Provision of metrics and visualisation of sea ice information and forecasts to ensure relevance for Arctic maritime stakeholders

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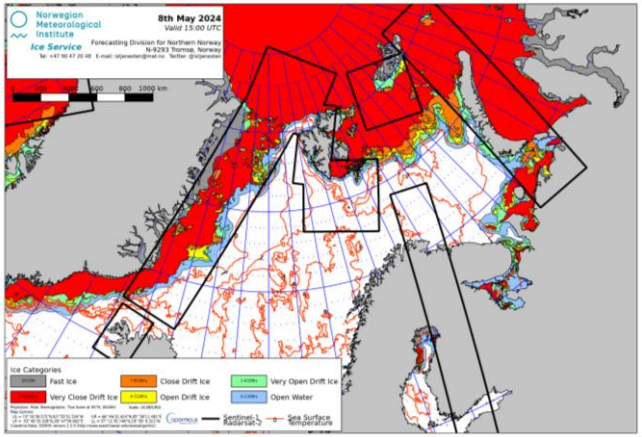
Key Parameters for Sea Ice Information

- Sea Ice Extent
- Sea Ice Concentration
- Sea Ice Stage of Development
- Sea Ice Drift



All have limitations in terms of detection and modelling

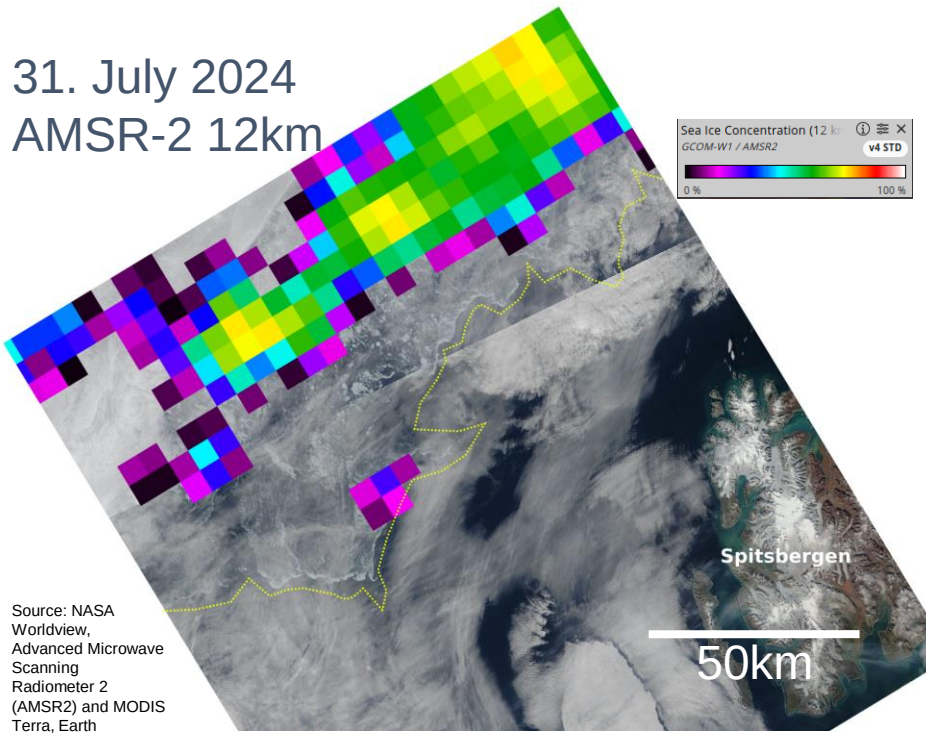
Address this by evaluating/bringing in :

- Increase update frequency of ice conc. (Automation for ice/water)

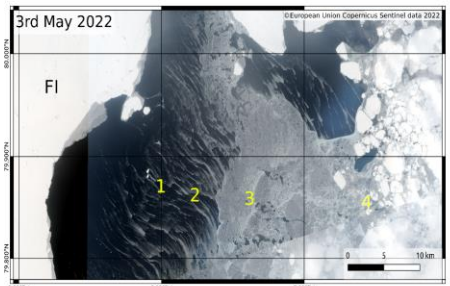
  and will derive ice edge and extent from concentration.
- Short term sea ice forecasts: 1-3 days
- Stage of development (secondary)

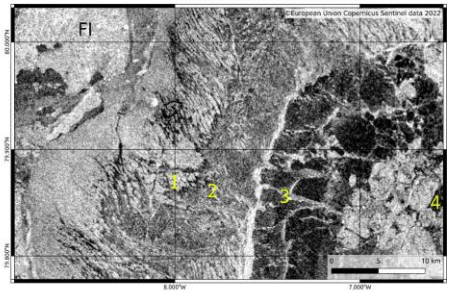
Resolution and reliability requirements

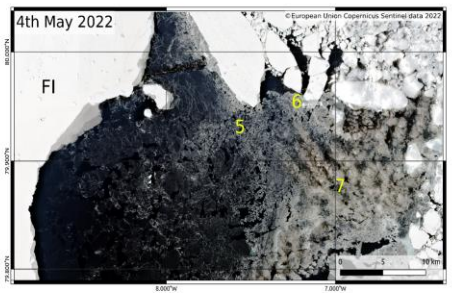
31. July 2024
AMSR-2 12km

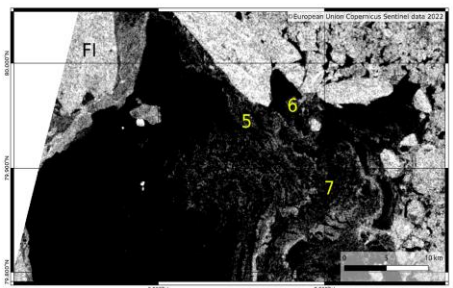


Source: NASA Worldview, Advanced Microwave Scanning Radiometer 2 (AMSR2) and MODIS Terra, Earth Observing System Data and Information









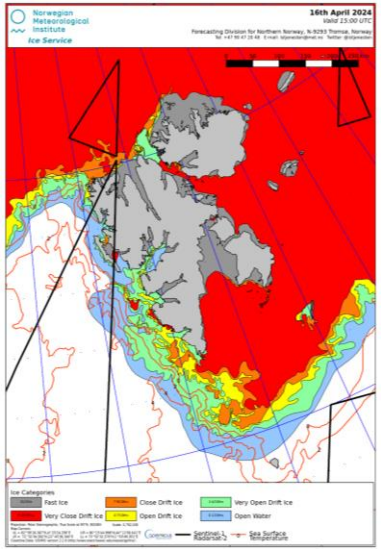
1. Patches of grease ice, pancake ice strips, two icebergs to the NW.
2. Nilas of pancake ice
3. Cemented pancake ice
4. Grey white ice and ridged first year ice floes

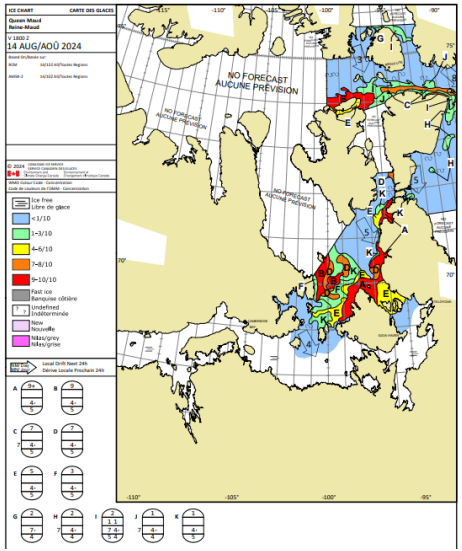
5. Cemented pancake ice and grey ice + frost flowers
6. First year ice floe with multiyear ice floe to the NE.
7. Cemented pancake ice and grey-white ice.

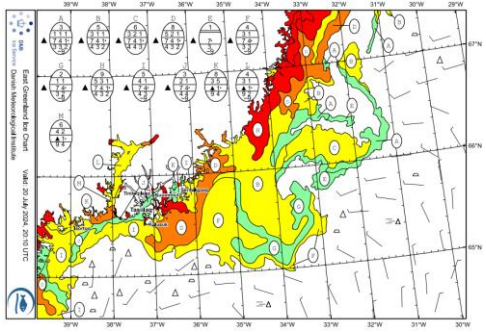
Copeland et al. 2024

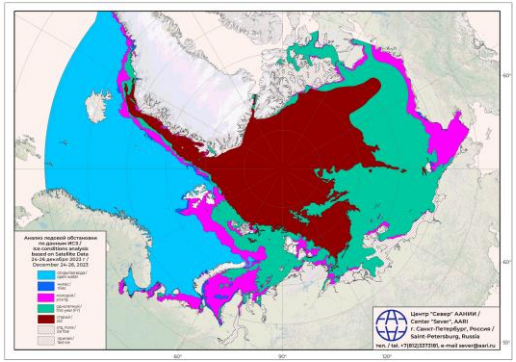
Importance of metrics and types of Visualizations

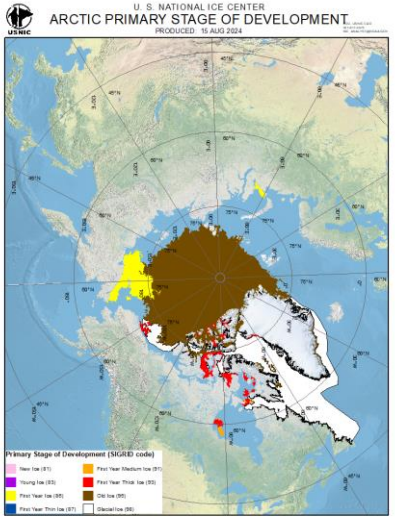
Ice charts, variations across different services etc - We need to provide very clear guidelines and nomenclature to support decision making etc.





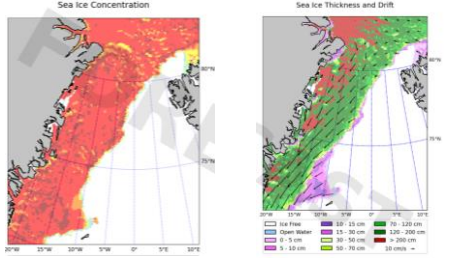






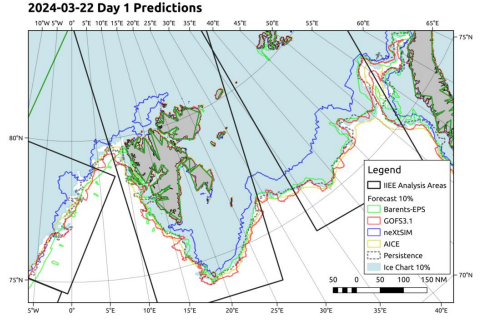
We are conducting QC of automatic charting, drift and sea ice forecast models

Algorithms for automatic sea ice concentration

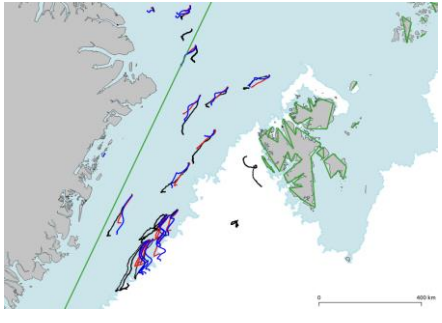


Short-term vs. Long-term Forecasts:

- Daily to seasonal predictions. Seasonal performing better than short term.



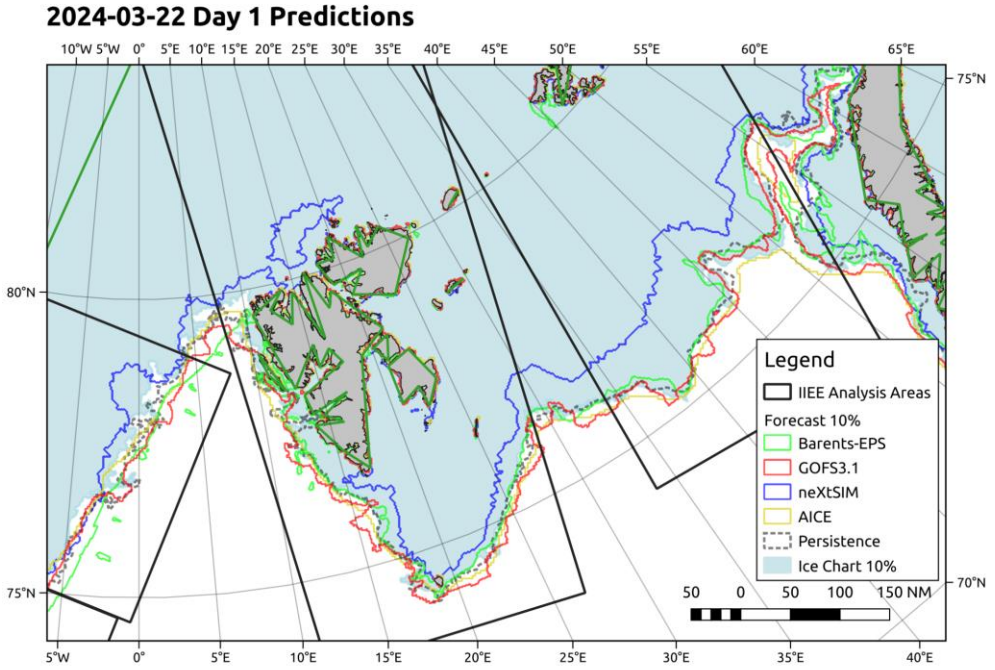
Many models are in their infancy stage, we need an established criteria that will allow for a more controlled verification process where the ice service can provide feedback (O2R), while maintaining the quality of routine products, given little resources.



Example of R2O-O2R at MET Norway

Examples of clear visuals that have helped our team, and how we're linking research with services to improve decisions and communication.

- 4 models
  - Barents-EPS (deterministic)
  - Copernicus neXtSIM
  - U.S. Naval Research Lab GOFS3.1
  - AICE (AI)
- **Sea ice edge**
  - 10% (very open), 40% (open) and 70% (close) drift ice
  - 4 AOI's within Barents-EPS domain
  - Comparison against ice charts



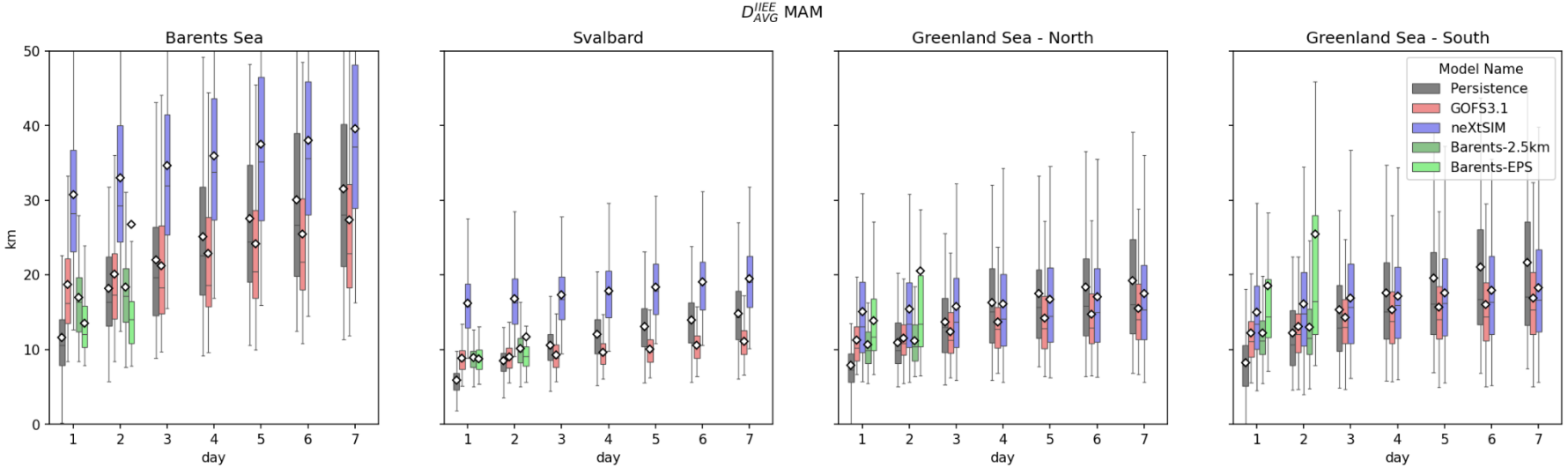
N.Hughes 2024

Forecast Model Evaluations using Ice Edge

Ice edge metrics from Melsom, Palerme and Müller 2019

https://doi.org/10.5194/os-15-615-2019

- Focus on **edge-length averaged integrated ice edge error (IIEE) displacement**



N.Hughes 2024

Friday 2024-03-22 - Forecast Day 1

Barents Sea

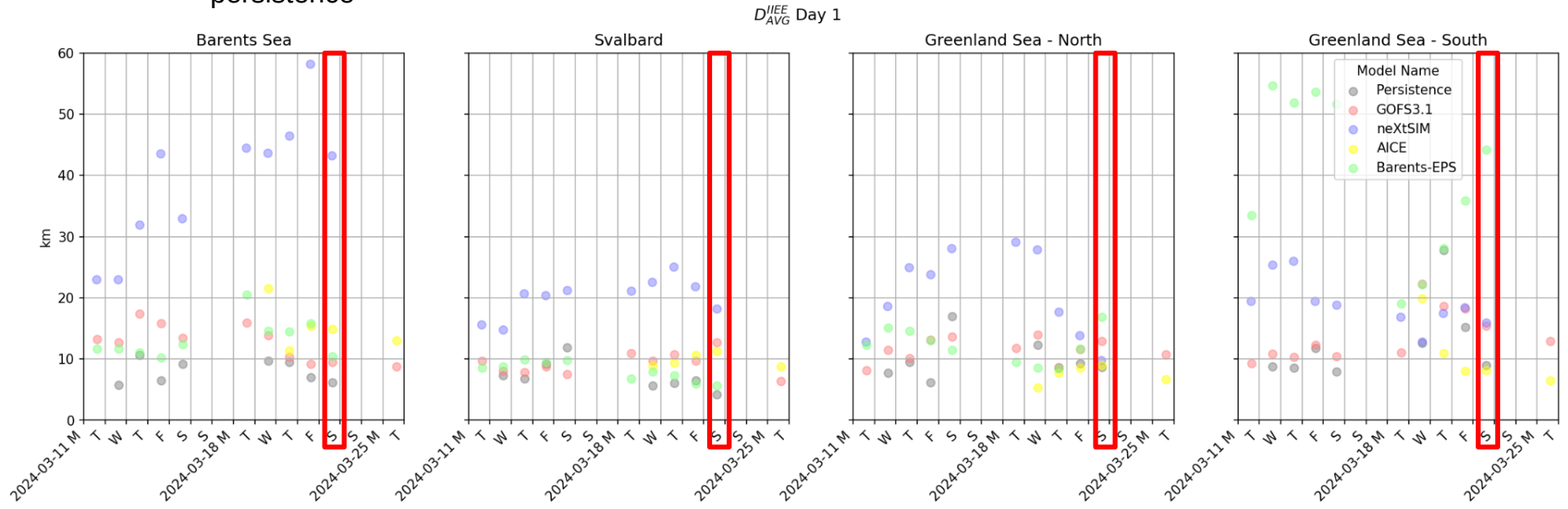
- Wide spread
- GOFS3.1 and Barents-EPS close to persistence

Svalbard

- Barents-EPS and Persistence closest to observed

Greenland Sea (North and South)

- AICE and Persistence closest to observed

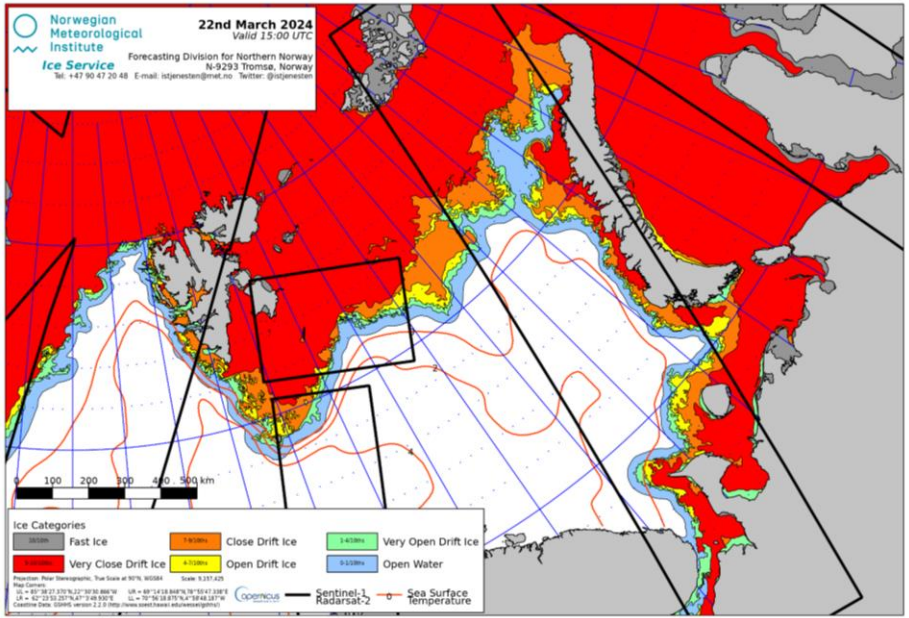


Fleet Faces Ice Problems as Barents Sea Snow Crab Season Nears End

by Oliver McBride | Mar 18, 2024 | Latest News, Norwegian Fishing Industry

With the Barents Sea snow crab season coming to a close tonight, the Norwegian fleet is faced with mounting ice problems Photo: Fiskebåt/Arne Birkeland

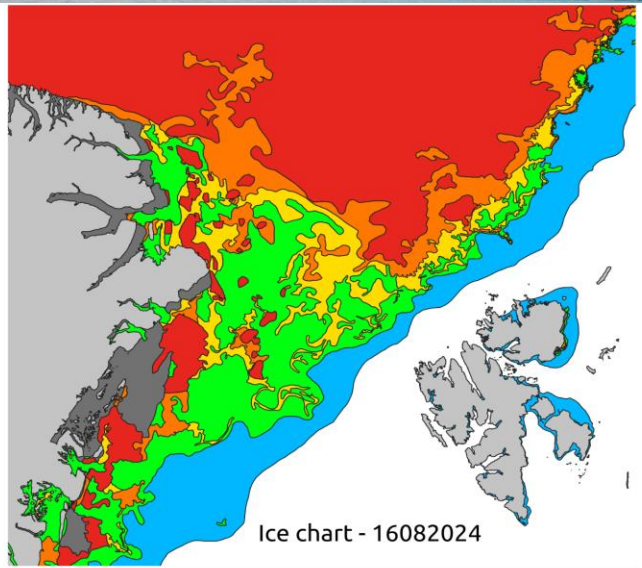
Strong winds from the north have caused significant ice problems for the Barents Sea snow crab fleet as the end of the fishing season approaches.

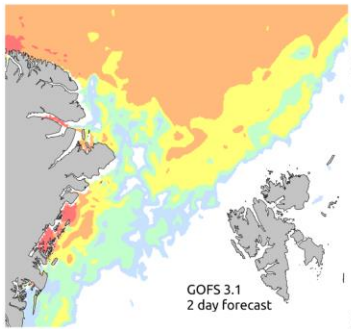


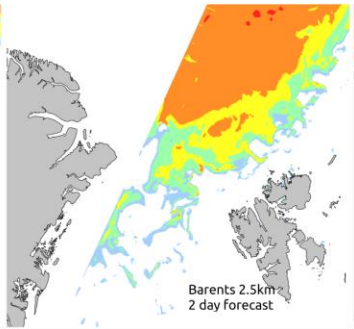
Short term sea ice forecasts continued

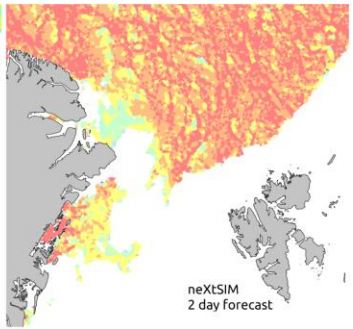
Higher concentrations are more reliable than the marginal ice zone and ice edge - Especially in winter.

Potential for bringing in the high concentration detection into operational services to reduce time spent by the analysts. (Especially for NIS on Mondays).









Summary and Future Directions

Expectation of more semi-automated processes in the future, but this will require consistent level of ongoing verification and QC simultaneously

- Potential for more automation during winter and more human resources during melt and summer season.
- Need to be clear about the boundary between implementing and testing vs. building dependencies, before we have a good overview on capabilities.
- Reliability metrics and visualisations need to be clear and understandable to stakeholders so that they can make clear informed decisions.

Advances in processing power, data availability and visualization are improving reliability.