A statistical representation of oil spill fate in the Salish Sea based on AIS ship traffic, oil transfer data, and a Monte Carlo model framework.

Dr. Rachael Mueller

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A statistical representation of oil spill fate in the Salish Sea.

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1. University of British Columbia, 2. Dalhousie University
The Salish Sea: A transportation HUB

2018 vessel traffic footprints from Automatic Identification System (AIS) ship tracks
What are the spatial characteristics of oil spill fate in the Salish Sea?
This project: Moving beyond a single spill scenario toward maps of likelihood

MOHID + SalishSeaCast

Oil Spill Fate Model

Evaporation

Spreading

Emulsification

Dispersion

Dissolution

Biodegradation

Sedimentation (in development)

Bedford Inst. of Oceanography
wave tank tour
by Brian Robinson

2018 oil transfer data

Refineries

Oil transfer terminals

2018 ship tracks

Graphic by Cameron Power

DEPARTMENT OF ECOLOGY
State of Washington
MOHID & SalishSeaCast modeling platform

Hydrodynamics
(SalishSeaCast)
- u-, v-, w- velocities
- Salinity
- Temperature
- Sea Surface Height
- Vertical Diffusivities
- Model Level Thickness

Waves
(Wave Watch III®)
- Whitecap Coverage
- Wave Height
- Mean Wave Period
- Stokes Drift

Winds
(HRDPS)
- u-velocity
- v-velocity

Oil spilled at the surface is weathered and moved around at surface and depth by these sea, wave, and wind conditions.
Generating 10,000 statistic-based spills and spill volumes

**Time:**
Choose the month, weighted by VTE, choose the date/time uniformly

**Location:**
Choose the lat/lon grid box weighted by spatial distribution of VTE for that month, choose specific lat/lon uniformly

**Vessel Type:**
Choose vessel type weighted by VTE for that month in that grid box

**Vessel Length:**
Choose a vessel track weighted by VTE for that month, in that grid box, for that vessel type.
Container ship fuel capacities vs. ATB and Handymax oil cargo capacities
Distribution of the 100 largest spills in the 10,000 spills presented in this talk
Questions to be addressed

• Where is oil most likely to end up?
  • Evaluate 1D mass balance result for general characteristics
  • Evaluate 3D results for a regional view based on oil types

• Where is there a greater risk of larger volumes?
  • Evaluate 3D results for a regional view based on oil types
Oil fate fraction (from 1D results)

Water Column, Surface, Coast, Air
Likelihood of oil type on coastlines

Coast
Oil volume along coastline

ANS  Bunker-C  Diesel  All Oils

Coast

beached oil volume [liters/m] as geometric mean across runs
Take-aways

• Most oil goes to the coast
• Crude oil is the least likely to spill but has the greatest impact volume
• Likelihood of oil type varies by region
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A question for Coast Salish communities:

We have this information.

What would you like us to do with this knowledge?

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Thank you
Preliminary evaluation of spill sources for specific regions of coastal impact

- Selected area for demonstrating the reach of spill sources for coastal impact
- Approximate area of spills included in this preliminary example
monte-carlo classification

- ANS
- Bunker-C
- Dilbit
- Diesel
- Gasoline
- Jet Fuel
- Other

volume (liters)

1e9

oil type categories
Spatial characteristic of 10,000 spills shown here
Variation in the number of spills (9 iterations)

This study

Number of spills

Median number of spills

Range of spills (.75 - .25 Quantile)
Our study: Number of spills and spill volumes

This study

Volume of spills

Median volume of spills (.75 - .25 Quantile)

Range of volumes