

D5.2 Report on annual multi-sector user forum

MAY 2023

Main authors: Jaroslav Mysiak and Chiara Calderaro (Euro-Mediterranean Centre on Climate Change)

Contributing authors: Panos Athanasiadis, Magdalena Alonso Balmaseda, Xavier Bordes, Mauro Buonocore, Suraje Dessai, Francisco J. Doblás Reyes, Sam Grainger, Jason Lowe, Jaroslav Mysiak, Stacey New, Andria Nicodemou, Nube González Reviriego, Beena Sarojini, Marta Terrado,

Document information

D5.2 Report on annual multi-sector user forum	
Grant Agreement number	101081460
Project title	Adaptation-oriented Seamless Predictions of European Climate
Project acronym	ASPECT
Project start date	1 January 2023
Project duration	48 months
Work Package	WP5
Deliverable lead	Euro-Mediterranean Centre on Climate Change (CMCC)
Author(s)	Jaroslav Mysiak and Chiara Calderaro (CMCC) Contributing authors: Panos Athanasiadis , Euro-Mediterranean Centre on Climate Change (CMCC), Magdalena Alonso Balmaseda , European Centre For Medium-Range Weather Forecasts (ECMWF), Xavier Bordes , Codorniu (CODORNIU), Mauro Buonocore , Euro-Mediterranean Centre on Climate Change (CMCC), Suraje Dessai , University of Leeds (ULEEDS), Francisco J. Doblas Reyes , Barcelona Supercomputing Center (BSC), Sam Grainger , University of Leeds (ULEEDS), Jason Lowe , UK Met Office (UK MET), Stacey New , UK Met Office (UK MET), Andria Nicodemou , Barcelona Supercomputing Center (BSC) Nube González Reviriego , Barcelona Supercomputing Center (BSC), Beena Sarojini , University of Oxford (UOXF), Marta Terrado , Barcelona Supercomputing Center (BSC)
Type of deliverable	Report (R)
Dissemination level	Public (PU)
Date of first submission	08 May 2023
Revision n°	-
Revision date	-

Please cite this report as: Mysiak, J., Calderaro, Ch., Athanasiadis, P., Balmaseda, M.A., Bordes, X., Buonocore, M., Dessai, S., Doblas Reyes, F.J., Grainger, S., Lowe, J., New, S., Nicodemou, N., González Reviriego, N., Sarojini, B., Terrado, M., Report on annual multi-sector user forum, D5.5 of the ASPEC project.

Disclaimer: *Funded by the European Union. Views and opinions expressed are, however, those of the author(s) only and do not necessarily reflect those of the European Union or the European Climate, Infrastructure and Environment Executive Agency (CINEA). Neither the European Union nor the granting authority can be held responsible for them.*

Table of Contents

Executive Summary	iv
About ASPECT	v
1 Introduction	1
1.1 Purpose and objectives of the User Forum.....	1
1.2 Organising aspects	2
1.3 Contingency risks management	4
1.4 Evaluation of the Forum's performance	5
2 First User Forum	6
2.1 Summary of the Forum's first session	6
2.2 Summary of the Forum's second session.....	10
3 Assessment of the First user Forum	15

List of tables

Table 1. Overview of the key performance criteria (KPIs) for the First User Forum event.....	16
-----------------------------------------------------------------------------------------------------	----

Executive Summary

ASPECT's User Forum serves as a platform for stakeholder and user engagement, offering a space to share knowledge, experiences, and challenges related to climate predictions. The Forum is designed to bring together researchers, users and beneficiaries of climate services, purveyors of climate services and other stakeholders who use climate predictions in their work or are interested in learning how to use them more effectively and efficiently. The Forum provides a unique opportunity to explore user requirements and use cases for the implementation of climate predictions.

The inaugural User Forum meeting was held in two sessions. The **first** session took place on March 24th as a guest event during the ClimateEurope2's Climate Innovation and Services webfestival. The session explored how the ASPECT project can produce climate data that is useful, usable, and used by stakeholders. The agenda included keynote speeches, panel discussions and interactive sessions focusing on forms of engagement and ways of producing climate information that enhance existing applications. The participants were invited to express their interest in co-producing seasonal-to-decadal prediction information that will benefit their organizations and others. The **second** session was held on April 21st as a dedicated event for those who aspire to become closely engaged in the project's activities as superusers. The session advanced the discussion in a more informal and technical manner, and featured breakout group discussions where participants shared their experiences with climate forecasts and explored how ASPECT's data could enhance their activities. The Forum served as a platform for stakeholders to engage in mutually-useful discussions and foster collaborations aimed at addressing climate risks and improving adaptation strategies.

This report offers a comprehensive analysis of the User Forum's management, delving into its objectives, governance, practical organizational considerations, potential risks, and stakeholder engagement evaluation (Section 1). It emphasizes that the Forum is a shared responsibility across all Work Packages (WPs) and includes an outline of their respective roles. Additionally, the report includes a summary of the discussions held during the inaugural Forum event (Section 2) and a reflective evaluation of the event (Section 3). The inaugural User Forum event successfully established an initial community of more than 270 users closely connected to ASPECT. The two-session event showcased diverse content, facilitated close audience interaction, and highlighted project objectives and benefits. Collaboration opportunities were identified to expand the user community, with a focus on engaging underrepresented sectors. Performance indicators and sectoral composition were analysed, showing a promising start with room for improvement. The event maintained a balanced representation of male and female speakers. Future efforts will involve developing a customized communication and engagement strategy, with the consortium contributing to its implementation.

About ASPECT

ASPECT aims to set up and demonstrate a seamless climate information (SCI) system with a time horizon up to 30 years and accompanied with underlying research and using climate information for sectoral applications. The project's goal is to improve existing climate prediction systems and to merge their outputs across timescales together with climate projections to unify a SCI as a standard for sectoral decision-making.

The project focus will be on European climate information, but we will also look where there is a wider policy interest (e.g., disaster preparedness) and in regions of European interest. We will maintain a strong link with the WCRP lighthouse activities to exploit learning for explaining and predicting earth system change. To provide a bandwidth diversity of information, the SCI system will be based on multi-model climate forecasts and will build on learning from projects such as EUCP. It will align with new activities on Digital Twins within Europe, including DestinE. The SCI will combine physical science aspects with those from other disciplines to ensure the information is robust, reliable, and relevant for a range of user-driven decision cases. The information package will incorporate baseline forecasts and projections (plus uncertainty), and will explore new frontiers (e.g., extremes which are of socioeconomic high-level interest).

To ensure success, the research will encompass: an understanding and attribution of various processes along timescales (such as exploring signal-to-noise ratio) and their impact on predictability, new ways of initialisation of the prediction systems, merging predictions with projections, provision of regional SCI for Europe by downscaling (statistical methods, AI) and HighRes models (including convection-permitting models) and innovative post-processing method enhancing the skill and robustness of the climate forecasts.

1 Introduction

In this section, we will first introduce the purpose and objectives of the multi-sectoral User Forum established in the ASPECT project. We will then delve into specific practical arrangements, contingency risks, and key performance indicators (KPIs) to ensure the success of the Forum.

1.1 Purpose and objectives of the User Forum

The ASPECT consortium acknowledged that providing accessible, understandable, and actionable climate information is crucial for making effective climate change adaptation and mitigation decisions. However, such decisions vary greatly across sectors, geography, and time-scales, making it challenging to provide information that is both broadly applicable and specific enough to be useful. The ASPECT project aims to assess the requirements for climate information at both a broad sectoral level and in-depth for a number of case studies. This will be pursued by working closely with a smaller number of closely engaged users – referred to as **superusers** – and developing a deep understanding of their decision-making processes and specific requirements. Additionally, the project aims to investigate risk-informed hazard indicators and other relevant types of information that cater to a broader range of users' needs.

To interact with and build a community of users of climate information, specifically regarding climate predictions, the ASPECT project has committed to establishing a multi-sector user forum. A multi-sector forum is a collaborative platform designed to bring together stakeholders from various sectors, including researchers, policymakers, and practitioners, to exchange knowledge and experiences. The objective of the **ASPECT User Forum** is to promote collaboration among research partners, the wider community of users and providers of climate services, and wider stakeholders towards the ultimate goal of guiding research towards greater impact. To enhance the usability of climate predictions, the User Forum will:

- promote a deeper understanding of how climate information and knowledge can assist organizations in preparing for and mitigating the risks associated with climate change,
- facilitate effective interactions between ASPECT climate scientists and users of climate predictions,
- explore the feasibility of scaling up the use of climate predictions and determine the necessary steps to do so.

The primary objectives of a multi-sector forum include:

- To provide a **platform for collaboration**: The Forum's primary objective is to foster collaboration between the ASPECT consortium and various users and stakeholders while gathering insights on the practical application of climate forecasts and identifying potential barriers that hinder their adoption. Through the Forum, knowledge, best practices, challenges, and opportunities are exchanged, facilitating the development of more practical, accessible, and widely adopted climate forecasts.
- To **promote innovation**: The Forum is setup to promote innovation in the use of climate predictions for decision-making and policy development. It facilitates the identification of new research areas and methodologies that can enhance the delivery of climate forecasts, thereby improving their value in informing policy development and decision-making processes.
- To promote **knowledge dissemination**: The Forum serves as a platform for disseminating knowledge and information about climate forecasting to a wider audience. By sharing

research findings, best practices, and innovations, the Forum helps to raise awareness about the importance of climate forecasting and the potential impacts of climate change.

1.2 Organising aspects

This section explains how the User Forum events are organized to inform the scientific innovation endeavour of the ASPECT project across the different workstreams and areas.

Collaborative responsibility for organizing user forum events: The Forum events facilitate user interactions throughout the project, with shared responsibility among different WPs:

- WP5 organizes the User Forum events, typically on day two of the project general assemblies. The format is flexible and can evolve throughout the project. The first Forum event included sessions on user contexts, rapid assessment of user needs, and early guidance on information sources and methodologies. Dialogues between producers and users were encouraged. Subsequent events will focus on different sectors, with input from superusers and reporting on scientific advancements. Efforts will be made to maximize synergies with other projects and the communities they engage with, such as Climateurope2, CLIMAAX and MAGICA. In addition, online interaction will be actively promoted between Forum events to facilitate continuous engagement and collaboration among participants.
- WP4 is responsible, at a later stage, for sharing the developments achieved in collaboration with the first and second cohorts of super users with the Forum participants. This will allow to show examples of the type of enhanced climate information ASPECT is able to deliver and, at the same time, collect feedback from the stakeholders involved in the Forum and explore how outputs obtained with superusers can be scaled up to be useful for a wider range of users.
The first cohort of superusers' requirements were collected early on and have been integrated with feedback obtained from the User Forum and external sources (deliverable D5.1) to inform developments in WPs 1-3. Stakeholders' feedback gathered through the User Forum will also foster a common understanding between climate scientists and superusers.
- The WPs 1-3 are focused on developing methods that are customized to meet the specific needs of the users, whereas WP6 concentrates in the operationalisation of the climate information and services to promote their uptake. The feedback collected through the User Forum will be instrumental to these technical WPs and will help to shape the development of the project outputs ensuring they can effectively support the users' decision making processes. This feedback loop ensures that the project stays aligned with the needs of the users and maximizes its societal impact.
- WP7 facilitates user engagement by creating suitable materials to effectively communicate project information and scientific concepts to audiences not specialised in climate science. This includes developing short videos to explain the project and digested explainers presenting key scientific aspects leveraging the enhancements and benefits provided by the project, which can be used in user surveys and Forum events.

Logistics and coordination of the event: Roles and responsibilities, schedules, and communication plans are essential practical arrangements for successful User Forum events. The section 1.3 elaborates on contingency management risks and plans in case of unexpected events.

- **Time schedule:** The Forum events are planned to occur concurrently with the annual general assemblies (GAs) of the project. The inaugural GA took place in January 2023 as

a kick-off meeting. Given the 12-month intervals between GAs, the subsequent three GAs are scheduled for January-February in 2024, 2025, and 2026, with the final GA set for December 2026. Updates for this deliverable are due at months 18, 30, and 46 (30/06/2024, 30/06/2025, 31/10/2026), allowing flexibility in the User Forum's timing. This enables alignment with the scope of related activities such as Climateurope2 web festivals and MAGICA events.

The Climateurope2 web festivals are scheduled to occur every six months, with events set for September 2024, March and September 2025, and May and December 2026. In-person Climateurope2 festivals are planned for March 2024 and October 2025.

Leveraging the opportunities to align Climateurope2 and ASPECT schedules for User Forum provides larger benefits, as demonstrated in the first User Forum event. Some arrangements that can be applied to take advantage of these synergies are:

- The **second User Forum** event should be held in conjunction with the project General Assembly in January-February 2024. As outlined in the DoW, the second day of the GA could be dedicated to the User Forum event. The Climateurope2 festival is scheduled for March 2023, and the ASPECT project could participate by presenting selected talks or hosting a session focused on climate forecasts.
- The **third User Forum** event could be held in conjunction with the Climateurope2 webfestival in March 2025, or the Forum event could be split in two sessions with the first one held as a part of ASPECT GA in January-February 2025 and second session as a part of the online webfestival.
- Likewise, the potential **fourth User Forum** event could be held in two sessions: one in January-February 2026 and another in May 2026 as part of the Climateurope2 web festival.
- **Online activities** between User Forum events could take advantage of other editions of Climateurope2 and MAGICA events and may include virtual workshops, conferences, seminars or webinars. The plan for these activities will be discussed as part of joint WP5 and WP7 initiatives and presented to the Management Board for consideration.

Roles and responsibilities: A governance structure should be established to ensure that the events and activities of the Forum operate efficiently and effectively. This involves setting up a steering committee composed of representatives from all WPs to oversee the Forum's activities, creating an organizing committee composed by WP5 and WP7 representatives to prepare for events, and appointing a forum manager to coordinate activities and ensure that objectives are being met.

- The **steering committee** will determine the overarching goals and specific objectives for each event, establish event dates, and allocate contributions from different work streams.
- The **organizing team** will be responsible for sending out invitations, determining hosting arrangements, and ensuring effective communication across various channels.
- The **forum manager** will lead and chair meetings for both committees, as well as monitor progress to ensure that goals and objectives are being met in a timely manner

Participants: The Forum brings together diverse communities, such as researchers, users of climate services, and climate service providers from various industry sectors. The organizational structure focuses on recruiting potential members while considering their ideal size, composition, and arrangement within the User Forum. We leverage initial contacts and working relationships established through previous research and innovation activities, close collaboration with ongoing projects like Climateurope2, MAGICA and CLIMAAX and the snowballing effects generated by our dissemination and outreach activities. There is no

predetermined target size for the User Forum, although diversity will seek to maximise the opportunities of scaling up the project results to a wide community.

1.3 Contingency risks management

While the User Forum can bring numerous benefits, there are also several critical contingency risks that need to be considered and mitigated. The risks identified in at the onset of the project and included in the description of work include:

- **Difficulty engaging stakeholders or experiencing stakeholder fatigue.** Likelihood: Low. Severity: High. This contingency risk pertains to mobilizing superusers and their application use and case studies. In assessing this risk, we have considered the existing trust-based relationships and, for later-engaged superusers, the capacity to draw from a diverse pool of potential participants with the ability and interest to participate in project activities.

Other identified contingency management risks include those that impact the ability to meet superusers' expectations and deliver customized knowledge products directly relevant to decision-making and policy development within the contexts in which the superusers operate.

Additional contingency risks specifically related to the User Forum include:

- **Lack of participation.** This risk encompasses challenges in identifying, reaching out to, and motivating users across various policy and practice domains, which could ultimately diminish engagement and hinder the achievement of intended goals. To mitigate this risk, the Forum employs a comprehensive strategy to identify key stakeholders and ensure their active engagement and involvement in the forum's activities. Our strategy involves leveraging networks established by partners and collaborating with other projects like Climateurope2 and MAGICA to reach additional user groups and expand our stakeholder base.
- **Inadequate structure and forms of engagement:** The structure of Forum's events and way of interacting with users may not be aligned with their interests and priorities, leading eventually to low participation and perception of limited value by users and stakeholders. We are cognisant of the fact that the Forum events need to be flexible, well adapted to the preferences of the users from various knowledge communities, with measurable outcomes that demonstrate the Forum's value and impact.
- **Ineffective communication:** Effective communication is crucial for the Forum's success. A variety of communication channels should be established to facilitate the exchange of information and ideas among participants. This includes handling invitations, collecting and utilizing feedback from users, and reporting the impact of their input. To prevent confusion, misunderstandings, and reduced participation that may arise from poor communication between users and Forum management, the Forum will establish efficient communication channels and develop clear communication guidelines, ensuring that members remain consistently engaged and well-informed.

1.4 Evaluation of the Forum's performance

The Forum's activities should be consistently monitored and evaluated to ensure objectives are met and to pinpoint areas for improvement. Participant feedback should inform future planning and actions. As previously emphasized, the Forum is a shared responsibility among all Work Packages (WPs), so the evaluation process and Key Performance Indicators (KPIs) described below are intended to encourage dialogue. The KPIs have been developed from WP5's perspective.

The User Forum's evaluation should cover all objectives mentioned in section 1.1, including WP5 Forum events, WP4 User journeys, WP7 communication activities, and the integration of user feedback in WP1-WP3 research and innovation efforts. The criteria can be summarized as follows:

- Diversity and Inclusivity: Assessing the Forum's size, composition, diversity (e.g. in terms of sector), and representativeness.
- Quality of Engagement: Evaluating the shaping of discussions, how User Forum members influence events and activities beforehand, and their satisfaction levels afterward.
- Responsiveness to Feedback: Analysing how the consortium addresses and follows up on the advice and input received.

For the scope of Forum events under WP5's responsibility, the following KPIs may be considered:

KPI 1. Diversity and Inclusivity

- KPI 1.1 Size and diversity of the Forum's participants: This set of indicators encompasses both newly registered members joining the User Forum and active participants in the Forum's events.
- KPI 1.2 Membership retention: These indicators reflect the ongoing engagement and repeated participation in events.

KPI 2. Quality of Engagement

- KPI 2.1 Perceived quality of discussions: This includes the number of Forum members sharing experiences, asking questions, and providing feedback during events.
- KPI 2.2 Members' satisfaction: This assesses how Forum members evaluate the content, agenda, presentation quality, and the format and delivery of information.

The KPIs outlined above serve as guidance for Section 3, where a preliminary assessment of the First User Forum event is presented. Prior that, Section 2 provides a summary of the agenda and the various contributions made during the event.

2 First User Forum

The inaugural edition of the Multi-Sector User Forum, hereafter referred to as the User Forum or Forum, was held in two separate sessions in March and April 2023. The first session was organized as a guest event within the context of the Climateurope2 webstival of climate innovation and services, March 22-24, 2023. Climateurope2 is a coordination and supporting Action (CSA) under Horizon Europe, aimed at promoting high-quality and equitable climate services in Europe and beyond. The project also focuses on developing community protocols, standard-setting criteria, processes, and taxonomies, building upon the community-building activities of the predecessor Climateurope project¹. The ASPECT's guest event was held on March 24th from 10:00-12:30 CET. The second session of the Forum event took place as a stand-alone event organized solely by the ASPECT consortium on April 21st from 10:00-13:00 CEST.

The agenda and slides used during the event can be found in the annex. This public report does not include the list of participants due to privacy concerns.

2.1 Summary of the Forum's first session

The first session was moderated by **Marta Terrado** (Barcelona Supercomputing Center, BSC) and **Suraje Dessai** (University of Leeds) and featured several keynote speeches and pitch presentations from selected users and purveyor of climate information.

Jason Lowe from the UK Met Office introduced the ASPECT project, which aims to help us navigate from our current 1.1-1.2-degree warmer world to a 1.5- or 2-degree warmer world over a range of time scales from a season up to around 30 years. ASPECT stands for "Adaptation-oriented, Seamless predictions and European Climate Targeted". The project focuses on user-driven scientific research in three key areas. First, improving seasonal to decadal forecasts by developing better initialization methods, representing uncertainty better, and increasing vertical and horizontal resolution. Second, developing methods to produce consistent predictions over 30 years. Finally, the project focuses on downscaled results using statistical methods, convective permitting models, analog approaches, and machine learning to adapt to local conditions. Box 1 contains the full transcription of Jason's talk.

When asked about the differences of decadal climate forecasts to other timescales, Jason explained that climate forecasts and climate simulations differ in their time scales and the level of detail they provide. Climate simulations aim to model the entire climate system and its interactions over long time scales, often decades to centuries. In contrast, climate forecasts focus on predicting future climate conditions for shorter periods, ranging from a few months to a few years, which are critical for making strategic decisions. Decadal forecasts, which are a type of climate forecast, use models similar to those used for seasonal or climate projections. However, the key difference is their ability to provide more accurate and skilful information for the timescale of a few months to a few years. This is possible by incorporating both natural variability and external forcing signals, which is an exciting development from a scientific perspective. The challenge with decadal forecasting lies in making these forecasts operationally relevant and usable for decision-making. Although decadal forecasts are currently in the pilot study phase for many applications, we are starting to see the use of

¹ More information about Climateurope2 (Supporting and standardizing climate services in Europe and beyond, 2022-2027) and Climateurope (European Climate Observations, Modelling and Services, 2015-2021) project can be found at <https://climateurope2.eu> and <https://www.climateurope.eu/>.

seasonal forecasts to make operational decisions. The ultimate goal is to provide decision-makers with accurate and reliable information for the timescale that matters most to them, which is often shorter than the timescale covered by climate simulations.

Answering a question on the uncertainties in climate predictions, Jason explained that in the short term, emission scenarios are close together, and their uncertainty is not the main factor in decadal and 30-year forecasts. The main sources of uncertainty are natural variability and structural differences in the models. ASPECT has access to multiple modelling systems, allowing for the exploration of both types of uncertainty and the tail of natural variability. Uncertainty is important for decision-making, and we need to improve our understanding of it. Storylines and probabilistic approaches both have value in communicating climate information and checking models. The goal is to use both methods to make better decisions.

Xavier Bordes discussed how Codorníu uses climate forecasts and the benefits it has gained from their implementation. Codorníu is a wine company in Spain that specializes in producing cava using traditional methods. With over 18 generations of winemaking experience, it is one of the world's oldest family-owned businesses. The company uses weather forecasts and experiments with seasonal forecasts as part of the European innovation project VISCA. Xavier explained that frost in the spring is the most damaging phenomenon for wine production, and the likelihood of temperatures dropping below zero degrees is crucial for investments in frost protection systems. Similarly, excessive heatwaves, exceeding 40 degrees, can impact grape production, making it crucial for seasonal and decadal forecasts. The availability of water for irrigation is also important for the company, as it affects irrigation efficiency and the need for water ponds. Xavier expressed the expectation that ASPECT will provide tools to make the company more resilient and adaptable to climate extremes. He stressed that vineyards are long-term investments, unlike annual crops, and decisions must be made with a longer-term view. As seasons become warmer, alternative wine varieties that are better adapted to hotter and drier climates may be favoured. When asked about the most critical climate variables, Xavier highlighted temperature and rainfall related extremes, which can be essential at different phenological stages.

Sam Grainger from the University of Leeds discussed the initial screening of evidence on how organizations can use climate information and knowledge to prepare for and reduce the risks of climate change. The research aims to explore the types of climate information used by organizations, the contexts in which it is used, why it is used, and any assessments of their information and contextual needs. The evidence is being gathered from published literature, a questionnaire sent to National Met Services, an internal user requirement database from the Copernicus Climate Change Service, and a call for evidence. The articles are categorized into three contexts: seasonal climate forecast information for operational and risk management, adaptation planning for future longer-term climate change, and tailored tools and products for citizens or local-scale businesses. The demand for seasonal forecasts was found to come mainly from large private organizations in the energy, water, insurance, and transport sectors. The research also found that the accessibility of information and the degree of interaction between providers and users during policy formation were prioritized over accuracy.

Dan Bernie from the UK Met Office has put out a call for additional superusers to engage with ASPECT's climate information. These superusers are expected to actively participate in meetings with climate services scientists and share relevant information to help identify weather and climate risks. There are no monetary costs nor monetary compensation associated with engaging with the project's scientists, but a time commitment and willingness to collaborate is required to ensure that the project's climate services are tailored to their

specific needs. In exchange, superusers will gain privileged access to experimental data and climate knowledge packages customized to their requirements.

Finally, two purveyors of climate services shared their views on the challenges and opportunities posed by climate predictions in various policy domains.

Alberto Troccoli is a director of the World Energy & Meteorology Council (WEMC), a non-profit organization that promotes the use of weather and climate information to support the energy sector. WEMC aims to enhance the exchange of information and cooperation between the energy and meteorology communities and develop innovative approaches to tackle weather and climate-related challenges in the energy sector. In his talk, Alberto used the metaphor of boiling water to describe the funding and activities in climate services. He believes that case studies are the main vehicle for interacting with users and that good expertise, a good plan, and good ethics are necessary for success. He suggested that visual tools are important for sustaining services, and his company has developed a public tool for seasonal forecasts. To wrap up, Alberto emphasized the urgency of taking decisive action on climate now.

Paolo Mazzolli is the CEO at Gecosistema srl, an Italian environmental consultancy firm that provides services related to environmental assessment, monitoring, and management. Gecosistema works with various clients, including public administrations, private companies, and non-profit organizations and develops services related to environmental impact assessments, water resource management, flood hazard and risk assessment, and sustainable energy planning, among others. Paolo explained a range of applications of climate services, such as a service that utilizes decadal prediction from Copernicus and a crop balance model to provide information on expected irrigation demand. Gecosistema is working on creating human-centric climate services by collaborating with stakeholders in laboratories. Additionally, they are working on climate disaster risk management projects, aiming to develop tools and knowledge to handle disaster risk reduction and climate change adaptation. Paolo emphasized the importance of user interaction in the development of climate services and their goal to provide value at a local level by utilizing information from a higher scale.

Answering the question who's using the climate forecasts and how, Alberto stressed the importance of timely weather and climate forecasts for different users, including traders who require quick decisions within a few hours, and big energy companies who use complex economic models to work out power production. He mentioned the importance of providing value for users, such as setting up systems to deal with droughts and providing information on water resources. User interaction needs to be kept at the centre of developing these services. Alberto also stressed the importance of going first in decision-making and the timeliness of seasonal forecasts. Paolo stressed that users could interact with the service in various ways, depending on their needs. For example, hydro power producers need timely information for operational planning, while regional authorities need information on longer-term perspectives for water availability and climate planning. The users can be divided based on their level of expertise and need for customization. Some are interested in getting accurate information quickly without needing to know the details of the system, while others require more in-depth knowledge to customize the service to their needs.

Box 1: Transcription of the key-note speech of Prof Jason Lowe

I want to start by thinking about where we are. Society has clearly been through a period where the climate has already changed. And the plot on the left-hand side is showing the global average temperature from pre-industrial levels. Last year was the sixth warmest on record, but you can see as well as that trend upwards in the figure, you can also see the year-to-year variation and natural variability. And as we move through the present into the future, we have to capture both that trend due to large-scale climate change, but we also need to think about how it interacts with the changing variability, and ASPECT will do that.

On the right-hand side, I wanted to illustrate that when we think of climate change, we need to also think about extremes. And we've already seen detectable changes in, for instance, intense rainfall events or very high temperature events. And we're starting at many locations to see an emergence of the signal for drought. We're also seeing big changes in aspects such as sea level rise and changes in Arctic sea ice cover. And the latter can be very important because it has an important impact on European climate as well as local consequences.

So a question that I'm guessing a number of you ask yourselves is, how can I make better climate-sensitive decisions? As a user, how can I bring the information that scientists like me, Suraje, Bernie, etc., provide? How can we take that information, access it, and use it in a way that makes a difference to our organizations? And this diagram is trying to capture some of the types of decisions that people make across time scales. So you can see going from left to right, we're going to longer and longer time scales, and ASPECT will sit in this space going from a season up to around 30 years ahead. And you can see within that space, there are actually a very large number of decisions as we move from the tactical into the strategic.

So those include thinking about resource planning, reinsurance decisions that take place in that space. Thinking about investment strategies, thinking about risks to assets and property portfolios sit in that category. Regulator standards, updating them, and complying with them sit in that category. Overall, it's a space where we need to think about adaptation to present and future climate. ASPECT will help with that. And ultimately, how can we help to make better decisions? Well, by using better climate information, by using more relevant climate information, by making sure we have easier access to the climate information, and also by bringing together the weather and climate information with much more user-relevant information on exposure and vulnerability. We will hear more about that from the case studies.

One way I think about this is that in ASPECT, we are aiming to help navigate from our current 1.1-1.2-degree world compared to pre-industrial times to a 1.5- or 2-degree world. The plot illustrates the median model response across all of the scenarios covered in IPCC working group 3 for 2020 and 2050, highlighting how ASPECT fits into this space as we move towards a 1.5- or 2-degree world.

ASPECT is an acronym that stands for "Adaptation-oriented, Seamless predictions and European Climate Targeted". Our focus is on the European climate, but the methods developed will also be relevant to other parts of the world. ASPECT started in January of this year (2023) and will run until December 2026. As part of the project, a prototype delivery system will be developed, but it is worth noting that ASPECT is a research project and not an operational one. The aim is to leave behind a legacy that can feed into operations at the next stage.

In ASPECT, the users are central to the project, and scientists will be driven by the users. We acknowledge that the users know more about their applications than we do, and the co-development and co-production approaches need to put all parties on an equal footing for discussions. The hierarchy of users within the project ranges from superusers at the centre to a wider community on the outside. Today's event is part of building a wider engaged community, and ASPECT hopes to provide benefits to attendees on the early results.

There is dedicated effort to work with met-services, as they are often a route to broadcasting and spreading the value of climate information. However, not all climate service users and purveyors can attend events like this, and ASPECT aims to reach a greater number through communication approaches and data delivery systems. The idea of amplifying discussions to a wider community is important, and attendees are encouraged to act as champions for those discussions.

In terms of the case studies, we are looking at a range of spatial and time scales, from local to national and regional, and from a month or so to the 30-year time horizon. There are three case study areas,

the first of which focuses on the grape and wine sector in agriculture. The decisions made in this sector span different time horizons, and having good quality information and a consistent understanding of that information is crucial for making the best decisions. The second case study is on the finance sector, specifically pension funds. There is a real appetite in this sector to engage with climate decision-making, but some parts are still at the awareness-raising stage, and the goal is to provide access to the best information on time scales up to 30 years. The third case study is on governance, linked to the mission on climate adaptation, aiming to produce improved risk assessments and adaptation plans.

There are two gaps where additional users can be added, and we will hear more about this later. A delivery system is also in place to bring together the data produced, and the methods expressed as workflows, with ECMWF contributing its expertise in Climate Data Store. ASPECT aims to encourage an ecosystem to form around the data it produces, and other parts of upscaling beyond data will be considered, building on toolkits from other projects such as the SPF UK climate resilience program.

ASPECT also focuses on cutting-edge scientific research in three areas. The first is improving seasonal to decadal forecasts, including better initialization methods for the slower varying components of the earth system, representing uncertainty better, and investigating the benefits of increased vertical and horizontal resolution. The second area is developing and comparing methods to produce seamless predictions to 30 years, building consistency across time scales. ASPECT will investigate taking initialized forecasts and running them further into the future or merging data from different systems through a constraining approach or intelligent stitching together of different ensemble members.

The final areas I want to highlight are that, because adaptation is place-based and local, we need to be able to downscale results for quantities that are extreme or rare. These events are associated with the greatest damage. On the left-hand side, I am illustrating the latest generation of very high-resolution convective permitting models, which can capture many features of the observations. I am showing a simulation over the Alpine region, which is a particularly difficult region to capture. The plot next to it shows rainfall intensity from ERA5, the black line, through a traditional regional model. These models are usually around 12 km, but if we want to get near the observations, in this case, the green line showing radar observations, only the very high-resolution models are able to do that. So we will be looking at downscaling approaches to derive climatologies of extreme events. We will also recognize that people need time series. Therefore, we will be using statistical methods to downscale the full time series period and will make use of a variety of techniques, including drawing on the convective permitting models that have been developed over recent years. We will look at analog approaches and also machine learning techniques as part of the study.

To finish, the last slide focuses on the legacy of the project. There will be a scientific legacy, with new methodologies developed with the users to improve models and experimental design, appropriate downscaling techniques, and improved time merging. There will be new datasets focusing on time merged or seamless over time, as well as extended initialized experiments. We hope there will also be a capable and enabled user community that will contribute through these User Forum events, case studies, data delivery activities, and also advice to meteorological services.

2.2 Summary of the Forum's second session

The second session of the User Forum event focused on technical modelling frameworks and requirements for using climate predictions. The session was open to all interested in climate prediction, but particularly invited were those who wanted to share their experiences or explore the use of novel climate predictions and forecasts. The project launched a competition earlier this year to become a superuser and interested organizations were invited to attend the second session for follow-up and tailored discussion. During the session, interested users presented the use cases that they had developed as part of their application. The actual and potential superusers explained their use of climate predictions and anticipated their requirements.

The session was moderated by **Jaroslav Mysiak** (Euro-Mediterranean Centre on Climate change, CMCC) and featured contributions from various workstreams of the ASPECT project, as well as pitch presentations from various candidate superusers mobilised previously. Jaroslav provided a summary of ASPECT's focus on developing extended forecasts beyond the typical 5 to 10-year range, downscaled to user-relevant scales. The consortium aims to deliver user-centred climate predictions building on ECMWF's experience with C3S and the climate data store. Attendees of the first session identified enablers, including standardisation and access to public data, and barriers such as a lack of funding and low confidence. They expressed interest in forecasts at 10 to 30 years and multi-annual forecasts for strategic decision-making, calling for more evidence to understand the needs of different users. The Forum encouraged productive dialogue and building connections. Closing his introduction, Jaroslav said

»As we gather here, let us remember that we all come from different backgrounds, but we share a common interest in improved climate risks and information needed for this end. We hope to engage in productive dialogue and build connections that will last beyond this event. Thank you for being a part of this community«

The ASPECT expert panel consisted of representatives from the three technically-focused WPs: **Magdalena Alonso Balmaseda**, the Head of Earth System Predictability at the European Centre for Medium-Range Weather Forecasts (ECMWF); **Panos Athanasiadis**, a senior scientist at the Euro-Mediterranean Centre for Climate Change (CMCC); and **Beena Balan Sarojini**, a climate scientist at the University of Oxford.

Magdalena introduced some of the goals of the ASPECT project, which include developing a new generation of forecasting systems, increasing the number of ensemble members, and improving calibration and skill assessment. She emphasized that user input and guidance are necessary for driving these advancements. The main objective of the project is to create a "bridge integration" between seasonal and decadal prediction. This integration can be achieved through various means, such as extending the seasonal forecast to 24 or 48 months or increasing the number of ensemble members for the first two years of the decade. These improvements have significant potential for practical applications, particularly in Europe, where it is crucial to differentiate between a one-year drought and a multi-year drought. Another bridge integration will connect the decadal with projections by extending the forecast range to 20 or 30 years.

Panos discussed the types of climate forecasts available and being developed in the ASPECT project, including seasonal, decadal, extended seasonal, and extended decadal predictions. He highlighted the sources of predictability and the skill assessments for precipitation, temperature, and wind, which vary based on target and initialization month. However, the usefulness of forecasts is not solely based on skill and can provide information on changing statistics and extreme events. Panos mentioned the potential for hybrid approaches to improve skill and acknowledges that there may not always be a sufficiently skilful forecast available.

Beena explained that the ASPECT project involves creating and evaluating seamless climate information using temporal merging techniques focused on joining seasonal and decadal predictions. Additionally, it aims to provide seamless climate information at high spatial resolution using downscaling models. She explained the two methods used in temporal merging, stitching, and shadowing, and the types of downscaling, statistical and dynamical downscaling. The ASPECT project will take into account information about the user needs to select the most appropriate data and provide a framework for downscaling future climate and extreme events in a kilometre-scale spatial resolution.

During the discussion and while answering the moderator's questions, **Beena** provided further details on the benefits of seamless climate predictions. Currently, the information related to climate predictions is widely dispersed and not easily accessible as a single source of information. The concept of a seamless prediction system implies the use of the same forecast model and the production of information from the same source. This allows for a more multi-modal and simplified approach to forecasting, as different European forecasting models can be considered and combined to produce a single model. Such a model would make the information more readily available and easy to understand, leading to a better representation of uncertainty.

Panos highlighted the primary benefit of initialized climate predictions, which is that they start from realistic initial conditions, leading to a more precise representation of natural internal variability. In contrast, climate change projections cover a more extended time horizon but lack initialization from a realistic state. Certain low-frequency climate components operate on multi-decadal timescales, such as the Atlantic meridional overturning circulation, which needs initialization to determine the exact phase of low-frequency variabilities during the forecast. Climate change projections may fail to capture this information, making initialized climate predictions more valuable on this timescale. Regarding prediction skills, the objective is to exploit the assured predictability of a phenomenon through known teleconnections.

Magdalena elaborated on the importance of initialized climate predictions, emphasizing the need for observations to understand the real state of the world and the current time. In contrast, climate projections lack this information and only consider changing greenhouse gases or policy. Magdalena highlighted that initialized predictions can provide valuable information on current conditions and constrain probabilities, but their validation poses challenges. This exercise aims to address the changing climate and determine where nature stands in this process. The skill and internal variability of decadal predictions can produce divergent paths, making it important to combine them with more frequent seasonal predictions. Although there may be uncertainty in predictions, there are no fundamental flaws in their conception.

Nube González Reviriego, head of the Climate Services team at the Barcelona Supercomputing Center (BSC), introduced co-production plans for the project and the role of superusers. While there is a wealth of climate data available online from various sources, it's not the same as climate information. Through co-production, the project aims to work with superusers to understand their needs, process the data, and tailor it to meet their requirements. Several approaches will be used to accomplish this, such as working meetings in a friendly atmosphere, surveys, and user forums. The project aims to provide personalized climate information to superusers interested in decisions across different temporal scales. To achieve this, the project team will engage with superusers through co-production plans and use various methodologies to understand their needs and contexts. The team will then map the superusers' knowledge needs onto decision-making processes and develop case studies, such as harvest management in agriculture or water management. Each case study will specify the type of forecast (seasonal or decadal), the target period, and the necessary information. By adopting participatory approaches, the project seeks to gather the required information and create tailored climate information that can be used to make decisions.

The **panel of candidate superusers** consisted of five experts from diverse backgrounds. **Maurizio Mazzoleni** represented the Mission Adaptation project CLIMAAX and is from the Institute for Environmental Studies at VU Amsterdam (IVM). **Valentina Pavan** and **Rodica Tomozeiu** are employed in operational weather and climate services at the Regional Agency for Prevention, Environment and Energy of Emilia-Romagna (ARPAE), Italy. The climate purveyors included **Stefano Bagli**, the CEO of Gecosistema srl; **Sara Dal Gesso**, the CEO of

Amigo Solutions srl, and **Eleftheria Exarchou** from Mitiga Solutions Ltd. These panellists brought valuable perspectives and insights from their respective fields.

Maurizio presented the CLIMAAX project, which is the flagship project of the EU Mission on climate adaptation. The Mission aims to prepare Europe to deal with climate disruptions, accelerate the transformation towards a climate-resilient future, and build deep resilience by scaling up actionable solutions through an ambitious framework for local and regional transformative adaptation. To achieve this, innovations in local and regional climate risk assessments are needed across key vulnerable community systems, such as health and social care systems, critical infrastructure and entities, water supply, landscape productivity, and ecosystem health. The CLIMAAX project aims to develop a customised framework and toolbox for climate risk assessment at the local and regional scales that address these systems.

The CLIMAAX framework and toolbox are initially tested in five pilot areas: Finland and Latvia at the national level, and Catalonia (Spain), Setúbal (Portugal), and Zilina (Slovakia) at the sub-national level. Later, the framework and toolbox will be applied to 50 additional regions as part of the same project. The regions selected for the CLIMAAX project will have the opportunity to improve their local and regional climate risk assessments through the use of cascading funds managed by the project, which can serve as a catalyst for transformational change. ASPECT can contribute to this effort by collaborating closely with the CLIMAAX pilots and the subsequent beneficiaries of the cascading funds. By doing so, ASPECT can help to expand the outreach of the project and incorporate climate predictions into the climate risk assessment framework and toolbox outlined in the Mission's Implementation Plan.

Valentina and **Rodica** represented one of the Mission Adaptation's regions, the Emilia Romagna region in Italy. They both represented the Regional Agency for Prevention, Environment and Energy of Emilia-Romagna (ARPAE), a public institution dedicated to the protection of the environment, public health, and safety in the Emilia-Romagna region. ARPAE works to prevent and control environmental pollution and promote sustainable development by providing scientific and technical support to local authorities, businesses, and citizens. Its activities include monitoring air and water quality, managing waste, promoting renewable energy, and providing information and education on environmental issues. The ARPAE Climate Observatory Service is well acquainted with the cutting-edge climate services based on climate prediction. For example, as part of the H2020 CLARA project, ARPAE developed a climate service called Water Requirements for Irrigation (WRI) which uses probabilistic seasonal forecasts to estimate whether irrigation demand determined using Earth Observation can be met with the expected water availability. The Agency also provides specialised climate knowledge products for local and regional climate adaptation and mitigation strategies and plans.

Stefano Bagli is the CEO at Gecosistema srl, a company already introduced during the first session of the User Forum (see section 2.1). In the current session, Stefano provided a summary of the applications already produced and explained how the decadal forecasts could enhance and complement the existing services.

Eleftheria Exarchou, representing MITIGA Solution, a spin-off company founded in 2018 by risk modelling experts with 20+ years of experience, shared how the company utilizes science and technology to create real-world solutions against natural hazards for the industry and society. MITIGA Solution is certified by various organizations and has won awards, including the best start-up in Catalonia. Their goal is to advance risk assessment and mitigation, develop innovative technology, and maintain a leading position in the industry.

Amigo Climate was founded in 2013 to democratize climate information and empower businesses for adaptation to climate change. The company believes that reliable and accurate climate data and modelling are essential to create a climate-proof society. Amigo Climate provides tailored tools and services for climate risk assessment and forecast in insurance, finance, agriculture, infrastructure management, and utilities through their product TERRA. The company has a global network of partners, including research institutions, international organizations, SMEs, and large enterprises, and is committed to co-design and constant dialogue with end-users. Amigo Climate started as consultants and worked on projects like the eXtreme Climate Facility, established by the Africa Risk Capacity and the World Food Programme.

After the refreshment break, the session continued with two breakout groups for further discussion. One group focused on ASPECT's contribution to the EU Mission on Adaptation to Climate Change and the involvement of regional authorities and agencies from the regions enrolled in the Mission. Recently, the EC published a list of 284 regions and local authorities from 25 EU Member States, and 17 regions and local authorities from Associated Countries to Horizon Europe that have signed the Mission Charter. The Mission Charter is a memorandum and a letter of commitment to transformational adaptation change. The second breakout group discussed climate service providers who can leverage cutting-edge climate predictions through innovative applications. The other group engaged both the providers of climate services and the end users. The discussion revolved around topics such as timing and rules of engagement, as well as the benefits for the users' organizations.

3 Assessment of the First User Forum

The inaugural User Forum event aimed to establish a community, beginning with the initial contacts and users already connected to the consortium members. The event was organized in conjunction with Climateurope2, which helped raise awareness about the project's scope and purpose. The ASPECT project benefited from the numerous communication channels used to promote the Climateurope2 web festival. These have been leveraged with ASPECT consortium's own communication and social media channels.

The two sessions of the inaugural User Forum event showcased a diverse range of content and fostered close interaction with the audience. The first session aimed to inform the community about the project's objectives and the benefits of engagement. This session also featured the launch of calls for evidence and the invitation for participants to become superusers, with an explanation of the underlying principles. In the second session, superuser candidates presented their work, context, and potential applications that could be expanded through the use of decadal predictions. Ample time was allocated for more intimate interactions in smaller groups, enabling everyone to ask questions and share their perspectives. Targeted communication and dissemination campaigns supported the event's organization efforts. This approach facilitated the establishment of an initial community of climate prediction users closely connected to ASPECT.

Several opportunities can be leveraged to further expand the ASPECT user community. First, closer collaboration can be established with other ongoing projects focused on climate services and the use of climate predictions. Second, the project will continue to work with Mission Adaptation and the communities and regions invited to sign the Charter and/or participate in projects that have been approved for funding. Third, climate service providers can be closely engaged, and a sub-community of users and providers can be created under the umbrella of the Climateurope 2 project. To capitalize on these opportunities, a customized communication and engagement strategy should be developed, with the entire consortium contributing to its implementation. Special attention should be given to communities and areas of policy and practice that are less engaged and thus benefit less from this project. This includes business and financial sectors driven by policies and guidelines for disclosing climate-related financial risks.

Table 1 presents the performance indicators that have already been completed. The number of registered people and attendees only includes individuals outside the consortium partners. This has been achieved by filtering out all participants who belong to any of the ASPECT consortium member organizations. By applying this filter, we have also excluded those who are affiliated with partner organizations but are not involved in the project's implementation.

The sectoral composition of the initial user community is skewed towards research and innovation organizations, which comprise 45% of attendees. This was expected and aligns with previous experience, as the delivery of climate services is driven by cutting-edge research and innovation. The business community accounts for around 17% of participants, reflecting our ability to engage small and medium-sized enterprises specializing in the provision of climate services. Public agencies and authorities represent about 20%, while civil society organizations make up approximately 10%. These results are encouraging and will be further improved. Other sectors include media and undisclosed categories. We have been mindful of and successfully achieved a balanced representation of male and female speakers.

Some of the KPI indicators will be completed after the submission of this deliverable. This is because, while collecting participants' feedback, we also aim to provide community members with additional information, including on the future User Forum events. The missing KPIs from the first User Forum event will be included in the next update of deliverable D5.2, as explained in section 1.2.

Table 1. Overview of the key performance criteria (KPIs) for the First User Forum event. Where available, values separated by forward slash indicate the values of first and second session of the first Forum event.

Key performance criterion	Assessment	Comment
KPI 1 Diversity and Inclusivity		
KPI 1.1 Size and diversity of the Forum's participants		
Registered participants – number	242/38	Session 1 / Session 2
– sectoral split	45-18-17-9-12	RTD-Public-Business-CSO-Others*
Actual participants – number	99/23	Session 1 / Session 2
– sectoral split (%)	45-19-14-8-10	RTD-Public-Business-CSO-Others*
– average time in the session	95 min (63%)	Time actively spent in the session 1
Speakers – gender balance	12-9	Male-Female, both sessions together
KPI 1.2 Membership retention		
% of participants in session 2 who attended session 1	50%	
% of participants wishing to participant in next Forum events		
KPI 2 Quality of Engagement		
KPI 2.1 Perceived quality of discussions		
number of users' contributions	3/6	Session 1 / Session 2
number (length) of break-out groups	0/2 (1hour)	Session 1 / Session 2
quality of the discussion	moderate/good	The first session attracted moderate discussion and 2/3 questions on average after each talk. Second session included in-depth dialogues and break-out discussion
KPI 2.2 Members' satisfaction		
% of participants who assessed the quality good or excellent		
% of participants wishing to codesign the agenda of next event		

Legend: *RTD- research and academia, Public- public authorities and agencies, Business-companies, CSO- civil society organisations, Others – other organisations