Integrated Arctic Observation System

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Project coordinator:
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Deliverable 7.7

Educational Material V1
Report on existing teaching and outreach materials

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6	IOPAN		**29**	U Helsinki	
7	DTU		**30**	GFZ	
8	AU		**31**	ARMINE	
9	GEUS		**32**	IGPAN	X
10	FMI		**33**	U SLASKI	
11	UNIS		**34**	BSC	
12	NORDECO		**35**	DNV GL	
13	SMHI		**36**	RIHMI-WDC	
14	USFD	0.6	**37**	NIERSC	
15	NUIM		**38**	WHOI	
16	IFREMER		**39**	SIO	
17	MPG		**40**	UAF	
18	EUROGOOS		**41**	U Laval	
19	EUROCEAN	0.1	**42**	ONC	
20	UPM		**43**	NMEFC	
21	UB		**44**	RADI	
22	UHAM		**45**	KOPRI	
23	NORUT		**46**	NIPR	
			47	PRIC	

DISSEMINATION LEVEL		
PU	Public, fully open	X
CO	Confidential, restricted under conditions set out in Model Grant Agreement	
CI	Classified, information as referred to in Commission Decision 2001/844/EC	

EXECUTIVE SUMMARY

This report provides an overview of existing dissemination materials and products that are targeted for teaching and/or intended for outreach purposes. The referenced teaching materials include products aimed at students ranging from school to university level. The outreach materials are aimed at communicating knowledge about the INTAROS project, the scientific work, key findings as well as promoting general knowledge about climate and climate change.

The teaching and outreach materials referenced in this report include products produced within the INTAROS project as well as products produced outside the project that are considered particularly relevant by the project partners.

This report provides a reference point of existing materials and products, thus assisting in the identification of potential gaps, and target the development of new teaching and outreach materials within the INTAROS project. Referenced materials and products in this report were compiled with inputs from INTAROS partners.

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1. Introduction

This report provides references and outlines existing dissemination materials specifically related to teaching and/or outreach, which have either been produced within INTAROS project or produced outside the project but are considered particularly relevant in relation to the INTAROS project.

Each material/product is referenced separately including information regarding:

- Type of material (e.g. Teaching/Outreach)
- Target audience (e.g General public, Schools, Universities)
- Format (e.g teaching material, presentations, videos)
- Title
- Author
- Year of production
- Key message (short description of the key message of the product)
- Location (e.g website, online videos)
- Copyright

This report provides a reference point of existing materials and products, thus assisting in the identification of potential gaps, and target the development of new teaching and outreach materials within the INTAROS project. Referenced materials and products in this report were compiled with inputs from INTAROS partners.

1.1 Dissemination and outreach

The INTAROS project has a strong multidisciplinary focus, with tools for integration of data from atmosphere, ocean, cryosphere and terrestrial sciences, provided by institutions in Europe, North America and Asia. The dissemination activities aim also to share knowledge about the Arctic with academia and with the general public. The Engagement Strategy was prepared in WP1 and used for capacity building and other dissemination work in WP7.

The dissemination and exploitation activities are closely linked with communication and stakeholder engagement, which is part of WP1 where the Engagement Strategy was formulated in the first year of the project. The target audiences include research, public services, commercial operators, investment, insurance, environmental organizations, policy makers, local communities, and educational institutions.

One of the INTAROS objectives is to disseminate project results to raise awareness of Arctic challenges and to inform and engage key users and stakeholder communities to improve their understanding of the Arctic environmental state and processes. The further aim is to build capacity in using the new products and services originating from the INTAROS project.

1.2 Description of Task 7.6

The main focus of Task 7.6 is to contribute to development and implementation of modules within Climate Change teaching packages for school students and teachers in Arctic and non-Arctic regions. Further activities will aim to link schools with ongoing climate monitoring programs and activities and real life data collection. incl. initiatives such as the EU BEST funded PISUNA project and other citizen or community-based climate change observing programs in the Arctic as identified by Task 4.2 of WP4. As part of this task, connections will also be made with the ‘Arctic in a Class Room (ARCUS)’ programme coordinated by the Arctic Research Consortium of the United States. Participation in the

"Make an Impact" workshop to explore opportunities for discussing best practice and sharing teaching materials and approaches is also planned.

1.3 Next steps in Task 7.6

Two packages of educational materials for teachers and students of lower and upper secondary schools will be prepared to enhance literacy of Arctic Observations among teachers and students (IGFPAS). Each package will consist of methodological material for teachers, and multimedia material and worksheets with tasks for students. For classes using these packages, webinars conducted in national languages and in English will be also offered.

Teachers will be prepared for using packages during workshops conducted within cooperation with other European projects e.g. Scientix (community for science education in Europe), and EDU-ARCTIC (H2020 project). Moreover, schools will be encouraged to use packages via different activities (sending invitation to STEM teachers, including materials in Scientix repository, contact with teachers from at least 5 European countries taking part in EDU-ARCTIC project).

Separate work will be devoted to prepare informational package and exhibition material, including photos and videos from field work in the Arctic, for use in Science Centers in EU countries e.g. Arktikum Science Centre in Finland or VilVite in Norway. This activity will also contribute to promote tourism, by highlighting the unique nature and environment of the Arctic regions.

In addition to the present report (D7.7), the following deliverables are planned as part of Task 7.6:

- **Deliverable 7.9** Educational materials for teachers and students of lower and upper secondary schools to enhance literacy of Arctic Observations among teachers and students (Resp. IGPAN, GINR, UNEXE, USFD, M48)

- **Deliverable 7.13** Contribution to the Arctic in a Class Room (ARCUS)' programme in the United States, workshops for teachers and educational activities promoting educational materials (Resp. USFD, UNEXE, IGPAN, GINR, M54).

2. Teaching materials

2.1 Teaching materials produced within INTAROS

Type of material	Teaching
Target audience	Elementary school
Format	Presentation
INTAROS deliverable ID	D7.7
Title	Sea ice and climate change in the Arctic
Author	Prof. David Lipson (San Diego State University)
Year of production	2019
Key message	Lecture about sea ice and climate change in the Arctic with students making 4x4" art pieces about things that are important to them in the Arctic. All the artwork were scanned and will make a digital version of the poster. The whole activity will document in the coming weeks and make an interactive webpage where you can click on the individual painting for detail and get a few choice recordings of the kids' statements.
Location	Webpage available soon
Copyright	

Type of material	Teaching
Target audience	People in public natural resource management positions and Greenland-based university students (graduate level).
Format	Three-day intensive course comprising 12 lectures and 4 exercises (individual, paired and group exercises) in English with translation services to Greenlandic. Nuuk, Greenland.
INTAROS deliverable ID	Contributes to Del. 4.3 and Del. 6.6. (Task 4.3 and 6.6)
Title	In service education course on collaborative management and monitoring of Arctic natural resources
Author	Finn Danielsen, Martin Enghoff, Lene K. Holm, Mark Nuttall
Year of production	2019
Key message	An introduction to fundamental aspects of collaborative management and monitoring of Arctic natural resources. The course was developed and undertaken in cooperation between UArctic, NORDECO, Greenland Climate Research Centre, KNAPK, and Hokkaido University. It was held at the premises of the Greenland Climate Research Centre in Nuuk in Oct 2019. The course was funded by Government of Denmark and the EU - through INTAROS. The compendium and course materials are envisaged used again for further courses in Greenland and elsewhere in the Arctic in the future, if funding permits.

Location	https://www.uarctic.org/organization/thematic-networks/
Copyright	Publicly available. Links to the website have been made from a number of other homepages including SAONs.

Type of material	Teaching
Target audience	University students, Arctic researchers.
Format	Seminar/webinar presentation. Alaska, Fairbanks
INTAROS deliverable ID	Contributes to Del. 4.3 and Del. 6.6. (Task 4.3 and 6.6)
Title	Enhancing Community-based Observing Programs in the Arctic
Author	Michael Køie Poulsen
Year of production	2019
Key message	Presentation on the work of INTAROS WP4. On Wednesday, April 10th at 8:00am AKST (12:00pm EST, 5:00pm GMT), ARCUS and IASC was co-hosting a seminar/webinar exploring the use of public participation techniques such as citizen science and community-based monitoring in Arctic research and observing systems. Four different speakers gave an overview of how they have engaged Arctic residents or visitors in the process of data collection to enhance our understanding of northern environments and how they are changing today.
Location	The presentation is available at: https://www.arcus.org/research-seminar-series/archive

Type of material	Teaching
Target audience	University students.
Format	Lecture and PP presentation once each semester for the "Community Based Monitoring of natural resources and Traditional Knowledge" component of the Polar Biology course at DIS – Study Abroad in Scandinavia. Copenhagen, Denmark.
INTAROS deliverable ID	Contributes to D4.3 and D6.6 (Task 4.3 and 6.6)
Title	Community Based Monitoring of natural resources and Traditional Knowledge
Author	Michael Køie Poulsen
Year of production	Most recent: 2019 (new update each semester)
Key message	An introduction to fundamental aspects of collaborative management and monitoring of Arctic natural resources.
Location	Course description: https://canvas.disabroad.org/courses/3689/assignments/syllabus?_ga=2.4839283.1513233521.1572275855-410089486.1503989568
Copyright	The PP is shared with teachers and students at DIS.

Type of material	Teaching & Outreach
Target audience	High-schools, universities, general public
Format	YouTube video (INTAROS part: 42 sec)
INTAROS deliverable ID	
Title	INTAROS Project
Author	EU DG RTD / EASME
Year of production	2019
Key message	Short message from each project about the main objectives of the research.
Location	https://youtu.be/6LuSckEL_pY
Copyright	Open on YouTube

Type of material	Teaching & Outreach
Target audience	High-schools, universities, general public
Format	YouTube video (3 min)
INTAROS deliverable ID	
Title	INTAROS 2018 field experiment
Author	Hanne Sagen, NERSC
Year of production	2019
Key message	Presentation of the research field activities during the KV Svalbard cruise in August-September 2018.
Location	https://youtu.be/WWC_XfO7Lc8
Copyright	Open on YouTube

Type of material	Teaching
Target audience	PhD Students. IPS18: International PhD School onboard Amundsen scientific Canadian ice breaker organized by Sentinel North.
Format	Video, lecture, presentation (of floats deployments) and exercise (data retrieval from Argo database GDAC Coriolis, data processing). International Arctic Field School.
Title	Autonomous platforms
Author	Takuvik (M.babin;C.Marec; A.Randelhoff, J.Lagunas)
Year of production	2018
Key message	In link with Task 3.4 Distributed ice-ocean observing systems : (Argo buoys in Nordic Seas and Baffin Bay) • Present basics of operation of autonomous platforms. • Hands on training on the preparation and on BGC Argo floats deployments • Follow the deployment in RT with the possibility to dialog with the platform

	• Process the data in RT and in delayed mode
Location	https://sentinelnorth.ulaval.ca/en/baffin2018
Copyright	Video with Copyright : Parafilms / Takuvik, Green Edge

Type of material	Teaching
Target audience	PhD Students. IPS18: International PhD School. Iqaluit organized by Sentinel North.
Format	Video, lecture, presentation and exercises. International Arctic Field School.
Title	The Changing Cryosphere: From Sensors to Decision-making
Author	Takuvik (F. Domine)
Year of production	2018
Key message	This training program addressed the complex and interrelated scientific issues linked to the changing Arctic cryosphere. Participants experienced a hands-on integrative training with a wide range of disciplines such as optics/photonics, arctic ecology, chemistry, geology and human health. They were also provided tools for community engagement, international networking and collaboration in research.
Location	https://sentinelnorth.ulaval.ca/en/training/changing-cryosphere-sensors-decision-making
Copyright	Takuvik

Type of material	Teaching & Outreach
Target audience	High school students, university students, civil society organisations, government agencies, environmentally interested community members in the Arctic.
Format	Website resources
INTAROS deliverable ID	INTAROS D4.2 (Task 4.2)
Title	Community based monitoring library: programs and experiences
Author	Michael K. Poulsen et al.
Year of production	2018
Key message	The website resources comprise information about Arctic community based monitoring programs, including the manuals they use and an overview over the most important lessons learned. The materials have been prepared by the organizers of each community based monitoring program. The website constitutes INTAROS D4.2. It is the result of cooperation between multiple institutions and Arctic CBM programs, incl. e.g. ELOKA, University of Alaska Fairbanks, Yukon River Inter-Tribal Watershed Council. Below we have included a screenshot in case it can be useful.

Location	https://mkp28.wixsite.com/cbm-best-practice
Copyright	Publicly available. Links to the website have been made from a number of other homepages including SAONs.

Type of material	Teaching and Outreach
Target audience	Secondary school, general public and scientists
Format	Videos, exercises, infographics, photos, interactive game.
Title	AOA / Arctic Ocean - Scientific Adventures
Author	Takuvik / Parafilms / Kgnfu
Year of production	2017
Key message	The team from the Takuvik Joint International Laboratory is offering an educational program to help you better understand the impact of current environmental disturbances, caused climate change and anthropogenic activity, on phytoplankton blooms and the food chain in the Arctic Ocean.
Location	http://aoa.education/en/thematique/12
Copyright	Takuvik / Parafilms / Kgnfu

Type of material	Teaching and Outreach
Target audience	General public, schools teachers, secondary students
Format	Conferences and demonstrations at public institutions, schools, museums or Universities.
Title	Autonomous platforms and snow
Author	Takuvik's scientists and communicators
Year of production	2016-2019
Key message	Collaboration with more than 30 schools, museums and public institutions to communicate on the arctic field (floats, snow).
Location	For example: IUEM: Summer School: Mer Education or Teacher's day 51st CMOS Congress, "Arctic Ocean: A cold dive in the green" or Public Event Consulat de France or Schools activities, "Le Nord comme si vous y étiez" or IPS18 or Summer School "Met et Éducation"
Copyright	Takuvik

Type of material	Teaching & Outreach
Target audience	High-schools, universities, general public
Format	YouTube video (6 min)
INTAROS deliverable ID	

Title	INTAROS introduction video: INTAROS: Integrated Arctic Observation System - a EU Horizon2020 project (2016-2021)
Author	Hanne Sagen, NERSC
Year of production	2016
Key message	Presentation of the INTAROS project at the KO-meeting in January 2017.
Location	https://www.youtube.com/watch?v=4zphDKqTRNs
Copyright	Open on YouTube

2.2 Relevant teaching materials produced outside INTAROS

Type of material	Teaching
Target audience	1. + 2. Undergraduate students in University (Taiyuan University of Technology: TUT), Graduate and postgraduate students in Universities (Nanjing University: NU; Dalian University of Technology: DUT). 3. International interdisciplinary PhD and Post-Doc research school, Nansen International Environmental and Remote Sensing Centre (NIERSC), Russia. 4. The 4th Chinese-Finnish Workshop for Polar Sciences 2019, Beijing.
Format	1. + 2. Lecture in TUT; Presentations in NU, DUT. 3. Lecture and exercise in NIERSC. 4. Presentation in Chinese-Finnish Workshop for Polar Sciences.
Title	1. Snow and sea ice measurement by SIMBA buoys. 2. Multi-Parameters Arctic Environmental Observations and Information Services (MARIS). 3. Snow and sea ice thermodynamics in the Arctic Environment: observation and modelling. 4. Snow and sea ice thermodynamics in the Polar Oceans: observation and modelling.
Author	Bin Cheng, Roberta Pirazzini, Timo Vihma (FMI) Reibo Lei (Polar Research Institute of China: PRIC)
Year of production	2018/2019
Key message	1. The objective of this dissemination seminar is to teaching the principle of SIMBA ice mass balance buoys. To demonstrate the snow and ice information retrieved from SIMBA buoys that were deployed in the Arctic Ocean during several ice expeditions since 2012. 2. The objective of this seminar is to provide knowledge dissemination on INTAROS project as well as its Chinese counterpart project MARIS funded by the Ministry of Science and Technology (MoST) of China. The presentation is to draw attention from Chinese cryosphere research community on INTAROS/MARIS activities and promote to establish Arctic snow and sea ice observation network and share the in situ observations. 3. The objective of this teaching seminar is to carry out knowledge dissemination on in situ snow and sea ice observation, in particular the mass balance observations. The talk also describe the thermodynamic snow/ice modelling, a study subject that will enhance our understanding of spatial and temporal distribution of snow depth and sea ice thickness. The model can also be used to filling the gap of erroneous SIMBA buoys measurements in

	summer season. The target audience are graduate and postgraduate students. 4. This knowledge dissemination describes the joint research between FMI and INTAROS Chinese partners not only on Arctic Sea ice research, but also on research work that has been extended to the high mountain and cold regions (Arctic, Antarctic and Qinghai-Tibet Plateau (QTP)).
Location	PPT presentations available upon requests
Copyright	

Type of material	Teaching
Target audience	School students (age 13-19)
Format	Educational toolkit (consisting of: syllabus, lesson plan, materials for teachers, worksheet for teachers (with answers), video (recorded webinar), worksheet, experiment scenario).
Title	Glaciers Toolkit
Author	INTERACT
Year of production	2018
Key message	The Glaciers Educational Toolkit is designed for primary/secondary school teachers. It offers comprehensive and detailed information about glaciers in a form of a package containing various educational materials, ready to use in the classroom: video (recorded webinar), worksheet, and experiment scenario. The teachers are also equipped with materials and tools supporting the teaching process: syllabus, lesson plan, materials for teachers, worksheet for teachers (with answers). The key message of the product: glaciers play a crucial role in understanding the polar and alpine ecosystems, and are fascinating objects to study. Also, they are a key indicator of past and present climate changes.
Location	https://eu-interact.org/arctic-awareness/
Copyright	Creative Commons CC BY

Type of material	Teaching
Target audience	School students (age 13-19)
Format	Educational toolkit (consisting of: syllabus, lesson plan, materials for teachers, worksheet for teachers (with answers), video, presentation, worksheet, experiment scenario).
Title	Permafrost Educational Toolkit
Author	INTERACT
Year of production	2018
Key message	The Permafrost Educational Toolkit is designed for primary/secondary school teachers. It offers comprehensive and

	detailed information about permafrost in a form of a package containing various educational materials, ready to use in the classroom: video, presentation, worksheet, and experiment scenario. The teachers are also equipped with materials and tools supporting the teaching process: syllabus, lesson plan, materials for teachers, worksheet for teachers (with answers). The key message of the product: the permafrost plays an important role in polar ecosystems, and currently undergoes rapid and significant changes due to climate change. Those processes have a strong influence on plants, animals, hydrology, and geomorphology, and various aspects of life of people in the Arctic.
Location	https://eu-interact.org/arctic-awareness/
Copyright	Creative Commons CC BY

Type of material	Teaching
Target audience	Lower secondary school, upper secondary school (13-19 years old)
Format	Educational Package containing video, presentation, worksheets, animations, exercises, guide for teachers.
Title	Glaciers basic (for Lower secondary school) Glaciers extended (for Upper secondary school)
Author	Dr. Jerzy Giżejewski, IG PAS
Year of production	2018
Key message	The educational package “GLACIERS” aims to increase knowledge of the glaciers, beyond standard school textbooks. The package consists of a general part – the introduction of substantive information on glaciers and part with work sheets – to be filled in by the students. The first part includes: 1. General description of the glaciers, the geographical conditions of their occurrence, presentation of the basic types (mountain glaciers (valley glaciers), piedmont glaciers, ice dome, outlet glaciers, and ice sheets), erosion, transport and accumulation and basic glacial morphology forms. 2. Presentations of selected issues such as: – Mass balance of glaciers, – Internal drainage system and glacial karst, – Glacier motion, calving, surge, – Glacial erosion and accumulation forms, fluvio-glacial forms. 3. Documentary films, showing the details of the issues discussed Second part of the package includes tasks related to the presentations to be performed by the students. Each exercise will

	allow students to become familiar with the methods of monitoring of various glacial processes and the way of their use. For filling in the work sheets students will be using sets of measuring data, attached to tasks or obtainable in public free databases e.g. www.eklima.met.no. An additional effect of the work with the package will be to familiarize students with the rules of use of the available online scientific databases.
Location	https://www.igf.edu.pl/eris.php
Copyright	CC BY 4.0

Type of material	Teaching
Target audience	Lower secondary school, upper secondary school (13-19 years old)
Format	Educational Package containing video, presentation, worksheets, animations, exercises, guide for teachers.
Title	Meteorological measurements in the Arctic basic (for Lower secondary school) Meteorological measurements in the Arctic - Extended (for Upper secondary school)
Author	Dr. Tomasz Wawrzyniak, IG PAS
Year of production	2018
Key message	Meteorology is interdisciplinary scientific study of the atmosphere and its phenomena. Knowledge on the weather (state of the atmosphere at a particular time) and the ability to predict future weather conditions (weather forecasting) is an important part of a person's life. It is not limited to helping with the selection of a daily wardrobe, but it is also of great importance in the economy of the country, particularly in agriculture and transport. There is a network of meteorological observatories around the world, where observatories and atmospheric measurements are made. The data and statistics collected and the knowledge of the laws governing atmospheric processes are used to determine the most likely future weather conditions – weather forecasts. The proposed work package aims to familiarize students with meteorological measurements at meteorological site of Polish Polar Station Hornsund on Spitsbergen and to compare them to the current weather in the place of residence. Suggested meteorological databases are available online. The "Meteorological measurements in the Arctic" package is designed to educate students about the use of databases. It refers to the meteorological data that pupils use through school education – from simple observations in primary school to advanced statistical data analysis in the fourth educational stage. Meteorological data are also known to students in everyday life, so dealing with worksheets should not cause them much difficulties.
Location	https://www.igf.edu.pl/eris.php

Copyright	CC BY 4.0

Type of material	Teaching
Target audience	Lower secondary school, upper secondary school (13-19 years old)
Format	Educational Package containing video, presentation, worksheets, animations, exercises, guide for teachers.
Title	Polar Lows basic (for Lower secondary school) Polar Lows extended (for Upper secondary school)
Author	Chantal Claud, Maxence Rojo, UVSQ
Year of production	2018
Key message	Understanding Polar Lows Using Satellite Imagery During winter, small cyclones – typically 200 to 600 km in diameter – develop in subarctic regions over areas free of sea ice. The most intense cyclones are called polar lows. These severe storms usually form when polar air is transported over maritime areas. This cold and dry air destabilises the lowest layers of the atmosphere when it arrives over relatively warm waters, creating a polar low. Short-term forecasting of polar lows remains challenging, because they develop very rapidly, in areas with very few observations. The understanding of the formation of polar lows has been substantially improved with the advent of satellite observations in the late seventies. Retreating sea ice exposes new ocean areas to extreme weather systems such as polar lows. Climate change could therefore potentially change where and when polar lows will occur in the future. Why are we interested in the Polar Lows? These systems are associated with strong surface winds with very often gusts that can be very violent. The conditions at sea during the passage of a Polar Low can be dangerous with strong waves, brutal snowfall and blizzard. The Polar Lows, characterized by a rather small spatial and temporal extension, can be triggered extremely rapidly, making them particularly difficult to predict, and dissipate shortly after reaching the ribs. These extreme weather events represent a real risk to the region's maritime and coastal activities, including shipping, fishing and offshore oil and gas platforms.
Location	https://www.igf.edu.pl/eris.php
Copyright	CC BY 4.0

Type of material	Teaching
Target audience	University students

Format	Seminar talk
Title	Atlantic Water and its heat: what happens north of Svalbard?
Author	A. H. H. Renner
Year of production	2018
Key message	Angelika Renner (Institute of Marine Research) will talk about her work in oceanography and physics.
Location	https://uit.no/tavla/artikkel/558457/akvasen_by_angelika_renner

Type of material	Teaching and Outreach
Target audience	School students (age 13-19), teachers, general public
Format	Online teaching platform
Title	EDU-ARCTIC
Author	EDU-ARCTIC consortium consisting of six partners from three European Union Member States and three EFTA countries.
Year of production	2017-2019
Key message	EDU-ARCTIC is an EU-funded project focused on using Arctic research as a vehicle to strengthen science education curricula all across Europe. It aims to encourage students aged 13 to 20 to pursue further education in science, technology, engineering and mathematics (STEM). The EDU-ARCTIC project uses a mix of different tools to bring a fresh approach to teaching STEM subjects, including: • online webinar lessons in virtual classrooms with polar scientists; • a “citizen science” environmental monitoring programme; • teacher trainings and workshops; • online “Polarpedia” portal; • a chance for students to win a trip to an Arctic research station!
Location	EDU-ARCTIC: https://edu-arctic.eu/ POLARPEDIA: https://polarpedia.eu/en/
Copyright	https://edu-arctic.eu//cookies-policy

Type of material	Teaching & Outreach
Target audience	School students (age 13-19), teachers, general public
Format	Webinar recording - set of videos on dedicated YouTube channel. Webinar recordings are accompanied by promotional/intro videos and short explanatory videos tackling various topics.
Title	ONLINE LESSONS
Author	EDU-ARCTIC project (HORIZON 2020 funded project, GA 710240)
Year of production	2017-2019

Key message	232 webinar recordings (ca. 15-50 minutes long) are available. These videos contain audio and video of presenter's lecture and presentation related to the topic. They are divided into 18 playlists (Biology, Environment pollution, Energy, Technical sciences, Polar research, Astronomy Meteorology, Climatology, Geography, Polar exploration, Anthropology, Oceanography, Hydrology, Glaciology, Seismology, Mathematics, Geology, Miscellanea). The videos explain polar phenomena, explain how polar regions are studied, present researchers' field and laboratory work. Scientists, both female and male are also presented as role models and their career paths are discussed.
Location	YouTube Channel: https://www.youtube.com/channel/UCAXMalFigsqOYQjjfbAc0BA
Copyright	Standard YouTube License

Type of material	Teaching & Outreach
Target audience	School students (age 13-19), teachers, general public
Format	Multilingual online encyclopedia-illustrated glossary with additional resources. Polarpedia terms are individual entries that contain text, written by scientist and professionals based on Polar research, on various Arctic issues relevant for educators and students. Further information include: photos; graphics; animations or videos.
Title	POLARPEDIA
Author	EDU-ARCTIC project (HORIZON 2020 funded project, GA 710240)
Year of production	2016-2019
Key message	Polarpedia is a component of EDU-ARCTIC's educational program, providing an extensive knowledge base and education support tools on the Arctic region and STEM topics in general. It provides teachers and students with an educational support that can facilitate their work on scientific issues and expressions in English. Currently 486 term entries are available in English, which is the projects principal language. Many of the entries have been translated into as many as 16 other national European languages (Polish, Russian, Norwegian, Danish, Albanian, Greek, Bulgarian, Italian, Macedonian, Serbian, Croatian, Icelandic, French, German, Romanian, Spanish) due to high external interest and support of educators. Term entries are divided into 9 categories: ICE & SNOW, LAND & GEOLOGY, PLACES & STORIES, PEOPLE & SOCIETY, ATMOSPHERE, WATER RESOURCES, CLIMATE & WEATHER, ANIMALS & PLANTS, SPACE. Analytics indicate that the number of users is constantly increasing. Search is the most common way of finding the program and its individual terms. The users have visited from almost all the

	countries of the world with Albania, Poland, Bulgaria and the USA topping the list. Languages available for each term are presented with a national flag of the country both in the overview category view as well as under the individual term entry. Terms that are related to available recording of webinar on YouTube are marked with the EDU-ARCTIC hat icon.
Location	https://polarpedia.eu
Copyright	Creative Commons CC BY; certain resources (mainly images) with separate license (CC-BY-SA, CC-BY-NC etc.)

Type of material	Teaching & Outreach
Target audience	School students (age 13-19), teachers, general public
Format	An additional part of Polarpedia online glossary (polarpedia.eu), which contains educational support resources for teachers and students in the form of online games, quizzes, worksheets, experiments or teamwork proposals and miscellanea.
Title	GAMES & QUIZZES
Author	EDU-ARCTIC project (HORIZON 2020 funded project, GA 710240)
Year of production	2018-2019
Key message	The Games and Quizzes are available in five languages a part from English: Polish, Norwegian, Italian, Russian and Albanian. 154 resources are divided into 6 categories: Online games, quizzes, worksheets, experiments, teamwork and miscellanea. These supporting resources offer various forms of entertainment-based learning, both online (e.g. crosswords, riddles, jigsaws, memory games etc.) and ready-to-download and print (boardgames, taboo cards, bingo cards, experiment scenarios). All content refers to POLARPEDIA.EU terms and/or other resources.
Location	https://polarpedia.eu/en/category/games-quizzes/
Copyright	Creative Commons CC BY. Online resources are based on external tools dedicated to designing teaching materials; some of them require registering on external websites, nevertheless, they do not require any additional software and are available free of charge.

Type of material	Teaching and Outreach
Target audience	Teaching: Kindergarten, primary and secondary schools Outreach: Ocean science-policy events and policymakers
Format	Book
Title	The Ocean is My Home. For Children, Parents, and Our Ocean.
Author	Dina Eparkhina and Karri Lehtonen
Year of production	2017

Key message	What most people know about the ocean's ecosystem and economic services, and the importance of ocean data and information to maintain and advance those services, varies greatly. This book is written for children and their parents as a basis for dialogue between them, ultimately for better decisions related to ocean health and sustainability.
Location	http://eurogoos.eu/publications/
Copyright	EuroGOOS.

Type of material	Teaching
Target audience	School students
Format	A ready-to-print material for teachers (in the form of a two-page leaflet), with experiment scenario and explanation.
Title	Arctic Climate Change: Ocean currents and the role of the Arctic
Author	INTERACT & Wicked Weather Watch
Year of production	2017
Key message	The product offers a simple experiment scenario on ocean currents. It is designed for teachers willing to explain the dynamics and role of the ocean currents on the global ecosystem and climate change. Also, it provides explanation of the experiment ("The science behind the results") and information on what the students can learn from it, and why it matters.
Location	https://eu-interact.org/arctic-awareness/
Copyright	

Type of material	Teaching
Target audience	School students
Format	A ready-to-print material for teachers (in the form of a two-page leaflet), with experiment scenario and explanation.
Title	Changing climate and weather: Revealing the secrets of ponds and peat bogs
Author	INTERACT & Wicked Weather Watch
Year of production	2017
Key message	The product offers a simple demonstration how to create a simple coring device aimed at understanding what ponds and peat bogs can tell us about climate and weather in the past. It is designed for teachers willing to explain how the scientists are gathering information about past environments and how to understand changes occurring in the past. Also, it provides explanation of the demonstration and information on what the students can learn from studying past environments, and how this knowledge can help us

	understand how current climate change affects the ecosystems in which we live.
Location	https://eu-interact.org/arctic-awareness/
Copyright	

Type of material	Teaching
Target audience	School students
Format	A ready-to-print material for teachers (in the form of a two-page leaflet), with experiment scenario and explanation.
Title	Arctic Climate Change: What causes the sea level to rise?
Author	INTERACT & Wicked Weather Watch
Year of production	2017
Key message	The product offers a simple experiment scenario on melting ice. It is designed for teachers willing to explain the influence of melting ice on sea levels, and the difference between melting sea ice and land ice, as well as the influence caused solely by warming water. Also, it provides explanation of the experiment ("The science behind the results") and information on what the students can learn from it, as well as information about the consequences of rising sea levels.
Location	https://eu-interact.org/arctic-awareness/
Copyright	

Type of material	Teaching
Target audience	High school students in Denmark/Greenland
Format	Online teaching platform with descriptions, stories, data and exercises guiding the teachers and students trough recent changes in the in the High Arctic environment at Zackenberg, NE Greenland (Language: Danish)
Title	Zackenberg
Author	Kirstine Skov and Niels Vinther
Year of production	2017
Key message	The teaching material has been developed in close collaboration between the GeoBasis programme and Egedal Gymnasium (high school) to ensure easy use for teachers and that it adheres to the Danish curriculum. Through text, data and exercises the students are guided through recent changes in the High Arctic environment at Zackenberg in Northeast Greenland, using the unique time series from ClimateBasis and GeoBasis programmes. The material consists of a short introduction to the Arctic and the Zackenberg area, followed

	by six themes, each with sufficient material for approximately one teaching module. The themes include: • Temperature • Snow • Permafrost • Carbon dioxide fluxes (CO2) • Radiation balance • Energy balance Each theme is set up as an individual 'Story Map' in ArcGIS Online (made freely available for Danish high schools through the SkoleGis programme, supported by GeoInfo A/S). In the story maps, the text and exercises unfold through cascades with background figures and photos. This new lay out is used with the aim of making the material more comprehensible, as the students scroll their way through many years of data. Language: Danish
Location	https://sites.google.com/view/zackenberg/startside
Copyright	Greenland Ecosystem Monitoring (GEM; www.g-e-m.dk)

Type of material	Teaching
Target audience	High school students in Denmark/Greenland
Format	Online teaching platform with an interactive GIS tool, instructional videos, teaching guides and inspirational materials. (Language: Danish)
Title	ICE FRONTIERS – Is Greenland melting?
Author	Copenhagen University and Mediafarm
Year of production	2017
Key message	ICE FRONTIERS enables high school students to measure and compare glaciers in Greenland in the past and present. The teaching materials is developed together with and directed towards high schools in Denmark and Greenland. The materials include: • Interactive GIS tool • Instructional videos • Teaching guides • Inspirational materials. Language: Danish (Greenlandic)
Location	https://snm.ku.dk/skoletjenesten/gymnasium/materialer/ice-frontiers/
Copyright	Copenhagen University

3. Outreach materials

3.1 Outreach materials produced within INTAROS

Type of material	Outreach
Target audience	Graduate and PhD students, Post Docs, university researchers
Format	EGU Conference session
INTAROS deliverable ID	D7.7
Title	Where human and natural systems meet: promoting innovative tools for Arctic outreach and education
Author	T. Zenone, F. Bouchard, S. Sandven, Y. Sjöberg, D. Zona
Year of production	2020
Key message	Occupying more than 20 million square kilometers, permafrost is a key landscape component of high-latitude regions and is strongly impacted by current environmental changes at different scales (from local to global). Ongoing climate warming, which is especially acute in the circumpolar North, results in a series of profound environmental impacts including permafrost thaw, costal erosion, and release of greenhouse gas emissions in the atmosphere. Frozen-ground landscapes have been used by various indigenous communities for settlement and hunting–fishing grounds, resulting in an extensive traditional knowledge. Moreover, infrastructure development and maintenance in the Arctic is already meeting pressing challenges for sustainability, a trend that will likely continue in the future. There is thus a need to gather experiences and expertise across disciplines about the changing arctic environment (e.g., thawing permafrost, coastal erosion, sediment and nutrient exchanges, hydrological cycling) and the impacts on local communities, as well as adaptation strategies. The aim of this session is to bring together researchers from both social and natural sciences who are involved or interested in reaching out to stakeholders and the general public, and share successful experiences. Examples from past, ongoing and future initiatives that include traditional indigenous knowledge and scientific tools and techniques are welcome. Collaborations with artists and storytellers (e.g., novels, cartoons, movies, podcasts) also represent a promising outcome for scientific results and implications.
Location	https://meetingorganizer.copernicus.org/EGU2020/session/34762

Type of material	Outreach
Target audience	High school students, university students, civil society organisations, fishermen, hunters, herders and other environmentally interested community members in the Arctic.
Format	Book. Part of a new UAP book series on Arctic ‘good practices’.

INTAROS deliverable ID	Contributes to D4.3, 4.4 and D6.6. (Task 4.3, 4.4 and 6.6)
Title	Provisional title “Arctic voices with global relevance”
Author	Finn Danielsen, Noor Johnson, Olivia Lee, Maryann Fidel, Lisbeth Iversen, Michael K. Poulsen, Hajo Eicken, Ania Albin, Simone G. Hansen, Peter L. Pulsifer, Peter Thorne and Martin Enghoff
Year of production	2019-2020 (will be published in spring 2020)
Key message	A review of the capabilities, good practices, opportunities and barriers of community based environmental monitoring programs in the Arctic, with a focus on decision-making for resource management. The book is based on INTAROS D4.1 technical report (survey of community based monitoring programmes in the Arctic, capabilities, good practices, challenges and opportunities). The text has been peer-reviewed and further developed with several additional chapters, and it has been transformed into book format. The book is the result of cooperation between many Arctic institutions and CBM programs, including e.g. ELOKA, University of Alaska Fairbanks, Yukon River Inter-Tribal Watershed Council, and Centre for Support of Indigenous Peoples of the North.
Location	University of Alaska Press.

Type of material	Outreach
Target audience	General public
Format	Report
INTAROS deliverable ID	D7.7
Title	Barrow (AK) science fair 2019
Author	Barrow Arctic Research Center/Environmental Observatory
Year of production	2019
Key message	The BARC Science Fair 2019, supported by the the National Science Foundation to plan, prepare, and host events where arctic scientist and local residents have the opportunity to meet each other, spend time, and share ideas. The BARC Science Fair is one part of a larger effort by UIC Science to bring coordination and collaboration to science outreach and engagement efforts across Arctic Alaska. The event included three days of youth and family-friendly activities, BARCbeques, and evening community presentations and discussions about the main findings of arctic research.
Location	Not publicly available.

Type of material	Outreach
Target audience	General public
Format	Exhibition

INTAROS deliverable ID	Task 3.1 Greenland and Task 3.3 Fram Strait
Title	Arctic Blues
Author	Laurent Chauvaud, scientists and artists from the BeBest laboratory, Fovearts
Year of production	The exhibition took place in 2019 and is based on seven years of polar experience
Key message	Biologists were wondering how to tell their emotions about the beauty of the poles and the certainty of the disaster? They invited artists to share their Arctic missions. Arctic Blues reflects the richness of this dialogue. Photography, video, writing, musical creation respond to or clash to create a singular object, an attempt to amalgamate art and science where the two are revealed, with new, complementary and unpredictable colours.
Location	Passage des ateliers, Les Capucins, Brest (from 22 June to 22 September 2019). This exhibition is intended to travel. For more information: https://www.liabebest.org/projets/exposition-arctic-blues

Type of material	Outreach
Target audience	General public
Format	Video
INTAROS deliverable ID	
Title	Studying snow – SnowAPP field campaign 2019
Author	Produced by Niko Nurminen (Correspondent)
Year of production	2019
Key message	Join an international team of researchers in the field as they study Arctic snow properties and monitor snow evolution. This film follows the SnowAPP field campaign organised in Sodankylä, Finland in March 2019.
Location	http://www.intaros.eu/news/recent-news/new-film-snowapp-field-campaign-2019/

Type of material	Outreach
Target audience	General public
Format	Video
INTAROS deliverable ID	
Title	OBS Cruise 2019 UiB INTAROS
Author	Video by Tarcisio Infriccioli, animations by Zeinab Jeddi
Year of production	2019
Key message	In August 2019, scientists from University of Bergen went on board ACC Mosby, a Norwegian fishery vessel, to recover three ocean

	bottom seismographs (OBS) in the Greenland Sea. The instruments were redeployed in Storfjorden near Svalbard. The field campaign is part of the research projects INTAROS (funded by the European H2020 programme) and EPOS-Norway (funded by the Norwegian Research Council).
Location	https://www.youtube.com/watch?v=U6ch88KY9Dk&feature=youtu.be

Type of material	Outreach
Target audience	General public
Format	Video
INTAROS deliverable ID	
Title	INTAROS 2018 TRAILER
Author	Produced, filmed and edited by Håvand Sagen for the INTAROS Project.
Year of production	2018
Key message	This is a teaser about the 17 scientists heading north of Svalbard with the Norwegian icebreaker KV Svalbard in September this year. Their goal was deploy moorings heavily equipped with instruments to measure ocean temperature, salinity, and chemical properties for 1-2 years. These measurements are important for monitoring changes in the Atlantic water flowing into the Arctic Ocean. During the cruise the scientists were carrying out light and turbulence measurements in the ocean under the ice, in open ocean, and near ice shelves. Changes in the ocean properties and processes will influence the ecosystems in this region. In this way the INTAROS project contributes with important observations from the sparsely sampled ocean North of Svalbard.
Location	https://www.youtube.com/watch?v=JHiZB4XbD08

Type of material	Outreach
Target audience	General public
Format	Video
INTAROS deliverable ID	Task 3.5
Title	Ambarchik: Research on permafrost at the Siberian arctic coast
Author	Mathias Göckede, Friedemann Reum, Max Planck Institute for Biogeochemistry, Jena, Germany
Year of production	2018
Key message	The Arctic is warming due to climate change. What are the consequences for greenhouse gases in the atmosphere? Friedemann Reum and Mathias Göckede from the Max Planck Institute for Biogeochemistry want to find out. They measure greenhouse gas

	concentrations in the air on-site - in the remote locality Ambarchik, at the Siberian coast of the Arctic Ocean. With their data they calculate how much carbon dioxide and methane escapes from the permafrost soils of the Siberian Arctic into the atmosphere.
Location	https://youtu.be/ZhGcJnRgzy4

Type of material	Outreach
Target audience	General public
Format	Documentaries 52 min or 26 min.
Title	Arctic Bloom
Author	Parafilms
Year of production	2018
Key message	A team of scientists heads north towards Baffin Bay and near the community of Qikiqtarjuaq, to study the phytoplankton Bloom.
Location	https://vimeo.com/163206186
Copyright	Takuvik / Parafilms / Kgnfu

Type of material	Outreach
Target audience	General public
Format	Poster at Arctic Observing Summit 2018
INTAROS deliverable ID	
Title	Mapping requirements for observations in the Arctic
Author	Erik Buch, Michael Tjernström, Shaun Quegan, Andreas Ahlstrøm, George Heygster, Thomas Soltwedel, Finn Danielsen, Geir Ottersen, Truls Johannesen, Stein Sandven
Year of production	2018
Key message	An integrated approach to the Arctic is critical to further our understanding of this complex and sensitive environment. Furthermore, this will inform any decision making in the Arctic, to the benefit of the environment, people living in the region, and sustainable commercial activities.
Location	https://intaros.nersc.no/content/poster-arctic-observing-summit-2018-intaros-requirement-mapping

Type of material	Outreach
Target audience	General public
Format	Poster at Arctic Observing Summit 2018
INTAROS deliverable ID	

Title	The Coordinated Arctic Acoustic Thermometry Experiment – CAATEX
Author	Hanne Sagen; Matthew Dzieciuch; Helene Langehaug, Espen Storheim, Peter Worcester, Mats Granskog, Stein Sandven, Andrey Proshutinsky, Patrick Heimbach, Brian Dushaw, Florian Geyer, Torill Hamre, and Asuka Yamakawa
Year of production	2018
Key message	The central Arctic Ocean under the sea ice is poorly observed and remains largely unknown. The CAATEX project is designed to address four major research questions: • What is the spatiotemporal variability of mean ocean temperature in the central Arctic Ocean? • How do local atmosphere-ice-ocean interaction processes vary between seasons and regions? • How well do climate models estimate the heat content of the Arctic Ocean? • How do climate models with the least biases in ocean heat content project the fate of the Arctic sea ice?
Location	https://intaros.nersc.no/content/poster-arctic-observing-summit-2018-caatex-project

Type of material	Outreach
Target audience	General public
Format	Poster at Arctic Observing Summit 2018
INTAROS deliverable ID	
Title	Integrated Arctic Observation System Development - Activities in 2018
Author	INTAROS
Year of production	2018
Key message	INTAROS is building an efficient integrated Arctic Observing System (iAOS) by extending, improving and unifying existing systems in different regions of the Arctic. Multidisciplinary observing systems covering atmosphere, ocean, sea ice, marine ecosystems, glaciology, snow, hydrology and other land surface processes, natural hazards and community-based system.
Location	https://intaros.nersc.no/content/poster-arctic-observing-summit-2018-overview-intaros-field-work

Type of material	Outreach
Target audience	General public
Format	Summary on COP23 EU-Arctic Cluster Event

INTAROS deliverable ID	
Title	POLAR INSIGHTS FOR CLIMATE ACTION
Author	
Year of production	2017
Key message	POLAR INSIGHTS FOR CLIMATE ACTION Arctic science contributions to implementing the Paris Agreement. Warming at almost twice the global average rate, the Arctic is a key re-gion for understanding wider climate change impacts. Mitigation and adaptation strategies in the Arctic are thus an integral part of the EU's wider efforts to combat climate change and to implement the Paris Agreement. This session provided up-to-date and policy-relevant information on Arctic change and its global implications.
Location	https://intaros.nersc.no/content/arctic-clustercop23-event

Type of material	Outreach
Target audience	General public
Format	Brochure for COP23 EU-Arctic Cluster Event
INTAROS deliverable ID	
Title	Providing answers for a changing Arctic
Author	
Year of production	2017
Key message	Warming at almost twice the global average rate, the Arctic is a key region for understanding wider climate change impacts. Mitigation and adaptation strategies in the Arctic are thus an integral part of the EU's wider efforts to combat climate change and to implement the Paris Agreement.
Location	https://intaros.nersc.no/content/arctic-cluster-brochure

Type of material	Outreach
Target audience	General public
Format	Videos (drone, 360 and conventional) & Augmented Reality. Website / Cinema 3D
Title	Chasseurs de carbone
Author	Cité des Sciences
Year of production	2017
Key message	A collaboration with RFI and the Cité des Sciences for the creation of a Webdoc on arctic snow-vegetation interactions. Link given above + the links (at the end of the webdoc) to the 2 episodes "Arctic, permafrost under high surveillance".

Location	http://webdoc.rfi.fr/chasseurs-carbone-rechauffement-climat-degel/long-format/index.html
Copyright	La Cité des Sciences / Takuvik

Type of material	Outreach
Target audience	High school students, university students, civil society organisations, government agencies, environmentally interested community members in the Arctic, practitioners and facilitators of community based monitoring programs, scientists
Format	Book format (proceedings)
INTAROS deliverable ID	D7.16 (Task 7.7)
Title	These are proceedings from workshops on community based environmental monitoring in the Arctic. The workshops were held in Fairbanks (Alaska), Quebéc City (Canada), Longyearbyen (Svalbard), and Yakutia (Arctic Russia) during 2017-2019.
Author	• Fairbanks workshop proceedings: Fidel, M. et al. • Quebéc City workshop proceedings: Johnson, N. et al. • Longyearbyen 2018 workshop proceedings: Iversen, L. et al. • Longyearbyen 2019 workshop proceedings: Poulsen, M.K. et al. • Yakutia workshop proceedings: Enghoff, M. et al.
Year of production	• 2017 (Fairbanks workshop proceedings) • 2018 (Quebéc City and Longyearbyen workshop proceedings) • 2019 (Longyearbyen, and Yakutia workshop proceedings)
Key message	The proceedings summarize the presentations and discussions among facilitators and practitioners of Arctic community based monitoring programs, scientists, government agencies, and donors. The proceedings have been prepared by the organizers of each workshop. The proceedings are the results of cooperation between many Arctic institutions and CBM programs, including e.g. ELOKA, University of Alaska Fairbanks, Yukon River Inter-Tribal Watershed Council, UNIS, and Centre for Support of Indigenous Peoples of the North.
Location	• Fairbanks workshop proceedings: http://www.intaros.eu/news/recent-news/report-from-community-based-monitoring-workshop-in-fairbanks-alaska/ • Quebéc City workshop proceedings: http://www.intaros.eu/news/recent-news/cbm-workshop-quebec/ • Longyearbyen Dec. 2018 workshop proceedings: http://www.intaros.eu/media/1549/report-from-workshop-v5-1-final.pdf • Longyearbyen March 2019 workshop proceedings and Yakutia workshop proceedings will be available online in late 2019.
Copyright	Publicly available. Links to the proceedings have been made from a number of other homepages.

Type of material	Outreach
Target audience	General public
Format	Brochure on INTAROS
INTAROS deliverable ID	
Title	INTAROS – Integrated Arctic Observation System
Author	INTAROS
Year of production	2016
Key message	INTAROS will develop an efficient integrated Arctic Observation System by extending, improving and unifying existing and evolving systems in the different regions of the Arctic.
Location	https://intaros.nersc.no/content/intaros-brochure-2-pages

3.2 Relevant outreach materials produced outside INTAROS

Type of material	Outreach & Training
Target audience	General public, university level for training
Format	Video
Title	Deep Down in the Arctic - OBS Expedition 2019
Author	Seismology group at University of Bergen
Year of production	2019
Key message	In August 2019, scientists from University of Bergen went on board ACC Mosby, a Norwegian fishery vessel, to recover three ocean bottom seismographs (OBS) in the Greenland Sea. The instruments were redeployed in Storfjorden near Svalbard. The field campaign is part of the research projects INTAROS (funded by the European H2020 programme) and EPOS-Norway (funded by the Norwegian Research Council). Video by Tarcisio Infriccioli, animations by Zeinab Jeddi and music by Fox Sailor ("Release the Ocean" from album "Sea Legends").
Location	https://vimeo.com/363997085

Type of material	Outreach
Target audience	School students (age 13-19), teachers, general public
Format	A mobile app
Title	ARCTIC EXPLORER GAME
Author	EDU-ARCTIC project (HORIZON 2020 funded project, GA 710240) The concept of the game was developed by Yngva Sigurdsdottir Lamhauge from the Faroe Islands, who prepared it as a project for the 2. Edition of the Arctic Competition in 2018 under the guidance of her teacher Niklas F. Joensen.
Year of production	2019
Key message	The Arctic Explorer app is a smart entertainment for everyone. The history of the application of the Arctic Explorer Game (available free of charge, currently on Android), created as part of the European project EDU-ARCTIC, is special. The author of the idea is 13-year-old Yngva from the Faroe Islands, who submitted in the competition the idea of creating a virtual journey through the Arctic, which, thanks to the form of a quiz, allows to broaden knowledge about this region. The virtual journey through the Arctic begins in Svalbard. Users can choose questions from various domains: biology, geography, geology and science in general, on three different levels of difficulty. If an answer is correct, users collect "coins" that allow to reach in other parts of the Arctic - Iceland, Greenland, Faroe

	Islands, Scandinavia or North American polar areas. The answers are accompanied by explanations, photos, links to additional materials. But the most important element is the ability to co-create the application by its users - that is, to add questions and answers, which is also awarded with virtual "coins".
Location	Google Play: https://play.google.com/store/apps/details?id=pl.americansystems.arcticexplorer
Copyright	The app is free of charge. American Systems Ltd. (Poland) holds the license to the Yngva's idea.

Type of material	Outreach
Target audience	General public
Format	Popular science article
Title	Warm water, fresh water, wind and tides - ice or no ice around Svalbard?
Author	A. H. H. Renner, S. Lind, A. Sundfjord
Year of production	2019
Key message	
Location	Fram Forum 2019, p. 106-111 https://framsenteret.no/forum/2019/warm-water-fresh-water-wind-and-tides-ice-or-no-ice-around-svalbard/

Type of material	Outreach
Target audience	General public
Format	Touchscreen console
Title	Touchscreen console for ocean literacy and ocean data viewing
Author	Norwegian Institute for Water Research
Year of production	2018
Key message	Ocean literacy "stories" related to pressing environmental issues related to the oceans; ocean data viewing including modeled temperature, ice cover, currents, as well as INTAROS data collected by M/S Norbjørn FerryBox in the Barents Sea Opening.
Location	Touchscreen consoles are installed on passenger ferry/cruise ships, science institutions, national park visitor centers and more.

Type of material	Outreach
Target audience	General public
Format	Newspaper article
Title	Varmere og isfritt hav nord for Svalbard

Author	A. Sundfjord, A. H. H. Renner
Year of production	2018
Key message	
Location	Aftenposten https://www.aftenposten.no/viten/i/jP20aA/varmere-og-isfritt-hav-nord-for-svalbard

Type of material	Outreach
Target audience	General public
Format	Documentary series produced the online channel The Young Turks and Go90
Title	True North
Author	The Young Turks, John Iadarola
Year of production	2018
Key message	Documentary that followed amongst others, the A-TWAIN project on the mooring service cruise north of Svalbard in 2017
Location	https://www.facebook.com/truenorthshow/

Type of material	Outreach
Target audience	General public, schools and universities
Format	Website and Videos
Title	The Global Ocean Observing System (GOOS)
Author	The Global Ocean Observing System (GOOS)
Year of production	2004-present
Key message	The Global Ocean Observing System (GOOS) is a sustained collaborative system of ocean observations, encompassing in situ networks, satellite systems, governments, UN agencies and individual scientists. We are organized around a series of components undertaking requirements assessment, observing implementation, innovation through projects, and a core team.
Location	Website: https://www.goosocean.org/index.php?option=com_content&view=article&id=7&Itemid=101 Videos: https://www.goosocean.org/index.php?option=com_oe&task=viewDocumentRecord&docID=24590

4. Critical analysis of Teaching and Outreach Materials in Numbers

Table 1 shows the resources developed within INTAROS and those external to the project and their intended target audience. The table includes all resources developed for Teaching, for Outreach, and for Teaching and Outreach.

	INTAROS				EXTERNAL				
Resources	Ele-mentary School	General	Profes-sionals	University Students	General	High School	Profes-sionals	University Students	Total
App					1				1
Article					2				2
Book		5			1				6
Brochure		1							1
Course			1	1			1		3
Documentaries		1							1
Documentary Series					1				1
Exhibit		1			1				2
Online Resources		1			1	4			6
Package		2		1		11			14
Poster		3							3
Presentation	1		1	2			1	3	8
Report		3							3
Video		8			1	1			10
Total	1	25	2	3	8	16	2	3	61

Table 1. Resources developed within INTAROS and those external to the project and their intended target audience.

Overall 61 resources were identified, 32 from within INTAROS, and 29 from external sources. The audiences for these materials ranged from Elementary school students, to university students, professionals and the general public. Resources were described as being for Teaching purposes (23), Outreach purposes (26), or for Teaching and Outreach purposes (12).

Resources for teaching,or for teaching and outreach were more tailored in terms of their target audience than the resources identified as being for Outreach, whose audience was usually mixed or general in scope. Teaching resources included 3 courses aimed at university or young professional level students, 12 packages of materials, 7 presentations and 1 online resource. Teaching and outreach comprised 1 book, 4 online resources, 2 packages and 5 video resources. Outreach resources were varied and included books, articles, documentaries, online resources, exhibitions, and even an app.

In terms of the material specifically targeting high school students, INTAROS has not yet developed any materials solely targeting this audience, although 10 resources exist that can be used with this group as well as the broader public. Of the external resources, 16 are dedicated

directly towards high school students, and include 4 online resources and 11 teaching packages.

Gaps in Approaching Capacity Building for High School and the General Public

In terms of the gaps identified here, there is little missing from the variety of materials developed for Arctic education among high schools and the general public. The materials that exist are varied and up to date, with most material being developed in the past 1-3 years.

The challenge for INTAROS will be to encourage engagement with high schools and uptake of the existing and new materials being developed for these target audiences. Focus should also continue to follow the trend towards online materials and apps, as well as complete dedicated packages and courses, in order to ensure continuity of the engagement secured during the project.

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INTAROS

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