



**NATIONAL  
WEATHER  
SERVICE**

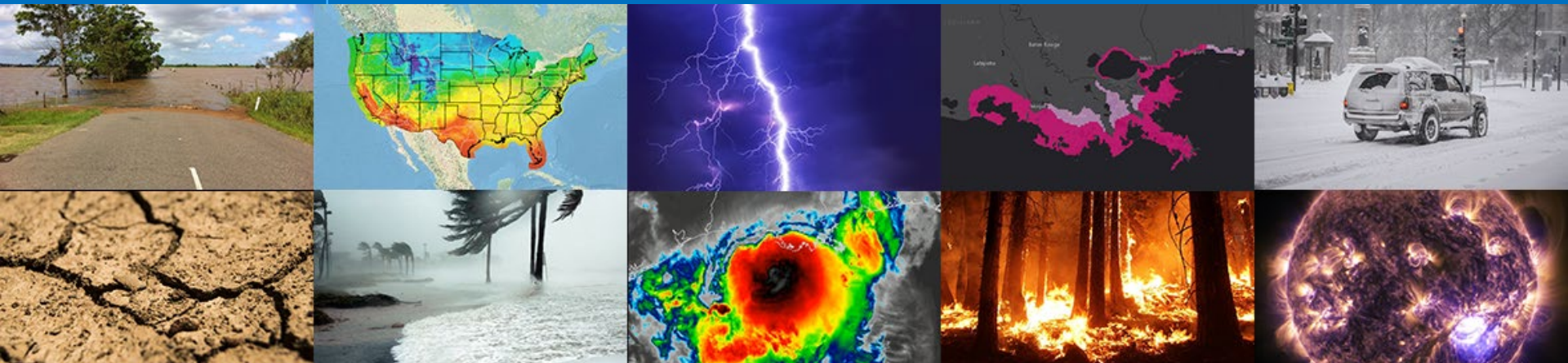
# Tailoring NOAA Seasonal Outlooks for Local Audiences

**MAY 10, 2023**

Presenter: Tim Armstrong

Meteorologist & Climate Program Leader

NWS Wilmington, NC



# Agenda

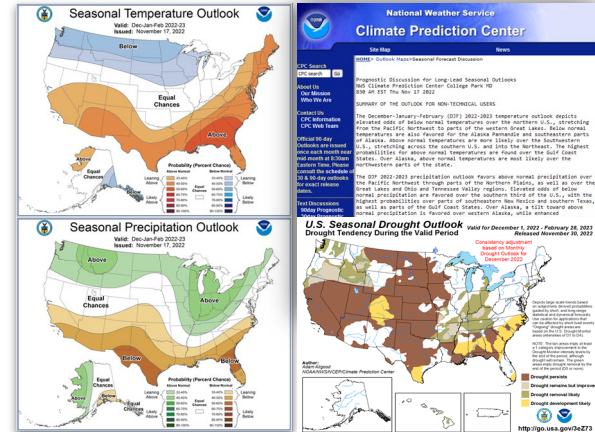
- First Attempt at Local Downscaling: Rainfall Anomalies During the Strong El Niño of 2015-16
- All Hazards Expansion for Improved DSS: Coastal Flooding, Drought, Wildfire, and more
- The Future: Sharing Techniques & Learning from Others



# CPC Outlooks vs. Local Needs

## Climate Prediction Center Outlooks

- Overlapping three-month seasonal temperature and precipitation probabilities for above and below normal terciles
- Expert Prognostic Discussions
- Seasonal Drought Outlook



## Personal discussions and anecdotes suggest local users *realistically* want:

- Potential for extreme climate events or individual weather events
- Degree of certainty or uncertainty associated with the outlook
- Actionable outlook for seasonal temperature and precipitation anomalies and amounts



# Strong El Niño of 2015-2016

My first attempt at local climate outlook downscaling

## CPC forecast was based on a powerful El Niño

- I wanted to relay CPC's Outlook to local users, customized with information specific to North and South Carolina's expected impacts

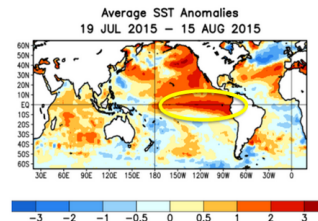
### El Niño's Impact on Winter 2015-2016 for North & South Carolina

NWS Wilmington, NC  
Weather Forecast Office

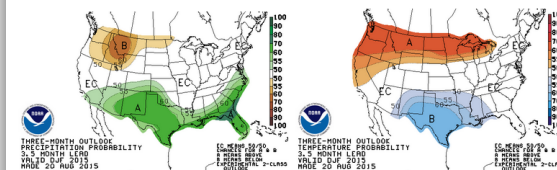
Current Hazards Current Conditions Radar Forecasts Rivers and Lakes Climate and Past Weather Local Programs

El Niño is expected to continue through this upcoming winter and into the spring of 2016. Although El Niño is a warming of the tropical eastern Pacific Ocean and the overlying atmosphere, it has global weather impacts with changes in temperature and precipitation patterns across the planet. El Niño typically reduces the severity of our hurricane season due to increased wind shear across the tropical Atlantic and Caribbean. However its largest local impacts are noted during the winter with heavier precipitation typically occurring across the southern United States including the Carolinas.

El Niño is actually just one phase of the El Niño/Southern Oscillation, often called by the acronym ENSO. ENSO has two phases: a warm phase we call El Niño and a cool phase called La Niña. These alternate at irregular intervals of 1 to 4 years.



### Winter Outlooks from the NWS Climate Prediction Center...



These outlook graphics from the Climate Prediction Center show the probability of above- or below-normal precipitation (left) and temperatures (right) for the upcoming winter months of December 2015 through February 2016. Darker green colors on the left indicate



# Strong El Niño of 2015-2016

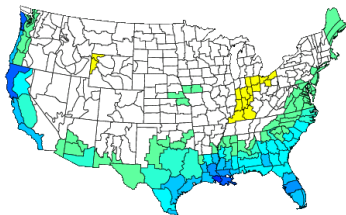
My first attempt at local climate outlook downscaling

## CPC forecast was based on a powerful El Niño

- I wanted to relay CPC's Outlook to local users, customized with information specific to North and South Carolina's expected impacts
  - High potential for above normal precipitation
  - Previous strong El Niño analog seasons showed consistently large rainfall amounts and flooding across the eastern Carolinas

El Niño should bring lots of rain to the Carolinas...

NOAA/NCDC Climate Division Composite Precipitation Anomalies (in Dec to Feb 1957-58, 1965-66, 1972-73, 1982-83, 1991-92, 1997-98 Versus 1981-2010 Longterm Average



In almost all cases a strong El Niño brings above-normal rainfall to the Carolinas during the winter months of December through February. During the winters of 1981-1982 and 1997-1998 extremely large amounts of rain fell causing long periods of river flooding across the eastern Carolinas. Some of the highest river crests ever observed occurred on the Cape Fear River at [William O. Huske Lock and Dam](#), on the Little Pee Dee River at [Gallivant's Ferry](#), and on the Black River at [Kingstree, SC](#) during El Niño winters.

This map shows the observed winter precipitation anomalies averaged across the last six strong El Niño events. Over the three winter months (December through February) rainfall was consistently above normal across all of the Carolinas. Precipitation anomalies were largest near the coast; the southern coastal plain of North Carolina averaged 3.04" above normal while the northern coastal plain of South Carolina averaged 3.37" above normal. Above-normal precipitation typically extends across much of the Southeastern United States and also along the west coast during El Niño winters.

What produces this heavy rain? Huge thunderstorm clusters over the unusually-warm tropical eastern Pacific Ocean lift tremendous amounts of moisture into the atmosphere. Powerful subtropical jet streams (frequently observed during El Niño winters) efficiently transport this moisture across the southern United States where it falls as rain -- or occasionally snow!

	Normal winter	Observed Winter Precipitation (Dec-Feb) during strong El Niños					
		1957-1958	1965-1966	1972-1973	1982-1983	1991-1992	1997-1998
Raleigh, NC	9.80"	10.09"	10.43"	13.18"	11.81"	8.68"	16.03"
Wilmington, NC	11.00"	11.87"	12.67"	14.51"	20.21"	11.37"	23.34"
Charlotte, NC	9.98"	9.81"	9.81"	14.41"	12.26"	10.58"	13.64"
Asheville, NC	11.02"	9.28"	10.09"	12.38"	13.06"	11.60"	19.32"
Florence, SC	9.16"	10.26"	11.02"	12.11"	14.60"	7.58"	16.20"
Charleston, SC	9.78"	14.81"	12.49"	14.52"	15.41"	8.78"	22.94"
Columbia, SC	10.41"	10.40"	12.40"	16.39"	12.76"	9.92"	17.54"

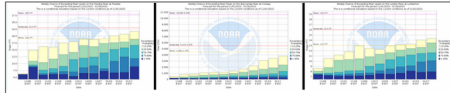


# Expansion to *All Hazards* Outlooks

## River Flood and Coastal Flood Potential

The expectation for expanding drought this winter supports for a lower than average risk for river flooding. Current river levels across the eastern Carolinas are low, and it would take a significant period of rainfall for rivers to rise to flood stage.

Probabilistic river stage forecasts provided by the NWS Southeast River Forecast Center show the weekly risk for flooding should remain less than 10 percent through December, and less than 25 percent until the end of January.

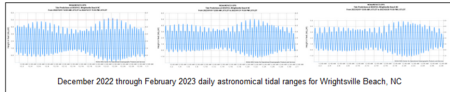


NWS Southeast River Forecast Center probabilistic flood outlooks for the Pee Dee, Waccamaw, and Lumber Rivers

If the risk for river flooding grows, current and forecast stages as well as any river flood warnings are available at <https://water.weather.gov/ahps2/index.php?wfo=ilm>

At the beaches, tidal ranges naturally become larger and smaller over the span of a month as the phase of the moon changes. During a Full Moon or New Moon high tides are at their largest; if a Nor'easter or a period of strong onshore winds develops during that time coastal flooding can easily occur.

Astronomical tidal predictions for the winter season of 2022-2023 show only one period where tides will be particularly large: December 21 through 25 during the final New Moon of 2022. Maximum astronomical tides during January and February should remain more than one foot below minor coastal flooding thresholds.



December 2022 through February 2023 daily astronomical tidal ranges for Wrightsville Beach, NC

The National Ocean Service produces the *NOAA High Tide Bulletin* with more information about the risk for coastal flooding over the coming season, available here: <https://oceanservice.noaa.gov/news/high-tide-bulletin/winter-2022>

Current water level forecasts that include wind and storm tide anomalies are available for [Wrightsville Beach](#), [Murtle Beach](#), and for the [Cape Fear River at downtown Wilmington](#)

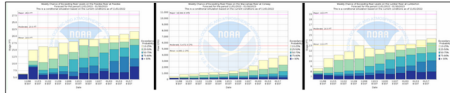
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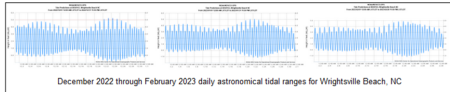


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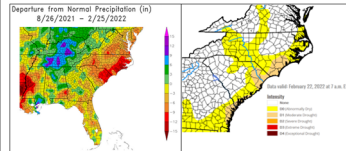
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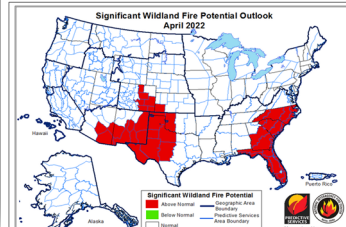
## Drought and Wildfire Risk

Precipitation totals over the past six months have been six to 12 inches below normal for most locations across southeastern North Carolina and northeastern South Carolina. This is the driest we've been since the 2013-2014 fall and winter seasons, and moderate drought conditions continue as we begin the spring season.



Departure from normal precipitation (inches) over the past six months. For the eastern Carolina (small inset) have ranged through occurring across portions of southeastern North Carolina and northeastern South Carolina. From USL, Drought

Drought during spring is often associated with an increased wildfire risk across the eastern Carolinas. The National Interagency Coordination Center (a government wildland fire resource agency) is predicting an above normal risk of wildfires across South Carolina in March, and across both North and South Carolina in April. This is due to the expectation for above normal temperatures coupled with an ongoing drought.



- Local river flood and coastal flood risk, leveraging RFC probabilistic forecasts and NOS High Tide Bulletins

- Drought and Wildfire risk, utilizing CPC outlooks and NIFC Seasonal Fire Outlooks



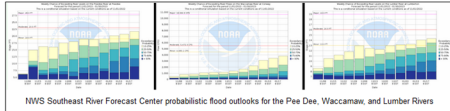


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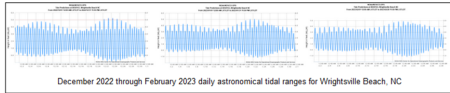
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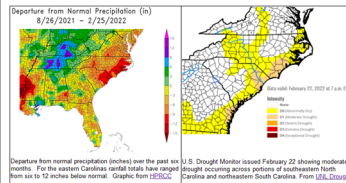


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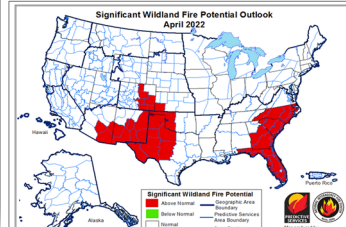
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## Hurricane Season

The Atlantic Hurricane Season officially begins June 1 and lasts through November 30. This is when the majority of tropical storms and hurricanes occur in the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico. Routine *Tropical Weather Outlooks* are issued by the National Hurricane Center between May 15 and the end of the hurricane season. The official NOAA seasonal *Outlook* issued on May 20 calls for a 60 percent chance of another above-normal season with more than the usual number of tropical storms and hurricanes developing.



Factors likely affecting this year's hurricane season:

- **Neutral ENSO or Re-developing La Niña:** Although the number of Atlantic tropical cyclones is typically highest during La Niña years and lowest during El Niño years, ENSO-neutral conditions like we currently have can still allow a significant number of storms to develop. La Niña could intensify during the heart of the hurricane season in September, creating light-wind shear across the Atlantic that favors more and stronger tropical cyclones.
- **Strong West African Monsoon:** Increases the number and strength of tropical waves that move off the African coast and potentially become tropical cyclones.
- **Above normal sea surface temperatures:** Warm water is the fuel that powers hurricanes. Above-normal water temperatures like currently found across the Gulf of Mexico, the Bahamas, and much of the subtropical Atlantic Ocean can more easily develop or sustain tropical cyclones.
- **Ongoing High Activity Era for Atlantic Hurricanes:** While the existence of the Atlantic Multidecadal Oscillation (AMO) has recently been called into question, there is no disagreement that ocean and atmospheric conditions have allowed an unusually large number of Atlantic tropical cyclones to develop beginning in 1995 and continuing to the present. This overall pattern should continue into this year's hurricane season.

- Local river flood and coastal flood risk, leveraging RFC probabilistic forecasts and NOS High Tide Bulletins
- Drought and Wildfire risk, utilizing CPC outlooks and NIFC Seasonal Fire Outlooks
- Special seasonal Issues: Hurricane Outlook, Spring & Fall Freezes, Winter Weather, Severe Weather



# Dissemination and Additional Info

https://www.weather.gov/lin/SummerOutlook2022

**2022 Summer Climate Outlook for southeast North Carolina and northeast South Carolina** NWS Wilmington, NC  
Weather Forecast Office

Weather.gov > NWS Wilmington, NC > 2022 Summer Climate Outlook for southeast North Carolina and northeast South Carolina

Current Hazards Current Conditions Radar Forecasts Rivers and Lakes Climate and Past Weather Local Programs

2022 Summer Climate Outlook for southeast North Carolina and northeast South Carolina

NATIONAL WEATHER SERVICE Wilmington, NC

Building a Weather-Ready Nation

MORE VIDEOS

Summer is just around the corner and it looks like a hot one across eastern North and South Carolina. Outlooks from the NWS Climate Prediction Center show an **increased potential for above-normal temperatures this summer** across most of the United States. And in what may be a welcome reversal, the summer precipitation outlook shows an **increased chance for above-normal rainfall** from Florida across the Carolinas into the Mid Atlantic states.

**1 Seasonal Temperature Outlook**  
Valid: **including 2022**  
Issued: **May 19, 2022**

Equal Chances

Warmer than normal  
Equal Chances  
Cooler than normal

**2 Seasonal Precipitation Outlook**  
Valid: **including 2022**  
Issued: **May 19, 2022**

Equal Chances

Wetter than normal  
Equal Chances  
Drier than normal

2022 Summer temperature outlook

2022 Summer rainfall outlook

- Outlooks are generated seasonally (4 times per year) and distributed via webpages, social media, and emails to core partners
- Youtube videos were added in 2020 to reach additional users and to provide a brief summary of the outlook
- CPC is the official source for U.S. government climate outlooks. Local messaging will never contradict CPC but should downscale their outlooks to the local level -- amplifying the message and applicability for local users



# Feedback

## Government

**Hendrix, Mark L.** [hendriml@dhec.sc.gov](mailto:hendriml@dhec.sc.gov) via [dhec.onmicrosoft.com](mailto:dhec.onmicrosoft.com) Fri, Nov 3, 2017  
to Steven, me ▾

Most excellent and thanks to both of you!

That gets me all I need for the Winter Weather section of our discussion!

Thank you,

Mark Hendrix,  
Pee Dee Region Director of Public Health Preparedness  
SC Dept. of Health & Environmental Control  
email: [hendriml@dhec.sc.gov](mailto:hendriml@dhec.sc.gov)  
145 E Cheves Street / Florence, SC / 29501  
Office: 843-673-6546 / Cell: 803-983-9097 / Fax: 843-661-4859



**Steve Hughes** [s Hughes@landfall.org](mailto:s Hughes@landfall.org)  
to me ▾

Great read and informative. Thanks Tim.

Best Wishes:

Steve

Stephen D. Hughes  
Chief Operating Officer  
Landfall COA

## Media

**Ed Piotrowski** [ed@wpde.com](mailto:ed@wpde.com) via [sbgj.onmicrosoft.com](mailto:sbgj.onmicrosoft.com)  
to me ▾

Great job on this Tim!

Your video presentation was awesome.

**Ed Piotrowski**  
Chief Meteorologist  
WPDE ABC15 | WWMB CW21  
Cell: 843.742.9815

**Matthew Robertson** [MRobertson@scnow.com](mailto:MRobertson@scnow.com)  
to me ▾

For what it's worth I'd appreciate if we could dial down the sea temperatures a bit. Such warmth only encourages hua they need that kind of encouragement. ☺

Thanks.

Matthew Robertson  
Online Coordinator  
843-317-7332 Office  
[MRobertson@scnow.com](mailto:MRobertson@scnow.com)



The Morning News & SCNOW can deliver to your business an audience of 500,000. Ask me how!

**Jefferson Weaver** [jeffersonweaver155@gmail.com](mailto:jeffersonweaver155@gmail.com)  
to me ▾

Well, THAT wasn't reassuring!  
Thanks, Tim, as always. You folks are the best, even with less-than-good news.

Thanks kindly,  
Jefferson Weaver  
Managing Editor, [columbuscountynews.com](http://columbuscountynews.com)  
News Director, WTTY Radio  
910.632.4965

## Business

**Wayne Marquino** [wayne.marquino@gmail.com](mailto:wayne.marquino@gmail.com)  
to me ▾

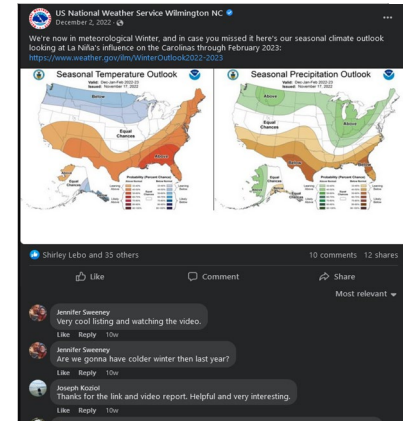
Thanks Mr. Armstrong

Good to have evidence based forecasts from **NWS**

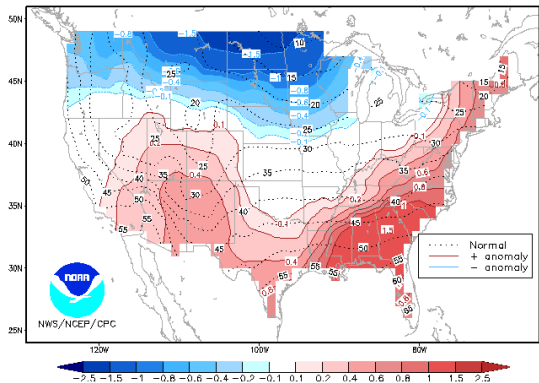
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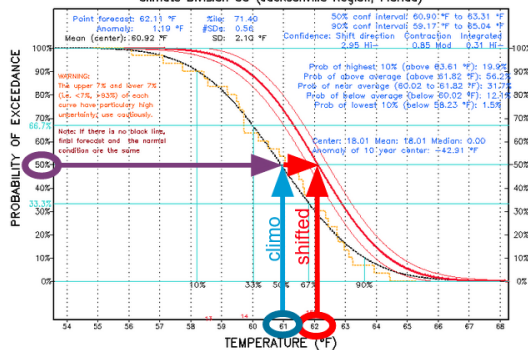
## Public



# CPC Mid Value Anomaly Maps



MEAN TEMPERATURE OUTLOOK FOR FMA 2023  
0.5 MONTH LEAD OUTLOOK – MADE Jan 19 2023  
Climate Division 66 (Jacksonville Region, Florida)



- Behind each CPC outlook is a “Mid Value Anomaly” map and probability of exceedance graphic. These show the anticipated shift in temperature or precipitation *probability distribution* for each overlapping three month season.

*Note: This is not a deterministic forecast anomaly, only the shift to the probability distribution*

- This mid value anomaly can be expressed to local users as energy savings or excess energy expenditures through shifts in heating degree days (HDD) or cooling degree days (CDD) relative to normal.

# Sharing Local Downscaling Techniques

- 1 AMS Annual Meeting – January 2023
- 2 National Climate Services Meeting – February 2023
- 3 NWS ER Spring Showcase – March 2023
- 4 Climate Prediction Applications Science Workshop – May 2023





# Questions

