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Interactive comment on "Revisiting the DeepWater Horizon spill: High resolution model simulations of effects of oil droplet size distribution and river fronts" *by* Lars R. Hole et al.

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The goal of the article was to simulate the movement of the surface oil of the DWH on the water surface paying attention to the size distribution of droplets and the Mississippi River system. The article has many good contributions such as the comparison between various models for droplet formation and entrainment (Delvigne and Sweeney and Li et al 2017b,c). The OpenOil model seems promising. However, the writing of the article is poor and misleading, and I am not sure anyone could benefit from it, as the major findings are not supported by the needed explanation (for example what are floating droplets and what are submerged droplets?).

The article is too wordy. For example, the Introduction seems to focus on discussing

a couple papers related to the MR rather than providing a background for investigating the DWH spill in relation to existing works that modeled the DWH surface spill, such as the works of McFaddyen et al. (EOS, 2011) and Boufadel et al. (ES&T, 2014). In fact, only by comparing to such works that the authors can highlight their contributions. How do the results based on the more accurate HYCOM compare to results obtained using NCOM, NGOM, etc? The oil behavior appears to be an aftermath of the exercise, which is to highlight the role of the MR. One is led to wonder, what would be the fate of the oil if one assumes that the droplets are neutrally buoyant? What was the depth of mixing? In essence, there were too many things that the authors considered giving the impression that the article was put together hastily without a goal in mind. Detailed comments are below. "Next, the study showcases how NGoM oil pathways are influenced by river plume circulation and river induced fronts. We also investigate whether" It is preferable to stick to one tone of writing, either passive (the study discusses) or active (we investigate). Mixing the two is not common.

"As part of the efforts made by the National Oceanic and Atmospheric Administration (NOAA) to asses the extent and impact of the DWH spill, participants on this team analyzed hundreds of satellite images (microwave and optical) and produced oil extent delineations throughout the lifetime of the spill. Classifications derived from the satellite analysis of the DWH SOP can be accessed through the NOAA-ERMA website (ERM)."

Which team? The NOAA team or the authors? Also, why not writing that "we analyzed satellite images (microwave and optical) of the spill from the NOAA site ERMA" ? Why using such a wordy approach?

"The shapefiles were used for both initialization of the oil drift simulations and for verification of results."

By whom? By NOAA or by the current authors?

"For the present study, we performed two simulations: one with the attributes mentioned above, called Reference simulation, and one called No river, in which the salinity fronts have been removed by shutting off the river discharge, setting precipitation to zero, and turning off the assimilation of salinity profiles."

Please mention here in a sentence why the two choices were made. Assuming that one wants to evaluate the impact of the MR, how realistic would be to turn off the flow of the Mississippi? Wouldn't using the minimum flow be more realistic? Is the goal to conduct an academic exercise to evaluate the impact of the MR on the near shore hydrodynamics? If yes, then, this should be conducted only in a Monte Carlo framework as done by NOAA's Barker (EOS, 2011). Otherwise, the results and conclusions would be dependent on the hydrodynamic and climatological conditions during the DWH spill (i.e., not general).

"The physical mechanism behind this wind drift factor is not obvious, and is discussed in Jones et al. (2016)."

What was the summary from Jones et al. (2016)? The increase in oil drift is well understood for anyone who worked on transport. Based on simple momentum considerations, one could learn that anything that is on the top of the water surface (and has a smaller density) would move faster than the water beneath it if the wind is blowing (i.e., the whole idea of a sail boat !). Also, the fact that the oil viscosity is much higher than that of the water beneath it, makes the oil behaves locally as an "object". But if the authors have no idea why the oil moves faster than the water beneath it, I am not sure they should be conducting oil spill simulations using complicated models for evaporation, emulsification, dispersion, etc. Also, these processes were mentioned early on, and then were not discussed afterwards.

"According to our mass balance calculations for the DWH spill, using the Light Louisiana Sweet oil type from the NOAA oil library and environmental conditions as described above, it seems reasonable to assume that 80% of the oil mass is removed from the surface after 10 days. This is within the range in our simulations 30 that is typically 60 to 95% (see examples of mass balance plots further down). The simulations

for May 2010 are initialized by seeding 48730 super-particles in a polygon obtained from NOAA shapefiles. Each particle represents initially 1 m3 oil. A continuous point source at the sea floor seeds an additional 8460 particles (8460 m-3) per day during the simulation. After June 3rd these numbers are increased by 20% to 10368 m3 day-1."

The work by Boufadel et al. (2014, EST) specifically addressed this issue. See, for example, their Figure 2. They found that the oil disappears of the surface at around 20% per day. " The OpenOil simulation shown on top in Fig. 3 is carried out using the classical DS88 oil droplet size distribution (Delvigne and Sweeney, 1988)."

What was the thickness of the "Surface Layer" in the simulation? 1.0 m? 10.0 m? Obviously, this affects the meaning of concentration.

"Fig. 3 lower panel shows the results from repeating this simulation using the new Li17 formulation. In Fig. 7 we show the mass balance during seven days for 5 the Li17 simulation. There is virtually no difference between DS88 and Li17 and only the former is shown here."

Why discussing Figure SEVEN prior to Figures 4, 5, and 6? Should Figure 7 be made as Figure 4?

Table 2 provides oil deposited on the shorelines, and the amount needs to be compared with the work of Boufadel et al. (2014, ES&T).

How are the authors deciding what is on the surface and what is submerged? What was the cutoff depth? I find it unusual that they did not provide such information considering that GOMRI works including their own showed the importance of depth (on the order of centimeters) on the hydrodynamics.

"A realistic description of droplet formation is required to describe the effects of an oil spill on the environment"

True, but there is no citation for this statement.

“The parts of the oil spill at the surface is more hazardous to birds and the beach communities, while the small, submerged parts will have a substantially larger surface to 30 interact with water and plankton (Carroll et al., 2018).”

The authors cite a paper on the impact to the Northeast fisheries in spite of the HUGE amount of papers dealing with the DWH spill. It is pretty strange. Maybe they can start with the review by Short (2017, Archives of Environmental Contamination and Toxicology). Maybe they can peruse the GOMRI website?

“To the best of our knowledge, this is the first time the importance of the effect of river fronts on oil slick transport in the gulf has been demonstrated using high resolution models.”

The work of the authors themselves addressed the impact of the MR on coastal hydrodynamics. Kourafalou, V. H. and Androulidakis, Y. S.: Influence of Mississippi River induced circulation on the Deepwater Horizon oil spill transport, Journal of Geophysical Research: Oceans, 118, 3823–3842, 2013. Le Hénaff, M. and Kourafalou, V. H.: Mississippi waters reaching South Florida reefs under no flood conditions: synthesis of observing and modeling system findings, Ocean Dynamics, 66, 435–459, 2016.

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