1880.

### ARCTIC SEA ICE EXTENT

November 2015 sea ice extent was 8.3 percent below the 1981–2010 average—the sixth smallest November sea ice extent since satellite records began in 1979.

### RUSSIA

Near to cooler-than-average temperatures were observed across parts of central and eastern Russia.

### ALASKA

Alaska had its wettest November since 1979 and the fifth wettest since statewide records began in 1925.

### CONTIGUOUS UNITED STATES

Above average precipitation was observed across much of the Great Plains, Midwest, and Southeast. Nationally, this was the fourth wettest November since national records began in 1895.

### EUROPE

As a whole, Europe experienced its warmest November since 1910. Several countries experienced a top ten November: Austria (7th), Denmark (3rd), France (3rd), Spain (7th), Switzerland (3rd), and United Kingdom (3rd).

### JAPAN

Wetter-than-average conditions were present across much of Japan in November 2015.

### CYCLONE CHAPALA

(October 28<sup>th</sup>- November 4<sup>th</sup>, 2015)  
Maximum winds - 250 km/hr  
Chapala was the first hurricane-strength storm (Category 1 in the Saffir-Simpson scale) on record to make landfall in Yemen.

### HURRICANE SANDRA

(November 23<sup>rd</sup>-28<sup>th</sup> 2015)  
Maximum winds - 230 km/hr  
Sandra was the latest major hurricane observed in the Eastern North Pacific basin since reliable records began in 1971.

### CENTRAL & SOUTH AMERICA

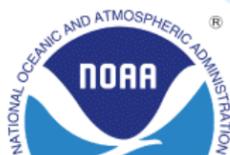
Above average temperature was observed across much of Central and South America, with much of Central and northern South America experiencing record warmth. South America as a whole had its fifth warmest November on record.

### AUSTRALIA

Australia, as a whole, had its third warmest November since national records began in 1910. Regionally, Queensland, New South Wales, South Australia, Western Australia, and Northern Territory experienced a top 10 November.

### ANTARCTIC SEA ICE EXTENT

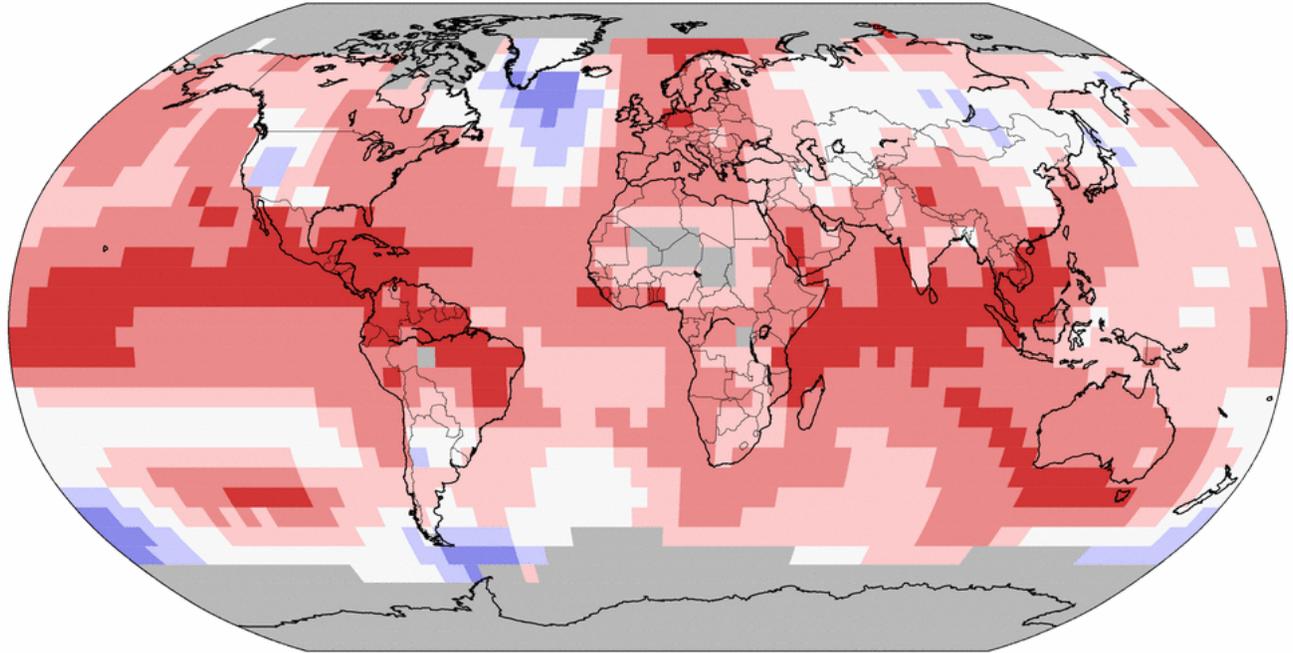
November 2015 sea ice extent was 1.2 percent above the 1981–2010 average—the 14th largest November sea ice extent on record.



# Land & Ocean Temperature Percentiles Nov 2015

NOAA's National Centers for Environmental Information

Data Source: GHCN-M version 3.3.0 & ERSST version 4.0.0



  
Record  
Coldest

  
Much  
Cooler than  
Average

  
Cooler than  
Average

  
Near  
Average

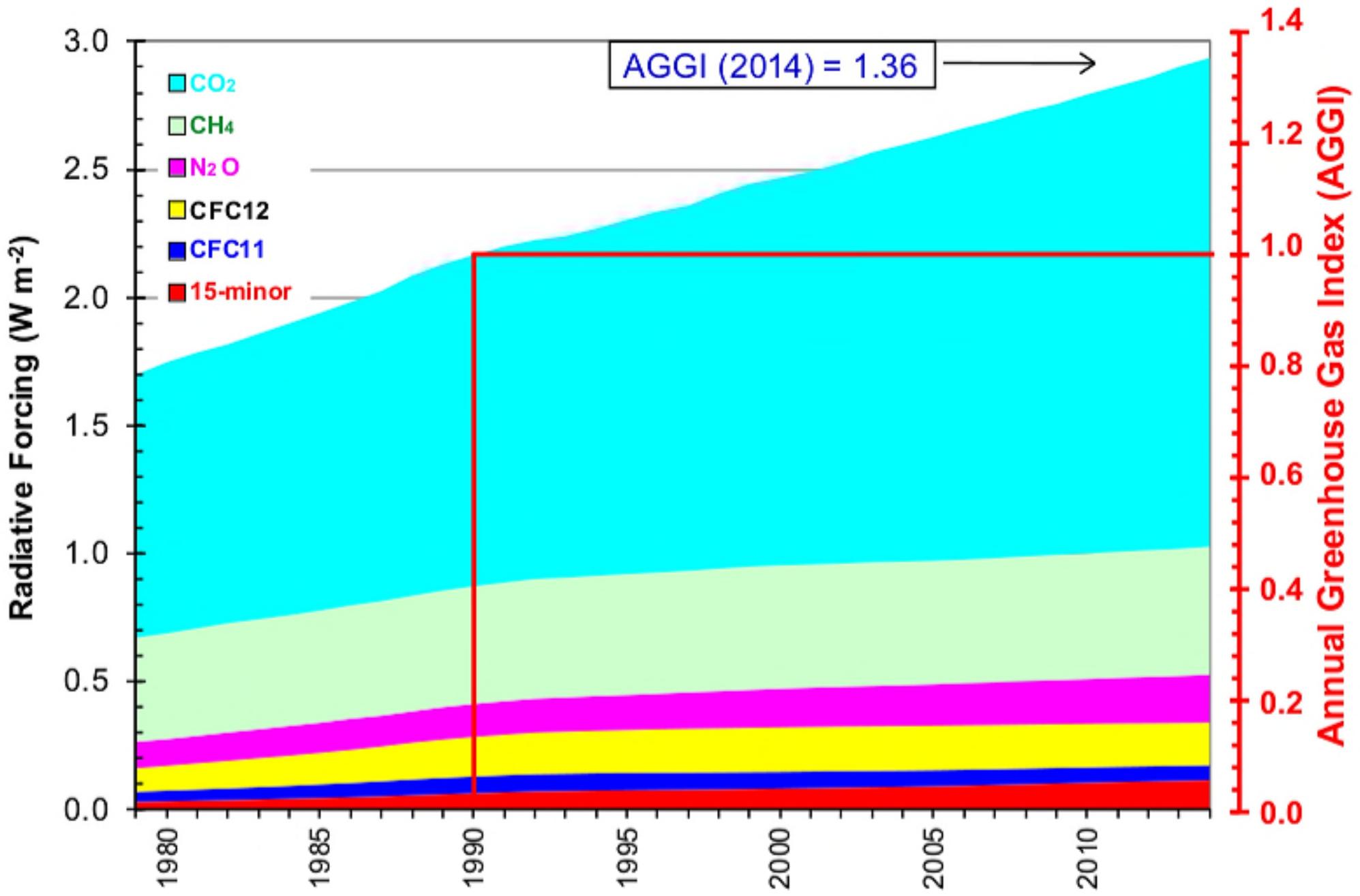
  
Warmer than  
Average

  
Much  
Warmer than  
Average

  
Record  
Warmest



Mon Dec 14 07:16:10 EST 2015





**The University of Louisiana at Lafayette**

## **Wimpy winter comes to end, 2015 hottest year on record**

12 January 2016

Alex Whittington Column

<http://thevermilion.com/wimpy-weather-ends/>

### **Christmastime in the swamp was good this year.**

I loved our December weather; we got to wear shorts through most of it. Being a Conference Center resident myself, it was actually usually warmer outside than it was in my dorm room over winter break (they like to keep it at a cozy 46 degrees or so inside.)

Sunny walks in the park aside, it's a sobering thing to know that all that perfect hammocking weather comes at a price. 2015 has replaced 2014 as the warmest year on record globally, according to analyses by several groups. A report released in late November by the World Weather Attribution initiative found that the ocean's recent El Niño weather activity contributed to warmer global temperatures, but that the largest contributor to warmer temperatures is our rising rate of greenhouse gas emissions.

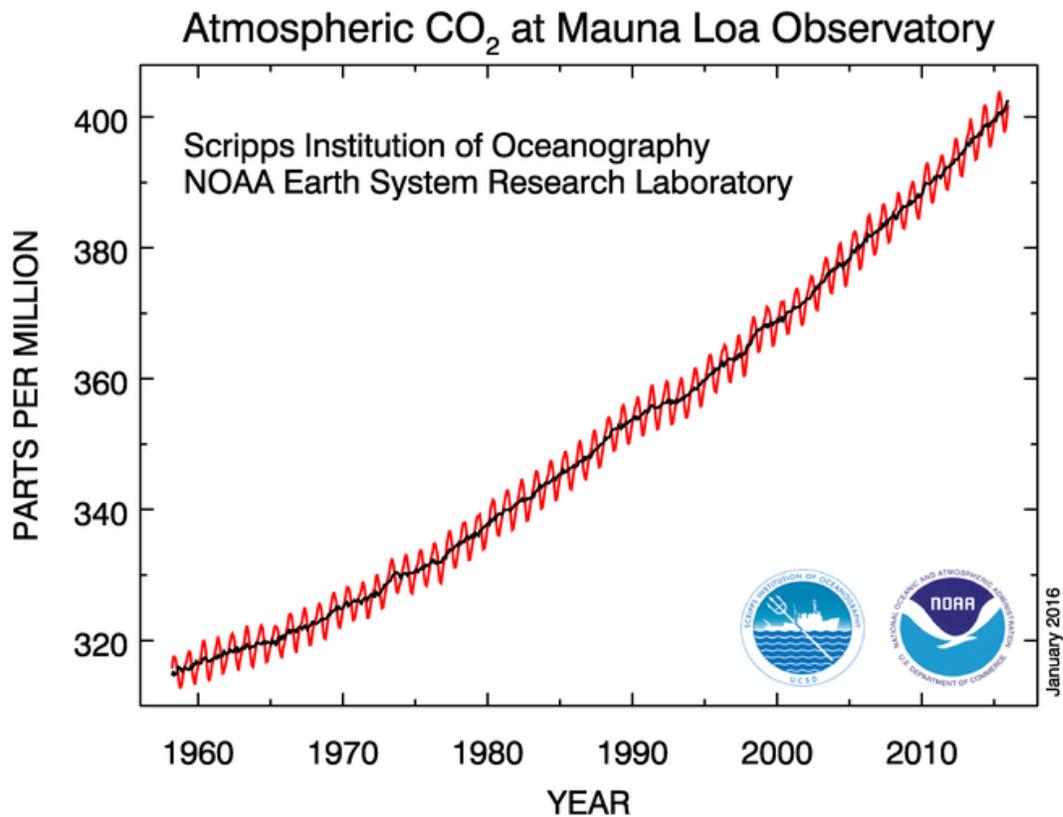


Photo via [ESRL.noaa.org](http://ESRL.noaa.org)

The battle is a hard one to fight, and even our best efforts to clean our atmosphere are easily reversed by reckless industrial activity. For instance, one privately-owned well in Aliso Canyon, California has been leaking around 100,000 pounds of natural gas hourly since last October. The gas leak has already released over 82,000 metric tons of methane, and has yet to be fully stopped.

Data collected by both the National Atmospheric and Oceanic Administration and Scripps Institution of Oceanography, two leading meteorological research organizations, found that atmospheric carbon dioxide levels have risen above 400 parts per million. To give a little context, our parent's generation grew up with concentrations around 330 ppm, levels far lower than our and our children's generations will probably ever experience.

Carbon dioxide in the atmosphere is a natural thing, and levels fluctuate over time just like global temperatures. Yes, the climate does cyclically warm and cool itself. The oceans do naturally acidify and alkalize on their own, too, but these global shifts occur over periods of thousands and millions of years. Human activity is altering the trends of that cycle, and the long term results of these abrupt shifts are terrifying to consider.

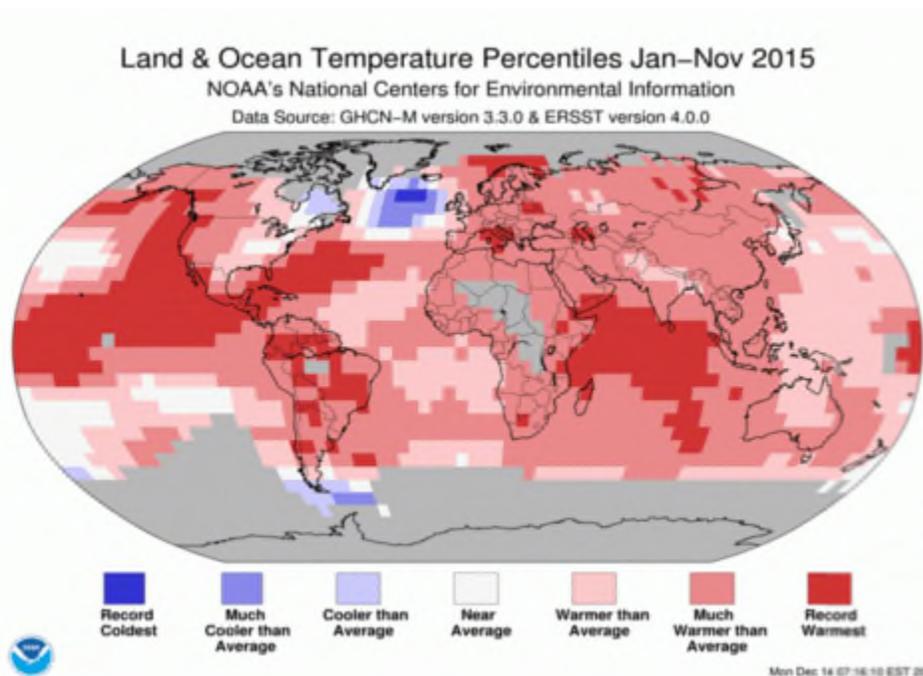


Photo via [esrl.noaa.gov](http://esrl.noaa.gov).

The only thing about all this that is comforting for me is that the Earth will probably be alright no matter what. For all our technological advancement, I honestly believe that humans are incapable of destroying life on Earth. It's been around a lot longer than we have, and it's seen far worse days too.

The planet's going to be fine. It's only our great-grandchildren's habitat and lives we're destroying.



**Alex Whittington**

Alex Whittington is a sophomore chemical engineering and chemistry major at ULL with concentrations in organics and bioprocessing, political columnist for The Vermilion, and aspiring poet.

When not waist-deep in calculus and existential crises, he enjoys walks in the park, sitting in the Sylvia Plath section of the library, and garden therapy.