Integrating Activities for Advanced Communities

D8.4 – Plan for development of screening monitoring networks and enhancing application of screening monitoring

Project No.871120– INTERACT

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Dissemination Level

PU	*Public*	*X*
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)*	

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Publishable Executive Summary

Over the past three decades, and based on increasing research and monitoring effort, bodies such as the Arctic Monitoring and Assessment Programme (AMAP) have documented the presence and effects of (chemical) environmental contaminants in the Arctic. This information has been used to inform policy- and decision-making at the national and international level aimed at reducing and where possible eliminating the sources of such contaminants.

The 2017 AMAP assessment Chemicals of Emerging Arctic Concern (CEACs) documented the presence in Arctic environmental media of a number of 'new' chemicals/groups of chemicals. Some of these CEACs have been introduced to replace banned substances, many lack information concerning their properties and possible toxic effects, and many are challenging to analyse. Some CEACs will reach the Arctic due to long-range transport, others are associated with consumer products that may be used in Arctic communities and therefore enter waste streams in the Arctic. CEACs may also have sources associated with industrial development in the Arctic, or even research activities themselves.

The Arctic is undergoing unprecedented change, primarily associated with climate warming from emissions of greenhouse gases and short-lived climate forcers. Surface air temperatures in the Arctic have increased at three times the global average over the past 50 years, resulting in cryosphere change (loss of sea- and land ice, permafrost thaw, etc.) and changes to Arctic ecosystems. Related to these environmental changes are improved access, in particular marine access, to areas that are potentially rich in natural resources. Human development of the Arctic has increased, and this trend is expected to continue. With increasing human presence in the Arctic comes increasing use of chemicals within the region. Climate change is also altering pathways and fate of environmental contaminants, potentially remobilizing contaminants that have accumulated in Arctic snow, ice, water, and sediments as well as altering their uptake and transfer through Arctic ecosystems and food webs.

Under INTERACT WP8, work has identified chemicals that could be considered for a coordinated research/monitoring effort involving the Arctic research station network, their scientific research community, and associated local communities (D8.1), and options for practical work that could be implemented at INTERACT stations to support environmental contaminants monitoring and research (D8.2). To build capacity and extend the geographical coverage of screening monitoring of POPs and CEAC work was undertaken to establish links to ongoing screening monitoring programs and networks to test protocols designed to enhance screening monitoring applications at INTERACT Stations (D8.3).

This final WP8 deliverable (D8.4) reports on outcomes of the 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 inform appropriate agencies of potential threats from emerging pollutants.

1. Purpose and scope of this document

The INTERACT station network provides an opportunity for enhancing research to better understand the occurrence and sources of contaminants such as Persistent Organic Pollutants (POPs) and Chemicals of Emerging Arctic Concern (CEACs), including increasing engagement of INTERACT stations in monitoring programmes such as that coordinated by the Arctic Monitoring and Assessment Programme (AMAP).

Previous INTERACT III WP8 deliverable identified chemicals of potential interest in this context (D8.1) and options for practical work that could be implemented at INTERACT stations to support environmental contaminants monitoring and research (D8.2). Use of passive air samplers (PAS) and passive water samplers (PWS) was identified as particularly appropriate in this respect, given the location, facilities, logistical and staffing situations existing at most INTERACT stations.

With this background, contacts were established between a number of INTERACT station managers and operators of passive sampler networks, and plans were developed for deployment of passive samplers during the 2023 and/or 2024 field seasons (D8.3).

Work under WP8 was impacted both by the Covid pandemic and the restrictions introduced following the Russian invasion of Ukraine; however, the extension to the project period and agreement that some WP8 resources could be reallocated allowed greater than originally planned practical work to facilitate, test and gain experience from deployment of PAS and PWS at 9 INTERACT Stations.

This final deliverable (D8.4) reports on outcomes of the practical work performed, including experiences in field deployment of passive samplers to date, and concludes the pilot implementation work by developing recommendations to (i) inform appropriate agencies of potential threats from emerging pollutants and (ii) promote the further development of collaboration between INTERACT stations and relevant monitoring networks to maintain and build on the pilot activities undertaken in INTERACT III WP8.

2. Results of Work to Date

A main objective of WP8 involved working with INTERACT station managers to identify potential sources of emerging contaminants of concern and reduce their impacts by:

- Identifying/establishing screening monitoring protocols for emerging pollutants; field testing protocols at INTERACT stations.
- Working with INTERACT station-managers/researchers to promote and support screening monitoring studies.
- Refining existing systems at INTERACT stations to minimize introduction and use of new chemicals/pollutants of concern.

Previous reports document WP8 work to identify chemicals that could be considered for a coordinated research/monitoring effort involving the Arctic research station network, their scientific research community, and associated local communities (D8.1), and options for practical work that could be implemented at INTERACT stations to support environmental contaminants monitoring and research (D8.2). To build capacity and extend the geographical coverage of monitoring of POPs and screening for CEAC, work was undertaken to establish links to ongoing screening/monitoring programs and networks to test protocols to enhance screening/monitoring applications at INTERACT Stations (D8.3).

During the final (ca. 18-month) period of the project, pilot implementation of passive sampler deployment was undertaken at 9 INTERACT stations (see Figure 1). These 9 stations were selected for pilot implementation based on consultations between coordinators of international monitoring programmes and station managers regarding site suitability and, e.g., programme objectives to regarding filling geographical gaps. Thirteen other INTERACT stations expressed an interest in this WP8 activity and could be considered in future follow-up work.

Details of the test deployment are described in sections 2.1 and 2.2.

Figure 1. INTERACT sites where pilot implementation of studies using PAS (dark blue) and PWS (green: marine deployment; light blue: freshwater deployment) has been undertaken, also showing other INTERACT stations (grey) where managers expressed an interest in possible participation in pilot and/or future activities to deploy PS devices.

2.1. Test deployment of Passive Air Samplers

Test deployment of Passive Air Samplers (PAS) was arranged through collaboration with the Global Atmospheric Passive Sampling (GAPS) Network, an established programme that contributes to both Arctic regional monitoring systems such as that of the Arctic Monitoring and Assessment Programme (AMAP) as well as global systems, including the Global Monitoring Programme (GMP) of the Stockholm Conventions (REF).

At the end of 2022, work was initiated that resulted in pilot implementation involving deployment of PUF-PAS samplers at 4 INTERACT Stations in 2023/2024 (Table 1, Figure 1). For the GAPS network, this pilot implementation addressed spatial gaps in coverage for the Arctic region (see Figure 2). One sampler housing and three PUF disks (one for field blank) were shipped to each station. At two stations, additional sampling materials were provided to establish a second sampling location at a distance from the station itself, to assess potential local sources affecting POPs contamination around the station.

Table 1: Summary of INTERACT GAPS Network sites and deployments under the pilot implementation[1].

Site Name	*Sampler Location*	*Period 1 – Start*	*Period 1 – End* *Period 2 – Start*	*Period 2 – End* *Period 3 – Start*
CEN Kangiqsuallujjuak Research Station	*Station*	*July 2023*	*Dec/January*	*May 2024*
	Remote	*July 2023*	*Dec /January*	*May 2024*
CEN Whapmagoostui-Kuujjuarapik Research Station, Nunavik	*Station*	*June 2023*	*Dec /January*	*May 2024*
	Remote	*June 2023*	*Dec /January*	*May 2024*
CEN Bylot Island	*Station*	*July 2023*	*Dec / January[3]*	*May 2024[3]*
Greenland Institute of Natural Resources, Kobbefjord (Greenland)	*Station*	*October 2023*	*~April 2024*	*Early-June 2024*

Karoline Nordberg Nilsson changes the PUF filter on the PAS deployed at Kobbefjord, Greenland. Photo: Katrine Raundrup

[1] Characteristics of INTERACT stations engaged in pilot implementation of PAS or PWS under WP8 are detailed in Appendix 1.

For most sites, samples are being collected biannually (i.e., sampler deployments of approx. 6-month) in order to provide sufficient air sampling volume for detecting target chemicals. This schedule also allows for summer+fall vs. winter+spring period comparison. The first two samples have been collected at each of the sites and currently the third sample is deployed.

Analysis of the PUF-PAS samples is a contribution of the GAPS programme and is currently (as of summer/fall 2024) ongoing on samples collected during the initial deployment period (Period 1). Analyses will include POPs listed under Stockholm Convention, e.g., PCBs, organochlorine pesticides, flame retardants, and other target analytes routinely monitored under the GAPS program. First results for concentrations in air are expected in early-2025 and would be included under the Stockholm Convention GMP4 reporting

2.2. Test deployment of Passive Water Samplers

Test deployment of Passive Water Samplers (PWS) was arranged through collaboration with the Aquatic Global Passive Sampling Network (AQUAGAPS/MONET), an established programme that contributes to both Arctic regional monitoring systems as well as global systems (REF).

At the start of 2023, work was initiated that resulted in pilot implementation involving deployment of SSP silicon samplers at 7 locations (2 marine and 5 freshwater) at 5 INTERACT Stations in 2023/2024 (Table 2, Figure 1). For the AQUAGAPS network, this pilot implementation addressed spatial gaps in coverage for the Arctic region and contributed to the second round AQUA-GAPS/MONET campaign (see Figure 3).

The pilot implementation started in 2024 with a deployment period varying from 3-6 months depending on environmental conditions and staffing at the stations concerned. For each station, sampling frames and SSP disks (including field blanks) were shipped to the station. Analysis of the PWS samples is a contribution of the AQUAGAPS/MONET programme with initial analyses of the standard suite of contaminants included under this programme planned in 2024.

In addition to the collaborative work with the AQUAGAPS/MONET network, the INTERACT Greenland Institute for Natural Resources (GINR) station assisted in deploying a PWS in Kobbefjord over the summer of 2022. Unfortunately, the deployed sampler was subject to accidental or intentional interference and could not be recovered.

Table 2: Summary of INTERACT AQUA-GAPS/MONET Network sites and deployments under the pilot implementation.

INTERACT STATION	*Site*	*Sampler number/ Location*	*Status*
West Greenland Arctic Station	*Sanningasup Tasia, Greenland*	*296/L_079 freshwater (moraine) lake*	*deployed*
Polish Polar Station	*Ragnar lake, Svalbard*	*297/L_076 freshwater lake*	*deployed*
	Petunia Bay, Svalbard	*300/L_077 marine (coastal)*	*deployed*
Abisko Research Station	*Långa Harrsjön, Stordalen, Sweden*	*298/L_072 freshwater lake*	*deployed*
Zackenberg Research Station	*Zackenberg, Greenland*	*299/L_078*	*sent, pending permit*
Sudernes Science and Learning Centre	*Saurbæjarvík, Hvalfjörður, Iceland*	*301/L_070 marine (coastal)*	*deployed 16/05/2024*
	Reykjanes Peninsula (lake), Iceland	*302 / freshwater lake*	*sent*

Ragnar lake, Svalbard (Polish Polar Station)

Saurbæjarvík, Hvalfjörður (Sudernes Science and Learning Centre)

Långa Harrsjön, Stordalen (Abisko)

Sanningasup Tasia, Greenland (Arctic Station)

INTERACT station PWS deployments

3. Conclusions and Recommendations

3.1.Station Managers and Programme Operator feedback

Managers of stations participating in the pilot passive sampler deployments and operators of the GAPS and AQUAGAPS monitoring programmes were invited to comment on their experiences to inform possible future work. The following summarises the responses received from four stations and the two programmes:

Asked whether involvement in WP8 and interaction with the GAPS/AQUAGAPS network had increased knowledge, understanding or interest of site managers in issues relating to presence of Arctic environmental contaminants in general and/or around the stations, the replies were mixed. In one case it was strongly affirmative, in another the opposite. It was recognized that at most sites deployment was still ongoing and/or sites were still awaiting the results of analysis of their samples as this activity is funded and scheduled according to the priorities of the programmes concerned. Programme organizers confirmed their intent to actively follow-up with station managers to discuss the results, both as part of the routine feedback process but also to discuss results of PAS deployments at and at distance from the stations (which can provide information on local contamination) and to evaluate the possibilities and suitability of the stations for continued participation in the programmes concerned.

Consideration of new thinking or practices at stations to avoid introduction of harmful environmental contaminants as a result of the pilot operations were also largely pending the results of the sample analysis. Two stations reported preexisting awareness of issues related to potential environmental impact of station operations and the need to minimise these, welcoming new insights in this respect. One station also noted local sources of (metal) contamination from mining activities in the vicinity and their practices to adhere to relevant regulations and guidance in this connection.

Concerning experience in participating in the pilot deployment of passive air/water samplers at the INTERACT stations, the responses from both programme and station managers was consistently positive. Station managers also indicated that they would recommend such activity to other stations, as a good example of how to integrate environmental station monitoring with international projects. They noted the benefits this brings for both scientists/managers in appreciating the wider relevance of their work as well as the role that greater participation in coordinated international work can make to understanding geographic and temporal trends of organic pollutants.

Generally, the passive samplers were considered to be relatively easy to set up, not requiring unreasonable effort or time. It was however noted that station managers should consider their site suitability with respect to the available protocols that are not developed specifically for Arctic sites.

All involved stations reported very positive (good/excellent) experience in interaction and engagement with managers/coordinators of the passive sampler networks, including expressing appreciation to the individuals involved in this respect. Communication with the network coordinators worked well, feedback and answers to questions that arose concerning sampler deployment was prompt and helpful. Such support was considered essential for the successful implementation of the work.

In addressing whether the practical work involved was manageable, or more complicated/easier than anticipated, station managers reported that the work was generally manageable. In some cases the work required was more difficult than anticipated from the description in the protocols received. In such cases this generally reflected typical challenges of working at remote Arctic sites; the need to carry equipment long distances; use of boats (and at one site divers) to deploy samplers - and at the same time avoid contamination; need for 2-3 persons to conduct the work to install samplers and/or change samples. The pilot deployments may identify additional issues, for example limited periods for site access and/or the survival of PWS in waters that freeze, which can require adjustments to normal deployment strategies and protocols.

Shipment of the passive samplers themselves generally proceeded without problem; sample storage prior to return, and arrangements for (international) shipment of samples introduced complications. One station lacked the facility on-site to store samples in a fridge that is not used for storage of chemicals, and arrangements for paying for shipment of samples between countries proved more complicated than expected.

None of the stations reported issues associated with the need to consult with local residents; for example, to avoid interference with samplers, although this could still be an issue at sites that did not respond to the post deployment feedback request.

Several comments referred to protocols currently available from the passive sampler monitoring programmes, both generally and concerning specific parts; this may reflect the fact that such protocols are normally targeted at individuals more familiar with working with environmental contaminants. From a station manager perspective, protocols (for PWS) would ideally be shorter and written in a more simple way assuming complete ignorance of the procedures involved. However, for PAS, it was noted that the protocol may need to be more elaborate/detailed as setting up the device in a relatively windy area required additional tools and brackets to those included in the PAS package supplied.

Some specific points mentioned in relation to protocols included:

- information (e.g. on the need to store some equipment in a freezer prior to deployment), that could be better communicated during preliminary discussions rather than only in the protocol documents;
- specific advice on clothing not to wear (with pictures) would be useful as it is not always possible to obtain appropriate clothing at remote field sites;
- specific description on how to mount (12) sheets without overlap on PWS devices (supplied frames did not seem to accommodate more than 8;
- possible need to describe/recommend the use of small boats for deploying PWS in lakes where conditions may be more challenging than those expected in other regions.

Station managers had, for the most part not fully considered communicating results of the pilot implementation work to site visitors or local communities, although this was planned at one station. Most reported that this would be considered once the results of the analysis were available and had been discussed with programme coordinators.

All responding stations indicated an intention or willingness to continue (and potentially expand) this type of work at their stations, to contribute to establishing long-time series, assuming similar levels of

work were involved and depending on the interest of the monitoring networks in this respect. Requirements included continued funding or logistical assistance associated with shipping of samples rather than staff costs.

3.2.Main achievements

Considering the challenges to implementing planned work under WP8 associated firstly with Covid-19 restrictions and then adjustments to the INTERACT project implementation plan, the pilot implementation of passive samplers reported in D8.4 (building on work reported in D8.1-8.3) exceeded expectation in terms of the number of INTERACT stations involved. The original concept identified three stations for pilot implementation, nine participated with four stations implementing PS work at multiple sites (two to cover both marine and freshwater systems and two to investigate on-site vs remote site source influence).

Although work to complete sample laboratory analysis continues, the established relationships between the participating stations and the passive sampler networks concerned will result in both delivery of results and their comprehensive discussion with station managers. These discussions will inform future consideration of continued engagement of stations in the programmes and may give insight into the extent to which stations are possible sources of local contamination and how to avoid this.

The work under WP8 was intended to create a legacy that extends beyond the end of the INTERACT III. The pilot implementation facilitated through WP8 has demonstrated the capability of INTERACT stations to contribute to and extend the scope of contaminant monitoring in support of Arctic regional/international monitoring programmes. The positive experiences of the participating stations in the pilot implementation work not only establishes a basis for possible continuation/extension of their engagement in international contaminant monitoring programmes, but also provides examples that can be used to promote wider adoption of this type of work at other INTERACT stations.

The pilot implementation focussed on target screening for environmental contaminants; however, samples archived from the work to date also present possibilities for non-target screening (currently being considered under the AQUAGAPS programme).

From the perspective of the international monitoring programmes, the work completed under INTERACT III WP8 has filled geographical gaps in international monitoring programmes in the Arctic region (see Figures 2 and 3). The results of the pilot implementation will be used to further develop the monitoring programmes, including improving existing protocols and updating of AMAP monitoring guidance documents that are currently under preparation.

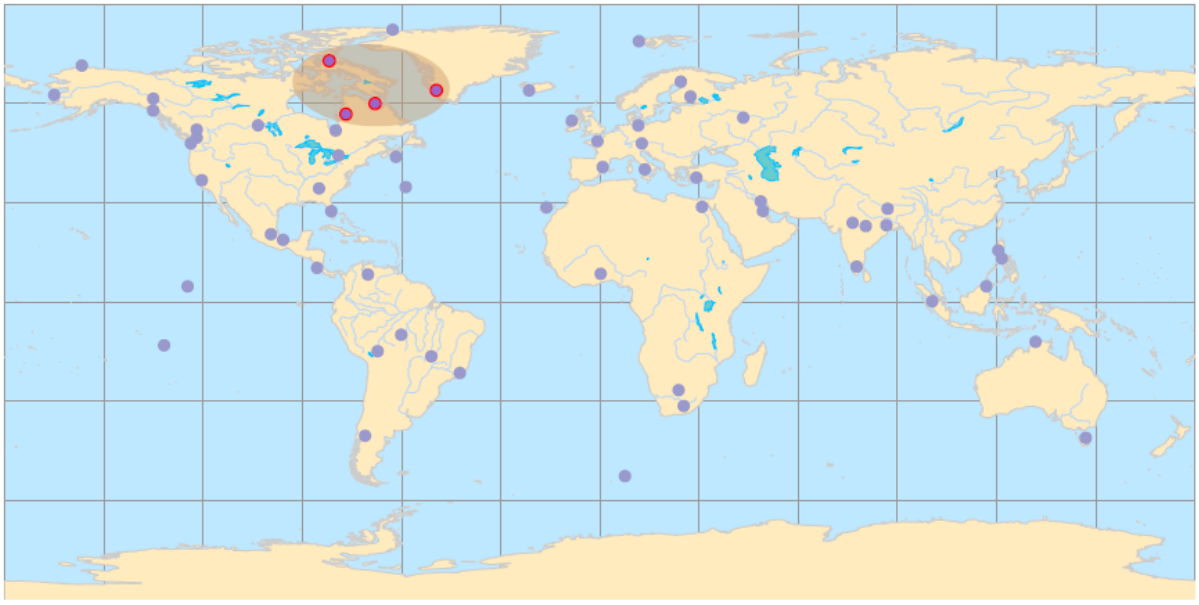

Figure 2: GAPS PAS network showing the geographical area filled by INTERACT sites participating in WP8 pilot implementation.

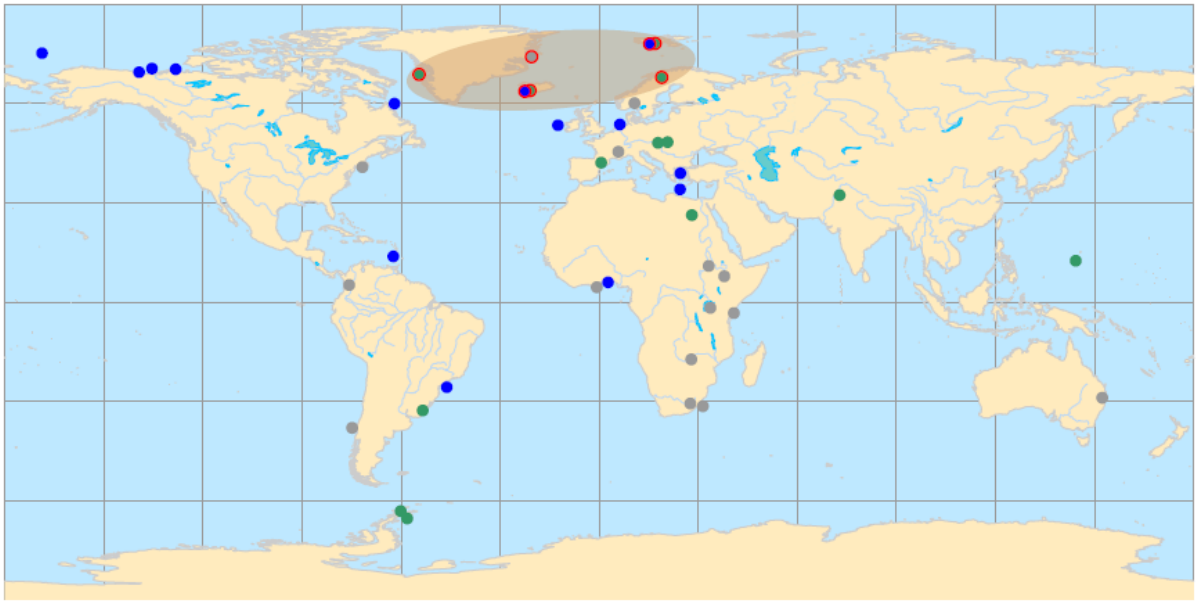

Figure 3: AQUAGAPS PWS network (green: freshwater; blue: marine; grey: deployment pending) showing the geographical area filled by INTERACT sites participating in WP8 pilot implementation.

3.3. Informing appropriate agencies of potential threats from emerging pollutants

First results for concentrations in water and air are expected in late-2024 and early-2025, respectively, and will be included under the global Stockholm Convention GMP4 reporting. On an Arctic regional level, results will be available for use in AMAP assessments addressing local and long-range transported POPs and CEACs.

3.4.Recommendations

Relevant information including INTERACT station descriptions and contact information and contact points for the respective passive sampler networks are compiled in previous deliverables (D8.3).

Recommendations based on the field implementation work are provided below.

Geographical gaps: The experience of participants in the pilot implementation work should be shared with others in the INTERACT station network, e.g., through the INTERACT station managers forum, with a view to encouraging further stations to consider joining the contaminant monitoring networks. The pilot implementation has facilitated extension to the geographical coverage of AMAP/international monitoring that will hopefully continue as a legacy of the INTERACT III project work. The project identified further gaps could be filled, for example by considering inclusion of the Villum Research Station (VRS) in the GAPS network and Toolik Lake site in the AQUAGAPS network. Both site have experience in deployment of PS and the VRS also operates active air monitoring that would allow for comparison with the PAS results. Coverage of Arctic Russia currently represent a major geographical gap in all international monitoring programmes.

Co-location of air and water (passive) sampling was not realised in the pilot implementation, but could be promoted in future work, both to provide a more complete picture of environmental contamination and also to enhance linkages between relevant networks, including both national and international programmes.

Legacy: Under existing arrangements with the GAPS network, sampling will continue at the stations involved in the pilot implementation until 2025, at which time the future of the collaboration will be discussed. Looking to the future, if the arrangement between the GAPS network and INTERACT stations involved in sample deployment can be continued, sampling which would begin in 2025 (Period 4+) could shift focus to consider more volatile POPs (e.g., HCB, PeCB. HCBD, PFASs) by using a SIP disk instead of PUF disks deployed in the sampler housings.

Under AQUAGAPS continuation of work in the near-term would depend on resources for preparation of samplers, shipment and laboratory work; continued inclusion of Arctic stations will be evaluated in relation to available resources.

Community-based monitoring: Where stations have possibilities to engage with local communities, they could promote the type of work implemented within the context of community-based monitoring. This could provide a means of both enhancing community relations with research stations

and potentially increase the capacity for supporting practical work, e.g. in periods where stations are not manned.

Resources: Relevant funding agencies should consider the results of the pilot implementation in relation to allocation of funding to support continuation and possible expansion of the pilot activities. The pilot studies demonstrated that the costs of the sampling equipment, deployment of the samplers and related shipping are relatively low. The major costs would be associated with laboratory analysis – work covered in the pilot study by the collaborating networks.

Communication: The need for good communication between individuals (programme managers and station managers/operators) involved in the work is critical, especially in the initial stages of the collaboration. This needs would decrease as sites gain experience and operators become routine in the work involved. Reported experiences in the pilot implementation work were very positive in this regard, reflecting the experience of the programme contacts involved at GAPS and AQUAGAPS in building their networks of sites around the world. There is potential to build the station capacity through training of local community members where this is a possibility, to develop community-based monitoring capability.

Protocol development: There may be a need to adapt existing protocols to account for the particular challenges associated with deploying passive samplers at Arctic sites. These challenges are associated with harsh weather conditions, ice, unanticipated interference with samplers, and limitations on deployments due to short season/darkness. For example, PWS deployments in the pilot study were typically 3-6 months rather than a year; marine deployments generally proved more challenging than freshwater lake deployments in this regard.

Several site operators reported the need to interact with programme managers on questions regarding deployment or clarification of instructions for constructing the samplers on-site; prompt responses in such situations was critical to the success of the pilot implementation work. Practical testing of the guidance/instructions by those responsible for the work prior to actual field work is recommended.

Technical assistance from station managers: Work to streamline the process of obtaining permissions for deployment of passive samplers and related shipment of samplers and samples could be improved. Programme operators needed to become acquainted with different requirements associated with different countries/sites in this respect. Station managers helped locate (online) permit forms, etc., and experience gained in this process can be carried forward, but there may be a greater role for, e.g. the station managers in obtaining permissions based on their knowledge of the procedures involved for other station work.

4. References

INTERACT III D8.1: Catalogue listing local and transboundary emerging pollutants.

INTERACT III D8.2: Protocols for (target and nontarget) screening of contaminants of emerging concern at INTERACT stations.

INTERACT III D8.3: Compilation of results from testing of protocols with managers at selected INTERACT stations.

5. Glossary

CEACs: *Chemicals of Emerging Arctic Concern*

PAS: *passive air sampler*

POPs: *Persistent Organic Pollutants*

PWS : *passive water sampler*

Appendix 1: Characteristics of INTERACT stations engaged in pilot implementation of PAS or PWS under WP8

(characteristics of other INTERACT sites considered for PS deployment can be found in D8.3)

INTERACT Station	*WP8 pilot deployment*	*Site information*
Abisko	*PWS*	***Country:*** *Sweden* ***Climate zone:*** *Located in mountain birch forest, approx. 380 m.a.s.l., near the shore of Lake Torneträsk. Surrounded by birch forests, mires, freshwater bodies, mountains and alpine tundra. 68°N.* ***Operational period:*** *Year-round operation, permanent staff.* ***Nearest town/settlement:*** *Located near the village of Abisko (~150 permanent inhabitants, many seasonal tourists). Station located near paved road (approx. 125m; Luleå-Narvik, E10, speed limit 90 km/h, passenger vehicles and trucks) and railroad (approx. 150m; four passenger trains per day and 10+ iron ore trains per day).* ***Contact point:*** *Emily Pickering Pedersen <emily.pedersen@polar.se>* ***Other:*** *Long-term environmental monitoring programme on-site, focusing on meteorological measurements. Potential to have passive air and/or water samplers deployed in connection to the already-existing environmental monitoring programmes.*

INTERACT Station	*WP8 pilot deployment*	*Site information*
Arctic Station	*PWS*	***Country:*** *Greenland* ***Climate zone:*** *Low Arctic, coastal climate.* ***Operational period:*** *Year-round operation, permanent staff.* ***Nearest town/settlement:*** *Located near the village Qeqertarsuaq (~850 inhabitants) on Disko Island, central West Greenland. Transport to Disko from Ilulissat or Aasiaat; by boat during summer (May-October) and by helicopter during winter (Nov-May).* ***Contact point:*** *Charlotte Sigsgaard <cs@ign.ku.dk>* ***Other:*** *Connections to local community; access to boats for marine deployment. Arctic Station is part of Greenland Ecosystem monitoring (GEM) and is running a long-term monitoring programme covering both Marine and Terrestrial activities (www.g-e-m.dk). Potential to have both PAS and PWS installed. There are sensors deployed in the river Røde Elv each year and there are a lake nearby (Moræne sø) for potential lake deployment. See INTERACT Station catalogue for more info about Arctic Station (27). There are laboratory facilities at Arctic Station. Shipping of equipment; air freight ~1 week, sea freight~4 weeks.*
CEN – Whapmagoostui-Kuujjuarapik	*PAS*	***Country:*** *Canada* ***Climate zone:*** *Located at the terrestrial boundary between taiga and tundra; discontinuous or scattered permafrost occurs throughout the region and is degrading rapidly; climate is strongly influenced by the proximity of Hudson Bay, and the recent pronounced loss of sea ice has been accompanied by large increases in air temperature* ***Operational period:*** *Year-round operation* ***Nearest town/settlement:*** *The station is located on the eastern shore of Hudson Bay at the maritime limit of James Bay, and in the adjacent villages of Whapmagoostui (Cree First Nation) and Kuujjuarapik (Inuit).* ***Contact point:*** *Mickael Lemay <mickael.lemay@cen.ulaval.ca>* ***Other:*** *Interest of CEN to deploy PAS at Whapmagoostui-Kuujjuarapik; could maybe install 2 PAS, one in the station vicinity (probably recording the influence of the diesel electric central) and one outside the community in the natural environment (far from direct sources of contamination). Station has good connection with local community; access is by commercial airlines; access to the surrounding area by chartered flights, boat, and all-terrain vehicles can be arranged*

INTERACT Station	*WP8 pilot deployment*	*Site information*
CEN – Kangiqsuallujjuak	*PAS*	***Country:*** *Canada* ***Climate zone:*** *The area is characterized with discontinuous permafrost.* ***Operational period:*** *Open year-round* ***Nearest town/settlement:*** *The station is located directly within the limits of the village of Kangiqsualujjuaq which has a population of 942 inhabitants.* ***Contact point:*** *Mickael Lemay <mickael.lemay@cen.ulaval.ca>* ***Other:*** *Interest of CEN to deploy PAS at Kangiqsuallujjuak (Nunavik); could maybe install 2 pAS, one in the station vicinity (probably recording the influence of the diesel electric central) and one outside the community in the natural environment (far from direct sources of contamination). Station has good connection with local community; daily access by commercial airline (Air Inuit) from Kuujjuaq*
CEN – Bylot Island *Other possible sites: Umiujaq, Salluit and Clearwater Lake*	*PAS*	***Country:*** *Canada* ***Climate zone:*** *see links for the different stations* ***Operational period:*** *see links for the different stations* ***Nearest town/settlement:*** *see links for the different stations* ***Contact point:*** *Mickael Lemay <mickael.lemay@cen.ulaval.ca>* ***Other:*** *If deployment at CEN - Bylot Island proves successful, could consider additional remote sites, with an irregular sampling frequency of the PAS (e.g. from August/September to May/June (winter) and from May/June to August/September (summer)). Other possible sites would be Umiujaq, Salluit and Clearwater Lake*

INTERACT Station	*WP8 pilot deployment*	*Site information*
Greenland Institute of Natural Resources (GINR)	*PAS*	***Country:*** *Greenland* ***Climate zone:*** *Low Arctic ecosystem (Nuuk and the Kobbefjord) with different biotopes such as dwarf-shrub heaths, fens, grasslands, and lakes. Niaqornat, Uummannaq is at the border between Low and High Arctic.* ***Operational period:*** *Year-round operation (Nuuk), satellite stations – seasonal.* ***Nearest town/settlement:*** *Main facilities are located in Nuuk (ca 16 000 inhabitants); additional facilities include field stations in Kobbefjord and Niaqornat (ca. 70 inhabitants) close to Uummannaq. Access via commercial flights to Nuuk; transportation to Kobbefjord is by one of GINR's own smaller boats carrying up to 12 persons. The field station in Niaqornat can be reached twice a week by helicopter from Uummannaq.* ***Contact point:*** *Katrine Raundrup <kara@natur.gl>* ***Other:*** *GINR has potential interest in deployment of GAPS PAS and the freshwater passive samplers*
Petunia Bay (Svalbard)	*PWS*	***Country:*** *Svalbard* ***Climate zone:*** *High Arctic tundra, in zone of continuous permafrost.* ***Operational period:*** *seasonal, mainly summer.* ***Nearest town/settlement:*** *Pyramiden harbour (4 km from the station; tourist ships in summer season); Longyearbyen, 60 km away; station located on the western coast of Petunia Bay (Petuniabukta) in NE part of Isfjorden, central Spitsbergen. In the vicinity of former Russian coal mine Pyramiden, abandoned in 1998, now operating for tourism. Access via Longyearbyen (air) and Pyramiden (ship) and on foot from harbour or using zodiac boats for transportation within the fiord.* ***Contact point:*** *Juliana Kasprzyk <Juliana.souza-kasprzyk@amu.edu.pl>* ***Other:*** *Interest in AQUA-GAPS/MONET PWS network, with possibility to send the samplers between Poland and Czech.*

INTERACT Station	*WP8 pilot deployment*	*Site information*
Sudurnes SLC	*PWS*	***Country:*** *Iceland* ***Climate zone:*** *Maritime subarctic* ***Operational period:*** *Year-round operation* ***Nearest town/settlement:*** *Sudurnes Science and Learning Center is located by Sandgerdi (ca. 1600 inhabitants) harbor on the western coast of the Reykjanes Peninsula, about 50 km west of the capital, Reykjavik. Accessible by car/public transport.* ***Contact point:*** *Sölvi Rúnar Vignisson <solvi@thekkingarsetur.is>* ***Other:*** *It would be possible for the centre to arrange for installation of PAS on Iceland in an area with no human contact (one site on Iceland already contributes to the GAPs network); deployment of PWS in lake settings (large/small lake, close to population or remote) would also be possible; deployment of a PWS in marine system would require funding but station has access to boat and suitable setup for this.*
Zackenberg	*PWS*	***Country:*** *Greenland* ***Climate zone:*** *High Arctic in an area with continuous permafrost* ***Operational period:*** *Station open from April to September/ October.* ***Nearest town/settlement:*** *No nearby community; located in Young Sund/Tyrolerfjord in the southern part of NE Greenland national park; nearest settlement is Daneborg (military outpost) 25 km from station; nearest town is Ittoqqortoormiit (450 inhabitants, 450 km distant). Access via combination of commercial and charter flights.* ***Contact point:*** *Marie Frost Arndal mfa@ecos.au.dk, Mikhail Mastepanov <mikhail.mastepanov@ecos.au.dk>* ***Other:***

Appendix 2: Monitoring Network contacts

GAPS PAS Network:

Contacts: *Tom Harner (ECCC) Tom.Harner@ec.gc.ca and Amandeep Saini (ECCC) Amandeep.Saini@ec.gc.ca*

Documentation: *GAPS SOP for the deployment of the PUF disk sampler in air.*

AQUA GAPS/MONET PWS Network:

Contact: *Branislav Vrana <branislav.vrana@recetox.muni.cz>*

Documentation: *Example protocol for deployment of PWS in AQUA-GAPS. This type of open cages is applicable in both marine and freshwater deployments. Freshwater deployments are generally much easier since deployment is possible using simple stainless steel BBQ frames that are easy to transport or obtain locally. Passive samplers are available from RECETOX.*

Further details are available at this dedicated website: http://www.aqua-gaps.passivesampling.net/

An illustrative video on deployment of aquatic passive samplers in freshwater is here:

https://www.youtube.com/watch?v=or0CdVRewRQ