

# CURRENTS, HURRICANES, & MIXING IN THE GULF OF MEXICO

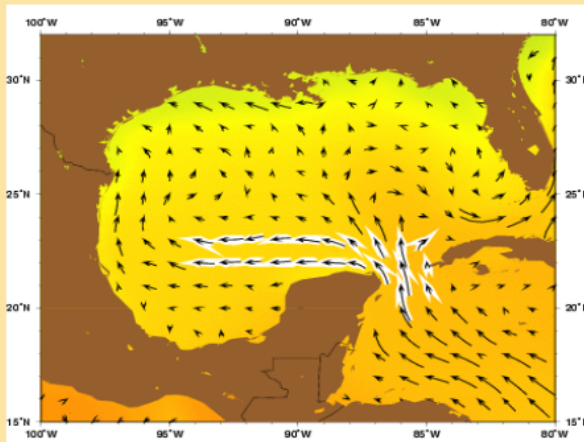
## TAKE HOME MESSAGE

The Yucatan Current and The Loop Current provide the majority of the warm seawater entering the Gulf of Mexico from the Caribbean. The Yucatan Current travels N. through the Straits of Yucatan and then West into the gulf. The Loop Current varies, but mainly travels N. through the Straits of Yucatan in the gulf, then loops back S. and E. out through the Straits of Florida. Occasionally, a Loop Eddy will break off from the Loop Current, circulating W. into the gulf with warm, deep water. Many strong hurricanes in the Gulf of Mexico in recent decades have been linked to Loop Eddies: the deep, warm water of the eddy creates a deep ocean mixed layer, the layer between the ocean's surface and cold, deep water, provides more fuel for hurricanes than a shallow mixed layer. The forces hurricanes exert on the surface of the ocean cause mixing, so if the mixed layer is shallow, cold water will reach the surface sooner. As climate changes creates conditions where hurricanes are stronger but occur less frequently in the gulf, the impacts on ocean mixing will also change.

## MAJOR CURRENTS OF THE GULF OF MEXICO <sup>1-5</sup>

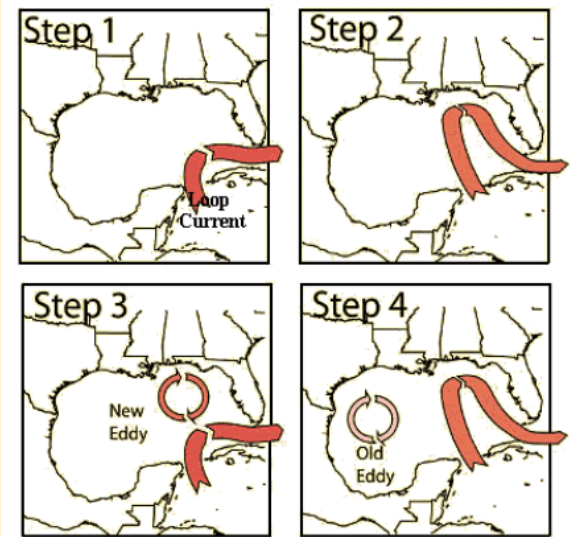
### THE YUCATAN CURRENT

The Yucatan Current is a current that flows from the warm Caribbean to the Gulf of Mexico through the space between the Yucatan Peninsula and Cuba, known as the Straits of Yucatan. The current passes through the straits and then travels predominantly westward. The Yucatan Current is strongest in the summer. The Yucatan is one of the main inflow sources to the gulf.



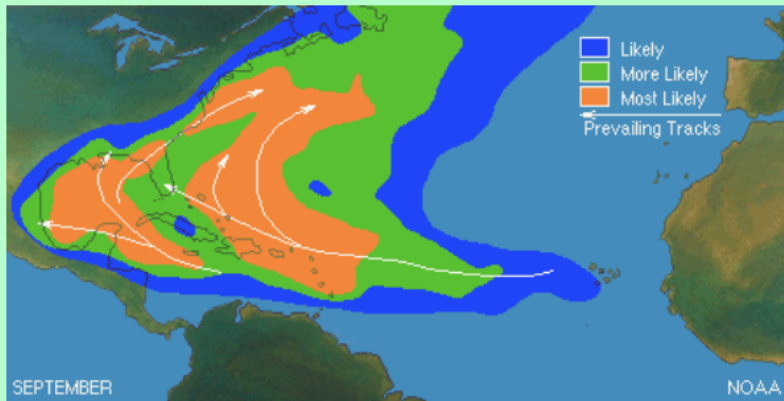
### THE LOOP CURRENT

The Loop Current is the second major current that transports water from the Caribbean into the Gulf of Mexico. Inflows from the channel between Florida and Cuba (the Straits of Florida) rarely occur, so the Loop and Yucatan Currents provide the majority of the warm seawater in the Gulf. The Loop Current's flow is variable: at times, it flows North through the Straits of Yucatan and then immediately East through the Straits of Florida. Other times, true to its name, it flows much farther North into the Gulf before looping back South and then East out the Straits of Florida. Arguably the most important feature of the Loop Current is the deep, warm eddies it releases off of the main body of the current, called Loop Eddies. These eddies break off from the Loop Current spinning in a clockwise direction, and travel west toward the coast of Texas and Mexico. These eddies can continue circulating for years after their first separation from the main current, and are important for two main reasons: first, these eddies travel over the Flower Garden Banks NMS, and are thought to have carried larvae of Caribbean reef species to the gulf to form the northernmost reefs in the continental U.S. Second, Loop Eddies play an important role in the generation and strengthening of hurricanes.



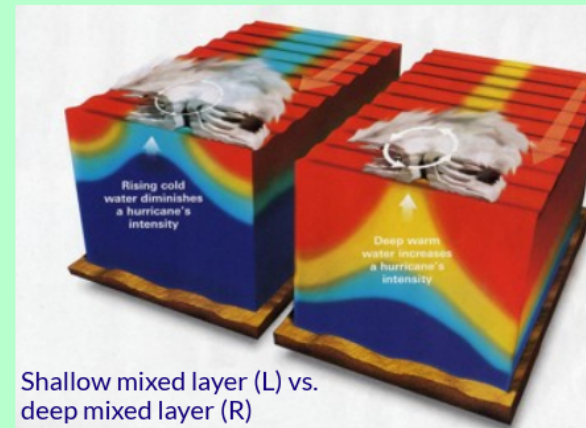
**WHERE DO HURRICANES FORM?**

Hurricane season in the Northern Hemisphere Atlantic Ocean is from June 1st to November 31st, when ocean temperatures are higher. Over the years of hurricane tracking and record-keeping, no hurricanes have originated from within 5 degrees of latitude from the equator, because Coriolis forces are too weak there to create the spin needed for a hurricane. In the middle of hurricane season, the warm Gulf of Mexico is a prime location for hurricane formation, as shown by this map of the average zones of origin and tracks of hurricanes during the month of September.



**LOOP EDDIES & THE MIXED LAYER**

In 1891, Isaac Cline, Chief Meteorologist of the Galveston, TX, U.S. Weather Bureau office, wrote an article dismissing the idea that any hurricane could ever hit Galveston. Cline believed that hurricanes would not be able to travel left to the West due to Coriolis forces in the Northern Hemisphere pushing wind patterns to the right. The Great Storm of 1900 proved this wrong, and the U.S. Gulf Coast has seen many strong storms since. Many of these hurricanes have been powered by Loop Eddies carrying deep, warm water into the gulf. The strength of Hurricanes Harvey and Katrina have both been attributed to these eddies. A deep mixed layer, the layer between the surface and the thermocline separating the warmer water of the mixed layer and cold water of the deep,

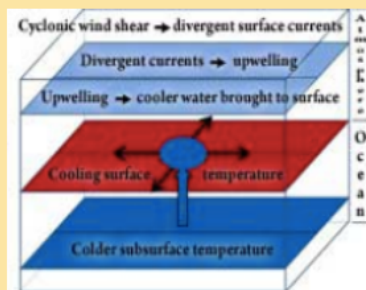
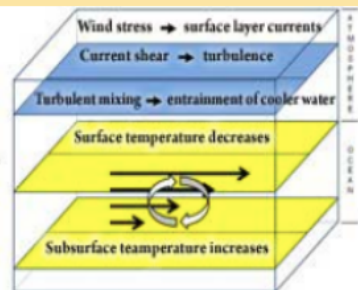


creates the perfect conditions for a hurricane. The forces that hurricanes exert on the surface of the ocean cause mixing, so if the mixed layer is shallow, colder water will reach the surface more quickly. If the mixed layer is deep, the hurricane's warm water fuel lasts longer. So when a deep, warm Loop Eddy breaks off from, it creates the perfect source to generate a hurricane or to strengthen an already existing hurricane.

**HURRICANES & OCEAN MIXING 11-13**

1. Hurricanes cause mixing from the turbulence and waves they create on the surface of the water.

2. Hurricanes also cause upwelling because of the divergent currents created by cyclonic wind stress.



**Will climate change lead to increased hurricanes and therefore increased mixing in the Gulf of Mexico?**

While research has shown that warmer SSTs will lead to more intense hurricanes sustained for longer periods of time, the frequency of hurricanes may actually decrease. These stronger hurricanes would cause more mixing, but this may occur less frequently than it does now.

**EDITORIAL NOTE <sup>14</sup>** >> The Gulf of Mexico is home to a phenomenon that occurs only 4 other places in the world: EEZ Donut Holes. This is the result of the lines that are drawn to mark the 200nm EEZ for two adjacent states leaving a space (or two) that cannot be claimed by either state but is completely surrounded by the EEZs of the two states.

# RESOURCES

## CONTENT

1. Natural Setting of the Flower Garden Banks National Marine Sanctuary. (n.d.). Retrieved February 2, 2019, from <https://flowergarden.noaa.gov/about/naturalsetting.html>
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## IMAGES

- Yucatan Current: same as #2
- Loop Current: same as #4
- Hurricane Origins and Tracks: same as #9
- Hurricanes & The Mixed Layer: same as #11
- Hurricanes & Ocean Mixing: same as #11
- Gulf of Mexico Donut Holes: Mexico and USA agree to talk about oil rights in the Gulf of Mexico's "Western Doughnut Hole". (n.d.). Retrieved February 2, 2019, from <http://geo-mexico.com/?p=1676>