# Scenarios and Responses to Future Deep Oil Spills

Steven A. Murawski • Cameron H. Ainsworth
Sherryl Gilbert • David J. Hollander
Claire B. Paris • Michael Schlüter
Dana L. Wetzel
Editors

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## Fighting the Next War

Springer

*Editors*
Steven A. Murawski
College of Marine Science
University of South Florida
St. Petersburg, FL, USA

Cameron H. Ainsworth
College of Marine Science
University of South Florida
St. Petersburg, FL, USA

Sherryl Gilbert
College of Marine Science
University of South Florida
St. Petersburg, FL, USA

David J. Hollander
College of Marine Science
University of South Florida
St. Petersburg, FL, USA

Claire B. Paris
Rosenstiel School of Marine
& Atmospheric Science
University of Miami
Miami, FL, USA

Michael Schlüter
Hamburg University of Technology
Hamburg, Germany

Dana L. Wetzel
Mote Marine Laboratory
Sarasota, FL, USA

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# Foreword and Dedication

Global production of liquid fossil hydrocarbons was 34 billion barrels in 2017,[1] with production increasing an average 1.1% per year during the preceding decade (BP 2018). Maintaining and increasing production now involves expansion into "frontier" areas including nontraditional terrestrial and aquatic realms. Marine oil exploration and production has advanced steadily offshore since its inception in the Gulf of Mexico in the 1930s (Murawski et al. 2020). For the first time, in 2017, more crude oil was generated from ultra-deep (>1 mile deep) waters of the Gulf of Mexico than in shallower waters (Murawski et al. 2020). This trend to deeper production is occurring in all major marine oil provinces of the world.

The *Deepwater Horizon* (DWH) oil spill was the world's first ultra-deep well blowout, but likely not the last. Deep well fields in the Gulf of Mexico now extend to depths nearly twice that of DWH. Ultra-deep wells present unique technical and environmental challenges. Because of the immense depths and pressures, ultra-deep wells are more complex, risk-prone, and expensive to construct and maintain as compared to equivalent shallower facilities. Notwithstanding these issues, and depending on the price of oil, the volumes of oil produced at ultra-deep wells can be enormously profitable, yielding many times the production rates of those inshore (Murawski et al. 2020).

The purposes of this book are to synthesize relevant science related to potential oil spills in frontier marine domains and to project the fate and impacts of simulated ultra-deep blowouts. No two spills are alike, and the conditions of the next ultra-deep well blowout will be different from both the DWH and the shallower Ixtoc 1 experiences. Prior to DWH, response planning for marine oil spills primarily assumed a scenario similar to the last major marine oil spill in the United States – the *Exxon Valdez* tanker accident in Alaska. Thus, responders were generally unprepared for the scenario of a deep and unconstrained well blowout in terms of infrastructure and basic science to reasonably inform the use of novel response measures.

[1] One stock tank barrel = 42 gallons = 158 l; includes crude oil, shale oil, oil sands, and NGLs (natural gas liquids, the liquid content of natural gas where this is recovered separately)

Rather than concentrating on unresolved issues remaining post-DWH, we simulate spills in the Gulf of Mexico regions where oil and gas exploration and production may in the future occur (e.g., deep water in the eastern, western, and southern Gulf). Likewise, we consider spills in other frontier areas (e.g., off West Africa and in the Arctic). These location-specific simulations of oil fates and their relative impacts on ecological communities and economic activities (fishing) differ from the DWH scenario in fundamental and important ways. Under alternative conditions of oil type, gas/oil ratios, water depth, etc., oil fate and effects will vary still. The point of these simulations, and the importance of closing existing research gaps, is that conditions will be different and therefore response strategies must be nimble to effectively deal with the next ultra-deep oil well blowout, pipeline rupture, tanker-platform collision, industrial sabotage incident, or whatever the scenario may be. Assuming a replay of DWH will surely repeat the cycle of anticipating the next "war" by preparing for the last. Having a fuller repertoire of science applicable to a wide array of idiosyncratic conditions is the key to anticipating and effectively responding to the next spill of significance.

Despite the nearly $1 billion spent on relevant science since the DWH accident, there remain a number of critical science gaps that preclude consensus on best options to prevent or at least more efficiently respond to the next major spill. A short list of recommended science priorities and policy options is discussed. Nevertheless, there will always be uncertainty concerning the physics, chemistry, geology, and ecology associated with particular ultra-deep well blowouts. Perhaps as important to closing the science gaps that remain, identifying the attributes of locations that are too risk-prone or too ecologically or economically sensitive to permit oil exploration and production should be a priority. Should all frontier areas where oil and gas resources are technically feasible to recover be produced? This is the domain of policy, and informing the consequences of policy choices is the province of environmental science as characterized in the chapters that follow.

Much of the science synthesized in this volume was a result of support and funding from the Gulf of Mexico Research Initiative (GoMRI). The GoMRI enterprise was funded through a $500 million grant established in the wake of the DWH accident. Many of the authors and all of the coeditors of this book are members of the Center for Integrated Modeling and Analysis of Gulf Ecosystems (C-IMAGE), one of the several research centers supported by GoMRI. Authorship of this volume also includes contributions by members of other GoMRI-funded centers, as well as those from government, academic, and private research organizations. We are deeply grateful to the leadership, staff, and research board of GoMRI for supporting these efforts to better understand the science of deep oil spills and to synthesize that science into actionable alternatives to inform government and industry.

This volume is dedicated to the 11 men who lost their lives aboard the MODU (Mobile Offshore Drilling Unit) *Deepwater Horizon* on April 20, 2010:

Jason C. Anderson, age 35
Aaron Dale Burkeen, age 37
Donald Clark, age 49
Stephen Ray Curtis, age 39
Gordon L. Jones, age 28
Roy Wyatt Kemp, age 27
Karl D. Kleppinger, Jr., age 38
Keith Blair Manuel, age 56
Dewey A. Revette, age 48
Shane M. Roshto, age 22
Adam Weise, age 24

The work described herein has been undertaken with the goal of preventing such accidents from ever happening again and reducing risks to the environment and people should they reoccur. In this way, we honor those whose lives were lost that they helped stimulate national and international action to make marine oil and gas production safer. The families of those who lost their lives in the *Deepwater Horizon* accident expect and deserve nothing less.

St. Petersburg, FL, USA Steven A. Murawski
St. Petersburg, FL, USA Cameron H. Ainsworth
St. Petersburg, FL, USA Sherryl Gilbert
St. Petersburg, FL, USA David J. Hollander
Miami, FL, USA Claire B. Paris
Hamburg, Germany Michael Schlüter
Sarasota, FL, USA Dana L. Wetzel

## References

BP (2018) BP Statistical Review of World Energy. 67th edn 25 pp. https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2018-full-report.pdf

Murawski SA, Hollander DJ, Gilbert S, Gracia A (2020) Deep-water oil and gas production in the Gulf of Mexico, and related global trends (Chap. 2). In: Murawski SA, Ainsworth C, Gilbert S, Hollander D, Paris CB, Schlüter M, Wetzel D (eds) Scenarios and responses to future Deep Oil Spills – fighting the next war. Springer, Cham

The C-IMAGE research consortium, January 2014, Mobile, Alabama

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