



The Gulf Stream Near The Rhumb Line Southern New England to Bermuda  
May 27, 2013  
An Analysis of Conditions

W. Frank Bohlen ([Bohlen@uconn.edu](mailto:Bohlen@uconn.edu))  
Mystic, Connecticut

As expected (hoped for) the meander in the main body of the Gulf Stream crossing the rhumb line SNE to Bermuda shown on the May 10, 2013 composite satellite image (see Gulf Stream Note #1 on race website) has developed and deepened over the past two weeks. Initially this process produced only a minor change in the location of the point where the core of the current crossed the rhumb line and no substantive change in the crossing angle (currents continued tracking from the northwest to the south east). By the 15<sup>th</sup> of May (Figure 1) the crossing point was approximately 25nm to the east of the 10 May location in the vicinity of 37° N 67° 40' W. To the east of this point the Gulf Stream rather abruptly changed direction with flows proceeding in a counter clockwise pattern from the southeast to east to northeast and back through the west before beginning a clockwise return through the north back to the southeast. This “button hook” configuration had the potential to pinch off forming a cold core ring with the satellite image providing some indication of entrainment near 38° N 67° 30' W. If this had been race day the configuration favored entry enroute Bermuda to the west of the rhumb line near 38° N 69° W, all other factors permitting.

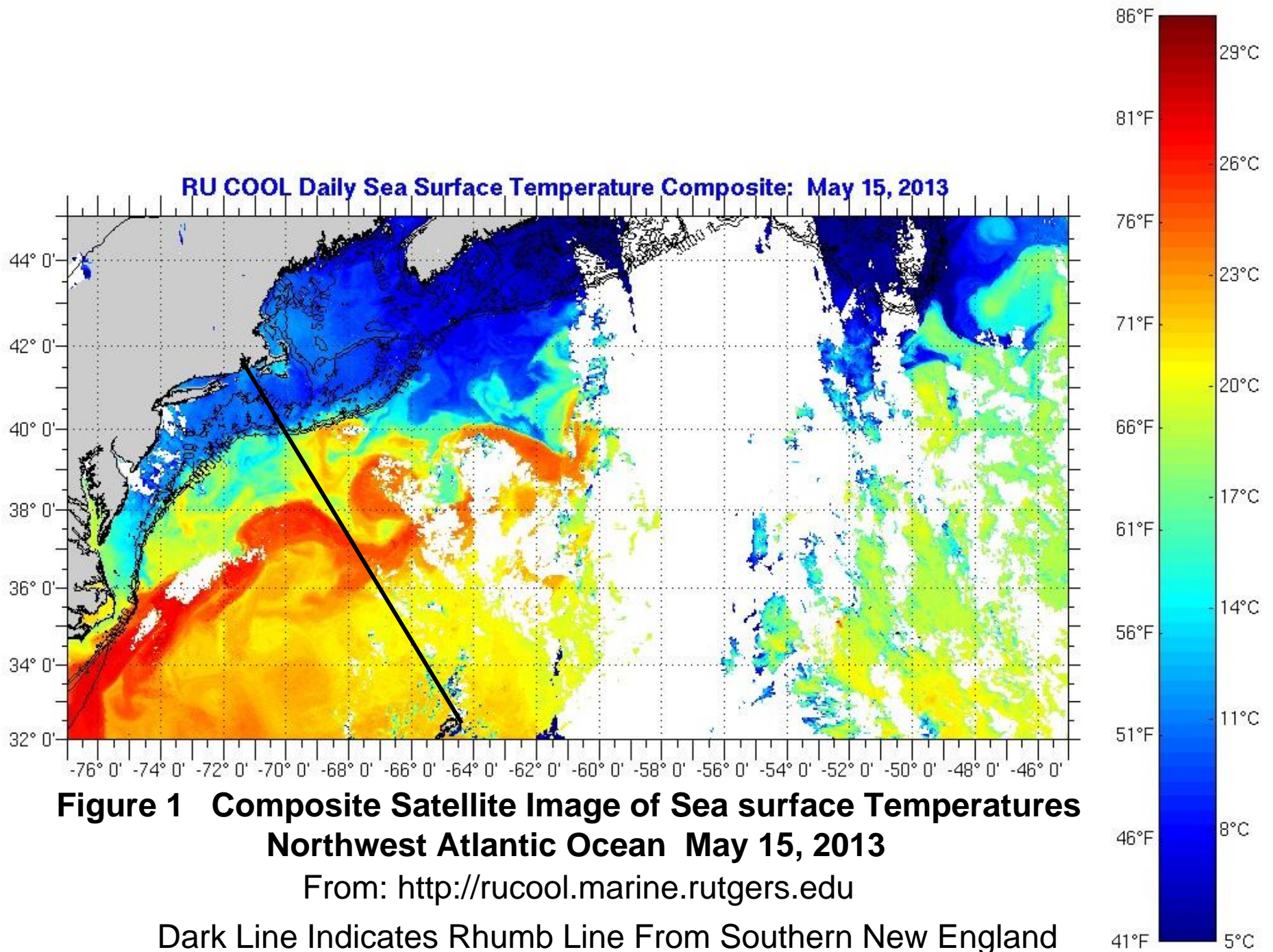
Over the next week the leading edge of the meander appears to have moved more than 50 nm to the east with the “button hook” moving primarily to the north (Fig.2). However, careful examination of the sea surface temperature (SST) composite image indicates that this change in surface configuration was accompanied by a relatively small change in the location of the core of the Stream. This portion of the flow, shown by the darker reds, appears to be little changed from that observed on the 15<sup>th</sup> (Fig.1). The easterly extension of the meander looks to be simply a surface feature most probably the result of wind driven transport of a portion of the main body of the Stream or possibly an artifact associated with the image compositing process. If temperature measurements verify the existence of warmer water, there will be some amount of flow associated with this patch but speeds will be significantly less than those in the vicinity of the higher temperature waters (dark red band). The favored waypoint for entry remains essentially the same as that favored on 15 May, above.

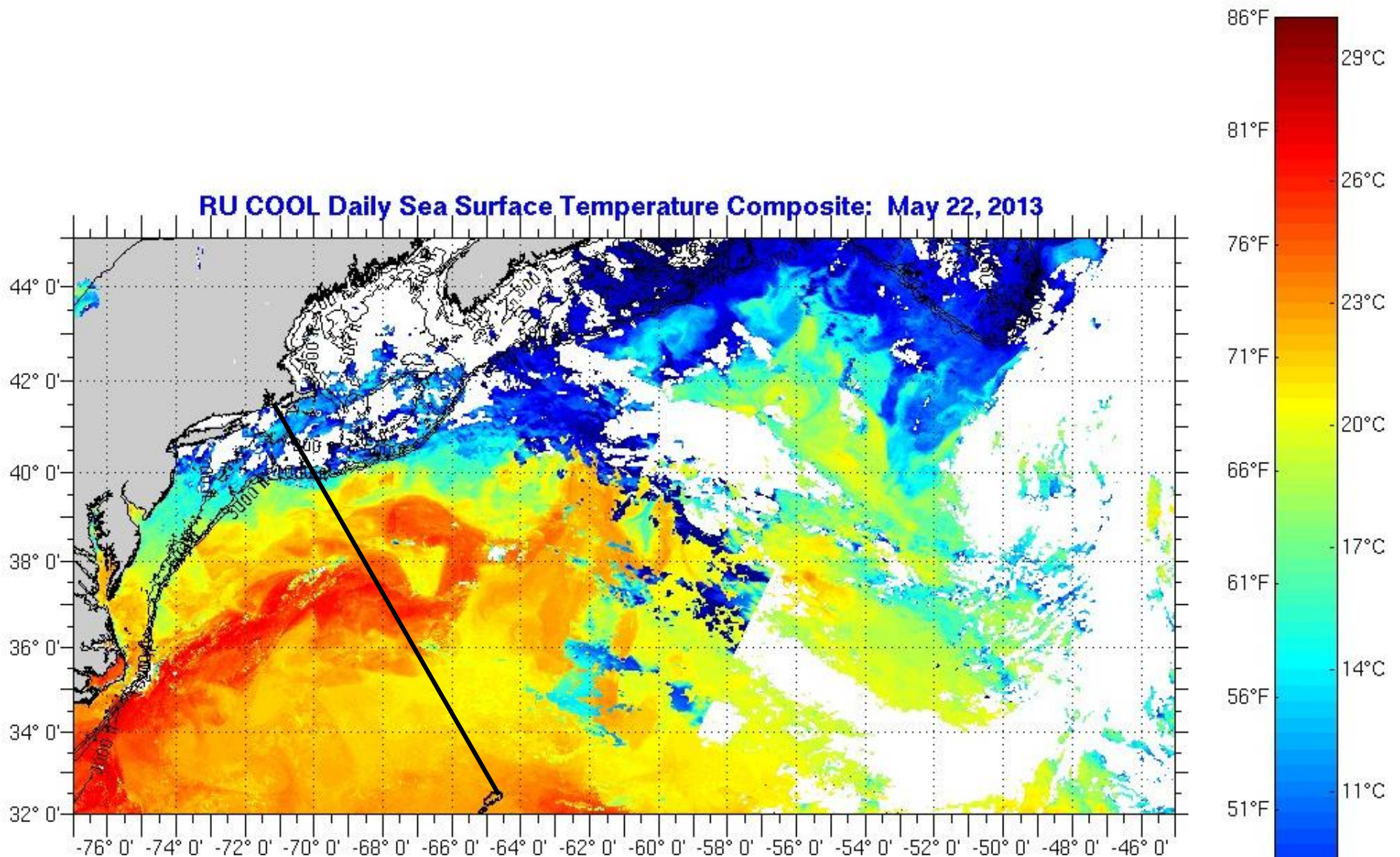
By the 27<sup>th</sup> of May the meander affecting the SNE-Bermuda rhumb line has in fact moved approximately 30 nm to the east of its 15 May position. This unusually slow migration is accompanied by an increase in the speed of movement of the meanders further east of the rhumb line (Fig.3). This migration has nearly obliterated the “button hook” feature that may in time be

shed from the main body of the Stream and form a warm core ring. For the moment it remains in contact with the main body of the Stream (the white portion of the “button hook” on Fig. 3 is a cloud patch). On this day the northern edge of the Gulf Stream is located approximately 240 nm from Narragansett Bay while the core of the current crosses the rhumb line near  $37^{\circ}$  N  $68^{\circ}$  W with flows proceeding from the northwest to the southeast. Over the next few weeks this easterly progression of the meander is expected to continue which may produce a northerly movement of the point at which the core of the flow crosses the rhumb line and a more nearly west to east crossing.

A sense of the actual flows associated with the SST satellite composite image of 27 May (Fig.3) can be developed using the altimetry based model provided by NOAA (Fig.4). This model is based on a ten day average of sea surface heights for the period just before the indicated date. I generally add a couple of days to allow for the processing delay. The need for this is typically justified by comparisons of several days of results starting on the referenced date (e.g. here 27 May) to the SST images.

The altimetry based model results clearly favor a course to the west of the rhumb line to enter the Stream near  $38^{\circ}$  N  $69^{\circ}$  30' W or approximately 30 nm west of the rhumb line. Currents in this area are approximately parallel to the rhumb line but slowly turn counter clockwise and cross the rhumb line in the vicinity of  $37^{\circ}$  30' N  $68^{\circ}$  15' W. This progressive change in direction with distance south and the associated potential of the flow to carry boats east of the rhumb line must be factored into the selection of the entry point, particularly if winds are light. Longer times in the flow favor more westerly points of entry with the exit point remaining fixed in the vicinity of  $36^{\circ}$  30' N  $67^{\circ}$  45' W to avoid any adverse set or drift that may be produced by the circular feature centered at  $36^{\circ}$  30' N  $68^{\circ}$  30' W. All of these characteristics, the meander, the main body flow structure and any associated eddy like flows can be expected to change substantially over the next few weeks sufficient to affect race strategies. They warrant close watching.

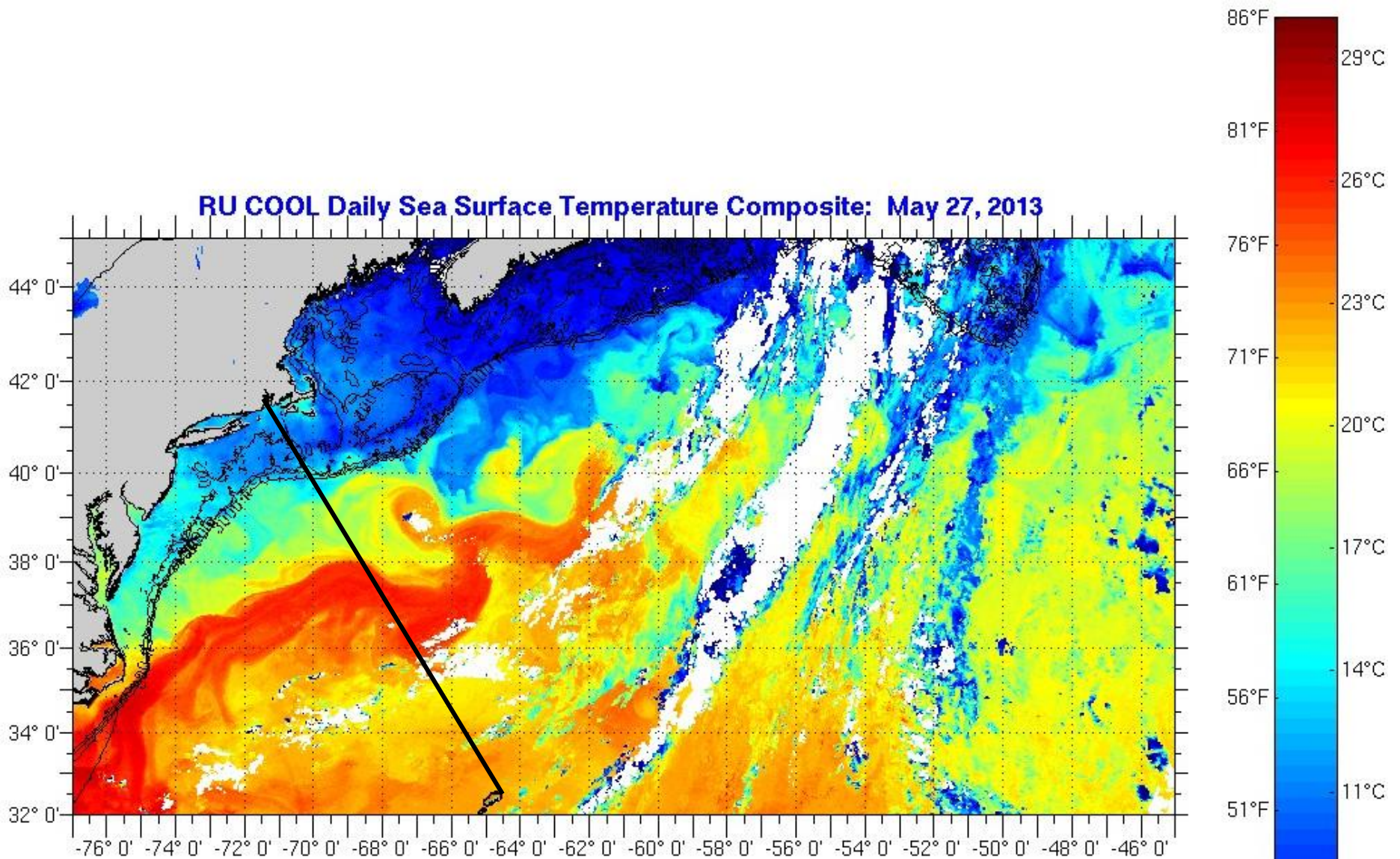




**Figure 2 Composite Satellite Image of Sea surface Temperatures Northwest Atlantic Ocean May 22, 2013**

From: <http://rucool.marine.rutgers.edu>

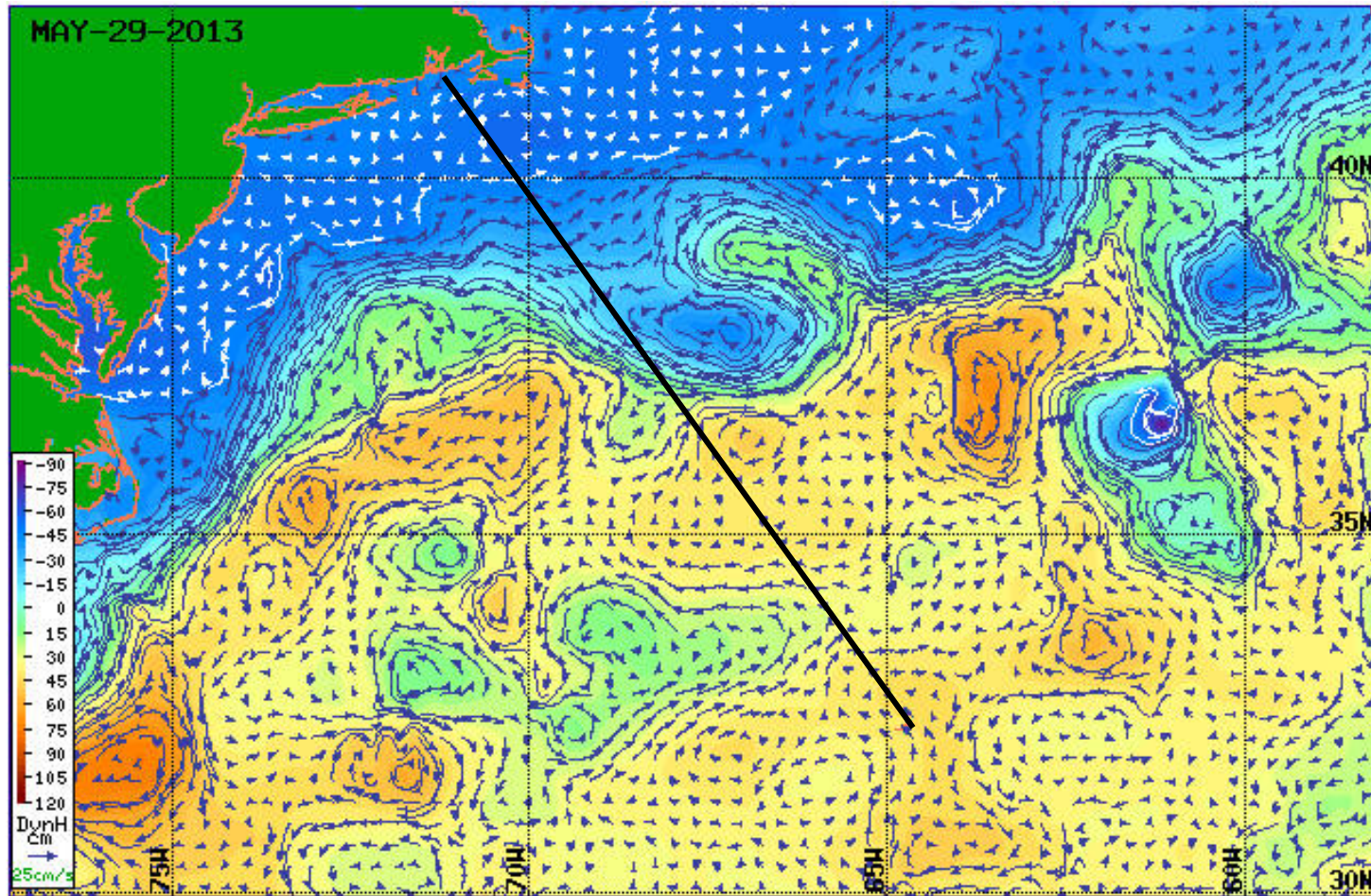
Dark Line Indicates Rhumb Line From Southern New England



**Figure 3 Composite Satellite Image of Sea surface Temperatures Northwest Atlantic Ocean May 27, 2013**


From: <http://rucool.marine.rutgers.edu>

Dark Line Indicates Rhumb Line From Southern New England



Lon   Date     Currents  Vel Field

Lat    Data Points  Contours  S. Wave Height  

 Mask depths:

**Figure 4 Modeled Current Speeds and Directions Near SNE-Bermuda Rhumbline Based on NOAA/AOML Altimetry Data**

<http://www.aoml.noaa.gov/phod/dataphod/work/trinanes/INTERFACE/index.html>

Dark Line indicates Rhumb Line