Vessel Movement Module – Updates and Follow Up

Modeling Team
JD Ross Leahy (Presenter), Adam Byrd, Alex Suchar

Today’s agenda

1 Background
2 Review of Technical Discussions
3 VMM Progress Update
4 Next Steps
5 Questions and Comments
Today’s discussion topics

- Feedback or comments on recent technical discussion sessions
- Current status of our work on the vessel movement module
- Ways to improve upcoming webinars and discussions

Legislative background

- ESHB 1578 was passed in 2019 to reduce the risk of oil spills, and protect Southern Resident Killer Whales

- Ecology's Spills Program tasked to undertake or assist with multiple policy initiatives in the bill, including the development of an oil spill risk model
Our project team

- Adam Byrd, PhD
  Database administration, Geographic Information Systems
- Alex Suchar, PhD
  Statistical and mathematical modeling
- JD Ross Leahy, Licensed Master
  Maritime operations

Research philosophy

- Transparent
  • Open
  • Inclusive
- Reproducible
  • Well documented
  • Methodologically sound
- Credible
  • Peer reviewed
  • Validated
Model development project goals

- Produce a **tool** to quantitatively assess current and potential oil spills risks from covered vessels in Washington waters
- Provide a **framework** for future oil spill risk analyses

**Modeling Approach**

- **Vessel Movement Module**: Vessels move in the system according to their empirical distribution
- **Encounter Module**: Measures and evaluates relationship of each vessel to the shore and other vessels
- **Accident Module**: Evaluates situations for their potential to lead to accidents
- **Oil Outflow Module**: Estimates the size of oil spills that result from accidents
Vessel Movement Module

Purpose:
- Simulate vessel activity and potential changes in traffic volume with AIS driven model

Vessel Movement Module Review

- Identify vessel tracks
- Collect tracks into routes
- Statistical analysis of factors that could affect vessel distribution on tracks
- Simulate vessels on tracks based on distribution
- Simulate additional rules and non route based vessels
Vessel Movement Module: Components

Vessel Movement Module

- Geographic Area
- Track Selection Factors
- AIS Messages
- External Rules
- Track Identification
- Dependent Vessels
- Route Identification
- Non-AIS Vessels

Technical discussions on module components

- Technical Input and Discussion Sessions
  - October 21, 2020 – Track Selection Factors
  - October 27, 2020 – External Rules
  - October 29, 2020 – Dependent Vessels
  - November 4, 2020 – Non AIS Vessels

Module Component Summaries
- Written description of selected components
Track Selection Factors: Vessel Type

Need to classify vessels by type:

- Vessel type information provided by AIS is not specific enough to meet our needs
- For instance, vessels with the AIS type of “cargo” may range in size from a deep draft container ship to an interisland landing craft

Proposed list of vessel types

- Assist/Escort Tug
- ATB (Articulated Tug and Barge)
- Bulk Carrier
- Car Ferries
- Container Ship
- Crude Tanker
- Cruise Ships
- Fast Passenger Ferries
- Fishing Vessel (<40m)
- General/Other Cargo Ship
- General/Other Cargo Vessel (<40m)
- Large Fishing Vessel (>40m)
- Large Rec. Vessel/Yacht (>40m)
- Liquefied Gas Tanker
- Mono-hull Passenger Ferries
- Other/Unassigned
- Other tugboats and workboats
- Pilot Boat
- Pocket Cruise Ship (>40m)
- Product Tanker
- Product Tanker – Bunkering
- Rec. Vessel/Yacht (<40m)
- Research Vessel
- Search/Mil/USCG (<40m)
- Smaller Harbor Tug
- Tanker/Chemical Tanker
- Tour Vessel
- Towing Vessel (Non-Oil)
- Towing Vessel (Oil)
- Towing Vessel (Oil) – Bunkering
- Military/USCG Vessels (>40m)
- Vehicle Carrier
Additions to proposed list of vessel types

- Fishing Vessel (<40m)
  - Commercial Fishing Vessel
  - Tribal Fishing Vessel
- Recreational Vessel/Yacht (<40m)
  - Recreational Vessel/Yacht
  - Sport Fishing Vessel
- Tour Vessel
  - Tour Vessel
  - Whale Watching Vessel

Track Selection Factors: Others

Need to identify other potential factors in track selection:

- A list of potential factors
- Statistical hypothesis testing to determine influence on track selection
Track Selection Factors: Others

Proposed list of factors
• Current/tide
• Wind
• Sea state
• Time of day
• Visibility

Additions to proposed list
• Presence of a fishing opener
• Presence of a tug escort
• Day of the week
• Domestic vs International Flag

Rules That May Affect Vessel Movements

The VMM needs to represent:
• New rules that might not be apparent in the historical data
• Rules that only come into effect during certain times of the year
• Rules that are based on vessel interactions, i.e. only come into play under specific circumstances
Rules That May Affect Vessel Movements

**Proposed rules for inclusion in VMM:**

- Turn Point Special Operating Area
- Eastern San Juan Island Archipelago VTS Special Area Regulations
- Echo Program Voluntary Vessel Slowdown for Haro Strait and Boundary Pass
- Echo Program Strait of Juan de Fuca Voluntary Inshore Lateral Displacement
- Transport Canada Interim Sanctuary Zones
- Swiftsure Bank Voluntary Ship Slowdown Trial

Movements Associated With Other Vessels

**Dependent Vessels**

- Vessels whose movements are dependent on the arrival or existence of another vessel, e.g.
  - Tug boats providing escorts
  - Pilot boats delivering or retrieving pilots
  - Vessels delivering bunkers
Dependent Vessels

**Proposed list of dependent vessels**
- Vessels providing bunkers
- Escort tugs
- Assist tugs
- Pilot boats

**Additions to proposed list**
- Crew boats
- Submarine escorts

Vessels That Do Not Transmit Via AIS

**Who isn’t required to carry AIS?**
- Recreational vessels
  - Sailboats
  - Yachts
- Commercial vessels under 65 feet
  - Whale watching vessels
  - Fishing vessels
- Towing Vessels under 26 feet
Vessels Not Represented in AIS

Proposed list of non-AIS Vessels
- Recreational vessels
- Commercial fishing vessels
- Small workboats/tugs

Additions to proposed list
- Navy and other military vessels
- Tribal fishing vessels
- Sport fishing vessels

Track Selection Factors
- Whale sightings reported via WRAS

Rules
- COLREGs (Rules of the road)
- Traffic Separation Scheme
- New Commercial Whale Watch Rules

Dependent Vessel Movements
- Boom Boats
- Seine Skiffs
VMM Development Progress

Adjustments to Routing Strategy

- Route based vs non-route based vessels
- Identification of route segments and waypoints
- Concept of vessel journey and journey network

Route Identification

Many vessels share common origins and destinations

Each has a unique track

A route = a collection of tracks with the same origin and destination
**Complex Routes**

- Only certain vessel types operate on replicable routes.
- Breaking routes down into segments allows improved simulation flexibility.
- Separate vessels by route type.
- Identify route nodes.

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**Separate Vessels by Route Type**

<table>
<thead>
<tr>
<th>Route Based Vessels</th>
<th>Partially Route Based Vessels</th>
<th>Non-Route Based Vessels</th>
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Identify Route Waypoints

Waypoints are the intersections along a route.

Identified waypoints are now included in our list of origins and destinations.

Vessel Journey and Journey Network

Vessel Journey starts when a vessel enters the model geographic area, and ends upon departure.

Vessel Journey Network is a collection of route segments connected by waypoints.

Time at anchor or facility is incorporated as a unique part of Vessel Journey.
Non Route Based Vessels

Potential modeling strategies:

- Clusters of points in specific locations
- Manually created movements to and from clusters
- Identification and simulation on tracks without combining into routes

VMM Progress and Next Steps Summary
VMM Progress and Next Steps Summary (1\textsuperscript{st} Half)

**RULES & ALGORITHMS**
- Incorrect MMSI algorithm
- "Ghost" vessels algorithm
- Duplicate points algorithm
- Faulty points algorithm
- Origin/destination algorithm
- Track identification algorithm
- Route identification algorithm
- Vessel taxonomy algorithm

**INPUT AIS DATA**
- AIS DATA CLEANING
- TRACK IDENTIFICATION
- PRELIMINARY ROUTE IDENTIFICATION
- VESSEL TYPE & EXTERNAL FACTORS DATA INTEGRATION

**DATASETS (with fields)**
- Raw AIS dataset
- Cleaned AIS dataset
- Cleaned AIS dataset with tracks
- Cleaned AIS dataset with tracks & routes
- Visibility dataset
- Wind dataset
- Tides dataset
- Currents dataset
- Vessel info dataset

- Completed
- In progress
- Just started

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VMM Progress and Next Steps Summary (2\textsuperscript{nd} Half)

**ROUTE IDENTIFICATION**
- ROUTE STATISTICAL ANALYSIS
- ROUTE SUMMARIZATION (OPTIONAL)
- VESSEL TRAFFIC SIMULATION
- CALIBRATION/VALIDATION

- Completed
- In progress
- Just started
Module Description Document
- Comprehensive description of each module
- Draft documents will be posted to the webpage for comments and feedback

Additional feedback opportunities on VMM

Webinars and Technical Discussions

- Vessel Movement Module
- Vessel Encounter Module
- Vessel Accident Module
- Oil Outflow Module
Upcoming events

February 10th, 2021 -- 1 pm to 3 pm
- Presentation on Vessel Encounter Module

Discussion logistics
Today’s discussion topics

- Feedback or comments on recent technical discussion sessions
- Current status of our work on the vessel movement module
- Ways to improve upcoming webinars and discussions related to Vessel Encounter Module

Contact Info

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