Cape Hatteras, Shelf/Gulf Stream Currents, Routing and Weather”

January 8, 2023

One of the most renown and dangerous capes of the world, Cape Hatteras is called the “Graveyard of The Atlantic.” A ‘cape’ is a protrusion of land into the ocean, and there are many such as Cape Horn, Cape Good Hope, as well as Cape Hatteras. Cape Hatteras, is formed by the Northern Banks, of North Carolina, a stretch of low eroded land forms, a cape of shallow near shore water with converging currents, shifting sand bars, and is the location of over 600 known shipwrecks. In adverse weather conditions the passages can be deadly with sea states building rapidly to extreme conditions.

This article is written not as scientific research, it is to share water and sea features of concern for small vessels passaging along the mid East Coast USA, via Cape Hatteras, North Carolina. We share information of interest to include currents, weather/winds/sea state, and the underwater shelf structure comprising this complicated section of ocean. Also mentioned are the stationary buoy systems as well as wind-farm installations, which can influence our small boat routing offshore. As always, it is the responsibility of each captain to make routing, and passage decisions for their vessel, using most recent and updated marine charts, and weather information from reputable sources utilizing data from National Oceanic Atmospheric Administration’s National Weather Service (NWS) which monitors Hatteras.

First what makes a designation of ‘cape; its A cape is a high point of land that extends into a river, lake, or ocean. For major cape landmasses such as Cape Horn, Cape Good Hope or Cape Hatteras they also support converging currents from large masses of water with differing water qualities of salinity and temperature, with shelf currents suddenly converging with deep ocean waters.
Some vessels, challenged by the currents and with adverse weather, suffer damage or loss of vessel/lifer. This article hopes to show the various underwater features, the currents and the impact our changing weather has for vessels attempting Cape Hatteras.

The below paragraphs cover the underwater/near water aspects of Hatteras, the major currents impacting vessels; reviews the effect of sea vs wind and currents of this cape, We also discuss some weather features making this area more storm prone for the near future. And finally we provide a short overview of new placement of in the water obstacles of interest to cruisers. These include moored buoy systems for research, as well as wind farms for wind generation.

Cape Hatteras is the subject of much research with the most interesting, from a cruisers point of view being a study of currents. Recent research from a collaboration between the US National Science Foundation with primary researchers, of the University of North Carolina, Chapel Hill, provides some of the best insights available for this complicated area.

A study” Processes Driving Exchange At Cape Hatteras Program” (PEACH) just completed, with additional research to follow. PEACH Figure 1 is a graphic of the complicated systems of currents impacting boats transitioning thru the area. Note the ‘Shelfbreak Jet’, the purple marked arrow running north to south along the continental shelf edge, the Middle Atlantic Shelf (MAB), the blue marked arrow, also running from north to south. These two colder flowing currents meet the north east flowing Gulf Stream off the tip of Hatteras. The currents coming from the south include both the much warmer Gulf Stream as well as the warmer and saltier Southern Atlantic Bight(SAB) Shelf waters. The SAB is the light green arrow coming from the south west. There is a smaller bright green semi circle marking

the Hatteras Shelf, which includes a sudden and rapid drop from shelf to deep sea floor. Along these shelf areas and to the immediate east, where the currents collide, cruisers have experienced what they call “the washing machine.” The sea states are dramatically impacted during storms as well northerly “wind against current” events. Figure 1 graphics clearly shows an area where boats can find more extreme cruising conditions due sea against wind conditions.

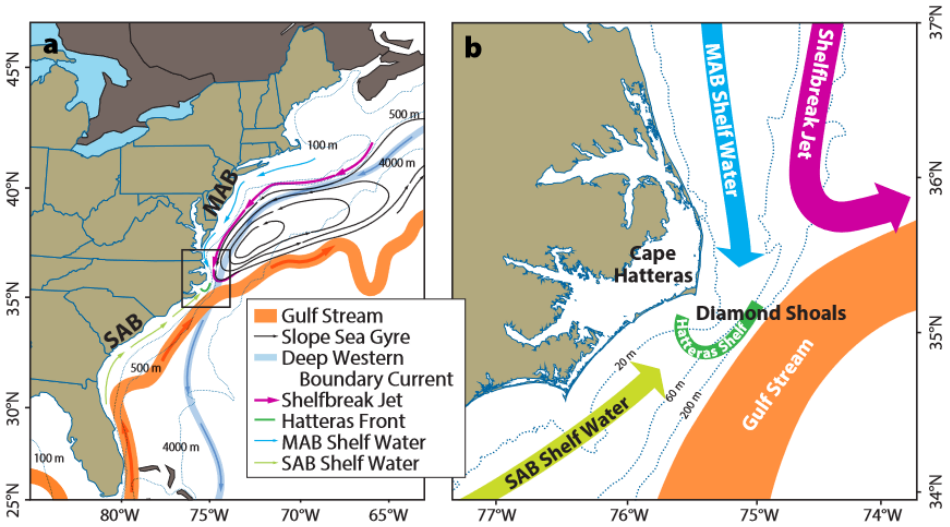
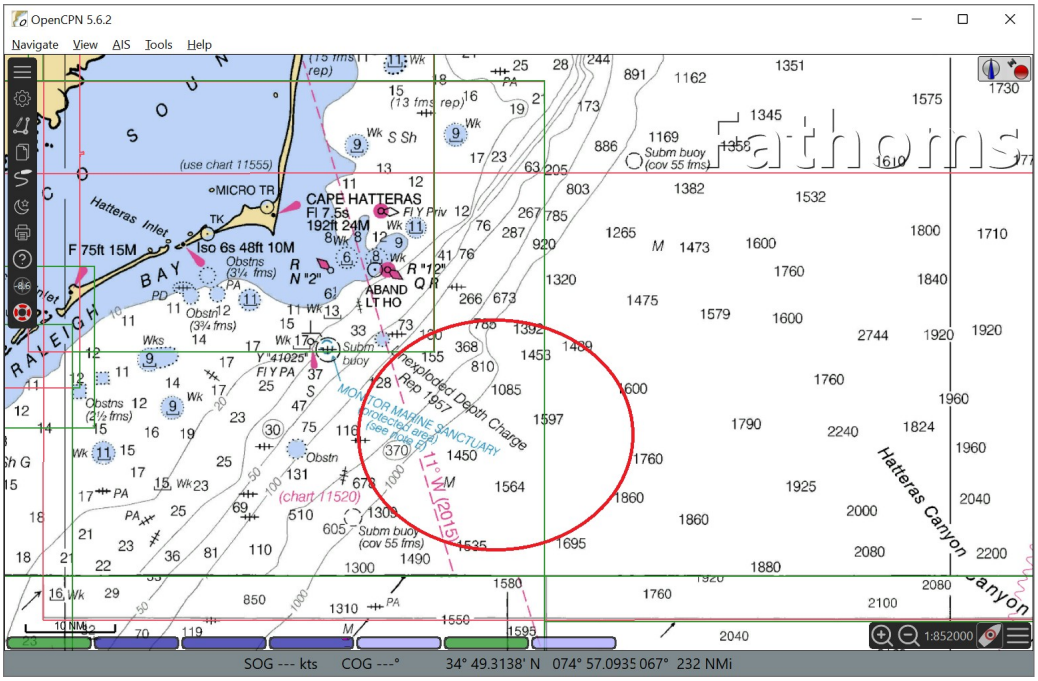


FIGURE 1. (a) Schematic depiction of circulation in the Northwest Atlantic and (b) zoom in on the Cape Hatteras region. SAB = South Atlantic Bight. MAB = Mid-Atlantic Bight. *Created by Anna Boyette, after Schmitz (1996) and Csanady and Hamilton (1988)*

The Gulf Stream, part of the Atlantic Ocean Circulation System, forms one of the largest and most critical cape current features. Its follows a path along the east coast of the USA to Hatteras. It is at this shelf convergence point the current then sheers off to the east and into the North Atlantic and changes from a “boundary trapped current to a free jet” and where ‘the magnitude of this convergence implies a large export of shelf water to the open ocean.” (Oceanography, The Official Magazine of the Oceanography Society, https://tos.org/oceanography/article/overview-of-the-processes-driving-exchange-at-cape-hatteras-program).

For boaters, this means a sudden and fast flow of water which can cause rapid sea stage build and those dreaded flat backed breaking wave sets. This is especially true of the areas just to the east of the Hatteras land form, just off the shelf where currents collide. The danger area of three currents merging is clearly seen in the above image and the area of Gulf Stream change to free jet shown below.



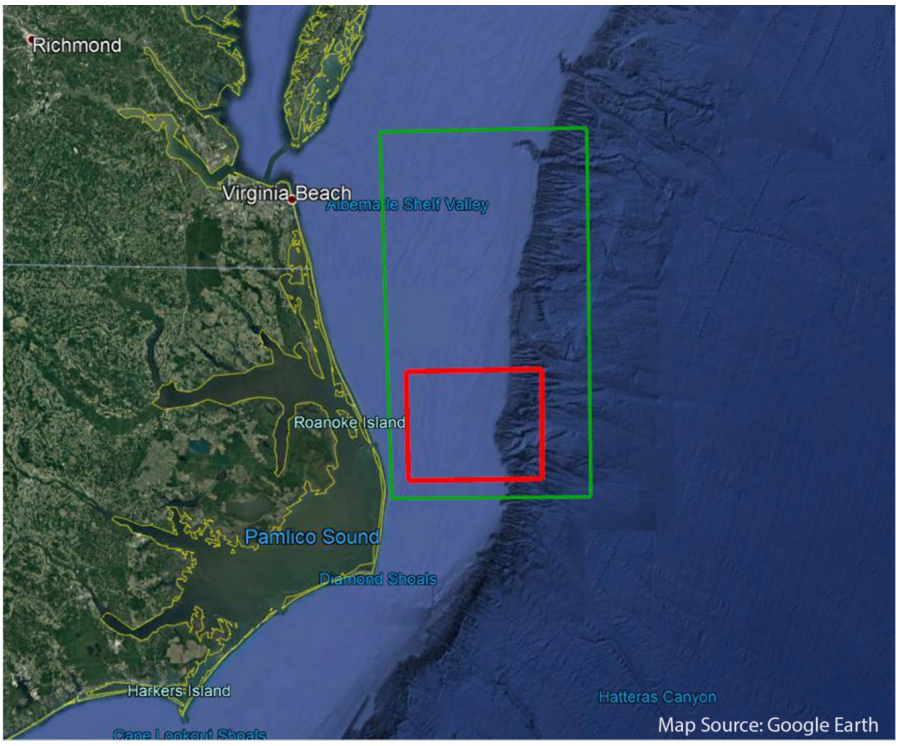
OPENCPN chart of one area of sudden shelf drop to deep ocean where the Gull Stream loses its boundary becoming a 'free jet (red circle)"

Its best not to intentionally passage in wind against current situations, as a 25 foot wave can actually have a close to 50 foot drop. Even a slight north or north eastern component cause rapid, large and short period waves to form suddenly. And from experience, a hull hitting water from height coming off a wave is like hitting a concrete wall. Plus in this kind of sea state, even attempting to take a wave at a favorable angle, does not eliminate the breaking wave danger. Of interest, read a description of the Gulf Stream waves in Ocean Navigator (2011) by Nils Muench, https://oceannavigator.com/why-are-waves-higher-in-the-gulf-stream/. Winds against current are always issues in oceans. On the converse, winds with currents, as mentioned in the 'Gulf Stream Waves" article, can lead to flat smooth seas; our most memorable crossing featured a heavy fog bank as we approached the edge of the stream, then suddenly breaking thru to heat and absolutely turquoise waters with sargassum weed strands. The flat seas Capt Muench alludes to. It is these features, current, weather that have raised the interests of researchers as the obvious changes are seen since at least the 1960s.

PEACH research has concluded, however due to the persuasive data provided by the program, additional work is ongoing to identify the changes we are experiencing with the Gulf Stream, along with weather implications. "An important change in recent years is in an increase in the meanderings or 'wiggliness' of the Gulf Stream. In addition the Gulf Stream has been generating more 'Warm Core Rings", large clockwise eddies.("National Science Foundation, Ocean Observatories Initiative, Fishermen and OOI Scientists Working Together to Advance Science," Www.oceanobservatories.org.)

Another issue for captains to consider as they plan routes are the buoys, boats and other fixed objects found off the cape. Besides currents, there are the research or energy generation "objects" located in the waters off Cape Hatteras and the Norfolk Canyon. Many may not be listed on current charts or updates to those charts.

Post PEACH, the next research efforts include the relocation of the Middle Atlantic Bight (MAB) Pioneer Array to offshore Hatteras area(11 moored buoys, 2 gliders). The location is “the region of the MAB between Cape Hatteras and Norfolk Canyon. Per publications, the “region offers opportunities to collect data on a wide variety of cross-disciplinary science topics including cross-shelf exchange, land-sea interactions associated with large estuarine systems, a highly productive ecosystem with major fisheries, and carbon cycle processes. This location also offers opportunities to improve our understanding of hurricane development, tracking and prediction, and offshore wind partnerships.“(National Science Foundation, Ocean Observatories, Initiatives, https://ooifb.org/activities/pioneer-array-relocation/pioneer-array-phase2/)



Pioneer Array, MAB Regions for deployment of buoys, red square. Green square is the operational area for operations of underwater autonomous vehicles. The University of North Caroline, Chapel Hill participates in this research. The MAB Pioneer Array consists of “ten instrumented moorings and four gliders “, https://oceanobservatories.org/tag/coastal-pioneer-array/. The moorings are said to be in place, with dates between 2023/24 for full operation. The buoys should be clearly seen on ships radar, and may transmit Automatic Information System (AIS) signals; charts should be updated to avoid these objects.

More in the water obstacles to chart include the new energy generating turbines, or wind farms, being placed off the mouth of the Chesapeake Bay. Of most interest for passaging vessels are the new pilot wind farms being installed at the mouth of the Chesapeake Bay.” While not a direct issue for Cape Hatteras, they are located in the operational area of the MAB Pioneer efforts. And they are something for cruisers to be aware of for route planning. The 112,799-acre lease area will see construction of an additional 188 turbines set to begin in 2024, with an estimated completion date of 2026 in this area, is the new deployment of Wind Farms, outside the Chesapeake Bay mouth.” (USA NOAA Office of Coastal Survey, https://nauticalcharts.noaa.gov/updates/surveying-the-approaches-to-the-chesapeake-

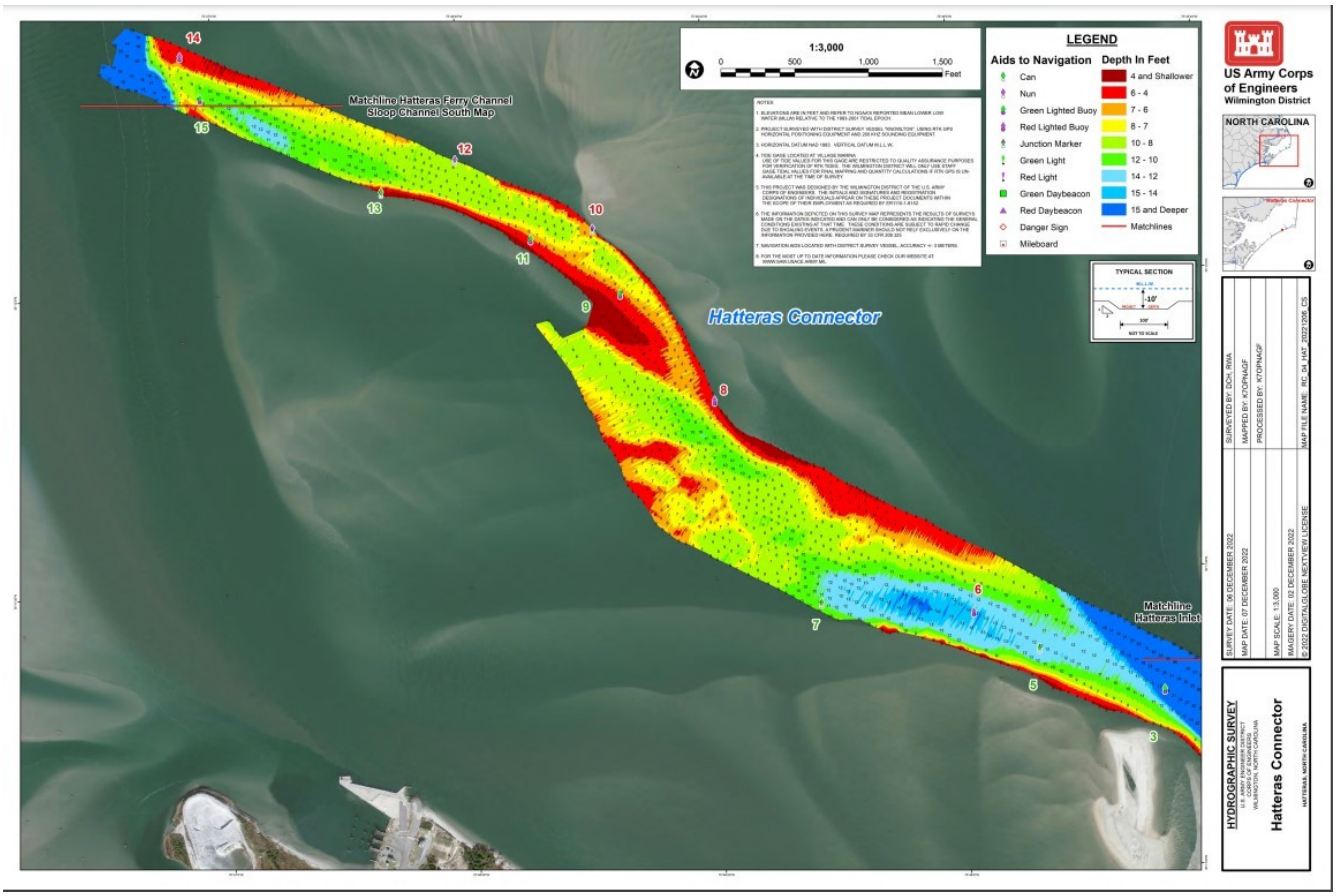
bay/). Additional projects include similar turbines off Ocean City Maryland. Updated charts will be critical for safely in these areas of development and research, see below location for the Chesapeake turbines, the green red and blue rectangles..

Multi beam Echo Sounder in relationship to Pilot Wind Farm, NOAA Office of Coastal Survey.

Weather systems and currents continue to make changes to Cape Hatteras inlets and the routes boats take around the cape. For Hatteras, there are several routes to consider based on either a north/south—south north passage, or offshore heading to or from the Caribbean. There are the offshore to Bahamas or Eastern Caribbean route to and from, the round Hatteras to and from North Carolina anchorages/harbors, and then the routes both for return from the southern regions with a north around the cape. All need the consideration of the above underwater features as well as wind against current.

Once a boat commits to leave the bay, they should be committed to passage. The area of Cape Hatteras, due to the shoals and shifting sands and modifications to the actual land due to storm systems, depths and entry change frequently. Oregon Inlet, marked on charts, is considered a ‘Local Knowledge” inlet. And in storm conditions, this inlet can have the same ‘rage’ situation found in cuts in the Bahamas. Further to the south, one other inlet, Hatteras Inlet has just been enlarged/dredged by the US Corp of Engineers; its advertised as a new connector inlets. USCG announced March 22, 2022i n Notice to Mariners the removal of buoys from the South Ferry Channel; this channel has shoaled to a depth of 3 to 4 ft. Its is no longer to be used for traffic from offshore. In May 17, 2022, the USCG a released an announcement reporting that a new navigational channel, the Hatteras Connector, has been established in Hatteras Inlet to allow unimpeded traffic from offshore to the Pamico Sound. The US ACES surveys for the Ferry Channel, some as of 2023, are found at https://www.saw.usace.army.mil/Missions/Navigation/Hydrographic-Surveys/Side-Channels-Small-Harbors/

The Hatteras Connector, considered as a ‘new waterway’ in the USCG announcements, is shown below. As always, navigation is the responsibility of the captain, this article is for informative purposes only and not to be used for navigation.



US Coast Guard, US Army Corp of Engineers (ACES) survey of new Hatteras Connector.

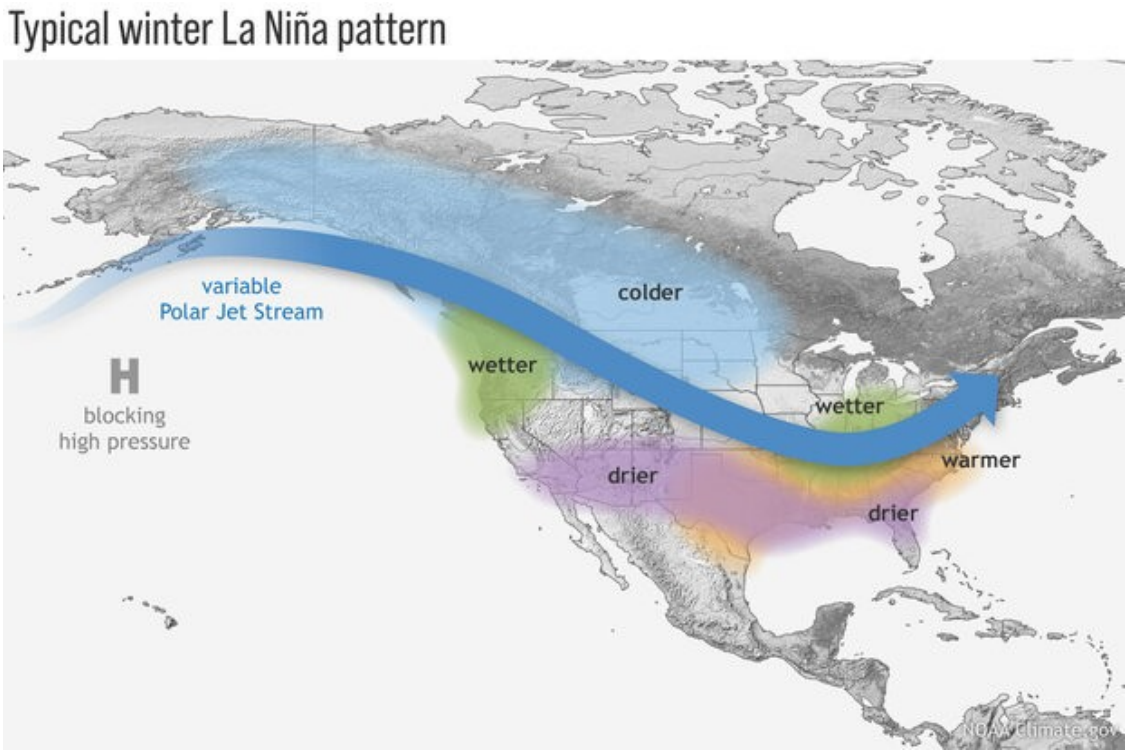
After passing the cape, there is an anchorage, without amenities, Cape Lookout, where vessels anchor to wait for weather windows. The next inlet, Ocracoke has been impacted for several years, with hidden sand bars, and continuous shoaling. Its is not recommended for use unless with local knowledge. Beaufort NC to the west of Cape Lookout offers the best location with both anchorage and docks/amenities. Boats can wait for weather windows or proceed down the ICW from this inlet.

As mentioned above weather is a major factor for any passage around or near Cape Hatteras. This year, again, global weather features have seriously impacted Cape Hatteras weather for 2022 passages, due in part to the weather feature, La Nina. This will continue into 2023.

Over the years, the Hatteras area has experienced difficult weather windows, impacting fall/winter boat migrations along the east coast USA. Organized rally efforts have experienced major issues with adverse weather patterns during the timelines they have for offshore sailing to the tropics.

These past several years, a partial cause is found in the year three of La Nina. The weather systems impacted by La Nina influence has made a major impact to east coast boaters attempting to reach the

tropics. November 1 is the date established by insurance companies with boat coverage. But as seen in the diagram below, during La Nina the challenge is not when to go, its where is a safe weather window. And with the unprecedented ongoing La Nina forcing weather over the mid Atlantic areas, meteorologists are challenged in offering accurate forecasts for marine vessels. The current La Nina pattern continues to drive low pressure systems over the mid USA as seen in the below image. Its not known when this feature will shift to the El Nino Phase.



Weather is changing, with sudden and unexpected weather systems, as well as stronger micro weather effects. In the years since the early 2010s, we are are also seeing more and more of these impacts to offshore vessels such as the sudden formation of double lows off Hatteras 2013, with the lost of three vessels, and damages to at least nine others. Damages included lost of rudders, engine failure, rigging failures all due to large seas in between the two pressure systems, as well as sheer lines with 85 kt winds suddenly shifting from one direction to the other. And those in the Gulf Stream suffered the most. The United States Coast Guard sent out two of their large vessels, one taken out of dry dock at the last moment to rescue sailors in trouble. Several boat loads of crew were airlifted to safety, as their vessels sank. This particular weather system(s) suddenly developed, with a secondary low forming over land in North Carolina, only identified after rally vessels were underway and in the currents. This was a wake up call to boaters to keep informed on fast moving and dynamic weather systems to use onboard systems and review all data prior to departure.

This article is not meant as a guide to electronics, communications or navigation; its meant to advise on the changes we are seeing at Cape Hatteras, both from an oceanographic and meteorologic point of view but also from human impact. Captains should make sure they have the correct information regards charts, weather, and plan for the impact of sea/waves and currents on their routes.

Seim, H.E., D. Savidge, M. Andres, J. Bane, C. Edwards, G. Gawarkiewicz, R. He, R.E. Todd, M. Muglia, J. Zambon, L. Han, and S. Mao. 2022. Overview of the Processes driving Exchange At Cape Hatteras program. *Oceanography* 35(2):6–17, https://doi.org/10.5670/oceanog.2022.205.