

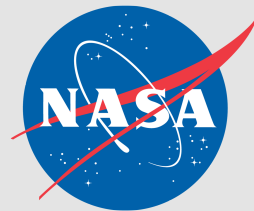
**NOAA/NASA**

# Annual Global Analysis for 2016

*2016 was third successive record-warm year*

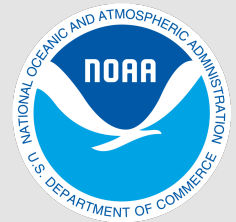
**Gavin A. Schmidt**

*Director, NASA's Goddard Institute  
for Space Studies*



**Derek Arndt**

*Chief, Monitoring Branch, NOAA's National  
Centers for Environmental Information*



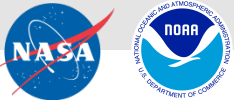
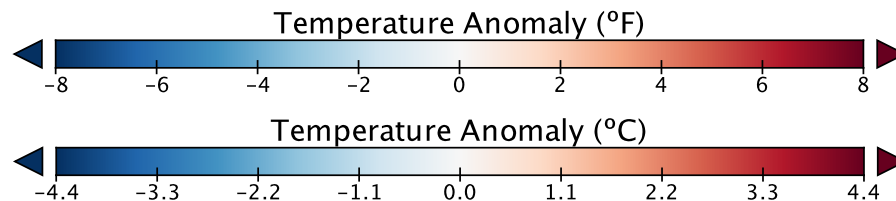
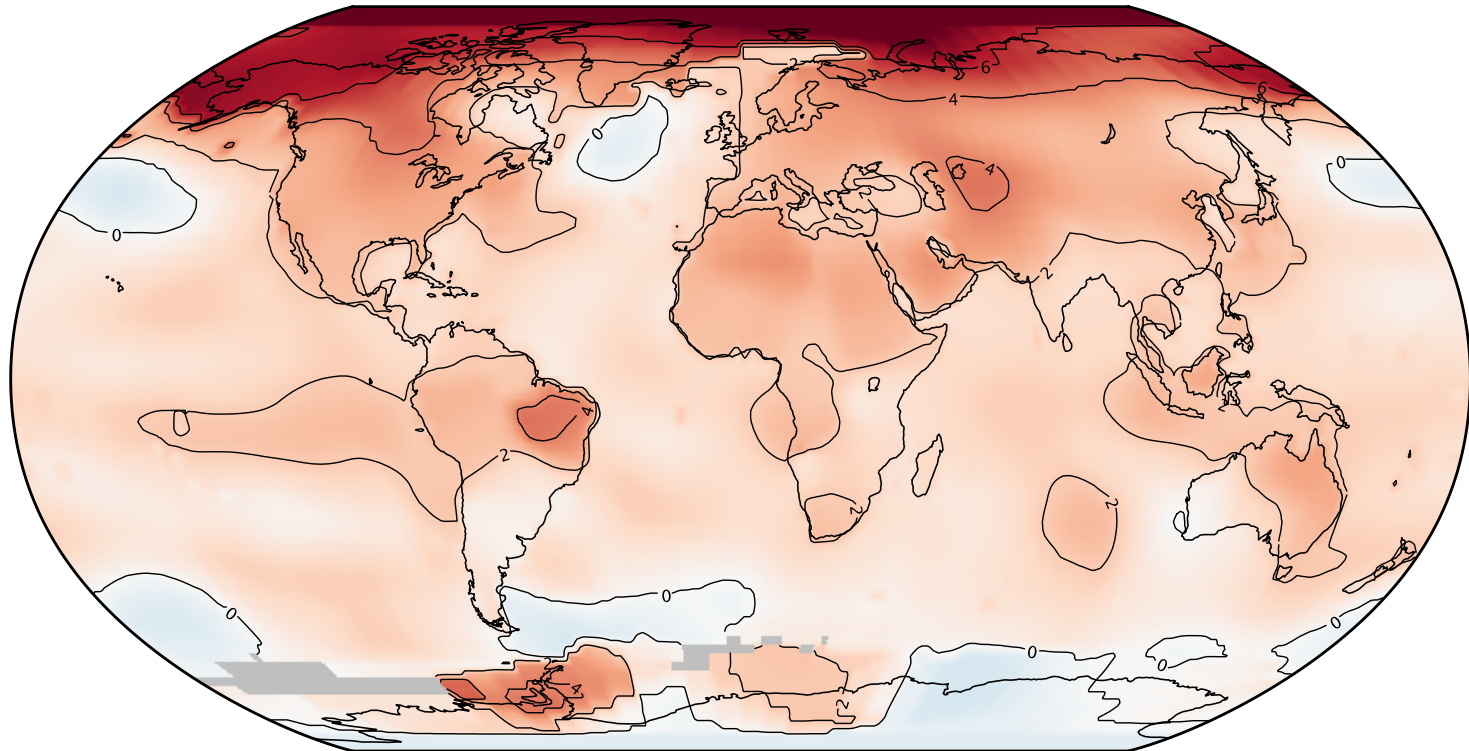
January 2017

# NASA 2016 Global Temperature

**2016:**  
0.99°C / 1.8°F  
above 1951-80  
average

Warmest year of  
NASA GISTEMP  
record

GISTEMP Annual Mean 2016  
Baseline 1951-1980

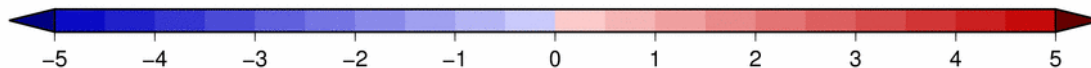
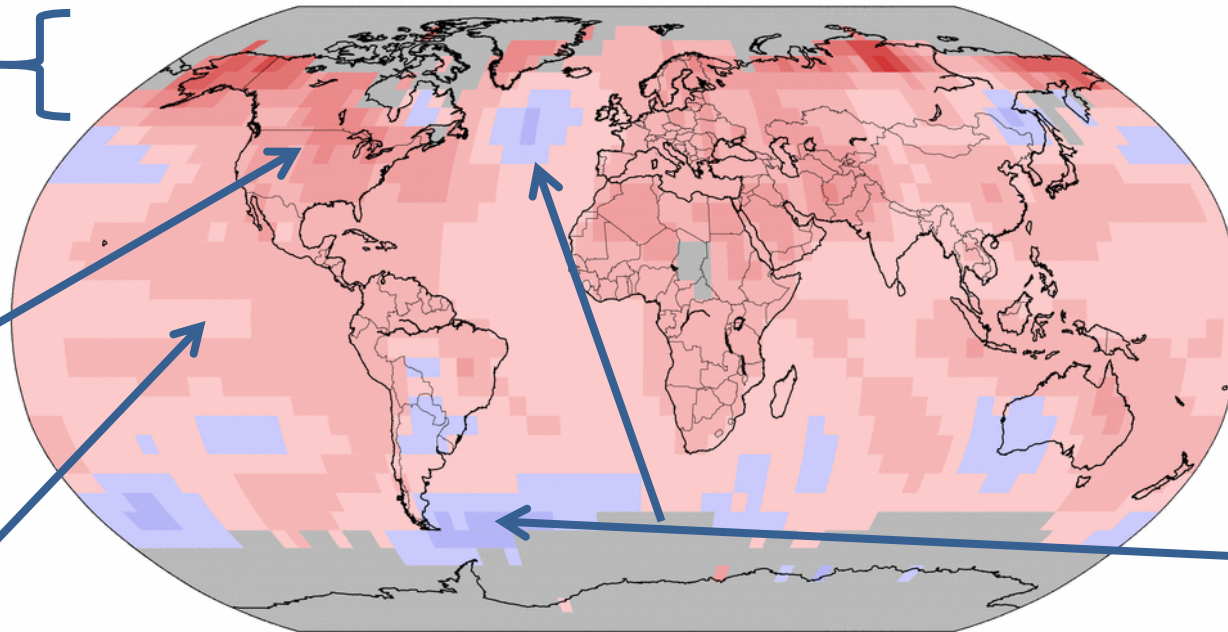


# NOAA 2016 Global Temperature

0.94°C / 1.69°F above 1901-2000 average; warmest year of record

Land & Ocean Temperature Departure from Average Jan–Dec 2016  
(with respect to a 1981–2010 base period)

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



National Centers for Environmental Information  
Wed Jan 11 07:07:27 EST 2017

Please Note: Gray areas represent missing data  
Map Projection: Robinson

**North of 60°N latitude:**  
Warmest year of record by 0.94°F

**USA - CONUS**  
2<sup>nd</sup> warmest year  
Wetter than average  
**Alaska**  
Warmest year

**Tropical Pacific**  
El Niño fades in early 2016

**Continental Temperatures**  
records begin 1910

**N. America**  
Warmest year

**Africa, S. America**  
2<sup>nd</sup> warmest year

**Asia, Europe**  
3<sup>rd</sup> warmest year

**Oceania**  
5<sup>th</sup> warmest year

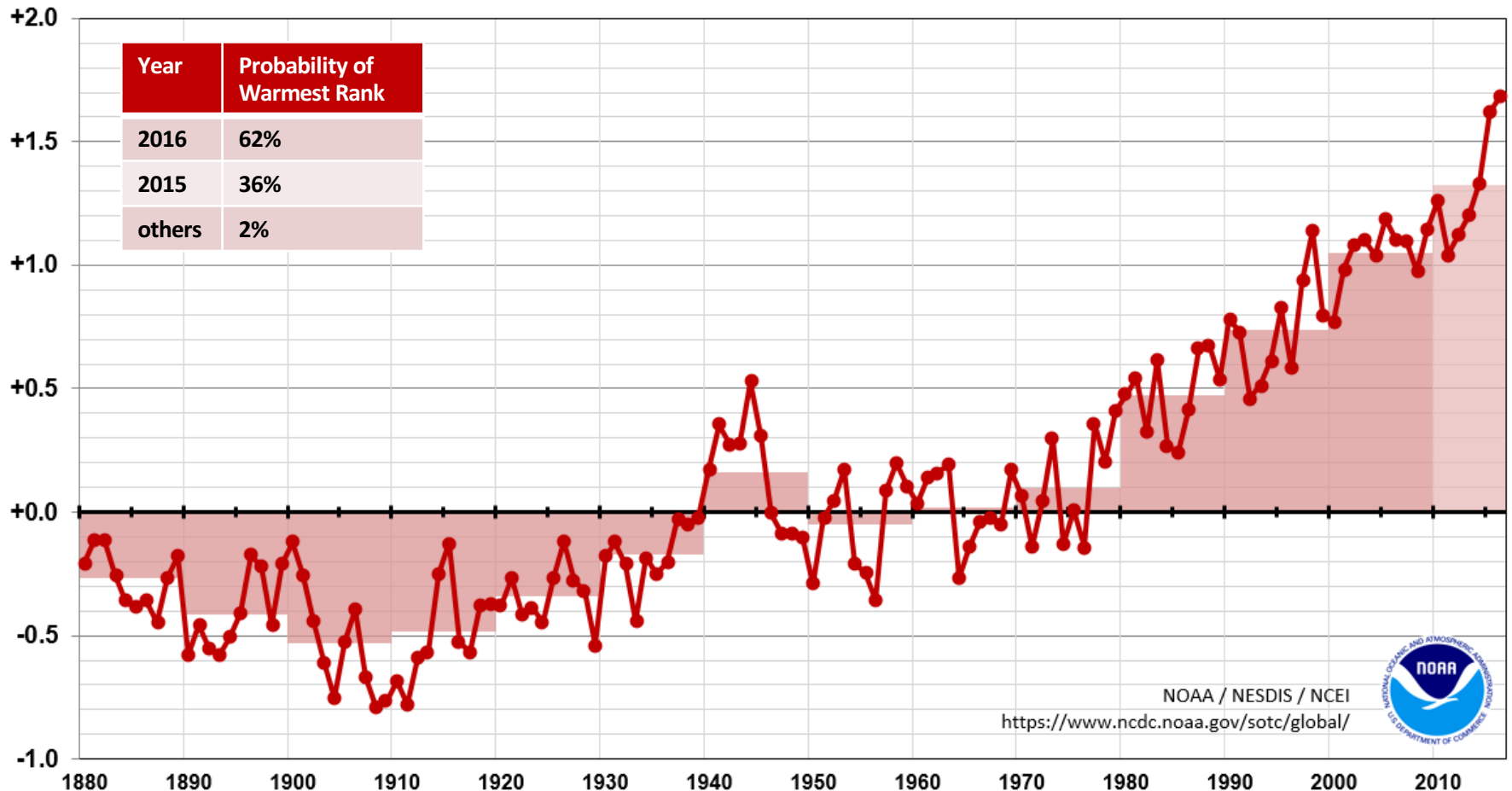
**N. Atlantic cool spot fades somewhat**  
**S. Atlantic spot persists**



# Global Temperature Time Series

## NOAA GlobalTemp

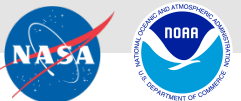
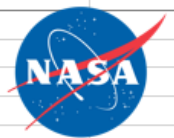
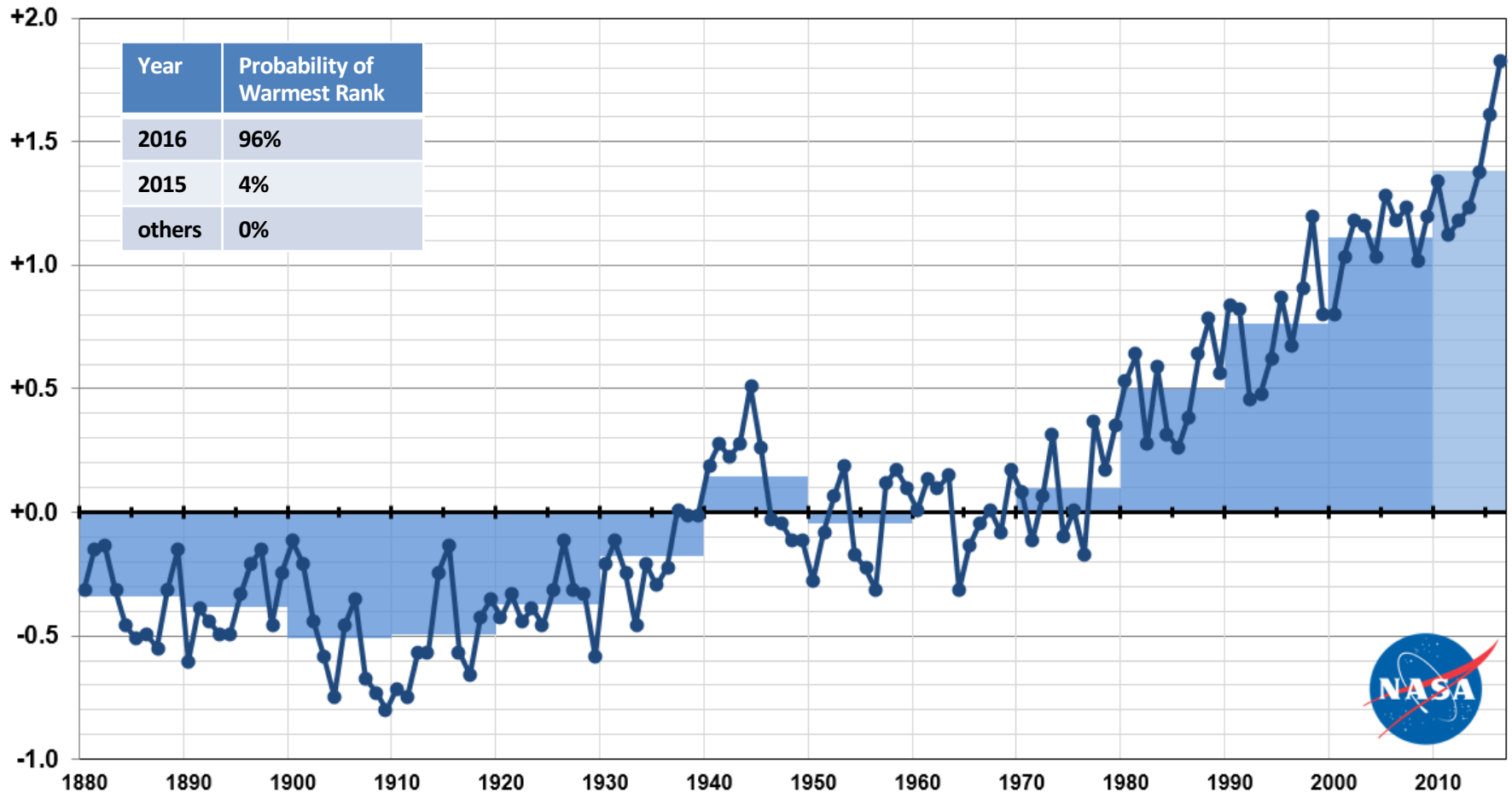
Annual Global Temperature: Difference From 20<sup>th</sup> Century Average, in °F



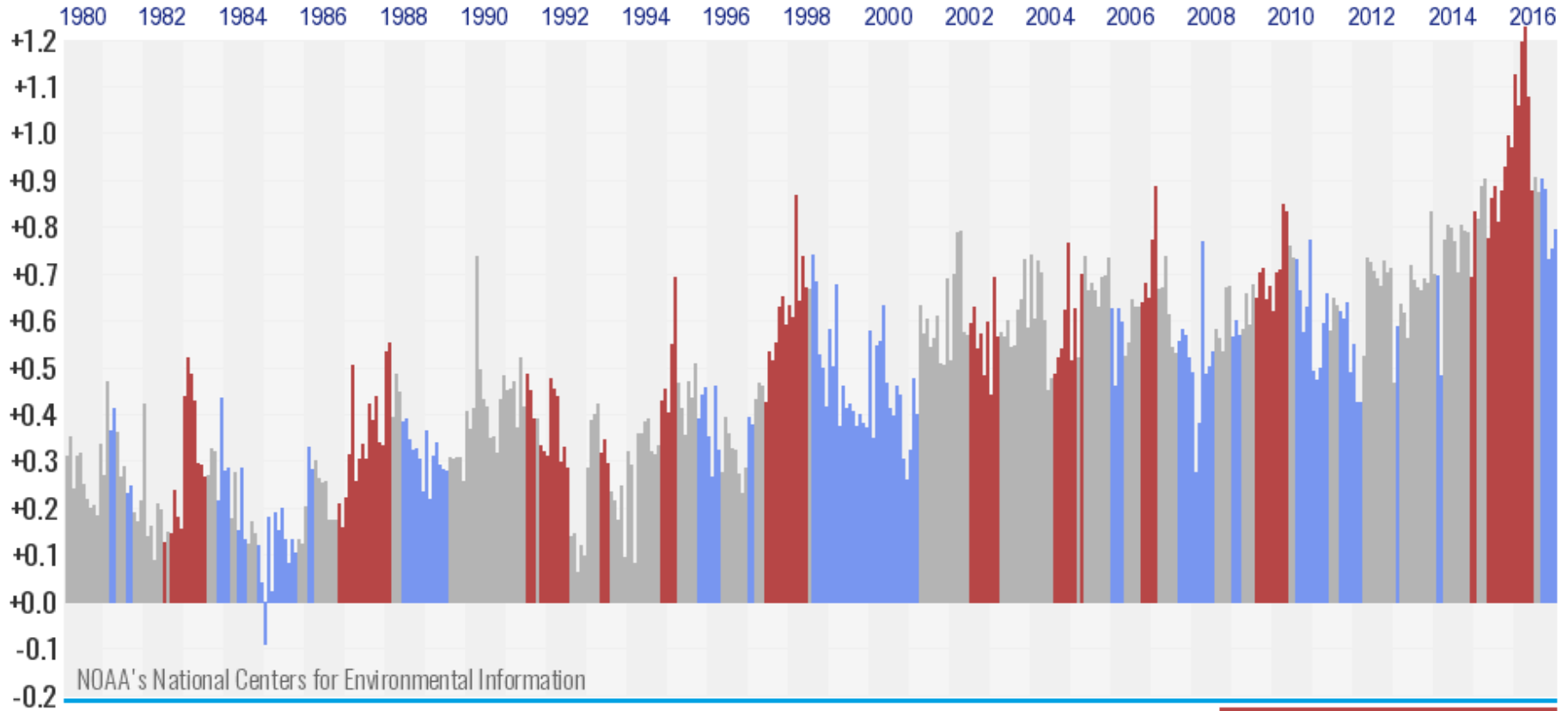
# Global Temperature Time Series

## NASA GISTEMP

Annual Global Temperature: Difference From 20<sup>th</sup> Century Average, in °F



# El Niño / La Niña & Global Temperature



Global Surface Temperature Departures in °C, colored by monthly Niño3.4 values  
Jan 1980 through Dec 2016

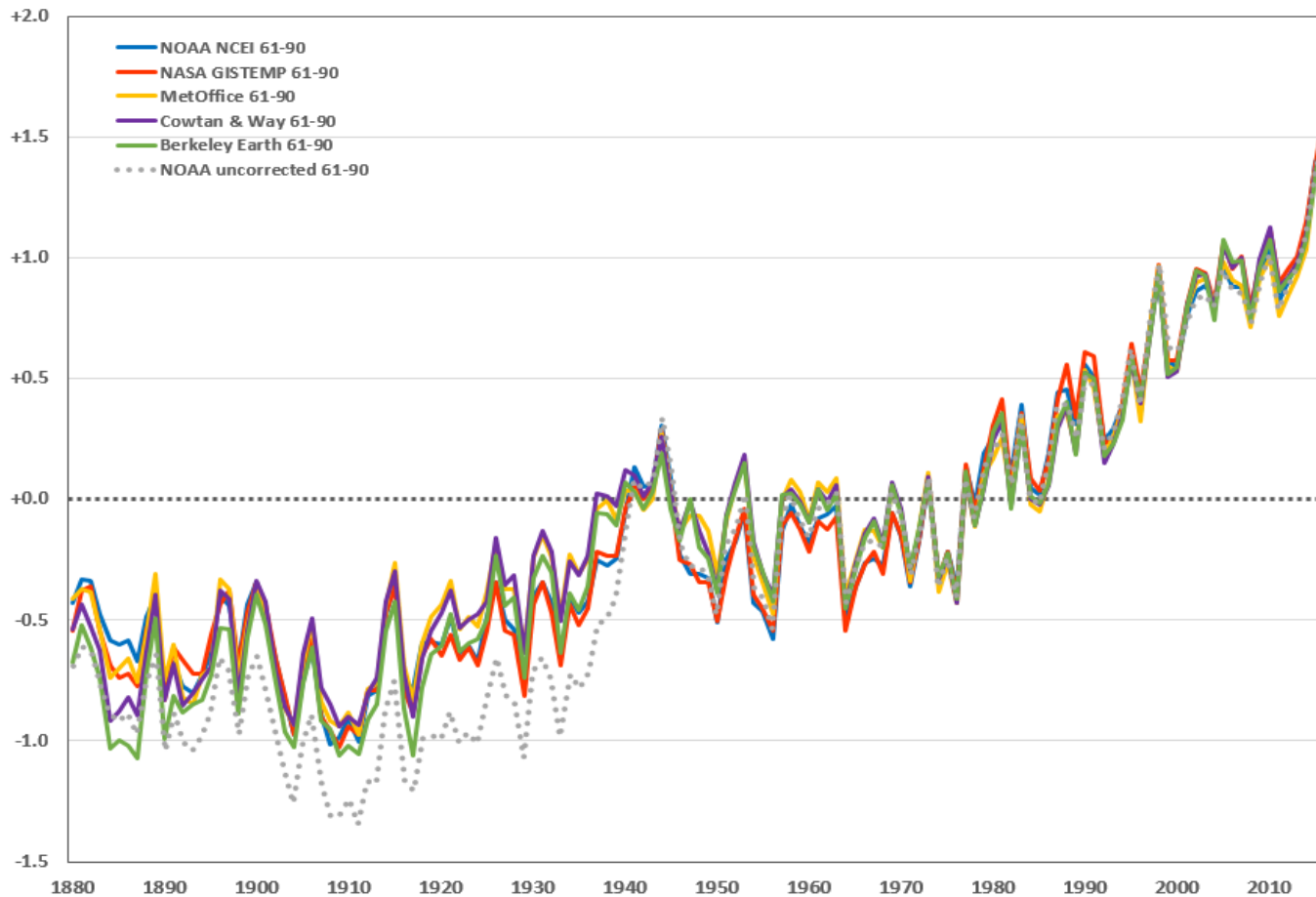
Conditions similar to El Niño
ENSO Neutral Months
Conditions similar to La Niña

Months with La Niña sea-surface temperature conditions in blue  
Months with El Niño sea-surface temperature conditions in red



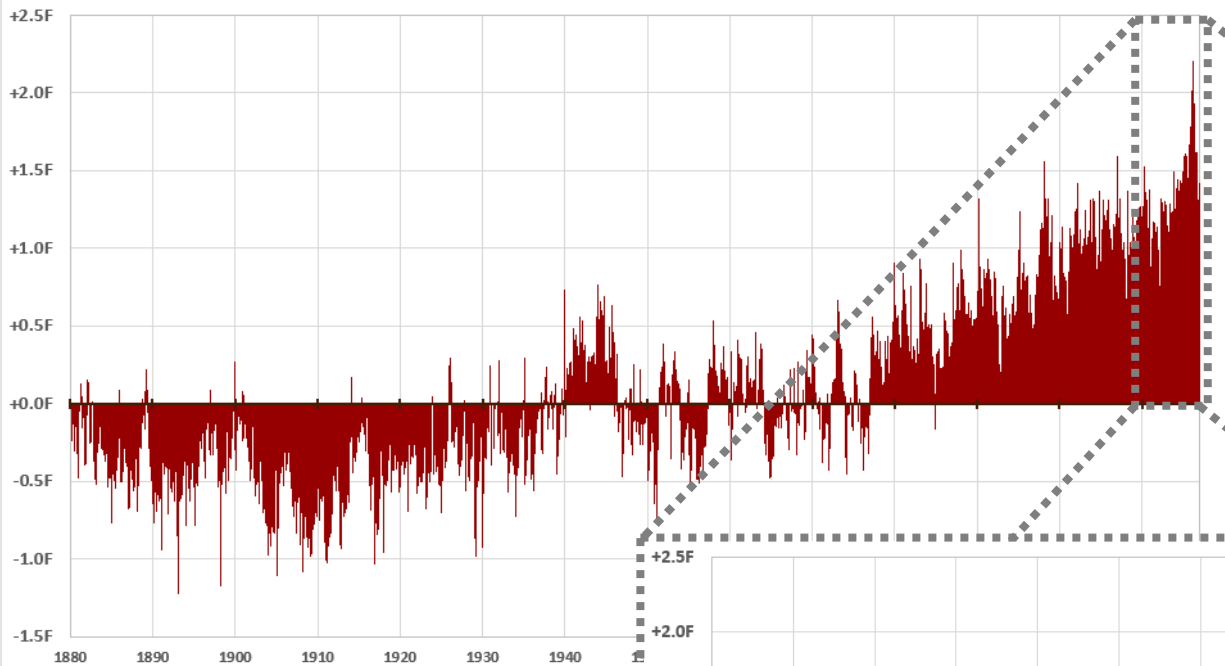
# Global Analyses Side by Side

Several major datasets: Relative to a common 1961-90 base period

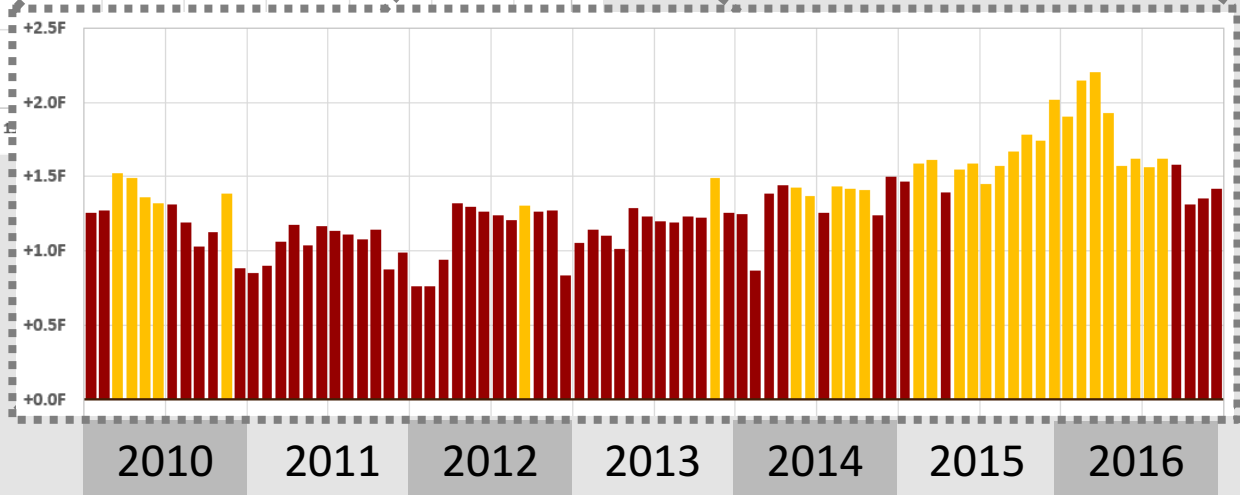




# Global Temperature by the Month



16 successive months (May '15 through Aug '16) broke or tied the previous record for that month. Record months since 2010 are shown in gold (incl. those that have since been broken).



NOAA GlobalTemp





# Looking at the Atmosphere

- Lower Stratosphere (37-yr record)

- All datasets (UAH, RSS, NESDIS): *coolest* on record

- Middle Troposphere (37-yr record)

- All datasets (UAH, UW-UAH, RSS, UW-RSS, NESDIS): warmest on record

- Lower Troposphere (37-yr record)

- All datasets (UAH, RSS): warmest on record

- Radiosonde / balloon data (58-yr record, not shown)

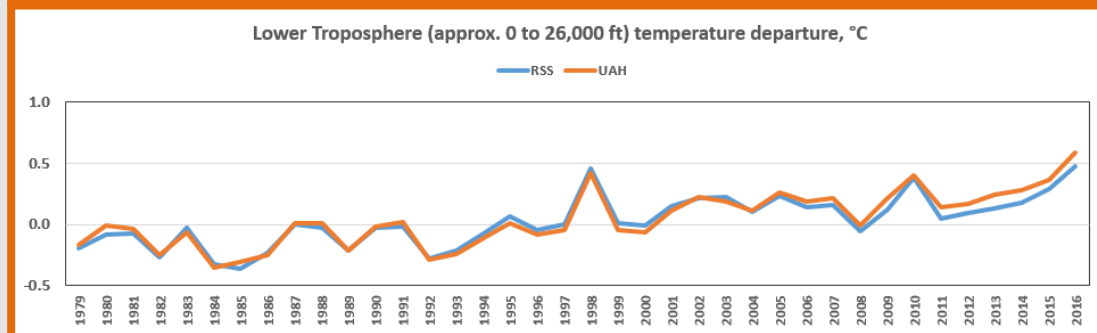
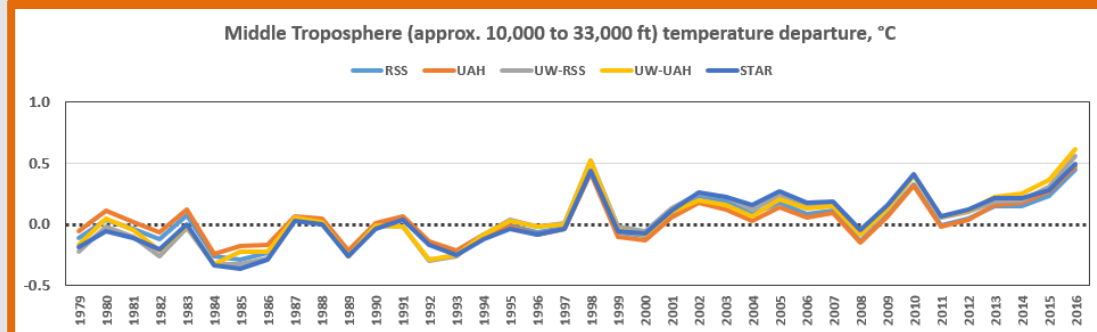
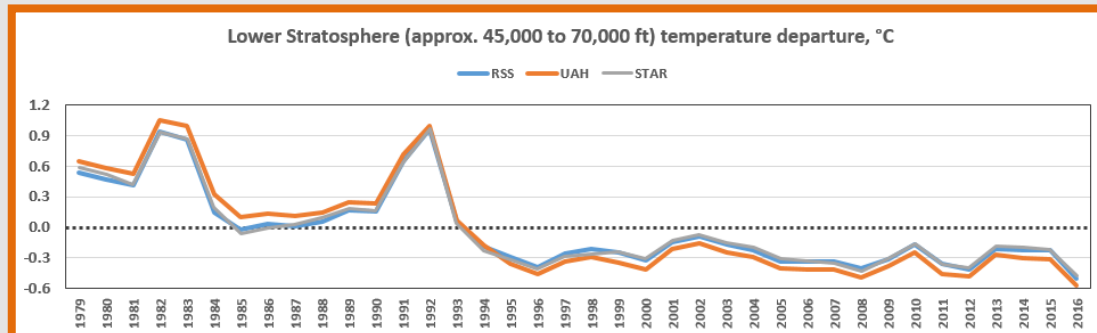
- ~5,000 ft (850mb): warmest

- ~10,000 ft (700mb): warmest

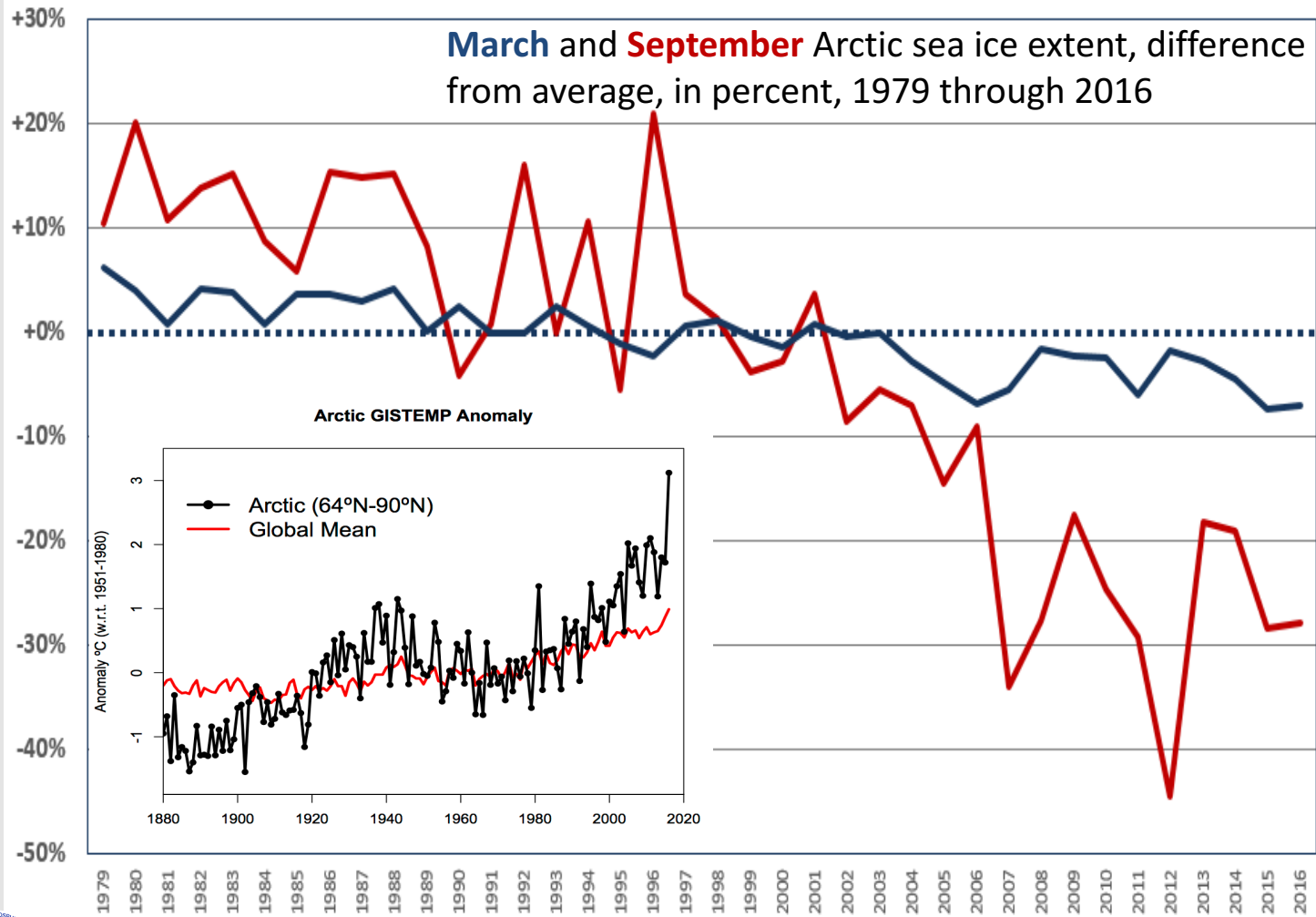
- ~18,000 ft (500mb): warmest

- ~30,000 ft (300mb): warmest

- ~40,000 ft (200mb): 2<sup>nd</sup> warmest

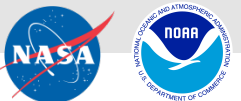
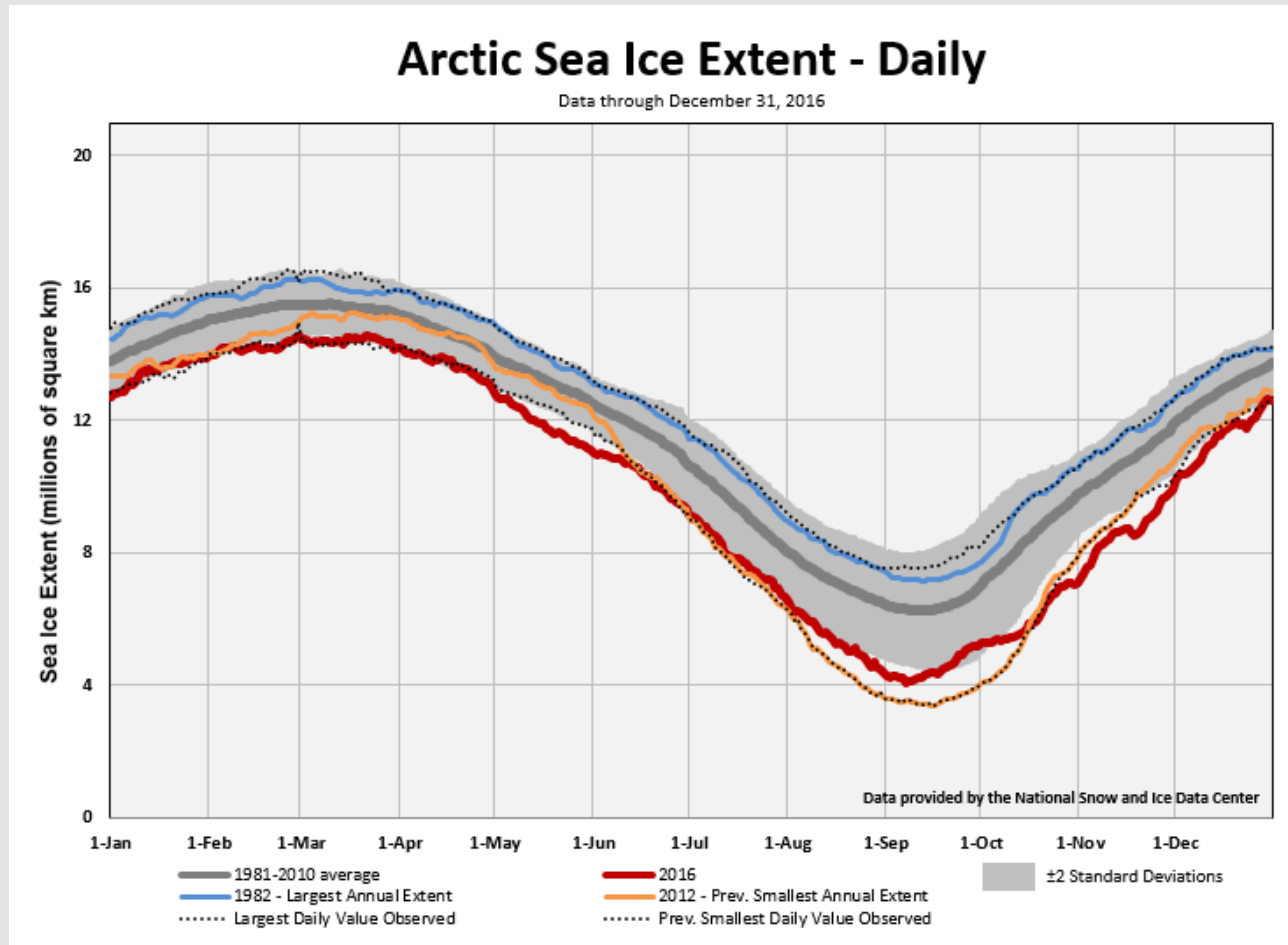


# Arctic Sea Ice Since 1979



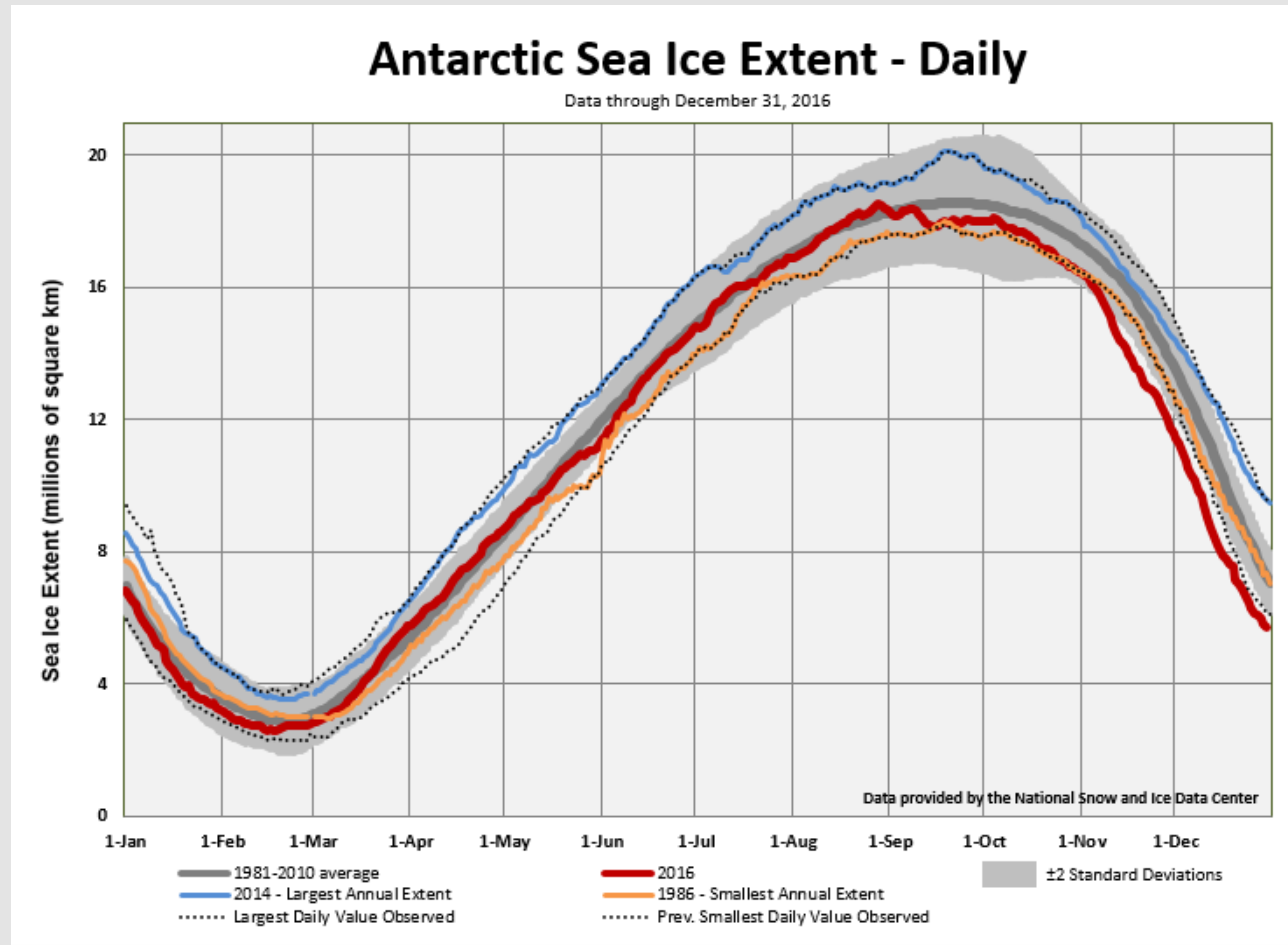
# Arctic Sea Ice: Day-by-Day in 2016

Mon	% below average	Rank (of 38)
Jan	-7.14%	Smallest
Feb	-7.54%	Smallest
Mar	-7.02%	2 <sup>nd</sup> smallest
Apr	-6.87%	Smallest
May	-10.19%	Smallest
Jun	-11.37%	Smallest
Jul	-16.87%	3 <sup>rd</sup> smallest
Aug	-23.08%	4 <sup>th</sup> smallest
Sep	-27.83%	5 <sup>th</sup> smallest
Oct	-28.52%	Smallest
Nov	-17.68%	Smallest
Dec	-7.85%	2 <sup>nd</sup> smallest
<b>Year</b>	<b>-12.58%</b>	<b>Smallest</b>



# Antarctic Sea Ice: Day-by-Day in 2016

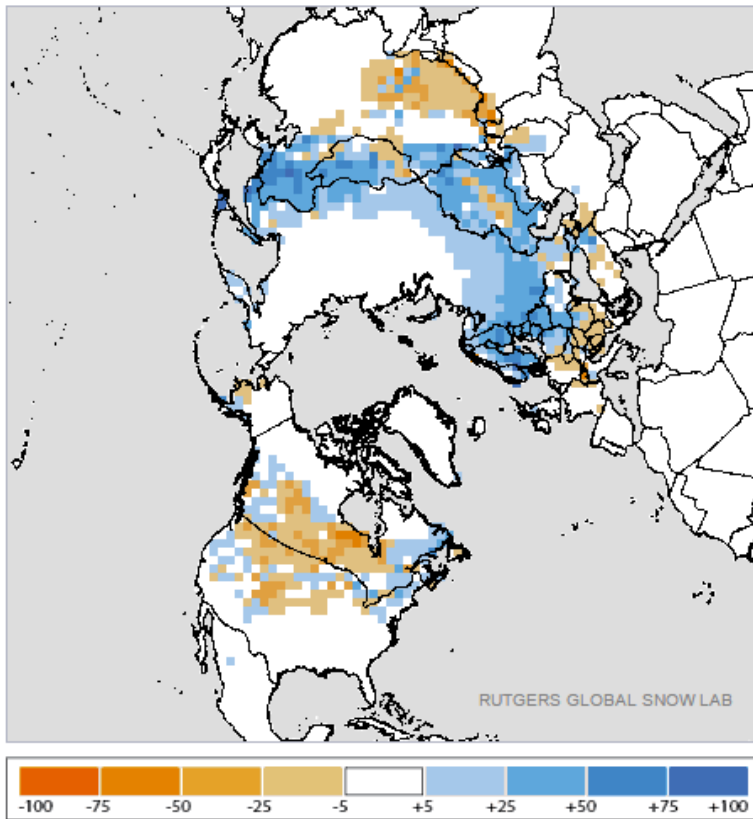
Mon	% vs average	Rank (of 38)
Jan	-4.26%	17 <sup>th</sup> smallest
Feb	-9.54%	6 <sup>th</sup> smallest
Mar	+5.44%	14 <sup>th</sup> largest
Apr	+3.91%	14 <sup>th</sup> largest
May	-0.74%	14 <sup>th</sup> smallest
Jun	-0.79%	13 <sup>th</sup> smallest
Jul	+0.18%	19 <sup>th</sup> smallest
Aug	+0.22%	19 <sup>th</sup> smallest
Sep	-2.02%	5 <sup>th</sup> smallest
Oct	-4.03%	2 <sup>nd</sup> smallest
Nov	-11.07%	Smallest
Dec	-22.20%	Smallest
<b>Year</b>	<b>-4.16%</b>	<b>2<sup>nd</sup> Smallest</b>



# Northern Hemisphere Snow Cover Extent

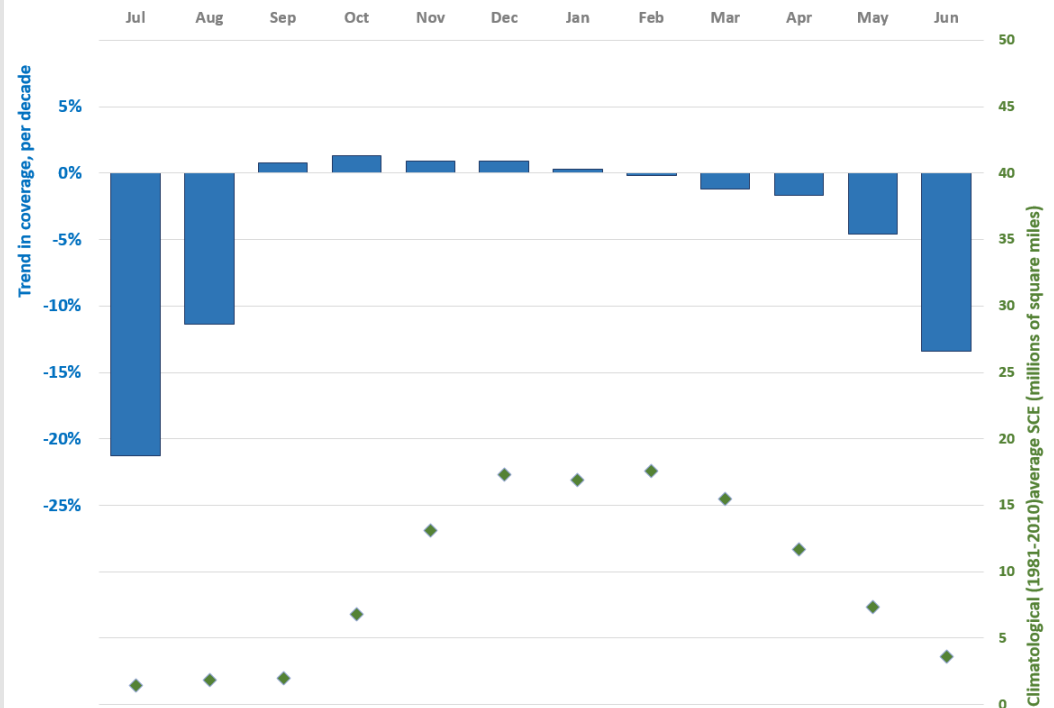
Period of record: 1967-2016 (49 years)

Departure from Normal – November 2016



Data provided by the Rutgers Global Snow Lab  
<http://climate.rutgers.edu/snowcover/>

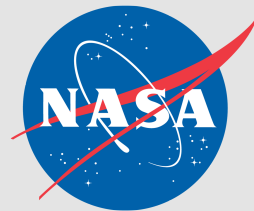
Northern Hemisphere Snow Cover Extent Trends



# Questions?

**Gavin A. Schmidt**

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