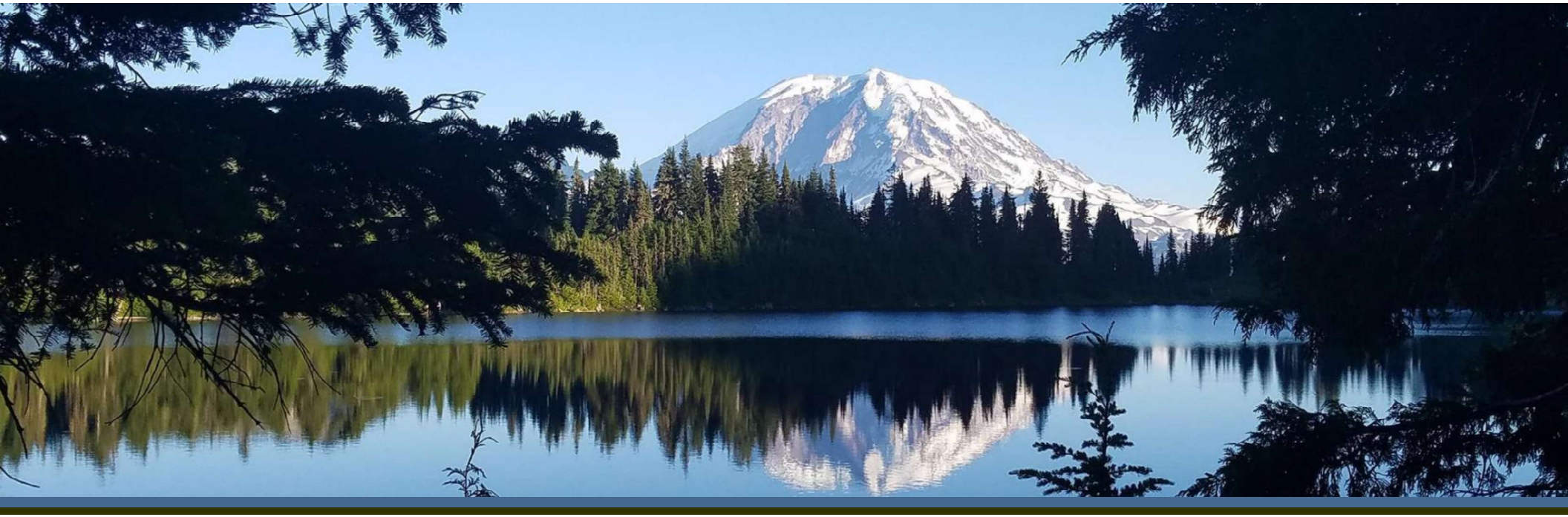


Vessel Encounter Module Updates and Follow Up

Modeling Team

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

March 24, 2021

DEPARTMENT OF ECOLOGY
State of Washington

Today's outline

1. **Background**
2. **Movement Module Update**
3. **Encounter Module Update**
4. **Next Steps**
5. **Questions and Comments**

Today's discussion topics

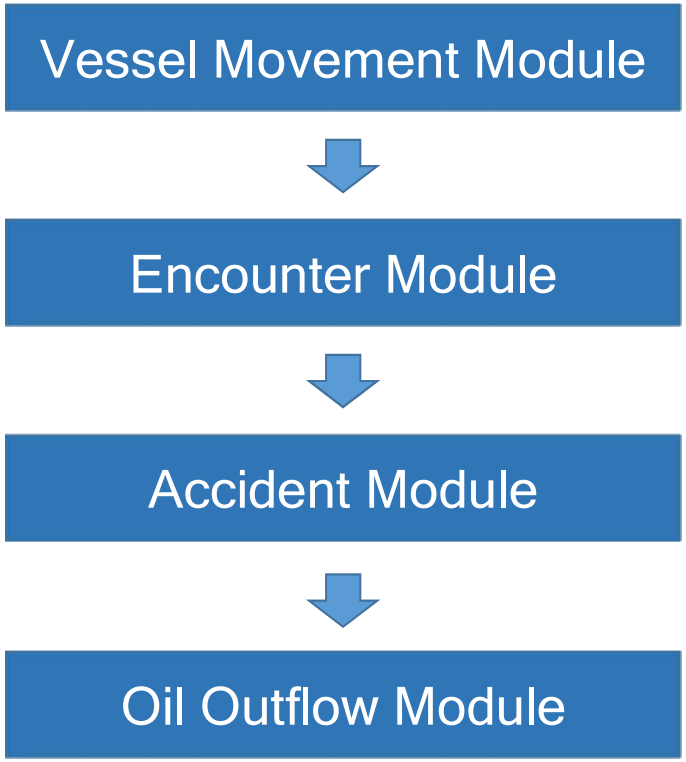
- Current status of our work on the Vessel Movement Module
- Current status of our work on the Vessel Encounter Module
- Next steps for Model Development

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

Modeling Approach



Vessels move in the system according to their empirical distribution

Measures and evaluates relationship of each vessel to the shore and other vessels

Evaluates situations for their potential to lead to accidents

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

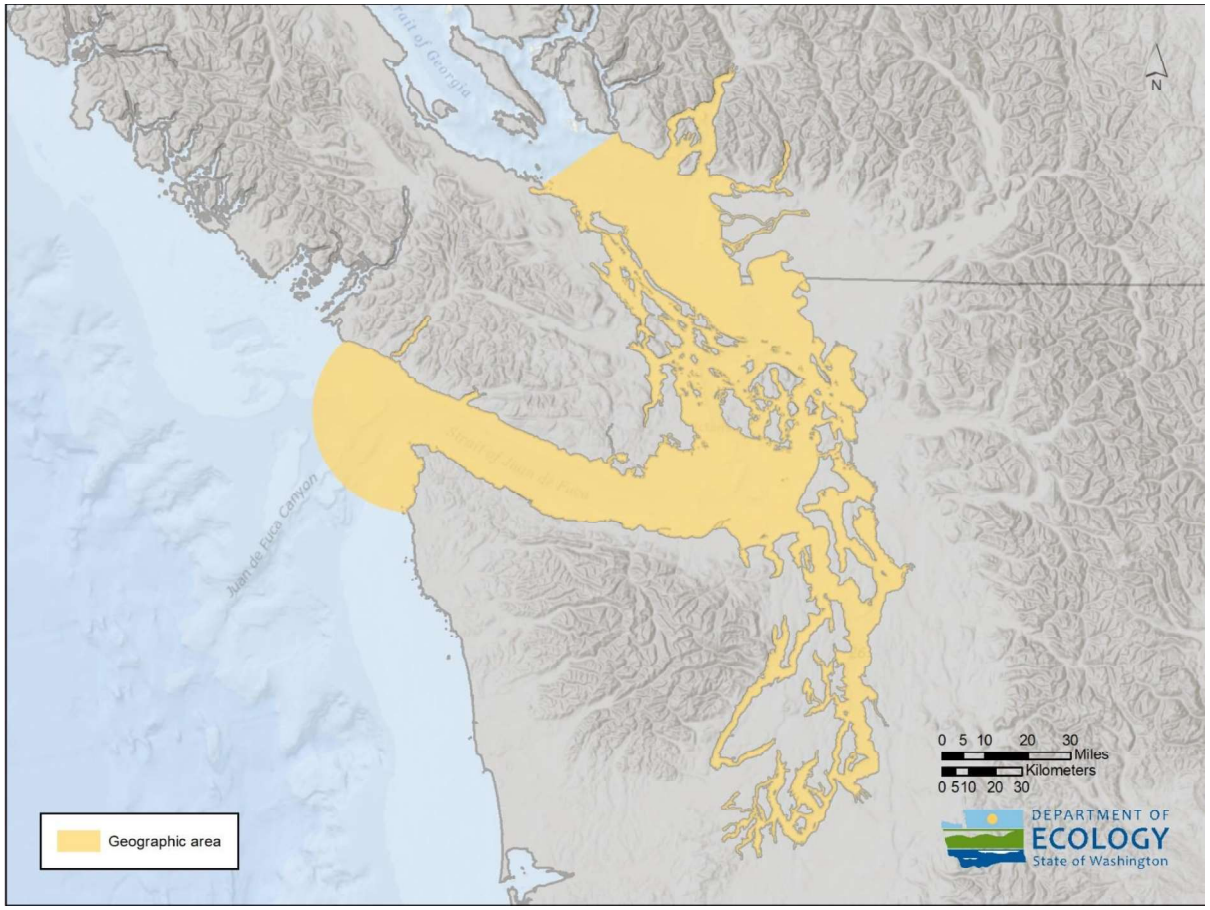
Each vessel moves on unique tracks

Tracks are created from AIS

Non AIS vessels TBD

Simulation output:

- Sets of simulated AIS messages
- Output resembles the observed AIS messages
- Has the flexibility to change traffic volumes by vessel type, origin, destination, etc.



Movement Module: Next Steps

Near Term:

- Add additional months of data to test set
- Add Ferries
- Continued testing of simulation algorithm

Longer Term:

- Non-AIS based vessels (tribal fishing, sport fishing, whale watching)
- Towing Vessels
- Dependent vessels (pilot boats, escort and assist tugs)
- Module Description Document

Vessel Encounter Module

Purpose:

- To identify if a vessel or obstacle is nearby enough to represent the possibility of a collision or a powered grounding

Role of the Encounter Module

Identify locations and potentialities of collisions

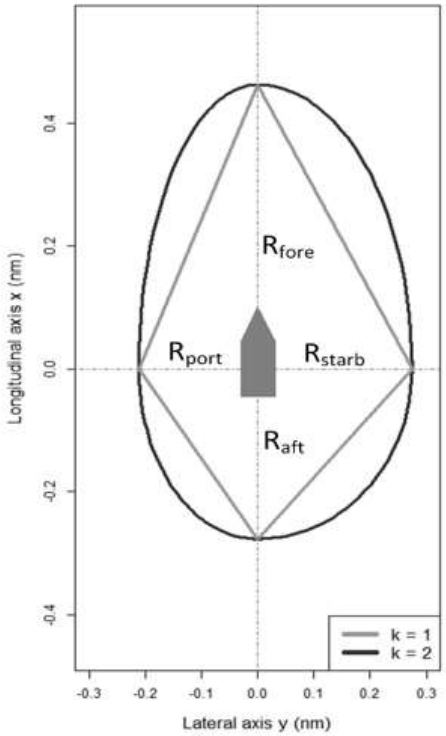
- A collision requires at least two vessels
- Excludes from accident calculation areas and moments where collisions can't occur

Identify locations and potentialities of powered groundings

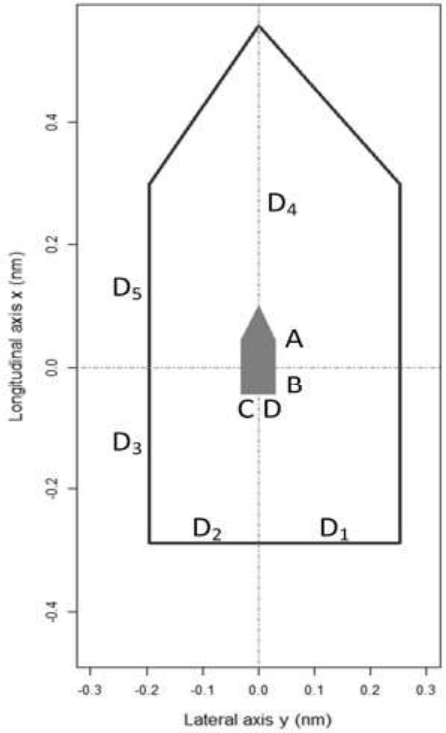
- A powered grounding requires a shoreline or underwater hazard
- Excludes from accident calculation areas and moments where groundings can't occur

Technical Discussion Review – Comparing Ship Domains

Quaternion Ship Domain (QSD) (Wang 2010)



Pentagonal Ship Domain (Bakdi 2019)



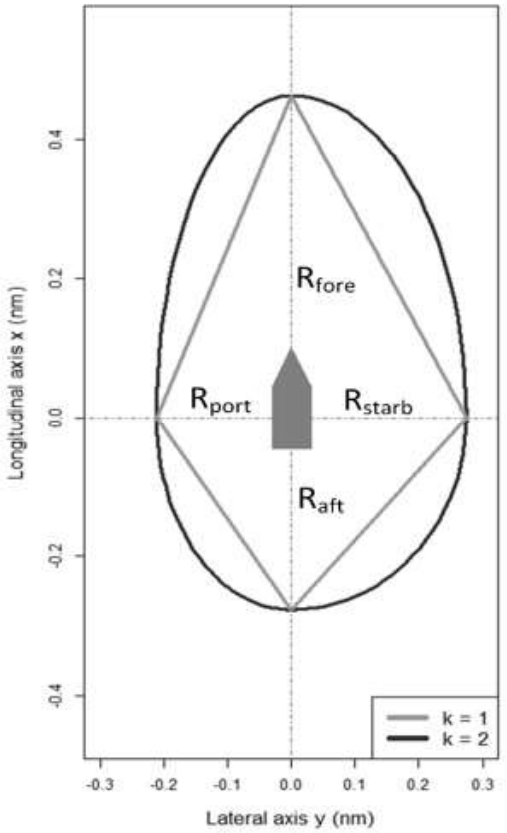
Areas for Further Discussion

Tugs Towing Astern

- Length of tow/length of barge

Grounding Encounters

- Representing the possibility of a collision or a powered grounding

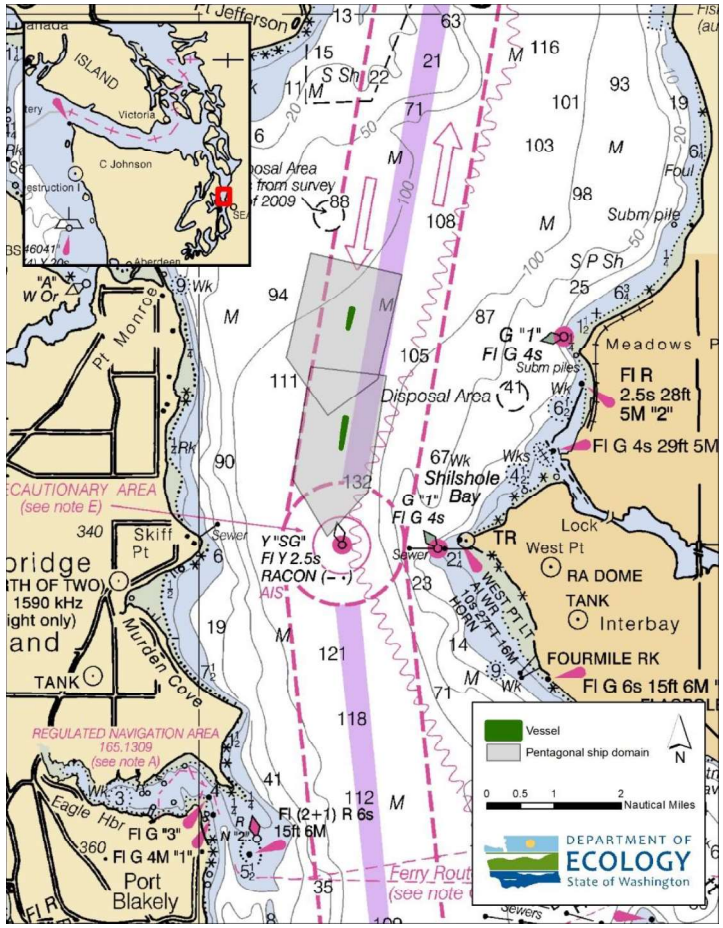


Ship Domains for Tugs and Tows

Vessel characteristics include tow length and barge length

- Towing Astern:
  - Length of Tow: .13 nautical miles
  - + or - .05 nm

- Pushing Ahead
  - Identified subset of vessels



An Approach for Powered Groundings

Defining powered grounding

- Grounding due to navigational error or mechanical issue while vessel is under power

Defining a "grounding candidate"

- The simultaneous presence of a vessel and an underwater hazard in a finite area

How nearby is nearby enough

- No consensus on proximity measure and threshold

Fewer models available in the literature

- Ship domain and CPA based approaches

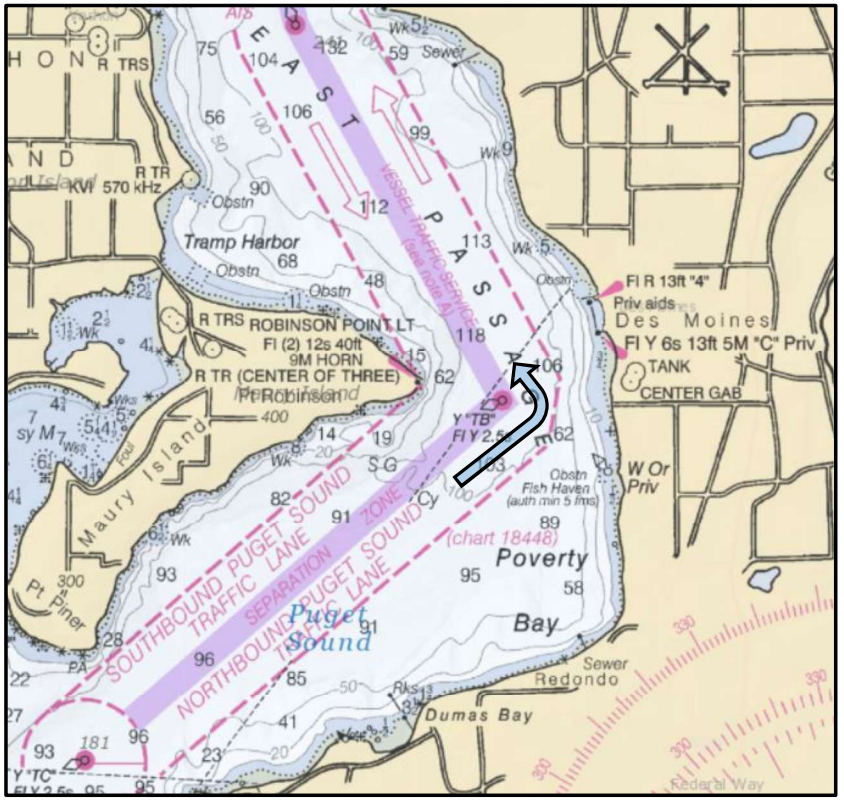
Selecting an Encounter Model for Powered Groundings

Model requirement

- Appropriate for critical turns

Critical turn models

- Calculate straight line extending along vessel heading
- Of varying lengths, of varying shapes



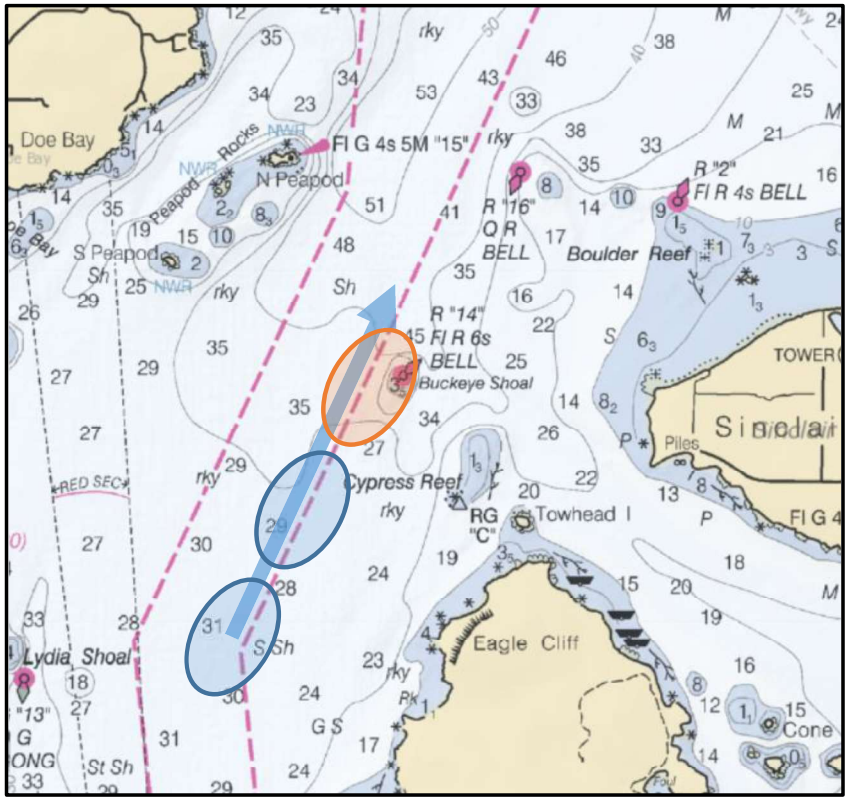
Selecting an Encounter Model for Powered Groundings

Model requirements

- Appropriate for lateral proximity

Lateral proximity models

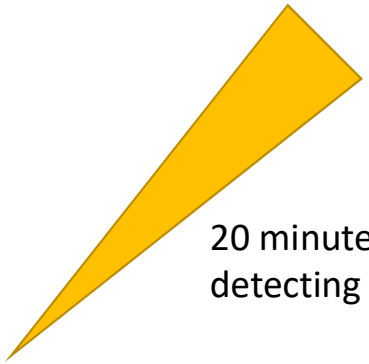
- Various ship domains



Combined Approach for Grounding Candidates

Critical turn detection

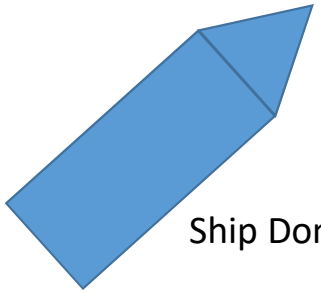
- 20 minute vector cone
  - Fowler and Sorgard (2000)
  - Skinnemoen (2018)



20 minute vector cone for detecting critical turns

Lateral proximity detection

- Existing ship domain model
  - Wang (2010)
  - Bakdi (2019)



Ship Domain for detecting lateral proximity

Detecting overlap with underwater hazards

Two types of grounding candidates

- Vessel draft exceeds water depth
  - within area of cone
  - within area of ship domain

Data Sources

- Vessel drafts
- Bathymetric data

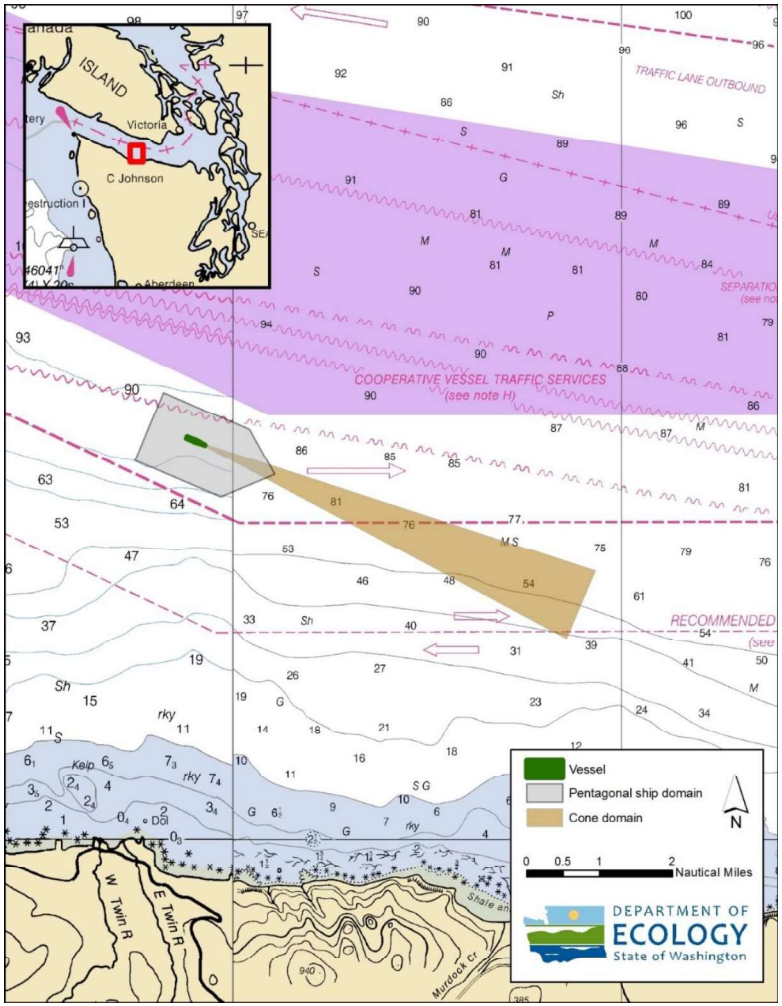
Grounding candidate model selection

Variety of vessels	• Ship domain includes ship length and width
Sensitive to speed	• 20 minute vector linked to speed
Okay for simulated data	• Does not require detailed maneuvering data
Detects turns and lateral proximity	• Combined approach
Computational efficiency	• Relatively simple, well documented and reproducible

Potential Grounding Candidates

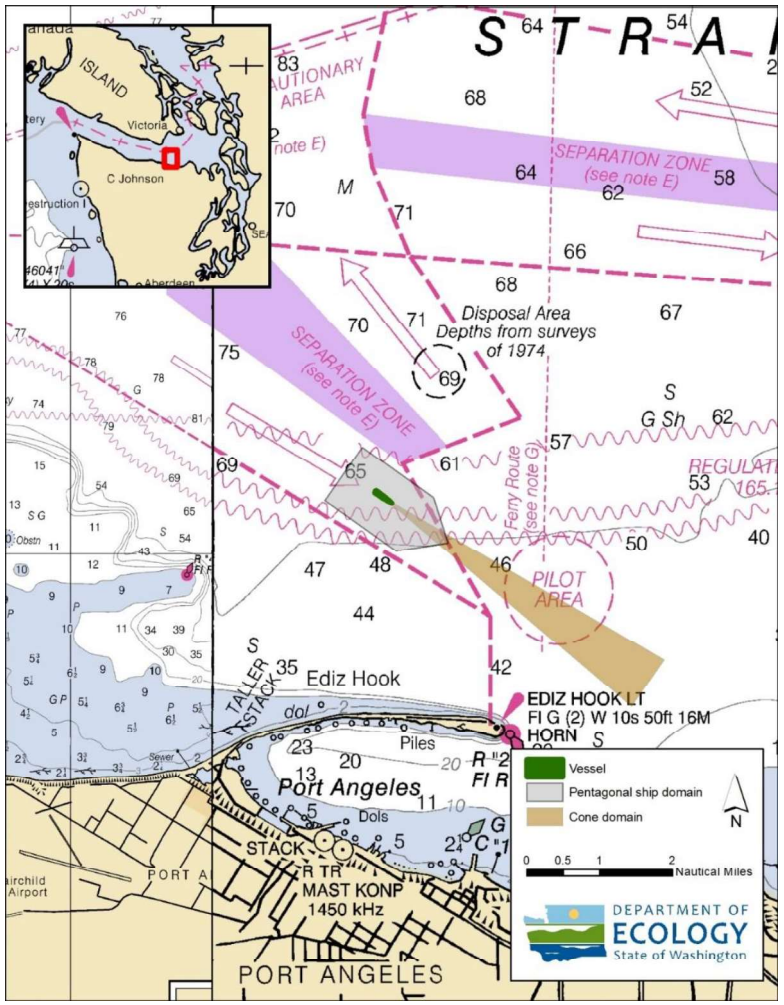
Inbound in Strait of Juan de Fuca

- LPG Tanker
  - Length: 740 feet
  - Beam: 120 feet
  - Draft: 30 feet



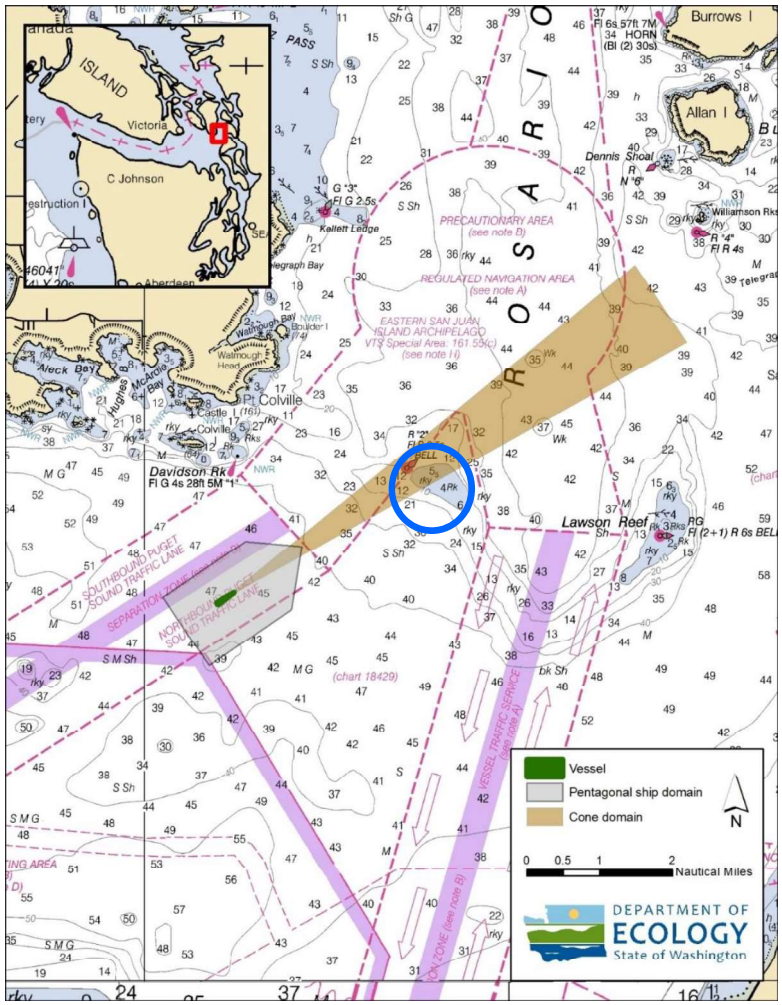
Potential Grounding Candidates

Approaching Port Angeles Pilot Station



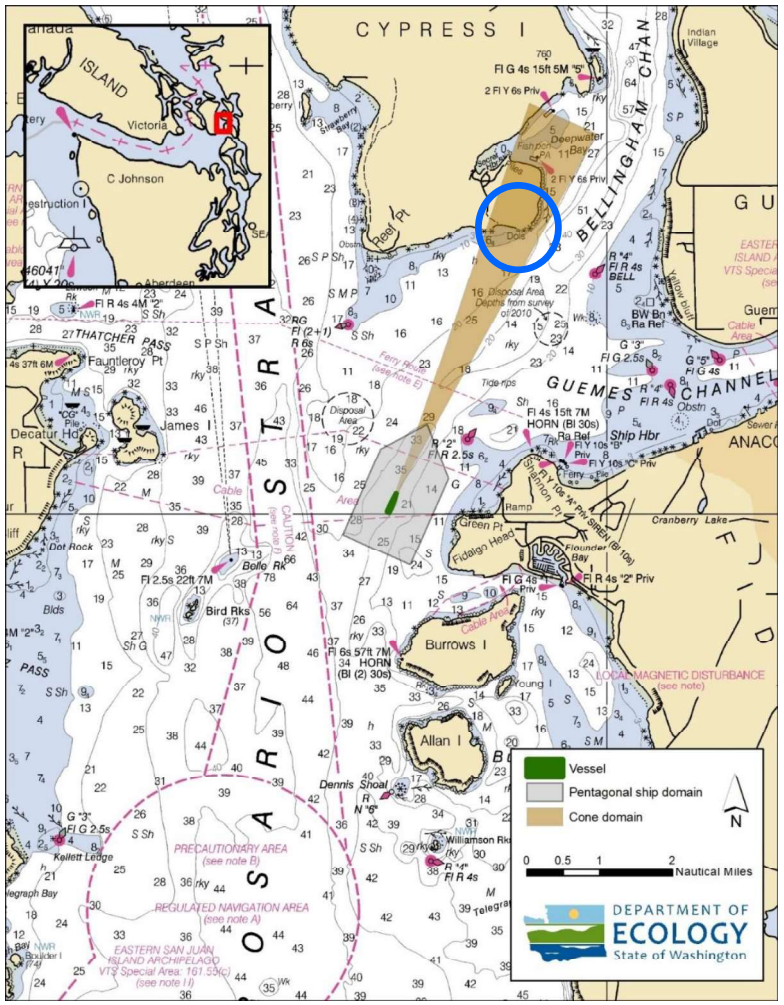
Potential Grounding Candidates

Approaching Southern Entrance to Rosario



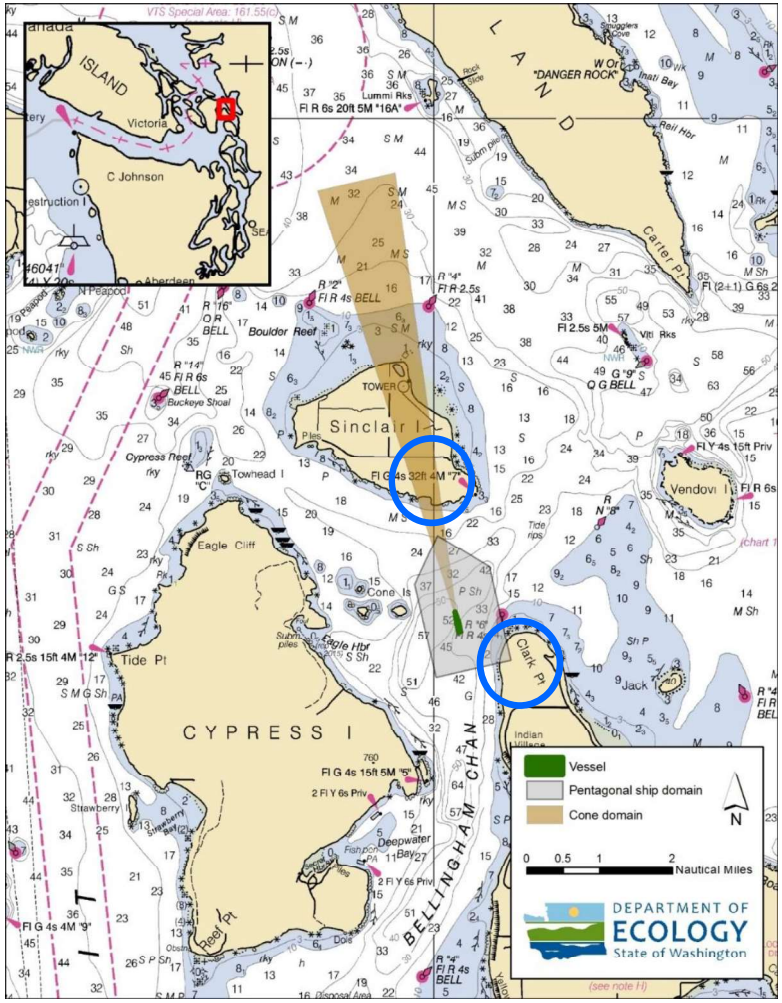
Potential Grounding Candidates

Approaching Southern End Bellingham Channel



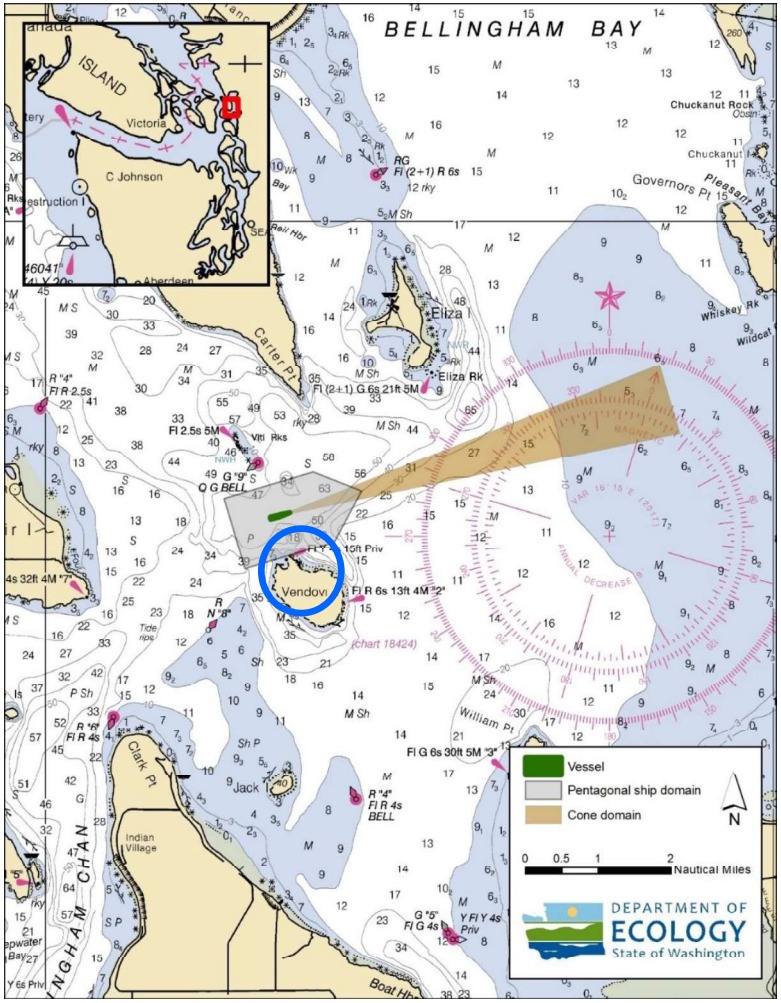
Potential Grounding Candidates

North End Bellingham Channel



Potential Grounding Candidates

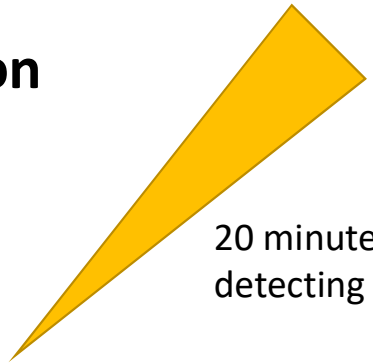
Approaching Vendovi Anchorage



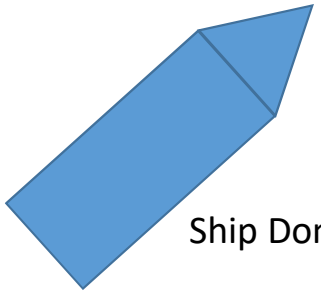
Areas for Further Discussion

Grounding Candidates of Long Duration

- Narrow channels
- On approach to port



20 minute vector cone for detecting critical turns



Ship Domain for detecting lateral proximity

Encounter Module: Next Steps

Near Term

- Test Encounter Models
- Test Grounding Models

Longer Term

- Validate model results for simulated data and AIS data

Survey on Model Development Outreach

First survey for feedback on outreach process

- Sent out to more than webinar 400 registrants
- 17 responses received

Survey Results

Generally happy with outreach so far

- Webinars described as very helpful, helpful, or somewhat helpful
- Rated outreach efforts at 7-10 out of 10
- 86% say our outreach process is meeting their expectations

Not all outreach tools are helpful

- 44% described eComment as unhelpful

Survey Results

Sample comments

- Please be less scripted in the webinars
- Get greater industry participation and involvement
- Simply equating congestion to vessel encounters will not be sufficient
- How will localized weather conditions be incorporated into the model?

Outreach Adjustments

Streamline tools

- Discontinuation of eComment tool, for now

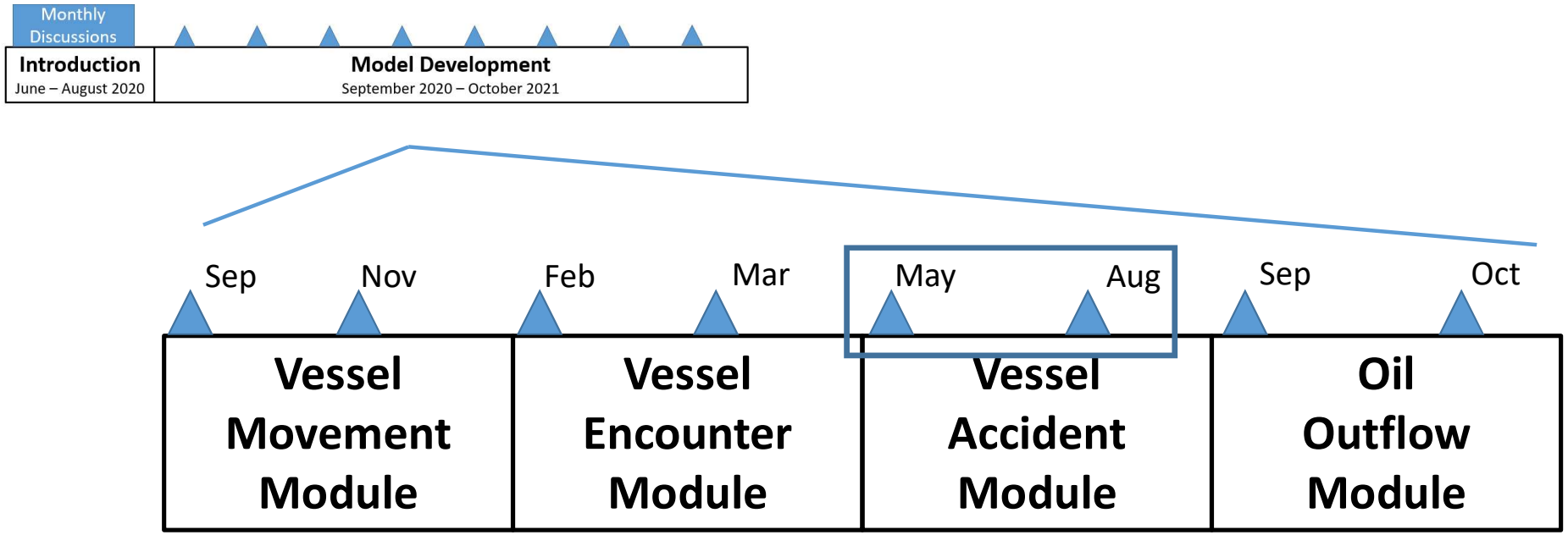
Reduce scriptedness

- Alterative platforms for technical discussions

Produce additional resources

- Frequently asked questions document

Webinars and Technical Discussions

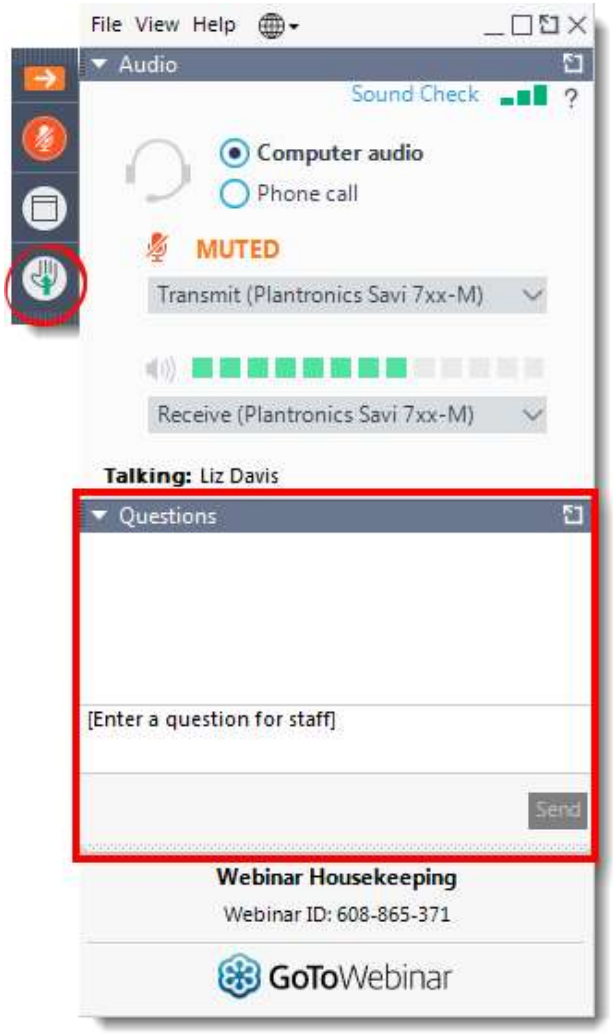


Upcoming events

May 26th, 2021 -- 1 pm to 3 pm

- Vessel Accident Module Webinar

Discussion logistics



Today's discussion topics

- Current status of our work on the Vessel Movement Module
- Current status of our work on the Vessel Encounter Module
- Next steps for Model Development

Contact Info

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References

Bakdi, A., I. K. Glad, E. Vanem, and Ø. Engelhardtsen. 2019. AIS-Based Multiple Vessel Collision and Grounding Risk Identification based on Adaptive Safety Domain. Journal of Marine Science and Engineering 8:5.

Fowler, T.G., and E Sorgard. 2000. Modeling Ship Transportation Risk. Risk Analysis 20:225-244.

Skinnemoen, M. M. 2018. Automated calculation of risk related to ship traffic: 28.

Wang, N. 2010. An Intelligent Spatial Collision Risk Based on the Quaternion Ship Domain. Journal of Navigation 63:733–749