The Gulf Stream Near The Rhumb Line - New England to Bermuda June 13, 2023
An Analysis of Conditions

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The rapid changes in Gulf Stream structure and location that started in late April early May of this year are continuing producing a complexity of flows and complicating optimum routing for boats going to or coming from Bermuda. Some of this complexity, and too often differences between model predictions and observed conditions, was experienced first hand by the Bermuda 1-2 competitors during their Newport to Bermuda leg. Some of these differences were the result of interactions between the flows in the main body of the Stream and those associated with warm and cold core rings. Of particular interest was the response of the warm core ring clearly observed in early May sited near 39^0 30'N 68^0 30'W adjoining the edge of the continental shelf (Fig.1). As the meander developed over the next two weeks this ring looked to be "absorbed" by the main body (Fig.2). This belief was supported by both the altimetry based model and the Navy HYCOM model. Direct observations however, by boats transiting the area, suggest that the ring maintained a structure sufficient to produce a well defined clockwise circulation resulting in some amount of adverse current (for south going boats) along the rhumb line just south of the continental shelf. The evolution of this feature over the last two weeks is even more interesting.

The satellite IR image of June 11 (Fig.3) shows a large parcel of warm water in the area straddling the rhumb line between 38^0 30'N and the edge of the continental shelf. This parcel is in close contact with the main body of the Stream but may be standing clear for the moment. The IR image shows warm water surrounding an area of cooler water similar to that expected in a cold core ring. This feature was evidently not formed due to an unstable meander pattern but rather looks simply to be an eddy shed from the main body of the Gulf Stream much in the way that eddies are produced in a turbulent river flow. Whatever the cause the temperature patterns and the associated water column density distributions appear sufficient to produce some counterclockwise flow with speeds of 1-2 knots.

This unusual feature and the surrounding mass of warm water affects conditions over a relatively large area north of the main body of the Stream. The four day composite (Fig.4) shows it spanning nearly 90nm along the rhumb line. The classic Navy analysis shows a similar impact area and provides a defined cold core ring residing just east of the rhumb line (Fig. 5). A result supported by the Navy HYCOM model (see Figs. 6 and 7).

The only resource not showing this ring is the altimetry based model (Fig. 8). It continues to show a prominent clockwise rotating flow feature centered near 39º N 68º 30'W well to the east of the rhumb line. In the area of the cold core feature shown in the other data sets, the altimetry based model has currents flowing to the east and southeast, directions similar to those expected due to the ring but for different reasons. Given this similarity the navigator transiting this area need only consider the effect of a southeasterly current on the ship's progress. The cause matters little.

Proceeding south along the rhumb line into and across the main body of the Stream, all resources indicate significant southeasterly currents for more than 90nm south of ~ 38º 30'N. South of 37º 30'N the altimetry based model shows flow turning to the west as part of a prominent counterclockwise pattern affecting more than 90nm of the rhumb line (Fig.8). The Navy HYCOM shows flows more nearly paralleling the rhumb line to 36º N where they become entrained in the counterclockwise circulation of the evident cold core ring centered near 36º 30'N 66º 30'W (see Fig 8). This ring has been present for several months and is slowly drifting to the west. Again this combination of factors suggests a dominance of southeast going currents along much of the rhumb line to the north of 36º N. This dominance likely continues to some extent to 35º N.

South of 35º N flows are affected by a clockwise rotating feature centered on the rhumb line near 34º N 66º W (Fig.8). This feature has been present for some time and is slowly drifting to the west. Currents ranging between 1 and 2 knots may be encountered.

Given the unusually rapid rate of change in Steam characteristics observed over the past two months it's important to realize that the conditions encountered may differ to some extent from those discussed above. The significance of these changes will vary and be more important to some boats than others. The prudent navigator will include the possibility of significant change is all optimum routing-strategic planning.

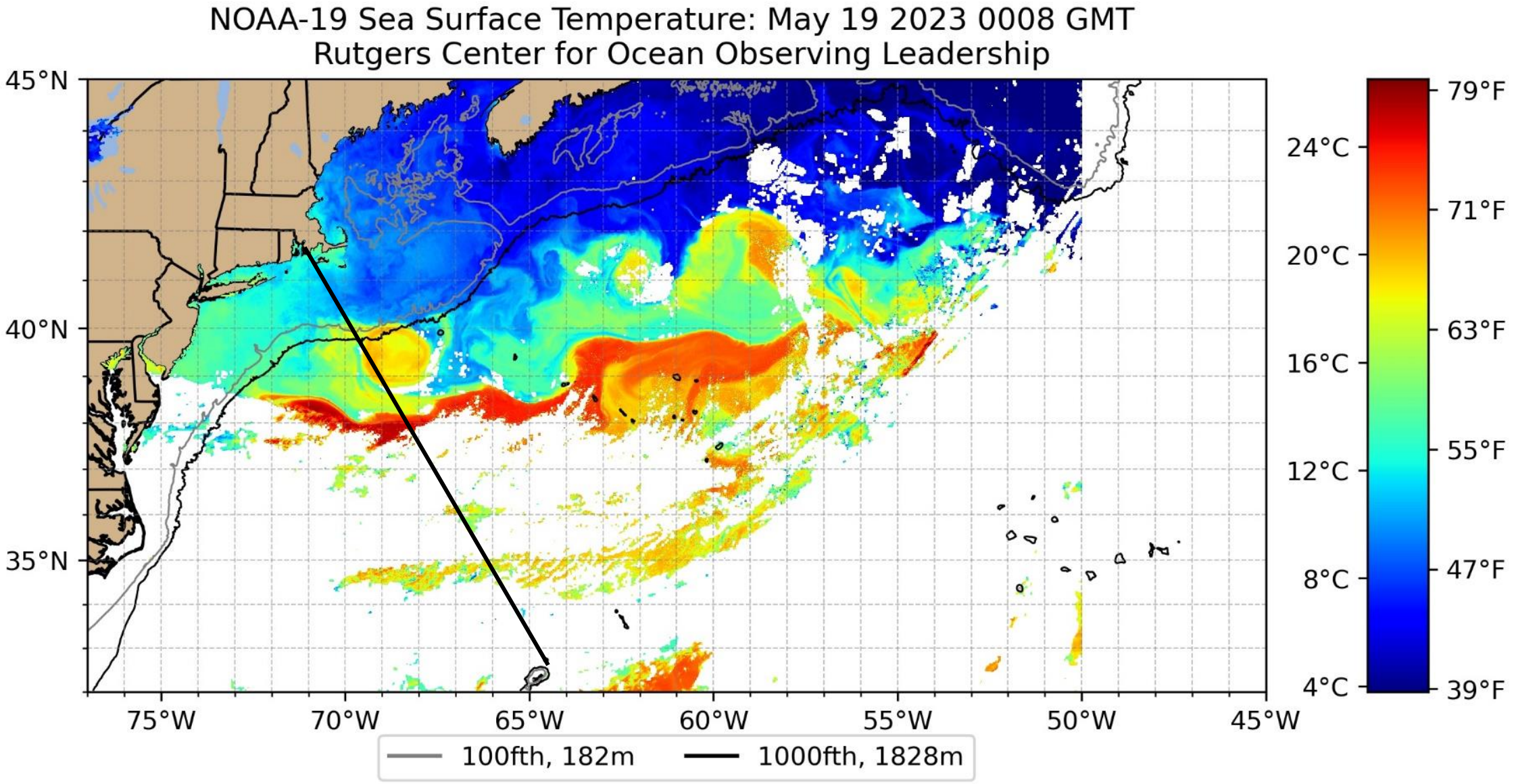

Figure 1 Satellite IR Image of Gulf Stream Surface Temperatures – May 19, 2023

Black Line Indicates Rhumb Line Southern New England to Bermuda

Source: https://rucool.marine.Rutgers.edu

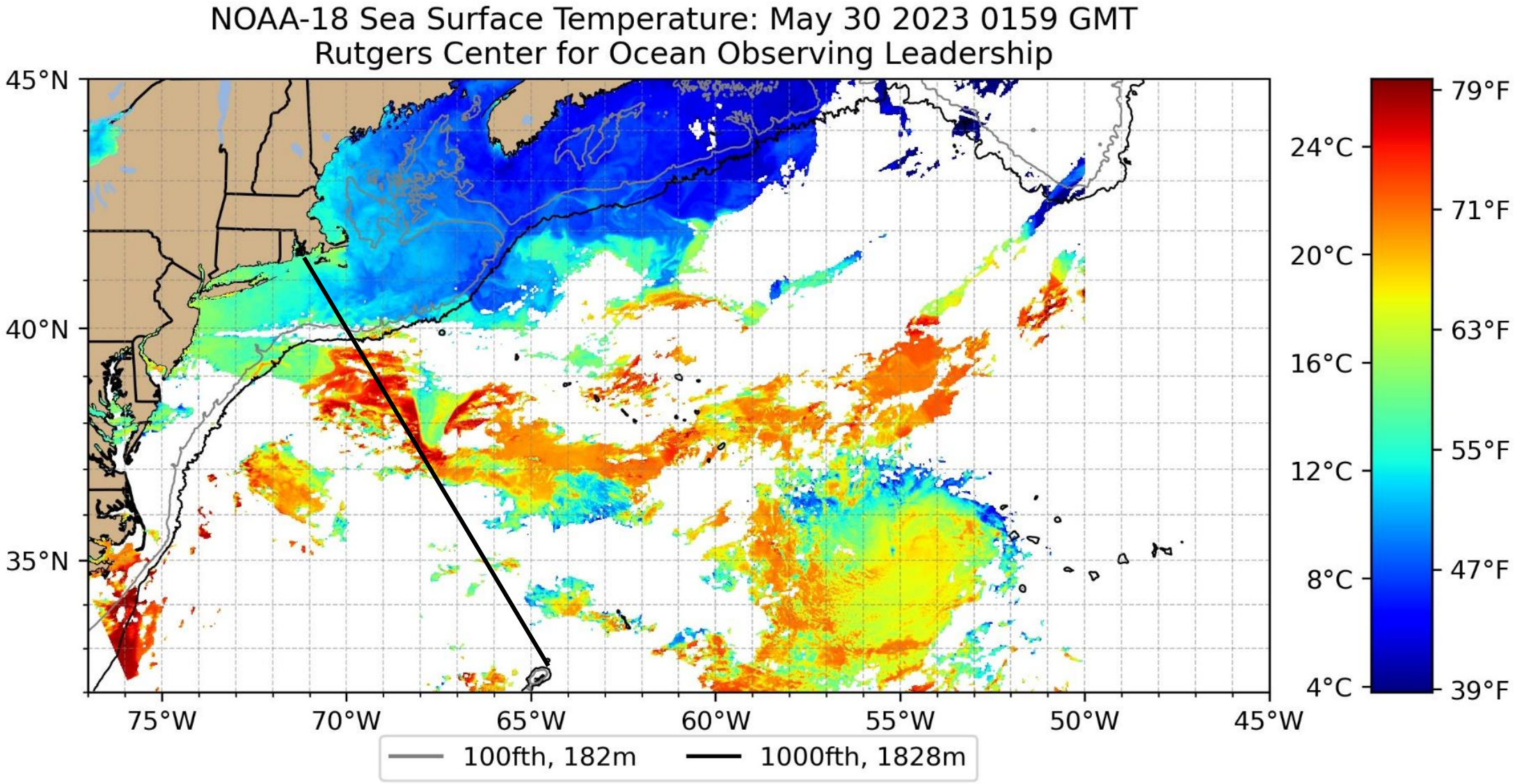

Figure 2 Satellite IR Image of Gulf Stream Surface Temperatures – May 30, 2023

Black Line Indicates Rhumb Line Southern New England to Bermuda

Source: https://rucool.marine.Rutgers.edu

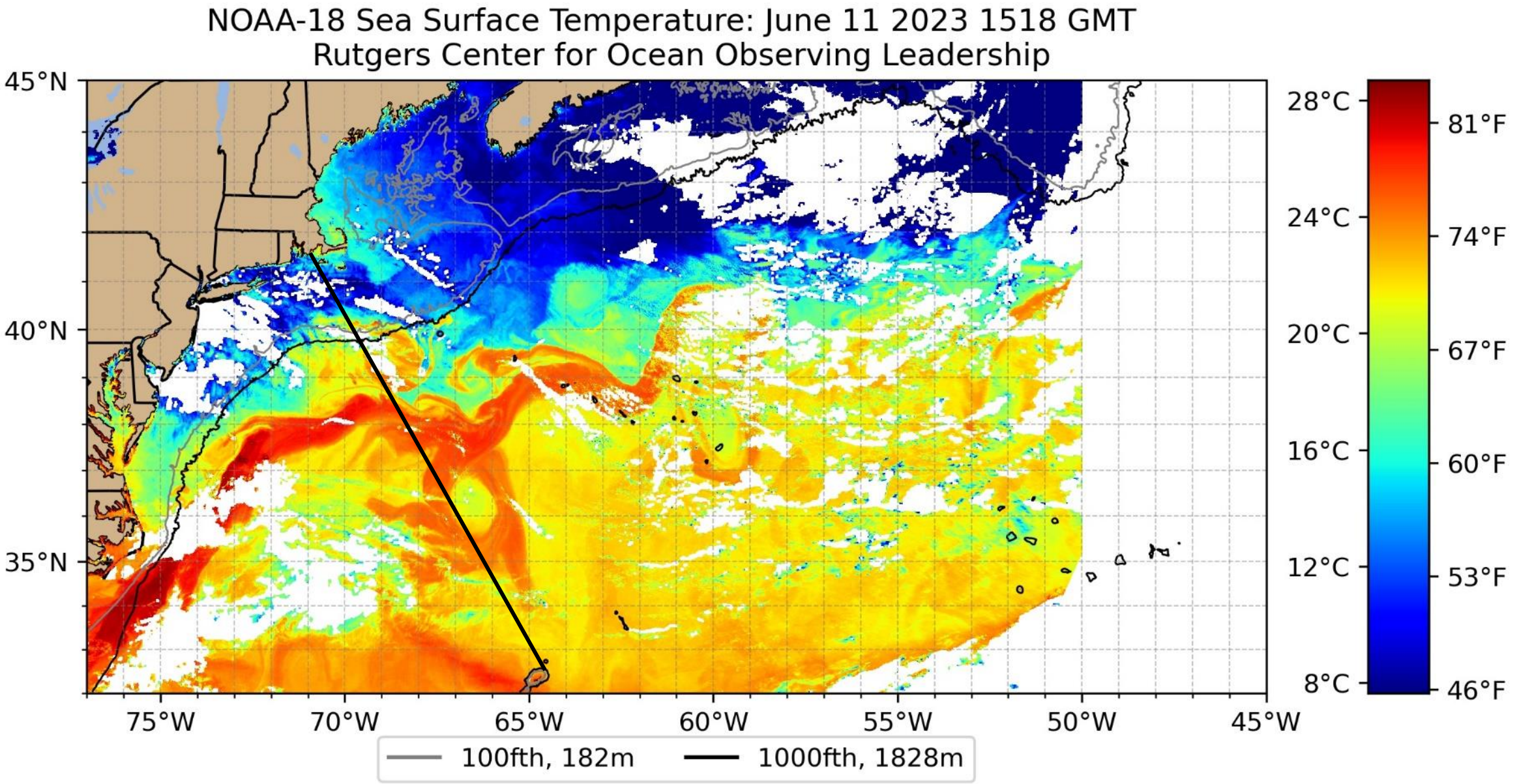

Figure 3 Satellite IR Image of Gulf Stream Surface Temperatures – June 11, 2023

Black Line Indicates Rhumb Line Southern New England to Bermuda

Source: https://rucool.marine.Rutgers.edu

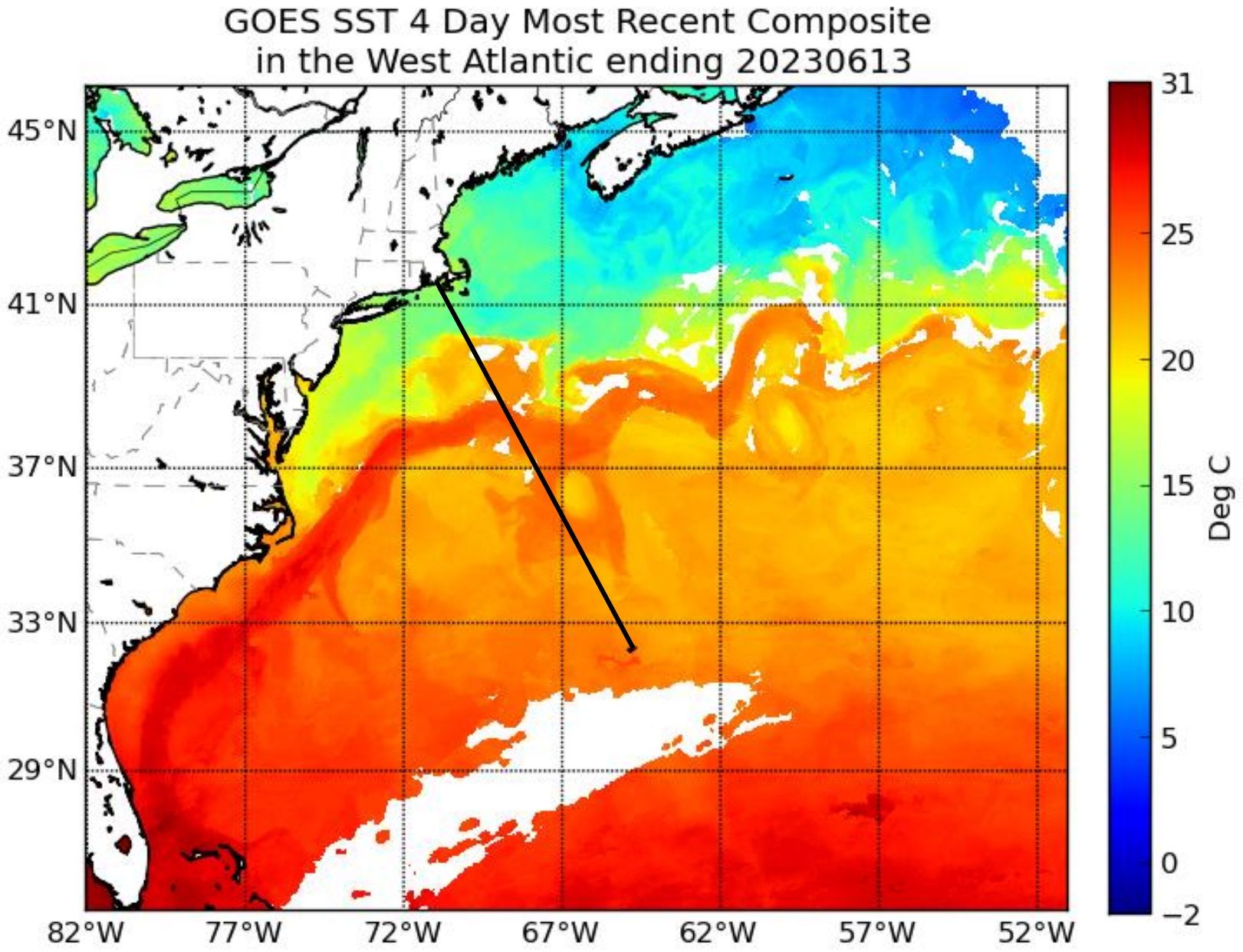

Figure 4 Four Day Composite – Satellite IR Image – Northwest Atlantic – June 13, 2023

Black Line Indicates Rhumb Line Southern New England to Bermuda

Source: https://ocean.weather.gov/

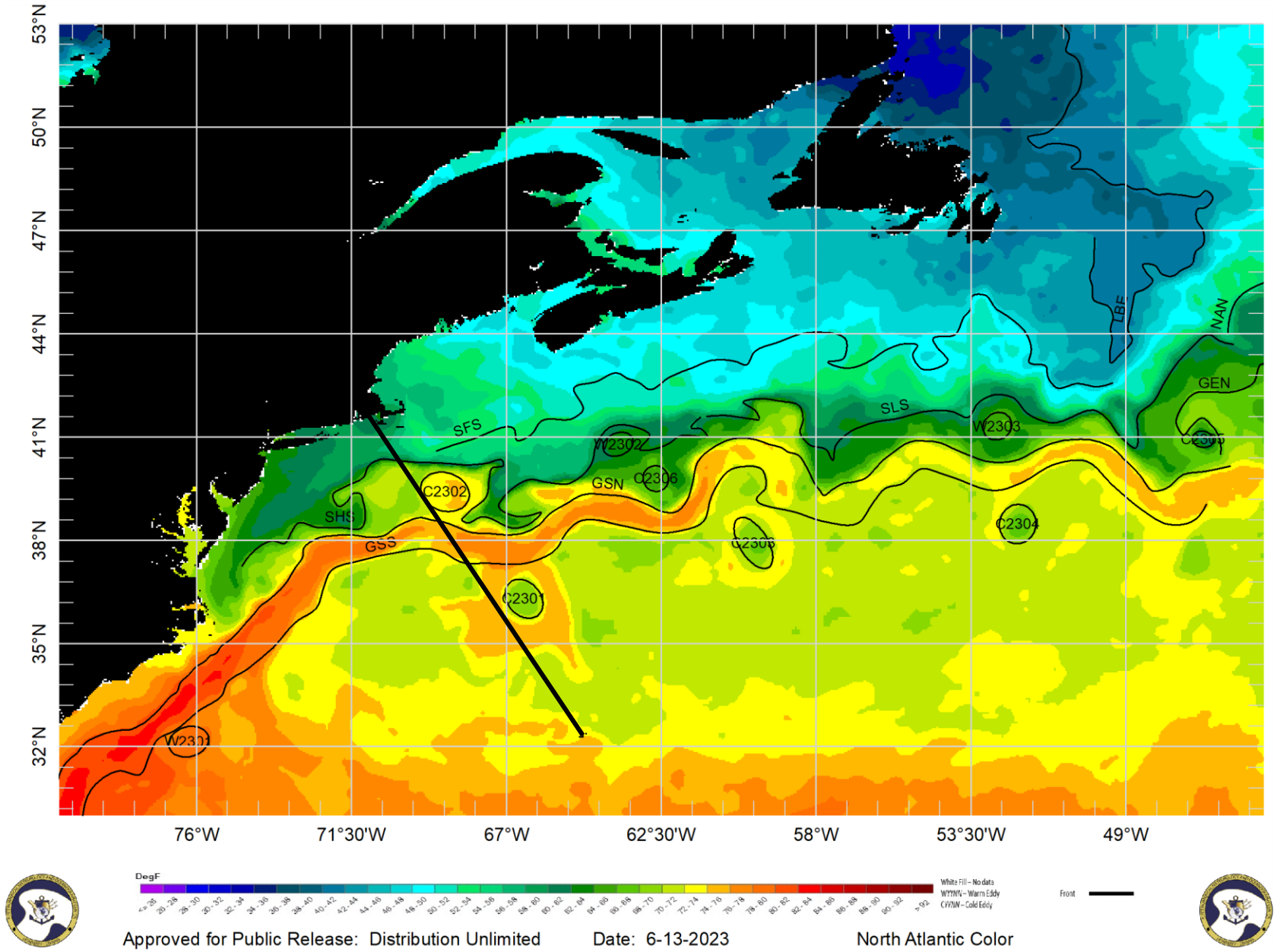

Figure 5 Gulf Stream Location, Structure and Sea Surface Temperatures June 13, 2023

Black Line Indicates Rhumb Line Southern New England to Bermuda

https://www.ncei.noaa.gov/jag/navy/data/satellite_analysis/gsncofa.gif?id=75957

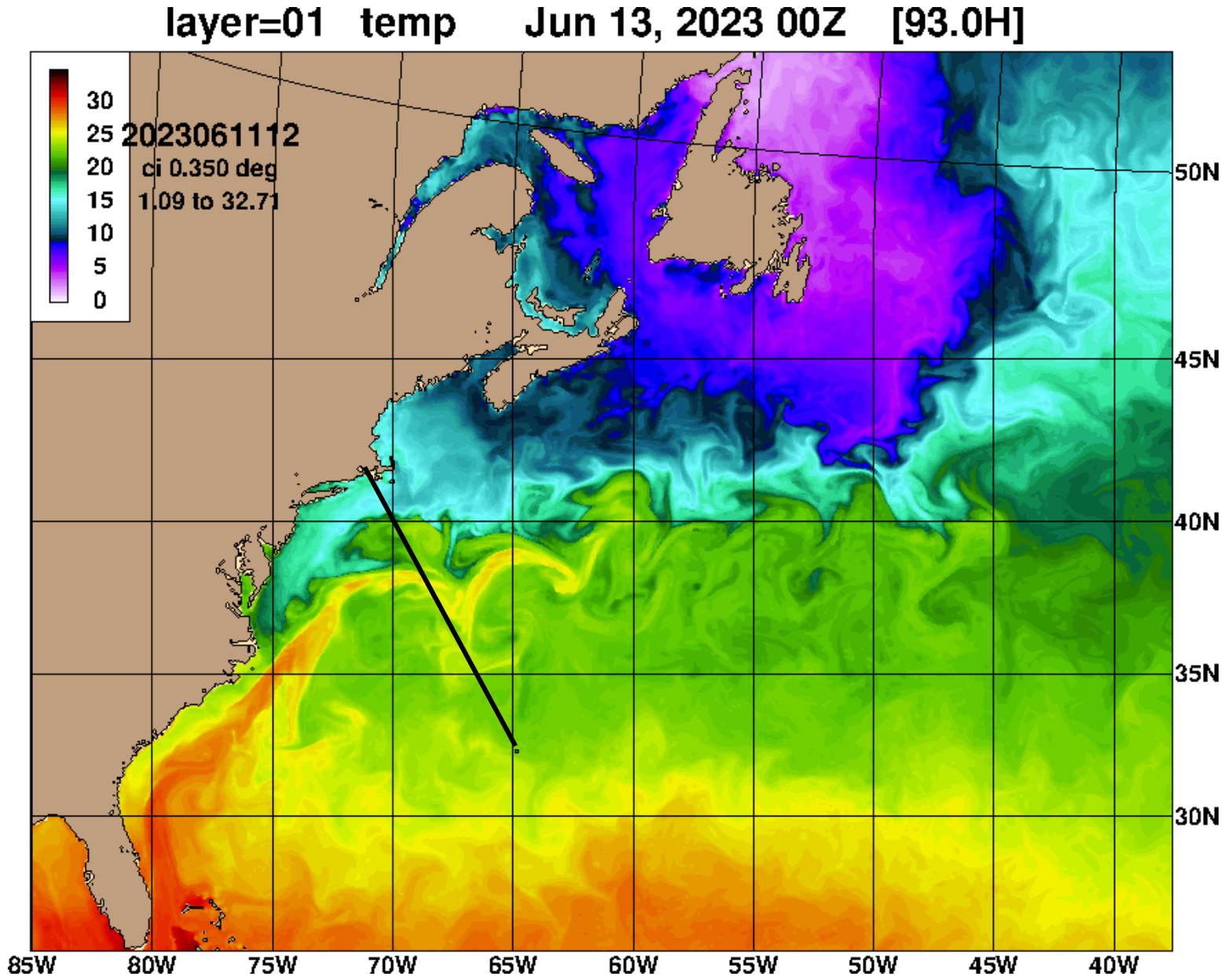

Figure 6 U.S. Navy $1/12^0$ Global HYCOM Model of Gulf Stream Sea Surface Temperatures

Black Line Indicates Rhumb Line Southern New England to Bermuda

https://www7320.nrlssc.navy.mil/GLBhycomcice1-12/

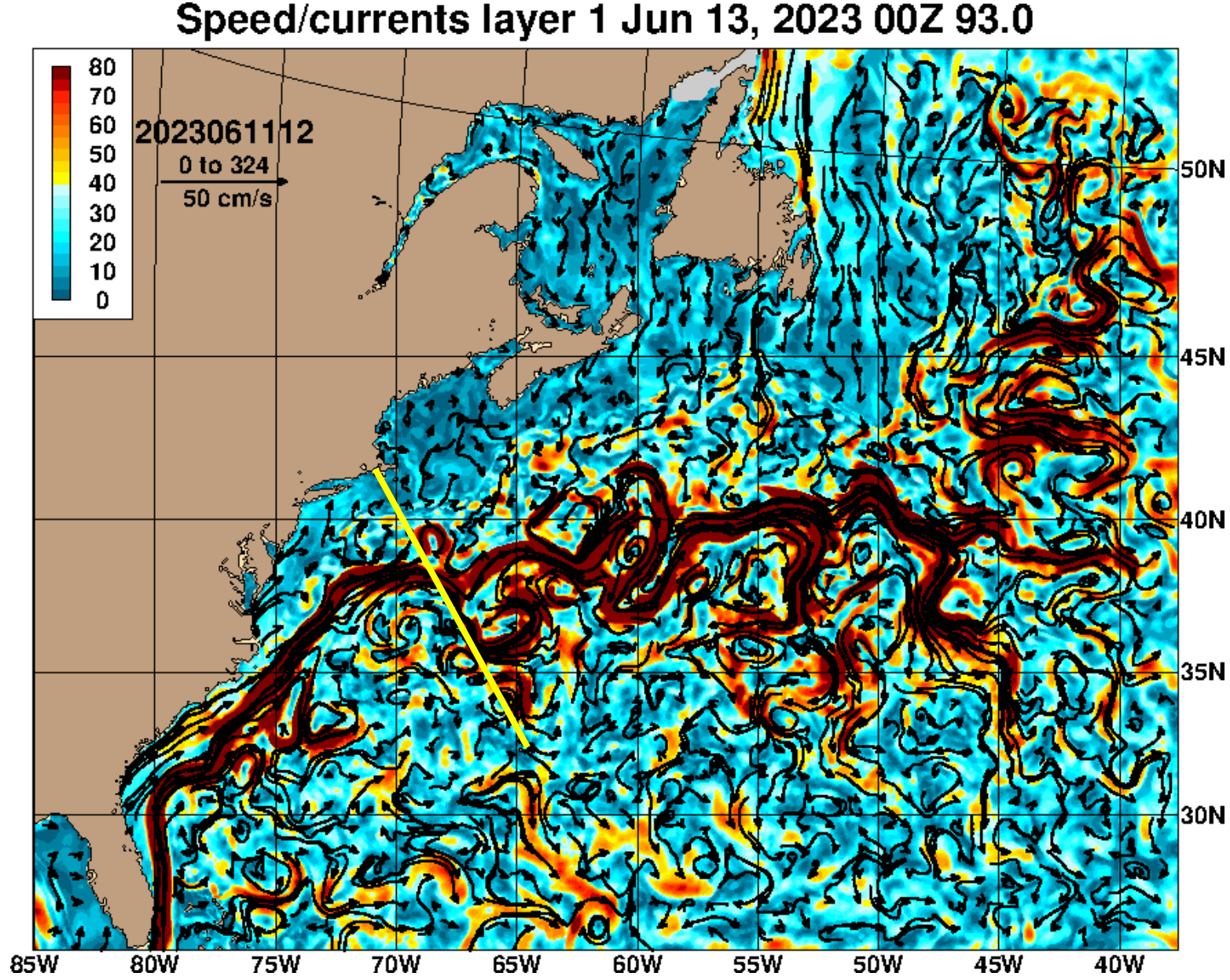

Figure 7 U.S. Navy 1/12^0 Global HYCOM Model of Currents – NW Atlantic Ocean

Yellow Line indicates rhumb line Southern New England to Bermuda

https://www7320.nrlssc.navy.mil/GLBhycomcice1-12/

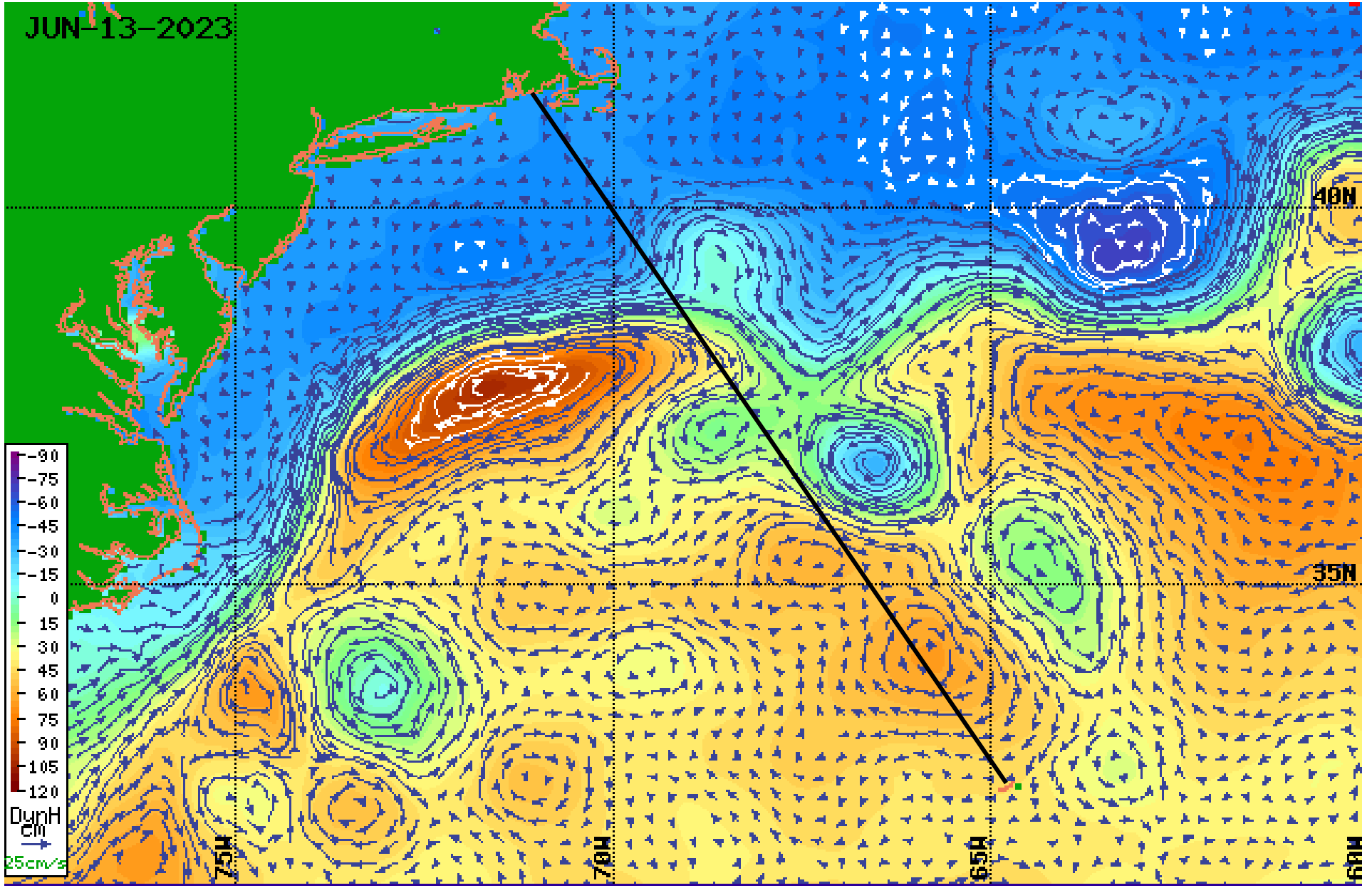

Figure 8 Altimetry Based Model of Northwest Atlantic Ocean Currents – June 13, 2023

Black Line Indicates Rhumb Line Southern New England to Bermuda

https://cwcaribbean.aoml.noaa.gov/CURRENTS/index.html