The Gulf Stream in the Vicinity of the Rhumb Line Newport to Bermuda May 15, 2011
An Analysis of Conditions

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When viewed on April 18th (see the Analysis of April 18, 2011 posted) the northern wall of the Gulf Stream leading to the crossing of the Newport to Bermuda rhumb line was marked by a deep meander which had been developing for several weeks. A single cold core ring was located near 36° 30' N 68°W. By the 30th of April this meander had become much more prominent resulting in an evident north and east migration bringing the main body of the Stream close to the edge of the continental shelf near 40°N 71°W (Fig.1). To the east of this point flows proceeded to the southeast crossing the rhumb line at a point approximately 140 nm from Newport. This structure favored routes that would ultimately proceed to the east of the rhumb line until clear of Stream influence.

By the 8th of May the meander deepened still more bringing the main body of the Stream onto the continental shelf near 71° W, closer to Newport, and producing flows parallel to the rhumb line (i.e. flows going from north to south) near 40° N 70°W (Fig.2). This structure favors Stream entry 20-30 nm west of the rhumb line. Further south of this point the evolution of the meander and its progressive easterly drift brought the north and western edge of the main body of the Stream to within approximately 35nm of the rhumb line along 38°N producing strong adverse currents along the rhumb line for boats bound for Bermuda. Under these conditions the boat track from the initial entry to the west of the rhumb line must cross the line near 39° 30' N and follow a southeasterly course to a point approximately 45nm east of the rhumb line before turning more to the south to find favorable, and avoid adverse, currents. The potential influence of a cold core ring suspected to be in the vicinity of 36°N is difficult to assess due to cloud cover.

During the next week the easterly migration of the meander continued. This and the drag or friction imparted by the shallowing depths along the edge of the continental shelf resulted in a progressive breakup (i.e. a “tearing apart”) of the upper limb of the meander and the formation of a warm core ring centered near 39° N 71° 30" W by May 15th(Fig.3). Detailing this ring has been made difficult by the cloud cover affecting the area over the past several weeks. It is expected to become progressively separated from the adjoining portion of the upper limb and to drift slowly to the west, towards Cape Hatteras, along the edge of the continental shelf. The proximity of relatively shallow depths may lead to its early breakup.

The May 15th sea surface temperature distribution (Fig.3) shows the north wall of the main body of the Gulf Stream crossing the rhumb line near 40°N or approximately 100nm from Newport. Flows across the line proceed from the southwest to the northeast. This area, being a portion of the northern limb of the meander, is quite narrow with flow directions changing substantially over a relatively short distance. Along the rhumb line the initial flows from the southwest to the northeast change to southeast to northwest flows within approximately 40nm. Further south, clear of the northern limb, near 39° N a strong adverse south to north flow is expected. This complex of flows complicates optimum routing particularly if winds do not favor

a track displaced to the east of the rhumb line by up to 60nm. The alternative would proceed to the west of the rhumb line hoping to take advantage of the clockwise currents expected in the warm core ring and from there planning an entry to the main body of the Stream in the vicinity of 37°30' N 69°30' W or slightly further west depending on wind conditions. The latter might be the shorter distance to Bermuda if conditions permit a relatively quick crossing of the Stream. The concern of course is that light winds in the Stream might allow an easterly set sufficient to bring the boat into the strong north to northeasterly currents expected near 69° W ultimately countering progress to Bermuda. Decisions under these conditions are critically dependent on the accuracy of the weather forecast as well as the adequacy of the sea surface temperature (SST) data to define the flow field. It is, after all, important to remember that the SST images (e.g. Figs 1-3) do not provide a direct indication of flows representing only a surrogate. An extremely valuable surrogate but a surrogate nonetheless. We would much prefer direct measurements of current speeds and direction but since these are not generally available we have to rely on the SST supplemented in recent years by altimetry based models. These latter products have proven to be quite accurate and have the additional advantage of being relatively insensitive to cloud cover.

An examination of the altimetry based results for May 15th (Fig.4) shows the warm core, clockwise rotating feature centered near 39° 30' N 71° W. The feature appears to be still affected by the main body of the Stream resulting in some amount of entrainment, which may slow westerly drift, and a southeast to northwest flow to the east of the rhumbline from the northwestern limits of the main body of the Stream. To the south of the ring the altimetry indicates an extensive area of foul currents sufficient to make the westerly route, mentioned above, much less attractive than initially suggested by the SST images. The altimetry favors a rhumbline or slightly west track to approximately 39° N followed by a more easterly routing to cross the Stream as quickly as possible near 69° W and proceeding southeast along a track 20-30nm to the east of the rhumb line to take advantage of the southeast going Stream flows between 37° N and 35° 30' N. Beyond the latter point the track would lead directly to Bermuda. There's no indication of significant adverse currents in this area.

The observations of the past three weeks or so provide graphic indication of the rate at which the structure of the Gulf Stream can change and the extent to which these changes can affect small boat navigation. This fact in combination with the extent and persistence of the cloud cover over the past several months illustrates the value in early study of conditions well in advance of the scheduled date of departure. Given the observed rates of change it's clear that the character of the Gulf Stream along and adjacent to the Newport to Bermuda rhumb line is very likely to change still more before June. The prudent navigator would be well advised to take every opportunity to view Stream structure during the remaining time before the race. I'll be providing an update of conditions around the 1st of June. It may well be that a continued easterly drift of the meander and westerly movement of the warm core ring will result in relatively benign conditions as far as the flow field is concerned. We'll be interested in seeing the extent to which this is true.

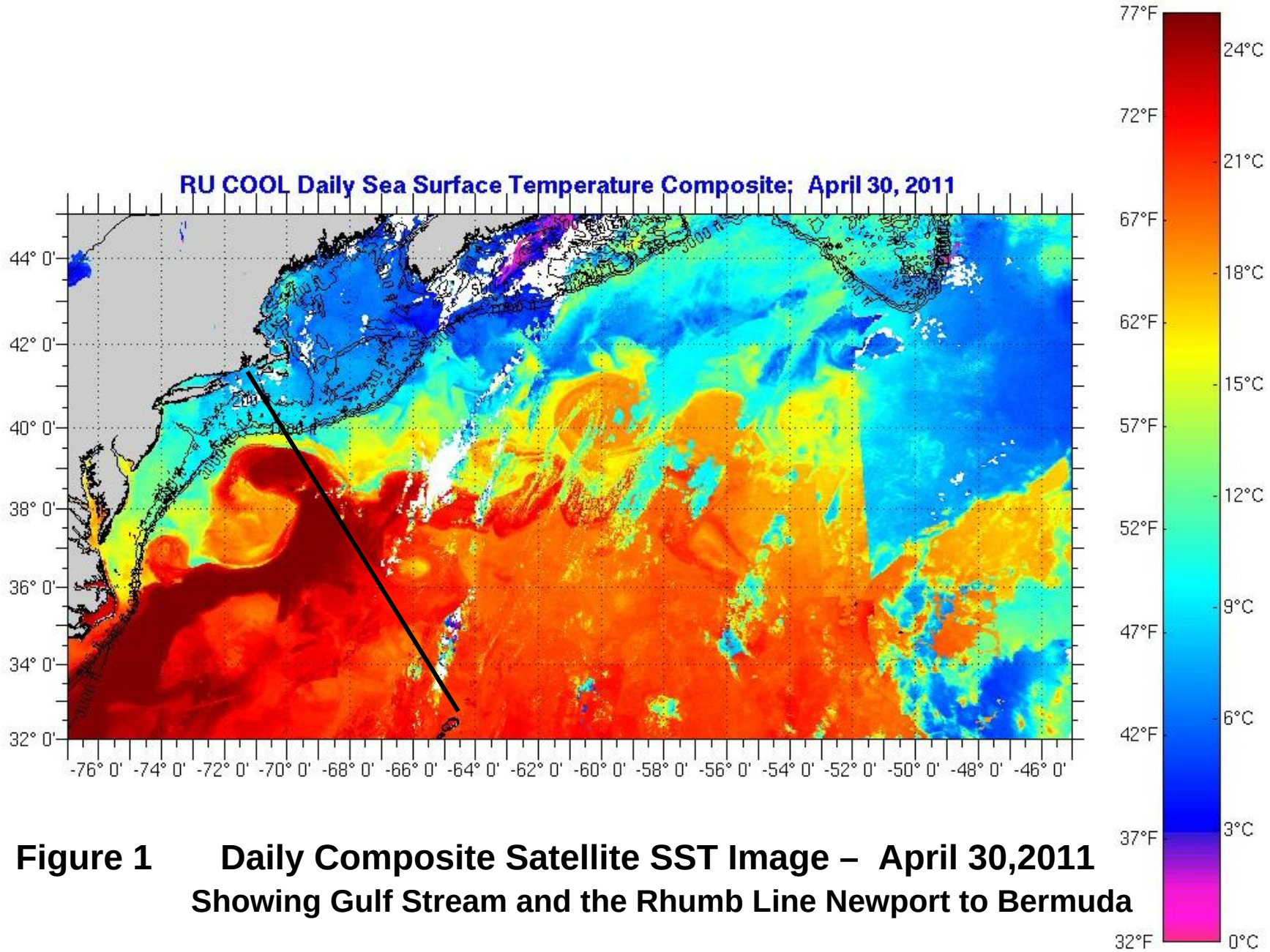

Figure 1 Daily Composite Satellite SST Image – April 30,2011
Showing Gulf Stream and the Rhumb Line Newport to Bermuda

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

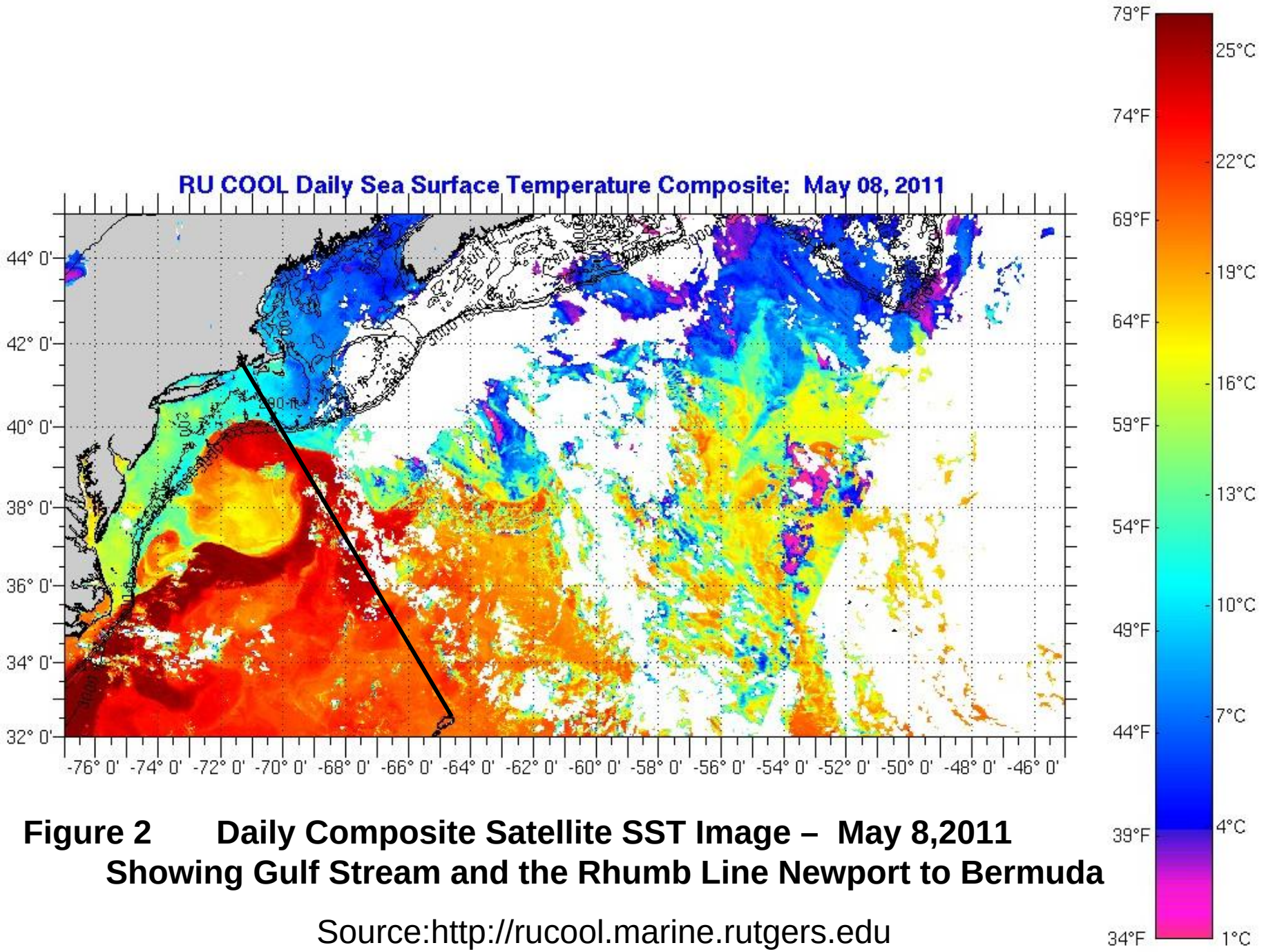

Figure 2 Daily Composite Satellite SST Image – May 8,2011 Showing Gulf Stream and the Rhumb Line Newport to Bermuda

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

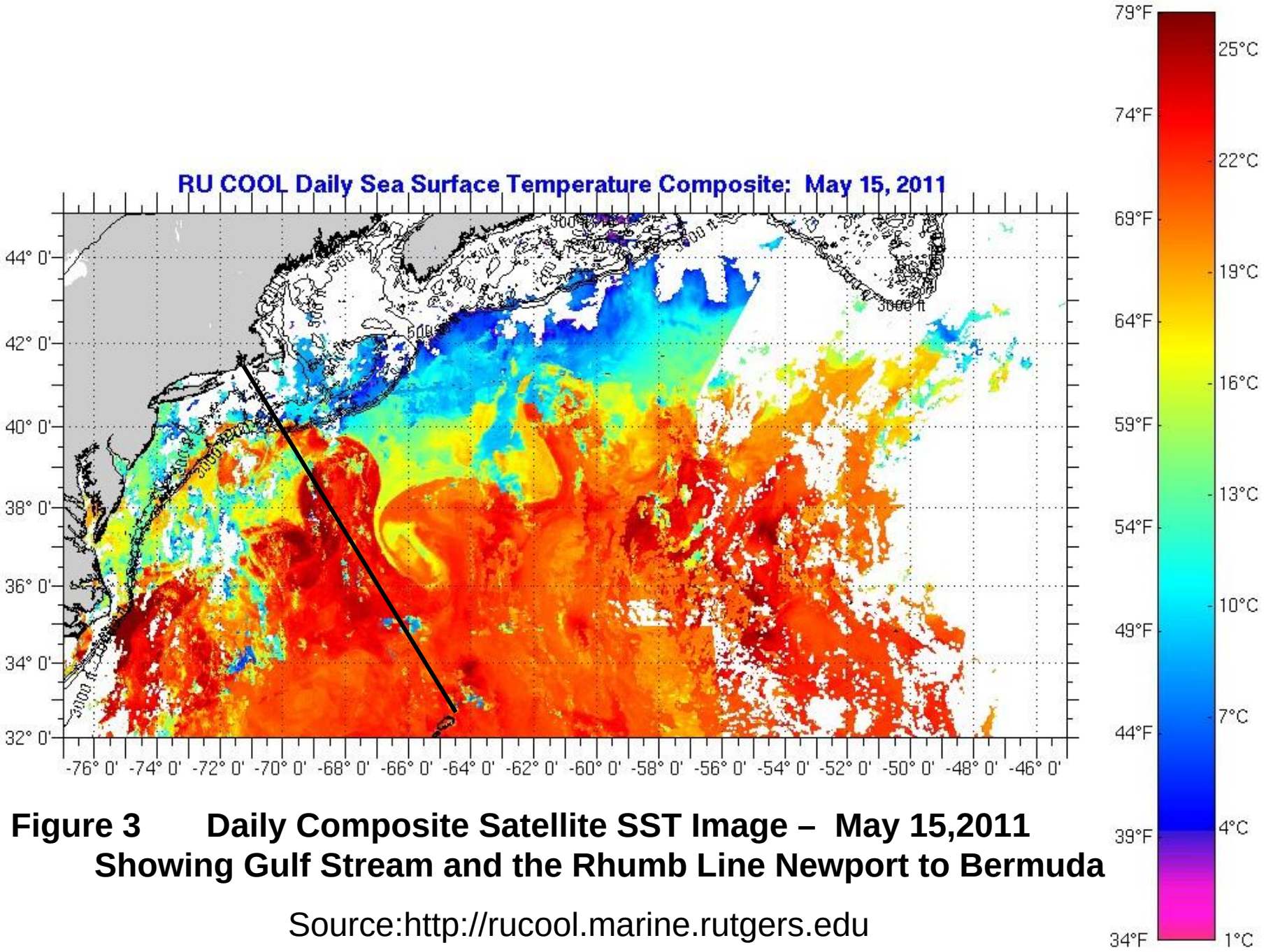

Figure 3 Daily Composite Satellite SST Image – May 15,2011 Showing Gulf Stream and the Rhumb Line Newport to Bermuda

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

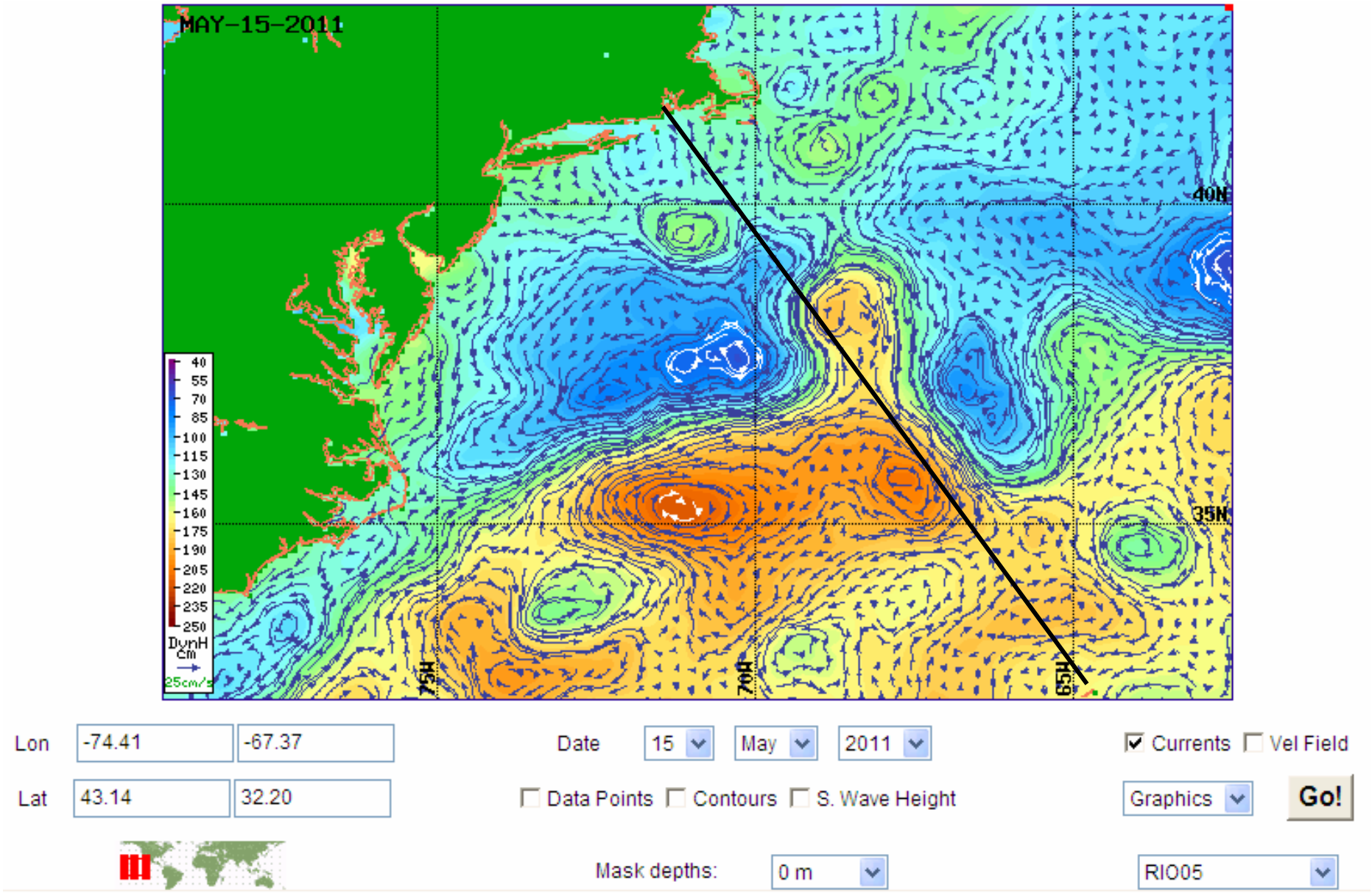

Figure 4 Satellite Altimetry Derived Surface Currents – NW Atlantic Region

Black Line Shows Newport to Bermuda Rhumb Line

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