Cuba oil spill: the scenarios

Numerous articles continue to be written about oil exploration off the coast of Cuba. Some federal officials, while discussing potential spill mitigation, claim that the swift currents of the Gulf Stream will protect South Florida by carrying most oil away before it could hit the beaches. Is this correct, or might a threat to South Florida's beaches exist, given a drilling mishap?

ROBERT H. WEISBERG

The Gulf Stream indeed is swift, but if it isolated Florida from Cuba, then how did so many Cuban rafters reach the shoreline between Miami and Palm Beach over the past 50 years? To address this and the potential for oil to reach the Florida coastline, it is important to consider the Gulf Stream in its entirety.

There are two primary components of flow. The first, driven by the large-scale winds over the Atlantic Ocean, is geostrophic. The second is driven by local winds. Neglecting eddies, the geostrophic part alone would tend to isolate Cuba from Florida because it would be difficult for surface oil picked up on the Cuban side of the Gulf Stream to traverse across the region of maximum speed to the Florida side. However, the local wind-driven part can achieve this.

The geostrophic part is a balance between two forces, the pressure difference across the Gulf Stream and the Coriolis force by the Earth's rotation. The result is a flow that nearly parallels the coastline. The local wind driven part is also a balance between two forces, the friction of the wind on the sea surface and the Coriolis force by the Earth's rotation. The result is a net transport of water directed to the right of the wind.

This Ekman transport, named after the discovering scientist, explains why sea level is higher than the normal high tide level on Florida's East Coast under northerly winds and lower than the normal high tide level under southerly winds. The reason is that water under the influence of northerly winds is driven toward Florida's East Coast. The converse occurs along Florida's West Coast. Thus flooding of low-lying areas on the East Coast tends to occur after the passage of strong weather fronts when the winds are northerly, whereas this tends to occur on the West Coast in advance of the front when the winds are southerly.

Given this conceptual discussion, it is possible to simulate the movement of oil that may be spilled on the surface using a computer model that contains these physics (geostrophic and Ekman motions). One particularly suited for the task is run by the Navy along with academic partners.

By downloading the modeled velocity fields and inserting virtual particles indicative of surface oil, my associates and I can track where the oil might go in time and space. For illustrative purposes, we used January 2012. Neutrally buoyant particles were distributed about an exploration site claimed to be 22 miles north of Havana, and new particles were seeded every three hours to mimic a continual release of oil.

Two examples are provided, one for a period of time when virtual particles encountered East Coast beaches about five to seven days after release, the other for a period of time when they did not. The differences are due to the local winds during these week-long simulation intervals.

Recognizing that weather fronts regularly transit the Florida peninsula, with southerlies on the leading side and northerlies on the trailing side, and that the interval between successive fronts is days to a week or so, we can expect that a prolonged spill would likely bring oil to South Florida beaches. Regardless of these simulations, simply recall the tar on South Florida beaches in the 1970s before the Clean Water Act restricted offshore bilge pumping.

Whereas a vibrant economy requires energy, risks are inherent to oil exploration and production. Such risks increase with deepwater drilling in swift currents, and the swift Gulf Stream regularly transits the deepwater region north of Cuba. It is unfortunate that we were unable to surmount the political and diplomatic issues pertaining to the present oil exploration in Cuban waters because once the oil potential was identified years ago, drilling was inevitable. Without readily achievable energy alternatives to hydrocarbons, other than nuclear, it is ever more important for the United States to adopt a sound energy policy.

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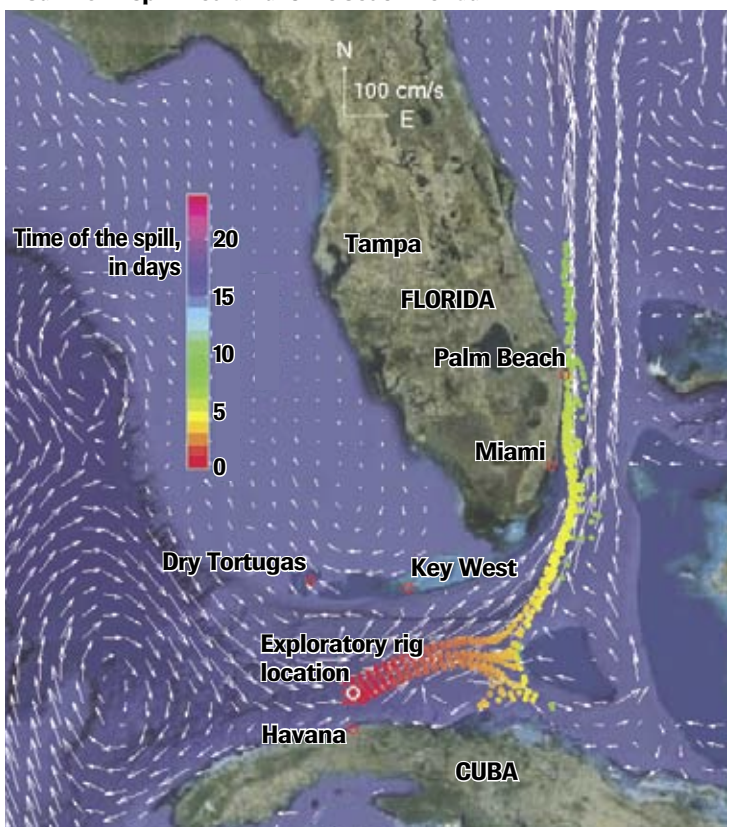
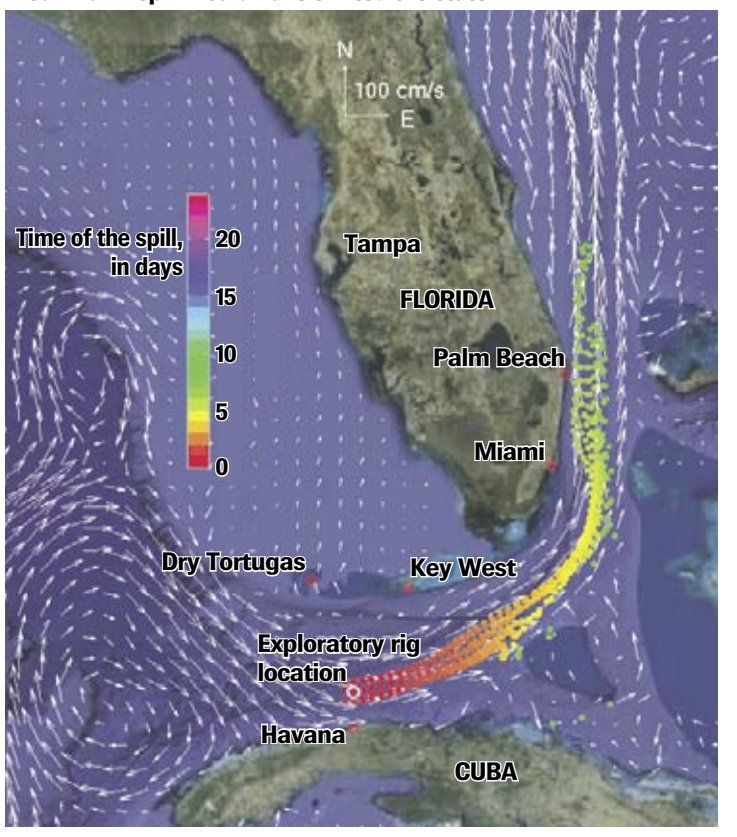
Would the Gulf Stream protect South Florida?

Cuba is exploring for oil off its shores. With that in mind, USF professor Robert H. Weisberg used computer models to track the path of a theoretical spill: Would the fast-moving Gulf Stream protect Florida? His model, using real-life conditions for two weeks last month, plots the trajectories of "virtual particles" from an oil exploration site 22 miles north of Havana. Each dot represents a particle seeded within the surface velocity field of a U.S. Navy global ocean circulation model. The color coding indicates the time in days after the particle was seeded near the exploration site. Thus, on the first map, showing Jan. 10-17, virtual particles would reach the Miami to Palm Beach coastline within five to six days. On the second map, Jan. 15-22, the spill skirts the coast. If a spill were long-lasting, the chances are great it would hit South Florida shores.

A Jan. 10-17 spill would have hit South Florida



A Jan. 15-22 spill would have skirted the state



Source: Robert H. Weisberg, USF

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