Oil Outflow Module

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Model Development Team

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Today's outline

1. **Background**
2. **Oil Outflow Considerations**
3. **Mechanical/Mechanistic Approach**
4. **Statistical Approach**
5. **Next Steps**

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

Describing oil spill risk

Scenarios

- Hazard identification: collision, allision, grounding, etc.

Probability

- How likely is each hazard?

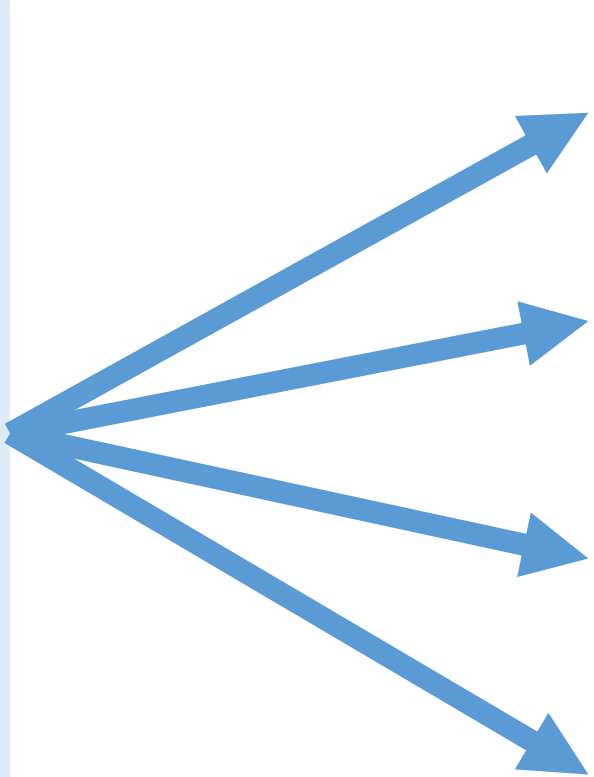
Consequences

- If an accident happens, how likely is that an oil spill occurs, where will it occur, and what volume and type of oil will be released?

Consequence

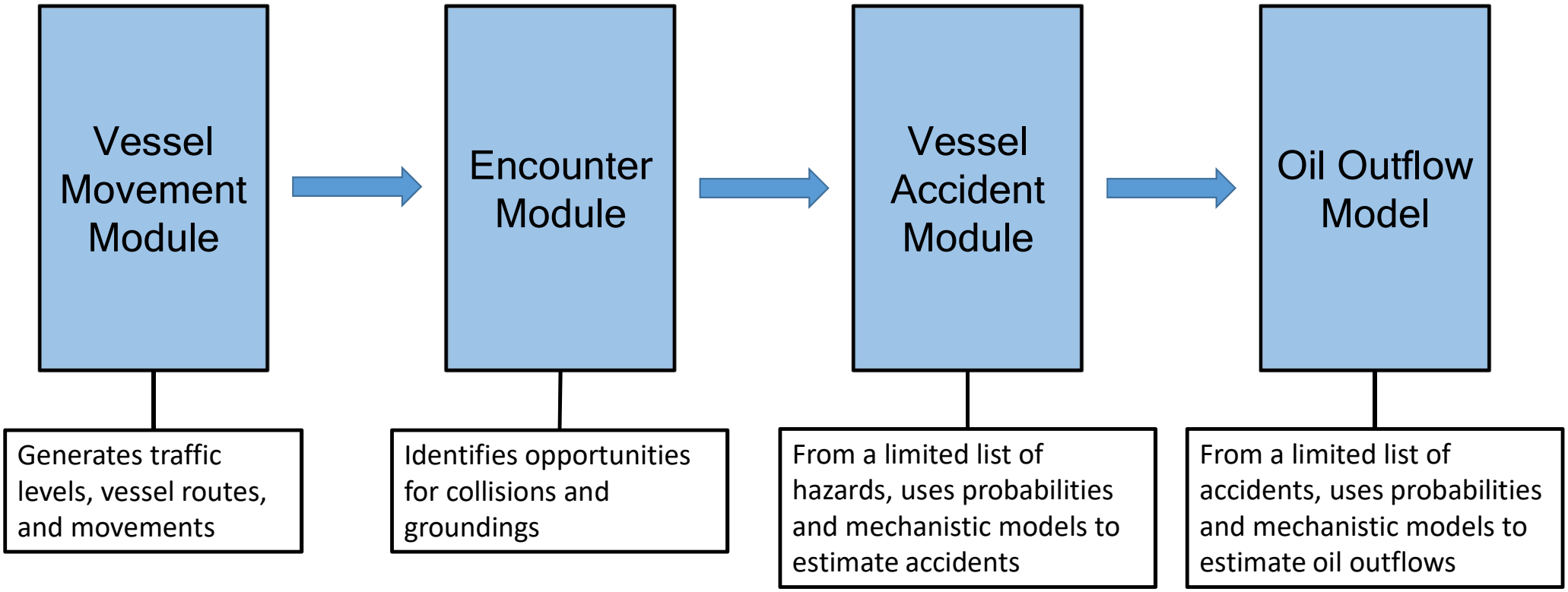
Model Outputs:

- Geographic location of spills
- Date and time of spills
- Type of oil spilled
- Amount of oil spilled
- Incident characteristics
- Accident characteristics



- Cultural Damage
- Ecological Damage
- Economic Damage
- Human Health Hazard

Modeling Approach



Oil Outflow

After determining an accident has occurred

- Does oil enter the water?
- How much oil enters the water?

Why ask if oil enters the water?

- Some hazards may not necessarily result in a spill, e.g.
  - Allisions
  - Collisions
  - Groundings

Decoupled From Hazard Probability

Probability of Oil Entering the Water

- Two step process
- Hazard + Outflow

Benefits of Decoupling

- Hazard occurrence can be an output of the model
- We can use different populations of interest for hazards vs outflows

Approach to Modeling Oil Outflow

Statistical

- Data based
- Derived from historical occurrences

Mathematical/Mechanistic

- Theory based

Mathematical/ Mechanistic Approach

Primary Approaches in Literature

- Damage estimation
  - Damage Location and Extent
- Outflow dynamics
  - Rates of oil flow based on the location and size of the breach

Hybrid Approaches

- Models of simulated results of other models
- Only available mechanistic models only cover groundings and collisions for tank vessels.

Mathematical/Mechanistic Approach

Strengths

- Better at representing less common events
- Allow us to incorporate accident and vessel characteristics
  - E.g. Rocky bottom, double hull, etc.

Weaknesses

- Rely on a number of assumptions

Plan for Mechanistic Approach

Hybrid Method

- Tank Vessels: Product Tankers, Crude Tankers, ATBs, Towed Oil Barges

- Collisions and Groundings

Methodology

- Parallel to VTRA methods
- Simulation using SIMCOL and DAMAGE models
- Regression analysis to estimate:
  - damage extent given ship velocities, ship masses, and collision angles
  - the probability that oil spill occurred

Parameters for Mechanistic Approach

To be calculated from model outputs

- Vessel and accident characteristics
  - E.g. Vessel mass and speed, collision angle, etc

To be pulled from existing data

- Tank configuration
- Bottom characteristics

To be estimated

- Oil cargo onboard
- Fuel onboard
- Oil distribution between tanks

Statistical Approach

Data-based approach

- Establish population of interest
- Count occurrences (e.g. oil spill)
- Count opportunities (e.g. grounding)

For all remaining vessel and hazard types

- All non-tank vessel accidents
- All tank vessel accidents that are not collisions, allisions, and groundings

Plan for Statistical Approach

Probability of Oil Spill

- Establish population of interest
- Count occurrences (e.g. oil spill)
- Count opportunities (e.g. grounding)

Quantity Estimate

- Review occurrences (oil spills)
- Review spill volumes
- Build a function for spill volume based on potential factors (e.g. vessel type, oil capacity, etc)

Population of Interest for Oil Spill and Oil Outflow

Should be large

- We can't rely on "zero failure methods" in the case of insufficient data

Less sensitive to geography

- Spill occurrence and quantity have more to do with vessel and accident characteristics
  - E.g. vessel size, speed, etc

Some sensitivity to temporal scope

- Recent rule changes for fuel tank protection

Limitations and Potential Challenges

Limitations

- Spills modeled as “instantaneous”
- Mechanistic model can’t account for post accident interventions

Potential Challenges

- Data limitations could limit factor evaluation

Current Status of Model Development

Modeling Approach

- Oil Outflow presentation is milestone in development of our modeling approach
- All four modules sketched out and in place

Next Steps

- Coding, research and statistical analysis to put the model pieces together and fill in the details

Current Status

Vessel Movement Module

- Ongoing coding of movements associated with anchoring stays, Turn point and Rosario “one-way” rules
- Initial progress on coding movements of dependent vessels

Vessel Encounter Module

- Initial coding complete for calculating domain sizes for both QSD Domain and Pentagonal Domain

Upcoming Outreach

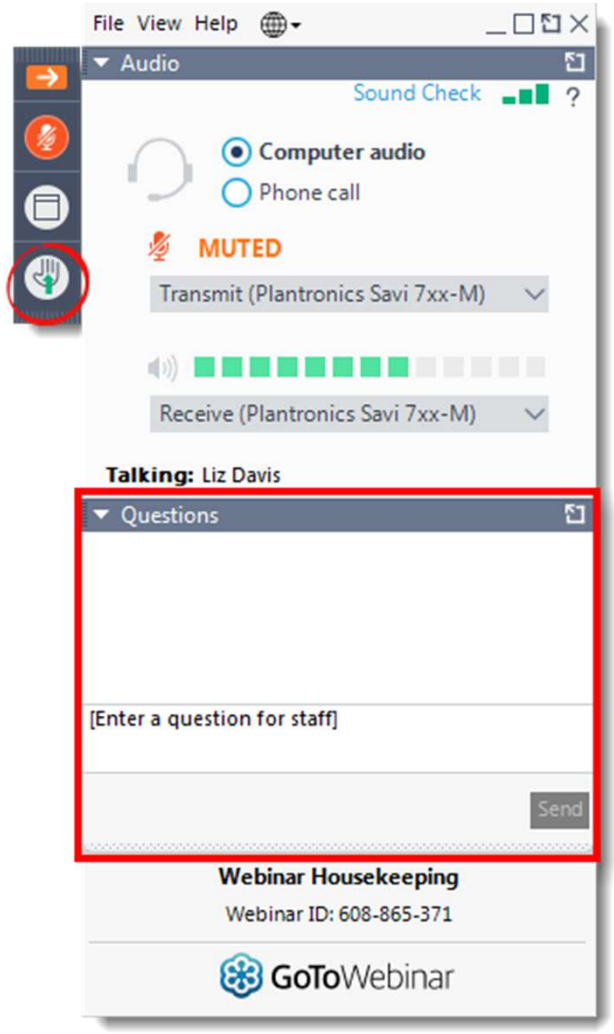
Modeling Development

- Outreach as needed to communicate progress and solicit feedback
- Targeting Spring 2022

Analysis Projects (ERTV and Tug Escorts)

- Draft Scopes of Work for ERTV and Tug Escort out for comment
- Webinars and events planned for 2022

Discussion logistics



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