

Expert Meeting on the Robustness of Climate Change Information for Decisions

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Contact information

All enquiries regarding this report should be directed to wcrp@wmo.int or:

World Climate Research Programme
c/o World Meteorological Organization
7 bis, Avenue de la Paix
Case Postale 2300
CH-1211 Geneva 2
Switzerland

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Impressum

Authors list:

Bruce Hewitson, University of Cape Town, South Africa
Dragana Bojovic, Barcelona Supercomputer Center, Spain
Wendy Sharples, Australian Bureau of Meteorology, Australia
Louis-Philippe Caron, Ouranos, Canada
Alessandro Dosio, European Commission Joint Research Centre (JRC), Italy
Naomi Goldenson, WCRP-RfS IPO,
Lincoln Alves, National Institute for Space Research, Brazil
Kevin Horsburgh, Organizing committee co-chair, Green Climate Fund
Richard Jones, UK Met Office



Expert Meeting on the Robustness of Climate Change Information for Decisions

Workshop Report

Workshop on Robust Information
April 2024
Publication No: 4/2025

<https://www.wcrp-rifs.org>

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Organizing committee

The Regional Information for Society (RIfS) Core Project conceived and convened the Expert Meeting. RIfS has a mandate to facilitate research activities on providing actionable information, and integrates the best available science aligned with the scales of relevance to society's decision contexts.

Bruce Hewitson, Organizing committee co-chair, University of Cape Town, South Africa

Kevin Horsburgh, Organizing committee co-chair, Green Climate Fund

Lincoln Alves, National Institute for Space Research, Brazil

Paul Block, University of Wisconsin-Madison, USA

Dragana Bojovic, Barcelona Supercomputer Center, Spain

Louis-Philippe Caron, Ouranos, Canada

Anne Debrabandere, WCRP-RIfS IPO,

Alessandro Dosio, European Commission Joint Research Centre (JRC), Italy

Naomi Goldenson, WCRP-RIfS IPO,

Luke J. Harrington, University of Waikato, New Zealand

Richard Jones, Met Office Hadley Centre, UK

Morten Larsen, Danish Meteorological Institute, Denmark

Jemimah Maina, International Centre for Humanitarian Affairs, Kenya Red Cross Society

Julia Mindlin, University of Buenos Aires, Argentina

Monica Morrison, National Center for Atmospheric Research, USA

Jon Padgham, START International, USA

Sara C Pryor, Cornell University, USA

Wendy Sharples, Australian Bureau of Meteorology, Australia

Silvina Solman, University of Buenos Aires, Argentina

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- The extensive support from the RIfS International Project Office.
- The endorsement of the Global Framework for Climate Services.
- The organizing committee, panel members, convenors, chairs and facilitators, and of course the participants representing the diverse communities of practice.

This support not only facilitated face-to-face discussion and discourse but also enabled participants from disadvantaged or developing regions to participate, whose voices would not normally be heard. The representative communities of practice included participants from Africa, small island nations, south east and central Asia, Latin America as well as ECRs.

Additionally, many participants co-sponsored the workshop in terms of donation of their time and expertise both during and after the workshop. These participants were very generous with their time and willing to share their experiences as panel members, convenors, chairs, facilitators and rapporteurs (see participants listed in the Agenda – Annex 2). Without participants in these key roles, the workshop would not have been as effective and fruitful.

Executive Summary

The challenge and context: There is no general agreement on how to assess the robustness of regional climate information where sources of information differ. The scientific community has made little progress in addressing this issue in a systematic, agreed, and scalable way. Hence a dilemma remains, the choice of climate information sources can significantly impact decision consequences for society.

The participants: More than 100 experts from around the world from communities of physical climate, impacts and adaptation research, climate services, decision maker representatives and funders.

The objective: To catalyze a cross community collaboration to advance research and capacity to understand, develop, and assess the robustness of climate information aligned to the decision context; By developing a dialogue around the different perceptions, lived experiences, and practical realities of the communities represented.

The structure: The Regional Information for Society (RIfS) core project of the World Climate Research Program (WCRP) reached out to scientists and stakeholders to design a three-day expert meeting on the robustness of climate change information for decisions. It used conversation and dialogue to share narrative experiences and insights from the participants. Listening, not advocating, was a core principle. It recognized that there is a diversity of ways to frame a problem. This required paying attention to language and terminology, and striving for equity across different communities, regions, seniority, and gender. The invited participants represented diversity of perspectives, and the agenda was designed to be as inclusive as possible (see Section 3).

The program followed a narrative over the course of the three days, each with a specific purpose in mind. Day 1 explored the diversity of participants' backgrounds, inviting participants to step out of their own framing of issues and see the problems from the perspectives of other communities.

Building on these foundations, Day 2 moved to develop new and necessary dialogues between communities about regional climate information. Through a series of breakout groups, panels and plenary sessions, the participants explored their different approaches to what robust climate information entailed. This included a look back at lessons learned from our collective past experiences, envisioning pathways forward, and considering ways to structure new collaborations.

Day 3 focused on ways to develop new actions. Through plenary discussion prompted with inputs from panelists, and breakout groups, the participants explored the priorities for moving ahead, and practical possibilities to make progress.

The conversations: The diversity and insight of the conversation was made possible by participants who stepped aside from partisan agendas to engage in rich discussions. Of special note was the confidence and insight from the early career researchers and from the global south participants. In general, the conversations can be captured under the following emergent topics.

- The epistemic issue: The challenge to assessing the robustness of information with expanding volumes of data is daunting. Often there are multiple equally defensible data sources available to decision-makers. This lack of clarity necessitates exploring new scientific approaches and new metrics, both quantitative and qualitative, to assess the data. To reduce epistemic uncertainties additionally requires innovation and transdisciplinary thinking to go beyond business as usual, and seek new knowledge informed by the realities of decision makers.

- The transparency issue: The underlying limitations of the data and tools are not adequately known, poorly articulated, weakly communicated, and often inaccessible to those that need the insight.
- The ethical, context and accountability issue: Decisions have real societal consequences that raise questions of accountability and raise the question of how stakeholder values can be better incorporated in the design and activities of research. It is necessary to recognize the heterogeneity of context and cultures and the challenges in aligning climate information with the realities of the decision context.
- The community collaboration issue: New and deeper transdisciplinary collaboration is a necessity when considering the wide spectrum of issues that need to be considered in developing robust information for decision makers. The group agreed that the tendency of research to operate in disciplinary silos is a barrier to overcome.
- The power-dynamics issue: The issue of unequal power relationships surfaced repeatedly, for example, in the context of funding, collaboration, and who convenes the agenda. Power dynamics exist within regions and not only between the Global North and South.
- The climate literacy issue: We identified a need to build a far broader understanding of literacy across the web of actors, not just among decision-makers as is conventionally understood. For example, a climate modeler would require a better understanding of the operational realities of a decision maker, or a donor agency in the global north could better understand the lived experience of a climate researcher in the global south.
- The guidance and standards issue: Additional guidance is needed on how to work with climate information, while accommodating the issues mentioned above. To establish community-wide and accepted standards will require an equity of global south perspectives, and an expanded literature that addresses critical gaps on which to ground such guidance and standards.

The next steps:

- The establishment of a working group under the RIfS mandated to take forward the range of topics presented above.
- Pilot actions. Concept proposals have been developed to translate the expert meeting foci into new actions to explore the identified issues.
- Identify and leveraging the breadth of current and complementary actions within regions to better contribute to developing communities of practice on research for robust information that are transdisciplinary, innovative, and contributes to building resilience and adaptation.
- Filling gaps in the scientific and gray literature through position papers, review papers, and white papers. Topics could include “Mapping Barriers and Challenges”, “Defining robustness from different community perspectives”, “Ethics and epistemic issues and accountable responsibilities”.
- A follow-on workshop to this Expert Meeting.

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1. Context: framing the critical need to assess information robustness

1.1. The history of regional climate information behind this Expert Meeting

While there has long been a range of disparate activities that touch on the subject, perhaps a useful starting point is the 3rd assessment report of the IPCC which included the first regional chapter on information, titled *“Regional Climate Information”*. The chapter sought to assess *“regional climate information from Atmosphere-Ocean General Circulation Models (AOGCMs) and techniques used to enhance regional detail”* and mostly concluded that much remained to be done.

Subsequently most of the research community’s efforts on regional information focused on developing methods to downscale, with limited effort on explicitly assessing the robustness of one source relative to another. The IPCC 4th assessment report continued this focus with a chapter *“Regional Climate Projections”* which sought to reach regional statements of climate change, and while still divorced from decision context paid more attention to the methods of constructing regional information.

Leading up to the 5th assessment report was the 2010 IPCC Expert Meeting on Assessing and Combining Multi Model Climate Projections¹. The meeting sought to develop *“recommendations for good practice in using multi-model ensembles for detection and attribution, model evaluation and global climate projections as well as regional projections relevant for impact and adaptation studies.”* Nonetheless the meeting also acknowledged that it *“does not, however, provide specific recommendations regarding which performance metrics to use, since this will need to be decided for each application separately.”*

The WCRP Open Science Conference of 2011 picked up the challenge of regional information for decision makers, implicitly recognizing the robustness by speaking of *“actionable information”* and introducing for the first time the concept of *“distillation”*, both terms that became more prevalent in subsequent years in both the literature and science meetings. Still, there was no comprehensive effort by the community to address the issue of how to assess what is robust in context of the decision maker.

The robustness issue began to be increasingly raised in subsequent years, emerging more in climate services communities (mostly focused on delivery and communication paradigms) and co-production practices (as bespoke solutions to a problem). The WCRP 2014 Working Group on Regional Climate’s Expert Meeting on *“The Information Distillation Dilemma”* laid new foundations through cross-community discussions, but for logistical issues did not gain traction. The IPCC 5th assessment report took a climate process-based view in a chapter on *“Climate Phenomena and their Relevance for Future Regional Climate Change”*. The 6th assessment report, in a chapter on *“Linking Global to Regional Climate Change”* provided some valuable worked examples and suggested a framework for distillation.

The 2023 WCRP Open Science Conference further highlighted the accelerating journey to producing ever more data with newer model generations, bigger ensembles, ever increasing spatial resolution, added complexity with the inclusion of convection permitting models, and new downscaling solutions.

At the beginning of 2024, there remained a lack of coordinated and comprehensive efforts across the relevant communities to address the question of what is robust for decision makers when faced with multiple sources of information. Consequently, and with increasing recognition by donor agencies of the importance of developing contextually aligned information, RfS conceived, designed, and initiated the 2024 Expert Meeting as an express response to the increasing urgency for relevant communities to come together in engage more deeply on how to address this pressing dilemma that decision maker’s face.

¹ <https://www.ipcc.ch/site/assets/uploads/2010/01/expert-meeting-assessing-multi-model-projections-2010-01.pdf>

1.2. Why an expert meeting on Robustness of Climate Change Information?

The short answer is: we have no systematic and accepted way to determine the robustness of regional climate information used to inform the decision process leading to societal consequences.

The meeting was explicitly designed to be a first step to catalyze new cross-community attention on the urgency to manage the dilemma of assessing climate change information in the face of multiple, equally defensible sources that do not fully agree, and where the choice of which source to use could lead to differing conclusions. The meeting focuses on this dilemma following a history of the research community circling the issues of regional climate information without comprehensively tackling the robustness challenge.

Limited advances² are being made on how to systematically assess the robustness of climate information that is intended to inform decisions with societal consequence, and to do so in ways that are widely accepted and understood across the diversity of relevant communities.

The problem is epistemic because it is about how to know what is robust climate information as seen from the decision context. The problem is ethical because our choices about data, analysis, interpretation, communication, and decisions are framed by personal values that are not always held in common.

This heterogeneity of values and culture, coupled with realities of variable access to data, inequity in capacity, and constraints in skill and climate literacy, together create a dilemma for responsibly using climate information in decisions and lead to real impacts on societal outcomes.

There continues to be massive growth in the generation of new climate projection data with ever increasing detail. Yet this is not accompanied by a commensurate increase in capacity to assess the information robustness for decision making with societal consequence. The mere choice of an alternate data source can lead to markedly different outcomes for society.

Why is “Robustness” an issue?

The heterogeneity of values and culture, the variable access to data, and the capacity and resource constraints for interpretation create a dilemma for using climate information in decisions. This is an “ethical-epistemic” problem and may be presented from different perspectives.

1. Formal problem statement: When sources of climate change information do not agree or are misaligned to decision contexts, there is a lack of consensus on how to resolve these two problems to inform local-to-regional decision-making that lead to impactful consequences.
2. Pragmatic perspective: How robust is this information for informing my decision context and which will have substantial societal consequences?
3. Ethics and accountability: Who has proportional accountability for the real consequences of my decision based on this information?

We note the need to implement climate adaptation and resilience measures where each action occurs in a unique context. This is the imperative for the meeting: to catalyze the community to develop new ways to assess whether information is robust enough to responsibly inform actions to manage climate risk and which have societal consequences.

These challenges are compounded by the increasing pressure on society to act now as we experience ever more climate impacts. The lack of clear and agreed upon approaches to assessing the robustness of the climate information is especially critical given the complexity and heterogeneity of decision contexts, and this raises deep questions of ethics and accountability.

² Research in this area largely focuses on understanding uncertainty, e.g. Moure et al (2023, <https://doi.org/10.1007/s40641-023-00189-x>) or Hourdin et al (2023, DOI: 10.1126/sciadv.adf2758). Other approaches to address this largely relate to labor intensive bespoke co-production with constrained scalability.

Climate information is commonly delivered from scientists to decision makers via a complex web of actors and portals, with differing accessibility and perceived authority, using a variety of data processing methods, drawing on different subsets of data, and communicating measures of confidence that may be hard to defend.

Furthermore, the climate information is often presented at aggregated scales in time and space that are poorly aligned with the decision context needs, with little transparency on the choices made in creating the information products, and minimal guidance on how to incorporate the climate information into the decision context.

Most problematic is the limited assessment of the robustness of the provided climate information specific to a particular context of risk assessment for actions with consequential outcomes for society³.

The meeting was concerned with climate information across timescales, but it is worth highlighting the specific challenges associated with generating robust information about long term climate change (beyond 1 year) to inform adaptation. Long term climate projections run into a future which we have never observed before, and therefore cannot be validated before adaptation decisions are made. They are not operational products. They also diverge substantially for some variables and regions (for example for many regions some models suggest there will be an increase in precipitation and some models suggest there will be a decrease). This makes these climate projections very difficult to use, and scientists do not agree about how much we should trust them, or whether or not we can use them to make statements about the probability of future change.

1.3. What does “robust” mean?

What do we mean by the term “robustness”? First, we should note that robustness only has relevance when considered in the context of an application. Two extremes are scientists generating quantitative metrics and confidence assessments that are largely divorced from the application context⁴ or some decision-makers and lay people having an intuitive yet subjective perception in relation to managing risk. In all cases how the concept of robustness is perceived and articulated depends on a range of factors that include personal values and perceptions, institutional policies and mandates, and the sense of risk exposure to a broad host of climate drivers and even more non-climate factors.

For this Expert Meeting we considered “robustness” in how it relates to concepts such as the adequacy or fitness-for-purpose, with an express emphasis that the decision-context is the primary framing and essential for developing any such assessment.

1.4. The importance of the decision context

We recognize that the decision context defines the unique climate information attributes that are required (scale, variable, etc.). Moreover, the decision makers operate under specific resource, capacity, and climate literacy constraints, while the context’s culture and values are significant factors that frame how “robust” information is interpreted.

³ While, for a given context, the robustness of climate information may be partly assessed through labor intensive co-production methods, these are not readily scalable to the magnitude of the challenge, nor easily transferable to new contexts.

⁴ For example, the IPCC guidance on calibrated language:

https://www.ipcc.ch/site/assets/uploads/2017/08/AR5_Uncertainty_Guidance_Note.pdf

The decision contexts we considered are typically at the local-to-regional scale, not matters of policy at the global scale. The discourse was not about questions of robustness of, for example, the scientific consensus on the anthropogenic origins of global climate change at this moment in history (a question which we consider having been adequately and robustly answered).

Rather, we adopted a pragmatic view and considered the need for robust information for decisions that one might encounter in strategic resource planning or in implementing adaptation actions. For example, decisions made at the level of a city's water infrastructure, a country's agricultural or energy policy, or similar contexts for managing climate risk and building climate resilience.

In these cases, decision-makers are commonly faced with making consequential choices that need to be informed by robust climate information. Yet, the multiple sources of climate information these same decision makers commonly rely on may indicate contrasting or even contradicting details about the future climate at their decision scale.

Example of a Decision maker's context

Consider an urban planner needing to develop stormwater infrastructure for a new urban expansion. A key choice is the size of the pipes to be used and the expected lifetime of the pipes. The choice has major budget implications for the city and will potentially divert budget from other pressing needs, such as developing low cost housing for the poor.

Climate information on changes in future rainfall intensity and frequency is critical to making responsible design choices for stormwater management. Yet the choice among different sources of climate information may lead to differing geoengineering conclusions and result in contrasting decisions.

Without an assessment of the relative robustness of the information in this decision context, the outcome may lead to maladaptation or costly over-design.

1.5. Complexities of the decision maker's context

The problem of how to assess what is robust climate information is becoming more urgent as the effects of climate change creates increasing pressure for local adaptation actions. This challenge is no longer some future hypothetical but is a present urgency. This is a crucial moment for the world where sectors of society are rapidly seeking to implement measures to manage their climate risk. The challenge in achieving this is complicated by the continued expansion of new data and contrasting sources. It is difficult to identify and defend what is robust information that is both contextually aligned and shown to add value for the decision-makers.

The ability to take informed and responsible actions is undermined by the limited progress that has been made in reducing some of the epistemic uncertainties⁵ and matching this with practical means to assess the robustness of the derived climate information.

A good example is the wide divergence in precipitation projections that remains apparent in the lack of consensus within and between different sources of data, as well as the multiplicity of differing methods that seek to distill information to inform the decision-scale response to global change.

These problems are far worse in some regions than others, especially in the global south which is subject to a host of additional complications that include constrained data access, limited historical

⁵ Epistemic uncertainty has multiple sources including missing data, incomplete knowledge, inadequate tools, and conceptual misunderstanding. It is recognized that there is always a measure of irreducible uncertainty due to the semi-deterministic nature of the climate system and the unknowns of how society will evolve into the future.

observations, cross-cultural power dynamics (especially between the Global North and South⁶), and limits in climate literacy and interpretive capacity to responsibly incorporate the climate information. The absence of any agreed way to assess the robustness of climate information compounds the challenge to responsibly implement actions, and opens the door to potential mal-adaptation.

At the same time, new data and information products proliferate and are made available through multiple avenues where the data may be easily inferred as actionable information. Most information sources of future climate change are based on global climate model (GCM) projections via the Coupled Model Intercomparison Project (CMIP) that form the basis for the Intergovernmental Panel on Climate Change (IPCC) assessments. The CMIP model projections disagree fundamentally among themselves about some of these local-to-regional signals, as well as between different generations of CMIP models. Inter-model variance is high, and the subjective choice of future greenhouse gas forcing scenarios plays an additional and large role in complicating the constraining of projected regional climate change, while non-greenhouse gas drivers can further confuse the regional and local signals of change (e.g. land surface modifications).

Compounding this is the diversity of past and new emerging high-resolution and downscaled climate data products. These can include the simulations of the physical climate system performed under standard protocols like the Coordinated Regional Climate Downscaling Experiment (CORDEX) and extend beyond this with new km-scale global model simulations, and a plethora of bespoke statistical downscaling methodologies.

New enterprises offer products claiming increasingly high resolution in response to a perceived demand for hyper-local information, yet with limited transparency about their methodologies, and may induce skepticism from experts aware of the observational and methodological limitations, and general lack of skill, at the purported scales.

Transparency about the design of modeling experiments, the data production, and the information construction is thus urgently required to better enable assessing information robustness. Such transparency is often limited, may even be absent, or inaccessible and buried deep in jargon laden scientific literature.

Yet much is still knowable, but only with significant efforts. When experts engage in a distillation and co-production process, they can develop robust and decision-relevant information about physical climate risks. However, it is often a complicated process, labour intensive, not readily scalable, and often produces a unique solution for a particular context which limits transferability of lessons learned.

Example of a donor agency context

One might consider the problem an international funder faces when evaluating competing adaptation proposals from different countries. The case made by each proposal is predicated on a perceived risk exposure as understood by the projected climate change.

To present a persuasive case to the funder, each proposer depends on their choice of climate information being defensible to justify their stated climate risk exposure. Such robustness is commonly presumed, yet without clear ways to assess the robustness of relevant climate information, the funder faces a fundamental conundrum. How to objectively assess proposals where each has different contexts and made different choices about climate information as they seek to articulate the avoided climate impacts their proposed project would achieve.

⁶ The terms Global north and Global south are contested terms, yet part of the common parlance. We use it here for reasons of familiarity and to represent the resource rich nations relative to resource constrained nations and the contrasts in resource and capacity leading to power imbalances. We recognize that power dynamics occur within the global north and within the global south as well.

2. Meeting design and process considerations

Given the World Climate Research Programme (WCRP) mission to bring the best science to questions of global urgency, the Regional Information for Society (RIfS) core project conceptualized, organized, and invited the spectrum of relevant communities to participate in an Expert Meeting to address the challenge of developing decision-relevant robust information on physical climate risks. The aim of the meeting was to catalyze new initiatives to develop approaches, methodologies, and collaborative partnerships to make progress globally on this important issue.

2.1. Catalyzing collaboration

The participants of the meeting were of a common view that addressing this challenge requires deeper collaboration and a transdisciplinary⁷ perspective. While there are advances that are needed within different communities (e.g. reconciling differences between regional and global model solutions, addressing model biases, developing new approaches to distillation and communication, better understanding the issues of ethics and transparency), the bigger issue is that for global progress we urgently need to better understand how different actors and communities, operating in a diversity of contexts, perceive and respond to the question of “how do we understand what is robust information”.

What will addressing the dimensions of this bigger issue look like? The expert meeting was designed as a starting point to draw together the diversity of communities needed to engage with these critical questions and so catalyze new productive activities

To provide robust information for decision makers, four factors were identified as needing exploration to enhance our understanding

1. Better define uncertainty: our incomplete understanding of the fundamental epistemic uncertainties in the climate system of relevance to regional decisions. Uncertainty arises for a multiplicity of reasons, and is yet commonly presented as a spread of values without deeper explanations of the contributors to the uncertainty and how these may be relevant to the decision maker’s context.
2. A map of methodologies and their value in developing climate change information: the diversity of information distillation methodologies coupled with a limited systematic assessment of the relative added value derived from each. Selected methodologies are being increasingly operationalized in different ways for many parts of the world using contrasting climate service approaches, frequently as a bespoke activity with limited transparency⁸.
3. Ways to assess robustness in the context of specific decisions: how to assess the robustness of information in the context of a decision that has a climate information dependency, and how to then explore the multiple contrasting sources that characterize the information landscape, as well as negotiating the competing web of actors using different approaches to knowledge production.

⁷ Transdisciplinary is a term that may be intuitive to some, yet strict definitions are complicated. We use the term here to encompass the necessity that to comprehensively address the robust information challenge, the required research is co-dependent on knowledge from multiple disciplines including non-academic communities of “stakeholders”, decision makers, and the broader society, and the research is designed to concretely inform and motivate societal action. Le Hunte (<https://doi.org/10.1007/978-3-030-90913>) introduces it as “Transdisciplinarity is a practice that transcends disciplines and fields, extending the notion of what is known and knowable and what is possible to discover and create across, between, and beyond all our disciplines.” Rigolot (<https://doi.org/10.1007/978-3-030-90913>) speaks of it as “a way of being”. Lawrence et al. (<https://doi.org/10.1016/j.oneear.2021.12.010>) provide an overview of terms, definitions, and schools of thought.

⁸ When we refer to transparency, we consider whether the information is accessible to those who require it. A technical description in the scientific literature constitutes transparency for the scientific community, but not in a practical sense for decision-makers.

4. Ethical framings relevant across cultures, values, and capacities: what are the relevant and appropriate ethical framings of knowledge products and practices in a heterogeneous world of culture, values, and capacity, along with identifying and articulating the proportional responsibilities and accountability of different actors and communities.

2.2. Meeting design, participants, and expectations

2.1.1 Framing the design

In designing the meeting, the leading focus was that decision makers face multiple challenges with climate information when making decisions on managing climate risk exposures. These include bridging gaps between producers and users, distilling the vast and expanding amount of data into something understandable, and assessing climate information for quality, credibility, and whether it's fit-for-purpose. The key here is robustness as understood by the decision maker who is principally accountable for the consequences of a climate-informed decision. For example, the contrasts and spread of climate information between differing sources creates significant confusion when decision makers seek to access, understand, and develop relevant tailored information that is defensibly robust and fit for a given application: for decision maker this can be an almost insurmountable challenge.

This challenge was the framing principle in designing the meeting and so the basis for the range of critical questions identified as important to be addressed. For example, what does the “robustness” of climate change information mean in different communities? How should we approach the assessment of robustness in ways that the communities agree are systematic, reliable, and accepted? To what extent is it possible to construct standardized and transferable metrics to help identify the degree of information robustness, and how should these be aligned with decision contexts? What would a common understanding of robust climate information look like? How could the communities best tackle these objectives in a way that is collaborative, accepted, and relevant across communities?

In addition to the fundamental challenge of “what is robust information”, there are further challenges about the adoption of climate information at the national, local or sectoral level. These include:

- Readily available, defensible and community accepted guidance and standards that cater to different practices and contexts. This requires support by metrics that can evaluate the diversity of model data (e.g. the multiple generations of models in the WCRPs Coupled Model Intercomparison Project or CORDEX regional downscaling project), approaches to test model assumptions, and methods to assess their applicability at relevant decision scales in a given region.
- Accessible archetypal/example problems to facilitate wider collaboration and incorporation of diverse expertise, where, through the identifying common concerns and problems, collaboration between different groups could be facilitated (e.g. via WCRP My Climate Risk Regional Hubs).
- Creating better visibility of available, accessible, and credible sources of climate information⁹ relevant at decision scales, assessed for actionable adoption in a trans-disciplinary perspective, aligned to the capacity and climate literacy of the decision makers, and constructed with peer-engagement stakeholders as equal partners.

To address the spectrum of issues underlying the robustness question it is imperative that all relevant communities engage in the conversation. Finding solutions to these issues is not something a single

⁹ Such information should consider the range of possible sources for relevance, including, for example, km-scale climate outputs, CORDEX urban modeling, other efforts to provide locally relevant data, climate portals and climate services, and/or efforts to produce seamless climate information spanning (sub)seasonal to multi-decadal predictions to climate projections. Examples of efforts to achieve this by the global north communities could include the Horizon Europe projects Impetus4Change and ASPECT.

community could hope to successfully address and necessitates a transdisciplinary perspective.

Within the logistical resource constraints for the meeting, the organizers identified the necessity for adequate representation from the core communities of climate science research, donor and funding agencies, impacts and adaptation, climate services, and the decision maker's community. Noting the diversity of the decision maker's community, it was accepted this representation would have to be limited to representatives of organizations that are broadly engaged with decision makers.

To ensure all voices were heard, the program and format was explicitly designed for maximizing conversations and giving opportunity to all be heard. An explicit focus was on structured listening, providing substantial time for open and inclusive discussion, and supporting online tools to capture additional comment and input from participants. Significant efforts to ensure that online participants were given just as much opportunity to contribute as those attending in-person were made including virtual whiteboards, dedicated conveners and facilitators for the virtual breakout groups, as well as several opportunities for virtual attendees to provide feedback to the entire workshop.

2.1.2 Levelling the playing field – giving equal voice to different communities

Following a broad consultative process by the organizing committee to identify as wide a range of potential participants as possible, a subset of ~120 participants (maximum of 70 in person) were selected. The selection sought to best recognizing the diversity of the lived experience of the different communities, the different expertise, and different knowledge types involved in the climate change problem. While selecting participants to invite is inevitably an exercise on compromise, the following principles informed the process:

- Diversity in expertise and knowledge types that balanced representation from:
 - researchers in climate science including physical climate processes, impacts modelers, data generators, and data curators
 - researchers in social sciences, ethics, and decision making.
 - climate funding and donor agencies supporting research and climate adaptation actions
 - climate service providers including consultancies, commercial activities, online tools and portals, and local to global institutions and agencies
 - those with experience representing the multiplicity of decision-maker contexts.
- Diversity in equity and inclusivity of:
 - Gender
 - All continents represented, including small island states
 - A balance of representation from the Global North and Global South, recognizing that the communities most vulnerable to climate change and hence in need of developing decision-worthy robust information are in the Global South and represent ~80% of the world's population.
 - Experience with decision making at multiple scales covering global, continental, regional, national and local scales, including city scales.
 - Different career stages with particular attention to strong representation by early career researchers (ECRs) to bring new perspectives and challenge any propensity to revert to business-as-usual thinking.

2.1.3 Developing a shared responsibility: expectations of participants

We recognize a shared ethical responsibility across communities to collaborate in moving beyond business-as-usual and respond to the potential impacts of climate change. Decision makers urgently

require new and expanded dialogue, coordination, and leadership across communities to work on what is fundamentally a trans-disciplinary challenge.

To address this, in advance of the meeting all participants received suggested primary readings along with an extended reading list of additional resources. Each session was framed by a comprehensive narrative of its objectives and expectations to set the discussion foci, and assist common understanding despite the participants differences in backgrounds, experience, terminology, and concepts.

Sessions chairs were carefully assigned to facilitate equal contribution, with attention given from day one on learning how to engage in structured listening to facilitate participants to see issues from other communities' perspectives. The expansive pre-meeting material for participants was designed to help overcome any inherent perceptual and terminology difference across communities, and in doing so to:

- expand the discourse to best help envision, design, and frame potential new initiatives that worked across communities
- help participants look beyond any parochial perspectives and best comprehend the lived experience of others
- accept the differentiated responsibilities to address the challenge.

The agenda by design included only one keynote address that set the stage and help participants gain insight on the diversity of views and was especially provocative, which challenged participants to think with a fresh view on the issues¹⁰.

To best enable all voices to be heard, the balance of the three days was given over to panels, open plenary discussion, breakout groups (in-person and dedicated virtual groups) and a world-café (see the list of key sessions in Table X and the complete agenda in Annex 2). This was supported by dedicated rapporteurs to capture all sessions, with a Miro online board for capturing comments and further inputs where there was not enough time for these to be accommodated in the open discussions. Throughout the meeting, the aim was to have a geographically diverse set of perspectives highlighted and supported by dynamic conversations and input from all.

Table 1. List of session and breakout group titles

Session Title	Breakout groups
Leveling the playing field on the understanding of what is a robust regional climate information	Defining "robust information"
Developing new and necessary dialogues between communities on regional climate information	Developing new and necessary dialogues between communities regarding regional climate information
Lessons from the past on dealing with non-congruency of regional climate information	Brainstorming pragmatic opportunities for collaboration
Theory and practice: envisioning ways forward	World-café on written output topics
Collation and categorization of options for initiatives already raised	Concept proposals for post workshop actions
Pathways forward towards enhancing robust, actionable and adequate for purpose regional climate information	

¹⁰ The keynote presentation by Prof Coleen Vogel presented a strong (and entertaining) challenge about how we think about climate information and the decision context, our respective ethical responsibilities, and the associated societal consequences.

3. Conversations, experiences and conclusions

3.1. Finding common framing across communities.

How do we as different communities perceive, assess, measure, and communicate the robustness of information?

The meeting was framed by the question of assessing and articulating the robustness of climate information explicitly in the context of applications. However, very quickly the participants from a diversity of communities recognized the need to explore a common language, and that the term 'robustness' was itself used differently in different communities, and potentially a source of contention.

For example, scientists may consider robustness to indicate a degree of confidence gained from their expert judgment of multiple independent lines of evidence, including physical realism¹¹. Conversely, for decision makers, robustness might necessitate integrating the climate information with additional factors to reduce risks. Decision makers have to include the risk from allocating limited resources, and being able to defend a climate informed decision in the context of their operational and institutional responsibilities and accountability. Such contextual factors may lead to overly cautious responses or even inaction through a heightened concern with false positives in the climate information.

This dichotomy between two interpretations of robustness — the scientist and the practitioner — and many other nuances that may lie between them, emphasizes the primary importance of understanding the context in which information is developed. Context will strongly influence how the climate information challenge is viewed and will steer all subsequent choices. So someone wary of false positives might prefer/require a storyline approach that helps understand the information in the context of known experiences, while a probabilistic approach might be more appropriate in another context. Alternatively, decisions that involve engineering may require detailed quantitative information, while policy development may be adequately supported by simpler qualitative information.

We thus observe a clear connection between the methodological choices about climate information and the role of contextual values influencing the creation, formulation, and dissemination of climate information. Numerous such decisions are generally made while developing a climate service product or during a scientist's research project; however, these choices are often invisible to the users of that information who live and operate in a different context with societal consequences. Therefore, how can we ensure that these (value-based) decisions are transparently accessible to stakeholders, understood in how they influence information robustness, and so align with their decision priorities?

We highlighted the importance of context and consequence. Context is and should be the starting point for assessing the climate information, along with the values guiding the choices and shape of the path taken from context to explore the confusing landscape of information.

The term non-congruency was used freely through the meeting to refer to the misalignment of information sources, and was recognized to have two complementary applications:

- a) Non-congruency between information sources, where, for example, one set of models may indicate a different magnitude of projected change to another set of models (e.g. CMIP 6 and CORDEX in the IPCC AR6 WG1 Atlas), or even presenting a contradicting sign of projected change in some regions.

¹¹ e.g. Ch 10 of the IPCC AR6 WG1: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter10.pdf

- b) Non-congruency may equally apply to a misalignment between the climate information as constructed and communicated and the realities of the decision context. For example, using low-resolution GCM data to inform urban scale questions in a region of complex topography.

Such non-congruencies may sometimes be mitigated when scientists and decision-makers embark together on the journey of co-production to design climate knowledge products with specific purposes in mind. Co-production approaches are well represented in the literature and can be highly effective. Nonetheless, co-production is time consuming, uniquely tailored to the context, commonly labour and resource intensive, and not readily scalable or transferable to new contexts.

Other forms of non-congruency are also bound to arise when decision-makers face a complex array of information sources (e.g. different sources presenting alternative attributes of a climate variable, or a different subset selection of models, or making different assumptions about the cultural value priorities). These factors may additionally contribute to different decision outcomes with inevitable tangible consequences.

Thus, the meeting by design began with focusing on the information problem from the decision-makers perspective, and the meeting's conversations evolved to explore the different aspects of managing non-congruency. This guided the participants in their discussions on ways forward for the communities to collaborate in developing answers and guidance to this simple question:

Given my unique context, how can I know whether I can act on the information that is provided/available to me?

To address this, the meeting engaged in a process of extensive dialogue and consensus-building about what constitutes robust information across the communities represented.

3.2. Headline observations from the conversations on information robustness

A notable indicator of how important the issues were perceived was that all participants, whether in-person or virtual, remained highly engaged throughout the meeting. These included the notably strong voices of early career researchers (ECRs) bringing new perspectives¹².

A central and pervading concern highlighted the near absence of strong and coordinated cross-community collaboration addressing the core issues for decision-worthy robust information. It was clearly acknowledged that the challenge is fundamental to all communities, has received limited attention, and is of high priority.

Discussions were vigorous and thoughtful, with commendable openness to learn through discussion, rather than defending or advocating a particular domain or partisan perspective. The participants took on board the need to engage in structured listening of counter perspectives, and the ensuing dialogues were constructive and focused on reaching positive outcomes. Indicative of this approach to inclusive thinking and how much it was valued was that over 60 participants subsequently expressed a desire to be included in new developments, including many volunteering to champion or lead new initiatives.

Discussions underlined the fact that climate information only becomes usable for practitioners when the users can effectively incorporate it into the context of a decision process. However, how to assess the added value from incorporating the information remains a research challenge. Research into this question requires a transdisciplinary perspective in which decision makers become peer partners with

¹² Such was the sustained energy and engagement that a number of participants noted the (productive) intensity of effort it required. Notably, the ECRs brought energetic and constructive critiques of the business-as-usual thinking, in particular presenting the importance of culturally different contexts and perceptions of the Global North-South power dynamic.

the research scientists, each bringing needed insights to build a collective understanding that can be linked to societal action.

One example of this necessity for peer partnerships is the urgent need for standardized guidance and defensible standards to support decision-making processes in constructing, communicating, accessing, interpreting, and responsibly adopting climate information. These need to be developed through broad consultation to incorporate the diversity of perspectives, especially recognizing the global north-south tensions. Such guidance and standards should ideally carry endorsement of agencies that have broad credibility to encourage their adoption. Materials may include the development of tools such as standardized guidance for different practices and contexts, and tools for assessing climate model assumptions, however caution should be used in advocating a “recipe” solution as a panacea for all contexts. Importantly, guidance and standards should be dynamically evolving and not be a static snapshot of the current understanding, and be supported by ongoing research into what may be elevated as new transferable knowledge versus that which remains contextually unique.

As noted, non-congruency is likely to occur when decision-makers in different contexts are faced by multiple information sources whose choice will potentially lead to different conclusions. This can be somewhat managed when information production involves both scientists and decision-makers. However, bespoke co-production of knowledge products does not eliminate the need for collaboration across communities to build a broad and common comprehension and understanding of how climate information is perceived and used across different perspectives.

In this way effectively addressing the robustness of climate change information requires a shared ethical responsibility and coordinated efforts across various communities. The meeting set the stage for new initiatives, dialogues, and leadership to tackle the transdisciplinary challenge of climate change, aiming to move beyond business-as-usual and towards a more resilient and informed approach to supporting decision-making.

The preceding messages, along with additional challenges identified by the participants as intrinsic to the activities of their respective communities, can be distilled into the following key points. These capture the priorities that emerged from the discussions as being especially in need of urgent attention.

- Expand ways to bridge gaps between data producers, information constructors, climate service providers, and users as a co-dependent web of actors who need the insight and understanding from other communities. A co-dependent web of actors contrasts the currently normative linear supply chain paradigm that implicitly distances one end from the other.
- Assess the quality, credibility, and relative added value of different sources of climate information by building defensible supporting evidence with clear methodologies.
- Innovate new approaches to select, assess, and distill the vast (and growing) amounts of data into actionable insights.
- Develop processes and avenues for providing transparency about the strengths and limits of climate information and the varying methods used to assess the credibility and relative merits of difference sources.
- Explore, discuss, and articulate the ethical issues inherent in the roles of different actors and how these should frame the engagement and activities of different communities.
- Where appropriate, develop and test context-sensitive metrics of robustness that are scalable and transferable across contexts.
- Improve cross-community structures for peer collaboration and conversation to enhance mutually beneficial learning.

- Foster a common language and literacy with an improved definition and understanding of “robustness” that may be understood across communities.
- Collaborate on authoritative guidance and minimum standards for information, especially for climate action practitioners.

On a pragmatic note, the conversations noted that the WCRP RfS Core Project and its growing community are in a strong position to facilitate actions for moving ahead. RfS sits at the nexus of the WCRP Core Projects on physical climate science and is mandated to engage with external communities of donors, impacts research, climate services, and a diversity of stakeholders. Furthermore, RfS sits within the WCRP which is the global leader in helping coordinate climate research and is strongly linked to the WMO and IPCC. RfS has a mandate to research better practices that build guidance for decision makers. RfS is well-positioned to contribute to developing transdisciplinary collaborations and adding value to the broad array of communities engaged with decision makers. RfS does not seek to lay exclusive claim to this domain of activities, but rather seeks to be a co-catalyst and so foster community-wide engagement and initiatives.

Two institutions with which we seek to co-catalyse these developments is the IPCC and WMO. As noted in IPCC AR6 one of its key roles is to be an authoritative starting point to collating, assessing, and building climate information. This aspect of IPCC assessments will always be snapshots in time and even the IPCC does not have the resources to account for the contextual realities of, and thus provide for the, information needs at all local to regional scales of decision making. Thus, there is a need to bridge the gap between the scientific assessments of the IPCC and these contextual realities at national, local or sectoral level. Here again, RfS can facilitate a cross-cutting and sustained dialogue between the research and user communities to enhance understanding of regional climate information robustness with appropriate metrics of robustness, as well as supporting guidance aligned with the decision maker’s perspective, this latter also a focus for the WMO. The RfS community offers itself for catalyzing consensus-building around all aspects of the construction and adoption of climate information, and in doing so adding further value to IPCC and WMO products and syntheses.

3.3. Observations on the design and process principles

A more general point to emphasize about the meeting was the importance of a participatory process. While earlier sections focused on the framing and content, we believe that the design of the meeting itself as an engaging experience was essential. By documenting the design and structure of the meeting, and the rich information gathered as a result, we hope to inspire more meetings with diverse participants to consider devoting the majority of the time to interactive panel discussions and small group activities. In so doing, we tried to model the types of inclusive processes that we seek to develop in each local-to-regional context.

3.4. Commitments, follow-on actions, future directions, and concept proposals

One objective of the expert meeting was to open discussions and establish foundations to catalyse new cross-community and transdisciplinary activities on this theme, thereby leveraging the WCRP/RfS-mandate to foster new activities in a broader community of practice.

The expert meeting was motivated by RfS recognition that there was no community-wide coordinated effort in addressing the challenge of robust information for decision making. We noted that partial examples of addressing robust information for decisions are embedded in stand alone projects¹³ or

¹³ For example, the FRACTAL project in Africa (www.fractal.org.za) sought to begin in the decision context of cities and from there to explore the relevant climate information space.

within the structures and framing of institutional interests¹⁴. Nonetheless, we also recognized that there is limited coordination or collaboration, an often-compartmentalized approach, and indeed even sometimes implicit competition between activities. Moreover, the presence of commercial climate services further clouds the issues and raises deep ethical questions of responsibility and accountability.

To move beyond the meeting's conversations, immediately following the meeting a survey was circulated among the in-person and online workshop participants. They were requested to respond within one week while their thoughts and experience of the meeting were still fresh. The survey asked participants to rank the various topics that had been touched upon over the course of the workshop in order of their perceived priority/importance and to indicate whether they were interested (and able) to sustain a continued engagement on these topics, and the extent of commitment they could offer.

Almost all survey respondents indicated that they were keen to stay engaged to the degree their other commitments permitted on at least one aspect related to the robustness of climate information.

Four topics generated most interest from participants, though note this only represents the leading topics as measured by the number of participant's personal responses on each.

- Guidance around fitness for purpose of climate information
- Development of standards around climate service delivery and decision-support tools
- Global North-South collaborations and power dynamics
- Development of context aligned metrics for climate information

Maybe more importantly, the survey allowed the RfS to identify scientists willing to act as champions and willing to dedicate some of their time to building activities addressing various aspects of the non-congruence of climate information.

In parallel to the survey, a two-page flyer¹⁵ summarizing the meeting was constructed and shared with communities, and made available on the RfS website¹⁶. This flyer presents the problem statement, the meeting objectives, the program design, and initial outcomes, as a useful way to engage people and organizations interested on this topic but that could not participate themselves in the meeting.

Following the conclusion of the meeting, the next substantial action was to establish an Interim Working Group (IWG) to take the new actions forward. Ten people were selected to form the core of the IWG tasked broadly with translating the discussions from the workshop into actions, and report to the RfS as the hosting organization.

This IWG was constituted to facilitate development of new initiatives and, aligned with the broader RfS mission to connect science and society, collaborations across the commonly silo'd activities of different communities. The selection of this core group was designed to cover the largest number of related topic areas as well as providing a geographic/gender/career-stage balance to the group. It is worth noting that while some RfS SSG members are part of this initial group, none are IWG co-chairs.

To avoid unnecessarily constraining this new IWG, and recognizing the facilitation role of RfS, the scope and terms of reference for further planning, coordination, dialogue, capacity-sharing structures, and

¹⁴ For example, the World Meteorological Organization's (WMO) Global Framework for Climate Services (GFCS) establishes some actions in a value supply chain paradigm that begins in climate data. The EU Copernicus Climate Change Service (C3S) incorporates some elements of the robust information question, again with a somewhat linear and one directional flow of information that likewise mostly begins in the climate data. At the smaller scale are national and individual institutions seeking to develop activities of delivering "useful" information. Each, however, constructs a bespoke approach where the decision-maker is usually cast as an end-user,.

¹⁵ <https://www.wcrp-rifs.org/wp-content/uploads/2024/06/flyer-workshop-Robustness.pdf>

¹⁶ <https://wcrp-rifs.org>

setting the initial priorities were left up to the IWG. In the months following the meeting, the IWG began to be actively engaged in developing initial steps, and to establish initial task groups responsible for developing relevant near-term activities and long-term direction in parallel with the above actions.

The IWG and organizing committee engaged on developing a set of pilot action concept proposals for discussion with donors. Four initial proposals are being developed for actions that leverage near term opportunities and regional priorities, and which inherently address some of the elements of the priority topics identified by participants.

1. Mapping from decision context to consequence through climate information pathways

Using a common framework, this seeks to establish a suite of small, bottom-up, champion-led local studies that each begin in a unique decision context. From each context's starting point a team will explore the information landscape to try and identify relevant robust information for informing the real-world decision's climate information need that will lead to societal consequences. The results from each information exploration will be assessed for the barriers, experiences, signposts, dead ends, constraints, etc. that are encountered in the process, and commonalities identified regardless of the initial context starting point. From this the activity seeks to build a framework of transferable lessons to guide practitioners when searching for robust information, while identifying those attributes of contexts that might still require custom attention.

2. The intersection of transparency, ethics, and climate information

This concept proposal seeks to unpack the roles of ethics in different communities engaged in the data production, information construction, communication, and adoption of climate information (including the donor agency community). This will further explore where transparency issues and collaborative dynamics (including global north-south engagements) act to curtail the understanding of the limits to robust information.

3. Evolving CORDEX-Africa to become a community of decision-relevant information

With the rapid and continuing expansion of new data products, and the resource constraints on new climate modeling in Africa, the active and committed community from past phases of CORDEX-Africa activities are optimally positioned to become a catalyst for a new collaboration in Africa. This would focus on an integrated web of actors spanning data generation, information creation, climate services, information communication, and stakeholder decision contexts. It would leverage the heterogeneity of Africa's cultural values, climate vulnerability, and decision contexts to deeply explore the issues with the potential to be a knowledge leader in developing new paradigms for robust climate information for decisions. Seed funding toward an initial workshop in 2025 has already been granted.

4. Climate literacy in the web of actors.

While climate literacy is often seen as developing the skills of the stakeholder to use climate information, this project would explicitly consider that all communities have a need to learn about the climate context of other communities. For example, modeling communities need to better understand application contexts in design of experiments, global north institutions need to better understand the lived experience of the climate researcher in the global south, donor agencies need to develop capacity in their target communities to better allow them to set the agenda, and some climate services need to learn a much richer and deeper understanding of the complex operational contexts of the decision makers who are recipients of their climate information.

The above concept proposals are mutually beneficial and enhanced by building on each other. For example, the role of ethics in climate literacy, or mapping from decision context to consequence as a framework to help evolve the CORDEX-Africa community to become developers of robust information.

Additional proposals will emerge, but the success of the IWG is partly contingent on donor agencies supporting initial actions to build momentum and cross-community collaboration.

The IWG was further tasked with identifying additional capacity required by the IWG and developing a process for (self-)nominations to expand representation and capacity. Finally, they will assess any budget needs necessary for the initial activities. It is anticipated that once momentum has been established, the IWG will become a formal and permanent working group of RfS with a well-defined structure that is integral to the ongoing WCRP/RfS activities, addressing the spectrum of evolving issues of non-congruence of climate information and facilitating cross community and transdisciplinary collaboration.

3.5. Narrative experience of the process, including any anecdotal evidence or selections from the survey.

Gauging the workshop participants experience of the process is a crucial indication of its success and also how to advance the topic of robustness of climate change information for decisions and the broader themes discussed in the workshop. Participants were asked to reflect on their experiences and take home messages from the workshop, both in a panel discussion and via a post workshop survey.

The survey was designed to provide the option for participation in the following stages of the dialogue that was initiated during the workshop. The participants were asked to share their reflections on the workshop, and what they see as priorities among the next-steps discussed. Care was taken to ensure all communities of practice were represented; physical climate researchers, climate impacts and adaptation researchers, donors, climate services community, and decision makers.

The post workshop experience from the participant perspective is covered in the following sections (3.3.1 and 3.3.2)

3.2.1 Survey Results

Post workshop, all participants were surveyed to gauge their views on immediate and future priorities and to offer opportunity to volunteer to be part of the continued activities.

The survey consisted of questions related to the post workshop activities, i.e., participation in the Interim Working Group or support with documenting and sharing workshop results. The next set of questions aimed at shaping future collaboration by surveying the participants' interest in contributing to different topics (Fig. X), as well as by ranking these topics to help prioritise the efforts. The survey also inquired into participants' interest to attend a meeting like this again, recommend it to a colleague, and the online vs. in-person format preference for the future meetings. Finally, participants had an opportunity to suggest further topics for collaboration, provide feedback, and make suggestions.

Out of 108 participants that received it, 65 completed the survey; 40 workshop participants from the in-person group and 25 from the online group. The general feedback was very positive, with 97% of participants (63) expressing an interest to attend a meeting like this again and 60 participants would recommend participation in such a meeting to a colleague. Also, more than 50% of respondents (31) wanted to contribute to the meeting report and/or to the meeting summary. Furthermore, 21 participants were interested in helping with an op-ed for a popular venue on this topic. Finally, 70% of participants (46) were happy to share any of this material in their networks.

The participants were also surveyed about the particular topics they would like to contribute to. The strongest interest was in the *guidance around fitness-for-purpose, global North-South collaboration and power dynamic*, as well as *moving towards minimum standards for decision-making* (Fig. 1)

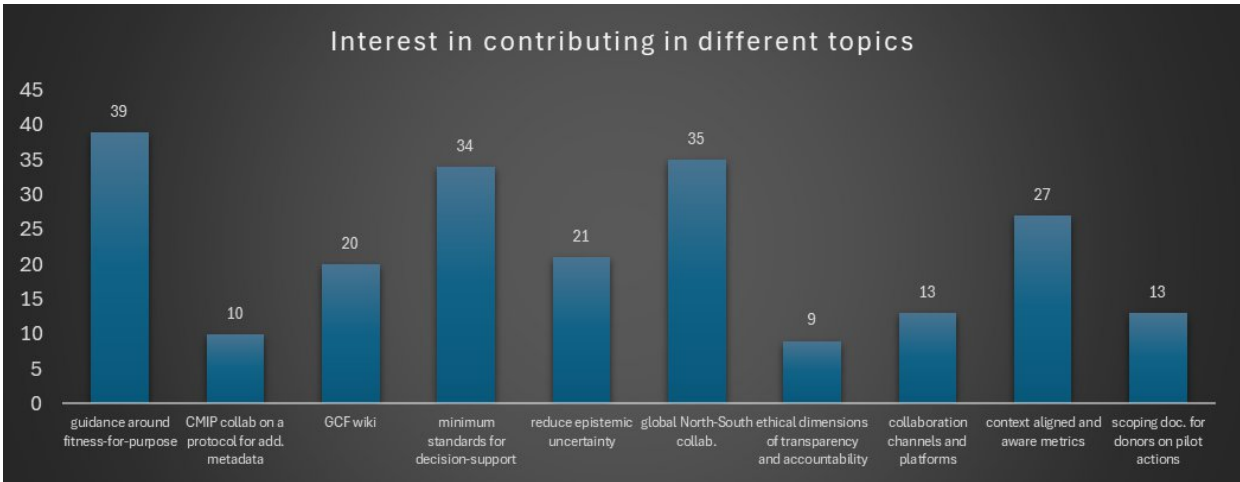


Fig. 1. Interest in contributing to different topics.

Ranking of the topics where we should put the most effort reflected the above described interest in contributing to these topics. However, topics such as *ethical dimensions of transparency and accountability* and *collaboration channels and platforms*, for which the participants did not show such a high interest in contributing to (9 and 13 participants respectively), ranked as a high priority for more than 50% of participants (34 and 33 respectively) (Figure 2).

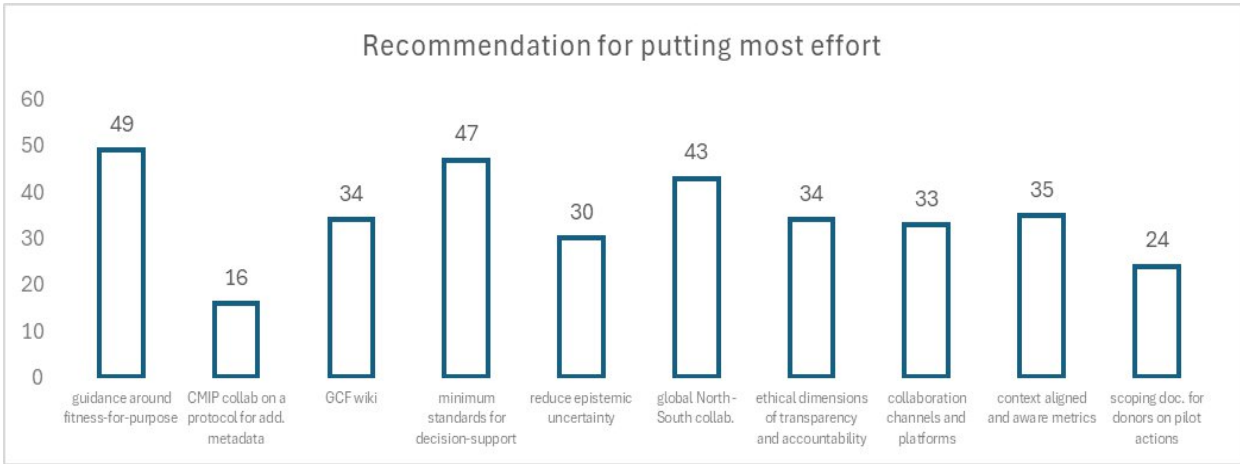


Fig. 2. Ranking of priorities where we should focus more effort. The high priority were considered those topics that received scores 4 or 5 on the 1-5 scale.

Other topics of interest that the participants specified included: a glossary to assure a shared language, scaling up and finding the transferable lessons from co-development of specific climate services, pilot actions, operationalisation of climate projections, effective societal engagement, regular collection of data on extreme weather events to support attribution studies, standardizing a minimum level of user information, a typology of adaptation decisions, a user guidance on how to trust climate information, and input into IPCC WG II adaptation guidance. Some participants also expressed interest to serve as liaison between this and other groups and initiative, e.g., on standardization of climate services, stakeholder communities (finance /insurance, electric power, and agriculture were specified), a similar US-specific effort on robustness of climate information, and IPCC/WMO initiatives.

The survey results showed a strong interest in the Interim Working Group (IWG) proposed to take forward the various themes discussed in a systematic and coordinated manner, namely into an overarching coordination on the robustness topic follow-on activities. Concretely, 8 participants expressed interest to co-lead this IWG, 29 to participate in it, while 13 said that they could not join it but could provide review of materials.

At the end of the survey, participants had an opportunity to leave feedback and suggestions. The comments received mainly praised the format, interaction and dynamic of the workshop. One recommendation was to have a dedicated facilitator in the room for the online participants, to align and consider even further the online discussions. There was one concern that, although well managed, the hybrid participation might have resulted in “different take home sentiment” between the online and participants in the room. Finally, one participant raised concern regarding the mismatch between the meeting narrative focusing on long term projections and decision makers’ concern with shorter time frames that could better be addressed by seasonal predictions.

3.2.2 Anecdotes and reflections from the different participant communities

At the workshop’s end, participant communities were asked to reflect on the meeting’s discussion for pathways forward towards enhancing robust, actionable, and adequate-for-purpose regional climate information.

Each community of practice representatives shared what they are taking away, and what they see as priorities among the next-steps discussed. The following section details anecdotal reflections from the different communities of practice within the meeting participants.

Researcher community reflections:

- Speaker A take away messages:
 - Storylines could be a good tool to bring robustness to climate information and enable/promote dialogue.
 - We could develop careers that facilitate inter/trans-disciplinarity while continuing to do science at ECR stage.
 - We need to build on the human aspect of our work, in the face of AI advancement, which provides a buffer against being replaced by AI.
- Speaker B take away messages:
 - The distillation dilemma has an analogy of a disease epidemic, where with the advent of new drugs, scientists have conflicting messages on their effectiveness and what the disease is.
 - Like with medicine, we need to build climate literacy, where scientists need to be more useful and need a real world way to communicate hazard information, as well as needing to simplify it.
- Q&A:
 - Machine learning and AI is not a threat but an opportunity and we need more discussion of this changing landscape.

Funding community reflections:

- Speaker A take away messages:
 - There is a clear need for robustness of information on use of data for decision makers, considering the complexities of stakeholders, disciplines, contexts.
 - There is a strong consensus on ‘flipping the script’, in the funding community with respect to data adequacy and it being fit for purpose.

- There is also a need for multi-directional decision making, with standards to unify different user groups. This streamlines the ability of decision making to be linked to better climate science in order to access climate finance.
- Speaker B take away messages:
 - There is a real opportunity to marry use of science with production of science.
 - Conversations are changing towards greater engagement of non-climate science (e.g. Geotechnical solutions).
 - Big adaption decisions are being made, involving large amounts of money – can technology deliver? It requires more lived experience to know where to move and change.
 - Climate change and health is an emerging topic with a rapid increase in funding.
 - There is a lack of involvement from the creative community in getting messages across – the arts and humanities know how to communicate difficult concepts. For example, InRoads (a game) helps negotiators to understand how decisions on mitigation strategies affect investment outcomes.

Impacts and adaptation community reflections:

- Speaker A take away messages:
 - Thought the diversity of people in the room impressive. Where do we go from here?
 - End of day 1: A lot of expertise, how do I access it? Leveraging capacity (people, data, skill sets, processes), to get robustness of information.
 - End of day 2: If I were not in this room, how would I know about this expertise? What is the pipeline for knowing, participation, and where are the entry points for inclusion? Are all regions mapped to expertise?
 - End of day 3: How will my region know what is discussed? For effective community engagement, discussions have to start at the regional level. What can be pulled from this meeting into the regional context? Perhaps use of games as a means of prompting action.
- Speaker B take away messages:
 - Enjoyed the robust discussion.
 - Robustness of climate change information for decision makers should involve transparency guided by trust.
 - Diversity of people from different backgrounds and inclusivity (local and indigenous), as well public and private organizations should be considered.
 - Consideration of North-South dynamics and empowerment is key. Capacity sharing as well as capacity building. Southern hemisphere representation and collaboration.
- Speaker C take away messages:
 - More exploration of non-congruency within climate science and its methods and tools. No one size fits all.
 - Awareness that there are both short-term and long-term challenges.
 - Had many discussions relating to work of being a forecaster, versus being a climate service provider.
 - Knowledge brokers are not necessarily embedded, and we need sectoral knowledge through knowledge brokers.
- Q&A:
 - Understand the potential co-conspirators to work with where there are gaps in evidence base. What can/can't be provided, what evidence points to limits of adaptation?
 - Consideration of development priorities that are considered in the context of climate unknowns and discontinuities.
 - Continuing issue of there being one group in one northern location. Really need to get information happening at regional levels, embedded within the regions.

Climate services reflections:

- Speaker A take away messages:
 - Appreciative of the program design, and conscious choice towards diversity, and small groups as a means of inputting. Keen to take it back to my regional context and see how it is received.
- Speaker B take away messages:
 - Thought there was a healthy balance of discussion. With a fruitful discussion on climate risk and risk services.
 - There is a desire and need for discussion on guidance and standards at international down to regional/national levels.
 - What is happening in the verification space? Noting that given we are now halfway through 2020s, we can start verifying past climate projections and know where we sit.
 - Need to understand distilling climate information versus climate risk information.
 - Need clear understanding of non-congruence issue in different regions and impacts on decision makers.
 - Need more precise information.
 - With regards to existing services, how does RfS sit alongside GFCS, etc.?
 - Global south to north learning could be facilitated by climate service partnership.
- Q&A:
 - There are already examples of using behavioural psychology to understand guidance and its impact/lack of impact.
 - Need a good model for updating and responding to new climate extremes.
 - Climate services - get them in the room and learn from them. What services are needed?
 - Differentiating between decision makers needs.
 - Verification of climate models is already producing favourable results. Attribution evidence gives a good indication of the power of current models.

Decision makers reflections:

- Speaker A take away messages:
 - Stakeholders largely trust climate information but it is fragile. There is a low understanding of the limitations. What does robustness need in the context of building trust?
 - Climate researchers need to take responsibility regarding climate information. Fragility exists at different levels. They need to help build trust.
 - There is an example problem in Canada where regulations for flood plains are changing due to floodplain maps having a larger spatial extent to include climate change. Needed to build trust with sectoral experts, and add to maps to bring in climate change uncertainties. With this example, there is guidance coming from large community.
- Speaker B take away messages:
 - Shared insights from a workshop in their community (crops, livestock, fisheries, etc.). Highlighted main problem – which is that the sector is not well aware of non-congruence.
 - Open to being in contact and looking for opportunities to collaborate. Will undertake homework about how to formulate better long-term adaptation decisions.
- Q&A:
 - Games and humanities helpful – could use behavioural psychologists.
 - How do we in the global south interest the global north to engage with us on our terms, considering our lived realities?

Annex 1 - List of Participants

Last Name	First Name(s)	Institution	Country (work)	Attendance
Alverson	Keith	WCRP-CLIC	United States	virtual
Alves	Lincoln	INPE	Brazil	in-person
Archer	Emma	University of Pretoria	South Africa	virtual
Ayanlade	Ayansina	Obafemi Awolowo University, Ile-Ife, Nigeria	Nigeria	in-person
Bazo	Juan	Red Cross Red Crescent Climate Centre	Perú	virtual
Bende-Michl	Ulrike	Australian Bureau of Meteorology	Australia	virtual
Bharwani	Sukaina	SEI Oxford Centre	United Kingdom	virtual
Block	Paul	University of Wisconsin-Madison	US	virtual
Bojovic	Dragana	Barcelona Supercomputing Center	Spain	in-person
Boucher	Olivier	IPSL, Sorbonne Université / CNRS	France	in-person
Caron	Louis-Philippe	Ouranos	Canada	in-person
Chasco	Maria Julia	World Meteorological Organization	Suiza	virtual
Christensen	Jens Hesselbjerg	Niels Bohr Institute, University of Copenhagen	Denmark	virtual
Collins	Mat	Representing CLIVAR	United Kingdom	in-person
Corre	Lola	Météo-France	France	in-person
Cruz	Faye Abigail	Manila Observatory	Philippines	in-person
Currie-Alder	Bruce	Climate Adaptation and Resilience (CLARE), partnership of UK-FCDO and Canada's IDRC	Canada	virtual
Daron	Joseph	Met Office / University of Bristol	United Kingdom	in-person
David	García León	Joint Research Centre (European Commission)	Spain	virtual
De la Cruz Montalvo	Gustavo	National Service of Meteorology and Hidrology	Perú	virtual
Debrabandere	Anne	WCRP RfS IPO	Canada	in-person
Dentener	Frank	European commission, Joint Research Centre	Italy	virtual
Diarra	Aminata	USAID/West Africa	Ghana	virtual
Diaz	Delavane	EPRI	US	in-person
Diedhiou	Arona	IRD - University Felix Houphouet Boigny	Côte d'Ivoire	virtual
Dinku	Tufa	Columbia University	USA	in-person
Doblas-Reyes	Francisco	BSC and ICREA	Spain	in-person
Dosio	Alessandro	European Commission Joint Research Centre	Italy	in-person
Driouech	Fatima	UM6P	Morocco	virtual
Easterbrook	Steve	University of Toronto	Canada	in-person

Feldman	Daniel	Lawrence Berkeley National Laboratory	USA	virtual
Friedel	Marina	ETH	Switzerland	virtual
Funk	Chris	University of California, Santa Barbara Climate Hazards Center	United States	virtual
Garcia Carreras	Luis	Department for Energy Security and Net Zero	UK	virtual
Goldenson	Naomi	WCRP RfS IPO	Canada	in-person
Golding	Nicola	Met Office	United Kingdom	virtual
Gotangco Gonzales	C. Kendra	Ateneo de Manila University	Philippines	virtual
Govender	Sarika	Climate system analysis group	South Africa	virtual
Grose	Michael	CSIRO	Australia	virtual
Gutowski	William	Iowa State University	USA	in-person
Hachigonta	Sepo	National Research Foundation	South Africa	virtual
Hall	Alex	UCLA	USA	in-person
Han	Juhyeong	Seoul National University	South Korea	in-person
Harrington	Luke	University of Waikato	New Zealand	virtual
Hart	Melissa	Australian Research Council Centre of Excellence for Climate Extremes	Sydney	in-person
Hewitson	Bruce	University of Cape Town	South Africa	in-person
Horsburgh	Kevin	Green Climate Fund	South Korea	in-person
Imada	Yukiko	Atmosphere and Ocean Research Institute, the University of Tokyo	日本	in-person
Jacob	Daniela	Helmholtz-Zentrum Hereon, Climate Service Center Germany (GERICS)	Germany	virtual
James	Rachel	University of Bristol	United Kingdom	in-person
Jones	Richard	Met Office Hadley Centre	United Kingdom	in-person
Kanamaru	Hideki	FAO	Italy	in-person
Kendon	Elizabeth	Met Office Hadley Centre	UK	in-person
Klutse	Nana Ama Browne	University of Ghana	Ghana	in-person
Kotlarski	Sven	MeteoSwiss	Switzerland	virtual
Kuruppu	Natasha	ADB	Manila	virtual
Lavado Casimiro	Waldo	SENAMHI	Peru	virtual
LaVoi	Anthony	U.S. National Oceanic and Atmospheric Administration (NOAA)	United States	virtual
Lawrence	Judy	Climate Change Research Institute/ Antarctic Research Centre, Victoria University of Wellington	New Zealand	in-person
Lempert	Robert	RAND	United States	virtual

Lera St.Clair	Asun	DNV / BSC	Norway	virtual
Lewis	Kirsty	FCDO	United Kingdom	virtual
Lipschultz	Fred	US Global Change Research Program	United States	virtual
Luke	Harrington	University of Waikato	New Zealand	virtual
Maina	Jemimah	Conservation International	Kenya	virtual
Maraun	Douglas	University of Graz, Wegener Center for Climate and Global Change	Austria	virtual
Masaba	Vaileth	Tanzania Meteorological Authority	Tanzania	in-person
Maure	Genito Amos	Eduardo Mondlane University	Mozambique	virtual
Maycock	Amanda	University of LEeds	United Kingdom	in-person
Mearns	Linda	NCAR	United States	virtual
Mindlin	Julia	University of Leipzig	Germany	in-person
Moise	Aurel	Centre for Climate Research Singapore (CCRS)	Singapore	virtual
Morgenstern	Olaf	National Institute of Water and Atmospheric Research (NIWA)	New Zealand	virtual
Morrison	Monica	NSF National Center for Atmospheric Research	United States	in-person
Mtilatila	Lucy	Department of Climate Change and Meteorological Services	Malawi	in-person
Nazemi	Ali	Concordia University	Canada	in-person
Ogallo	Linda	IGAD Climate Prediction and Application Centre/NORCAP	Kenya	in-person
Padgham	Jon	START	United States	in-person
Philp	Tom	Maximum Information/London School of Economics	UK	in-person
Pinto	Izidine	Royal Netherlands Meteorological Institute (KNMI)	Netherlands	in-person
Pryor	Sara C.	Cornell University	United States	virtual
Pulwarty	Roger	NOAA	USA	virtual
Rossiter	John	Pacific Community (SPC)	New Caledonia	in-person
Schwalm	Christopher	Woodwell Climate Research Center	USA	virtual
Sharples	Wendy Katherine	Australian Bureau of Meteorology	Australia	in-person
Singh Shrestha	Mandira	International Centre for Integrated Mountain Development (ICIMOD)	Nepal	in-person
Sobel	Adam	Columbia University	US	virtual
Sobolowski	Stefan	Geophysical Institute, University of Bergen	Norway	virtual
Solman	Silvina Alicia	University of Buenos Aires/CONICET	Argentina	virtual
Sparrow	Michael	WCRP	Switzerland	virtual

Steynor	Anna	UK Met Office	United Kingdom	virtual
Tadross	Mark	United Nations Development Programme	South Africa	in-person
Tall	Arame	World Bank	Senegal	virtual
Taylor	Michael	University of the West Indies	Jamaica	in-person
Thomas	Adelle	Climate Analytics	USA	virtual
Thomson	Madeleine	Wellcome	UK	in-person
Tinni Halidou	Seydou	AGRHYMET RCC-WAS	Niger	virtual
Turcotte	Richard	Quebec Ministry of the Environment, Climate change, Wild life and Parks	Canada	in-person
Van den Hurk	Bart	Deltares and IPCC	Netherlands	in-person
Vano	Julie	Aspen Global Change Institute	USA	virtual
Vidale	Pier Luigi	NCAS, Dept. of Meteorology, University of Reading	Regno Unito	in-person
Vincent	Katharine	Kulima Integrated Development Solutions	South Africa	virtual
Vogel	Coleen	Global Chnage Insitute, Univ Witwatersrand	South Africa	in-person
Vogel	Elisabeth	Water Research Centre, University of New South Wales, Sydney	Australia	virtual
Wanzala	Maureen	World Meteorological Organization	Geneva	in-person
Wolski	Piotr	Climate System Analysis Group, University of Cape Town	South Africa	in-person
Zermoglio	Maria Fernanda	USAID	USA	virtual
Zhang	Xuebin	Pacific Climate Impacts Consortium	Canada	in-person

Annex 2 – Meeting Agenda

April 22 - Perspectives on the challenges	
9.00 - 10.30 ROOM 4A	1.1 Opening perspectives This session seeks to present a big-picture view to aid the diversity of participants in engaging with the breadth of the challenge we seek to address. This challenge of non-congruency between data sources has been a long-standing barrier in creating actionable climate information for decision makers and has raised a number of key issues, which include: 1. There is no scientifically adopted systematic approach to assessing robustness of climate information for decisions nor any coordinated effort to address this. 2. Even the understanding of what it means to say information is robust is predicated on perspectives that differ widely across the participating communities of researchers, practitioners, and funders. 3. There remain poorly recognized ethical issues and responsibilities that differ between communities, but ultimately underpin the final accountability a decision maker carries when climate information leads to decisions with societal consequence. <u>Where have we come from?</u> The journey to this meeting has a long history and includes key milestones that may be helpfully recognized: the 2010 IPCC Expert Meeting on Assessing and Combining Multi-Model Climate Projections (largely rooted in the physical science); the introduction of the concept of “information distillation” at the 2011 WCRP Open Science Conference, the 2014 WCRP WGRC Expert Meeting on “The Information Distillation Dilemma”, the IPCC AR4, AR5, and AR6 assessment reports which addressed the issue, and the 2023 WCRP Open Science Conference in Kigali. Despite these and other activities, the capacity to assign robustness to climate information for action has seen little advance, and there remains minimal cross-community coordinated effort to address the challenge. <u>What does it mean to speak of “robust” information?</u> The challenge lies in the non-congruence of modelling outputs and observational data, the lack of consensus on what defines robust, and how to even qualify/quantify what is robust. There are different perspectives, such as the scientific approach to quantified uncertainty as a modeller may view it, or how robustness of an adaptation action may be viewed across climate scenarios, or even the more philosophical discourse on what robustness means. Ultimately, robustness in the current context is how to arrive at a statement for a decision maker such that it warrants the societal risks and consequences from making a given decision. <u>The responsibilities facing the community.</u> There is a shared ethical responsibility to move beyond business as usual to respond to the time imperative of climate change. This urgently requires new dialogue, coordination, and leadership across communities to work on what is fundamentally a transdisciplinary challenge.

	This meeting seeks to expand the discourse to develop new initiatives, look beyond the parochial perspectives, and to accept differentiated responsibilities to address the challenge. As such, a measure of this meeting's value is whether we are able to open new paths and catalyse activities that productively move us forward in timely and pragmatic endeavours. Moderators: Kevin Horsburgh and Bruce Hewitson ● Welcome from the co-chairs (Bruce Hewitson and Kevin Horsburgh) ● Ice-breaker activity ● Perspectives panel: a. Perspectives and priorities of national, international, and philanthropic organisations on the need for and development of robust climate information (Arame Tall) b. Climate services and the construction and communication of robust information on future climate (Richard Jones) c. Science of robust regional climate information (Francisco Doblas Reyes) d. Ethical considerations (Monica Morrison) ● Capturing burning questions
10.30-11.00 Tea	
11.00 - 13.00 ROOM 4A	1.2 Leveling the playing field on the understanding of what is robust regional climate information The session on “leveling the playing field” is all about the imperative of context, and how awareness is a vastly different matter compared to comprehension. Principally the session recognizes the diversity of the lived experience of the different communities. For example, a well-resourced modeller in a world-leading research institution in the global north compared to an impacts researcher in the global south who faces challenges that deeply compromise the daily viability and sustainability of their work. Alternatively, a manager in a donor agency with substantial financial resources who seeks to enable research yet is constrained by policy and institutional agenda that may inflexibly define foci and objectives, whereas a local research community seeking support has a lived experience of the contextual realities and finds the funding terms of reference inappropriate and divergent to the knowledge needs for developing local actions. To this end, the session will engage in an unusual exercise of structured listening to the lived experiences from different communities. Though consideration of the personal emotional experience, the heterogeneity of values and world views framing the activities, and the structural constraints, the session seeks to broaden the discourse and understanding of context. The session discussions set the stage for the breakout group that follows (session 1.3), which explores the challenge to defining and assessing “Robust information”. Moderator: Monica Morrison • Language and terminology keynote presentation: Coleen Vogel • Introduction to deep listening: Bruce Hewitson • Learning narratives: b) Physical science: Bart van den Hurk and Genito Maure c) Climate services: Faye Cruz d) Funding agency: Mark Tadross

	e) Financing agency: Madeleine Thomson f) Cities: Katharine Vincent g) Small Islands: Michael Taylor • Panel: Reflection on commonalities in the narratives from rapporteurs • Open discussion
13.00 - 14.00 Lunch	
14.00 - 15.30 ROOMS 4A, 3A, 3C	1.3 Break-out #1: Defining “Robust information” Context: Given how different sources of climate information are non-congruent yet each are nominally defensible, a leading imperative is to develop defensible measures of information “robustness” that are appropriate for informing decision maker’s choices that lead to real societal consequences. Goal of the discussion: To move the different communities forward to better assess and articulate measures of robustness of climate information for decisions with societal consequence. The group should explore the diversity of understanding of what the term “robust information” means in different communities, how this is assessed, the appropriateness and inadequacies of current approaches, and suggest new avenues of development potential to enhance the measures of robustness. Intended outcomes: The discussion should lead to ideas for the development of new avenues of research/collaborations that can advance: generating and analyzing relevant climate data; developing approaches to constructing information; and framing and articulating information robustness. Collectively such actions may advance the collective understanding of how to better assess and articulate the robustness of climate information for decisions that have consequence for society. Starting point: We recognize the most prevalent framing for “robust” emerges from the IPCC and is strongly conditioned by the IPCC approach to confidence statements and measures of quantitative uncertainty (e.g. Kause et al., 2022). This is a dominantly academic and technical perspective that is not strongly rooted in the application context. Alternative framing of climate information robustness exists, such as may be found in the robustness of adaptation actions across climate scenarios (e.g. Whatleley et al., 2014). One may even take the more philosophical discourse on reasoning about what robust means when considering model outputs (e.g. O’Loughlin, 2021). Questions: - What are the different ways to understand what “robust” should / does mean? - What (new) metrics could better help to identify degrees of robustness? - What (new) approaches could enhance the process to reach context-relevant measures of robustness?
15.30 - 16.00 Tea break	
16.00-17.00 ROOM 4A	1.4 Report back and open discussion Moderator: Richard Jones
April 23: Exploring pathways to moving forward	

8.45 - 10.00 ROOM 4A	2.1 Developing new and necessary dialogues between communities on regional climate information This session aims at exploring how to better foster crucial dialogues between diverse communities in order to enhance the development and application of regional climate information. This panel discussion will explore innovative approaches to bridge some of the gaps that exist between the science community, funding agencies, national governments, and stakeholders, as well as limitations therein that need to be addressed in order for such bridging to occur. It will also examine conditions that are needed to establish sustained cross-cutting dialogues, explore knowledge gaps and knowledge-translation needs, ensure stronger representation of the global south in climate research agenda-setting and action, address disparities in funding agendas, and highlight missing dialogues that are needed to advance climate literacy. Through case study examples, the speakers will explore the knowledge gaps that constrain, and knowledge needs that could enhance, the efficacy of their activities. The concluding plenary discussion opens the conversation to interrogate the leading challenges and opportunities. This discussion is preparation for the detailed discussions in the breakout group that follows on developing new and necessary dialogues between communities (Session 2.2). Moderator: Wendy Sharples • Recap of day 1: Bruce Hewitson • Panel discussion: Developing new and necessary dialogues between communities on regional climate information h) Building dialogues within the science community: Mat Collins and Izidine Pinto i) Building dialogues between funding / finance agencies / national governments / and the science community: John Rossiter and Sepo Hachigonta j) Building dialogues around climate services and climate literacy: Jon Padgham and Mandira Shresta k) Open discussion
10:00-11:00 ROOMS 4A, 5B	2.2 Break-out #2: Developing new and necessary dialogues between communities regarding regional climate information In our increasingly interconnected world, the exchange of regional climate information is primordial for informed decision-making, sustainable development, and effective adaptation strategies. However, bridging the gap between various communities involved in climate-related endeavours poses a significant challenge. The Breakout group 2 focuses on the crucial task of developing new and necessary dialogues between communities regarding regional climate information. We recognize three key areas where such dialogues are vital: a) Building dialogues within the scientific community: Scientists play a central role in understanding, analysing, and disseminating climate information. However, effective communication and collaboration within the diverse scientific community are essential to ensure the interdisciplinary learning, accuracy, relevance, and accessibility of climate data and research findings. b) Building dialogues between funding/finance agencies and the scientific community: Adequate funding and support are critical for advancing climate research, link with the society, data collection, and technological innovations. Establishing constructive dialogues between funding agencies and the scientific community is essential to align priorities, allocate resources efficiently, and foster innovation in climate science.

	c) Building dialogues around climate services and climate literacy: Climate services provide valuable information and tools to help stakeholders understand, interpret, and utilize climate data effectively. Useful and usable climate services are co-produced through a transdisciplinary collaboration between science and society. Enhancing climate literacy and promoting dialogue among diverse stakeholders, including policymakers, practitioners, and the public, is essential for enabling collaboration, building resilience, mitigating risks, and fostering sustainable development in the face of climate change. Based on what was presented in the previous Panel session, we will explore the following questions in three groups: – What types of sustained dialogues would be beneficial? – What modalities would be functional and pragmatic? By engaging in collaborative discussions and sharing insights, we aim to identify actionable strategies and foster partnerships that will facilitate the co-production and exchange of regional climate information and promote collective action towards a more sustainable and resilient future.
11.00-11.30 Tea	
11.30 - 13.00 ROOM 4A	2.3 Panel discussion: Lessons from the past on dealing with non-congruency of regional climate information In this session, we will delve into the complexities of dealing with non-congruency (inconsistency across different sources and forms of information) in regional climate information and the lessons gleaned from past experiences. The session will feature case examples from both the Global North and the Global South, highlighting efforts to overcome the dilemma where climate information plays a central role in stakeholders' decision-making processes. Structured around four different perspectives – stakeholders, climate service providers, the climate research community, and global North-South collaboration – the session will comprise eight presentations. Each perspective will be presented once from a Global South viewpoint and once from a Global North viewpoint, offering an understanding of the challenges and strategies from diverse geographical contexts, complicated by issues inherent in the heterogeneity of culture, values, and capacity. Through these presentations and the following discussion, we hope participants will gain insights into effective strategies, best practices, and potential pitfalls when dealing with non-congruent regional climate information. The session aims to foster dialogue, exchange lessons learned, identify looming challenges in need of more attention from different communities, and inspire future efforts towards more robust and inclusive climate adaptation and decision-making processes globally. This session the subsequent session on envisioning ways forward frames the critical discussions of breakout session 2.6 which focuses on brainstorming pragmatic opportunities for collaboration. Moderator: Dragana Bojovic Panelists: l) Mandira Shrestha m) Lola Corre n) Michael Grose o) Mat Collins p) Linda Ogallo

	q) Vaileth Jonas r) Alex Hall
13.00 - 14.00 Lunch	
14.00 - 14.30	2.4 Report back on break-out #2 Moderator: Kevin Horsburgh
14.30 - 15.30 ROOM 4A	2.5 Theory and Practice: Envisioning Ways Forward Moderator: Bruce Hewitson This session will set the stage for the rest of the meeting's discussions about next steps. We aim to encourage a balance between creativity, working within practical constraints, and setting realistic targets of measurable progress. We will propose some potential structures for ongoing organizing and approaches for building broader consensus among our colleagues and communities of practice. We will challenge participants to alternatively engage in idealistic "blue sky" thinking, and play "devil's advocate" about pragmatism. After this whole-group session, we will be moving into break-out group discussions to brainstorm new initiatives. We hope that this whole-group session will prime everyone to think creatively and also to be grounded in some common understandings while holding a goal of achievably moving us collectively toward enhancing the value for the decision maker.
15.30 - 16.00 Tea	
16.00 - 17.00 ROOMS 4A 3B	2.6 Break-out #3: Brainstorming pragmatic opportunities for collaboration where the outcomes reflect "the whole is greater than the sum of the parts" Goal of the discussion: Brainstorm new initiatives on advancing "robustness" of regional information for society and how to develop new approaches to overcoming the non-congruence in ways that are practical, sellable (i.e. would appeal to funders), and could deliver measurable added value. Intended outcomes: The discussion should build on previous discussions on robust information and lead to suggestions for pragmatic approaches to develop constructing information by means of collaborations within and between different sectors. These proposed ways forward should inactivate projects in this direction. Areas for collaboration include: s) Within and across the climate science community, with specific focus on building collaboration between the historically silo'd science communities (e.g. WCRP silos); t) Within and across the impacts community, including social and physical sciences and resilience / vulnerability; u) Research collaboration within and across the climate services communities, GCFS + regional (e.g. COPERNICUS C3S), NMS, other institutions, commercial services; v) Collaborations aimed at developing good practice guidance and ethical frameworks, including frameworks for developing transparency. Guiding questions for consideration

	w) What are <i>important background factors and considerations</i> that shape the potential collaboration area for addressing non-congruence? What's the context? x) <i>What factors hinder</i> collaborations to address non-congruence, in the context of the potential collaboration area under discussion? y) What are <i>key opportunities</i> for collaborations that addresses non-congruence in the context of the potential collaboration area under discussion? z) What are <i>concrete actions/next steps</i> that need to be taken?
19.00 Meeting Dinner	

April 24 : Actions	
8.30 - 8.45 Arrival Please make sure you come early and bring your QR code to enter the venue	
8.45 - 9.30 ROOM 4A	- Recap of day 2 - Report-back from Break-out group #3 3.1 Collation and categorization of options for initiatives already raised - Open discussion to refine priority foci Moderator: Bill Gutowski
9.30 - 10.30 ROOM 4A	3.2 World cafe on written output topics
10.30-11.00 Tea	
11.00 - 12.00 ROOMS 4A, 3A, 3C	3.3 Break-out #4 Developing concept proposals for post workshop actions to build collaboration initiatives that are cross community Goal: Identify key topics that would most benefit from further and sustained activity following this meeting, leading to specific outputs. Define those outputs, those responsible for further actions, and time scales. The six different groups will each focus on one of the topics below. Participants will be invited to sign up for one group during day 1 of the meeting. The topics are: a) Developing good-practice guidance for decision makers that draws on transdisciplinary perspectives (that is synergistic with or contributes to other international activities (e.g. IPCC, World Adaptation Science Programme) b) Establishing sustained platforms (local/regional/international) for supporting decision makers based on transdisciplinary expert communities c) Research actions/outputs on characterizing and communicating uncertainty and non-congruence of model projections d) Research actions/outputs on definitions and metrics of robustness of regional information that are relevant to decision makers/in a decision-making context e) Initiatives for transforming the global north-south power dynamics into peer partnerships with equality in adaptation decision support f) Developing transparency and ethical responsibility to support equity and inclusion in decision-making. Guiding questions: 1. How important is it to develop sustained activity for this topic compared to the others above, or another not currently listed? 2. What are the practical challenges for success of further action and how might they be overcome? 3. What resources are needed and likely to be made available for the future activities we recommend? How can action be sustained? 4. Who will take responsibility for future actions? 5. What are the next steps required?

12:00 -13:00 ROOM 4A	Report back Moderator: Francisco Doblas Reyes
13.00 - 14.00 Lunch	
14.00 - 15.30 ROOM 4A	3.4 Reflecting on the meeting's discussion <u>for pathways forward towards enhancing robust, actionable, and adequate for purpose regional climate information.</u> In this final plenary of the meeting, we will have five brief panels in which 2-3 people (per panel) will have been invited to reflect on the entire workshop. Each panel of 2-3 will represent differing perspectives from within a community of practice that has participated in the workshop: the research community, funders, the impacts and adaptation community, climate services, and decision-makers. These individuals will share what they are taking away, and what they see as priorities among the next-steps we will have discussed. As throughout the meeting, we aim to have a geographically diverse set of perspectives highlighted supported by dynamic conversations and input from all. After the series of short panels we will have time for a general discussion among participants, before we move on to a wrap-up session with our co-chairs. Moderator: Kevin Horsburgh One panel per topic (panelists TBC): ● The WCRP climate research community ● The funding / finance community ● The Impacts and Adaptation community ● The climate services communities ● The Decision maker communities
15.30 - 16.00 Tea	
16.00 - 17.00 ROOM 4A	3.5 Closing summary and open discussion to capture outstanding issues Moderators: Bruce Hewitson and Kevin Horsburgh

Annex 3 - Details of the Interim Working Group

A new interim working group (IWG) has been constituted under RfS to facilitate the development of new initiatives, and RfS has allocated budget to support their activities. Its remit includes developing relevant publications and reference materials, building new collaboration across the silo'd communities, and facilitating and coordinating new research with regional teams.

A range of topics were identified as in urgent need of deeper attention. These include (among others) context sensitive metrics, ethical dimensions of information transparency and accountability, cross community collaboration, defining “robustness”, and guidance and standards for information.

The IWG is tasked to:

- Outline and propose to the RfS SSG the possible scope, terms of reference, and initial priorities of the IWG;
- Develop a suggested structure of initial task groups for developing relevant near term activities and long term directions;
- Identify needed additional capacity for the IWG and to co-opt and/or develop a process for (self-)nominations for such capacity as are needed;
- Assess any budget needs for the initial IWG activities.

Members:

- Douglas Maraun, co-chair, University of Graz, Wegener Center for Climate and Global Change
- Genito Maure, co-chair, Eduardo Mondlane University
- Monica Morrison, co-chair, NCAR
- Arona Diedhiou, IRD – University Felix Houphouet Boigny
- Rachel James, University of Bristol
- Richard Jones, Met Office Hadley Centre
- Lucy Mtilatila, Malawi Department of Climate Change and Meteorological Services
- Alessandro Dosio, European Commission Joint Research Centre
- Luke Harrington, University of Waikato
- Wendy Sharples, Australian Bureau of Meteorology
- Bruce Hewitson, Ex-officio, RfS SSG co-chair, University of Cape Town