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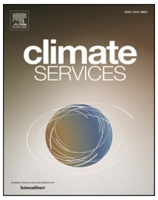

Perspective

Climate services for managing societal risks and opportunities

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ABSTRACT

The Earth's climate and changes to it impact our lives, well-being and economy in numerous ways, some positive and some negative. Managing the risks that arise from changes in the climate over the coming months, years and decades is one of the most pressing challenges that society faces, but there are also some opportunities. The provision and use of climate information in decision-making (i.e. climate services) are central to managing the risks and opportunities. In this article we describe the seemingly complex climate service landscape, the actors in it, what the services are used for, and what next, to help stimulate further action to enable society to reduce risks and realise benefits, particularly timely as the world looks ahead to build a green recovery from the COVID-19 pandemic on the path to net zero emissions. Through a consideration of the value chain for climate services, we emphasise the importance of dialogue and collaboration between those developing, providing and using climate information in decision-making, and stress that a climate service is only worth delivering if it is going to be used by someone to influence an outcome. Co-production can be highly useful for enabling the dialogue and collaborating across the value chain, helping create services based on credible, salient and legitimate knowledge.

Introduction

Throughout 2020, and continuing into 2021, the world has been faced with new and unprecedented challenges brought about by the coronavirus COVID-19 pandemic, leading to extremely widespread social and economic disruption. However, even during this massive disruption, climate variability and climate change are still recognised as being amongst the most pressing challenges that society faces, and continue to grab news headlines with widespread reports of extreme or record-breaking conditions and concerns for what the future may bring (WMO Press Release, 2020a; WMO Press Release, 2020b; BBC News, 2020; The Lancet, 2020; Walton and Van Aalst, 2020; WMO, 2020).

Key to addressing the climate challenge are climate services, which for simplicity in this introduction can be considered as the provision of climate information (where climate typically relates to timescales from months and longer) for use in decision-making, although more on this below. Climate services have been provided and used in some form since climate information was made available in the 20th Century, if not before, originally in the form of climate records based on long-term observational datasets (Hecht, 1984; Vaughan and Dessai, 2014), although they weren't widely referred to as climate services at the time. It is during the course of this century that the term has started to be used more widely, fuelled by major advancements in developing the scientific and technical capabilities that can be of use or value to society and decision-makers, and a growing interest in the potential value of the services from society and decision-makers.

Climate services are slowly but surely being embedded within decision-making – they are becoming integral within the United Nations Framework Convention on Climate Change (for example, within the Paris Agreement, UNFCCC, 2015), the Intergovernmental Panel on Climate Change's (IPCC) Assessment Reports, governments' national adaptation plans, funding agencies' investments, and a growing number of sectors and industries worldwide.

This article describes the landscape of climate services, the actors in the landscape, what climate services are being used for, and highlights some of the successes and problems, to stimulate debate and ultimately to help drive action to tackle the climate challenge. The article is based on our experiences through being centrally involved in many international activities over the past 10 years, particularly the Global Framework for Climate Services, the global Climate Services Partnership, the World Meteorological Organization and regional (particularly Europe and Asia) and national (particularly UK and Australia) climate service developments. This perspective is enhanced with knowledge gained from published literature, widespread interactions and collaborations,

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and practical experience from working in this area.

What is a climate service?

The question "what is a climate service?" is often asked and being able to agree on defining such a concept can be useful. The Introduction above provided a simple description of what a climate service is, and specific definitions have been discussed and published (see for example, Brasseur and Gallardo, 2016; Lourenço et al., 2016), but there is not a unique agreed definition, with different nuances provided in different publications. Can a unique definition of a climate service be agreed upon? Having experienced numerous attempts to do so, we think the answer is no, in part because the context and use of each climate service create different nuances. Indeed, services in other disciplines aren't necessarily uniquely defined. So, do we need to have one agreed definition, who cares about a definition, and why do they care? It is perhaps more the academic community who are striving for a unique definition, and given that the services are only really relevant and of value if someone uses them to assist in decision-making, then it is the users of the service (a phrase that we will come to later) who it should matter to the most.

This still leaves the questions, do we need a definition, and why? Some form of framing is needed to provide scope to understand what the services are, but perhaps we don't need a unique agreed one. Therefore, we suggest a simple framing, such as "a climate service is the provision of climate information for use in decision-making" and additional details and nuance can be added if and where needed, depending on the context and use case. A similar approach, and debate, has been used for other services, for example for "energy services" (Fell, 2017).

It is important to appreciate that climate information is often only one, possibly relatively minor, element of what is needed by the recipients of the climate service for their decisions (Goddard, 2016), and in such cases the climate service ideally needs to be integrated or translated along with other information or service elements of additional relevance to the decision-makers to create sufficient value (Stone and Meinke, 2005). For example, some authors describe "climate adaptation services" (Goosen et al., 2013) that build on a climate service by designing and appraising strategies for adapting to climate change, something that is beyond the scope of the climate service itself but a possible extension by suitably knowledgeable specialists. In the water and disaster risk reduction communities, decision-makers often require services based on combining hydrological and meteorological information, and on climate timescales "hydromet and climate services" is a concept better articulating what the decision-makers need (World Bank Group, 2020). In the agriculture community, a sector that has long-established climate services, climate-informed digital agricultural advisory services are being developed which integrate climate services, agricultural advisory services and digital innovation combining different data sources, to produce tailored advisories for the users.

The landscape of climate services

The number and diversity of individuals and organisations that make up the landscape of climate services is growing and evolving. One way of viewing and understanding this landscape is to consider the value chain for climate services. The value chain is context-dependent and represents the range of activities needed to research, develop, produce and deliver the product or service to the end user (Porter, 1985). The chain doesn't necessarily represent a linear flow from one end to the other, and there will often be iterations and cycles between different parts of the chain, and some contexts may be better visualised by a "value web" representing something more complex with more connections than a chain affords.

To improve efficacy, climate service providers should understand all of the different links in the value chain (or web), identifying key actors to engage with or collaborate with to co-develop services of value to the market and society (Fig. 1). In fact, all of the actors across the value chain would benefit from better understanding all of the links in the value chain. For example, the actors involved in developing capability upstream in the value chain would benefit from better understanding how their capability underpins services and creates value downstream in order to help develop future capability of greater value to society. Similarly, the actors involved in using the services downstream in the value chain would benefit from better understanding the upstream capability, although in many cases this understanding is often a valuable part of the climate service offering. In the following discussion, many of the examples from the published literature are based on projects and activities in Europe where there has been a huge investment in developing climate services and stimulating a market (Street, 2016).

At one end of the value chain ("Inbound logistics" in Porter's model (Porter, 1985), Fig. 1) are the upstream activities and institutes involved in creating the scientific and technical capability and data that underpins the services, typically involving academic research institutes, National Meteorological and Hydrological Services (NMHSs), and national and international research and infrastructure programs. Many of these institutes and programs are integral to innovation along the entire value chain, as well as testbeds for new capability and services, and potential service providers themselves (see Cortekar et al., 2020 for a summary for the European context).

The climate service providers are in the middle of the value chain, sitting in the so-called "valley of death" (Osawa and Miyazaki, 2006) between the organisations and activities who generate the underpinning capability, and the end users and decision-makers. Some climate services are provided by NMHSs, some by Regional Climate Centres, and some by bespoke Climate Service Centres, both public and private. The climate service providers have the difficult task of needing to understand decisions across the whole value chain, including management decisions at one end and research and development decisions at the other. As good practice, the climate service providers typically collaborate closely with the research institutes and programs upstream in the value chain to understand, assess and use the underpinning capability to develop services, or collaborate closely to jointly develop services, however, there currently is no requirement or standards that demand they do this (Fiedler et al., 2021). Some service providers are large enough to undertake research themselves and can draw on their own upstream capability, although as emphasised below, it is unlikely that any one organisation will have the capability and capacity to do all of the required research, development and delivery alone and collaboration at some level will be needed. The service providers also engage closely with the recipients of the services to understand what the recipients' needs are to ensure that the service is tailored to deliver sufficient value to the customers and to facilitate what it is that the customer wants to achieve. In some cases climate service providers collaborate closely with actors in other parts of the value chain to jointly develop services, be it with those upstream to improve the capability underpinning the service, or the users downstream to co-develop services with the recipients to increase the value and usefulness of the service. Whatever the approach, having an understanding of the decisions, the decision-makers and their value chain (which will likely be different to the climate service value chain) is essential and needs appropriate engagement, depending on the context (Everingham et al., 2002; Hewitt et al., 2017).

At the right hand end of the value chain are the downstream recipients (the users) of the services making decisions and taking action (Bruno Soares et al. 2018; Opitz-Stapleton et al., 2020). The term "user" has also been the subject of academic debate (Skelton et al. 2019). Phrases such as user, next user, and end user have been conveyed to recognise differing interests and needs. Again, does it really matter in practice in terms of delivering and using climate services? It perhaps matters more to the climate service providers since they need to know who they are serving and to properly understand their needs, than it does to the "users". The important point is for the climate service developers and providers to be clear themselves as to who they are

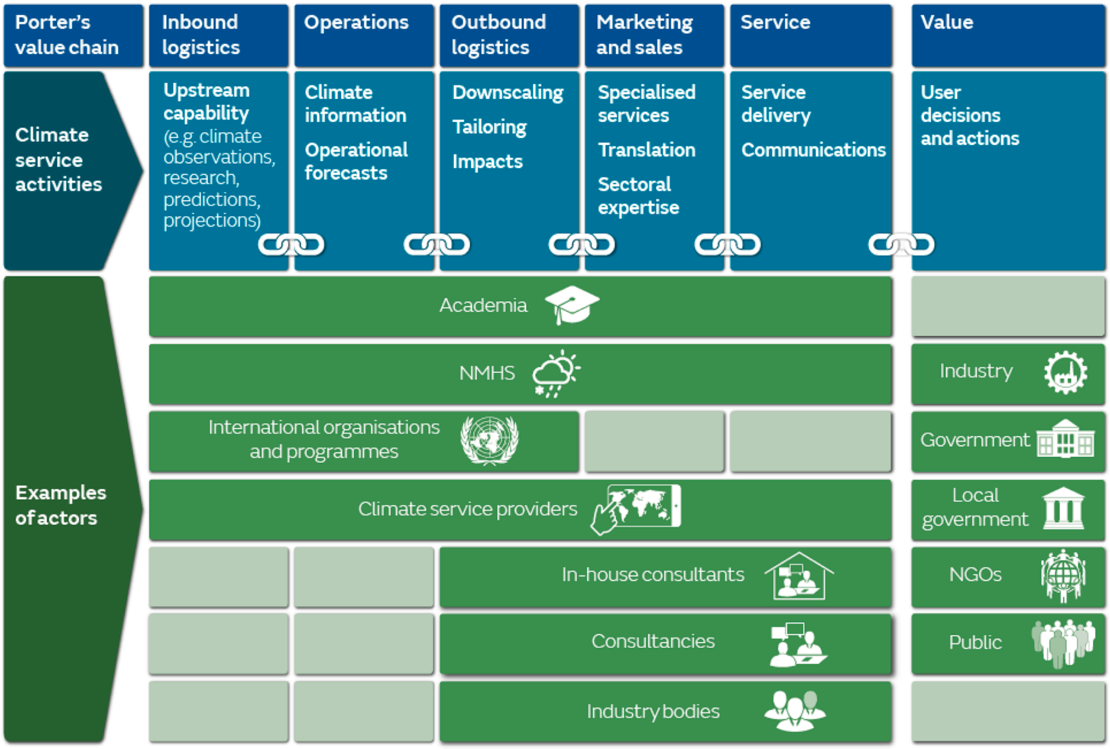


Fig. 1. Schematic of the climate services value chain structured around Porter's value chain (Porter, 1985). The schematic shows some of the key activities, and examples of the types of actors typically, but not exclusively, involved in different parts of the value chain. Notes: NMHS is National Meteorological and Hydrological Service; the climate service activities listed are illustrative and some are inter-related and could map to more than one part of the value chain; the examples of actors for user decisions and actions aren't necessarily meant to align with the actors listed in the same row to the left in the value chain.

providing the service to – they are their users – and then how to best engage with and serve their users as recipients of the service (Hewitt et al., 2017).

An additional dimension to the climate services landscape which cuts across the value chain is the enabling environment for the services, in terms of showing the need and creating the demand for the services, and the mechanisms for developing, delivering and using the services. The need is largely driven by societal exposure and susceptibility to climatic events, with individuals and organisations wanting or needing to manage risks and opportunities, or responding to policy or regulatory frameworks which themselves would typically be created to help manage the climate-related risks. The mechanisms for development, delivery and use include partnerships and shared resources, innovation, entrepreneurship, and protection of intellectual property. Large development and investment organisations, in particular the multi-lateral development banks, UN Agencies, the European Commission and national governments, have been making sizeable investments in climate research and climate service projects and programs for many years.

While understanding this landscape and getting involved in it might seem daunting, the societal need for climate services was explicitly recognised at the World Climate Conference-3 in 2009, which called for worldwide effort to have a Global Framework for Climate Services (GFCS) under the leadership of key UN Agencies (Hewitt et al., 2012; WMO, 2009). Since then the GFCS has provided the guidance and presented potential models for governance for nations and societies to develop and deliver their climate services if they wish to do so, including identification of the main stakeholders in the climate service landscape. A key aspect of the guidance and governance from the GFCS is to develop National Frameworks for Climate Services ensuring the key stakeholders within a nation are brought together through appropriate coordination to improve the co-production, tailoring, delivery and use of climate services (WMO, 2018). Successful examples of such coordination at the national level are starting to appear (Hama et al., 2017; Hewitt et al., 2020a; Hewitt et al., 2020b; Wang et al., 2020).

How are climate services of use and used?

The IPCC's Working Group 2 for their Fifth Assessment Report (AR5) provided a risk framework assessing the risk of climate-related impacts as resulting from the interaction of climate-related hazards with the vulnerability and exposure of human and natural systems (see Fig. 19-1 of Oppenheimer et al., 2014). The risk framework was devised in the context of avoiding and adapting to dangerous climate change. While avoiding and adapting to dangerous climate change are undoubtedly of high societal importance, in the broader climate service landscape climate information can also be useful in decision-making to assess opportunities arising from climate-related events. A framework dealing with hazards, exposure, vulnerability and risk is predisposed to considering negative and harmful situations and not necessarily helpful when considering different situations where climate information can be used for decisions leading to benefits.

In some contexts, the same underlying climatic conditions can lead to both negative and positive outcomes depending on the decisions being considered. For example, a climatic event leading to wet conditions could lead to harmful impacts through flooding, or beneficial conditions for crop growth. Finding terminology which caters for both negative and positive outcomes from climate-related events isn't simple, but we offer one suggestion for framing the management of risks and opportunities, shown in Fig. 2. Climate services can provide essential input, in the form of information about climatic conditions or events, to such a decision-making framework when combined with the decision-maker's knowledge of their exposure and susceptibility, helping the decision maker either mitigate risks or realise benefits.

The justification for investing in the development of climate services is often based on addressing the societal challenge of being resilient to climate-related events through managing risks from hazards or

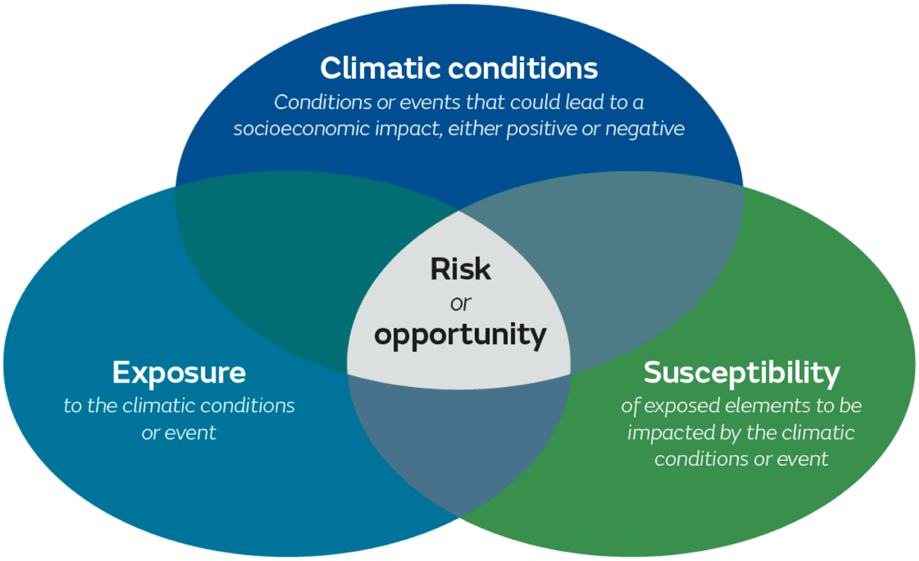


Fig. 2. Schematic of components for assessing risks or opportunities arising from climatic conditions or events.

exploiting opportunities from favourable conditions, as well as specific industry needs, socio-economic value, technological potential, and deficient supply and demand (Harjanne, 2017). Attempts have been made to assess the (economic) value of the climate service market (Georgeson et al., 2017; Vaughan et al., 2019), but there are huge uncertainties and challenges, not least in separating weather services from climate services, and this is a continuing field of study. For example, in 2019 the World Meteorological Organization (WMO) started producing an annual "State of Climate Services" report to help identify where and how governments can invest in effective climate services to strengthen countries' resilience to multiple weather, climate and water-related hazards.

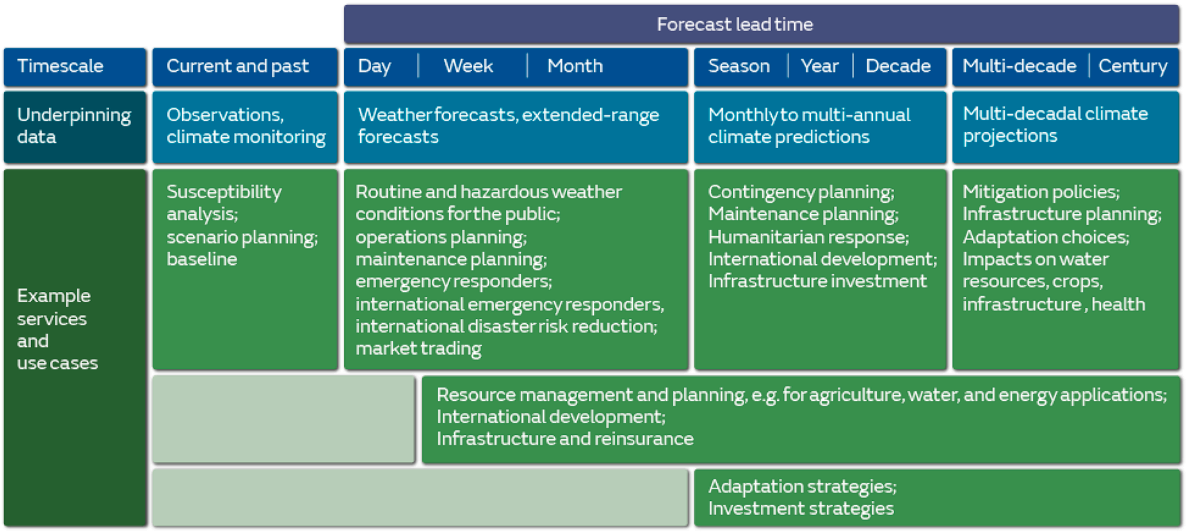
Whatever justification is used, as stated above a climate service is only worth delivering if it is going to be used by someone to influence an outcome. Decision-makers are more likely to use the service when the providers strive for salience, credibility, and legitimacy of the information they provide (Cash et al., 2003; Brasseur and Gallardo, 2016) and ensure the information is accessible, relevant and usable (Lemos et al., 2012). A demand-driven approach to the development of services, as opposed to a capability-driven approach, is therefore clearly important. However, the climate service market is a relatively new and emerging one, which leaves room for innovation in speculative development and testing in the hope that some developments will eventually prove to be of use. Indeed, the earliest climate service developments were capability-driven, being more focussed on improving access to climate data, in effect pushing the service to a potential market of whoever was interested. While this capability-driven approach usefully highlighted the value of climate information in decision-making, in effect initiating the market, such a supply-driven focus based on existing capability may result in services not well aligned to what is needed. For example, developing a service based on scientific capability such as the skill of seasonal forecasts or understanding of climate change drivers won't necessarily guarantee that the information is of use or value to the decision-makers (Stone and Meinke, 2005).

A natural evolution and improvement to the science-push approach has been to develop science-driven, user-informed services as a co-development between the different parties, in particular bringing the providers and users of the service together in the development of the service (Vincent et al., 2018). A variation of this has been to move towards a much more demand-driven, but science-informed approach (Lourenço et al., 2016; Alexander and Dessai, 2019) and use this to drive scientific advances. Being demand-driven should be seen by research and development teams as a means to drive scientific innovations to try to meet user needs rather than to shy away from them (Golding et al., 2019). This doesn't mean that we should avoid developing climate services based on current scientific capability, because there is already a huge amount of valuable information for decision-makers, if we can better get it to them (Trenberth et al., 2016). One example is climate attribution services. The Siberian heatwave referenced in the Introduction is an example of the newly emerging rapid attribution studies, which have the potential to be highly useful climate services (World Weather Attribution, 2020). The scientific capability is approaching the level of being ready to provide scientifically credible information for decision-making, although (arguably) before the decision-makers are ready to use such information. The concept of "scientific readiness levels" has been mooted by Earth Observation programmes to establish a standard measure of the maturity of evolving science with respect to satellite missions as a variant of the "technology readiness level" approach (European Space Agency, 2015), and is a useful concept for climate services.

Attempts have been made to compile compendia of climate services that are being provided and used around the world (e.g. by the World Meteorological Organization, WMO, 2012) to raise awareness of the climate service landscape and its use and value, but it has proven problematic determining what would be included in the compendium, how to get sufficient and common information for all listed services, and how to avoid the list becoming hopelessly out-of-date. A more tractable approach is to refer to examples of different categories or types of climate services (Bruno Soares et al., 2018).

The first category of climate services is those that provide information based on the current and past climate (see Fig. 3), to serve as a baseline for decision-makers to assess how the climatic conditions affect their domain, perhaps in terms of how susceptible and resilient a system is to climatic events presently, or to provide a record of observed events, or to provide the context for predicted future events. Without understanding this baseline, it is difficult to consider how harmful or beneficial future climatic events may be.

Once the decision-maker understands their exposure to the current and past climatic conditions then their needs may well require information about future climatic conditions to assess their future exposure and risks or opportunities that may arise. One way of categorising such climate services is into the following three broad timescales of interest largely based on the modelling systems, scientific research, and availability of climate data that underpin the services. Firstly, there are numerous well-established services and use cases requiring and using information for the coming months and seasons in terms of short-term



<table>
<tr><td></td><td></td><td colspan="3">Forecast lead time</td></tr>
<tr><td>Timescale</td><td>Current and past</td><td>Day | Week | Month</td><td>Season | Year | Decade</td><td>Multi-decade | Century</td></tr>
<tr><td>Underpinning data</td><td>Observations, climate monitoring</td><td>Weather forecasts, extended-range forecasts</td><td>Monthly to multi-annual climate predictions</td><td>Multi-decadal climate projections</td></tr>
<tr><td rowspan="3">Example services and use cases</td><td>Susceptibility analysis;
scenario planning;
baseline</td><td>Routine and hazardous weather conditions for the public;
operations planning;
maintenance planning;
emergency responders;
international emergency responders,
international disaster risk reduction;
market trading</td><td>Contingency planning;
Maintenance planning;
Humanitarian response;
International development;
Infrastructure investment</td><td>Mitigation policies;
Infrastructure planning;
Adaptation choices;
Impacts on water resources, crops, infrastructure, health</td></tr>
<tr><td></td><td colspan="3">Resource management and planning, e.g. for agriculture, water, and energy applications;
International development;
Infrastructure and reinsurance</td></tr>
<tr><td colspan="2"></td><td colspan="2">Adaptation strategies;
Investment strategies</td></tr>
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Fig. 3. Illustrative examples of services across a range of timescales, with the potential to link climate services (on month-century timescales) seamlessly to weather services (on day-week timescales). Note that some of the example services and use cases listed can be applicable on additional timescales than shown in the figure.

climate variability, with climate services based on forecasts for the coming months to a year or so based on seasonal forecasts (Buontempo et al., 2014; Bruno Soares et al., 2018; Vaughan et al., 2018). Typical use cases are for planning for operations, maintenance and resource management, financial decisions such as market trading and reinsurance products, international development, and disaster risk reduction. Some of these use cases extend beyond the month-annual timescale both into longer and shorter timescales. On the shorter timescales there is the untapped but emerging possibility to link to weather services on the day-week timescales. On the longer timescales, an innovative and growing application for climate services on seasonal timescales is as a step towards helping decision-makers adapt to a changing climate and build resilience to longer term climate change (Hansen, 2005).

The second broad timescale of interest is longer term climate change based on multi-decadal climate projections (Asrar et al., 2012; IPCC, 2014; Bowyer et al., 2015). Typical use cases are to inform mitigation policies and adaptation choices, long-term planning for infrastructure, and assessment of impacts of climate change on various sectors. There is a wealth of use cases and literature, and as noted in the Introduction, climate services are becoming integral within the UNFCCC, IPCC, adaptation plans, climate investments, and a growing number of sectors and industries worldwide.

The third timescale of interest is the multiannual-decadal timescale, a combination of natural climate variability superimposed on to the longer-term climate change. To date, this timescale has relatively few actual use cases, but the combination of emerging scientific understanding and forecasting capability with growing user interest, such as for investment strategies, resource planning, assessment of mitigation policies, and nearer term climate change adaptation, make this an exciting new area for climate service development (Verfaillie et al., 2020; Smith et al., 2019; Solaraju-Murali et al., 2019).

In some cases, the decision-maker's interest or need isn't determined by any specific timescale and is more about raised awareness of risks and opportunities arising from proper assessment and management of climate-related events, often served by activities to build their capabilities and capacities. On the other hand, some (perhaps many) recipients of climate services may be interested in a wider range of timescales. A particular interest and need is for a seamless link from climate timescales to weather timescales, as alluded to above, with the climate timescales providing advance warning of risks or opportunities linked to a possible impending climate event on the decision-maker's timescale of interest (perhaps a dry summer or a cold winter), and as the time of their interest approaches then seamlessly linking from the seasonal to the monthly climate service to the weekly (sub-seasonal) timescale, and then in turn to a daily weather service. However, while the pursuit of seamless weather and climate *forecasts* has been a hugely active area of research and development (Shukla et al., 2009), seamless weather and climate *services* are as yet undeveloped.

Conclusions and forward look

There has been impressive progress made developing, delivering, and using climate services in what is a fairly new domain and market, and of course, more can and needs to be done to deliver greater societal benefits. One of the key challenges is that the underpinning scientific and technical capability are often not able to properly meet the decision-makers' requirements. There are huge ongoing investments and activities to continually improve the underpinning capability that powers the climate services (the left-hand upstream end of the value chain in Fig. 1) and enhance dialogue and collaboration with other parts of the value chain. While we won't discuss this topic further here, because this capability gap has been discussed extensively elsewhere (Brasseur and Gallardo, 2016; Hewitt et al., 2020a; Hewitt et al., 2020b; Hewitt et al., 2021; Skelton et al., 2019; van den Hurk et al., 2018), we do support such developments to the underpinning capability as essential in order to improve the salience, credibility, legitimacy, accessibility, relevance and usability of today's climate services, and also to develop future climate services of greater value to society.

One specific aspect of climate services which hasn't yet received much attention is quality assurance and standards for the services, where we believe that progress can and will be made over the next five years. Standards and quality assurance processes do already exist for meteorological data and systems through the WMO, but not for the climate services. Quality assurance and standards are needed at the provider-user interface to ensure that the services meet agreed levels and convey suitable saliency, credibility and authoritativeness, but ideally also for the use of the services to avoid inappropriate or unintended misuse, as well as to build two-way trust between the providers and recipients. Standards are also important at the next two links in the value chain upstream from the provider-user interface (i.e. downscaling/tailoring/impacts and specialised services/translation in Fig. 1). For example, even if the underpinning climate data meets WMO standards, if this high-quality data is fed into downstream systems that are flawed then this could potentially lead to poor quality information or advice for the decision-maker. The issue of quality is complicated because some use cases might not need as high-quality climate information or services as others. The users of the services therefore have an important role in assessing quality (Vedeld et al., 2020). Co-production of the services, through which both providers and recipients of the system contribute to the knowledge product, to create credible, salient, and legitimate knowledge (Cash et al., 2003) should be seen as a good practice approach wherever possible.

This idea of co-production highlights the importance of collaboration and partnerships in general and enhancing dialogue across the value chain. It is unlikely that an individual organisation will have all the required capability, skills, knowledge and capacity to develop and deliver many services and therefore collaborating and partnering where needed, and where useful in the value chain, is likely to be mutually beneficial. One common and successful approach for collaborating and co-developing is through developing prototypes and conducting trials of these prototypes with actors across the value chain, helping to build relationships and trust, assessing needs, identifying gaps and co-developing services of use to decision-makers (Hewitt et al., 2020a; Hewitt et al., 2020b). There are challenges though ensuring that successful prototypes make it through to operational services, when needed. Many prototypes and trials are conducted in fixed-duration projects and disappear after the project finishes, so plans for taking the prototype through to operational service should be considered, and realised where appropriate, during the active development phase. Collaborations and partnerships may provide the solution for making the successful services operational.

Looking forward, the market and the need for climate information in decision-making to confront the climate-challenge for society is only set to grow for the foreseeable future, and in parallel the underpinning capability will continue to improve, i.e. the right hand and left hand ends respectively of the climate service value chain (Fig. 1). However, engagement throughout that value chain needs to improve, drawing in different disciplines and different actors where needed. There is an opportunity for innovation here. For example, the COVID-19 pandemic forced a huge increase in online engagement and delivery in the climate service arena in 2020. Could new delivery channels be created building on this widespread growth in people's ability and acceptance of modern technology and communications (Fabregas et al., 2019)? Alternatively, could data science solutions such as machine learning, be developed for climate services building on existing work in the related fields of weather services, climate modelling and climate research (Huntingford et al., 2019)?

To conclude, while this article has described the scope of climate services and the actors in the landscape, perhaps now is the time and the opportunity to fully exploit and evolve these climate services to drive more advanced and integrative services as we look to recover from the COVID-19 pandemic. The virtual Climate Ambition Summit 2020 (Climate Ambition Summit, 2020) in the run up to the 26th UN Climate Change Conference of the Parties (COP26) in November 2021 has called for this recovery to be a green recovery as the world sets a pathway to net zero emissions. Climate information has an essential role to play as one of the building blocks of such a green recovery if used effectively and innovatively, integrating the information with other building blocks and providing a catalyst for change through managing risks and realising opportunities.

CRediT authorship contribution statement

Chris D. Hewitt: Conceptualization, Investigation, Methodology, Visualization, Writing - original draft, Writing - review & editing. **Roger Stone:** Investigation, Writing - original draft, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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