



ESMO - Earth System Modelling and Observation

Interim-co-chairs: Cath Senior and Susann Tegtmeier

44th Session of the WCRP Joint Scientific Committee

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Climate Center, Brussels, Belgium



International
Science Council



Progress: IPO and candidate list for JSC



DKRZ, Hamburg

- Establishment of the ESMO International Project Office (IPO) at the German Supercomputing Centre (DKRZ) in Hamburg in May 2023
- An advertisement for the Director of the IPO should go out soon.
- Open call for the SSG in early 2023
- SSG candidate list submitted to the JSC

Progress: ESMO Structure

International Project Office (IPO)

- Will consist of a director, scientific officer and a science communications and engagement officer

Scientific Steering Group (SSG)

- 10-12 members, meets 3-4 times per year
- Works closely with WG co-chairs, who act as ex-officios

Annual Meeting

- Includes SSG and WG cochairs
- Invites representatives from core projects, lighthouses and partners

WGCM

WGNE

WGSIP

Obs4MIPs

ESRIE

S2S

AI/ML?

WGOR

WGSED

✓ Advertisement for Director will go out soon

✓ Will be active once candidates have been approved

✓ Kick-off meeting is planned for end 2023 or early 2024

✓ Well established and active modelling WGs

✓ Obs4MIPs: currently being re-invigorated

✓ S2S is coming to an end

✓ ESRIE: proposed WG on Earth System Reanalysis

✓ Need for new observational and AI/ML(?) WGs

Progress and Future plans: WGSIP

WG on Subseasonal to Interdecadal Prediction

WGSIP 24 (ECMWF, Reading, March 2023)

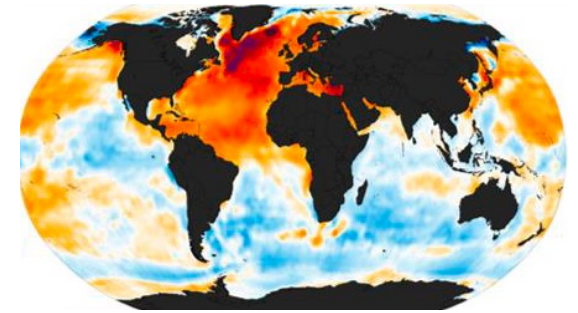
- Increased communication/engagement with Core Projects/LHAs
- Scientific legacy of S2S within WCRP
- New home & updating mechanism for CHFP seasonal hindcast archive

WCRP symposium on Frontiers in Subseasonal to Decadal Prediction)

- Hybrid event hosted by ECMWF, March 2023
- Presentations on:
 - Digital Earths and the future of climate information
 - Earth system reanalyses
 - Emerging roles of artificial intelligence
 - Global carbon cycle
 - Modeling aspects: ocean mesoscale, vegetation, systematic error reduction, ...

Current challenges:

- CIMA support for CHFP no longer sustainable, alternative needed (see above)
- Membership static since 2020 due to pandemic & ESMO spin-up. Numerous members have changed positions, rotated off, or reached end of terms → significant renewal for 2024 to be proposed to ESMO SSG

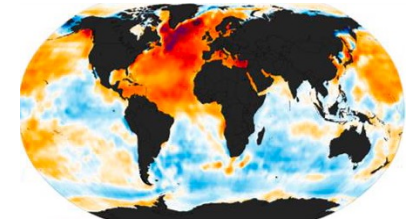


Progress and Future plans: DCP

Decadal Climate Prediction Project, reports to WGSIP

DCPP Panel meeting (UK Met Office, March 2023 in conjunction with EPESC LHA)

- Initial planning for CMIP7 DCP experiments (to be finalized by early 2024)
- Interest is growing in 2-3 year predictions initialized 2-4 times annually
- Benefits of enhanced spatial resolution are becoming increasingly apparent



Volcanic Response Readiness Exercise

- SPARC/DCPP initiative: prepare producers to modify decadal predictions in the event of a major volcanic eruption
- Predictions from 2022 repeated with stratospheric aerosol from hypothetical 2xPinatubo eruption (10 participating models)
- Paper will provide durable documentation of this process for WMO decadal operations

Major membership renewal in 2023

Current challenges

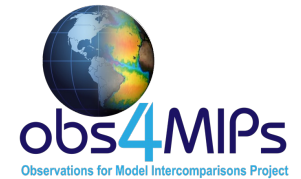
- Tension between suggestions for “slimmed down” CMIP7 DCP vs need for & value of large ensembles, frequent initialization, high resolution...



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Progress and Future plans: obs4MIPs



Achievements:

218 datasets available on ESGF

Current status:

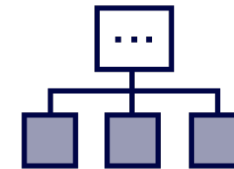
15 dataset proposal submissions (EoIs)



Task groups

9 topics identified, 4 currently active:

- ESGF (publication & information)
- Guidance and capacity building
- Inclusion of satellite-based exploratory datasets
- Workflow efficiency: Improving workflow for preparing obs4MIPs compliant data



Plans:

- Recommendation on future within ESMO

Challenges:

- Interim governance status
- Reducing the lag between EoI and inclusion
- Community awareness

Website: <https://pcmdi.github.io/obs4MIPs/> Github: <https://github.com/PCMDI/obs4MIPs-cmor-tables>

Progress and Future plans: WGNE

WG on Numerical Experimentation Reports to the Research Board

WGNE “Blue Book”: providing yearly updates on model system development

- **Deadline: 12 May 2023 to submit contributions** (<https://wgne.net/publications/wgne-blue-book/>)

Continuous updates, references and sharing of modelling progress and process-oriented verification and prediction skill from major modelling centres worldwide (wgne.net)

Topical discussions: Numerical model development; AI/ML + bias correction; Earth system coupling; HPC adaptation & emerging technologies; digital twinning; linking to GASS and GLASS activities

Specific topical projects

- MJO-TF surfaces fluxes and SST sensitivity
- MUMIP model uncertainty intercomparison
- Survey on global model budgets (& physics-dynamics coupling)
- Process-oriented verification (via Joint working group JWGFVR)
- Aerosol interactions (with S2S follow-up project)

6th WGNE workshop on systematic errors in weather and climate models

- **summary paper to BAMS May 23**



Progress and Future plans: S2S

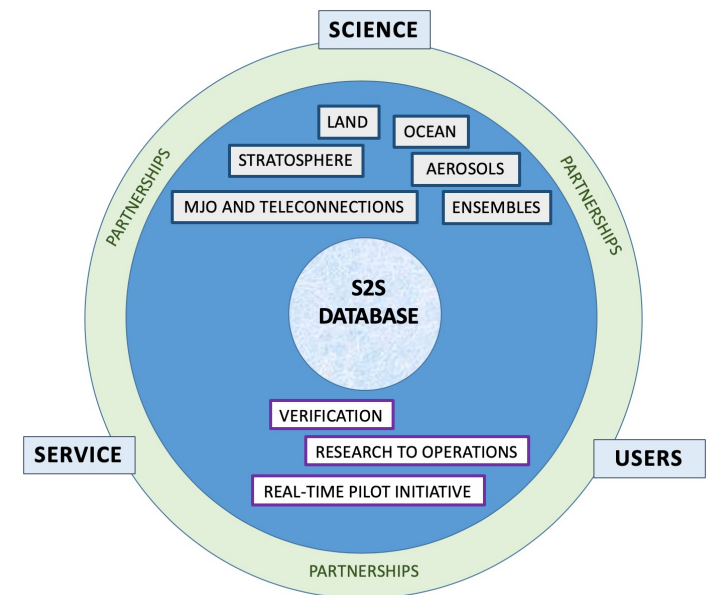
Subseasonal to Seasonal Prediction Project

S2S in 2022- 2023

- Science project activities and coordinated experiments.
- Real-time pilot project – document main findings
- Maintain S2S AI/ML challenge data and computing environment
- Final report on S2S Phase 2 activities
- Organize S2S summit – 3-7 July 2023 University of Reading

Legacy of S2S

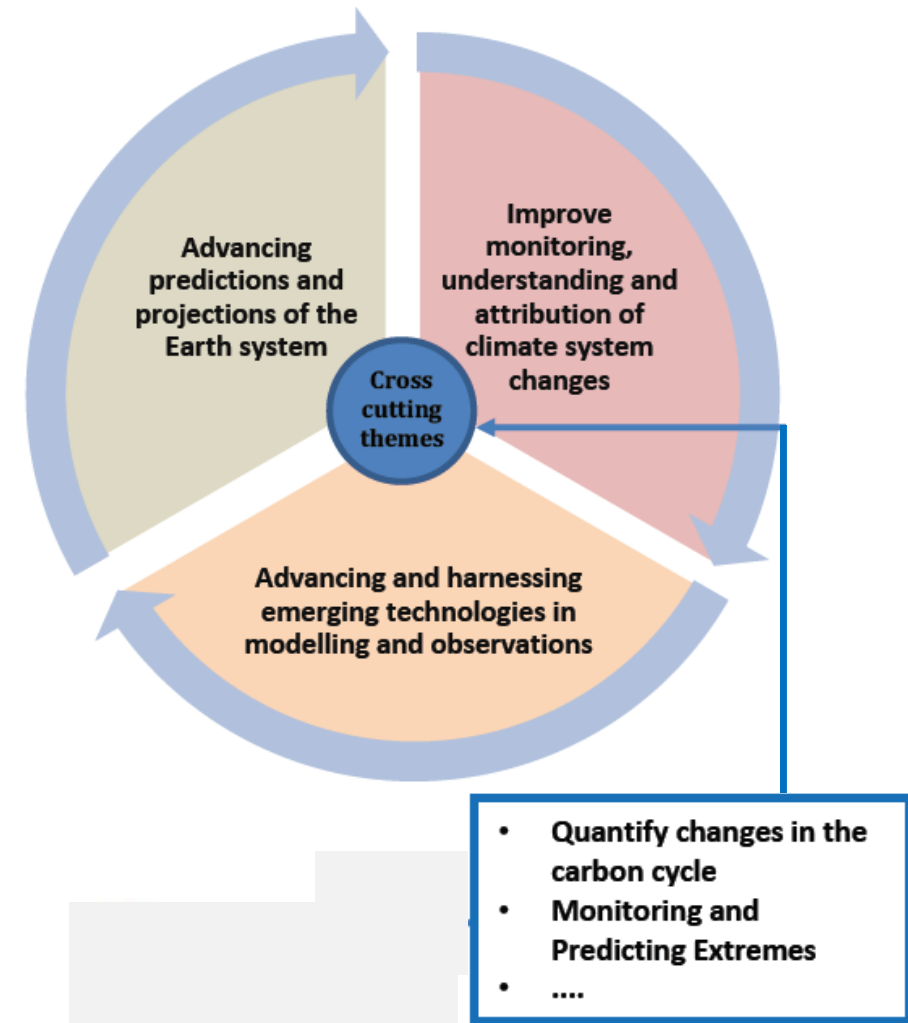
- WWRP new Applications for Agriculture and Environment (SAGE) project
- WWRP Polar Coupled Analysis and Prediction and WWRP/WCRP Monsoon project Office activities
- S2S database will continue at ECMWF for now and establishment of a new lead centre for databases is planned
- New WMO Lead Centre for sub-seasonal to seasonal forecasts (LC-SSFMMME) hosted by ECMWF



Future plans: ESMO Strategy

Finalize the Strategic Plan based on feedback from the SSG

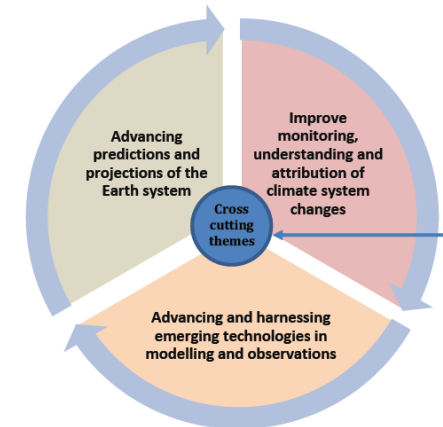
- Strengthen ESMO's role in advancing new ideas and approaches as well as leading WCRP efforts
- Oversee directions of the future of climate modelling (based on outcomes from workshops, JSC strategic direction and international community activities)
- Include references to Cross-cutting themes (GPEX and cycles Tiger Teams)
- Better connection of objectives with other Core Projects
- Highlight CMIP and mention connections with CORDEX on regional model developments
- Include how objectives will drive the work of the WGs
- Aspects related to model biases and model improvement/development should be highlighted



Future plans: Climate Modelling

Several modelling workshops have been organised in 2022 and 2013:

- Model Hierarchies workshop (Stanford, USA, August 2022)
- WCRP km-scale modeling workshop (Boulder, USA, October 2022)
- Analysis of PPEs in Atmospheric Research (APPEAR) workshop (online, October 2022):
- 6th WGNE workshop on systematic errors in weather and climate models (Reading, UK, November 2022)
- Joint WGCM-WGNE meeting (Boulder, USA, November 2022)
- WGSIP-24 (Reading, UK, March 2023)

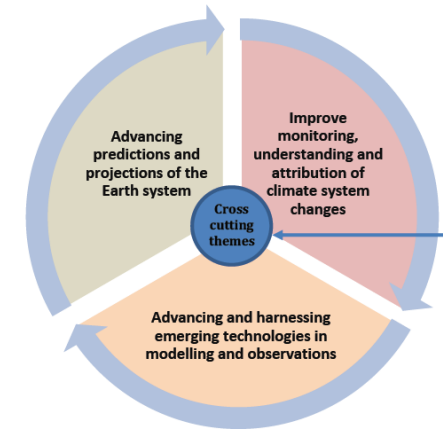


ESMO will oversee the strategic direction of the future of climate modelling taking forward and coordinating outcomes from these workshops, JSC strategic direction and international community activities including CMIP and CORDEX (with RiFS).

Future plans: Reanalysis and DA

ESMO's strategic plan includes a strong focus on reanalysis and data assimilation:

- For model initialisation, calibration and evaluation, use of DA increments
- Use of observational data sets as input to data assimilation and reanalyses
- Common understanding of reanalysis uncertainties and common standards for reanalysis evaluation with application-oriented focus

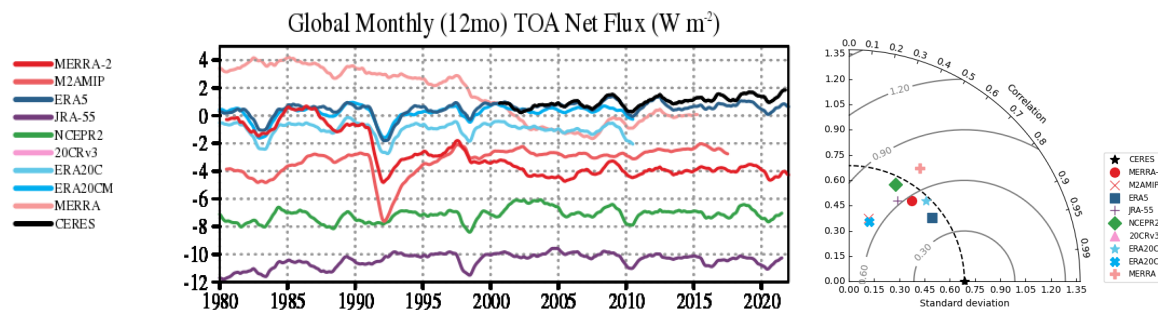


First steps: Engage on these topics across the ESMO WGs and with the other core projects and LHAs

Future plans: Reanalysis and DA

TIRA - Task team for the Intercomparison of ReAnalysis

- TIRA was charged with developing a white paper to consider 1) the need for a reanalysis WG, 2) what it's mission would be
- WG should consider the Earth System
- Membership would include ES reanalysis developers and the WCRP panels to facilitate two way discussions including new results, best practices and fit to purpose
- WG would not necessarily carry out Reanalysis Intercomparison Projects (RIPs), but facilitate the communications between panels, developers and the RIPs that WCRP panels design
- Name: WCRP Earth System Reanalysis Intercomparison and Evaluation group (ESRIE)?
- **Goal: based on updated white paper TIRA established as WG of ESMO**



Future plans: Observations

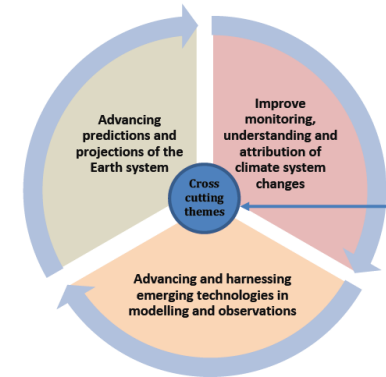
Plan to establish two additional observational WGs

WG on Observational Requirements within WCRP (WGOR)

- Global survey of observational needs to support model evaluation that goes beyond ECVs.
- Coordinate solicitation and collection of observational requirements for carbon cycle monitoring (to be provided to GCOS)
- Establish strong interface to space agencies through the CEOS/CGMS Working Group on Climate to provide guidance on the needs of the WCRP community for space-based observation

WG on Systematic Errors in observational Data (WGSED)

- Develop a common understanding of observational uncertainties via promotion of common vocabularies, concepts, and standards
- Develop methodologies and tools for handling observational uncertainties, e.g., for binning uncertainties that are correlated across space and time.
- Organisation of observation inter-comparison projects to identify and correct systematic errors
- Implementing metrology concepts to quantify uncertainty in observational data sets at different time and space scales.



Linkages with Core Projects, Lighthouse Activities etc.

- Strong collaboration with Digital Earths Lighthouse activity on the km-scale activity.
- ESMO was presented at various meetings of the other core projects and LHAs as a starting point for potential collaborations, e.g.:
 - EPESC (March 2023) topics around DCP, DA methods for climate, Reducing systematic model biases, Design and requirements of observational systems, Monitoring and predicting Extremes
 - SLC (March 2023) topics around CMIP7 scenario design, Quantifying changes in the carbon cycle, Monitoring and Predicting Extremes, TCRE assessment, links from GCM to IAM communities
 - GEWEX (May 2023) topics around Understanding of the water and energy cycle processes, Reducing systematic model biases, Monitoring and predicting Extremes
- More detailed plans and collaborative activities will be developed based on the expertise of the new SSG.

Partnerships with entities outside of WCRP

- External partners of ESMO will include, but are not limited to, the Global Climate Observing System (GCOS); the Global Ocean Observing System (GOOS); the CEOS/CGMS Working Group Climate (WG Climate); the World Weather Research Programme (WWRP) and the Global Atmosphere Watch (GAW) of the World Meteorological Organization (WMO); Future Earth; and the Global Carbon Project.
- ESMO will foster all existing collaborations of its WGs with external partners and will establish currently missing collaborations via specific activities and events.