Offshore Integrated Assessment Modeling (IAM) -
Spill prevention, rapid response & risk reduction

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https://edx.netl.doe.gov/offshore
NRAP & CCSI – Developing a common predictive approach that facilitates uncertainty & risk quantification; leveraged into toolset

- Predict Component Performance
- Predict System Performance
- Control/Verify System Performance

Detailed Models for Components
- Leverage multiple research & commercial codes
- Validate using lab and field data

Reduced Order Models
- Develop lookup tables & response surfaces (PSUADE); surrogate models (NRAP only)
- Validate relative to detailed models

Integration via System Models
- Produce common system models and platform
- Quantify uncertainty

Monitoring for Verification & Control
Approach for Assessing Spatial Trends & Potential Risks with UCR Systems

Developing & demonstrating a flexible, customizable approach for use by scientists, policy makers & regulators to:

- Identify knowledge gaps, uncertainty
- Identify areas where a single variable may increase or decrease risk of impacts
- Identify areas where cumulative variables increase or decrease risk of impacts

Near Surface System: Groundwater wells

Potential Fluid Migration Pathways: natural and stimulated

Target Reservoir Interval

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Programmatic Goal: Develop a scientific base for predicting and quantifying potential risks associated with exploration and production in offshore environments.

Project Goal: Develop integrated tool & platform to support prediction of potential risks and rapid response needs associated with deep offshore hydrocarbon development in the GOM. Produce analyses and report on spatial/ temporal risks via maps and publications.

Schematic representation of offshore spill risk profile

% of recorded spills & drilling phase in the GOM & North Sea

-Source: SINTEF Database

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Offshore IAM Needs:

Award winning researchers focused on reducing risks & impacts associated with offshore hydrocarbon development

Spill Prevention & Risk Reduction Project
Targets Key Knowledge & Technology Gaps with Offshore Hydrocarbon E&P

1. Need a one-stop shop for data/inputs spanning subsurface to shore
   - Needed for numerical simulations & assessments
   - Coordinated with the BOEM-NOAA-UNH Erma tool

2. Need for advanced geospatial/statistical approaches for predictions

3. Need for an open-source, adaptable modeling suite for subsurface flow, and water column flow from the subsurface to the shore

4. Need for a secure, coordinated system for inter-agency/entity assessments and evaluations

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A comprehensive modeling suite for offshore blowout events, adapted for jet/plume behavior, high pressures, gas and hydrate dynamics, droplet-size distributions, and subsurface plume formation.

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Reducing Uncertainty - Subsurface Databook

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Reducing Subsurface Uncertainty

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Reducing Subsurface Uncertainty

Geospatial analyses & geostatistical predictions of subsurface properties
NETL’s Subsurface Trend Approach
Geospatial Analytical Approach for Reducing Subsurface Uncertainty

**Goal**, offer higher resolution insights about subsurface reservoir attributes such as porosity, permeability, temperature, depth etc.

Subsurface Trend Analysis helps develop a scientific base for predicting and quantifying potential risks associated with exploration and production.

Mark-Moser, M., Rose, K., Bauer, J., Disenhof, C., and Miller, R., in prep, Geospatial Trends of Hydrocarbon Accumulations in the Deepwater\Ultra-deepwater Gulf of Mexico, Journal of Marine Petroleum Geology (or the new AAPG/SEG journal Interpretation)
Reducing Subsurface Uncertainty

NETL Geospatial Analytical Approach

- Current working domains are a combination of two of Galloway’s structural and depositional domain maps
- Reduces size of domains while preserving a domain’s relationship to its geologic characteristics
  - Ties domains to spatial & temporal autocorrelative relationships
- Inputs leveraging BOEM’s publically available reservoir data & NETL’s interpretations

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Given Knowledge at these locations

Infer something at this location

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Roger’s talk...
Example of Future Work:

Integrating GOM IAM work for Subsurface Materials Risk Assessment

- Reservoir properties
- P & T gradients
- Fluid compositions & distributions
- etc

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Technical Accomplishments & Publications/Presentations

Modeling Related:


  — Awarded best student paper at the EMI Conference

• Ghanem, R., Aminzadeh, F., Thimmisetty, C., Khodabakhshnejad, A., Jabbari, N., Rose, K., Bauer, J., and Disenhof, C., in review, Multiscale stochastic representation of wellbore signatures over the Gulf of Mexico, American Institute of Aeronautics and Astronautics.

• Sim, L., Rose, K., King, P., and Graham, J., in preparation, Blowout and Offshore Spill Occurrence Model: Plume Model and Initial Validation, Hydrologic Research/Marine Pollution Bulletin


• Sim, L., Graham, J., King, P., and Rose, K., in preparation, Blowout and Offshore Spill Occurrence Model: Transport Model, Hydrologic Research/Marine Pollution Bulletin


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Technical Accomplishments & Publications/Presentations

Data Related:

• Mark-Moser, et al., *in review*, Gulf of Mexico Geology in Support of Subsurface Hydrocarbon Research for ORD: A Summary and Literature Review, NETL TRS

Spatial Analytical, Etc Related:

• Romeo et al., *in review*, Evaluating adapting current NETL IAM models and existing datasets for risk assessment for offshore Arctic, TRS
• Bauer et al., *in review*, Advancing Tool, Techniques and Approaches to Support Offshore Spill Prevention - Spatial Analyses for Risk Assessment and Uncertainty Reduction Spanning the Subsurface, Wellbore and Water Column for GOM , TRS
• Cont. on next slide...

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Technical Accomplishments & Publications/Presentations

Spatial Analytical, Etc Related:


• Rose, K.; Gulf of Mexico IAM team. Integrated Gulf of Mexico Modeling. Presented at the Interagency Coordinating Committee on Oil Pollution Research (ICCOPR), Washington, DC, June 18, 2014.


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4. Need for coordinated system for assessments and evaluations

- EDX is DOE’s platform to promote efficient coordination & collaboration and timely development & access to data and analytical tools
  - Internal data sharing and analysis
  - External knowledge transfer

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Thank you!

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