Impact Assessment Modeling:
robust multivariate spatial analysis tools

Cumulative Spatial Impact Layers

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I. Background
II. Measuring Impacts
III. Product Goals
IV. Cumulative Spatial Impact Layers (CSILs)
V. Design challenges
VI. Next level & additional applications
Abbreviated history of domestic offshore spills

**Santa Barbara Blowout**
January 1969
- Over 72,000 bbl
- ~30 miles of coastline

**Exxon Valdez Spill**
March 1989
- ~240,000 bbl

**Deepwater Horizon Blowout**
April 2010
- ~4.9 million bbl
- Over 1,000 miles of coastline

1 barrel = 42 gallons
Past approaches for impact measurements

• Data collection
  – Observational, interviews, historical studies

• Measurements
  – Qualitative (historical studies, interviews)
  – Quantitative ($$$, sensitivity indexes)

• Current options for decision makers & stakeholders...
  – Data archives & a lot of **BIG DATA**...

How to efficiently bring together *disparate data* from an *array of sources* to output a *useful product* for *disaster management*?
1. Support spill prevention & response readiness through design of a spatio-temporal approach to analyze offshore spill risks & impacts

2. Automated approach through series of tools that are intuitive & robust
   - User-friendly, efficient, spatially & temporally robust
   - Handles diverse types of datasets
   - Different regions & applications
   - Works in conjunction with Offshore NETL tools & models

Cumulative Spatial Impact Layers (CSILs) quickly measures the total number of activities OR estimated economic cost per area (cell)

See Bauer et al. 2015 for more information

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Introducing CSILs

• Written in Python 2.7
• Simple additive design
• Data-driven

• Can measure variety of impacts
• Geographically robust

Input Data

Cumulative Spatial Impact Layers

- Oil Platforms
- Marine Protected Areas
- Vessel Tracklines
- Commercial Fish Catch Probability

Acquire Data

Data Processing

- Vector Raster
- Analyze Data

CSIL Output

- Uses per Square Km

Uses & Economic Summary Layers

Create Economic Raster(s)

ArcToolbox contains tools to rapidly output Use & Economic Summary Layers, as well as Create Economic Raster(s)

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Tool construction challenges

- Big data
- Spatial accuracy
  - Spatial reference system
  - Output extent errors
- Processing data
- Data & tool storage
- Avoidance of creating “black box” tools
- Data-driven
CSILs in today’s world

Intuitive tools for prevention and response readiness that...

- Combines disparate data
- Quantifies use or cost
- Rapid output

Current events

- ‘Plains All American Pipeline’ in Santa Barbara
- 2,500 barrels released, 500 bbl entered Pacific Ocean, spread across 9 miles of coastline
- Shell approved for drilling in Chukchi & Beaufort Seas off Alaska’s North Slope
- Potential impacts on indigenous groups who subsist on marine life

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Broader applications

CSILs approach and tools measure impacts for a variety of disasters:

- Earthquakes
- Floods
- Fires
- Landslides
- Hurricanes

If Hurricane Ike (2008) Happened Today

- Result map shows economic costs within 20km of Hurricane Ike
- Measures potential economic loss due to disasters

Hurricane data from the National Weather Service

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Taking it to the next level!

SWIM

Take impact modeling to the next level with the Spatially Weighted Impact Model (in development!)

- Applies user-defined weights to impacts
- Density and distance analysis used to accurately measure impacts
- Identifies response resources

Working in conjunction with NETL Offshore Tools & Models

- Apply validated BLOwout & Spill Occurrence Model outputs for multiple regions
- Implement spatial uncertainty analysis with Variable Grid Method

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Relevant Publications


Sim, L., Graham, J., Rose, K., Duran, R., Nelson, J., Umhoefer, J., and J. Vielma. in review. Developing a Comprehensive Deepwater Blowout and Spill Model, Environmental Modelling and Software

For more information on our research, CSILs, and other tools and models in the offshore portfolio:

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Thank you!

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