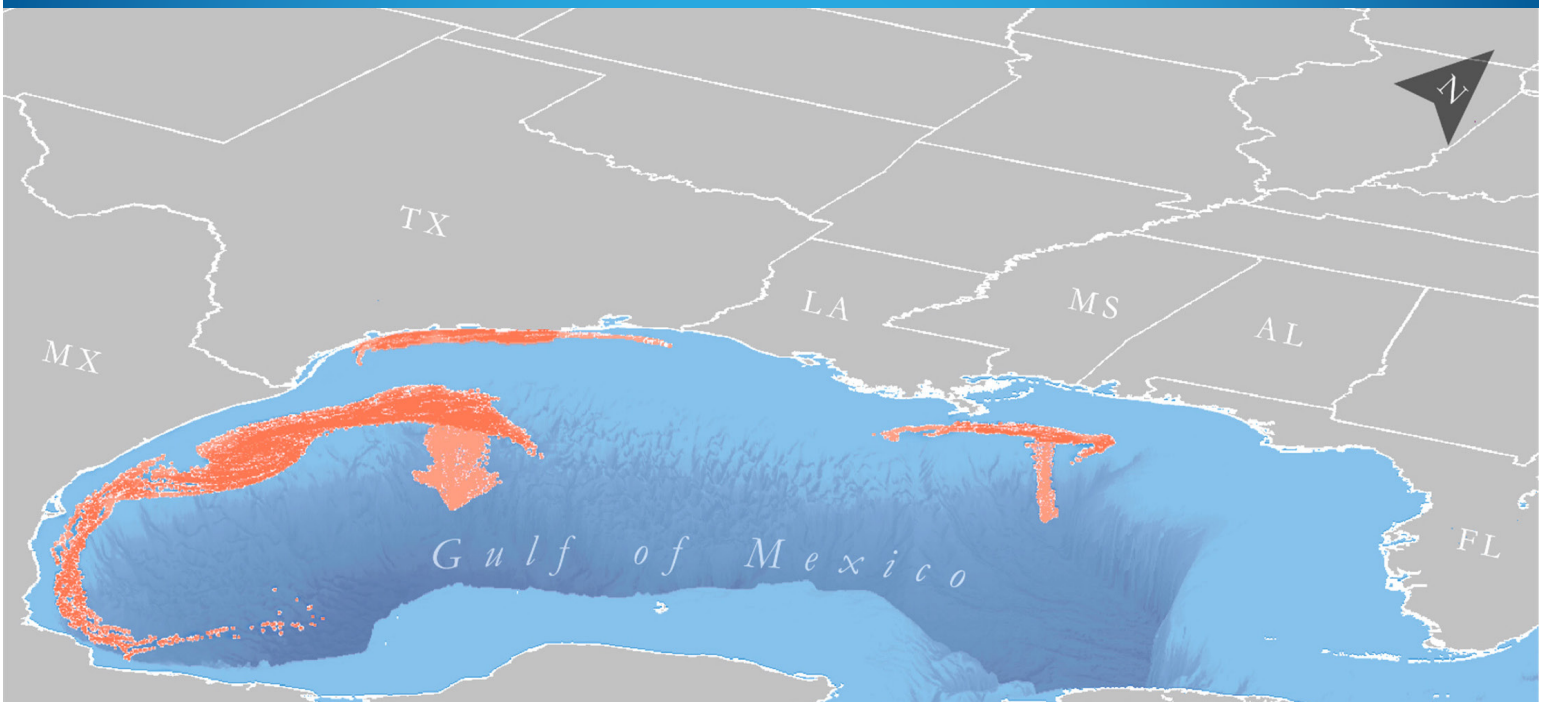
NETL'S BLOWOUT AND SPILL OCCURRENCE MODEL (BLOSOM)



NETL

NATIONAL ENERGY TECHNOLOGY LABORATORY

BACKGROUND

The NETL has created an integrated data and modeling system to support DOE's objective to produce science-based evaluations of engineered and natural systems to ensure sustainable, environmentally responsible access to domestic resources, and to mitigate the risk of hydrocarbon spills. The Blowout and Spill Occurrence Model (BLOSOM) is an integrated system designed to simulate offshore oil spills resulting from deepwater (>500 feet) and ultra-deepwater (>5,000 feet) well blowouts. BLOSOM assists with risk assessment and is key to our overall efforts to prevent future hydrocarbon spills. In addition, BLOSOM serves as a comprehensive tool for response planning. BLOSOM is part of the NETL's broader integrated risk assessment and spill prevention research effort in the Offshore Energy Resources research portfolio, which is focused on developing a scientific basis for reducing and quantifying potential risks associated with exploration and production in extreme offshore environments.

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This research supports NETL's Geological & Environmental Systems competency.

R&D193, August 2022

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PROJECT DESCRIPTION

BLOSOM offers a flexible suite of modeling modules designed to work together as a single system to assess the multiple environmental uncertainties associated with deepwater and ultra-deepwater environments, blowouts, and spills. All components are designed to be explicitly three dimensional and use equations best suited for high-pressure environments while maintaining the flexibility to operate with limited or highly uncertain data.

BLOSOM incorporates into one tool the capabilities of several modules:

- Jet/Plume Module simulates the initial oil and gas jet rising from the wellhead during an underwater blowout discharge. This module tracks the blowout's physical properties, including the crude oil, gases, and water within a conceptual control volume, until it reaches a terminal level at which point the plume is converted into individual oil particles.
- Conversion Module transfers elements from the Jet/Plume and Transport modules and amalgamates the two contrasting approaches in each, while converting control volumes of mixed fluids into particles. This model also appropriately distributes oil droplet sizes to best capture subsurface plume formation, optionally simulating the direct application of dispersants at the source of the blowout (a practiced impact mitigation technique).
- Transport Module simulates the long-term fate and transport of the spill. Beaching and sinking events are also monitored. Surface spills can be simulated using the Transport Module.
- Dispersant Module optionally partitions the active oil into two proportions of oil: that which has been exposed to dispersants, and that which has yet to be affected. The methodologies used to determine when and where

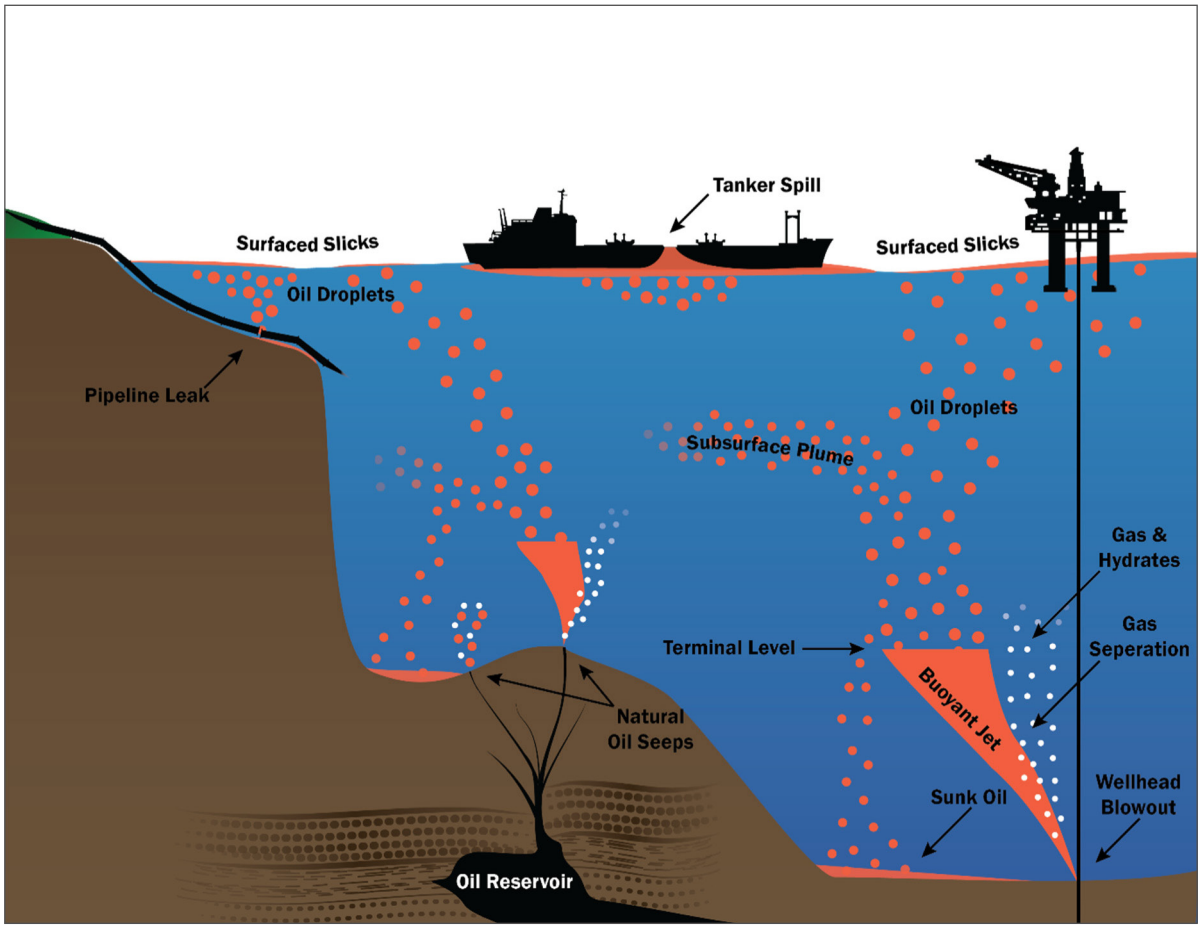

FIGURE 1. A hypothetical marine cross-section displaying BLOSOMs capabilities, including the simulation of uncontrolled hydrocarbon release events, such as surface spills and subsurface blowouts, throughout the water column.

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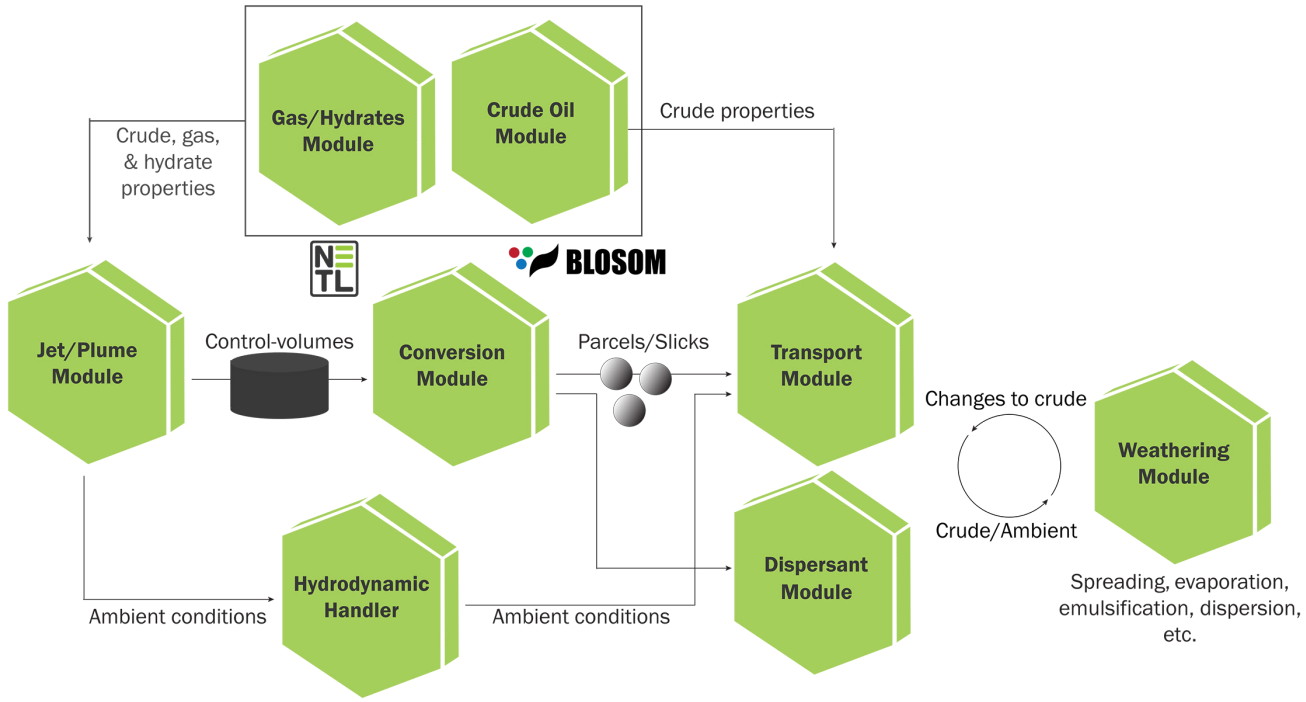

FIGURE 2. Interaction diagram of BLOSOM's simulated processing modules.

dispersant is applied in the simulation will become more refined as development of BLOSOM progresses.

- Weathering Module simulates oil weathering and degradation processes, including spreading, evaporation, emulsification, and dispersion. Other processes, such as biodegradation, dissolution, photolysis, sedimentation, and surface application of dispersants are planned for future incorporation.
- Crude Oil Module simulates changes to the oil's physical and chemical properties in high-pressure environments like the deep ocean. This module also simulates changes to the oil due to degradation using a pseudo-components approach. The components may be built with detailed crude information or interpolated from more readily obtainable crude assay data.
- Gas/Hydrates Module simulates gas properties, dissolution, and the formation and decomposition of hydrates for a variety of gases that may be present in an oil or gas well blowout.
- Hydrodynamic Handler handles ocean data for use in the other modules and is capable of providing its own correlations and interpolations from the available data. It is designed to be flexible with multiple file formats and output types.

This comprehensive suite of tools is designed to track an oil spill anywhere in the water column and follow the fate of the hydrocarbon until beaching, sinking, or complete degradation.

ACTIVITIES

In 2014, BLOSOM participated in a model inter-comparison study on plume dynamics and droplet sizes, particularly in the presence of dispersants. The effort evaluated a wide variety of blowout modelers to determine the strengths of each model and identify areas of larger uncertainties.[1]

As of 2017 BLOSOM is being integrated into a web-accessible common operating platform (COP), which will allow a number of simulation tools to be run in combination with one another to assist with oil spill prevention activities. Other existing NETL risk assessment tools to be incorporated with the COP include Spatially Weighted Impact Model (SWIM), Cumulative Spatial Impact Layers (CSIL), and Variable Grid Method (VGM).

BENEFITS

BLOSOM complements NETL's existing Offshore capabilities, enhances several other NETL oil spill risk assessment tools, and aids in risk assessment and response planning in deepwater and ultra-deepwater conditions. Ultimately, BLOSOM helps to predict, assess, and prevent well blowouts in these challenging environments.

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www.NETL.DOE.gov

ENERGY DATA EXCHANGE

Energy Data eXchange (EDX) is NETL's online collection of data and tools, including the BLOSOM website. EDX contains information on the tools' backgrounds, relevant resources, publications, presentations, and tutorials. In addition, the BLOSOM EDX website provides news and media sources that have featured BLOSOM, including E&P Magazine and Offshore Technology Focus.

For more information on BLOSOM's background, capabilities, and accomplishments, check out the BLOSOM EDX page using the URL or QR Code below.

NETL is a U.S. Department of Energy national laboratory that drives innovation and delivers technological solutions for an environmentally sustainable and prosperous energy future. Through its world-class scientists, engineers and research facilities, NETL is ensuring affordable, abundant and reliable energy that drives a robust economy and national security, while developing technologies to manage carbon across the full life cycle, enabling environmental sustainability for all Americans, advancing environmental justice and revitalizing the economies of disadvantaged communities. Leveraging the power of workforce inclusivity and diversity, highly skilled innovators at NETL's research laboratories in Albany, Oregon; Morgantown, West Virginia; and Pittsburgh, Pennsylvania conduct a broad range of research activities that support DOE's mission to ensure America's security and prosperity by addressing its energy and environmental challenges through transformative science and technology solutions.

edx.netl.doe.gov/blosom/

[1] This work was published in a paper, "Intercomparison of Oil Spill Prediction Models for Accidental Blowout Scenarios with and without Subsea Chemical Dispersant Injection." Marine Pollution Bulletin 2015, 96, 110–126.

Partners

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