Integrating Activities for Advanced Communities

D1.15 - Innovation Progress Report

Project No.871120– INTERACT

H2020-INFRAIA-2019-1

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Dissemination Level		
PU	Public	
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the Consortium (including the Commission Services)	
CO	Confidential, only for members of the Consortium (including the Commission Services)	X

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Publishable Executive Summary

Within the Innovation Watch Dog activities, the monitoring of various indicators to measure the rate of innovation introduced in the INTERACT III project was envisaged.

This is the final report highlighting the results achieved within the project in various aspects: economic, scientific, social, educational, and technological.

The introduction of such monitoring was innovative in itself because it contributed to raising awareness that any project is also valued based on the results it is able to bring. This does not mean that if a project does not produce tangible results, it is necessarily of little use, but that the introduction of measurement indicators helps participants to increase awareness of their role within a project path, and this was precisely the attitude of all the WP Leaders who enthusiastically accepted the adoption of some measurement tools. For example, introducing an economic value to the scientific databases that have been painstakingly collected over decades and are now available to everyone through Virtual Access has increased awareness of the value of efforts to network this information.

In INTERACT III several innovation factors have been identified, and 20 of them have been selected as the most important (see table 1). To monitor and measure innovation a specific metrics has been identified introducing 26 indicators.

The monitoring was possible for 24 indicators out of 26. For one of them, data collection proved too complex, having to trace all the resources generated over 5 years of the project in the educational field, which were indeed countless.

Most of the monitored indicators aimed to foster people awareness on Arctic themes (9 indicators) and to grab new opportunities, new procedures, and technological applications (8). Following this, 6 indicators noted improvements in process efficiency and service level to internal and external users, and lastly, 3 indicators concerned innovation in the organization.

Therefore, the experience of measuring the degree of innovation connected to the results of a scientific project has been certainly positive, demonstrating what the father of science, Galileo Galilei, stated: "measure what is measurable and make measurable what is not."

1. Introduction

1.1. Innovation in INTERACT III

As described in deliverable D1.13 – Innovation Monitoring Plan, innovation in INTERACT III is intended to enhance process efficiency, to improve service level, to develop new opportunities, to expand Arctic environment awareness, etc.

In INTERACT III several innovation factors have been identified and 20 of them (see table 1) have been selected as the most important to quantify improvements. Some of them aim to foster people awareness on Arctic themes (e.g. IF.3, IF.7, IF.14-15-16, and IF.19), some others to improve process efficiency and service level to users (e.g. IF.5-6, IF.10), and some to involve as many new stakeholders as possible (e.g. IF.8, IF.20). Moreover, to grab new opportunities, innovative organization (IF.1-2), new procedures (IF.9, IF.17-18) and technological applications (IF.4, IF.11-12-13) will be pursued.

	Task /Del	Title	I.F.	Task /Del	Title
1	T1.3-5	INTERACT "Watch Dogs"	**11**	T5.2	Exploring new communication technology possibilities for remote sensor
2	T1.7	INTERACT non-profit legal entity	**12**	T6.2	Exploring possible applications of machine-learning for data mining focusing on topics
3	D2.7-8 D2.11-13	Pocket Guides	**13**	D6.4	Report on future strategy and planning for the area of AI and ML to be applied in Arctic Research
4	D2.9	Repository with selected data from INTERACT stations integrated in INTERACT GIS	**14**	D7.1-4	Outreach films
5	M3.2	Access modality selection flow-chart	**15**	D7.5	Educational tool-kits
6	T3.4	VA Single-Entry Point	**16**	D7.6	Online lessons for secondary schools
7	T3.5	Synthesis Papers	**17**	D8.2	Protocols for (target and non-target) screening of contaminants of emerging concern at INTERACT stations
8	T4.2	Arctic Resident Observing Network (Nenets)	**18**	D8.4	Plan for development of screening monitoring networks and enhancing application of screening monitoring
9	T2.1, T4.4	Arctic weather predictions improvement	**19**	T9.1	Educating the tourists and tourist operators
10	D5.1	Report on Significance of the Agreement on Enhancing International Arctic Scientific Cooperation for Research in the Arctic	**20**	D9.2	Recommendations for improving tourist policies and regulations

Table 1 - From the many Innovation Factors (I.F) in INTERACT III, 20 have been selected for being monitored throughout the lifetime of the project

Every innovation factor could affect both INTERACT network processes (promoting for example new organization and protocols) and external entities (stakeholders, public, communities, …).

Furthermore, these factors could have a mixed impact on technical and scientific development as well as economic evolution, such as quality improvement, efficiency and societal challenges. Finally, impacts could

be clustered in technology, process, social and educational evolution. Figure 1 shows the impacts distribution of innovation factors along the mentioned dimensions.

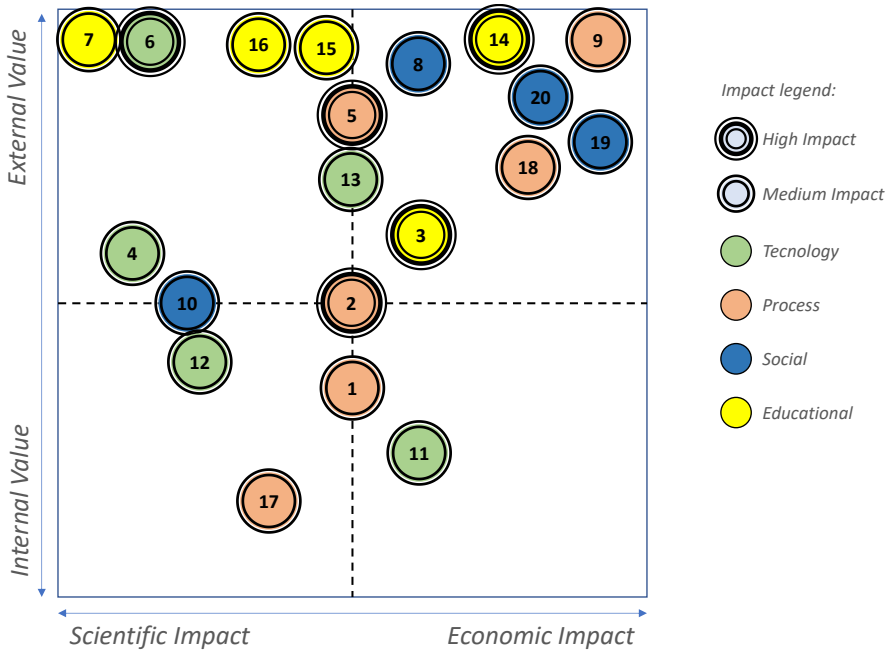


Figure 1 - The expected benefits of the 20 selected Innovation Factors

To measure impacts and improvements, WP leaders have been involved in metrics definition identifying one or more representative indicators for every Innovation Factors. The discussion that followed brought important value to the project, promoting greater attention to impact measurement, process improvement and user satisfaction (internal customers).

In general, indicators belong to two different categories:

- Key Performance Indicators (KPI)
- Key Activity Indicators (KAI).

KPI represents a result of project improvement, e.g. efficiency, effectiveness, quality, whereas KAI represents an impact measurement, or rather, the amount processed to achieve a purpose of project improvement.

In INTERACT III, like any non-profit consortium, KPI are used to highlight internal process improvement or better service level to internal customer (e.g. the Transnational Access Service Level in WP3 for INTERACCES applicants). KAIs are the most utilized indicator category in INTERACT III because they show the degree of involvement of communities and stakeholders to achieve a specific result, e.g. organization involved to adopt recommendations for improving tourist policies and regulations in WP9, stations engaged to plan for development of screening monitoring networks and enhancing application for screening monitoring in WP8, document produced such as Pocket Guides edited in WP2, or audience reached for educational purpose.

1.2. General Definition

A standard table lists definitions, features, procedures, and organizations involved for each metric. Below is a description of the different headings:

Innovation Factor	Element identified inside the project that will improve and innovate internal processes, experiences, awareness, …
Description	An extended description of the Innovation Factor
Impact	Describes the expected impacts, internal and external, scientific and economic
Proposed Metrics	
Indicator	Indicator title
Indicator type	Key Performance Indicator (KPI) or Key Activity Indicator (KAI)
Performance monitoring	A description of performance or impact that the indicator monitors
Procedure	Illustrates data collection process and calculation model
Report Frequency	Defines monitoring frequency or specific due dates
Responsible	Who is responsible for indicator monitoring and data providing
Partners involved	Partners involved in data gathering
Final Target	Result expected for the indicator as a performance target

For every monitored indicator a general definition will be shown in detail.

1.3. Indicators Monitoring Plan

Throughout the project two Innovation Progress Report has been planned to be produced.

After the previous deliverable (D1.14 - Innovation Progress Report v0) which reported a measurement of the indicators that up to that point (M25) had brought tangible results, at the end of the project this deliverable aims to report the progress and results for all the identified indicators.

The following table reports the timeline of indicators monitoring plan identified in D1.13 – Innovation Monitoring Plan. In *bold* the indicators that have been measured and stated in the previous report D1.14 - Innovation Progress Report v0.

WP	Innovation Factor	Indicator	Months			
			13	20	25	60
WP1	IF.1 – Watch Dogs	Number of topics collected during the project as new educational resources				X
		Number of indicators monitored		**X**		X
	IF.2 – INTERACT non-profit legal entity	***Number of station members***	**X**	**X**	**X**	X
WP2	IF.3 – Pocket Guides	Breadth of pocket guides distribution				X
	IF.4 – Repository establishment	Repository degree of use				X
WP3	IF.5 – Access modality selection flow-chart	***TA/RA versus VA distribution***		**X**		X
		TA Service Level	**X**	**X**	**X**	X
	IF.6 – VA Single-Entry Point	***Costs saving estimation for VA adoption***		**X**	**X**	X
		Datasets value		**X**		X
	IF.7 – Synthesis Papers	Number of papers				X

WP4	IF.8 – Arctic Resident Observing Network	***Number of local communities and organizations involved***			**X**	X
	IF.9 – Arctic weather predictions improvement	***Number and nature of issues detected***			**X**	X
		Number of solutions adopted				X
WP5	IF.10 – Information of researchers' free movement bottleneck	***Number of scientists/stations involved on issues compilation and barriers description***			**X**	X
		List of policy briefing attendees				X
	IF.11 – New communication technology opportunities	*Number of applications that could potentially use new technologies*				X
WP6	IF.12 – ML application opportunities	***Time saving estimation using AI automatic detection***			**X**	X
		Cost saving estimation using AI automatic detection			**X**	X
	IF.13 – AI and ML application in Arctic Research	*Count possible applications of AI in Arctic Research*				X
WP7	IF.14 –Outreach films	*Number of visualizations/downloads of each film*				X
	IF.15 – Educational tool-kits	***Number of students/teachers/secondary schools involved***		**X**		X
	IF.16 – Online lessons for secondary schools	Number of online lessons produced				X
WP8	IF.17 – Contaminants screening	***Number of scientists/stations involved on contaminants screening survey***			**X**	X
	IF.18 – Screening monitoring	*Number of stations participating in contaminants screening improvements*				X
WP9	IF.19 – Educating the tourists and tourist operators	Number of Station Managers trained				X
	IF.20 – Recommendations for improving tourist policies and regulations	Number of existing policies and regulations analyzed, confirmed, and reviewed				X
		number of indicators to be monitored	**2**	**7**	**9**	**26**

2. Innovation Progress Report

2.1. WP1 Project Coordination

2.1.1. IF.1 – Watch Dogs

Regarding watchdog activities, two indicators have been identified:

1. "Number of topics collected during the project as new educational resources", to monitor the project's ability to produce educational tools and disseminate Arctic-related themes.
2. "Number of indicators monitored", to concretely measure advancements in the field of innovation itself.

Innovation Factor	**IF.1 – Watch Dogs**
Description	Watch Dogs roles have been introduced in INTERACT III to keep watch on education, innovation and data management across the project
Impact	To achieve significant advances in beyond state-of-the-art activities for ensuring innovation, data accessibility and education
Proposed Metrics	
Indicator	**Number of topics collected during the project as new educational resources**
Indicator type	Key Performance Indicator (KPI)
Performance monitoring	New resources would be collected from all work packages for future educational applications. In this sense this indicator measures a performance because the more, the better.
Procedure	At the end of the project a survey will be conducted to produce a list of new educational topics collected.
Report Frequency	At the final Innovation Progress Report (deliverable D1.15).
Responsible	Katharina Beckmann, ULUND
Partners involved	USFD
Final Target	NO

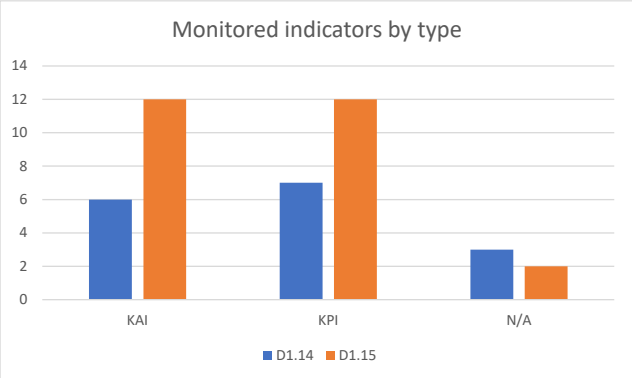
This indicator has proven to be very difficult to monitor because the number of contributions for educational applications has been countless and distributed across all the work packages of the project. Some partial results can be evaluated in some indicators (for example IF.3, IF.14, and IF.16), but this is just an example of what has been produced in 5 years of the project.

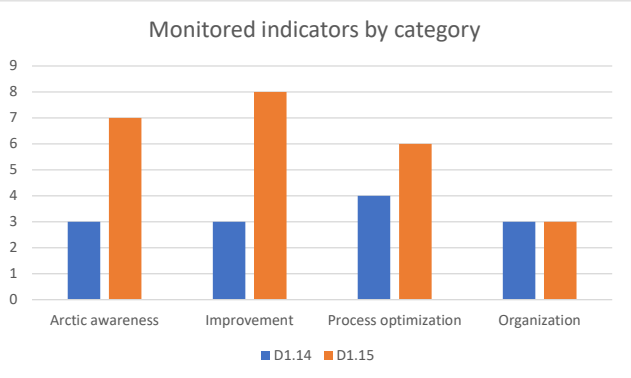
Regarding the evaluation of the innovative content introduced in INTERACT III, it could only be monitored by the number of indicators that were defined and quantified.

Proposed Metrics	
Indicator	**Number of indicators monitored**
Indicator type	Key Activity Indicator (KAI)
Performance monitoring	Due to the nature of some activity and the unknown progress, introducing metrics to monitor innovation for all factors is challenging. That is why this indicator has been introduced to monitor the real capacity of the project to monitor its own improvements.
Procedure	The Innovation Progress Reports that will be produced during the project will provide an immediate measure of indicators really monitored.

Report Frequency	At the Innovation Progress Report (deliverables D1.14 and D1.15)
Responsible	Giorgio Falsaperna, LINKPRO
Partners involved	LINKPRO
Final Target	20

As planned, the present report reveals both an advancement of the indicators previously monitored (**13**) and the monitoring at the end of the project of almost all indicators (**24 out of 26**). At this point, the statistic by type and category is complete.





- *KAI* (Key Activity Indicator) includes indicators that monitor activity progress or a degree of involvement of communities and stakeholders to achieve a specific result.
- *KPI* (Key Performance Indicator) represents a tangible result of project improvement.
- *Arctic awareness* category contains all measurable activities oriented to education, lessons produced, people involvement, …
- *Improvement* category comprises technology innovations, cutting-edge applications, forecast model progressions, and innovative contaminants screening processes.
- *Process optimization* includes indicators that monitor support and simplification to station management.
- *Organization* collects main organizational changes metrics (non-profit legal entity) and TA service level measurement.

2.1.2. IF.2 – INTERACT non-profit legal entity

INTERACT member stations annually host thousands of researchers from around the world and this infrastructure is seen as a major terrestrial research network in the North with global recognition.

INPA is a non-profit association that is offering to INTERACT stations a long-term sustainable platform to continue to play a major global role to build capacity for research and monitoring throughout the Arctic in the future.

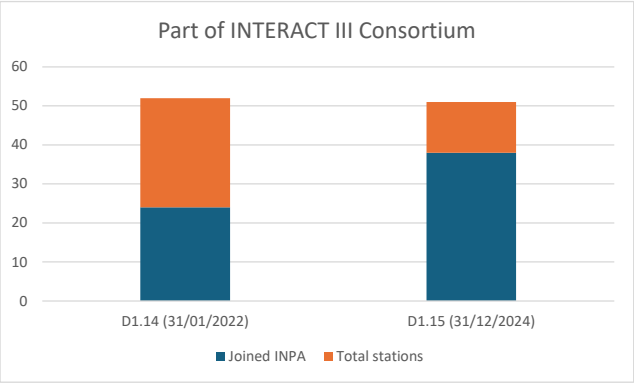
INPA's mission is to support the use and operational procedures of infrastructures in Arctic, sub-Arctic, boreal and alpine regions, to support research and scientific development in the field of climate change and environment, and to increase general awareness about these topics within the general public and among politicians and decision makers.

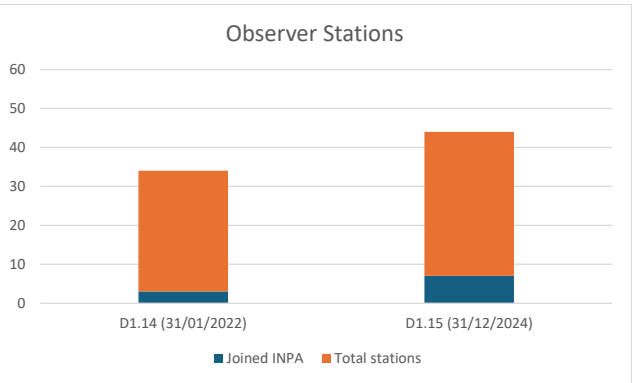
To achieve its purpose, the main objectives of INPA are to improve international cooperation, to coordinate resources and research initiatives, to provide access to members' infrastructures, to improve infrastructures' operation and to financially support research and monitoring focusing on the Arctic, sub-Arctic, boreal and alpine areas and its global implications.

To measure the impact of this organizational innovation, INTERACT III project introduced the following indicator:

Innovation Factor	**IF.2 – INTERACT non-profit legal entity**
Description	Create an international non-profit association of stations members.
Impact	To secure a long-term economic sustainability of INTERACT and extend its activities, making INTERACT a true circum-arctic player
Proposed Metrics	
Indicator	**Number of station members**
Indicator type	Key Performance Indicator (KPI)
Performance monitoring	Number of terrestrial research stations registered as official member of INTERACT non-profit association
Procedure	A Membership campaign will be performed by INTERACT Non-profit association and all INTERACT Stations will be asked to join the Association as a Member. The INTERACT association Board (including DMG people) will constantly update Association Members List
Report Frequency	At all INTERACT General Assemblies and for the Innovation Progress Report (deliverables D1.14 and D1.15)
Responsible	Margareta Johansson, ULUND
Partners involved	ULUND, USFD, UCPH, UOULU, 4PM
Final Target	3 scenarios by the end of the project: Bronze: 23 stations Silver: 44 Stations Gold: 59 Stations

Currently, **45 stations have joined INPA association out of 95 (47%)**. In the previous innovation report (D1.14 – Innovation report v0), at the beginning of 2022, there were 27 out of 86 (31%). Detailed increasing on consortium stations and observer stations is shown below:





It is interesting to note the increase in the number of stations involved during the project, which went from 86 to 95. Additionally, starting from January 2025, the 37 stations not yet affiliated with INPA will be proposed to maintain relationships as observer stations for possible future collaborations.

As a final note, of the 21 Russian stations involved in the INTERACT III project, the 8 registered with INPA are still on hold.

2.2. WP2 Station Manager Forum (SMF)

The aim of WP2 is to foster a culture of cooperation among research stations in an advanced infrastructure community, and between this advanced infrastructure community and scientific communities, industries, local communities, and infrastructures in other regions.

As per the original plan, these indicators are being monitored for the first time in this report at the end of the project.

2.2.1. IF.3 – Pocket Guides

Innovation Factor	**IF.3 – Pocket Guides**
Description	Guides editing and distribution on: • How to reduce CO_2 emissions in Arctic science • metadata standards for scientific networks • How to reduce plastic consumption and pollution • How to handle effects of tourism at research stations and in adjacent local communities • How tourists should behave around research station, including their study areas and local communities
Impact	High impact on education, targeting potentially at all concerned people: • The research community using the INTERACT stations, funding and services • Local communities near the INTERACT research stations • Arctic Council Working Groups • Projects, networks and organizations of relevance • Private companies of relevance • NGO's of relevance • Educational institutions in the Arctic and beyond • The general public in the Arctic and beyond
Proposed Metrics	
Indicator	**Breadth of pocket guides distribution**
Indicator type	Key Activity Indicator (KAI)
Performance monitoring	For each pocket guide, number of hard copies handed out.
Procedure	Hard copies will be counted at handing out events. Administrators of websites containing pocket guides links (i.e. INTERACT, APECS, FARO) will provide relevant statistics. Monitoring starts at the pocket guide publishing deadline: • M26 - Pocket guide on how to reduce CO2 emissions in Arctic science (D2.7)

	• M29 - Pocket guide on metadata standards for scientific networks (D2.8) • M40 - Pocket guide on how to reduce plastic consumption and pollution (D2.11) • M30 - Pocket guide on how to handle effects of tourism at research stations and in adjacent local communities (D2.12) • M30 - Pocket guide for tourist on how to behave around research station, incl. their study areas and local communities (D2.13)
Report Frequency	At the end of the project, after first guide publication: M37, M48
Responsible	Morten Rasch, UCPH
Partners involved	UCPH, AU, ULUND, APECS
Final Target	NO

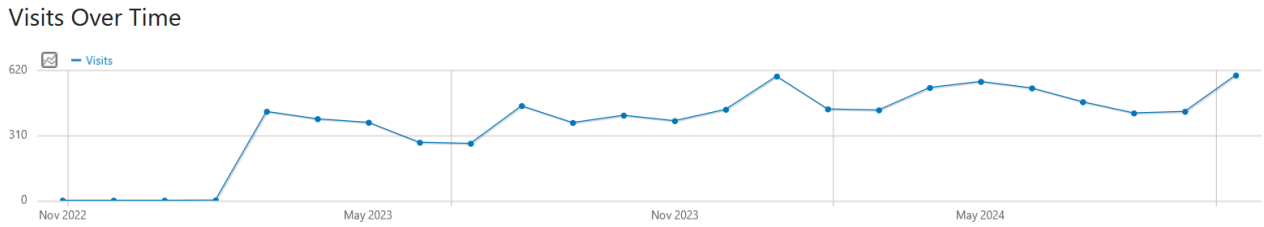
Publications have been distributed at conferences. Every year at Arctic Science Summit Week and Arctic Circle Conference and more sporadically at other events like Arctic Frontiers, European Polar Science Week, Forum of Arctic Research Operator event in Brussels and national events like Greenland Science Week, Hindgavl Arctic events in Denmark, etc. Guidebooks are also distributed by Association of Polar Early Career Scientists (APECS) and we distribute guidebooks upon request to research stations, institutions and organizations.

Between **400 and 700 copies** of all guidebooks have been distributed, and some are out of stock.

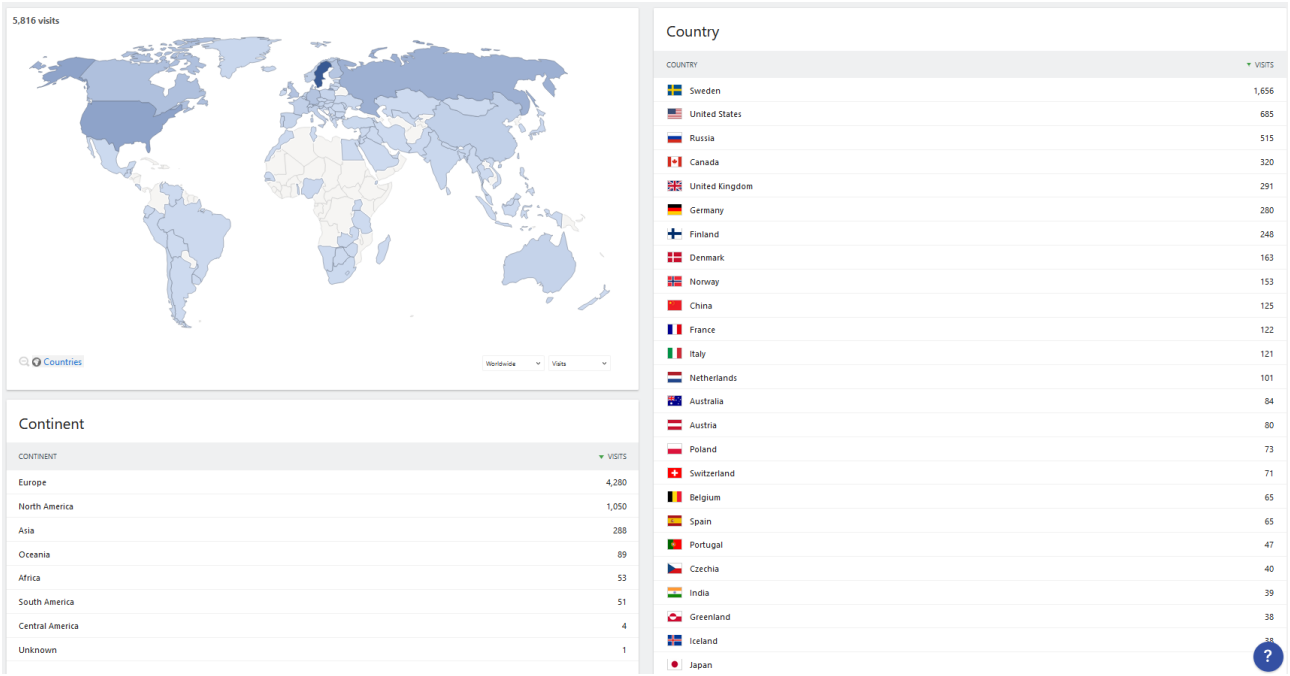
2.2.2. IF.4 – Repository establishment

Innovation Factor	**IF.4 – Repository establishment**
Description	Repository with selected data from INTERACT stations integrated in INTERACT GIS
Impact	Scientific impact both internal and external use of the network.
Proposed Metrics	
Indicator	**Repository degree of use**
Indicator type	Key Activity Indicator (KAI)
Performance monitoring	The number of users visiting the repository will be monitored
Procedure	Umeå University will constantly monitor downloading from repository. The repository should be implemented at M44 (D2.9). In case of advanced implementation, the monitoring will be anticipated.
Report Frequency	At the end of the project
Responsible	Morten Rasch, UCPH
Partners involved	UmU
Final Target	NO

The following graph shows the monthly number of open accesses to selected scientific data from INTERACT repository integrated in INTERACT GIS (in cooperation with the Data Watchdog).



Additionally, the geographic spread of the 5,816 visits is as follows:



2.3. WP3 Giving Access to the Arctic

2.3.1. IF.5 – Access modality selection flow-chart

With the aim of improving the service for researchers and at the same time making the exchange of data and information to as many users as possible efficient and effective, the following indicators have been introduced:

- **TA/RA versus VA distribution** to monitor the amount of access that could be addressed to the most efficient Virtual Access modality.
- **TA Service Level**, considering the applicant as a customer, this indicator evaluates the service level provided during the application procedure.

Innovation Factor	**IF.5 – Access modality selection flow-chart**
Description	This tool will support selection of access modality (TA/RA/VA) for TA applicants. Thanks to this interactive tool, applicants will be addressed to the most appropriate access modality.
Impact	It is part of a range of service tools, together with Station selection tool and TinderAct tool, it specifically promises to optimize the use of resources through

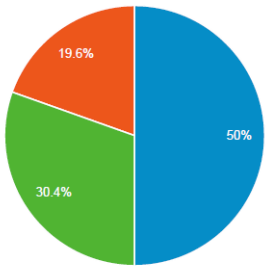
	costs saving adopting VA modality when data are already available online instead of TA/RA.
Proposed Metrics	
Indicator	**TA/RA versus VA distribution**
Indicator type	Key Performance Indicator (KPI)
Performance monitoring	Structured as a wizard, the tool can monitor the distribution of users addressed to TA/RA versus VA in percentage. Knowing this percentage helps to identify a distribution model of access modality (for example 60% TA/RA, 40% VA). In terms of ideal performance, the greater VA modality the better.
Procedure	The indicator will be automatically tracked by the online tool. At every flow-chart completion the counter of the suggested modality (TA/RA or VA) will be updated.
Report Frequency	Monthly or quarterly for internal use. For the Innovation Progress report (deliverables D1.14 and D1.15)
Responsible	Hannele Savela, UOULU
Partners involved	UOULU, INKODE
Final Target	NO

The method for monitoring the percentage ratio between TA/RA and VA underwent a change during the project due to the introduction of GDPR. As a result of this regulation, Google modified the rules for statistical analysis on Google Analytics, and since 2022, a statistic derived from the tool that supported the selection of the access modality is no longer available.

To monitor the savings related to the adoption of VAs compared to TAs/RAs (IF.6), we prefer to use in this document the previous measure of the percentage of VA usage that emerged in the deliverable D1.14 - Innovation Progress Report v0. In the period Sep 2020 - Dec 2021 46 wizard compilation events were recorded on the website. The distribution in the various suggested access modalities was as follows:

This data was filtered using an **advanced filter**.

Event Action	Total Events	Total Events	Contribution to total: Total Events
	46 % of Total: 69.70% (66)	46 % of Total: 69.70% (66)	
1. TRANSNATIONAL ACCESS	23	50.00%	
2. VIRTUAL ACCESS	14	30.43%	
3. REMOTE ACCESS	9	19.57%	



Since this monitoring referred to the early stages of the Project, when the dataset suggesting adherence to VA was more limited, it can be stated with certainty that, as the project progressed, the suggested VA percentage increased. Therefore, the following savings calculation is certainly underestimated.

As said above, the following indicator evaluates the service level provided during the application procedure.

Proposed Metrics	
Indicator	**TA Service Level**
Indicator type	Key Performance Indicator (KPI)
Performance monitoring	The scope of this indicator is to monitor the service level provided to TA applicants in terms of process efficiency. Several components contribute to its evaluation: • Time from call closure to Evaluation (by TA Coordinator) • Time from TA Board meeting to access decisions (by TA Coordinator) • Time from access decision to announcement (by Coordinator) • Time from access visit to project report (by TA User) • Time from project report to reported publications (by TA User) • Time from access visit to reimbursement (by TA Station) • Time from recommendation to decision (by TA Station) To summarize in one specific KPI, the overall improvement rate (e.g. average time reduction of all proposed time lapses together) over project life will be calculated.
Procedure	Every time interval will be automatically collected by INTERACCESS on-line application, evaluation and reporting system used by both TA Users, Stations and TA Coordination. To have a complete trend of this indicator, every component will be evaluated from the beginning of INTERACCESS tool (2017).
Report Frequency	At all INTERACT General Assemblies and for the Innovation Progress Report (deliverables D1.14 and D1.15).
Responsible	Hannele Savela, UOULU
Partners involved	UOULU, INKODE
Final Target	NO

The value of this indicator was reconstructed in the previous INTERACT II and monitored in two phases during the current project. It is important to remember that during the intermediate monitoring of the current project, the values were affected by the presence of the COVID-19 pandemic. To complete, this report also presents the overall value in INTERACT III at the end of the project.

Key Indicator	INTERACT II (2017-2021)		INTERACT III (30 June, end of RP1)		INTERACT III (30 Dec 2021)		INTERACT III (2020-2024)	
	days	#projects	days	#projects	days	#projects	days	#projects
days From Call Closure To Evaluation	9	*430*	15	-	17	*204*	12	*390*
days From Access Recommendation To Decision	37	*326*	30	-	28	*100*	21	*390*
days From Access Decision To Announcement to TA Applicants	13	*326*	24	-	27	*100*	10	*389*
days From Access Visit To Reimbursement	238	*181*	-	*0*	-	*0*	179	*65*
days From Access Visit To Project Report	82	*198*	50	*8*	53	*18*	61	*159*
days From Project Report To Reported Publications	545	*62*	-	*0*	71	*3*	372	*29*

There is a general reduction in turnaround times in each of the monitored phases, demonstrating how the service level offered to program users has been a continuously sought and effectively achieved objective.

Evaluating the weighted average of waiting days in each phase relative to the number of projects managed, the value from INTERACT II to INTERACT III **decreased from 74 days to 34 days (-54%)**, with a comparable number of projects managed.

2.3.2. IF.6 – VA Single-Entry Point

The VA access modality allows to avoid expenses of collecting and extracting data and information already available. The use of this modality therefore allows to avoid operating costs that could be easily estimated. With this in mind, the savings associated with the use of VAs can be estimated and a value to online datasets could be assigned.

Innovation Factor	**IF.6 – VA Single-Entry Point**
Description	The online INTERACT VA Single-Entry Point will provide users with an easy and efficient way to access metadata, data, and related data products, visualizations and services.
Impact	Data availability will improve quality research, giving access to a wide range of data and information and optimizing access costs: users could collect and use available data avoiding duplication of TA/RA costs. A large VA Single-Entry Point adoption should optimize resources without any limitation on knowledge dissemination.
Proposed Metrics	
Indicator	**Costs saving estimation for VA adoption**
Indicator type	Key Performance Indicator (KPI)
Performance monitoring	To estimate savings related to VA adoption two scenarios should be considered: VA Single-Entry Point versus the absence of this utility. The main question is: what if we did not have VA Single-Entry Point? Most likely, the duplication of TA/RA to collect same or similar data already available could not be avoided. Thus we can say that, for every use of VA Single-Entry Point platform, an equivalent TA/RA cost would be saved. This equivalence is comparable with the effort to create from scratch the same data or information: travel costs and labor costs, just to mention the main quantifiable efforts, other than risks and carbon footprint as a not easily quantifiable cost. Since the number of downloads cannot be tracked, the only way to estimate that saving is to consider the real amount of TA granted proportionally to TA/RA and VA distribution (see previous IF.5 indicator **TA/RA versus VA distribution)**. For example, with 4 M€ transnational access granted (TA_g) and 60% ($TA/RA_{\%}$) - 40% ($VA_{\%}$) distribution between TA/RA and VA, the estimated saving is: $$S_{VA} = \frac{TA_g \times VA_{\%}}{TA/RA_{\%}} = \frac{4 \times 0{,}4}{0{,}6} = 2{,}67\ M€$$ Actually, the TA granted is a limited budget value and likely part of total applicants not granted could take advantage of VA Single-Entry Point as well, so this value could be underestimated even though it is based on a statistical assumption.
Procedure	IF.5's indicator evaluation and yearly granted transnational access amount are needed to be estimated
Report Frequency	At all INTERACT General Assemblies and for the Innovation Progress Report (deliverables D1.14 and D1.15).
Responsible	Hannele Savela, UOULU

Partners involved	UOULU
Final Target	NO

Thanks to the adoption of VA, the first innovation deliverable (D1.14 - Innovation Progress Report v0) reported estimated savings of approximately 385 k€. At that time, the granted value was 900 k€, and the VA usage percentage was 30%.

At the end of the project, **the estimated savings are 515 k€**, because the granted value is 1.2 M€, and the VA usage percentage to be considered is 30%. As mentioned above in the description of IF.5, this value is certainly underestimated.

Another interesting economic indicator that can be estimated is the overall value of the available datasets. This indicator is valued at the cost that would be incurred to collect the data from scratch that is effectively already available.

Proposed Metrics	
Indicator	**Datasets value**
Indicator type	Key Activity Indicator (KAI)
Performance monitoring	As mentioned before, the VA adoption will represent a very efficient way to access data and information, avoiding TA/RA costs. Thus, datasets will acquire a real value that could be estimated comparing each of them with the equivalent effort to collect a dataset by TA.
Procedure	The average estimated value of one dataset obtained by an equivalent TA is based on the length of a usual TA visit per user group (an average of 40 days) and the daily unit cost of the specific station, considering also the estimated cost of travel and logistics per user group to the station and back. Multiplying the number of available VA datasets with the average cost of a dataset will rapidly demonstrate the increasing value of the data provision as we more and more populate the new VA single-entry point. A report will be produced automatically by online tools.
Report Frequency	Monthly or quarterly for internal use. For the Innovation Progress Report (deliverables D1.14 and D1.15).
Responsible	Hannele Savela, UOULU
Partners involved	UOULU, INKODE
Final Target	NO

From the previous survey, the number of datasets has increased and consequently the value generated by the project.

Station	Value per dataset (€)	31/12/2021 (mid term project)		31/12/2024 (end of project)	
		Datasets per station	Value per station	Datasets per station	Value per station
Abisko Scientific Research Station	7.710	54	416.340 €	126	971.460 €
Arctic Station	14.540	43	625.220 €	43	625.220 €
CEN Whapmagoostui-Kuujuarapik Research Station	16.667	59	983.353 €	59	983.353 €
Greenland Institute of Natural Resources	16.508	84	1.386.672 €	84	1.386.672 €
Dirigibile Italia				28	268.296 €
Kainuu Fisheries Research Station				9	254.520 €
Oulanka Research Station				1	8.265 €
Pallas-Sodankylä Stations	16.050	29	465.450 €	29	465.450 €
Research Station Samoylov Island	14.560	301	4.382.560 €	353	5.139.680 €
Sonnblick Observatory				170	3.533.960 €
Station Hintereis	6.542	135	883.170 €	137	896.254 €
Svartberget Research Station	9.150	557	5.096.550 €	557	5.096.550 €
Tarfala Research Station	11.940	89	1.062.660 €	89	1.062.660 €
Zackenberg Research Station	19.675	209	4.112.075 €	209	4.112.075 €
Hyytiälä				3	107.421 €
Värriö				3	99.270 €
Kevo Subarctic Research Station				4	41.220 €
TOTAL		**1.560**	**19.414.050 €**	**1.904**	**25.052.326 €**

In three years, the equivalent value of the datasets produced by INTERACT **has increased by almost 30%**, demonstrating a continuous focus on making research more efficient. Indeed, higher value datasets can correspond to lower costs associated with TA/RA.

2.3.3. IF.7 – Synthesis Papers

A specific target of WP3 was to integrate researches and create synergies and collaboration within the TA User Community to address large-scale issues that have Arctic and global importance. This will be achieved by utilizing various methods such as joint meetings, webinars, the TINDERACT-tool and various outreach activities. The result will potentially lead to Synthesis Papers in high-ranking scientific journals in collaboration with the stations and INTERACT JRA's.

Innovation Factor	**IF.7 – Synthesis Papers**
Description	Utilizing the cross-fertilization of ideas and enhanced collaboration of scientists, multi-authored and multi-disciplinary Synthesis Papers will be published as a new form of outcome on contemporary topics.
Impact	The TA User Community consist of previous, current and potential TA Users and station representatives –involving nearly a thousand people annually- and facilitates networking and knowledge exchange to foster team-spirit, peer-support, communication, integration of inter-related projects, awareness among the scientific community of each other's activities and collaboration in working on major and widespread issues.
Proposed Metrics	
Indicator	**Number of papers**
Indicator type	Key Activity Indicator (KAI)
Performance monitoring	At the end of the project will measure the success of this new form of outcome.

Procedure	Count the number of Synthesis Papers produced at the end of the project
Report Frequency	End of the project (for the final Innovation Progress report, deliverable D1.15).
Responsible	Hannele Savela, UOULU
Partners involved	UOULU
Final Target	NO

It is important to know that large-scale synthesis articles take so much time and effort both from the data collection and analysis point of view and from the synthesis point of view that it easily takes 3-5 years before the results are published, and that the synthesis articles directly derived from INTERACT 3 start coming out within the next 2-3 years.

What we see emerging in the "first wave" of publications are congress abstracts, followed by the "second wave" of regular journal articles, and then the "third wave" of synthesis papers. We are now in the "second wave" in INTERACT III, and there are many journal articles in the making and several in review for publication, but it's still early for the synthesis articles, especially considering that there was virtually no field work taking place in 2020 and 2021 because of COVID.

Monitoring of the publications coming out as a result from INTERACT TA will continue in the future via the INTERACCESS system and also via our recently established Zenodo community, as well as e.g. by utilizing the TA User ORCID IDs in tracking their publications resulting from INTERACT TA.

Just as an example, the database of publications (INTERACCESS) shows one article that fits the criterion (large-scale initiative, large scale synthesis, multidisciplinary, multi-authored, published in topmost scientific journal) published in November 2024 in Nature.

The INTERACT TA User Group involved in the study was GSSP (Global spore sampling project), lead by Otso Ovaskainen from University of Jyväskylä in Finland. Also, several INTERACT Stations were involved in this global-scale project, mapping fungi from air samples. In addition to INTERACT, the overall study was also supported by another EU-funded project called LIFEPLAN.

Article information:

- Airborne DNA reveals predictable spatial and seasonal dynamics of fungi, Abrego, N., Furneaux, B., Hardwick, B. et al, Nature 10.7.2024
- DOI: https://doi.org/10.1038/s41586-024-07658-9
- Link to the Nature magazine article: https://www.nature.com/articles/s41586-024-07658-9

Links to press releases:

https://eu-interact.org/interact-project-on-air-borne-funghi-published/

https://cordis.europa.eu/article/id/454282-mapping-global-fungi-from-air-samples?WT.mc_id=exp

2.4.WP4 Unpredictable Arctic

2.4.1. IF.8 – Arctic Resident Observing Network

To identify societal impacts of extreme weather and other events and explore ways in which local communities can contribute to identify these events and their impacts, there is a unique opportunity for INTERACT to work with a development of a new and innovative network led in conjunction with a health organization in the Nadym area of the Yamal-Nenets Autonomous District, Russia. The organization assembles community members including the Nenets reindeer herders, workers in the gas and oil fields and other Arctic residents to provide an observing network that will initiate increased data flow (e.g. photos, temperature measurements, snow depth) on extreme weather events, unexpected changes in ecosystems and perceptions of changes in health and wellbeing from the phenomena reported.

Innovation Factor	**IF.8 – Arctic Resident Observing Network**
Description	Information and data collection will be useful to process information and consult with appropriate analytical laboratories in Russia and INTERACT, while seeking guidance from the ECMWF on which observations and measurements are most beneficial for improved weather forecasts.
Impact	Beneficiaries of the proposed development include Indigenous and other Arctic residents, local enterprises and public services.
Proposed Metrics	
Indicator	**Number of local communities and organizations involved**
Indicator type	Key Activity Indicator (KAI)
Performance monitoring	The objective of this indicator is to highlight the breadth of the analysis
Procedure	Statistical information will be collected during the task
Report Frequency	In progress report at M24, and final report at M29
Responsible	Jonathan Day, ECMWF
Partners involved	ECMWF
Final Target	NO

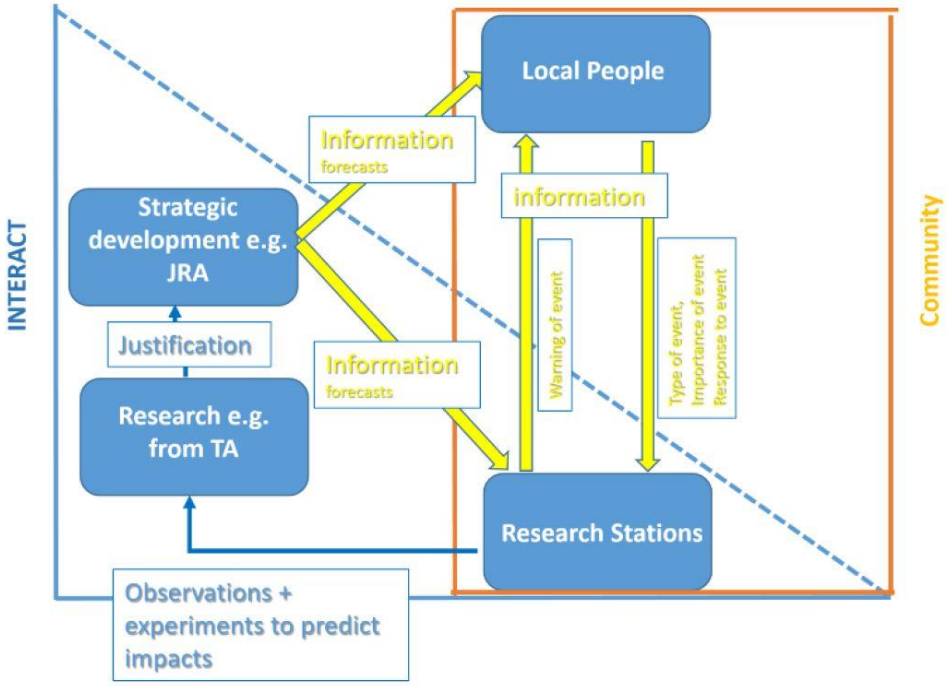
Thousands of people have been contacted and have either been interviewed or have agreed to submit observations:

- Reports from about 500 people including local residents, administrative staff, emergency service, teachers and students of secondary and vocational schools, reindeer herders reporting to https://siberiaweather.ftf.tsu.ru/ by mobile phone and browsers
- Visits to settlements with medics
- Survey of about 1,000 Indigenous People from the Nadym area by the Task Leader and medical researchers to investigate changing traditional diets and the implications of these changes for health and reproductive success
- Survey of 680 local people along a latitudinal transect of 1,500 km from the Arctic settlements of northern Yamal to the city of Tomsk in the south. This sociological study explored the perceptions of local people on climate change and then compared these conceptions with meteorological observations from met stations along the transect
- In-person meeting of citizen science network in September 2021

The main insights derived from this data collection and observations can be summarized as follows:

- The experiences of extreme events by Indigenous and local people need to be collated continually with appropriate acknowledgement and feedback.
- Indigenous and local people need to be better forewarned of impending potentially harmful events through better weather forecasting in the short term and predictive environmental manipulation experiments in the longer term.
- Outreach on climate change and its impacts needs to be strengthened and targeted to correct imprecise perceptions by Indigenous and local people so that necessary adaptation and mitigation measure can be more easily accepted and implemented.

The following scheme illustrates the level of integration that must be maintained and continuously improved:



2.4.2. IF.9 – Arctic weather predictions improvement

To evaluate the degree of weather prediction model improvement, the following key activity indicator has been introduced:

Innovation Factor	**IF.9 – Arctic weather predictions improvement**
Description	Arctic regions pose specific challenges to quality of weather forecasts related to processes which are historically difficult to model. This task would demonstrate the utility of data collected at the INTERACT stations for improving weather forecasts by using them to diagnose the sources of forecast errors.
Impact	To improve the skill of forecasts and their usability over time.
Proposed Metrics	
Indicator	**Number and nature of issues detected**
Indicator type	Key Activity Indicator (KAI)
Performance monitoring	An important step in making forecast improvements is identifying issues with it. The work proposed in Task 4.4 aims to do just that by confronting forecasts at four

	INTERACT stations with actual observations from those sites. The aim is to identify common forecast issues in the Arctic region. This could be a systematic or conditional error in a certain parameter.
Procedure	A list of classified issues by nature will be collected at the end of task 4.4 (M29)
Report Frequency	In progress report at M24, and final report at M29
Responsible	Jonathan Day, ECMWF
Partners involved	ECMWF
Final Target	NO

The first report (D1.14 - Innovation Progress Report v0) highlighted a couple of issues focusing on the evaluation of forecasts of extreme heat in the Arctic at lead-times of 1-6 weeks and links to land surface properties and their errors and the analysis had identified two main problems which are linked:

1. The first is that snowmelt is too slow in the model in Northern Europe and snow stays on the ground longer than observed.
2. The incoming solar radiation seems to be too low at the Sodankylä site (which will contribute to the causes of 1).

After these, further problems have emerged that can be summarized as follows.

A common feature of several sites, namely Sodankylä, Barrow, Tiksi and Eureka, is a warm bias during periods of extreme cold that goes hand in hand with a lack of temperature variability in the lowest ~100 m of the atmosphere. This lack of variability is investigated further at Utqiaġvik, Tiksi and Sodankylä where radiation components were observed and provided in the MODFs and MMDFs, which enabled to investigate the sensitivity of T2m to radiative forcing.

3. At all three sites the models tend to underestimate the sensitivity of T2m and the surface skin temperature to variations in radiative forcing and do not capture extreme minima in these variables, although the AROME-Arctic and CAPS models perform better in this regard.

At Utqiaġvik and Sodankylä, since turbulent fluxes were also provided, the link between these fluxes and the bulk parameters was investigated. This highlighted the following points.

4. Differences were found in the parameterisation of turbulent fluxes, particularly the specification of the roughness length for momentum, which varies by a little less than an order of magnitude between different models.

5. The high importance of the atmosphere-to-snow heat flux was also noted, particularly at the Utqiaġvik and Tiksi sites, where stable conditions dominate. Note that despite this importance, this flux is not observed at these sites.

Identifying the problems listed above has provided opportunities to improve predictive models. For this purpose, the following indicator was designed, aiming to understand how many of the issues that emerged could be useful for improving the forecast model.

Proposed Metrics	
Indicator	**Number of solutions adopted**
Indicator type	Key Performance Indicator (KPI)
Performance monitoring	Any forecast issues identified will also be added to the ECMWF *Known IFS Forecast Issues* list, as appropriate. Where this analysis leads to a potential solution (to an

	existing or newly identified issue), for example changing a parameter in the model, this will also be counted as an innovation.
Procedure	A list of solutions adopted will be produced at the end of task 4.4 (M29)
Report Frequency	At the final Innovation Progress Report (deliverable D1.15)
Responsible	Jonathan Day, ECMWF
Partners involved	ECMWF
Final Target	NO

ECMWF confirms that there has been development work to improve some of these issues, including the implementation of a new snow model, but INTERACT only funded the evaluation work, not model development activities. However, they definitely say that **all the issues identified will feed back into the model development** at ECMWF and other weather centres.

2.5. WP5 Connecting the Arctic

2.5.1. IF.10 – Information of researchers' free movement bottleneck

Even though the indicator introduced for this innovation factor is only indicative of the degree of representativeness of the analysis, the final result is certainly innovative from the point of view of process optimization.

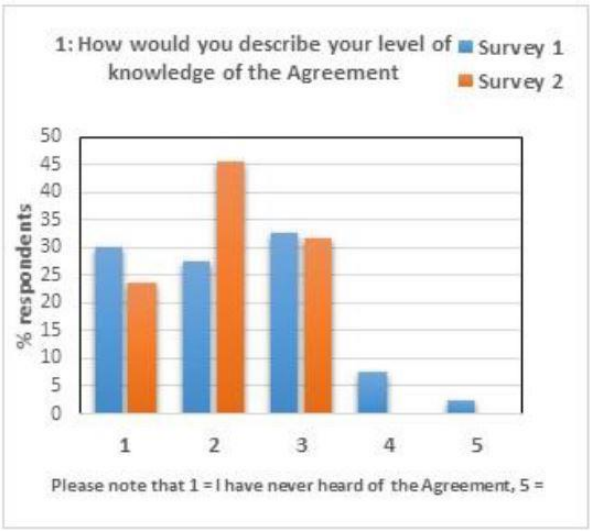
Innovation Factor	**IF.10 – Information of researchers' free movement bottleneck**
Description	Identify and help to reduce barriers of exchanging people and transporting scientific samples across national boundaries
Impact	Studying the benefits and possible shortfalls of implementation of the Agreement on Enhancing International Arctic Scientific Cooperation
Proposed Metrics	
Indicator	**Number of scientists/stations involved on issues compilation and barriers description**
Indicator type	Key Activity Indicator (KAI)
Performance monitoring	To confirm that the analysis is sufficiently representative
Procedure	Data collection in charge of WP2 (D2.6)
Report Frequency	At the Innovation Progress Report v0 (deliverables D1.14)
Responsible	Svenja Holste, APECS
Partners involved	UCPH
Final Target	NO

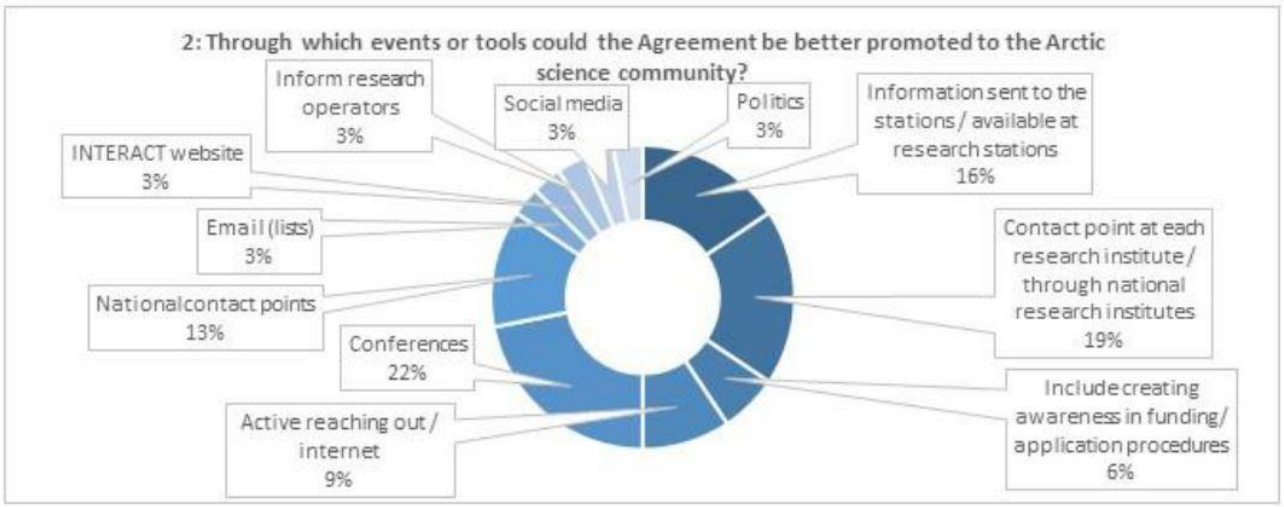
A review of the permit systems of relevance for scientists travelling to any of the Arctic countries has been realized. Permits needed to conduct science in the Arctic include station access systems, visa application systems, sample and equipment import/export systems as well as other authority permits. While scientists are responsible for ensuring they possess all relevant permits, navigating through all the different national permit systems appears to be a challenge.

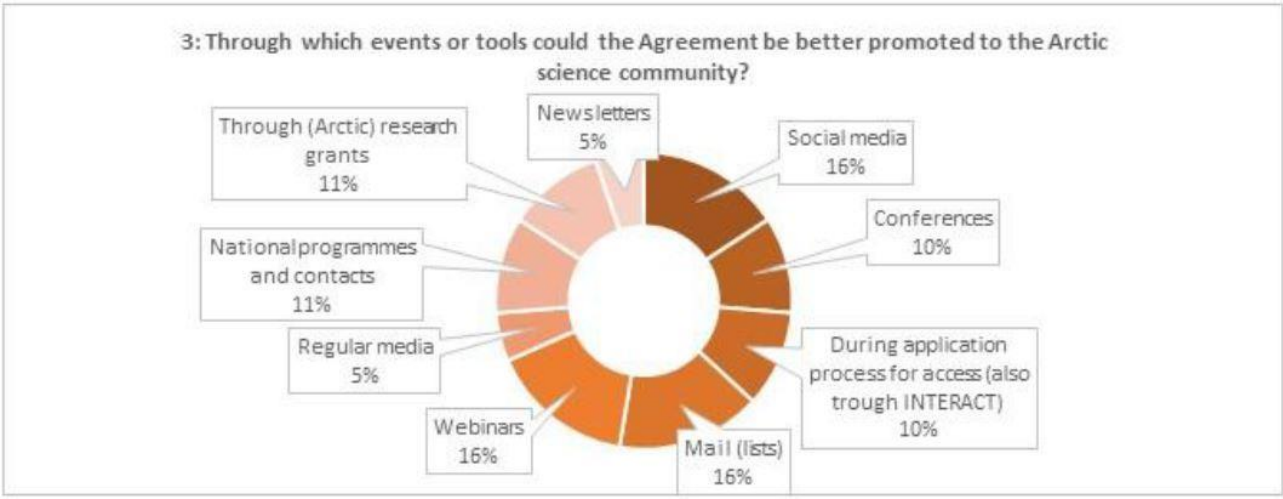
Two comprehensive surveys were conducted to assess the most significant bottlenecks faced by researchers during their travels.

Survey 1 was filled in by **40 representatives of research stations in seven of the eight Arctic Council member states**. The respondents were station managers, technical or logistical staff, educators, administrators, scientific staff and a director. Survey 2 has been filled in by **22 respondents**, which is less than Survey 1. This can be explained that Survey 2 was solely conducted online as there was no in-person opportunity, and the consortium had become smaller with the suspension of its Russian members due to new regulations for EU funded research projects. This confirms that the analysis is sufficiently representative.

Results are well represented in deliverable D5.1. Here, only the salient data is reported here to highlight the most important elements that emerged: actual level of knowledge of the Agreement, potential improvements for promoting the Agreement emerged in both surveys.







A policy briefing and session was organised by INTERACT III and the European Polar Board focused on aligning Arctic research, infrastructures and access to ICARP IV priorities on the 21st of October during the Arctic Circle Assembly 2023 in Reykjavik. The session included a presentation by the European Polar Board's Project Officer on the report on the Agreement of Enhancing International Arctic Scientific Cooperation, which was presented to the audience which included policy makers, representatives from industry sectors and scientists.

Proposed Metrics	
Indicator	**List of policy briefing attendees**
Indicator type	Key Activity Indicator (KAI)
Performance monitoring	Monitor the level of involvement of various stakeholders to the identified recommendations on improving access to and from the Arctic region
Procedure	Data collection in charge of WP2 (D2.6)
Report Frequency	At the Innovation Progress Report v0 (deliverables D1.14)
Responsible	EPB
Partners involved	EPB
Final Target	NO

The session included presentations from:

- Jennifer Mercer, NSF USA, *Opening Words by FARO – Forum of Arctic Research Operators*
- Gerlis Fugmann, IASC, *ICARP IV process and research infrastructures*
- Elmer Topp-Jørgensen, Aarhus University, *INTERACT Network, INTERACT GIS and INTERACT Access Systems*
- Pjotr Elshout, European Polar Board, *European Polar Board – Transnational access, international scientific collaboration and the Arctic Science Agreement*
- Jan Rene Larsen, *POAwg – Facilitating information about research & monitoring assets in polar regions*

Unfortunately, a list of participants is not available, but we can publish a photo of the event here.

The presentations were followed by a panel discussion, where presenters were asked questions by the chair and the audience on the current ICARP IV process and on the impact of ICARP III.

2.5.2. IF.11 – New communication technology opportunities

In the realm of pure technological innovation, an analysis has been conducted to identify state-of-the-art communication systems for researchers, stations and local and Indigenous communities, and finally exploring the possibilities of applying new communication technology for remote sensors at INTERACT Stations that could lead to innovative research and community monitoring.

Innovation Factor	**IF.11 – New communication technology opportunities**
Description	There are many possibilities to create new environmental research opportunities using new technology, for example drone, AI, IoT. Solutions should be derived from opportunities and needs identified by the Arctic environmental researchers.
Impact	Enhance research activities by making monitoring and data collection more efficient.
Proposed Metrics	
Indicator	**Number of applications that could potentially use new technologies**
Indicator type	Key Activity Indicator (KAI)
Performance monitoring	This indicator represents the possibility that the stations will be able to adopt more efficient and effective innovative solutions in the future thanks to technology.
Procedure	Survey and brainstorming with Station Managers
Report Frequency	At the final innovation report
Responsible	Tomas Gustafsson, AFRY
Partners involved	AFRY
Final Target	NO

Group discussions during a workshop with some 50 researchers from the INTERACT community led to several conclusions on general area of interest for applications of drones and sensors and **19 possible applications have been identified**.

Frequent requests	Medium requests	Minor requests
Detailed 3D mapping	Collect samples: air, water, soil/mud/gravel, from trees	Follow tagged animals or find equipment
Count population	Mount or place sensors in places difficult to access for humans	Measure water salinity
Snow coverage/layers	Spectral measurements	Measure (changing) riverbed of water streams
Vegetation mapping	Radar measurements	Laser emitting light and sensor measuring fluorescence created
Temperature measurements	Measure greenhouse gas fluxes	Delivery
Recurrent measurements and upscaling	Heat camera	
	Safety, surveillance	
	Marketing videos	

All the identified and listed opportunities can be translated to needs, which further can be solved by some drone platform in combination with some sensor, sampler or other custom-made solution.

Some projects and ideas that include new applications of existing sensors and some new applications of how to utilize the drone for services that might facilitate the collection of samples or sensor data have been investigate. Some of them are:

- Measuring greenhouse gas.
- Measuring snow depth and layers with radar.
- Measuring land, ice, snow, vegetation, sea with radar.
- Identifying vegetation with stereo camera and artificial intelligence.
- Collect data in very remote areas with drones.
- Collect data from underwater sensors.
- Snow changes tracking aid using sensor fusion.
- Water sampling.

2.6. WP6 Climate Action

2.6.1. IF.12 – ML application opportunities

Artificial intelligence applications represent in INTERACT III a real innovation which, in addition to expanding the possibilities of data analysis, implies improvements in the efficiency of the analysis. With this in mind, the following indicators have been introduced:

Innovation Factor	**IF.12 – ML application opportunities**
Description	Cutting-edge applications of Artificial Intelligence and Machine Learning come true in the last years, introducing new business models, improving process efficiency and

	quality, supporting human activities. In Interact Project a pilot project has been implemented to evaluate benefits of these applications
Impact	Employ AI/ML techniques by helping to reduce manual work for researchers.
Proposed Metrics	
Indicator	**Time saving estimation using AI automatic detection**
Indicator type	Key Performance Indicator (KPI)
Performance monitoring	Automatic Image recognition would avoid human work simplifying detection and categorization of images.
Procedure	Estimation of human work saved in the pilot project (work days)
Report Frequency	In progress report at M24, and final report at M29
Responsible	Maria Erman, AFRY
Partners involved	AFRY
Final Target	NO
Proposed Metrics	
Indicator	**Cost saving estimation using AI automatic detection**
Indicator type	Key Performance Indicator (KPI)
Performance monitoring	Automatic Image recognition would avoid human work simplifying detection and categorization of images.
Procedure	Estimation of human work saved in the pilot project (stated in €)
Report Frequency	In progress report at M24, and final report at M29
Responsible	Maria Erman, AFRY
Partners involved	AFRY
Final Target	NO

The savings values extracted in the first report D1.14 - Innovation Progress Report v0 are confirmed here.

Assuming the accuracy that can be achieved using human classification and AI, as demonstrated in [1], to be comparable; the main time saving pertains to an AI automatically detecting and classifying images instead of a human manually detecting and classifying the same images. This would decrease labor time and costs in proportion to the number of images classified.

An AI model can run 24/7, hence, the actual time used classifying images is tripled compared to a normal 8-hour workday for humans. The AI model is also significantly faster in classifying images than humans. Specifically, for INTERACT III, using Örn's master thesis work [2] conducted in connection to INTERACT III, conservatively estimated, the time used for classifying one image using the AI tool Google Colab [3], is 1 second, while the human equivalent is in the order of at least 10 seconds [1]. This means that the ratio of images classified is 30 times greater using AI compared to humans.

[1] M. S. Norouzzadeh, A. Nguyen, M. Kosmala, A. Swanson, C. Packer, and J. Clune, "Automatically identifying wild animals in camera trap images with deep learning," *Proc. Natl. Acad. Sci.*, vol. 115, Mar. 2017, doi: 10.1073/pnas.1719367115.

[2] F. Örn, "Computer Vision for Camera Trap Footage : Comparing classification with object detection," Division of Visual Information and Interaction, Department of Information Technology, Mathematics and Computer Science, Disciplinary Domain of Science and Technology, Uppsala University, 2021.
[3] "Google Colaboratory." https://colab.research.google.com/ (accessed Jan. 17, 2022).

Human: 8 x 3.600 / 10 images per workday and per person = 2.880 images per day and person

AI: 24 x 3.600 = 86.400 images per day

The pilot project in INTERACT III classified 15.300 images, giving time savings of roughly 5 working days. The general expression for the number of saved days is:

Number of images/2.880 - Number of images/86.400,

which in the case of the pilot yields

(15.300/2.880) - (15.300/86.400), i.e., approximately 5 working days.

Regarding cost saving estimation using AI automatic detection, **t**he main cost savings entail less labor costs set against the cost of cloud computing resources. As the AI tool used for the work in [2], Google Colab [3], is free of use, no additional cost for running the AI tool was accrued. However, it should be noted that there are limitations to the free tier version of Google Colab (and the pro version is only available in a few selected countries), meaning that the user will be allotted resources depending on availability, and performance may hence vary. As such it should only be used for prototype purposes.

The cost saving estimation is thus the cost of labor. As 15.300 images were classified in the pilot project with a time saving of roughly 5 working days, the cost saving can be estimated as 5 days x 8h x S €, where S is the salary in € per hour.

2.6.2. IF.13 – AI and ML application in Arctic Research

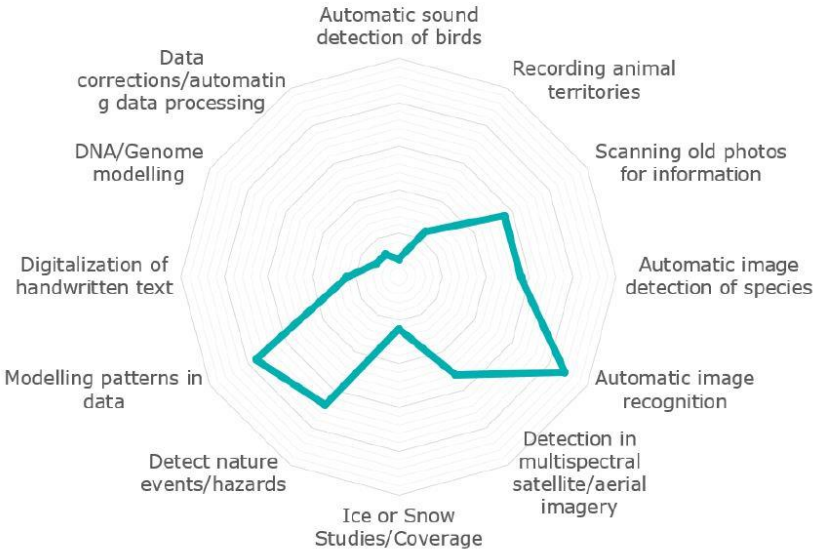
Valuable data are collected by dedicated researchers involved in INTERACT III, and some research stations

have conducted measurements for many decades. Analysis of these data may provide unimaginable links to understanding key concepts and bringing crucial insights into climate change research. AI could be the right technology to accelerate this process.

Innovation Factor	**IF.13 – AI and ML application in Arctic Research**
Description	Identify the future strategy and planning for the area of AI and ML that can be applied in Arctic Research.
Impact	Employ AI/ML techniques by helping to reduce manual work for researchers.
Proposed Metrics	
Indicator	**Count possible applications of AI in Arctic Research**
Indicator type	Key Performance Indicator (KPI)
Performance monitoring	Evaluate the future utility of AI technologies that are truly applicable in Arctic research.
Procedure	Report on AI experts.
Report Frequency	At the final Innovation Progress Report
Responsible	AFRY
Partners involved	AFRY
Final Target	NO

Considering that the usefulness of AI applications primarily depends on the availability and quality of initial data, it should be noted that the INTERACT network of stations currently predominantly has photos, images, and time series from other research projects. Therefore, based on the feedback collected from the

stations themselves, the following scheme highlights in which areas AI is more likely to be useful and in which less so:



In other words, 80% of the interests expressed by the stations focus on **6 possible applications**:

- Automatic image recognition
- Modelling patterns in data
- Detect nature events/hazards
- Scanning old photos for information
- Automatic image detection of species
- Detection in multispectral satellite/aerial imagery

Just one final consideration to conclude: funding is an issue for many stations, and if AI can help save man hours giving increased resources for more advanced research, many researchers would be eager to incorporate AI and ML in their workflow.

2.7. WP7 Preparing for a future world

2.7.1. IF.14 –Outreach films

All the metrics in work package 7 measure the improvement of social education and awareness of the scope and impacts of global change and the Arctic's role.

To counteract public inertia on climate action and to influence policy, awareness of climate impacts in the Arctic and its widespread implications will be increased at a global level by producing high quality outreach videos made by a world leading organization. Consequently, the first indicator introduced wants to measure the spread of views:

Innovation Factor	**IF.14 – Outreach films**
Description	Increase public awareness of Arctic environmental change and its global implications producing video clips freely available using the vast outreach sources of INTERACT.

Impact	To counteract public inertia on climate action and to influence policy, awareness of climate impacts in the Arctic and its widespread implications at a global level.
Proposed Metrics	
Indicator	**Number of visualizations/downloads of each film**
Indicator type	Key Performance Indicator (KPI)
Performance monitoring	Number of visualizations/downloads measure the level of diffusion of the message and, indirectly, the real impact on public opinion.
Procedure	For films uploaded on INTERACT's YouTube channel it will be very easy to count number of views. Google analytics will be used for any different link provided on websites.
Report Frequency	At the Innovation Progress Report (deliverables D1.14 and D1.15).
Responsible	Katharina Beckmann, ULUND
Partners involved	USFD
Final Target	No

The project involved the BBC producing 4 episodes: **The Changing Global Arctic**. The episodes were made in English with subtitles in English, Swedish, Danish, German, and Italian. The number of views was as follows:

Total Youtube views: 6.862 Episodes: Trailer: 307 Extreme: 3.277 Magnification: 1850 Disappearing: 938 Tourism: 490
Live viewing: ≈ 380 Premiere at the Arctic Circle (Reykjavik, 20 October 23) - 50 people Screening and panel debate at Kiruna Snow Festival (Jan 24) - ≈ 200 people Screening at Greenlandic Learning event in Nuuk (1 March 24) - 80 people Screening at Warsaw Science Festival 2024 (21 September 24) - 50 people

Additionally, a series of 8 episodes was produced with the aim of promoting the INTERACT network to disseminate the main activities of the stations: **Northwards, together for the future**. Filmed in English, with subtitles in English and Italian, it received the following views:

Total Youtube views: 5.272 2.157 in English 3.115 in Italian
Live viewing: 990 Premiere in Rome (Cinema Troisi, 13 Oct 23) - 270 people Screening + debates (Orvieto, 14 October 23) - 120 people Screening + debates (Chieri, 17 May 24) - 300 people

Screening on board of Le Commandant Charcot (21 September 24) - 300 people
TV Broadcasting views: ≈ 48.000 RAI SCUOLA (26 May - 1 June 24) - 0,08% share RAIPLAY on-demand web platform (5 years worldwide) - not monitored, but freely accessible by 300 million Italian in Italy and abroad

2.7.2. IF.15 – Educational tool-kits

Similarly to the first indicator, the following wants to monitor the spread of views of educational tool-kits on the social media and INTERACT website.

Innovation Factor	**IF.15 – Educational tool-kits**
Description	Developing online educational resources in the form of tool-kits for schools
Impact	To empower the younger generation with knowledge and tools to adapt to the most profound impacts of climate and environmental change.
Proposed Metrics	
Indicator	**Number of students/teachers/secondary schools involved**
Indicator type	Key Performance Indicator (KPI)
Performance monitoring	It is evident that this indicator will show the real impact of this educational program.
Procedure	Gradually, count students/teachers/schools involved.
Report Frequency	At the Innovation Progress Report (deliverables D1.14 and D1.15).
Responsible	Katharina Beckmann, ULUND
Partners involved	IGF-PAS
Final Target	No

Below is a table showing the main tool-kits with final view counts compared to the previous D1.14 - Innovation Progress Report v0 (31/01/2022):

Youtube video	Views D1.14	Actual views
Patterned ground	3.088	12.000
Tundra permafrost dynamics	1.396	2.400
Glacier Dynamics	1.300	3.100
Glaciation and hanging valleys formation	38.874	74.000
Analysis and importance of peatlands	287	400
Secrets of dead plants	61	104
The Rapidly Changing Arctic in a Global Context	99	248
TOTAL VIEWS	**45.105**	**92.252**

Finally, the unique views estimation of INTERACT website publication pages follows:

PAGE	Views D1.1	Actual view
/publication/	1.320	2.838
/publication/interact-fieldwork-planning-handbook/	591	1.086
/publication/images-of-arctic-science/	788	1.038
/publication/interact-station-catalogue-2020/	642	946
/publication/1349/	383	845
/publication/interact-practical-field-guide/	509	775
/accessing-the-arctic/publications/	313	671
/publication/interact-fieldwork-planning-handbook-e-book/	0	469
/publication/interact-stories-of-arctic-science-ii/	193	431
/publication/interact-communication-and-navigation-guidebook/	160	375
/publication/research-and-monitoring/	196	352
/publication/page/2/	33	328
/publication/interact-reducing-co2-emissions-in-arctic-science/	0	295
/publication/test-publication/	196	288
/publication/interactive-e-book-stories-of-arctic-science-ii/	148	287
/publication/interact-station-card-game/	163	281
/publication/interact-reducing-the-environmental-impact-of-arctic-fieldwork/	51	261
/publication/interact-management-planning-arctic-northern-alpine-research-stations-examples-good-practices/	157	256
/smf-publications/	115	231
/publication/ta/	58	152
/publication/interact-reducing-plastic-consumption-at-arctic-research-stations/	0	151
/publication/interact-management-planning-for-arctic-and-northern-alpine-research-stations/	0	144
/publication/?publication_type=interact-publications	71	111
/new-interact-publication-images-of-arctic-sciences/	57	74
/publication/?publication_type=smf-publications	17	52
/publication/?publication_type=station-catalogue	20	51
/interact-transnational-access-project-published-in-nature/	0	50
/interact-views-on-how-russias-war-in-ukraine-impact-the-arctic-collaboration-is-published-in-nature/	0	50
/new-interact-publication-available-how-to-reduce-the-environmental-impacts-of-your-fieldwork/	14	47
/publication-available-pan-arctic-report-on-gender-equality-in-the-arctic/	33	45
/new-publication-from-interact-ta-users/	20	44
https://eu-interact.org/interact-ta-visit-results-published-in-natures-scientific-reports/	0	42
https://eu-interact.org/bring-and-publish-your-data-workshop-darwin-core-archive/	0	38
/station-managers-forum/publications/station-catalogue/	13	27
/publication/?publication_type=interact-publications&publication_year=0&search=	20	20
/publication/interact-card-game-2020/	14	14
/publication/interact-pocket-guide-on-data-management/	13	13
TOTAL VIEWS	**6.308**	**13.174**

2.7.1. IF.16 – Online lessons for secondary schools

As per the original plan, this indicator is being monitored for the first time in this report at the end of the project.

Innovation Factor	**IF.16 – Online lessons for secondary schools**
Description	Lessons will be offered to the network of teachers and educators participating in the EDU-ARCTIC educational programme (H2020 project). Thanks to this cooperation more than 1150 teachers and their students aged 13-19 from 58 countries will get the opportunity to become familiar with INTERACT stations and polar research.
Impact	Online lessons will be beneficial to both parties: scientists disseminating their research and schools participating in the webinars. They could serve also as a great promotion of each station.
Proposed Metrics	
Indicator	**Number of online lessons produced**
Indicator type	Key Performance Indicator (KPI)

Performance monitoring	This indicator will show the spread of this educational program.
Procedure	Station managers will be involved at the end of the project with a simple survey to list the conducted online lessons.
Report Frequency	At the end of the project (final Innovation Progress Report deliverable D1.15).
Responsible	Katharina Beckmann, ULUND
Partners involved	IGF-PAS and all partners that own a research station
Final Target	60

INTERACT online lessons started on 5th October 2022 (first lesson) and lasted till 5th December 2023 (last lesson). In total **70 lessons** (21 online lessons were conducted in Polish) were offered and 176 groups participated.

The INTERACT online lessons were offered to STEM teachers and educators registered in the EDU-ARCTIC project (in total 2502 teachers from 70 countries). The map below presents the countries of origin of the registered teachers.

2.8. WP8 Cleaner Arctic, cleaner world

Regarding pollutants impacts in the Arctic, preliminary discussion at the beginning of the project revealed the opportunity to better understand the state of the art of pollution monitoring at the station. For that reason, a survey has been sent to stations to gather information on their activities, concerns, and existing procedures relating to pollution issues.

The innovation factors were identified during the project based on the results of the preliminary survey.

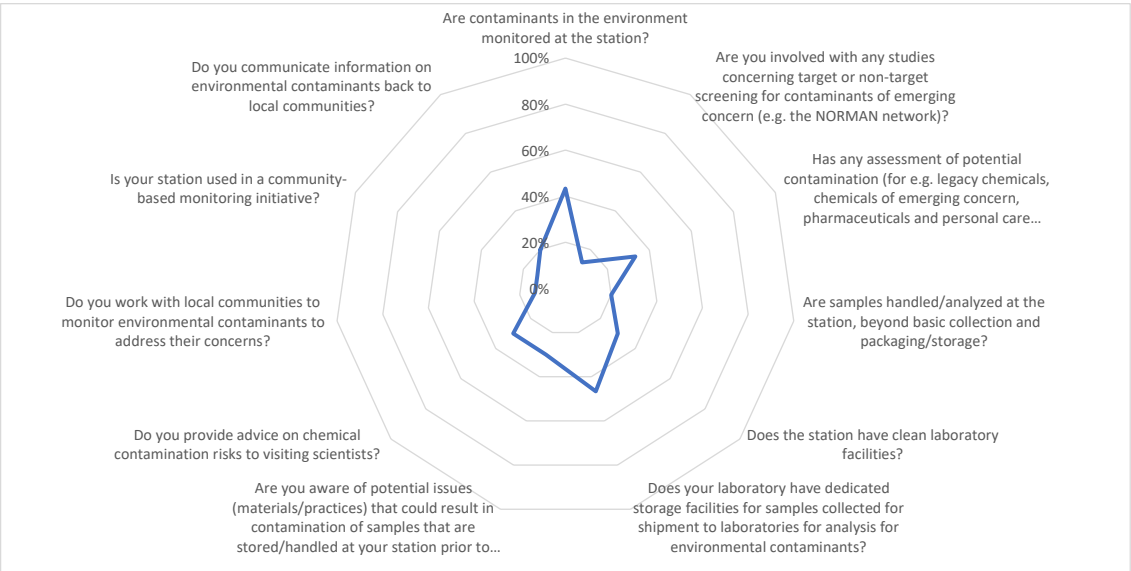
2.8.1. IF.17 – Contaminants screening

Pollutants have a range of impacts in the Arctic that depend on the nature of the pollutant. To document and respond to a full range of pollutants, considerable potential exists using the INTERACT station network as both a core resource for looking into local sources of pollution and ensuring that the stations themselves

are not contributing to this pollution. For this reason, the following indicator has been implemented to measure Arctic awareness:

Innovation Factor	**IF.17 – Contaminants screening**
Description	Identifying emerging pollutants where INTERACT can play a role, and where policies may be suggested to reduce or minimize their use and impacts
Impact	Existing information on chemicals of emerging Arctic concern will be reviewed to identify those that are most relevant with respect to possible use/presence at or around selected INTERACT research stations, for possible investigation of occurrence and/or actions to reduce possible local contamination
Proposed Metrics	
Indicator	**Number of scientists/stations involved on contaminants screening survey**
Indicator type	Key Activity Indicator (KAI)
Performance monitoring	To confirm that the analysis is sufficiently representative. The survey will be repeated at the end of the project to measure the awareness improvement on contaminants topics
Procedure	Data collection in charge of WP8
Report Frequency	At the Innovation Progress Report v0 (D1.14) and at the end of the project (D1.15)
Responsible	Simon Wilson, AMAP-SEC
Partners involved	AMAP-SEC
Final Target	NO

The preliminary survey involved 30 stations and showed a low level of engagement on issues related to contaminants. The figure below represents the percentage of positive responses to the questions posed in the survey and highlights a situation with many opportunities for improvement.



2.8.2. IF.18 – Screening monitoring

Innovation Factor	**IF.18 – Screening monitoring**
Description	Development of protocols for screening monitoring at and close to selected INTERACT monitoring stations
Impact	Designing, in consultation with INTERACT Station Managers and others, as relevant, protocols for investigating the presence of chemicals of emerging concern at or around INTERACT stations using target and/or non-target screening methods.
Proposed Metrics	
Indicator	**Number of stations participating in contaminants screening improvements**
Indicator type	Key Performance Indicator (KPI)
Performance monitoring	Since the initial condition highlighted by the survey showed a rather basic situation, it proved necessary to set up an improvement work that will serve as a basis for standardizing and extending future screening methods at the stations.
Procedure	Data collection in charge of WP8
Report Frequency	At the end of the project (D1.15)
Responsible	Simon Wilson, AMAP-SEC
Partners involved	AMAP-SEC
Final Target	NO

To enhance the monitoring process by involving the stations and standardizing the monitoring methods, a workshop was organized (D8.3): **22 INTERACT Stations** involved in the workshop with the aim of sharing standard monitoring methods (Passive Sampler) and organizing pilot implementation projects.

Practical work performed, including experiences in pilot field deployment of passive samplers at **9 INTERACT Stations**, and presents recommendations to assist stations and networks in maintaining and further developing the pilot activities in the context of their future work, and informing appropriate agencies of potential threats from emerging pollutants.

This demonstrates that the foundations have been laid for a potential future extension of a standardized monitoring method to all stations.

Moreover, the coordinators of one of the international networks involved (AQUA GAPS) stated: “[the deliverable report] nicely addresses all aspects of the ongoing passive sampling campaign. It will help AQUA-GAPS/MONET to improve its sampling protocols and also points at the critical points in communication between monitoring program and Arctic station managers. …. we can show a record of a successful collaboration with the Arctic research infrastructures. “.

2.9. WP9 The Arctic Resort

The aim of WP9 is to support global communities to experience and value the Arctic and to educate tourists from around the world on Arctic issues, reducing their impact on the environment and local and Indigenous communities. Doing that, at the same time there is a need to maximize opportunities to local and Indigenous communities of sustainable tourism.

The selected IFs to be monitored during the project are:

- **Educating the tourists and tourist operators,** developing guidelines for tourists visiting research stations (IF.19).
- **Recommendations for improving tourist policies and regulations**. Gather and summarize existing policies and regulations concerning arctic nature-based tourism, and suggest revisions based on the perspectives of local and Indigenous People (IF.20).

2.9.1. IF.19 – Educating the tourists and tourist operators

As per the original plan, this indicator is being monitored for the first time in this report at the end of the project.

Innovation Factor	**IF.19 – Educating the tourists and tourist operators**
Description	The inherent innovation is on awareness improvement of the sensitivity of the Arctic to disturbance, giving value to this unique environment and ensuring sustainable tourism.
Impact	Tour operator's knowledge and processes could be affected by additional educational resources refining best practices for reducing impacts on the environment. Measures and tools used to ensure sustainable tourism to research activities in station management would be impacted as well.
Proposed Metrics	
Indicator	**Number of Station Managers trained**
Indicator type	Key Activity Indicator (KAI)
Performance monitoring	To build effective guidelines, Station Managers will be involved in a survey where results will be used to develop a template for station specific tourism guidelines to be realized during the project. Every station will be invited to use the template on a voluntary basis.
Procedure	The template, together with instructions on how to use it and two final pilot guidelines, will be presented to all Station Managers who attend the Station Managers' Forum in Winter 2022 (SMF Meeting 3, month 25). The number of participants will set the indicator. In case of extra presentations at the following meeting (SMF Meeting 4, month 37), the indicator will be updated.
Report Frequency	At the final Innovation Progress Report (deliverable D1.15).
Responsible	Melissa Nacke, AECO
Partners involved	AECO
Final Target	At least 50% of the total number of stations

The preliminary survey necessary to build effective guidelines saw the involvement of a large representation: 33 stations.

One station, Koppefjord research station, developed guidelines and subsequently, at the INTERACT Station Managers Forum in September 2022 in Iceland, 69 participants shared the Station Specific Tourism Guidelines and template to develop their own specific tourism guidelines. This document will also be available for download on the INTERACT webpage https://euinteract.org/tourism/.

2.9.2. IF.20 – Recommendations for improving tourist policies and regulations

As per the original plan, this indicator is being monitored for the first time in this report at the end of the project.

Innovation Factor	**IF.20 – Recommendations for improving tourist policies and regulations**
Description	JNL will work together with local- and Indigenous communities in Scandinavia to identify the impacts that Arctic nature-based tourism activities have on local and Indigenous communities and their livelihoods, traditional resource management systems and/or perspectives on natural resource stewardship.
Impact	Policies and regulations are needed to prevent arctic tourism from becoming an industrial activity that has a negative impact on local- and Indigenous communities, their livelihoods and the natural environment. There are currently several projects aiming to develop guidelines for a more sensitive practice in Arctic tourism. However, there is little focus on nature-based tourism such as dog-sledging, small game hunting and sports fishing where the basis for the activity is natural resources.
Proposed Metrics	
Indicator	**Number of existing policies and regulations analyzed, confirmed, and reviewed**
Indicator type	Key Activity Indicator (KAI)
Performance monitoring	Considering that the aim of the activity is to summarize in an effective way a wide and fragmented range of policies and regulations, it would be significant for the quality of the analysis to consider as many policies and regulations as possible. Focus will be put on arctic nature-based tourism existing policies and regulations in Norway and Sweden. If simplification and standardization will be pursued, the number of revisions would be considered a tangible innovation for local and Indigenous communities.
Procedure	Policies and regulations analyzed will be counted and respectively classified in confirmed and reviewed.
Report Frequency	At the final Innovation Progress Report (deliverable D1.15).
Responsible	Niklas Labba, JNL
People involved	JNL
Final Target	NO

During the Project, 17 policies, guidelines, and advertisements were analysed, 5 of which concerned Indigenous communities. Below are the detailed results:

Policies and regulations (Indigenous in bracket)	**Analysed**	**Confirmed**	**Reviewed**
policies	5 (1)	5 (1)	1 under process (0)
guidelines	1 (4)	1 (4)	0 (0)
advertisements	11 (0)	11 (0)	0 (0)

Policies directly connected to the Sámi people is the reindeer herding ACT in Sweden and Norway (there is no ethnicity connected to the reindeer herding AVT in Finland, in opposite to Sweden and Norway).

Sami organisations has developed guidelines for Sámi tour operators and the Sámi parliament of Finland has published a guideline for visitors of Sápmi. The Lapponian agreement may be understood as a guideline for nature protection develop by local Sámi communities and the county of Norrbotten.

Tourist companies, interest organisations and member owned organisations are advertising available tourist trips. In these advertisements there are also recommendations of how to be safe and sustainable.

Specific recommendations have been identified at the level of Policy makers (at national, regional, and municipal level), for Tourist businesses, and for Sami communities (see D9.2 - Recommendations for improving tourist policies and regulations)

3. Conclusions

The monitoring activity of the innovation introduced in the INTERACT III research project has shown remarkable success. The introduction of a series of indicators has allowed for an effective and detailed evaluation of the progress and results achieved. These indicators have been well received by all project stakeholders, highlighting their usefulness and relevance in the research context.

Thanks to these monitoring tools, it has been possible to obtain a clear and precise view of the impact of the implemented innovations, facilitating the management and optimization of resources. Furthermore, the collaboration between the various teams has been strengthened, promoting a more integrated and synergistic working environment.

In conclusion, the adoption of these indicators has represented a significant step forward for the project, contributing decisively to the achievement of the set objectives and laying the foundations for future successful initiatives.