Vessel Drift and Response Analysis for the Strait of Juan de Fuca to the Southern Strait of Georgia

Islands Trust Council Meeting

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Project Team

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**Appreciation, influence, but not necessarily concurrence*

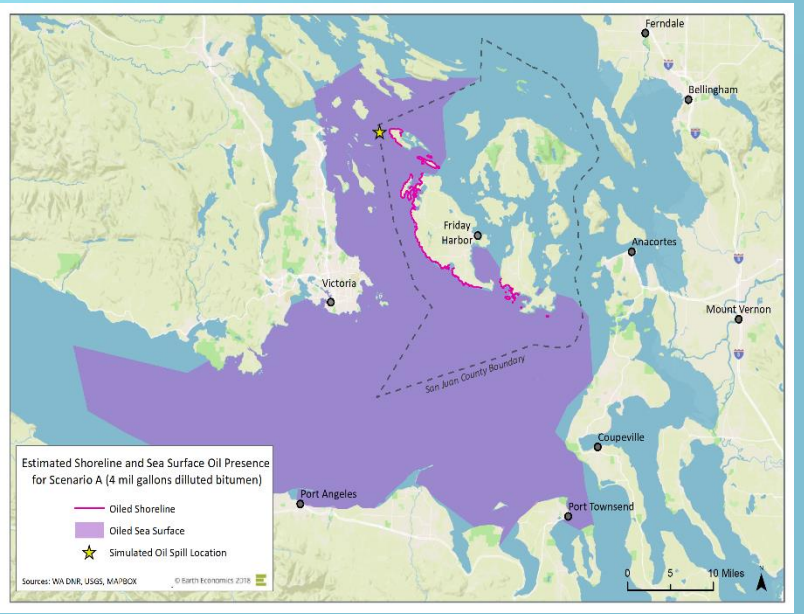
Agenda

1. Background
2. Project Objectives
3. Research Question 1 – Drift Time to Grounding
4. Data Sources
5. Limitations
6. Results – Time to Grounding Maps
7. Research Question 2 – ERTV Response Time Analysis
8. Findings
9. Questions and Discussion of Next Steps

Background

- Investment in an emergency response towing vessel (ERTV) to reduce the risk of an oil spill has transboundary support

- Sept 2016: ERTV for Haro Strait and Boundary Pass was ranked a priority risk mitigation measure at Dept of Ecology Spill Risk Mitigation Workshop – **needing cost/benefit business model**



COMPLETED JAN 2019

- May 2018: Islands Trust and San Juan County jointly requested Transport Canada to position an ERTV in Sidney

Background

- 2018: SB 6267

  Owners of operators of covered vessels transiting to or from WA port to establish fund for an ERTV (did not pass)

- 2019: HB 1578 Sponsored by Rep. Lekanoff

  Requires Dept of Ecology to develop a model and quantitatively assess whether an ERTV serving Haro Strait, Boundary Pass, Rosario Strait, and connected navigable waterways will reduce oil spill risk by Sept 1, 2023 (adopted Mar 7, 2019)

- Nov 2019: Orca Task Force Recommendation 24

- Questions remained on whether or not an ERTV could be effective in responding to incidents in these narrow waterways

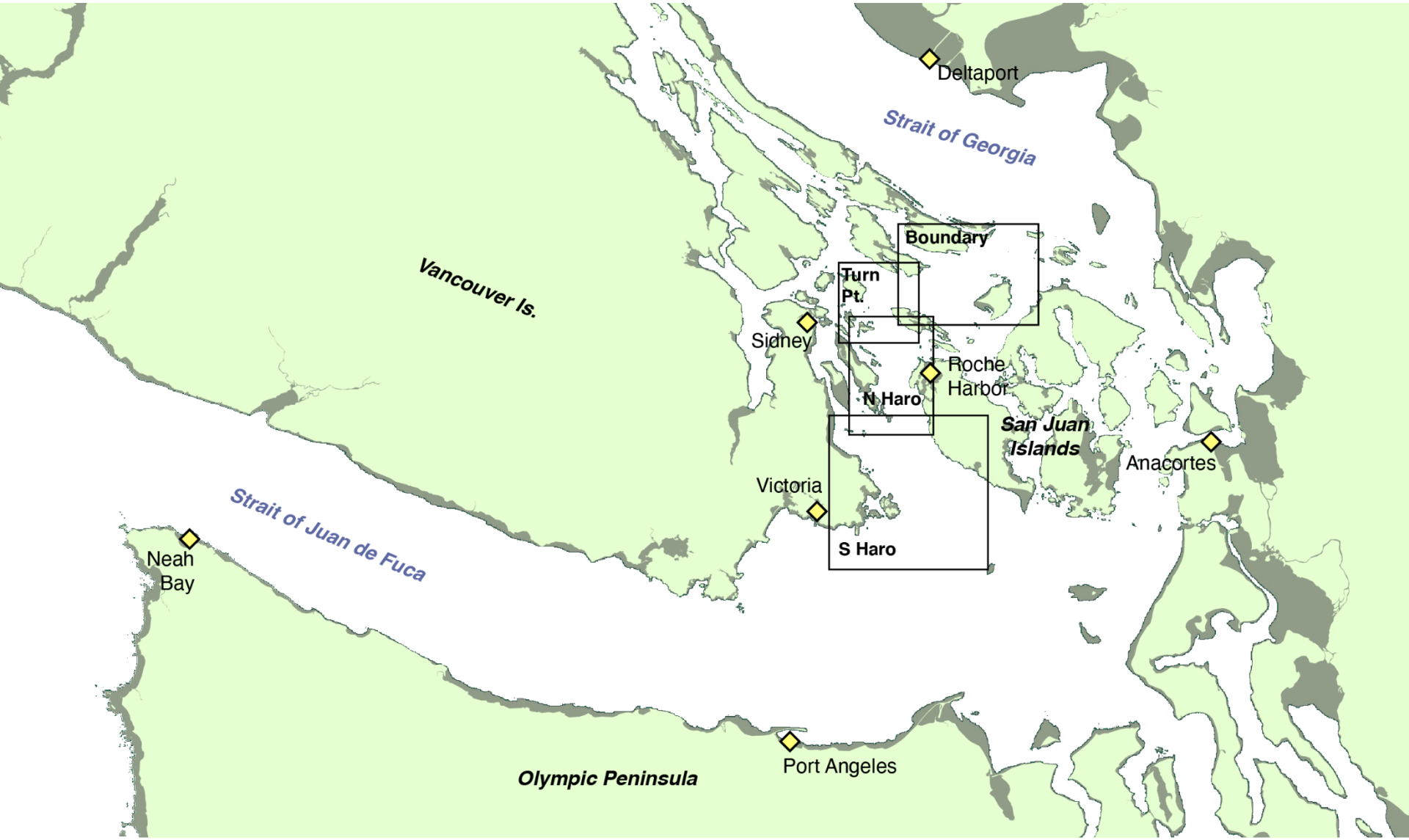
Project Objectives

- To inform discussions and decisions on vessel traffic safety and oil spill risk mitigation measures in the Salish Sea.
- Apply methods and model developed by Nuka Research and Planning Group, LLC for Canada's west coast extended to inland waters.
- To analyze the time available to rescue a disabled vessel adrift in the inland waters extending from the Strait of Juan de Fuca to Burrard Inlet before it grounds, and the time that it would take for an emergency response towing vessel (ERTV) to rescue ships adrift on the north and west sides of the County, thus reducing the risk of an oil spill.

Research Question 1

1. For any given location, how much time would be available for an ERTV to arrive at a disabled ship before it may drift aground when considering wind and currents?

Study Area


Deltaport
Strait of Georgia
Boundary
Turn Pt.
Vancouver Is.
Sidney
Roche Harbor
N Haro
San Juan Islands
Anacortes
Victoria
S Haro
Strait of Juan de Fuca
Neah Bay
Port Angeles
Olympic Peninsula

Model Inputs

1. Currents and winds from the Salish Sea Current Model (SSCM) produced by the University of Washington for the years 2014 – 2017
2. Ship drift algorithm

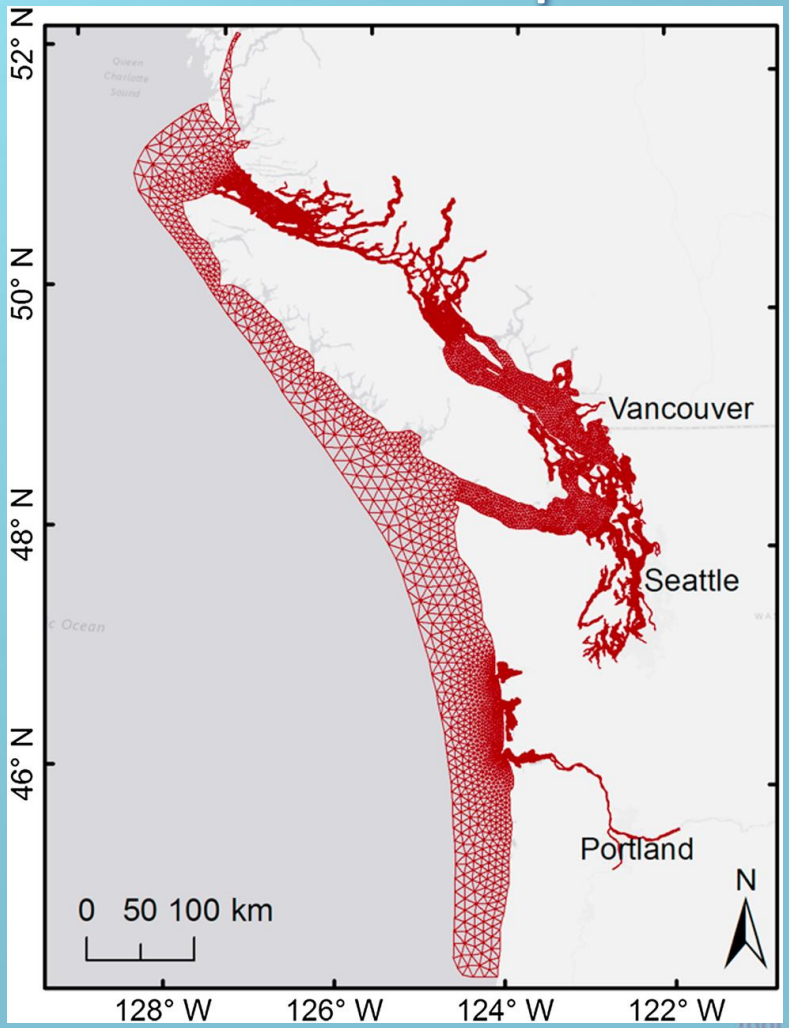
Model Runs

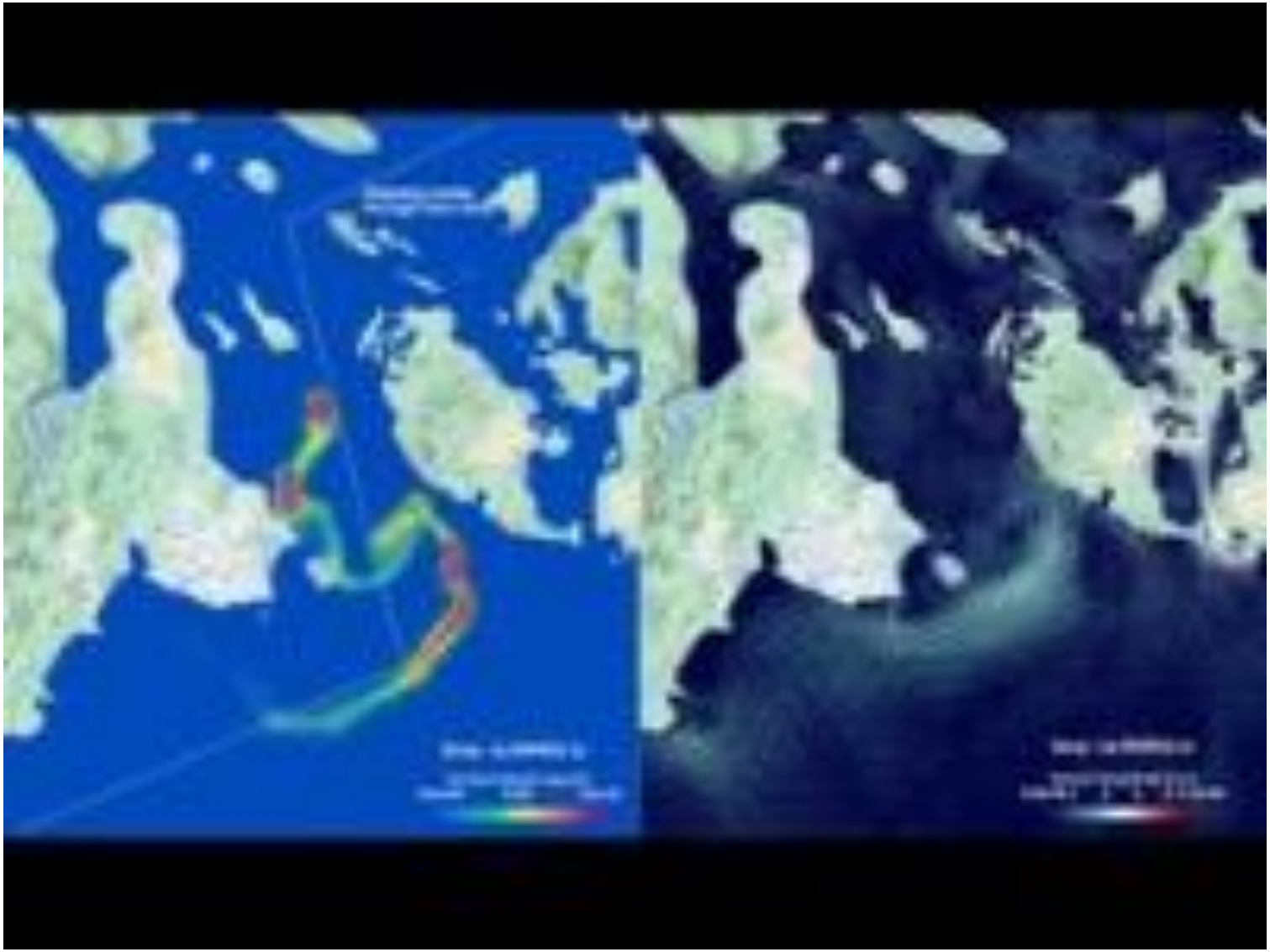
Model Resolution - The geographic scope was divided into approximately 3.7 million 100-m x 100-m grid cells.

Model Runs and Data - approximately 6,500 model runs yielded approximately 15.6 billion estimates of ship drift-to-grounding times. This dataset is the basis of subsequent analysis.

Salish Sea Model Development 2009 – present

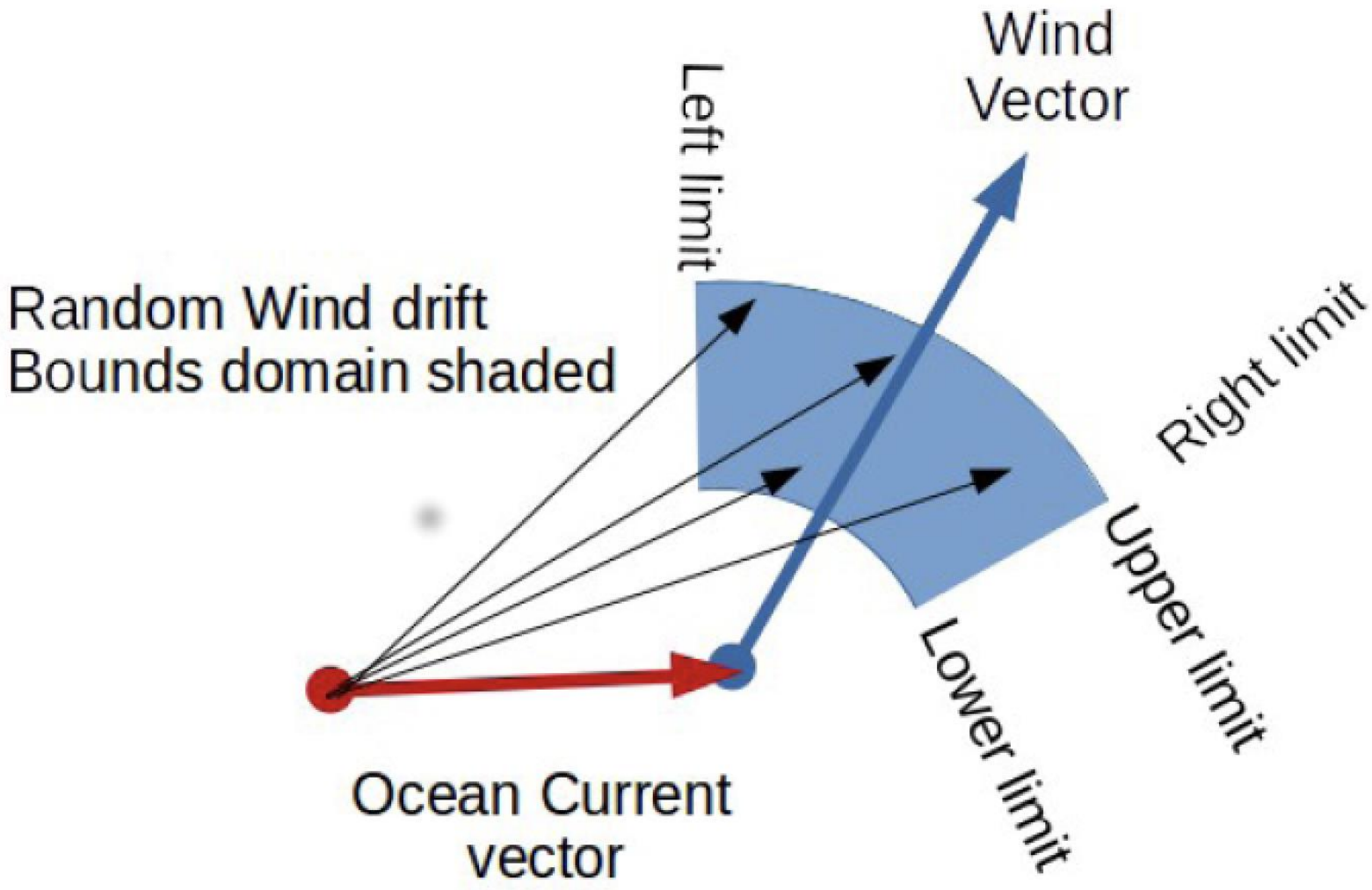
- Originally for Hypoxia and Nutrient Pollution Management
- Zooplankton, Eelgrass/SAV, Turbidity & Light, DO, pH
- Calibration to NOAA buoy wind and currents (2015-2017)





Ship Drift Trajectory

- Calculated for a loaded, mid-size containership (7,500 TEU, 83,000 DWT)
- 100% of the current speed and direction
- Proportion of the wind speed calculated from a wind drift analysis
- Varied randomly by a function drawn from a normal distribution of drift angles between 45 degrees left or right of the wind to account for uncertainty of the vessel sailing off the wind



Based on Galt and Hanson, 2015

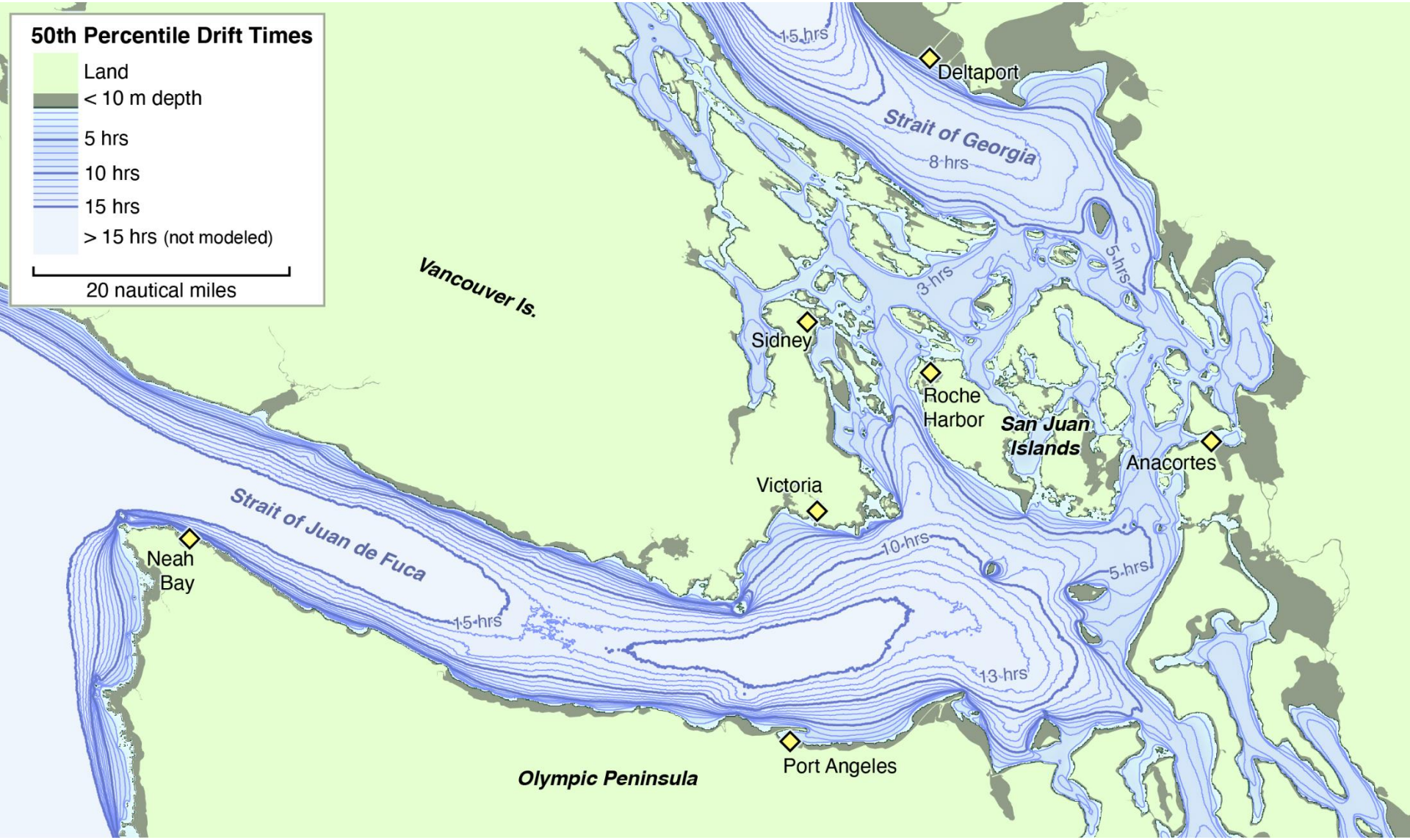
Understanding Results

Maps showing the amount of time a ship is estimated to drift before grounding from any point in the geographic scope of the model.

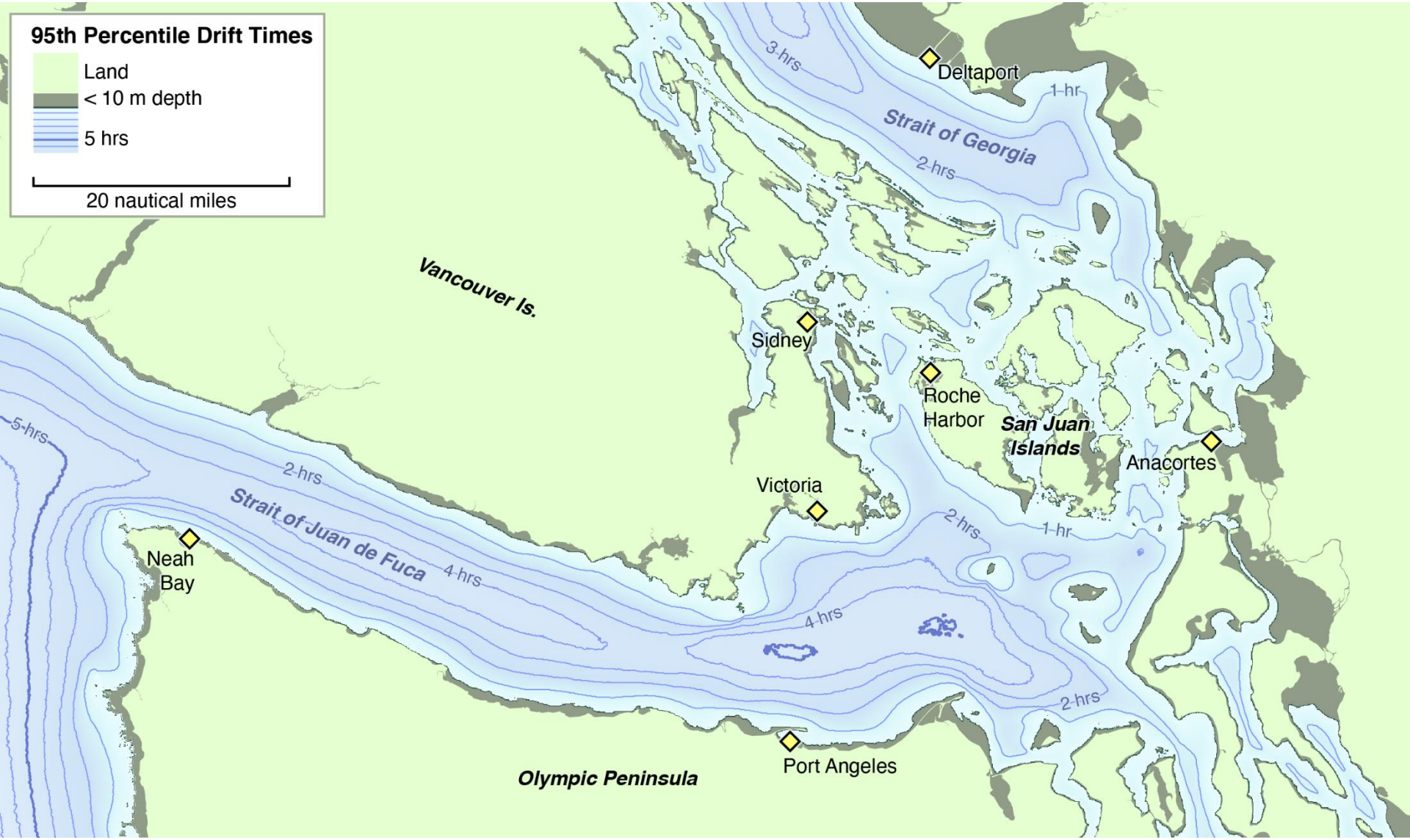
Limitations

- Models are a limited attempt to approximate complex real-world systems with a numeric analysis. Many models are useful, but no model is an exact representation of actual events.
- The model does not account for the disabled vessel's momentum, either as it slows from loss of power or as the force on the vessel changes direction. The analysis begins at the time the vessel's movement is controlled solely by currents and winds.
- The model does not account for actions of the master, pilot, or crew to self-arrest, maneuver or otherwise intervene in the drift of the vessel.
- This study modeled a mid-size container ship. There is more uncertainty about drift characteristics for other ship types.

“Median Case”


50th Percentile Drift Times
Land
< 10 m depth
5 hrs
10 hrs
15 hrs
> 15 hrs (not modeled)
20 nautical miles
Vancouver Is.
Strait of Georgia
Strait of Juan de Fuca
Olympic Peninsula
San Juan Islands
Deltaport
Sidney
Roche Harbor
Anacortes
Victoria
Neah Bay
Port Angeles
1.5 hrs
8 hrs
5 hrs
3 hrs
10 hrs
13 hrs

“Bad Case”

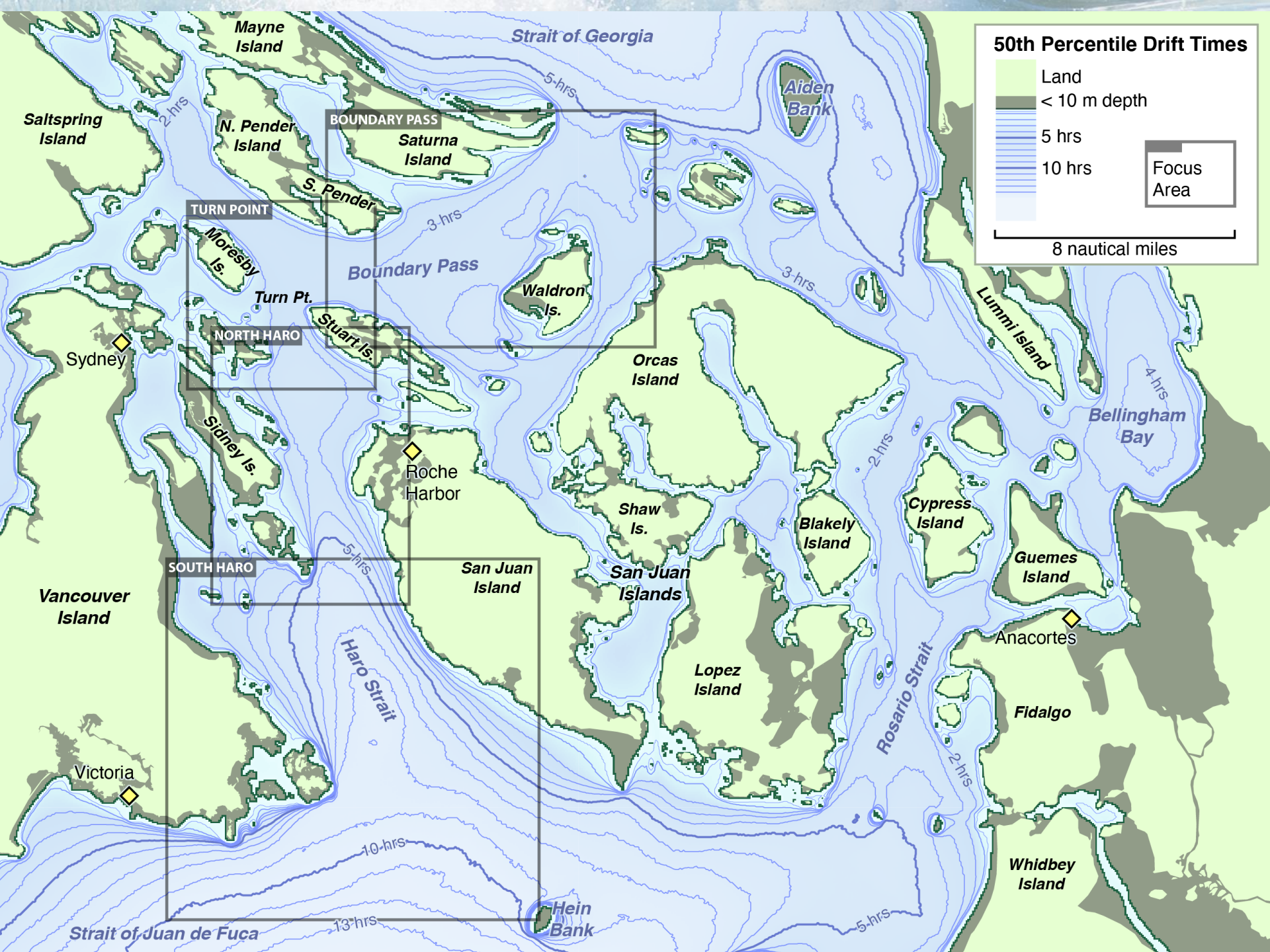

95th Percentile Drift Times
Land
< 10 m depth
5 hrs
20 nautical miles
Vancouver Is.
Olympic Peninsula
Strait of Georgia
Strait of Juan de Fuca
San Juan Islands
Deltaport
Sidney
Roche Harbor
Anacortes
Victoria
Neah Bay
Port Angeles
3-hrs
2-hrs
1-hr
5-hrs
4-hrs

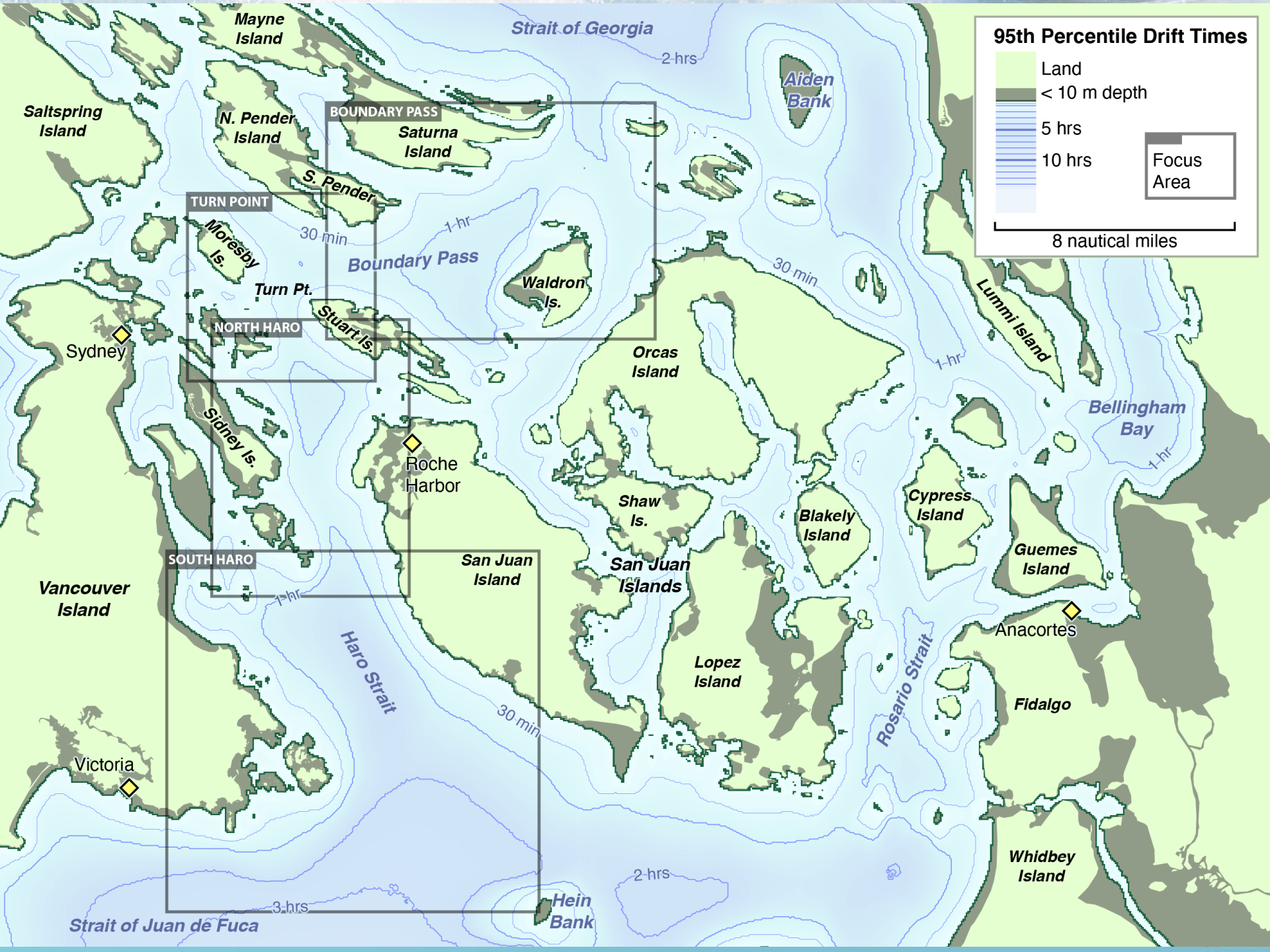
Questions on vessel drift model?

Research Question 2

2. Considering four focus areas around San Juan County, what is the probability that a tug could arrive before a disabled ship on a typical route might drift aground?

- Estimates response times to 4 focus areas from 7 potential ERTV origin points


50th Percentile Drift Times
Land
< 10 m depth
5 hrs
10 hrs
Focus Area
8 nautical miles
Strait of Georgia
Mayne Island
Saltspring Island
N. Pender Island
Saturna Island
S. Pender
BOUNDARY PASS
TURN POINT
NORTH HARO
SOUTH HARO
Moresby Is.
Turn Pt.
Stuart Is.
Boundary Pass
Waldron Is.
Aiden Bank
Orcas Island
Lummi Island
Bellingham Bay
Sydney
Sidney Is.
Roche Harbor
Shaw Is.
San Juan Island
San Juan Islands
Blakely Island
Cypress Island
Guemes Island
Anacortes
Vancouver Island
Haro Strait
Lopez Island
Rosario Strait
Fidalgo
Victoria
Whidbey Island
Hein Bank
Strait of Juan de Fuca
2-hrs
3-hrs
4-hrs
5-hrs
10-hrs
13-hrs


95th Percentile Drift Times
Land
< 10 m depth
5 hrs
10 hrs
Focus Area
8 nautical miles
Strait of Georgia
2 hrs
Mayne Island
Saltspring Island
N. Pender Island
Saturna Island
S. Pender
BOUNDARY PASS
TURN POINT
NORTH HARO
SOUTH HARO
Moresby Is.
Turn Pt.
Stuart Is.
Sidney Is.
Sydney
Boundary Pass
30 min
1 hr
Waldron Is.
Aiden Bank
Orcas Island
Roche Harbor
Shaw Is.
San Juan Island
San Juan Islands
Blakely Island
Cypress Island
Lummi Island
Bellingham Bay
Guemes Island
Anacortes
Fidalgo
Whidbey Island
Rosario Strait
Lopez Island
Haro Strait
Vancouver Island
Victoria
Hein Bank
3 hrs
Strait of Juan de Fuca

ERTV Origin Points Analyzed

- Neah Bay
- Port Angeles
- Anacortes
- Roche Harbor
- Victoria
- Sidney
- Deltaport

Understanding Results

Graphs showing how the percentage of ships still drifting versus time and compared to the amount of time it takes an ERTV to arrive on-scene from a given start location.

Estimated Time to Rescue for Areas of Interest

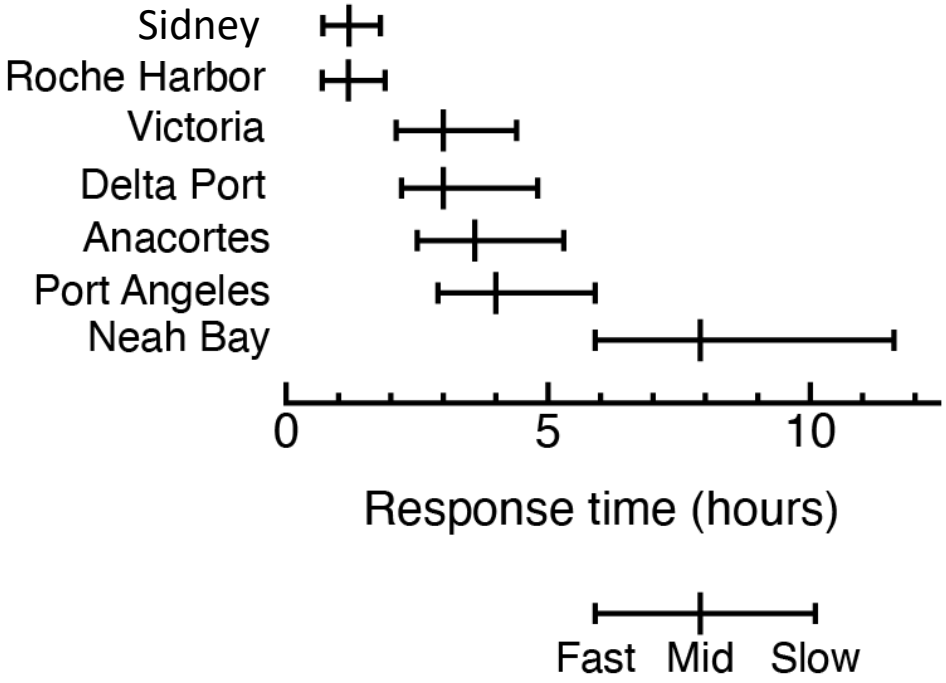
(hours) Includes transit time plus 0.5 hours for mobilization and time on-scene

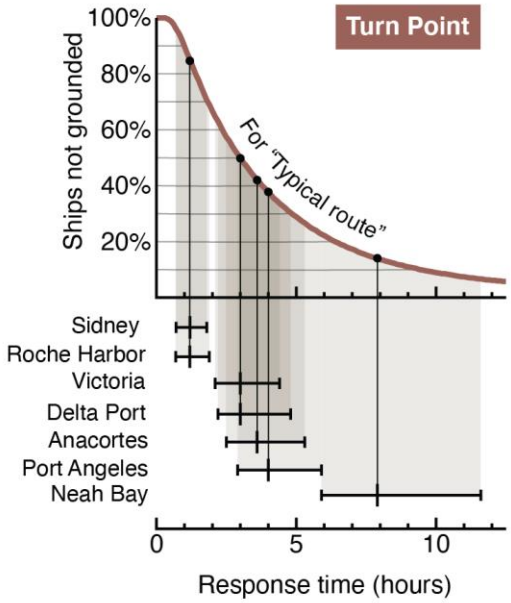
	Turn Pt		
	Fast	Mid	Slow
Sidney	0.7	1.2	1.8
Roche Hrb	0.7	1.2	1.9
Victoria	2.1	3.0	4.4
Delta Port	2.2	3.0	4.8
Anacortes	2.5	3.6	5.3
Port Angeles	2.9	4.0	5.9
Neah Bay	5.9	7.9	11.6

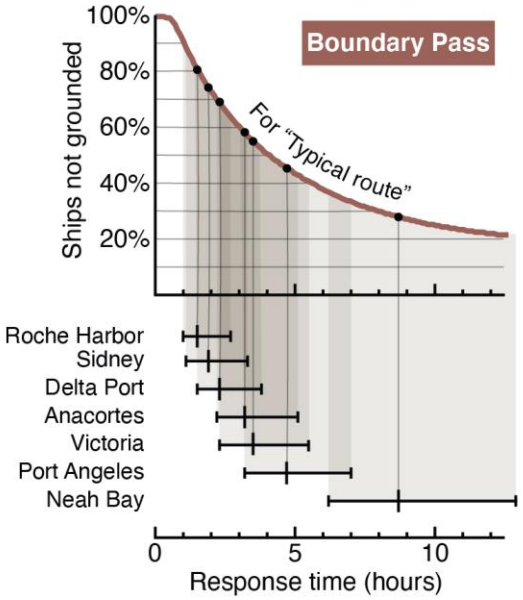
	Boundary Pass		
	Fast	Mid	Slow
Roche Hrb	1.0	1.5	2.7
Sidney	1.1	1.9	3.3
Delta Port	1.5	2.3	3.8
Anacortes	2.2	3.2	5.1
Victoria	2.3	3.5	5.5
Port Angeles	3.2	4.7	7.0
Neah Bay		8.7	12.9

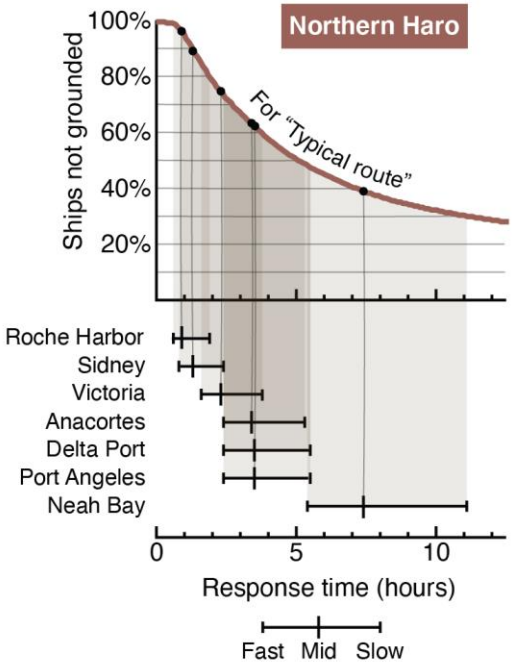
	N Haro		
	Fast	Mid	Slow
Roche Hrb	0.6	0.9	1.9
Sidney	0.8	1.3	2.4
Victoria	1.6	2.3	3.8
Anacortes	2.4	3.4	5.3
Port Angeles	2.4	3.5	5.3
Delta Port	2.4	3.5	5.5
Neah Bay	5.4	7.4	11.1

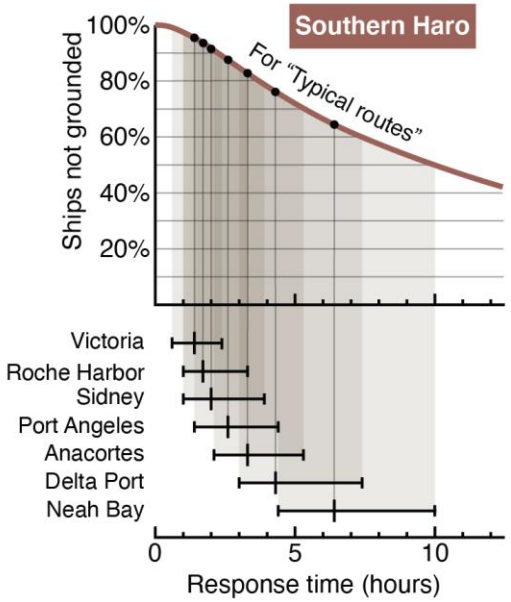
	S Haro		
	Fast	Mid	Slow
Victoria	0.6	1.4	2.5
Roche Hrb	1.0	1.7	3.3
Sidney	1.1	2.0	4.0
Port Angeles	1.4	2.6	4.4
Anacortes	2.1	3.3	5.3
Delta Port	3.0	4.4	7.4
Neah Bay	4.4	6.4	10.0




Turn Point
100%
80%
60%
40%
20%
Ships not grounded
For "Typical route"
Sidney
Roche Harbor
Victoria
Delta Port
Anacortes
Port Angeles
Neah Bay
0
5
10
Response time (hours)


Boundary Pass
100%
80%
60%
40%
20%
Ships not grounded
For "Typical route"
Roche Harbor
Sidney
Delta Port
Anacortes
Victoria
Port Angeles
Neah Bay
0
5
10
Response time (hours)


Northern Haro
100%
80%
60%
40%
20%
Ships not grounded
For "Typical route"
Roche Harbor
Sidney
Victoria
Anacortes
Delta Port
Port Angeles
Neah Bay
0
5
10
Response time (hours)
Fast
Mid
Slow


Southern Haro
100%
80%
60%
40%
20%
Ships not grounded
For "Typical routes"
Victoria
Roche Harbor
Sidney
Port Angeles
Anacortes
Delta Port
Neah Bay
0
5
10
Response time (hours)

Findings - Strait of Juan de Fuca

- In the median case (50th percentile) the time to grounding in the Strait of Juan de Fuca is generally greater than 10 hours
- In a bad case (95th percentile) the time to grounding is at least 3 hours

Findings - Southern Strait of Georgia

- In the median case (50th percentile) the time to grounding in the Southern Strait of Georgia is generally greater than 5 hours
- In a bad case (95th percentile) the time to grounding is at least 2 hours

Findings - Boundary Pass

- In the median case (50th percentile) the time to grounding in Boundary Pass is generally greater than 3 hours
- In a bad case (95th percentile) the time to grounding is less than 1 hour
- When considering the mid time for an ERTV to arrive to a vessel drifting from the typical route, an ERTV stationed at Roche Harbor would arrive in time to save 80% of disabled vessels.
- Other rates of save include:
  - Sidney and Delta Port 75% and 70%
  - Anacortes and Victoria 55%
  - Port Angeles 45%
  - Neah Bay <30%

Findings - Turn Point

- In the median case (50th percentile) the time to grounding in Turn Point is generally less than 3 hours
- In a bad case (95th percentile) the time to grounding is less than 1 hour
- When considering the mid time for an ERTV to arrive to a vessel drifting from the typical route, an ERTV stationed at Roche Harbor or Sidney would arrive in time to save over 80% of disabled vessels.
- Other rates of save include:
  - Victoria and Delta Port about 50%
  - Anacortes 40%
  - Port Angeles 35%
  - Neah Bay <20%

Findings - North Haro Strait

- In the median case (50th percentile) the time to grounding in North Haro Strait is generally at least 3 hours
- In a bad case (95th percentile) the time to grounding is less than 1 hour
- When considering the mid time for an ERTV to arrive to a vessel drifting from the typical route, an ERTV stationed at Roche Harbor or Sidney would arrive in time to save over 90% of disabled vessels.
- Other rates of save include:
  - Victoria about 75%
  - Anacortes, Delta Port, Port Angeles about 60%
  - Neah Bay about 40%

Findings - South Haro Strait

- In the median case (50th percentile) the time to grounding in South Haro Strait is generally at least 5 hours
- In a bad case (95th percentile) the time to grounding is greater than 1 hour
- When considering the mid time for an ERTV to arrive to a vessel drifting from the typical route, an ERTV stationed at Victoria, Roche Harbor, or Sidney would arrive in time to save over 90% of disabled vessels.
- Other rates of save include:
  - Port Angeles about 85%
  - Anacortes about 80%
  - Delta Port about 75%
  - Neah Bay about 65%

Summary

- The constricted waters around Haro Strait and Boundary Pass represent a significant challenge to the existing capability to execute a successful emergency tow.
- In the worse cases a disabled ship traveling on the typical route would have under an hour before grounding after losing momentum.
- An ERTV located in Roche Harbor or Sidney would have the best chance of a successful rescue in these areas, arriving in time to rescue over 80% of the cases studied.
- Findings based on a robust, generally conservative, peer reviewed analysis of the best available data.

Questions

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