Impact Assessment Modeling: robust multivariate spatial analysis tools

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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

Barrels = bbl
1 barrel = 42 gallons

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Past approaches for impact measurements

• Data collection
• Measurements
• Current options

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 risks & impacts*

2. Automate approach with *intuitive & robust tools*
   - User-friendly & efficient
   - Spatially & temporally robust
   - Handles diverse datasets
   - Works with Offshore NETL tools & models
   - Multiple applications
Introducing CSILs

Cumulative Spatial Impact Layers

- Simple additive design
- User-friendly
- Measures variety of impacts
- Geographically robust

Input Data

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

Data Processing

- Acquire Data
- Analyze Data

CSIL Output

- Additive Model
- Weighted Model

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

For more info on the approach, check out Bauer et al. 2015

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CSILs ArcToolbox

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

- **Cumulative Spatial Impact Layers (CSILs)**
  - Use Summary (CSIL)
  - Create Economic Raster(s)
  - Economic Summary (CSIL)

- Written in Python 2.7
- Data-driven
- Currently in testing

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Construction challenges

• Big data
• Spatial Accuracy
  – Projections
  – Extents
• Processing data
Construction challenges continued

- Avoidance of creating “black box” tools
- Data-driven

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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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## CSILs vs. SWIM

### Cumulative Spatial Impact Layers

- **Shipping Lanes**
- **Platforms**
- **Marine Protected Areas**

### Offshore Texas

#### CSILs Output

User-defined weights can be applied to layers

<table>
<thead>
<tr>
<th>Activity/Use</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shipping Lanes</td>
<td>60%</td>
</tr>
<tr>
<td>Platforms</td>
<td>30%</td>
</tr>
<tr>
<td>Marine Protect Areas</td>
<td>10%</td>
</tr>
</tbody>
</table>

#### SWIM Output

- Fishnet design
- Amount of oil
- Days oiled

- No weights applied
CSILs & SWIM 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

Together CSILs & SWIM measure, evaluate, and analyze impacts for a variety of needs:

- 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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For more information on our research, CSILs, and other tools and models in the offshore portfolio: [https://edx.netl.doe.gov/offshore/](https://edx.netl.doe.gov/offshore/)
Thank you!

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