Gulf Stream Characteristics

June 17, 2004

Note No. 3

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The start of the 2004 Newport-Bermuda Race is fast approaching and the Gulf Stream continues to evolve throughout the area adjoining the rhumb line. On the 16th the northern edge of the Stream was located approximately 285 nm from Newport. The boundary was marked by an abrupt increase in water temperatures from 22C to 28C. Following from our discussion of the effects of temperature gradients on flow it should not be surprising that current speeds increase significantly in the vicinity of this boundary from less than a knot in the cooler waters to approximately 4kts near the maximum temperature gradient sited 10-20 nm to the south of the boundary. Flows follow a northeasterly track across the rhumb line resulting in a slight adverse current (Fig. 1).

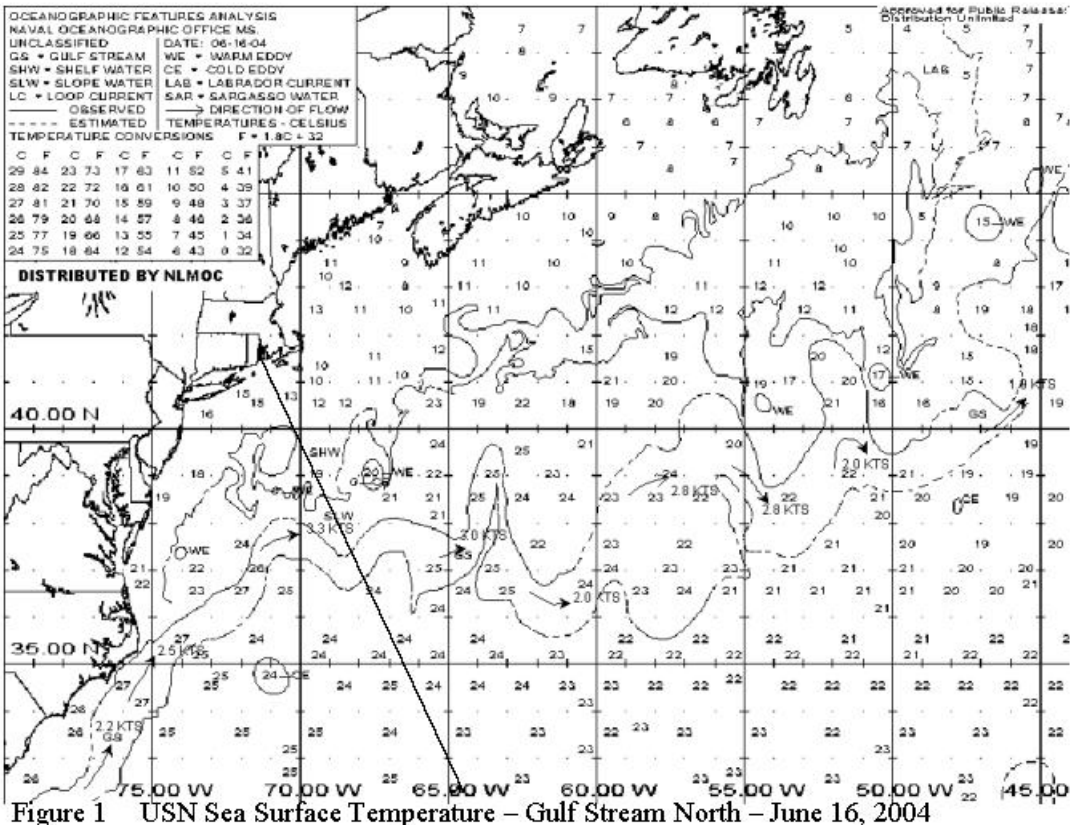

Figure 1 USN Sea Surface Temperature – Gulf Stream North – June 16, 2004

To the west of the rhumb line the meander first observed in early June has deepened slightly resulting in flows to the southeast with maxima approaching 4+ kts. Again flow maxima are sited within the feature in the region of maximum temperature gradients. This feature is moving slowly eastward as it evolves. Over the four (4) day period June 10-14 an overlay of SST satellite images indicates a movement of approximately 28nm to the east placing the eastern edge of the meander approximately 48nm to the west of the rhumb line on the 14th (Fig.2).Obviously, at this rate there is a potential that the meander will cross the rhumb line by the 21st or 22nd of June.

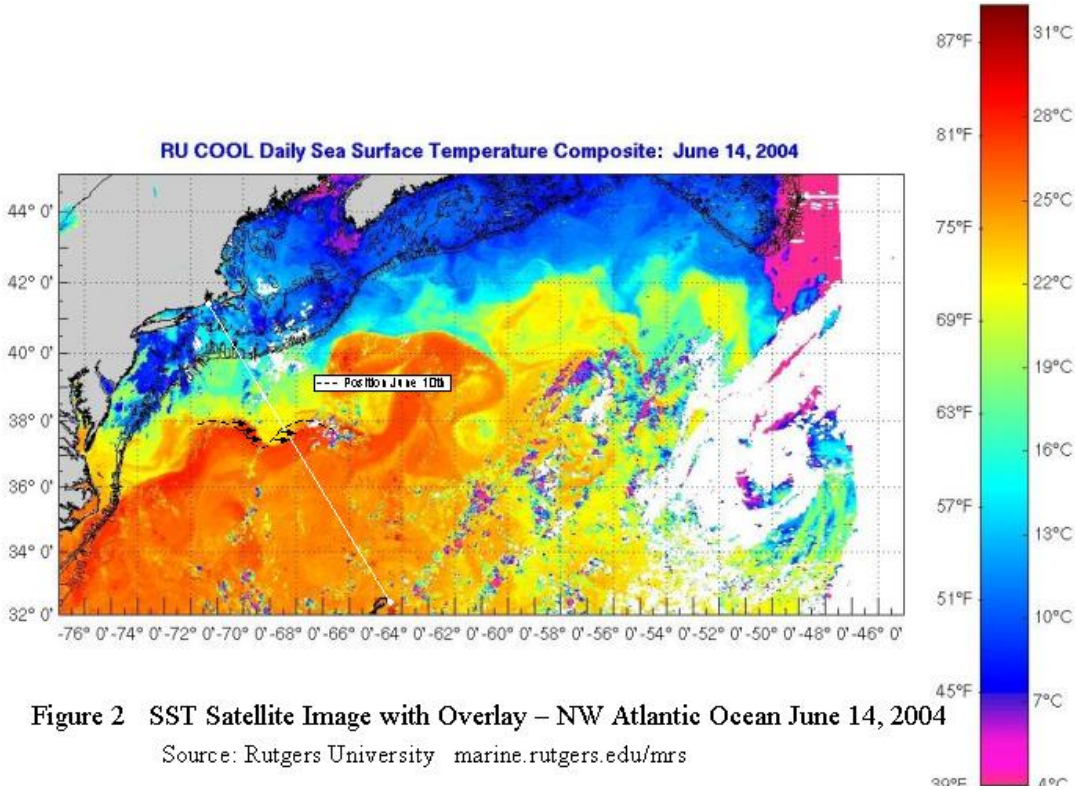

Figure 2 SST Satellite Image with Overlay – NW Atlantic Ocean June 14, 2004

Source: Rutgers University marine.rutgers.edu/mrs

In addition to the flow structure within the main body of the Stream there are several secondary features to the north and to the south. To the north, over and adjacent to the continental shelf, There are two areas of eddy or eddy-like development. To the east a warm eddy sited near 39N 67.5W continues to move slowly westward influencing an area approximately 60nm in diameter. Gradients suggest that maximum speeds in this ring may approach 2kts. Consistent with the sense of this gradient these flows will follow a clockwise trajectory around the feature.

Just to the west of the rhumb line near 39.5N 71W an ring-like feature is visible in the SST images. Again, remembering that placement of the warm water to the right and cold water to the left of the observer leaves one looking downstream, the thermal gradients associated with this feature can be expected to produce a clockwise rotary current, on average. The diffuse mature of the feature may serve to reduce the strength of these flows resulting in probable maxima of 1-1.5kts. The spatial variability, much like a patchwork quilt, may also result in areas of countercurrent. These should, however, be relatively

short-lived.

In addition to these two reasonably well-defined areas, the region of the inshore is in general marked by significant spatial variability in SST. This temperature variability can be expected to be accompanied by a fair amount of variability in the associated flow field. With the sensitivity of our navigational systems this may very well affect indicated COG and/or SOG. On occasion such variations are taken as indication of positioning within a major flow feature such as a ring or even the main body of the Stream. Avoidance of such mis-interpretation requires care and patient analysis of thermal gradient characteristics.

To the south of the Stream, a warm core feature has formed in the vicinity of 35N 66W. This relatively diffuse feature straddles the rhumb line. Gradient based estimates indicate maximum currents of approximately 1.5kt, again with a clockwise trajectory. A drift to the west is expected, at rates lower than those affecting rings to the north of the Stream.