Assessing fate and transport issues of the DWH oil spill using simulations and merged datasets

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• The influence of cyclones on the DWH oil spill
• Update on datasets to validate oil spill simulation
The influence of cyclones on the Deepwater Horizon Oil Spill

Oil spill simulation from 6/20/10-7/10/10 using AMSEAS NCOM data

Note inshore movement of oil starting late June
Model description

• Lagrangian particle tracker with random walk diffusion

• Input consisted
  i. latitude and longitude parcel positions in the oil-contaminated area
  ii. wind (validation show reasonably accurate with absolute errors of 1.4 ms⁻¹ and 33 deg).
  iii. Current (validation to be shown in this talk)
  iv. array of pseudo-random numbers (from Mersenne Twister algorithm, initial seed from machine noise)

• New parcels were released damaged Macondo rig location at each timestep

• Twenty-five parcels were released at each position, and when combined with a 10 m²s⁻¹ diffusion coefficient, resulted in a natural trajectory spread with time

• Initial positions based interpretation on
  i. NASA MODIS
  ii. SAR imagery from http://www.cstars.miami.edu
  iii. NOAA/NESDIS Satellite Analysis Branch (SAB) experimental surface oil analysis products at http://www.ssd.noaa.gov/PS/MPS/deepwater.html
  iv. NOAA’s Office of Response and Restoration oil trajectory maps at http://response.restoration.noaa.gov

• Parcels advected at 80% of the ocean current speed and at 3% of the wind speed. Bilinear interpolation of wind and current applied from model grid to parcel location.
Elevated water from Alex
Elevated water from low

Shell Beach tide data 6/15/10 - 7/15/10

Waveland tide data 6/15/10 - 7/15/10

E. Pascagoula tide data 6/15/10 - 7/15/10
Oil transport mostly governed by ocean currents
• However, surge events associated with tropical cyclones and non-tropical lows can push oil far into the marsh system
• Difficult to know if a hurricane landfall would have been catastrophic
  ➢ Hurricane tend to flush the ecosystem of pollutants
  ➢ But the potential of inland pollution existed. Our ADCIRC simulations (not shown) suggested deep movement of oil into the marsh system
  ➢ Fortunately, no hurricane landfall occurred.
Merging of Oil Datasets

• Shoreline Cleanup and Assessment Technique (SCAT) datasets
• State DEQs
• Louisiana Bucket Brigade
• Lake Pontchartrain Basin Foundation
• Investigating other potential datasets

Original purpose is to provide validation against the oil spill model after dispersion, emulsification, and evaporation/dissolution terms are added.

However, it should be beneficial for other DWH research endeavors.
SCAT data

• The SCAT teams performed survey of affected shorelines and collected data on shoreline oiling conditions
• MS-AL SCAT data very coarse and only a few days. Not useful
• LA SCAT data covers most of the oil spill and ample datapoints
  ➢ Spreadsheet available and contains metadata
  ➢ However, many temporal data “holes” exist in different regions. This problem is common for all the datasets, and is the motivation for compositing all the datasets
Louisiana Bucket Brigade data

• Volunteer organization which tabulated all oil spill news and information from the media, phone calls, emails, etc.
• Available in a spreadsheet
• Covers the entire oil spill and plentiful datapoints
  ➢ Temporal data holes
  ➢ Dataset also contained news accounts, community meetings, tidbits such as “smells from oil burning.” These have been removed
  ➢ Latitude and longitude not always included, just a specific location. We have added an estimated latitude and longitude if possible
State DEQ

• The DEQs released almost daily statements of oil spill information in pdf reports
• This data is not digitized.
• Covers different timeframes of the oil spill with modest datapoints
  ➢ MS DEQ contained latitude and longitude for most incidents. It also sometimes described geographic coverage, not just points. MSU has developed a spreadsheet of these reports.
  ➢ LA DEQ is similar, but covers the entire period and contains more data. However, it does not provide latitude and longitude. Geographic regions in the marsh or sounds are referenced instead. We are working on a spreadsheet, but it is tedious.
MDEQ dataset example
1. Chandeleur Islands
2. Eastern Biloxi Marsh
3. LakeBorge / LakePontchartrain
4. Mississippi River Mouth
5. Sandy Point
6. Barataria Bay North End
7. Grand Isle / Fourchon
8. Terrebonne Bay / Timbalier Bay North End
9. Last Islands
10. Atchafalaya Delta
11. Russell Sage Mash / Vermillion Bay / West Cote Blanche Bay
Eastern Biloxi Marsh
Lake Borgne and Lake Pontchartrain

SCAT-LA Oil Observations - Region 3

Oil Order vs. Date

- **9** = Heavy Oiling
- **8** = Moderate Oiling
- **7** = Light Oiling
- **6** = Very Light Oiling
- **5** = Trace Oiling with Heavy Tarballs
- **4** = Trace Oiling with Moderate Tarballs
- **3** = Trace Oiling with Light Tarballs
- **2** = Trace Oiling with Negligible Tarballs
- **1** = No Observed Oil
Future work

- Development of oil spill databases for Louisiana DEQ and Lake Pontchartrain Basin Foundation
- Synthesize datasets for comprehensive analysis
- Analysis of all databases, with a summary of all oil incursion along coastline region, wetlands, and in the open waters
- Incorporate dispersion and evaporation components into oil spill model
- Validate oil spill model against database
- Overall goal: fate and transport analysis