The Gulf Stream Near The Rhumb Line Southern New England to Bermuda
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An Analysis of Conditions

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Anyone attempting to accurately define the location of the northern limits of the Gulf Stream south of New England (SNE) since the beginning of 2013 has been often frustrated by the persistence and extent of the cloud cover. It is only over the past few weeks that we have been able to obtain more than a very brief view of sea surface temperatures (SST) sufficient to define the Stream structure in the vicinity of the rhumb line to Bermuda and to study its evolution. These conditions certainly point to the value of persistence in the study of the Stream and the need to begin study as early as possible.

The first reasonably useful views of the Gulf Stream this year were obtained in late March. These composite images of SST from the Rutgers University website (http://rucool.marine.rutgers.edu) showed the Stream located approximately 270nm from SNE and to be relative featureless with a slight meander in the vicinity of the rhumbline. The flow proceeded northwest to southeast across the rhumb line. To the north of the Stream several warm core features appeared in the images.

The March sighting of the Stream was short lived and it wasn't until mid April that another useful series of images was obtained. By this time the Stream had become much more "interesting" with the earlier near linear form replaced by a series of deep meanders (Fig.1). Two warm core features were clearly evident north of the main body of the Stream, one to the east of the rhumb line and the other to the west. The northern edge of the Stream was approximately 30nm closer to New England than in March and crossing the rhumb line from west to east at nearly a right angle (Fig.1). Under normal circumstances these features are expected to progressively evolve with time with the meanders migrating to the east-northeast at a rate of approximately 10nm/day and the warm core rings drifting slowly (2-3nm/day) to the west. Such an evolution can significantly affect optimum routing both in terms of set and drift and sea state.

By late April the meander had progressed to the east deepened and entrained the eastern most warm core feature. Deepening and migration continued into May and by the 10th the northern edge of the main body of the Stream crossed the rhumb line obliquely at a point approximately 270 nm southeast of New England. Flow directions at this point were nearly parallel to the rhumb line (Fig.2). To the north of the main body of the Stream the composite image showed a complex pattern of SSTs with apparently minimal organized development such

as a warm core ring. Despite this the pattern suggests that some amount of current or flows should be expected in this area. The strength will be a function of the temperature gradient increasing as the gradient steepens. Flow direction will governed by the temperature distributions with flows adding to boat speed produced by warm water to starboard, cold water to port.

Comparison of the April 14th SST image (Fig.1) to the SST image of May 10 (Fig.2) indicates that the meander in the main body of the Stream moved progressively to the east-northeast at an average rate of approximately 6nm/day. If this drift is maintained it can be expected to produce a significant change in relationship between the Gulf Stream and the rhumb line by early to mid June.

To the south of the main body of the Stream the composite SST image of May 10th (Fig.2) shows what may be interpreted to be a cold core ring just east of the rhumb line in the vicinity of 36º N 66º 40' W. This may however, be an artifact of the compositing process and can/should be verified using some independent source such as the altimetry based current model provided by NOAA. (See http://www.aoml.noaa.gov/phod/dataphod/work/trinanes/INTERFACE/index.html)

Examination of the May 13th model results rather than those of 10 May, to accommodate the delay associated with data recovery and model runs, gives no indication of an organized flow feature south of the main body of the Stream along the rhumb line (Fig.3). A weak counter-clockwise rotation is evident further south approximately 90nm northwest of Bermuda. Experience from past races suggests that this might be a relatively persistent feature. The remaining flows, foul and fair, appear simply related to the turbulent nature of the flow field adjoining the Gulf Stream and can be expected to vary significantly over relatively short periods of time. This rate of change typically makes it difficult to impossible to incorporate them in a strategic plan for a small boat passage.

In addition to the character of the flow field south of the main body of the Stream, the altimetry model provides a valuable adjunct to the satellite SST images. For example, using the SST image to select an optimum point of entry for a boat heading to Bermuda ,and remembering that the maximum currents are typically found approximately 30nm from the northern edge of the main body of the Stream, would result in a waypoint near 37º 45' N 69º W (Fig.2). The altimetry results indicate that the currents at this point are indeed to the southeast providing a nice boost towards Bermuda. Slightly stronger currents, however, are indicated further west near 69º 15' W. Here again the differences between the satellite image and model results may be associated in part with the compositing process. The extent of this error can be evaluated by use of an instantaneous satellite image. Unfortunately over the past few months very few quality instantaneous images have been available due to cloud cover. Hopefully these conditions will change over the next month. This and the ongoing changes in the structure of the Stream should make the remaining period of time before the June races to Bermuda a very “interesting” time !

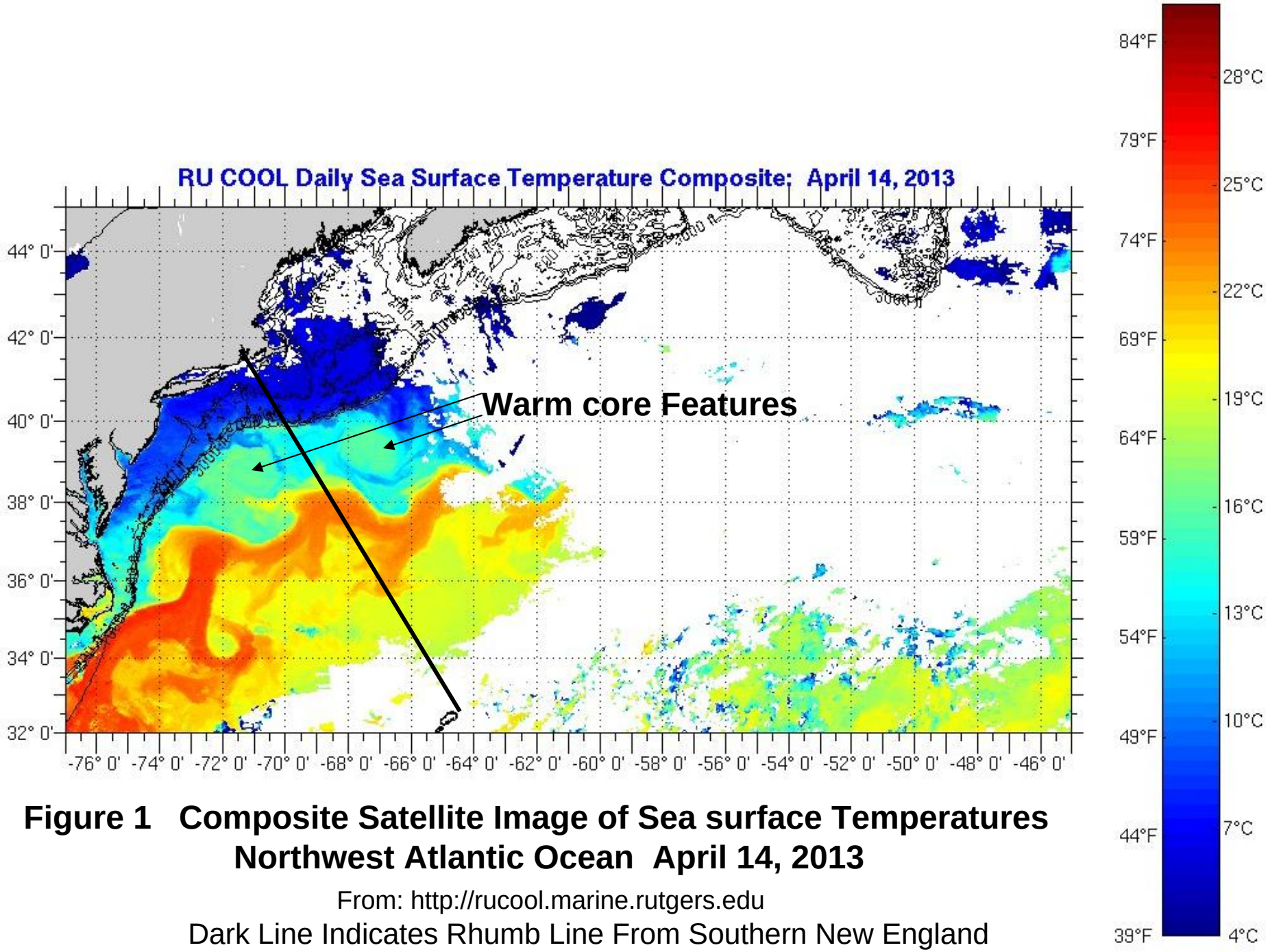

Figure 1 Composite Satellite Image of Sea surface Temperatures Northwest Atlantic Ocean April 14, 2013

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

Dark Line Indicates Rhumb Line From Southern New England

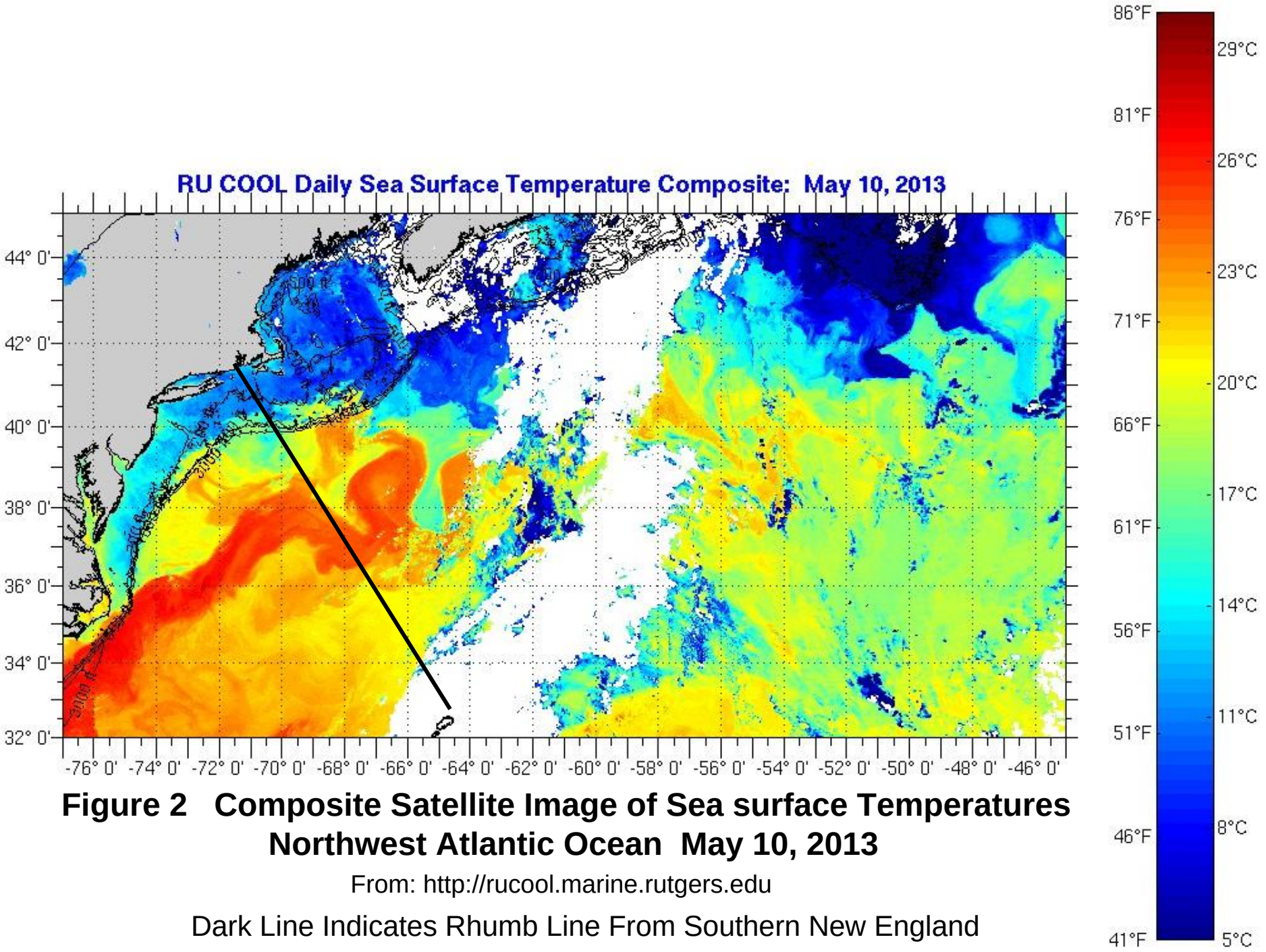

Figure 2 Composite Satellite Image of Sea surface Temperatures Northwest Atlantic Ocean May 10, 2013

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

Dark Line Indicates Rhumb Line From Southern New England

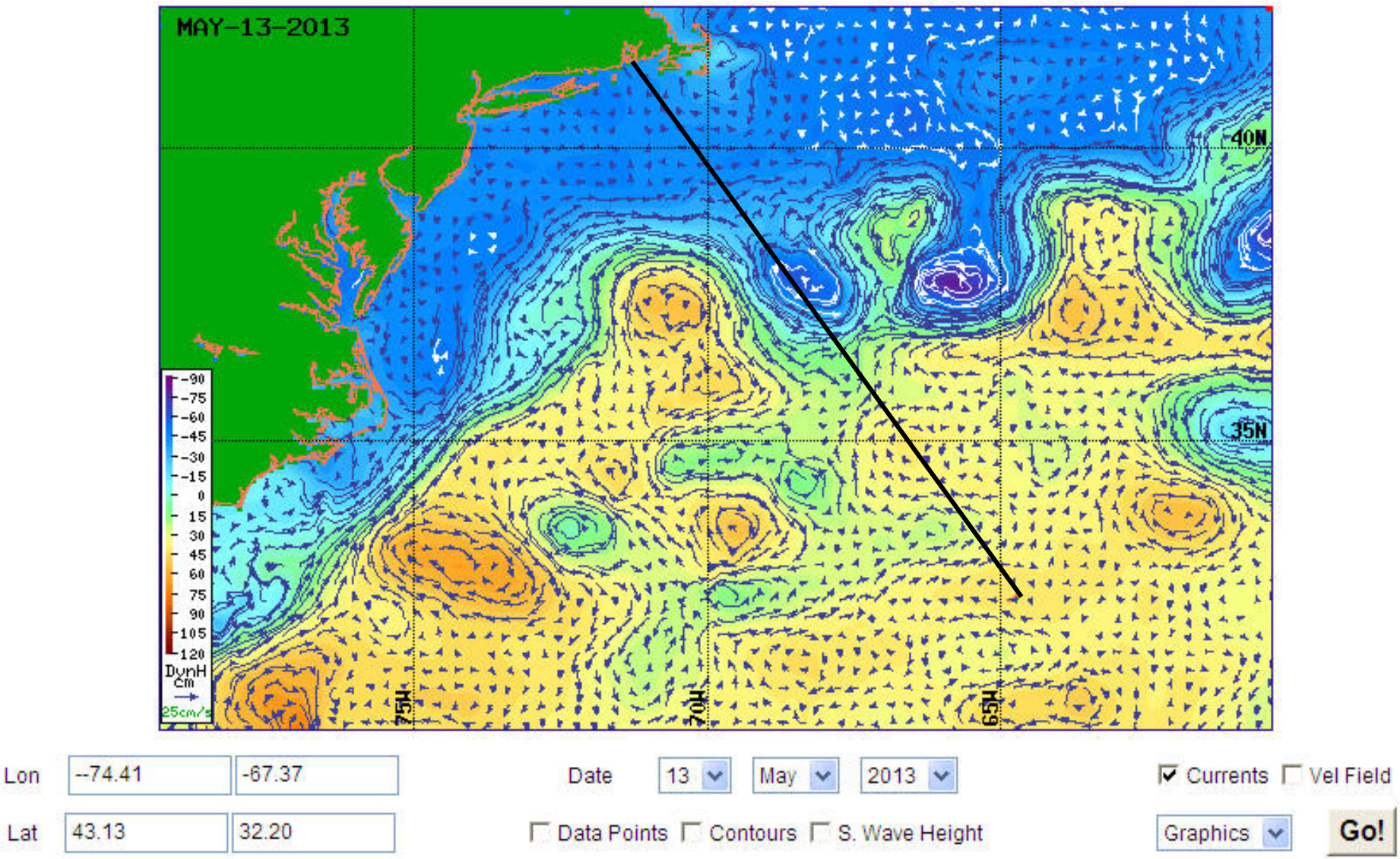

Figure 3 Modeled Current Speeds and Directions Near SNE-Bermuda Rhumbline Based on NOAA/AOML Altimetry Data

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

Dark Line indicates Rhumb Line