

# Fast Track v1 survey analysis

*CMIP International Project Office  
January 2024*





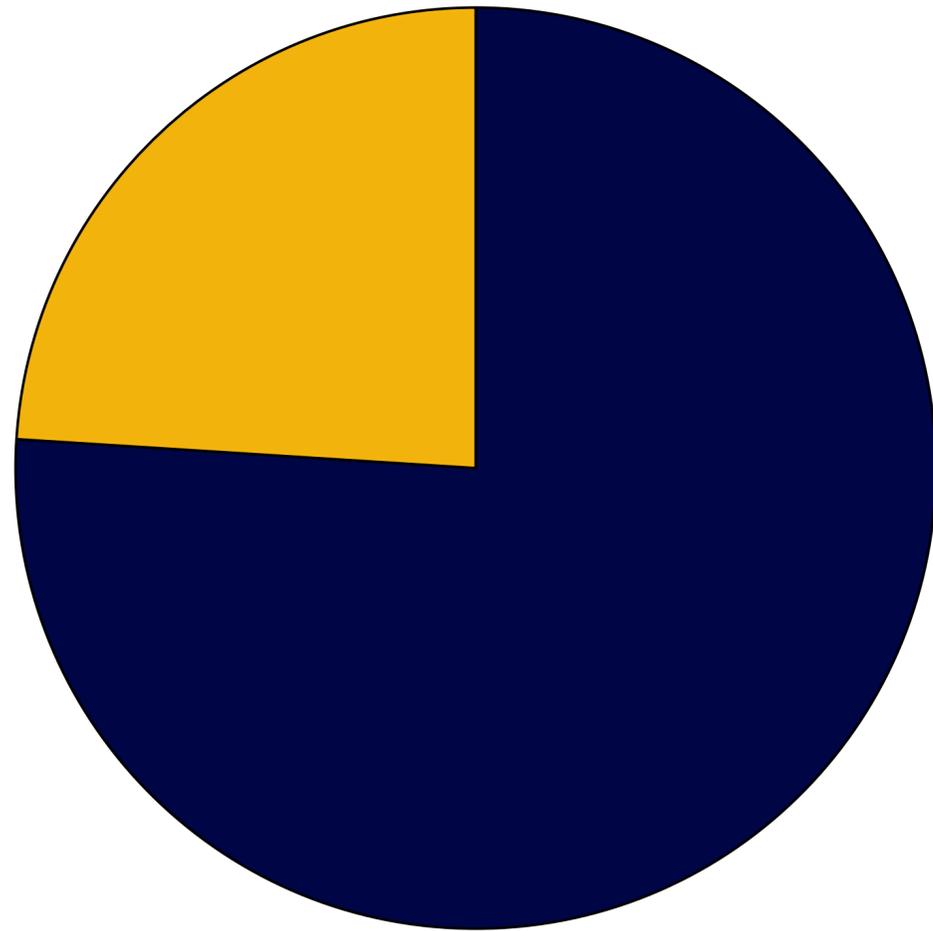
# **Section 1: Respondent information**



## The response

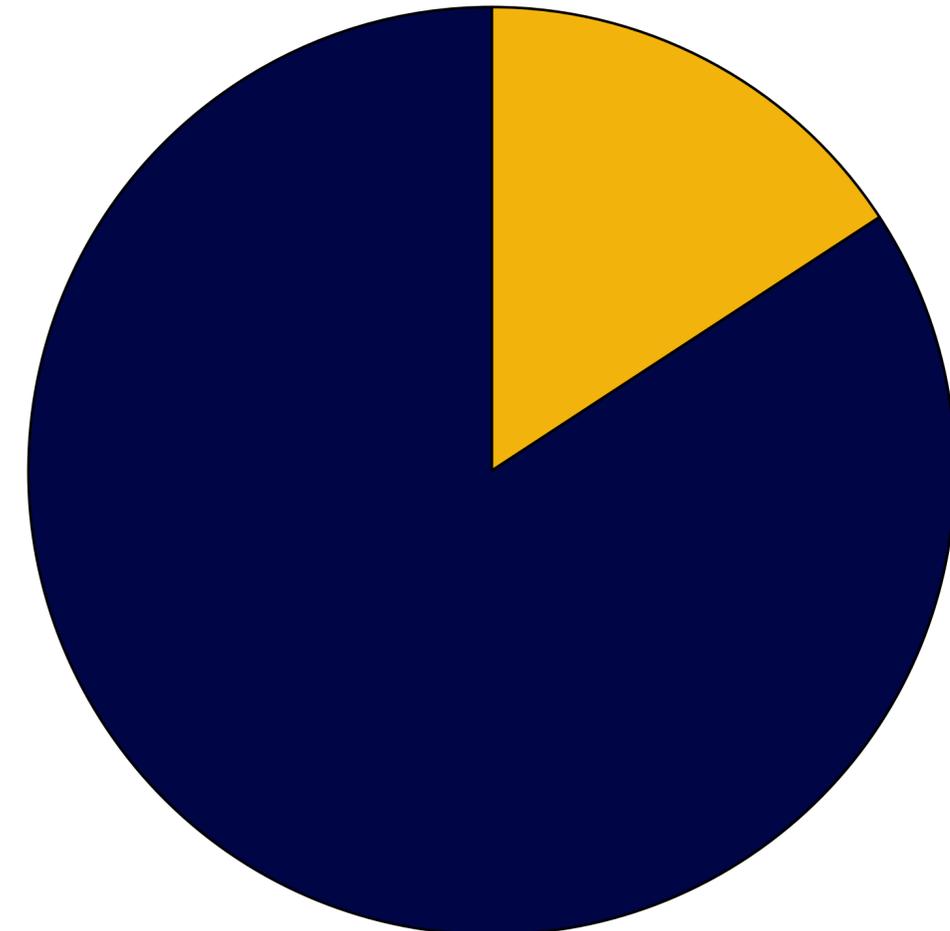
- A total of 25 responses were received representing a good geographical coverage.
- Do you plan to contribute simulations to CMIP7? – All responded “Yes”

Is your modelling centre/group capable of running with CO<sub>2</sub> emissions?



■ Yes ■ No

If yes, would you plan to run all historical/scenarios as emission forced runs or also run concentration forced runs?



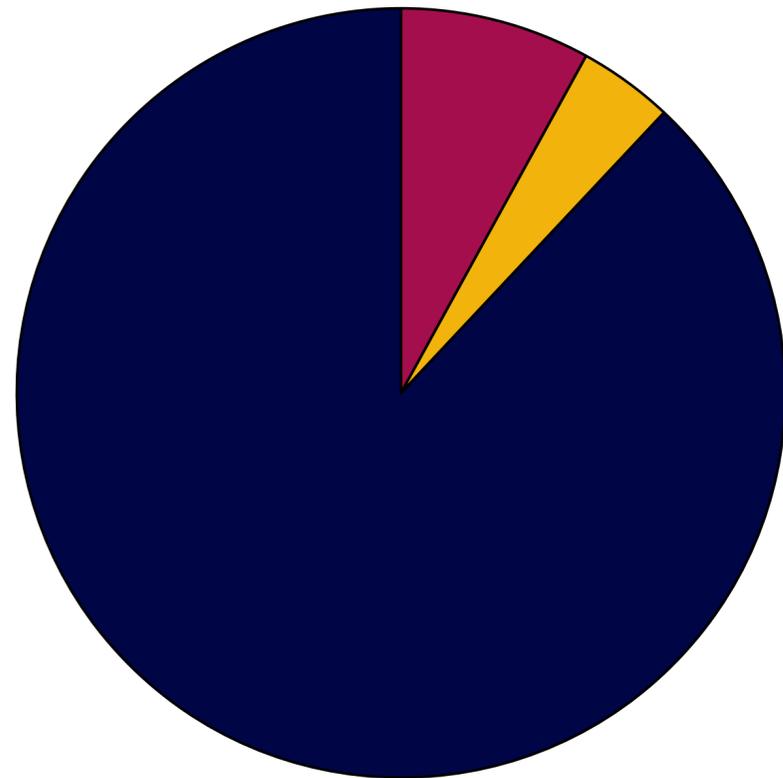
■ Emissions only ■ Both emissions and concentrations



# Section 2: Experiment review



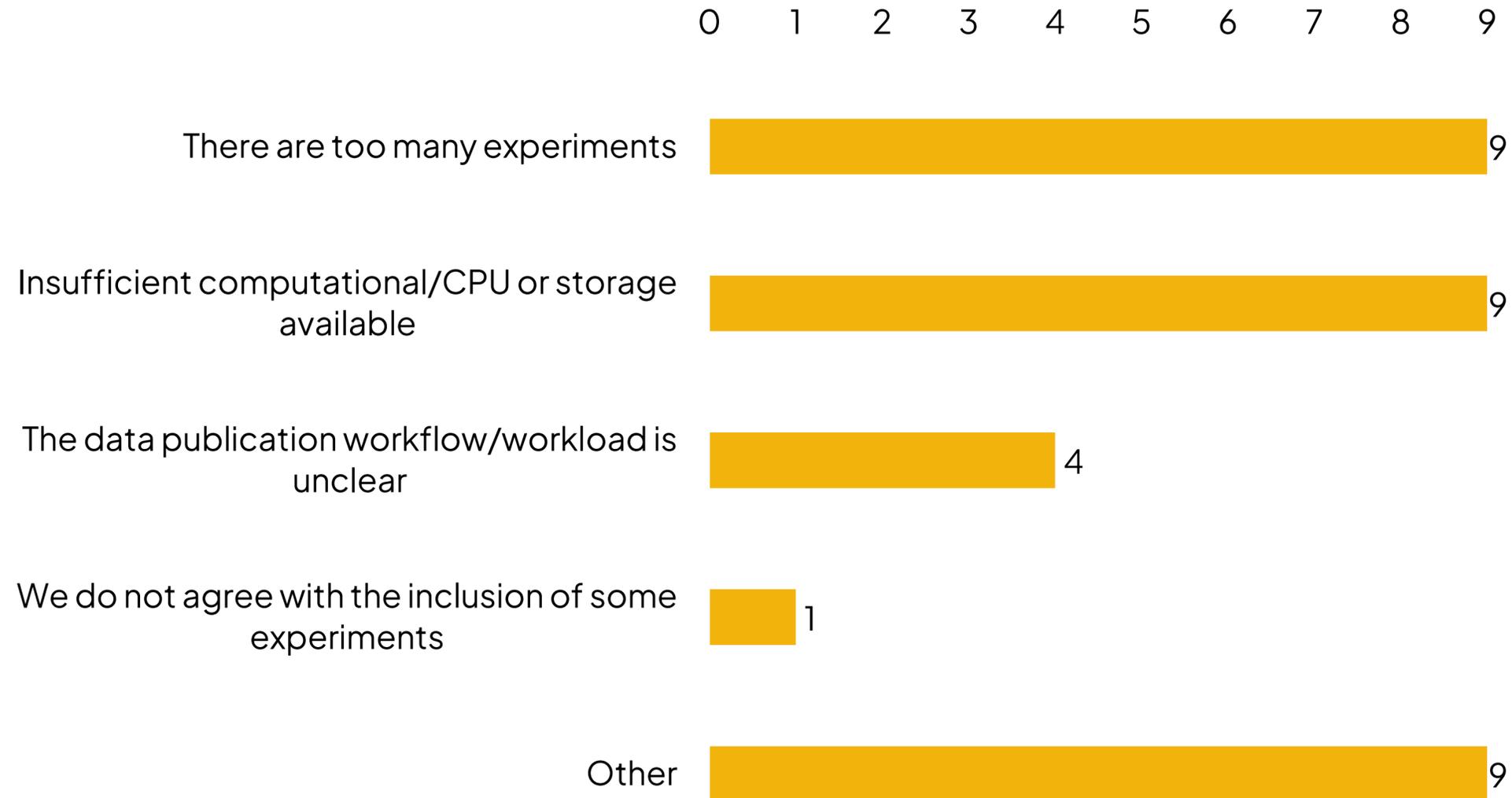
Is your modelling centre/group interested in running the Fast Track simulations targeted at IPCC needs?



- Yes, all experiments and all requested data
- No
- Yes, but not all experiments/data

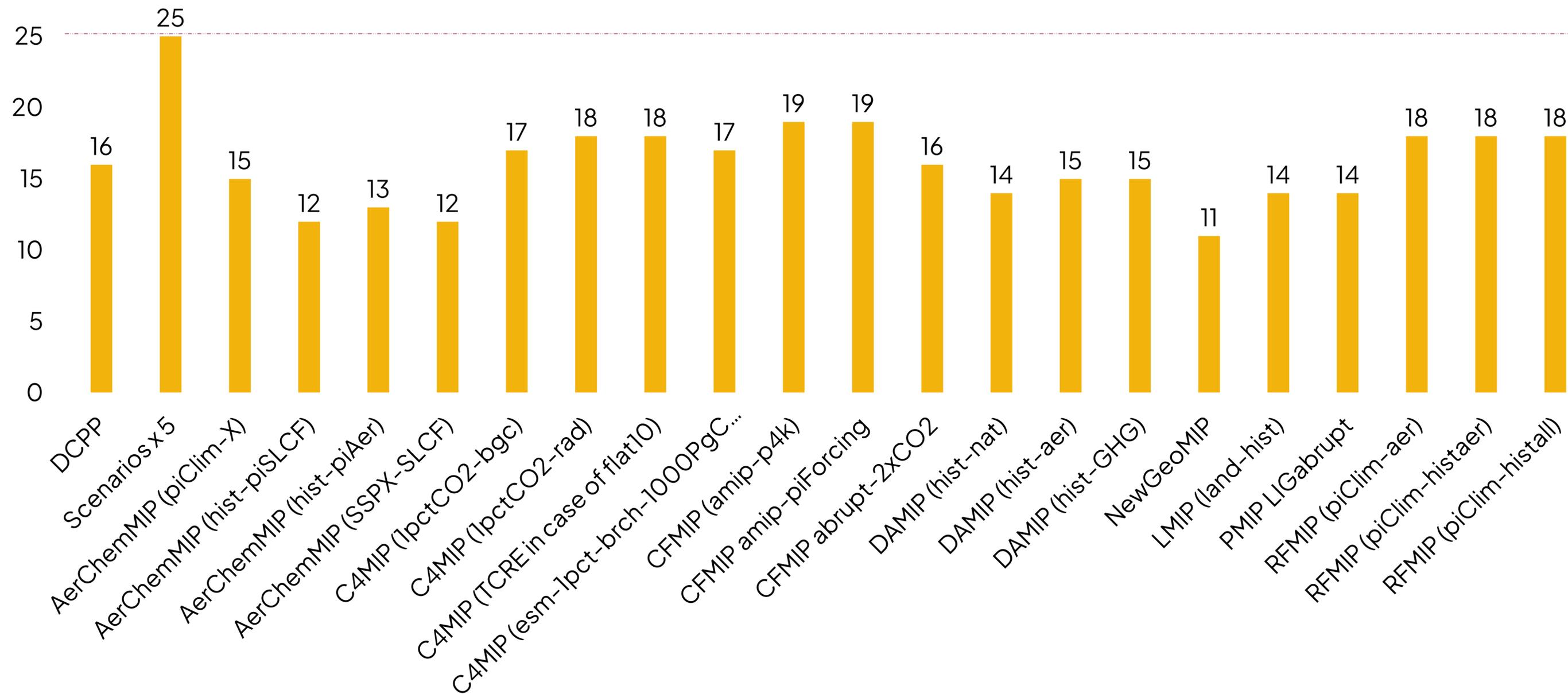
All who answered Yes, all experiments and Yes, but not all said they would prioritise running the Fast Track experiments.

If "Yes but not all experiments" is this decision due to:



Those who answered Other cited uncertainty/inability to run some experiments, relevance to model configuration, if running with CMIP6 model (due to timeline) there will be little difference, being a national agency with designated remit, interest/functionality of centre does not cover all proposed experiments.

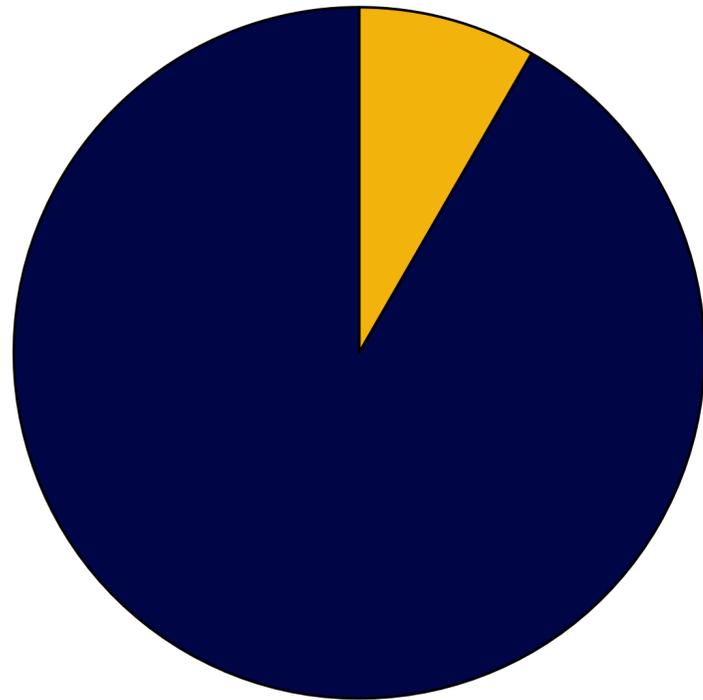
### Number of centres/groups planning to run each proposed experiment



Experiment	Comments		
<b>DCPP</b>	<ul style="list-style-type: none"> <li>• Number of responses highlighted plans to use CMIP6 model version (in contrast to rest of Fast Track).</li> <li>• Encourage DCPP and CMIP to define pre-requisites for a model / group to contribute to the DCPP fast-track experiment in terms of hindcasts and/or other relevant experiments.</li> <li>• Not skilful, too expensive (single response)</li> <li>• Number highlighted using physical model rather than full ESM.</li> </ul>		
<b>Scenarios x 5</b>	<ul style="list-style-type: none"> <li>• Only experiment that all responding centres indicated they will run.</li> <li>• Number of centres indicated they will/have capacity to run emissions driven will be a priority but a numbers mentioned will also run concentration-driven (computational resource highlighted as a limiting factor).</li> <li>• One centre would start with a single ensemble member.</li> <li>• Comment submitted to highlight importance of establishing a dialogue between modelling centres and ScenarioMIP on what CDR methods will be considered and how they should be implemented. Some prototyping might be needed.</li> </ul>		
<b>AerChemMIP (piClim-X)</b>	<ul style="list-style-type: none"> <li>• Of comments submitted concern was raised regarding the expense of AerChemMIP experiments in general.</li> <li>• Number of comments suggested they would run more than 3 but less than 17 (<i>others indicated selection provided on experiment grid in previous slides</i>).</li> <li>• Some suggested needed further information before deciding on which single forcing experiments to run and their associated capacity to run them.</li> <li>• Some centres suggested would run with AER but not CHEM configuration (compute resources highlighted as limiting factor).</li> </ul>		
<b>AerChemMIP (hist-piSLCF)</b>			
<b>AerChemMIP (hist-piAer)</b>		<ul style="list-style-type: none"> <li>• For models without CHEM, Collins et al, 2017, says hist-piNTCF and hist-piAer are identical. Would this be the same for these experiments?</li> <li>• Believe that hist-piSLCF is enough</li> </ul>	
<b>AerChemMIP (SSPX-SLCF)</b>			
<b>C4MIP (1pctCO2-bgc)</b>	<ul style="list-style-type: none"> <li>• Some stated support for flat10 experiment (including a centre involved in the trial experiment).</li> <li>• One centre highlighted they may consider an intermediate configuration for emissions-driven runs.</li> <li>• Another suggested will wait for final design before deciding.</li> </ul>		
<b>C4MIP (1pctCO2-rad)</b>			
<b>C4MIP (TCRE in case of flat10)</b>			
<b>C4MIP (esm-1pct-brch-1000PgC or flat10-zec)</b>			

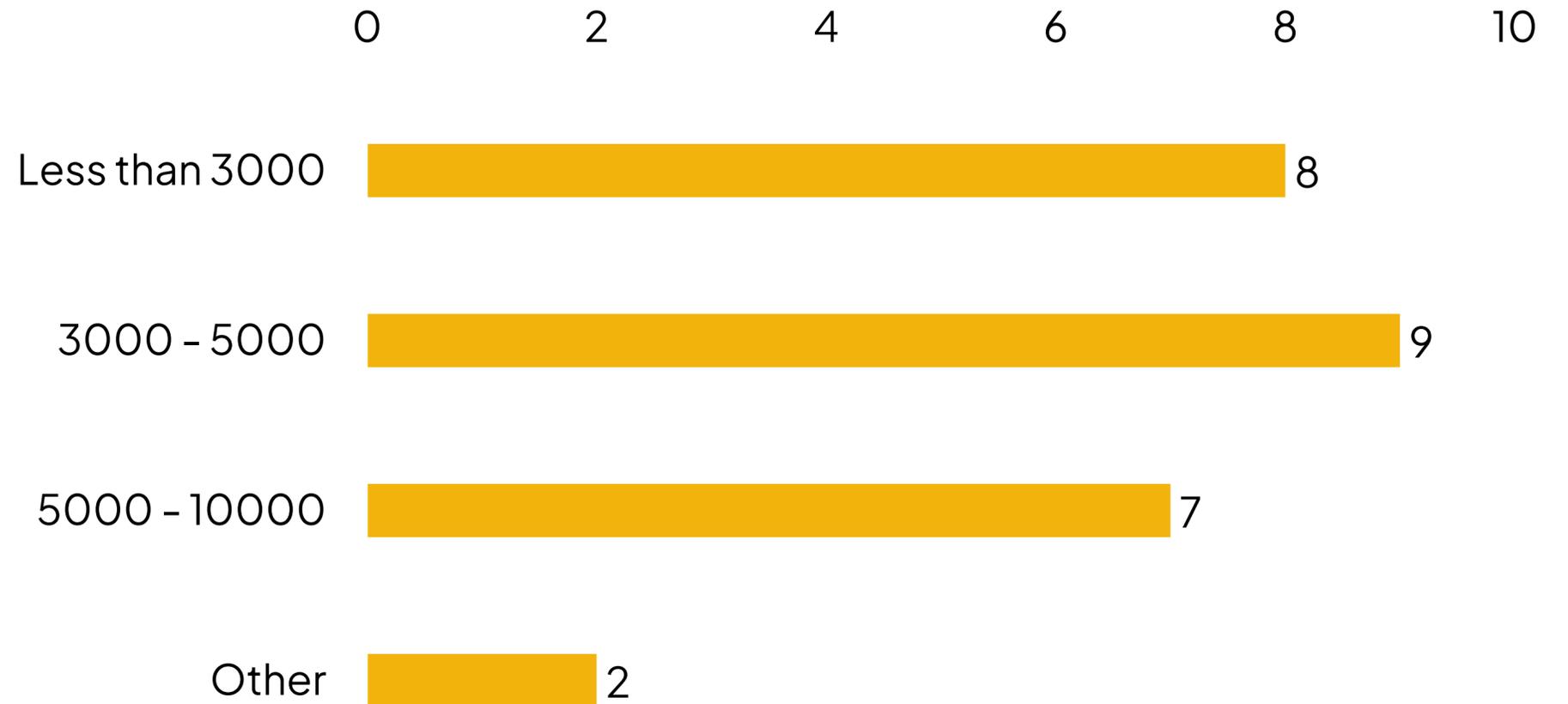
Experiment	Comments
CFMIP (amip-p4k)	<ul style="list-style-type: none"> <li>No substantive comments</li> <li>Individual centres provided planned model configurations.</li> </ul>
CFMIP amip-piForcing	
CFMIP abrupt-2xCO2	
DAMIP (hist-nat)	<ul style="list-style-type: none"> <li>Number of centres stated their capacity to run these experiments was strongly linked to human and compute resources.</li> <li>One centre suggested their decision may be based on degree of changes to forcing from CMIP6.</li> <li>Another queried if could run without prognostic chemistry (and therefore cheaper computational) and would be more likely to run.</li> <li>One comment suggested that DAMIP should define new objectives beyond AR6 and AR7.</li> </ul>
DAMIP (hist-aer)	
DAMIP (hist-GHG)	
NewGeoMIP	<ul style="list-style-type: none"> <li>Some comments suggesting dependent on resource availability.</li> <li>One comment expressing uncertainty on how this experiment will be configured can AOD additions be applied as done for volcanoes, or must the stratospheric sulphur cycle be explicit?</li> </ul>
LMIP (land-hist)	<ul style="list-style-type: none"> <li>One response expressed uncertainty as to the details of the forcing. Elena Shevliakova and David Lawrence (NCAR) expressed scepticism of the viability of existing 4x daily and recommended 8x daily with Sheffield-like(<a href="https://journals.ametsoc.org/view/journals/clim/19/13/jcli3790.1.xml">https://journals.ametsoc.org/view/journals/clim/19/13/jcli3790.1.xml</a>) recalibration of raw reanalysis</li> </ul>
PMIP LIGabrupt	<ul style="list-style-type: none"> <li>One centre conducted an initial test and found the signal in maximum sea ice extent requires multiple centuries to be robust, arguing against limiting the simulation to 100 years.</li> </ul>
RFMIP (piClim-aer)	<ul style="list-style-type: none"> <li>Some individual centres likely model configurations provided (e.g., AGCM-AER-ISM, AGCM-AER-CHEM or AGCM-AER-BGC).</li> <li>One centre suggested should be identical to AerChemMIP counterpart for their model and not an additional run.</li> </ul>
RFMIP (piClim-histaer)	
RFMIP (piClim-histall)	

Does your centre/group plan to run the Fast Track with a CMIP6-class model or a more recent version?



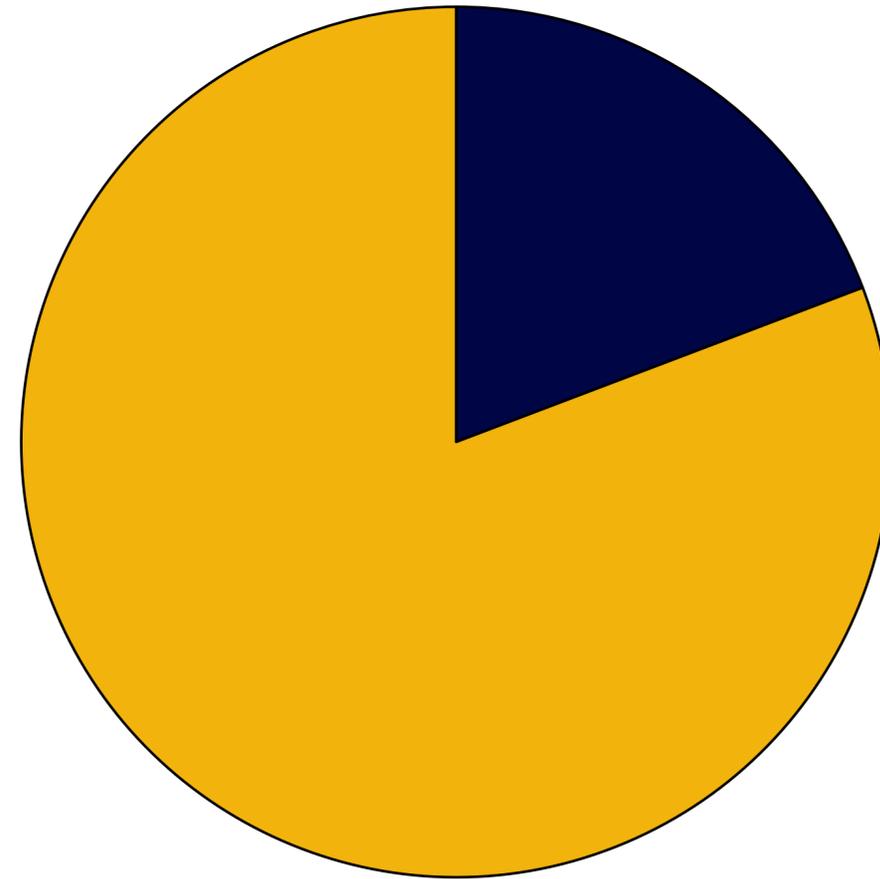
■ CMIP6-class model ■ More recent model version

How many simulated years would your centre/group accept as realistic for FastTrack?



Those who answered Other suggested: difficult to determine at this point when model configuration and resolution is not fixed; and encourage the CMIP panel to carefully consider what is really needed for the "fast-track" simulations and wherever possible keep the number of simulated years and different experiment protocols to the minimum possible.

Do you think there are experiments missing from the proposed Fast Track selection?



■ Yes ■ No

### Any other feedback on proposed Fast Track experiments

- If we thought of the proposal (excluding the DECK) as three broad categories of experiments: (1) scenarios, (2) characterizing climate response/historical, (3) emerging issues, is the balance right? It seems like most of the model years contribute to group (2). We think there should be more new experiments targeting emerging issues and likely more emphasis on building ensembles for the scenario simulations.
- What was well used for the last IPCC report may not be a good indication of what is needed this time. Perhaps we need to build more flexibility into the fast track to add experiments as the IPCC process develops, provided they are relatively simple to implement. Would it be useful to set up another task team to facilitate interaction with IPCC authors to be responsive to emerging needs, or is this part of the strategic ensemble design task team role?
- To some extent CMIP7 will be defined by the Fast Track so we think it needs to focus on what is new. Partly that will be new models but it also needs to be new experiments. Emissions-driven can be an important part of what's new and doesn't seem to be highlighted enough in the current proposal. (One of the arguments we are using for trying to get additional local for CMIP7 funding is that it is different/adds to CMIP6 rather than just repeats).
- While it is acknowledged that there is no expectation that all models will run all experiments, the desire to provide a manageable/realistic set of experiments still tends to imply that most models will attempt most experiments. Another approach would be to have an intentionally broader set of experiments with a target number of models to complete each one. Modelling centres could be encouraged to focus on experiments that best suit their model's capability and the interest of the modelling centre (e.g. carbon, ocean). Would it even be worth considering a more coordinated approach where modelling centres are asked to prioritize certain experiments to spread the compute cost but still end up with a sufficient multi-model ensemble?
- The decision to execute an experiment depends on more than just the 'potential computational load,' which solely considers computational resources. The level of human input, or capital, required to fulfil the demands of a specific MIP experiment is equally important and this can vary significantly, ranging from minimal to potentially prohibitive.
- It seems the proposed Fast Track comprises a huge number of experiments. We will perform the experiments for CMIP7, but it may depend on resources (computer power, storage, and also human resource/funding) to make it as Fast Track.
- We understand that the very specific timeline of the Fast Track is yet to be determined. The model version we use will be strongly dependent on it.
- We plan to use CMIP6-class model for some experiments (e.g., DCP, ESM) and a more recent model version for others (e.g., DECK, ScenarioMIP).
- With respect to a significant number of those detailed, we likely will run these, but may not be able to do so on the fast-track timescale. If we have problems getting fast-track runs done in time we would prioritize the DECK, historical and scenario runs.
- A major constraint on our data delivery of fast track simulations is the time available for implementing the forcing, making the runs and when the data needs to be published. Our data delivery will be decided by the length of this time window.
- If there is need to prioritize experiments in the fast track we recommend the panel emphasize the DECK, historical and scenario runs.

### Any other feedback on proposed Fast Track experiments

- The PMIP selection is odd. Why not target the mid-Holocene or early-Holocene where you have more observational constraints for greatly reduced Arctic sea ice? There would be greater take up for MH as well since the boundary conditions are simpler.
- hist-aer/hist-GHG are not very well-defined for interactive composition models - the breakdown is different (e.g. hist-slcf(incl. CH<sub>4</sub>)/hist-GHG(no CH<sub>4</sub>, no CFCs), hist-CFCs etc.) since the some drivers (e.g. CH<sub>4</sub>, biomass burning, CFCs) impact GHG levels and aerosols. Thus the appropriate breakdown will depend on the model configuration and so including them as 'must haves' for the FT seems wrong since you want to include interactive composition models.
- The 'ESM' terminology should be more defined. Perhaps clearly distinguish between interactive carbon cycles/CO<sub>2</sub> and interactive composition (aerosols/chemistry) - some models may have all of this, but others will only have one or the other (at least in specific configurations).
- The GEOMIP experiment is a moral hazard. We would have to think hard about whether to do this (leaning towards no at the present). Note that it would only be worth doing (scientifically) in models with interactive composition and so it's unclear why it would be in the FT.
- In general, we do not have problems with the Fast Track v1 proposal, though we also expect it will change and additional experiments will be added, which may start to pose a computational burden.
- We are in the process of finalizing the model configuration and determining the computational cost of the new model which is expected to be considerably higher than our previous version. The team has not yet made all of our decisions about which model configuration will be the default version. Decisions about the default version, especially relating to whether or not we run with prognostic chemistry or not, will have a strong bearing on the level of participation.
- This uncertainty is why we did leave a couple of the more expensive simulations in model years off the list of simulations that we currently plan to run, but this could certainly change.



# Section 3: Data Request



Which of the following statements about the scope of the CMIP Data Request most closely reflects your experience?

It was difficult to identify clear priorities in the early stages of the CMIP6 cycle, but we are expanding our range of variables as time goes on.



We were able to use the tools provided to extract information we needed for our workflows and the system worked well.



The complexity of the request and the frequent updates made it impossible for us to priorities efficiently



The overall scope of the CMIP6 data request was too large and should be reduced for CMIP7



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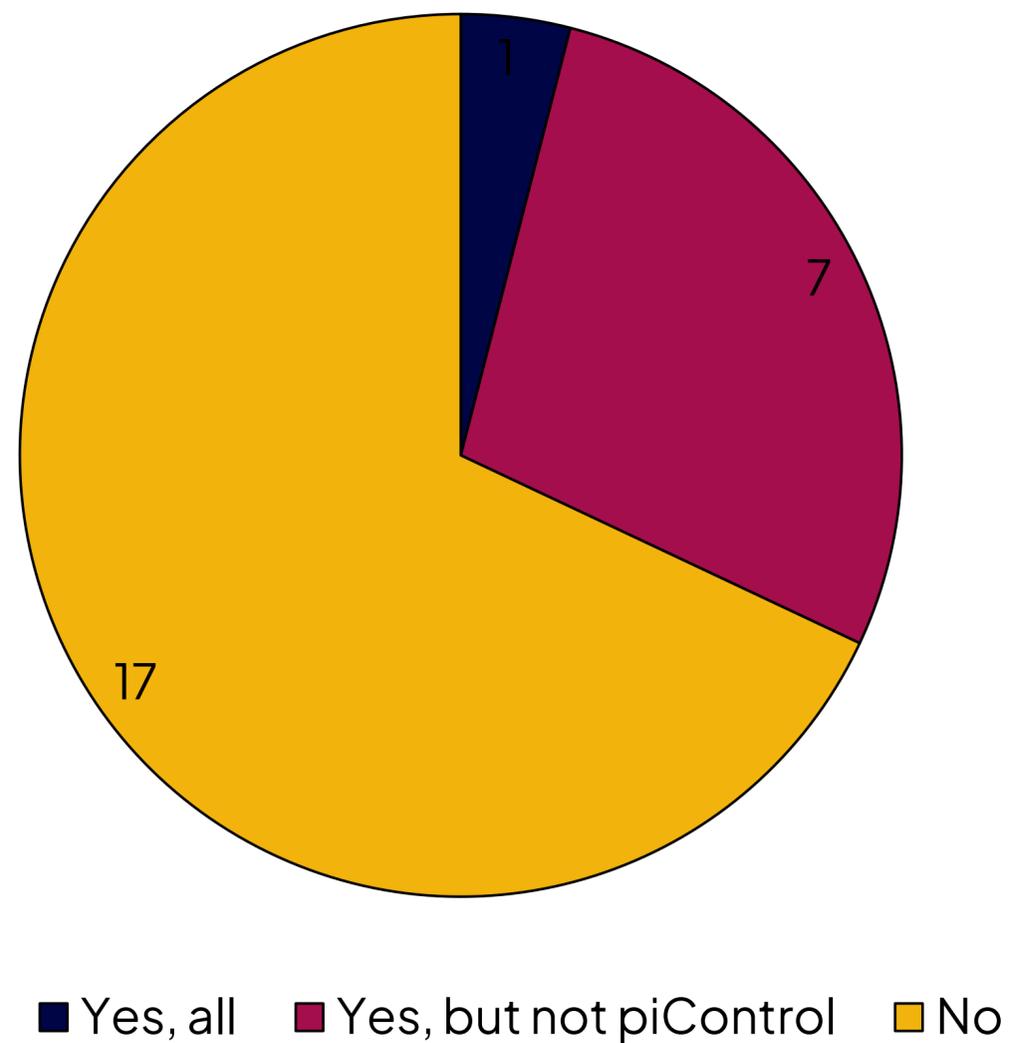
## Suggestions on how overall scope of data request may be reduced

- Perhaps a clearer distinction on priority variables so these can be targeted earlier.
- Review the download statistics from the ESGF server to determine the specific timeseries that were downloaded most leading up to the cutoff date for results entering AR6. This would provide a first cut at the variables to include for CMIP7.
- Also, modelling centres invested a significant amount of effort to build the technical pipelines that transform model output into CMORized NetCDF data, using the CMIP6 data request interface. As such, it would be enormously beneficial if the data request interface remained as close as possible to the CMIP6 interface (i.e. using the same json dictionary structures). This would allow modelling centres to avoid building brand-new pipelines, and instead either re-use their existing technology or adapt it to account for minor differences.
- Focus on core variables (as already suggested) for all experiments. Review access numbers in ESGF from CMIP5 and CMIP6 to find out what is really used.
- The overall data request in CMIP6 was too large, and full of repetition (e.g. daily, monthly, 6 hourly data for the same variables), ambiguous definitions (e.g. the use of "Lev"/"PLev" and/or "Pt" in the table\_id), inconsistent usage of units (e.g., emilnox in mol/s rather than kg/m<sup>2</sup>/s or kg/m<sup>3</sup>/s), and other metadata (compare, e.g., conventions for volume mixing ratios of "dms" and "co" with those for "o3").
- We suggest that the CMIP-IPO to evaluate the usage of variables/experiments, e.g., which variables/experiments are more frequently downloaded from ESGF, or cited in publications. These which are seldom used should be considered to take out from the data requests/experiment list, or at least put at very low priority.

## Suggestions on how overall scope may be reduced

- We understand that the effort is going on to set up the "standard variables" under the Data Request Task Team. We hope that the MIP coordinators will be referred to it when they design their output protocol.
- Focus on observables and remove variables that are model specific (i.e. replace cloud fraction by model layer with COSP defined cloud outputs), similarly replace LWP/IWP with CloudSat/CALIPSO versions).
- Remove all variables defined on model layers, and only request data on fixed pressure levels (or depths).
- Include more useful derived data e.g. MSU/SSU for atmospheric temperatures, also ocean heat content (0-700m, 0-2000m, whole ocean).
- Remove the variables that nobody used.
- Add climate impact diagnostics (monthly summaries of changes in extremes etc).
- Suggestion that we use CMIP6 experience and DR matrix tool to calculate data archive need.
- Can there be level of participation? Minimal, full etc?

Would you repeat Fast Track experiments later in the CMIP7 cycle to support an expanded harmonised data request?



## Additional feedback on Data Request

- Might expand ensembles with an expanded data request rather than repeating the same experiments. Also willing to repeat sections of runs to get higher temporal resolution.
- We would recreate those simulations that can be performed again based on the available modelling and data processing capacity.
- If there is to be an expanded harmonized data request it should be defined and finalized in time for the Fast Track MIPs. Modelling centres expend a significant effort to have models, infrastructure and model output, formulated, tested and finalized on very tight and inflexible CMIP timelines. It does not seem unreasonable to also ask MIPs to collaborate on a reasonably sized harmonized data request on that same timeline. If we are serious about trying to minimize our carbon footprint in the CMIP7 exercise, we should not be considering an approach which involves the repetition of 5500-7500 simulated years by all CMIP modelling centres.
- Crucial point is to have a frozen DR version all along the Fast Track exercise.
- If there are severe problems with variables that were not provided in the fast track and enough resources are available, it could be that we rerun experiments that we consider as important.
- The data requests in CMIP6 were ever changed that led to substantial extra work and should be avoided in CMIP7. The data request needs to be frozen early in the CMIP process.
- It would be nice to formulate special short data request for fast track experiments.
- Our CMC processes output data on the fly, thus it is paramount that the CDR is comprehensive with as few errors as possible
- It is not easy to repeat experiments due to the limited computational resources.

## Additional feedback on Data Request

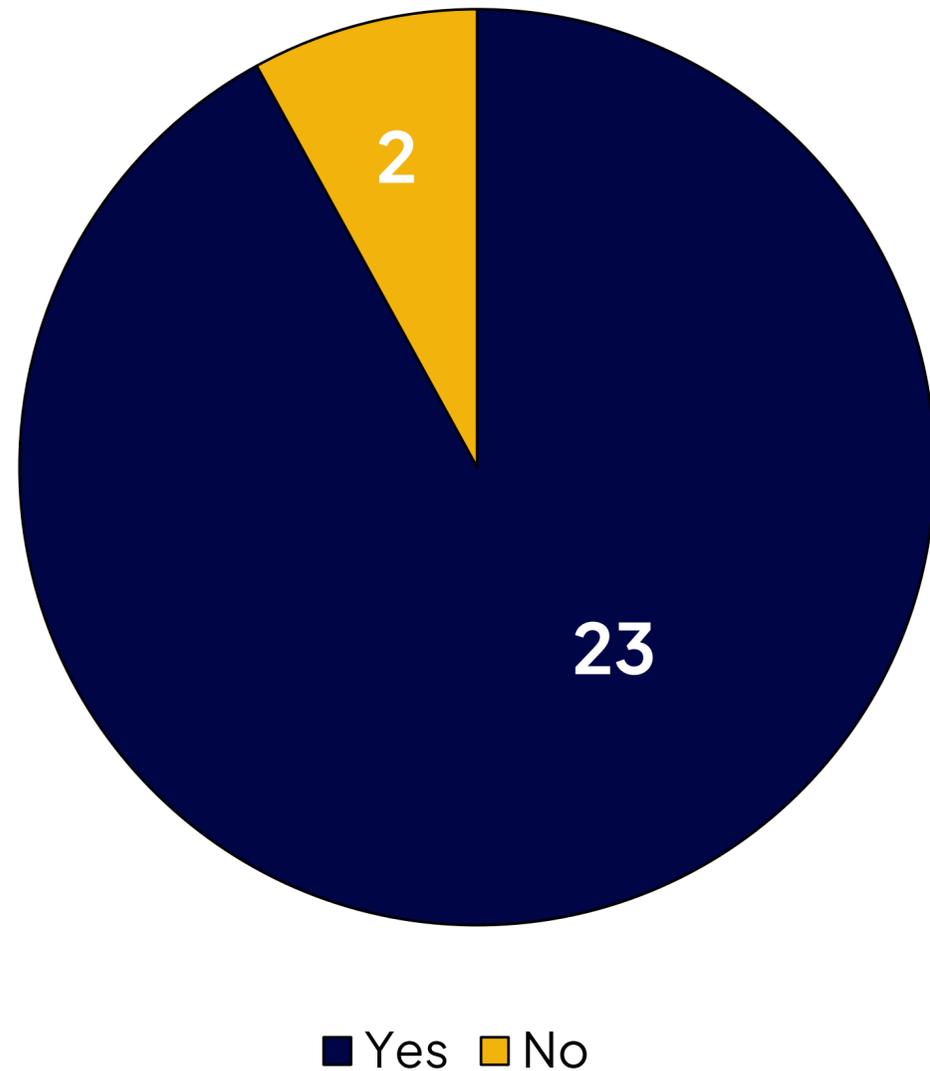
- We think we should repeat experiments because boundary data will be updated.
- Please control the best time for modeling centers to start the piControl & other experiments for the Fast Track and for the CMIP7.
- We do not want to repeat experiments many times using many testing versions of boundary data.
- We leave it to the community MIPs to repeat experiments to get missing diagnostics as required.
- Fast Track experiments may be repeated to increase ensemble size if expanded harmonised or unharmonised variables are required for the community MIPs we will participate.
- We will not repeat piControl.
- Just stick to one set of data requests per component. We are not going to tailor the CMORization for different runs or experiments - one size has to fit all.
- We expect that it would be unlikely that we would reproduce experiments with an expanded harmonised data request, perhaps with the exception of ScenarioMIP, if the harmonized data request provided more useful/actionable variables for the wide array of users of ScenarioMIP simulations.
- Although we chose "We were able to use the tools provided to extract information we needed for our workflows and the system worked well", it was a challenging exercise, particularly to get the workflow in place for the first published CMIP6 experiments.
- Frequent update of data request in CMIP6 cycle resulted in some delays in work, so this needs to be taken into consideration in CMIP7.
- Request for release of Prototype Data Request in 2024
- Would like to see the Essential Climate Variables ASAP
- Request for consultation with impacts community for high resolution surface output fields from control, historical, and scenarios - in particular, request to save land forcing (8x daily)



# Section 4: Model documentation



Would your centre/group support the proposal for Minimum Viable Model Documentation?



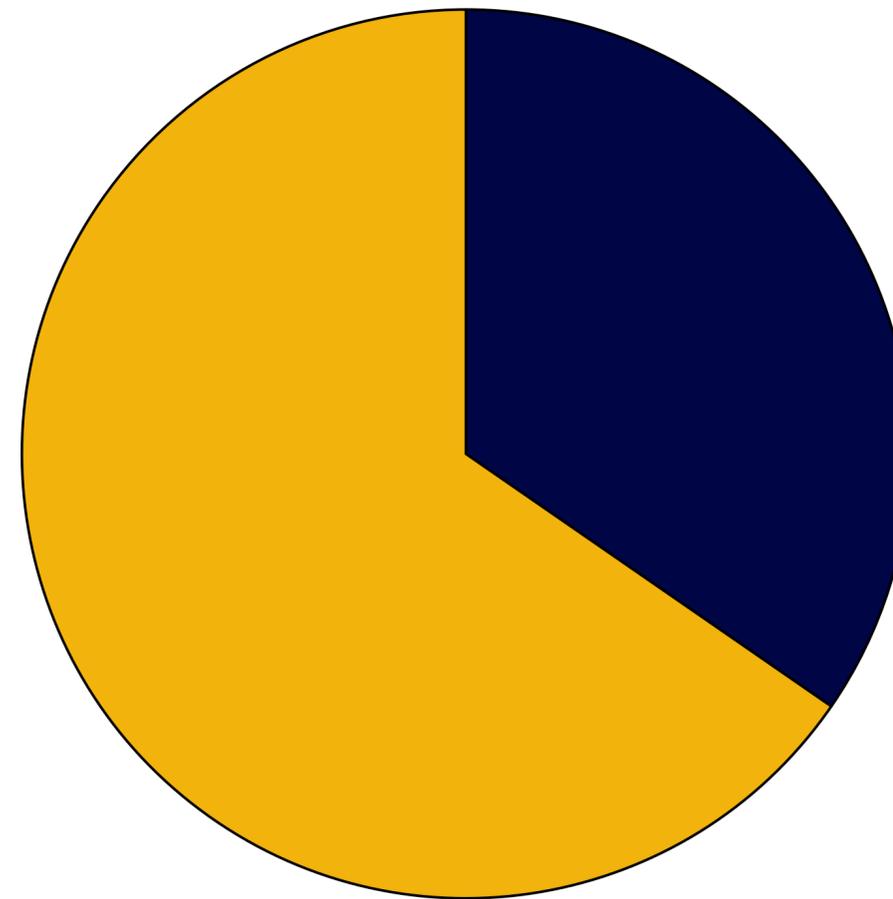
Those who answered **Yes** all agreed also that 4 hours sounded like a reasonable amount of time to spend on the MVD.



# Section 5: Carbon footprint



Does your modelling centre/group take into consideration or monitor the carbon footprint associated with running CMIP simulations?



■ Yes ■ No



# Section 6: Final comments



## Final comments

### Re CMORizing:

- In CMIP6 we found it particularly challenging to bring our model data into a CMOR-conforming format.
- While it is clear that data will have to be CMORized somehow, it would be certainly helpful for modelling centers with less capacity and experience in this field to get dedicated support from data processing groups at ESGF data nodes - not only towards checking whether CMOR-conforming format is delivered, but also towards helping with setting up the computing environment to generate CMOR-conforming data in the first place.

### Re model generation / version:

- We plan to contribute with a CMIP7 generation model but have a CMIP6 generation model that has been further developed since then as a fallback / additional option.

### Re configurations:

- Regarding running the model in emission-driven mode. We definitely plan to run the model, for those simulations where doing so is sensible, in emission-driven mode.
  - We note that first steps in running the model in that mode have been made, but there is still work in progress.
  - Depending on the model generation and version employed we might have the capacity to also run a model in ISM mode; whether we would do so depends on scientific interest.
- 
- Note that in the case of a new model, the potential computational load for DCPD will require additional 6200 years (in the case of 10 members) to perform the hindcast simulation.
- 
- Our engagement strategy given here (using a CMIP6 generation model) is mainly based on the Fast Track target time in late 2026. In case of notable shift in the agenda, we may strongly revise our modelling plan.

## Final comments

Regarding is your modelling centre/group capable of running with CO2 emissions?

- This is not certain at the moment, because our model is still in development.
  - We hope to complete all necessary parts in time to be able to run emission driven experiments.
  - If we can run emission driven experiments, there is no decision yet if we will in addition also run concentration driven experiments
- 
- The emission-driven simulations should become the new standard rather remain a nice-to-have addition.
  - A clear guideline (suggestions) on how to spin up the model in e-driven mode to avoid a drift in CO2 concentrations may prevent making two piControl (c-driven and e-driven), thus encouraging the modelling groups to prioritize the e-driven DECK and Scenarios.
  - If enforcing groups to run both e-driven and c-driven piControl runs there is a risk that the e-driven simulations may become a nice-to-have set.
- 
- We agree with the need to move towards emission-driven runs as much as possible. This said, some simulations (piControl and abrupt4xCO2) are here to track progress and document changes over time. Therefore the CMIP setup should stay the same and we recommend these simulations are concentration-driven and are not adapted for emission-driven model configuration.
  - We also encourage CMIP to set some standard for emission-driven runs in terms of stability of the C cycle or validation against the historical period. There is little value in historical simulations with CO2 concentrations off by 20 or 30 ppm.
  - Finally an idea of when MIPs are expected would influence our contribution to AR7 fast-track. Plans may also evolve regarding the degree of novelty of the model that we expect to use for AR7 fast track. It maybe a different version for emission-driven and concentration-driven experiments.

## Final comments

- We are willing to contribute to the AR7, but with the proposed timeline it would be difficult to efficiently advance the IPCC cycle and science at the same time.
  - Our group is concerned about whether many modeling centers will be able to run the new version of their model and submit output data by "end of 2026." The timeline is too early for our model development.
  - We feel that running our developing version of model using boundary data, which might also be incomplete (perhaps, ScenarioMIP data may delay), may not be useful. Or is the primary purpose of the Fast Track simply an extension of CMIP6 (e.g. historical from 1850-2014 to 1850-2021)?
- We assume there will be a 2nd opportunity to follow up on the questionnaire once results are in from most groups.
- We are happy with the (slight) expansion of the DECK runs.
  - However, it seems to us that the FastTrack effort is a step away from the (very sensible) decision in CMIP6 to federate the MIPs. Indeed, this looks very much like a centralized CMIP3-style effort that is going to please no-one. We suggest going back to the federated idea, and have the MIPs themselves define a 'Tier 0' set of runs that they feel would be super-important to do (and publish) first but as part of their overall suite. Then, as before, IPCC can survey the literature and available data to see what is relevant for their report at the time - it might just be the FT runs or it could be something else entirely.
  - If IPCC decides to only pursue special reports (with a much stronger focus on specific questions) in the AR7 then it would make sense to have specific MIPs be set up to support those needs. The only efforts (that we see) as meriting something special would be ScenarioMIP since the development and harmonization of new scenarios are likely to be the main holdup in the whole effort.
  - But maybe we should abandon storyline scenarios within the ESMs in any case, in favor of single driver scenarios that can be used with ML to create bespoke storyline scenarios on the fly? These could be the Tier0 for ScenarioMIP with 'proper' scenarios to follow.

## Final comments

- These responses reflect our ambition and what we are currently working towards. Much of our CMIP7 effort must be financed with external projects which are yet to be secured, thus posing a risk in the ability to meet these ambitions.
- For model documentation the description should be more explicit that science papers will remain the primary documentation rather than internally coordinated through CMIP. We support adding model computational data and CPMIP as part of model documentation
- Publications the JAMES and other Journal editors are keenly interested in updates as to when to expect model documentation papers.
- We are concerned that the Citation/minting of DOI process for CMIP7 is unclear without DKRZ support. We have a new DOI minting process through an agreement with our institution, but this would not apply to other centers.