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CONNECTING SCIENCE WITH SOCIETY

Deliverable 2.3

Inventory of existing monitoring and modelling programmes

Submission of Deliverable

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Executive summary

An overview is given of current monitoring and modelling programmes in the polar regions. The inventory is the result of communication with key representatives of national and international agencies and organisations, parallel inventory work conducted by SAON for the Arctic and internet search. The inventories are given as two Excel documents for observational and modelling programmes separately. This document presents the status at the time of writing, and needs to be updated during the project to reflect new monitoring and modelling initiatives as they arise.

1. Introduction

Many countries have conducted programmes for observations and monitoring of environmental variables in the Arctic and the Antarctic. The eight Arctic Council countries have been operating such programmes for several decades to meet national and international obligations. In addition, a number of mainly Asian and other European countries have historically had Arctic observational activities. In the Antarctic, several European countries have a long tradition of polar observations linked to major research facilities and infrastructures, to some extent coordinated by the Scientific Committee on Antarctic Research (SCAR), which has approximately 40 members.

> This task builds on current national and international monitoring and modelling activities (…). It will develop an inventory of existing monitoring activities, including the parameters monitored, frequency, sampling locations (to the extent possible), and associated data reporting and data handling arrangements. (…)
>
> This Task will focus on:
> - Preparing an inventory of existing monitoring and modelling programmes. (…)"
>
> **Box 1: Task Description**

In addition, a number of global and regional organisations have observational or monitoring programmes which are either entirely polar or have a polar component.

More recently modelling programmes have been developed aimed at integrating environmental observations to study spatial and temporal changes, and to better understand interactions between components of the climate system, the biosphere, and the solid earth. Such modelling programmes are often hosted by international organizations and frequently have an observational component.

Up to date a consolidated overview of these programmes does not exist, and this inventory is meant to fill that gap.

At the same time, the EU-PolarNet inventory runs parallel with, and is a contribution to similar work undertaken by SAON (Sustaining Arctic Observing

Networks), which is currently organising inventories of Arctic observational assets (networks, platforms, programmes, and projects).

The current deliverable is a contribution to Task 2.3 ("Optimisation of existing monitoring and modelling programmes") of Work Package 2 ("Polar research for Science and Society'). The task description is found in Box 1. Within Task 2.3, the inventory will serve as input to:

- D2.5 Strategic analysis of the different monitoring and modelling programmes and related infrastructures
- D2.6 Roadmap for optimisation of monitoring and modelling programmes

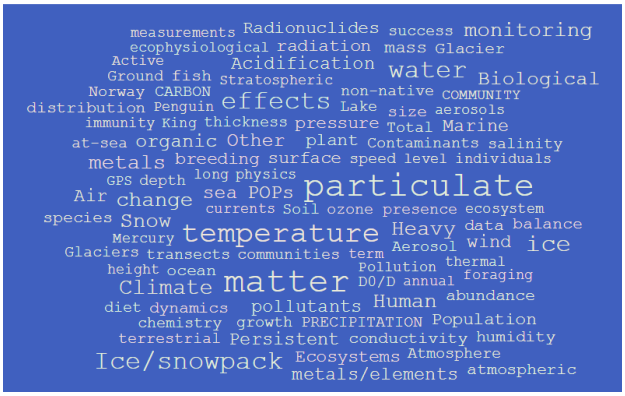
2. Sources and methods

2.1. Monitoring/observational programmes inventory

2.1.1 Identification of sources of information

Sources of information have been identified through the following approaches:

- Communication with members of the EU-PolarNet Consortium
- Communication with members of the European Polar Board (EPB)
- Communication with members of the Scientific Committee on Antarctic Research (SCAR)



Box 2: Word cloud of parameters in the monitoring/observational programmes inventory

- Contact to global and regional organisations known to be involved in monitoring/observational programmes (like AMAP, CliC, ESA, ICES, NASA, WMO, etc.)
- Inventory work conducted by the SAON Committee on Observations and Networks (CON), as described in the SAON CON Inventory Work Plan[1]. CON started the organisation of inventories of Arctic observational assets in the spring of 2016.
- Internet search
- Authors' own knowledge and research.

[1] http://www.arcticobserving.org/images/pdf/Committees/CON/Inventory_work_plan/CON_inventories_work_plan_23rd_february.pdf

2.1.2 Source types

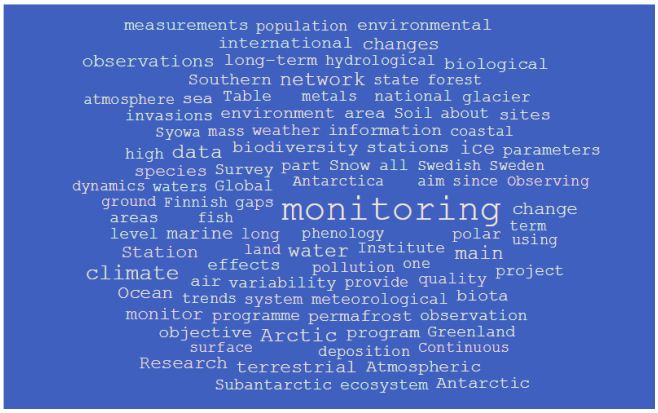
Many countries or organisations have neither structured nor unstructured overviews of their monitoring/observational programmes. In some cases the overview resides within a few persons within the countries or organisations. In other cases such overviews have been produced at a particular point in time and for a particular purpose, but have not been updated later. Finally, in some cases overviews exists but are not practically accessible. This could be because they are either stored only on paper or in electronically inaccessible formats like pdf or html files.

The situation is generally different for modelling programmes, which usually have a dedicated website to advertise and coordinate their activities.

2.1.3 Source harvesting and processing

Depending on the technical nature of the source, different methods have been used to harvest and process the information:

1) Existing, accessible databases: The owner of the database was contacted and provided the information in a spreadsheet file. This process was used for the 'AMAP/ENVINET/SAON Project Directory'.
2) Spreadsheet files: For the 'Canadian Monitoring Inventory' the information was available on the web as a spreadsheet file, which was downloaded.



Box 3. Word cloud of the descriptive text in the monitoring/observational programmes inventory

3) Web page information: In the cases where a contact pointed to a web page as the source of information, the information was harvested manually from that web page and transferred into the inventory. This is for instance the case for the information from the Scientific Committee on Antarctic Research (SCAR), the Southern Ocean Observing System (SOOS), and the Standing Committee on Antarctic Data Management (SCADM).
4) Email correspondance: In many cases, information was provided through an email correspondence with the contacts. In some cases the information was given in a spreadsheet file, which could be loaded directly into the directory. In other cases the information was given as MS Word of pdf files or as text in the body of the email. In these cases, the information was transferred manually into the inventory.
5) Published reports: In two cases (COMNAP and USA), information was extracted from published reports and transferred manually into the inventory.

Appendix 3 gives an overview of the technical nature of the sources.

2.1.4 Formatting and mapping of monitoring programmes

The outcome of the harvesting and processing was a series of spreadsheet files which in some cases deviated in structure (columns):

- The major, structured sources (like 'AMAP/ENVINET/SAON Project Directory' and the 'Canadian Monitoring Inventory') have independent column definitions.
- In the cases where information was harvested directly from web pages, the information was organized directly according to the final inventory structure. This meant that it was not always possible to harvest all the information needed.
- In the cases where the information was harvested through email correspondence, the information provided was not always consistent or complete.

In all cases, the authors did a mapping of the information into the final inventory structure (Appendix 1). Especially the major, structured sources deviate in column definitions as can be seen from the listings in Appendix 5.

2.2 Formatting and mapping of modelling programmes

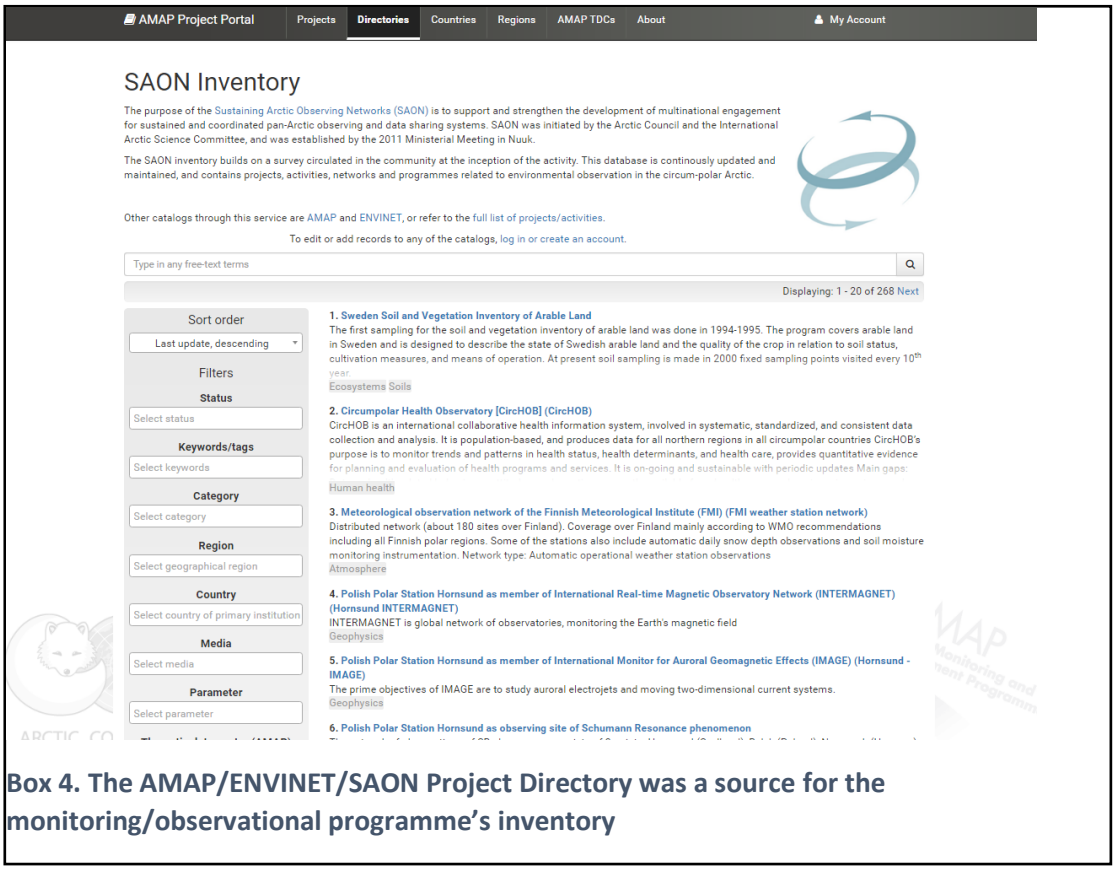
The harvested information was mapped into the inventory structure as described in Appendix 2.

2.3 Filtering

The nature of the information harvested has been diverse and it has been necessary to apply a high degree of filtering. The final inventories contain information about programmes, but in many cases, information about other types of activities or institutions have been harvested. The authors reviewed the information and filtered information that was not related to programmes.

The definition applied in this filtering process was that a *monitoring or observational programme* is an activity with a broad scope and a broad geographical coverage. It is a long-term continuous activity with a broad long-lasting base for support and governance. We did not include activities with a narrow scope and shorter duration of say 3 years or less; in this context such an activity would be a project.

Modelling programmes are thought of as overarching collaborative research initiatives, often hosted or sponsored by an international organization, and which have a dominant modelling component. These initiatives often do not carry any funding other than support for a project office and workshop meetings, but rely on research contributed by consortium or network members. This definition excludes modelling programmes run by individual institutes, but these are in almost all cases represented under a national or international programme. Additionally, many nations support an own polar research programme, but apart from the big countries, these are usually too limited to cover a specific modelling or modelling-dominated programme, and are therefore not listed as such.



Box 4. The AMAP/ENVINET/SAON Project Directory was a source for the monitoring/observational programme's inventory

In some cases, it was not possible to determine if an activity met the above criteria, and the filtering was based on the authors' judgement. If a source labelled an activity a monitoring/observational programme, then this activity was usually included in the inventory. If an activity covered a very narrow geographical area (like a river), it was not included.

3. Inventory review

The inventories have been circulated among consortia members. During this, updates were provided to the inventory on monitoring/observational programmes as described in Appendix 3. No updates were received for the modelling programmes inventory.

4. Inventory access and contents

The inventory of the monitoring/observational programmes is organised as an Excel file with the columns as described in Appendix 1. The inventory of the modelling programmes is equally organised as an Excel file with the columns as described in Appendix 2.

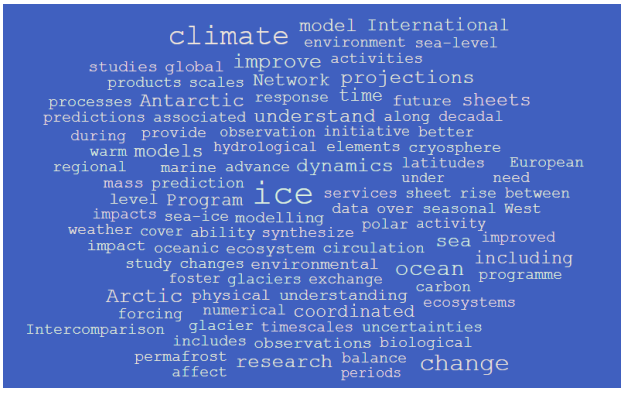
5. Inventory development and issues encountered

5.1 Monitoring/observational programmes inventory

The work with the inventory has raised a series of questions/issues that should be addressed for the inventory to be of value in the future.

Logical issues:

- Several countries and organisations have reported that overviews do not exist, are in-accessible or are not maintained. The inventory is only of value if the underlying sources are updated and accessible.
- Some of the programmes have a national basis but are also components of international programmes. This means that for instance the AMAP national programmes and the overall AMAP programme are recorded as independent programmes. This issue has partly been addressed by adding an 'Affiliation' column in the inventory.
- As described above, the harvested information has been filtered and only approximately 1/5 of the records harvested, ended in the inventory. In addition, the filtering was partly based on personal judgement. Especially the distinction between programmes and projects has left some activities in a grey zone, where they could have ended up in the wrong category.



Box 5. Word cloud of the descriptive text in the modelling inventory

- It is known that there are additional sources that are not developed or are inaccessible, and these have not been harvested. This applies specifically to:
    - Arctic Observing Viewer. It has not been possible to technically access this source.
    - Council of Managers of National Antarctic Programs (COMNAP), who are currently establishing inventories.
    - Svalbard Integrated Earth Observing System (SIOS) has been established recently and will maintain overviews of observational activities in Svalbard.
    - Svalbard Science Forum (SSF) maintains the 'Research in Svalbard' database. The database mainly contains projects, not programmes. Information about several Svalbard programmes has been harvested through other sources.

Technical issues:

- The sources that have been harvested have been technically diverse in nature. The range is from structured, maintained database to text in the body of email communications

(Appendix 3). The effort to load this information into a common structure is significant, and alternative, automated or semi-automated harvesting methods are preferable.

- The sources have also been different in structure (columns). There is a need to develop formats or protocols for the information.
- Some of the sources harvested are secondary in the sense that they themselves harvest from underlying, primary sources. If several secondary sources harvest from the same primary source, then the resulting inventory will contain duplicates.
- Some of the sources harvested contain duplicate information. In some cases a duplicate has been removed by the authors after their judgement.

Polar Climate Systems	116
Cryosphere	79
Paleoclimate and Paleoenvironment	8
Polar Biology, Ecology and Biodiversity	201
Human impacts	42
Solid earth and its interactions	43
Sustainable management of resources	7
People, Societies and Cultures	12
Human health and wellbeing	31
Astronomy, Astrophysics and Space	24
Overall national/international programmes	9
Other	223

Box 6. Number of monitoring/observational programmes in the inventory with EU-PolarNet Polar Research Priorities in their scope. Each programme may have more than one scope

5.2 Modelling programmes inventory

A major issue in the development of the modelling inventory is that many of the listed programmes do not solely focus on modelling. Very few pure modelling programmes exist according to the criteria put forward. Often the modelling component is linked in a broader context to observations from both surface and satellite platforms. This situation is indicated in the inventory.

In a number of cases modelling programmes focus on a particular theme with relevance for the polar regions, but are not geographically restricted to the Arctic or Antarctic. These have been labelled as ‘global’.

Institutional research programmes that focus fully or partly on polar modelling have not been retained in the modelling inventory, nor have models developed and maintained at individual research institutes.

6. Summary

A series of nations and organisations with Arctic and Antarctic monitoring/observational and modelling activities have provided information for constructing the inventories.

A total of 670 monitoring/observational programmes have been registered in the inventory. Out of these 491 are Arctic, 166 are Antarctic, and 13 are both (Appendix 4). A total of 14 countries and 4 organisations have contributed to the inventory (Appendix 3). Box 6 gives an overview of the number of programmes that have EU-PolarNet Polar Research Priorities

(Deliverable D2.1) within their scope. Appendix 4 gives an overview of the number of monitoring/observational programmes and their distribution on countries. For the distribution on countries there is reason to believe that the numbers are biased by the effort that individual countries have put into organising national inventories.

A total of 32 programmes have been registered in the modelling inventory. Out of these 13 are Arctic, 8 are Antarctic, 6 are bi-polar, and 5 are global. Most of the modelling programmes focus on climate and cryosphere, with a few of them addressing palaeoclimate, ecosystem and geodynamic modelling. 14 entries deal only with modelling, 18 others contain an observational component. Of the pure modelling programmes, the majority are intercomparison initiatives aiming at performing common experiments to improve models and reduce uncertainties.

The inventories give a snapshot of the information as it existed when it was harvested. It is by nature out-dated since the information in the underlying sources is continuously updated. Therefore the inventories will only have value if they are continuously updated and developed. Arrangements will have to be made with SAON and the European Polar Board for the maintenance of the inventories until the end of EU-PolarNet in 2020 and beyond.

Appendix 1. Monitoring/observational programmes inventory: Structure (columns)

The columns in the monitoring/observational programmes inventory MS Excel file are

Programme Name
Programme Description
Programme Theme
Parameters
Sampling Location
National/International
Arctic/Antarctic/Both
Country
Frequency
Data reporting and data handling arrangements
Affiliation
Started
Comments
URL
Contact information
Abbreviation
Source

Appendix 2. Modelling programmes inventory: Structure (columns)

Programme name
Programme abbreviation
Programme description
Host organisation
Theme
Arctic/Antarctic/Both/Global
Modelling only [Yes/No]
National/International
Activity
Start date
Contact
URL

Appendix 3. Monitoring/observational programmes inventory: Source list

Country	Contribution type	Date	Records reported	Records after filtering
Canada	MS Excel sheet ('State of Environmental Monitoring in Northern Canada', http://www.polarcom.gc.ca/eng/content/state-environmental-monitoring-northern-canada)	DEC2014	882	16
	Web site (Polar Data Catalogue, https://www.polardata.ca)	31AUG2016	94	20
Finland	MS Word files	15MAR2016, 26APR2016, 02MAY2016	7	6
France	MS Excel sheet	01JUL2016	99	91
Germany	MS Excel sheet	19JUN2016	1	1
Netherlands	Email body text	30JUN2016	7	7
Norway	MS Word file	14JUL2016	3	3
Poland	MS Word file	19JUN2016	14	14
Portugal	Email body text	02JUL2016	1	1
Spain	Pdf file	22JUL2016	16	16
USA	Published report: "NSF 08-42, Arctic Observing Network (AON): Toward a U.S. Contribution to Pan-Arctic Observing" (Published report , http://www.nsf.gov/pubs/2008/nsf0842/nsf0842_7.pdf)	2007	142	16
Total			1172	191

International organisation	Contribution type	Web	Date	Records reported	Records after filtering
Arctic Monitoring and Assessment Programmes (AMAP) / Sustaining Arctic Observing Networks (SAON)	Database (AMAP/ENVINET/SAON Project Directory)	http://projects.amap.no	19AUG2016	937	181
Council of Managers of National Antarctic Programmes (COMNAP)	Manual harvesting from published reports	http://www.antarctictreaty.org/devAS/ie_annual.aspx?lang=e	28AUG2016	47	40
International Network for Terrestrial Research and Monitoring in the Arctic (INTERACT)	Manual harvesting from web site	http://www.eu-interact.org; http://gis.au.dk/interact/Default.aspx	05SEP2016	344	167
Scientific Committee on Antarctic Research (SCAR)	Manual harvesting from web site	http://www.scar.org	19AUG2016	44	3
Authors' own contribution – international	-	-	-	185	24
Authors' own contribution – national	-	-		8	3
Total				1565	418

After the review, updates were provided by

Country/Organisation	Contributor	Contribution type	Date	Number of records reported
Denmark	Naja Mikkelsen Søren Rysgaard	Updated MS Excel sheet	19SEP2016 20SEP2016	52
Estonia	Rein Vaikmäe	Confirmation	6SEP2016	(N/A – contents was approved)
France	Johan Etourneau, Yves Frenot	Updated MS Excel sheet	26SEP2016	91
Italy	Vito Vitale	MS Excel sheet	26SEP2016	28
Portugal	Gonçalo Vieira	Updated MS Excel sheet	11SEP2016	3
Sweden	Ulf Jonsell	MS Excel sheet	27SEP2016	80
Authors' own contribution - international	-	-	-	28
Authors' own contribution – national	-	-	-	9

Appendix 4. Number of monitoring/observational programmes per country

Country	Number of programmes	Arctic	Antarctic	Both
Australia	1		1	
Canada	51	51		
Denmark/Greenland/Faroe Islands	52	50		2
Finland	95	95		
France	89	18	71	
Germany	3	3		
Iceland	10	10		
India	4		4	
Italy	28	12	16	
Japan	22	2	20	
Netherlands	7	7		
Norway	66	62	4	
Poland	23	22	1	
Portugal	3	1	2	
Russia	16	16		
Spain	16	2	13	1
Sweden	80	80		
UK	4		4	
USA	49	44	5	
Ukraine	6		6	
Venezuela	2		2	
International	43	16	17	10
Total	670	491	166	13

Appendix 5. Monitoring/observational programmes inventory: Structure (columns) of two sources that have contributed to the inventory

Structure (columns) of AMAP/ENVINET/SAON Project Directory

Title, Link, Last update, Category, Region, Parameter, Media, Directory, TDC, Summary, Notes, Tags, Primary First Name, Primary Last Name, Primary Mailing, Primary Phone, Primary Fax, Primary Email, Primary Www, Other Contact, Other Data, Other Area, Stations, Archived TD, Data Reporting, Data Access, Publications, Specimens Banked, Specimens Banked Info, Methods Procedures, Methods Quality, International, Other Institutes, Other Reporting, Related, Indigenous, Editors, Maintenance Notes, Project Start Year, Project End Year, Data Start Year, Data End Year, Data Process Start Year, Data Process End Year, Data Report Start Year, Data Report End Year, Country, NIP, Comments, Project Status

Web: http://projects.amap.no

Structure (columns) of Canadian Monitoring Inventory

Activity, Project title, Program title (if associated with a broader program or coordination initiative), Principal investigator, Organization conducting, Geographical coverage of project, Territory/Province, Community-based monitoring? (Y if known), Start Year, End Year, Duration as of 2014, Status of data collection, Links to data, Variables monitored- listed if different from those in keyword tags that follow, Air temperature, Soil temperature, Soil moisture, Precipitation, Humidity, Wind, Pressure, Radiation, Clouds, Atmospheric composition, Atmospheric profile, Greenhouse gas, Snow, Permafrost- all, Active layer, Glaciers, Sea ice, Coastal ice, Ground ice, Freshwater ice, Water quality, Water chemistry, Water temperature, Water supply, Hydrology, Lake, River, Wetlands, Nutrients, Metals, Ion concentration, Fishes, Benthic Invertebrates, Benthic algae, Chlorophyll, Zooplankton, Phytoplankton, Bacteria, Water temperature, Water chemistry, Salinity, Sea level, Nutrients, Ocean currents, Bacteria, Sea ice biota, Phytoplankton, Zooplankton, Benthos, Fishes, Sea birds, Marine mammals, Mammals, Birds, Amphibians, Arthropods, Vascular plants, Fungi, Moss, Lichens, Soils, Nutrients, Biogeochemistry (all)- terrestrial, freshwater, and marine, Tundra, Forests, Treeline, Contaminants, Nutrition and food security, Maternal health, Children and development, Disease and physical health, Mental health, Health, Education, Demography, Adaptation, Housing, Infrastructure, Traditional knowledge, Employment and livelihoods, Culture, Language, Energy, Resource development, Keywords that are not variables monitored, Website

Web: http://www.polarcom.gc.ca/eng/content/state-environmental-monitoring-northern-canada