Environmental Studies Program: Ongoing Study

Study Area(s): Gulfwide

Administered By: Gulf of Mexico OCS Region

Title: Simulation Modeling of Ocean Circulation and Oil Spills in the Gulf of Mexico (NSL #GM-11-02)

BOEM Information Need(s) to be Addressed: This study will develop, validate, and implement an integrated, 3-D oil spill model which accurately simulates oil plume movement and fates in surface and subsurface waters of the Gulf of Mexico. Scenario runs will be conducted to inform BOEM oil spill risk assessment and contingency planning, as well as NEPA documents, on the range of possible spill outcomes.

Total BOEM Cost: $1,123,000 **Period of Performance:** FY 2011–2017

Conducting Organization(s): RPS-Applied Science Associates, Inc.

Principal Investigator(s): Jill Rowe (Jill.Rowe@rpsgroup.com)

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Description:

Background: The Department of Interior (DOI), specifically the Bureau of Ocean Energy Management (BOEM), invests in ocean research through the Environmental Studies Program to provide science in support of management decisions. An objective of the bureau's Oil Spill Modeling Program is to conduct research that will improve its estimates of oil-spill transport, fate, and impacts to the environment. To this end, numerous studies have previously been funded in the Gulf of Mexico to improve the understanding of the physical oceanography, oil-spill fates, and ecological impact processes in the region. Recent deepwater events in the Gulf of Mexico created a need for modeling efforts to simulate plume behavior in both surface and subsurface waters and to perform a variety of scenario runs to meet BOEM's various research and management objectives. It is essential for BOEM to simulate deep oil spills and their environmental impacts, so that it can fully understand what has happened in the past, learn from those events, and have better risk assessment and oil spill contingency plans in the future.

Objectives: The objective of this project is to develop and apply an integrated oil spill model that incorporates many of the processes which are unique to deep oil spills, with the ultimate goal of accurately simulating oil plume behavior at different depths in the water column. This modeling will incorporate the various processes responsible for oil transport and fate. In addition, model results will provide a variety of scenario runs exploring a range of outcomes from deep oil spills. An important aspect of the intended work will be comparison between model results and oil observations.

Methods: The objectives of this study are being met through development and application of an integrated oil spill model which simulates oil plume behavior as accurately as possible by incorporating the various environmental and chemical elements unique to deep spills. The study is developing an oil spill model, using an existing 3D ocean circulation model integrated into a 3D particles and concentrations model, which simulates oil plume transport and fate in the surface, sub-surface water column, and deposited in sediments and along shorelines. This modeling includes development of a new predictive blowout model. Model parameterization is incorporating oil attenuation and weathering processes, such as advection and dispersion, evaporation, settling, and degradation in water and sediments. An important component of the study is validation of the model with actual observations of plume transport and oil concentrations, including data from airplane overflights, satellite imagery, and water and sediment chemistry measurements. The integrated model is being applied to a series of scenario runs, which include, for example, changes in the spill release location and water depth, gas-to-oil ratio, oil type, subsurface dispersant application, and environmental conditions (wind and currents).

Current Status: Final development to the model interface, model engine and post processor were completed in March, 2015. The stochastic model scenarios runs were completed in June, 2016. The delivery of the current model version and model system training occurred at BOEM HQ during October 11-13, 2016. The draft Synthesis Report and appendices were delivered, including: Model System User Manual, Oil Fates Model Technical Manual, Blowout Model Technical Manual, Model Use Strategy, Data Manual, and Data Collection, Analysis, and Model Validation. The draft Synthesis Report is currently in the editorial review process.

Final Report Due: August 1, 2017

Publications Completed:

McCay, D. F., Li, Z., Horn, M., Crowley, D., Spaulding, M., Mendelsohn, D., & Turner, C. (2016), Modeling Oil Fate and Subsurface Exposure Concentrations from the Deepwater Horizon Oil Spill. In Proceedings of the 39th AMOP Technical Seminar on Environmental Contamination and Response, Emergencies Science Division, Environment Canada, Ottawa, ON, Canada (pp. 115-150).

Li, Z., Spaulding, M. L., & French-McCay, D. (2017), An algorithm for modeling entrainment and naturally and chemically dispersed oil droplet size distribution under surface breaking wave conditions. Marine Pollution Bulletin, 119(1), 145-152.

Spaulding, M., C. Galagan, L. McStay, T. Isaji, D. Stuebe, R. Green (2014), Use of Ensemble Based Methods for Oil Spill Risk Assessment Investigations, Paper for 37th AMOP Technical Seminar on Environmental Contamination and Response.

Spaulding, M. (2017), State of the art review and future directions in oil spill modeling, Marine Pollution Bulletin, http://dx.doi.org/10.1016/j.marpolbul.2017.01.001.

Affiliated WWW Sites:

https://marinecadastre.gov/espis/#/search/study/100032

Revised Date: February 14, 2018