

AI in Routine Production of Regional Sea Ice Charts – Evolution, Challenges, Recommendations

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BIG DATA IS HERE 😊

Regional Ice Charting Timeline – Data and Analysis

Pre mid-90's :	Aircraft, low res optical (NOAA), passive microwave Paper, MBYTES, analyzed manually
Mid- to late 90s → :	Aircraft, Synthetic Aperture Radar (Radarsat-1), low res optical (NOAA), passive microwave Paper, MBYTES, analyzed manually
Early to mid-00's → :	Synthetic Aperture Radar (Radarsat-1, Envisat), optical (NOAA, MODIS), passive microwave FEW GBYTES, analyzed manually
Late 00's → :	Synthetic Aperture Radar (Radarsat-1, Radarsat-2, Envisat), optical (NOAA, MODIS) GBYTES, analyzed manually
Mid-10's → :	Synthetic Aperture Radar (Radarsat-2, Sentinel-1, CosmoSkyMed, TerraSAR-X), optical (MODIS, Sentinel-2) FEW 10s of GBYTES, analyzed manually
Late 10's → :	Synthetic Aperture Radar (Radarsat-2, Sentinel-1, CosmoSkyMed, TSX, PAZ), optical (MODIS, Sentinel-2) Several 10s of GBYTES, analyzed manually
2020's → :	HELP !

Towards Smart Production (2)

DMI Science Project "Automatic Sea Ice Products (ASIP)" started in 2017:

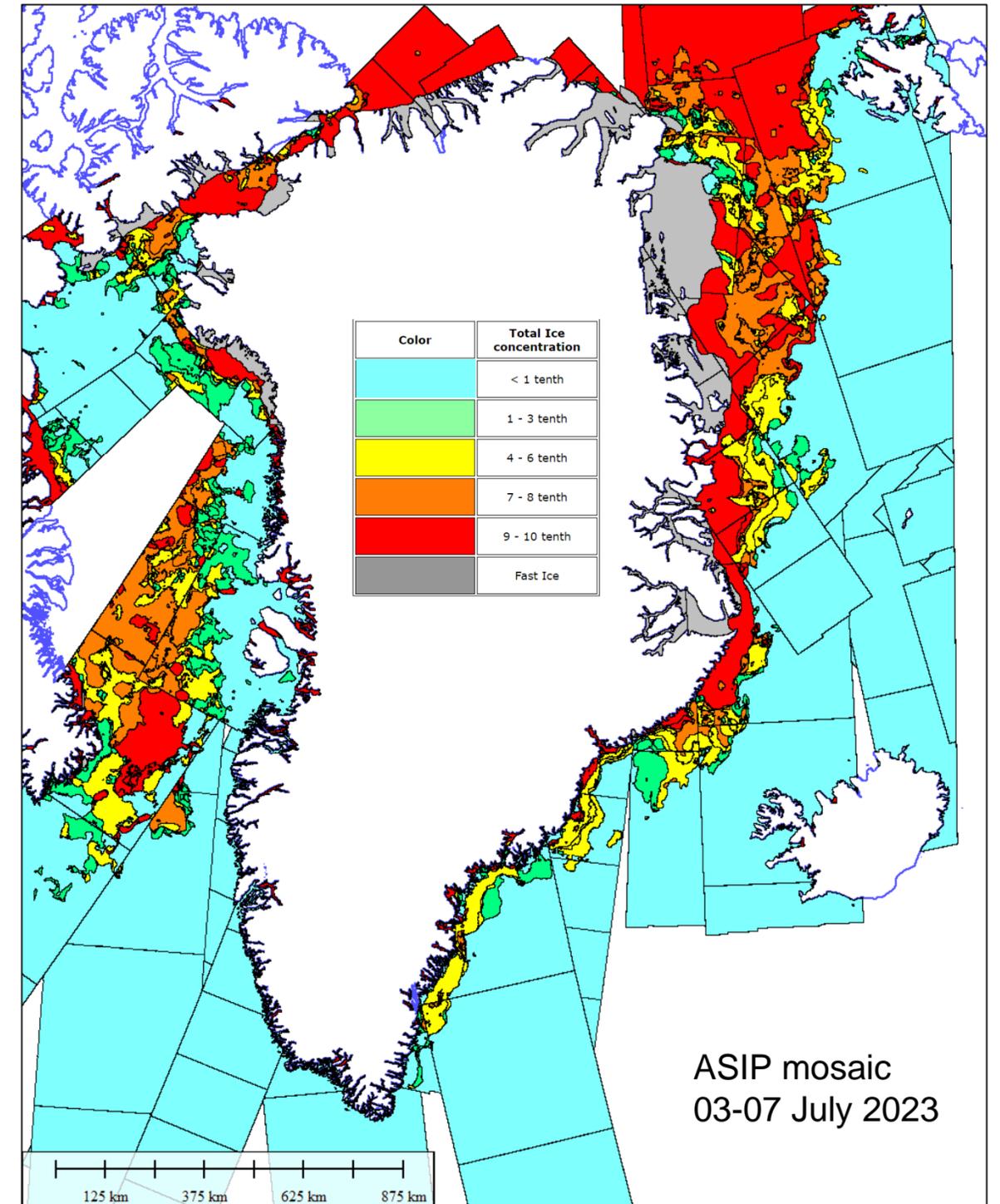
- Artificial intelligence
- Take advantage of large daily Sentinel-1 data volumes
- Training data extracted from DMI regional ice charts
- Automated processing
- Export to SIGRID3 (and other formats)

Ice products and services:

Actual
Accurate
Relevant
Accessible
Reliable

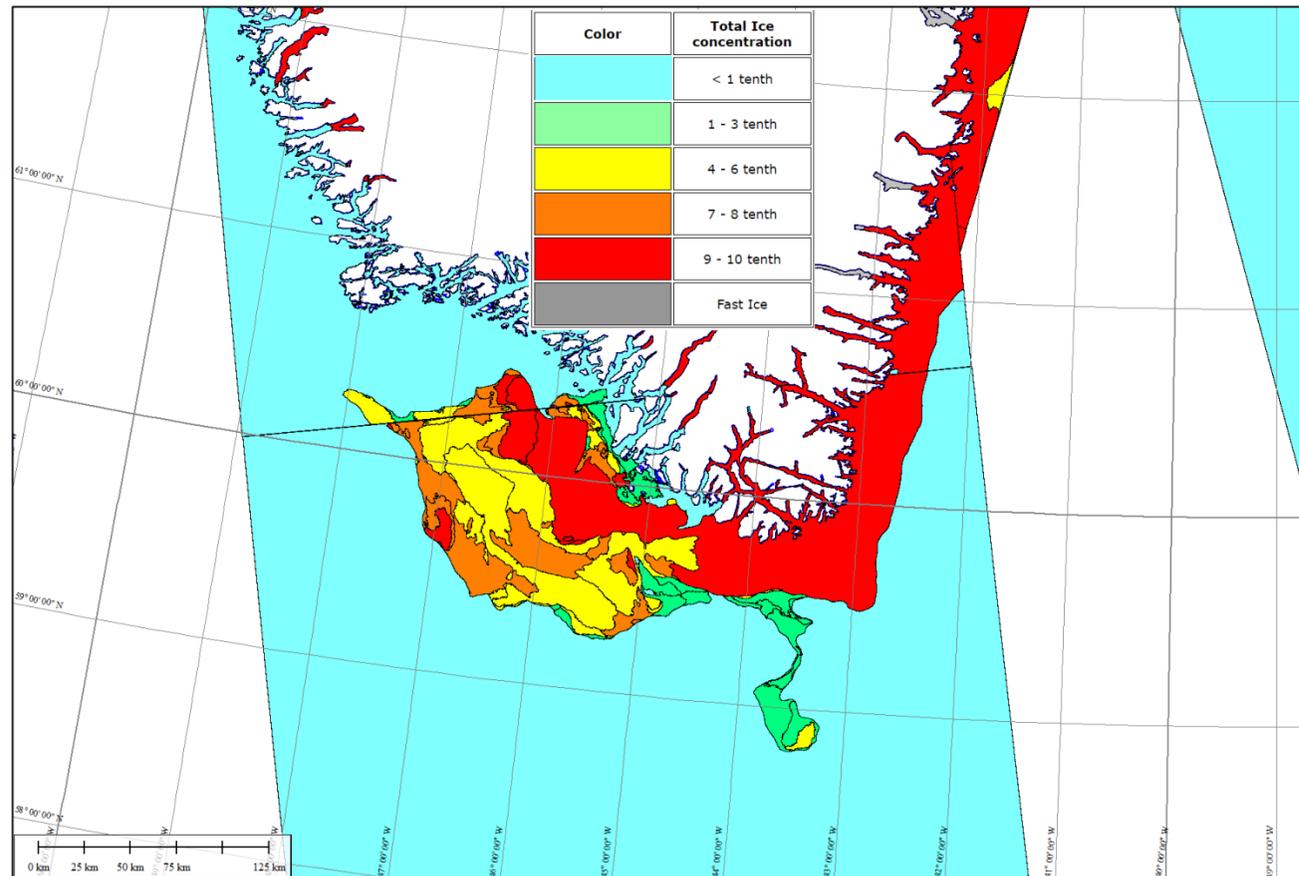
Three questions to the Ice Service:

- 1) Do you see potential in this project?
- YES
- 1) Do you receive data exported from ASIP?
- YES
- 1) Are you using ASIP data in your production line?
- NO

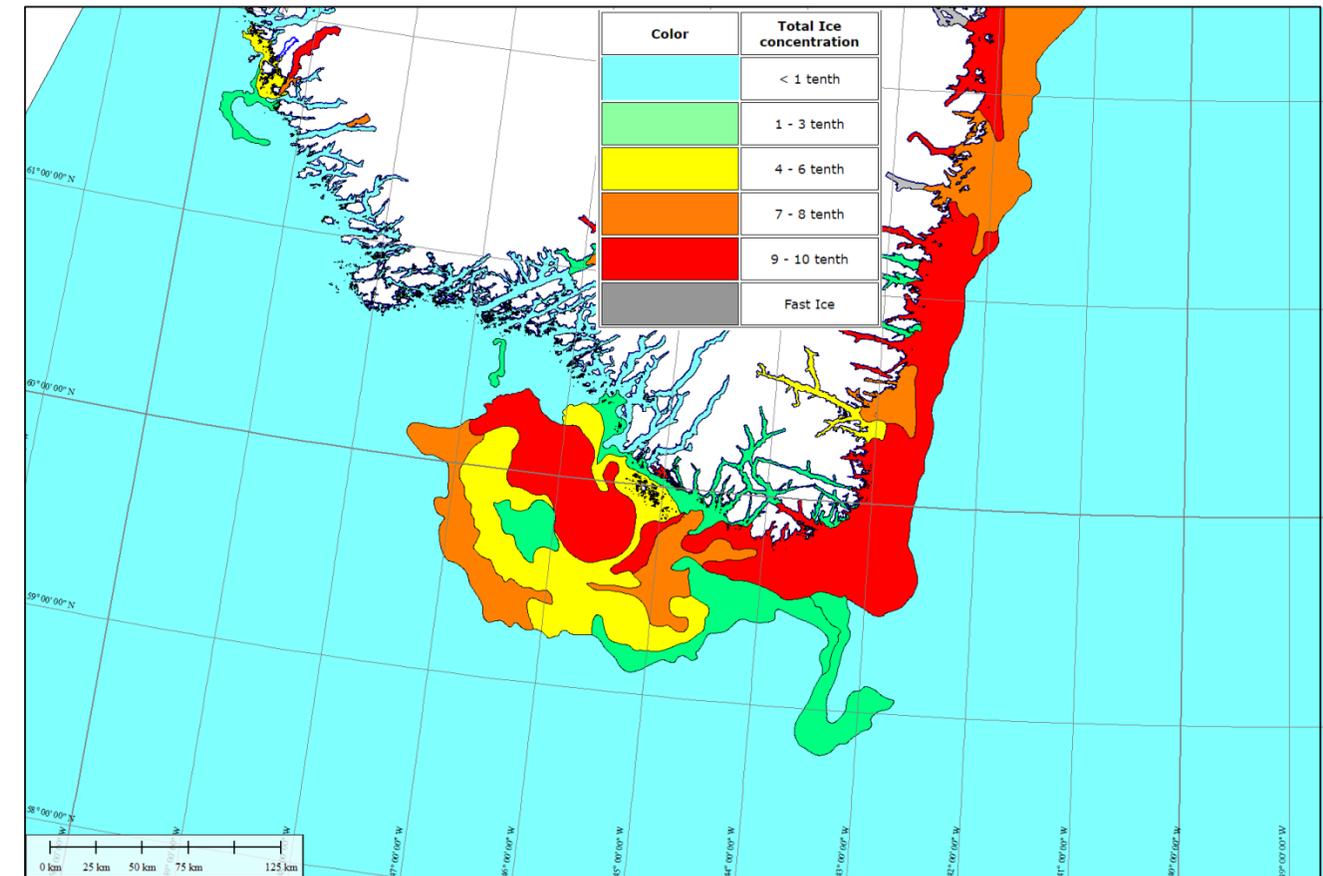


Towards Smart Production (3)

Many excellent examples on successful AI sea ice mapping



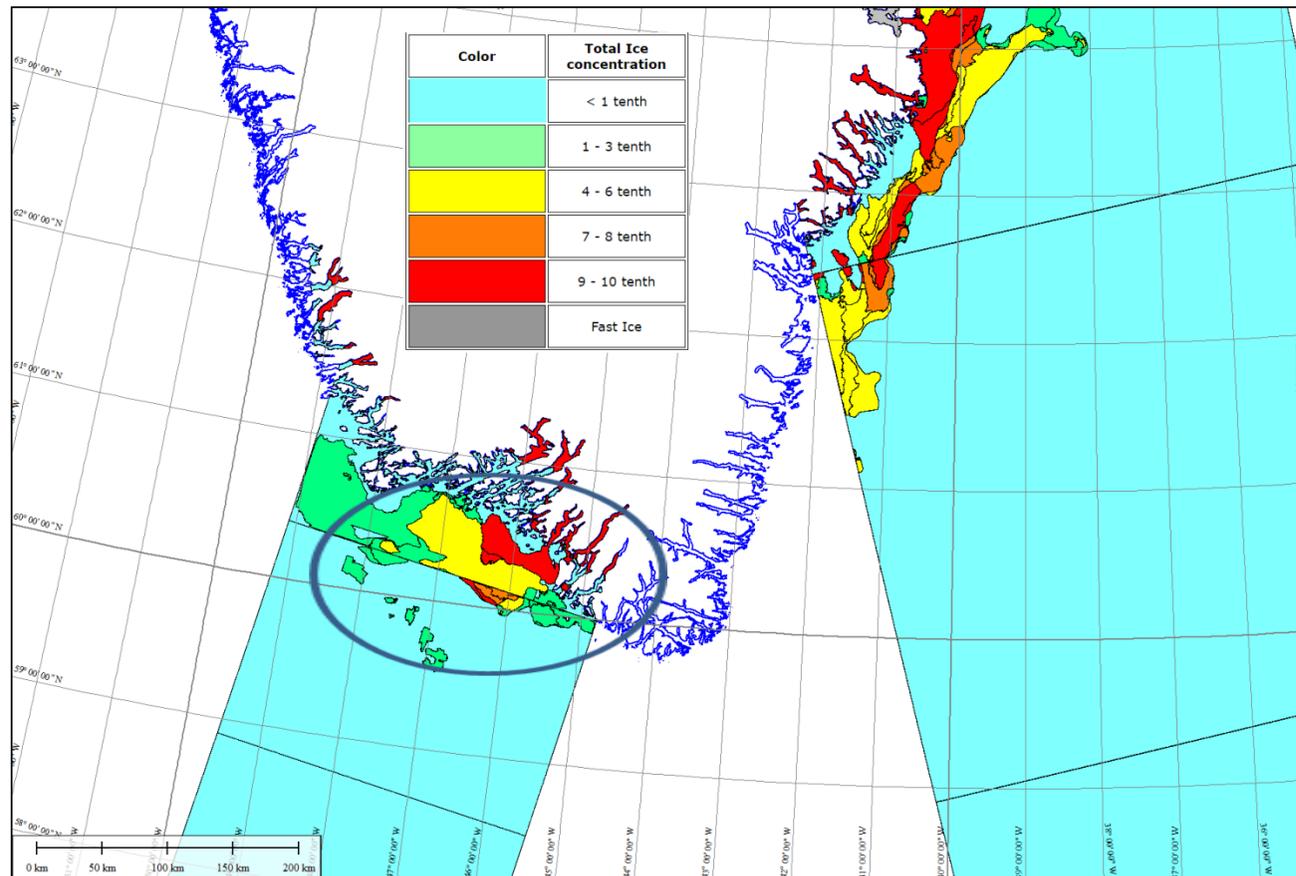
ASIP 15 June 2024 2030 UTC



ICE SERVICE Sea Ice map 15 June 2024 2030 UTC

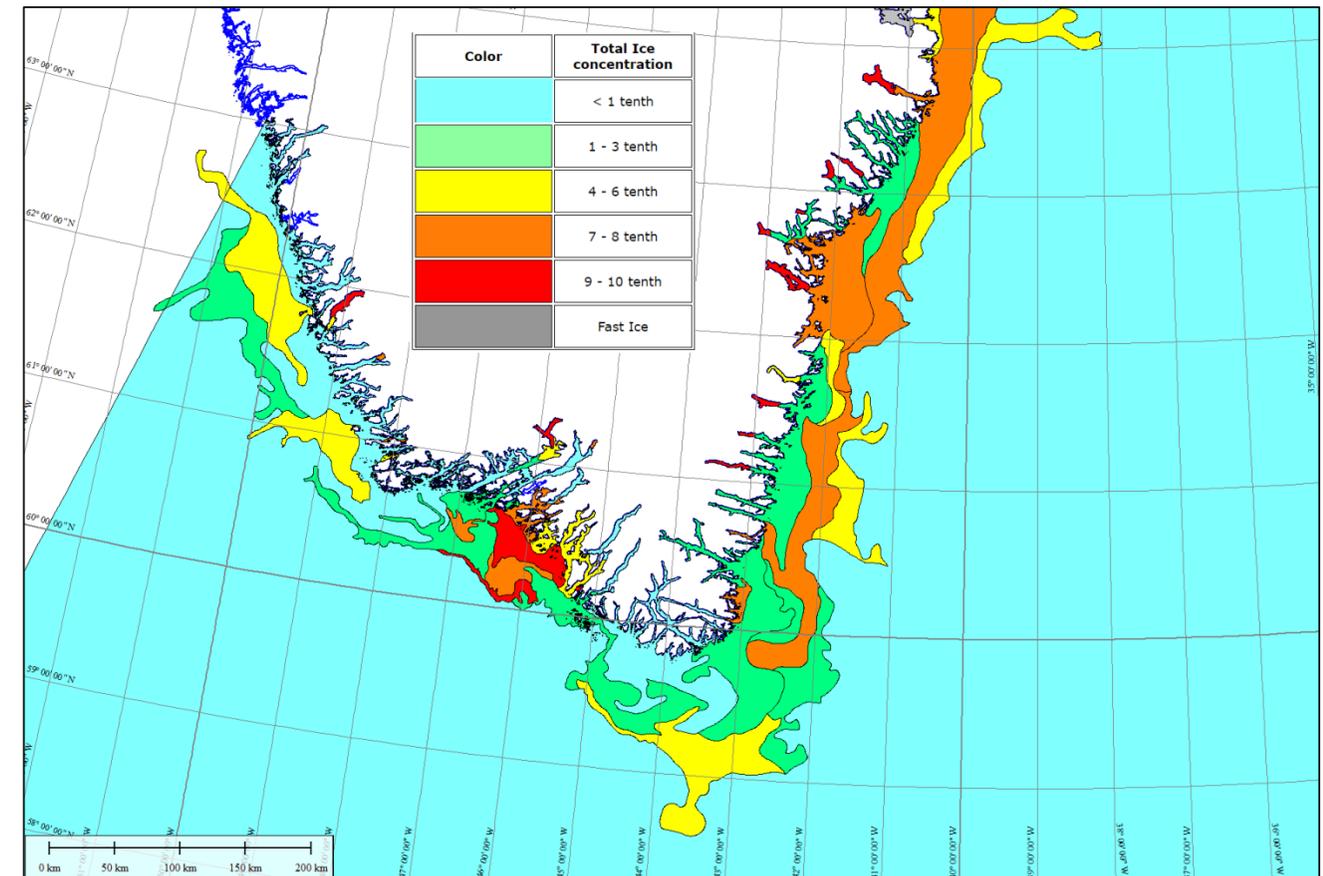
Towards Smart Production (4)

What are we missing in the Ice Service? **Satellite coverage going into AI, frames side by side**



ASIP 01 July 1200 UTC - 02 July 2359 UTC 2024

Available ~ 1 hour after satellite data download



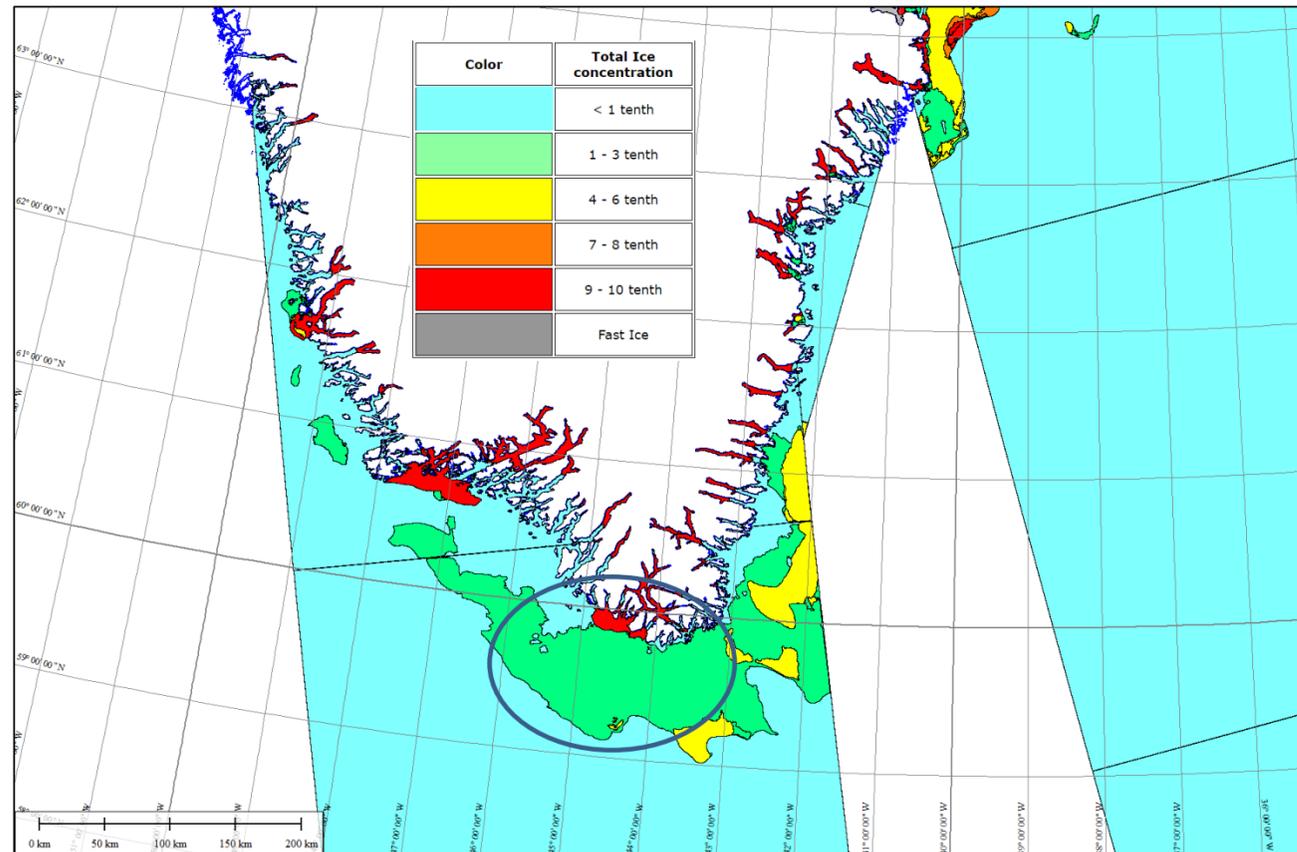
ICE SERVICE Sea Ice map 02 July 2024 0930 UTC

Available: 02 July 2024 1352 UTC

→ AI is fast, Ice service analysis takes several hours

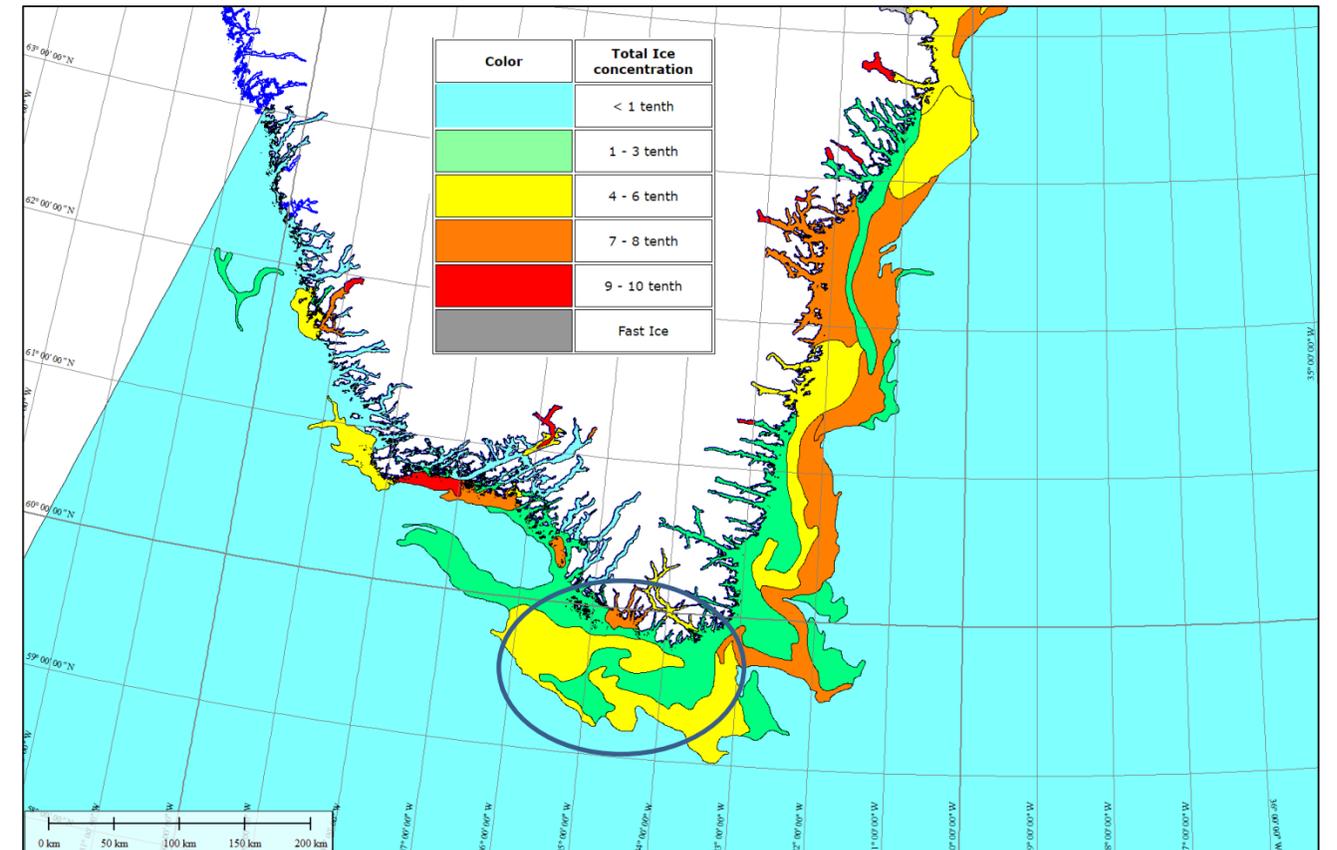
Towards Smart Production (5)

What are we missing in the Ice Service? **Low Concentration confidence, ice thickness, floe size**



ASIP 09 July 2024 2036 UTC

200+ polygons



Ice Service Sea Ice map 09 July 2024 2030 UTC

54 ice polygons

CT	CA	SA	FA	CB	SB	FB	CC	SC	FC	CN	CD	CF	POLY_TYPE	HATCH
10	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	I	8

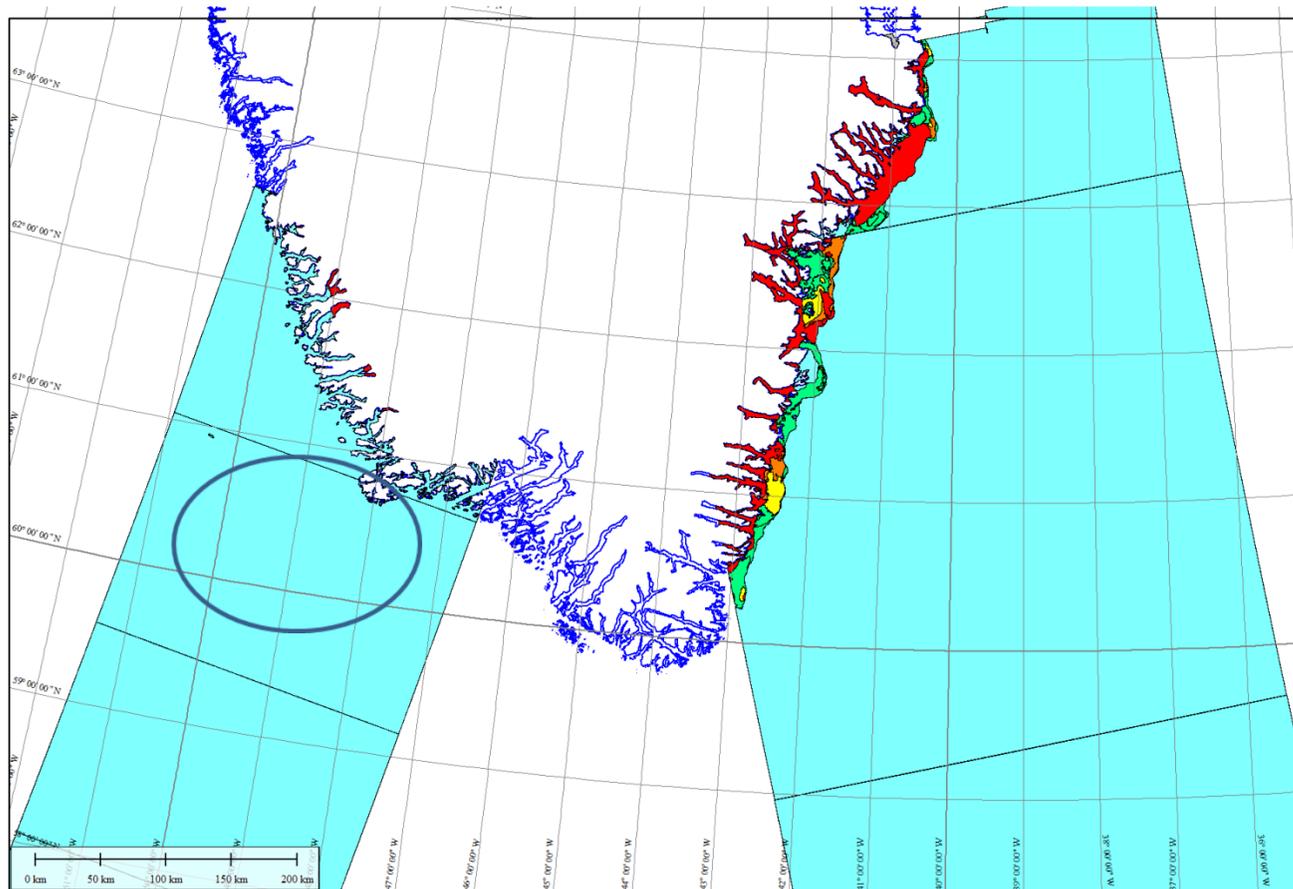
Total Sea Ice Concentrations ONLY

CT	CA	SA	FA	CB	SB	FB	CC	SC	FC	CN	CD	CF	POLY_TYPE	HATCH
40	-9	95	2	-9	-9	-9	-9	-9	-9	98	-9	19	I	7

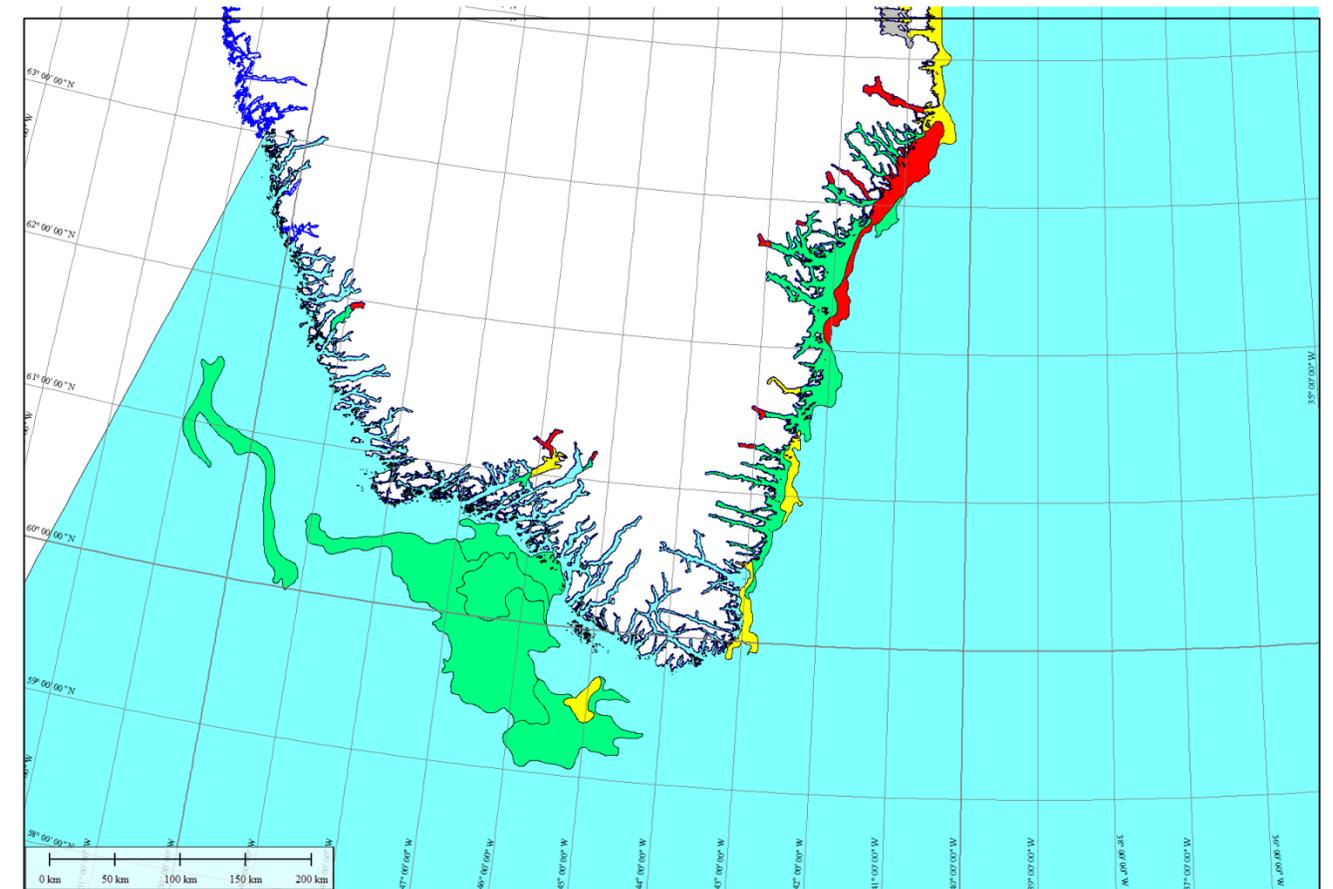
Total sea ice concentration, stage of development, flow size available

Towards Smart Production (5)

What are we missing in the Ice Service? **1/10 of sea ice is very different from open sea / bergy waters.**
Can ASIP be the future authoritative product?



ASIP 19 July 2024 0935 UTC

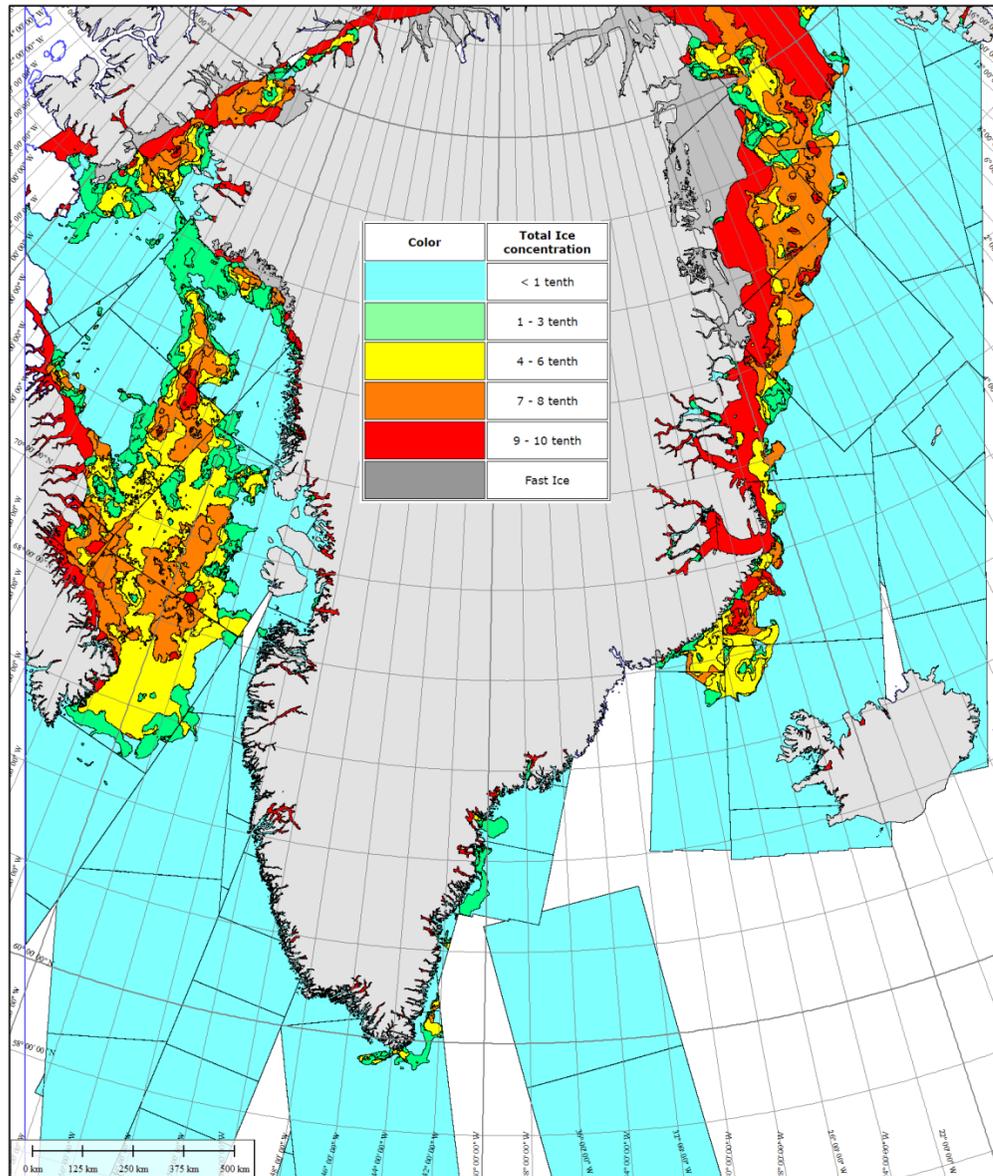


Sea Ice map 19 July 2024 0930 UTC

1/10 (or more) of ice **NO GO** for non ice classed ships

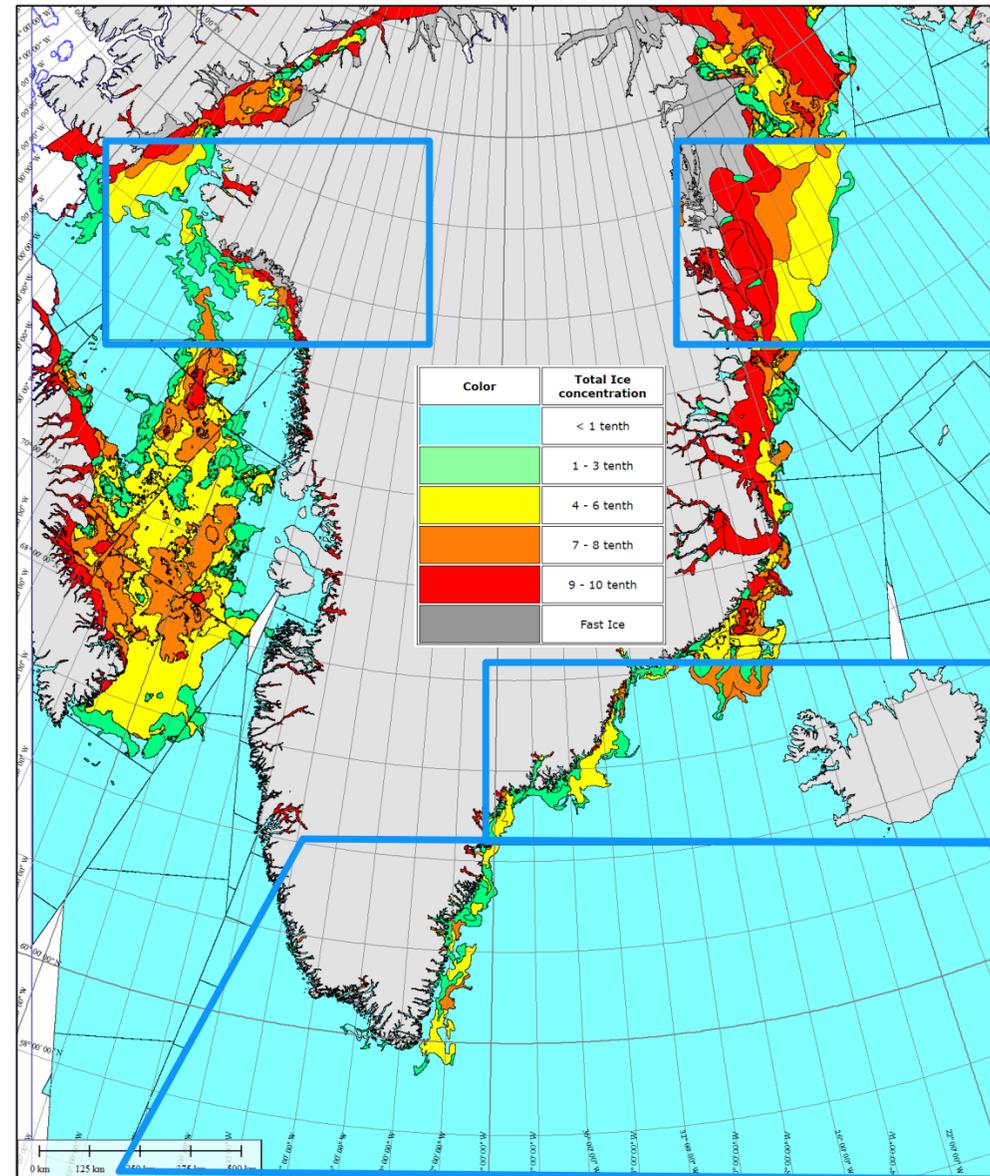
Towards Smart Production (7)

What are we missing in the Ice Service? **Methodology for merging ASIP / manual SIGRID3 files**



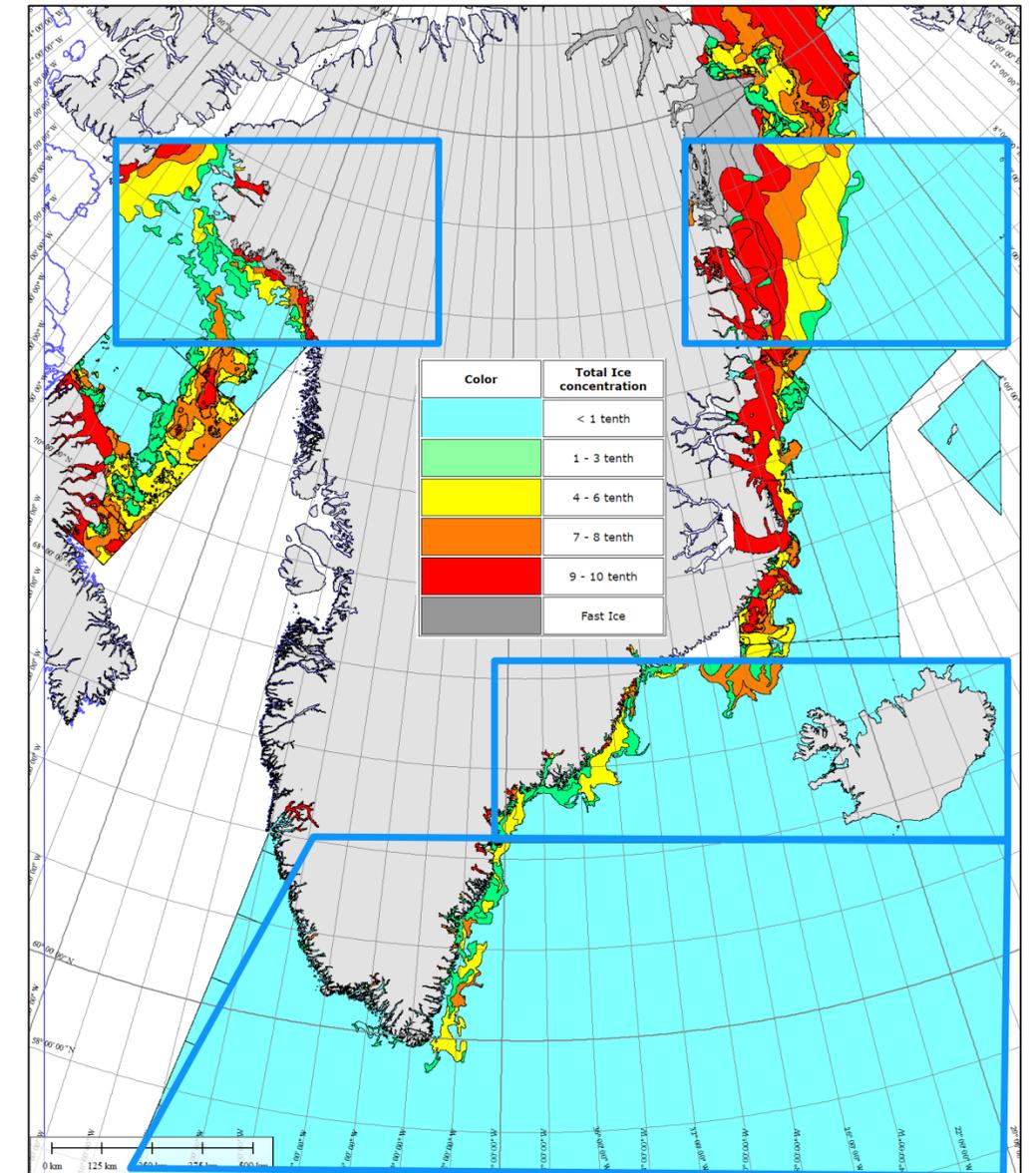
ASIP 4 days mosaic (ONLY) for 14-18 July 2023

?



ASIP 4 days mosaic for 14-18 July 2023, with 18 July 2023 Ice Service sea ice analysis overlaid (blue boxes)

?



ASIP 1 day mosaic for 18 July 2023, with 18 July 2023 Ice Service sea ice analysis overlaid (blue boxes)

?

Recommendations:

To Science

- 1) Keep up the good work !
- 2) Add more data from NRT satellites
- 3) Make sea ice thickness (SoD) available
- 4) Include Operations in development program
- 5) Limitations of technology

To Management

- a) From demonstration project to full implementation
- b) Vision, plan, resources
- c) Ice analyst role, from producer to advisor
- d) International coordination, partnerships

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BIG DATA is here, but **CLIMATE CHANGE** is also here