



ARCTIC  
PASSION



S Y K E

10 November 2022

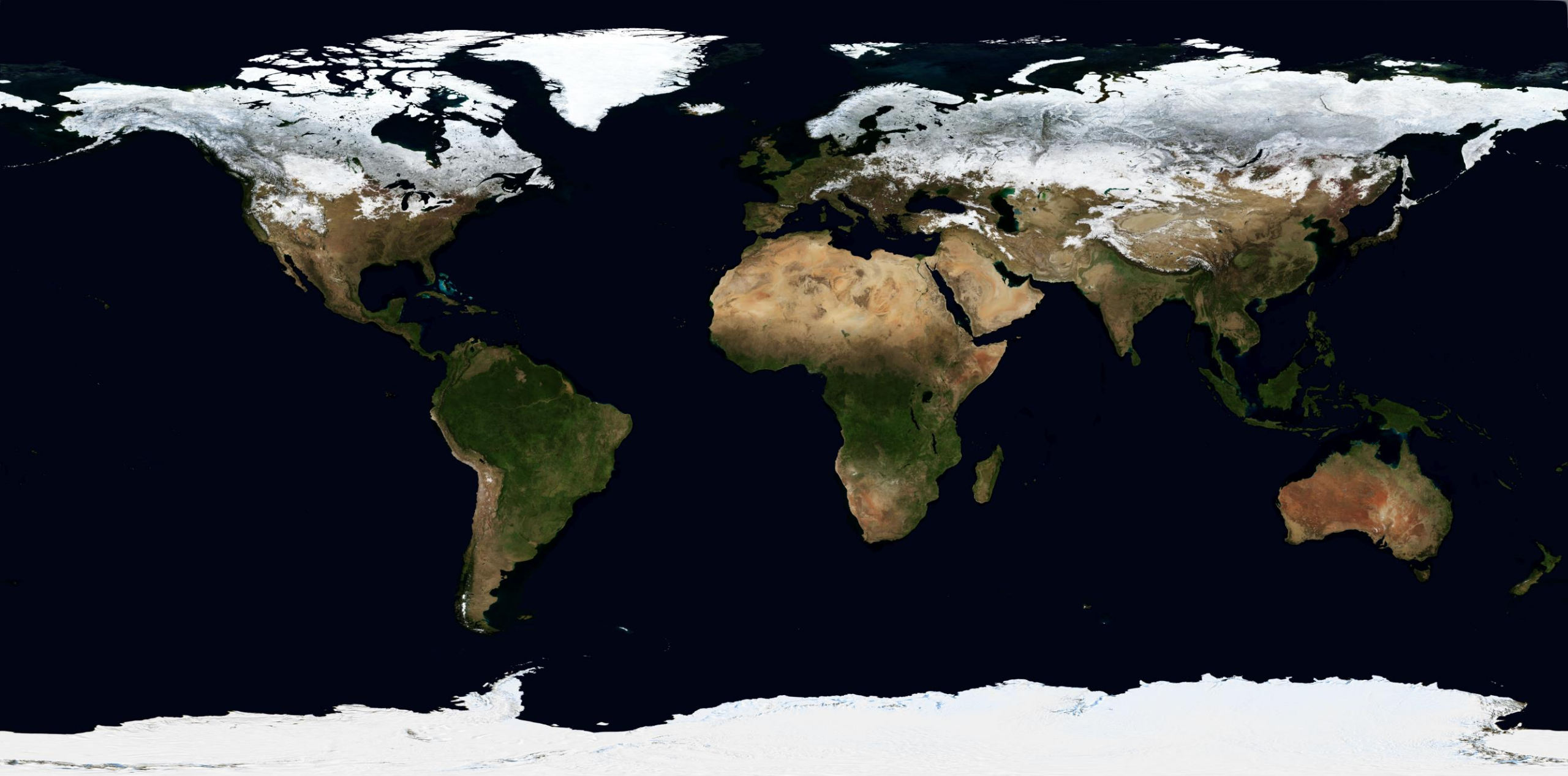
# Lake Ice Service for Arctic Climate and Safety

Webinar: Lake ice information in your pocket

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# Lake Ice Service

- Collects lake ice information from multiple sources
- Visualizes the information in a format that is easy to access and understand

## Earth observation data

- Copernicus Lake Ice Extent products
- High resolution true color images

## In situ data

- Citizen observations
- Official lake ice observation networks

- Users: Scientist, Civil society (Fishing, Hunting, Reindeer herding etc.), Policy makers, Industry, General public

Information on lake ice is important for many reasons:

- Transportation
  - Recreation
  - Local weather
  - Water quality
  - Limnological and biological processes within lakes
  - Earth energy balance
  - Sensitive climate change indicator
- In recent decades, the changes in lake ice have become even more apparent
    - Number of extremely early break-ups and late freeze-ups has increased

Image references: 1,4,6,7 Riku Lumiaro, SYKE's image bank; 2 Lari Lievonen, Maaseudun tulevaisuus; 3 Auri Sarvilinna, SYKE's image bank; 5 Esa Nikunen, SYKE's image bank



# Lake Ice Service

- Integrated to public TARKKA+ service
  - The lake ice service forms its own theme
  - OpenLayers web-service compatible with all modern web-browsers
- Development state

Users may propose other value-added information to be included in the service

**TARKKA+**  
SYKE's EO service

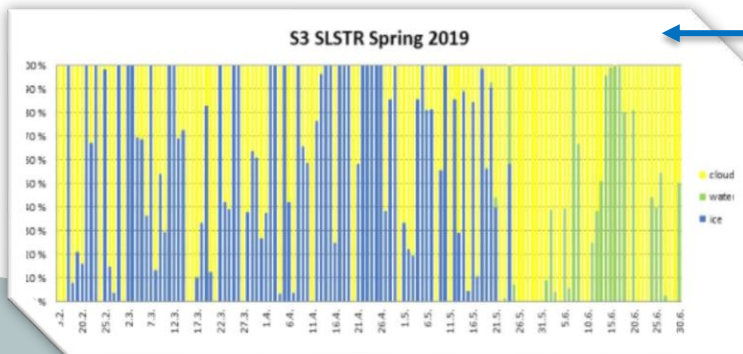
Select theme

- Lake ice service
- All data
- Surface algal blooms
- Turbidity
- BalticAIMS demonstration material
- Lake ice service

True color images (3)

Basemaps (1)

<https://testbed.ymparisto.fi/eo-tarkka/mapandwaterareas/>



**TARKKA+**  
SYKE's EO service

What's up EO map viewer Gallery Projects More info

Lake ice service

Lake ice service (1)

- ☒ Lake Ice Extent Northern Europe (250m)
- ☐ Lake Ice Extent Northern Hemisphere (500m)

True color images (3)

- ☒ Sentinel-2 MSI (10 m)
- ☒ Landsat-8/9 OLI (30 m)
- ☒ Sentinel-3 OLCI (300 m)

Basemaps (1)

Lake ice

- Fully snow-covered ice
- Partially snow-covered or snow-free ice
- Open water
- Cloud

Cloudless observations (S2)

2020-04-04

April 2020

#	Mo	Tu	We	Th	Fr	Sa	Su
14	30	31	1	2	3	4	5
15	6	7	8	9	10	11	12
16	13	14	15	16	17	18	19
17	20	21	22	23	24	25	26
18	27	28	29	30	1	2	3

Sisältää muokattua Copernicus Sentinel-3 dataa, SYKE USGS/NASA Landsat Program Sisältää muokattua Copernicus Sentinel-2 dataa, SYKE

Feedback

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2022-05-13

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20	16	17	18	19	20	21	22
21	23	24	25	26	27	28	29
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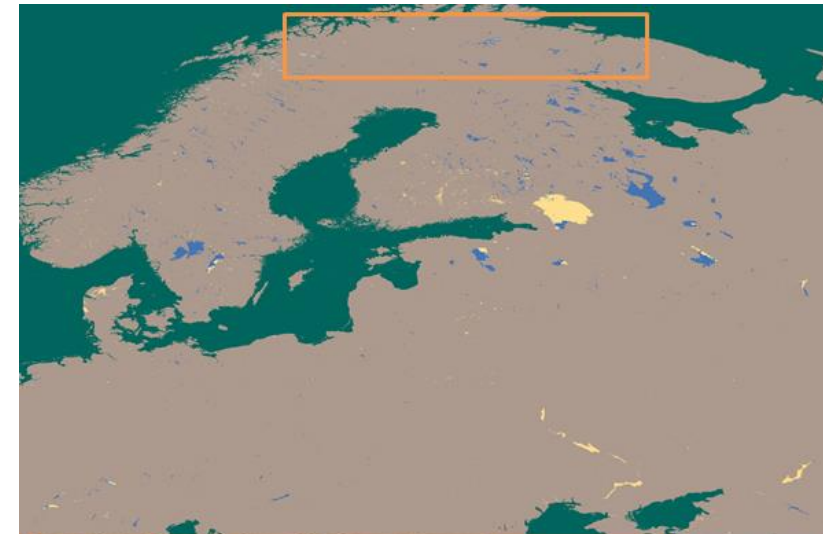
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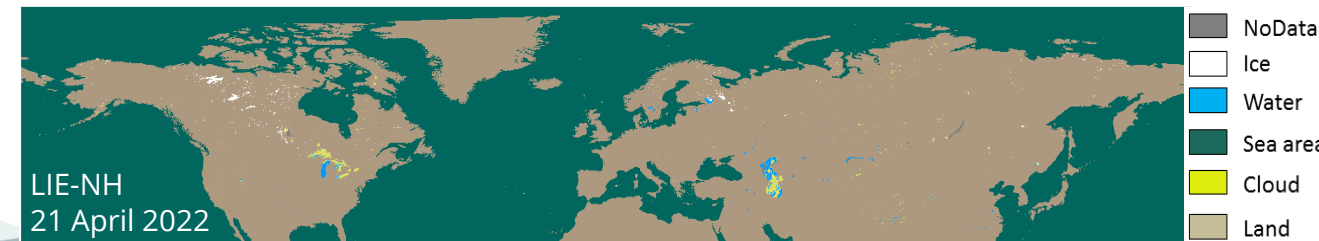
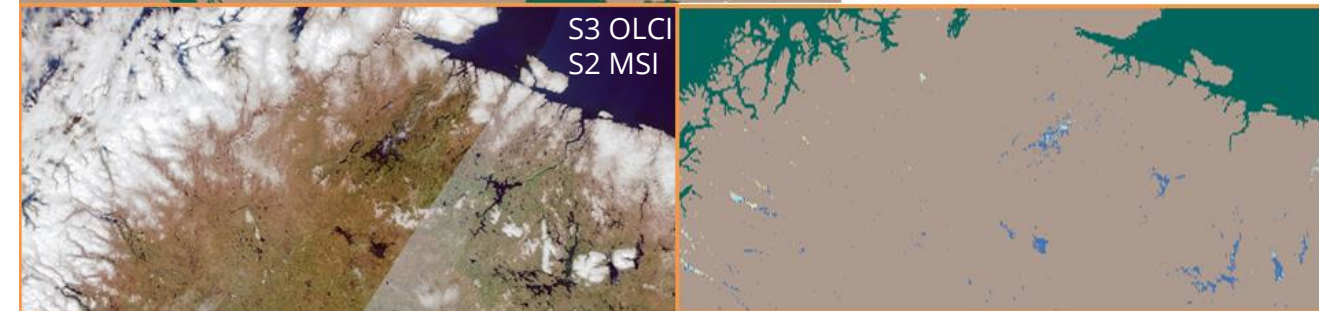
# Earth observation data in Lake Ice Service

## ■ Medium resolution products

- Daily NRT Lake Ice Extent for Northern Europe (LIE-NE)
  - 250m resolution MODIS-based product
  - Online in Copernicus Global Land Service since 03/2017
- Daily NRT Lake Ice Extent for Northern Hemisphere (LIE-NH)
  - 500m resolution Sentinel-3 SLSTR -based product
  - Online in Copernicus Global Land Service since 04/2021
- Daily NRT Sentinel-3 OLCI RGB images
- SYKE is the LIE service provider in CGLS
  - Algorithm developed at SYKE
  - Processing together with FMI and ENVEO



LIE-NE on 3 June 2021



LIE-NH  
21 April 2022

## ■ High resolution products

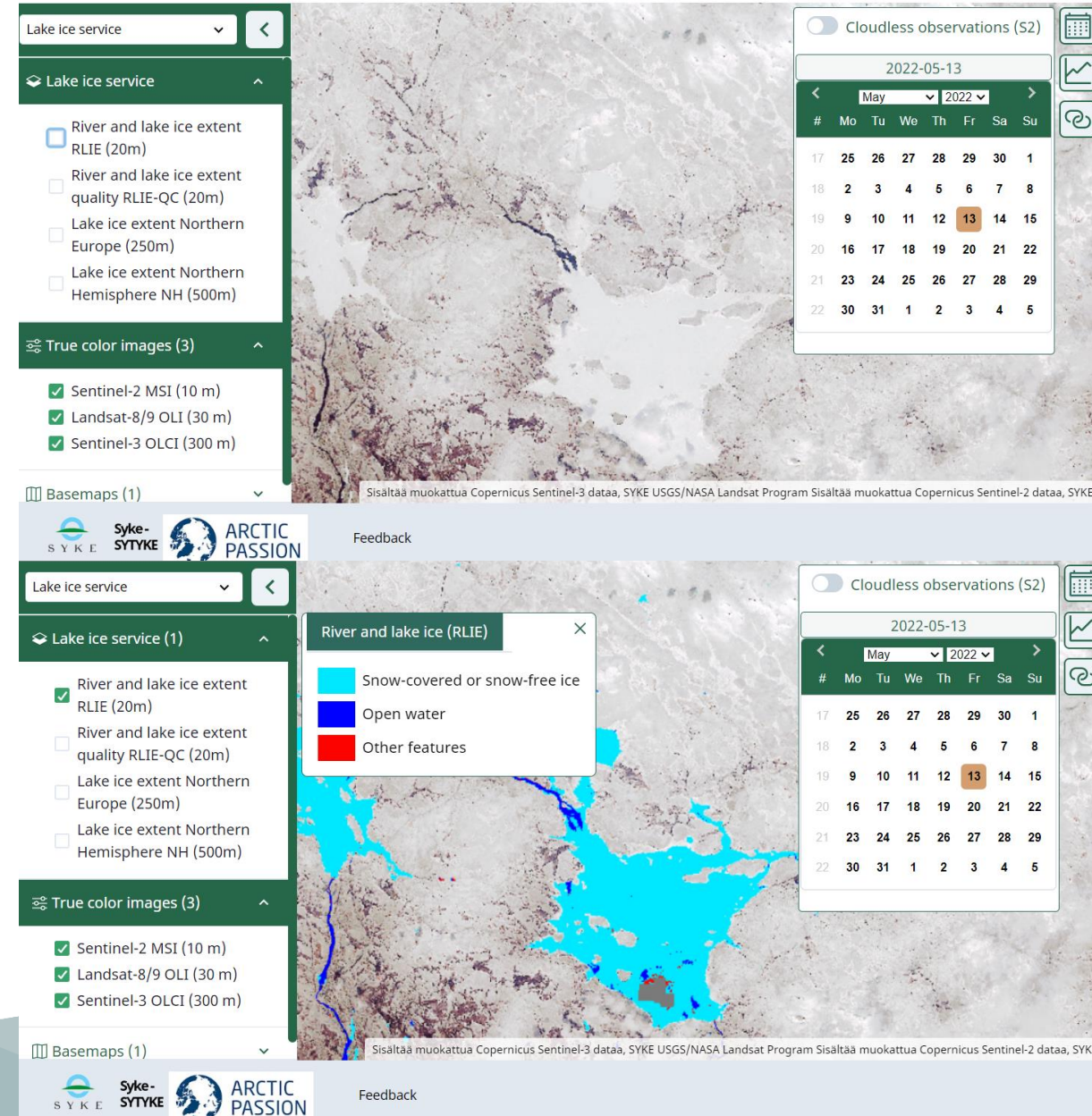
- Sentinel-2 MSI (10m) and Landsat-8 OLI (30m) true colour images
  - Temporal resolution a few times per week depending on latitude
- Later, River and Lake Ice Extent (RLIE) for Pan-European region
  - 20m resolution Sentinel-2 MSI and/or Sentinel-1 SAR -based product
  - Temporal resolution a few times per week depending on latitude
  - Online in Copernicus Land Monitoring Service since 2020

<https://land.copernicus.eu/pan-european/biophysical-parameters/high-resolution-snow-and-ice-monitoring/ice-products/ice-cover>

TARKKA

S2 MSI RGB image on 13 May 2022

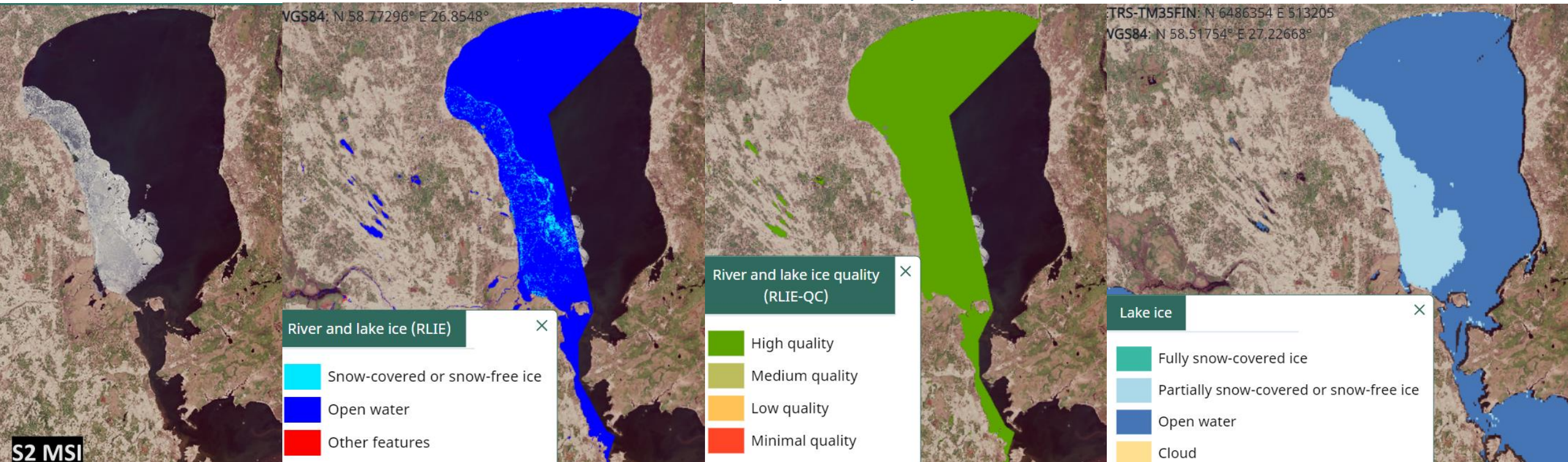
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# Earth observation data in Lake Ice Service

- River and Lake Ice Extent (RLIE) has occasionally difficulties in ice classification
- Includes a confidence level
  - Could be utilized to accept only high and medium quality interpretations
  - At the moment it is not convenient
- Included to the Lake Ice Service later
- S2 MSI 20m true color images available

Peipsi on 21 April 2022



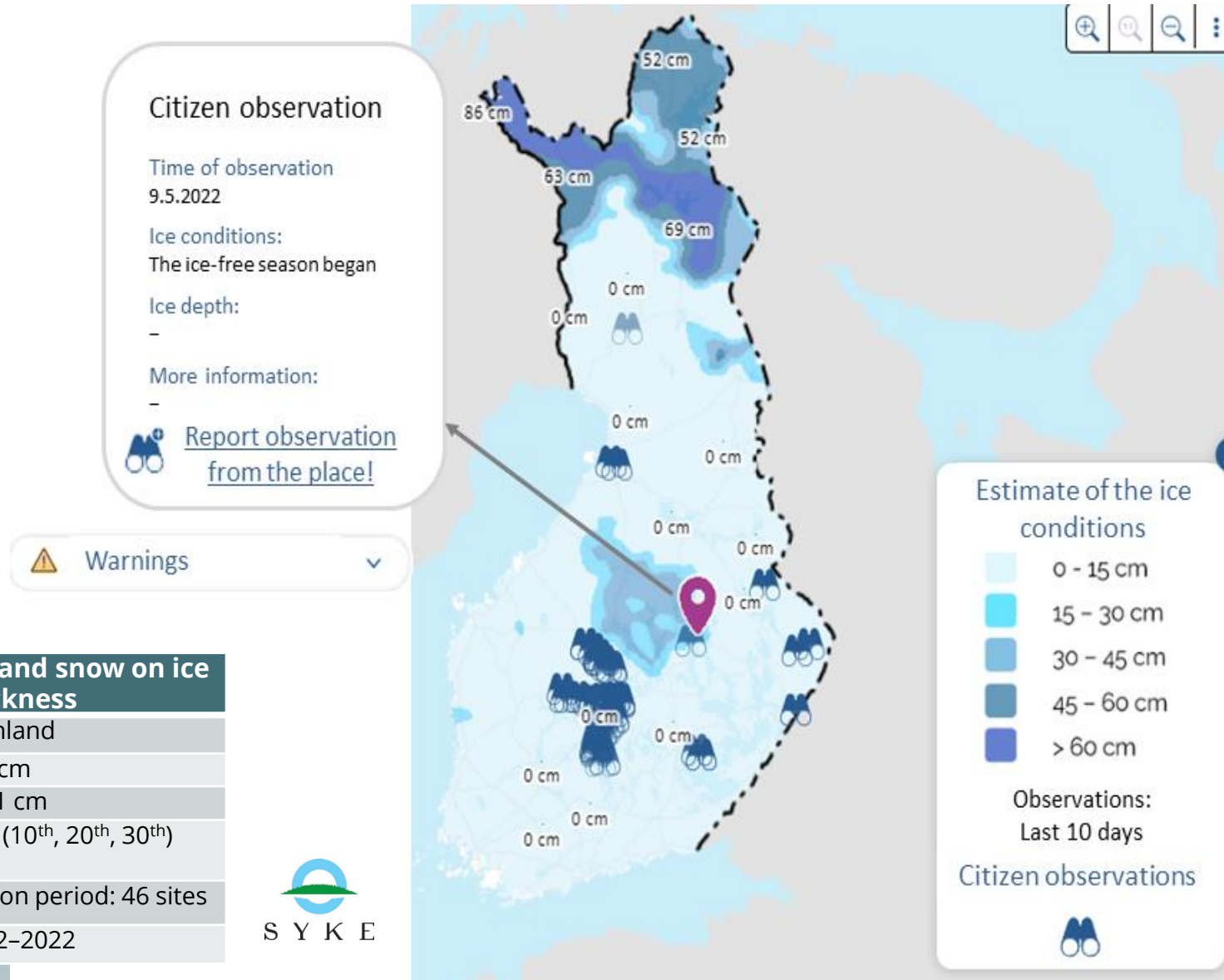
# In-situ data in Lake Ice Service

## ■ Citizen observations

- Järviwiki ([www.jarviwiki.fi](http://www.jarviwiki.fi))
- CitobsDB
- To collect and store citizen observation data
- Further development to match with the needs of people living in the arctic environments
  - Translation to different local languages
  - Mobile applications that works with limited internet connections

## ■ Official in-situ ice phenology observations

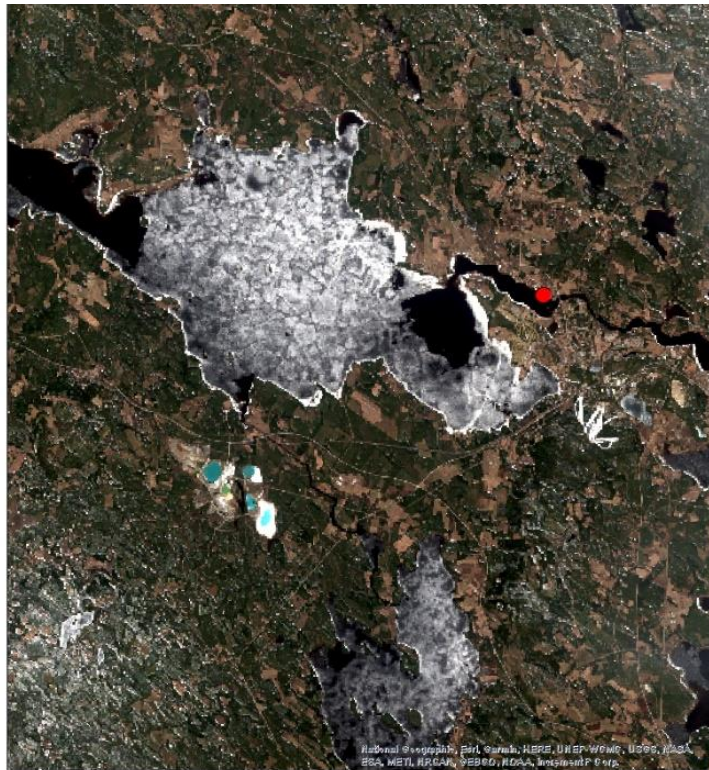
SYKE in-situ dataset	Freezing and breakup	Ice thickness and snow on ice thickness
Coverage	Finland	Finland
Unit	Date	cm
Accuracy	±1 day	±1 cm
Observation interval	Daily observations	3 per month (10 <sup>th</sup> , 20 <sup>th</sup> , 30 <sup>th</sup> )
Areal extent	Entire observation period: 50 sites	Entire observation period: 46 sites
Temporal coverage	1753–2022	1912–2022



# Lake Ice Service for Arctic Climate and Safety

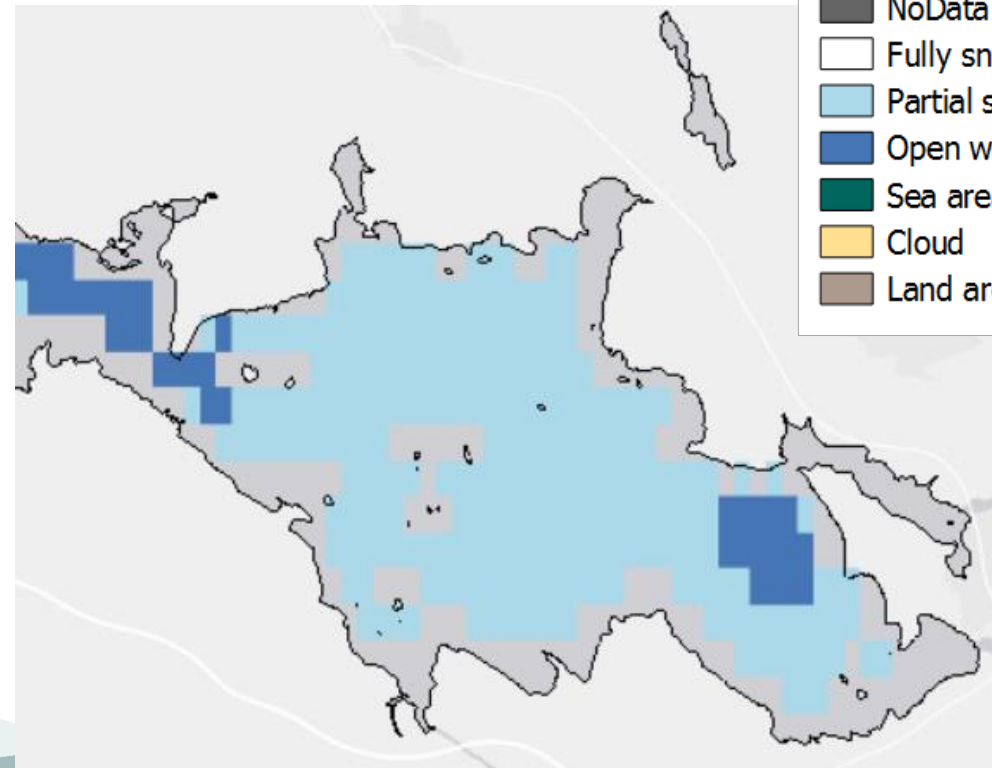
- Combining data for different resolutions is essential
  - Different sources serves different purposes

S2 MSI RGB on 28 April 2019



● in-situ

LIE-NE on 28 April 2019



- NoData
- Fully snow covered ice
- Partial snow covered ice/ clear ice
- Open water
- Sea area
- Cloud
- Land area

In-situ observation:  
"The whole horizon  
is ice-free" in  
Nuasjärvi, Finland, on  
28 April 2019

# Lake statistics in Lake Ice Service

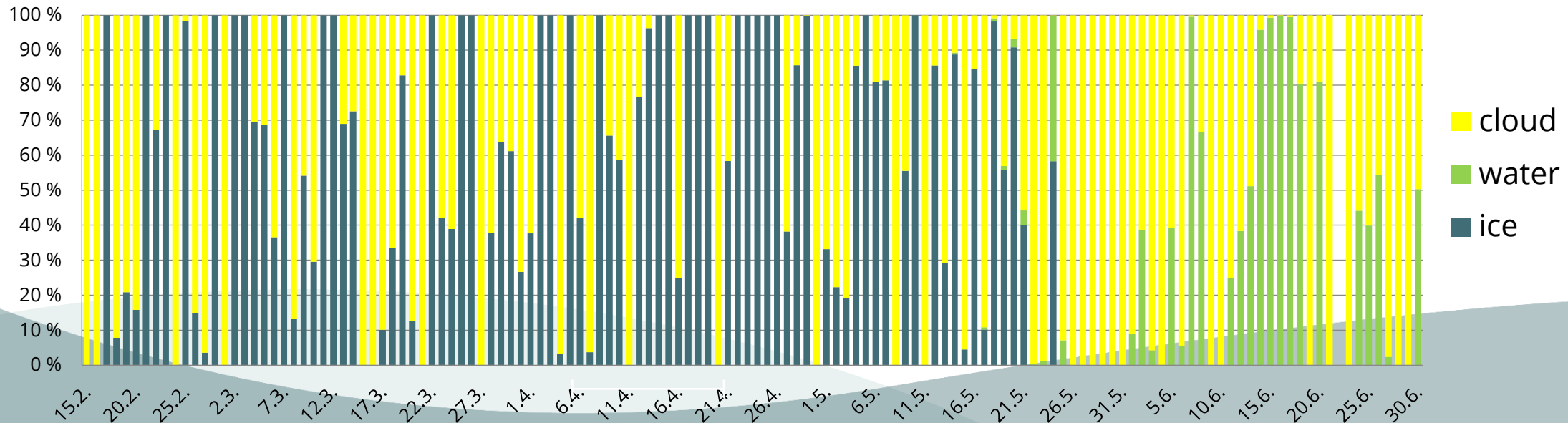
- Statistical ice information of lakes will be added to the Lake Ice Service
- Next step is to build processing pipeline to calculate daily statistics for individual LIE-NH Arctic lakes with an area  $> 10 \text{ km}^2$ 
  - The number of lakes will be gradually increased



5 km

Lake Lokka reservoir in  
Finland on 24 May 2019  
Sentinel-2 MSI RGB image

## Sentinel-3 SLSTR (500m) based LIE in Lokka Reservoir during spring 2019



# Lake Ice Service: Current status and future plans

- Currently available:
  - Lake Ice Service integrated to TARKKA+
    - EO data
      - Lake Ice Extent Northern Europe
      - Lake Ice Extent Northern Hemisphere
      - High and medium resolution true color images
    - Includes a tool to find information on certain lake by defining/typing in the lake name
  - Platforms for connecting EO and Citizen observation (CO) data (SYKE/TARKKA and SYKE/CitobsDB)
  - Language independent gathered data:
    - Numeric values of options in CO can be used to directly compare with EO product classifications
    - Technical configuration information makes it possible to translate the instructions in a structured manner
  - Widgets for displaying observation submission questionnaires on web applications
  - Demonstration questionnaire in TARKKA to submit citizen observed features from satellite EO data

# Lake Ice Service: Current status and future plans

- Next steps:
  - Feedback on user requirements on gathered data and the observation activities in general
    - The northern people, scientists and decision makers
  - Fine tuning of questions, options and instructions for observers
  - Translation of observation submission questionnaires for different local languages
  - Better language support for user interfaces
  - More convenient Citizen Observation user interface technology
    - Mobile phone friendly systems which are less dependent of web access, installation to mobile phones etc.
  - Modification of visualizations and adding tools for statistics in TARKKA+ lake ice service

Interested user requirements specifiers? 😊



Winter by Jacob Grimmer in 1577

Thank you!