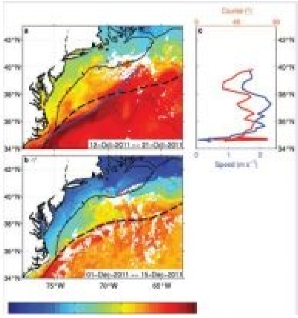
Gulf Stream Shift Identified



Scientists from Woods Hole Oceanographic Institute (WHOI, USA) have discovered that the Gulf Stream diverged well to the north of its normal path last year, causing the warmer-than-usual ocean temperatures along the New England continental shelf from late October 2011 onwards. The investigation began after local fishermen made physical oceanographers Glen Gawarkiewicz and Al Plueddemann aware of unusually high surface water temperatures and strong currents on the outer continental shelf south of New England in December 2011.

The researchers' findings, "Direct interaction between the Gulf Stream and the shelfbreak south of New England," were published in *Scientific Reports*.

To begin to unravel the mystery, Gawarkiewicz and his colleagues assembled data from a variety of sources and recreated a record of the Gulf Stream path during the fall of 2011. First, they tapped into data collected by a programme called eMOLT, a non-profit collaboration of fishing industry, research, academic and government entities, run by James Manning of National Oceanic and Atmospheric Administration's Northeast Fisheries Science Center. For more than a decade the programme has recorded near-bottom ocean temperatures by distributing temperature probes to lobstermen.

Manning and scientists from WHOI, including Robert Todd and Magdalena Andres, analysed a time series of temperatures from two eMOLT sites, OC01 and TA51, which were located over the outer continental shelf near the shelfbreak, and identified two events when temperatures suddenly increased by 6.2 and 6.7°C, respectively, to highs of more than 18°C. The maximum recorded temperature in December 2011 was the warmest bottom temperature recorded in 6 years of records at the OC01 site.

In typical years, the warm Gulf Stream waters only indirectly influence ocean currents and temperatures near the continental shelfbreak south of New England when eddies, called warm core rings, pinch off from the Gulf Stream and drift toward the outer continental shelf. Such rings normally drift past a site after a few weeks, and therefore cause only limited warming of the water on the outer shelf.

Gawarkiewicz and his colleagues collected additional data on water temperature and salinity from 4 December 2011 through 4 January 2012, from instruments on temporary test moorings placed 12km south of the shelfbreak by the Ocean Observatories Initiative (OOI). The researchers compared those salinity measurements to historical data, and discovered that high salinity levels – consistent with the salinity of waters carried by the Gulf Stream – coincided with the warming periods.

The extent and duration of the two 2011 warming events combined with the high salinity observed by the researchers suggested the cause was not a transient warm core ring, but the Gulf Stream itself that carried warm, salty water to the outer shelf.

To solidify that finding, Gawarkiewicz received serendipitous help from students in the Marine Advanced Technology Education (MATE) program at Cape Fear Community College in Wilmington, NC, who had deployed a surface drifter during the period coinciding with the two warming events. Drifters use satellites to transmit their positions roughly every six hours, key information for the WHOI scientists, who analysed the drifter tracks and speeds.

The periods of high speeds for the drifters coincided with the records for high temperatures on the outer shelf, which told the scientists that the core of the Gulf Stream had diverted to 39.9°N at 68°W – 125 miles north of its mean position, further north than had ever been recorded by satellite altimeters at this particular longitude.

It is unclear what might have caused this shift in the Gulf Stream path. It occurred shortly after Hurricanes Irene and Katia drenched the east coast with rain, and this might have impacted the Gulf Stream separation from the continental shelf near Cape Hatteras. Another possibility is that a cold core ring, an eddy south of the Gulf Stream core, might have deflected the Gulf Stream. Further research will be necessary to determine exactly how and why this occurred, which will be helpful in the long term in predicting Gulf Stream motions.

In the meantime, Gawarkiewicz and his colleagues will be keeping an eye on what the Gulf Stream does this fall, with the hope of someday being able to predict such a shift.