KEPLER Deliverable Report

Report on Deliverable D6.4

Deliverable name	Dissemination and Exploitation			
Scheduled delivery	**month:**	30	**date:**	June 2021
Actual delivery	**month:**	30	**date:**	June 2021
Report type	Internal report			
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Context of deliverable within Work Package

This deliverable covers the dissemination and exploitation of all results across all Work Packages, for the whole project. It is the output of Task 6.3. It follows the aims and objectives (activities, stakeholders, messaging) that were determined in both the original Grant Agreement (formed from the proposal), and following the structure from the Communications Plan (D6.1, Task 6.1).

The Communication tools that were set up in Task 6.2 (e.g. website, social media, branding, promotional materials, newsletters, etc. (D6.2)) are utilised in all the activities mentioned. The use of these is described first below. These are project-wide activities, centrally coordinated through this work package.

This report is long as it includes reports from each of the Milestones within this Work Package. These were determined in the Grant Agreement and D6.3, the dissemination and exploitation plan. Each of the milestones are linked to one or more of the Work Package 1-5, and also link in to other activities and projects, for example through the EU Polar Cluster (previously EU Arctic Cluster, for the first half of the project lifetime).

Contents

Co-funded by the Horizon 2020 programme of the European Union

D6.4 Report – dissemination and exploitation

Overview

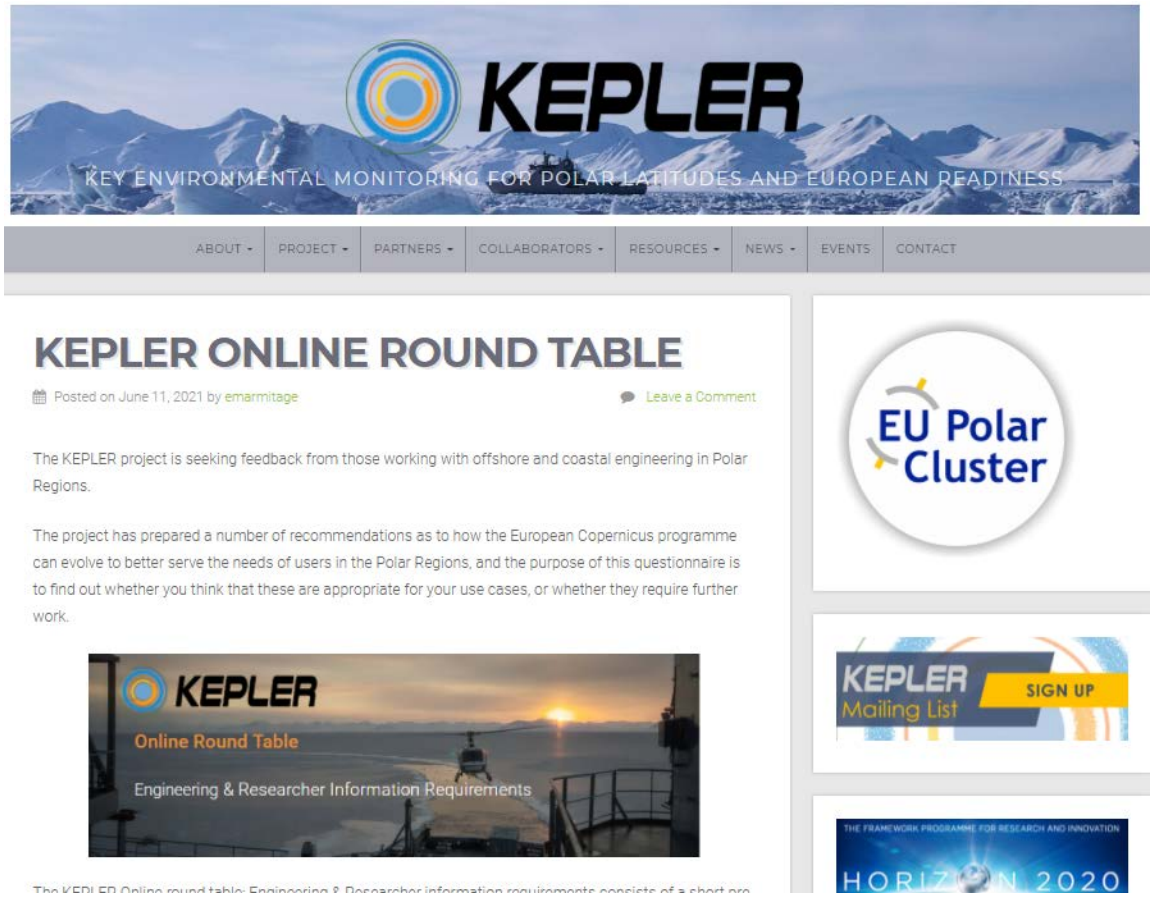
This report summarises the dissemination activities that we have undertaken, along with the outputs that we have created (e.g. website, newsletters, social media, etc), with links and metrics where available, to give an indication of our impact. In addition, reports are given on all workshops and round tables that we have completed as part of this project. These have all fed into other Work Packages 1 to 5,, and the deliverables therein.

Key activities:

Website

The KEPLER website, www.kepler-polar.eu was set up at the start of the project. It details the project aim and objectives, consortium participants; including institutes, scientists and collaborators. Regular news items are posted to promote the project, including events, completed reports and surveys It is a portal for dissemination, collaboration, and data access.

The KEPLER project home page describes the main goals of the project and highlights key areas and recent news/headlines. Links are also provided to the EU and H2020 websites, and EU Polar Cluster. There is also an automatic update from the KEPLER Twitter feed (see below), and a link to the KEPLER Facebook and newsletter sign-up form. Key news items are highlighted at the top of the page.



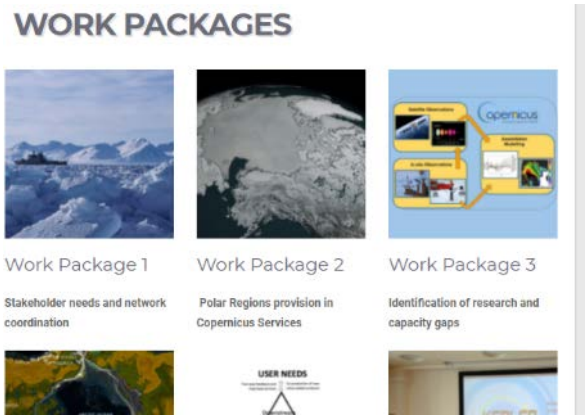
Website contents:

ABOUT – This area is mostly aimed at the wider science community, and young people who might be thinking of getting involved either in science, or in a large-scale project. It explains the objectives, background and mission, as well as the project timeline. This drop-down menu also includes the KEPLER project brochure- more information about this can be found here in Promotional materials.

PROJECT – The project section is a deep dive into the core of KEPLER including:

- **Programme:** An overview of the core activities within KEPLER, and the project approach.
- **Tasks:** A complete list of KEPLER tasks, titles and task leaders.
- **Deliverables:** A complete list of KEPLER deliverables, which includes links to publicly available reports and project output.

- **Work Packages:** This section acts as a hub for work package information and updates. Work package leaders have been able to add to their own section as the project has developed. Individual work package pages cover objectives, tasks, output, deliverables, meetings and automatically show posts that have been tagged within that work package.



PARTNERS -

- This section contains a list of participating institutions with a graphical representation of their expertise : Copernicus Services, Operational Ice services, Forecasting Development, Maritime and Terrestrial Monitoring. Links and dependencies of KEPLER are also depicted in this section.

- **Who we are:** Graphics in this section detail the various partners and organisations involved in KEPLER, as well as the connections between other projects, and stakeholder groups including **l**inkages- detailing the various partners and organisations involved in KEPLER, as well as the connections between other projects, and stakeholder groups
- **Institutes** (Project Institutes): The websites, logos and twitter accounts of KEPLER partners.
- **People:** Photos of project participants, who is involved, and Twitter feeds of key scientists in that work package

COLLABORATORS –

- **Key Collaborators** Links to the European Commission and Copernicus are highlighted in this section for transparency. This section also contains sub pages about:
  - **Copernicus:** A dedicated page to detail how KEPLER and Copernicus are linked.
  - **Data Users:** Referencing KEPLER'S work to identify the various types of data users to better identify user requirements

- EU Polar Cluster: A reference page that informs viewers of the EU Polar Cluster (formerly the EU Arctic Cluster). This is a collaboration between several of the Arctic, Antarctic, Southern Ocean, and Polar projects, funded through the European Commission's Horizon 2020 programme. The logo and link to the EU polar cluster website are also on the KEPLER website's front page.

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RESOURCES – Following feedback from the Project Advisory Board, we created an additional resource hub section to the KEPLER website to highlight data sources, such as reports from Previous EC and ESA project assessments utilised within KEPLER. This section also provides links to KEPLERs recorded online training events and a glossary of terms. The section aims to provide useful tools for early career researchers and stakeholders. Sub pages iinclude:

- Final project brochures
- Resources from surveys and training
- Another link to deliverables
- Glossary of terms

NEWS – This is the project home page. Events of interest to a wider audience, such as fieldwork, meetings, and scientific paper updates (when applicable) are posted here. There is also a sub-page with links to past editions of the project newsletter. In addition, news items are distributed on the project's social networking sites - Twitter (@KeplerEU) and Facebook www.facebook.com/KeplerEU , in addition to other events of interest. The Twitter account, @KeplerEU, has 210 followers to date.

EVENTS – All KEPLER events past and present are available to view in this section, with links to key event documentation such as agendas/programmes. Recorded events have video links provided.

CONTACT – This page provides users the options to get further information or initiate collaborations.

Maritime Feedback - A temporary page was added during the Arctic Shipping Forum, welcoming outside input from the operational maritime community about their sea ice requirements.

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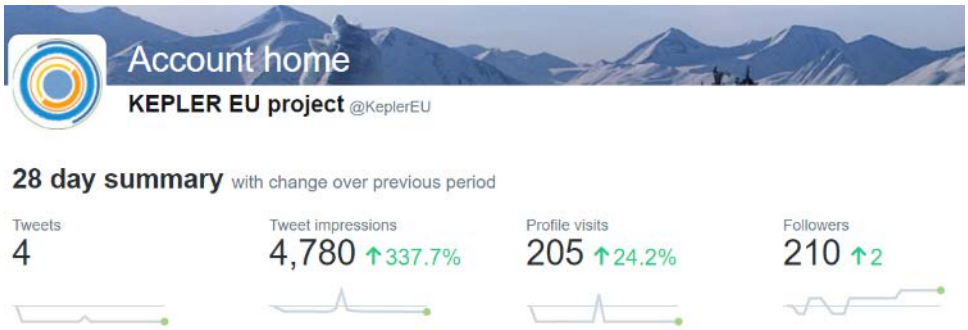
Social Media

KEPLER has utilised social media to reach a wide range of users and stakeholders, and informed the general public about project activities and output. Another key aim of KEPLER's social media accounts is to direct traffic to the KEPLER website, as explained above.

Twitter

https://twitter.com/KeplerEU

KEPLER's Twitter account is our primary social media platform. It has been actively involved in promoting project output, and supporting other projects and institutes involved in polar science. To date, the KEPLER Twitter account has over 200 followers, with around 200 monthly profile views. Our account has high engagement and viewership of content. Tweet 'impressions' (the number of times tweets have been seen) number over 4k in our monthly site statistics.



KEPLER have regularly interacted with other relevant projects and individuals on social media by liking and retweeting posts. Active involvement on this platform has led to KEPLER's content being shared by others. This includes promotion via key scientists from KEPLER who were keen to share project news on their own personal Twitter feeds.

Twitter content from @KeplerEU

Each post from the KEPLER website was tweeted out from our account to encourage more traffic towards our project site. We also promoted events and newsletters via twitter to reach a wider audience, utilising hashtags and tagging key stakeholders and relevant projects. With the emphasis on online 'virtual' workshops and events due to the COVID-19 pandemic, we utilised social media as much as possible in the second period of the project to boost dissemination and reach users despite the restrictions to in-person events.

Facebook

https://www.facebook.com/KeplerEU

KEPLER's Facebook page has also supported promotion of the project via social media. The page has been steadily gaining followers. To date our account has 160 followers and 154 likes.

As with our Twitter account, we interacted with other relevant projects and individuals on social media by engaging with their posts. We also utilised this platform to share relevant information such as reports (see below) that were relevant to KEPLER and our followers.

As mentioned earlier, our website was set up to automatically post news items directly to our Facebook account, to reach a wider audience. These posts also linked back to the website to direct traffic.

KEPLER Online Engagement Comparison

Towards the end of the first year of the KEPLER project, we reviewed its online engagement by producing a report on social media and website statistics. This report also recommended suggestions to boost both our audience numbers and reach.

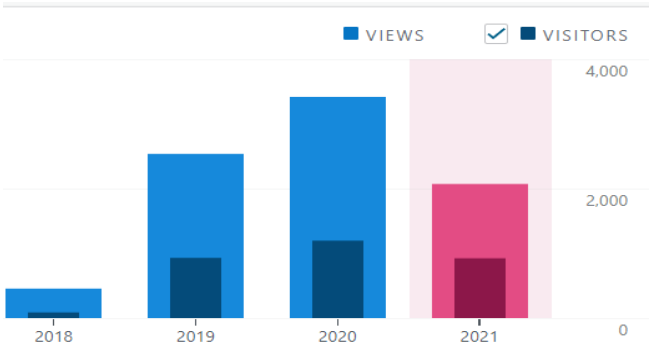
This report- dated 01/10/2019 was shared with the consortium and project advisory board and has served as a useful document to compare our online dissemination progress. KEPLER Online Engagement Report Oct 2019.pdf

The KEPLER projects online and social media presence has been compared with initial figures reported on 01/10/2019, sourced from the KEPLER project online account platforms.

Website:

KEPLER Website https://kepler-polar.eu/		
October 2019	**June 2021**	**%**
Total no of page views: **2290**	Total no of page views: **8480**	**+270%**
Total no of page visitors: **760**	Total no of page visitors: **3142**	**+313%**
Audience members predominantly from: **Norway**		

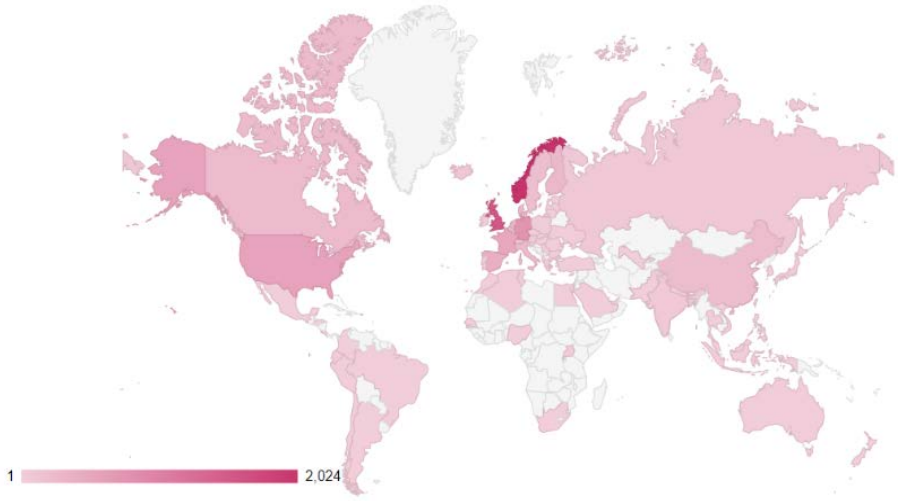
The general views/visitors to the site has steadily increased each year, with over 3k unique visitors to date and over 8k views. The most predominant viewership has originated from Norway, seconded by views from the UK.

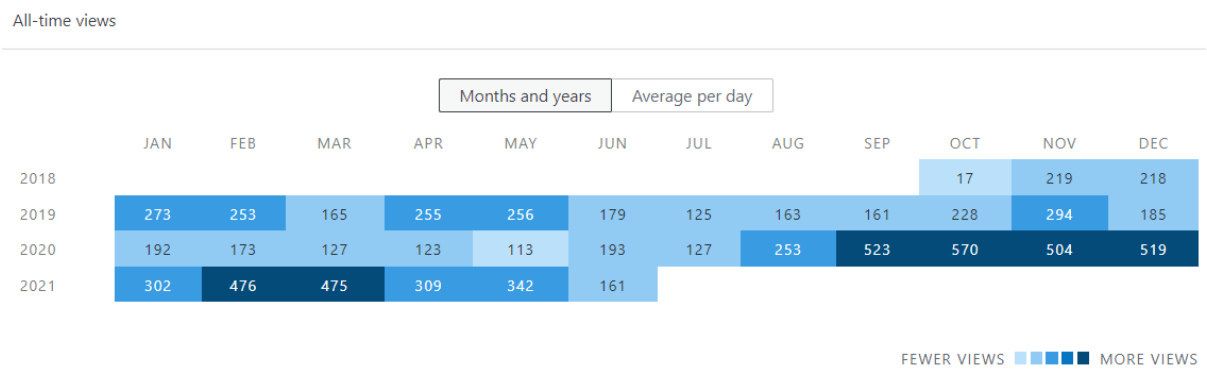


Efforts to increase the reach of the KEPLER website were successful, developing an audience globally throughout the project duration, as illustrated below.

October 2019 Global Reach

June 2021 Global Reach





A comparison with initial figures reported on 01/10/2019 has also shown increased audience reach and dissemination activities via the KEPLER project social media accounts. The number of followers gained across both platforms averaged at a 30% increase.

Twitter

KEPLER Twitter @KeplerEU		
October 2019	**June 2021**	**%**
Total no of follower: **153**	Total no of follower: **200**	**+30%**
Tweets to date: **86**	Tweets to date: **134**	**+55%**
Average impressions*: **2000**	Average impressions*: **4000**	**+100%**

**tweets views monthly*

Facebook

KEPLER Facebook @KeplerEU		
October 2019	**June 2021**	**%**
Total no of followers: **40**	Total no of follower: **160**	**+30%**
Total no of likes: **41**	Total no of likes: **154**	**+300%**

Mailing List & Newsletters

The KEPLER ALL internal mailing list is hosted through METNO, and managed by both BAS and METNO. In addition to this, stakeholders and members of the public have been welcomed to sign up to an external mailing list.

The audience engagement of these newsletters increased throughout the project. The sign-up link has received over 125 visits, and in combination we have approximately 140 subscribers to both the internal and external mailing lists.

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Throughout the KEPLER project, BAS has designed and produced seasonal newsletters to promote project output and events such as workshops and meetings.

Subscribers have come from various locations worldwide, top followings come from Germany and Norway.

1.	Hamburg, HH	Germany
2.	Oslo, 03	Norway
3.	Bergen, 12	Norway

Throughout the project, KEPLER has produced the following newsletters. Click the links below to view the full documents.

Spring/Summer 2019
Highlighting the KEPLER Kick-Off meeting and events. Introducing the project aims and promoting upcoming activities.

Spring/Summer 2020
Promoting KEPLER's involvement in YOPP 2020 and IS-ENES3. Highlights from the first General Assembly.

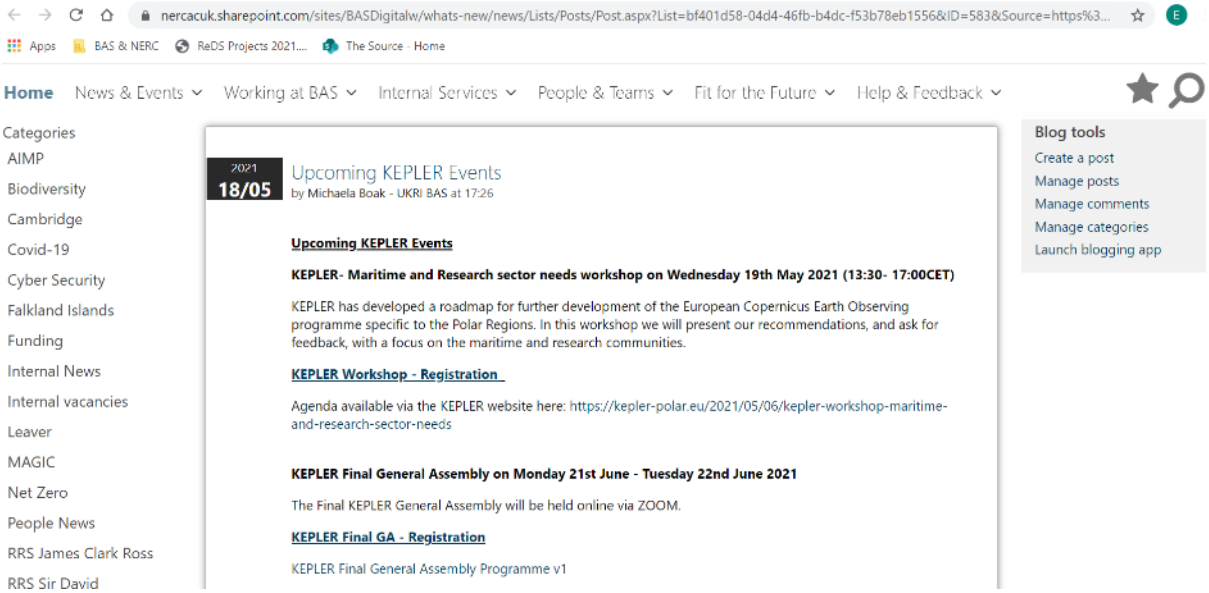
Autumn/Winter 2020
Sharing KEPLER progress and news of a project extension due to delays related to COVID-19. Promoting our involvement in European Polar Science Week and details about our training events including the Copernicus Marine Service Online Training and Early Career Researcher workshop.

Spring 2021
Featured charts on the status of project deliverables and milestones, the results of our workshops, updates to the project handbook and a timeline to explain the upcoming reporting process.

Summer 2021 - pending.
This newsletter will be distributed after the final review meeting on July 13th 2021. This will include a recap of all KEPLER activities up to the end of the project, highlights from the Final General Assembly, Review meeting and links to all deliverables and end of project dissemination activities. This will also include links to digital versions of the final project brochures.

Partner promotion

Partners were encouraged to share KEPLER events via their own institutions, media departments, websites, and social media accounts.



KEPLER events promoted via the British Antarctic Surveys internal web page.

We also collaborated with other projects to promote and support each other, sharing events and posts from project social media accounts, widening our audience and engagement with relevant communities working in industry/science fields within the Polar Regions.

PAB engagement

KEPLER utilised the knowledge and skills of individuals in the Project Advisory Board (PAB). Hosting bi-monthly meetings to review actions, the status of deliverables - and seek feedback on reports, planned events, and dissemination activities. The PAB has provided direct input on specific events/activities, such as linking WP1 to INTAROS for stakeholder engagement and joint events, WP3 to INTERACT for joint workshops (see below) and training activities with APECS (see D6.5).

The PAB has also reviewed deliverables, and given numerous suggestions and advice, such as on definitions of user types and data and information, how best to engage with stakeholders and present information. They have also shared our outputs with their networks, expanding our stakeholder reach.

Promotional materials

As per the communications guide (D6.1, WP6 Task 1) we created a suite of tools and resources to be made to promote and share KEPLER output. This included creation of the KEPLER branding based on the KEPLER logo, pulling these colour schemes and branding through to templates, for example for reporting, and presentations.

Inspired by the GCOS reports, we have commissioned a graphic designer to produce an easily identifiable KEPLER branded image to be used on the front page of key reports/deliverables. This can then also be used as a thumbnail when sharing online, or in presentations.

Roll banners and A0 posters have been created for improved visibility at events. At the kick-off meeting KEPLER branded pens and torches were given to the consortium for event distribution and project promotion.

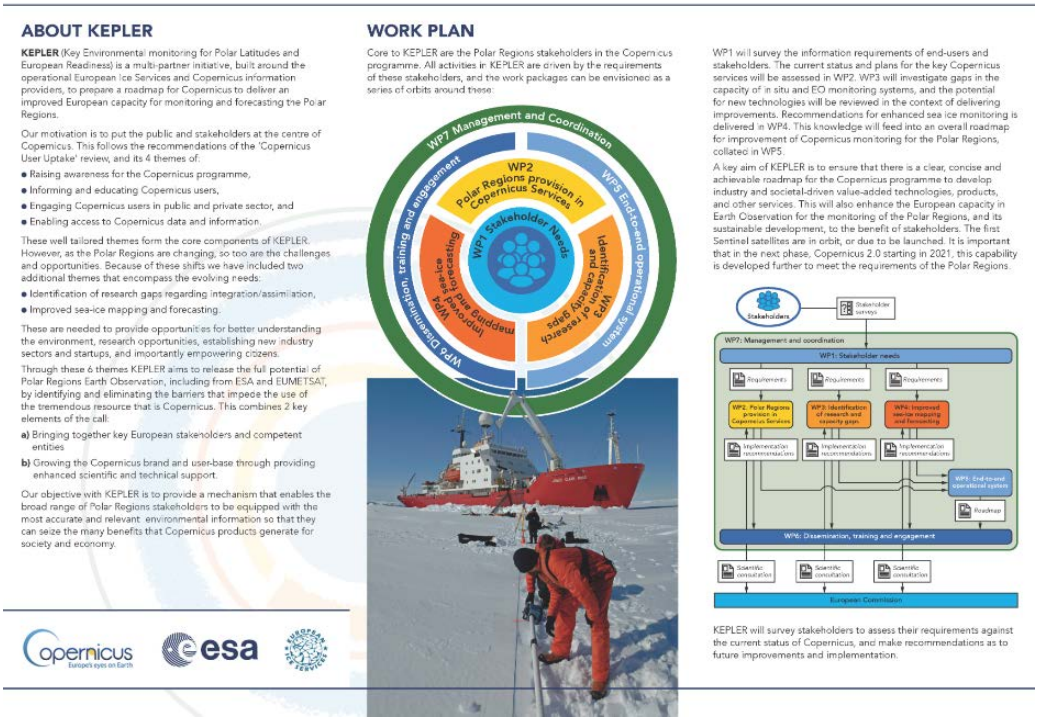
KEPLER Booth at the Arctic Shipping Forum, Helsinki 2019.

KEPLER promotional pen and torch.

KEPLER Brochures

KEPLER has created five brochures to promote the project, information was collated by the KEPLER Management Board, and a designer was hired to create visually appealing and accessible layouts. Draft versions were distributed amongst KEPLER partners and the Project Advisory Board for feedback, to ensure we were creating effective dissemination tools.

The first brochure was an overview brochure, created for the kick-off event in Oslo. This was also distributed at various conferences and events throughout the project such as the Arctic Shipping Forum in Helsinki 2019.



ABOUT KEPLER

KEPLER (Key Environmental monitoring for Polar Latitudes and European Readiness) is a multi-partner initiative, built around the operational European Ice Services and Copernicus information providers, to prepare a roadmap for Copernicus to deliver an improved European capacity for monitoring and forecasting the Polar Regions.

Our motivation is to put the public and stakeholders at the centre of Copernicus. This follows the recommendations of the 'Copernicus User Uptake' review, and its 4 themes of:

- Raising awareness for the Copernicus programme,
- Informing and educating Copernicus users,
- Engaging Copernicus users in public and private sector, and
- Enabling access to Copernicus data and information.

These well tailored themes form the core components of KEPLER. However, as the Polar Regions are changing, so too are the challenges and opportunities. Because of these shifts we have included two additional themes that encompass the evolving needs:

- Identification of research gaps regarding integration/assimilation,
- Improved sea-ice mapping and forecasting.

These are needed to provide opportunities for better understanding the environment, research opportunities, establishing new industry sectors and startups, and importantly empowering citizens.

Through these 6 themes KEPLER aims to release the full potential of Polar Regions Earth Observation, including from ESA and EUMETSAT, by identifying and eliminating the barriers that impede the use of the tremendous resource that is Copernicus. This combines 2 key elements of the call:

a) Bringing together key European stakeholders and competent entities

b) Growing the Copernicus brand and user-base through providing enhanced scientific and technical support.

Our objective with KEPLER is to provide a mechanism that enables the broad range of Polar Regions stakeholders to be equipped with the most accurate and relevant environmental information so that they can seize the many benefits that Copernicus products generate for society and economy.

WORK PLAN

Core to KEPLER are the Polar Regions stakeholders in the Copernicus programme. All activities in KEPLER are driven by the requirements of these stakeholders, and the work packages can be envisioned as a series of orbits around these:

WP1 will survey the information requirements of end-users and stakeholders. The current status and plans for the key Copernicus services will be assessed in WP2. WP3 will investigate gaps in the capacity of in situ and EO monitoring systems, and the potential for new technologies will be reviewed in the context of delivering improvements. Recommendations for enhanced sea ice monitoring is delivered in WP4. This knowledge will feed into an overall roadmap for improvement of Copernicus monitoring for the Polar Regions, collated in WP5.

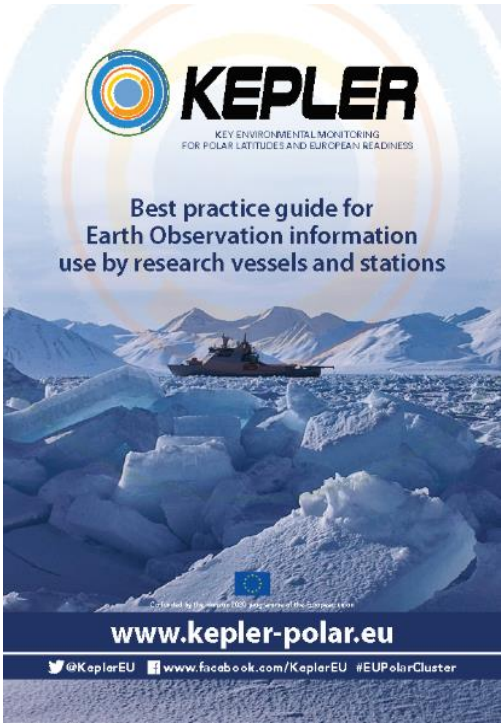
A key aim of KEPLER is to ensure that there is a clear, concise and achievable roadmap for the Copernicus programme to develop industry and societal-driven value-added technologies, products, and other services. This will also enhance the European capacity in Earth Observation for the monitoring of the Polar Regions, and its sustainable development, to the benefit of stakeholders. The first Sentinel satellites are in orbit, or due to be launched. It is important that in the next phase, Copernicus 2.0 starting in 2021, this capability is developed further to meet the requirements of the Polar Regions.

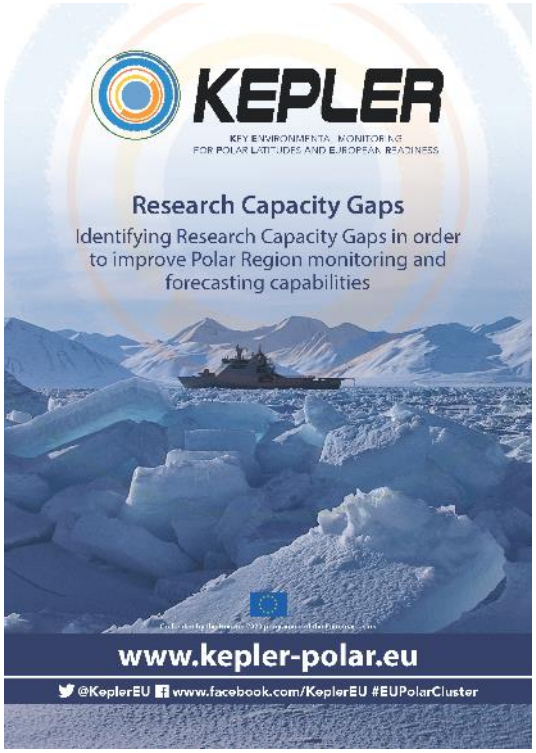
KEPLER will survey stakeholders to assess their requirements against the current status of Copernicus, and make recommendations as to future improvements and implementation.

https://kepler-polar.eu/home/brochure/

For end of project dissemination, KEPLER have commissioned the same graphic designer to create four glossy brochures from the following key documents from the KEPLER project:

1. KEPLER Best Practice Guide - https://kepler-polar.eu/kepler-best-practice-guide/
2. KEPLER roadmap for Copernicus services: https://kepler-polar.eu/roadmap/
3. KEPLER Research Capacity Gaps (D3.5- executive summary findings from Work Package 3): https://kepler-polar.eu/research-gaps/
4. KEPLER Complete Project Overview: https://kepler-polar.eu/kepler-overview/





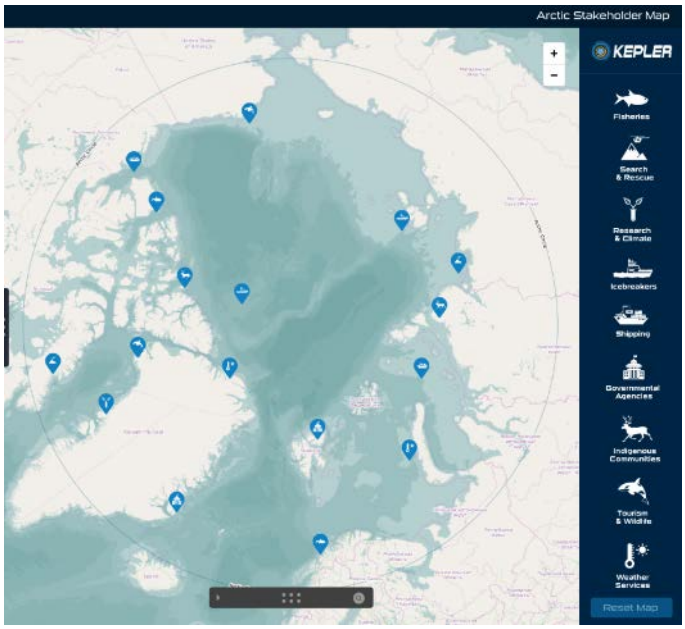
KEPLER Interactive Arctic Region Stakeholder Map

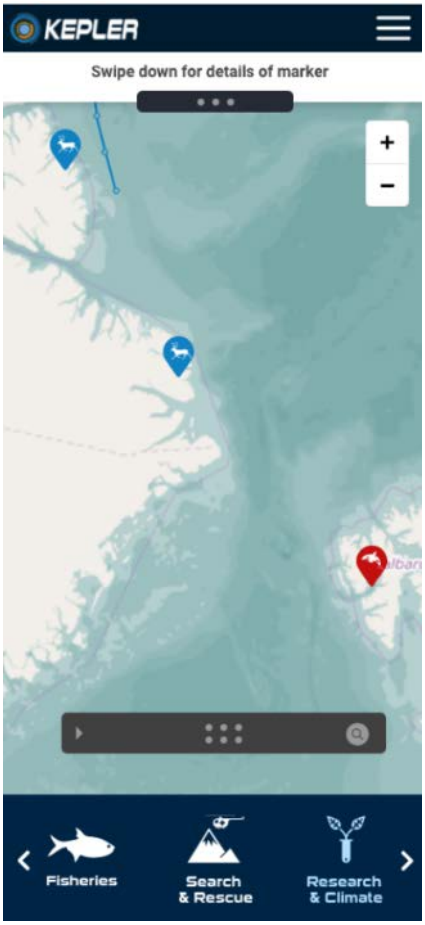
As part of the end of project dissemination, KEPLER has commissioned a software developer to develop of a platform to manage and display data relevant to our stakeholder's usage and concerns in the Arctic Polar Region

That platform includes a database that contained stakeholder interests from KEPLER, Copernicus and other relevant data streams*. The development of an Application Programming Interface allows users to access and display data in a visual map format, and view links to direct data sources for a more in-depth search.

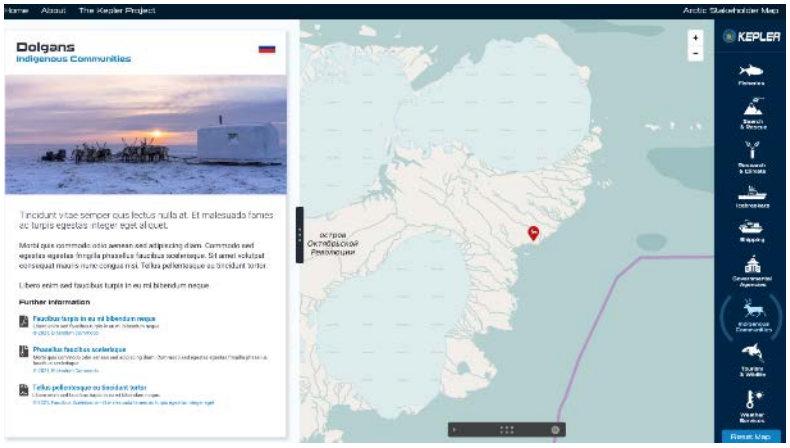
**i.e. Fisheries, Search and Rescue, Research and Climate, Arctic shipping- including Icebreaker vessels, Government Agencies, Indigenous Communities, Tourism/Wildlife and Operational Weather Services.*

This platform is in development at the time of this report submission, expected to launch by the end of the project. We hope this will be a legacy of KEPLER,and be continued through other projects such as Arctic PASSION, and maintained by the EU Polar Cluster.





Images of the interactive map- desktop and mobile versions.



Interactions with other EU funded projects

KEPLER has engaged with other projects funded by the European Commission through its central involvement in the EU Polar Cluster (www.polarcluster.eu/) (this was formerly the EU Arctic Cluster, up until July 2019, when the scope was increased and Antarctic and Southern Ocean projects were also included).

KEPLER project manager and WP7 lead, and WP6 co-lead, Elaina Ford became a co-lead for the Communications Task Group at the beginning of the project, along with Arctic Portal until 2020 then with JustNorth and INTAROS. In February 2021, following the departure of the previous Cluster coordinator from AWI, the Alfred Wegener Institute, Elaina took on the Coordinator role for the whole Cluster. This has been through close collaboration with EU-PolarNet 2, as Task Leader for Clustering activities. In addition, this close collaboration and the legacy of KEPLER will be able to be continued in the Arctic PASSION project, which starts just after KEPLER ends.

KEPLER has representation in the EU Polar Cluster task groups:

Contacts:			
Co-ordiantor and Policy Advice Task Group	Nick Hughes	Norwegian Meterological Institute	
Project Manager and Communications Task Group	Elaina Ford	British Antarctic Survey	elaina.ford@bas.ac.uk
Data and Stakeholder Task Groups	Penelope Wagner	Norwegian Meteorological Institute	penelopew@met.no
Training and Education Task Group	Fabrice Messal	Mercator Ocean International	fabrice.messal@mercator-ocean.fr

Specific activities with collaborations include:

- Arctic Shipping Forum - March 2019 - with INTAROS (M6.1)
- Incorporation of EU PolarNet deliverables and experience on stakeholder interaction (with WP1)
- KEPLER presentation to the EU Arctic Cluster - June 2019
- Arctic Circle - October 2019 - Collaborative workshop - with INTERACT II (M6.4)
- European Polar Science Week - with EU PolarNet 2 and EU Polar Cluster
- Co-leading the EU Arctic/Polar Cluster Communications Task Group

Advisory Board representation on Cluster projects:

- Stein Sandven (INTAROS)
- Hannele Savela (INTERACT)

Stakeholder engagement activities

Workshops, Round Tables and User surveys

A variety of stakeholder engagement activities were undertaken during the project. KEPLER reached out to the key communities for feedback to inform/confirm our recommendations for Earth Observation in the Polar Regions.

We hosted a number of workshops (both for community and training,) roundtable and side sessions as part of dissemination and stakeholder engagement. We incorporated user surveys into our events to gain feedback from participants. We compared this feedback to our recommendations, enabling us to assess if recommendations were appropriate and useful to users or whether they required further work.

Throughout the project, partners logged their participation in events, conferences and meetings using the meeting log project tool.

Meeting	Complete?	Meeting type	Date - start	date - end (if more than one day)	Lead	Location	Task	Del/MS	No of Participants invited	No of Participants attended	Details/ Document link
KEPLER Project Management weekly BAS& MET NO catch up	yes	Project	10/10/2018	24/02/2021	Nick Hughes	Skype	ALL	ALL	2-4	2-4	Weekly skype catch up to discuss upcoming milestones & deliverabl
KEPLER Project Management meeting	yes	Project	18/01/2019	-	Elaina Ford	Webex/ BAS Cambridge	WP7	ALL	2	2	Elaina & Emma KEPLER manage
Kick-Off Meeting	yes	Project	28/01/2019	30/01/2019	Nick Hughes	Webex/ Oslo	7.4	D7.2	-	44	https://drive.google.com/file/d/14E WZJnWplLlo/view?usp=sharing
PAB&KMB	Yes	PAB	29/01/2019	-	Elaina Ford	Oslo	7.4	ALL	18	15	https://drive.google.com/open?id= K_8yUiPvsMM
KMB	Yes	KMB	30/01/2019	-	Elaina Ford	Oslo	7.4	ALL	8	8	https://drive.google.com/open?id= IHWvyk11NqR0
KEPLER Project Management meeting	yes	Project	27/02/2019	-	Elaina Ford	Webex/ BAS Cambridge	WP7	ALL	2	2	Elaina & Emma KEPLER manage
KMB	Yes	KMB	12/03/2019	-	Elaina Ford	Webex	7.4	ALL	8	7	https://drive.google.com/open?id= OmMgRPO4-8JJ
KEPLER& INTAROS	yes	Project	14/03/2019	-	Penny Wagner	Webex	1.1		10	7	https://docs.google.com/open?id= aYE-vWovwsEzz3SrbCYCDy4
KMB ASF Prep	yes	KMB	20/03/2019	-	Elaina Ford	Webex	7.4	ALL	8	6	Arctic Shipping Forum Planning-
Workshop 2 for local and indigenous community feedback and training. Arctic Observing Summit Workshop, Inari	yes	Workshop	31/03/2019	-	Tero Mustonen	Inari, Finland	1.2	D1.2, MS6.7	6	6	https://drive.google.com/file/d/1Y ByMJUErcT/view?usp=sharing
KEPLER Project Management meeting	yes	Project	02/04/2019	-	Nick Hughes	Helsinki	7.4	ALL	4	4	n/a - Asana
WP1&4	yes	Project	03/04/2019	-	Antti Kangas	Helsinki	1.1		7	8	n/a - deliverable discussion. (Age
KEPLER Project Management meeting	yes	Project	10/04/2019	-	Elaina Ford	Webex/ BAS Cambridge	WP7	ALL	2	2	Elaina & Emma KEPLER manage
PAB&KMB	Yes	PAB	11/04/2019	-	Elaina Ford	Webex	7.4	ALL	16	12	https://drive.google.com/open?id=

KEPLER Meeting Log

Meeting	Complete?	Meeting type	Date - start	date - end (if more than one day)	Lead	Location	Task	Del/MS	No of Participants invited	No of Participants attended
Workshop 2 for local and indigenous community feedback and training. Arctic Observing Summit Workshop, Inari	yes	Workshop	31/03/2019	-	Tero Mustonen	Inari, Finland	1.2	D1.2, MS6.7	6	6
Weather and climate forecasting needs- (Round table 2 m6.2)	yes	Workshop	17/06/2019	19/06/2019	Helge Goessling	Germany	6.3	M6.2	50+	50+
WP1 land users questionnaire workshop	yes	Project	09/09/2019	12/09/2019	Margaretta Johanseen	Sweden, INTERACT meeting	1.2	M6.4	See report	See report
Round table 1 on operational ice mapping services needs from Copernicus (IICWG 2019)	yes	Workshop	23/09/2019	27/09/2019	Keld & DMI	IICWG, Copenhagen	6.3	M6.1	open	70, broadcast online
Copernicus Marine Service Training Workshop for the Arctic Sea region 2019	yes	Workshop	18/11/2019	19/11/2019	Fabrice Messal	Helsinki, Finland	6.5	WP6, milestone 6.9	Open	30
Round table 3 on CLMS needs (linked to Arctic Frontiers 2020)	yes	Workshop	26/01/2020	30/01/2020	Marko Scholze	Tromso, Norway	6.3	M6.3	Open	50+
Round table 4 with the observational research community on research and capacity gaps	yes	Workshop	02/03/2020	06/03/2020	Jeremy Wilkinson	Arctic circle ~~+ISAR6~~	6.3	M6.4	Open	30+
Copernicus Marine Service Training Workshop for the Arctic Sea region 2020	yes	Workshop	01/12/2020	-	Fabrice Messal	Online	6.5	D6.5 M6.9	Open	150+
ECR Workshop (replacing copernicus marine training workshop)	yes	workshop	17/02/2021	18/02/2021	Ole Jakob	Online	6.4	D6.4. M6.9	50+	50+
ASSW KEPLER Workshop Enhancing Copernicus 2.0 information products through optimised usage of in-situ data (Workshop 3)	yes	Workshop	20/03/2021	20/03/2021	Jeremy Wilkinson	ASSW- Online	6.4	M6.8	Open invite via ASSW	20+
Maritime and Research sector needs (workshop 1) M6.6	yes	Workshop	19/05/2021	19/05/2021	Nick Hughes	Online	6.5	M6.6	Open	20+
Engineering and researcher information requirements workshop- online round table.	Yes	Workshop	01/06/2021	23/06/2021	Nick Hughes	Zoom	6.5	M6.9	Open to all	N/A

Some of the workshops and roundtables were delivered as project milestones, further information about these key activities can be found in the section below.

Work Package 6 Milestones

Milestone 6.1: Round table 1 - ice mapping services needs from Copernicus (IICWG 2019)

Nick Hughes and Penelope Wagner, Partner: METNO

Milestone activity:
The 20th annual International Ice Charting Working Group (IICWG) meeting was held at Nordatlantens Brygge, Copenhagen, Denmark on 23-27 September 2019 and provided an opportunity to discuss KEPLER and topics relevant to the future evolution of Copernicus services.

Milestone completion date:
September 2019 (Month 11)

Context of milestone within Work Package:

Task 1 Work Package 1 “Stakeholder Needs” aims to explore the needs of end-users of products that build on polar environmental observations, with a particular focus on maritime users. Task 3 “Climate and Weather Forecasting Needs” explores the needs of intermediate users that transform polar observations into products that are intended for use by agencies such as ice services that support end-users, with a focus on forecast products This meeting provided an opportunity to connect to the wider international community of ice services, with KEPLER being referred to throughout the meeting. This included a dedicated presentation on the WP1 “User Needs Survey” results, and as part of a poster by METN. Numerous partners were active in the meeting including DMI (hosts), METNO, SMHI, FMI, BAS, MERCATOR, and AWI.

Milestone 6.1 Report and Evidence

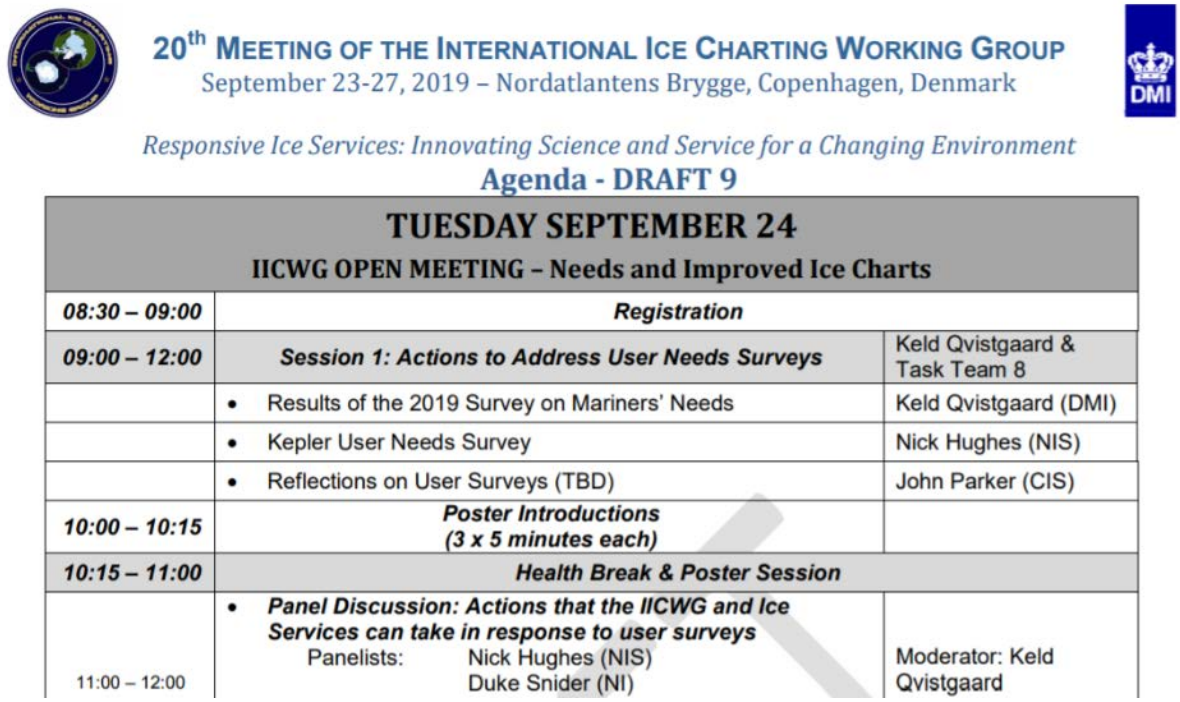
Lead author: Nick Hughes, METNO
Contributing authors:
Penelope Wagner (METNO), Keld Qvistgaard (DMI), Antti Kangas (FMI), Lisa Lind (SMHI)

The 20th meeting of the International Ice Charting Working Group (IICWG) was held in Copenhagen, Denmark during September 23-27, 2019. The meeting was hosted by the Danish Meteorological Institute (DMI). Ninety-two attendees representing 40 organizations from 18 countries participated. The theme for the meeting was "*Responsive Ice Services: Innovating Science and Service for a Changing Environment*". The theme of the meeting provided an opportunity to present the user requirements gathered by the project, and assess how science and services had evolved over the past 10-15 years in response to these. As was noted in the concluding report for WP1 (D1.4), it was found that the main user requirements of higher-resolution information products, and better access to telecommunications, were still valid and should be of concern to the future evolution of the Copernicus Services.

A panel session, "*Incorporating Automated Products into the Operational Production of Ice Information*" on 25 September revealed a degree of confusion on the part of the Copernicus Marine Environment Monitoring Service (CMEMS) as to their role and responsibilities that had to be addressed by the senior management of Mercator Ocean International. There were clear differences in the producers understanding of terminology, stemming from research, to that of the end-users and ice services for operational monitoring support. These issues were incorporated into recommendations from T1.1 and T1.4 and included as D1.1 and D1.4.

20th meeting of the International Ice Charting Working Group (IICWG)

Agenda



20th MEETING OF THE INTERNATIONAL ICE CHARTING WORKING GROUP
September 23-27, 2019 – Nordatlantens Brygge, Copenhagen, Denmark

Responsive Ice Services: Innovating Science and Service for a Changing Environment

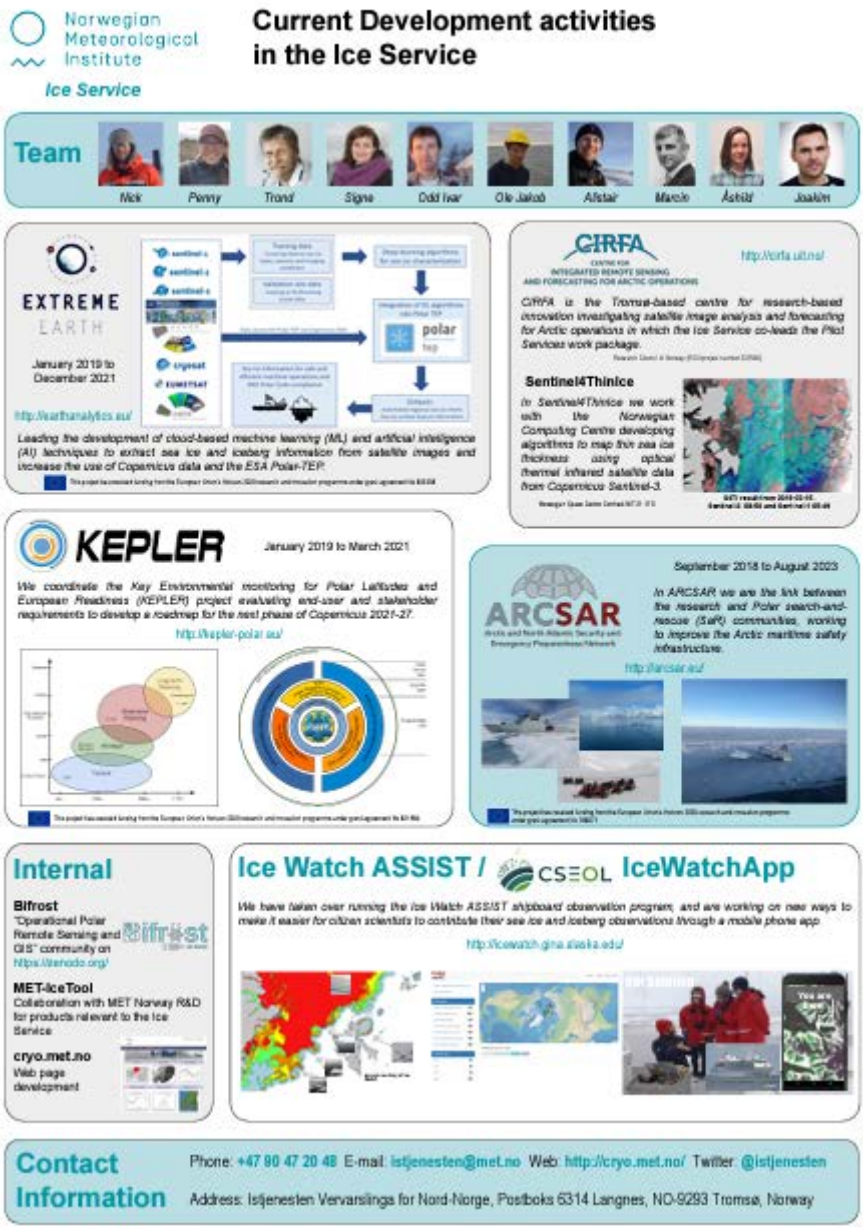
Agenda - DRAFT 9

TUESDAY SEPTEMBER 24 **IICWG OPEN MEETING – Needs and Improved Ice Charts**		
08:30 – 09:00	***Registration***	
09:00 – 12:00	***Session 1: Actions to Address User Needs Surveys***	Keld Qvistgaard & Task Team 8
	• Results of the 2019 Survey on Mariners' Needs	Keld Qvistgaard (DMI)
	• Kepler User Needs Survey	Nick Hughes (NIS)
	• Reflections on User Surveys (TBD)	John Parker (CIS)
10:00 – 10:15	***Poster Introductions (3 x 5 minutes each)***	
10:15 – 11:00	***Health Break & Poster Session***	
11:00 – 12:00	• ***Panel Discussion: Actions that the IICWG and Ice Services can take in response to user surveys*** Panelists: Nick Hughes (NIS) Duke Snider (NI)	Moderator: Keld Qvistgaard

User needs survey

Milestone 6.1 Mariner User Needs Survey.pdf

Promotional Poster at M6.1 round table event

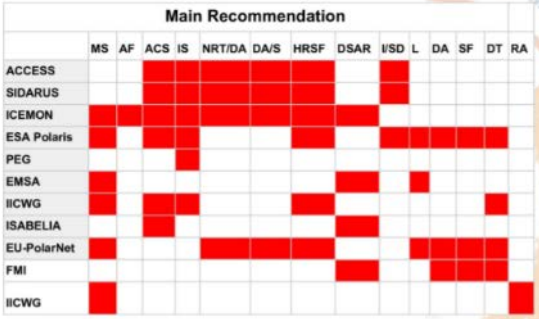


Slides from M6.1- results of user needs survey

The full presentation is available to view hereMilestone 6.1 KEPLER User Needs Survey presentation.pdf

T1.1 Maritime and Research Sector Needs

- Main recommendations from EC and ESA project reports (grey) and other surveys (white).
  - MS = Multiple Sensors/Complementary data
  - AF = Affordable data
  - ACS = Automatic Classification (SAR)
  - IS = In situ observations
  - NRT/DA = NRT Data Assimilation
  - DA/S = Data Assimilation from SAR
  - HRSF = High resolution Sea ice forecasts from SAR
  - DSAR = More details from SAR (i.e mode flexibility, increased coverage and higher resolution of sea ice features



  - I/SD = Iceberg size and drift
  - L = Improved latency on products
  - DA = Data that is easily understood and available
  - SF = Familiar data formats and standards
  - DT = Better dissemination, tools and training of different data products for non-specialists
  - RA = Risk Analysis.

WP 1

Conclusions

- The terms "*operational*" and "*high resolution*" need to be clearly defined
  - Different information provider communities use this differently
  - This can be confusing for the users
- Needs common to marine and terrestrial end-users
  - Intermediate users have different needs, but also need the end-users
- 1. **Affordable, higher bandwidth, communications**
  - Without access to communications, user uptake of high data volume products and services will be slow
- **2. True (meter-scale) high resolution information products**
  - The focus of the typical Polar user is on the short-term tactical (situational awareness)
    - How do I stay safe in what I am doing today?
  - If this is addressed, then the user has survived to maybe think about long-term planning and have a need the low resolution (kilometer-scale) information products currently on offer

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Milestone 6.2: Round table 2 on weather and climate forecasting needs

Helge Goessling, Partner: AWI

Milestone activity:
KEPLER-relevant aspects of the 9th International Workshop on Sea Ice Modelling, Data Assimilation and Verification (9th IICWG-DA Workshop) that was held 17-19 June 2019 in Bremen, Germany.

Milestone completion date:
June 2019 (Month 6)

Context of milestone within Work Package:
Tasks 1 and 2 of Work Package 1 "Stakeholder Needs" aim to explore the needs of end-users of products that build on polar environmental observations. In contrast, Task 3 "Climate and Weather Forecasting Needs" explores the needs of intermediate users that transform polar observations into usable products, with a focus on forecast products. This task thus aims to ensure that the satellite data, derived products and services needed for accurate and reliable predictions of weather and climate are identified. To this end, the users of Polar observations for environmental forecasting and climate research, including users of Essential Climate Variable (ECV) datasets, are engaged to document their requirements and suggestions for improvements. The outcomes of this Task (and the whole Work Package 1) feed into other KEPLER Work Packages (see Figure 1). This milestone is a summary of KEPLER-relevant aspects of the 9th International Workshop on Sea Ice Modelling, Data Assimilation and Verification (9th IICWG-DA Workshop) that was held 17-19 June 2019 in Bremen, Germany.

Explanation of delays:
No delay.

Milestone 6.2 Report and Evidence

Report
Lead author
Helge Goessling, AWI

Contributing Authors
Penelope Wagner (METNO), Steffen Tietsche (ECMWF), Thomas Lavergne (METNO), Laurent Bertino (NERSC), Gilles Garric (MERCATOR), Svetlana Losa (AWI), Ole Jakob Hegelund (METNO)

The *9th International Workshop on Sea Ice Modelling, Data Assimilation and Verification* was held 17-19 June 2019 in Bremen, Germany. The workshop was organized and sponsored jointly by the International Ice Charting Working Group (IICWG), the Year of Polar Prediction (YOPP – the flagship activity of the Polar Prediction Project by the World Weather Research Programme (WWRP)), GODAE Oceanview (GOV) and KEPLER. The overall workshop objective was to advance international capabilities for automated sea ice analysis and prediction on timescales from hours to a season. This includes the development of more mature and meaningful methods for sea ice verification as well as cross-cutting issues in sea ice modelling

and data assimilation and how deficiencies of current systems can be more efficiently diagnosed and addressed.

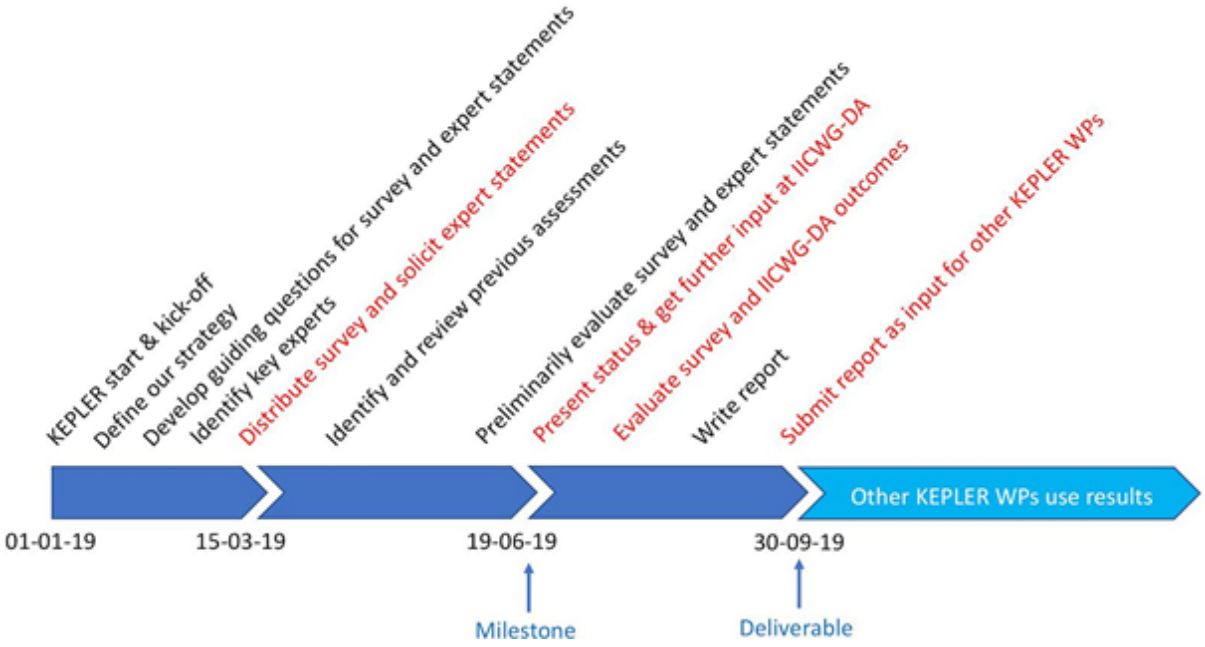

Figure 1: KEPLER WP1 Task3 timeline.

The workshop started off with a session dedicated to KEPLER, with Nick Hughes presenting the status of the project overall, Thomas Kaminski presenting on the Quantitative Network Design (QND) analyses of observational scenarios within KEPLER, and Helge Goessling presenting preliminary results of the KEPLER 1.3 questionnaire. The KEPLER session was followed by sessions on (i) sea ice observations and uncertainties, (ii) sea ice model parameterizations and coupling to the ocean and atmosphere models, (iii) sea ice data assimilation, and (iv) verification approaches for sea-ice analysis and forecasts. In the following we summarize the intermediate results of the questionnaire as presented at the workshop and the subsequent discussion.

By June, 17 responses to the KEPLER 1.3 questionnaire had been collected and preliminarily analysed. Until then, 7 responses had come from **Ice/Marine Services** (including private sector), 4 from **Weather Services**, 1 from a **Forecast Research** group, 4 from **Satellite Production Research/Service** groups, and 1 related to a **Copernicus Service**. The intermediate results from these responses as presented at the workshop are not provided here, but will be contained in the overall outcomes presented in the Task 1.3 delivery report.

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Figure 2: Group photo from the 9th International Workshop on Sea Ice Modelling, Data Assimilation and Verification, where KEPLER and preliminary outcomes of the questionnaire were presented and discussed.

One aspect that was received considerable attention at the workshop was that the gap between what automatic satellite products and model-based forecast systems can deliver and what end-users "want" in terms of spatial resolution (and real-time delivery) will remain for the foreseeable future, but also that it can be closed gradually from both sides. This can be achieved by increasing resolution and reducing latency of forecast products (and the underlying observational products) on the one hand, but also by optimising the way forecast products are used, such that they become useful also with resolutions previously considered too coarse.

Agenda

https://www.awi.de/en/science/climate-sciences/sea-ice-physics/main-research-foci/forecast-of-seaice-properties/iicwg-da.html

9th IICWG-DA workshop

Agenda:

Day 1: Registration / Welcome / Operational challenges / Sea ice observations and uncertainties

8:30	8:45	Registration		
8:45	9:00	Welcome		
9:00	9:30	Nick Hughes	Norwegian Ice Service	KEPLER - Key Environmental monitoring for Polar Latitudes and European Readiness
9:30	10:00	Thomas Kaminski	The Inversion Lab	Quantitative Network Design Analyses of Observational Scenarios within KEPLER
10:00	10:30	Helge Goessling / Steffen Tietsche	Alfred Wegener Institute / European Center for Medium-Range Weather Forecasts	KEPLER Questionnaire
10:30	11:00	Coffee + Poster		
11:00	11:30	Thomas Lavergne	Norwegian Meteorological Institute	Improving Sea Ice Concentration Algorithms in preparation for the Copernicus Imaging Microwave Radiometer
11:30	12:00	Sascha Willmes presented by Fabian Reiser	University Trier	High-resolution daily sea-ice concentration from MODIS thermal infrared imagery, 2002-2019: Current status and available products.
12:00	12:30	Matilde Brandt Kreiner	Danish Meteorological Institute	Multi-sensor data fusion for ice mapping around Greenland
12:30	13:30	Lunch		
13:30	14:00	Christian Haas	Alfred Wegener Institute	Ice Thickness and Deformation in the 2018 Greenland Polynya
14:00	14:30	Shiming Xu	Tsinghua University	Sea Ice and Snow Cover Interaction Revealed by Combined Retrieval of Sea Ice Thickness and Snow Depth with CryoSat-2 and SMOS
14.30	15:00	Stefan Kern	ICDC / CEN / University of Hamburg	Inter-comparison of ten sea-ice concentration products
15:00	15:30	Lars Kaleschke	Alfred Wegener Institute	About the synergistic use of SMOS and CryoSat observations for ocean-ice forecasts
15:30	16:00	Coffee + Poster		
16:00	16:30	Helge Goessling	Alfred Wegener Institute	The Sea Ice Drift Forecast Experiment: Insights from 25,000 forecasts and a look ahead
16:30	17:00	Giacomo De Carolis	CNR-IREA	On the SAR mapping of young sea ice in the marginal ice zone from ocean gravity wave attenuation
17:00	17:30	Rasmus Tonboe	Danish Meteorological Institute	Sea ice concentration uncertainties
17:30	18:00	Florent Garnier	LEGOS / University of Toulouse / CNRS / IRD / CNES / UPS	Sea-ice thickness and snow depth observations from satellite altimeters in Arctic and Antarctica for sea ice modelling
19:30		Social Dinner – at Schüttinger Gastbrauhaus		

9th IICWG-DA workshop

Day 2: Sea ice model parameterizations and coupling to ocean and atmosphere models / Sea ice data assimilation (methods and results) / Poster Session

9:00	9:30	Till Rasmussen	Danish Meteorological Institute	Improvement of the dynamical core of CICE
9:30	10:00	Jean-Francois Lemieux	Environment and Climate Change Canada	A new grounding scheme for modeling landfast ice
10:00	10:30	Nikolay Koldunov	MARUM / Alfred Wegener Institute	Fast EVP solutions in a high-resolution sea ice model
10:30	11:00	Coffee + Poster		
11:00	11:30	Christof Luepkes	Alfred Wegener Institute	New parametrization of bulk transfer coefficients for the stably stratified surface layer
11:30	12:00	Sarah Keeley	European Center for Medium-Range Weather Forecasts	Implementation of a dynamic sea ice model in a coupled NWP system
12:00	12:30	Alexander Komarov	Environment and Climate Change Canada	SAR Data Assimilation in Environment Canada Ice Prediction System
12:30	13:30	Lunch		
13:30	14:00	Anton Korosov	Nansen Environmental and Remote Sensing Center	Assimilation of sea ice deformation into a Lagrangian sea ice model
14:00	14:30	Mark Buehner	Environment and Climate Change Canada	Assimilation of ice thickness observations at ECCC
14.30	15:00	Lars Nerger	Alfred Wegener Institute	Ensemble Data Assimilation with the Parallel Data Assimilation Framework
15:00	15:30	Lonjiang Mu	Alfred Wegener Institute	Sea ice data assimilation in a seamless global coupled sea-ice prediction system
15:30	16:00	Coffee + Poster		
16:00	16:30	Keguang Wang	Norwegian Meteorological Institute	An improved COIN scheme for assimilating sea ice concentration in METROMS
16:30	17:00	David Hebert	U.S. Naval Research Laboratory	Improving sea ice forecasts by assimilating CryoSat-2 near-real-time ice thickness and VIIRS ice concentration observations
17:00	19:00	Poster session – Presentation of posters		

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9th IICWG-DA

workshop

Day 3: Sea ice data assimilation (methods and results) / Verification approaches for sea-ice analysis and forecasts / Wrap up / Goodbye

9:00	9:30	Gleb Panteleev	U.S. Naval Research Laboratory	Toward optimization of rheology in ice models through data assimilation
9:30	10:00	Hiroshi Sumata	Alfred Wegener Institute	A simultaneous optimization of Arctic sea-ice model parameters by a genetic algorithm
10:00	10:30	Charles-Emmanuel Testut	Mercator Ocean International	Improving sea ice thickness estimates by assimilating CryoSat-2 and SMOS sea ice thickness data
10:30	11:00	Coffee + Poster		
11:00	11:30	Madlen Kimmitz	NERSC and Bjerknes Centre for Climate Research	Assessing the contribution of ocean and sea ice initialization for seasonal prediction in the Arctic
11:30	12:00	Emma Fiedler (online presentation)	Met Office	Assimilation of sea ice freeboard observations into an ocean and ice analysis and forecast system
12:00	12:30	Angela Cheng	Environment and Climate Change Canada	Searching for inconsistencies: validating RIOPS modelled ice pressure using reported ship movements
12:30	13:30	Lunch		
13:30	14:00	Andrea Scott	University of Waterloo	Accuracy of ice/water data using categorical triple collocation
14:00	14:30	Gene Petrescu	NOAA / NWS Alaska	Operationally relevant verification of sea ice guidance
14.30	15:00	Arne Melsom	Norwegian Meteorological Institute	Validation metrics for ice edge position forecasts
15:00	15:30	Cyril Palerme	Norwegian Meteorological Institute	An intercomparison of verification scores for evaluating the sea ice edge position in seasonal forecasts
15:30	16:00	Coffee + Poster		
16:00	16:30	Steffen Tietsche	European Center for Medium-Range Weather Forecasts	The impact of sea-ice thickness initialization on subseasonal predictions
16:30	17:00	Nils Hutter	Alfred Wegener Institute	Leads and ridges in Arctic sea ice from RGPS data and high resolution sea-ice models
17:00	17:30	Wrap up of the sessions by session Chairs – Goodbye		

Co-funded by the Horizon 2020 programme of the European Union

Milestone 6.3: Round table 3 on CLMS needs (linked to Arctic Frontiers 2020)

Marko Schloze, Partner: ULund

Milestone activity:
KEPLER side event- 'Evolving the EU Copernicus programme for the Polar Regions' at the Arctic Frontiers Conference 2020

Milestone delivery date:
February 2020 (Month 14)

Context of milestone within Work Package:

Tasks 1 of Work Package 2 "Polar Regions provision in Copernicus Services" aims to assess the status on existing and planned capabilities of the Copernicus Land Monitoring Service (CLMS) to monitor polar terrestrial environments including land ice (such as glaciers, but also lakes and rivers), snow, permafrost, biogeochemistry and related hazards of Polar Regions. The consultations focus on fulfilled and future user requirements, as well as identified gaps and, are complemented by CLMS user uptake activities. One of the activities is a round table discussion with the users. This round table discussion has been arranged as a side event at the Arctic Frontiers 2020 conference. The outcomes of the round table will feed into the deliverable report D2.1 on ways to improve the description of the changing Polar Regions in the Copernicus Land Monitoring Service.

This milestone report presents the meeting minutes of the side event organised by KEPLER at the Arctic Frontiers Conference 2020 held on 29 January in Tromsø, Norway.

Milestone 6.3 Report and Evidence

Report
Lead author:
Marko Scholze, ULUND

Contributing authors:
Thomas Diehl (JRC), Eirik Malnes (NORUT), Nick Hughes (METNO), Marcin Pierechod (METNO), Ole Jakob Hegelund (METNO).

KEPLER organised the side event 'Evolving the EU Copernicus programme for the Polar Regions' at the Arctic Frontiers Conference 2020 which was held from 18:15-19:15 on 29 January 2020 in Tromsø, Norway. The side event consisted of a series of talks presenting findings of the KEPLER project in

Fig 1: Nick Hughes introducing the KEPLER side event at Arctic Frontiers 2020

its first year and two interactive Mentimeter (https://www.mentimeter.com) sessions to engage with the audience. The presentations showcased how Copernicus data and services can better support the development of information and knowledge needed for the smart Arctic. These include how Earth Observation technologies can lead to innovations resulting in more resilient societies through improved infrastructures and connectivity, both on land and in the maritime domain.

During the Mentimeter sessions, the audience could use their smartphones to connect to the presentation where they answer questions related to Copernicus (see Appendix for the results of the Mentimeter sessions). The responses by the audience were visualized in real-time on the presentation screen creating a fun and interactive experience for the audience.

The side event was streamed live with access points from the KEPLER homepage as well as the Arctic Frontiers conference website. The stream has been recorded and is available under this link: https://vimeo.com/screenstoryno/download/386930568/56e6aafda1

The full programme of the side session was as follows:

- Mentimeter session 1: *Getting to know the audience*
- Presentations:
    1. *Overview of the KEPLER project*, Nick Hughes
    2. *Maritime user information needs*, Ole Jakob Hegelund
    3. *Terrestrial users information needs*, Eirik Malnes
- Mentimeter session 2: *Interest of the Audience in Copernicus and land-related products*
- Panel (consisting of the speakers plus Marko Scholze and Thomas Diehl) discussion

Fig 2: Panel discussion on Copernicus Arctic land monitoring needs at the KEPLER side event at Arctic Frontiers 2020

The detailed results from the Mentimeter sessions are shown in the Appendix below, however, it was clear from the questions that most of the audience was familiar with Copernicus and its services even though a large fraction would be interested in Training courses. From the short interactive session with the audience it turned out that the most important data needs were concerned with snowmelt followed by avalanche risk and lake ice thickness. Consequently, the panel discussion then focused on the outcome of this Mentimeter session and discussed how the different service and product providers (e.g. ESA CCI) could be better streamlined together with Copernicus to create a one-stop-shop, allowing the users to access all Arctic-related products. One of the key points discussed was a seamlessly integrated access point where users and data providers can share their measurement data in a standardized format. To this regard the upcoming EO for Polar Science workshop co-organised by ESA and EC in Copenhagen in June 2020 was mentioned with the possibility to respond to the workshop call for discussion sessions (see http://eo4polar.esa.int, the deadline for contribution is 17 March 2020) with a dedicated session on the state of information on polar observations and their usage in science.

Session Agenda

KEPLER

Key Environmental monitoring for Polar Latitudes and European Readiness

Copernicus
Europe's eyes on Earth

Evolving the EU Copernicus programme for the Polar Regions

***Wednesday 29 January** - Arctic Frontiers Science - Knowledge-based development in the Arctic*

- **13:00 - 13:15** Margarinfabrikken 2
  KEPLER - How to link data gathering (Copernicus) with stakeholders and end-users
  Ole Jakob Hegelund, Penelope Wagner, Nick Hughes
- **18:15 - 19:15** Clarion Hotel The Edge - Kjøpmannskontoret
  Side Session: Evolving the EU Copernicus programme for the Polar Regions

The Horizon 2020 project KEPLER is **developing a roadmap for the evolution of the EU Copernicus programme** for the information needs of polar regions end-users and stakeholders in the 2020's.

The side session will present the findings of the project in its first year, and explore how **Copernicus data and services can better support the development of information and knowledge needed for the smart Arctic**. These include how Earth Observation technologies can lead to **innovations resulting in more resilient societies through improved infrastructures and connectivity**, both on land and in the maritime domain. In the Arctic seas **enhancing information provision will result in a more sustainable, and healthy Blue Future** so that communities throughout the Arctic can benefit.

Presentation 1, 10 minutes
Overview of the KEPLER project, Nick Hughes

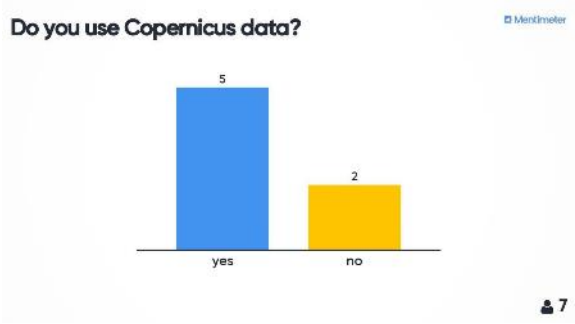
Presentation 2, 10 minutes
Maritime user information needs, Ole Jakob Hegelund

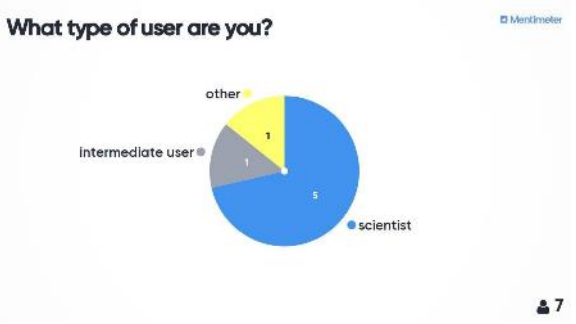
Presentation 3, 10 minutes
Terrestrial users information needs, Eirik Malnes

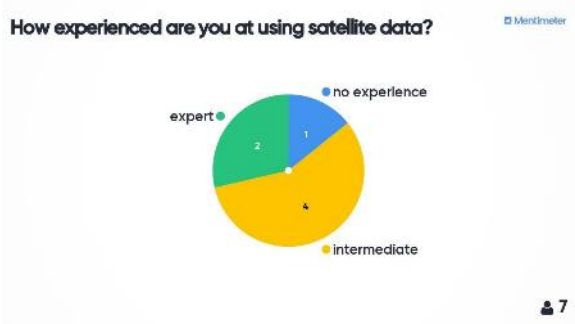
Round-table, 30 minutes
Discussion on user requirements,
with a focus on terrestrial and coastal

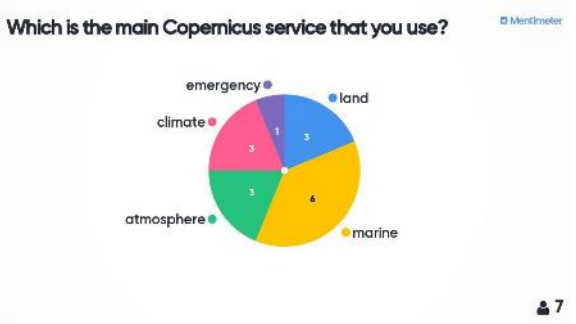
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 821984

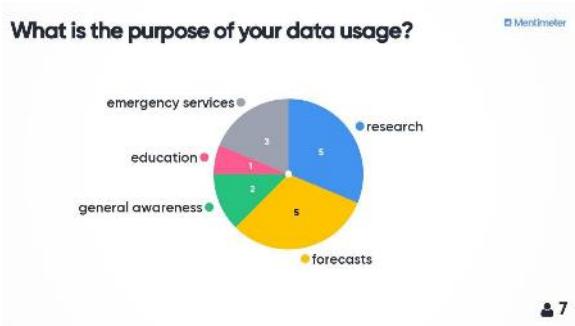
Session Questions and results

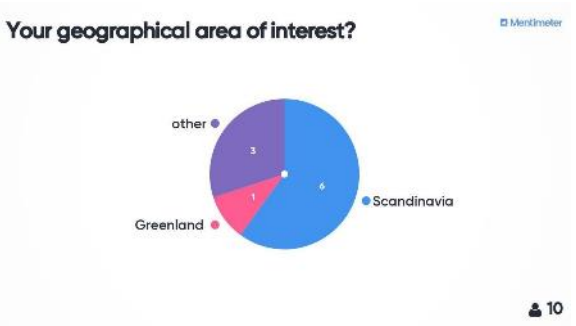


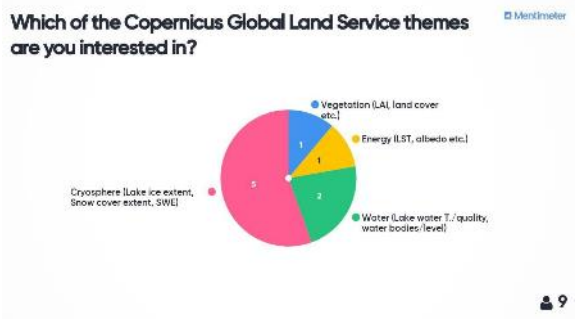


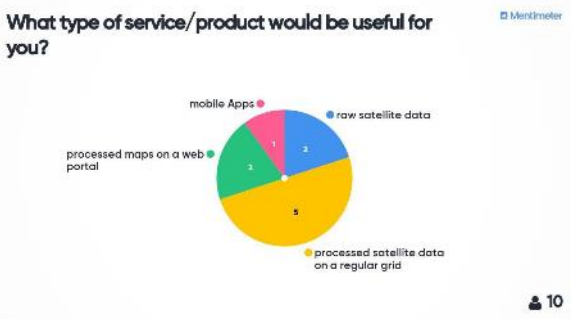


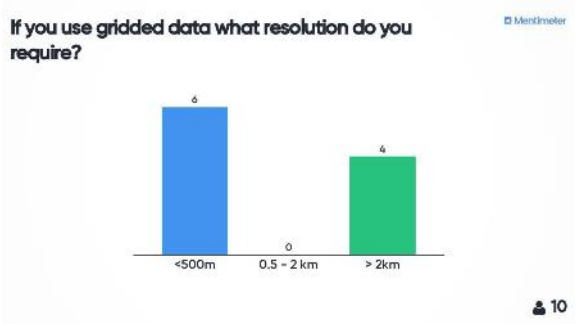


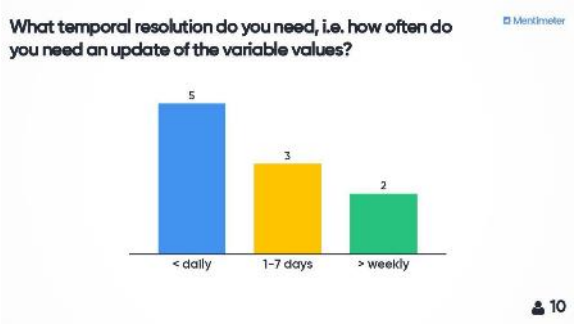


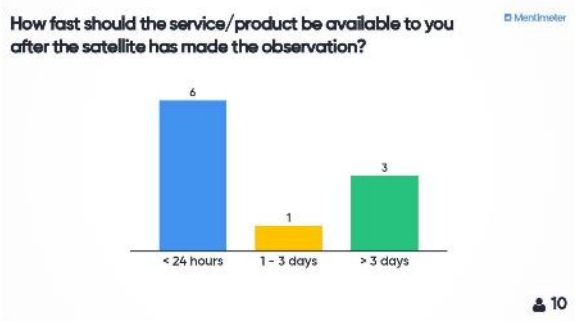




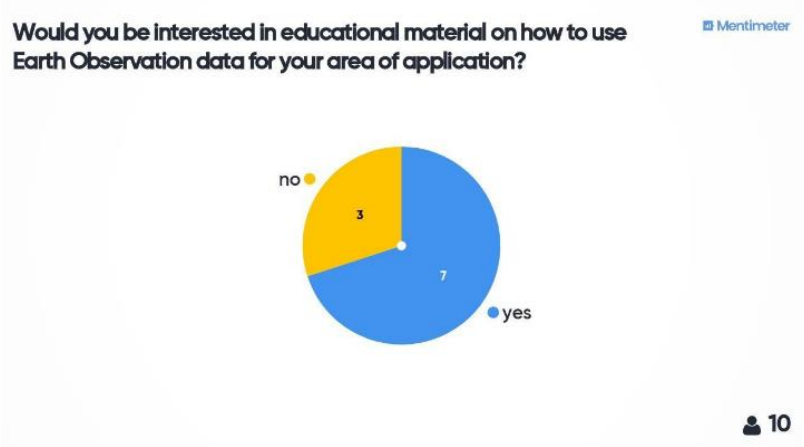


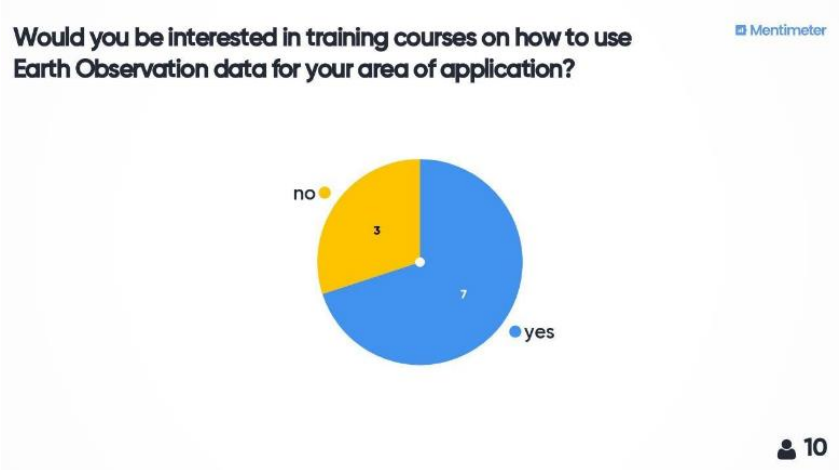

If you use gridded data what resolution do you require?
Mentimeter
6
0
4
<500m
0.5 - 2 km
> 2km
10


What temporal resolution do you need, i.e. how often do you need an update of the variable values?
Mentimeter
5
3
2
< daily
1-7 days
> weekly
10


How fast should the service/product be available to you after the satellite has made the observation?
Mentimeter
6
1
3
< 24 hours
1 - 3 days
> 3 days
10


What data product is most needed and currently not (easily) available?
Mentimeter
permafrost extent
permafrost ALT
ground motion
Lake ice thickness
Snow melt (dry and wet)
avalanche risk
glacier extent
soil moisture
low importance
high importance
10


Would you be interested in educational material on how to use Earth Observation data for your area of application?
Mentimeter
no
3
7
yes
10


Would you be interested in training courses on how to use Earth Observation data for your area of application?
Mentimeter
no
3
7
yes
10

Milestone 6.4: Round table 4 with the observational research community on research and capacity gaps (Arctic Circle)

Note: Milestone referred to as ''Round table 5 on engineering and researcher information requirements (IAHR 2020)' in the Grant Agreement.

Jeremy Wilkinson, Partner: UKRI-BAS

Milestone activity:

This milestone was completed not at the IAHR 2020, but in two phases to ensure we bring in both terrestrial and marine experts. The first was a collaborative round table with the EU Polar Cluster project INTERACT after their General Assembly. INTERACT is a pan-Arctic network of over 80 terrestrial field bases across the Arctic. At this round table we consulted the INTERACT team on their terrestrial Infrastructure Network and (a) how to address terrestrial observational research community access to Copernicus products, and (b) how they cooperate with the Copernicus services, and to recommend solutions to identified gaps.

The second was through KEPLER partner, Jeremy Wilkinson who created a similar questionnaire for research vessels M6.4 Research Vessel Questionnaire.pdf. This was brought together with additional consultation with the marine sector, which was performed by WP 1.1 of KEPLER, and was also supplemented by previous reviews on this topic (generally led by the European Ice Services, EIS). This was presented by KEPLER Partner Nick Hughes as part of a round table event at the Arctic Circle (Iceland).

Milestone completion date: Due October 2019 (Month 10)

Context of milestone within Work Package:
The above workshops/conference sessions, and their outputs from above-mentioned milestone activity were used with the Deliverable D6.6 Best practice guide for EO information use by research vessels and stations.

Explanation of delays:
We were going to present at the *IAHR 2020*, but as we were dealing with both terrestrial and marine we decided for a more inclusive dual approach. It did not deliver any appreciable delay, but ensured we widened our round table to both terrestrial and marine experts.

Milestone 6.4 Report and Evidence

Report

INTERACTers' view on research and capacity gaps in Satellite Earth Observations

Molly Buhl and Margareta Johansson

INTERACT and Department of Physical Geography and Ecosystem Science, Lund University

KEPLER

INTERACT

BACKGROUND

INTERACT

Figure 1. INTERACT is a network of 86 research stations located in all Arctic countries and adjacent high alpine areas.

INTERACT is a circumarctic network of currently 86 terrestrial field bases in northern Europe, Russia, US, Canada, Greenland, Iceland, the Faroe Islands and Scotland as well as stations in northern alpine areas. The project, which is funded by the EU, has a main objective to build capacity for identifying, understanding, predicting and responding to diverse environmental changes throughout the wide environmental and land-use envelopes of the Arctic. This is necessary because the Arctic is so vast and so sparsely populated that environmental observing capacity is limited compared to most other latitudes.

INTERACT is multidisciplinary: together, the stations in INTERACT host thousands of scientists from around the world who work on projects within the fields of glaciology, permafrost, climate, ecology, biodiversity and biogeochemical cycling. The INTERACT stations also host and facilitate many international single-discipline networks and aid training by hosting summer schools.

INTERACT station managers and researchers have established partnerships that are developing more efficient networks of sensors to measure changing environmental conditions and the partnerships are also making data storage and accessibility more efficient through a single portal. New communities of researchers are being offered access to terrestrial infrastructures while local stakeholders as well as major international organisations are involved in interactions with the infrastructures.

The trans-national access component is crucial to building capacity for research in the European Arctic and beyond. INTERACT is offering transnational access to 43 research stations located in the Arctic, and northern alpine and forest areas in the Europe, Russia and North-America. It is providing opportunities to researchers to work in the field in often harsh and remote locations that are generally difficult to access. In return, the input of new researchers has led to cross fertilisation, comparative measurements at different locations and new research directions at the individual infrastructures.

KEPLER

KEPLER (Key Environmental monitoring for Polar Latitudes and European Readiness) is a multi-partner initiative, built around the operational European Ice Services and Copernicus information providers, to prepare a road map for Copernicus to deliver an improved European capacity for monitoring and forecasting the Polar Regions.

A key aim of KEPLER is to ensure that there is a clear, concise and achievable road map for the Copernicus programme to develop industry and societal-driven value-added technologies, products, and other services. This will also enhance the European capacity in Earth Observation for the monitoring of the Polar Regions, and its sustainable development, to the benefit of stakeholders. The first Sentinel satellites are in orbit, or due to be launched. It is important that in the next phase, Copernicus 2.0 starting in 2021, this capability is developed further to meet the requirements of the Polar Regions.

AIM OF REPORT

INTERACT is through Lund University a partner in KEPLER and is contributing to Task 3.1 which will result in a report on the gaps in terms of situ observations in order to improve Polar Regions monitoring and forecasting capabilities. This was done through an in-depth consultation process where INTERACTers' view on research and capacity gaps in Satellite Earth Observations, and access to adequate in-situ observing systems were compiled.

METHODS

To compile INTERACTers' view on research and capacity gaps in Satellite Earth Observations and access to adequate in-situ observing system, a workshop was organized at Vindeln, Sweden, on the 12 September 2019 back to back with INTERACT's General Assembly. During the workshop Mentimeter (www.mentimeter.com) was used. This is a presentation software which allows you to ask the participants questions in your presentation, and afterwards display the result. This made it possible for the participants to instantly see and discuss the result. 33 INTERACTers participated in the workshop, where of 15 were women and 18 were men.

A complementary survey questionnaire was sent out to all station managers after the workshop to allow INTERACTers' that was not participating at the meeting to contribute to the survey. Eight additional answers were received from the complementary online survey.

The survey consisted of 15 questions and the results are described in the following section below.

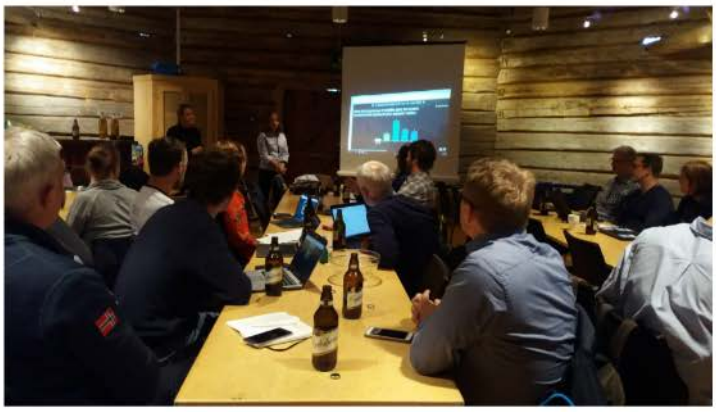


Figure 2. Workshop in Vindeln, Sweden.

RESULTS

YOU AS A USER

1. Does your research station use Copernicus or any other satellite data to monitor environmental change, or to help with real time operations?

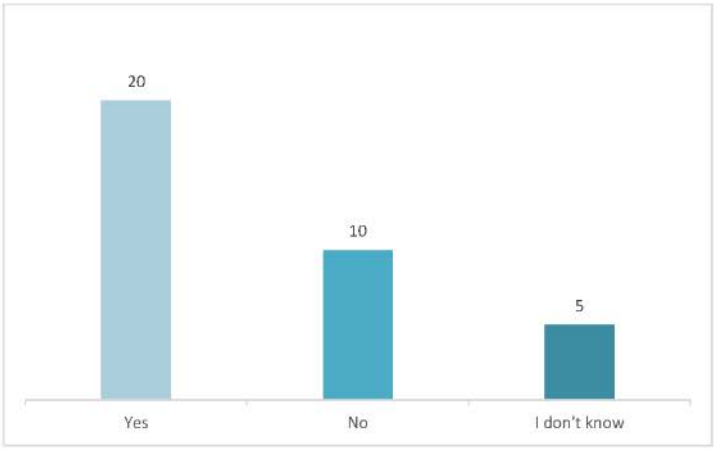


Figure 3. Responses from INTERACT community.

2. What are the parameters that are monitored using satellite data at your research station?

- Three participants responded "I don't know"
- Six participants responded "None"

Figure 4. Responses from INTERACT community.

3. Is the spatial resolution adequate for the parameters you monitor using satellite data?

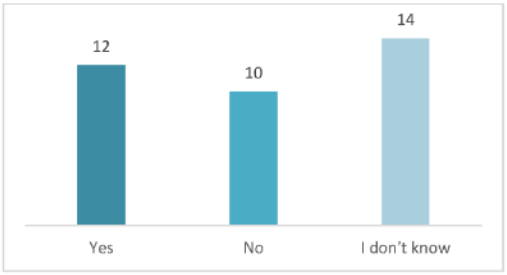


Figure 5. Responses from INTERACT community.

4. Is the temporal resolution adequate for the parameters you monitor using satellite data?

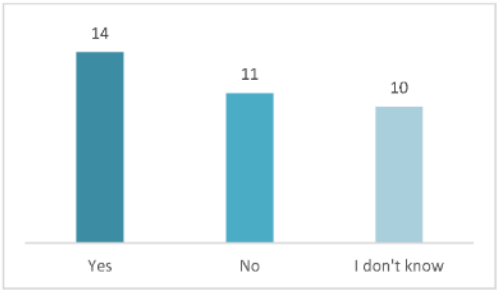


Figure 6. Responses from INTERACT community.

5. Estimate the percentage of visitors to your research station that use satellite data within their research.

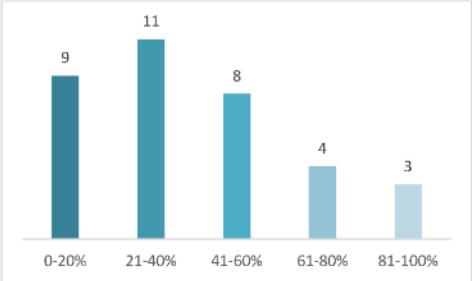


Figure 7. Responses from INTERACT community.

6. Rank the importance of satellite data for current environmental studies at your research station.

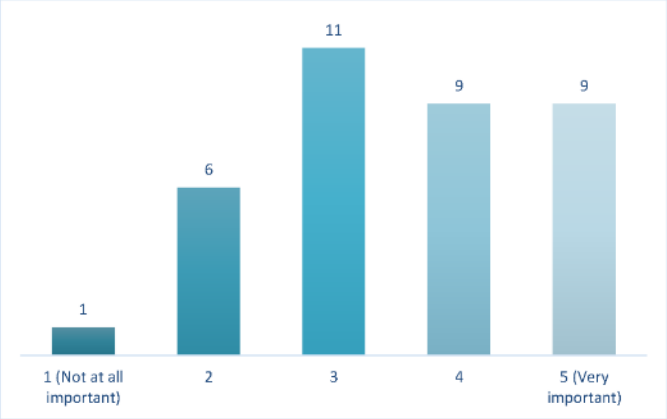


Figure 8. Responses from INTERACT community.

7. Rank the expected importance of satellite data for future environmental studies at your research station.

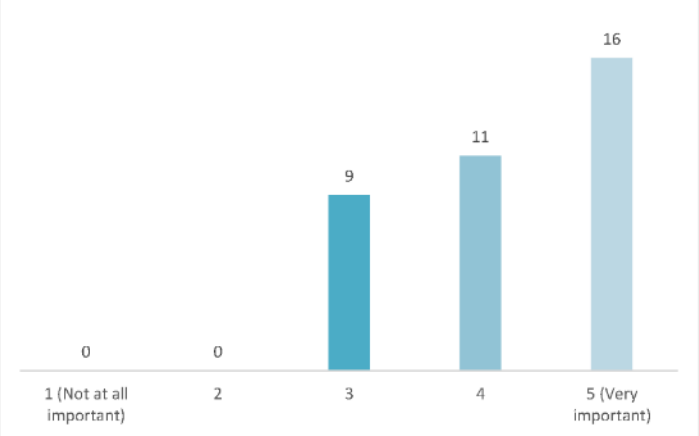


Figure 9. Responses from INTERACT community.

8. Are there additional parameters that you would like to monitor via satellite data at your research station?

- Three participants responded "I don't know"
- Three participants responded "No"
- Three participants responded "Yes"

Figure 10. Responses from INTERACT community.

9. What obstacles do you have in accessing satellite data today?

- Seven participants answered "I don't know"
- Three participants answered "No obstacles"

Figure 11. Responses from INTERACT community.

10. What do you think are the major research gaps in satellite data in the near future (by 2050)?

- Twelve participants answered "I don't know"

Figure 12. Responses from INTERACT community.

11. What are the major capacity gaps in satellite data today?

- Eleven participants answered "I don't know"

Figure 13. Responses from INTERACT community.

YOU AS A DATA PROVIDER FOR GROUND-TRUTHING AND OPERATIONAL DATA

12. Does your research station provide data for ground truthing or for operational needs such as delivering real-time meteorological data to the GTS?

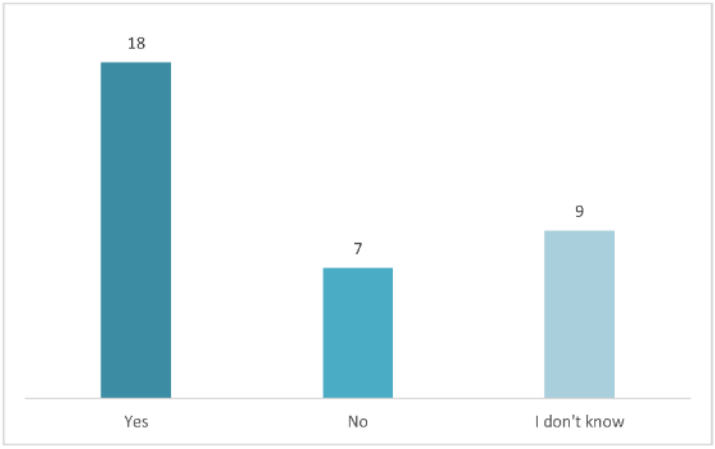


Figure 14. How many of the INTERACT Research stations that contribute with ground truthing.

13. What parameters does your research station provide?

- Six participants answered "I don't know"
- Four participants answered "None"

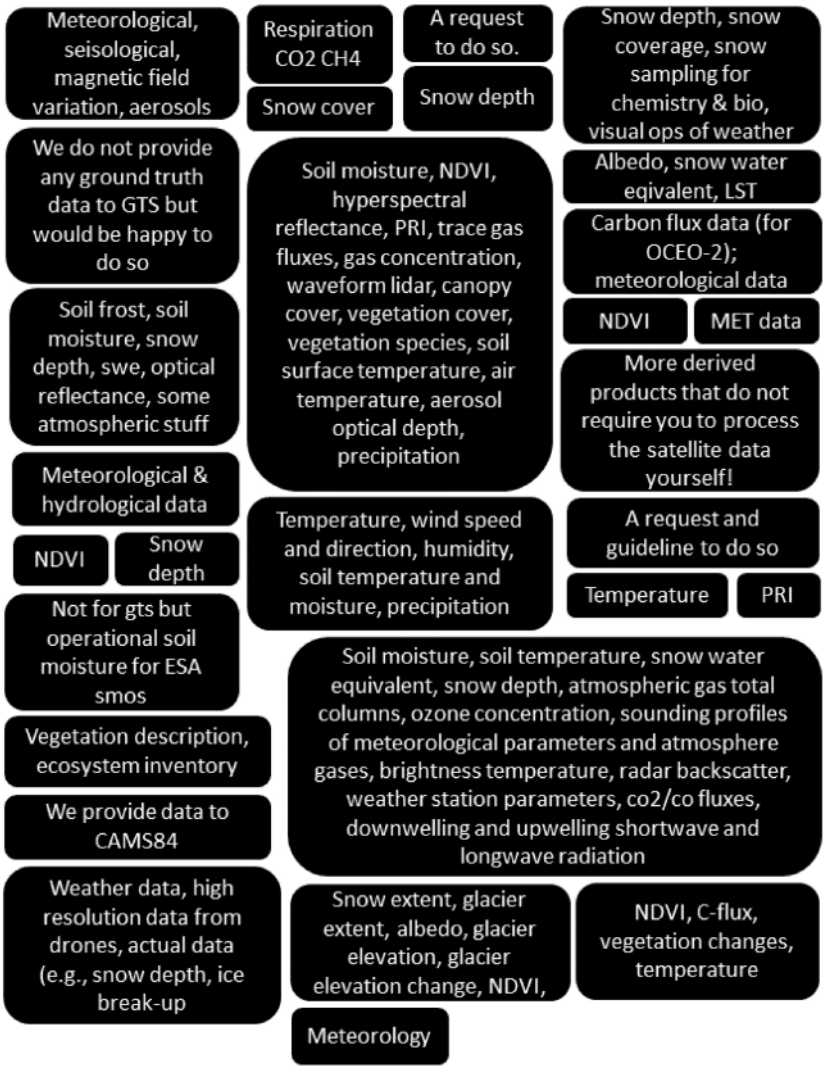


Figure 14. Parameters that INTERACT research stations provide for ground validation.

14. If you don't provide data for ground truthing or operational needs, what could make you contribute in the future?

- Three participants answered "I don't know"

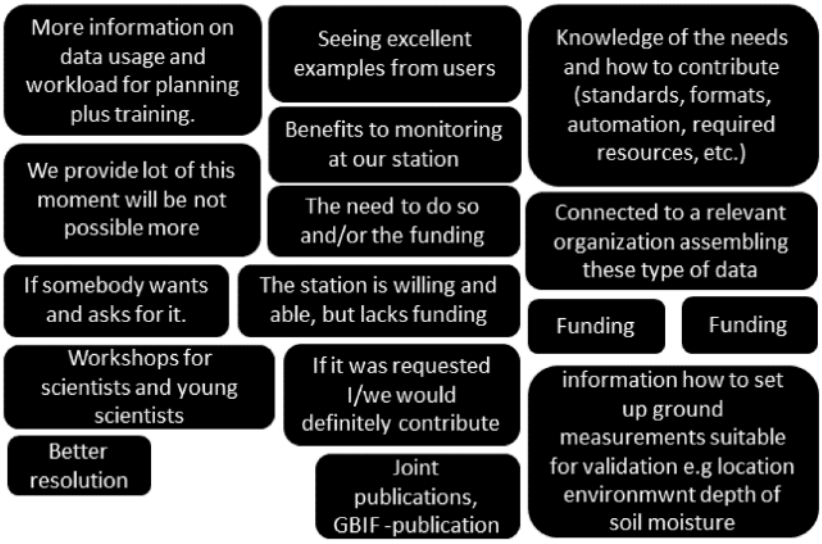


Figure 14. What would make INTERACT research stations provide more ground validation data.

15. How should satellite based products evolve to better meet your research station's future needs?

- Seven participants answered "I don't know"

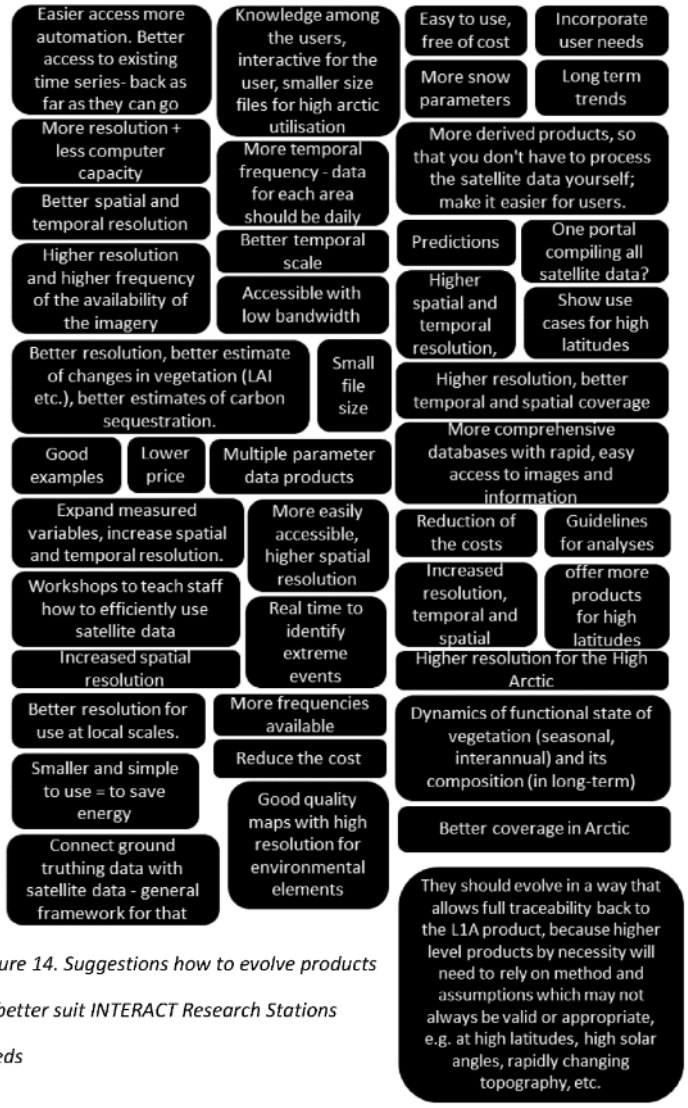


Figure 14. Suggestions how to evolve products to better suit INTERACT Research Stations needs

ADDITIONAL DISCUSSIONS

During the survey an additional question was added "Can data from drones replace satellite data at research station?"

The overall consensus was no because drones cannot fly on the same temporal resolution and over similar geographical areas as the satellite data. However it was concluded that drone data is a valuable complement to satellite data as:

- Drone data can complement with better spatial resolution
- Drone data can complement in cloudy conditions
- Drones can validate its own data (e.g. cutting leaves from trees)

CONCLUSION

Little more than half of the INTERACT research stations that contributed to this survey is using satellite data. It might be that many of the researchers that are using remote sensing data are actually not visiting the research stations, but is working at their home institutes instead. This survey was sent to the station managers, and most likely the response would have been slightly different if it was sent to the different researchers at the research stations instead. However, as INTERACT research stations are annually hosting more than five thousand researchers that would not have been feasible. In addition, many of the research stations have an extended monitoring programme which might be why satellite data might not be that important for the station.

INTERACT has great potential to become a ground validation network as many of the stations have the possibility to do ground validation. INTERACT want to contribute to this in the future and one way to do it might be through Virtual Access (found on INTERACT's web site eu-interact.org) that could contribute to ground validation in the future.

Milestone 6.5: Round table 5 on engineering and researcher information requirements

Nick Hughes, Partner: METNO

Milestone activity:

The KEPLER Online round table: Engineering & Researcher information requirements consists of a short pre-recorded video by Nick Hughes- (Project Coordinator and Ice Services leader at the Norwegian Meteorological Institute) and ten questions.

Milestone completion date:

Due June 2021 (Month 30)

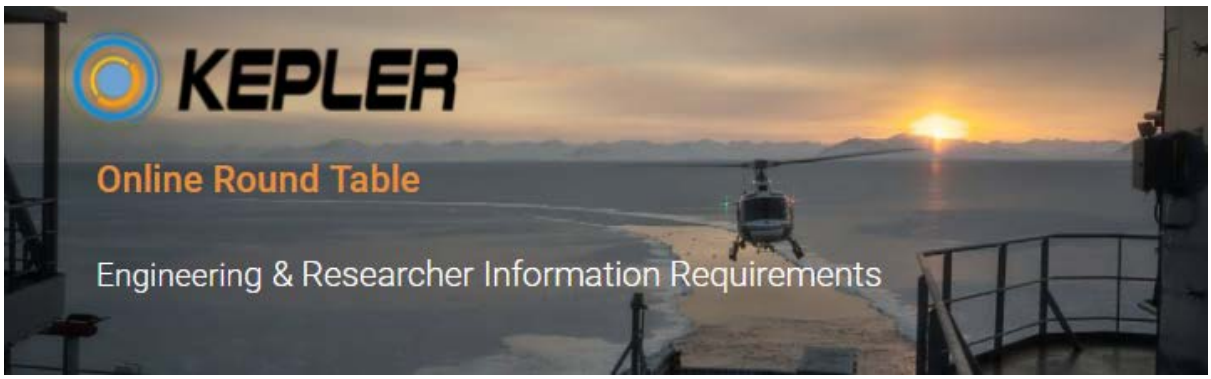
Context of milestone within Work Package:

The Milestone was originally intended to link to WP1 and provide an additional set of inputs particularly from the engineering sector. Given the thorough analysis of previous user surveys, and broad sectoral coverage of these, the need for specific input became somewhat superfluous. The Milestone was reorientated towards the end of the project to capture any final user reactions to KEPLER's findings and recommendations, and as it is in the form of an online questionnaire, it can continue running beyond the lifetime of the project.

Explanation of delays:

Due to the cancellation of IAHR 2020, an extension to the original deadline for this milestone was granted via the project amendment.

Milestone 6.5 Report and Evidence



Report

Components of this Milestone were covered by other activities during the project, particularly the involvement in the Arctic Shipping Forum in 2019 and 2020, Arctic Shipping Summit and Arctic Circle meetings in 2019, and the Arctic Ocean training session run by CMEMS/KEPLER in 2020. To follow-up on these engagements, and solicit final feedback, the online questions were crafted to follow up on the issues of spatial and temporal resolution, data format, missing parameters, and access identified earlier in the project. In addition, there was assessment of the willingness of participants to engage with in situ data collection efforts in Polar Regions, their use of forecast information, and whether they could advise on additional user stories to supplement the 3 presented in the KEPLER roadmap D5.2.

Online Round Table Evidence

KEPLER ONLINE ROUND TABLE

Posted on June 11, 2021 by emarmitage Leave a Comment

The KEPLER project is seeking feedback from those working with offshore and coastal engineering in Polar Regions.

The project has prepared a number of recommendations as to how the European Copernicus programme can evolve to better serve the needs of users in the Polar Regions, and the purpose of this questionnaire is to find out whether you think that these are appropriate for your use cases, or whether they require further work.

The KEPLER Online round table: Engineering & Researcher information requirements consists of a short pre recorded video by Nick Hughes- *(Project Coordinator and Ice Services leader at the Norwegian Meteorological Institute)* and ten questions.

Please provide your feedback here:

Participate in the KEPLER Online Round Table- Engineering & Researcher Information Requirements

Promoted via website, social media and mailing lists.

M6.5 Questions: Engineering & Researcher Information Requirements:

1. Do the current types of information products, typically targeted at users wanting climatological information at spatial resolutions of several kilometres, meet your requirements and provide sufficient information for activities in coastal areas?

2. Do you find the data format that information products are supplied in (typically gridded NetCDF) useful?

3. Are you able to derive the relevant information from this data and use it in a timely manner?

4. How do you acquire information on sea ice parameters such as sea ice type, deformation and ridging, better mapping of the ice edge and coastal zones and detection of leads for operations in sea ice encumbered areas?

5. Are you collecting observations in the Arctic and if so, what are they?

6. Are you willing to make them available to the wider community?

7. What currently prevents you from sharing observations?

8. What range of sea ice forecasts are useful for you, short-range (< 10 days), medium-range (10 days to 1 month), long range (seasonal out to 12 months, and climate out to several decades)?

9. The KEPLER roadmap features 3 user stories to give examples of EO data use and how this can be improved. These include: 1. Reindeer herders 2. Maritime Navigation and 3. Search and Rescue. Do you have any examples that you would like to share of how you see improved polar environmental information being used?

10. Do you have any further comments for KEPLER's consideration?

Co-funded by the Horizon 2020 programme of the European Union

Milestone 6.6: Workshop 1 on maritime and research sector needs

Nick Hughes, Partner: METNO

Milestone activity:

Due to the Covid-19 pandemic, an online meeting was arranged for 19 May 2021 to discuss outcomes of the KEPLER project with maritime and research sector representatives, and get feedback.

Milestone completion date:

May 2021 (Month 29)

Context of milestone within Work Package:

Task 1 Work Package 1 "Stakeholder Needs" explored the needs of maritime end-users for information products that build on polar environmental observations, with a particular focus on maritime users. The original intention was to hold this workshop as part of the fact-gathering of WP1, however the full schedule and large amount of information collated from previous studies resulted in a refocusing of the milestone into one to review and assess the outcomes. The meeting allowed for KEPLER to also hear from other H2020 projects, including SEDNA, ARICE, SAS and ARCSAR, that had been ongoing in parallel and developing their own user specific requirements.

Explanation of delays:

Full schedule in 2019, and then restriction to meeting activities due to Covid-19 in 2020 and 2021.

Milestone 6.6: Report and Evidence

Report

Lead author: Nick Hughes, METNO

The workshop was held as a half-day event on May 19, 2021 and was divided into 3 shorter sessions to cover maritime, research, and overall recommendations from KEPLER. The first session was led by Penelope Wagner (METNO) WP1 leader, and together with Keld Qvistgaard (DMI) they presented a review of the key findings and requirements coming from WP1. This was followed by presentations from Jeppe Carstensen, the Head of Course & Competence at Svendborg International Maritime Academy (SIMAC), Denmark who presented on mariner training centres and their use of Copernicus information, and Emmi Ikonen of the Joint Rescue Coordination Centre - North Norway (JRCC-NN), who presented on information requirements for search-and-rescue and the finding from the most recent table-top exercise (TTX) connected with the H2020 ARCSAR project.

KEPLER WORKSHOP – MARITIME AND RESEARCH SECTOR NEEDS

Posted on May 6, 2021 by emarmitage Leave a Comment

KEPLER are hosting an online workshop on **Maritime and Research Sector Needs** as part of our work to develop a roadmap for further development of the European Copernicus Earth Observing programme specific to the Polar Regions.

In this workshop we will present our recommendations, and ask for feedback, with a focus on the maritime and research communities. This is an open workshop- we welcome you to join us!

Wednesday 19th May 2021 (13:30- 17:00CET) (12:30- 16:00 BST)

Please **Register here** for the event.

The full agenda is available to view here:

KEPLER Workshop – Maritime and Research sector needs

NB timings in CEST

Co-funded by the Horizon 2020 programme of the European Union

Agenda

Agenda

NB timings in CEST

13:30 - 13:35	Welcome and house-keeping	Nick Hughes
13:35 - 13:45	Background to KEPLER	Nick Hughes
SESSION 1: MARITIME		
13:45 - 13:55	Maritime and Research sector needs, WP1.1	Penelope Wagner
13:55 - 14:05	IICWG surveys links to maritime community	Keld Qvistgaard
14:05 - 14:15	Maritime training centres, or SME use of Copernicus information	Jeppe Sylvest Carstensen
14:15 - 14:25	Information for Search-and-Rescue (SaR) (ARCSAR) Latest requirements from Joint Arctic SAR tabletop exercise.	Emmi Ikonen (JRCC-NN and ARCSAR)
14:25 - 14:35	Break	
SESSION 2: RESEARCH		
14:35 - 14:45	Need for better collaboration in the marine environment (ARICE)	Veronica Willmott
14:45 - 14:55	Synoptic Arctic Survey (SAS)	Oyvind Paasche (TBC)
14:55 - 15:05	Information for ship design (SEDNA)	Nicolas Fournier (UK Met Office and H2020 SEDNA)

SESSION 3: RECOMMENDATIONS AND DISCUSSION		
15:10- 15:30	Recommendations from KEPLER for Copernicus evolution	Frank Kauker/ Carolina Gabarro / Steffen Tietsche
15:30 - 15:40	KEPLER Roadmap	Frank Kauker
15:40 - 16:10	Discussion session (3-4 breakout groups) Seed Q's: • Do the recommendations fit your expectations? • Have we missed anything? • What do you expect from Copernicus over the next decade?	Moderator/rapporteurs WP leaders
16:10 - 16:20	Break	
16:20 - 16:40	20 mins - Feedback from groups	Nick Hughes
16:40 - 16:50	Discussion	Nick Hughes
16:50 - 17:00	Wrapping-up, needs to be refined further.	Nick Hughes

Milestone 6.7: Workshop 2 - local & indigenous community feedback & training, Inari, Finland

Tero Mustonen, Partner: SNOW

Milestone activity:

Community-Based Observing and Societal Needs workshop in Inari Finland

Milestone completion date: June 2019 (Month#6)

Context of milestone within Work Package:

The purpose of this milestone and subsequent report is to review the stakeholder needs and community-based observations for the EU project "Kepler"1. It will focus on the remote sensing needs of the local and Indigenous communities of NW Russia, Sweden, Finland and Norway. The approach includes a discussion of cryospheric hazards and traditional weather observation and prediction materials from the Sámi communities. It has been produced to capture the results of the WP 1 of the Kepler project.

Explanation of delays:

None.

Report and Evidence

This report was submitted as Deliverable D1.2 KEPLER Deliverable Report 1.2.pdf

Participants of the Inari Kepler Workshop: Stefan Mikaelsson, Pauliina Feodoroff, Kaisu Mustonen, Tero Mustonen, Eirik Malnes, Jevgeni Kirillov. Snowchange, 2019

Milestone 6.8 Workshop 3 on in situ observing systems

Note: Milestone referred to as 'Workshop 3 on in situ observing systems at 5th Arctic Observing Summit, Akureyri, Iceland' in the Grant Agreement.

Jeremy Wilkinson, Partner: UKRI-BAS

Milestone activity:

ASSW 2021- KEPLER Online Workshop- Enhancing Copernicus 2.0 information products through optimised usage of in-situ data

Milestone completion date:

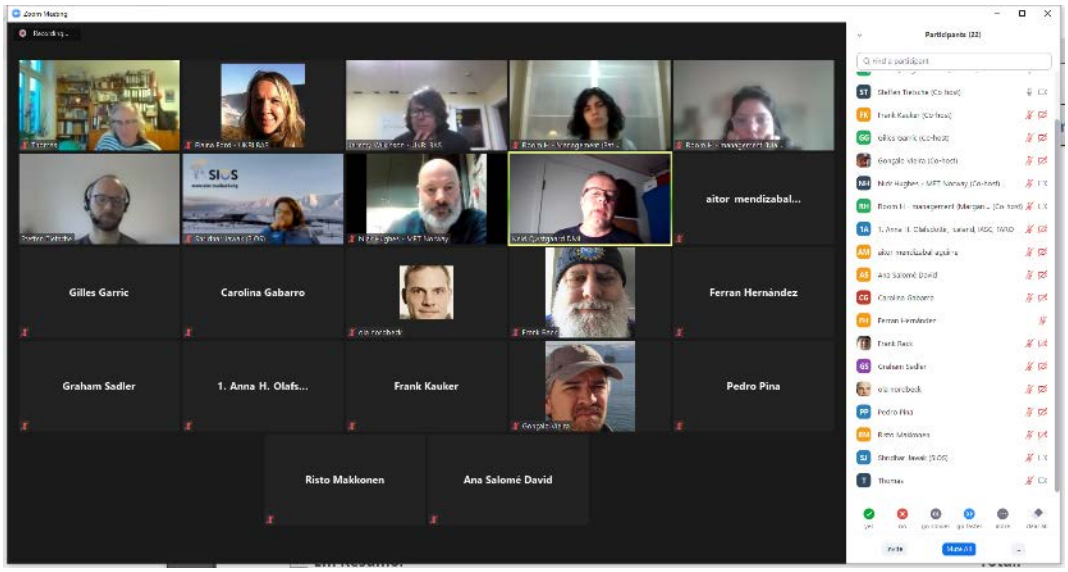
March 2021 (Month #29) Note this deadline was extended. See below.

Context of milestone within Work Package:

This milestone contributes to WP5, (D5.2), information gathered via this workshop will contribute to the roadmap by identifying how we can better coordinate, integrate, and share in-situ observational data in order to enhance the products offered by the Copernicus Services.

Explanation of Delay:

This milestone was delayed due to the COVID-19 pandemic, and the workshop was therefore held virtually at ASSW 2021 instead of the 5th Arctic Observing Summit.



Milestone 6.8: Report and Evidence

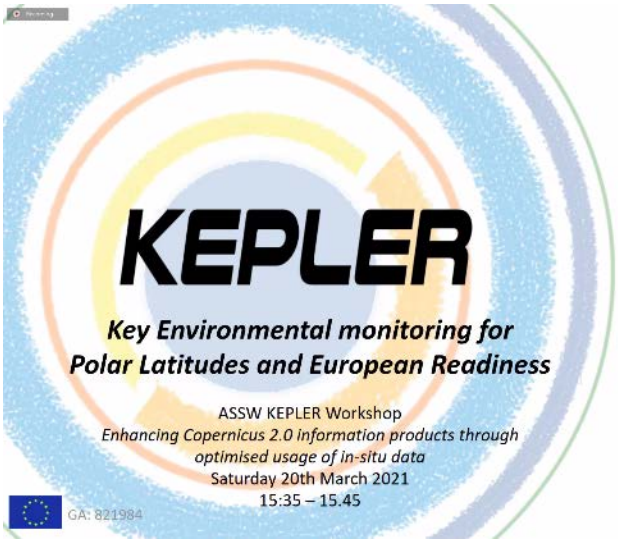
Report

Our Community Workshop brought together nationally and internationally recognized Earth Observation and in-situ monitoring Arctic experts. Its aim was to strengthen the calibration and validation of remotely sensed products, and forecast model data assimilation within Copernicus.

The workshop we organized in such a way that both experts and the audience were able to understand how the observational research community can better contribute in-situ monitoring to enhance Copernicus products, and the challenges in enhancing these interactions. It was organized in three sessions. These were:

1. Overview of Polar services in Copernicus
2. Stakeholder driven improvements
3. Visions for more integrated services

The discussion points of the workshop were noted and will contribute to the roadmap by identifying how we can better coordinate, integrate, and share in-situ observational data in order to enhance the products offered by the Copernicus Services. Despite being scheduled at a slightly awkward time, Saturday 20th March 15:30 - 18:30 GMT, there was good participation and integration between the audience and the experts.



Evidence: The workshop accepted by the ASSW as a formal event. Thus, it was scheduled on their website and they ran the technology associated with the on-line meeting.

Timetable

Saturday 20th March

15:30 - 18:30 GMT

https://next.brella.io/events/assw21/schedule/294790

1. **Overview of Polar services in Copernicus**
2. **Stakeholder driven improvements**
3. **Visions for more integrated services**

15:30 - 15:35	Introduction and aims of community workshop	Jeremy Wilkinson
15:35 - 15:45	Overview of KEPLER	Nick Hughes
1. Overview of Polar services in Copernicus		
15:45 - 15:55	Overview of Copernicus Arctic services	Andrew Fleming
15:55 - 16:05	KEPLER: WP2 Polar region provision in Copernicus services	Gilles Garric
16:05 - 16:15	Copernicus/ESA HPCM Missions	Nick Hughes
16:15 - 16:25	KEPLER WP3: Capacity gaps	Carolina Gabarro
16:25 - 16:40	Panel Q&A discussion Session	Jeremy Wilkinson
16:40 - 16:50	Break	
2. Stakeholder driven improvements		
16:50 - 17:00	Marine User Group- survey findings/ IICWG?	Nick Hughes
17:00 - 17:10	KEPLER WP 1&4 Marine needs & Training requirements	Keld Qvistgaard
17:10 - 17:20	KEPLER WP4 Improve sea ice forecasts	Steffen Tietsche
17:20 - 17:35	Panel Q&A discussion Session	Frank Kauker
17:35 - 17:45	Break	
3. Visions for more integrated services		
17:45 - 17:55	PEG report finding	Ola Nordbeck
17:55 - 18:05	KEPLER future vision	Frank Kauker
18:05 - 18:30	Wrap up	Nick Hughes

Co-funded by the Horizon 2020 programme of the European Union

Enhancing Copernicus 2.0 information products through optimised usage of in-situ data

Saturday 20th March
15:30 - 18:30 GMT
https://next.brella.io/events/assw21/schedule/294790

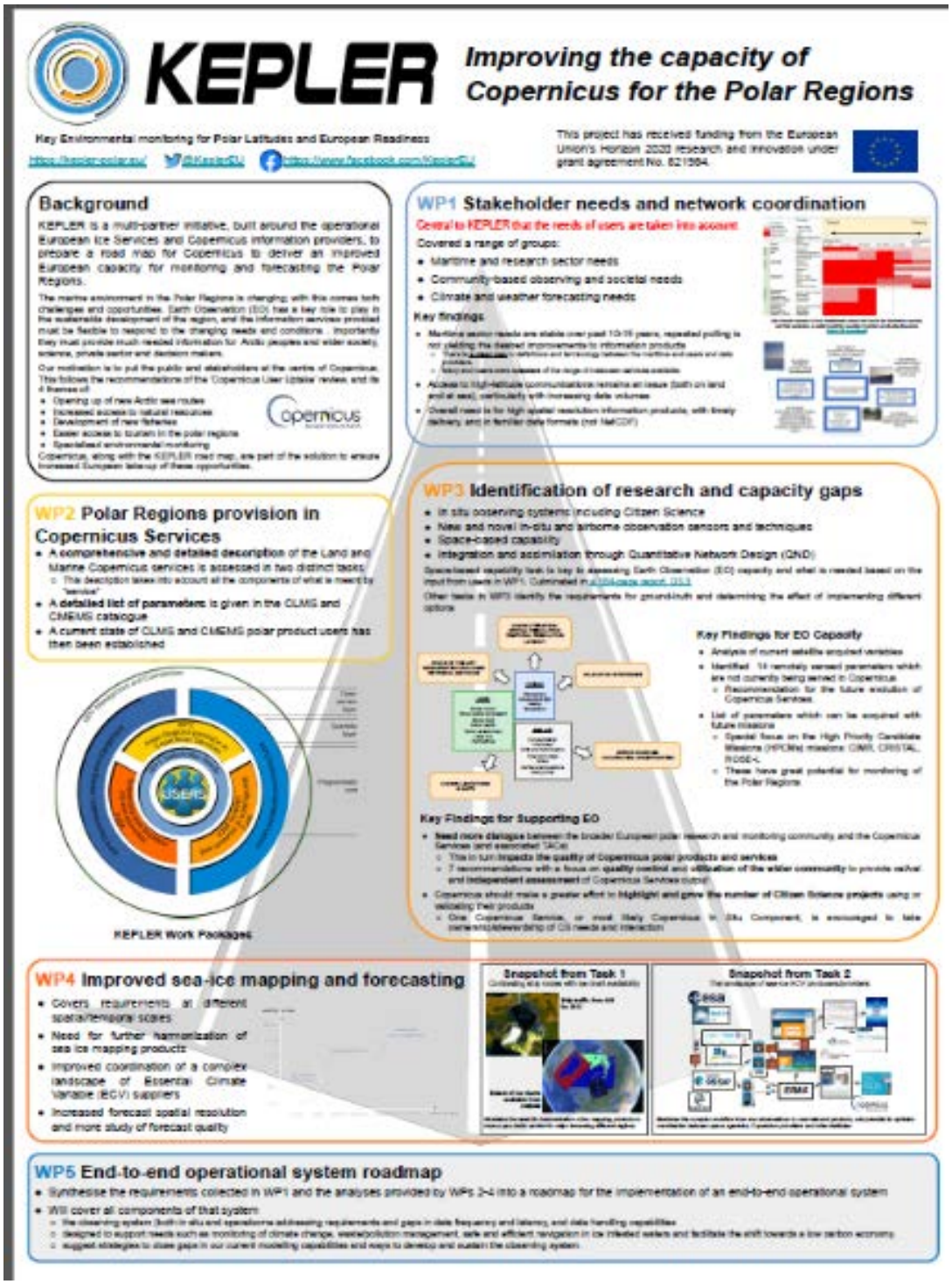
Abstract

This Community Workshop will bring together nationally and internationally recognised Earth Observation and in-situ monitoring Arctic experts. The aim is to strengthen the calibration and validation of remotely sensed products, and forecast model data assimilation within Copernicus.

Copernicus is the EU's environmental monitoring programme for planet Earth. It offers full, open and free-of-charge information services based on satellite, model forecasting and in-situ data. These are organised into 6 thematic Services, and an In-Situ Observing Component.

In-situ observations are critical, but at the present stage their integration into data products is limited. To address this challenge we need to understand how the observational research community can better contribute in-situ monitoring to enhance Copernicus products.

The issues associated with the better usage of in-situ observations needs an inclusive approach, involving a wide range of expertise. KEPLER, an EU H2020 project, kepler-polar.eu is a multi-partner initiative that has been tasked with preparing an end-to-end roadmap for Copernicus to deliver improved capacity for monitoring and forecasting in the Polar Regions. This Community Workshop brings together the expertise of KEPLER with other international experts. This workshop will contribute to the roadmap by identifying how we can better coordinate, integrate, and share in-situ observational data in order to enhance the products offered by the Copernicus Services.


KEPLER
Improving the capacity of Copernicus for the Polar Regions
Key Environmental monitoring for Polar Latitudes and European Readiness
This project has received funding from the European Union's Horizon 2020 research and innovation under grant agreement No. 821964.
Background
KEPLER is a multi-partner initiative, built around the operational European Ice Services and Copernicus information providers, to prepare a road map for Copernicus to deliver an improved European capacity for monitoring and forecasting the Polar Regions.
The marine environment in the Polar Regions is changing; with this comes both challenges and opportunities. Earth Observation (EO) has a key role to play in the sustainable development of the region, and the information services provided must be flexible to respond to the changing needs and conditions. Importantly they must provide much needed information for Arctic peoples and wider society, science, private sector and decision makers.
Our motivation is to put the public and stakeholders at the centre of Copernicus. This follows the recommendations of the Copernicus User Uptake review and its 4 themes of:
Opening up of new Arctic sea routes
Increased access to natural resources
Development of new fisheries
Easier access to tourism in the polar regions
Specialised environmental monitoring
Copernicus, along with the KEPLER road map, are part of the solution to ensure increased European take-up of these opportunities.
WP1 Stakeholder needs and network coordination
General to KEPLER that the needs of users are taken into account
Covered a range of groups:
Maritime and research sector needs
Community-based observing and societal needs
Climate and weather forecasting needs
Key findings
WP2 Polar Regions provision in Copernicus Services
A comprehensive and detailed description of the Land and Marine Copernicus services is assessed in two distinct tasks
A detailed list of parameters is given in the CLMS and CMEMS catalogue
A current state of CLMS and CMEMS polar product users has then been established
USERS
KEPLER Work Packages
WP3 Identification of research and capacity gaps
In situ observing systems including Citizen Science
New and novel in-situ and airborne observation sensors and techniques
Space-based capability
Integration and assimilation through Quantitative Network Design (QND)
Key Findings for EO Capacity
Key Findings for Supporting EO
WP4 Improved sea-ice mapping and forecasting
Covers requirements at different spatial/temporal scales
Need for further harmonization of sea ice mapping products
Improved coordination of a complex landscape of Essential Climate Variable (ECV) suppliers
Increased forecast spatial resolution and more study of forecast quality
Snapshot from Task 1
Snapshot from Task 2
WP5 End-to-end operational system roadmap
Synthesise the requirements collected in WP1 and the analyses provided by WPs 2-4 into a roadmap for the implementation of an end-to-end operational system
Will cover all components of that system

Milestone 6.9: KEPLER Training workshops

Note: This milestone was titled *Workshop 4 at ESA Cryospheric Remote Sensing Summer School in the GA.*

Fabrice Messal, Partner: MERCATOR

Milestone activity:

- -Copernicus Marine Service Training Workshop for the Arctic Sea region (2019)
- -Copernicus Marine Service Training Workshop for the Arctic Sea region (2020)
- -KEPLER Online Early Career Researchers Workshop (2021).

Context of milestone within Work Package:

Throughout the project, KEPLER have 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 of satellite-based information and derived products such as operational forecast and hindcasts.*
- *How to use EO / data tools already available and propose 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 area and their future needs for new environmental data in Polar Regions.

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, 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 via the KEPLER website. https://kepler-polar.eu/deliverables/

Three training activities contributed to Deliverable D6.5.

1. Copernicus Marine Service Training Workshop for the Arctic Sea region (2019)
2. Copernicus Marine Service Training Workshop for the Arctic Sea region (2020)
3. KEPLER Online Early Career Researchers Workshop (2021) - link to that report.

Explanation of delays:

ESA did not hold the Cryospheric Remote Sensing Summer School as we had expected at the time of submission of the proposal, and no other suitable training event was found that we could integrate with. We therefore decided to hold separate independent events. The Milestone was therefore delivered in the 3 training events listed above.

Other Dissemination Activities

Period 1

- **ARCSAR project kick-off meeting,**
  26-28 February 2019, Rome, Italy

  KEPLER activities were discussed with the Search-and-Rescue (SaR) community by MET Norway as part of the kick-off meeting for the ARCSAR (Arctic Security and Emergency Preparedness Network) project.

- **Arctic Shipping Forum,**
  2-5 April 2019, Helsinki, Finland

  KEPLER scientists to present talks and host discussions with stakeholders and Copernicus users. Our flyer in the programme is shown right.

  The KEPLER booth will encourage dialogue using interactive posters and will also provide promotional materials to participants.

- **ESA Living Planet Symposium,**
  13-17 May 2019, Milan, Italy

  An introduction to the project and a request for input from the remote sensing community will be presented in session "D2.02: EO for the Sustainable Development Goals (1)" on 14 May 2019.

- **WMO JCOMM Expert Team on Sea Ice, 13-15 May 2019, Geneva, Switzerland**

  KEPLER partners MET Norway, FMI and DMI will be attending, and will present KEPLER activities in relation to the international regulatory environment for the provision of maritime navigation and safety information.

- **9th International Workshop on Sea Ice Modelling, Data Assimilation and Verification,**
  17-19 June 2019, Bremen, Germany

  This workshop builds on a series of successful workshops organized by the IICWG Data Assimilation Working Group to advance international capabilities for automated sea ice analysis and prediction on timescales from hours to a season. In conjunction with the Year of Polar Prediction (YOPP) organized by the WWRP-PPP and GOV, a particular need has been identified regarding the development of more mature and meaningful methods for sea ice verification. The focus of the workshop is to discuss cross-cutting issues in sea ice modelling and data assimilation and how deficiencies of current systems can be more efficiently diagnosed and addressed.

Day 1 kicked off with three presentations about KEPLER, for high visibility early on in the workshop to initiate dialogue from the 75 workshop participants. Details about the meeting and the agenda can be accessed at https://www.awi.de/en/science/climate-sciences/sea-ice-physics/main-research-foci/forecast-of-sea-ice-properties/iicwg-da.html

- **International Ice Charting Working Group (IICWG-XX), 23-27 September 2019, Copenhagen, Denmark (M6.1)**

  KEPLER partner DMI hosted, and MET Norway are involved in the organizing committee.

- **Arctic Circle, October 2019, 2020, Reykjavik, Iceland**
- **Arctic Frontiers, Tromso, Norway, 2020 (M6.3)**
- **IAHR - International Association for Hydro-Environment Engineering and Research 2020 (M6.5)**
- **Arctic Science Summit Week (ASSW) including Arctic Observing Summit (AOS) workshop, Akureyri, Iceland. March 31st- 2nd April 2020 (M6.8)**
- **Online Training activities with CMEMS - KEPLER user training session- 2019 and 2020.**
- **Presenting at the 16th Conference on Polar Meteorology and Oceanography Virtual Meeting, 01-04 June 2020.** *'Online- Assessments of the impact of snow depth and freeboard products on the performance on sea ice forecasts'*
- **EO4Polar conference (November 2020): '** Key Environmental monitoring for Polar Latitudes and European Readiness (KEPLER): Assessment on Remote sensing Polar monitoring', C. Gabarro, V. González, L. Bertino, T. Lavergne, E. Malmes, T. Dielh, M. Scholze, N. Huges, A. Bracher, T. Madurell
- **A Full list of dissemination activities will be available in the periodic report.**

Open Access

KEPLER encourages, where possible, the use of Gold Open Access (no embargo) on any peer-reviewed scientific publications produced by the project. This can be either through prioritising a fully open access journal (e.g. The Cryosphere), or through payment of open access for the article in an otherwise closed journal. Where this is not possible or practical, Green open access will be utilised, where the paper will be added to relevant repositories after an embargo period as set by the journal. Repositories would include institutional own repositories, OpenAire, Google Scholar, and ResearchGate. The papers will be added to the KEPLER website when this is allowed by the journals.

Acknowledgements

All dissemination activities will be referenced with the acknowledgement text:

"This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 821984."

Project members will use KEPLER project branding and include logos of the EU flag, Copernicus, and ESA where appropriate.

Review of Outreach and Dissemination

The original plan (KEPLER D6.3) called on interactions with a large number of key stakeholders. In this KEPLER had successfully interacted with most of these, plus a number of others who were not identified at the start of the project.

KEPLER's presence at a wide range of meetings ensured that the project was widely known. During 2019 these were mostly physical meetings, and these continued until the onset of Covid-19 travel restrictions in March 2020. Following that meetings were all online. Whilst this also allowed a wider opportunity for participation, it also reduced the number of one-on-one focused discussions that can provide more specific feedback.

The specific objectives of the KEPLER communication strategy were to:

1. Engage end-users and stakeholders on their requirements for the future development of Copernicus for the Polar Regions. This will enable the development of key requirements by KEPLER that can be used to provide a sound foundation for future policy by the Commission (DG GROW);
2. Explain the current plans for Copernicus development, particularly future satellite observing missions, to all stakeholders, and discuss how and why this information is important to them;
3. Promote and explain to a wide audience how Copernicus can currently benefit those interested in the Polar Regions, and what steps could be taken to further increase its relevance;
4. Establish KEPLER and its partner institutes as a key source of information on Copernicus for the Polar Regions.

We have achieved these objectives respectively through many activities, including:

1. We have included stakeholders from the beginning of the project, in questionnaires (WP1), events such as the Arctic Shipping Forum (2019), and Arctic Frontiers (2019, 2020), through to the best practice guide in WP3, and the Roadmap in WP5.2.

   Ola Nordbeck from GD GROW has been engaged throughout the project, and had attended project meetings, and input on deliverables.

2. We have informed stakeholders at all stages, from events listed above, the training events in D6.5, and all the milestones in this report, of the status of Copernicus, and both noted where we feel this is important, and also engaged their views on key areas (see WP1 and 3). https://kepler-polar.eu/copernicus/ shows the overview of this.
3. Again the societal relevance has been covered in many areas of this report and other deliverables, and our consistent approach has enabled this.
4. Many of the partner institutes, especially those that run the European ice services in their respective countries, are already known as key sources of information. KEPLER has brought these together, and also provided a conduit to the EU, ESA, and Copernicus. This has also been further expanded through our role in the EU Polar Cluster, and the links with the ESA Polar Cluster.

We have engaged with all of our stakeholders in a variety of mechanisms throughout the project. This includes all the sections of this report - notably the website and social media, conferences and meetings, and the workshops and round table discussions described above. Whilst covid has inevitably had an impact on this engagement through the second half of the project, we have continued as best as possible through online mechanisms. Although this may have reduced some of the discussion and networking opportunities, it does have scope for a larger reach.

We hope to continue the dissemination of the results, primarily through social media and the publication of the reports and overview brochure in a typeset form, which will hopefully make the results more accessible.