

HURRICANE FLORENCE

TS

Category
(tropical storm)

10.5

Inches of Rain

44

Miles per hour
of Max Wind Speed

2.48

Feet of Storm Surge
(max)*

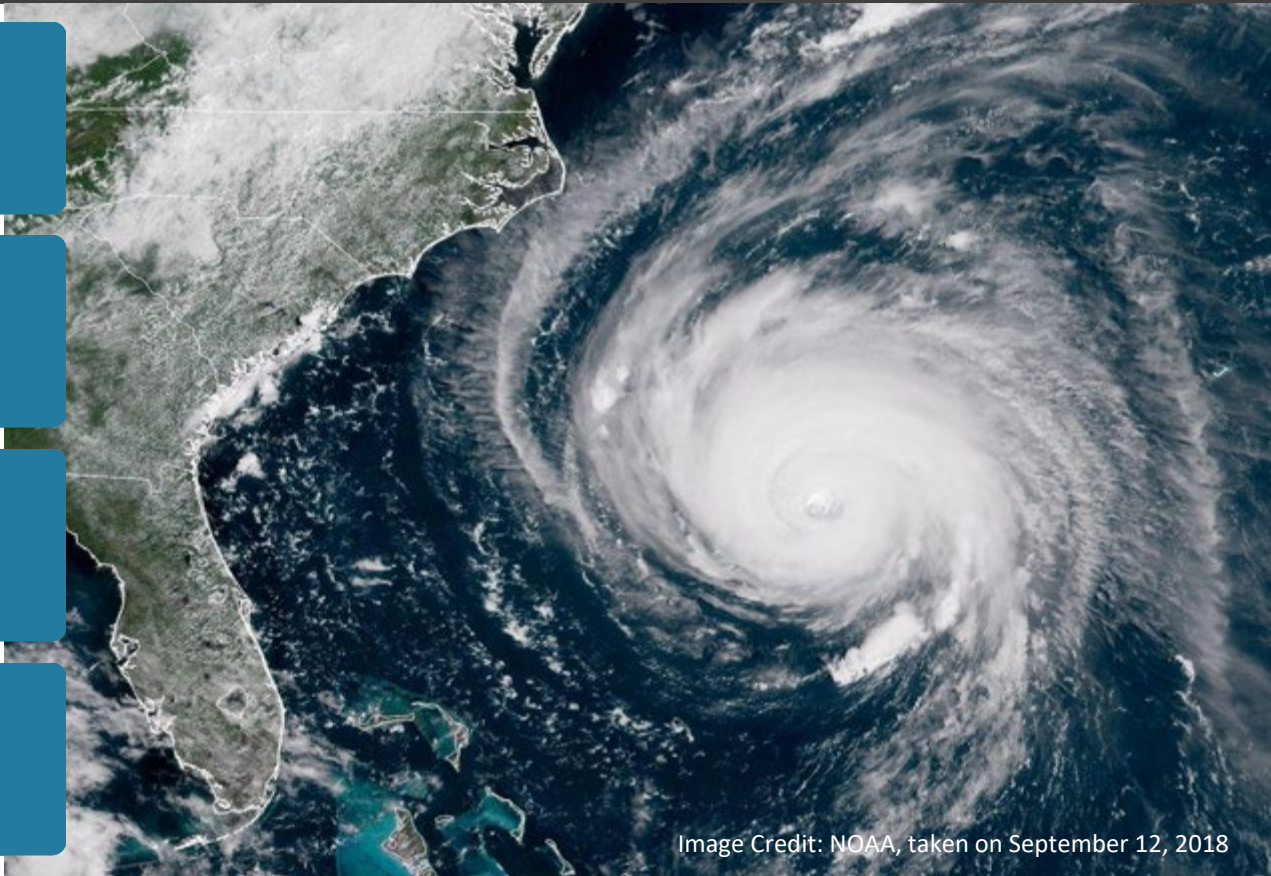


Image Credit: NOAA, taken on September 12, 2018

Monitoring the Impact of Hurricane Florence at “North Inlet – Winyah Bay”



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Hurricane Florence, a large and slow-moving Category 1 hurricane, made landfall along the southeastern coast of North Carolina. As Florence traveled inland across South Carolina, it weakened to a Tropical Storm. Torrential rain fell for days and caused historic flooding. The most devastating impacts were not from the initial wind, rain, and storm surge but from the extreme riverine flooding that lasted for several weeks following Florence’s landfall.

The effects of Florence were observed at the **North Inlet –Winyah Bay (NIWB) Research Reserve** through the System-Wide Monitoring Program (SWMP), which tracks short-term variability and long-term change of weather and water quality in the areas surrounding Georgetown, South Carolina.

**STORM
STORIES**



NATIONAL
ESTUARINE
RESEARCH
RESERVE
SYSTEM



**National Estuarine
Research Reserve System
Science Collaborative**

Data shown are based on the NIWB weather monitoring site

*NOS Oyster Landing site

Created on April 22, 2022

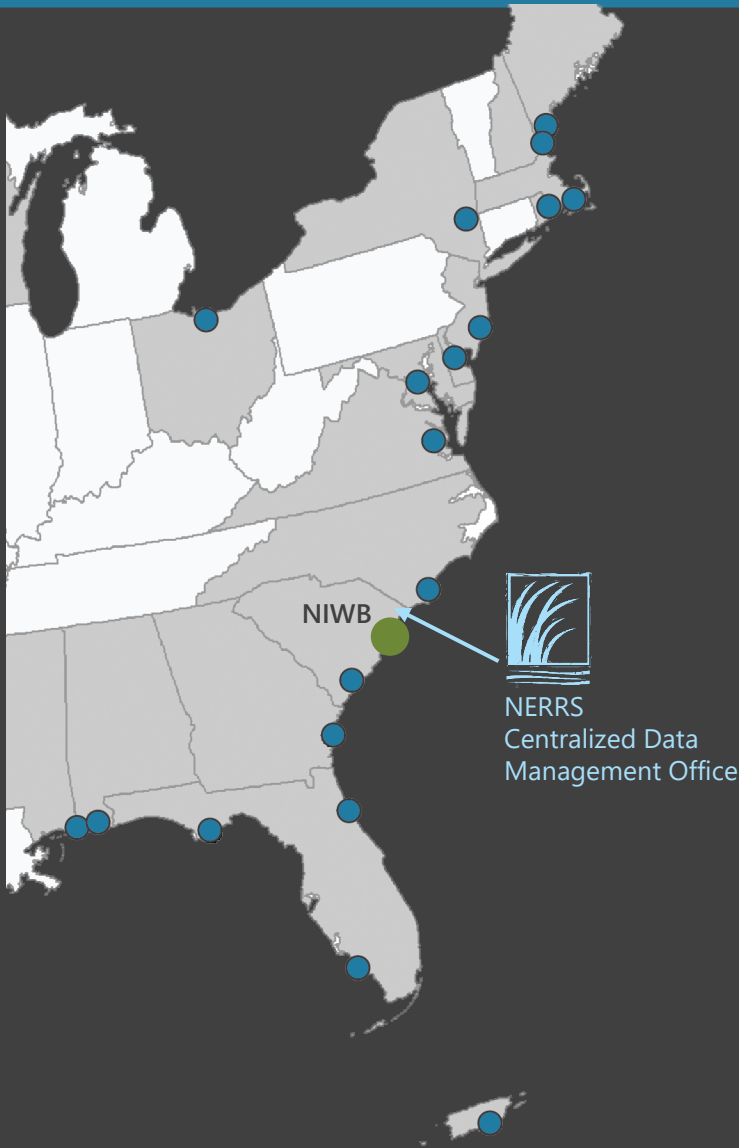
NIWB

North Inlet–Winyah Bay (NIWB) is one of 29 sites in the **National Estuarine Research Reserve Systems (NERRS)**. Each site is a state-federal partnership that combines research, monitoring, and education to advance the understanding and management of estuarine environments.

Locally Relevant, Nationally Significant

The **System Wide Monitoring Program (SWMP)** tracks weather and water quality as a storm happens and the impacts that follow. Scientific instruments (i.e., data sondes and sensors) are deployed at Reserves along the Atlantic and Gulf of Mexico coastal areas collecting data on the condition of our estuaries 24/7 to help protect people and places.

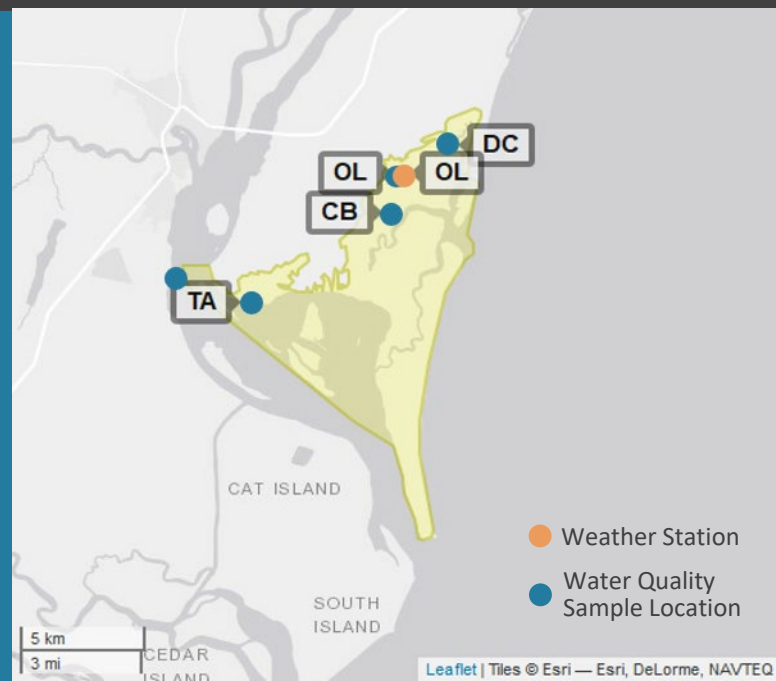
Data from the extensive monitoring network are delivered to the **Centralized Data Management Office (CDMO)**. Near real-time SWMP data are now available to via smartphone or tablet at: www.nerrsdata.org/mobile



NIWB Storm Monitoring

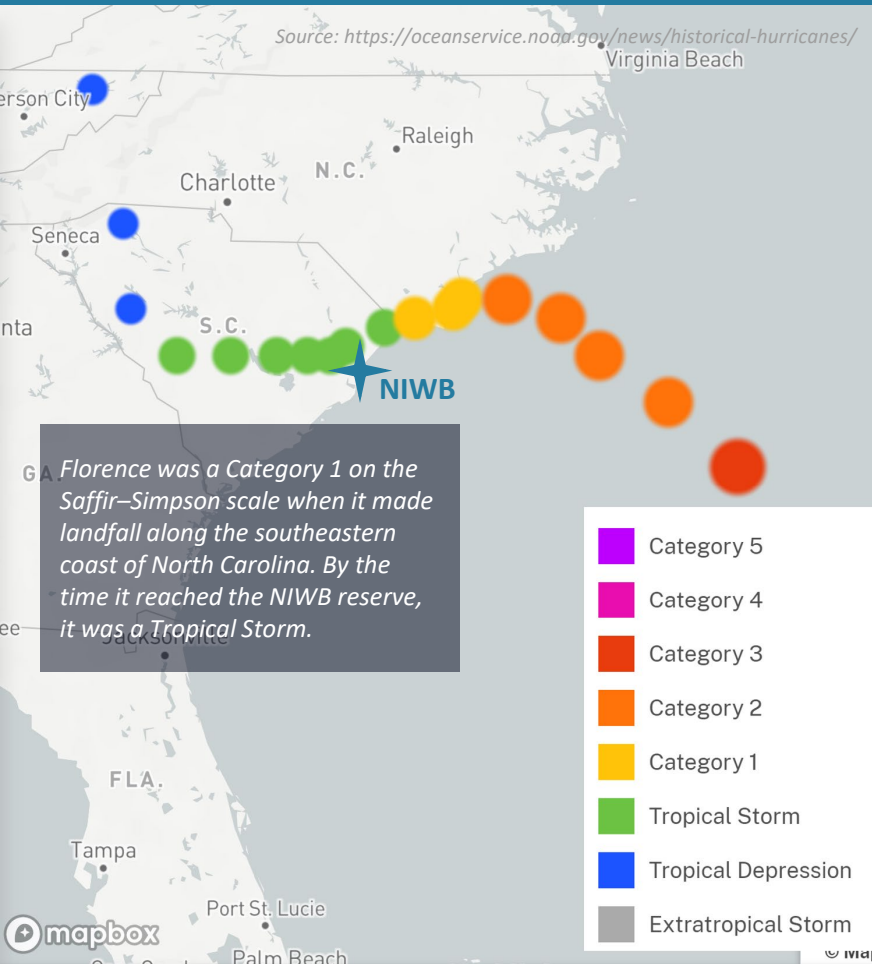
NIWB operates a weather station located in Oyster Landing (OL) and maintains six continuous, long-term water quality stations at Oyster Creek (OC), Debidue Creek (DC), Clambank (CB), Thousand Acre (TA), Winyah Bay Bottom (WB), and Winyah Bay Surface (WS) locations.

NIWB is part of the SWMP. As Hurricane Florence approached South Carolina, NIWB monitored the weather and water quality, collecting data every 15 minutes for the following parameters: air temperature, relative humidity, atmospheric pressure, rainfall, wind speed and direction, water temperature, depth, salinity, dissolved oxygen, turbidity, and pH.



Storm Track

Florence made landfall near Wrightsville Beach, North Carolina on September 14. Florence stalled for an entire day before it began a slow turn to the southwest, traveling across South Carolina at a speed of 2-3 mph. The storm continued to weaken during September 15 and then traveled north-northeast out of the state on September 16.



Event Impacts

Human Health & Safety

- In South Carolina, four direct fatalities resulted from freshwater flooding and were all vehicle related.
- SCEMD reported 11,386 homes with moderate or major damage across the state, 455,000 people evacuated, and 11 dams breached or failed.
- Flooding resulted in a lack of access to and from communities, complicating recovery and response efforts.

Economic Losses

- Damage and losses due to Florence’s impacts in South Carolina totaled \$2 billion.

Ecosystem Impacts

- Aquatic life, like oysters, crabs, shrimp, finfish, phytoplankton, etc. rely on specific levels of salinity and dissolved oxygen to thrive and survive. The freshwater flooding that resulted from Florence caused significant drops in the levels of salinity and dissolved oxygen for varying periods of time, potentially stressing organisms.



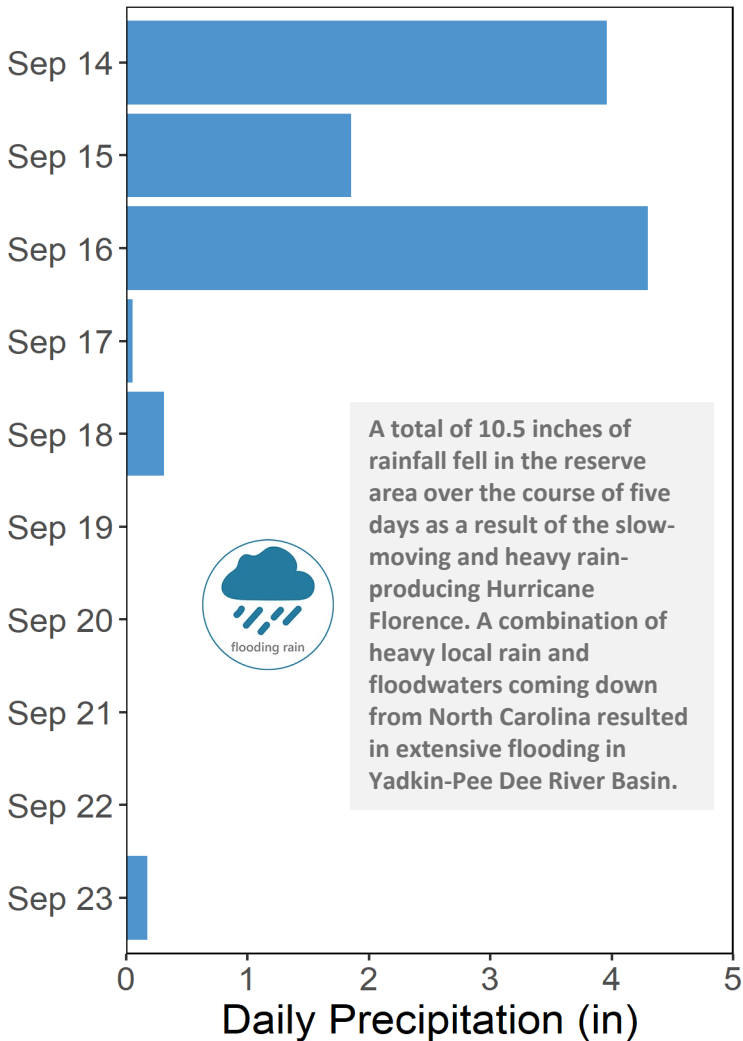
Weather Data

Station	Date	Rainfall Total (in)	Rainfall Average Intensity (in/hr)	Wind Speed Max (mph)	Wind Speed Average (mph)
Oyster Landing	9/14/2018	2.31	0.121	41.2	29.9
Oyster Landing	9/15/2018	3.46	0.144	44.5	30.4
Oyster Landing	9/16/2018	3.58	0.149	36.0	24.2
Oyster Landing	9/17/2018	0.83	0.034	31.1	17.3
Oyster Landing	9/18/2018	0.31	0.013	17.4	12.0

The highest local rainfall and wind measurements were recorded when Florence made landfall in North Carolina and then moved and traveled across South Carolina.

RAINFALL

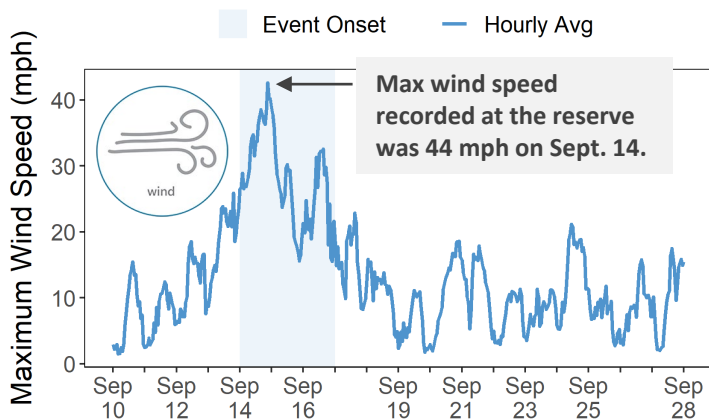
Oyster Landing (OL)



Rainfall measurements at the Oyster Landing weather station from Sept. 14 through Sept. 23.

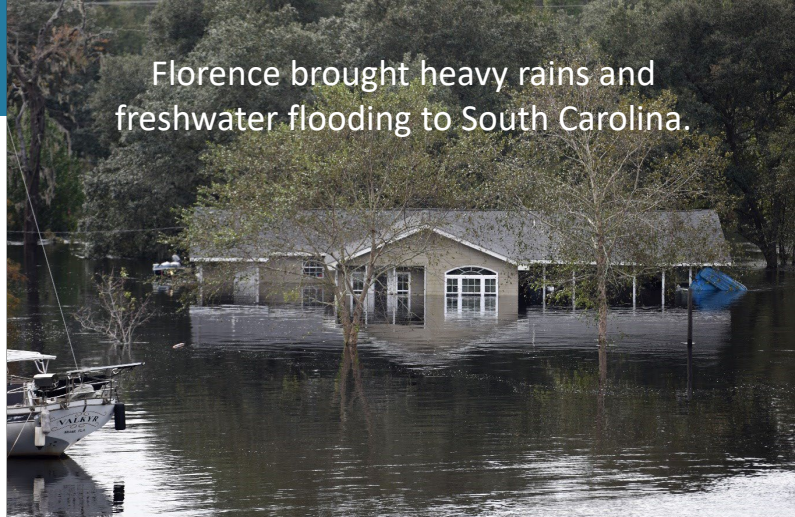
WIND SPEED

Oyster Landing (OL)



Maximum Wind Speed readings at the Oyster Landing weather station from Sept. 7 through Sept. 28.

Florence brought heavy rains and freshwater flooding to South Carolina.



Photos from the SC National Guard, taken in Conway, SC (Horry County) on September 25, 2018.

Initial impacts from Hurricane Florence were felt locally from the heavy rains and high winds, including flooding, downed trees, power outages, and some damage to building structures. However, the most devastating impacts happened several weeks later. While landfall occurred in North Carolina, the storm's slow forward movement and unique track brought unprecedented rainfall across large portions of North and South Carolina, resulting in several weeks of extreme riverine flooding.

All of the rain that fell in North Carolina (up to 3 feet in some locations) had to travel downstream and flow straight through major rivers in South Carolina to reach the Atlantic Ocean through Winyah Bay. On Sept. 25, in Georgetown County, authorities urged thousands of people to evacuate ahead of the historic flooding. Making matters worse was the potential for tides to exacerbate floodwater levels. Flood waves on the Waccamaw and Great Pee Dee rivers reached the city of Georgetown (~2 weeks post landfall), causing flooding across several tide cycles. The extensive flooding required coordination and support from the Federal Emergency Management Agency (FEMA), the American Red Cross and aid from state and local agencies.



Water Quality Data

Salinity levels quickly dropped at Thousand Acre (TA) as Florence approached the reserve and then remained low as extreme freshwater flooding came to the area over a week later.

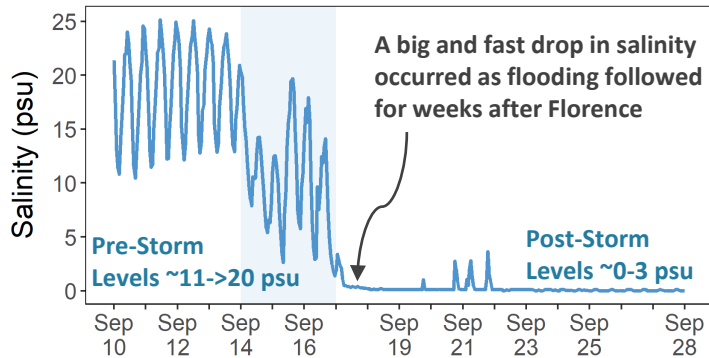
Station	Date	Depth Maximum (ft)	Salinity Minimum (psu)	Salinity Maximum (psu)	Dissolved Oxygen Minimum (mg/L)	Dissolved Oxygen Maximum (mg/L)
Winyah Bay Bottom	9/14/2018	18.14	6.8	21.6	4.5	6.1
Winyah Bay Bottom	9/15/2018	18.73	2.5	20.4	5.0	6.5
Winyah Bay Bottom	9/16/2018	-	2.3	19.3	3.7	6.7
Winyah Bay Bottom	9/17/2018	-	0.3	5.7	4.7	6.5
Winyah Bay Bottom	9/18/2018	17.78	0.1	0.3	3.1	5.4

Data reporting time periods for Hurricane Florence: 9/14/2018 - 9/18/2018

SALINITY

Winyah Bay Bottom (WB)

Event Onset — Hourly Avg

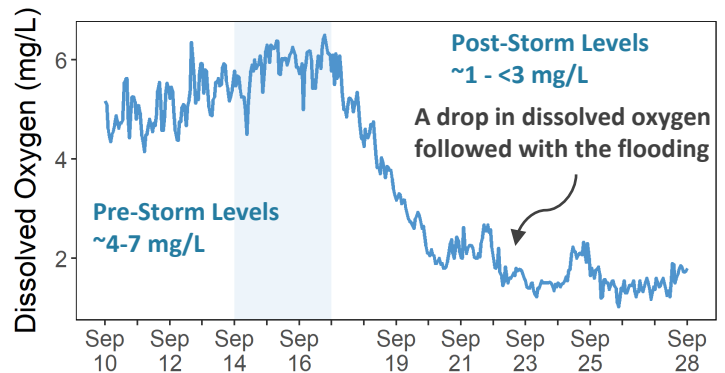


Salinity levels from Sept. 7 to Sept. 28.

DISSOLVED OXYGEN

Winyah Bay Bottom (WB)

Event Onset — Hourly Avg



Dissolved Oxygen levels from Sept. 7 to Sept. 28.

Salinity and Dissolved Oxygen levels that were recorded at the Winyah Bay (WB) station show initial and post-storm impacts on water quality in this area. Salinity levels quickly dropped at the onset of the storm, recovered slightly as the storm moved on, and then dropped significantly for an extended period of time as the area experienced extreme flooding. Dissolved oxygen levels were impacted as well but the impact was more prominent post-storm when the flooding was most severe. The regular diurnal cycle was compressed and levels stayed in a lower range (< 3 mg/L) during the flooding.

Dramatic changes in salinity and lower levels of oxygen can cause stress to some aquatic organisms depending on the species and how long the levels deviate from what is normal. Water quality stresses can impact survival and future populations.



About NERRS

Established in 1972, the NERRS is a network of 29 ecologically significant, locally treasured estuarine places in 23 states and Puerto Rico. Each Reserve is a partnership between NOAA and a state agency or university. Most of the 1.3+ million acres of estuary lands and waters that Reserves help to protect and steward are open to the public. Reserves work with local decision makers, states, universities, nonprofits, and others to set natural resource management priorities and address them through research, environmental monitoring, education, training, and stewardship.

The health of every reserve is continuously monitored by the System Wide Monitoring Program (SWMP). SWMP is a robust, long-term, and versatile monitoring program that uses the NERRS network to intensively study estuarine reference sites for evaluating ecosystem function and change. Reserve-generated data and information are available to local citizens and decision makers. For more information, go to: <https://coast.noaa.gov/nerrs/>



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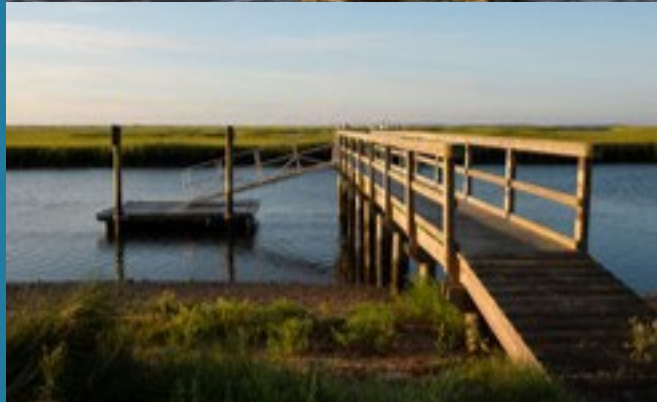
DATA

Visit www.nerrsdata.org to view and download weather and water quality data from North Inlet - Winyah Bay NERR.



EXPLORE

Interested in learning more? Visit <http://northinlet.sc.edu/>. For video, news updates, online storm data and prediction visualization tools, check out our Storm Story Map at www.stormstorymap.url.



National Estuarine Research Reserves Protect People & Places

This work is/was sponsored by the National Estuarine Research Reserve System Science Collaborative, which supports collaborative research that addresses coastal management problems important to the reserves. The Science Collaborative is funded by the National Oceanic and Atmospheric Administration and managed by the University of Michigan Water Center (NA19NOS4190058).

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