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APPLICATE^{*}

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EXECUTIVE SUMMARY

The main objective of the APPLICATE project is to develop enhanced predictive capacity for weather and climate in the Arctic and beyond, and to determine the influence of Arctic climate change on the Northern Hemisphere. To produce usable and trustworthy predictive information for decision making, APPLICATE will actively engage with stakeholders, including policy makers, businesses and society within and outside the EU. Only by effectively exchanging information with stakeholders and co-developing knowledge, can we assure the stakeholder-relevance of the project results and its impact by enhancing their capacity to adapt to long-term climate change.

The proactive dialogue with users is being performed using modern and interactive user engagement mechanisms that are being developed and maintained throughout the project. This updated plan describes already applied engagement approaches and activities, as well as those planned for the rest of the project. It provides a detailed description of the three main user categories defined by the project – key, primary and secondary. It builds around four main mechanisms of user engagement to be applied in the project: i) User Group involvement, ii) Participation in relevant conferences and meetings and organization of workshops, iii) Case studies development, iv) User blog and interviews.

Dedicated policy events will be held in Brussels (first half 2020), in Akureyri, Iceland, at the Arctic Science Summit Week (ASSW) in March 2020 and at the Third Science Ministerial in Japan November 2020.

In addition, different communication channels are being utilized as a part of the project, enhancing information exchange, knowledge transfer and impact, presenting the first step towards user engagement, reaching and impacting a broad and diverse group of users.

1. INTRODUCTION

1.1. Background and motivation

One of the aims of the APPLICATE project is to increase awareness about the impact of Arctic changes on the weather and climate of the Northern Hemisphere and to adequately convey project results to stakeholders, including any user of climate and weather services. To achieve this, the project will develop relevant and effective forms of communication, cooperation and engagement with projects and stakeholders within and outside the EU. In addition, in order to provide at the same time scientifically robust and user relevant and usable knowledge about the climate and weather in the Arctic, the project needs to maximise exposure of the science produced to different users and collect and consider feedback from them. In order to assure knowledge sharing and exchange with stakeholders and measurable impact, in this plan we propose and explain different user engagement mechanisms that have been developed and maintained throughout the project.

The terms user and stakeholder are used interchangeably in this plan. Stakeholders or users include all those that can be interested in and/or can benefit from better knowledge of the weather and climate in the Arctic and Northern Hemisphere. By pro-active user-engagement, the latest advances in forecasting system development can be effectively communicated to and benefit those economic sectors and social aspects that rely on improved forecasting capacity.

To develop and conduct targeted user engagement activities, knowledge transfer and exchange, we divide users in three categories:

- 1) Key users – Business and governmental stakeholders in the Arctic, within and outside the EU
- 2) Primary users – Scientific community, meteorological and climate national services, NGOs and local and indigenous communities
- 3) Secondary users – Business stakeholders from mid-latitudes.

By continuously taking into account user needs and feedback to the APPLICATE results via the User Group, workshops, meetings, interviews with key stakeholders, virtual consultations, and development of case studies and policy briefs, the APPLICATE community will increase the stakeholder-relevance of its research and hence directly impact by improving stakeholders' capacity to adapt to climate change.

1.2. Organisation of the plan

The user-engagement plan is structured around the main proposed mechanisms for user engagement. This includes i) User Group involvement, ii) interactions at workshops, meetings and conferences, iii) development of case studies and policy briefs and iv) user blog and interviews with stakeholders. In addition, user engagement is closely merged with the other two components of WP7 – communication and dissemination of the project results

and training. Some of the communication channels, such as the project website and social media, are also very effective tools for user engagement. Moreover, communication is understood as the first step in motivating stakeholders’ participation, to be followed by more profound and bi-directional knowledge exchange and engagement approaches. These communication channels will thus be shortly presented in this plan, and elaborated on in more depth in the APPLICATE Communication and Dissemination Plan.

2. APPLICATE USER-ENGAGEMENT PLAN

User engagement is an essential part of APPLICATE since the project aims to establish an effective dialogue with a network of key stakeholders in order to obtain feedback to help and improve weather and climate modelling and forecasting. All the user engagement activities are lasting throughout the project duration. Table 1 lists the activities envisaged with the user engagement plan. It details the procedure and expected outcomes of each of the activities. While we will continue with these activities in the last year of the project, Table 1 also provides examples of tasks that are already completed, such as events organised in the past, or completed case studies. More details are provided under the section: Implementation of the plan.

Table 1: User engagement activities within the APPLICATE project.

Activity	Leader	Procedure	Expected outcomes
Project website	AP	<p>The project website is a channel for passive user engagement, where various stakeholders can learn about the project and get in contact. It will continue to be updated throughout the project.</p> <p>An interactive communication platform is being implemented to encourage stakeholder feedback and communication with the project participants, not least in relation to the case studies and educational activities.</p>	<ul style="list-style-type: none"> ▪ Provide a primary channel for communication about the project. • Present general information on the project, goals and objectives of the various work packages, news and events, dissemination material and project documents. • Provide a clear idea of what users can get from the project (e.g. type of knowledge generated) • Guide users in how to get in touch with the project User engagement team. • Promote all other user engagement activities. • Promote a direct link to the user blog.
Social media campaign	AP	<p>APPLICATE Twitter account and Facebook page are additional channels for both passive and active user engagement.</p>	<ul style="list-style-type: none"> ▪ Provide a channel for a two-way communication with various stakeholders, allowing for posts, comments and replies by users. • Learn about the user feedback and inform further

			<p>project developments, by regularly moderating and revising the information from our social media channels.</p>
User Group	AP, BSC	<p>Various representatives of key stakeholders have joined the User Group and the list might be enlarged if additional relevant stakeholders are identified. The group includes representatives from different sectors. Users take part in virtual consultations that WP7 coordinators organise on a regular basis. The first face-to-face meeting took place during the Arctic Circle Assembly in 2017, followed by a more-complete group meeting at the project general assembly in January 2018. The User Group meetings continued on a regular few months bases.</p> <p>Face-to-face interaction with some User Group members was repeated at Arctic Circle Assembly 2019. Some of the case studies developed by the project were discussed with stakeholders, who raised ideas for new case studies.</p>	<ul style="list-style-type: none"> ▪ Provide an external user-specific perspective and feedback on the relevance and presentation of project outcomes. ▪ Analyse and share feedback with i) user group participants to maintain discussion, and ii) the project partners to help shape project outputs into user relevant products. ▪ Assure timely response and feedback to the project outputs.
Workshops and meetings at professional events	AP, BSC	<p>APPLICATE partners participate in relevant external events or initiatives organized by the target sectors, as well as in scientific conferences. These activities are jointly organized with other relevant projects, such as YOPP, C3S tenders and the EU Arctic Cluster.</p> <p>The list of events is scheduled in the project calendar on the project website.</p> <p>Examples of the events organised in the past are:</p> <ul style="list-style-type: none"> - “Improved safety and environmentally sound operations in the Arctic Ocean – How to move forward?” organised on behalf of the EU Arctic Cluster (now EU Polar Cluster) at Arctic Frontiers, in January 2019. “Connecting Arctic science with society: Lessons learned and progress”, organised in collaboration with the EU-PolarNet and Nunataryuk projects, at the Arctic Circle, in October 2019. 	<ul style="list-style-type: none"> ▪ Promote and explain the project while interacting with users on different relevant topics. ▪ Broaden and reinforce our understanding of user needs, through feedback from actors not necessarily linked to the weather and climate research communities. ▪ Regularly analyse users’ feedback after each event and i) share it with the project partners, ii) when relevant, share it with other users via User Group and/or Blog or with other projects from the EU Polar Cluster.

<p>Blog – Polar Prediction Matters</p>	<p>AP, BSC</p>	<p>The project blog is a user engagement tool in the sense that it provides user’s perspectives to the project and, at the same time, engages other users familiar with the featured topics. The blog is hosted at the Helmholtz Blog website and jointly developed and maintained with YOPP and Blue Action. The content of the blog builds around articles that are regularly published on a monthly basis during the period mid-2017 – mid-2019. These articles present, from different perspectives, climate change in the Arctic, use of climate and weather data and similar topics and have the aim to encourage a discussion with users or other interested parties on the proposed topics. Different stakeholders are in charge of writing the articles with support from APPLICATE, YOPP and Blue Action partners. Although priority will be given to actual users, complementary contributions from people working at operational services, natural and social scientists, science managers and researchers are also welcome. The discussions are moderated by the APPLICATE and YOPP’s user engagement teams, and supported by the projects’ scientists.</p>	<ul style="list-style-type: none"> ▪ Trigger interest of different actors and open discussion on featured topics. ▪ Collect new perspectives on user needs and understandings. ▪ Regularly analyse discussions and inputs in the blog and inform the project partners on any relevant information about user requirements and needs.
<p>Case studies and working groups</p>	<p>AP, BSC</p>	<p>APPLICATE develops case studies to show the use of weather, climate and sea ice forecasts in the case of specific events with significant impact on certain sectors or communities.</p> <p>The events analysed in the case studies are selected together with users in User Group meetings, in thematic workshops, or through interviews.</p> <p>Once the topic is decided, collaboration is established between the working group, composed of a few users directly related to the particular case study, and the project scientists.</p> <p>Project results and developed case studies are communicated to various audiences (including</p>	<ul style="list-style-type: none"> ▪ Provide clear examples of success stories of using climate data to inform users. ▪ Establish focused, tailored collaboration with a few users from individual sectors (working groups) ▪ Establish collaboration between a working group and project scientists. ▪ Have a concise way to explain changes in the Arctic and its importance for various users, including European policy makers. ▪ Establish an effective communication approach that works for different sectors, such as reindeer herding, fishing, shipping and renewable energy. ▪ Further disseminate results within the sectors and

		<p>European policy makers) in a concise way as short communication materials.</p> <p>Two completed case studies - “How does Arctic sea ice affect energy production in mid-latitudes?” and “Is Svalbard prepared for extreme rainfall” - were distributed at the Arctic Circle 2019 event.</p> <p>New case studies will be developed on additional topics identified by stakeholders.</p>	<p>communities of the working group participants.</p> <ul style="list-style-type: none"> ▪ An interactive communication platform is being established on the Applicate website to encourage communication between the project and individual stakeholders.
<p>Policy briefs, policy events and project newsletters.</p>	<p>AP, BSC</p>	<p>Policy briefs and newsletters, summarizing the most relevant project activities and results, will be produced and distributed at dedicated policy events, relevant conferences and through mailing lists. Policy briefs, together with project case studies, will also be distributed at other events, targeting different decision-makers. An example is a policy brief about linkages between Arctic (sea ice) changes and weather and climate in mid-latitudes. This brief will be presented at the policy event for EU policy-makers.</p>	<ul style="list-style-type: none"> ▪ Showcase how project results can be used for decision-making. ▪ Increase awareness of the impact of Arctic changes. ▪ Identify research gaps. ▪ Provide tools and evidence for policy makers, therefore increasing the impact of research and innovation.
<p>Survey and interviews with users from different stakeholder groups</p>	<p>AP, BSC</p>	<p>We conduct interviews with representatives of different stakeholder categories and economic sectors of interest. This takes place during the events that we will attend or in separate meetings with users. Alternatively, interviews can also be conducted over the phone/Skype. We will particularly target those communities that are underrepresented in the other user engagement activities, as well as those that express particular interest in the forecast in the Arctic.</p> <p>Surveys will only be conducted if a particular need and a clear research questions emerge. Depending on the aim of the survey, it will be either broadly distributed or targeted at a particular stakeholder category or economic sector. Different communication channels such as emails, newsletters or social media, will be used to disseminate the survey and collect a large number of</p>	<ul style="list-style-type: none"> ▪ Better understand users’ needs and requirements. ▪ Analyse and share findings with project partners to shape project outputs and direct further project developments to be in line with user requirements.

		responses. In order to avoid user fatigue, we will however aim to obtain this information – such as user relevant metrics – from the existing findings in the other projects and tailor them in the User Group discussions, as well as in the meetings and workshops.	
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3. RISKS AND INTERDEPENDENCIES

Risks and interdependencies are outlined in the table below.

Table 2: Risks and interdependencies for user engagement activities within the APPLICATE project.

Risk	Probability	Response	Responsibility
Low interest of users	Low/Medium	This risk will be mitigated by using different user engagement mechanisms, such as virtual meetings and consultations. The project will reduce time and travel investments from users and promote their participation. In addition, project partners involved in relevant EU projects, international committees and steering groups can serve as ambassadors for APPLICATE and help disseminate project information and involve stakeholders.	AP and BSC, with support from all project partners
User fatigue	Low	This risk will be addressed by avoiding more “aggressive” user engagement approaches, such as surveys, and encouraging modern, attractive and interactive user engagement mechanisms and communication approaches instead, such as the blog, the User Group, social media, participation and organisation of workshops or discussion tables in relevant events. Coordinating joint user engagement activities with other projects with similar research objectives will in addition lessen the pressure on users.	AP, BSC
Low project visibility	Low	The partners will take part in relevant events presenting the project and getting in touch with different users. These efforts will be organised in strong coordination with other initiatives and projects, such as YOPP, Blue Action, EUPolarNet, EU Polar Cluster, European Polar Board, IASC and SAON, increasing the projects’ visibility, while lowering the risk of user fatigue or confusion with too much information from different projects.	AP, BSC, all partners, partners from other projects

Cultural & background differences	Low	The project partners have a long-term and well-established collaboration with different actors within the Arctic. The project will additionally improve this collaboration and through interchange with different stakeholder categories (e.g. secondary user group) better understand cultural differences, while integrating local knowledge in the project development.	AP, BSC, all partners
Low interest in writing the user blog posts	Low	APPLICATE, YOPP and Blue Action have contacts with numerous stakeholders that might be interested in contributing to blog posts. We will rely on these connections and on contacting participants well in advance, to assure that regular posting on the blog is maintained.	AP, BSC, YOPP, Blue Action
Too low interest of the targeted audience in the user blog	Medium	Developing and maintaining this activity jointly with other projects, such as YOPP and Blue Action, improves the visibility of the blog and interest and participation of different users, decreasing the risk of lack of participation.	AP, BSC, YOPP, Blue Action
Too high interest in the user blog	Low	To maintain a fruitful discussion that can tackle different topics, including scientific ones, we will assure active collaboration of the project scientists on facilitating the blog discussions.	AP, BSC, YOPP, Blue Action, all project partners
Lack of participation of mid-latitude and non-European users	Medium	Building on partners' existing networks and through participation in relevant European and international events, the project will be shared and discussed with stakeholders that are not traditionally interested in the Arctic issues. In this way, we will increase participation of mid-latitude and non-European users.	AP, BSC, all partners

4. IMPLEMENTATION OF THE PLAN

4.1 APPLICATE users

APPLICATE will apply modern user engagement tools for online facilitation and the most efficient channels for information exchange with users. The implementation of the User Engagement plan will build around three main users groups: Key users, primary users and secondary users.

1. Key users

WHO: Key users include **business and governmental stakeholders in the Arctic within and outside the EU**. This group includes private stakeholders from economic sectors such as insurance, shipping, tourism, energy or fisheries, as well as public sector, such as national and international authorities in the Arctic. This category comprises different user profiles, including high-skilled users (e.g. modellers in the energy sector), non-experts that might demand tailored products and services (e.g. decision-makers that should decide whether to apply or not a particular action), and policy-makers.

HOW: The APPLICATE members have strong relations with key users within Europe, Asia and North America. Key users will get involved via interviews, workshops and the User Group and can become effective co-designers of the APPLICATE outputs. Through this collaboration and feedback, the project aims to incorporate the needs of the public and private sector in the forecasting systems and in the eventual products generated as a result of the project. From the second project year, we have also started working with smaller working groups of users from specific sectors. Working groups have a strong link with project scientists and work on the case studies development. In addition, with the support from the project policy officer, we will approach European policy makers. We will target initiatives such as Horizon Europe and the EU in the Arctic. The main communication and engagement tool for decision- and policy-makers are short communications, case studies and policy briefs, that we use as supporting material to deliver the main project messages.

WHY: **Business stakeholders** can benefit from enhanced operational predictive capacity across various time scales. The forecast improvements at hourly-to-decadal timescales developed by APPLICATE will lead directly to improved services for the economic sectors that rely on forecasts. Energy, insurance, shipping, or civil protection stakeholders, among others, are increasingly in need of weather and climate information at these timescales and the effective transfer of new knowledge is a crucial component. Active engagement in APPLICATE will also help **governmental stakeholders** to use the knowledge produced in the project to shape the necessary actions and instruments to address future challenges and make better informed decisions. Direct engagement with key users, individual stakeholders and networks as the Arctic Economic Council and the Northern Forum, helps build trust and

understanding and allows to incorporate user requests and suggestions in APPLICATE activities, which will eventually provide business and governmental stakeholders in the Arctic with the information they actually need to make well-informed decisions.

2. Primary users

WHO: Primary users include the **scientific community, meteorological and climate national services, NGOs and local and indigenous communities**. This is a group ranging from advanced users, involving weather and climate scientists and national services with interest in polar regions, to non-expert users like NGOs, or local and indigenous communities that rely on traditional knowledge. Primary users may benefit from advancements in model development and predictive capacity as well as from educational activities, e.g. for early career scientists. The scientific community is also considered a primary user of the project, including individual scientists working on related topics as well as networks of scientists working collaboratively in projects (e.g. US Sea Ice Prediction Network, US CLIVAR Arctic-Midlatitude Working Group, IPCC). Furthermore, research departments in operational weather and climate prediction centres, with an interest in Polar Regions, will directly benefit from the project outputs. Enabling development of improved weather and environmental prediction services for the Polar Regions, on different time scales, will for example directly benefit the World Meteorological Organization's Polar Prediction Project within the World Weather Research Programme. APPLICATE project results will also be relevant to scientific community umbrella institutions and projects, such as the European Climate Research Alliance, European Polar Board and International Arctic Science Committee, as well as to the working groups of the Arctic Council and experts of international organisations like the International Maritime Organisation. Finally, project results will benefit local and indigenous communities, by allowing them to make better informed day-to-day decisions.

HOW: APPLICATE partners have strong links to these organizations and communities, with many consortium members being directly involved within their activities. Therefore, primary users can be approached via e-mail and or in jointly attended meetings and events. By participating in relevant scientific conferences (e.g. ASSW, EGU, AGU, EMS, Arctic Frontiers) and European and international events (e.g. PAMIP, EU Polar Cluster and YOPP workshops), APPLICATE scientists and outreach specialists promote the results of the project and interact with key users and partners. Attendance to networking events (e.g. Arctic Circle Assembly, Arctic Circle China Forum, ACI Shipping conferences in Hamburg and Montreal, Korea Arctic Week in Busan Korea, China-Nordic Research Assemblies in Norway and China and Northern Forum events in Russia) helps disseminate project results among non-expert audiences, including business and policy stakeholders, NGOs and local and indigenous communities. Different communication channels applied in APPLICATE are used to animate and involve the primary user group. This includes information exchange through the website, social media – the APPLICATE Facebook page and the Twitter account -, and the user blog. In particular, with the user blog we aim to involve primary users in an online discussion on different topics related to climate

change in the Arctic. More direct engagement with this group will be achieved through meetings and workshops, particularly with local and indigenous communities, with the support of the Northern Forum, The Arctic Mayors Forum and Indigenous Secretariat of the Arctic Council - IPS. We will collaborate with local communities on case studies development, on topics such as extreme weather preparedness and adaption, or reindeer herding in the face of climate change.

WHY: Efforts will be put on making primary users aware of the project and its results, i.e. to transfer the scientific knowledge produced in the project to them. Close collaboration with primary users can help APPLICATE scientists focus on the aspects that are the most needed by this community. In other words, primary users can indicate the research needs regarding climate change in the Arctic and, at the same time, act as a peer group, providing feedback on the scientific progress of APPLICATE. Some primary users may be interested in direct project outputs, models and techniques applied to produce data. Although climate change and weather extremes are areas of great interest to the global community, specific communities, however, are more likely to be engaged with specific issues, e.g. indigenous peoples in the Arctic are directly affected by the impacts of regional Arctic climate change. The main outcomes of APPLICATE, that is an improved ability to simulate and predict changes in the Arctic and their impacts on weather and climate of the Northern Hemisphere, will be of great interest to the general public and also to certain local communities. This new knowledge, however, needs to be shaped so to be useful and usable for this group. Integrating local knowledge with the scientific findings can bring more holistic and well accepted results, while this knowledge exchange will benefit both scientific and the local and indigenous communities.

3. Secondary users

WHO: The secondary user group refers to **business stakeholders from mid-latitudes**. This is group includes private stakeholders beyond the Arctic whose business activities may be affected by Arctic changes, including but not limited to decision-makers from the energy, environmental protection, shipping, tourism or insurance sectors.

HOW: APPLICATE partners also have strong links with secondary stakeholders, e.g. through collaborations involving the development of climate services tailored to particular users, or through connections established from the participation in other European research projects, including EU H2020 projects, Copernicus C3S contracts, and ERA4CS projects. Participation in projects has allowed continuous interaction with stakeholders, often involved as partners in the project consortium, related to the sectors of energy, insurance, agriculture and water management (e.g. S2S4E, EUPORIAS, Clim4Energy, SECTEUR, PRIMAVERA, MED-GOLD, VISCA, IMPREX). We also have relevant participation in initiatives directed to build a network of climate service suppliers, providers and 'in-betweeners' that interact at dedicated events (e.g. Climateurope).

WHY: Activities of secondary users that are not located in the Arctic can also be affected by Arctic changes. In this sense, the linkages that exist between the Arctic and northern hemisphere mid-latitudes (e.g. understanding the relationships between the reduction in the concentration of Arctic sea ice and particular weather regimes occurring in mid-latitude regions) are of interest for secondary stakeholders. Likewise, it is important to understand how these linkages impact different economic activities, such as renewable energy demand and production, river transportation, forest fires, and others.

4.2. Implementation of the key user engagement mechanisms

Besides the various communication channels that will enable information sharing with users and receiving their feedback (e.g. through social media), the most important user engagement activities applied in this project are the User Group, workshops and meetings, blog, interviews, and working groups for case studies development.

User Group

The User Group is a group of 7-10 representatives from the public and private sector (Key users). The group meets (virtually or in person) every few months, to discuss the development of the project outputs, with the aim to make them both user relevant and usable. The group supports the project with an external user-specific perspective by providing continuous feedback on the relevance of the results obtained and the way they are presented. Regular feedback from this group assures that the products generated in the project are tailored to user needs, maximising their relevance and usability. The User Group will serve the project as an additional advisory mechanism. The group is coordinated and monitored by AP and BSC. Originally, the User Group was established through personal contacts and project connections (e.g. we contacted those stakeholders who wrote a support letter accompanying the APPLICATE funding application). The group aimed at including stakeholders from around the Arctic and beyond, as well as representatives of relevant sectors and communities. Currently, the user group comprises representatives of: local communities; reindeer herders; shipping industry; icebreaker company; legal, policy and investment organisation; re/insurance company, sustainable development research, and international institutions working on Arctic maritime science (see list on the [APPLICATE website](#)). After communicating and consulting with the original stakeholder group members and reaffirming their interest and availability to participate in the User Group, we considered together representativeness gaps. We proposed other sectors that should be involved in the User Group, including nature conservation, energy, and tourism. However, despite the numerous invitation emails and personal contacts established (e.g. we contacted different offices of WWF, Greenpeace, and Bellona but without a positive answer), we haven't succeeded to involve some of these sectors yet (e.g. nature conservation). We adopted the strategy to establish these liaisons through other projects within the EU Polar Cluster or through contact persons in the European Commission (e.g. the project officer). In terms of energy, this is one of the areas of expertise of a User Group member, the Institute of the North and the Arctic Council AREA project they manage in cooperation with AP, although we additionally established collaboration with other EU projects (e.g. S2S4E and CLIM2POWER) in order to explore linkages between the Arctic and mid-latitudes. Also, we

will continue looking for new User Group members in the sectoral workshops as well as in the events we attend. In the case we cannot involve a certain sector in the User Group we will try to conduct individual interviews with a representative from that sector.

Early User Group discussions were targeting the Arctic as a whole, trying to understand the most pertinent issues for which enhanced weather and climate prediction could be an asset. With the new project results becoming available and providing better insights into the impacts of Arctic change on mid-latitudes, we will enhance liaison with participants from Europe. In particular, issues such as a higher frequency of extreme events in Europe related to Arctic changes and their impact on the energy sector could be of interest.

To assure that the members of the Group are up to date with the latest project achievements, we have been organising “updating” meetings with different WPs. In these meetings, representatives from WP1, WP2, WP3 and WP5 have been discussing with the User engagement team about their latest results and how the project can address user needs. The project researchers are also regularly invited to participate in the User Group meetings. The results from the hitherto user group discussions have been analysed, shared with the user group members, and reported in D7.11 and D7.12, as well as to the project coordination team. In addition, the results have also been disseminated in the form of two brief publications: (i) "Insights from the APPLICATE User Group meeting" in the Polar Journal and (ii) "A changing Arctic – dialogues from the North" in the Adaptation Futures conference proceedings.

Workshops and meetings

Organizing and performing workshops and meetings, and participating in relevant events serve to present the project results to various audiences, including both Arctic stakeholders and stakeholders from mid-latitudes. The project partners participate in relevant external events and carry out workshops and meetings during these events to get direct feedback from a user perspective. These events also include scientific conferences, where we have the chance to meet, discuss with and get feedback from our key stakeholder group. Besides, through participation in the initiatives organized by the target sectors, we have an opportunity to exchange information and collect feedback from the key stakeholder group, including many actors not usually linked to the weather and climate research communities. Finally, by taking part in various relevant events, we will also have the opportunity to meet with representatives from the primary and secondary stakeholder groups.

AP and BSC, together with other project partners, regularly take part and present in workshops and meetings of high relevance. Parallel sessions at these events, in the form of workshops, round tables, or splinter sessions, have been and will continue to be jointly organized with the EU Polar Cluster or in collaboration with other relevant H2020 projects (e.g. S2S4E, PRIMAVERA, Climateurope, KEPLAR and ARICE), C3S contracts (e.g. the C3S Global Shipping service), or ERA4CS projects (e.g. Clim2Power). This approach will ensure that we get in touch with various audiences and different stakeholders, while preventing user fatigue, through a coordinated action of different projects with the focus on climate change in the Arctic. Examples of these events are the workshop “Improved safety and environmentally sound operations in the Arctic Ocean – How to move forward?”

organised on behalf of the EU Polar Cluster at the Arctic Frontiers conference, in January 2019 and the side event “Connecting Arctic science with society: Lessons learned and progress”, co-organised with the EU-PolarNet and Nunataryuk projects, at the Arctic Circle Assembly, in October 2019. Another example is the webinar: “APPLICATE energy case study: Understanding linkages between the Arctic and mid-latitudes?”, provided by Marta Terrado (BSC) and hosted by [Climateurope](#).

The project partners will be encouraged to report on their participation in APPLICATE relevant events and on how they presented the project (e.g. in a scientific session, poster presentation, workshop, informal meeting, or distribution of project material). AP and BSC, with support from other project partners, will collect more concrete feedback from the users encountered in these events. These inputs will be regularly further discussed with the User Group and shared with the project scientists.

Development of case studies with working groups

Case studies are developed, in a form of storylines, around weather and climate events with significant impact on certain sectors or communities. Case studies aim to demonstrate how we can predict these events or use climate data and information to better understand them. Both User Group meetings and thematic working group meetings and workshops serve to select relevant case studies. Some of these meetings are organised in collaboration with the EU Arctic Cluster. In this regard, a workshop for the shipping industry was jointly organized at the Arctic Frontiers conference in January 2019. This workshop served to map the needs for improved weather and climate data for safer operations and smarter decision-making in the Arctic maritime affairs.

The case studies are developed in working groups. A working group is ideally composed of a few users from the relevant sector, young researchers involved in the project and the project (climate, social and communication) scientists. While the sectoral users will provide information from the ground – e.g. what information would serve them in the events described in the case study, project researchers will provide examples of what the project can provide in terms of weather and climate prediction information. We will then together analyse the role of climate data and prediction in the selected events and the users will evaluate the usability of such information in their decision-making. The case studies that have been developed so far aim to answer the following questions: (1) How does Arctic sea ice affect energy production and river transport in mid-latitudes? and (2) Is Svalbard prepared for extreme rainfall? This has been done through the analysis of three particular extreme weather events that include a cold spell affecting north-western Europe in 2016-17, a warm and dry spring impacting central and northern Europe in 2018, and a heavy rainfall event in Svalbard in November 2016.

Case studies make use of project results and focus in communicating them in a concise way in the format of brief communication pieces (4-6 pages). Case studies can be an effective communication tool to approach different sectors, such as local governments, reindeer herding, renewable energy and insurance. We disseminate these case studies at relevant events (e.g. the Arctic Circle Assembly, S2S4E General Assembly), via different communication channels (the project website, twitter account, partners' institutions websites),

or webinars (e.g. the Climateurope webinar, APPLICATE online course). We also expect the User group and working groups participants to disseminate the case studies further within their sectors and communities. Given that the climate services field is still in its infancy in the Arctic, we noticed the lack of such materials in the scientific conferences we attended. We expect this short, clear and compact communication pieces to thus be an excellent gateway to broader audiences, helping us improving the visibility of the project and disseminating project results, while at the same time enhancing awareness and the knowledge base within users.

Policy briefs and policy events

Despite clear evidence that the changes in the Arctic are affecting the mid-latitude weather, and that this has an important impact on different socio-economic sectors, the urgency implied by research findings appears to be disconnected from political reactions, which remain weak. In order to share scientific findings and science based policy recommendations with European policy-makers in a more efficient way, communication materials will be created within the APPLICATE project, starting by a policy brief explaining Arctic-midlatitude linkages, which will be presented at a dedicated policy-event.

APPLICATE will organise a policy event, targeting Policy Officers in Brussels, during the first half of 2020 (April-May). The event will focus on the topic of Arctic – mid-latitude linkages. The event will comprise a set of short presentations, conveyed by skilled speakers, and a networking light lunch. The presentations will tackle the link between climate change in the Arctic (most notably, changes in the sea ice concentration) and weather in Europe, providing examples of potential impacts on certain economic sectors, such as energy and river transport. Passing on the knowledge from the latest scientific findings, the speakers will present the relevance of weather and climate forecasting for decision-making. The policy event will also present indirect impacts that climate change in the Arctic can have for Europe, e.g. for maritime transport and tourism, on the one side, or for climate change adaptation and preparedness, on the other. This event will be organised jointly with other projects sharing a similar scope (e.g. PRIMAVERA, Blue-Action, YOPP and the EU Polar Cluster), to ensure a wider perspective and representativeness of the research findings.

Similar events will be held in connection to the ASSW in Akureyri, Iceland in March 2020, with participation of and in cooperation with the European Polar Board, Eu Polar Cluster IASC and the Arctic Council and at the Third Science Ministerial in Japan in November 2020.

Blog and interviews with stakeholders

The blog Polar Prediction Matters was set up in collaboration with YOPP and Blue Action and hosted by the Helmholtz Association. The blog serves as an online tool for harnessing user feedback and consulting with a broader stakeholder group and should foster the dialogue between those that research, develop, and provide polar environmental forecasts and those that use (or could use) polar environmental forecasts to guide their decisions. The joint effort with YOPP and Blue Action helps attract high profile contributors – stakeholders that write the blog posts, and also broad interest of the audience. The blog builds upon the articles that are posted once per month. These articles will provide individual views on how polar climate

forecasts (and other environmental information) are actually used, what additional needs exist, and what factors might yet limit the effective use of forecasts. The blog aims to launch a lively discussion with a broad audience. Regular posting on the blog and facilitation of the blog discussion will be performed by the YOPP partners, AP and BSC. The APPLICATE scientists have been invited to take part in the discussion as well. User information collected from the blog will be analysed and reported to the project WPs. The frequency of this analysis will depend on the activities of the blog and the relevance of the topics discussed. If this interactive platform gets momentum, it will both provide an effective channel for the project popularisation and for collecting user feedback.

Targeted interviews with representatives from main stakeholder categories will help collect additional in-depth knowledge on user needs, their understanding and perceptions. This intensive one-to-one approach will also help confirm or further clarify knowledge that we will receive through the described user engagement mechanisms. Face-to-face interviews will be performed at the relevant events attended both by APPLICATE and by stakeholders. Alternatively, interviews will be separately scheduled and conducted either face-to-face or over the phone/Skype, depending on the location and the interviewee's profile. So far, we conducted individual interviews with some of the User Group members. We will continue conducting interviews with representatives of main industry sectors of interest in the Arctic, as well as representatives from the mid-latitudes. The concrete list of interviewees will depend on the findings from the other user engagement activities – we will in particular target those communities that are under-represented (e.g. nature conservation), as well as those that express particular interest in the forecast in the Arctic. Findings from the interviews will be analysed and shared with the project partners. The findings will be used to shape project outputs and direct further project developments to be in line with user requirements.

Should a need for understanding a particular user requirement appear, that cannot be obtained from other user engagement activities and sources, we will conduct an online survey. The survey will have well defined questions and will aim to get information on particular aspects (e.g. type of impact indicator, data resolution). Similarly, if a certain user category is underrepresented in the project (e.g. actors from mid-latitudes) and it cannot be engaged through other user engagement activities, we will conduct a survey targeting this particular group. In this case, AP and BSC will develop, conduct and analyse results from the survey. The survey will be distributed using all available communication channels, professional contacts, emailing lists, newsletters, social media, and websites. The chosen dissemination plan will however depend on the targeted user group. In recent years, understanding the relevance and usability of climate information has become a key research topic, increasing the number of activities exploring this subject directly with users, including many surveys being conducted at the moment. To avoid user fatigue, the survey will be conducted only if the concrete need arises.

Both expert interviews and surveys will follow the confidentiality principles and guidelines and participants will sign a pre-prepared consent form for personal data protection and data storage. The confidentiality principles are based on rules regarding data protection and the European General Data Protection Regulation.

Results evaluation

We will use the results triangulation (consisting in results co-development with particular users and subsequent validation with a broader community) to evaluate the achieved results. This evaluation approach can be effectively conducted using case studies presented in the form of short communication materials. In this way, during the results dissemination activities at different events and occasions, we will try to validate the relevance of the information produced with a broader stakeholder community. Actually, this type of information triangulation was applied to the two first case studies, shared at Arctic Circle 2019, that were adjusted according to the feedback received at this event.

Another way to evaluate the impact of the projects user engagement and dissemination activities is by monitoring the number of (1) events organised by the project (e.g. side events in relevant conferences, policy events, etc.), (2) participants in the events that we organise, (3) readers of the case studies/policy briefs/newsletters – how many case studies have been handed in and/or downloaded from the project websites, and (4) participants attending webinars.

ACRONYMS

AGU – The American Geophysical Union

AP – Arctic Portal

APECS – Association of Polar early career scientists

APPLICATE - Advanced Prediction in Polar regions and beyond: Modelling, observing system design and Linkages associated with a Changing Arctic climate

BSC – Barcelona Supercomputing Center

C3S – Copernicus climate change services

EGU – the European Geosciences Union

EMS – the European Meteorological Society

EU – the European Union

H2020 – Horizon 2020 (EU Research and Innovation programme)

IPCC – Intergovernmental Panel on Climate Change

PAMIP – Polar Amplification Model Intercomparison Project

YOPP – the Year of Polar Prediction project