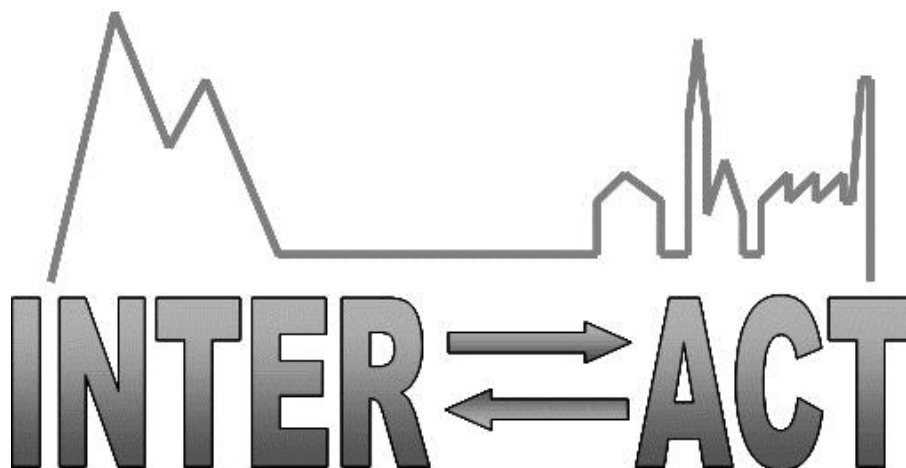


## Combination of CP & CSA



### D1.5 - Legacy Report

Project No.262693– INTERACT

#### FP7-INFRASTRUCTURES-2010-1

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## Publishable Executive Summary

The main aim of the Legacy Report is to document the numerous and many types of beneficial impacts derived from INTERACT that will persist into the future and the ways in which INTERACT has paved the way for future scientific research, education – and even diplomacy and advice to government. Two major types of legacy are outlined: a) seeking legacy by continuing the network and b) legacy derived for a large diversity of scientific-related activities together with INTERACT’s influence on high level activities.

INTERACT is seeking to continue to develop and innovate in its networking activities. It is applying for further funding within the EU Horizon 2020 (“Business as Usual”) and also by initiating the process of becoming a non-profit making foundation (an INPO). Already an application to the EU is in preparation while legal advice and expert help has been given for the first steps in making an INTERACT Foundation that will allow INTERACT to seek funding from the EU and from agencies outside the EU.

The true extent of the legacy from INTERACT in the worlds of science, education, outreach, and policy will become apparent only in the future. However, we can already document different types of legacy and we give some examples of these. They include legacy from improved infrastructure, particularly the growth of the network from 33 to 77 research stations between 2010 and 2015 and support of developing research stations. Examples are also given of legacy from improved research and monitoring achieved in many ways but particularly through Joint Research Activities that have enhanced monitoring and the cataloguing and making available of meta data on monitoring and research activities at INTERACT stations. Also, INTERACT has funded over 500 researchers to work throughout the Arctic within the Transnational Access scheme. Another mechanism has been the dissemination of INTERACT methods throughout many EU networks and even the GEO global cold regions and ecosystems activities.

INTERACT has influenced national and international polar and environmental policy. It has visibility at high political levels and reaches out to Royalty. The member stations of INTERACT have supported research and monitoring and environmental assessments that have underpinned conclusions in the IPCC reports that eventually resulted in the Paris agreement by 195 countries to limit carbon emissions (remembering that the Arctic is the area of planet Earth changing most dramatically and giving the clearest evidence of climate change).

Perhaps the greatest legacy will come from INTERACT’s influence on the next generation of researchers. INTERACT works with schools and early career researchers as well as the general public, reaching many thousands. Resources made available include school texts, mass outreach video course on Arctic Change, talks, and on-line material.

INTERACT works across all borders and sets an example for higher level diplomacy.

## 1. Introduction

INTERACT represents legacy from excellent networking throughout the Arctic during the International Biological Programme's Tundra Biome Project of the late 1960's and early 1970's (Bliss et al. 1981). This project led to successful circum-Arctic collaboration even during the Cold War period. As a PhD student and Post Doc, the future Coordinator of INTERACT received the equivalent of "transnational access" and visited many Arctic research stations and developed collaborations. These contacts and collaborations have persisted for nearly 50 years. In the year 2000, some of the station managers from stations in the eastern North Atlantic region formulated an infrastructure project to collaborate and stimulate research. This project was called SCANNET and received funding for 4 years. From the end of the project until 2010, the network grew to 33 research stations situated in all Arctic and northern countries – an important legacy from SCANNET leading to the present 7th Framework project INTERACT. During the current 5 years period of INTERACT, the number of research stations has risen to 77 that together host over 5,000 researchers each year and 76 networks in various disciplines.

Quantifying the legacy of INTERACT is not easy and its true legacy will be identified only after many years. However, it is already possible to identify some types of legacy and major impacts. This report gives examples of two fundamental types of legacy: firstly the continuation and expansion of the INTERACT network and secondly the long-lasting influences of INTERACT on science, education, diplomacy and environmental policy.

## 2. Continuation and Expansion of INTERACT

INTERACT has been an overwhelming success. Its rate of growth, novel products and activities and its unique services to national, regional (particularly EU) and international organisations (from Arctic to global) all highlight the need for INTERACT to continue and to develop further important services. One task underpinning deliverable D1.5 is therefore to ensure the future of INTERACT beyond the 4 year funding by the EU and to maximize the output of the project.

Several models for continuation are suggested. An application for a new phase of INTERACT will be made to EU Horizon 2020. Whether or not this application is successful, INTERACT will plan to become an international non-profit organisation – the INTERACT Foundation. It will also explore the merits of becoming a European Research Infrastructure Consortium if the application fails and in the interim, we will seek funding from various sources to continue prioritised low level networking activities.

## **2.1 Business as Usual – Application to Horizon 2020**

The success of INTERACT has also brought a dilemma, how to limit its geographical scope? INTERACT is already involved in the global organisation GEO as co-lead of its cold regions activity and it is also a contributor to its ecosystems activity. It is also working with the EPB to compile a catalogue of European infrastructures in both polar regions based on the highly successful INTERACT Station Catalogue. Furthermore, its Observer Stations now stretch as far south as the Tien Shan Mountains of Kyrgystan and the volcanoes of Kamchatka. INTERACT therefore now includes massive environmental gradients from high Arctic polar deserts, through tundra and taiga to temperate alpine regions and in every northern country. As EU guidelines (INFRAIA-01-2016-2017) include partners from associated countries that offer access, such as Canada, USA and Russia, INTERACT will continue to embrace pan-Arctic activities while fulfilling its commitment to the Antarctic (together with the EPB) and global cold regions. Furthermore, we will seek in-kind and transnational access funding from European and Non-European partners. This builds on the success during the first phase of INTERACT when funding was contributed from two sources in Canada and the NSF in the USA. As the application is so far incomplete, it would be inappropriate to give further details here.

Currently (December 2015), the application for phase II of INTERACT is in preparation. It builds significantly on the successful elements of the first phase but also introduces new, innovative activities.

## **2.2 INTERACT Foundation (INPO)**

This option for the continuation of INTERACT is not mutually exclusive of the “Business as usual” plan. Even if a new phase of INTERACT is funded under Horizon 2020, the membership of INTERACT will explore the creation of an international non-profit organization registered in one of the Arctic countries, probably Sweden. Developing in this direction would have the advantages of being able to operate anywhere in the world and guaranteeing some independence from political constraints which could be a strong limitation on pan-Arctic collaboration. In addition, the option of creating an international non-profit organization could be an opportunity to access funds to cover costs not covered by EU grants such as the full implementation of INTERACT technological and methodological developments at all stations. Examples include the energy and greenhouse gas measuring station (WP6), CBMP protocols, the “INTERACTGIS” (WP7) and recommendations from international planning activities such as ICARPIII and IASC.

Already, INTERACT has been given professional advice and offered legal aid and possibly start-up funding. The country in which the organization is based has been suggested as Sweden because of the legal status of “stiftelse” there which fits the purpose of the INTERACT Foundation best. Independence will be a prime pre-requisite.

Although seeking advice is continuing, some considerations can already be listed.

- WHAT can this non-profit making organization do? Any activities relevant to the mission of INTERACT except making money. Any funds donated to the organization from members, foundations, sponsors, etc. will be used for the organisation's agreed activities and staff salary where required.
- WHO will be involved? At least Station's Managers (and owners) but also any entity or individuals people willing to contribute.
- WHAT is needed next? To confirm the country where the organization should be registered and to establish the organization by defining the mission, guidelines, statutory arrangements, members, staff etc. Some modest funding has been offered and access to an expert in law of tax-exempt organizations has been promised. This legal expert would form the foundation formally and would apply for tax exempt status.
- HOW MUCH will it cost? A simple coordinating structure would be developed that can operate with a very limited budget (especially at the beginning). In the unlucky event that INTERACT II will not be funded through Horizon2020, the INPO should be able to collect enough money from members and external sources to cover at least some networking activities (travel costs and fees for INTERACT “ambassadors”) and meetings of the station managers.

### 3. The wider legacy and influence of INTERACT

As mentioned above, the true extent of legacy from INTERACT will become apparent only in the future. However, we can already document different types of legacy and give some examples of these.

#### 3.1 Infrastructure

INTERACT applies a united voice of 77 research stations (Figure 1) and institutional experience extending back more than 100 years to support the initiation of new research stations and more effectively manage existing stations. WP1 and partners have given advice to potential station owners and developers (e.g. CHARS, Canada, Ob Basin Mega Facility, Russia) and WP1 has written letters of support for stations threatened by closure. Advice on the development and management of research stations has been comprehensively compiled by WP2 based on best practices for station management, experience-sharing at Station Managers’ Forum Meetings and mentoring. INTERACT (WP1) has also given advice for the establishment of a Swedish infrastructure network (SITES) and a Greenlandic network (GEM: WP2).

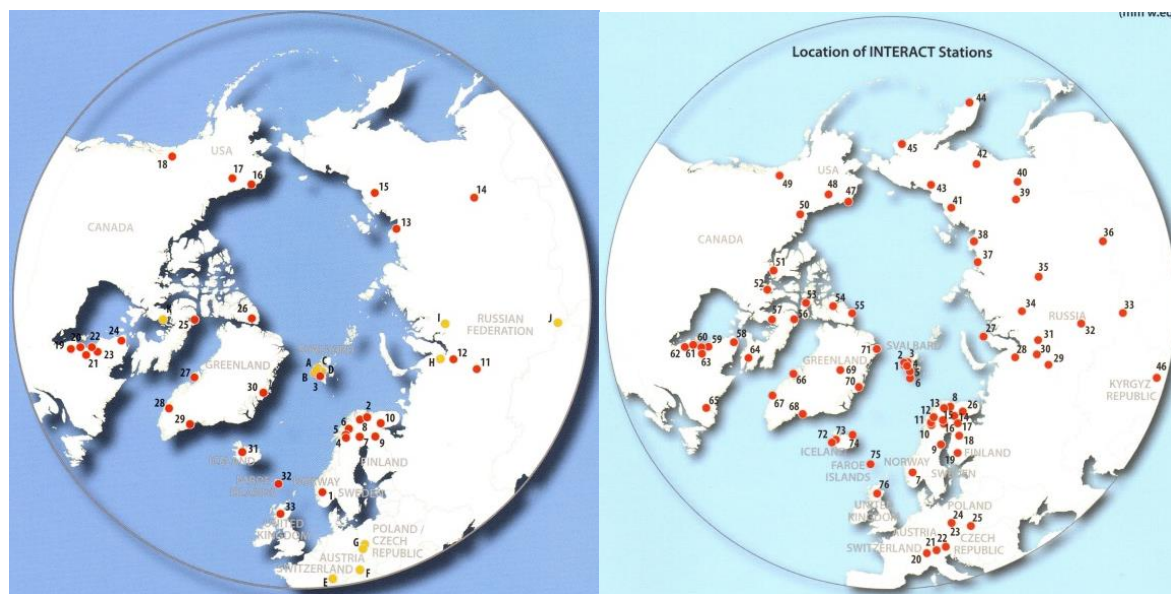


Figure 1. INTERACT grew from 33 partners in 2010 (left, including early Observer Stations) to 77 in 2015 (right: 76 shown)

### 3.2 Environmental monitoring

The INTERACT legacy for long-term monitoring by research stations consists of improved monitoring technology and methodology developed by JRAs (WPs 5 and 6), dissemination of proven and standardised best practices from specialist networks and station experience through the Research and Monitoring report (WP2; Figure 2), expansion of the monitoring capacity in a growing INTERACT network and export of experience from the Arctic to the Antarctic and global cold regions through collaboration with the European Polar Board and GEO/GEOSS (WPs 1, 2, 3 and 4).

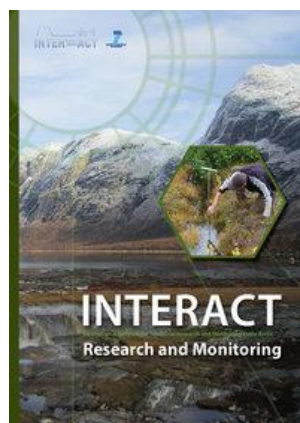


Figure 2. Research and monitoring report produced together with a searchable metadata base by E. Topp-Jørgensen, et al. 2015.

### 3.3 Research

INTERACT has built capacity for increased research, stimulated collaborative research, and under-pinned research developments.

A legacy of increased capacity for research has been achieved by increasing the network size by over 100% (WP1), enhancing research station facilities (measurement of carbon emissions and energy by JRA WP6 and communication between sensors distributed in the field and the central research station hub - JRA WP5), and making data more widely and easily accessible (JRA WP7: see below). A significant stimulation of research has been achieved through transnational access (WP4). Through this highly successful scheme, over 500 researchers have been funded, hosted and aided to work at 20 research stations in

every Arctic country and several neighbouring northern countries. Many of these researchers are early career scientists: many have used TA funding to leverage national funding: and many have started new collaborations with research stations and other researchers visiting the stations. This legacy is highly likely to stimulate significant new research into the future which will feed back to the need for infrastructure development and increased capacity. Already, one measure of increased research legacy is available: <100 publications from TA and 4 major volumes from WP2, and WP1 and 4.

A legacy in greater collaboration in research has been explicitly planned and successfully achieved. One important mechanism has been to prioritise TA calls (WP1 working with WP4) for projects based at more than one station. While scientifically targeting spatial variation in the research topic, the strategy also increases collaboration among stations hosting the same researchers and enlarges the pool of researcher contacts. A particular legacy from this experience is a TA user community planned for the next phase of INTERACT in which all recipients of TA funding will be required to interact. Another important stimulus to research collaboration is the initiative by WP2 in the Research and Monitoring volume (D2.9) to list 76 networks hosted by INTERACT stations with contact details and details of methodologies. This will expand the networks, collaboration within the networks and collaborations among researchers wishing to work within their topics throughout a wider range of environments. One particular success story was an experiment on pollinator activity at 16 INTERACT sites commented on in the world-leading journal “Science” (Figure 3).



*Figure 3. Real and artificial flowers of Dryas used to identify pollinators at 16 INTERACT sites. Project by Roslin et al. 2013. PLOS ONE 8 (6): e67367.*

New research developments under-pinned by INTERACT include development of the AbiskoGIS (WP7) into the NORDGIS applied to the “SITES” network of Swedish research stations, development of Arctic networking through the CLINF project (on infectious disease spread) funded by the Nordic Council of Ministers, representation on the EU-Polarnet by the Thule Institute partners, representation in ENVRI+ by the University of Copenhagen partner, representation in the proposed Arctic Union proposal by the Lund University partner and other INTERACT partners and representation in ILTER by the NERC partner. In addition, INTERACT has been used to advise major EU consortia such as Chairmanship of the Advisory Board of ANAEE and adviser to EURODISH (Royal Swedish Academy of Sciences partner). Clearly,



INTERACT is sought after even in unrelated topics because of its success. Its wide representation is providing legacy in research by providing expertise, data and facilities.

### 3.4 Data capture and accessibility

Making data more accessible and providing formats that make data use more easy ensure legacy for the vast quantities of data captured throughout the INTERACT research stations. A particularly innovative system developed by WP7 is the AbiskoGIS (later developed into NordGIS and INTERACTGIS; Figure 4) that combines station management, particularly the application procedure for visiting scientists, with the capture of metadata on projects that is displayed in GIS format (D 7.2). This system is being applied to an increasing number of INTERACT stations and also to the SITES network of Swedish Research Stations. Metadata captured by INTERACT is being fed into the SAON initiative.

In addition to making data more accessible, new software has been developed (ScanDB: Deliverable 7.6) to help researchers visualise and analyse data. This methodology is currently being applied to data from the Greenlandic Stations within INTERACT as part of the GEM program.

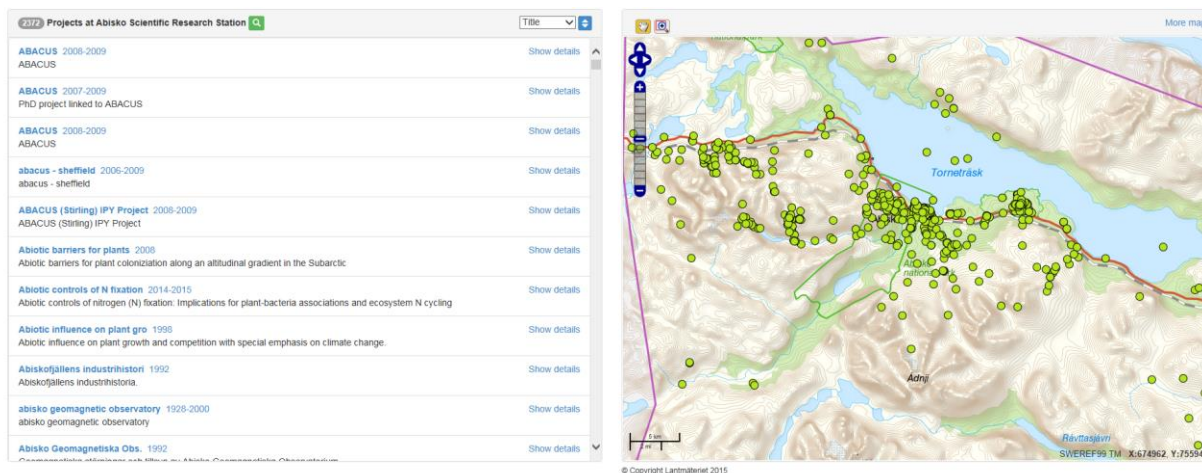


Figure 4. Projects at Abisko Scientific Research Station presented in INTERACT GIS.

### 3.5 National and international polar and environmental policy

Members of INTERACT interact with high level decision makers and national and international organisations and present INTERACT to them (Figure 5). Stations have been visited in the field by Royalty, Presidents, and Government Ministers. Presentations have been given to a Russian Minister, Russian Governors of 4 northern regions, Presidents (France, Iceland), Ambassadors (7), Senior Arctic Officials and senior members of the EU, NSF and Canadian funding agencies. Letters of support for a national Polar programme has been written and INTERACT is represented on an all-party, two-house, government advisory council. Although it is difficult to document decisions made as a result of INTERACT high-level activities, it can be speculated

quite securely that research and monitoring activities at northern research stations and INTERACT scientists contributed importantly to climate impacts assessments such as ACIA and SWIPA and IPCC that resulted in the agreement of 195 countries at the Paris meeting to limit carbon emissions.



*Figure 5. Examples of high-level visibility and contributions for INTERACT: top, Terry Callaghan, Coordinator, giving a plenary presentation at the Arctic Circle meeting in Iceland, 2015 (on stage are the British Ambassador to Iceland HE Stuart Gill (left) and James Gray MP, Chair of the All Party Group on Polar Regions (middle)), lower left, Morten Rasch, WP2 leader, presenting the Station Catalogue to Crown Prince Frederick of Denmark; lower right, Margareta Johansson, Executive Secretary, giving a key-note address at the IASC/ICARP plenary meeting, Toyama, Japan 2015.*

### **3.6 Education and Mentoring**

Perhaps the greatest long-term legacy that INTERACT can derive is through education and inspiration of younger generations and particularly of future generations of polar scientists. Mentoring is given to APECS members in several ways: by inviting them onto the Transnational access board, ensuring they are represented at science meetings, and encouraging them within transnational access projects. A MoU between INTERACT and APECS has been signed. A MoU has also been signed by INTERACT and the University of the Arctic. Together with Tomsk State University, Russia, we have produced a mass outreach video course “The Changing Arctic” freely available to students who can apply for certification (within 2 months of release,

about 700 students had visited the course). Many stations host undergraduate summer schools and support teaching at home universities. At the secondary school level, INTERACT members visit schools and have written two publications (one with a circulation of 16,000) for schools while up-dating teachers on Arctic issues. Presentations at teachers' conferences contributed to the inclusion of cold regions studies in Advanced level geography courses in the UK. In addition, the Transnational Access Board has recognised the linguistic and scientific cultural disadvantages of some early career scientists from Eastern Europe and has provided guidance and the opportunity to resubmit applications (Figure 6).



Figure 6. Education products: left, a text book produced for the Geographical Association (geography teachers of 16-18 year-old students); centre, article in the Biological Sciences Review, a magazine for biology school students; right, opening title of a video course and contributing organisations.

### 3.7 Public awareness

INTERACT members constantly engage with the public, both Arctic residents and the general public. Also, the web pages, particularly those of WP8 “Outreach”, communicate widely and provide resources for educators. Together, the INTERACT Community gives hundreds of public talks each year with individuals giving up to 20 talks per year, each attended by up to 250 people.

### 3.8 Environmental protection and conservation

The monitoring and research at INTERACT stations has been used to document the need for environmental protection and conservation. Some stations and partners are heavily focused on pollution (e.g. Bioforsk) while others document the population trends of vulnerable species (e.g. Labytnangi). Many stations (e.g. Abisko and Zackenberg) host environmental and ecosystem manipulation experiments that predict the effects of changing climate on biodiversity. In addition, several TA projects have research focused on pollution (particular black carbon impacts on

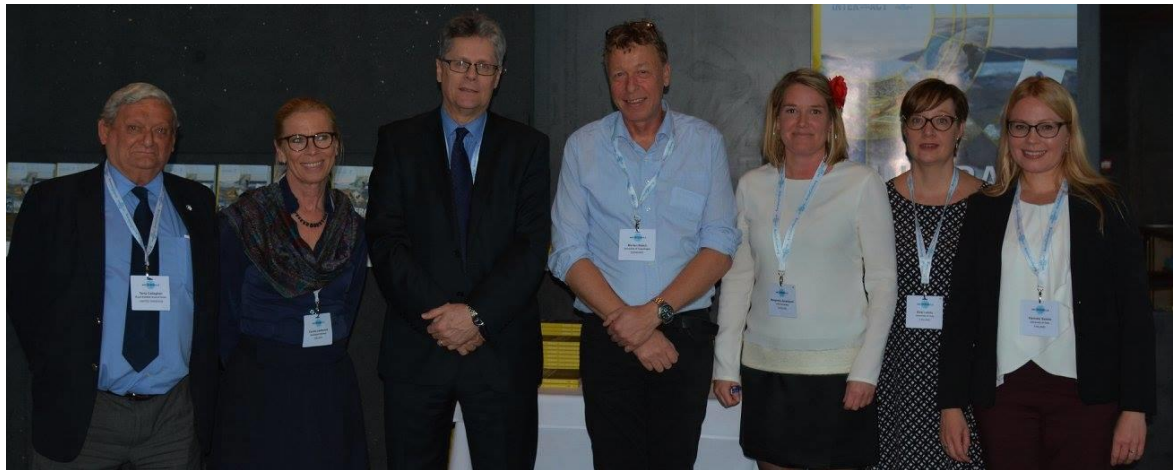
snow; Figure 7) and threatened biodiversity (e.g. bee species; Figure 7). To create even greater legacy, INTERACT is working with AMAP and CAFF that have responsibilities with and report to the Arctic Council and plan to develop these connections still further in a future phase of INTERACT.



*Figure 7. Transnational projects that aid environmental protection and conservation: left, filters from a thermo/optical carbon aerosol analyser (cut in half) showing dark half circles where tiny black carbon particles from snow melt water have darkened the filter (C.A. Pedersen et al. in INTERACT Stories of Arctic Science); right, the bumblebee *Bombus hyperboreus*, one of the vulnerable species studied at Toolik Lake, Alaska, to understand bumblebee diversity and abundance (B. Martinet et al. in INTERACT Stories of Arctic Science).*

### 3.9 Diplomacy

INTERACT does not recognise any national or cultural boundaries. It has successfully networked 77 research stations from 17 countries that work together and even share resources within the TA pool (see Deliverable 4.4). Although a bottom-up process, this “diplomatic” aspect has been recognised at a high level: 7 Ambassadors have either supported INTERACT directly via letters of support, or indirectly by attending meetings and providing receptions. Letters of support come from Their Excellences the US Ambassador to Sweden, The Canadian Ambassador to Sweden, and the Russian Ambassador to Sweden. Other types of indirect support come from Their Excellences the British Ambassador to Iceland, the Norwegian Ambassador to Iceland, the Canadian Ambassador to the Arctic and the Canadian Ambassador to Poland. The high visibility of INTERACT among Ministers in the Russian Duma and Governors of Russian Northern Provinces has led to INTERACT facilitating connections between national governments (WP1)(Figure 8).



*Figure 8. High-level contributions by INTERACT: top, British and Norwegian Ambassadors to Iceland attend the launch of the INTERACT Science stories book and bottom, INTERACT Coordinator (far right) makes an INTERACT presentation at the Arctic Days meeting in Moscow together with the Russian Minister of Natural Resources and Environment (centre).*

## 4. Acronyms

ACIA – Arctic Climate Impact Assessment

AMAP – Arctic Monitoring and Assessment Program

ANAEE - Analysis and Experimentation on Ecosystems

CAFF – Conservation of Arctic Flora and Fauna

CHARS – Canadian High Arctic Research Station

CLINF – Nordic top level research project within the “Responsible development in the Arctic, opportunities and challenges – Pathways to action”

ENVRI+ - Environmental and Earth System Research Infrastructures

EPB – European Polar Board

EU – European Union

EURODISH - Determinants - Intake - Status - Health: Studying the need for food and health research infrastructures in Europe

GEM – Greenland Ecosystem Monitoring

GEO – Global Earth Observation

GEOSS - Global Earth Observation System of Systems

IASC – International Arctic Science Committee

ICARP – International Conference on Arctic Research Planning

ILTER – International Long Term Ecological Monitoring

INPO – INTERACT Non-Profit Organisation

INTERACT – International Network of Terrestrial Arctic Research Stations

IPCC – Intergovernmental Panel on Climate Change

JRA – Joint Research Activity

MoU – Memorandum of Understanding

NERC – National Environmental Environment Council

NSF – National Science Foundation

SAON – Sustained Arctic Observing Network

SCANNET – Scandinavian/North Atlantic Network of Terrestrial Field Bases

SITES – Swedish Infrastructure for Ecosystem Science

SWIPA – Snow, Water, Ice, Permafrost in the Arctic

TA – Transnational Access

WP – Work Package