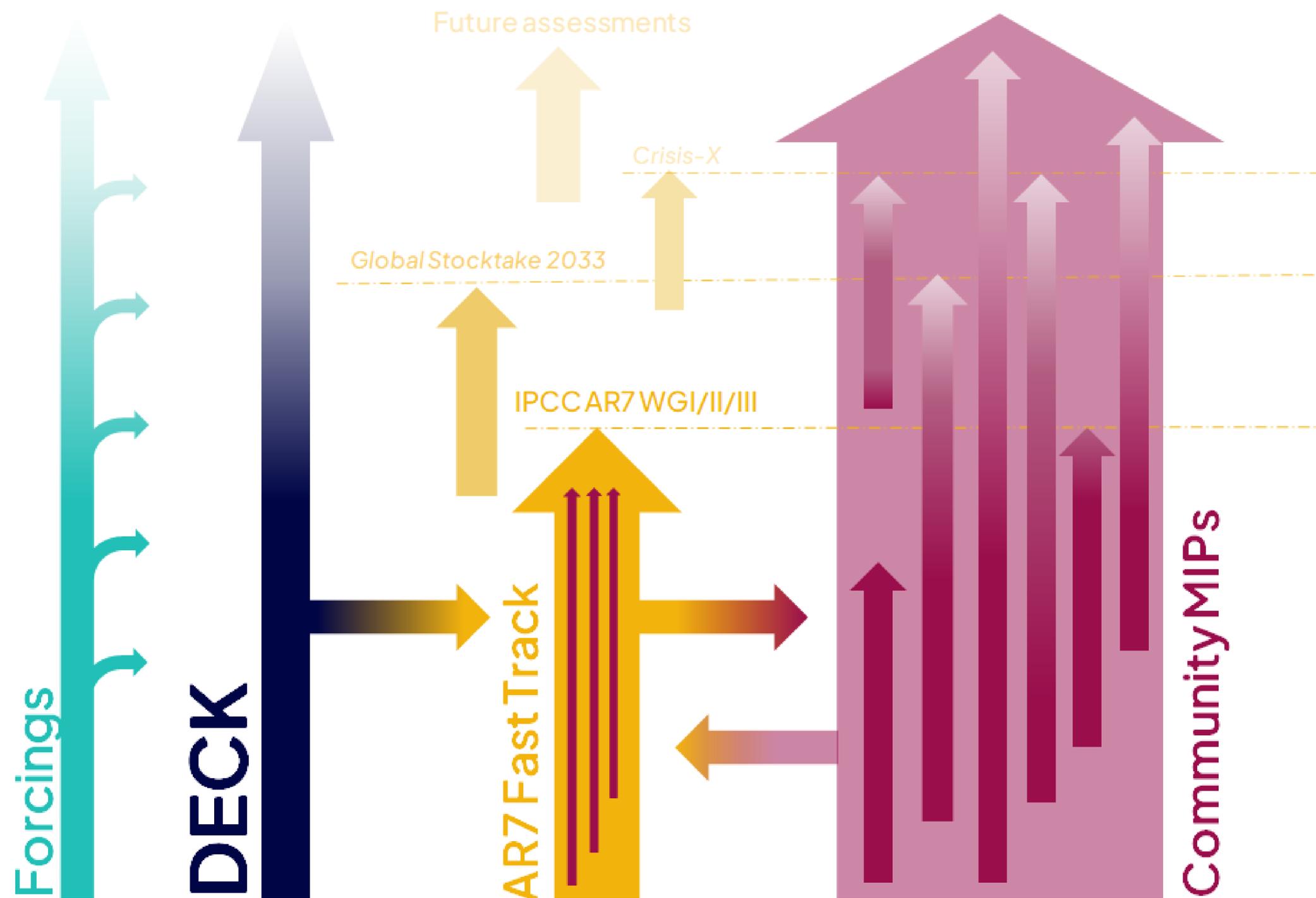An evolving CMIP design

A more continuous approach with small targeted "Fast Track" experiment sets. The first will respond to the needs of IPCC AR7.

CMIP infrastructure, standards and tools support ongoing science and assessment activities.

This design reflects extensive feedback from the modelling centres and wider user community.

Future assessments

Crisis–X

Global Stocktake 2033

IPCC AR7 WGI/II/III

Forcings

DECK

AR7 Fast Track

Community MIPs

CMIP7 science goals (to be finalised)

- The SST Pattern problem: How will tropical ocean temperature patterns co-evolve with those at higher latitudes? *- DECK, DCPP, CFMIP, HighResMIP, OMIP, CERESMIP, SOFIA*

- Changing weather: How will dangerous and impactful weather patterns evolve? *- DECK, GeoMIP, DAMIP, ScenarioMIP, RAMIP, LESFMIP/DAMIP, TIPMIP*

- Water-carbon-climate nexus: How will the Earth respond to human efforts to manage the carbon cycle? *- DECK, C4MIP, CDRMIP, ScenarioMIP, GeoMIP*

- Points of no return/ratcheting: What are the risks of crossing tipping points and triggering irreversible changes across possible climate trajectories? *- ScenarioMIP (overshoot scenarios), SOFIA, linking to ISIMIP, VIACS and CMIP6Plus experiments conducted through Horizon Europe TipESM, OptimESM*

The goals will be finalised within the CMIP7 description paper to be submitted in September/October in the <u>CMIP7 GMD Special Issue</u>. A commentary describing the more social and organisational elements of the CMIP evolution is also in preparation.
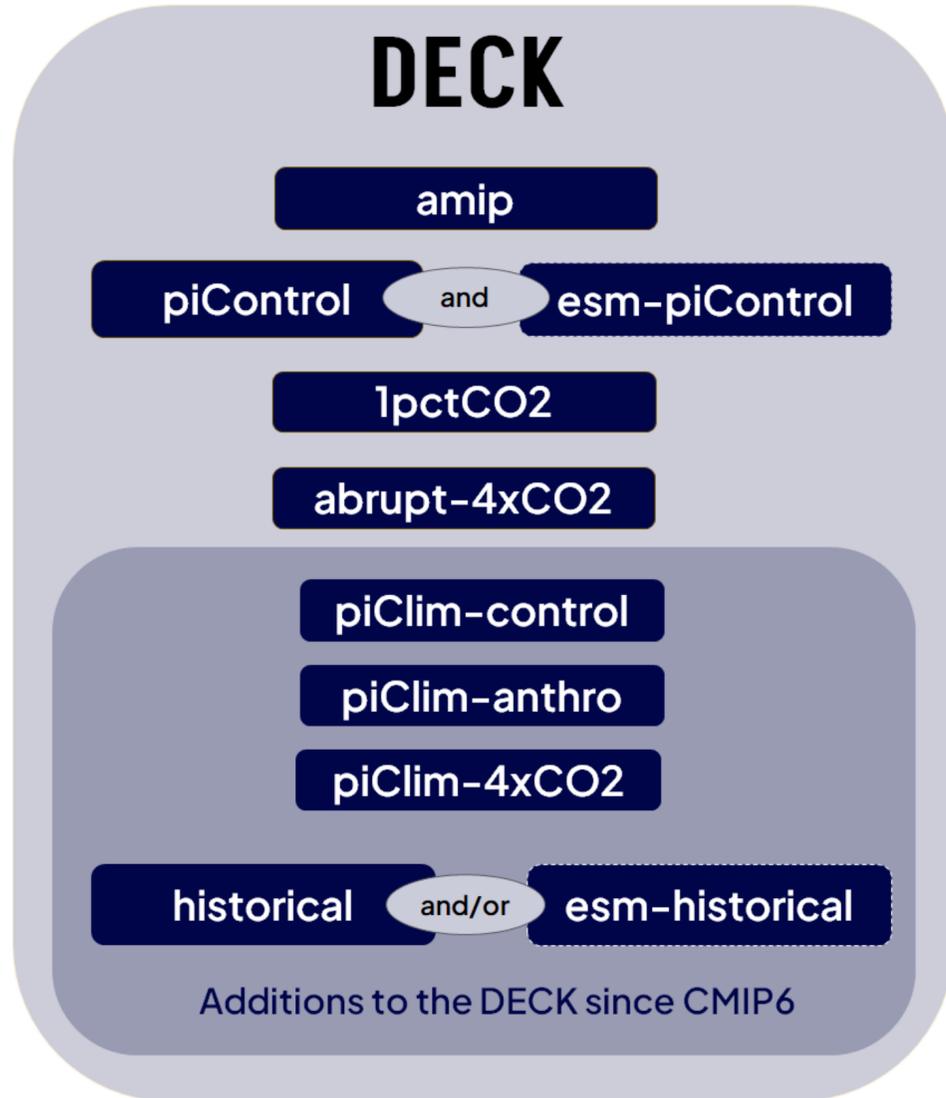
The CMIP AR7 Fast Track

What are the CMIP fast tracks?

- A compact set of experiments including the DECK and selected experiments from Community MIPs recommended by the CMIP Panel.

- Chosen to support specific needs e.g., scientific assessments such as AR7.

- Do not reflect prioritisation of experiments on any basis apart from timeline and relevance to the target user/problem.

- Participation in fast tracks or Community MIPs depends on scientific and other interests.

- Community MIPs can align with fast tracks or as their scientific timeline dictates.

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DECK

amip

piControl **and** esm-piControl

1pctCO2

abrupt-4xCO2

piClim-control

piClim-anthro

piClim-4xCO2

historical **and/or** esm-historical

Additions to the DECK since CMIP6

CMIP AR7 Fast Track

AerChemMIP

piClim-X

hist-piSLCF/hist-piAer

SSPX-SLCF

DAMIP

hist-nat

hist-aer

hist-GHG

GeoMIP

G7-1.5K-SAI

LMIP

land-hist

PMIP

abrupt-127k

RFMIP

piClim-histaer

piClim-aer

piClim-histall

C4MIP

1pctCO2-bgc

1pctCO2-rad

esm-flat10

esm-flat10-cdr

esm-flat10-zec

CFMIP

amip-p4k

amip-piForcing

abrupt-2xCO2

abrupt-0p5CO2

DCPP

Initialised prediction (2025-2036)

ScenarioMIP

High scenario

Medium scenario

Medium low scenario

Low scenario

Very low scenario

Low overshoot scenario

Climate services

Process understanding

Learn more about each experiment and why it has been included in the AR7 Fast Track

bit.ly/FastTrack-experiments

The AR7 Fast Track co-creation process

The Strategic Ensemble Design Task Team (TT) developed a proposed set of experiments to the CMIP Panel through brainstorming within the TT, with stakeholders, and interaction with MIP chairs.

Two rounds of consultation:
- Early v1 proposal shared with modelling centres for their views and appetite/readiness for CMIP7
- v2 proposal shared with both modelling centres and to open consultation with the wider CMIP and user community.

CMIP AR7 Fast Track experiment selection and DECK additions endorsed by WGCM in March 2024.

View the summary survey results

bit.ly/CMIPFastTrack-surveyresults

AR7 Fast Track timeline estimate (work in progress!)
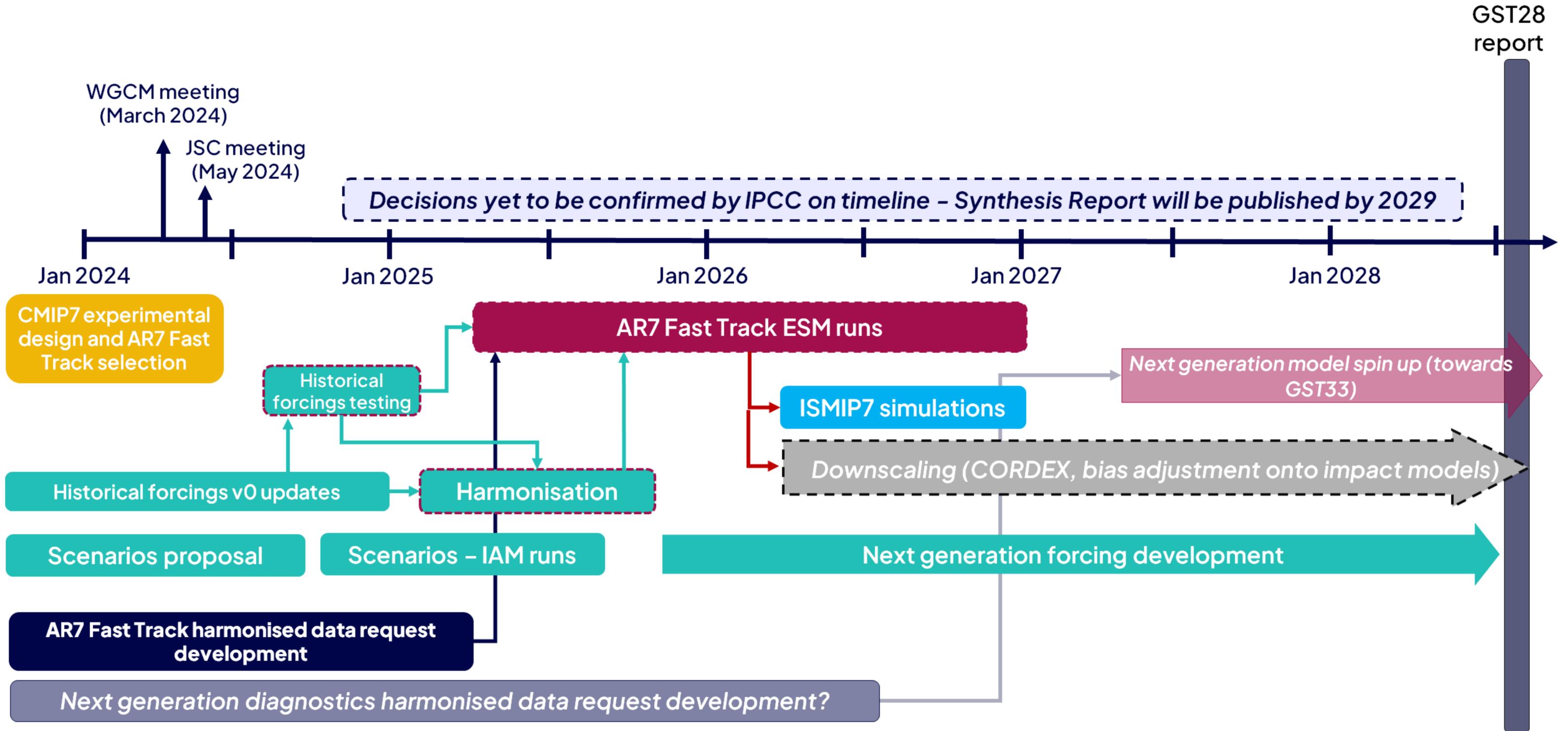
Forcings and scenarios update

Historical forcings

- CMIP Forcings Task Team working to resolve known forcing issues for CMIP7 DECK experiments and deliver data updates, extending until at least December 2021.

- Pre-release testing versions (v0) of most datasets are being generated and being made available through input4MIPs, currently available datasets can be found here.

- CMIP7 DECK datasets will be finalized and frozen for wider use in early 2025 (these will be different from CMIP6)

- Data available for broader use across AR7 Fast Track experiments; MIP-specific forcing data will not be covered by CMIP7 DECK datasets.

- Harmonisation WG established ensuring CMIP7 DECK to ScenarioMIP continuity.

- GMD forcing special issue - evaluation and documentation of CMIP7 forcings.

- Longer term ambition to move to a regular and sustained delivery of annual forcings update.

Status of v0 delivery (find latest here)

| Dataset	Forcing dataset	Status	Expected ESGF publication
1	**Anthropogenic short-lived climate forcer (SLCF) and CO2 emissions**	Bugs being fixed, data in preparation	Expected October 2024
2	Open biomass burning emissions	Data in preparation and final metadata checks	Expected October 2024
3	Land use	Data in preparation	**Available: v3.0 (0850 to 2024)**
4	Greenhouse gas historical concentrations	Preliminary dataset available	**v0.3.0 (0001-01 to 2022-12) available**
5	Stratospheric volcanic SO_2 emissions and aerosol optical properties	Preliminary dataset available	**v1.1.3 available (1750-01 to 2023-12)**
6	Ozone concentrations	Depends on 1, 2, 4, 5 and 8	Expected ~January 2025; 3 months after dependent datasets
7	Nitrogen deposition	Depends on 1, 2, 4, 5 and 8	Expected~January 2025; 3 months after dependent datasets
8	**Solar**	Preliminary dataset available	**v4.3 (1850-01 to 2023-12) available**
9	**AMIP** sea-surface temperature and sea-ice boundary forcing	Final v1 dataset available. v2 dataset awaiting HadISST v2.4 release	**v1.1.9 (1870-01 to 2022-12) available**
10	Aerosol optical properties/MACv2-SP	Depends on 1, test dataset being produced in the meantime	Expected ~November 2024; Expected a month after dependent datasets

ScenarioMIP proposed design (still to be finalised!)

If possible, scenarios are to be run in emission-driven mode (for CO_2). Updated scenarios are:
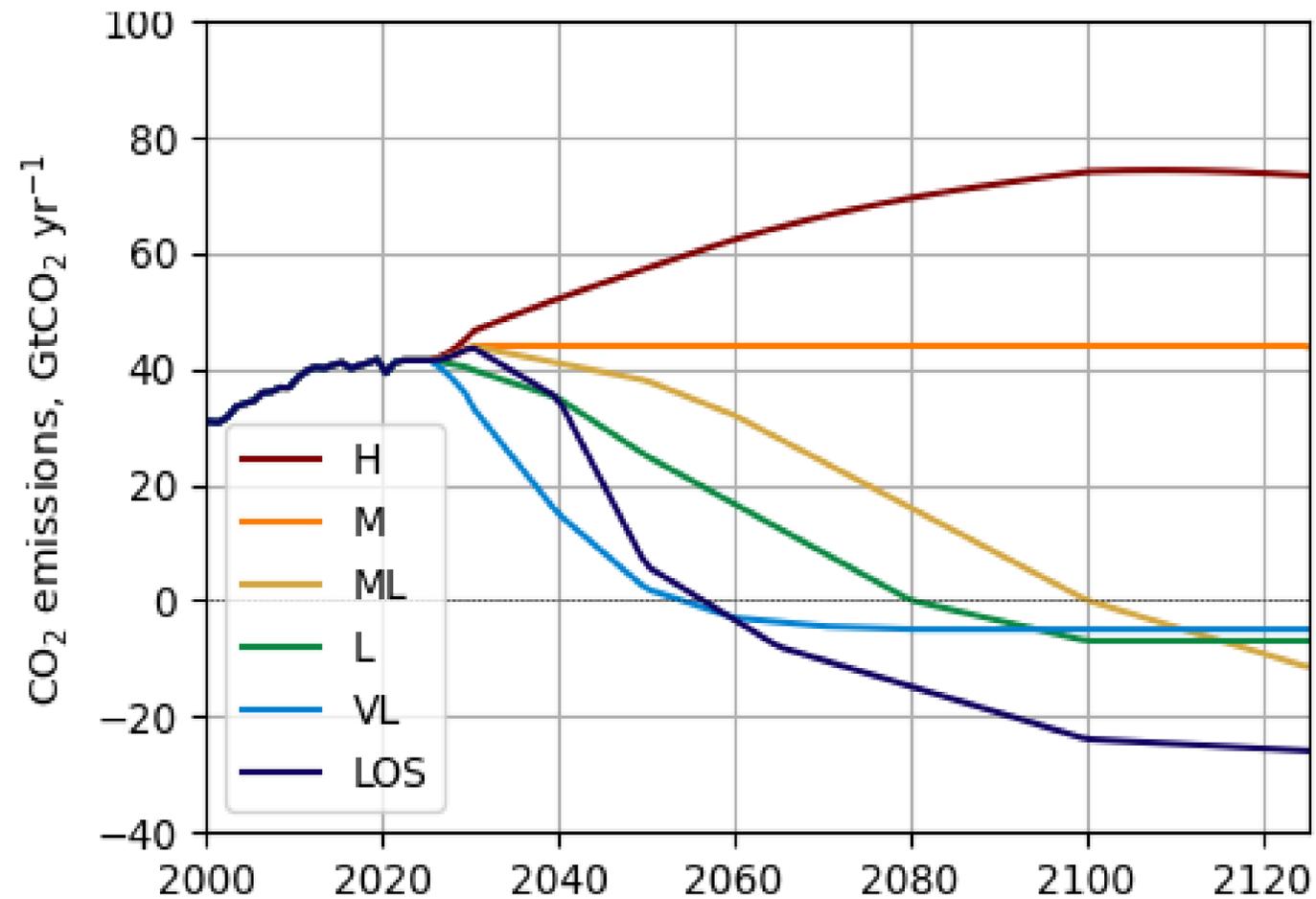
- High (H) is between SSP46 and SSP37.

- Medium (M) is approximately current policy.

- Medium Low (ML) is a moderate mitigation pathway (new in revision after consultation).

- Low (L) is 2°C scenario.

- Very low (VL) and Low overshoot (LOS) reach 1.5 °C by low and high CDR pathways.

ScenarioMIP preparing final protocol for GMD submission and WCRP endorsement.

ScenarioMIP extensions (still to be finalised!)
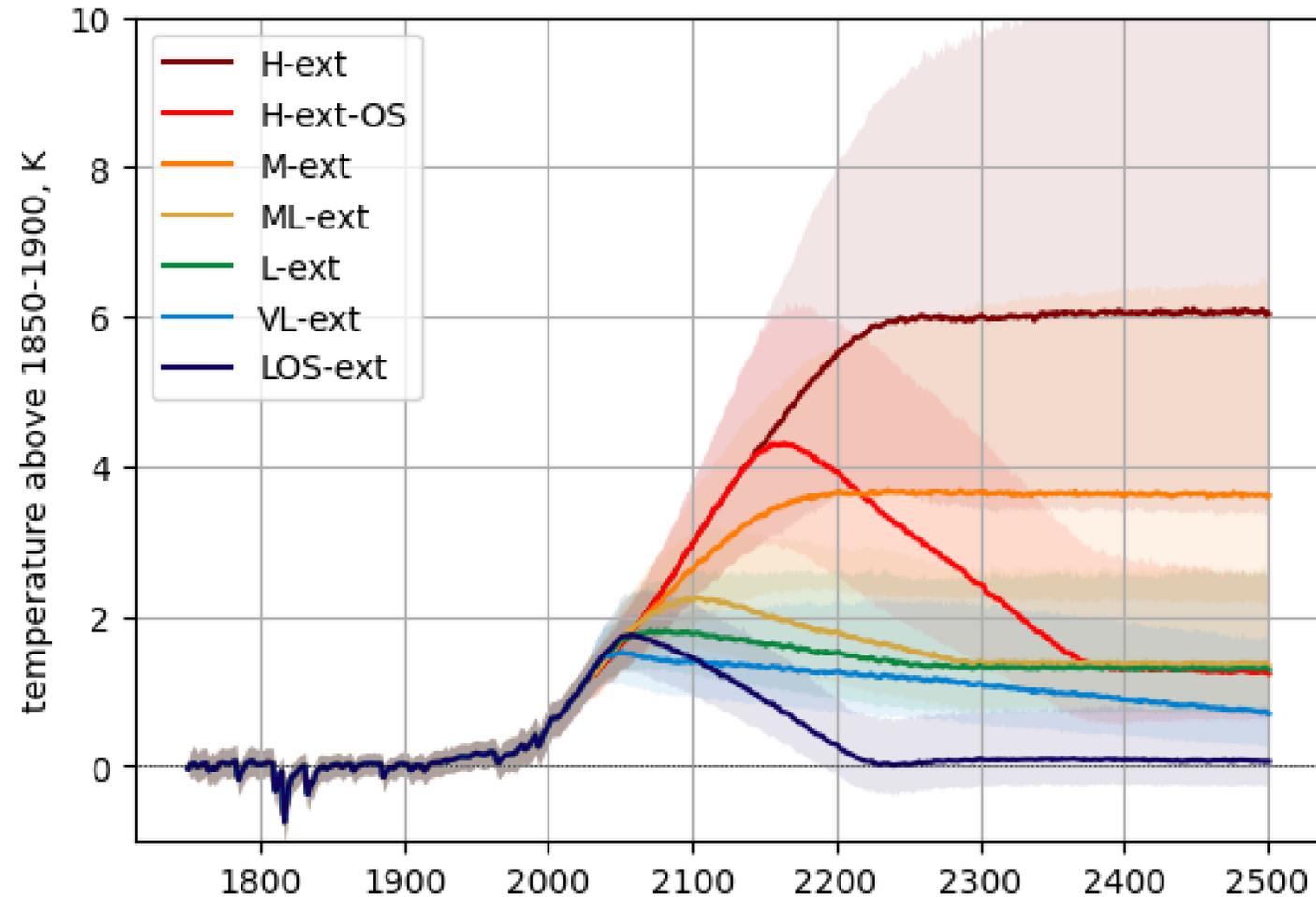
- Up to 2500

- Most eventually reach net zero CO_2 (not GHG…)

- Low overshoot (LOS) - climate restoration

- VL-ext: net-zero GHG ("Paris compatible")

- H-ext-OS, L-ext, ML-ext: all eventually reach stable 1.5, but with different levels of overshoot

- M-ext - ~4 degree stabilisation

- H-ext - ~6 degree stabilisation

Workshop: Pathway to regular and sustained delivery of climate forcing datasets

This four day workshop will be an opportunity to review the current provision model, discuss the key challenges, hear from users and potential users of the data, co-create a range of practical implementation options, develop the vision and generate concrete actions towards regular and sustained climate forcings dataset delivery.

ECMWF Reading, UK
28th-31st October 2024
Information and registration form can be found at:
https://wcrp-cmip.org/event/forcings-workshop

Rapid Evaluation Framework
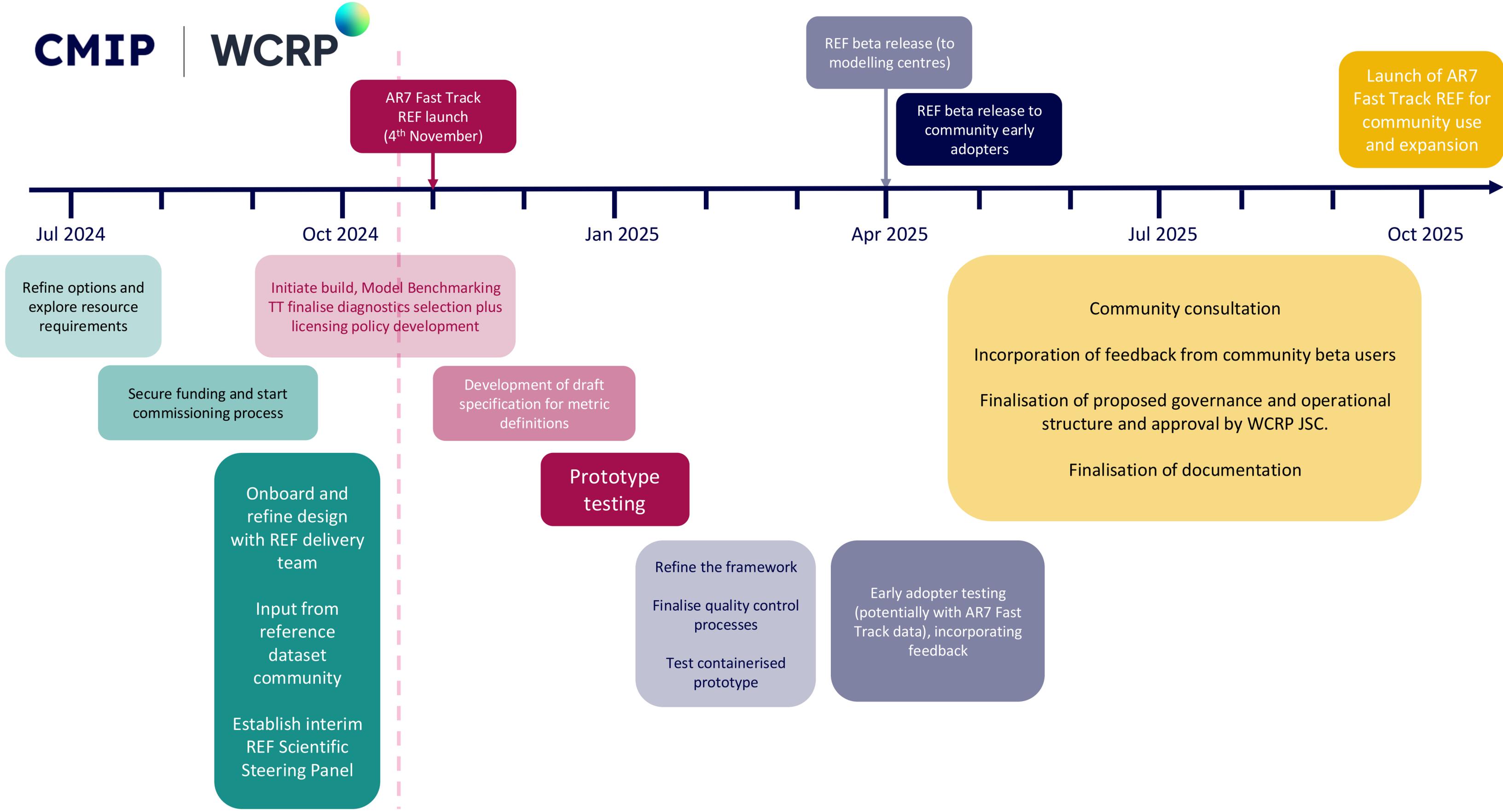
Rapid Evaluation Framework Overview

- The CMIP Model Benchmarking Task Team has designed an outline of a Rapid Evaluation Framework (REF) that is:

  - Open-source and modular

  - In the short term, focused on AR7 simulations, but extensible for all future Model Intercomparison Projects (MIPs)

  - Leveraging existing community evaluation and benchmarking packages

- Designed to be run at ESGF nodes or individual modelling centres

- The Task Team will work with the community to identify critical diagnostics for AR7 Fast Track simulations.

- Framework will assist analysts to select models (e.g. for downscaling or impacts modelling) and simulations suitable for their research.

Rapid Evaluation Framework Overview
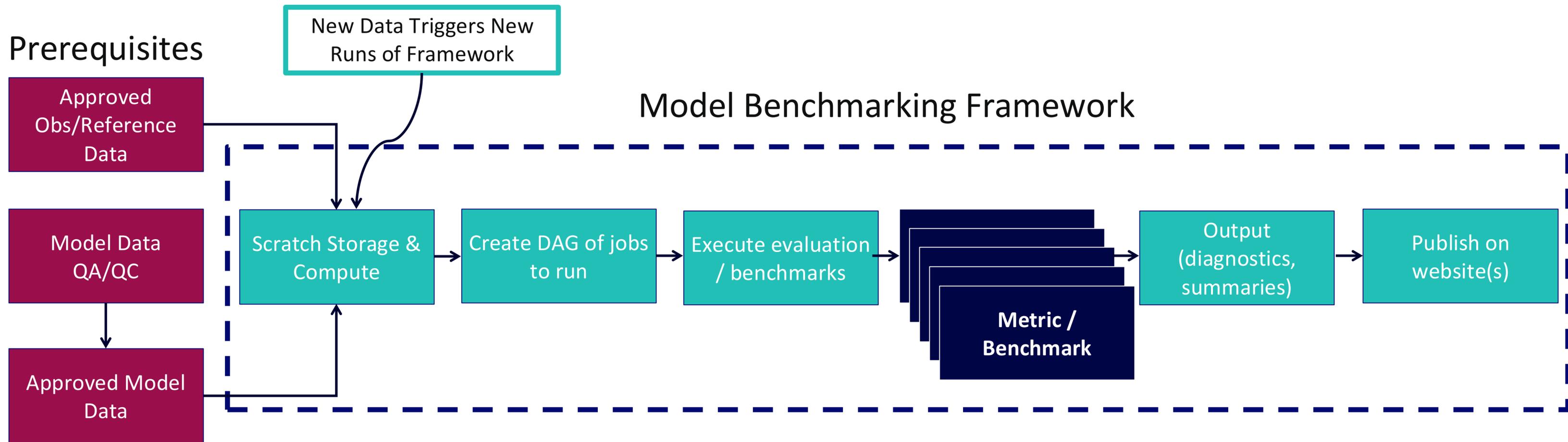
Milestones for REF development

- Milestone 1 – Community engagement to finalize the implemented metrics and diagnostics in a minimal version of the REF

- Milestone 2 - Provide recommendations for enhanced QA/QC package(s)

- Milestone 3 - Prototype workflow across at least two participating ESGF nodes and test containerised version with at least 3 modelling centres

- Milestone 4– Governance and operational structure for future evolution presented to and approved by WCRP JSC

- Milestone 5– Publication (peer reviewed) after the REF is in place and tested

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Timeline markers: Jul 2024 — Oct 2024 — Jan 2025 — Apr 2025 — Jul 2025 — Oct 2025

REF beta release (to modelling centres)

AR7 Fast Track REF launch (4th November)

REF beta release to community early adopters

Launch of AR7 Fast Track REF for community use and expansion

Refine options and explore resource requirements

Initiate build, Model Benchmarking TT finalise diagnostics selection plus licensing policy development

Community consultation

Incorporation of feedback from community beta users

Finalisation of proposed governance and operational structure and approval by WCRP JSC.

Finalisation of documentation

Secure funding and start commissioning process

Development of draft specification for metric definitions

Onboard and refine design with REF delivery team

Input from reference dataset community

Establish interim REF Scientific Steering Panel

Prototype testing
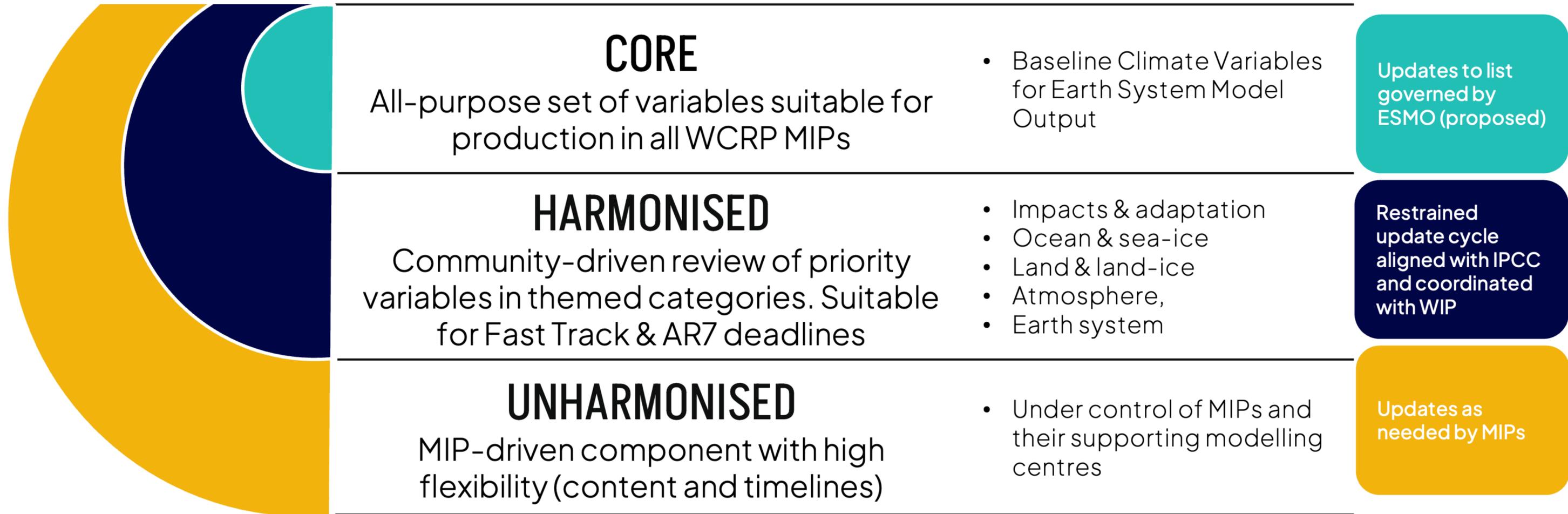
Refine the framework

Finalise quality control processes

Test containerised prototype

Early adopter testing (potentially with AR7 Fast Track data), incorporating feedback

CMIP Data Request

Harmonisation data request development update

Strategic approach for CMIP data request

CORE
All-purpose set of variables suitable for production in all WCRP MIPs

- Baseline Climate Variables for Earth System Model Output

Updates to list governed by ESMO (proposed)

HARMONISED
Community-driven review of priority variables in themed categories. Suitable for Fast Track & AR7 deadlines

- Impacts & adaptation
- Ocean & sea-ice
- Land & land-ice
- Atmosphere,
- Earth system

Restrained update cycle aligned with IPCC and coordinated with WIP

UNHARMONISED
MIP-driven component with high flexibility (content and timelines)

- Under control of MIPs and their supporting modelling centres

Updates as needed by MIPs

Strategic approach for CMIP data request

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Updates as needed by MIPs

Process underway to develop the Harmonised Data Request for the Fast Track

Harmonised Thematic Variables

The CMIP Data Request Task Team are working with community representative leads and engaging with the wider community to devise a controlled list of high priority variables that facilitate the majority of user needs, while keeping the request as small as possible.
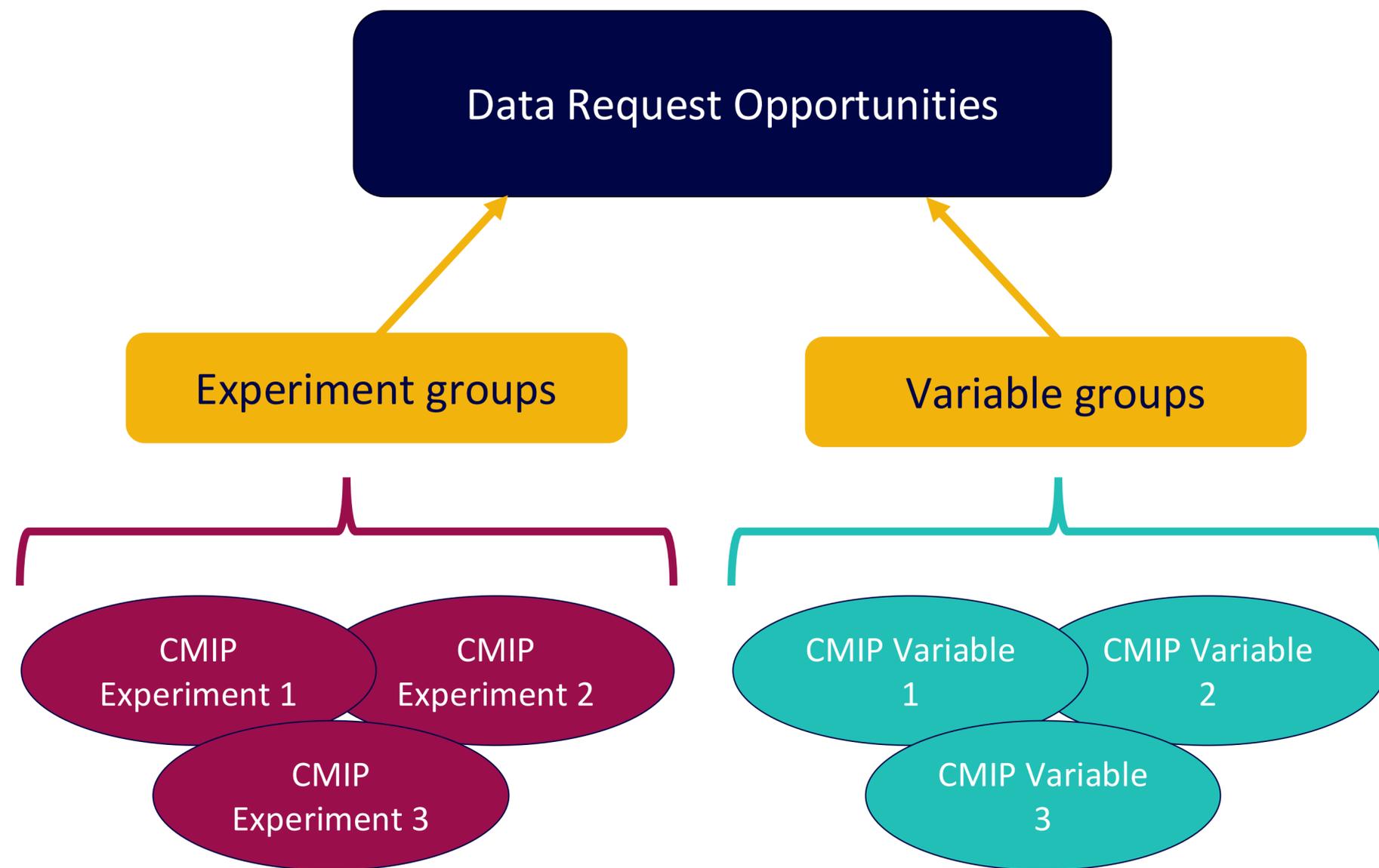
o Impacts and Adaptation theme *(CORDEX and VIACS represented)*

o Atmosphere, Ocean/Sea Ice, Land/Land Ice, Impacts & Adaptation, and Earth System themes

o Guide on scope: around 200 variables per theme.
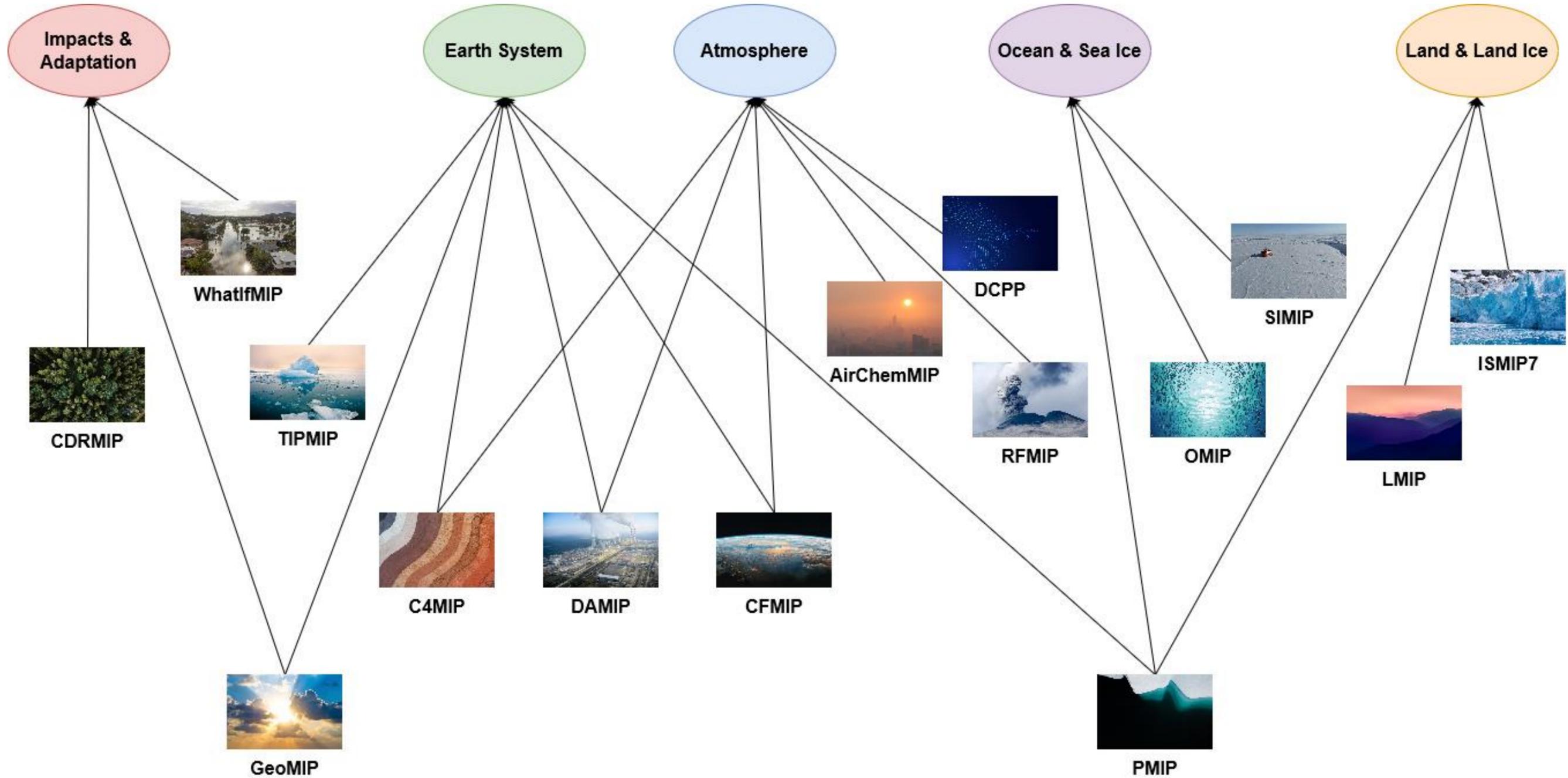
24

Harmonised Data Request structure

Data Request Opportunities

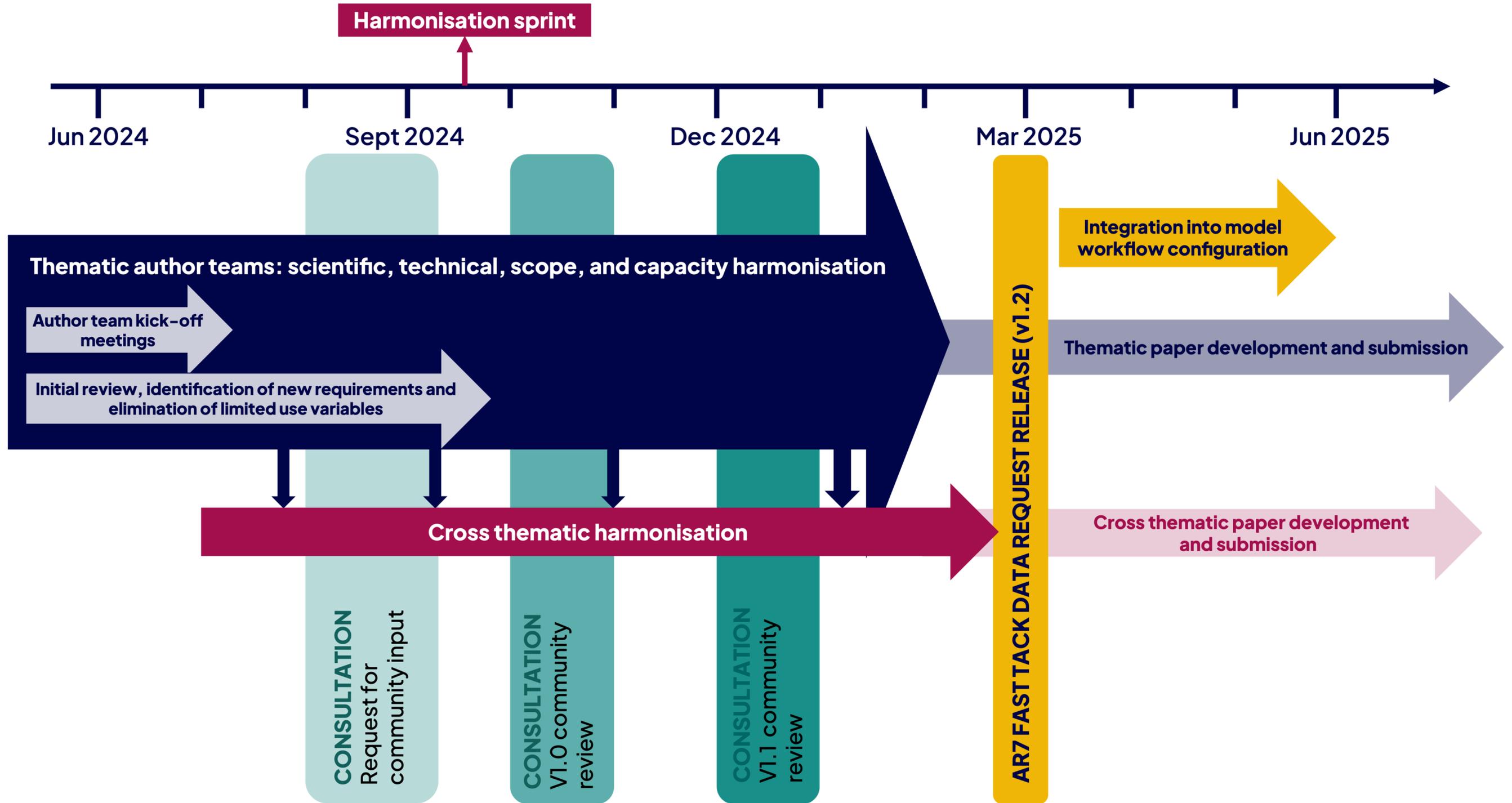**A scientific objective that can investigated using a set of variables from certain CMIP experiments**

Essential model documentation

Essential Model Documentation

- Essential Model Documentation (EMD), which is a high-level description of a CMIP7 model.

- It is intended to contain information on model formulation that can be easily compared between different models and allows model outputs to be better understood.

- It is not intended to contain all information about the models.

- EMD is only truly useful when it has been provided for 100% of models.

- To ensure that this occurs, it has been agreed by the CMIP Panel, in consultation with the community, for its creation to be a mandatory requirement for CMIP7 participation.

Scoping potential of a sustained mode CMIP

What could be under discussion for move to sustained delivery?

- Forcings

- Scenarios

- Updated simulations

- Data request

- Benchmarking/metrics output (longer term REF development)

Sustained delivery does not have to mean operational in the sense of the weather forecast!

Are there stakeholders interested in a sustained mode?

- Copernicus Climate Change Services (C3S)?

- WMO Annual to decadal forecast?

- Detection and attribution?

Is there a viable mechanism for a sustained mode?

- WMO lead centre style?

- Dedicated globally distributed climate projections centres?

- C3S and other funding?

What are the viable funding mechanisms reflecting the global diversity of funding for existing CMIP activities?

Scoping group

- Small group, chaired by Helene Hewitt (CMIP Panel Co-chair) and Greg Flato (WGCM Co-chair) to report back on scoping of:

  - The need for a sustained CMIP mode

  - Stakeholders

  - Viable mechanisms

  - Funding

  - Governance

  - Timing

- Report in a relatively short time frame (by April 2025).

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Thank You

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