Estimating Risk-Based Ship Transit Times in Ice using POLARIS

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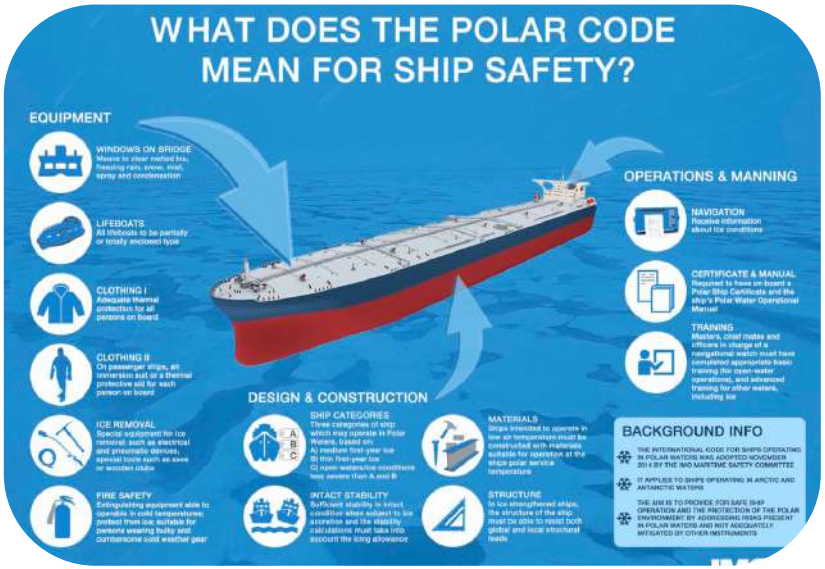
Rising Tide of Arctic Maritime Activity



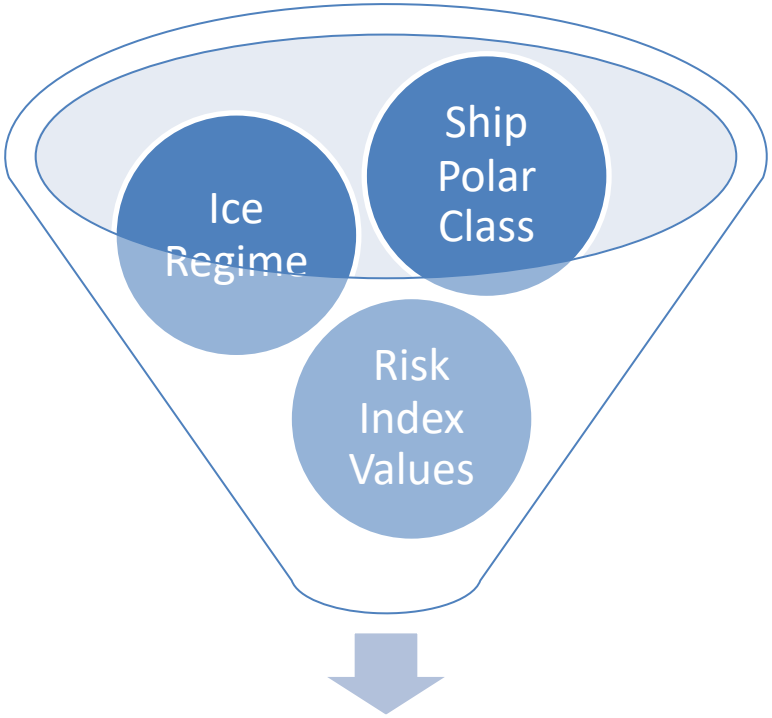
Maritime activity in the arctic is growing

- climate change is resulting in less ice in extent, duration, and thickness,
- Ship design and construction,
- economic drivers are inducing growth in resource extraction traffic, and
- adventure tourism.

The situation is dynamic demanding robust risk management and governance processes

- harsh weather,
- variable operating conditions,
- Poor communications and charting,
- Remoteness,
- Environmentally sensitive, and
- lack of straightforward emergency response options
- Lack of accident data to support risk-based decision making

POLARIS Risk Index Outcome (RIO)

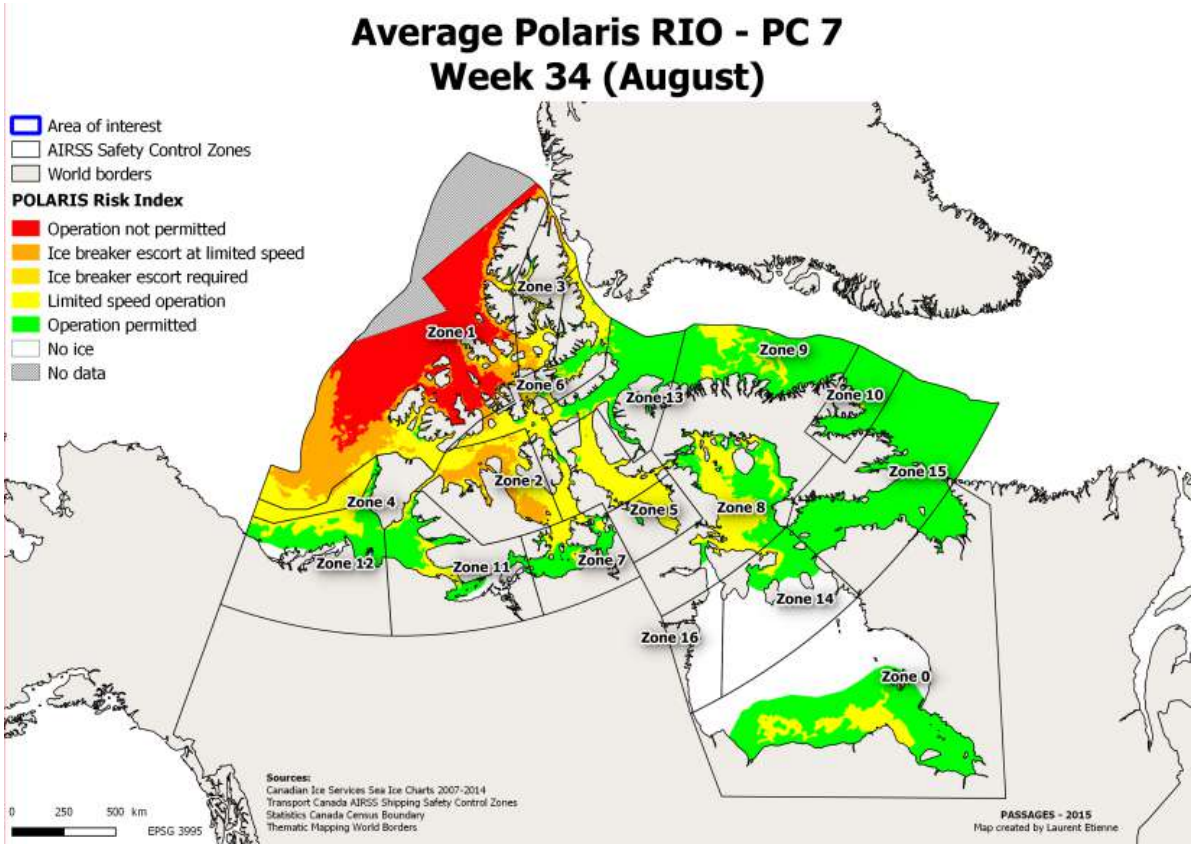


Risk Index Outcome

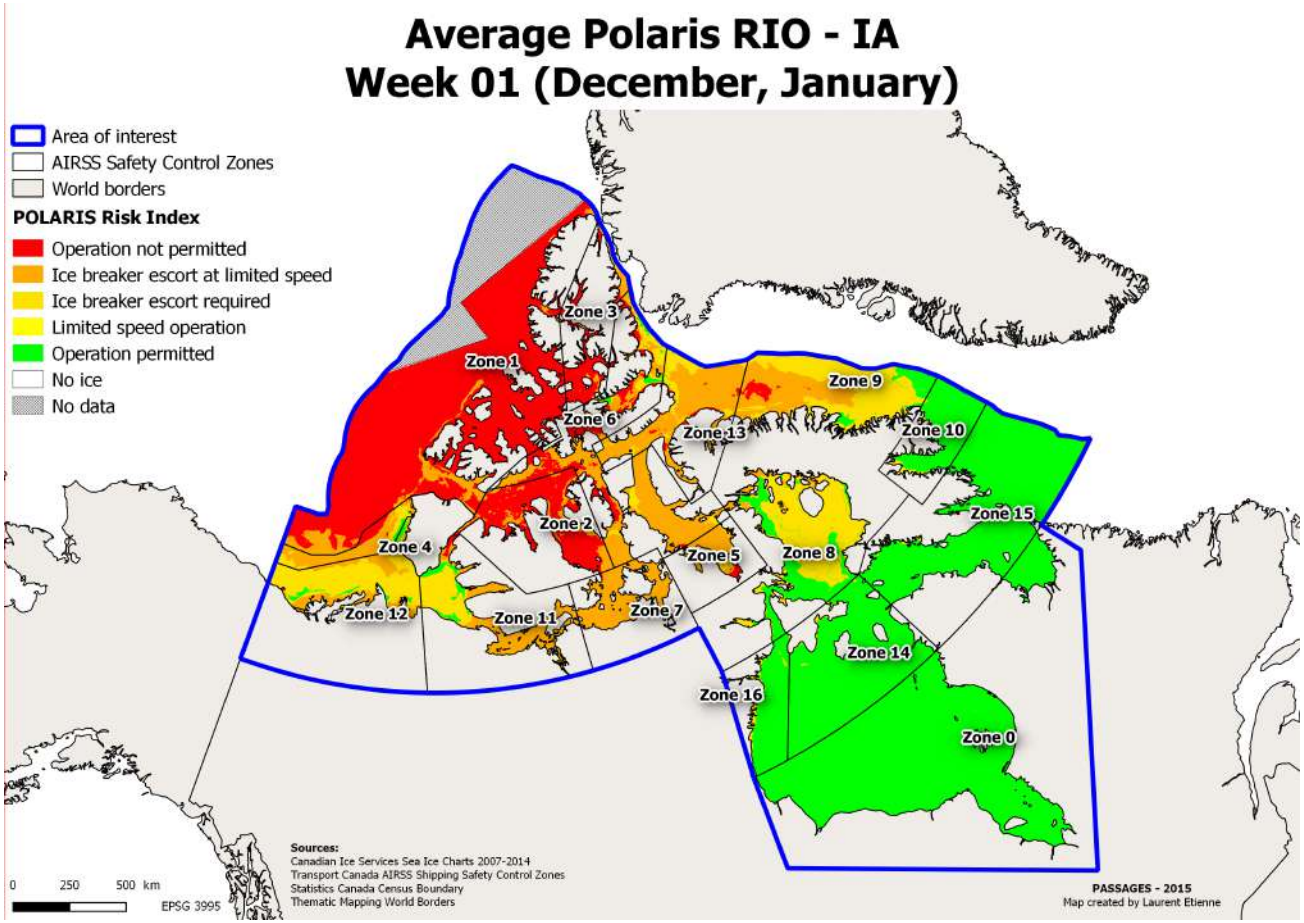
Operations Permitted	Limited Speed Operations permitted	Escort Operations Permitted	Escort Operations Permitted – Limited Speed	Operations Not Permitted
•RIO >= 0	•-10 <= RIO < 0	•RIO + 10 >= 0 (escorted)	•-10 <=RIO + 10<=0 (escorted)	•RIO < -10 •RIO + 10 < -10 (escorted)

Deck Plate POLARIS Assessment

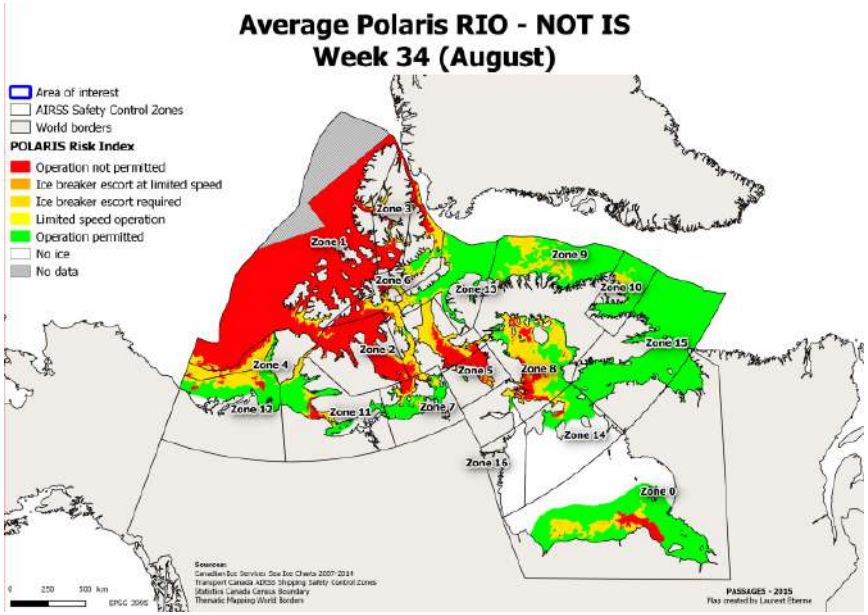
Ice Regime	Polar Ship Category	Ice Class	RIO	Result
4/10 Second Year Ice, 3/10 Thick First Year Ice (Decayed), 3/10 Ice Free	A	PC1	17	OP
		PC2	13	OP
		PC3	13	OP
		PC4	6	OP
		PC5	2	OP
	B	PC6	-5	ONP
		PC7	-12	ONP
	C	IAS	-12	ONP
		1A	-19	ONP
		1B	-19	ONP
		1C	-22	ONP
		Not Ice Strengthened	-26	ONP

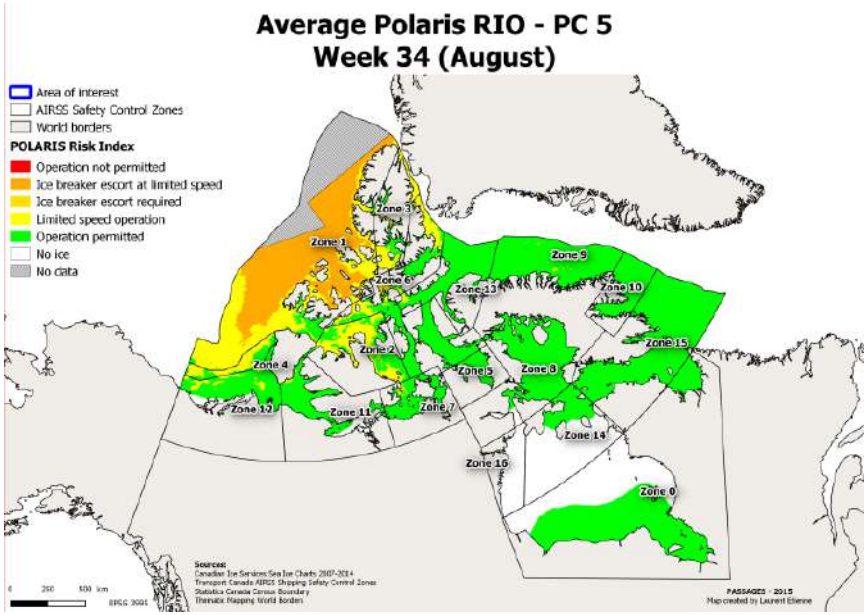


Wide-Area POLARIS Assessment

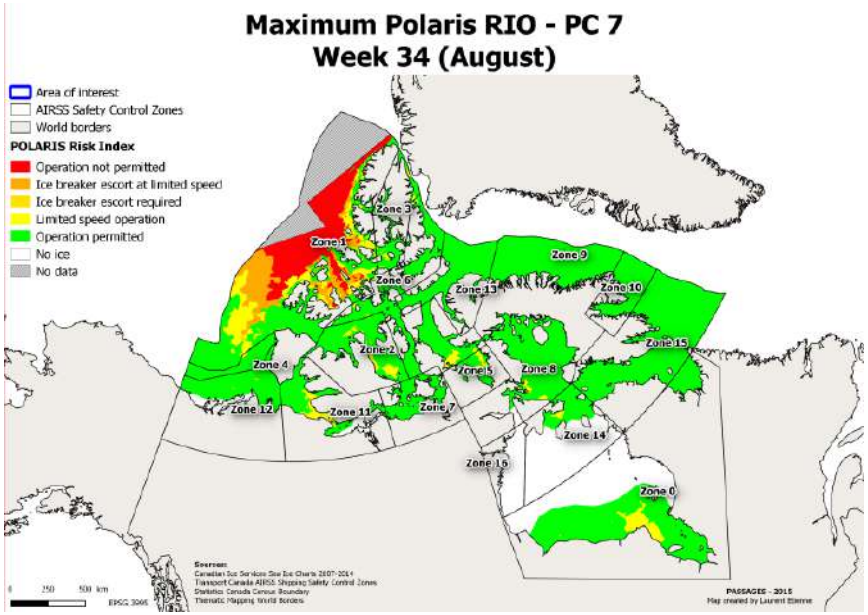


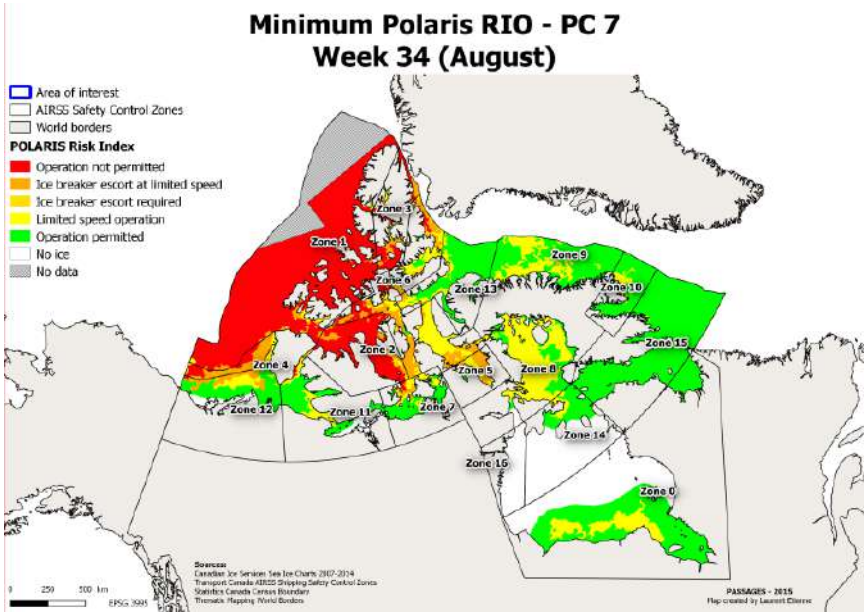
RIO Visualization – 52 Week Trend





Varying Ship Polar Classification





Varying Statistical Aggregation of Historical RIO

Risk-Based Ship Transit Times in Ice using POLARIS

Estimating Ship Transit Time

2012 Nov 08 15:20:01 Quebec 48 NUUK to GAS IN 1 of 1

Route Plan

From Waypoint	Latitude	Longitude	Planned Speed	Leg Type
223	64° 09.700' N	051° 43.500' W	12.00 kt	RL
222	64° 09.200' N	051° 44.000' W	12.00 kt	RL
221	64° 09.200' N	051° 48.000' W	12.00 kt	RL
219	64° 03.800' N	052° 08.000' W	12.00 kt	RL
224	64° 03.800' N	052° 31.000' W	12.00 kt	RL
225	64° 40.000' N	053° 26.500' W	12.00 kt	RL
230	67° 30.000' N	059° 00.000' W	12.00 kt	RL
231	68° 10.000' N	062° 00.000' W	12.00 kt	RL
232	73° 40.000' N	076° 00.000' W	12.00 kt	RL
233	74° 10.000' N	080° 00.000' W	12.00 kt	RL
234	74° 10.000' N	085° 00.000' W	12.00 kt	RL
235	74° 10.000' N	089° 00.000' W	12.00 kt	RL
236	74° 36.000' N	091° 20.000' W		

Signature: 1061 Date:

Devon Island, NWT

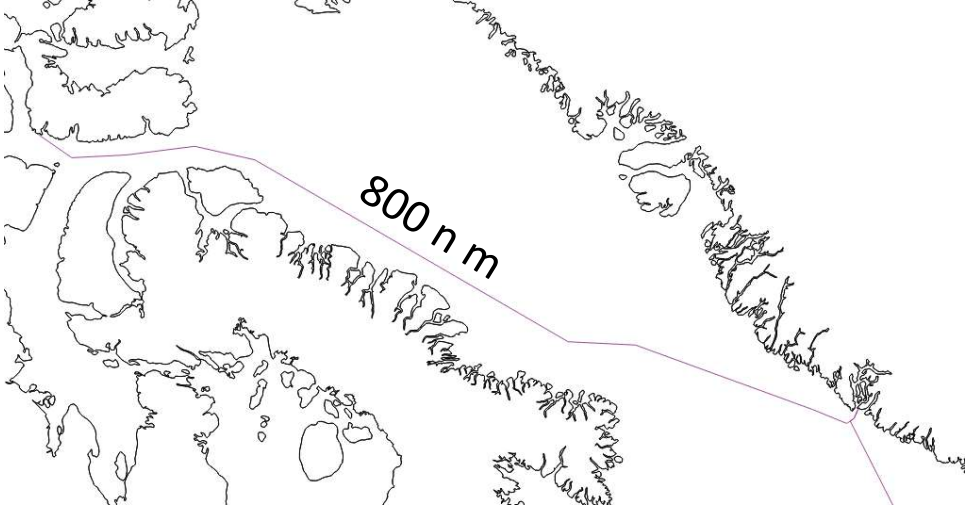
Destination

800 n m

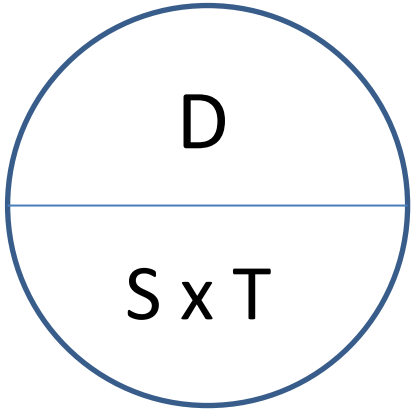
Vessel location

Nuuk, Greenland

Traditional ETA



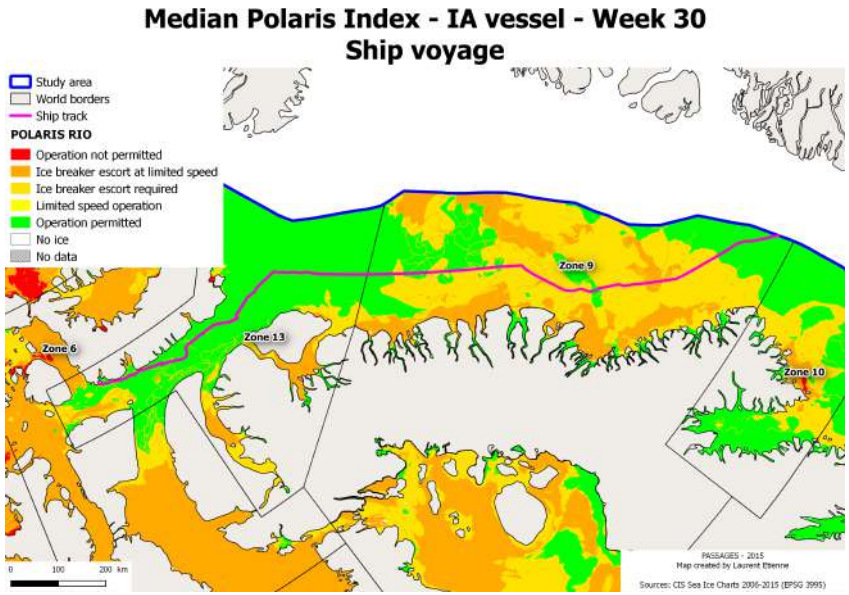
Conventional estimate of response ETA

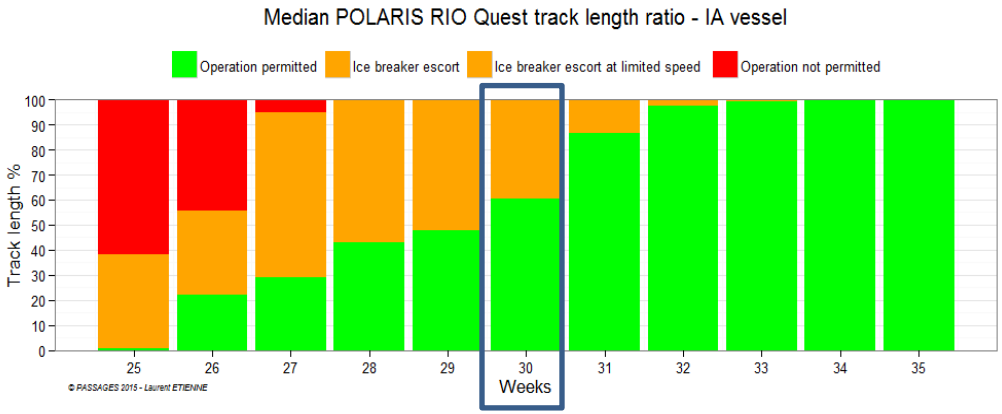


D = 800nm
S = 12 kts
T = ?

$T = \frac{800}{12}$ = 67 hours

POLARIS Risk-Based ETA in Ice





Week 30 Response ETA using 2007 – 2014 median RIO value

$$\frac{\sum_{k=1}^{5} D_{ijtk}}{S_{jk} \text{x } T_{ijt}}$$

T_{ijt} = ?
D_{ijtk} = [1,9,30,1: 480] , [1,9,30,2: 320] , [1,9,30,3: 0] , [1,9,30,4: 0] , [1,9,30,5: 0];
S_{jk} = [9,1: 12] , [9,2: 6] , [9,3: 4] , [9,4:2] , [9,5:0.5];

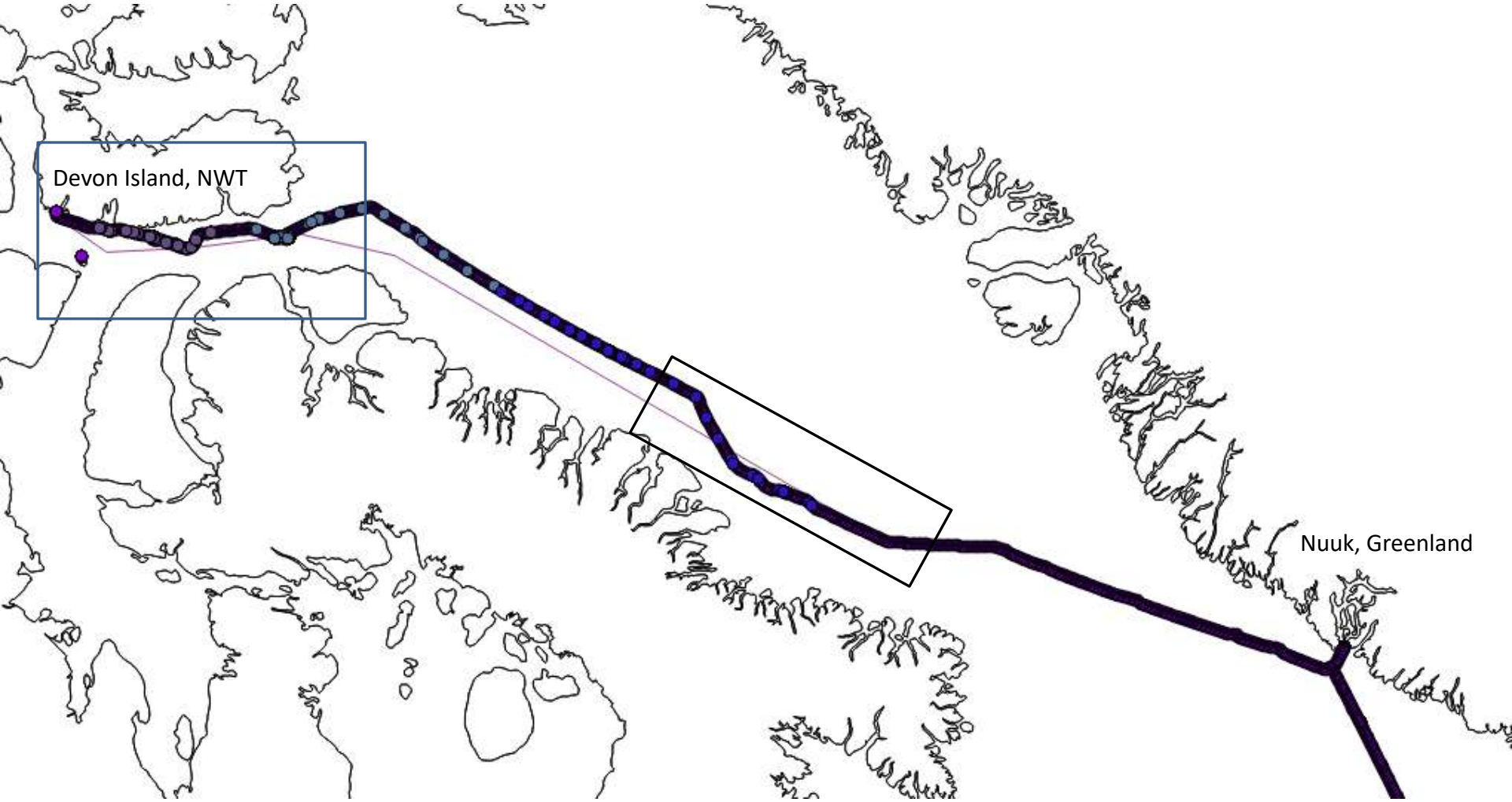
$$T_{ijt} = \sum_{k=1}^{5} \frac{D_{ijtk}}{S_{jk}} = \frac{480}{12} + \frac{0}{8} + \frac{320}{6} + \frac{0}{3} + \frac{0}{.5} = \text{93 hours (+ 39\%)}$$

Making Sense of Ship Observations in Ice using POLARIS

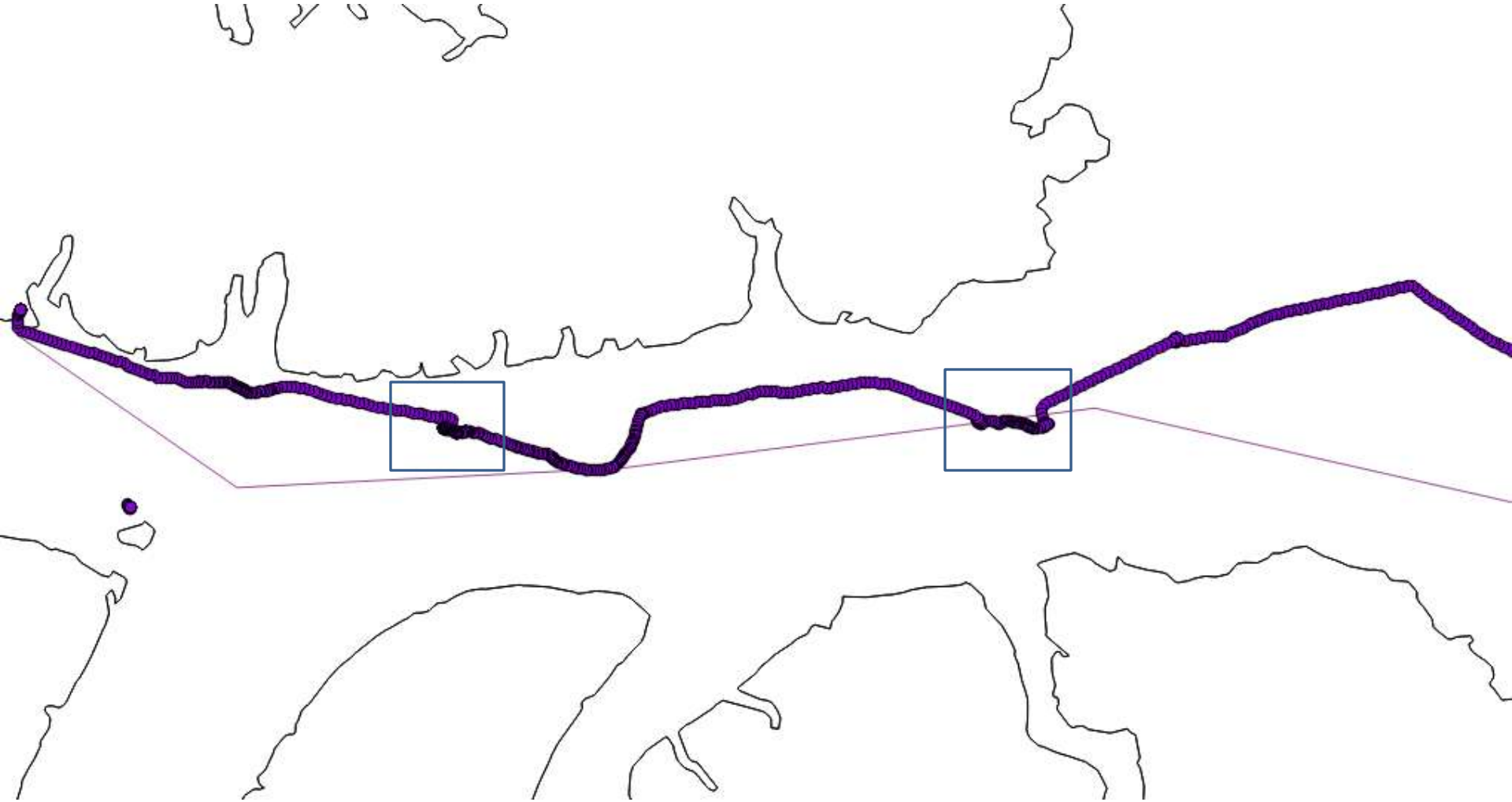
CFAV QUEST Planned Route

Ship Observations Along a Route - satAIS

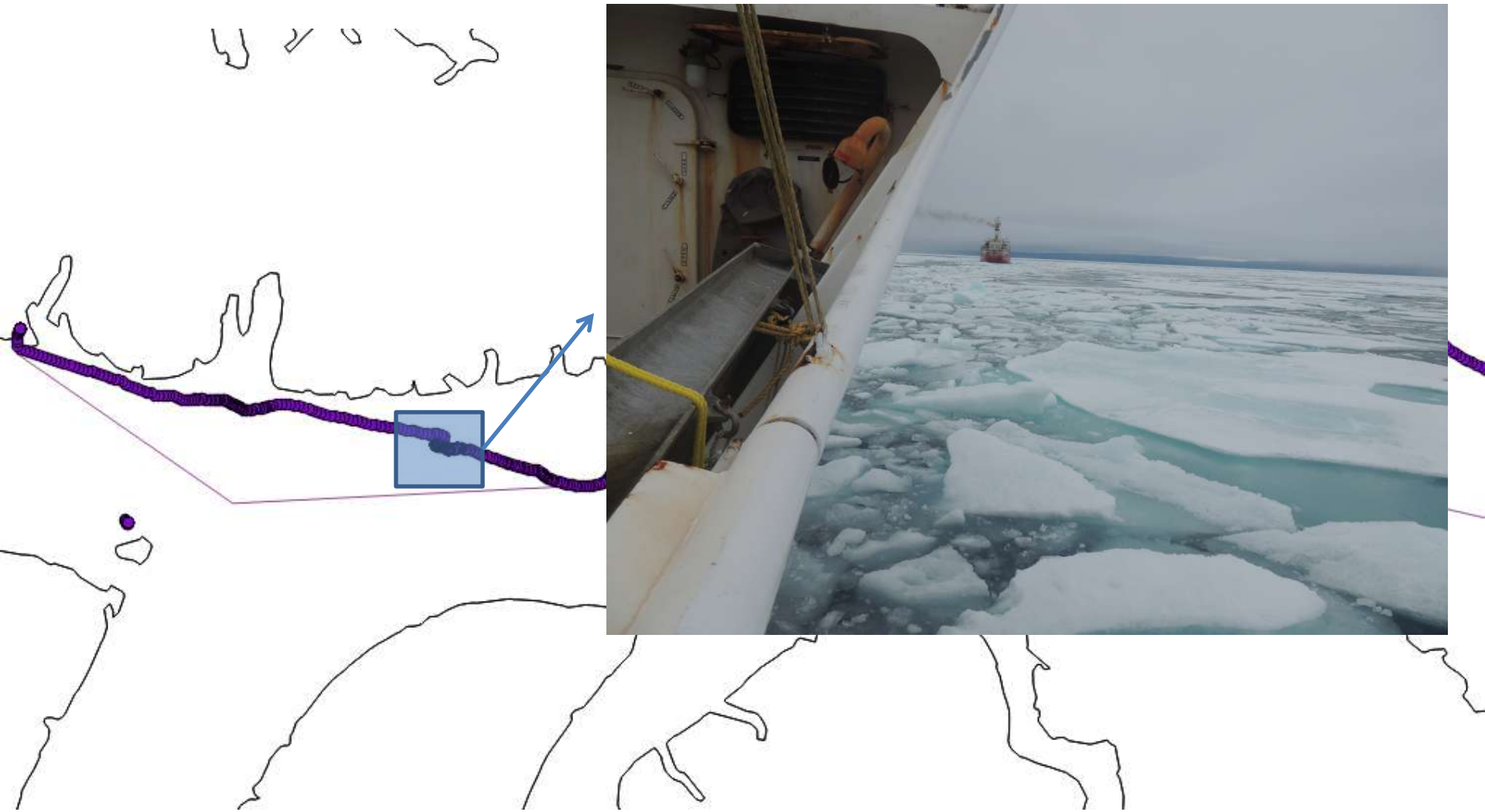
CFAV Quest Executed Route



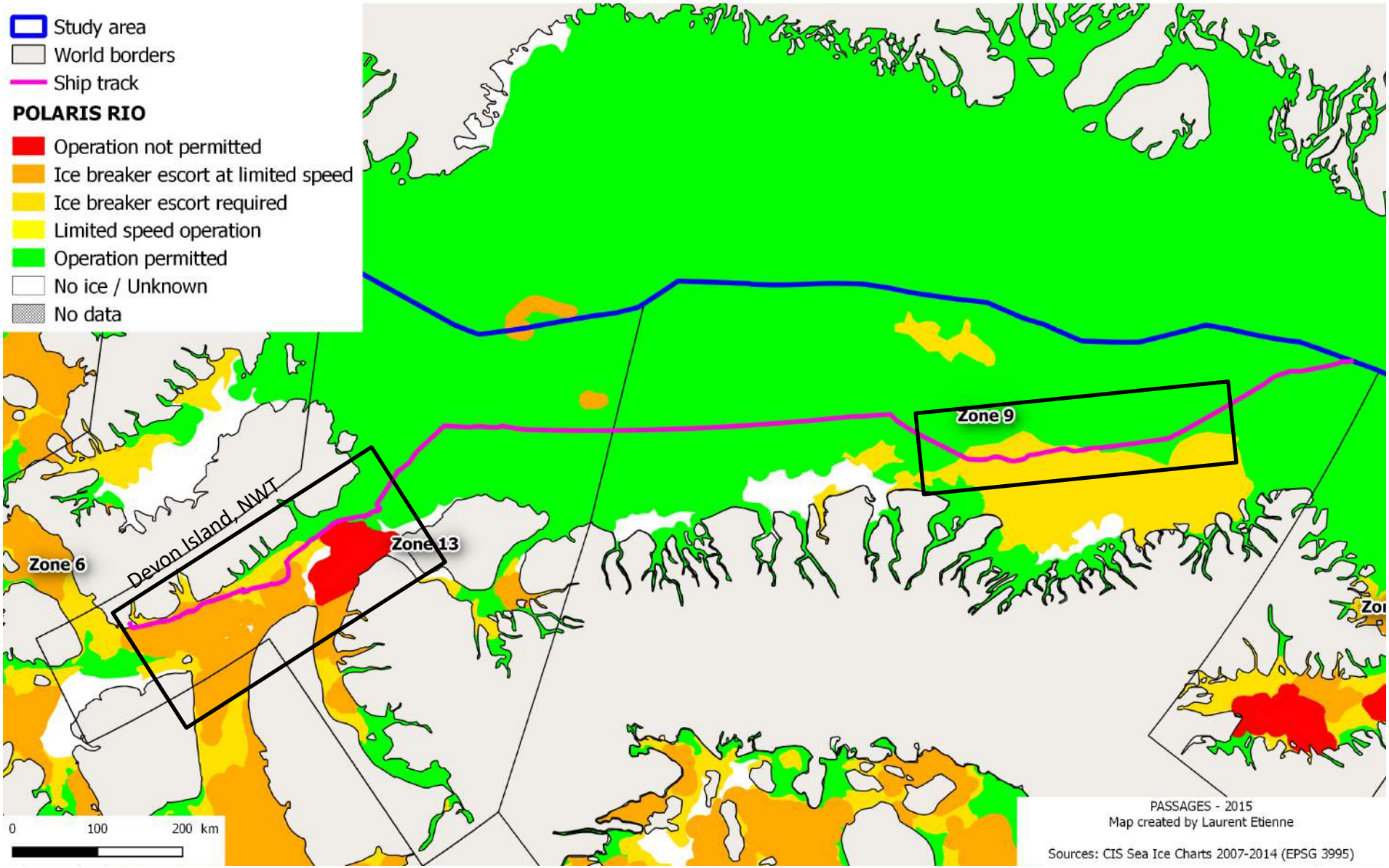
What is going on here?



The view from the ship



Polaris Index - IA vessel - Week 30 - 07/2012
GPS ship track



Platform as a Sensor Initiative

QUESTIONS?