

## Report on Deliverable D6.5

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<b>Deliverable name</b>	Training materials and results		
<b>Scheduled delivery</b>	<b>month:</b> 30	<b>date:</b>	June 2021
<b>Actual delivery</b>	<b>month:</b> 30	<b>date:</b>	June 2021
<b>Report type</b>	Internal report		
<b>Lead author</b>	Fabrice Messal: MERCATOR		

### Contributing authors

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Nick Hughes, Ole Jacob Hegelund, METNO.

Emma Armitage, Elaina Ford, UKRI-BAS.

### Training workshops - Contributing participants

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Emma Armitage (UKRI-BAS), Elaina Ford (UKRI-BAS), Ole Jacob Hegelund (METNO), Penelope Wagner (METNO), Fabrice Messal, (MERCATOR), Nick Hughes, (METNO), Carolina Gabarro (CSIC), Keld Qvistgaard (DMI), Laurent Bertino (NERSC), Gilles Garric (MERCATOR), Frank Kauker (OASYS), Steffen Tietsche (ECMWF)

### Context of deliverable within Work Package

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Throughout the project, KEPLER has organised a number of training workshops that consider both user and stakeholder requirements. Utilising analysis provided by Work Packages 1-4 we have aimed to provide training on:

- *How to access and use satellite-derived information and derived products such as operational forecasts and hindcasts.*
- *How to use available EO / data tools and practical exercises*

The project has also undertaken survey campaigns that ask for feedback from all users. Establishing user satisfaction about available environmental data in polar regions and their future needs for new environmental data.

This training is for both "intermediate" users (technical) and end user communities. It is open to a wide audience including early-career researchers (APECS), industry stakeholders, local communities,

## KEPLER Deliverable D6.5 - Training

fisheries, shipping, tourism, city, and regional public authorities. Workshop sessions on Copernicus Marine Service Training have been organised in connection with the Copernicus Academies, to train existing Copernicus Marine Service users and encourage new users.

Recordings, survey results and reports are available to view now via the KEPLER website:

<https://kepler-polar.eu/resources/>

### Report Overview

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This report is separated into three parts, covering KEPLER's training activities:

**Part 1:** Copernicus Marine Service Training Workshop for the Arctic Sea region (2019)

**Part 2:** Copernicus Marine Service Training Workshop for the Arctic Sea region (2020)

**Part 3:** KEPLER Online Early Career Researchers Workshop (2021)

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## Part 1: Copernicus Marine Service Training Workshop for the Arctic Sea region (2019)

### Overview:

On the 18<sup>th</sup> and 19<sup>th</sup> November 2019, in Finland, the Copernicus Marine Service organised a training workshop on the Arctic Ocean region. The aim of this workshop was to train existing Copernicus Marine Service users and also gain new users. The targeted audience of the workshop was the diverse communities concerned by Arctic Ocean data. A total of 29 participants were present, including researchers on sea ice monitoring, biodiversity or climate change, off-shore industries (oil & gas companies, fisheries), the maritime transport community, and weather forecast agencies. Participants were informed about the use of the Copernicus Marine Service products and services and their possible applications, by gaining knowledge during plenary and practical training sessions. Participants were encouraged to share their experience and express needs, as well as their requirements for new products to be included in the Copernicus Marine Service portfolio in the future.

The Objectives of the workshop were:

- Introduce the Copernicus Marine Service and its catalogue of products
- Train the audience on the use of the Copernicus Marine Service products and services and their possible applications,
- Assess potential users' experience/needs/priorities in terms of marine data and information with regards to the Copernicus Marine Service,
- Put into practice some of the existing examples and known solutions within marine hands-on technical sessions.



Such an event allows the data stream services like the Copernicus Marine Service to meet users (or future users) and to collect information on their requirements, their constraints, or their wishes for future improvements.

## KEPLER Deliverable D6.5 - Training

We took the opportunity to participate in this training event adding to the agenda a session dedicated to the KEPLER Project. We proposed a presentation of the project and a questionnaire to collect sea-ice data requirements from the audience.

Laurent Bertino from NERSC introduced the KEPLER project (see picture below) and ran the Kepler T1.3 questionnaire provided by Helge Goessling. The additional replies are available as a supplement of the original replies table, supplementary documents for KEPLER Deliverable 1.3. These are available to view here: [KEPLER Deliverable 1.3.pdf](#)

The results of this survey can be found here: [KEPLER 2019 TASK1.3 results.pdf](#)



We stay convinced that we need to propose a training session related to the Arctic Ocean combining different data stream services and sources of data.

<https://marine.copernicus.eu/events/copernicus-marine-service-training-workshop-arctic-sea-region>

## Part 2: Copernicus Marine Service Training Workshop for the Arctic Sea region (2020)



<https://marine.copernicus.eu/events/copernicus-marine-service-training-workshop-arctic-ocean>

### **Overview:**

Mercator Ocean International, Noveltis, and KEPLER organised the Copernicus Marine Service Online Training Workshop dedicated to the Arctic Ocean on December 01 2020 - 9:30 pm UTC+1.

The workshop aimed to bring together experts and users of marine products. It consisted of a mixture of plenary expert talks, round table discussions and hands-on practical exercises to explore the Copernicus Marine products catalogue. The target audience is mainly beginners and new users.

The objectives of this workshop were to enable users to:

- Describe the potential value of using Copernicus Marine products.
- Identify relevant Copernicus Marine products that would be appropriate for you to use.
- Navigate the Copernicus Marine product catalogue.
- Confidently use appropriate tools and products from the catalogue.
- Provide inputs for future design and development of Copernicus Marine Service tools and products.

### **Report**

The Arctic Ocean Copernicus Marine Service Online Training Workshop organized by MERCATOR OCEAN INTERNATIONAL (MOI) held on December 1st and December 15th, 2020. The workshop was composed of a first live session and a second “debriefing” session two weeks after. In between, the participants had access to a certain number of practical materials like Jupyter Notebooks to play with data including a special Jupyter notebook prepared by SOCIB for the KEPLER session.

**H2020 Project KEPLER - "Key Environmental Monitoring For Polar Latitudes and European Readiness"**  
Moderation by Mathilde Cancet & Laurent Bertino

AFTERNOON SESSION	Start (UTC+1)	Duration	KEPLER session	Speaker
	2:00 pm		15'	Overview of the project and outcomes
		15'	Sea Ice mapping solutions	Keld Qvistgaard
		15'	Research gaps of space-based Arctic monitoring	Carolina Gabarró
		15'	Training material available	All trainers
		15'	Live Survey	All
<b>End 3:15 pm</b>				

Figure 1: Agenda of the KEPLER session.

The first session was attended by 157 participants and 82 participants joined the debriefing session two weeks after. It is very positive to note that the attendees remained connected during the whole sessions, including for more than 4 hours during the first session, which is quite remarkable given that the KEPLER session was organized in the early afternoon of December 1st, 2020. More than 80 people were connected during the KEPLER session.

The moderation of the webinar and debriefing sessions was shared by MOI and NOVELTIS. The KEPLER session was moderated by Laurent Bertino, from NERSC, and NOVELTIS. The trainees, as well as the speakers, provided very positive feedback.

For each of these sessions, most of the attendees were from European countries, with 14% of the attendees from Norway, as shown in Figure 2. In general, the attendees came from more than 20 different countries, including outside Europe. These numbers confirm the potential of this kind of remote event to reach a much larger audience than face-to-face meetings in a given country.

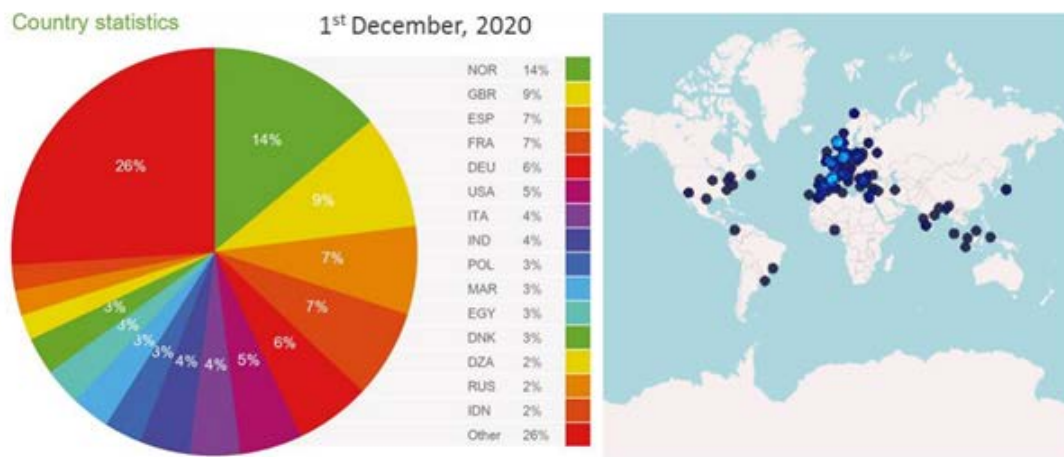


Figure 2: Country statistics for the first live session of the CMEMS Arctic training 2020.



## KEPLER Deliverable D6.5 - Training

During the KEPLER session, a live survey was proposed to know better the audience, questions included:

- What part of the Copernicus Marine Service and the sea ice products should be improved to enhance your use of the service?
- To process and visualize sea ice data, which kind of interface do you prefer?
- About sea ice file formats, which formats are you using the most?

Nick Hughes, as coordinator of the project, has presented an overview of the project. Then, Keld Qvistgaard did a presentation on how to improve sea ice mapping and forecasting (WP4). Finally, Carolina Gabarro gave a talk on the existing research gaps of space-based Arctic monitoring based on the result of the WP3.



The image shows two presentation slides from a video recording. The left slide is titled "EU Copernicus HPCM missions : CRISTAL" and describes the Copernicus Polar Ice and Snow Topography Altimeter mission. It lists the payload as a synthetic aperture radar (SAR) altimeter operating at Ku-band (13.8 GHz) and Ka-band (35.75 GHz), and mentions the continuity of CryoSAT and support to maritime operations. The right slide is titled "KEPLER Overview" and provides a summary of the project, including its duration (2.25 years), funding (€2.9 million), and call topics. The call topics include developing a roadmap for a mature European capacity for monitoring the Polar Regions and bringing the polar component of the CMEMS, CDS, CIMS, and CLMS services a step beyond the present state of art.

Above, extracts from the recording video of the KEPLER Workshop available on the Copernicus Marine Service YouTube channel: <https://youtu.be/9M1UQflnOAA>

The results of this survey are available to view: [KEPLER 2020 CMEMS Survey results.pdf](#)

### Part 3: KEPLER Online Early Career Researchers Workshop (2021)

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#### **Background**

KEPLER online workshop for Early Career Researchers (ECR) was conducted on 17-18th February 2021. The workshop was open for students and Early Career Researchers within Earth Observation (EO) and who use data from polar regions. This workshop was initiated from WP6 - Dissemination, training & engagement to reach out to ECR to discuss how they see the future challenges related to monitoring and forecasting in the polar regions. KEPLER aims at assessing the polar observational needs of the weather, ocean, sea ice, land and climate prediction research communities, and how this need is expected to develop over the next 10 years and beyond. Additionally, the breakout session during this workshop covered spatial and temporal resolution satellite needs, as well as data access and infrastructure (ie. data format, accessibility, provision of relevant information for specific users).

The outcomes of KEPLER will be used by European Commission (EC) to help guide the development of its Earth monitoring program: Copernicus Services, and to help develop future research funding calls related to the polar observing system.

Recordings for this workshop are available via the [KEPLER website](#). Be aware that some of the presentations were reserved from being recorded.

#### **KEPLER online ECR Workshop Agenda - Agenda & Survey**

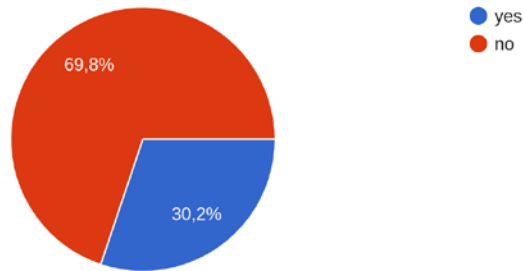
Prior to the workshop, a KEPLER survey was sent out in December 2020 to students and ECR's in earth observation for mapping out what different sessions and topics of interest should be covered. Some of these questions were also related to the Copernicus services (see diagrams below) and how ECRs are using EO data in their polar research.

The key points from this survey can be seen as how small amounts of the ECRs are using the Copernicus services and their products within polar earth observation and science.



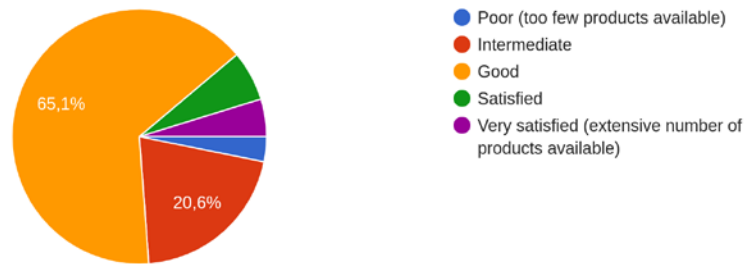
Are you familiar with the Copernicus services (e.g. CMEMS, CLMS, CAMS, C3S) and their products?

63 svar



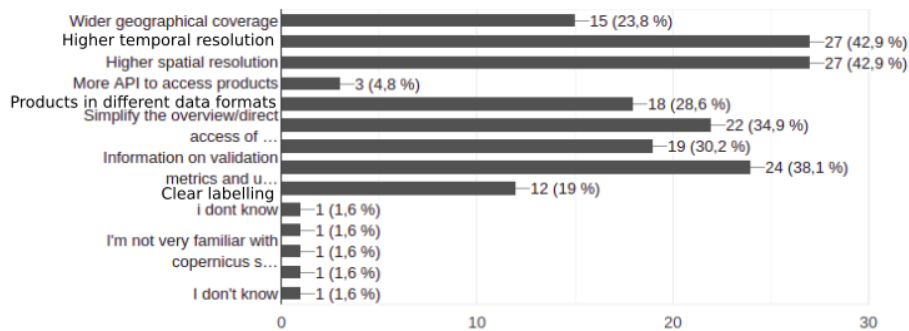
How would you rate the range of polar regions specific data products from Copernicus services?

63 svar



What part of the Copernicus Services and the sea ice products should be improved to enhance your use of the service?

63 svar



Results diagrams from KEPLER ECR survey.

Programme *Wednesday 17th February*

Time (UTC +1)	Title	Presenter
0900	Morning coffee, networking event	Ole Jakob Hegelund (MET Norway)
0930	Welcome and introduction	Ole Jakob Hegelund (MET Norway)
0945	General overview of the KEPLER Project	PI Nick Hughes (MET Norway)
1015	Break	
1030	Introduction to Copernicus and its services	PI Nick Hughes (MET Norway)
1045	ESA - Cryosphere Virtual Laboratory	Eirik Malnes (NORCE), Mikhail Itkin (NPI)
1100	Lunch break	
1200	Panel discussion - with KEPLER WPLs, QA Penelope Wagner (WP1), Gilles Garric (WP2), Carolina Gabarro (WP3), Steffen Tietsche (WP4), Frank Kauker(WP5) and Nick Hughes (WP6)	<b>Chair:</b> Richard Hall (Equinor), <b>Co-chair:</b> Shridhar Jawak (SIOS)
1310	Break/networking	
1325	<b>ECR/student - Arctic Case studies related to Copernicus</b>	<b>Chair:</b> Shridhar Jawak (SIOS)
1325	Using SAR satellite imagery to understand the effects of sea ice deformation on ice thickness	Luisa von Albedyll (AWI)
1335	The use of a Convolutional Neural Network (CNN) for sea/ice separation	Joakim L. Pedersen (MET Norway)
1350	Case study using differential InSAR technique from Zackenberg valley, Greenland	Lotte Wendt (ULUND)
1405	Ice-edge prediction forecast modelling	Bimochan Niraula (AWI)
1420	Break	
1435	<b>Training session:</b> Geospatial training session in Python (part 1)	Nick Hughes (MET Norway)
1545	Closing remarks day 1	Ole Jakob Hegelund (MET Norway)

## Programme Thursday 18th February

Time (UTC +1)	Title	Presenter
0900	Coffee, networking event	Ole Jakob Hegelund (MET Norway)
0930	Introduction	Ole Jakob Hegelund (MET Norway)
0935	<b>Training session:</b> Geospatial processing in Python (part 2)	Alistair Everett (MET Norway)
1035	Break	
1100	Breakout rooms: How is your data applicable to your research?	<b>Moderators:</b> Shridhar Jawak (SIOS), Penny Wagner (MET Norway), Ole Jakob Hegelund (MET Norway)
1130	<b>ECR/student - Polar Case studies related to Copernicus</b>	<b>Chair:</b> Shridhar Jawak (SIOS)
1130	Investigations of ice-caps on islands in Antarctica	Anatolii Chernov (National Antarctic Scientific Center of Ukraine)
1145	Case study from an Himalyan glacier	Shanta Kumar (Central University of Himachal Pradesh)
1200	Model-Data Fusion for improving quantification of CH <sub>4</sub> fluxes from Arctic wetlands with LPJ-GUESS	Jalisha Tk (ULUND)
1215	Segmentation of Arctic sea ice based on Bayesian inference	Christoph Herbert (Polytechnic University of Catalonia)
1230	<b>Free time slot</b>	TBD
1245	Closing remarks day 2	Ole Jakob Hegelund (MET Norway)

### Panel discussion

KEPLER hosted a panel discussion together with the work package leaders (WP1-7). Each of the Work Package leaders was given 5 minutes to present data from the most important findings addressing how KEPLER can help Copernicus with the focus on the user needs and the potential gaps between end-users and data providers.

KEPLER will deliver a policy document to the European Commission, and to use the document to make future decisions. This document tells the EC what information is available about the Arctic, where it comes from, and where to find it. These future decisions can be like;

- Which satellites to fund
- Which information/knowledge gaps to fill, and how satellites should be funded
- What type of data is not needed

- How to fill the technology gaps

In the end, the EC wants European citizens to make safe decisions made on good and available information.

The 2nd part of the discussion was focusing on students and ECRs, and the following topics and questions from the students were covered during the panel discussion;

- **According to WP leaders, which are the knowledge gaps in earth observation in the Arctic and which kind of skills ECRs should develop in coming years to fill such gaps?**
- **How is KEPLER promoting ECRs within the project?**
- **Since the KEPLER policy document will be very long, how will a prospective PhD student read this document to find the knowledge gaps?**
- **How WP of KEPLER inputs are useful to ECRs?**

Regarding the future implementation and earth observation capabilities, the ECRs requested further improvements with the services and data portfolios/platforms.

#### **KEPLER Breakout session: “How is your data applicable to your research?”**

The last day of the workshop, KEPLER invited the participants for a breakout discussion targeting a discussion between the user groups of Copernicus services on the topic “How is your data applicable to your research”

#### **Introduction:**

Data may be grouped into four main types based on methods in polar data: in-situ or observational, experimental, simulation/forecasts, or derived/compiled. The type of research data you collect may affect the way you manage that data. For example, data that is hard or impossible to replace (e.g. the recording of an event at a specific time and place) requires extra backup procedures to reduce the risk of data loss. Or, if you will need to combine data points from different sources, you will need to follow best practices to prevent data corruption.

Group discussions were set for 20 minutes, with an extra 15 minutes to summarize together key outputs.

#### **Discussion points:**

##### ***- In-situ/observational data***

It is collected using methods such as human observation, open-ended surveys, or the use of an instrument or sensor to monitor and record information - such as the use of buoys in the Arctic Ocean or citizen science. Because observational data is captured in real-time, it would be very difficult or impossible to recreate if lost.

##### ***- Experimental data***

Experimental data are collected through active intervention by the researcher to produce and measure change or to create a difference when a variable is altered. Experimental data typically allows

the researcher to determine a causal relationship and is typically projectable to a larger population. This type of data is often reproducible, but it often can be expensive to do so.

### **- Simulation/forecast models**

Simulation data are generated by imitating the operation of a real-world process or system over time using numerical models, for example, to predict weather conditions, economic development, chemical reactions, or seismic activity. This method is used to try to determine what would, or could, happen under certain conditions. The test model used is often as, or even more, important than the data generated from the simulation.

### **- Derived/Compiled data**

Derived or compiled data are using existing data, often from different data sources, to create new data through some sort of transformation, such as an arithmetic formula or aggregation. While this type of data can usually be replaced if lost, it may be very time-consuming (and possibly expensive) to do so.

## **Key findings from the break out discussion**

Among the ECRs, there is a high demand for compiled datasets for longer time series in sea ice but also atmospheric data in polar regions. From their experience, the data platform services are too complicated for beginners to navigate through all the portals (eg. Copernicus, NSIDC and Pangea) to find relevant information and data they need. Some of the ECRs are not familiar with either netCDFs or use of python scripts, and find it difficult to get the relevant data locally to their computers. The lack of a vectorized formats as shapefiles from Copernicus product portfolio was also lifted to be a problem for the students who are working in GIS systems (eg. ArcMap and QGIS). The person's needs to know exactly what they need and this is very difficult and non-intuitive.

There is a high need for high resolution (meter scale) remotely sensed data and in general in-situ observations in the Arctic and Antarctic ocean, but it's often not possible due to the harsh environment and due to the size of the data format and files. Additionally, stationed in-situ data in general does not compare well to simulation data because the temporal and spatial scales are different (so called 'representation error').

"However, in-situ measurements of these remote sensing products are rare, making calibration and validation of satellite algorithms very difficult and challenging."

"The current lack of continuity of microwave imagers that can be used to derive global SST is a major concern." and "The AMSR3 and CIMR missions are highly complementary and in combination would provide improved coverage and sampling in polar regions."

"With the exception of the CryoSat-2 mission, which covers the Arctic Ocean up to 88°N, altimetry missions do not cover poleward of 82°, leaving a vast region without any measurement."

Concerning sea-ice drift: "Revisit is the key here: higher revisit of SAR images is naturally required." and "Joint acquisition of multi-frequency SAR would enable accurate sea ice drift products, which is not possible with stand-alone current mono-frequency SAR missions."

Other end-users who depends on good availability of polar earth observation data:

## KEPLER Deliverable D6.5 - Training

- Maritime – vessels near the ice edge or within the ice.
- Winter Fishing, Energy exploration (Barents sea)
- Summer – tourism, cruise ships, and pleasure vessels. So change focus of output, e.g. make sure Svalbard is well covered. E.g. safety of crossing fjords. Also salvage operations – wanted to know about ice floes and icebergs. Also supporting research cruises, e.g. on mooring retrieval.
- Citizen science support
- Environmental agencies

### ECR Training Sessions

From the KEPLER survey, the ECRs highlighted a need for online live training sessions in Python and GIS. This resulted in two live training sessions during this workshop.

Day 1 with Nick Hughes (KEPLER Project Coordinator )

“How to get data from Copernicus Services using Python libraries with the help of Jupyter notebooks”.

#### KEPLER Early Career Researcher Training Workshop - Day 1 How to work with CMEMS forecast data using Python and Jupyter notebooks

##### 1. Prerequisites

One of the great features of Python is the many different different add-on libraries. It's also one of it's disadvantages, and it's very easy to end up with a a set up that is a mess, where it's difficult to add new libraries without breaking others.

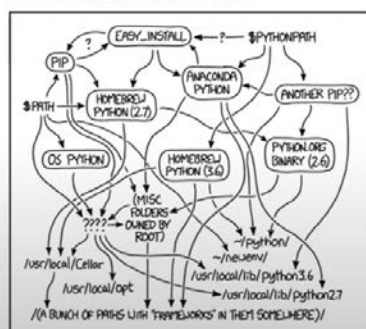


Photo: From the Python live training session with KEPLER PI, Nick Hughes

The participants could download a prepared KEPLER jupyter notebook file, and follow Nick Hughes live in the training session.

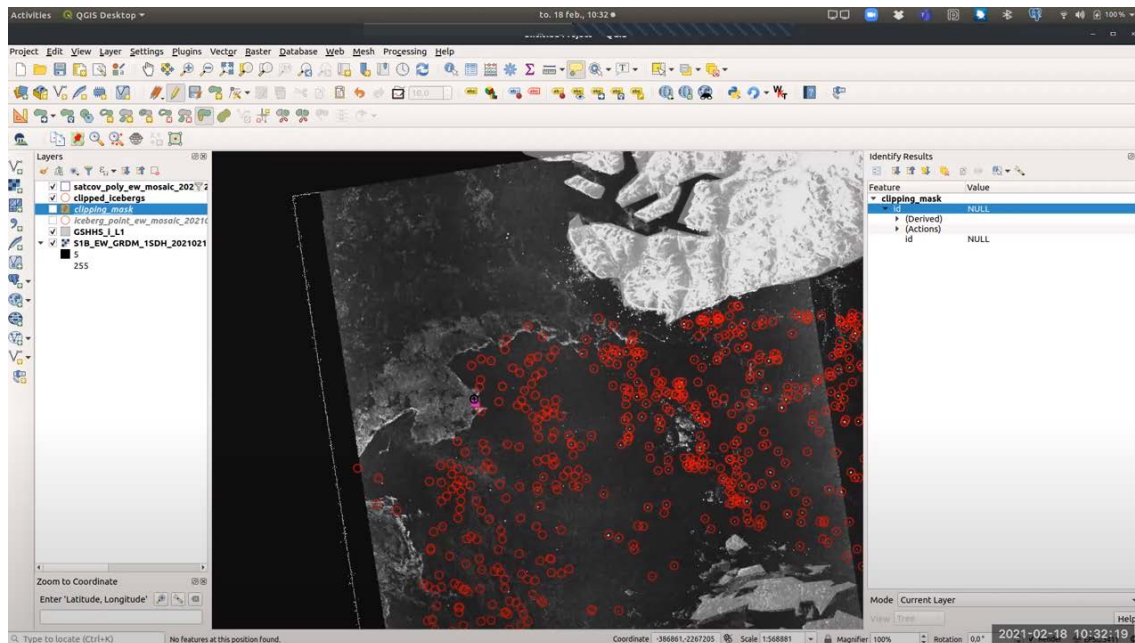
Recordings for this workshop are available via the [KEPLER website](#). Be aware that some of the presentations were reserved from being recorded.



**Day 2 with Alistair Everett (MET Norway) -**

[“How to visualize and use Copernicus data in QGIS”.](#)

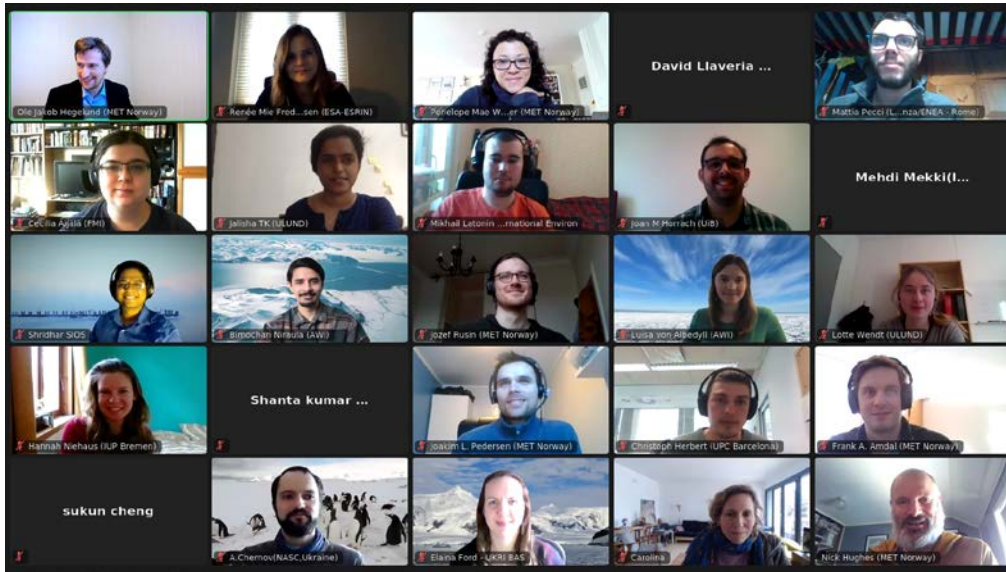
Preparation material ([for QGIS](#)) was sent out including a PDF manual with instructions on how to get the data and software set up. They were able to do most of the same things in ArcGIS. But this live training session was demonstrated on some datasets available through Copernicus and the use of QGIS to quickly investigate the datasets without writing a lot of code.



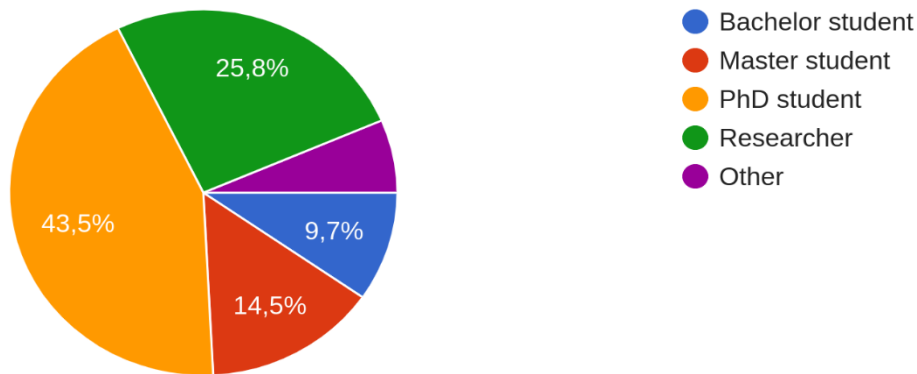
*Photo: From the QGIS live training session with Alistair Everett (MET Norway)*

**ECR/Student presentations**

The Early Career Researchers were asked prior to the workshop if some of them would like to present their research from Polar Regions related to Copernicus and Earth Observation. And out of 62 replicants, we received over 15 abstracts for presentations all the way from bachelor level to PhD level. Both days of the workshop consisted of student presentations and QA.



*Group picture of some of the participants at the end of the workshop*



*Diagram showing the range of student levels for the participants.*

## Summary

Training events are moments to share knowledge, expertise, information, and opinions. It's also a way to collect feedback and requirements for any topic. The training activities conducted during the KEPLER project have established:

- the need to prepare dedicated material on comparison of data in line with the diversity of Arctic product (data from marine, atmospheric and land),
- the importance to explain and teach how to manage the different data format of Arctic products,
- the potential of collecting all the existing material and having a platform to share experiences and material around existing and future data in order to prepare researchers.