Climateurope2

Key Messages on standardisation of climate services

Climateurope2 second synthesis report

February 2025

Funded by the European Union

www.climateurope2.eu

Introduction

Global standards and best practice guidance for providing climate information that supports disaster risk prevention and management, adaptation, mitigation and sustainability strategies, have never been more essential. 2024 was the warmest year on record globally and the first one in which the average global temperature exceeded 1.5°C above pre-industrial levels. [1] During this year, Europe has witnessed extreme heat during the summer followed by extreme and devastating rains in the autumn. [2] The severe impacts of these extreme weather events, driven by a combination of physical, social, economic and political factors, highlight a failure to fully recognise the potential of climate services, which should provide climate information in a manner that effectively supports decision making. These services should involve appropriate engagement between users and providers, be grounded in scientifically credible information and expertise, incorporate effective access mechanisms, and be specifically co-produced and tailored to meet user needs and enable informed decisions. Addressing this challenge requires much more than simply providing generic climate information to the public and businesses.

The latest findings of the Climateurope2 consortium, dedicated to advancing the development and uptake of climate services and informing their ongoing standardisation, are presented as a series of key messages and recommendations. These have emerged from an analysis using the Climateurope2 Framework for the equitable standardisation of climate services to test several criteria. [3] The criteria were derived by the consortium's ongoing work and in consultation with the climate services community through different engagement mechanisms, seeking to understand what can be considered fit-for-purpose climate services, that is, services that demonstrate not only technical quality but also quality requirements across all the components of climate services. The key messages emphasise the importance of viewing climate services from a holistic perspective and emphasise the importance of accounting for four interconnected components: the decision context, the actors and the co-production processes, the different knowledge systems, and the delivery mode and evaluation. [4]

---

[1] https://climate.copernicus.eu/copernicus-2024-first-year-exceed-15degc-above-pre-industrial-level#:~:text=The%20monthly%20global%20average%20temperature,2024%2C%20at%2017.16%C2%B0C .

[2] In Valencia, Spain, we saw the brutal devastation caused by these extremes. The official data from the Spanish National meteorological office, AEMET, at the Turís Mas de Calabarra station in Valencia tell us that on October 29 it rained 771.8 l/mˆ2. Protecting against this kind of event only through infrastructural investment is hardly possible and certainly extremely dangerous and expensive.

[3] See D1.2 Public deliverables — Climateurope2

[4] See Public deliverables — Climateurope2 and Events — Climateurope2

Climateurope2 recommends structuring the initiation of the standardisation of climate services by identifying the interconnected i) technical, ii) procedural and iii) performance criteria that would be required for fit-for-purpose climate services to ensure their complexity is captured and to ensure evaluation and eventual certification by accredited actors. Furthermore, we recommend parallel efforts to mature more flexible and open-source best practice guidance that can be made available in a shorter time period than standards. Many knowledge gaps for standardisation remain, and the Climateurope2 consortium also has recommendations for the research community and for forging necessary partnerships. Research efforts executed in partnership with public and private providers and relevant policy, industry, and community stakeholders are a necessary condition for relevant and salient knowledge and methodologies to become available. Once the relevant criteria for fit-for-purpose climate services have been clarified and enhanced, we will formulate them in the form of recommendations to be integrated into forthcoming regulations and other forms of governance at the EU level. This includes policies regarding resilient critical infrastructure, adaptation and mitigation strategies, the just transition, and other elements of the implementation of the European Green Deal.

Climateurope2 issues key messages and recommendations every year. In the coming year, the consortium will work to further evaluate and modify this initial standardisation strategy, revise and polish the criteria and requirements with additional project work also in collaboration with the community of climate services through ongoing engagement efforts. We will further work to assess the maturity of standardisation of climate services and outline, when possible, the content of concrete standards or guidance documents. To illustrate how this may be implemented in practice, the consortium will also compile case studies that use climate services for addressing the interconnections between adaptation and mitigation, with a special focus on cities.

1 Greater focus on inclusivity and decision contexts in climate services would drive more effective, equitable, and robust climate action

Simply providing climate data and information is insufficient to prepare our societies for climate variability and change, to inform sustainability transformation strategies, or to underpin effective risk management and climate change adaptation. Climate action demands continuous effort to ensure that scientific knowledge about current and future climate risks is conveyed clearly to all decision-making contexts. Climate service providers must ensure that credible knowledge not only informs macro-level planning and policy processes, but also the resilience, adaptation and mitigation strategies addressing individual climate-vulnerable communities, assets and supply chains. Achieving this requires climate services to adopt a holistic vision and be inclusive, context-sensitive and equitable, ensuring fair distribution of knowledge and support to those most at risk from the impacts of climate change and highlights the importance of considering all components of climate services holistically. At the same time, it is necessary to support the facilitation of a well-functioning market of trustworthy climate services providers, able to embed climate information into sector specific domains and align with existing standards.

#A HOLISTIC VISION

2 The complexity of climate services asks for a suite of diverse types of standards

The standardisation of climate services requires a suite of interconnected standards that govern climate services in their entirety and address their technical and procedural nature as well as ensure minimum thresholds for quality, usability and effectiveness. Climate services will benefit from three types of standards. Firstly, technical specification standard(s) for the treatment of climate and other data and information to be used in services. A second type addressing climate service processes such as co-creation with stakeholders, to prevent misuse of climate data, malpractice, and failures to make the right decisions informed by available knowledge. Then thirdly, performance standards that set the performance thresholds, requirements, or expectations that must be met. These three types of standards together could cover the needs of all the components of climate services and ensure synergies, prevent failures, improve uptake and contribute to a transparent, fair and effective climate services market.

#A SUITE OF STANDARDS

3 There is a need for technical standards that address the integration of climatic and non-climatic data, information and knowledge

There are many existing guidance documents that provide frameworks and recommendations for the robustness and salience of climate data and climate information, but many issues are not harmonised, and new knowledge is available such as practices in data management, ways to address uncertainty, documentation and traceability of climate data, the use of storylines. In addition, there are no recognised guidelines for integrating technical with non-technical data and ensuring their cross-fertilisation with requirements emerging from the other components of climate services. Climateurope2 partners call for attention to the integration of climate information with non-climatic data and information, and other factors essential for transforming climate information into a usable service. It is also key to consider the latest science around climate data and information, such as improving error protocols, ensuring the reusability of data or improving traceability of provenance. It is important to note that the increasing use of simulated data for attribution and artificial intelligence opens many opportunities to improve climate services but, at the same time, raises trust, ethical, and liability issues.

#TECHNICAL STANDARDS

4

Process-focused standards are necessary to ensure comprehensive design and delivery of climate services

Climate services development and delivery are dependent on a range of processes. Many of the documented malpractices and failures to make decisions are the result of flawed processes such as failure to consider the end-user capacity and enabling conditions for the uptake of this information effectively. The inclusiveness, uptake, and effectiveness of climate services, for instance, are also hugely dependent on appropriate processes. The community already recognises the central importance of co-production and user engagement, but other key process-related requirements such as subsidiarity, in depth stakeholder mapping, partnerships conducive to market creation, or innovation friendliness are less recognised. Collecting the best available knowledge of the different types of processes involved in the development and provision of quality, usable and fit-for-purpose climate services can give legitimacy to context and user-centred design, prevent top-down, science-driven approaches unable to capture local and context-related specificity, and enhance the actionability of climate services.

#PROCEDURAL STANDARDS

5

The standardisation of climate services needs to capture minimum thresholds of performance across all components, for both providers and users

It is key to establish and assess requirements and thresholds for technical robustness, processes, usability, equity, or efficiency through performance-standards. For instance, the delivery modality of climate services, such as digital platforms need to ensure appropriate information and in public climate services provision also the equitable access to climate services. The lack of stakeholder capacity to interpret and understand the technical content of the service, or the absence of feedback mechanisms for stakeholders, can all compromise the effectiveness, timeliness and accountability of climate services. Performance standards can also address the importance of clearly communicating uncertainties, the limitations of the applicability of a given climate service to prevent possible misuse. Performance standards, furthermore, could allow for learning and iterative evaluation and improved implementation of several of the requirements in technical or procedural standards, such as, for example, measuring the depth of a stakeholder mapping or evaluating the diversity of communication channels

#PERFORMANCE STANDARDS

6

Formal climate service standards go hand-in-hand with flexible and accessible best practice guidance for adequate and equitable climate services

Climateurope2 recommends working towards non-formal and flexible best practice guidance documents or recommended practices that can offer accessible advice to all actors, complementing formal standardisation efforts. There are two main reasons for this recommendation. First, the urgency to improve the climate services systems active in Europe to ensure their effectiveness and equity, and second, the difficulties that emerge from capturing the diversity of contexts and user needs in formal standards. Climateurope2 partners have identified many key issues that are unsuitable for formal standardisation but that nevertheless may benefit from a guideline based on best practices to govern the usability, equity and effectiveness of climate services such as capacity building and literacy, market conducive network building or capturing user's contexts. Secondly, less prescriptive guidance documents can contribute to provide readiness and capacity to interpret formal standards and thus serve as both preparedness and precursors to formal standards implementation. In addition, flexible guidance documents or recommended practices can also help ensure the use of the latest scientific knowledge.

#BEST PRACTICE GUIDANCE

7 Climate services providers, users and the research community should collaborate to shape the next generation of climate services

The coordinated competence of a multiplicity of actors is key. Many gaps remain for developing, delivering and implementing climate services in an effective, fair, equitable, and robust manner. Climateurope2 has already identified specific knowledge gaps such as: the need for identifying proxies that can assess sufficient knowledge of contexts and specific domains; insufficient understanding of the provenance of climate related, social and cultural relevant data, information and knowledge; the absence of tailored indicators for case study specifications to ensure the salience of climate information, or mature improvements in the assessment of uncertainties, to name a few. Identification of optimal facilitation and networks is essential. For example, the coordination with business schools and corporate research executed within industries is central as there is still a scarcity of innovative business models available. The fast-paced deployment of artificial intelligence (AI) tools or the use of digital twins (DT) in climate research and in climate-related activities requires special attention.

#PARTNERSHIPS

8 The European Commission is in a position to lead the effort to build suitable governance mechanisms for climate services

The European Commission (EC), through its position of oversight and ecosystem of research bodies, can lead and coordinate efforts to incentivise the participation of private climate services providers, industry associations, relevant national and local government agencies, and community organisations in standardisation efforts. Much needs to happen in addition to formal standardisation to truly govern climate services, level the market, and ensure both accountability and capabilities for all involved. The EC can set goals that are also relevant and inspiring for non-EU members. The Directorate General for Climate (DG Clima) could lead the coordination of efforts for the governance of climate services across several relevant Directorate Generals (DG), DG Research and DG Digital Services. It is also important to leverage the knowledge and convening power of European bodies such as the European Environmental Agency (EEA) and the Joint Research Center (JRC). All these efforts can support the development of community-led practices focused on climate-related decisions dialogues, building upon the outputs of Climateurope2.

#EUROPEAN COMMISSION

9 The contributions and cooperation of WMO and ECMWF are central for strengthening climate services governance

Successful climate services often emerge from a dense, sometimes incoherent, network of actors operating across multiple levels to support specific policy development and action and some of these actors may not even identify themselves as climate service providers. This intrinsic complexity means that any attempt to govern the ecosystem too rigidly risks doing more harm than good. All countries have national meteorological and hydrological services (NMHSs). Many have engaged with the broader ecosystem of service providers, while others may face challenges maintaining a complete and up-to-date understanding of the actors operating in their regions. This creates opportunities to strengthen collaboration, ensure more comprehensive coordination, and bridge existing gaps. The World Meteorological Organisation (WMO) and the European Centre for Medium-Range Weather Forecasts (ECMWF) are well-positioned to facilitate a more inclusive and collaborative governance structure for climate services due to their global mandates, guidance on standards, technical expertise, and established frameworks and networks for cooperation. Their combined strengths enable them to connect NMHSs, policymakers, and users, contributing to and ensuring that Climateurope2 recommendations for climate services are scientifically robust, operationally effective, and aligned with societal needs. There are other intergovernmental actors who may wish to play a role, such as the European Space Agency (ESA).

#WMO and COPERNICUS-ECMWF

Consortium

Coordinated by

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

cmcc
Centro Euro-Mediterraneo sui Cambiamenti Climatici

CERFACS

UNIVERSITY OF LEEDS

Climate KIC

Deltares

Universität Bremen

DIN

DKRZ
DEUTSCHES KLIMARECHENZENTRUM

DNV

DTU

ECMWF

eco logic

Fraunhofer IAIS

Helmholtz-Zentrum hereon

Koninklijk Nederlands Meteorologisch Instituut
Ministerie van Infrastructuur en Waterstaat

LGI
sustainable innovation

MARIS

Met Office

RAMBØLL

SMHI

the climate data factory

tecnalia
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

Technical University of Munich

UK Research and Innovation

CENTER FOR THE PROMOTION OF SCIENCE

webLyzard technology

WORLD METEOROLOGICAL ORGANIZATION

WAGENINGEN UNIVERSITY & RESEARCH

UNIWERSYTET WSB MERITO POZNAŃ

Climateurope2

Funded by
the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No. 101056933.

Key Messages of standardisation on climate services

Climateurope2 second synthesis report

2025

Edited by

cmcc

Climateurope2

www.climateurope2.eu