Gulf of Mexico Integrated Spill Response Consortium (GISR)

The scale of the Deepwater Horizon accident was unprecedented for an oil spill and highlighted a critical need to understand the important processes affecting fate and transport of petroleum fluids over the wide range of scales from the wellhead to the beach in the Gulf of Mexico and to assess the benefits of potential spill response activities. Evaluating the mechanisms controlling fate and transport of oil in the Gulf of Mexico through laboratory, field, and numerical experiments is the focus of this consortium proposal.

The Vision of the Gulf Integrated Spill Response Consortium (GISR) is to understand and predict the fundamental behavior of petroleum fluids in the ocean environment. This capability is critical to inform decisions during response to oil spills and for development of mitigation plans, ultimately yielding significant environmental and financial savings. The Mission of this consortium is to develop a multi-scale modeling system validated by field and laboratory experiments to track the pathways of transforming hydrocarbons released from deep oil spills in the Gulf of Mexico. Our approach will be to conduct a multi-scale suite of field and laboratory experiments that target critical deficiencies in our understanding of the physical, chemical, and biological behavior of petroleum fluids as they transit the Gulf from a deep oil spill to the beach, marsh, estuary, or atmosphere, and to.synthesize this understanding through the application of a validated, multi-scale numerical model of petroleum fate and transport in the Gulf.

The overarching outcome of GISR will be the validated set of numerical models. This output corresponds jointly to GRI Theme 1 (Oil and gas transport) and Theme 2 (Transformation) since these models must accurately account for the behavior of petroleum fluids from the well-head to the beach. Because the current state of knowledge of the fate and transport of oil and gas in the ocean environment is incomplete, GISR will also conduct a multi-scale suite of field and laboratory experiments to elucidate the fundamental behavior of petroleum hydrocarbons in the oceans. This project will achieve the primary mission of GISR by pursuing the following specific objectives:
1. Build a multi-scale modeling system for fate and transport of oil in the Gulf of Mexico.
2. Validate and improve models using data from the Deepwater Horizon accident and new experiments.

The multi-scale modeling system is a nested suite of models including (at increasing levels of resolution) a coupled ocean-atmosphere model of the full Gulf of Mexico and North Atlantic Ocean, a deep Gulf of Mexico model, a regional model of the Texas-Louisiana shelf, a 3D, non-hydrostatic bay model, a 3D Navier-Stokes model of the spill plume, and a particle tracking and transformation model for dispersed and dissolved oil and gas fate and transport integrated within the full flow domain. Experiments are planned for the laboratory and the field to investigate local processes occurring near deepwater accidental blowouts. These will focus on areas of uncertainty in the models, including bubble and droplet formation with and without dispersant application, dissolution, droplet-turbulence interaction, and evaporation with associated air quality.
assessment. Ultimately, these activities serve to close the gaps necessary to manage future oil spills and to responsibly continue deepwater oil exploration.

Spill management options must balance methods that reduce shoreline impact with the tradeoff of possible generation of hypoxic regions in deep waters. This balance requires the ability to predict shore-ward transport and subsurface fractionation and biodegradation of spilled oil and gas. The activities proposed by GISR will yield considerable insight on these processes with the goal to validate a multi-scale suite of numerical tools for oil spill modeling. The work will also benefit the physical, chemical and biological oceanography of the Gulf of Mexico through the collection of new field data on large-scale circulation in the Gulf. In addition to these science outcomes, the tools developed here will benefit society by greatly improving our ability to anticipate and mitigate the impacts of future spills. Moreover, the system will quantify human health risk to oil spills and test the efficacy of mitigation strategies by accurately predicting the fractionation of oil and gas among surface, subsurface, and atmospheric exposure pathways. Ultimately, these activities serve to close the gaps necessary to improve the response to future oil spills and to responsibly continue deepwater oil development and exploration.