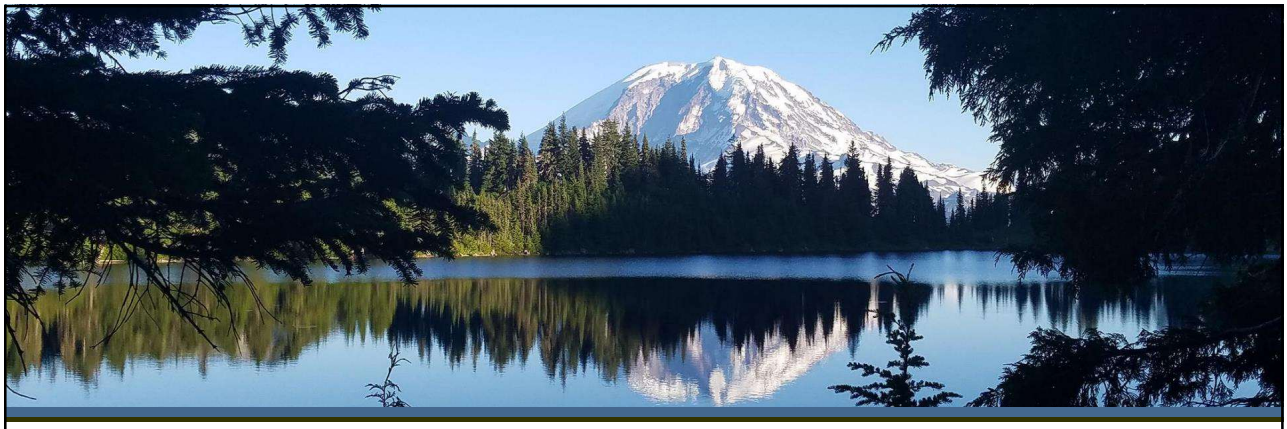

Vessel Movement Module

Modeling Team

JD Ross Leahy (Presenter), Adam Byrd, Alex Suchar, Melba Salazar-Gutiérrez

DEPARTMENT OF ECOLOGY
State of Washington

Today's agenda

1. **Background**
2. **Additional Feedback Opportunities**
3. **Vessel Movement Module Structure and Progress Update**
4. **Additional Module Components**
5. **Questions and Comments**

Today's discussion topics

- Structure of the vessel movement module
- Current status of our work on the vessel movement module
- Ways to improve upcoming discussions on key topic areas related to the vessel movement module

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
- Melba Salazar-Gutierrez, PhD
  Statistical and mathematical modeling
- JD Ross Leahy, Licensed Master
  Maritime operations

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Research philosophy

Transparent	• Open • Inclusive
Reproducible	• Well documented • Methodologically sound
Credible	• Peer reviewed • Validated

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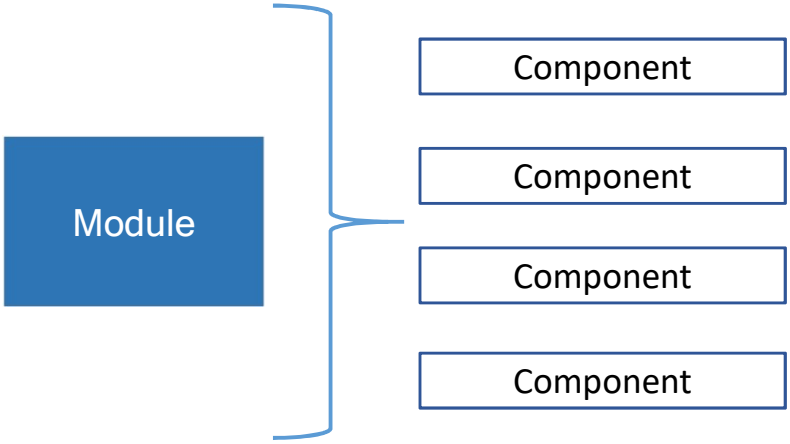
Model development project goals

- 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

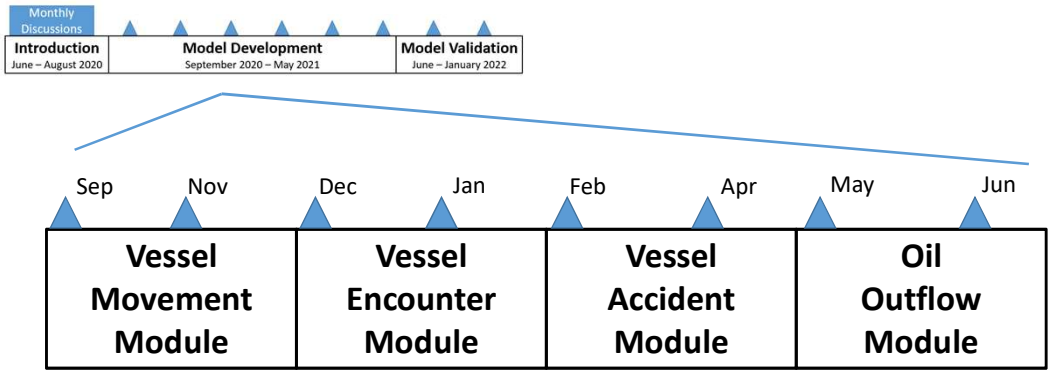
Modeling Approach

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

Modeling Approach



A step by step approach to building modules



Additional feedback and discussion opportunities

Module Component Summaries

- Written description of selected components
- Request feedback via eComments

Technical Input and Discussion Sessions

- Open format discussion sessions
- Solicit input from experts on our planned approach to specific module components

Additional feedback and discussion opportunities

Module Description Document

- Comprehensive description of each module
- Draft documents will be posted to the webpage for comments and feedback

Vessel Movement Module

Purpose:

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

Vessel Movement Module

- Macro-characteristics
  - Total vessel traffic per vessel types
  - Vessel destination and origin
  - Vessel time of arrival and departure distribution
- Micro-characteristics
  - Simulated tracks resemble observed tracks for vessels of similar types, similar origin/destination, similar conditions
  - Distribution of simulated tracks similar to the distribution of tracks in the AIS-based routes

Vessel Movement Module: Components

Vessel Movement Module

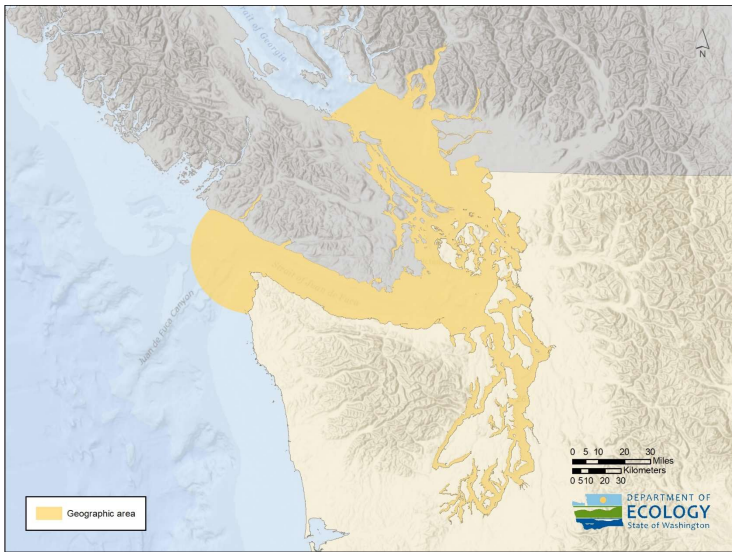
- Geographic Area
- AIS Messages
- Track Identification
- Route Identification

Geographic Area

Includes entirety of VTS Traffic Separation Scheme

Bounded to the North above Nanaimo

Bounded to the West just offshore of the traffic lanes

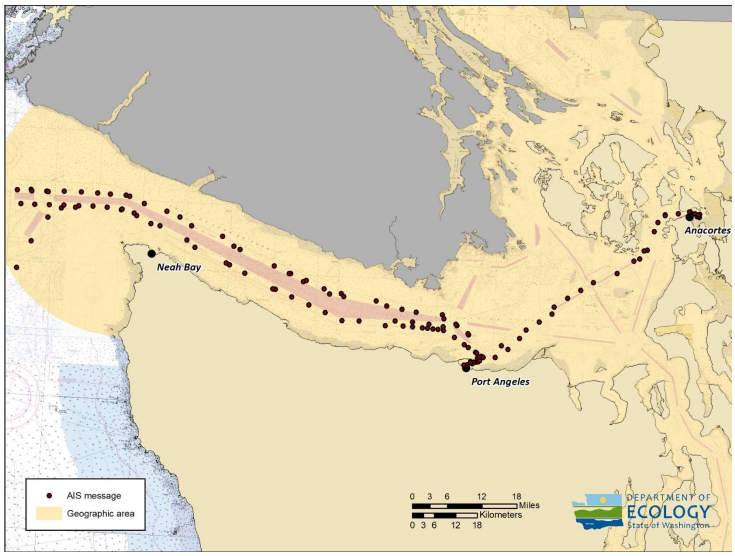


AIS Messages

Series of sequential messages sent every 2-10 seconds for underway vessels

Contains information on vessels

- Name
- Dimensions
- AIS Vessel Type
- Speed
- Latitude/Longitude



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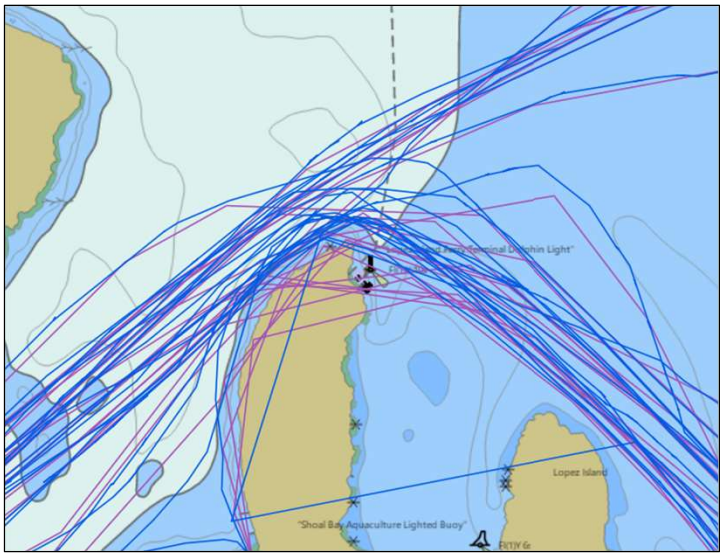
USCG AIS Data and Marine Exchange AIS Data

USCG provided data is averaged at 5 minute intervals

Marine Exchange data provides higher temporal resolution

No appreciable difference in geographic coverage



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USCG provided data in purple, Marine Exchange in blue

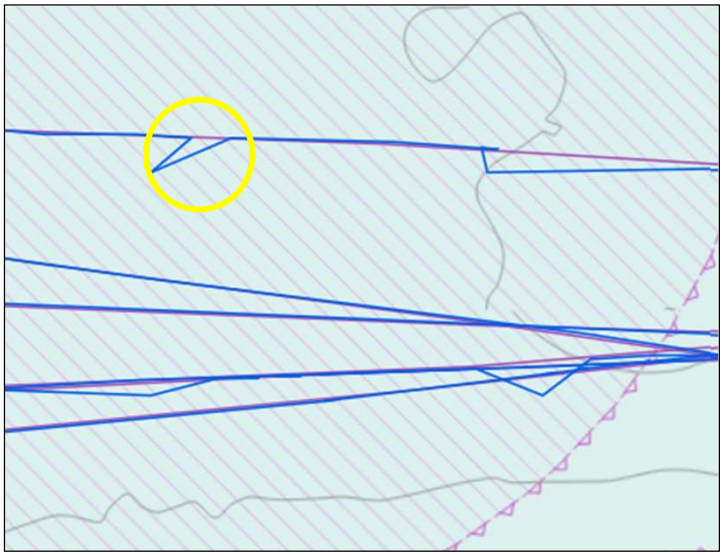
Cleaning AIS Data

Remove incomplete records (e.g. missing MMSI)

Remove data for “ghost vessels” with three or less messages

Remove duplicate points – points with a distance of less than 25 meters from previous

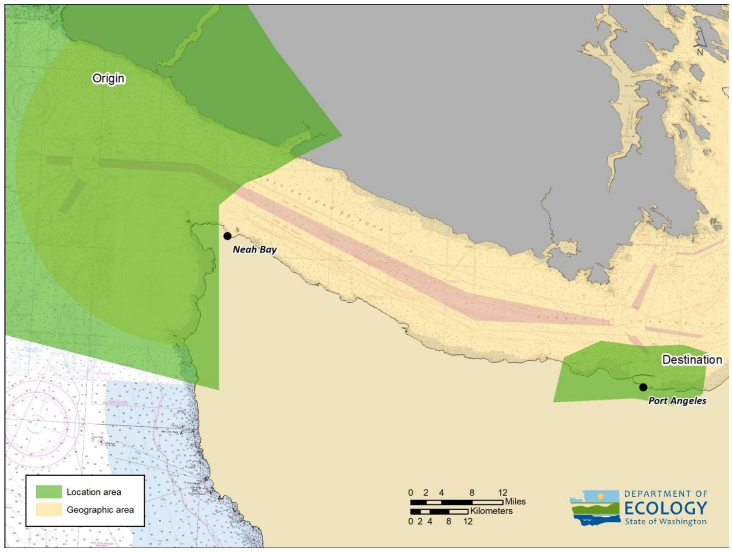
Remove faulty points that represent an impossible movement navigationally



Track Identification

Vessels can take any number of different paths between an origin and destination

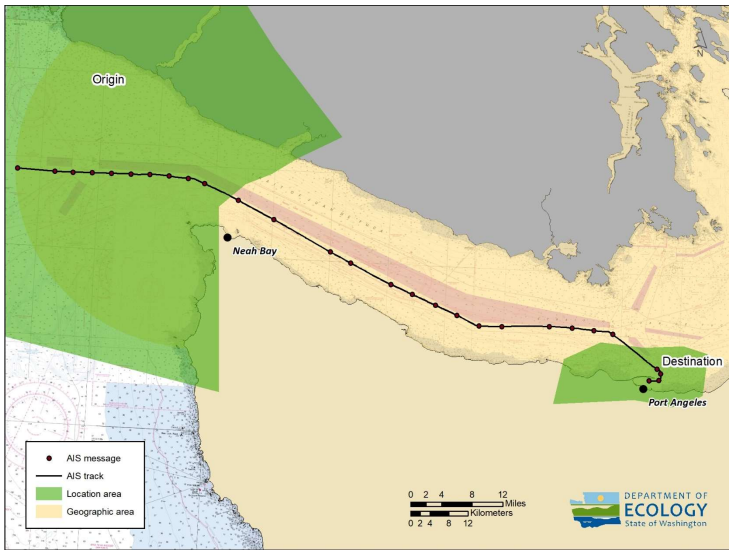
Origin: From Sea
Destination: Port Angeles



Track Identification

A track is a series of sequential points

With a start and end based on our track creation algorithm



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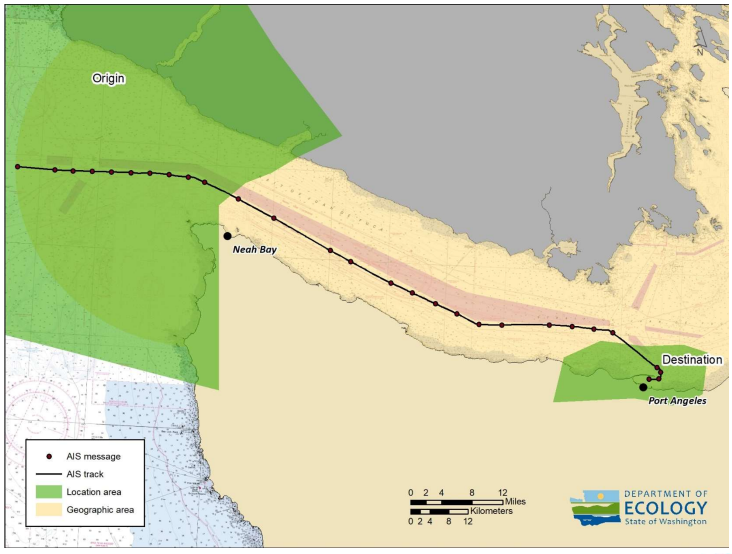
Track Identification

Modified version of the Python AIS Track Builder 3.1 script available from MarineCadastre.gov

A new track is created anytime a subsequent point is greater than 10 miles or more than 15 minutes from previous point



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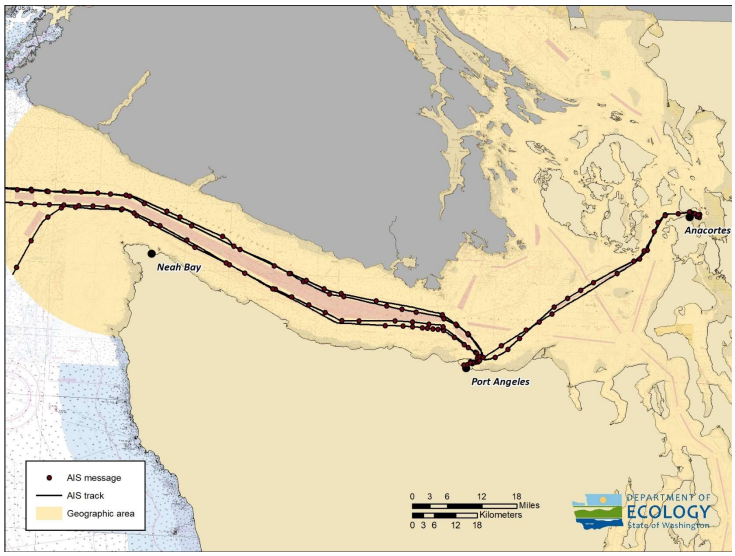
Track Identification

Establishing the beginning and end of a series of AIS messages



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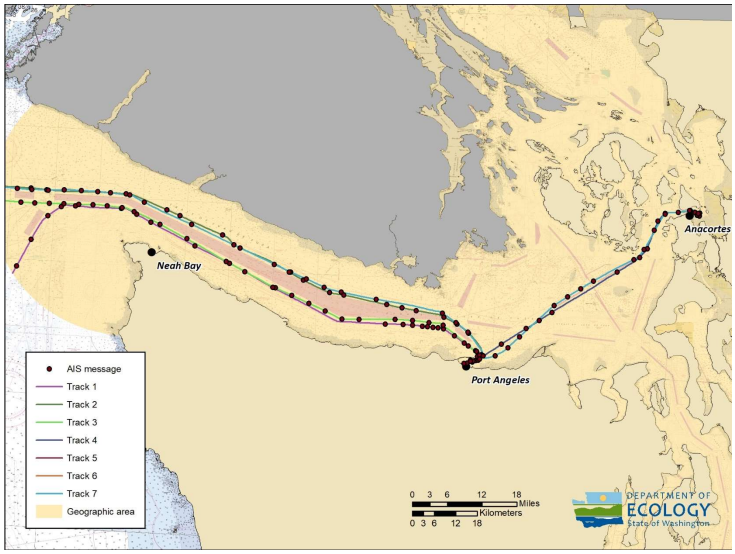
Track Identification

Establishing the beginning and end of a series of AIS messages



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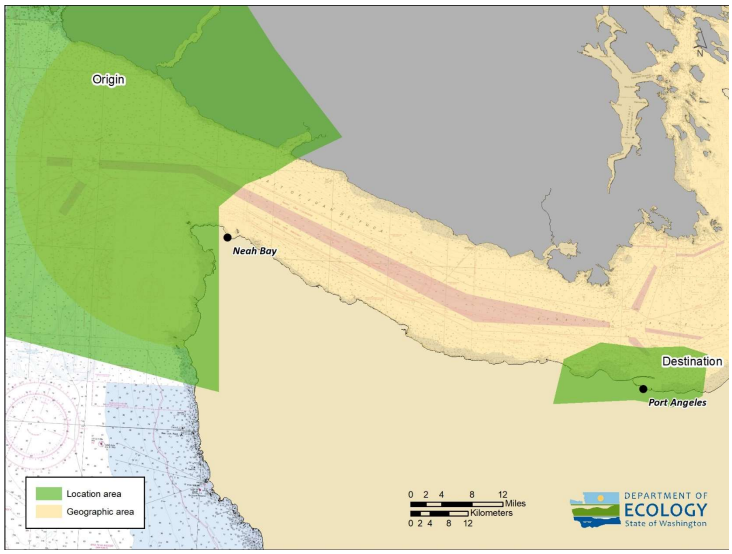
Track Identification

Each start and endpoint is assigned an origin or destination

Origin: From Sea
Destination: Port Angeles



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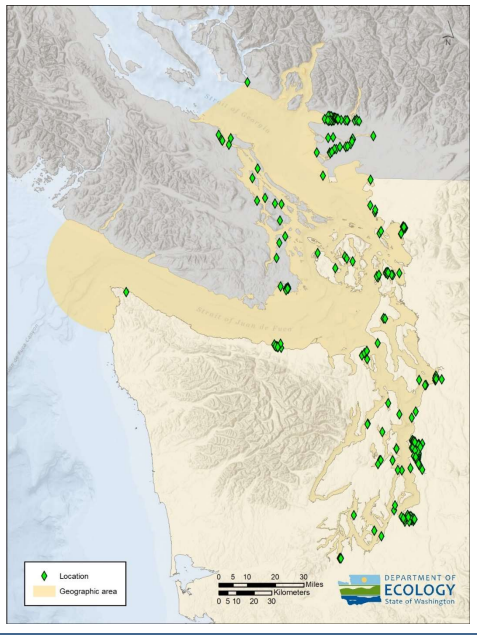
Origins and Destinations

Identifying potential origins and destinations within the Salish Sea



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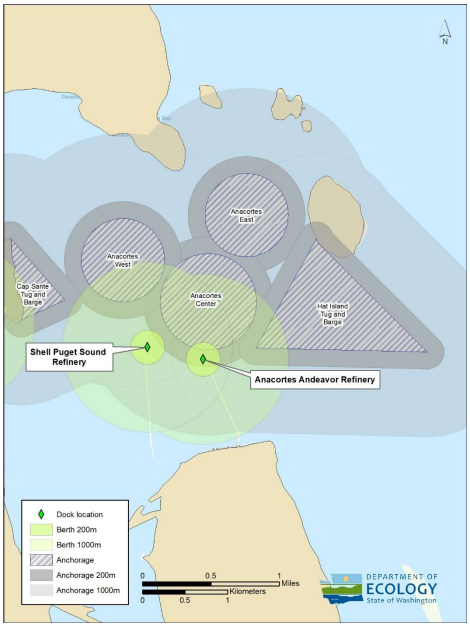
Origins and Destinations

Endpoint within 200 meters of a terminal location, then terminal is selected

Endpoint further than 200 meters from a terminal location but within 200 meters of an anchorage, then the anchorage is selected

Endpoint further than 200 meters from a terminal location or anchorage location, then the nearest terminal or anchorage up to 1km



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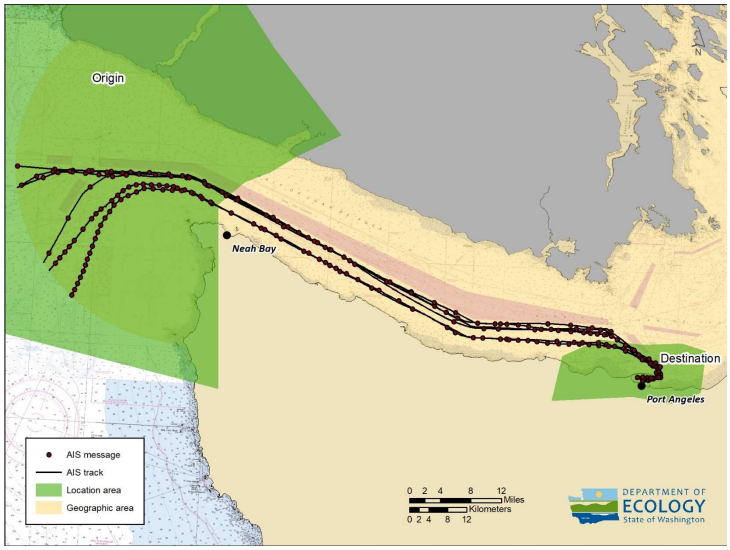
Route Identification

Many vessels share common origins and destinations

Each has a unique track

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



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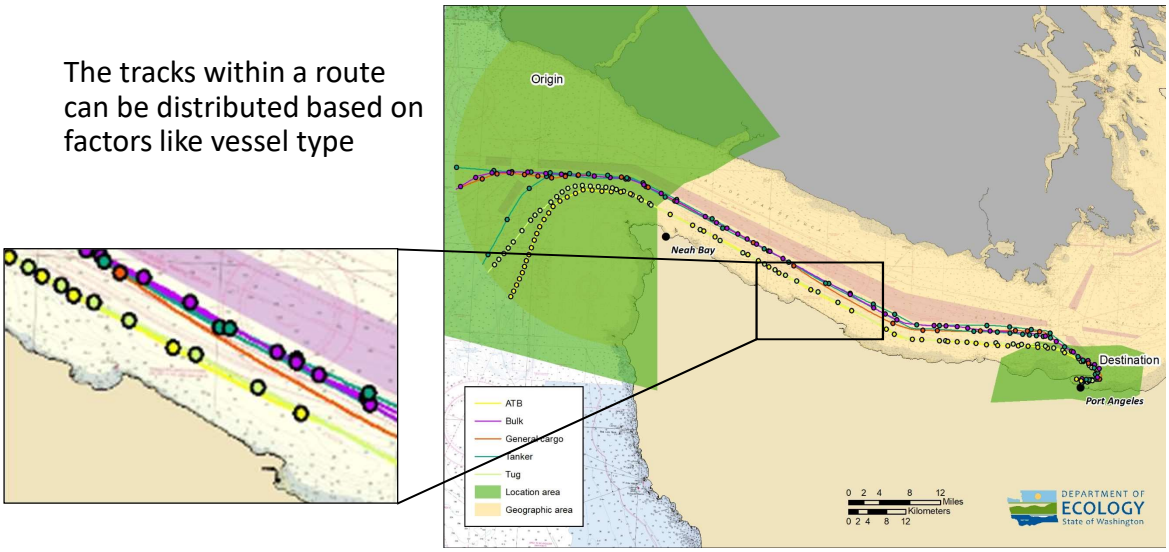
Route Identification

The tracks within a route can be distributed based on factors like vessel type



Vessel Movement Module: Components

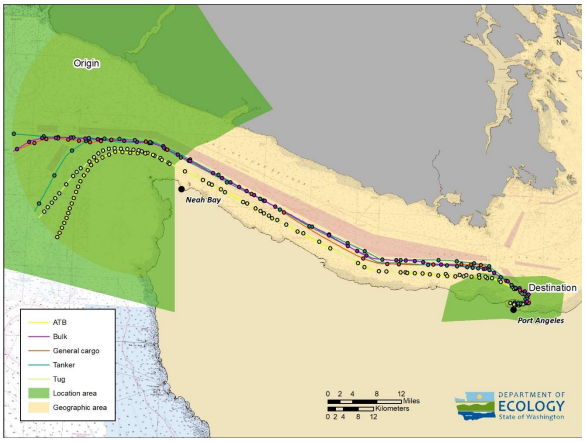
Vessel Movement Module

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

Track Selection Factors: Vessel Type

Need to classify vessels by type:

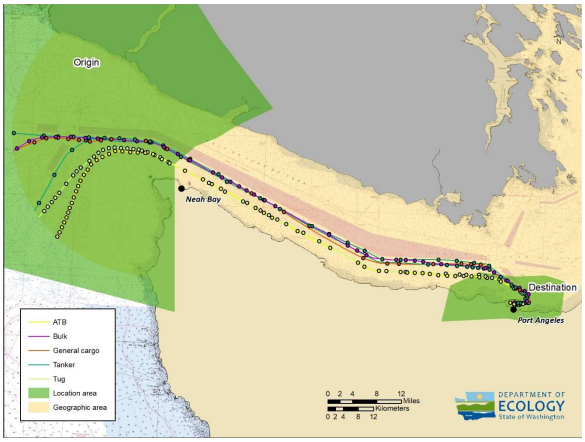
- Vessel type information provided by AIS is not specific enough to meet our needs
- For instance, vessels with the AIS type of “cargo” may range in size from a deep draft container ship to a interisland landing craft



Track Selection Factors: Others

Need to identify other potential factors in track selection:

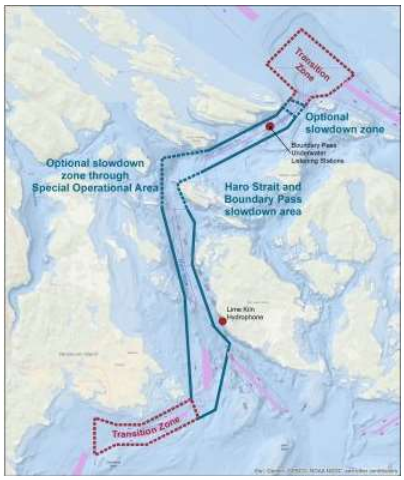
- A list of potential factors
- Statistical hypothesis testing to determine influence on track selection



External Rules

Need rules for:

- 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



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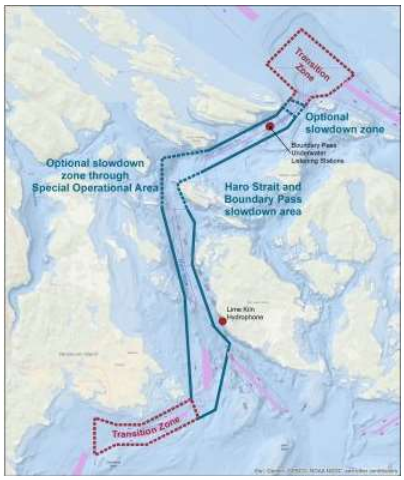
External Rules

Rules to consider including in the 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



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Dependent Vessels

What are 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

What do we need to model?

- Rules for dependent vessel behavior
  - Which ships need escorts?
  - Where do ships take pilots?
- Pre and post activity for dependent vessels
  - Where do they come from prior to providing services?
  - Where do they head to after providing services?

Vessels Not Represented in 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

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Vessels Not Represented in AIS

How to best approach this?

- Review of previous strategies
- Different approaches for different vessel types
- Open to your suggestions

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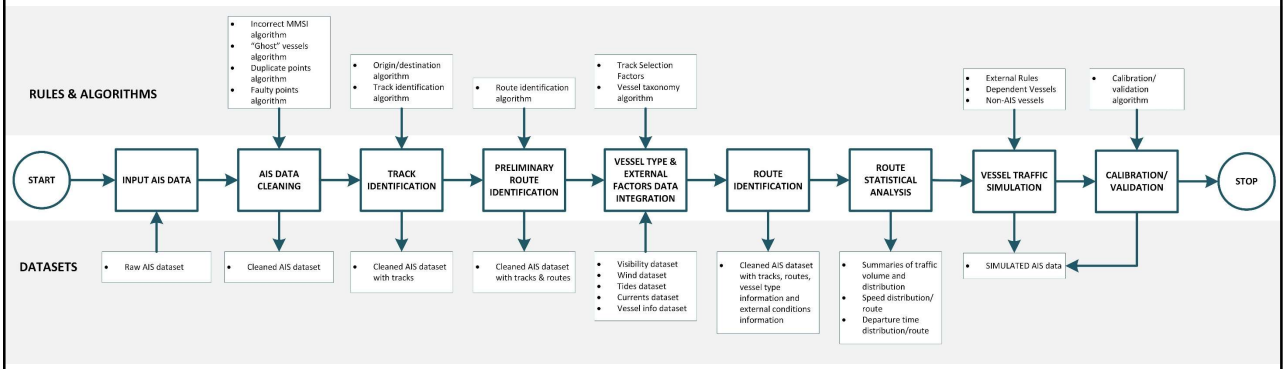
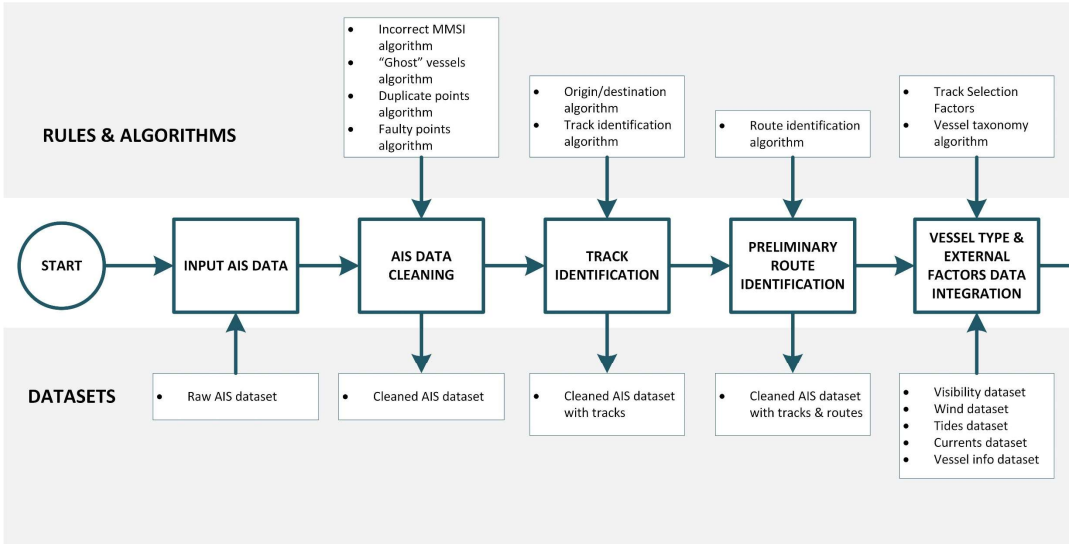
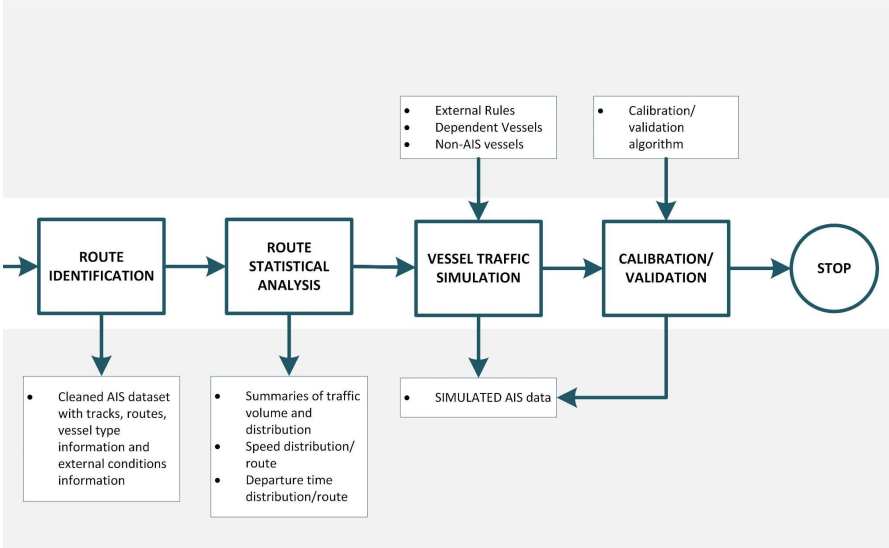
VMM Progress and Next Steps Summary



VMM Progress and Next Steps Summary (1st Half)



VMM Progress and Next Steps Summary (2nd Half)



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Provide input on module components

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

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Upcoming events

October 7th, 2020
- Progress Briefing to Puget Sound Harbor Safety Committee

October 14-15th, 2020
- Progress Briefing at Salish Sea Forum

November 18th, 2020 -- 1 pm to 3 pm
- Vessel Movement Module: Outstanding Topics and Follow Up

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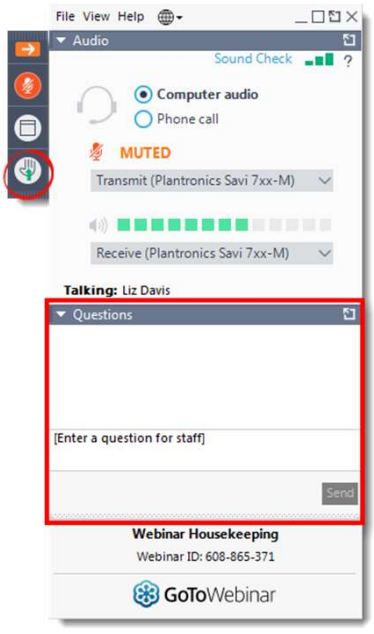
Discussion logistics



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Today's discussion topics

- Structure of the vessel movement module
- Current status of our work on the vessel movement module
- Ways to improve upcoming discussions on key topic areas related to the vessel movement module

Contact Info

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