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Scientific capacity building

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PU	Public, fully open	**X**
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EXECUTIVE SUMMARY

This report describes the work performed on building capacity among early-career researchers. This involved providing training to higher level and post-graduate students, as well as providing incentives to those young professionals to integrate more fully into the scientific community by actively participating in scientific conferences. The results are also reported in D7.12 Educational packages for scientists". In addition, results of capacity-building for high-school and the general public are reported in D7.7 and D7.9. The results include a number of videos showing various Arctic research, which have been prepared and are available for the public.

The plan to organize a summer school in 2020 had to be cancelled because of the COVID-19 pandemic. To compensate for the cancellation, two research school onboard KV Svalbard were organized by NERSC in 2020 and 2021. These activities were organized in collaboration with the Useful Arctic Knowledge project (coordinated by NERSC) and with the University of the Arctic Thematic Network on Collaborative Resource Management (coordinated by NORDECO). INTAROS also contributed to a further 12 courses organised by third parties.

Three prizes were offered to young professionals to support and incentivize their participation in scientific conferences. The first of these was a travel grant to EGU 2019, and the remaining awards were prizes for outstanding contributions to EGU 2021.

INTAROS will continue to support early career researchers throughout the remainder of the project by featuring their research in an online poster gallery, in a series of inspirational films about their work, and by encouraging their contribution to online learning materials for their peers.

Table of Contents

1. Introduction

This report present the work in Task 7.5 related to planning and implementation of three research schools onboard KV Svalbard organised by NERSC and one three-day short course on management of natural resources, organised by NORDECO in Nuuk, Greenland.

2. Research schools and a short course

2.1 UAK 2018 Research School

The first collaboration with the UAK project took the form of research school, hosted at the University Centre in Svalbard (UNIS), from 2-7 December 2018. This course addressed cross-disciplinary science in the Arctic in collaboration with local communities.

Topics for the research school were as follows:

Studies of natural and human-made hazards in the Arctic addressing problems such as earthquakes, oil spills, slope failures and ice-related hazards. The studies include physical processes and causes behind the hazards, how they can be detected and monitored, and how risks can be minimized, and impact mitigated.

1) Status and change of the ocean acoustic environment are affected by increased shipping, tourism and exploitation of resources in the Arctic regions. The research school demonstrated how acoustic data was collected, processed and used to study natural processes and human-induced noise.
2) Cross-disciplinary data analysis and data management is important in order to build knowledge from the increasing amount of data in the Arctic. The research school had lectures and practical exercises based on data from topic (1) and (2), satellite data and other data proposed by the students.
3) Community-based monitoring evolves as an important contribution to an integrated Arctic Observing System, with focus on collaboration and communication between academic research and local communities. The research school had lectures on such activities in Canada, Alaska and Svalbard.

Students also participated in a workshop on "Communication between science and local community in Longyearbyen", on 29th November. The aim of the workshop was to initiate a dialogue on knowledge, challenges and possibilities related to climate, nature, and the environment on Svalbard. A central question was how research on climate and the environment can be of use for the local community in Longyearbyen. Different local protagonists gave short statements about what they see as the most important challenges and possibilities related to climate, nature, and the environment within their sector, as well as what knowledge is needed. The results of the workshop are available in a report available at https://intaros.nersc.no/content/research-school-cross-disciplinary-science-arctic

The course included lecturing contributions from the following (INTAROS participants are shown in bold):

- Nansen Environmental and Remote Sensing Center (NERSC) - **Stein Sandven, Hanne Sagen, Torill Hamre, Lisbeth Iversen;**
- University of Bergen, Department of Earth Science (UIB-GEO) - **Mathilde Sørensen**,
- Norwegian Meteorological Institute (MET Norway) - Øystein Godøy;
- Western Norway University of Applied Sciences (HVL) - Kjell Eivind Frøysa;
- University of Manitoba (UM) - Søren Rysgaard;
- University of Calgary, Arctic Institute of North America (UC-AINA) - Maribeth Murray
- University of Colorado, Boulder, National Snow and Ice Data Center (UCB-NSIDC) - **Peter Pulsifer**.
- Terradue – **Pedro Gonçalves**.

Thirty students from all over the world took part in the research school: Norway, USA, Japan, Denmark, Canada, UK, France, Poland and Austria. According to the course feedback report, the course was very well received and perceived by the students as beneficial to their Arctic careers.

2.2 UAK 2020 Research School

The 2020 UAK Research School took place on board the KV Svalbard research vessel, from 20-30 June (https://uak.nersc.no/2020srs) . The expedition saw the research vessel travelling to the Barents Sea from Storfjorden, Norway. The cruise gave students a unique opportunity to learn about instrumentation, practical field experiments with data collection and data handling. The students were selected from the partner institutions (UiB GEO, UiB IFT, UiB GFI, HVL), with backgrounds such as in oceanography, ocean acoustics, ocean optics, seismology, other geosciences including instrumentation and data. Sourcing the students from within Norway allowed the course to go ahead despite the COVID-19 pandemic as it avoided the need for international travel and quarantine.

Topics for the research school were as follows:

1) Oceanography - measurements with CTD and water samples; oceanography in the Storfjorden region; instruments, measurements, processing and analysis tools; CTD measurements and data analysis. The data were uploaded to a data repository with associated metadata, to the Norwegian Marine Data Center (NMDC).
2) Passive acoustics - measurements and data processing; acoustics in the Barents Sea region; instruments, measurements, experiments, processing and analysis tools.
3) Marine optics - measurements of light in water; background on marine optics, data collection; data analysis; practical exercises in Barents Sea region using instruments; processing data and using analysis tools.
4) Seismology - measurements of earthquakes from Ocean Bottom Seismometers.

5) Data processing and data curation of data collected in the four topics described above. Focus on preparing metadata for all the collected data using pre-defined templates.

The course included lecturing contributions from the following (INTAROS participants are shown in bold):

- Nansen Environmental and Remote Sensing Center (NERSC) - **Hanne Sagen, Torill Hamre, Espen Storheim,** Frode Monsen**.**
- University of Bergen, Department of Earth Science (UIB-GEO) - **Zeinab Jeddi,** Felix Halpaap.
- University of Bergen, Department of Physics and Technology (UIB-IFT) - Håkon Sandven, Tristan Petit.
- Western Norway University of Applied Sciences (HVL) - Kjell Eivind Frøysa.
- University of Colorado, Boulder, National Snow and Ice Data Center (UCB-NSIDC) -
- **Peter Pulsifer**.

Ten students from University of Bergen and from Western Norway University of Applied Sciences, Norway took part in the Research School. According to student feedback, the course was very well received and perceived by the students as beneficial to their Arctic careers. The full report from the research school is available at https://uak.nersc.no/publications

2.3 UAK 2021 Summer School

The Nansen Environmental and Remote Sensing Center in collaboration with partners organized a scientific cruise with the Norwegian Coast Guard's icebreaker KV Svalbard from 5 to 18 June 2021. The cruise included a research school for Master and PhD students with focus on practical training in use of various instruments for sea ice and ocean observations. The cruise took place in the sea ice area north of Svalbard and offered a unique opportunity to learn about fieldwork and data collection in oceanography, ocean acoustics and sea ice research. The participants were really an international team of younger as well as more experienced researchers. The team consisted of 7 instructors and 12 students from nine different countries: Norway, Poland, USA, Germany, Denmark, Russia, Canada, United Kingdom, and Turkey.

The cruise departed from Tromsø on 5 June and sailed to Longyearbyen to pick up equipment and personnel. The fieldwork started with the deployment of an acoustic buoy on the first day when KV Svalbard entered the sea ice just north of Svalbard. The buoy recorded ambient noise data during the cruise and was received after one week on the way back to Longyearbyen. A part of the programme was the two-day long ice station where the students worked on the ice, learning how to use a number of different instruments for data collection. The work included drilling cores to measure sea ice thickness, snow cover and other properties. Drones were flown to obtain high-resolution images of the sea ice. An ROV with camera was used to observe the underside of the ice where ice algae were detected in many places. A 3-D scanning laser was used to map ridges in very high resolution. Satellite remote sensing data were obtained from

Sentinel-1 and Radarsat 2 for mapping sea ice on regional scale and for planning the location of the ice station. The SAR data obtained every day in near real-time were important for use ice navigation to ensure that KV Svalbard could find the best sailing route through the sea ice. The oceanographic programme consisted of CTD-stations, XBT-casts, recovery and deployment of a bottom-anchored mooring under the sea ice. Work with moorings in sea ice is a challenging task, but the crew on KV Svalbard has built up long experience in such operations. Drifting buoys for the International Arctic Buoy Program were also deployed on ice floes in different positions during the cruise. The activities on board the icebreaker and on the ice station were documented on video and will be part of the education and outreach material after the cruise. Before the cruise was completed and the participants went ashore in Longyearbyen all the data were assembled and organized on a hard disk for later processing and analysis.

The research school was part of the H2020 project INTAROS – Integrated Arctic Observation System, contract no 727890, and the project Useful Arctic Knowledge: partnership for research and education (UAK), funded by the Research Council of Norway (contract no 274891). The research school was also supported by the project Digital Arctic Shipping, funded by the Research Council of Norway (contract no. 309708) for the drone work conducted by NORCE. Furthermore, Norwegian Meteorological Institute's Ice Service contributed with personnel and SAR data and the CIRFA project at University of Tromsø contributed with Fine-resolution Quad-pol SAT data. Office of Naval Research Global contributed with personnel and travel support. Finally, the Norwegian Coast Guard is acknowledged for providing 14 days of ship time with KV Svalbard, which made it possible to organize the research school.

More information about the research school is available at https://uak.nersc.no/summer2021

2.4 Short Course on Co-Management of Natural Resources

INTAROS contributed heavily, via NORDECO, to a three-day course hosted by University of the Arctic Thematic Network on Collaborative Resource Management (coordinated by Finn Danielsen, NORDECO), and co-funded by INTAROS and the Danish Agency for Science and Higher Education (DASHE). The course was held at Greenland Climate Research Centre, Nuuk, from 22-24 October 2019.

The objective of the course was to build and improve the capacity of the participants in collaborative management and monitoring of living resources in the Arctic. The course was aimed at people in public natural resource management positions, with a focus on community-based approaches, and Greenland-based master's students.

The course comprised of four sessions:

1) Existing management and monitoring of living resources in Greenland, the Arctic and beyond.
2) Collaborative management and monitoring of living resources in Greenland, the Arctic and beyond.
3) Practical understanding of collaborative monitoring of living resources.
4) Discussion and understanding of governance related to collaborative management and monitoring in Greenland, the Arctic and beyond.

The following lecturing staff contributed to the course (INTAROS participants are shown in bold):

- Nordisk Fond for Miljø og Udvikling (NORDECO) - **Finn Danielsen**, **Martin Enghoff**.
- Greenland Climate Research Centre - Lene K. Holm.
- University of Greenland and the Greenland Climate Research Centre - Mark Nuttall.
- Association of Fishers and Hunters in Greenland (KNAPK) - Ababsi - Bjarne Lyberth.
- Hokkaido Sea Ice Museum - Shuhei Takahashi.

There were 25 participants in the course, half of whom were university level, early career researchers. More information is available at https://intaros.nersc.no/content/short-course-co-management-natural-resources

2.5 Other contributions to training and capacity building

Other activities carried out in the scope of INTAROS, towards training the next generation of Arctic researchers and building capacity in early career scientists are listed below:

Date	Title	Owner	Course
2017	Lecture on Marine ecosystems - climate effects and management at UiO International Summer School "A changing Arctic"	IMR	UiO International Summer School
2017	Lecture on Marine ecosystems - climate effects and management at UiO International Summer School "A changing Arctic"	IMR	UiO International Summer School "A changing Arctic"
2017 to 2019	Citizen science and participatory monitoring - Lecture at University of Copenhagen, Course on International Conservation Science	NORDECO	International Conservation Science, University of Copenhagen.
2018	Lecture on Marine ecosystems - climate effects and management at UiO International Summer School "A changing Arctic"	IMR	UiO International Summer School

Date	Title	Owner	Course
2018	EU Arctic cluster: INTAROS and its links to other Arctic projects	IGF PAN	Lecture in PhD course
2018	International initiatives to sustain Arctic Observations: from IPY to SAON, AON and others	IGF PAN	Lecture in PhD course
2018	An introduction to fundamental aspects of collaborative management and monitoring of Arctic natural resources.	Takuvik	International Arctic Field School.
2018	The Changing Cryosphere: From Sensors to Decision-making	Takuvik	International Arctic Field School.
2018	Influence of drought on forest and peatlands.	UH	https://www.helsinki.fi/en/inar/educ
2018 to 2019	Snow and sea ice measurement by SIMBA buoys.	FMI, PRIC	Undergraduate students, Taiyuan University of Technology
2018 to 2019	Multi-Parameters Arctic Environmental Observations and Information Services (MARIS).	FMI, PRIC	Graduate and postgraduate students in Nanjing University: NU and Dalian University of Technology: DUT).
2018 to 2019	Snow and sea ice thermodynamics in the Arctic Environment: observation and modelling.	FMI, PRIC	International interdisciplinary PhD and Post-Doc research school, Nansen International Environmental and Remote Sensing Centre (NIERSC), Russia.
2019	Community Based Monitoring of natural resources and Traditional Knowledge.	NORDECO	Polar Biology course at DIS – Study Abroad in Scandinavia. Copenhagen, Denmark.
2019 to 2021		GINR	International graduate course "Arctic Marine Ecosystems in a Changing Climate", Arctic Science Study Programme (ASSP), Greenland.
2020	Impacts of climate change on marine ecosystems.	IMR	Lecture at BIO 4331, IBV, University of Oslo.
2021	Arctic marine ecosystems: impacts of climate change.	IMR	International summer school, "A changing Arctic", University of Oslo.

3. Prizes and other Incentives

To further build capacity among early career stage researchers, INTAROS offered incentives for the participation in leading international scientific conferences, the American Geophysical Union (AGU) and European Geosciences Union (EGU) conferences.

The first incentive was offered to support travel of an early career researcher to the EGU 2019 meeting. This award was successful and was granted as described below.

The second award was given in the form of a prize rather than a travel grant, since travel to all conferences was restricted during 2020 and 2021, owing to the COVID-19 pandemic. Both EGU and AGU were exclusively online events during this period. Therefore, the final award was given for best presentation at EGU 2021 conference. Two prizes were awarded for participation in this conference, as described below.

3.1 Travel Grant to EGU 2019 conference.

INTAROS opened an opportunity to fund participation by early-career researchers in the EGU 2019 conference, which took place in Vienna, Austria, from 7–12 April 2019. During this meeting, INTAROS hosted a Special Session entitled "Evaluation, exploitation and enhancement of Arctic observing systems across disciplines" (session G13.7).

The successful candidate was Zeinab Jeddi, a young postdoctoral researcher from the Department of Earth Science at the University of Bergen, Norway. Zeinab presented her research on seismological research, highlighting the efforts involved in gathering more than 50 years of seismological data. Zeinab also gave a preview of the research that was planned for the summer of 2019 in Fram Strait and in Storfjorden in collaboration with EPOS-N (European Plate Observing System in Norway). More information at https://intaros.nersc.no/content/egu-session-arctic-observing-systems

3.2 Prizes for presentations at EGU 2021 conference.

In 2021, INTAROS awarded two special prizes to young scientists for their excellent presentations at EGU 2021. The conference took place online, owing to the ongoing COVID-19 pandemic. Both young scientists presented their work during the special session co- convened by INTAROS: EOS7.3 Effective communication of scientific & place-based knowledge of Arctic change: understanding interactions between indigenous & local knowledge, and natural & social science perspectives.

The first prize of €500 was awarded to Levi Westerveld, GRID Arendal, Norway, for his presentation: Topological mapping: new method to map, analyze, and visualize humanistic data in the Arctic.

The second prize of €250 was awarded to Grace Shephard, Department of Geosciences, University of Oslo, Norway, for her presentation: An Arctic transformation; from an in- person international summer school to a digital MOOC.

4. Support for early career researchers and young professionals from INTAROS

INTAROS is keenly aware not only of the knowledge the project can pass on to early career researchers through mentorship and training, but also of the valuable contribution that early career researchers make to the project. To celebrate this, a special poster session was organised to coincide with the 2020 General Assembly in Sopot, Poland. Young professionals were invited to provide a poster and to make a short presentation about it during a dedicated time slot in the meeting agenda. Although it was not possible to repeat this for the 2021 General Assembly, which was more time constrained owing to the virtual format imposed by the COVID-19 pandemic, there are plans to organise such a session during the final project meeting in 2022.

Throughout its duration, INTAROS has seen direct contributions from sixteen early career stage researchers, working in collaboration with consortium members at NERSC, UIB-GF, UIB-GEO, MISU, IOPAN, DTU, AU, GEUS, NORDECO, NUIM, MPG, UHAM, TAKUVIK, UH, and IGPAN. Of these, nine were supported by INTAROS funding. The project will continue to mentor and promote these researchers, and the wider community throughout the remainder of the project.

5. Conclusions

INTAROS was dedicated to the promotion and enhancement of skills among early career researcher and the increase in capacity among this group. As described in this document, a number of training initiatives were carried out to improve their academic competence, and to give them opportunities to assume their professional status and identity.

INTAROS will continue to support capacity building among the next generation of Arctic scientists by leaving a legacy of independent learning materials, Educational Packages for Scientists and Supplementary Educational Resources (including videos), available through the project website for at least 4 years after the end of the project. These materials will allow the knowledge gathered during INTAROS to continue to be shared after the conclusion of the project.

The INTAROS website will also continue to showcase the emerging results and research of the younger members of the INTAROS team by showcasing and promoting their research and dissemination activities (Posters and Publications) through the INTAROS website and social media.

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INTAROS

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