The Gulf Stream Near the Rhumb Line Newport-Bermuda June 12, 2018
An Analysis of Conditions

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Clouds continue to limit satellite views of the Gulf Stream allowing typically one or two quality instantaneous images each week. The frequency of composite views is only slightly better. The last available image of 9 June shows the north wall of the main body of the Stream crossing the rhumb line at a point approximately 200nm from Newport (Fig.1). The resulting flows are proceeding from the southwest to the northeast across the line. To the north there is a mass of warm water apparently "shed" from the Gulf Stream much in the way that winds displace waters from the crest of a breaking wave. The resulting distribution of warm water will produce some flows prior to the entrance to the main body but speeds are expected to be low most probably below 1 knot. The crest associated with this mass of warm water is part of the meander that has affected flows along and across the Newport-Bermuda rhumb line for more than a month. Over the past 10 days the wavelength of this feature has increased significantly with the trough now positioned nearly 120nm to the east of the rhumb line. The sequence of four (4) day satellite (GOES 16) sea surface temperature (SST) composites from the Ocean Prediction Center nicely documents this evolution and provides a valuable indication of the possible rates of change of meanders as well as the overall evolving form of the north wall of the Gulf Stream. https://ocean.weather.gov/Loops/ocean_guidance.php?model=GOES&area=MidAtl&plot=sstrec&day=0&loop=1 (Also, compare Fig 2 to Fig.3).

Examination of the altimetry based model results for June 11 (two day delay required for data analysis) (Fig. 4) shows flows crossing the rhumb line at near right angles or at a much less acute angle than indicated by the June 9 SST composite image (Fig.1). The difference , most likely due to the presence of the warm water mass north of the main body of the Stream, suggests that significant east going current will be encountered to the north of the maximum water temperature gradients in the vicinity of 38^{o} 30'N. This is a relatively unusual condition.

The altimetry based model shows the main body flows affect a well defined region extending for approximately 30nm along the rhumb line (Fig.4). To the south of this area flows are variable becoming progressively more west going by 38^{o} N. These westerly flows appear to be part of a counter-clockwise

rotating cold core feature that is in close contact with a clockwise rotating feature abutting the main body of the Stream. This close contact favors easterly displacements of both rotating features. At the moment the cold core feature produces some amount of adverse flow for boats enroute Bermuda of less than 1kt in a region 20-20nm to the east of the rhumb line. This position however, is subject to change depending on Stream influence on the rotating features.

Continuing to the south, the altimetry based model shows a well defined cold core ring centered near 36^{o} N 66^{o} W with an easterly margin producing southerly flows that affect nearly 70nm of the rhumb line(Fig.4). This feature has moved progressively to the west at a rate of 2-3nm/day over the past month while maintaining its structure. There is no reason to believe that this migration will not continue and result in increasing ring influence in the vicinity of the rhumb line over the next few weeks. At the present rate of drift such displacement will more likely affect boats returning from Bermuda than those participating in the Race.

To the south of the cold core ring the altimetry based model shows a clockwise rotating feature centered to the east of the rhumb line with a diameter of approximately 150nm (Fig.4). This feature is producing northerly flows along nearly 120nm of the rhumb line. It too has been drifting to the west over the past month but more slowly than the cold core ring. Over the past several weeks it has been nearly stationary. The coherence of this feature and its location is relatively unusual in terms of text book discussions of Gulf Stream rings. The availability of better observations and more powerful computer models however has shown that this variety of features is to be expected in turbulent flows with an abundance of rotating eddies and does not need the instability of a meandering current for their production. They are particularly common in the deeper waters to the south of the main body of the Stream where friction is less of a factor than in the shallow waters on and adjacent to the continental shelf. This fact makes the detail provided by the altimetry based model of particular value to the small boat navigator.

As discussed in my previous Notes, an additional model representation of the Gulf Stream is provided by NOAA's Global Real time Ocean Forecast System or RTOFS. Comparisons of this model to observations is of particular importance since RTOFS is often used in routing programs. The SST patterns produced by this model present a view of the main body of the Stream that is essentially similar to that detailed in the composite satellite image of June 9 (compare Fig.1 to Fig.5). Beyond this however the combination of cloud cover, the compositing process and the resolution of the computer model makes it nearly impossible to compare results. The same can be said of the RTOFS current depiction (Fig.6). The main body currents look to be reasonably similar to those predicted by the altimetry based model. Further south however the graphic image gives only a suggestion of coherent rotating flows or rings. Those features may be better shown in the actual data files. Evaluation of this is recommended before these model data are incorporated into routing programs.

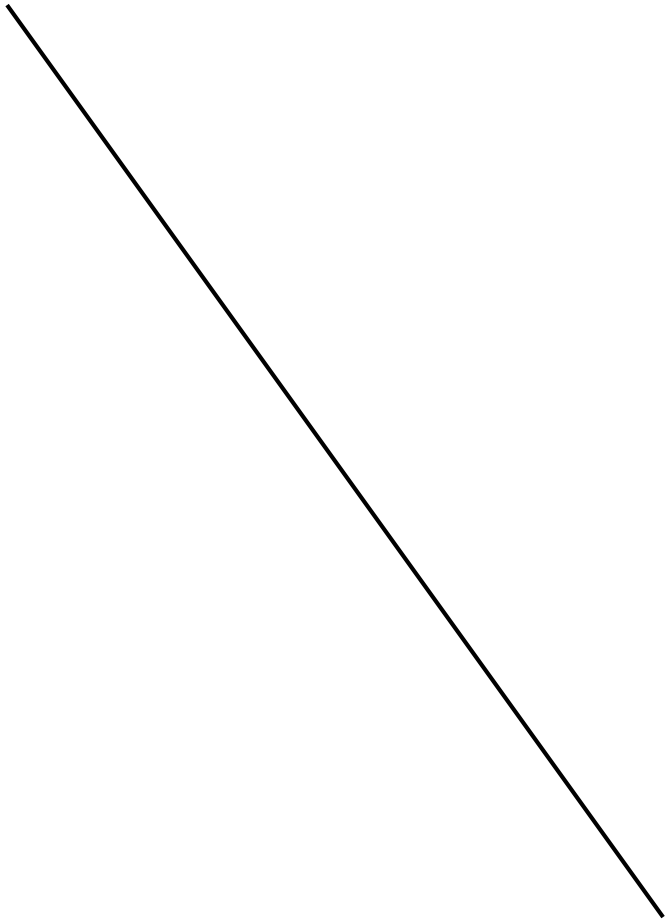

Figure 4 Satellite Altimetry Derived Surface Currents- NW Atlantic Region- June 11, 2018

Black Line shows Newport-Bermuda Rhumb Line

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

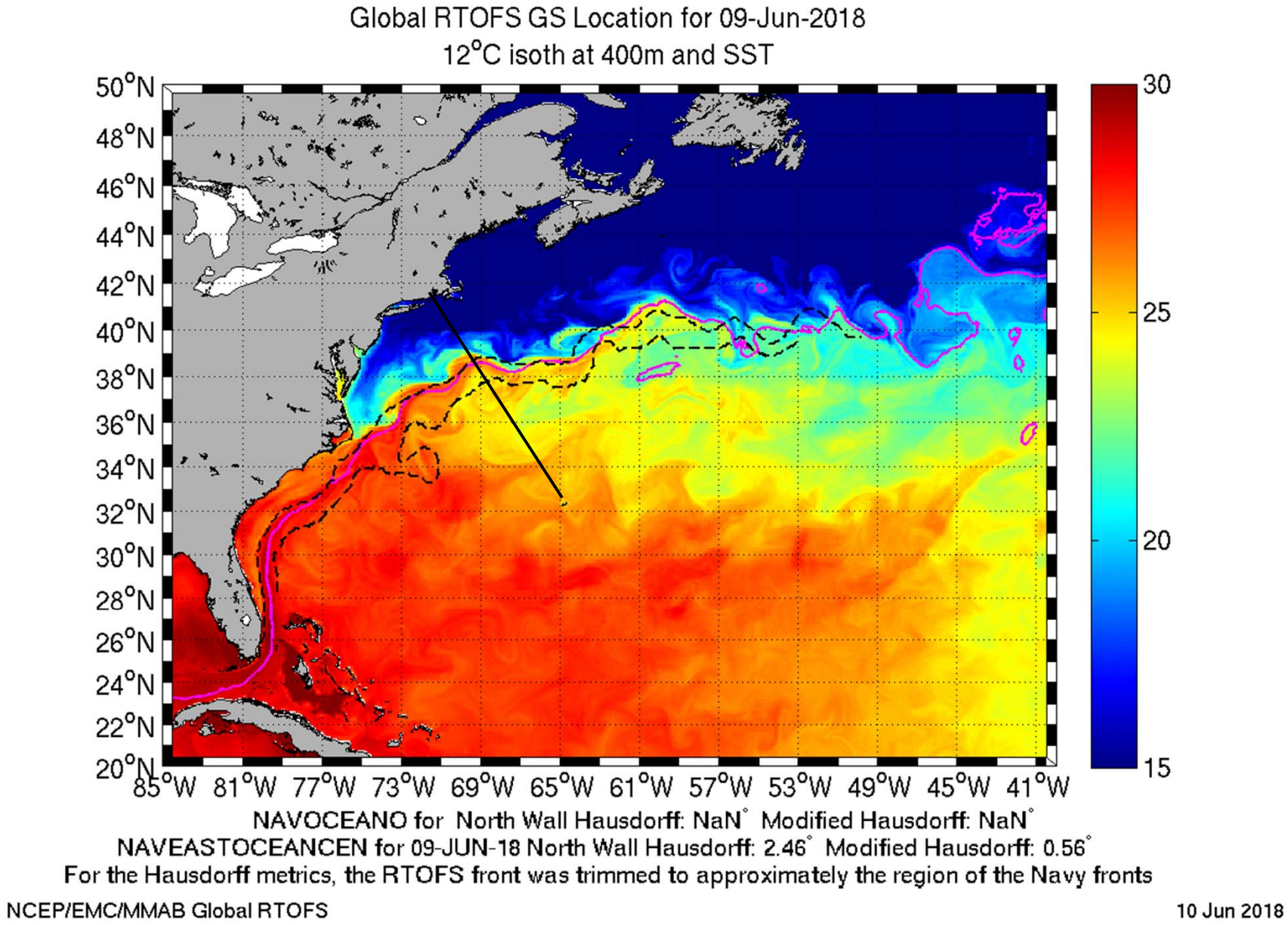

Figure 5 NOAA Numerical Model of Sea Surface Temperatures - June 9, 2018

Black Line Shows Newport-Bermuda Rhumb Line

http://polar.ncep.noaa.gov/global/monitor/

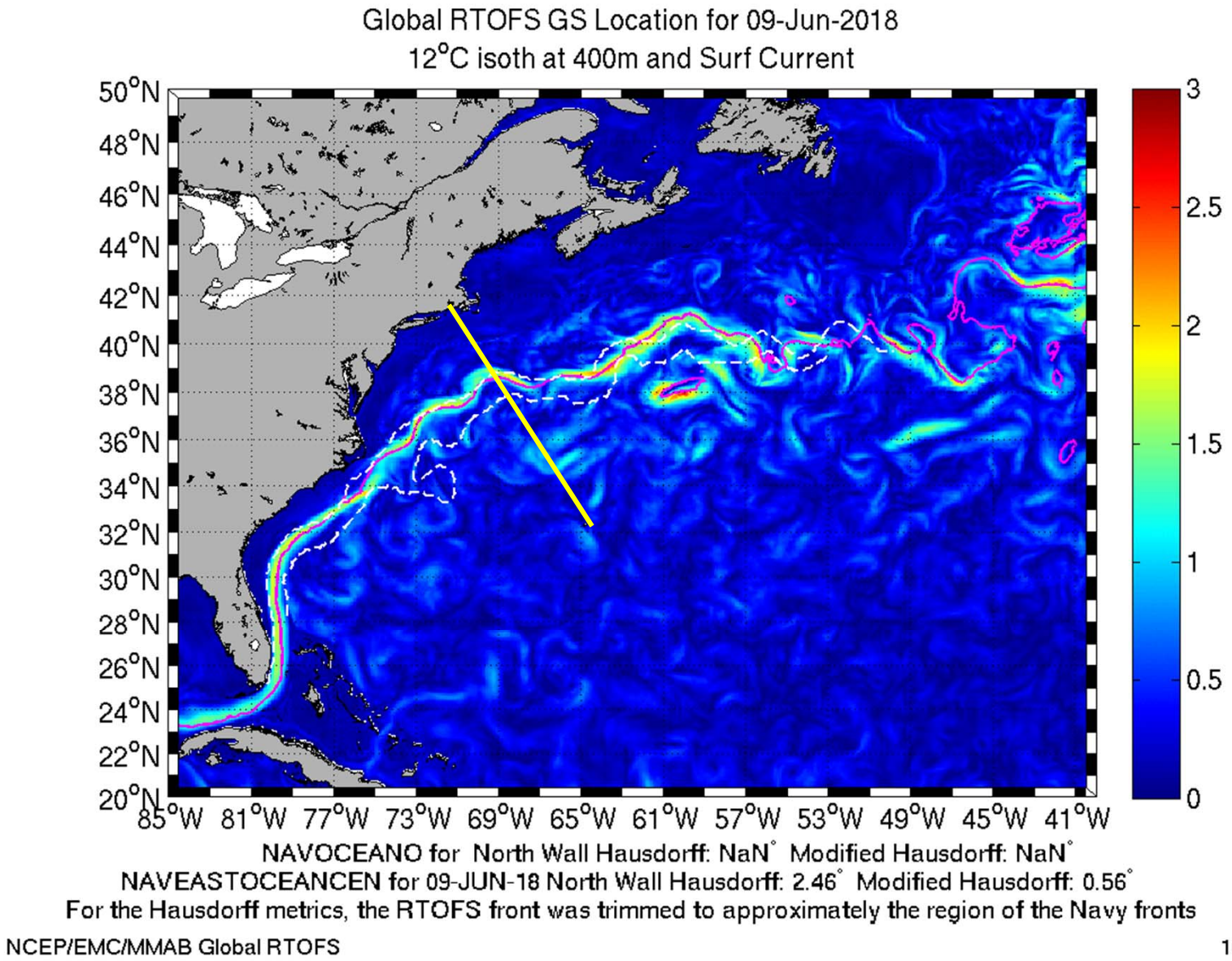

Figure 6 NOAA Numerical Model Gulf Stream Surface Currents - June 9, 2018

Yellow Line represents Newport-Bermuda Rhumb Line

http://polar.ncep.noaa.gov/global/monitor/