



45th Session of the World Climate Research Programme
Joint Scientific Committee



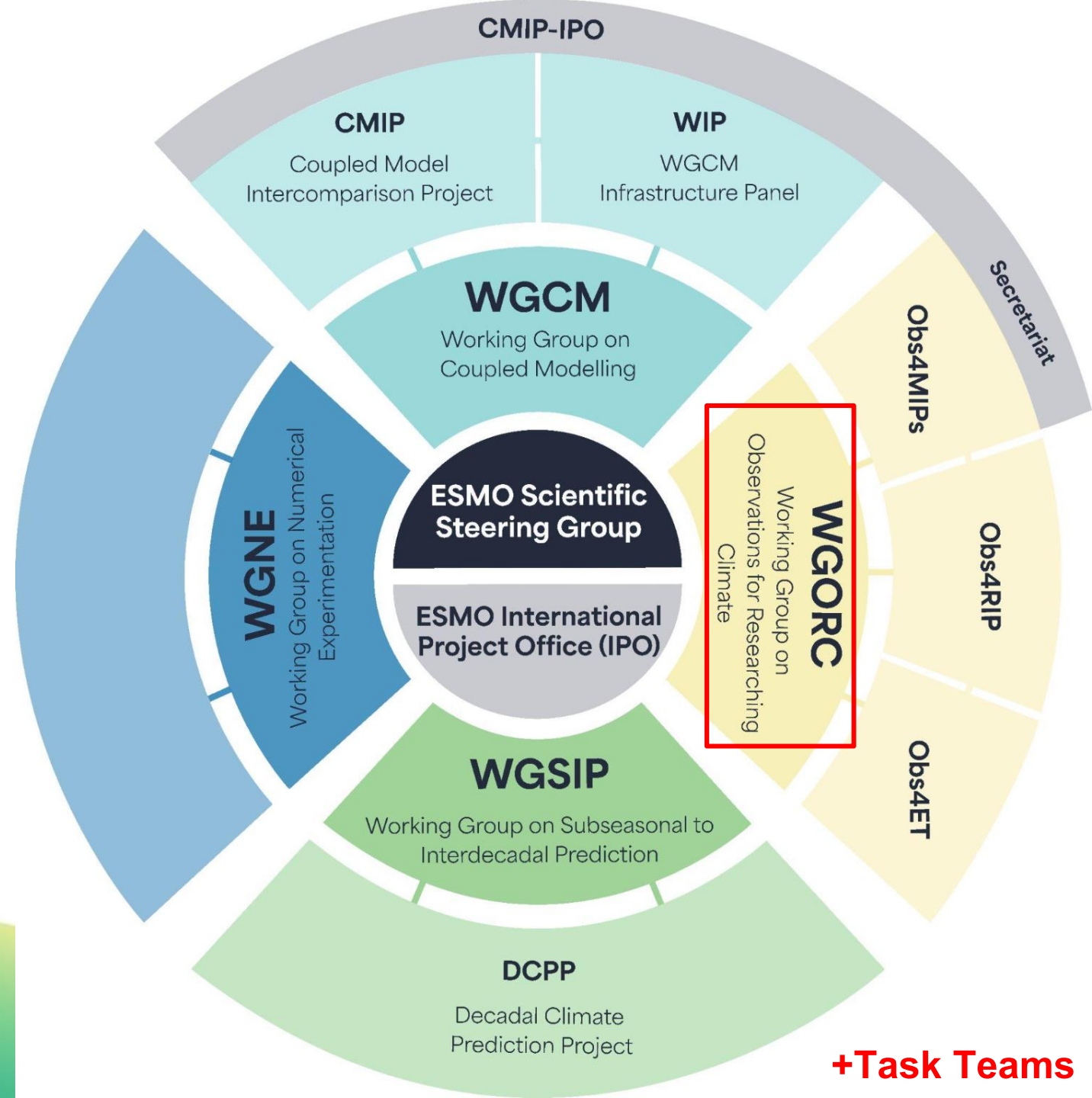
Earth System Modelling & Observations Core Project (ESMO) update

Co-chairs: Baylor Fox-Kemper (presenting) & Susann Tegtmeier

Highlights for Joint Scientific Committee

Recent ESMO timeline

- ESMO SSG active (June 2023)
- ESMO IPO active (November 2023)
- ToR updates (ongoing)
 - consistency
 - transparency (e.g. open calls)
 - equity across ESMO
- New Website, Logo (ongoing)
- New WG to be established (**WGORC**, planning begins in 2025)



Highlights for Joint Scientific Committee

Meetings / Workshops Held

- **1st WCRP ESMO meeting (DKRZ, March 2024, Joint with WGCM & CMIP)**
- **WGSIP** organised a “WCRP hybrid symposium on Frontiers in Subseasonal to Decadal Prediction” (ECMWF, March 2023)
- **WGSIP: WCRP EPESC/DCPP** workshop on “Integrated Attribution and Prediction” (MetOffice, March 2023)

Highlights for Joint Scientific Committee

Highlights from Working Groups

- **(WGCM) Most Earth System Modelling centres** plan to participate in CMIP7.
- **(WGSIP/CMIP) DCPD decadal forecasts** will be included in CMIP7 FastTrack.
- **WGNE new pilot project on South America (with WWRP/WGNE JWGFVR):** Regional Model Verification and enhancing the assessment of Extreme event global and regional forecasts to contribute to the **EW4All** initiative.
- **WGSIP, DCPD & APARC's : Volcanic Response Readiness Exercise (VolRes-RE)**
 - rapid forecasts revisions to incorporate estimated volcanic stratospheric aerosol forcings after eruption to the **WMO** Lead Centre for Annual to Decadal Prediction (*subm. BAMS*).
- **obs4MIPs reinvigorated**, with a Steering Group assisted by CMIP-IPO and WIP, and most recently via engagement with ESMO. Will be a key panel of **WGORC**.

Highlights for Joint Scientific Committee

Recent Publications

- **WGCM/WMO Bulletin** high-level papers on (1) new Developments in Climate Modelling, (2) km-scale Modelling of the Earth, (3) Climate Projections
- **WGSIP contributed to BAMS** submission “World Meteorological 1 Organization (WMO) Accredited Infrastructure to Support Operational Climate Prediction”
- **WGNE BAMS** paper from 2022 workshop on Systematic Errors in Weather and Climate Models.
- **WGSIP: DCPD contributed to recent studies** on effects of including volcanic aerosol forcing in decadal hindcasts (*Wu et al. 2023; Bilbao et al. 2024*)
- **WGSIP: DCPD coordinated experiments** to test the readiness of decadal prediction centres to forecast the impact of a volcanic eruption (*Merryfield et al. 2024*)

ESMO planned meetings

- **Joint WGNE40 / WGSIP25** annual meeting (Toulouse, Nov. 2024)
- **ICR6** - 6th International Conference on Reanalysis (Tokyo, Oct. 2024)
- **WGORC strategy meeting in 2025**: bring relevant actors together in person to set the foundation
- **Carbon cycle** cross-cutting activities (in discussion, need to engage with SLC LHA)

WGCM Activities

- Re-energise collaboration with **AIMES** (carbon cycle modelling), **CORDEX** (downscaling), **High-Resolution** community (via CMIP and Digital Earth LHA)
- Improve coordination on constraining measures of **climate sensitivity** (eg. ECS, TCR, TCRE)
- Establish **task team** to improve **communication between modelling centres on technical issues** related to model development
- **Improve model documentation** to support in-depth analysis and comparison across models
- Initiate discussion on ways to optimise emerging work on the use of **AI/ML in ESM**

There will be a CMIP update at the end of the presentation

WGNE Activities

- South American Regional Model Verification Pilot project (with JWGFVR)
- Evaluate:
 - **Aerosols** impacts on NWP
 - Physics-dynamics coupling and energy budgets in **ESMs**
- Contribute to:
 - **Ocean initialisation** paper (ESMO/CLIVAR/WGNE)
 - Different **MIPs**
 - **ML/AI weather forecasts**
 - Global model comparison
- **7th WGNE Systematic Errors Workshop** planned in South America (2026)

Planned science initiatives and major events

WGSIP Activities

- Focus on application of **ML to prediction** (subseasonal to decadal) for 2024-2029
- Proposed a **S2S Panel** under WGSIP to ESMO (follow-up of S2S Project)
- Plans an **International Conference on Subseasonal to Decadal Prediction** for Autumn 2026
- Plans a regionally-oriented **School on Climate System Prediction and Regional Climate Information for EMCR** (Argentina, early 2026)
- **DCPP**
 - Formalise international coordination on initialised climate predictions through agreement of the CMIP7 protocol including multi-annual and high-resolution prediction
 - DCPP-C forecasts in CMIP Fast Track
 - Also, DCPP-A -> minimal DCPP-DECK
 - Advocate for emissions-driven carbon cycle prediction metrics in WMO-ADCU
 - Plans to (co-)organize a large workshop on seasonal to decadal prediction in 2025 or 2026
 - Reactivate link DCPP - CLIVAR (on AMV pacemaker studies, links with all CLIVAR regional panels)

Planned products, high-level assessments or other key outputs/publications

- **WGCM/WGNE**: scope white paper on potential areas in which more systematic and institutionalized updates to forcing datasets, scenarios, data archives and other aspects of CMIP
- **Research Board WMO** - Digital Strategy Concept Note (*Wedi, Bouchet, et al. 2024*), in review
- **Artificial Intelligence and Machine Learning for Weather and Climate** (*Pappenberger, Wedi, et al, 2024*), contribution to the WMO United in Science 2024 report
- **WGNE Blue Book issue 2024**
- **WGNE 2025** - Output on systematic errors in weather and climate models survey related to the six hazards identified by INFCOM that were most frequently identified as “priority hazards” for 30 countries
- **WGNE Paper in BAMS in 2027** documenting 7th WGNE Systematic Errors Workshop
- **WGSIP Paper**: “Five challenges for subseasonal to decadal prediction research” (under revision)
- **WGSIP/DCPP**: CMIP7 protocol paper outlining new DCPP-C experiments
- **obs4MIPs** plans to include additional products to advance modeling science (e.g. higher spatio-temporal resolution, regional scale datasets)

Linkages with other WCRP activities

- **WGCM** - many **LHAs & CPs**
 - e.g., **CLIVAR** - OMDP working on ocean diagnostics and protocols for OMIP/CMIP7
- **WGNE** - **CLiC** potential: representation of cryosphere processes to reduce systematic errors
- **WGNE & WGSIP** - **CLIVAR**: Ocean component initialisation project, CLIVAR to be ex-officio
- **WGNE** - **GASS & GLASS**: in WGNE as ex-officio, GASS members in MUMIP
- **WGNE** - **Digital Earth LHA**:
 - Model Uncertainty – Model Intercomparison Project (MUMIP), Assessment of extremes & forecasts in South America, Evaluating physics-dynamics coupling and energy budgets in Earth System models, WGNE rep on DE Steering Committee
- **WGSIP** - **EPESC** (WG2) synergies (to be emphasised at WGSIP-25)
- **WGSIP** to link with **WCRP Academy** to plan regional school for EMCRs
- **WGORC**: following WCRP groups will be targeted => **APARC** (S-RIP, TUNER, SNAP), **GEWEX** (GDAP, GHP, GLASS, GASS), **CLIVAR** (OMDP, GSOP), **EPESC**, **Digital Earth**.
 - **Obs4MIPs** - **GDAP** complementary work (one advises on technical aspects regarding their suitability for model evaluation, the other does data quality assessments)

Partnerships with entities outside of WCRP

- WGCM & CMIP Panel have strong relationships with the **Integrated Assessment Modelling Consortium**, with the **IPCC WG1**, and will re-energise their relationship with **AIMES** (Analysis, Integration and Modeling of the Earth System within Future Earth).
- WGNE - **WWRP (World Weather Research Program)** through: JWGVFR, S2S, High Impact Weather project (HIWeather), S2S (WGNE S2S Aerosol project), potentially SAGE.
- WGNE - **GAW (Global Atmosphere Watch)**: (rep. in Scientific Advisory Group on Applications), and in the WGNE S2S Aerosol project.
- WGSIP - **WMO**:
 - Joint activities with the WMO Expert Team on Operational Climate Prediction System (**ET-OCPS**) on matters of Research-to-Operations and Operations-to-Research coordination.
 - WGSIP members represent WMO Subseasonal, Long-Range (seasonal), and Annual-to-Decadal Lead Centres and Global Producing Centres
 - DCP - **WMO** lead centre activity on annual to decadal climate predictions (**LC-ADCP**), which has taken over the coordination and dissemination of operational decadal predictions.
 - **WGORC**: targeting opportunities with **GCP**, **WGClimate**, **GCOS**, **GOOS**, **WMO (GAW)**, **CGMS WGs**, **CEOS Virtual Constellation**, **Reanalyses.org**, **Destination Earth**, **EVE**, **CCMI**.

Suggestions

- WGCM & CMIP presented to WCRP JSC the proposed **CMIP7 Socioeconomic Scenarios**
- Promote **career development of EMCS** and provide opportunities
 - Improve skills in high-res model development
 - WCRP Summer School on Climate Model Development
 - Focusing in developing and underdeveloped nations
 - WGNE - WCRP Academy, WGCM, WGSIP and Digital Earth LHA
- Perform intercomparison of **NWP models and ML models** (Different Models, Same Initial Conditions: DIMOSIC)
- **Global Fellowship** focus for a 2025 call:

A global fellowship program could offer placements to researchers from developing and underdeveloped nations at recognized institutions such as ECMWF, DWD, MPI, NCAR, NCEP, UKMet, and ECCO, primarily in Europe and North America - **not restricted to direct employees of official national meteorological services.**

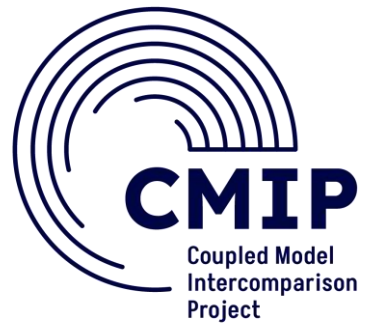
Suggestions & challenges

- **ESMO** to facilitate science initiatives to **integrate emerging methods (e.g., ML/AI, km-scale)** with existing streams of research and development (all ESMO WGs mention ML activities)
- **Earth system reanalysis** will be embraced by ESMO, but how?
- **WGORC** planning stage is beginning. Complex set of issues in collaborations and technical.
 - ESMO SSG suggested panels: obs4MIPs, obs4RIPs, obs4ET
- **Overlaps between CP&LHAs**: DCPD's remit overlaps with LHA-EPESC and WMO LC-ADCP
 - DCPD to take coordinating and strategic role supporting these activities
 - However, current DCPD priority is the development and completion of CMIP7 activities
 - DCPD scope refresh will be led by the next DCPD co-chairs & WGSIP
 - Enhance links DCPD to WMO LC-ADCP so that CMIP7 activities form the basis of future operational activities.



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CMIP update



WCRP
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*CMIP Panel and WIP
Tuesday 28th May
Part of ESMO update*



Highlights for Joint Scientific Committee



- CMIP AR7 Fast Track experiment selection (see Monday's presentation)
- Establishment of [Fresh Eyes on CMIP](#)
 - Set up during 2023 to integrate the voices of early career researchers, scientists and practitioners in CMIP
 - 151 Fresh Eyes members from across the globe
 - Organised into eight sub-groups linking to the Task Teams, CMIP Panel and WIP.
 - Spinning up a number of activities in addition to working in collaboration with Task Teams with the opportunity for mentoring from more senior members of the CMIP governance.
 - Example project: Responsible data use (in collaboration with RfS)

Planned science initiatives and major events



- CMIP analysis workshop, EMCR hackathon and user engagement event planned for early 2026.
- Will build upon the formats of the CMIP5 (Hawaii/Dubrovnik) and CMIP6 (Barcelona) Analysis Workshops.
- However, reflecting the growing user community, will also encompass user and policy engagement sessions/events and an ECR hackathon led by the Fresh Eyes on CMIP.
- Location to be confirmed.

Planned products, high-level assessments or other key outputs/publications



- Publication of CMIP7 experimental design and associated papers, and AR7 Fast Track guidance.
 - **GMD Special Issues:** [CMIP7](#) and [CMIP7 Forcings](#)
- Scoping report – viability and mechanisms for a **CMIP sustained mode**
 - Group established to scope the definition of “operationalisation” and a viability analysis of potential mechanisms with an initial focus on CMIP.
 - Includes CMIP Panel, WIP, WGCM and WGNE co-chairs.

Linkages with other WCRP activities



- CMIP has been actively engaging with a number of core projects and LHAs over the last year.
- Further engagement is welcomed but participation in CMIP events and consultations could be improved to ensure CP and LHA feedback is contributing to CMIP development.
- A synergy, which could be strengthened, is between CMIP and the Digital Earths LHA.

Partnerships with entities outside of WCRP



Some examples include:

- [Earth System Grid Federation](#) (ESGF): The ESGF consortium is a coordinated international project that develops shared infrastructure across numerous countries to publish and share local model data. The ESGF is vital to the delivery of open and accessible CMIP output.
- [IPCC](#) AR7 Working Group Chairs: The CMIP Panel Chairs have been engaging regularly with the IPCC WG Chairs as the AR7 timeline, format and content is developed.
- [Climate Match Academy](#): Development and review of training materials, chairing of showcase events and representation on steering committee.

Suggestions, issues or challenges



Lack of structural agreement with ESGF

Given the tight timeline of the AR7 Fast Track, the growing demand for CMIP output, and rapid evolution of data technologies and user expectations, the CMIP/WIP Panels have concerns regarding the lack of a structural agreement with the ESGF consortium and lack of clarity in responsibilities/governance across the WIP and ESGF Executive and Steering Committees. Funding uncertainty makes navigating this terrain complex.

Need for a dedicated scenarios activity within WCRP

Given the increased profile and importance of scenario development to climate policy assessments we feel greater visibility within WCRP may be beneficial to ensure timely delivery, adequate structural support, and establishing a closer connection with the Integrated Assessment Modelling community.

Thank You



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