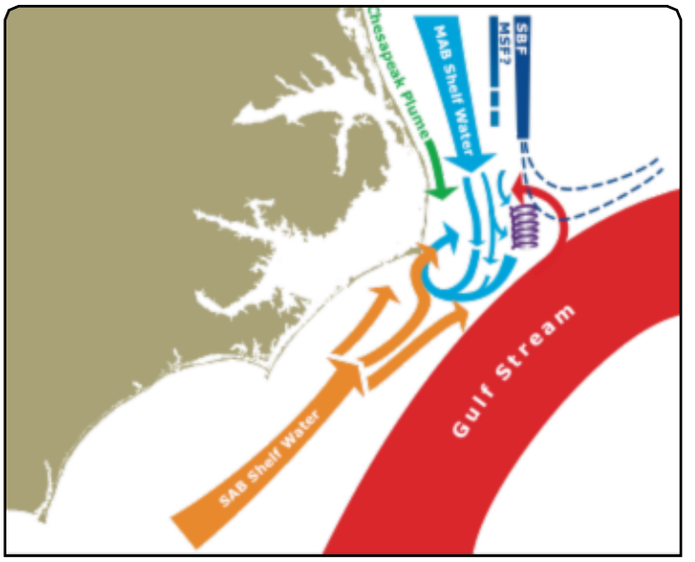
Gulf Stream Surprise: A Remarkable SeaSonde® - Observed Event

May 2015

We all know that the familiar Gulf Stream flows upward along the U.S. East Coast as induced by earth rotation – except when it doesn't. The normal picture is more complex.

It is described nicely in the schematic representing years of regional studies. The Gulf Stream is pushed outward by the protrusion of Cape Hatteras. Along the shelf from the north flows the colder Mid-Atlantic Bight (MAB) shelf water along Virginia and North Carolina. When countered by the weaker South Atlantic Bight (SAB) shelf waters and much stronger Gulf Stream toward the northeast, confusion reigns off the cape where things collide.

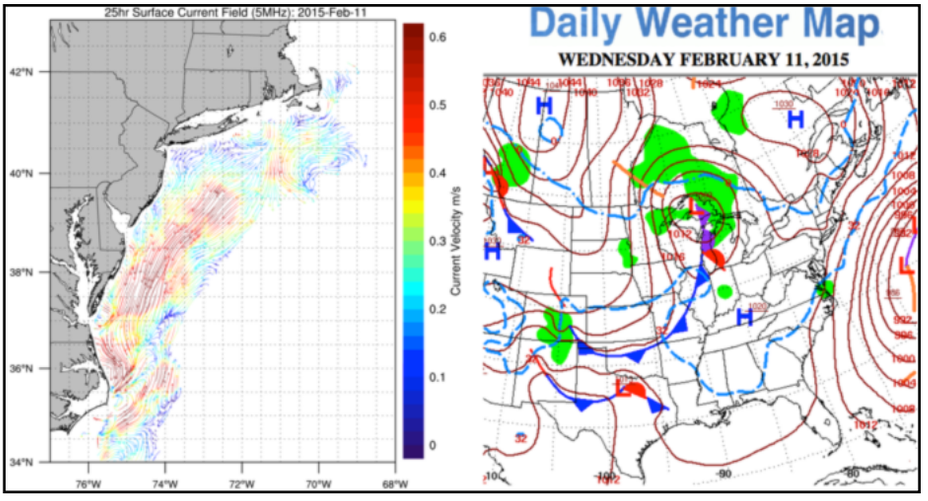


Explanations from M. Muglia of University of North Carolina are appreciated, including the "illustrated" sketch of typical flows attributed to D. Savidge and A. Boyette of Skidaway Institute of Oceanography.

But then occasionally, events occur to disrupt conventional wisdom, and this is one place where HF radar current maps prove their worth. One such event happened Feb. 11, 2015, when a very strong flow was seen in the Mid-Atlantic Regional Association Coastal Ocean Observing System (MARACOOS).

SeaSonde surface current map, shown next page top left. It lasted only a day. What caused this? Look at the National Weather Service map beside it for the answer. The unusual atmospheric pressure has a very low dip directly to the East (988 millibars), with a high of (1020 millibars) to the West. Notice the sharp gradient offshore where the currents are strongest; this bunching of the isobars directs an intense cyclonic wind down along the contours that exceeds 40 knots. This, in turn, drives the surface current to the south via wind stress, so it exceeds 60 cm/s on the surface (seen on the left), much stronger than the normal, lazy MAB cold-water shelf flow. That this is indeed the explanation (and not a coincidence) is attested by the fact that neither the strong current nor the intense pressure gradient was present either the day before or after this event. Also notice how the strong Gulf-Stream flow to the south of Hatteras shows up, pushing toward the northeast and colliding with the wind-driven jet, as the schematic above suggests.

Anything floating is transported by the surface flow. As seen, this kind of event can be very different from and much more transient than the more predictable geostrophic and tidal flows down deeper. But how would anyone have known, without the observations from coastal HF radars like the MARACOOS SeaSonde network? Surface currents are all important for vital oil spill as well as search-and-rescue operations, and especially useful for assimilating into numerical forecast models and simpler short-term predictive systems (STPS).



Current flows over the MARACOOS area of East Coast on Feb. 11, 2015, forwarded by H. Roarty of Rutgers University

Surface weather map from NOAA's National Weather Service on Feb. 11, 2015, with isobar contours showing atmospheric pressure that drives surface winds.