European Commission

EUROPEAN MASTER IN OFFICIAL STATISTICS

EMOS

Prague University of Economics and Business

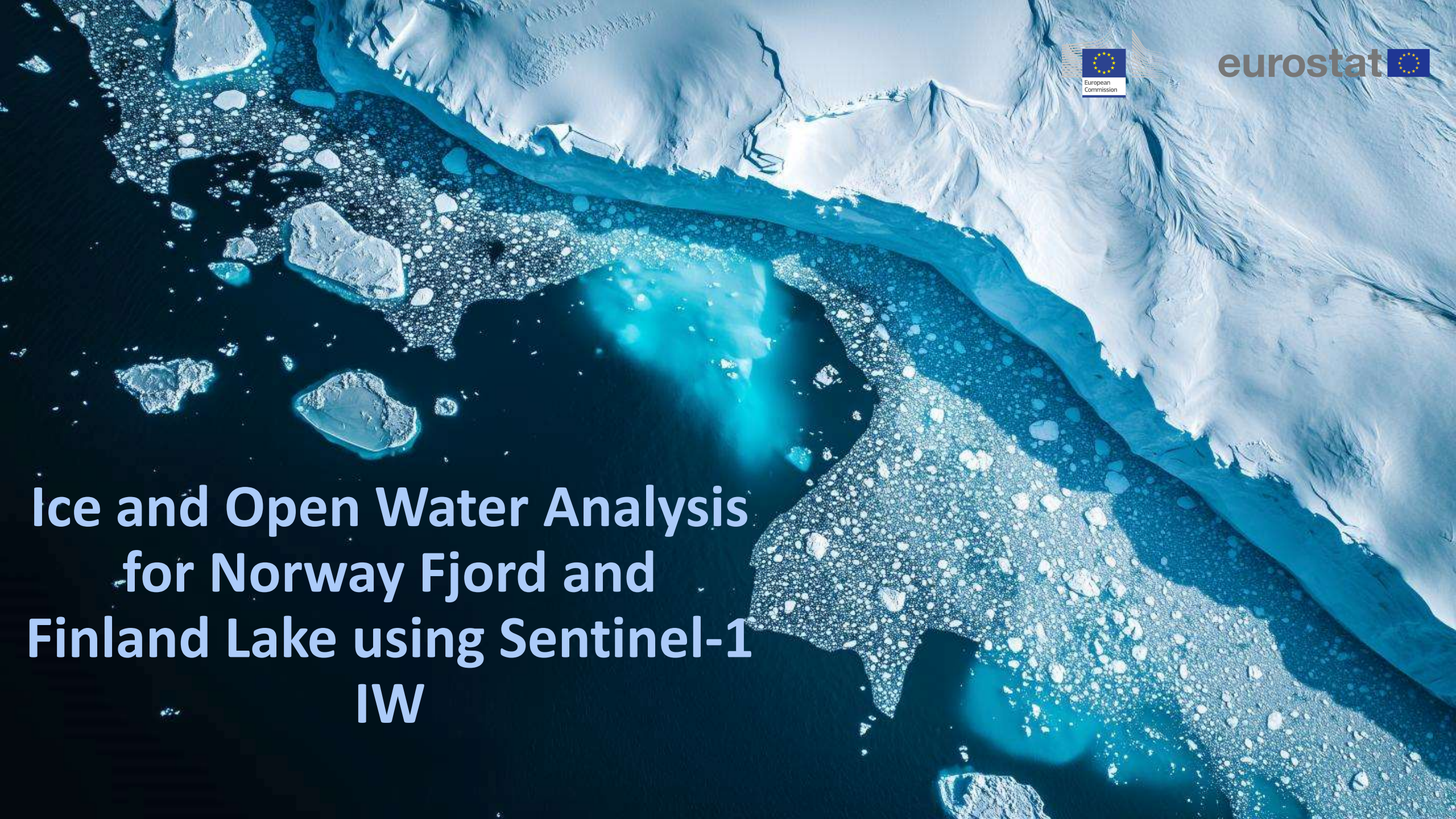
European Big Data Hackathon 2025

Earth Observation: from Space to European Statistics

Brussels, 6–11 March 2025

哈

eurostat

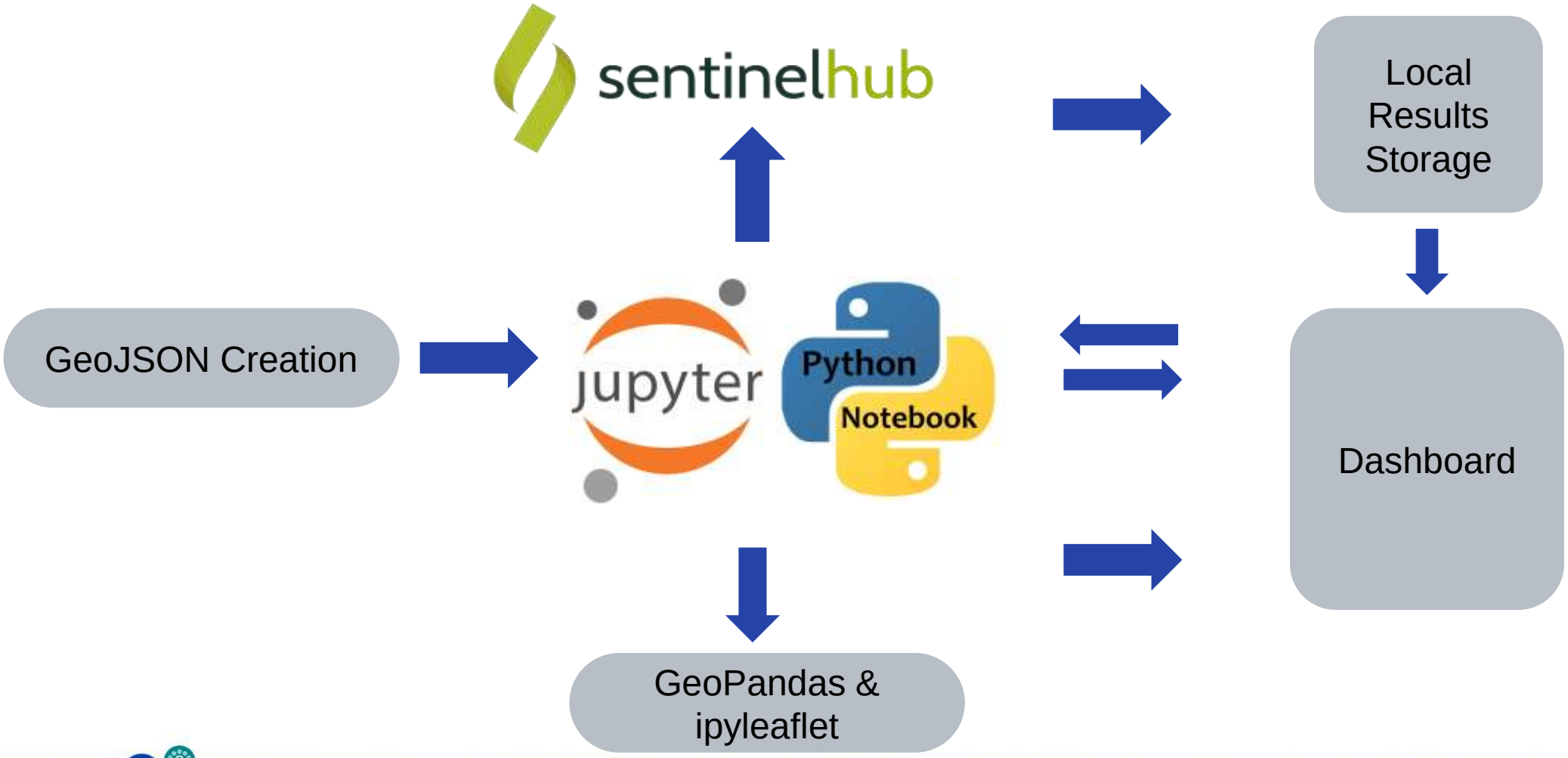


Ice and Open Water Analysis for Norway Fjord and Finland Lake using Sentinel-1 IW

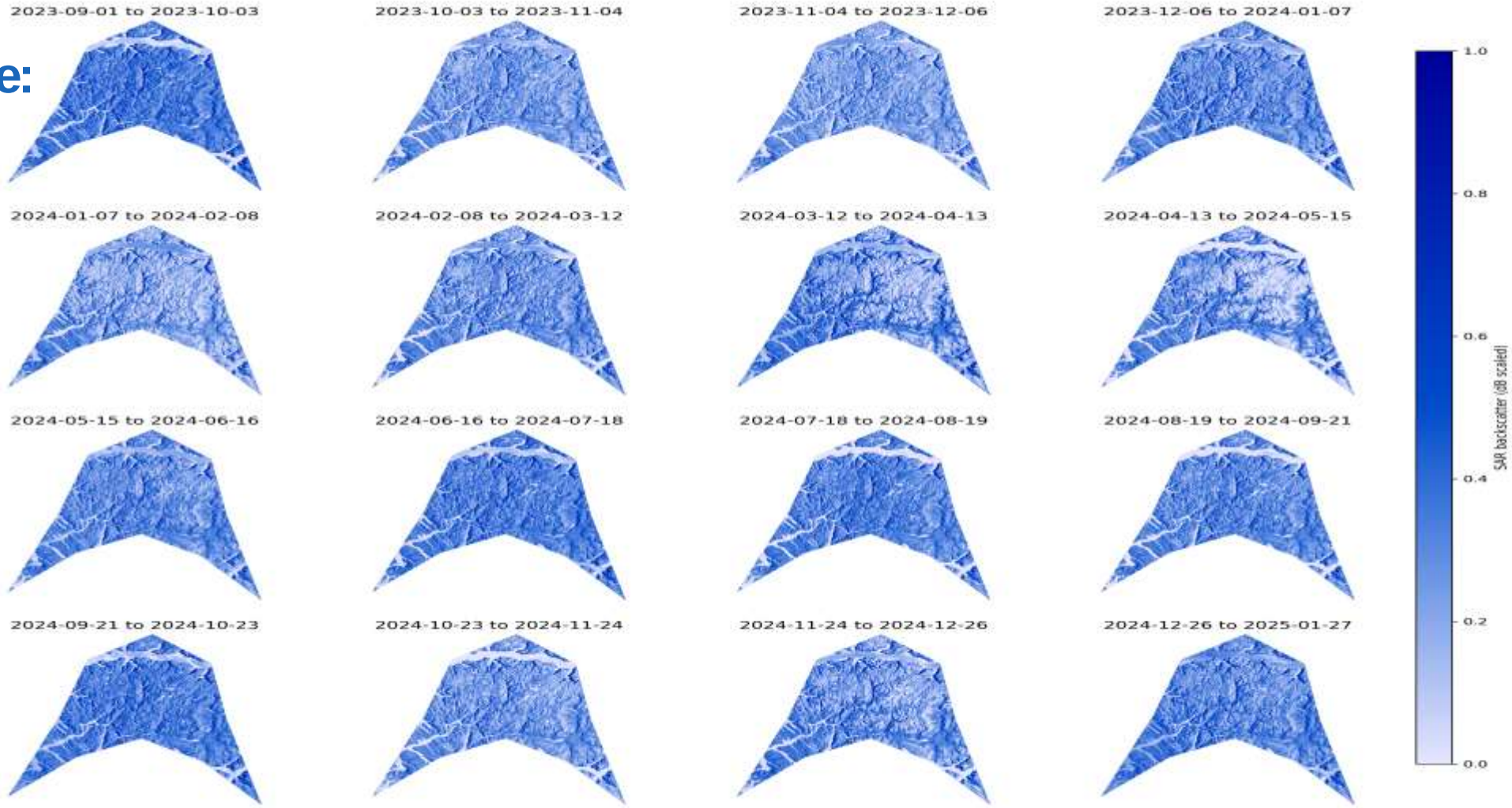
Project Objectives

- Data-Driven Arctic Insights: Our project delivers high-resolution ice metrics using Sentinel-1 SAR, enabling accurate monitoring of ice stability, coverage, and thickness for climate adaptation.
- Impactful Decision-Making: Supports safe Arctic navigation, climate modeling, and EU environmental policies by providing exportable ice data for long-term studies and real-time hazard assessments.
- Future-Ready Innovation: Integrates with Eurostat's statistical framework, offering scalable, automated ice monitoring solutions to enhance climate resilience and sustainable Arctic resource management.

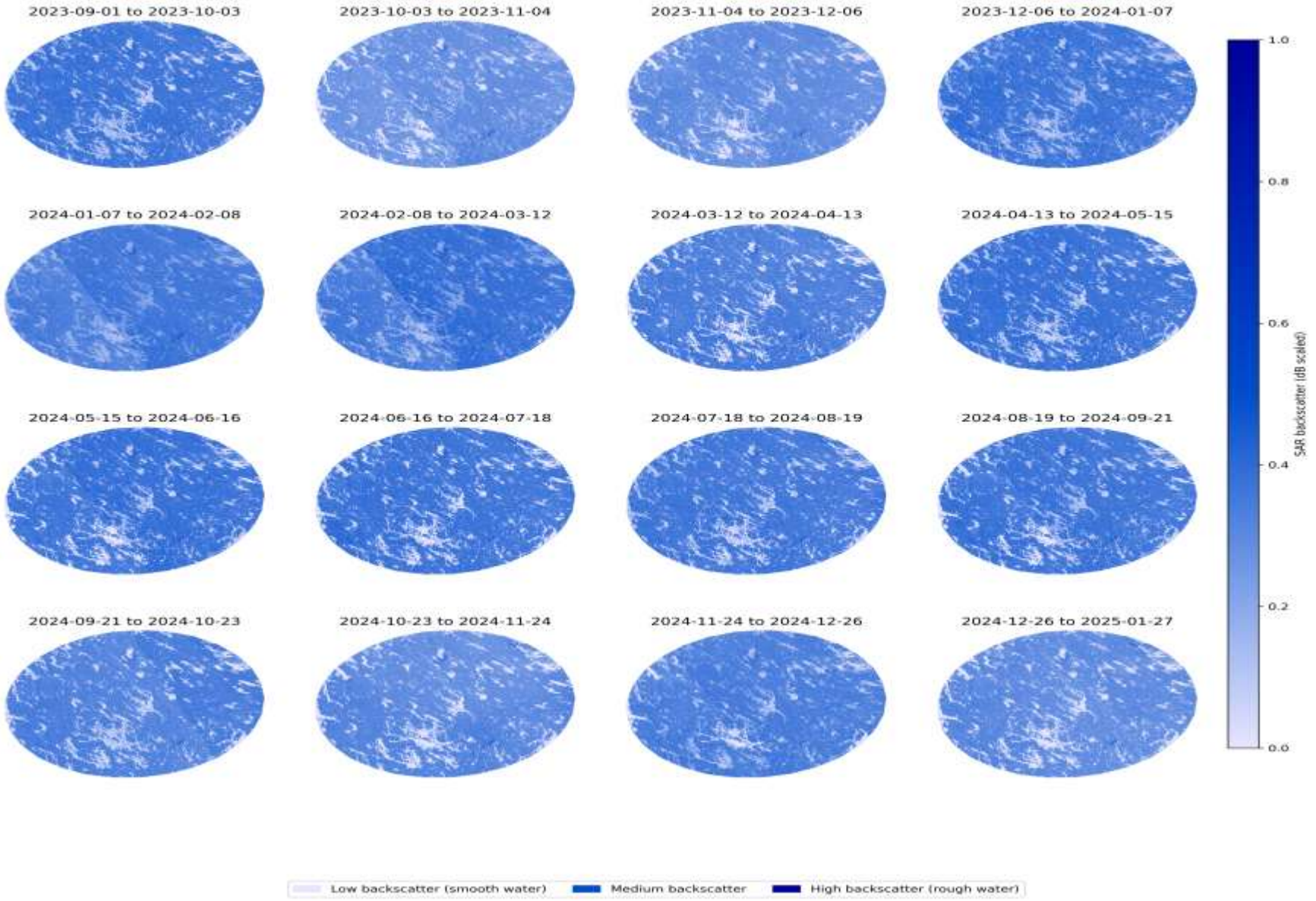
Technology Architecture



SAR Backscatter Analysis of Finland Lake: Seasonal Ice-Water Dynamics



SAR Backscatter Analysis of Norway Fjord: Seasonal Ice-Water Dynamics



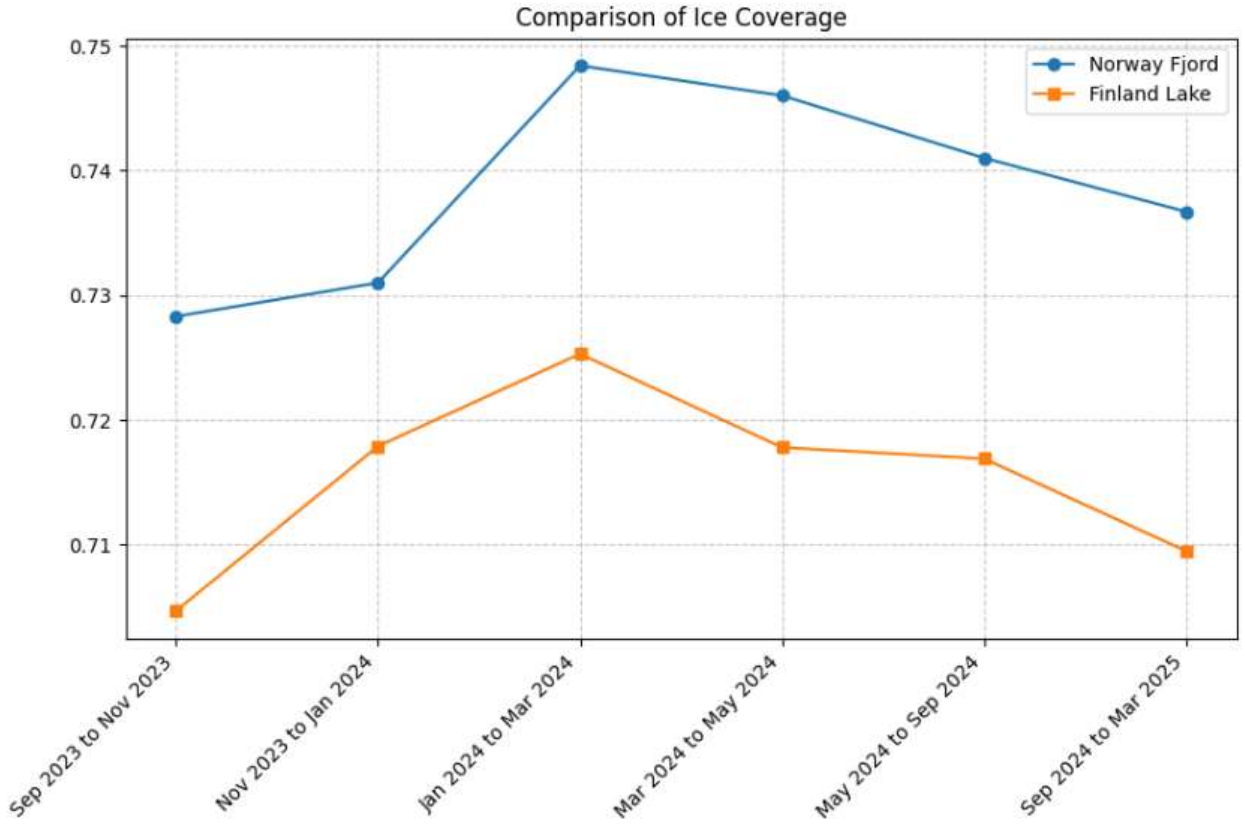
Ice Coverage Index

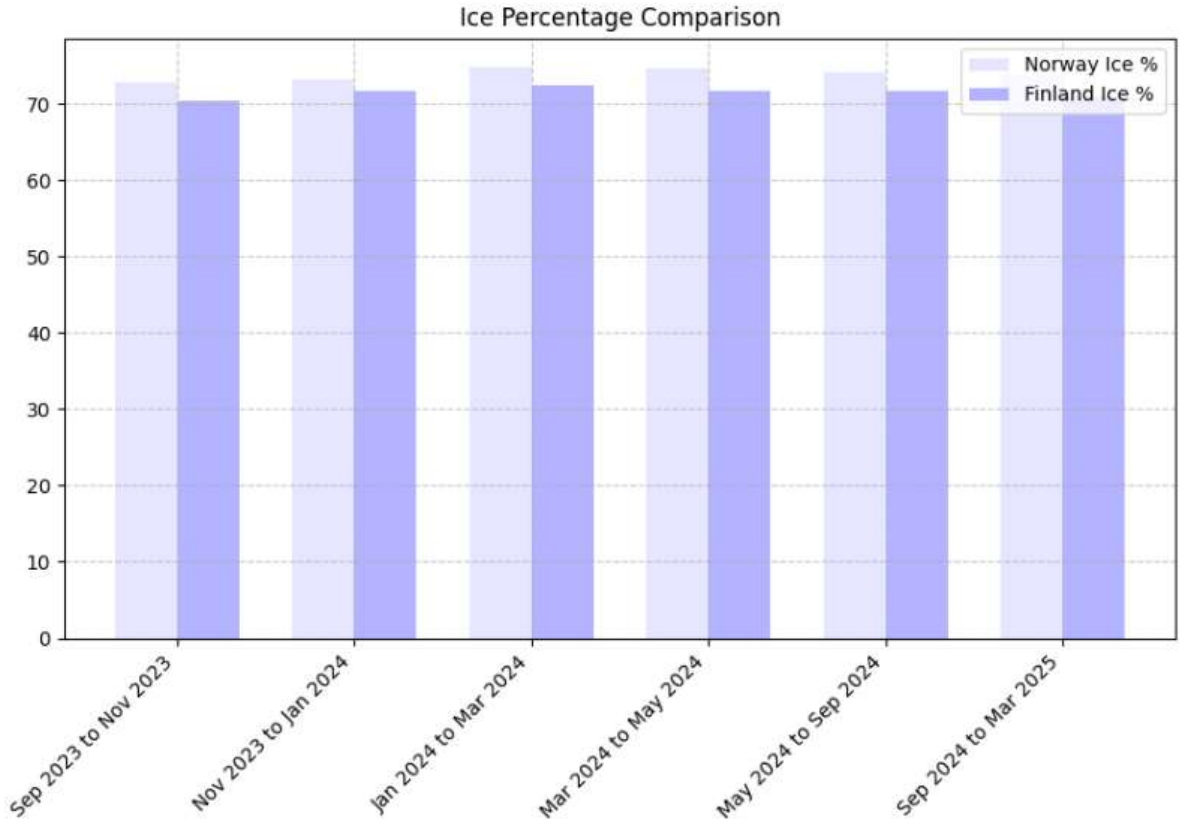
$$ICI = \frac{SIE_t - SIE_{t-1}}{SIE_{t-1}} \times 100$$

- SIE_t = Sea Ice Extent at time t
- SIE_{t-1} = Sea Ice Extent at previous time (e.g., previous year or month)
- ICI = Percentage change in ice extent

- This index indicates the extent and density of ice cover on the water surface.
- Higher values (closer to 1.0) typically indicate more extensive ice coverage.
- Provides real-time insights into ice extent variations, helping predict climate change impacts, support disaster readiness, and guide global climate adaptation strategies.

Ice Coverage Index





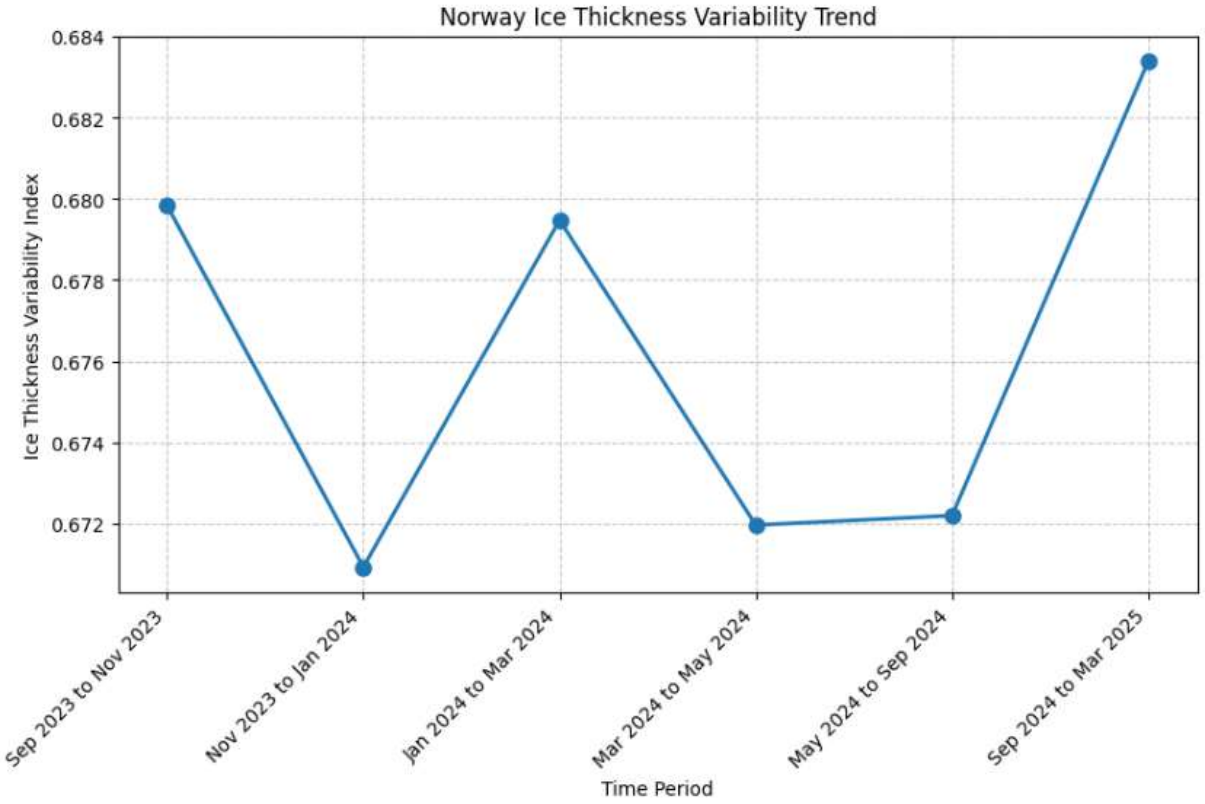
Ice Thickness Variability

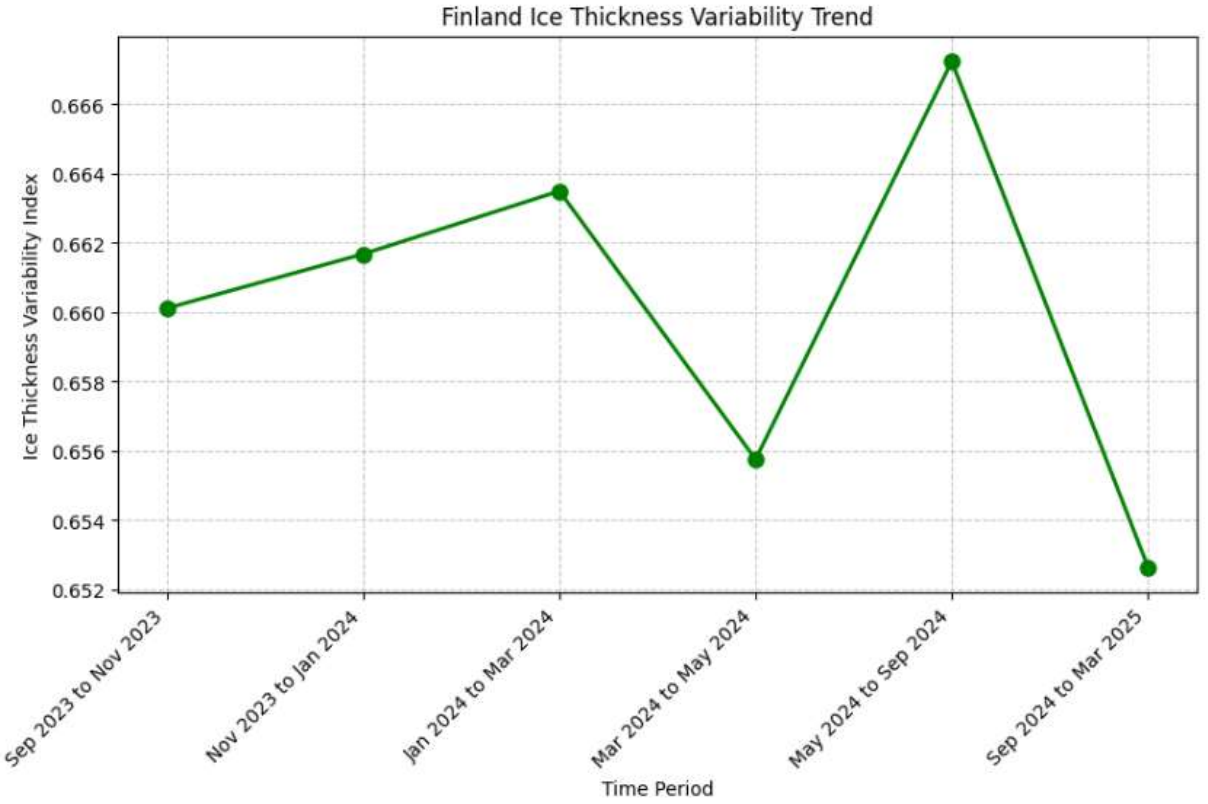
$$h = A \cdot (\sigma_0^{VV} - \sigma_0^{VH}) + B$$

- h = Ice thickness (meters)
- $\sigma_0^{VV}, \sigma_0^{VH}$ = SAR backscatter in VV and VH polarization
- A, B = Empirical coefficients based on field calibration

- This metric indicates how uniform or variable the ice thickness is across the monitored area.
- Higher values indicate more variable ice thickness or mixed ice conditions.
- Lower values suggest more uniform ice thickness or homogeneous surface conditions.
- This index helps identify areas with potential pressure ridges, cracks, or diverse ice formations that may impact navigation or infrastructure.

Ice Thickness Variability





Ice Temporal Stability

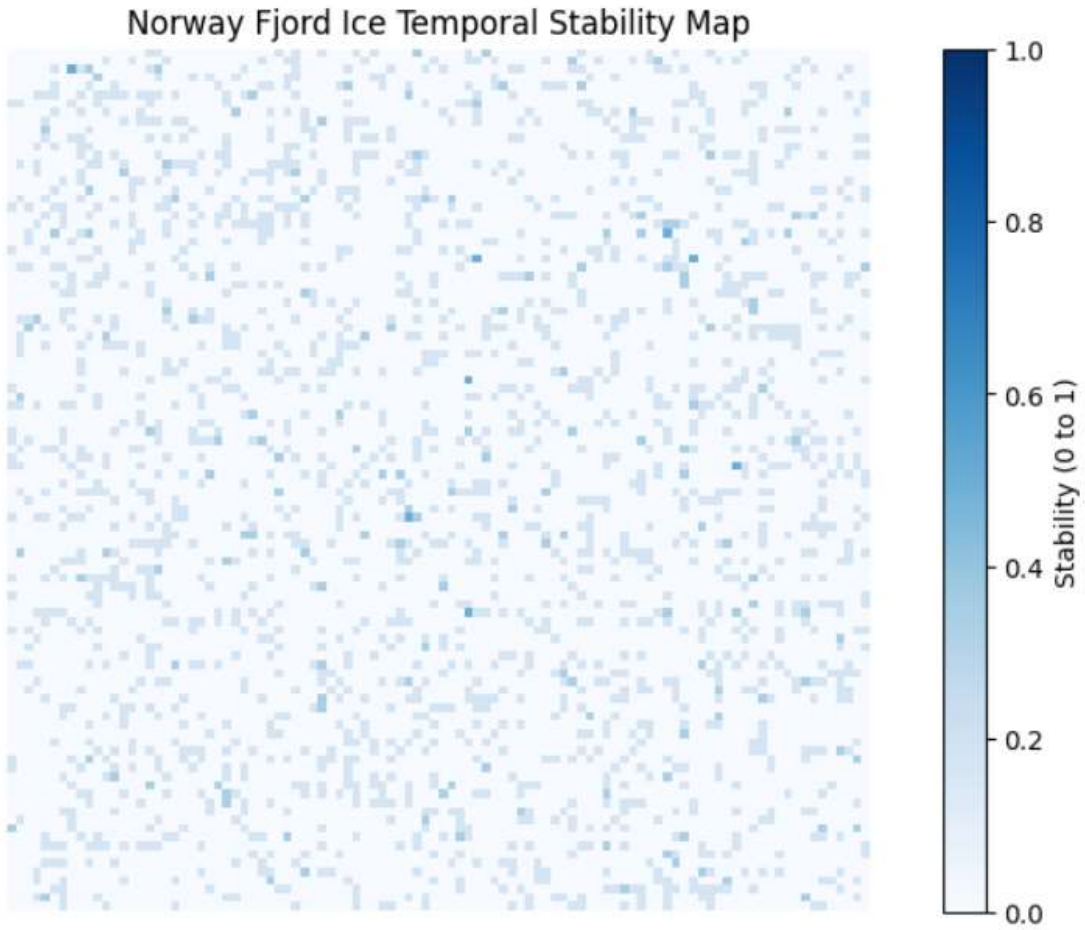
$$\frac{dC}{dt} = m$$

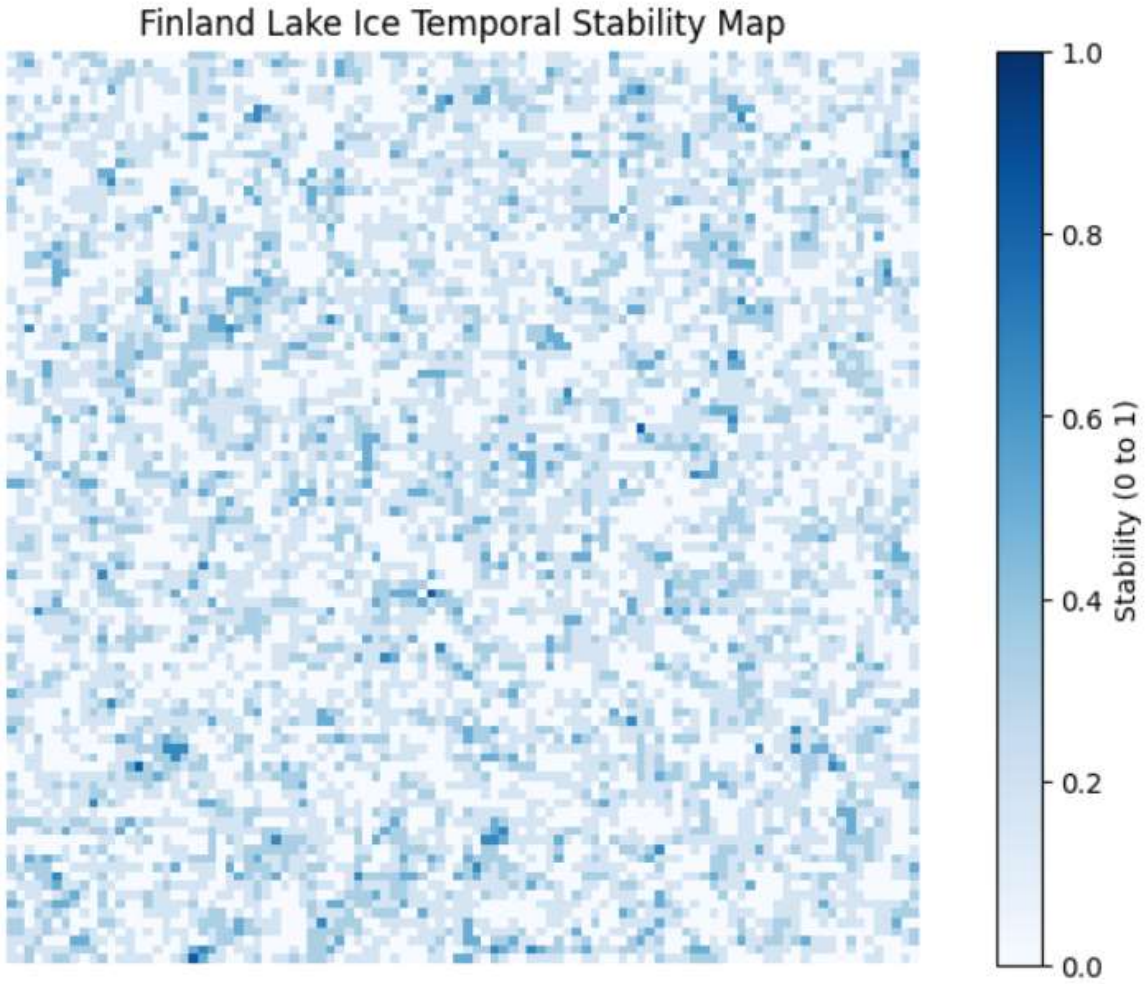
- $\frac{dC}{dt} = =$ Rate of change of sea ice concentration over time
- $m =$ Slope of the linear regression line fitted to ice concentration data

- This metric indicates the persistence and reliability of ice conditions over time.
- Higher values suggest more stable ice conditions that persist over longer periods.
- Tracking this index over seasons helps identify "stable ice zones" versus dynamic areas.
- Temporal stability is crucial for winter transportation routes, ice fishing activities, and predicting future ice behavior for climate studies.

Ice Temporal Stability

Norway Fjord Ice Temporal Stability Index: 0.1812
Finland Lake Ice Temporal Stability Index: 0.2361





Jing Zhang
Praveen Sharma

- “The Arctic Europe is underreported - the world should know more about it.”

Hannah Thule

Thank You!