ScenarioMIP workshop: Pathway to next generation scenarios for CMIP7

20th – 22nd June 2023, University of Reading, UK

Workshop report


Bibliographic Information

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ScenarioMIP Scientific Steering Committee: Brian O'Neill, Claudia Tebaldi, Detlef van Vuuren (co-chairs), Veronika Eyring, Pierre Friedlingstein, Katja Frieler, Tomoko Hasegawa, Reto Knutti, Elmar Kriegler, Jason Lowe, Louise Parsons Chini, Alex Ruane, Keywan Riahi, Ben Sanderson as of 19/07/2023.

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Contents

Introduction

On June 20-22, 2023, the first meeting of the ScenarioMIP project under the new phase of the Coupled Model Intercomparison Project, CMIP7, was held in Reading, UK. There were 78 meeting attendees in total, with 37 in person and 41 online. Participants were primarily members of scenario-related MIPs, including the ScenarioMIP Scientific Steering Committee, as well as relevant scientific experts identified by the MIPs, representatives of ESM modelling centres, and leadership of CMIP.

The goals of the meeting were:

- To understand the different needs that ScenarioMIP might serve.
- To understand the plans and needs for scenario-type simulations across MIPs to better coordinate MIP experimental designs related to scenarios.
- To discuss initial thoughts on ScenarioMIP designs and their implications for other MIPs.
- To develop a process for ScenarioMIP protocol development.

Scenarios in ScenarioMIP serve three important goals:

- **Service:** Providing information about future changes in climate variables that can be used for further research and analysis to better understand climate change, its impacts, risks, and response options, including mitigation choices.
- **Science:** Support studying and understanding of climate processes, and how their response to future anthropogenic forcings emerges from internal variability and model structural uncertainties.
- **Policy:** Providing information that helps to support climate policy development and communication.

ScenarioMIP outlines experiments for climate models (Earth System Models, ESMs, and General Circulation Models, GCMs). Given the computational expenses associated with setting up, running and archiving output from ESM experiments, ScenarioMIP can only choose a limited set of scenarios. Therefore, an optimal set of scenarios needs to be selected as a compromise that satisfies these three critical goals.

The agenda of the meeting was organized around three themes: 1) taking stock of ScenarioMIP past phase (under CMIP6) and of current activities and plans in other scenario-related MIPs, 2) discussing different ideas and criteria about the choice of the new ScenarioMIP design, and 3) agreeing on a way forward. Future steps involve a process that will result in the publication of a peer-reviewed article describing the new design, and the approval of such design by the appropriate level of WCRP. This process will ensure openness, transparency and inclusivity of a wide and diverse community.

On day 1, representatives of several MIPs invited to the workshop because of their “adjacency” to ScenarioMIP (e.g., because of interests in running variants of ScenarioMIP experiments) presented their view on possible scenario selection. Also, the full group of participants was given the opportunity to present specific proposals. On day 2, the group discussed specific proposals in more detail – divided in groups organized around the three scenario goals (service, science, and policy). On day 3, broad agreement was achieved on main features of a possible experimental design and the process going forward.

Summary of main outcomes

At the meeting, the criteria were revisited for the new scenario selection presented in O'Neill et al. (2016) for the choice under CMIP6 (given the three goals of ScenarioMIP), with the goal of ensuring that they are still relevant and exhaustive. Discussions at the meeting carefully reflected upon all different options in a very collaborative atmosphere.

During the discussions in the various break-out sessions and those in plenary, it was clear that there was a recommendation to run (most) simulations in emission driven mode – in contrast to the use of a concentration-driven approach in CMIP6 (it is an open question whether this includes all greenhouse gases or only CO_2). The former leads to a wider range of model outcomes, but that is more representative of the real uncertainty range. The runs would also be more consistent with current modelling capabilities, especially regarding the outcomes of land-based mitigation solutions, heavily dependent on feedbacks that would not be represented in concentration-driven experiments. This will mean that all/most scenarios are to be preferably emission-driven, but concentration data will also be provided for models that can only run in concentration mode. The runs could also include endogenous representation of the effectiveness of land-based mitigation solutions, but this depends on the capability of ESM model teams to do so.

Further consensus choices emerged for the following characteristics that the new scenario set should ideally reflect:

- There was an interest in a middle scenario to explore possible consequences of continuing current policies (at the time of the start of the ScenarioMIP process) without modification.
- There was an interest in a high emission scenario based on possible developments in an adverse direction, including, e.g., high demographic growth and slow technology development. This high emission scenario is likely below SSP5-8.5 (possibly near 7 W/m2).
- There was an interest in a set of scenarios at the low end that would inform policies consistent with the Paris Agreement. One of the scenarios should remain as low as possible given feasibility constraints (a majority indicated that ScenarioMIP should only prescribe plausible scenarios, leaving idealized/counterfactual pathways to different research exercises), while the others would research the impacts of overshoots, possibly of different sizes/lengths.
- The details for the individual scenarios still need to be elaborated further, including for instance the timing at which they would "break away" from current trends.

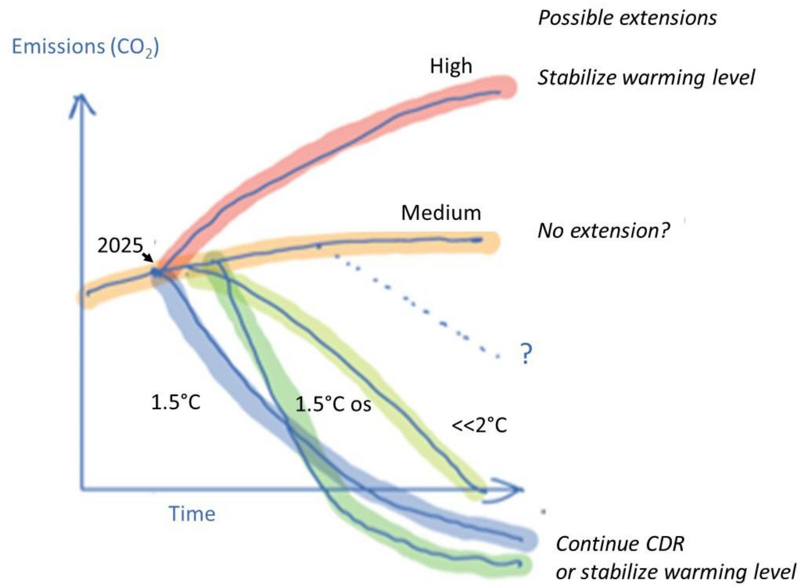

Figure 1: Draft outline scenarios developed on final day of work (the lines are only meant as illustration, e.g., decisions on timing still need to be taken); some further discussion is needed on the role of different tools (esp. ESMs vs emulators of climate model output). The use of emulators can be attractive both to fill in gaps in the design and to accelerate some of the outcomes of new scenarios, given the unavoidable time constraints.

- There are important reasons to investigate long-term dynamics (including long-term extensions). The IAM teams are asked whether their output could cover the period up to 2125. In that case, long-term extensions could start in 2125 (otherwise 2100). Figure 1 indicates the current proposals for such extensions. For the low scenarios, a decision still has to be made on the extensions. They could be based on a continuing CDR level or stabilizing warming (need to consider storage, bioenergy). For the high scenario, the preference is to stabilize at a warming level (need to consider fossil fuel availability for consistency). Extensions could run to 2200 or longer.
- Decisions need to be made on air pollution control (aerosols). The high scenario is a logical candidate for high sulphur emissions, partly because of a strong correlation between mitigation policies effects and air quality outcomes (i.e., air pollutant emissions are expected to be low in stringent mitigation cases). However, high aerosol emissions in the high scenario would also slow down warming. The alternative would be to have a scenario with the expected decrease in aerosol emissions (normal emission factors) and have a deliberate high aerosol scenario (based on higher emission factors) in AerChemMIP. It would be helpful to find out the effect of the assumptions in alternative mitigation policies on aerosol emissions.
- Decisions still need to be made on the use/size of ensembles (most likely at the low end of the scenario range where the emergence of a signal is expected to require ensembles of initial conditions).
- Decisions will also need to be made regarding the choice of underlying SSPs. In this regard, a larger effort will be made to communicate the separability of SSPs from RCPs, but the interest in exploring the assumption of separability was voiced (i.e., aiming at producing the same RCP levels with different SSPs and checking on the exchangeability of the latter).

- Related to the last point, the naming convention adopted under CMIP6 (e.g., SSP2-4.5) was faulted for contributing to the misconception of a tight coupling between a specific SSP and a given RCP level produced. Looking ahead, the group present at the meeting had a strong preference for a different naming convention, organized around clear words e.g., high, medium, Mitigation-high, Mitigation-Low.
- We are still considering an additional scenario that deviates from the medium (current policies) scenario at a later date (dashed line in Figure 1). This scenario would represent a world where substantial mitigation is not initiated until later in the century.

Next steps

There are two essential components in moving the process forward:

1) the development of the ScenarioMIP protocol; and
2) the implementation of the ScenarioMIP protocol.

Beginning with the former, we first describe the process from Reading to a full proposal in the form of a peer-reviewed publication and its subsequent approval by the appropriate level of WCRP.

Development of ScenarioMIP protocol

The full proposal should include the description of framework, description of scenarios and open questions, and a description of intended timeline. In the process forward, we propose to work based on two groups: a) the Scientific Steering Committee, a smaller group that will oversee the process and b) the Extended ScenarioMIP, involved in the process and consisting of a representation of MIPs, stakeholders (IPCC, ICONICS, etc), and relevant scientists. For both, it is important to ensure adequate representation of expertise and geographic diversity (and the SSC will be adjusted soon in this context). Additionally, we will establish four task forces to address the scientific questions related to defining:

- Low/overshoot scenarios: Can we design a feasible, low scenario? What kind of overshoot scenario is relevant and can modelled.
- High/middle scenarios. How does a scenario consistent with current policies Look like. What is a useful high-end scenario; what are the assumption that lead to such a high forcing.
- Scenario extensions beyond 2100/2125. What would be interesting ways to extend the IAM-based scenarios.
- Carbon Dioxide Removal (CDR) and Earth System Model/Integrated Assessment Model (ESM/IAM) interactions

The task forces are installed to address key open issues in writing the ScenarioMIP proposal. The extension of the SSC, the formational of the extended ScenarioMIP and the task forces will be formed through a combination of formulation of relevant selection criteria (diversity), a combination of open calls and SSC appointments.

The proposed timeline for writing the proposal is:

- **June:** ScenarioMIP workshop, Reading
- **August:** Open webinar presenting results from the Reading meeting and seeking feedback from its audience (likely through ICONICS channel)
- **October:** Strawman proposal
- Interaction for comments with stakeholders (modelling teams, scientists, policy makers and others)

- **January:** Revised proposal (quick review)
- **March:** Submission

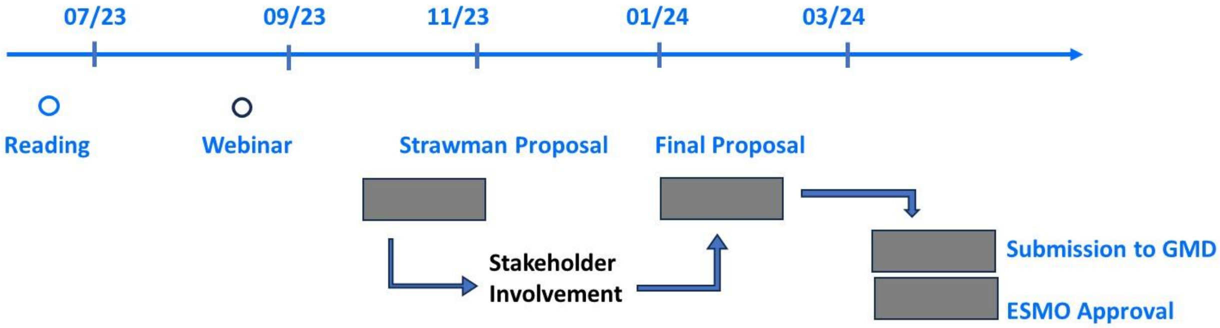

Figure 2: Draft timeline for community engagement with ScenarioMIP proposal development process (grey boxes indicate proposal and review).

Implementation of the ScenarioMIP protocol

Beyond the completion of the proposal for the ScenarioMIP experimental design in early 2024, an optimistic timeline has been elaborated here. This timeline could possibly result in a provision of ESM output before the Global Stocktake in 2028. This timeline would require:

- IAM runs are completed by the end of 2024 / beginning of 2025.
- Harmonization of emissions and land use between the scenarios and historical data is completed in parallel, by mid-2025.
- ESMs can begin simulations in mid-2025, with the first completed simulations becoming available in mid-2026, in time to help inform the Global Stocktake in 2028.
- The IPCC timeline is currently unknown.

This timeline does require that the harmonisation process is developed in parallel with the IAM runs (thus based on preliminary data). Moreover, also for the ESM runs, test data will have to be released earlier. This timeline is acknowledged to be very aggressive, given past experience with the time required for these steps. Alternatives include not aiming to complete ESM runs in time for the Global Stocktake, with ESMs completed in time for a (possibly later) IPCC AR7 cycle. In that case, for the Global Stocktake mainly CMIP6 data and IAM runs (including with simple climate model emulators of ESMs) would be used (or possibly new scenarios with existing ESMs). It is important to consider whether this timeline is realistic during the proposal writing stage.

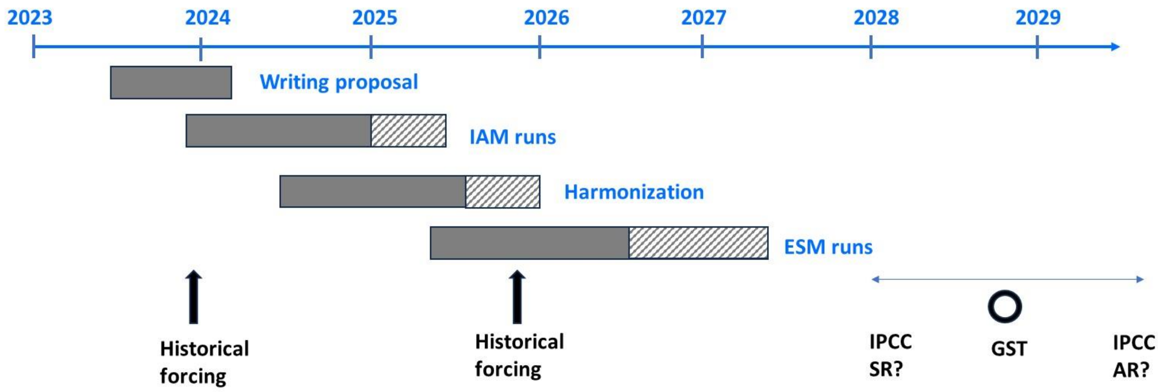

Figure 3: Outline ScenarioMIP protocol implementation timeline (ambitious). Timing of IPCC reports is particularly uncertain given the current transition phase between AR6 and AR7; no decisions have been taken yet on special reports, the assessment reports, literature cut-off dates and their timing.

Appendix 1: Workshop Agenda

Day 1 Tuesday 20 June

09:00 -10:00 Introduction to and overview of the meeting, including:

- Meeting goals and expected outcomes.
- ScenarioMIP process (role of this meeting in longer process)
- Criteria for choosing scenarios.
- Results from survey (possibly interwoven with the above) [Detlef van Vuuren and Brian O'Neill]

Discussion

10:00 – 10:45 CMIP panel perspective [Helene Hewitt and John Dunne, online]

Discussion

10:45 – 11:15 Break

11:15 -12:30 Important characteristics of the ScenarioMIP experimental design from the perspective of: (25 min each, including discussion)

- ESM community [Ben Sanderson, Jason Lowe, Pierre Friedlingstein]
- IAV community [Katja Frieler, online]
- IAM community [Keywan Riahi]

12:30–13:30 Lunch*

13:20 Group photo for in-person participants

13:30 – 14:00 MIP presentations: status and plans relevant to ScenarioMIP.
(8 min each)

- LUMIP [Dave Lawrence]
- AerChemMIP [Fiona O'Connor]
- C4MIP [Chris Jones, Pierre Friedlingstein]

14:00 – 15:00 Additional MIP/Task Team flash talks:
Status and plans relevant to ScenarioMIP (5 mins each)

- CDRMIP [Naomi Vaughn, online]
- GeoMIP [Daniele Visioni]
- RCMIP [Joeri Rogelj]
- RFMIP [Chris Smith]
- Strategic Ensemble Design Task Team [Ben Sanderson]
- Forcing Task Team [Louise Chini]
- *CORDEX [Daniela Jacob, Chris Lennard, José Gutiérrez, online]*
- VIACS AB [Alex Ruane, online]

Proposals from workshop participants

- Modelling centres proposal for emission-driven simulations in CMIP7 [Roland Séférian]
- A Case for Warming Level Driven Large Ensembles [Andy Jones, in person]
- Adaptive emissions reduction approach-MIP [Thomas Frölicher]
- Volcanic perspective on ScenarioMIP [Thomas Aubry]

- A community proposal for the next generation of the main Earth System Model scenarios: The representative emission pathways (REPs) [Carl-Friedrich Schleussner]
- Which warming can we still expect? What do national climate targets tell us about how much global warming to expect [Joeri Rogelj]

Discussion

15:00 – 15:30 Break

15:30 –17:30 Discussion of needs for ScenarioMIP design and wrap-up. [Detlef van Vuuren]

Day 2 Wednesday 21 June

9:00-9:30 Welcome and Presentation of BOG structure and timing. [Brian O'Neill]
Three BOGs structured around groups of questions (several questions will be provided as starting points)

9:30 – 10:15 Parallel breakout groups (BOGs), one per group of questions

- BOG 1 Questions driven by ScenarioMIP **science** [Pierre Friedlingstein chairing]
- BOG 2 Questions driven by ScenarioMIP **policy relevance** [Elmar Kriegler chairing]
- BOG 3 Questions driven by ScenarioMIP **service role** [Jason Lowe chairing]

10:15 – 10:45 Break

10:45 –11:15 Breakout groups continued

11:15 – 12:00 Report back (15 minutes per BOG 8+7)

12:00 – 13:00 Lunch*

13:00 – 14:00 University of Reading open event, "Towards the next set of scenarios for CMIP7" * [Claudia Tebaldi, Brian O'Neill and Detlef van Vuuren]

Staff and students of relevant departments will be joining the workshop for this session in person and online. *Please note the joining instructions are different to those of the workshop plenary. Workshop online participants will need to leave this and enter the lobby of the plenary at 13:55*

14:00 – 15:00 Emulation [Claudia Tebaldi and Sonia Seneviratne, Sonia online]

15:00 – 15:20 Break

15:20 – 16:35 Three parallel BOGs (same themes, same chairs, participants can switch if desired)

16:35 – 17:30 Report back and wrap-up [Claudia Tebaldi]

19:30 Bell and Dragon group meal for in-person attendees

Day 3 Thursday 22 June

9:00 – 9:30 Welcome and introduction to day 3 [Brian O'Neill, Detlef van Vuuren and Claudia Tebaldi]

9:30 – 10:15 Plenary discussion – building consensus.

10:15 – 10:45 Break

10:45 -12:00 Plenary discussion – process and timeline.

12:00 - 13:00 Lunch*

12:50 online participants need to join lobby so that they can take part in the online group photo at 12:55

13:00 - 15:00 Implications for design of ScenarioMIP and related MIPs [Detlef van Vuuren]

15:00 - 15:30 Next steps

15:30 Meeting adjourns

15:30 – 16:00 Refreshments and networking for in-person participants

Appendix 2: Summary of sessions

Presentation slides can be found at this link.

Here, we provide some brief descriptions of the results of each of the break-out groups.

Summary of the discussion in the Science Breakout Group

Overshoot Scenarios: The focus of overshoot scenarios could be on the reversibility of the system and the evaluation of various carbon dioxide removal (CDR) options. If multiple overshoot scenarios will be run, it is possible to distribute them across ScenarioMIP and other MIPs (e.g., BECCS in LUMIP, DAC in CDRMIP or C4MIP, etc.). An important scientific question to address is whether a ~0.2°C overshoot is sufficient to detect a signal. This can be assessed based on existing scenarios.

Lowest and Highest Relevant Scenarios: Determining the lowest and highest scenarios should be based on Integrated Assessment Models (IAMs) knowledge. The lowest scenario should incorporate other Sustainable Development Goals (SDGs) beyond climate, such as biodiversity protection and zero hunger, etc. (also in relation to large-scale CDR). The scenarios should be feasible. On the high-end, a lower scenario like SSP 7.0 might be useful since RCP8.5 is becoming unlikely.

The Role of Land Use, Aerosols, and Different GHGs: From a scientific perspective, it is valuable to encompass a range of inputs for land use, aerosols and different GHG to observe ESM results for relevant processes. In this regard, having two scenarios with similar global forcing but distinct trajectories for CO_2, non-CO_2, aerosols, or land use would be interesting. Such runs may not be part of ScenarioMIP but can be also included in other MIPs.

Extension: Post-2100 scenarios are crucial for studying the slow components of the Earth system and for high-end scenarios (long-term risks, adaptation, etc.). It is less clear whether extensions are useful for low-end scenarios. The proposal suggests that all scenarios should extend beyond 2100 (e.g., 2125), and for some scenarios, an extension to 2200 (or longer) would be beneficial.

The role of emulators and ensembles was not discussed.

Summary of the discussion in the Policy Breakout Group

Timeline of ScenarioMIP: The timing of ScenarioMIP is a key consideration. It is important to determine if it will be possible to provide input for the Global Stocktake (GST) in 2028, which would require results by 2027. This may necessitate a fast process for scenario development, the use of emulators, or a fast track involving pioneer ESMs. The timing of the IPCC is also crucial, although uncertain at present. One option for the GST is to analyze CMIP6 results with some infilling. If results become available after the GST, the focus would primarily be on informing questions related to the 2040 Nationally Determined Contributions (NDCs) (or strengthening the 2040 NDCs) and strengthening the 2035 NDCs. By that time, the impacts of climate change, adaptation needs, the mitigation-adaptation nexus, and committed warming will be much clearer. The majority of participants thought that scenarios should not run implausible scenarios.

Informing ESMs about Plans: It is important to inform ESM teams about the plans, including the ambition to conduct emission-driven carbon dioxide removal (CDR) runs. ESMs will require detailed and dynamic implementation for land-based CDR activities, particularly those aligned with NDCs, such as peatland restoration, soil carbon enhancement, agroforestry, forest thinning, etc. It would be valuable to survey what ESMs are capable of representing and planning to represent. In scenario design, it is crucial to be clear about the focus on land-based CDR activities. ScenarioMIP could explore scenarios with high and low land-based CDR. IAMs might encompass a broader range of CDR activities, including geological CDR (DACCS, EW) and CDR in building materials, which would be reported as negative flows. The land use and carbon cycle behaviour of ESMs could provide new insights, depending on the quality of representation of IAM output.

Added Value of ESMs in ScenarioMIP: ESMs provide internally consistent representations of carbon sinks and improved assessments of land sink efficacy and CDR. However, there are challenges, and ESMs can also better test biogeochemical science behaviour.

Lowest Scenario: From a policy perspective, it is important to include or closely align with the lowest scenario (C1) for the climate policy process. Additional action on methane could be considered in achieving this. It might be desirable to include two scenarios with low and high overshoots that return to 1.5°C. The low overshoot scenario would represent the lower end of the scenario range.

High-End: It is crucial to have a current policy scenario and a worst-case scenario with higher emissions. Both scenarios are important for the Vulnerability, Impacts, and Adaptation (VIA) community. Determining emissions in the worst-case scenario is a research question for the IAM community. A structured approach is needed to explore aggravating developments that would contribute to high emissions, such as policy rollbacks, high population growth, deforestation, slow energy technology development, etc. SSP3 is a good starting point. If emissions fall within the range of SSP 7.0, it will provide continuity and benefits, such as for CORDEX.

Current Policies: Consideration should be given to two policy scenarios within the current policy range, with careful exploration of the range between them. A second scenario branching off from the current policy scenario could explore the uncertainty range. For this scenario, only legislated policies should be included. The term "current" policy scenario is misleading, and the cut-off date for policies might be around 2025.

CDR: It is important to explore different CDR scenarios that achieve the same target (cumulative CO2 emissions) but are positioned at opposite ends of the CDR spectrum. The scenarios could encompass a broader range of technologies, including demand-side measures and various degrees of electrification, in addition to CDR. Linking with CDRMIP and running variations in CDRMIP should be considered. Solar Radiation Management (SRM) is not currently integrated into IAMs and the policy debate. It would be suitable to exclude SRM from ScenarioMIP and study it in a dedicated MIP (GeoMIP) that may utilize ScenarioMIP scenarios.

Representation of Impacts in IAMs: The inclusion of impacts such as fire and droughts in scenarios was discussed. This is an ongoing research frontier, and including such impacts could increase scenario realism but also introduce additional uncertainty.

Naming: Descriptive names for scenarios have benefits but also pitfalls. It is recommended to aim for descriptive names and support them with short rationales for the scenarios. Choosing the right language is crucial. A short and easy to understand description of each scenario and the underlying assumption might help users of the data to make better informed decisions.

Counterfactual Scenarios: Running high counterfactual world avoided scenarios does not require ESMs. Emulators could be used for such runs, especially for scenarios with increasing forcing. There is no need to compare emulators and ESMs.

Emulators: Emulators can be used to run some scenarios. There is no sampling bias when running scenarios with emulators compared to ESMs. All scenarios can be run with emulators for comparison.

Key Questions:

- Efficacy of CDR and land sinks. How resilient are mitigation strategies suggested by IAMs?
- Implications for mitigation and adaptation needs in 2030.
- The role of non-CO_2 GHGs in limiting peak warming.
- Air quality implications of different strategies.

- Limiting overshoot (lowest "possible" peak warming), 21st-century depth, and post-2100 depth for various CDR assumptions (extensions).
- Feasibility of achieving net-zero CO_2 by 2050.
- Climate consequences of current policies and the consequences of policy failure.
- Climate impact risks at different levels of climate change. Unavoidable and avoidable impacts.

Summary of the discussion in the Services Breakout Group

- **Timing.** The interface between Working Group 1 (WG1) and Working Group 2 (WG2) poses timing challenges. It might be considered how the publication lag can be avoided – by providing earlier access to IAV researchers (possibly also fast-tracking certain scenarios).
- **Overall scheme.** There is general support from impacts and risk users for a high-end scenario, a likely policy scenario (or current policy scenario) with a clear name indicating the date of the policy. Additionally, it is recommended to have at least two low-end scenarios with different degrees of overshoot.
- **High-end scenario**. The high-end scenario should surpass the current policy scenario and represent the tail of the emissions distribution. It would be helpful to provide clear narratives on what the scenarios represent in terms of policy choices and their likelihood.
- **Medium scenarios:** The scenarios would need to reflect current trends.
- **Long-term.** Scenarios should extend beyond 2100, as going only until 2100 is considered too short. While there is demand for longer scenarios (e.g., up to 2300) from some users, extensions may not be necessary for all cases. Longer scenarios are particularly important for sea-level rise impacts, vegetation impacts, and questions related to reversibility.
- **CORDEX.** Ensuring consistency with earlier Model Intercomparison Projects (MIPs) would be beneficial for impacts. The ability to reuse existing CORDEX runs by selecting new scenarios that align closely with the driver scenarios of CORDEX would be useful.
- **The role of extremes.** Many impacts and climate service users are interested in extreme events. Clear recommendations should be provided on which scenarios to prioritize as initial condition ensembles, with a current policy scenario potentially being the highest priority.
- **Emission driven.** Emission-driven scenarios are valuable for better sampling uncertainty. However, some modelling groups will require concentration-driven scenarios. It is advisable to offer a range of concentration scenarios for a given emission scenario to account for uncertainty. Narratives should explain why a group might choose high, medium, or low concentrations for a given emission case.
- **Availability of socio-economic data**. Regardless of the chosen scenarios, it is crucial to have a comprehensive set of socio-economic data readily available and accessible early on for impacts and risk studies.
- **GWL for categorization.** There is some interest in using Global Warming Levels (GWLs) for scenario categorization. However, there is also a need for transient pathways for adaptation planning, which are deemed essential. The categorization based on GWL might become even more difficult if emission-driven scenarios are used.
- **Integration of mitigation, adaptation / damage.** There is a need for a better integration of mitigation with impacts, considering both the impacts of mitigation (e.g., bioenergy impacts on food) and the implications of mitigation on economics.

Appendix 3: Workshop attendee list

Name	Institution	Online/in-person
Abdou Ali	Centre Régional AGRHYMET	Online
Abigail Snyder	PNNL - Pacific Northwest National Laboratory	Online
Alan Robock	Rutgers University	Online
Alex Ruane	NASA - National Aeronautics and Space Administration	Online
Anca Brookshaw	ECMWF	In-person
Andrew D Jones	Lawrence Berkeley National Laboratory	In-person
Andrew King	University of Melbourne	In-person
Anna Sorensson	Centro de Investigaciones del Mar y la Atmosfera, Argentina	Online
Benjamin Sanderson	CICERO - Center for International Climate Research	In-person
Brian O'Neill	PNNL - Pacific Northwest National Laboratory (event convenor)	In-person
Briony Turner	CMIP-IPO - CMIP International Project Office (event organiser)	In-person
Camilla Mathison	UK Met Office	In-person
Carl-Friedrich Schleussner	Climate Analytics	In-person
Carlo Buontempo	C3S-ECMWF	In-person
Cheikh Modou Noreyni Fall	University Cheikh Anta Diop of Dakar	Online
Chenyang Jin	Institute of Atmospheric Physics, Chinese Academy of Sciences	Online
Chris Jones	"MOHC/ UK Met Office - The UK Meteorological Office "	In-person
Chris Lennard	UCT - University of Cape Town	Online
Chris Smith	University of Leeds	In-person
Christian Steger	DWD - Deutscher Wetterdienst	In-person
Claas Teichmann	HZG - Helmholtz-Zentrum Hereon	Online
Claire Macintosh	ESA - European Space Agency	In-person
Claudia Tebaldi	PNNL - Pacific Northwest National Laboratory (event convenor)	In-person
Daniele Visioni	NCAR - National Centre for Atmospheric Research, Cornell University	In-person
David Lawrence	UCAR - University Corporation for Atmospheric Research	In-person
Detlef van Vuuren	PBL - PBL Netherlands Environmental Assessment Agency (event convenor)	In-person
Eleanor O'Rourke	CMIP-IPO - CMIP International Project Office (event organiser)	In-person
Elmar Kriegler	PIK - Postdam Institute for Climate Impact Research, University of Potsdam	In-person

Name	Institution	Online/in-person
Fangnon Firmin	Tongji University	Online
Fiona O'Connor	UK Met Office	In-person
George Hurtt	University of Maryland	Online
Greg Flato	CCCma - Canadian Centre for Climate Modelling and Analysis, ECCC - Environment and Climate Change Canada	Online
Hannah Liddy	AIMES -Analysis, Integration, and Modeling of the Earth System network, Future Earth	Online
Heather Graven	Imperial College London	Mixture
Helene Hewitt	MOHC/ UK Met Office - The UK Meteorological Office	Online
Hsin-Chien Liang	NTU - National Taiwan University, AS-RCEC - Research Center for Environmental Changes: Academia Sinica	Online
Jan Fuglestvedt	CICERO - Center for International Climate Research	In-person
Jana Sillmann	Universität Hamburg, FNK	Online
Jason Lowe	MOHC/ UK Met Office - The UK Meteorological Office	In-person
Joeri Rogelj	Imperial College London / IIASA - International Institute for Applied Systems Analysis	In-person
John Dunne	NOAA-GFDL - NOAA Geophysical Fluid Dynamics Laboratory	Online
José Gutiérrez	IFCA – Instituto de Física de Cantabria	Online
Julie Arblaster	Monash University	Online
Kaoru Tachiiri	JAMSTEC - Japan Agency for Marine-Earth Science and Technology	Online
Katja Frieler	PIK – Potsdam Institute for Climate Impact Research	Online
Keywan Riahi	IIASA - International Institute for Applied Systems Analysis	In-person
Klaus Wyser	SMHI - Swedish Meteorological and Hydrological Institute	Online
Kohei Yoshida	Meteorological Research Institute	Online
Laila Gohar	UK Met Office	In-person
Laura Wilcox	University of Reading	In-person
Louise Chini	University of Maryland	In-person
Malte Meinshausen	University of Melbourne	Online
Matthew Gidden	IIASA - International Institute for Applied Systems Analysis	In-person
Michael Grose	CSIRO - Commonwealth Scientific and Industrial Research Organisation	Online
Naomi Vaughan	University of East Anglia	In-person
Nico Caltabiano	WCRP - World Climate Research Programme	Online
Peter Lawrence	NCAR - National Centre for Atmospheric Research	In-person
Pierre Friedlingstein	University of Exeter	In-person
Piers Forster	University of Leeds	Online

Name	Institution	Online/in-person
Qi Shu	First Institute of Oceanography, MNR, China	Online
Roland Séférian	Météo-France	In-person
Rowan Sutton	University of Reading (event host)	In-person
Sakshi Mankotia	Jamia Millia Islamia	Online
Shuting Yang	Danish Meteorological Institute	Online
Sonia Seneviratne	ETH-Zürich - Federal polytechnic school	Online
Steven Rose	EPRI - Electric Power Research Institute	Online
Tatiana Ilyina	MPI-M - Max-Planck-Institut für Meteorologie e.V.	Online
Thomas Aubry	University of Exeter	In-person
Thomas Frölicher	University of Bern	In-person
Tilo Ziehn	CSIRO - Commonwealth Scientific and Industrial Research Organisation	In-person
Tim Carter	SKYE - Finnish Environment Institute	In-person
Tokuta Yokohata	National Institute for Environmental Studies	Online
Tomoko Hasegawa	Ritsumeikan University	Online
Tsuyoshi Koshiro	Meteorological Research Institute	Online
Vaishali Naik	NOAA-GFDL - NOAA Geophysical Fluid Dynamics Laboratory	Online
Vivek Arora	CCCma - Canadian Centre for Climate Modelling and Analysis, Environment Canada	Online
William Collins	University of Reading	In-person
Zhenya Song	First Institute of Oceanography, MNR, China	Online