

Advances in deep-sea blowout modeling and key technical challenges for improving predictions and mitigation

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Full 3-dimension spatial computation of [HnCn]



[Perlin and Paris, t.b.s.]

Two models approach: Near-Field & Far-Field



Coupled Near-Field Far-Field operational approach







Advanced compute systems

with integrated input/output data storage become critical for mass flux and hydrocarbons concentration computations for each droplet "type" (chemophysical properties, treated or untreated) at each time step





Coupled Near-Far Fields Algorithms

Appropriate discretization of HC components to accurately capture gas solubility of "live oil" and it phase behavior Accurate phase density **developing different EOS for the thermophysical live-oil behavior over a T/P range,** tested against phase behavior measurements in the lab Laboratory **validation for the scaling of water-oil IFT models**

Adapt probabilistic model post-processing and optimize algorithm

- Hot spots of oil mass for **first response** efforts
- Low concentrations of PAHs for **toxicity studies**
- •Faster computing capacities and high speed data storage







Variation in ε Across Crude Oil Experiments



ε_{max} (m²/s³)

TDR may better unify experimental length scales (cm to km)

- Data collected with different oils, unsaturated
- Up to 50% variation in thermophysical properties

[Aman et al., In Prep.] 9

Areas for Technological Advancements

Better Model Parameterization from Lab Experiments

- •Droplet Size Distribution (DSD):
 - *in situ* observations of changes as they rise for treated and untreated oil,
 - •Energy dissipation rates, degassing
- T/P biodegradation of untreated and treated oil
- oil partition behavior and influence of dispersants
- Influence of **hydrate formation** and local turbulent kinetic energy by high pressure sapphire autoclave

In situ Sampling Technology

- Measure deep current, vertical velocity and turbulent diffusion
- Discriminate dissolved surfactant from oil-bonded surfactant
- Water column sampling at the leading edge fo the modeled oil plume and observed surface slicks and rapid analysis (within 24 hours)

Validation: In situ sampling - BP Gulf Science Data





[Berenshtein et al., In Prep.]

[Trillo et al., in review.]





Modeling "treated" oil transport and fate during Subsea dispersant injection (SSDI)



[National Geographic, Oct 2010]



Nature Reviews | Microbiology

[Joye et al. 2015 Nature Reviews]