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THE EFFECTS OF CRUDE OIL AND DISPERSANT TOXICITY ON MARINE PHYTOPLANKTON PRODUCTIVITY IN THE GULF OF MEXICO

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Abstract: The Deep Horizon oil spill incident on April 20, 2012 compromised the Gulf Coast's ecosystem and human health potentially through the marine food chain. One of the mitigation strategies to impede oil migration to the Gulf Coast's shorelines was to burn off crude oil. Crude oil combustion resulted in the production of polycyclic aromatic hydrocarbon (PAH) emissions such as, benzo[a]anthracene, benzo[a]pyrene, and benzo[b]fluoranthene compounds. Noticeable high deaths of marine animals and a decline in phytoplankton productivity have been linked to PAH- and dispersant-toxicity. Phytoplanktons play a pivotal role in natural ecosystems by functioning as biological pumps that sequester CO_2, by serving as a food source for marine animals, and by releasing high levels of O_2 into the environment. Chlorophyll *a* is an essential photosynthetic compound that facilitates CO_2 entrapment. We hypothesized that exposure to benzenoid PAHs and oil dispersants will have deleterious effects on phytoplankton productivity. In the present study, chlorophyll *a* (9 km mg/m^3) was used as an indicator to study phytoplankton productivity in the Gulf of Mexico, region 97W-82W, 25N-30N. This region includes the shorelines of Texas, Louisiana, Mississippi, Alabama, and Florida pan-handle in the Gulf of Mexico. We used NASA Giovanni data and spectral satellite images to examine phytoplankton productivity around coastal shorelines. Area-Averaged Time Series from Giovanni data portal indicated that June was the peak month for high concentrations of chlorophyll *a* from 2007 to 2012; demonstrating high phytoplankton productivity. Next, we examined chlorophyll *a* concentrations from the range of 0.08 to 30 9km mg/m^3 in the month of June for 2007 through 2012. Spectral images showed that the highest concentration, 9km 30 mg/m^3 chlorophyll *a* was and widely distributed around the shorelines of Louisiana, Mississippi, and Florida pan-handle from June 2007 to June 2008. In June 2009, there was a drastic decline in phytoplankton productivity at the 2.5 9km mg/m^3 chlorophyll *a* in the Florida pan-handle; however phytoplankton productivity remained constant (9km 30 mg/m^3) around Louisiana and Mississippi shorelines. In June 2010 and 2011, 9km 30 mg/m^3 chlorophyll *a* was highly distributed around Texas, Louisiana, and Mississippi; demonstrating high phytoplankton productivity in new locations. In June 2012, satellite images data showed a low concentration chlorophyll *a* of 10 9km mg/m^{3}around the shorelines of Texas, Louisiana, Mississippi, Alabama, and Florida pan-handle in the Gulf of Mexico; indicating a drastic decline in phytoplankton productivity. Low phytoplankton productivity is attributed to PAH- and dispersant-toxicity.

Key words: chlorophyll *a*, phytoplankton, dispersants, and polycyclic aromatic hydrocarbons.

Acknowledgements: This research was supported by a grant from NASA Innovations in Climate Education: Engaging Minority University STEM Education Professors in the Science of Climate Change through Elizabeth City State University and University of New Hampshire.