

**Gulf Stream Note #3**  
**The Gulf Stream in the Vicinity of the Rhumb Line Newport to Bermuda June 4, 2015**  
**An Analysis of Conditions**

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Over the past few days, since my last note (see GS Note #2), there have been very few substantive changes in Gulf Stream position or structure. Although cloud cover has often limited direct satellite observations there have been enough partial views which indicate that the large meander straddling the rhumb line remains in place and shows no tendency to migrate to the north and east (Fig. 1). This IR image of sea surface temperatures (SST) shows water temperatures increasing progressively with distance from Newport from approximately 55°F to more than 83°F in the main body of the Stream. The satellite image shows water temperatures increasing abruptly near the edge of the continental shelf well to the north of the main body of the Stream. This may be in part an artifact of the compositing process. However review of the instantaneous images shows similar patterns if slightly more gradual and not as extreme. Depending on the vertical extent of the warm water masses the associated differences in density between the inshore and offshore waters may be sufficient to produce some flows proceeding from the west to the east near the edge of the shelf. The warming may also have the potential to affect some local weather conditions outside of those forecast. Both factors should be considered in routing.

Proceeding to the south the SST provides no indication of the presence of warm core rings and shows the left hand limb of the meander clearly west of the rhumb line (Fig.1). The track to Bermuda crosses the northern edge of the main body of the Stream near 37°N or approximately 300 nm from Newport. The image suggests that one will be sailing in warm waters for nearly 180 nm before entering the Stream proper. It will be important to maintain a close watch on water temperatures throughout the passage.

The U.S. Navy analysis of Gulf Stream structure (Fig. 2) is essentially consistent with the satellite image except for the indication of warm core rings just off the edge of the continental shelf near 39°N 72°W. Position and size relative to the image provided in my Note #2 suggests that these features are slowly disintegrating due to friction as water depths decrease on approach to the shelf edge. They don't appear to be a factor in route planning.

The altimetry based model of circulation (Fig. 3) also shows a weak area of clockwise rotation consistent with warm core ring characteristics near 39°N 72°W. Of more significance however is the flow shown in the area to the north of the main body of the Stream (see red circled area – Fig.3) near the shelf edge and near the northern edge of the large patch of warm

water shown on the satellite SST image (Fig.1) and discussed above. These flows cross the rhumb line at a near right angle before proceeding to the north and east. Speeds should be in the range of 0.5-1.0kt sufficient to result in significant set to the east in light wind conditions. These flows as well as those shown to the east of the rhumb line favor a course to Bermuda that would track west of the rhumb line in this area.

A westerly track would also favor entrance to the main body of the Stream near 38°N 69° 30' W where flows proceed to the south and ultimately to the southeast (Fig.3). The altimetry based model suggests that entry further west, while possibly providing high speeds, could also result in some amount of westerly set adding significant distance to Bermuda. Maintenance of the more easterly track appears favored.

On the assumption that wind conditions permit taking full advantage of the south going currents along the inner edge of the meander the next area of concern is to the south near the bottom of the meander where the currents rotate from south going to easterlies and ultimately to north going and up along the eastern limb of the meander (see black circled area Fig.3). This area is often of particular concern during periods of light air due to the potential for strong easterly set or even entrainment sufficient to carry the boat across the rhumb line. Care must be exercised since this area requires crossing the entire main body of the stream, a distance of approximately 60 nm) with full potential for currents in excess of 5 kts.

Consideration of the above flow pattern clearly favors a course to the west of the rhumb line enroute Newport to Bermuda over at least the next few days and probably more if the rate of change observed over the past few weeks persists. Without consideration of what the winds will allow the track might take the form shown in Figure 4. Once clear of the direct influence of the Gulf Stream in the vicinity of 35° 40'N 67° 40' W there is little indication of organized clockwise or counterclockwise rotating flows except for one small area immediately north of Bermuda. This should have negligible impact on set and drift.

One last point. Although it's unlikely that this pattern will change significantly over the next few days to the Bermuda 1-2 start on the 5<sup>th</sup> it remains advisable for competitors to attempt acquisition of additional satellite and altimetry based model results right to the time of the start. It's possible that small changes in the structure of the meander sufficient to affect points of entry and departure may occur so it's always worth the effort for at least peace of mind.

Here's to a fine Race !!