Robustness of Climate Change Information for Decisions

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The "Robustness of Climate Change Information for Decisions" workshop, organized by the Regional Information for Society (RIfS) core project under the World Climate Research Program (WCRP), took place in Brussels from April 22 to 24, 2024. The RIfS project aims to build links between climate research and societal information needs, fostering dialogue with stakeholders through context-adapted co-construction of climate information. It also addresses the reconciliation and integration of multiple climate information sources to produce decision-relevant knowledge.

Bruce Hewitson, co-chair of RIfS, encapsulated the dilemma of non-congruence in climate information with the phrase: "choose your source, get a different outcome." Recognizing that the absence of consensus or general agreement on how to address the non-congruence between climate information sources presents a significant barrier in the use of climate information to inform decisions, the workshop set out to establish a transdisciplinary dialogue to address diverse community perspectives, ethical and epistemological questions, and research challenges. It also aimed to identify new research actions necessary for managing data source non-congruence and associated uncertainties, and to lay the groundwork for a guide on best practices for using various climate data sources.

The workshop featured a dynamic mix of plenary sessions and discussion groups, allowing for active participation from attendees. Representatives from all communities involved in climate change adaptation—including climate research, impact studies, climate services, funders, and decision-makers—participated equitably from both Northern and Southern countries.

On the first day, discussions focused on defining "robustness." In the IPCC AR6 WG1 Atlas (Gutiérrez et al. 2021), a robust multi-model change is defined as a significant change (greater than unforced climate variability) with consistency across models for the sign of change (model agreement). In the report, the degree of certainty in AR6 findings is also assessed based on multiple lines of evidence which include model projections but also observations as well as literature and theoretical knowledge (Box 1.1, Figure 1 in IPCC, 2021: Chapter 1). Participants expanded on this definition to include the reliability of climate information for decision-making and the suitability of climate information for user needs (fitness for purpose). For example, for the adaptation of coastal regions in small Pacific islands, information is only relevant if it accounts for very fine spatial scale processes. The risk community insists on comprehensive coverage of all possible futures, including worst-case scenarios. The audience emphasized that building robust information requires

understanding and considering the context and values of users through iterative interaction processes based on trust and transparency—particularly crucial in projects involving both Northern and Southern countries.

Subsequent days were devoted to exploring ways to advance and gathering concrete action proposals. There was a strong emphasis on building upon existing work rather than duplicating efforts. The field of climate change adaptation literature is already rich; participants expressed a desire to learn from these lessons and highlight case examples of robust climate information production. While climate services are not a new idea, there is a critical need to continue their development, either within national services or through the private sector, with a priority on improving their connection with users. Like climate data and analysis methods, climate services and their outputs must be evaluated, requiring the development of assessment metrics and standards that could facilitate certifications. These would enhance user trust in climate information and acknowledge scientists' responsibility for decisions made based on the information provided.

Future action possibilities also included the idea of a pilot project to develop an operational climate product (i.e., ready for use in decision-making for adaptation, maintained over time, and updated as necessary) for a specific region. By synthesizing key ideas from the workshop, the following guidelines could steer the implementation of such a project:

1. Identify the adaptation stakeholders and meet with them from the start and throughout the project

Organization of transdisciplinary workshops to collectively define the expected outcomes: which sectors, what indicators, which scenarios/horizons/warming levels, what spatial and temporal scales, what types of events, which methods, what communication supports, etc.

The composition of the workshops must allow for equitable representation of the different stakeholders (equity meetings): scientists, users, and policymakers, the impact and risk community, social science experts (to help better define, understand, and respond to needs), communication actors (artists, designers, filmmakers, etc.), and more.

These workshops should be repeated throughout the project in an iterative process that allows for the evaluation and, if necessary, the redefinition of the framework, methods, and expected results. Establishing a communication space (both remote and in-person) among the stakeholders is crucial. It must both allow exchanges among all actors and facilitate discussions in smaller groups to address specific questions.

2. Inventory and evaluate the available information: contextual and climate data from various sources.

Climate information should be presented as one type of data among others that relate to the context (system thinking). Moreover, it is not limited to the multi-model climate projection ensembles (such as CMIP and CORDEX) but also includes observations and reanalyses, previous studies, literature (including grey literature), and more. Artificial intelligence has been mentioned as a potential tool for synthesizing past studies.

The evaluation should focus on both the biases and the agreement among different sources of information. The results must be communicated transparently.

The evaluation results should be accompanied by recommendations. Three types of recommendations are expected: 1. which data are usable/not usable for which purposes? 2. best practices: how to use these data? 3. what knowledge is necessary to use such data? The dissemination of climate data, indeed, is not sufficient and must be complemented by education in climate science to improve climate literacy.

3. Distillation: analysis, synthesis, and formatting of information

The analysis methods and final products must integrate both contextual and climate data. All methodological choices should be coordinated, transparent, and tailored to the needs and values of the users. The final product must be translated into the user's framework and come with recommendations for its proper use.

Various methods were mentioned, such as attribution studies, probabilistic analyses, risk quantification, and storyline approaches. The importance of working across different temporal scales was emphasized, for instance, leveraging the entire chain of weather forecasting, seasonal forecasts, and climate projections. New possibilities offered by artificial intelligence (emulators) for combining various sources of information were also noted. Various communication supports for the final products were proposed, including reports, web portals, graphics, training programs, artistic productions, games, and more.

4. Project evaluation and establishment of a sustainable organization for maintaining and updating the final product

The project evaluation covers both the development process (co-production, trust, transparency) and the product itself (quality, relevance, response to needs). The challenge posed by the short duration of projects was highlighted. Continuing efforts to sustain and update the products is therefore crucial. The final step involves identifying and communicating lessons learned in terms of methodology. This step is essential with the goal of facilitating the replication of robust studies.

Personal closing remarks

My daily work primarily focuses on issues related to climate data. Thus, coming into the workshop, I had in mind the evaluation of models (including recent trends), the improvement of understanding the causes of inconsistencies (quantifying the role of variability or employing storyline approaches), as well as the combination and synthesis of

different information sources (using observational constraints and regional warming level approaches). Few technical discussions on these points emerged during the workshop. However, meetings with other experts confronted with similar problems are already pointing the way to future collaborations. For instance:

- The interest of CSIRO (Australia) in the regional warming level approach developed by Météo-France,
- The prospect of collaboration with the Caribbean Modellers Consortium on producing regional climate projections for the Caribbean islands,
- Discussions with the Met Office about emulators and their maturity level for use in climate services; a very relevant issue given Météo-France's strategic choices regarding the future pool of projections for climate services.

The discussions largely focused on user-oriented issues. As a climate services provider, I followed the exchanges on the necessity to reverse the climate information production chain to start from the context, needs, and values of the users with great interest. My feeling is that instead of choosing one direction, we should employ a back-and-forth approach and alternate the process's direction: on one hand, proposing dedicated studies based on bottom-up approaches and deriving generalizable lessons; on the other hand, enhancing the top-down chain to meet the needs of all users and multiply studies based on a common foundation of climate information available to everyone.

In any case, it is essential to develop a space for exchange among the various climate service providers, like the recent initiative of the EURO-CORDEX Distillation Group. Regional groups are fully justified, particularly due to the shared use of some datasets. The workshop also demonstrated the importance of broadening the scope of discussions. The interest shown by CSIRO in our methods is a perfect illustration, as are the rich exchanges with Ouranos members. Also, note, for example, that the problem of sign disagreement among models regarding future precipitation changes is just as prevalent in metropolitan France, Africa, or Australia.

Finally, quite naively, I initially thought that I was not very concerned with the issues of interactions between northern and southern countries. However, contributions by participants from the Caribbean and Pacific islands made me realize that these issues can also translate within Météo-France, between metropolitan France and the overseas territories. This is particularly true for the Socle Outremer project aimed at improving climate services in the overseas regions. The project organization involves the production of data and the design of climate services in metropolitan France for use in the overseas regions. Although considering local needs is already an integral part of the project, particularly through strong involvement of the overseas directorates of Météo-France, careful attention to listening and understanding local values will be crucial to fully integrate the ethical dimension throughout the project.