KYSTVERKET

Historical AIS data – ”Havbase”

Iceland
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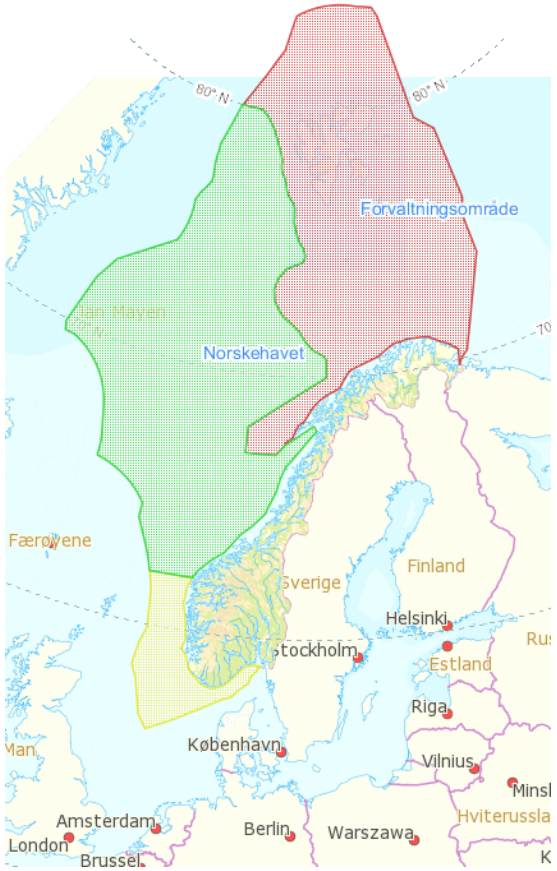
Historic reasons for the development[2]

- Need for a time series (statistic time series) for Management plans
- Input data for probabilistic risk analyzes (accidents and spills)
- Traffic analyzes for the National Transport Plan



- Coupling between Havbase and external ship databases (IHS Fairplay & Shipinfo) provides additional information about the ships compared to the basic information transponded in the AIS message itself. The joined data for example enables us to divide single ships into ship categories (IHS Fairplay ship type coding system is used).

- It enables us to take out and present sailed distance and operational discharges estimates for ship types

- Havbase provides correct geographical distribution of discharges

- Now you understand that all aggregation to different ship types is done from each individual ship sailing in time and space

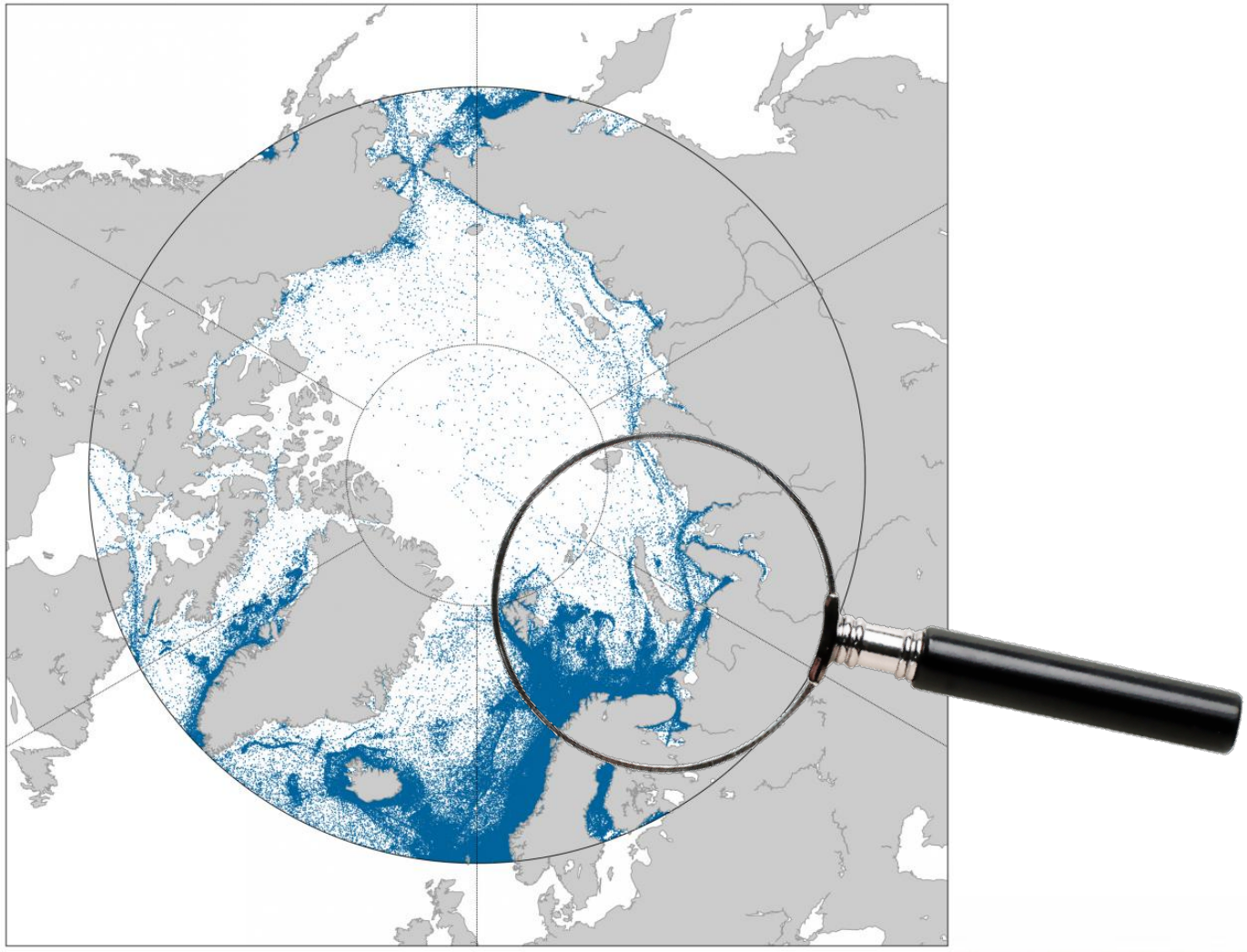
IHS fairplay

- https://www.pame.is/images/03_Projects/ASTD/Ship_type/ASTD_Ship_types.xlsx

Data sources[4]

- Land based AIS base stations
- AIS satellite (Mainly relevant outside 40 40nm from the coast)
- Ship registers (IHS Fairplay and Shipinfo)
- DNV-GL (Ship technical data on ships, engine and bunkers)

Every dot counts



How is discharge estimates done

- Speed
- Fuel consumption
- Ship type
- Engine measurement modification
- Conventional logarithms, but with improvements
    - CO_2
    - SO_2,
    - SO,
    - NOx,
    - PM
- Operational discharges of oil (bilge water and wash water) also included, but not published

Ship emission logarithm

$$E_{i,j} = \sum_{t=0}^{t=n} ((P_{ME_i} * \left(\frac{SOG_{i,t}}{V_{max_i}}\right)^3 * EF_{ME_{j,k,l,m}} + D_{AE_{p,i}} * EF_{AE_{j,k,l,m}} + D_{BO_{p,i}} * EF_{BO_{j,m}}) * 1\,\text{hour})$$

Where:

i = ship

j = pollutant

t = time (operating hour, h)

k = engine type

l = engine tier

m = fuel type

p = phase

$E_{i,j}$ = emissions (g) for ship i and pollutant j

P_{ME_i} = main engine power (kW) for ship i

$SOG_{i,t}$ = speed over ground (knots) for ship i at time t

V_{MAX_i} = maximum speed (knots) for ship i

$EF_{ME_{j,k,l,m}}$ = main engine emission facor (g/kWh) for pollutant j, engine type k, engine tier l, and fuel type m

$D_{AE_{p,t}}$ = auxiliary engine power demand (kW) in phase p for ship i

$EF_{AE_{j,k,l,m}}$ = auxiliary engine emission factor (g/kWh) for pollutant j, engine type k, engine tier l, and fuel type m

$D_{BO_{p,i}}$ = boiler power demand (kW) in phase p for ship i

$EF_{BO_{j,m}}$ = boiler emission factor (g/kWh) for pollutant j and fuel type m

ME power demand

The ME power demand varies as the ship SOG changes:

$$D_{ME_t} = P_{ME} * \left(\frac{SOG_t}{V_{max}} \right)^3$$

Where:

D_{ME_t} = ME power demand at time t
P_{ME} = ME power at 100% maximum continuous rating (MCR)
SOG_t = vessel speed over ground at time t
V_{max} = vessel maximum speed

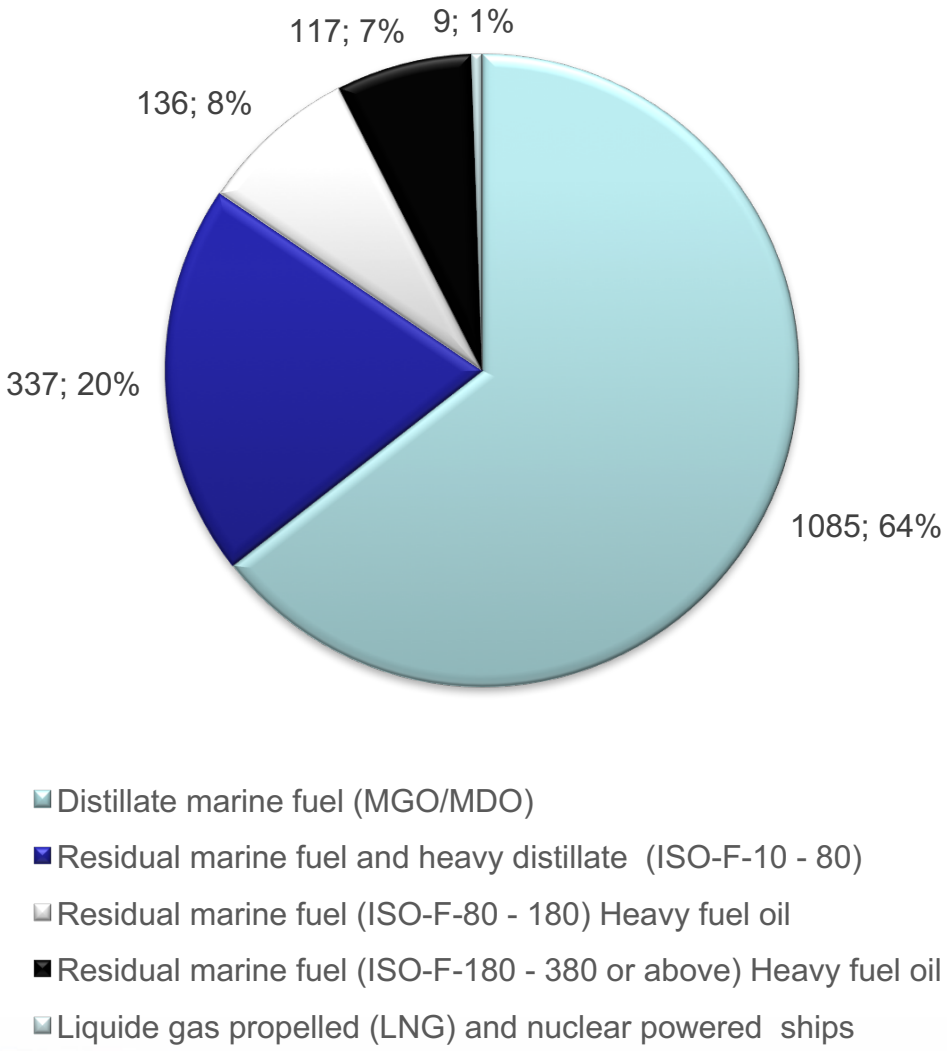
Future development

- Probability module (under development)
- National transport plan module
- Discharge module for the Arctic to correct for ice?

Vessels operating in the Arctic 2013

- Around 1600 vessels were accounted for in 2013 - 1472 unique IMO registered vessels.
- 5 nuclear powered vessels - removed from the emission analysis – accounts for 2 % of the total sailed distance.

1684 unique vessels and percentage of vessels using different grades of fuel in the Polar Code area in 2016



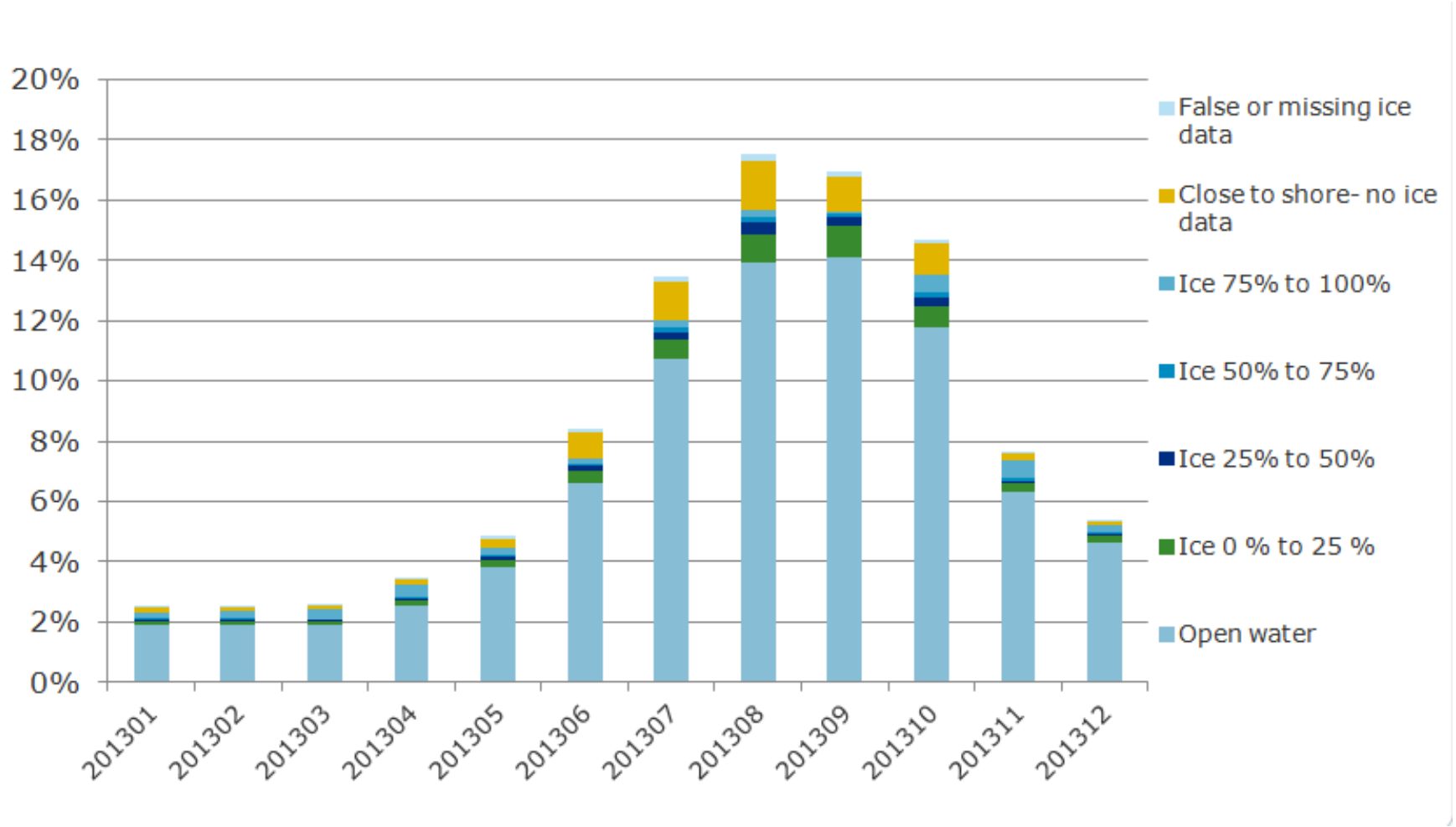
Total fuel consumption (independent of fuel type) in metric tons and sailed distance in nautical miles in 2016 per ship type

Ship type	Sum fuel consumption in metric tons	Sum sailed distance in nautical miles
Fishing vessel	126708	4181120
General cargo vessel	90337	1203282
Other vessels	68863	1535955
Oil tanker	65819	610974
Passenger vessel, including cruise	40346	602930
Chemical tanker and product tanker	30407	385686
Dry bulk vessel	29031	284491
Container vessel	16466	176128
Offshore supply vessel	14747	155564
Refrigerated cargo vessel	12804	159482
Ro Ro cargo vessel	6192	52371
Other offshore service vessel	1881	19403
Total	503601	9367386

11 - 14 percent of the ships is operating in Ice

Row Labels	Sum of Share Nautical Miles	Sum of Share Hours
Close to shore- no ice data	7,2 %	16,5 %
False or missing ice data	1,1 %	3,0 %
Ice 75% to 100%	3,6 %	3,5 %
Ice 50% to 75%	1,1 %	1,9 %
Ice 25% to 50%	1,8 %	3,5 %
Ice 0 % to 25 %	4,8 %	7,8 %
Open water	80,3 %	63,8 %
Grand Total	**100,0 %**	**100,0 %**

Ships operating in Ice

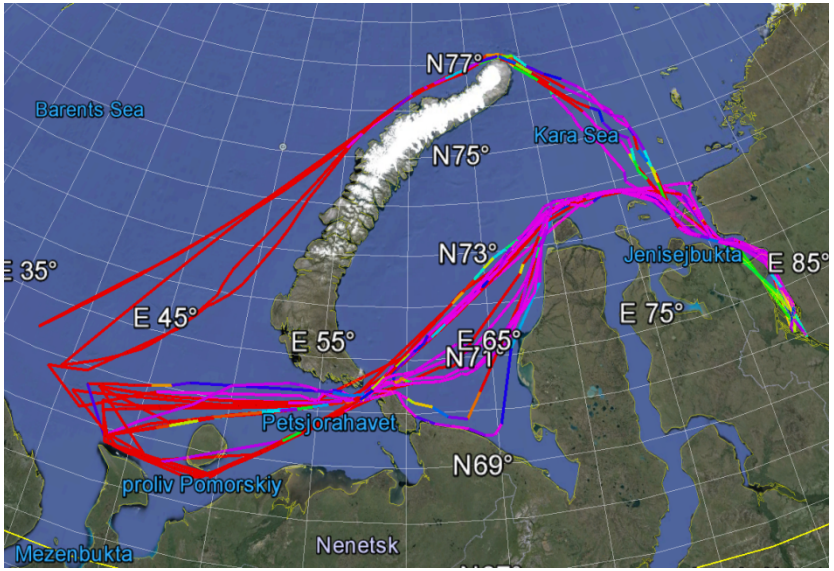


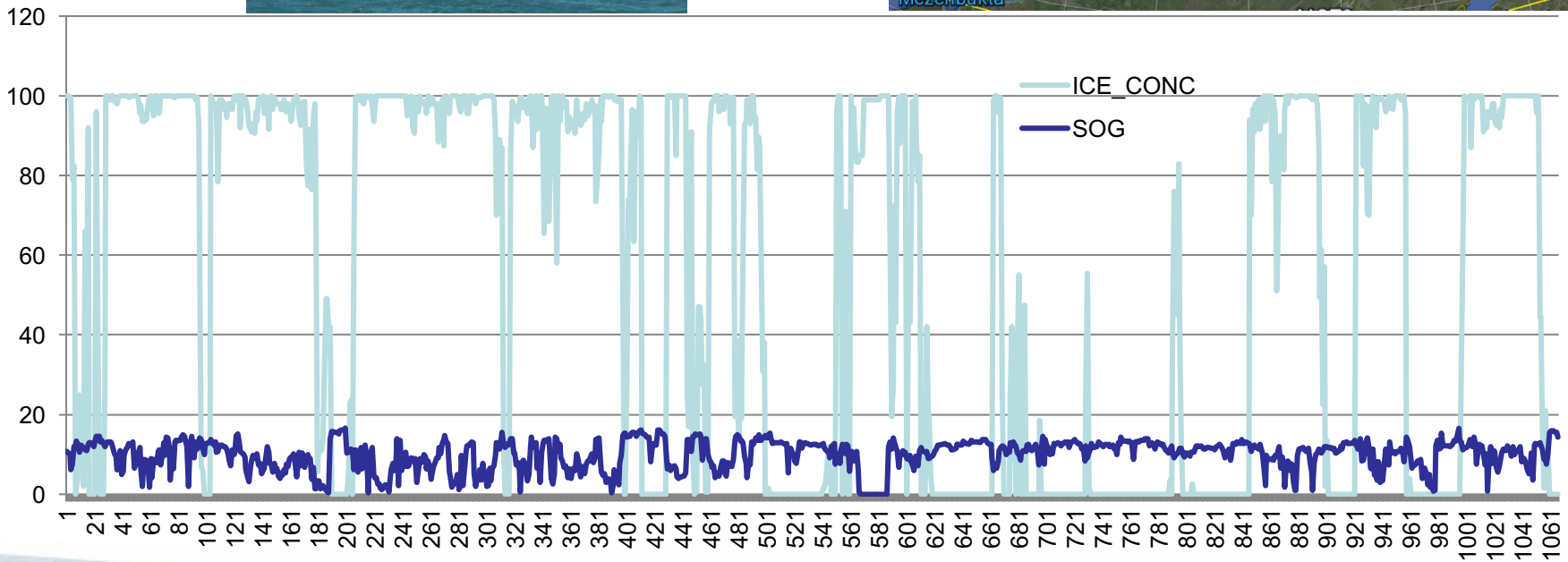
Open Sea Fuel Consumtion versus operation in Ice

Table 5-10 – Estimated fuel consumption in open sea mode (baseline) and fuel increase due to operation in ice

Fuel & Emissions	Fuel consumption in Arctic (ton)		
	Open sea calculations "baseline"	Increased fuel consumption due to operation in ice	Total fuel consumption in Arctic
Oil tanker	29602	29,7 %	38 404
Chemical/Prod tanker	10141	3,9 %	10 541
Gas tanker	880	40,0 %	1 232
Bulk carrier	10284	14,9 %	11 814
General cargo	29495	13,5 %	33 478
Container vessel	19273	21,0 %	23 320
RoRo	4853	0,1 %	4 859
Reefer	6397	1,1 %	6 470
Passenger	21829	11,1 %	24 251
Offshore supply vessel	7030	43,1 %	10 058
Other offshore service vessel	759	3,5 %	785
Other activities	43266	28,0 %	55 379
Fishing vessel	75242	1,9 %	76 707
Total	259050	14,8 %	297 300

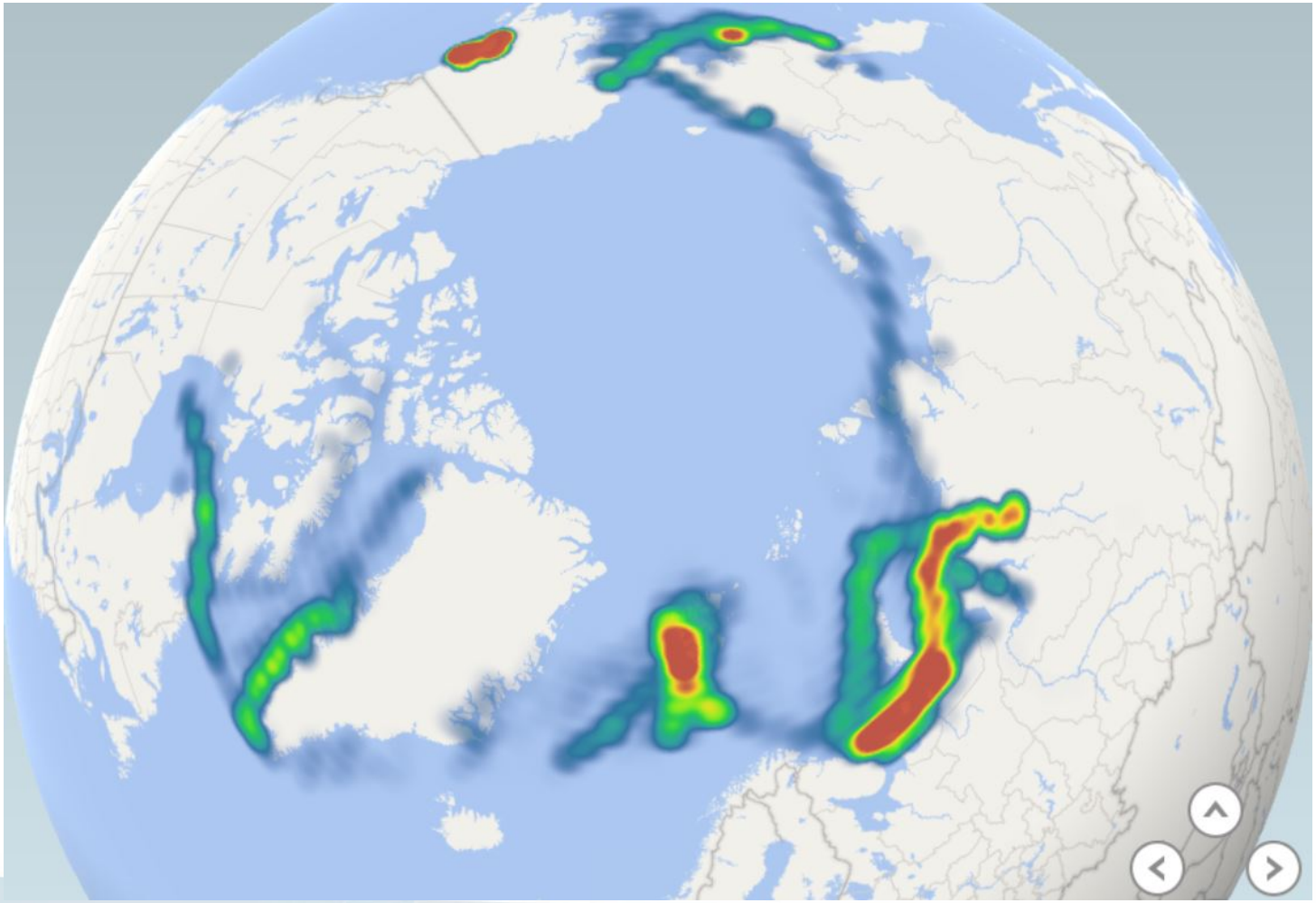
Single vessel analysis



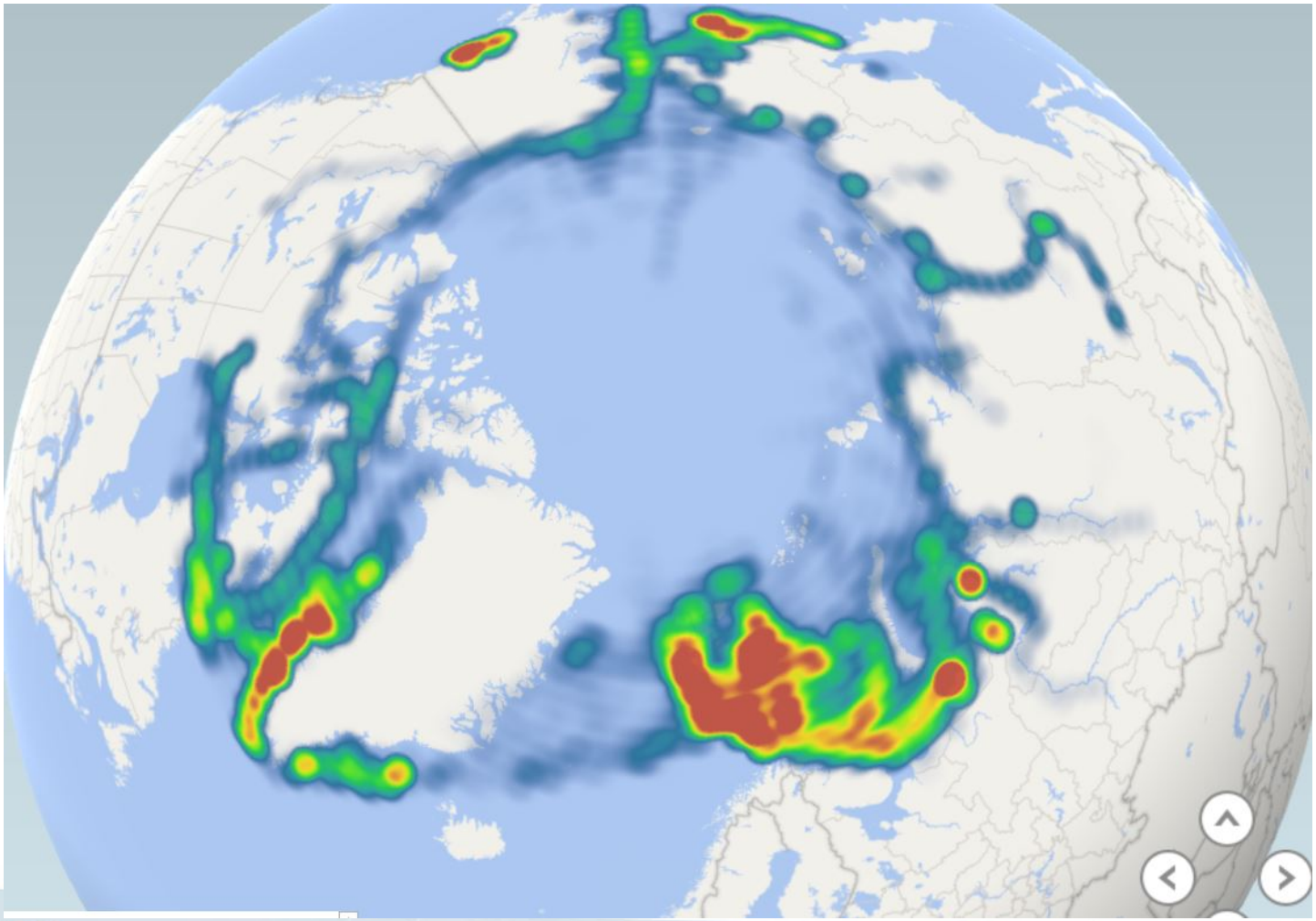


Transit traffic

Destination traffic



Internal traffic



Thank you for listening!

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