

Hydrologic Conditions and National Weather Service Winter Outlook for the DRBC FAC Meeting December 7, 2016

Ray Kruzdlo

NOAA's National Weather Service
Philadelphia/Mt. Holly NJ Forecast Office
Weather.gov/phi



Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

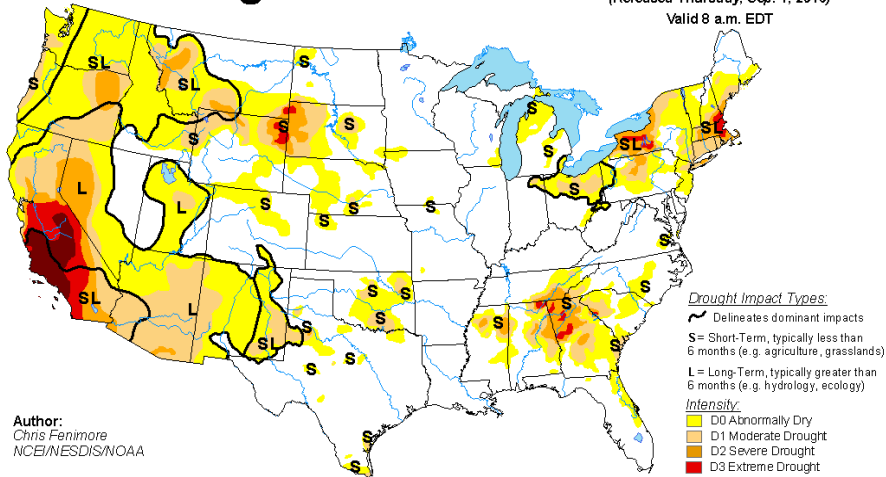
**National Weather Service
Philadelphia/Mt. Holly**

The National Picture

Extreme to Exceptional Drought continues across southern California. Drought conditions have improved across the Pacific Northwest. Noticeable changes have occurred across the Eastern U.S. with extreme drought now defined across portions of the Southeast and Northeast.

U.S. Drought Monitor

August 30, 2016
(Released Thursday, Sep. 1, 2016)
Valid 8 a.m. EDT



Author:
Chris Fenimore
NCEI/NESDIS/NOAA

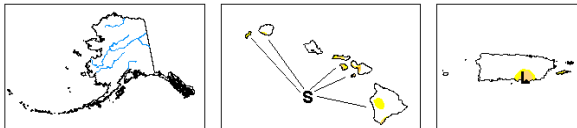
Drought Impact Types:
~ Delineates dominant impacts
S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)
L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:
D0 Abnormally Dry
D1 Moderate Drought
D2 Severe Drought
D3 Extreme Drought
D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

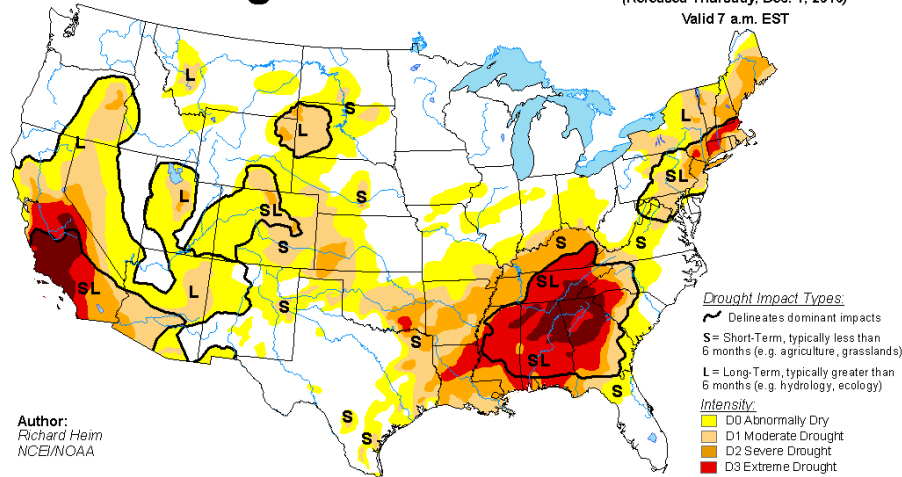


<http://droughtmonitor.unl.edu/>



U.S. Drought Monitor

November 29, 2016
(Released Thursday, Dec. 1, 2016)
Valid 7 a.m. EST



Author:
Richard Heim
NCEI/NOAA

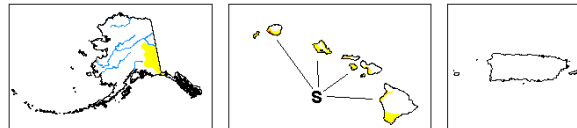
Drought Impact Types:
~ Delineates dominant impacts
S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)
L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:
D0 Abnormally Dry
D1 Moderate Drought
D2 Severe Drought
D3 Extreme Drought
D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.



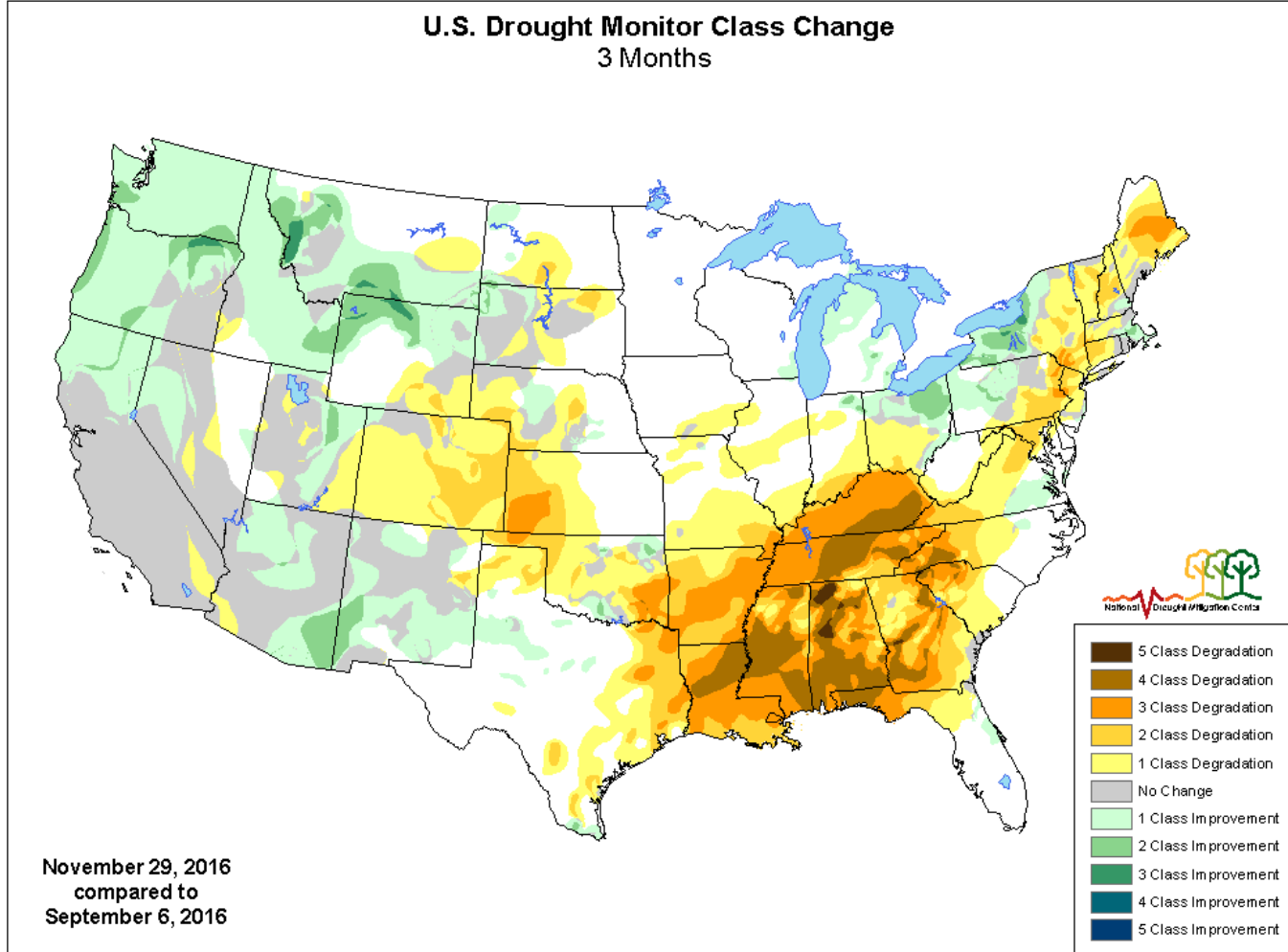
<http://droughtmonitor.unl.edu/>



Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

National Weather Service
Philadelphia/Mt. Holly

Changes Over the Last Three Months



<http://droughtmonitor.unl.edu>

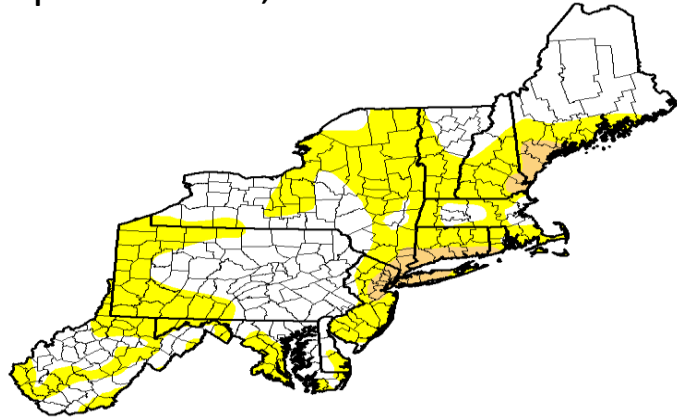


Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

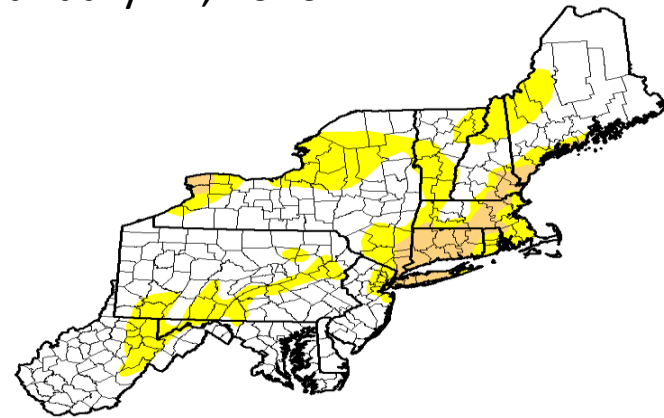
National Weather Service
Philadelphia/Mt. Holly

Moving pockets of “Abnormally Dry” and “Moderate Drought” in 2015 have intensified in 2016.

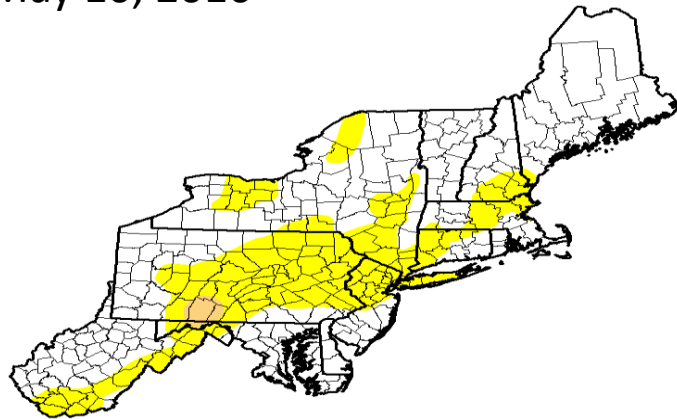
September 15, 2015



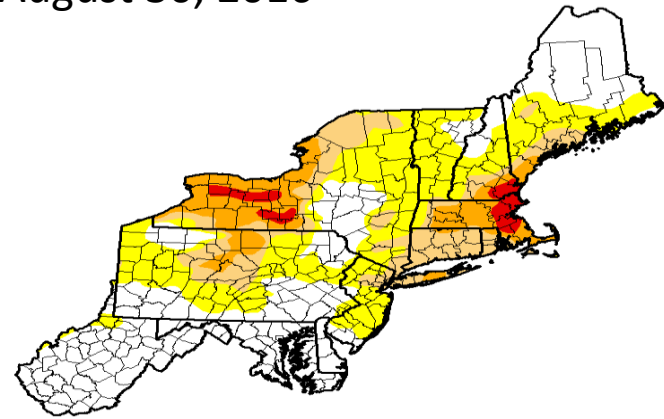
January 12, 2016



May 10, 2016



August 30, 2016



Extreme Drought in Red

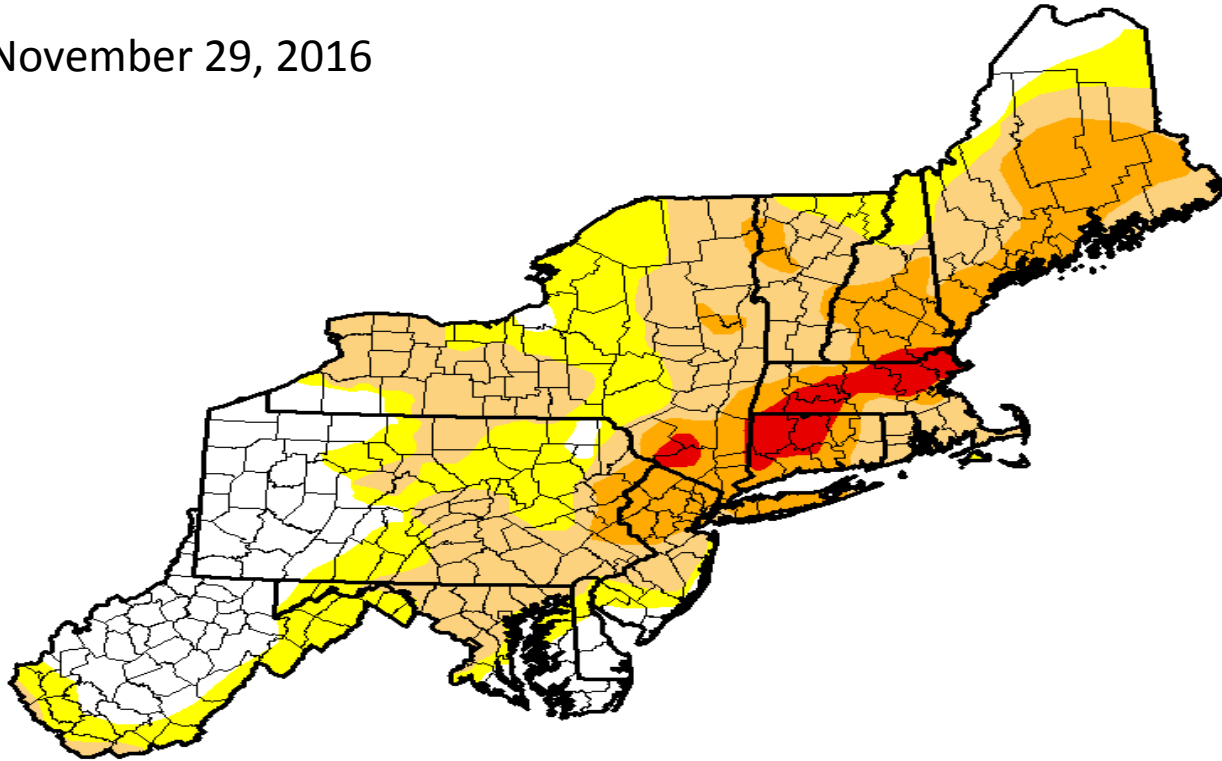


Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

National Weather Service
Philadelphia/Mt. Holly

Moving pockets of “Abnormally Dry” and “Moderate Drought” in 2015 have intensified in 2016.

November 29, 2016



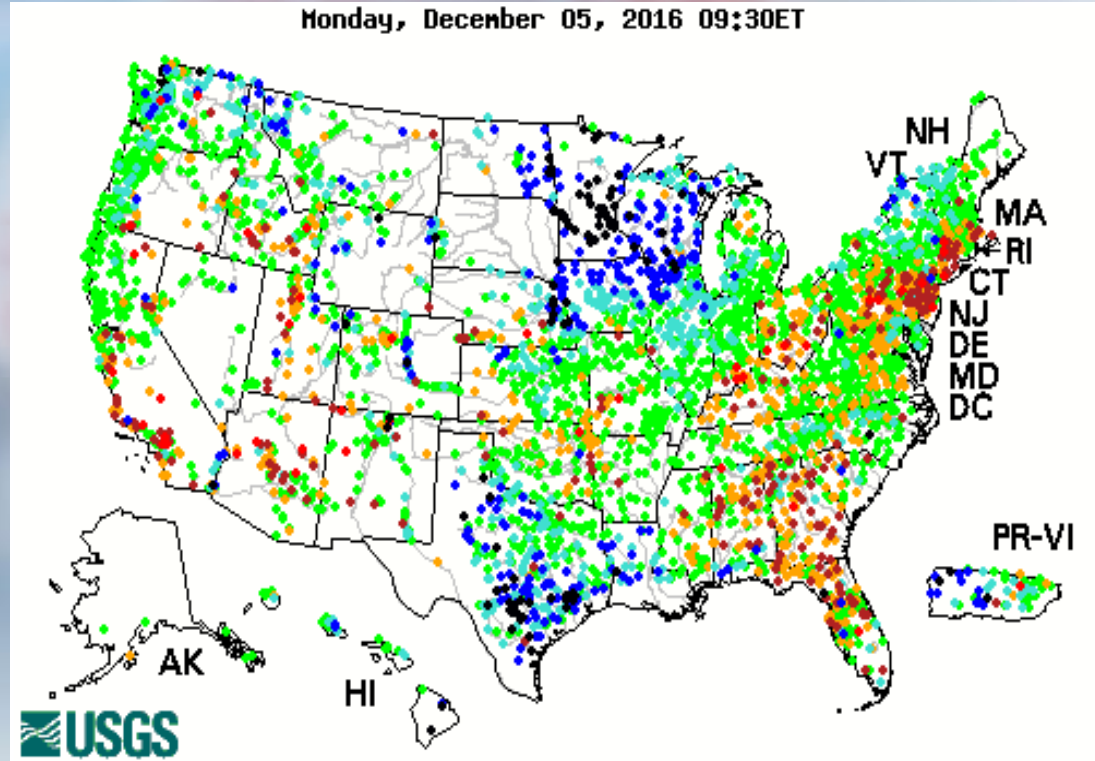
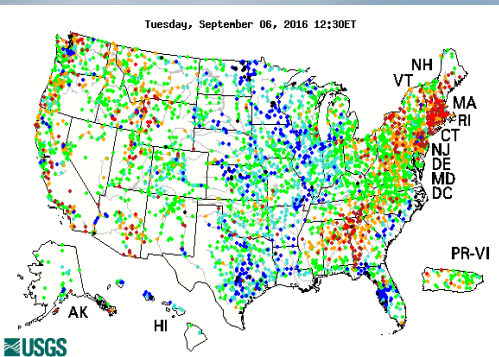
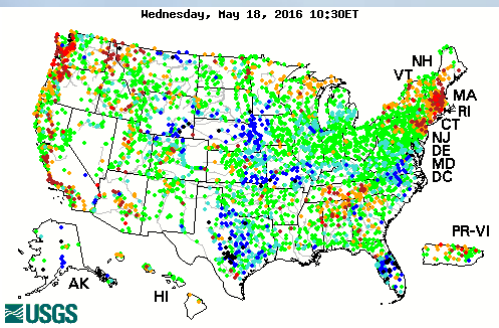
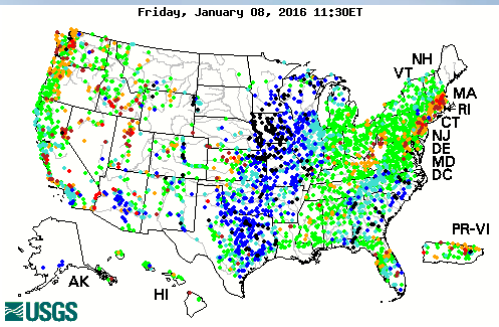
Extreme Drought in Red



Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

National Weather Service
Philadelphia/Mt. Holly

December 5, 2016: Below normal streamflow extends from the Northeast, Ohio Valley, down to Florida.



Explanation - Percentile classes

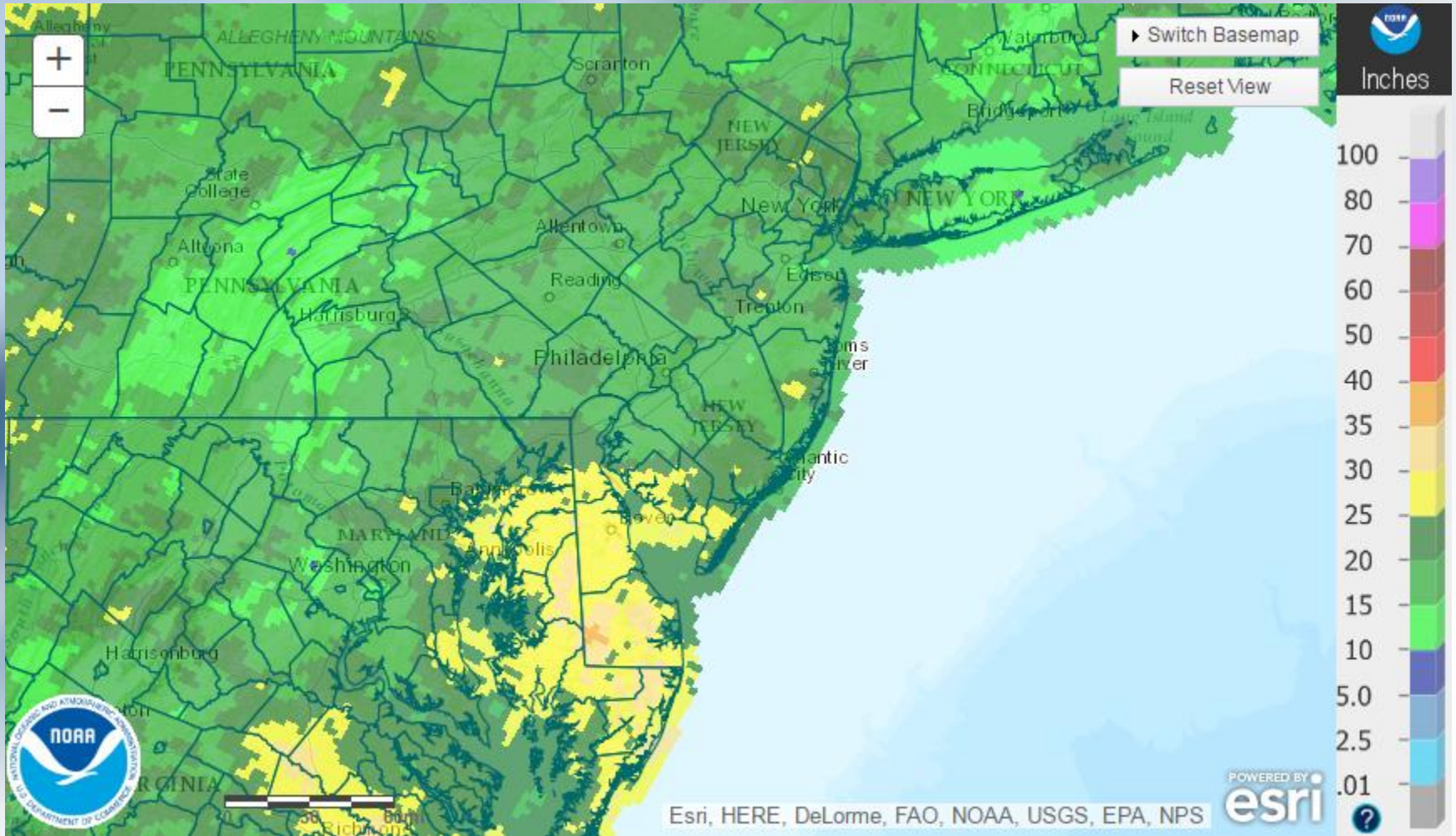
Low	<10	10-24	25-75	76-90	>90	High
	Much below normal	Below normal	Normal	Above normal	Much above normal	No Data



Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

National Weather Service
Philadelphia/Mt. Holly

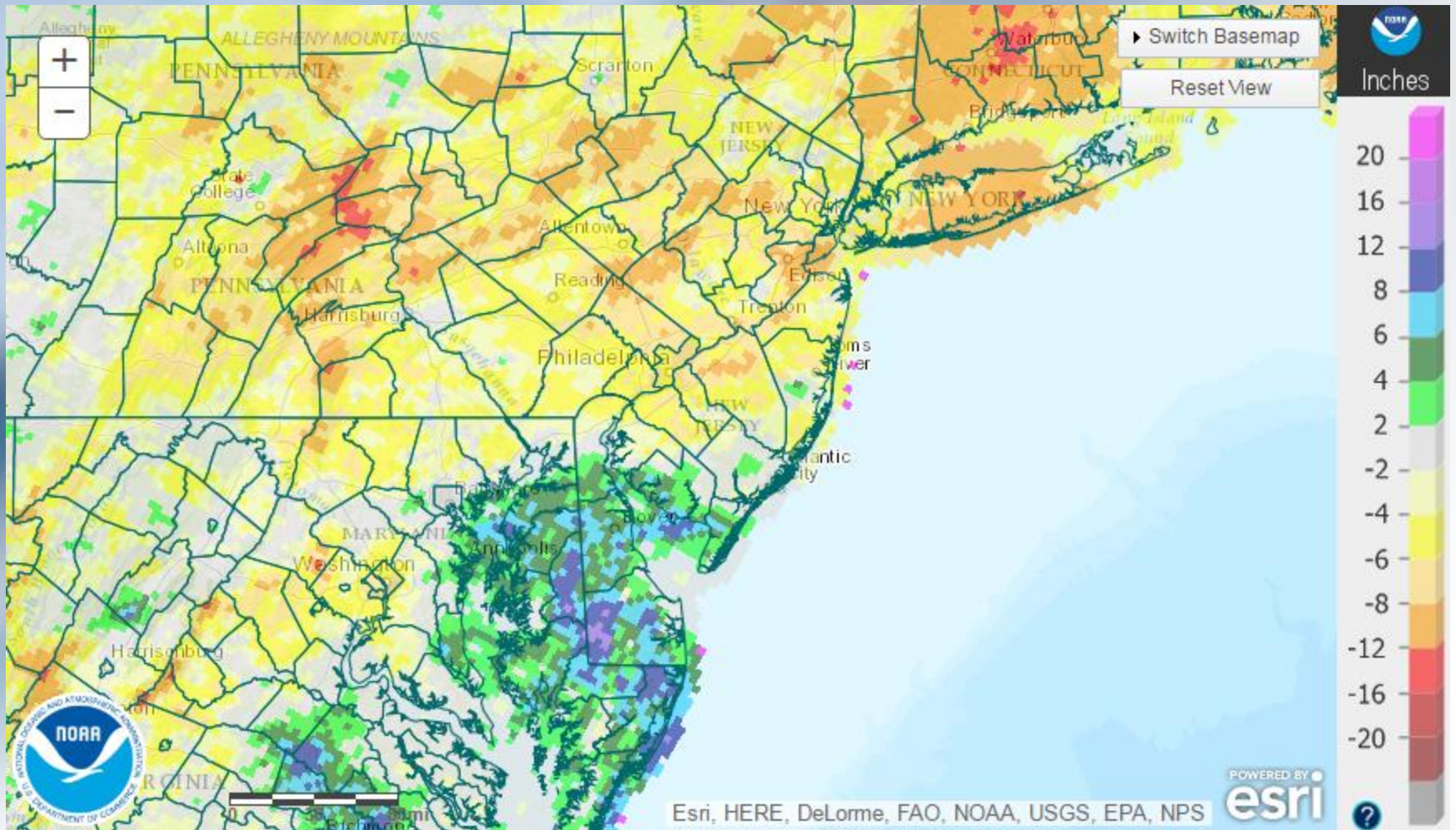
180 Day Precipitation



Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

National Weather Service
Philadelphia/Mt. Holly

180 Day Departure From Normal



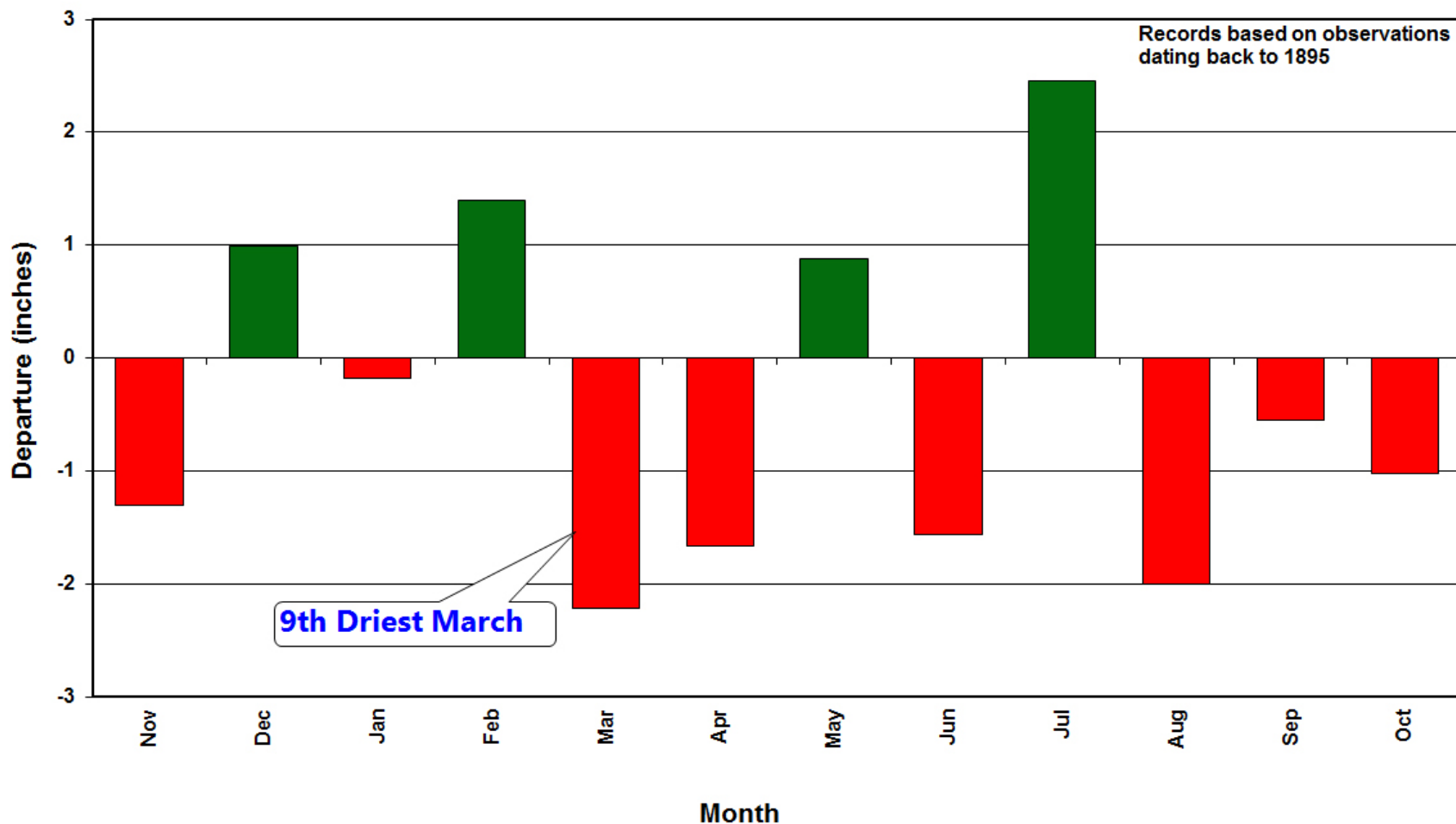
Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

National Weather Service
Philadelphia/Mt. Holly

Office of the NJ State Climatologist

NJ Monthly Precipitation Departures (November 2015 – October 2016)

Departures calculated from differences between observed monthly precipitation and 1981–2010 monthly averages



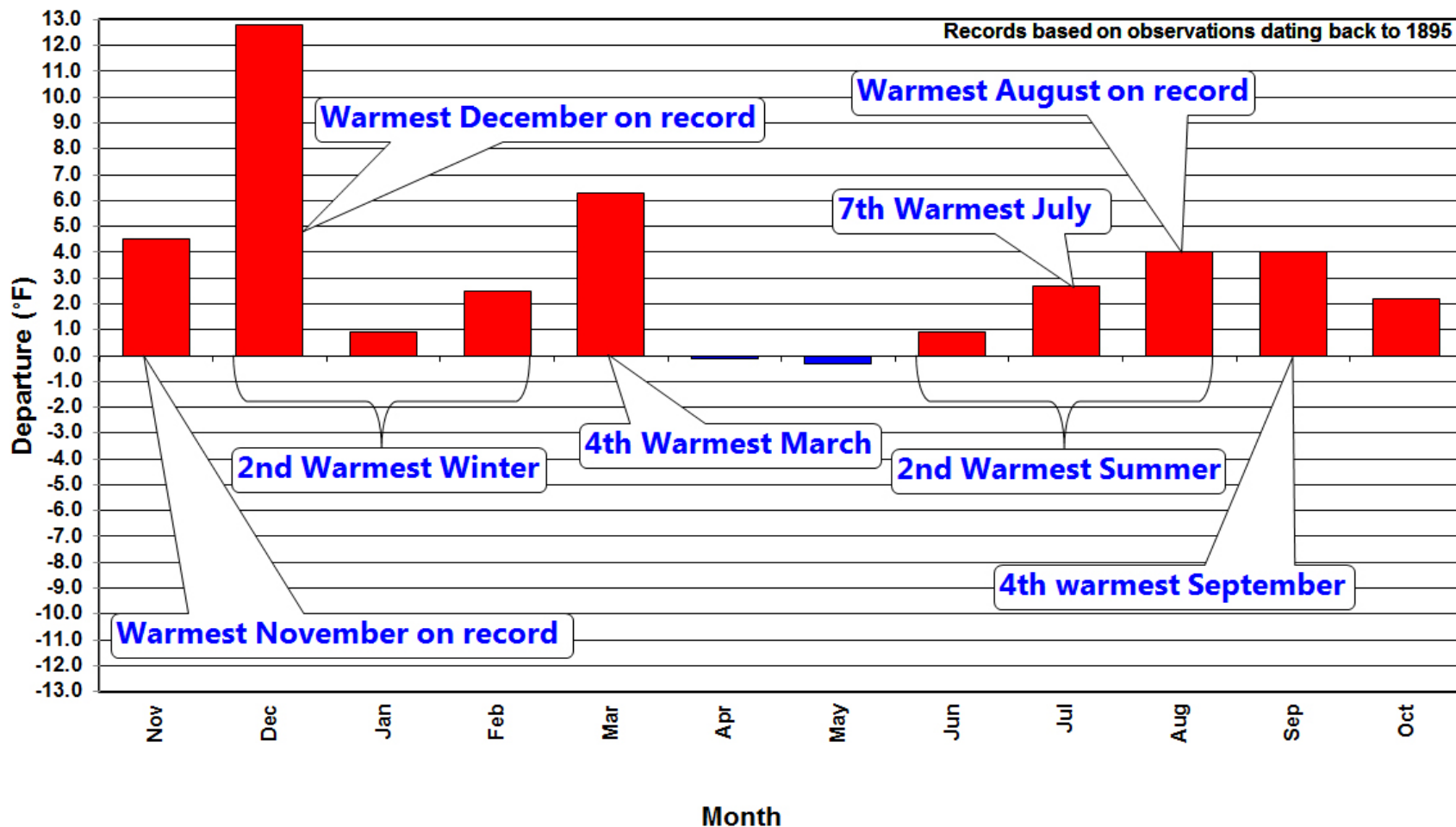
Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

National Weather Service
Philadelphia/Mt. Holly

Office of the NJ State Climatologist

NJ Monthly Temperature Departures (November 2015 – October 2016)

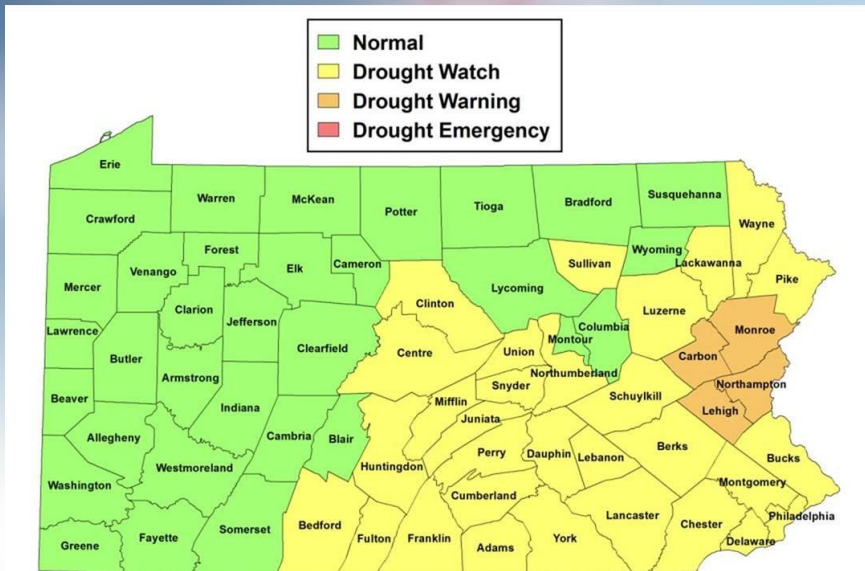
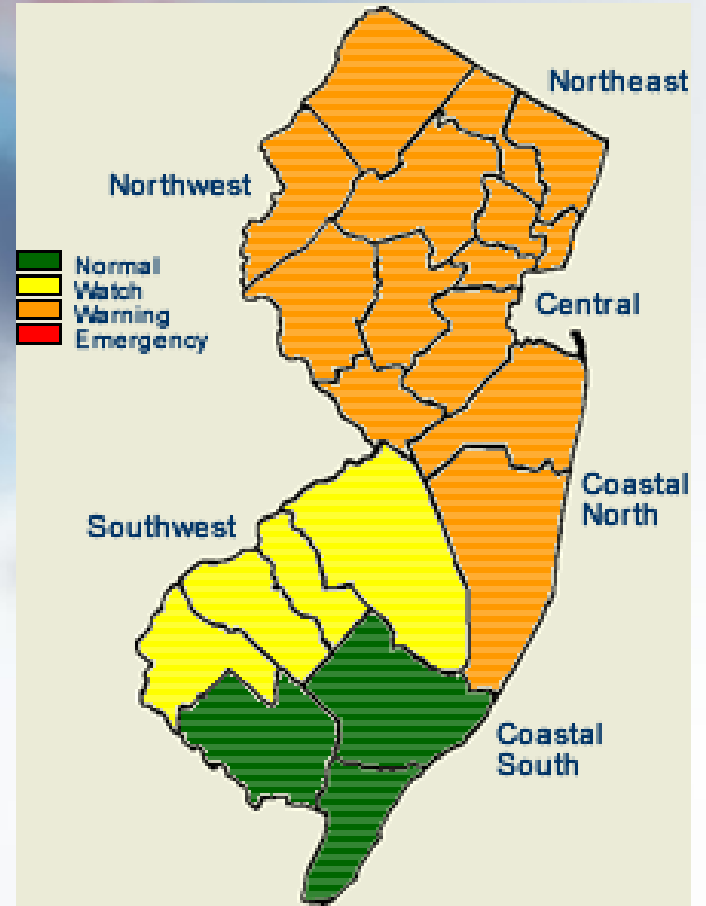
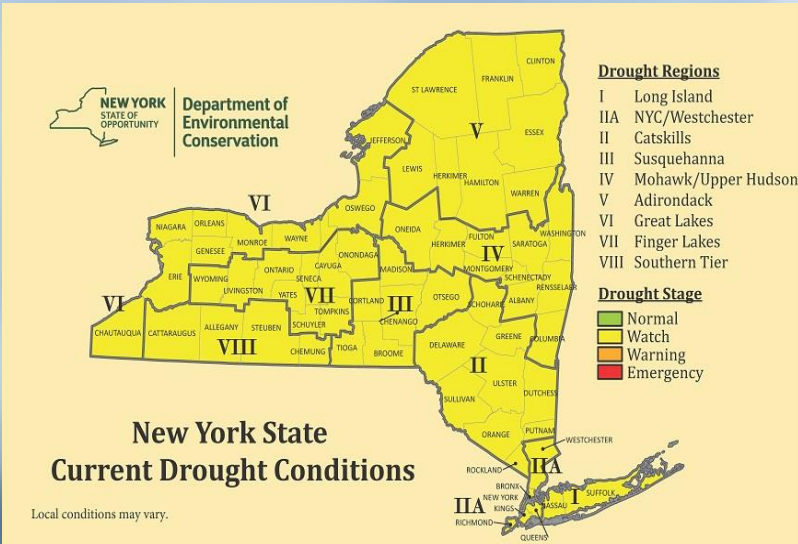
Departures calculated from differences between observed monthly temperatures and 1981–2010 monthly averages



Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

National Weather Service
Philadelphia/Mt. Holly

Drought Status

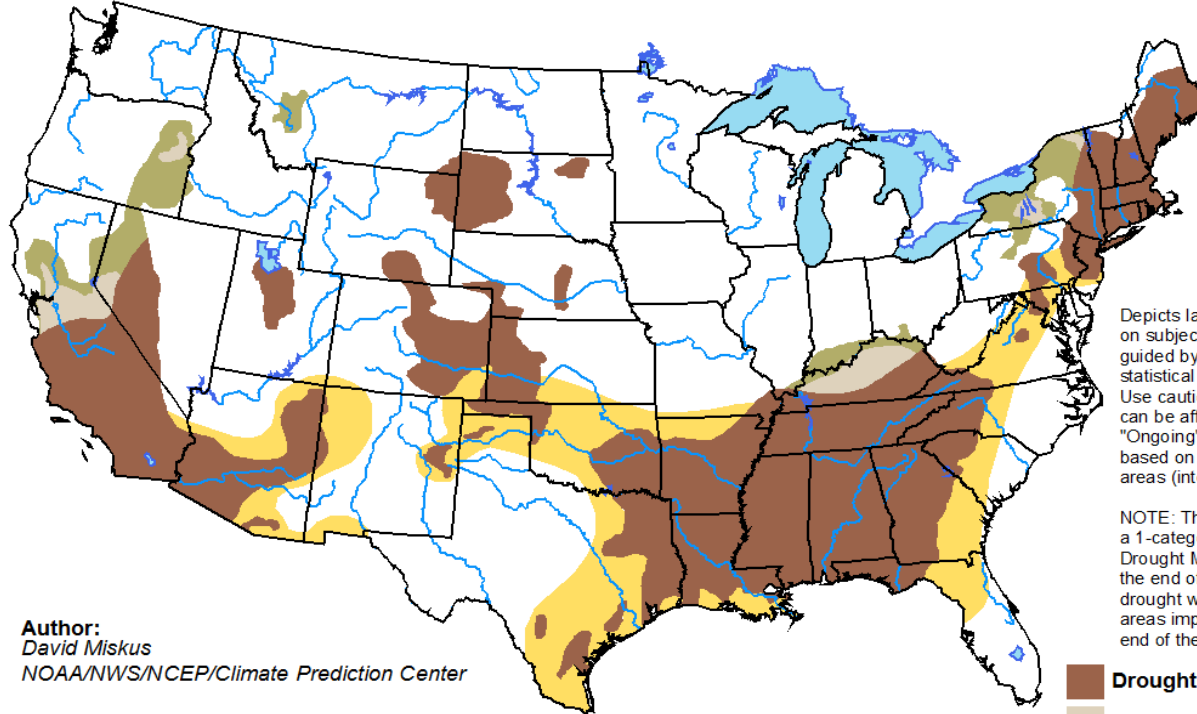


Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.



Drought Outlook





U.S. Seasonal Drought Outlook Valid for November 17 - February 28, 2017
Drought Tendency During the Valid Period Released November 17, 2016

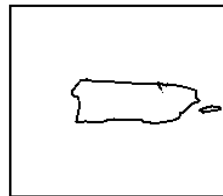
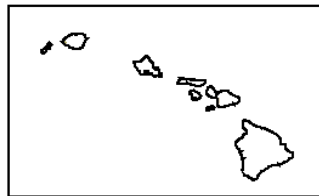
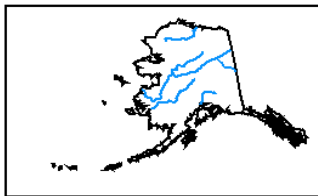


Depicts large-scale trends based on subjectively derived probabilities guided by short- and long-range statistical and dynamical forecasts. Use caution for applications that can be affected by short lived events. "Ongoing" drought areas are based on the U.S. Drought Monitor areas (intensities of D1 to D4).

NOTE: The tan areas imply at least a 1-category improvement in the Drought Monitor intensity levels by the end of the period, although drought will remain. The green areas imply drought removal by the end of the period (D0 or none).

Author:
David Miskus
NOAA/NWS/NCEP/Climate Prediction Center

-  Drought persists
-  Drought remains but improves
-  Drought removal likely
-  Drought development likely



<http://go.usa.gov/3eZ73>



Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

National Weather Service
Philadelphia/Mt. Holly

ENSO Status

ENSO Alert System Status: La Niña Advisory

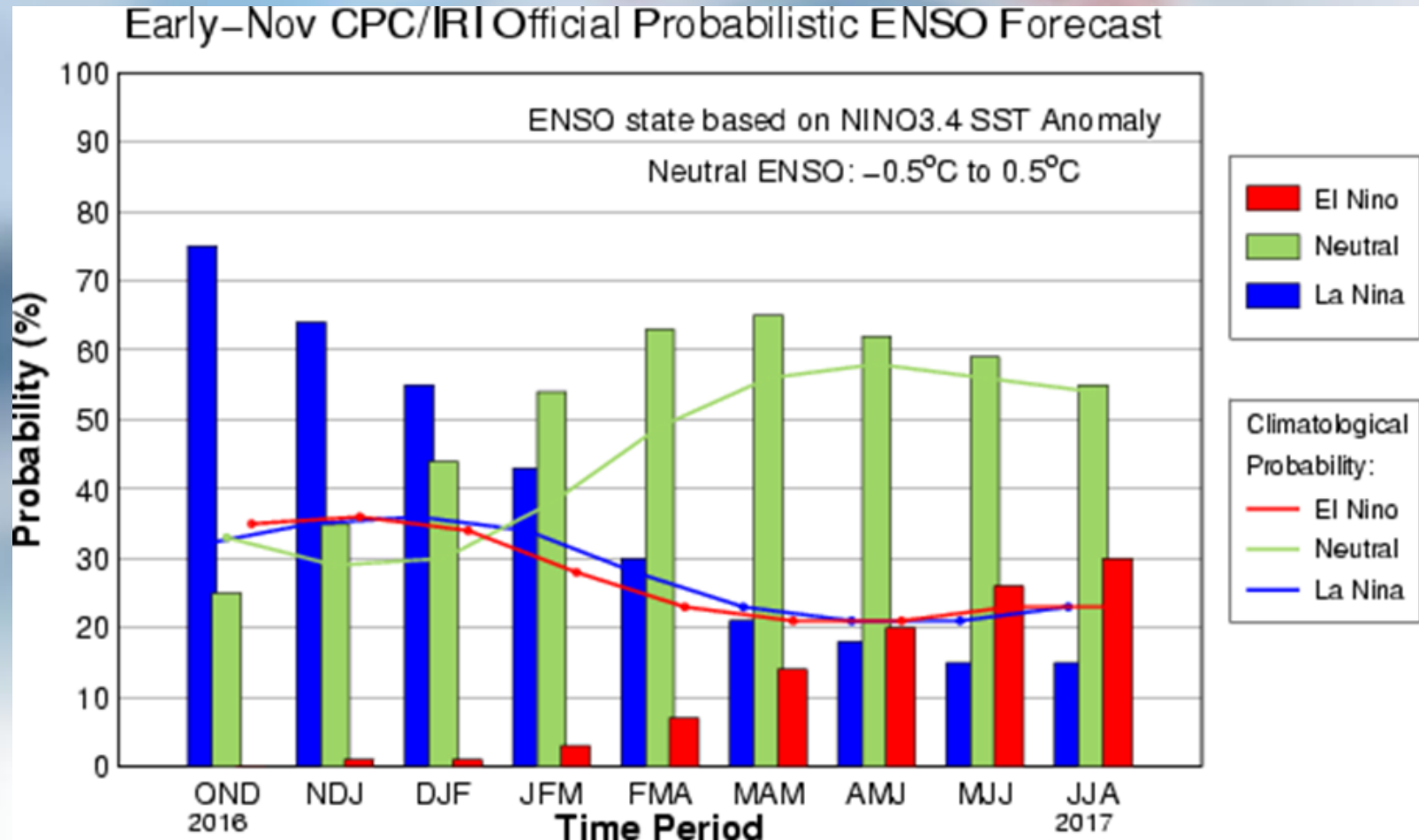
La Niña conditions are present.

Equatorial sea surface temperatures (SST) are below average in the central and east-central Pacific Ocean.

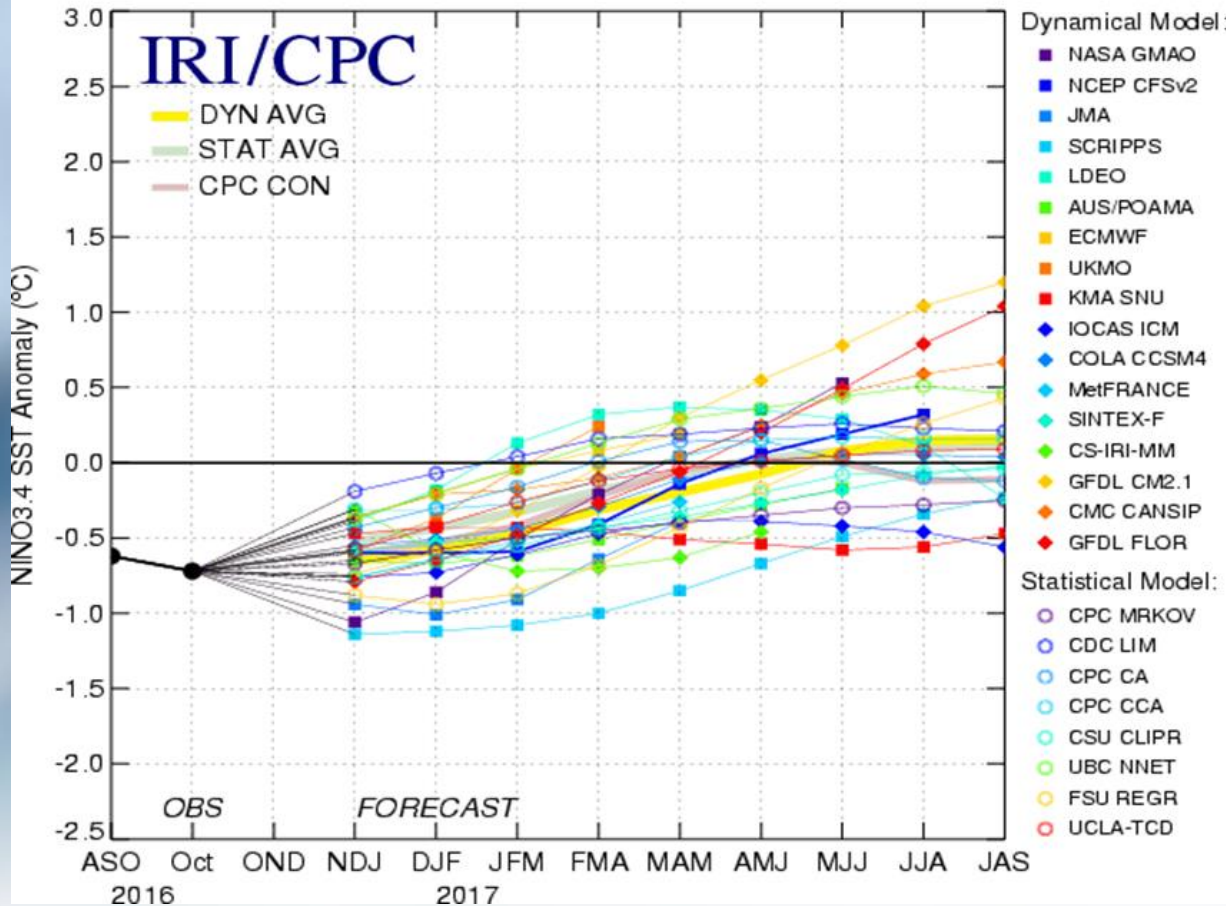
La Niña is slightly favored to persist (~55% chance) through winter 2016-17.*



La Niña is slightly favored to persist (~55% chance) through the winter 2016-17



Mid-Nov 2016 Plume of Model ENSO Predictions



Most multi-model averages indicate weak La Niña conditions through the Northern Hemisphere early winter 2016-17.



Two Week Forecast/Outlook

- 1 to 7 Day Forecast – Low pressure nearing James Bay will send a cold front through our area today. This will push separate low pressure off the Carolinas. Another cold front will pass through the region Thursday night as the low over James Bay moves across eastern Quebec into Friday. High pressure and cold air will move into the middle Atlantic on Friday and into this weekend. A warm front may approach our region by Monday.
- 8 to 14 Day Outlook – Temperatures below normal and precipitation above normal.



2016 Fall Outlook

- September and October look warm and continued dry. ✓
- A flip in November is possible to cooler and wetter conditions as La Nina takes hold. ✓





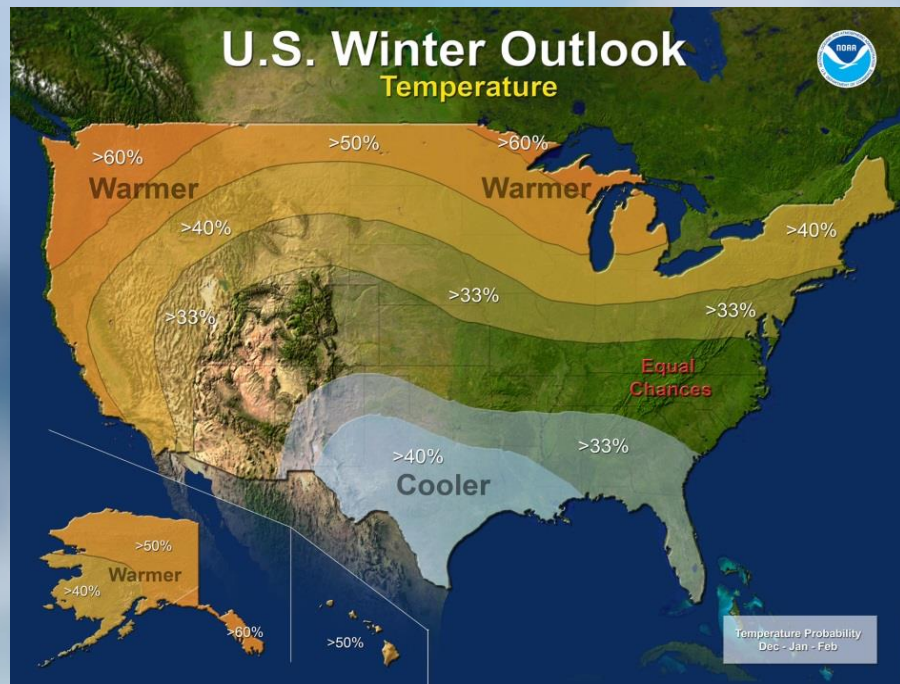
Winter Review and Forecast

- Winter 2015 – 2016 Review
- Winter 2016 – 2017 Outlook

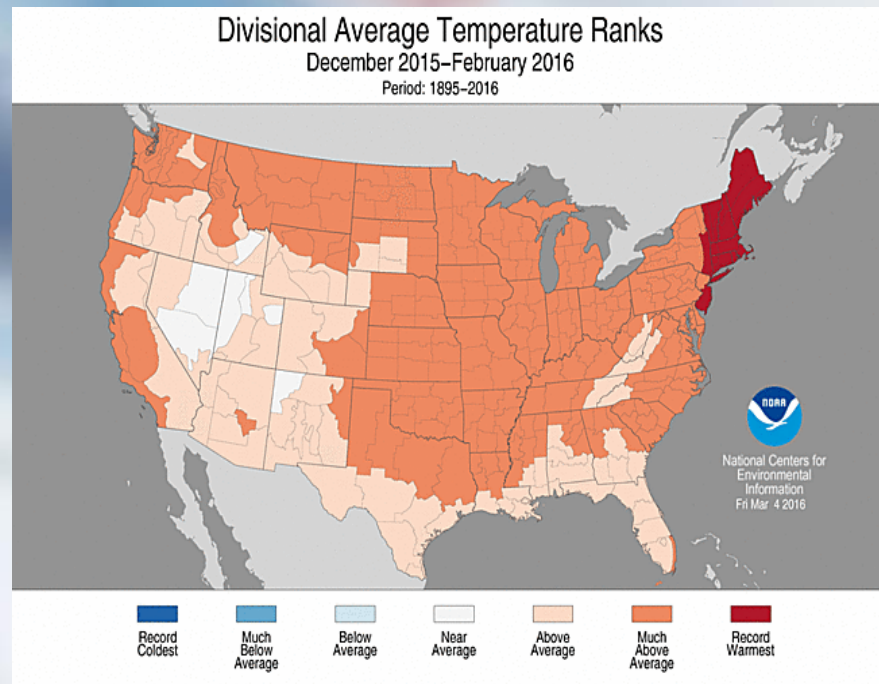




Temperatures Last Winter



**Last Winter's Temperature Outlook
(Issued Fall 2015)**



**Last Winter's Temperature
Verification (Issued Spring 2016)**



Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

**National Weather Service
Philadelphia/Mt. Holly**



Philadelphia Temperatures and Snowfall From Last Winter

	Philadelphia	Departure	Fall 2015 Analog Forecast
December	51.2F	+13.7	>+5
January	34.2F	+1.2	+2
February	38.6F	+2.9	-3.5
Winter Average	41.4F	+6.0	>+.9



Philadelphia Snowfall: 27.2” with 22.4 falling in one storm during January.

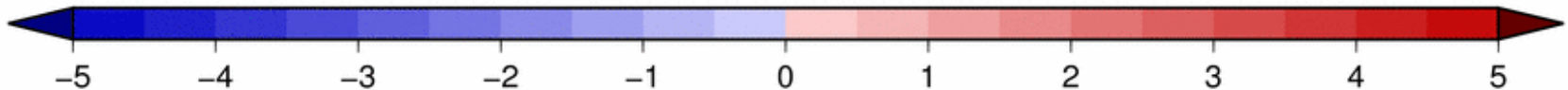
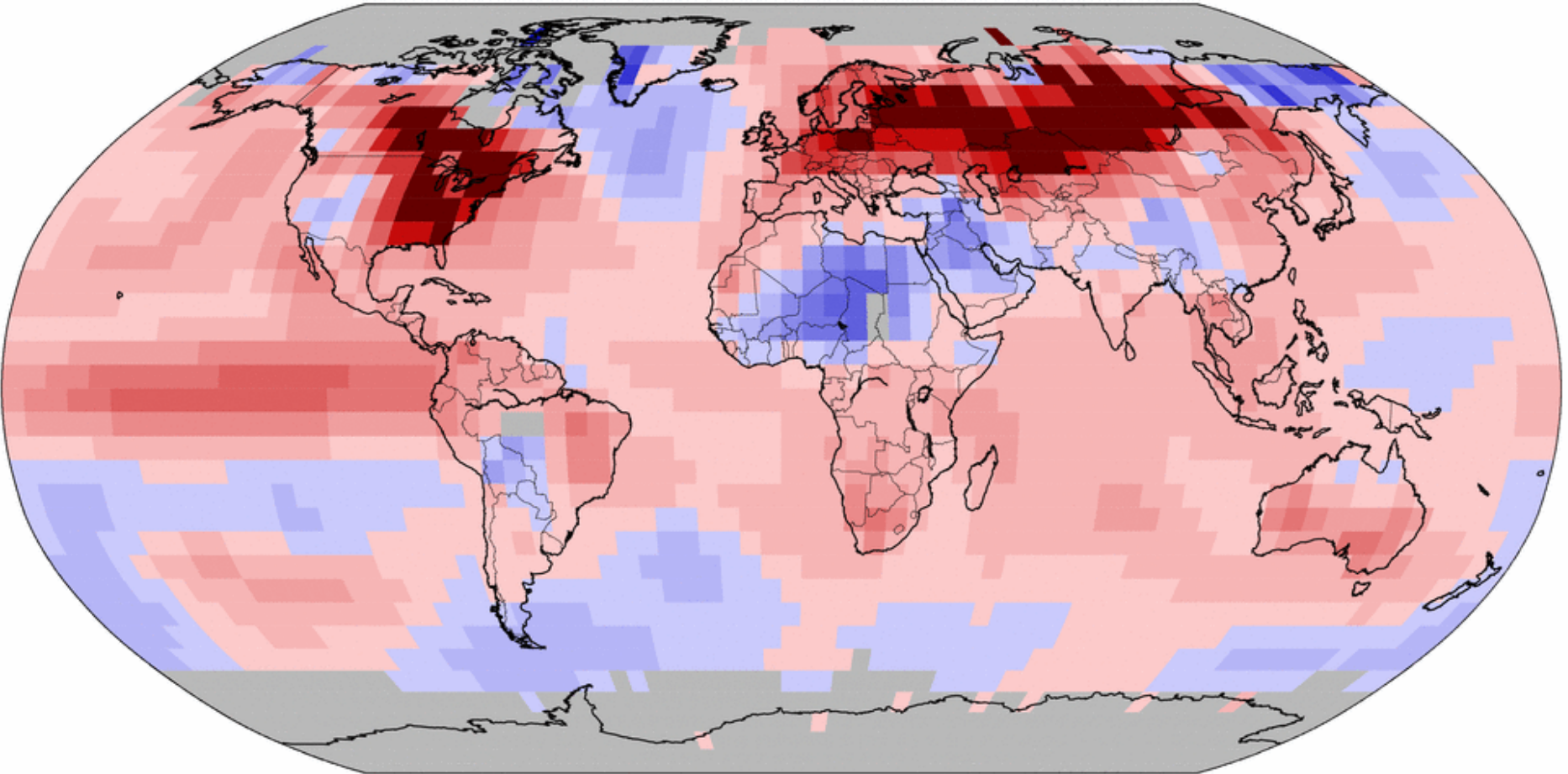


Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

**National Weather Service
Philadelphia/Mt. Holly**

Land & Ocean Temperature Departure from Average Dec 2015 (with respect to a 1981–2010 base period)

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



Degrees Celsius



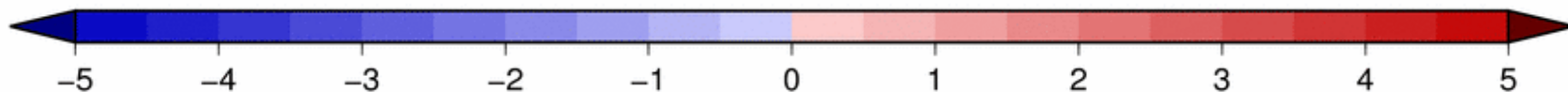
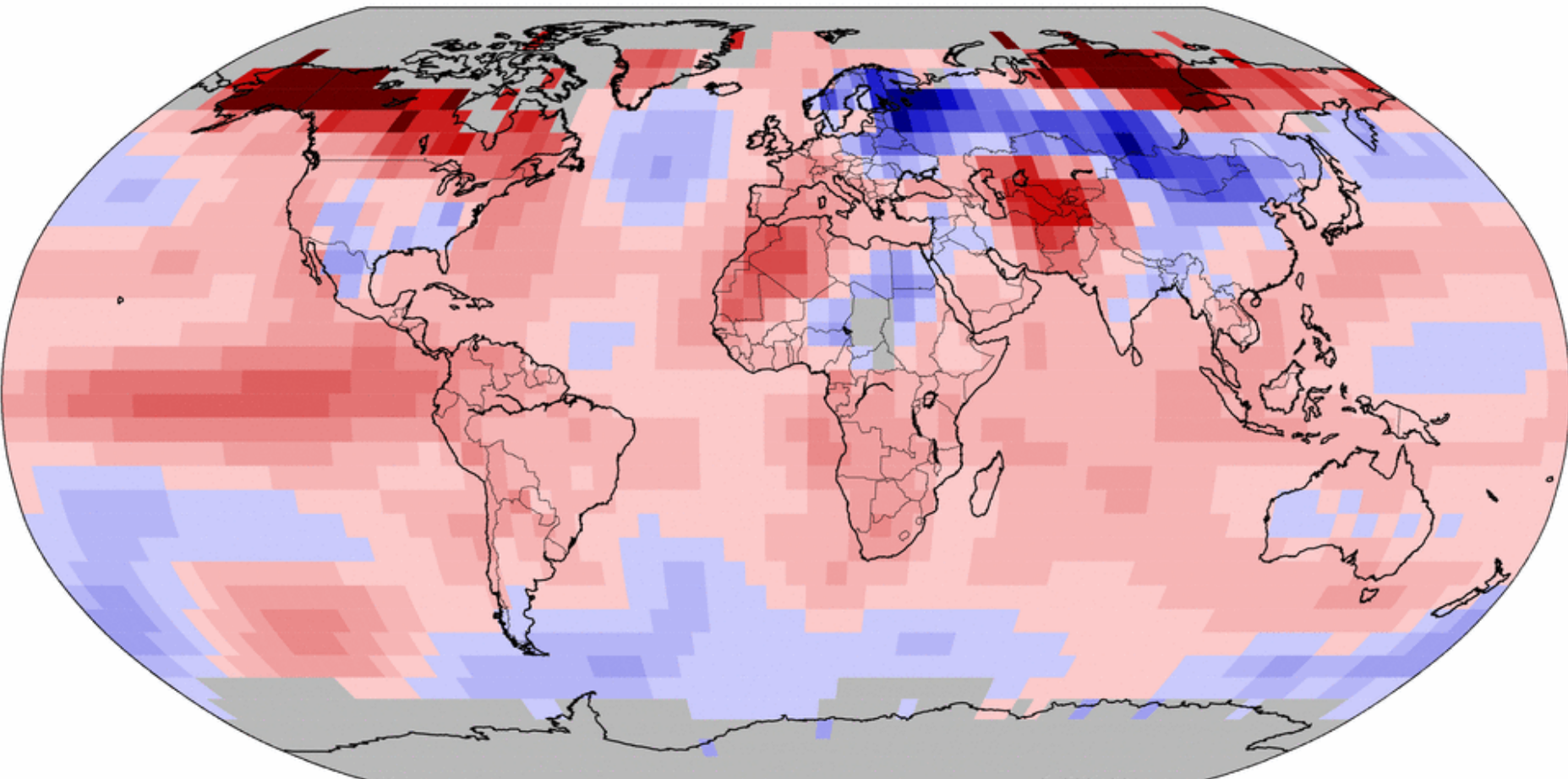
National Centers for Environmental Information
Wed Jan 13 12:14:51 EST 2016

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

Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

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

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



Degrees Celsius



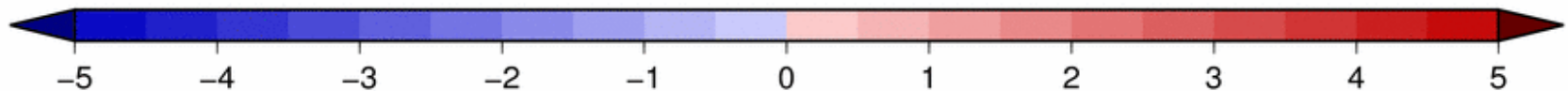
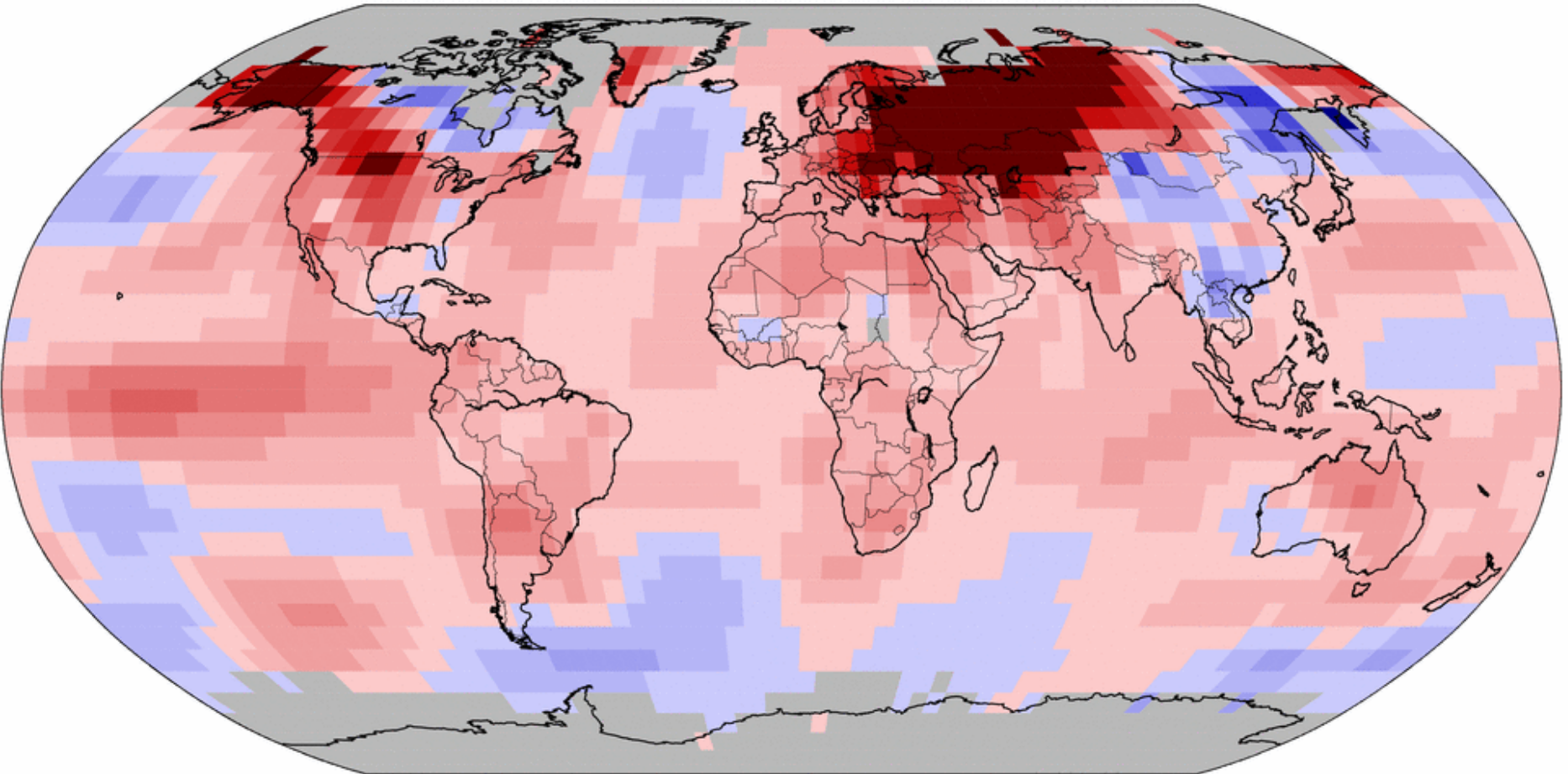
National Centers for Environmental Information
Fri Feb 12 06:40:51 EST 2016

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

Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

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

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



Degrees Celsius



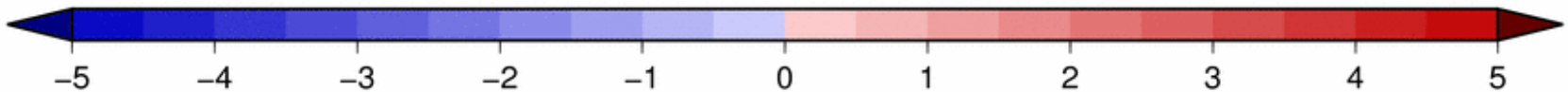
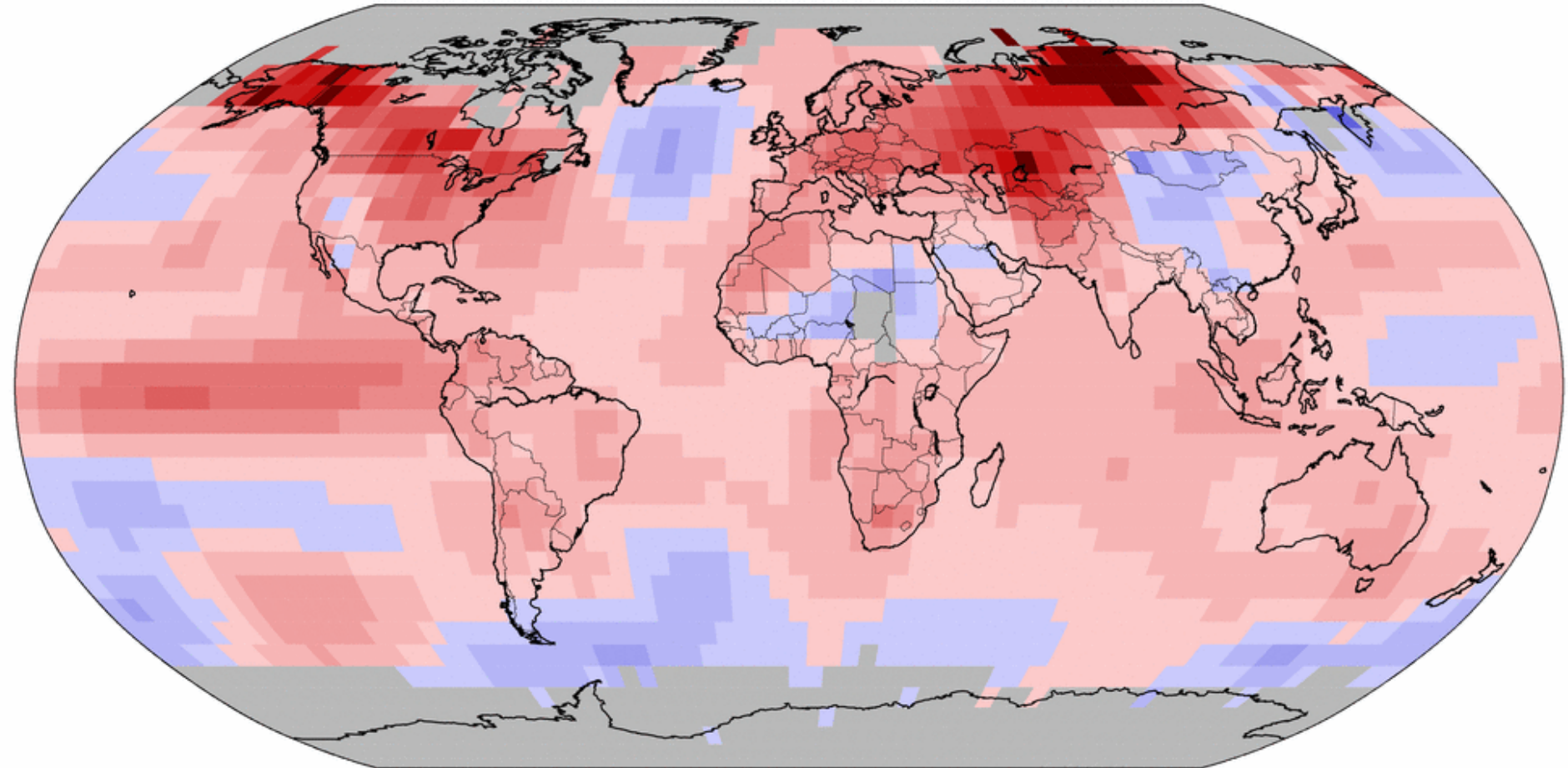
National Centers for Environmental Information
Mon Mar 14 07:22:03 EDT 2016

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

Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

Land & Ocean Temperature Departure from Average Dec 2015–Feb 2016 (with respect to a 1981–2010 base period)

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



Degrees Celsius



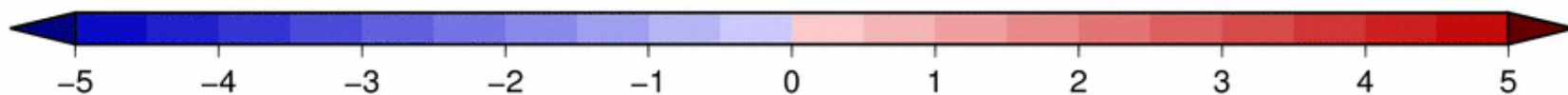
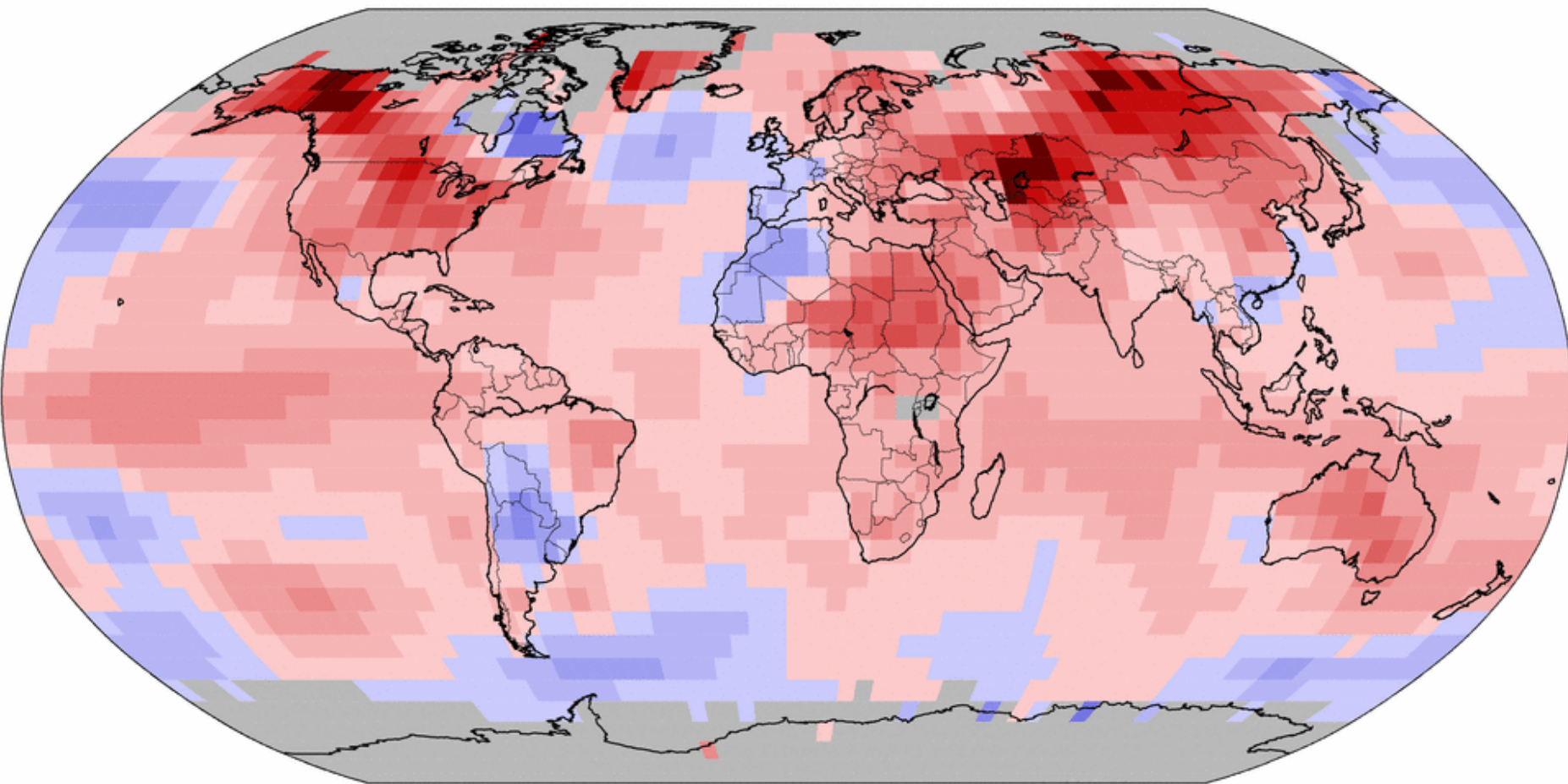
National Centers for Environmental Information
Mon Mar 14 07:22:03 EDT 2016

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

Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

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

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



Degrees Celsius



National Centers for Environmental Information

Fri Apr 15 07:05:58 EDT 2016

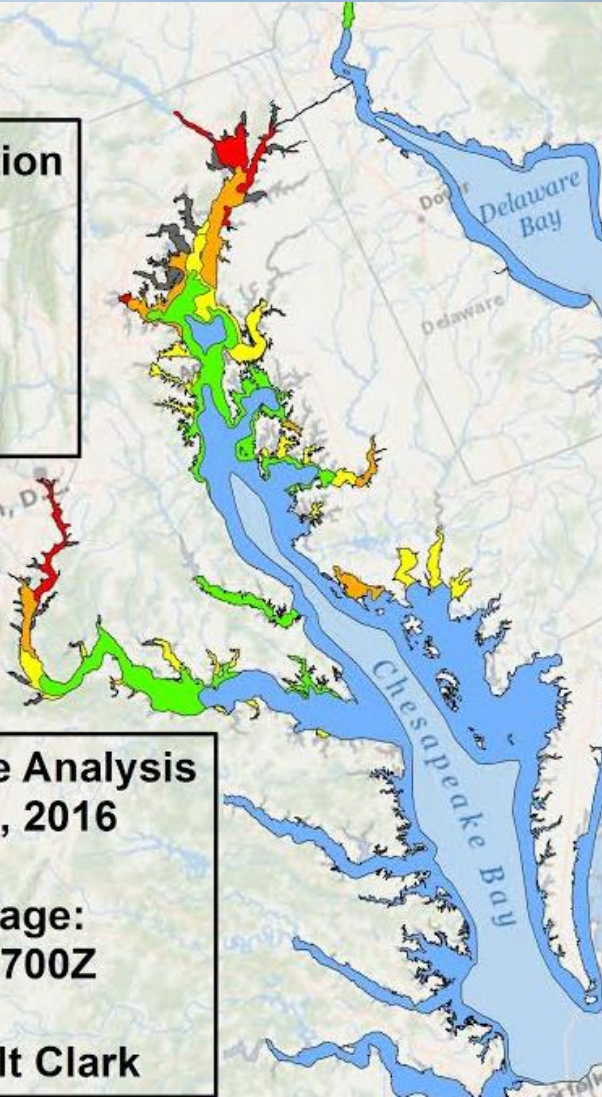
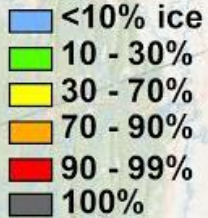
Please Note: Gray areas represent missing data

Map Projection: Robinson

Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

Two peaks in ice cover

Ice Concentration

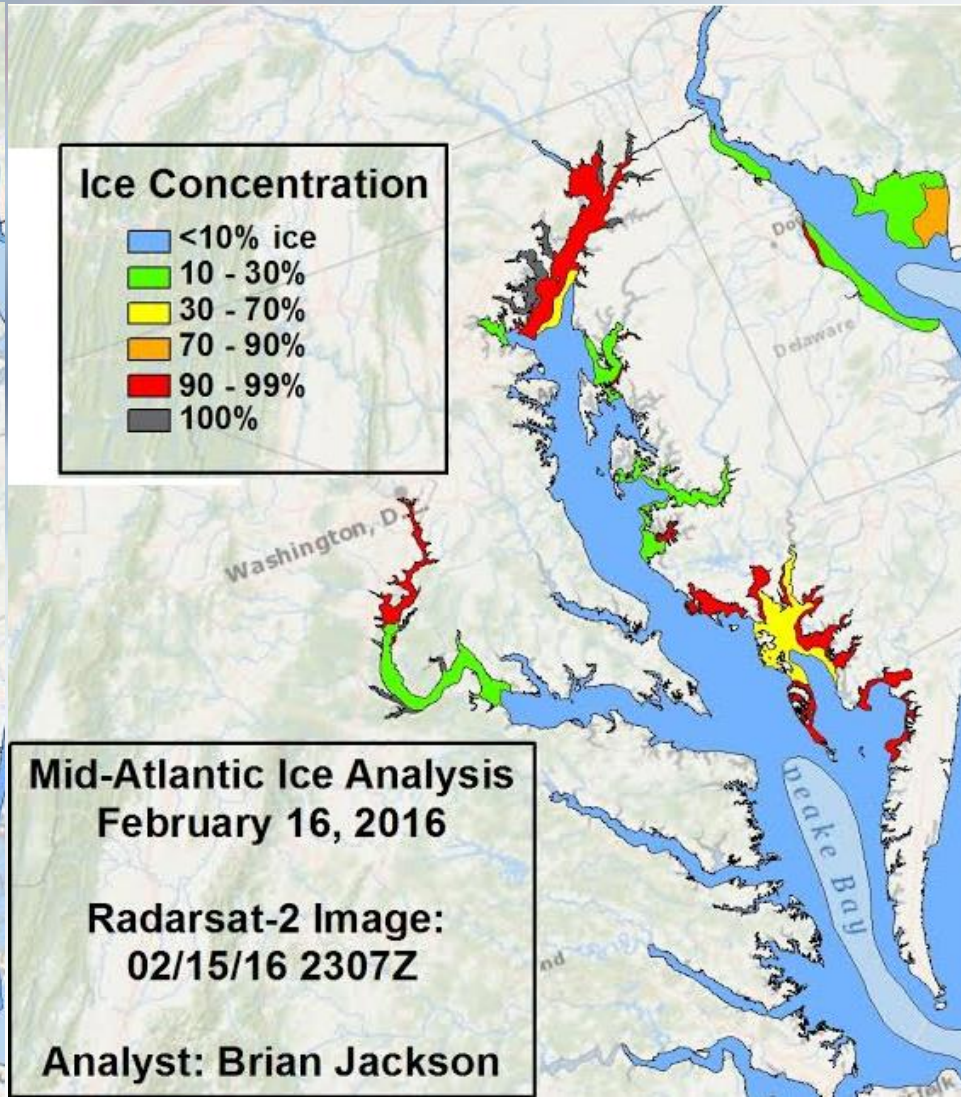


Mid-Atlantic Ice Analysis
January 26, 2016

MODIS Image:
01/25/16 1700Z

Analyst: Walt Clark

Ice Concentration



Mid-Atlantic Ice Analysis
February 16, 2016

Radarsat-2 Image:
02/15/16 2307Z

Analyst: Brian Jackson



Philadelphia Average Winter Temperatures (Past 8 Winters)

2015-2016: 41.4F

2014-2015: 32.6F

2013-2014: 33.0F

2012-2013: 38.2F

2011-2012: 40.7F

2010-2011: 33.1F

2009-2010: 33.8F

2008-2009: 34.9F

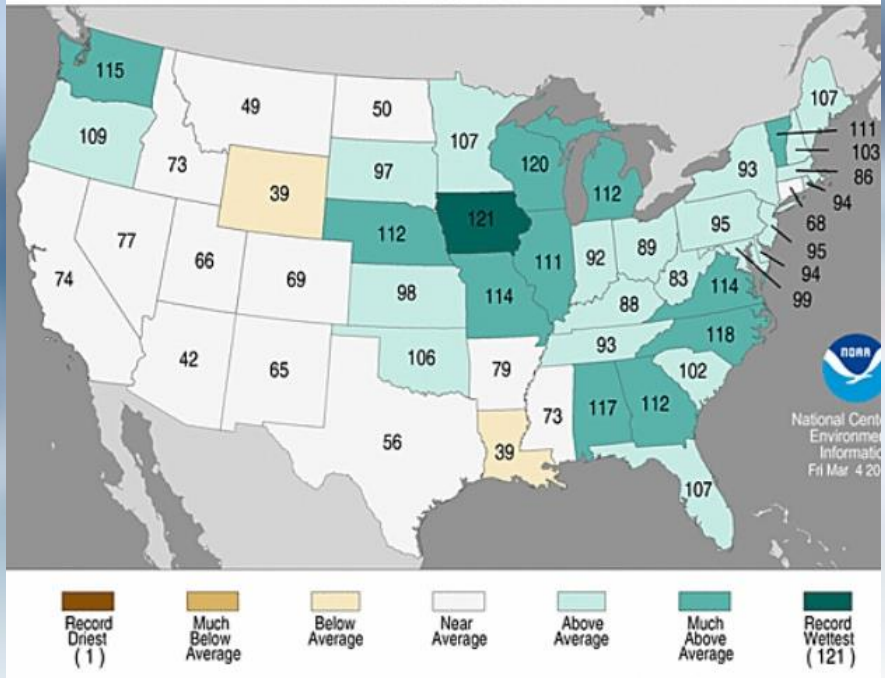
Average
Temperature:
34.8F





Precipitation Last Winter

Statewide Precipitation Ranks
December 2015–February 2016
Period: 1895–2016



	Philadelphia Precipitation	Philadelphia Snow
December	5.14 (+1.58)	0.0 (-3.4)
January	2.63 (-0.40)	22.9 (+16.4)
February	4.36 (+1.71)	3.3 (-5.5)
Winter Total	12.13 (+2.89)	27.2 (+4.7)
March	2.01 (-1.78)	1.0 (-1.9)

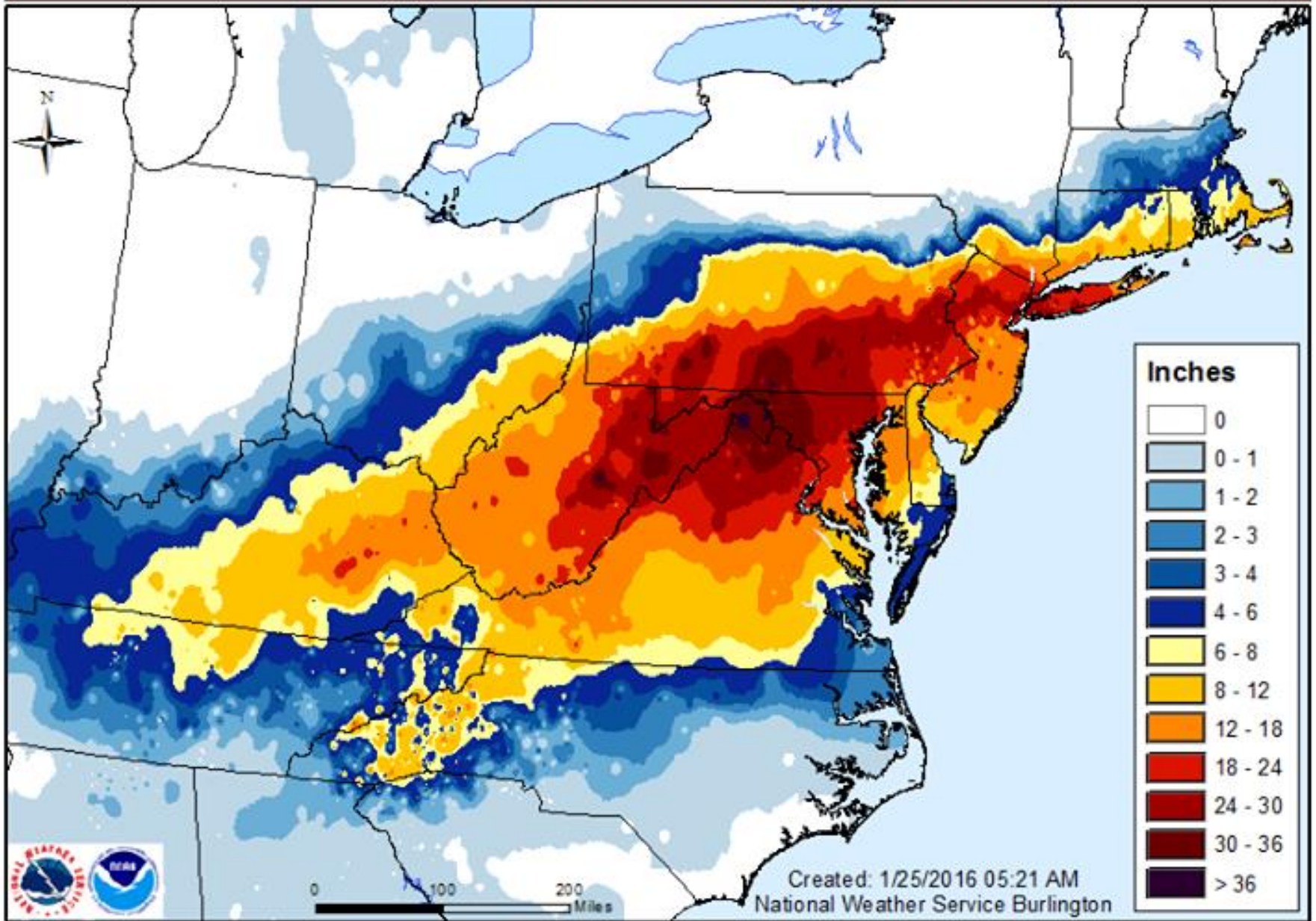
Actual (+/- from normal)



Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

National Weather Service
Philadelphia/Mt. Holly

Total Observed Snowfall January 22nd - 24th, 2016

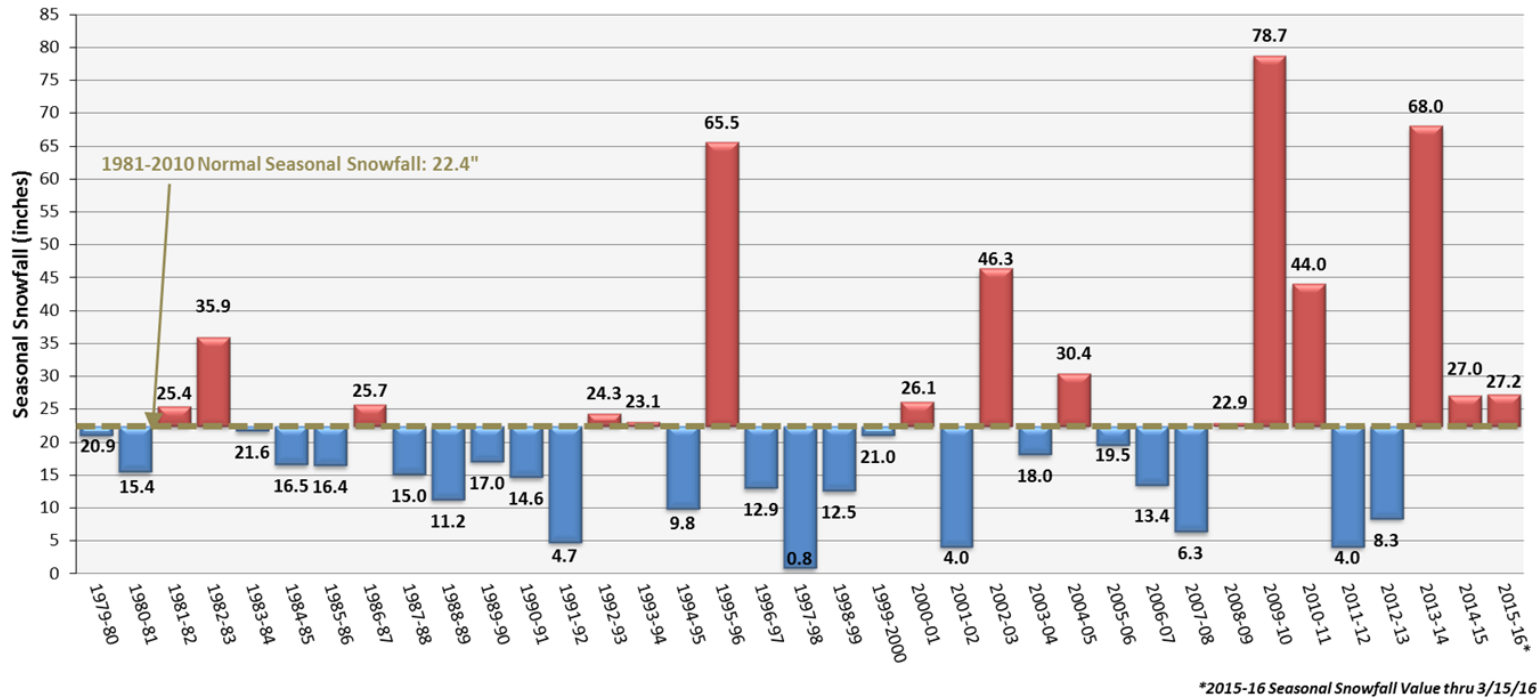


Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

National Weather Service
Philadelphia/Mt. Holly



Seasonal Snowfall for Philadelphia, PA (1979–2016)



*** PLEASE NOTE ***

Snowfall data on this page are PRELIMINARY (unofficial). CERTIFIED (official) data are available from NOAA's National Centers for Environmental Information (NCEI) at www.ncdc.noaa.gov



Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

National Weather Service
Philadelphia/Mt. Holly



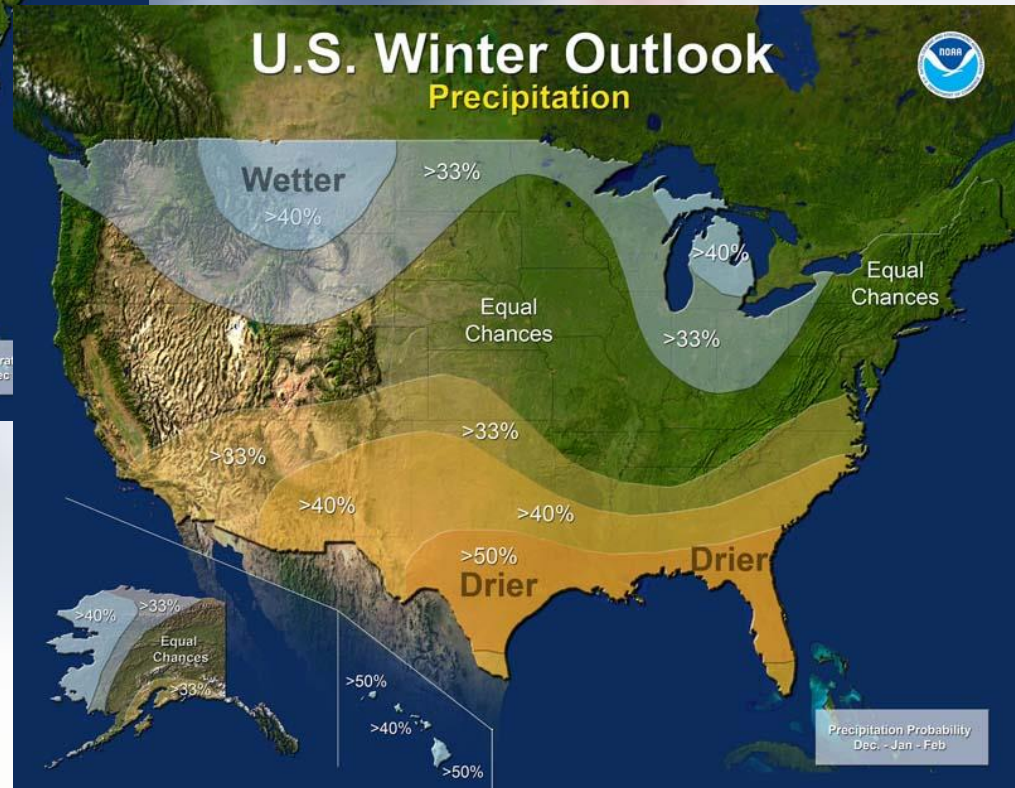
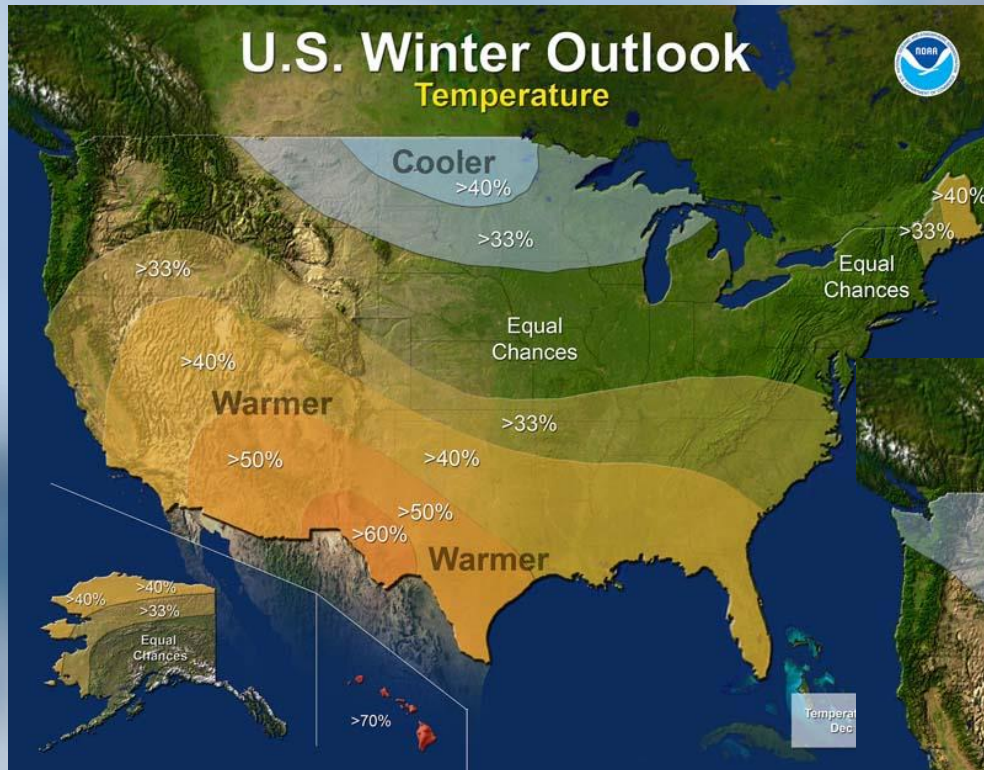
2016/2017 Winter Outlook



Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

**National Weather Service
Philadelphia/Mt. Holly**

2016-2017 Winter Outlook



Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

National Weather Service
Philadelphia/Mt. Holly



Summary Slide From 2015



- Likely a warmer first half to winter with Pacific flow and El Niño being the dominant player



- The strong positive PDO will likely show more impacts on the weather pattern later on by February with a colder pattern.



- The odds for a six inch snowstorm are higher than normal for the winter. However fewer smaller events are likely to occur, with snow near or below normal.

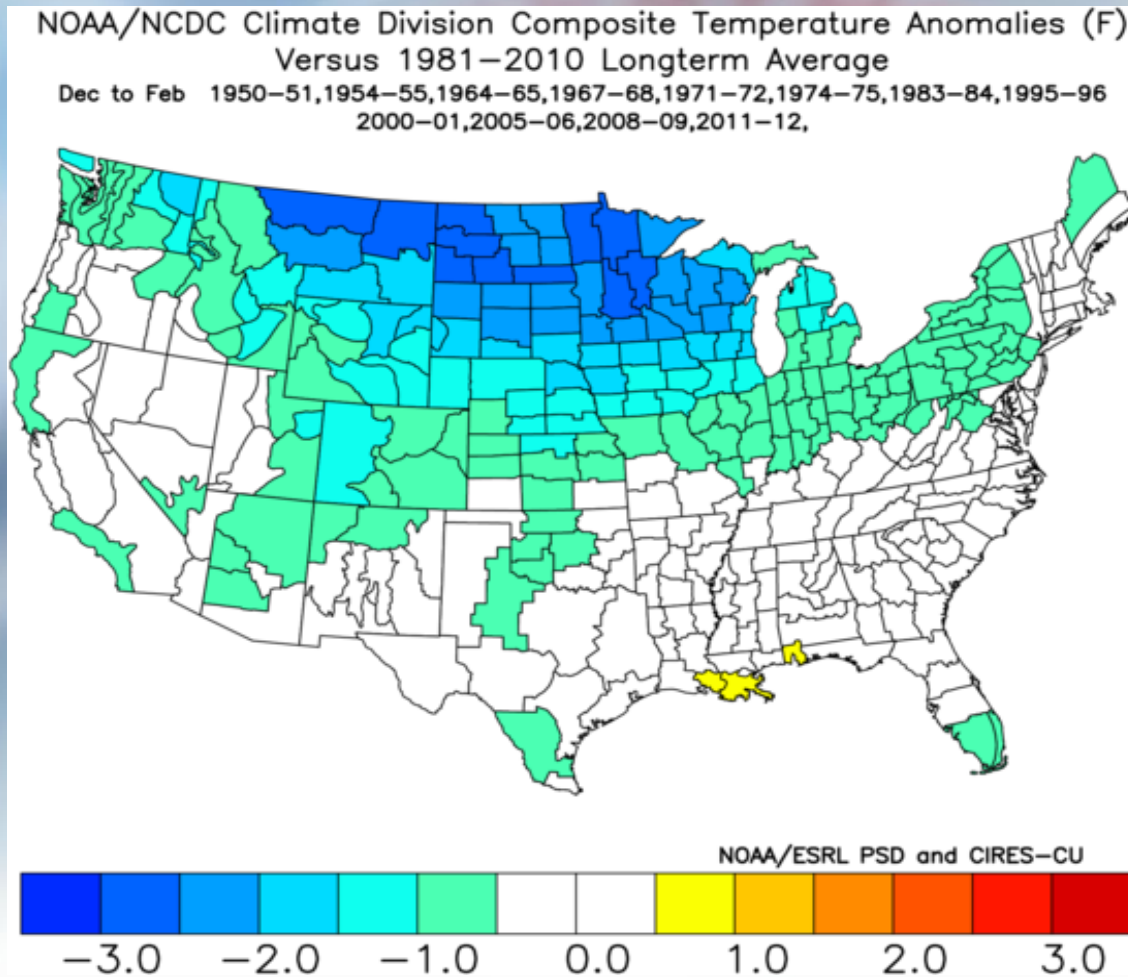
PDO is the Pacific Decadal Oscillation



Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

**National Weather Service
Philadelphia/Mt. Holly**

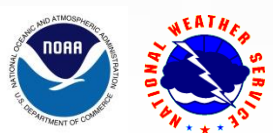
Temps in Past Weak La Niña Winters



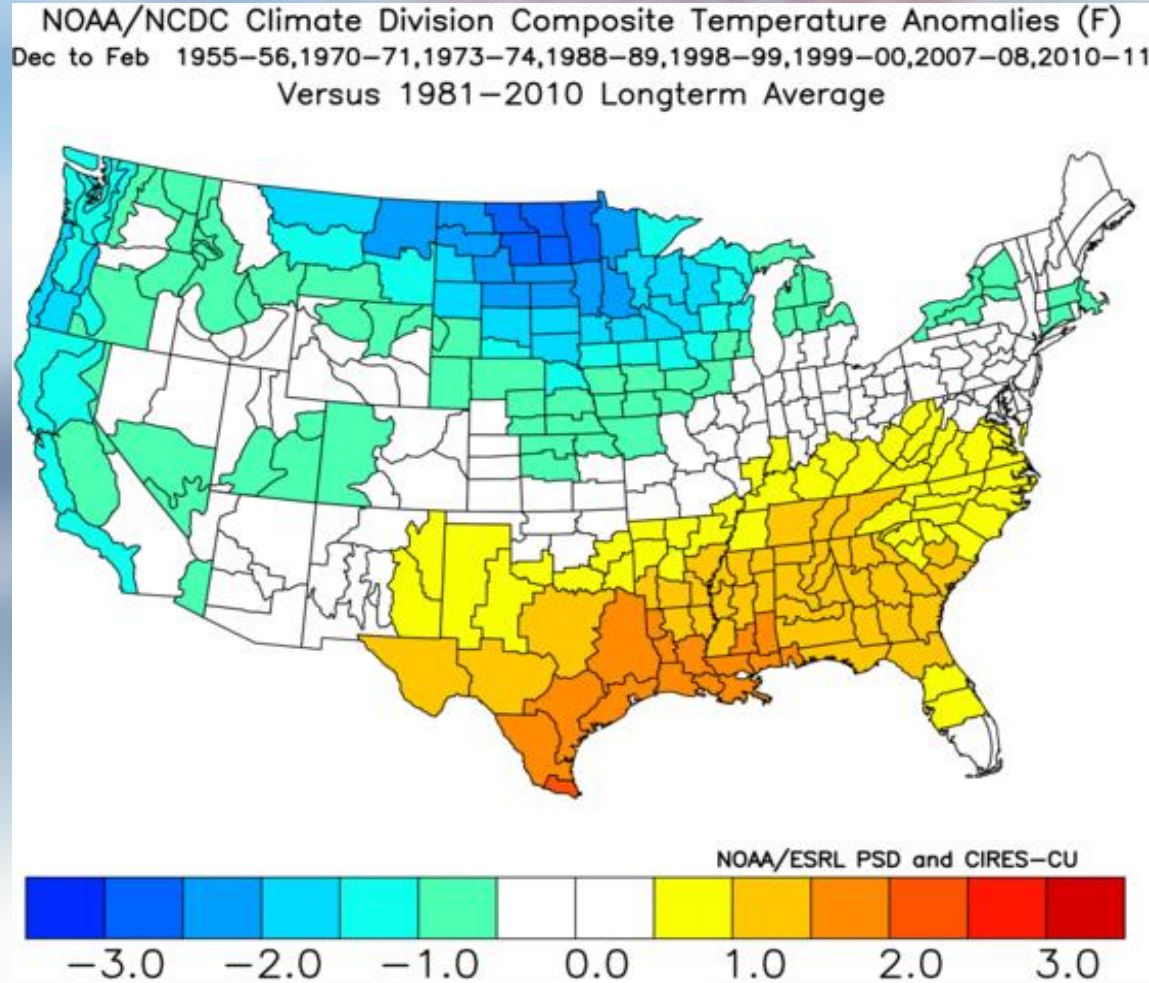
Weak La Niña winters favor at or slightly below normal temps locally.

Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

National Weather Service
Philadelphia/Mt. Holly



Temps in Past Moderate/Strong La Niña Winters



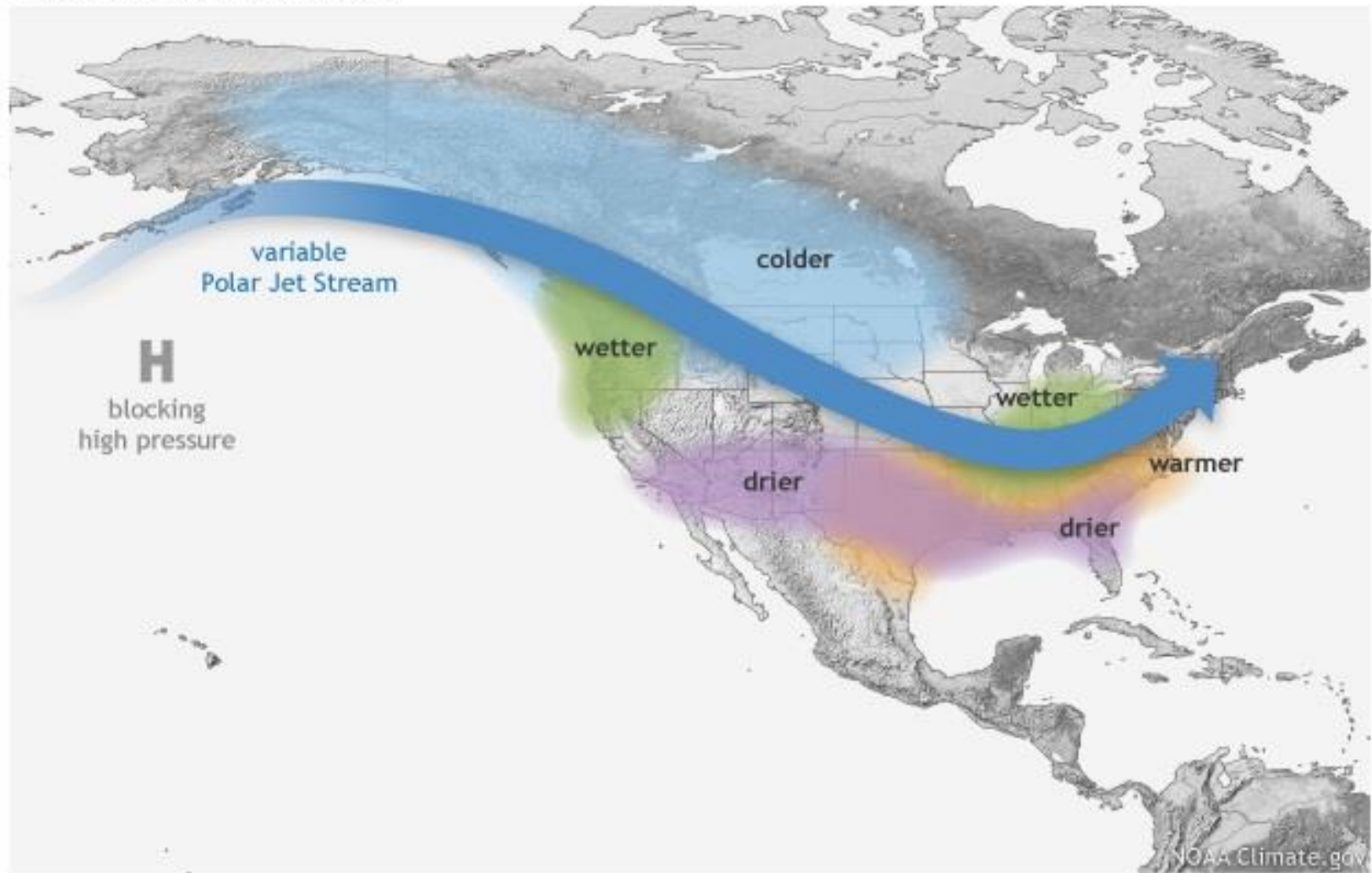
Moderate to Strong La Niña winters favor warmer conditions over the southeastern United States and into the Mid-Atlantic.

Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

National Weather Service
Philadelphia/Mt. Holly



Wintertime La Niña pattern



Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

**National Weather Service
Philadelphia/Mt. Holly**



Local Study: Winter Analogs

- Analog Years: 54-55, 64-65, 70-71, 66-67, 83-84, 92-93, 95-96, 10-11, 13-14.
- Mean analog temperature: -1.5 (Dec-Mar)
- Mean analog snowfall: 29.8 inches for Philadelphia (Dec-Mar)



Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

National Weather Service
Philadelphia/Mt. Holly

Number of PHL Significant Snowfall Events (1949-50 to 2015-16)

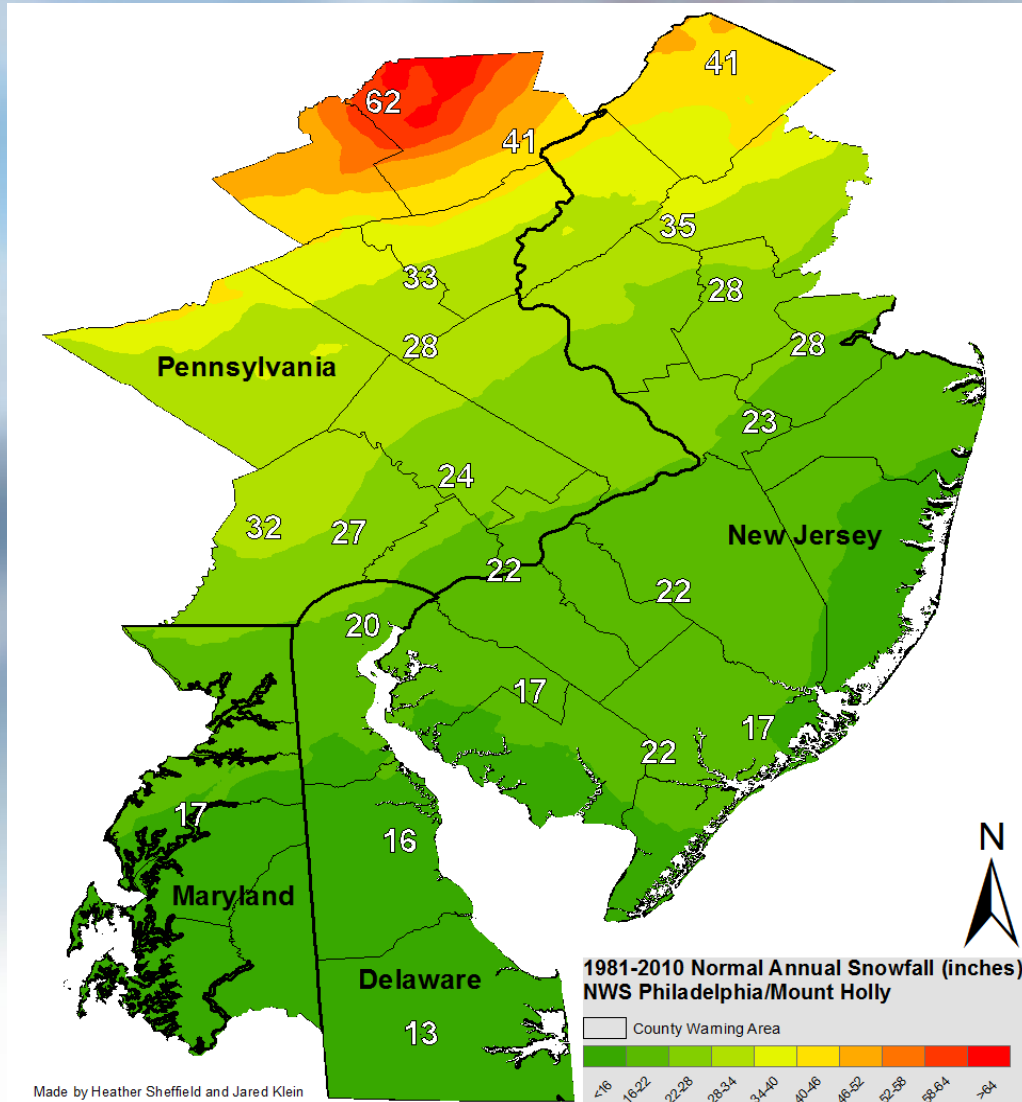
	Greater than or equal to 6"	Greater than or equal to 10"
• Strong La Nina (6 yrs)	3	0
• Moderate La Nina (6)	4	2
• Weak La Nina (9)	8	2
• Neutral (20)	19	8
• Weak El Nino (11)	9	4
• Moderate El Nino (6)	8	1
• Strong El Nino (7)	9	7



Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

National Weather Service
Philadelphia/Mt. Holly

1981-2010 Snowfall Climatology



Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

Philadelphia Winter Outlook

(Based on Average of Local Winter Analogs)

Month	Temp Departure (F)	Snowfall (Inches)	Snow Departure (Inches)
December	-2.3	4.5	+1.1
January	-1.8	11.3	+4.8
February	-.4	7.8	-1.0
Season	-1.5 (Dec-Feb)	23.6 (Dec-Feb)	+4.9
March	-3.2	6.2	+3.3

- ***Temperatures are expected to be slightly below normal. Colder departures in December and March (or early and late winter/early spring).***
- ***Based on potential late season cold, river ice could rebound/increase late season.***
- ***There is more uncertainty with snowfall accumulations during La Nina phases vs. El Nino. Seasons have ranged between 12" to 68", but this year's analogs show above normal this season.***
- ***More smaller snow events are expected this winter compared to last winter. History suggests larger snowfalls are more rare in La Nina phases.***



Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

National Weather Service
Philadelphia/Mt. Holly

A big thank you goes out to NWS's Mt. Holly Forecast Office Forecaster Mitchell Gaines who navigated through a lot of numbers to make this presentation possible.



Presented to the DRBC Flood Advisory Committee on Dec. 7, 2016. Contents should not be published or re-posted in whole or in part without the permission of DRBC.

**National Weather Service
Philadelphia/Mt. Holly**

Range of Possibilities – Snow Forecasting

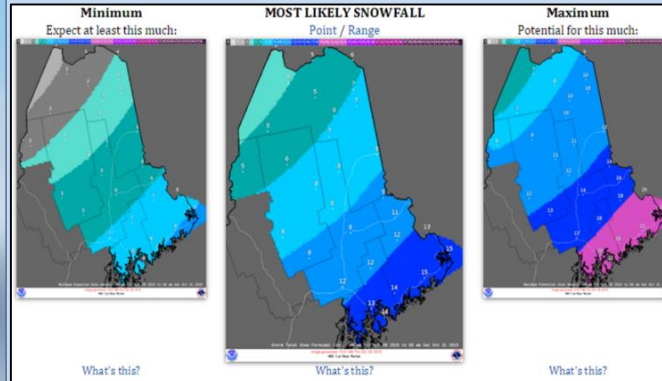
This will give everyone:

- The full set of forecast information, rather than just the current expectation, to enable better decisions by all.
- Our confidence in predicting the oncoming snow's accumulation.

What is it?

- An improved way to forecast snow
- *Range of possibilities*, as well as the current expectation
- Combination of forecaster skill and 70+ U.S. & international weather models.
- Range of possibilities for snow accumulation point-by-point across the region

3 New Tools



1) Min/Most Likely/Max

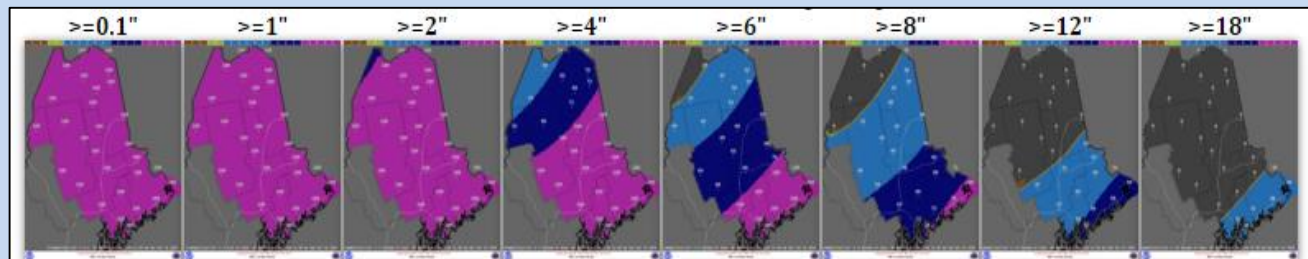
These show not only our current expectation (most-likely), but also the range of possibilities from the storm (max & min scenarios).

Location	Min	Likely	Max	>=0.1"	>=1"	>=2"	>=4"	>=6"	>=8"	>=12"	>=18"
Bangor, ME	6	11	17	100%	100%	100%	100%	100%	67%	47%	0%
Bar Harbor, ME	8	14	21	100%	100%	100%	100%	100%	74%	57%	34%
Calais, ME	7	13	19	100%	100%	100%	100%	100%	72%	54%	30%
Caribou, ME	4	6	10	100%	100%	100%	70%	52%	36%	0%	0%
Dover-Foxcroft, ME	5	9	13	100%	100%	100%	100%	68%	54%	30%	0%
Fort Kent, ME	3	4	7	100%	100%	100%	54%	31%	0%	0%	0%
Greenville, ME	4	8	12	100%	100%	100%	100%	63%	48%	0%	0%
Houlton, ME	4	8	12	100%	100%	100%	100%	63%	48%	0%	0%
Machias, ME	8	14	21	100%	100%	100%	100%	100%	100%	59%	37%
Madawaska, ME	3	5	7	100%	100%	100%	57%	34%	0%	0%	0%
Millinocket, ME	4	8	12	100%	100%	100%	100%	63%	49%	0%	0%

Switch to Range

2) Localized Listing

This shows the range of possibilities for individual towns and cities near you.



3) **Chance of Exceeding** – These show the percentage chance of exceeding a specific snowfall amount. Options are: 0.1", 1", 2", 4", 6", 8", 12", 18".

Webpage: www.weather.gov/car/winter

What's this?

For additional information explaining each of these and how to use them, select the "What's This?" link by each on the webpage.