ESMO
Earth System Modelling and Observations

WCRP
World Climate Research Programme

WCRP & ESMO introduction

ESMO IPO

WGNE39-WGSIP25 annual meeting

WCRP – mission and scientific foci

MISSION (2019–2028):

To coordinate and facilitate international climate research to develop, share, and apply the climate knowledge that contributes to societal well-being.

WCRP's objectives on these foci areas is achieved through its:

- six Core Projects
- six Lighthouse Activities
- the WCRP Academy.

I. A hierarchy of simulation tools
II. Sustained observations and reference data sets
III. Need for open access
IV. High-end computing and data management

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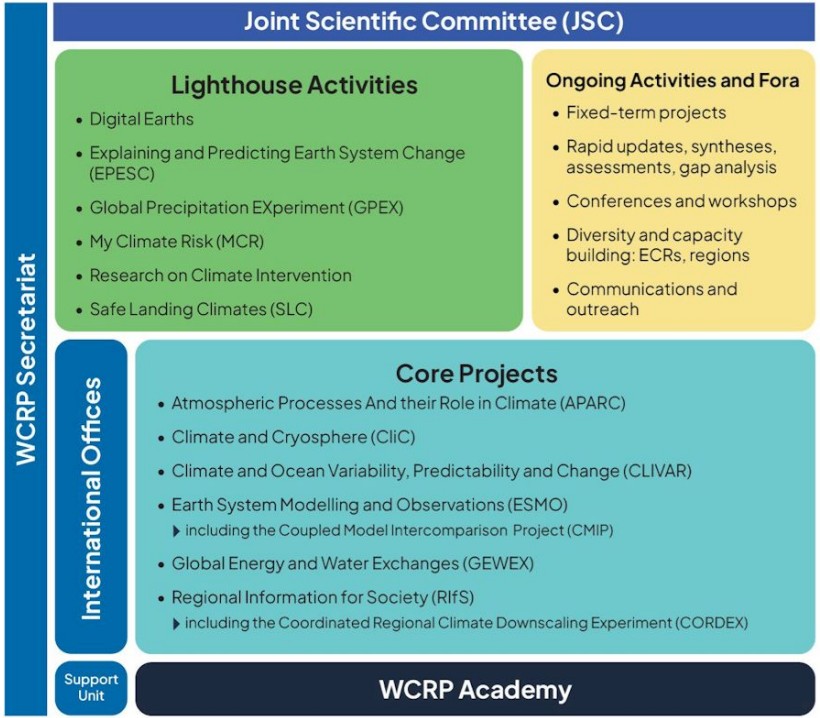
WORLD METEOROLOGICAL ORGANIZATION
unesco Intergovernmental Oceanographic Commission
International Science Council

WCRP Organisational structure



Core Projects

- Long-term activities that are dedicated to specific aspects of climate science within WCRP
- Are the home to various scientific communities – across oceans, cryosphere, land, and atmospheric science domains; process studies, modelling, and observations; and regional climate information
- Supported by International Project Offices with oversight by the WCRP Secretariat

- **Atmospheric Processes and their Role in Climate (APARC)**
- **Climate and Cryosphere (CliC)**
- **Climate and Ocean Variability, Predictability and Change (CLIVAR)**
- **Earth System Modelling and Observations (ESMO)**
- **Global Energy and Water Exchanges (GEWEX)**
- **Regional Information for Society (RIfS)**

Plan and carry out community activities targeting scientific and societal priorities.

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Atmospheric Processes And their Role in Climate (APARC)

Mission: enhance the understanding of how atmospheric chemical and physical processes interact with Earth's climate system.

- Assessment of long-term climate records
- Improved understanding of atmospheric composition processes
- Understanding atmospheric dynamics and climate variability to provide better climate projections on scales from seasonal to centennial

Assessment reports and community led white papers:
E.g.: assessment reports on stratospheric composition

Cryosphere and Climate (CLiC)

Mission: advance understanding of climate-driven changes in the frozen parts of our planet and to support efforts to mitigate and adapt to their impacts on ecosystems and human society.

- MIPs (ISMIP, MISOMIP, SIMIP, GlacierMIP)
- Research projects (e.g. Arctic Sea Ice Working Group..)
- Activities and interdisciplinary networks (eg. Permafrost Carbon Network..)

Assessment reports or community-led white papers:
E.g.: The Arctic Freshwater System in a Changing Climate. WCRP Climate and Cryosphere (CliC) Project, Arctic Monitoring and Assessment Programme (AMAP), International Arctic Science Committee (IASC), 2016

Climate and Ocean Variability, Predictability and Change (CLIVAR)

Mission: investigates the dynamics, the interaction, and the predictability of the climate system with emphasis on ocean-atmosphere interactions.

Objective: Facilitates observations, analysis, predictions of variability and changes in the climate system.

- Understanding the ocean's role in climate variability, change, and transient sensitivity;
- Understanding the drivers of regional climate phenomena that provide predictability on different time scales;
- Provision of coordinated observations, analyses and predictions of variability and change in the Earth's climate system;
- Development and evaluation of climate simulations and predictive capabilities.

Protocol papers…

Global Energy and Water Exchanges(GEWEX)

Mission: understanding Earth's water cycle and energy fluxes at and below the land surface and in the global atmosphere. It facilitates improvement of observations, process understanding and model improvements.

Objective: point out important gaps in knowledge and implements ways to fix those gaps, whether through new studies, reviews of datasets, gatherings of experts, or other opportunities.

Global observational datasets assessments
Precipitation, Water Vapor, Clouds, Radiative Fluxes, Aerosols, Earth's Energy Imbalance
One planned for land surface energy and water cycle closure

Evaluation studies
Upper Tropospheric Clouds and Convection Process Evaluation Study (GASS)

Regional Information for Society (RIfS) – includes CORDEX!

Mission: contribute to advance international collaboration and consensus to fill the gap between climate research and the information used for decision-making.

Objective: grow the foundations for effective links between climate research and the information needs of society.

For a science that is:
- aligned with the scales of relevance to society's decision contexts
- enabled in a co-creation/co-production framework

CORDEX provides RIfS with the necessary tools to advance the understanding of primary climate drivers of risk for specific sectors on multiple temporal and spatial scales, and their relation to regional climate change and variability.

Earth System Modelling and Observations (ESMO) – includes CMIP!

Mission:
Coordinate, advance and facilitate modelling, data assimilation and observational activities within WCRP.

Address critical gaps in our ability to monitor, predict, and forecast the climate across different timeframes and spatial scales.

Objectives:

- Advancing predictions and projections of the Earth system
- Improving monitoring, understanding and attribution of climate system changes and impacts
- Advancing and harnessing emerging technologies

Cross-cutting themes: e.g. Carbon Cycle quantification..

Modelling community within ESMO

Working Group on Coupled Modelling (WGCM)
Evaluation and development of coupled climate models

Working Group on Numerical Experimentation (WGNE)
ESMs development (design, implementation, error diagnosis, revisions)

Coupled Model Intercomparison Project (CMIP)
- Understanding of past, present and future climate changes
- Model performance evaluation

Working Group on Subseasonal to Interdecadal Prediction (WGSIP)
- Numerical experimentation for S2I variability and prediction

Decadal Climate Prediction Project (DCPP)
- Prediction of annual, multi-annual to decadal timescales

Observational community in WCRP

Topic-specific observational groups in core projects

GSOP
- CLIVAR Global Synthesis and Observations Panel

GDAP
- GEWEX Data and Analysis Panel

GASS
- GEWEX Global Atmospheric System Studies

APARC activities on
- Stratospheric ozone
- Temperature Trends

CLiC activities on
- Sea Ice Processes
- Permafrost Carbon Network

External Partners

GAW
- Global Atmosphere Watch Programme

GCOS
- Global Climate Observing System

GOOS
- Global Ocean Observing System

CEOS/CGMS WG Climate
- Committee for Earth Observation Satellites / Coordination Group of Meteorological Satellites

ESMO–WGORC: Working Group on Observations for Researching Climate

Research

- Identify research gaps and propose ideas to bridge this gap
- Develop and recommend precise methods for verification and intercomparison of different datasets

Communication

- Liaison platform with observational communities, space agencies and data centres
- Define and communicate specific user needs, research and access requirements as a single voice
- Seek for advice from and for the community – gap analysis

Dissemination

- Gather community needs in terms of observational data requirements for different aspects of ES modelling (3 panels in WGORC)
- Establish guidelines for data standards and structures (including non-gridded data)
- Promote curation and usability of specific observational datasets

obs4RIP (reanalyses, initialisation and prevision)
- near-real-time datasets
- Uncertainty quantification

obs4ET (emerging technologies)
- ML/AI training
- Km-scale (large datasets)

obs4MIPs (for ESMs)

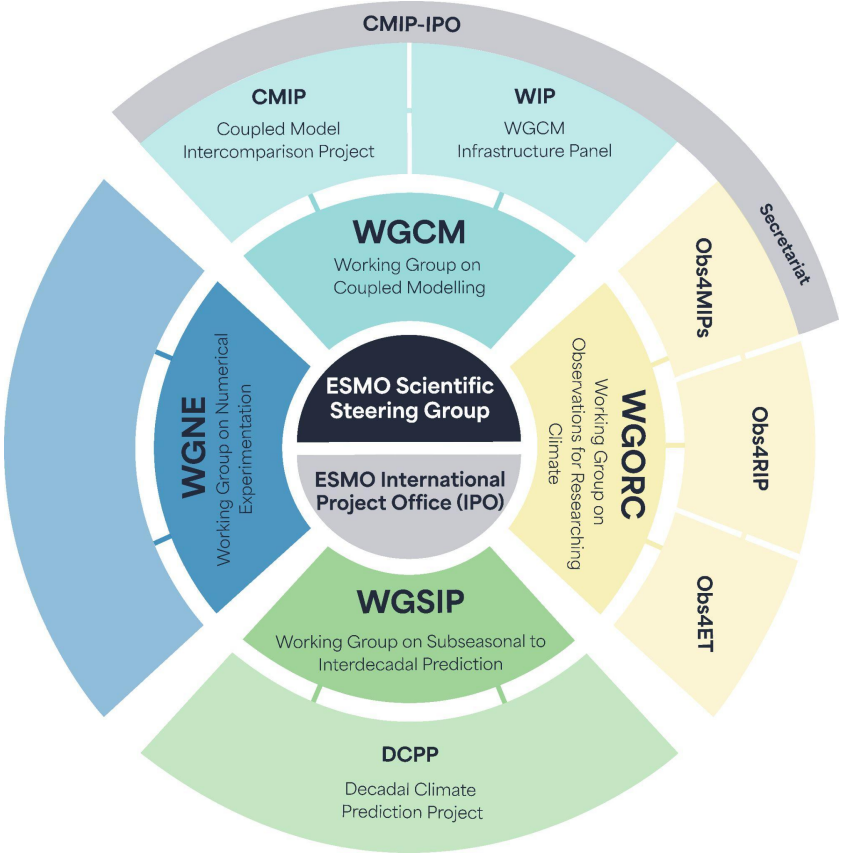
ESMO Structure

WORKING GROUPS

- Working Group on Coupled Modelling (WGCM)
- Working Group on Subseasonal to Interdecadal Prediction (WGSIP)
- Working Group on Numerical Experimentation (WGNE)
- Working Group on Observations for Researching Climate (WGORC) => NEW!

PROJECTS & PANELS

- Coupled Model Intercomparison Project (CMIP)
- WGCM infrastructure Panel (WIP)
- Observations for Model Intercomparisons Project (Obs4MIPs)
- Decadal Climate Prediction Project (DCPP)



Lighthouse Activities

- Designed to be ambitious and interdisciplinary, and work across core projects.
- Goal is to rapidly advance the major and new scientific approaches, technologies, and institutional frameworks required to meet society's need for robust and actionable climate information.

- **Digital Earths (DE)**
- **Explaining and Predicting Earth System Change (EPESC)**
- **Global Precipitation Experiment (GPEX)**
- **My Climate Risk (MCR)**
- **Research on Climate Intervention (CI)**
- **Safe Landing Climates (SLC)**

Digital Earth

Mission: push the co-development of high-resolution Earth-system modeling and the exploitation of billions of observations with digital technologies from the convergence of novel High-Performance Computing (HPC), big data, and Artificial Intelligence (AI) methodologies. The core of Digital Earths is to develop generic software-hardware solutions that allow simulation models and data assimilation to perform several orders of magnitude more efficiently.

Objective:carry out research activities that support the establishment of integrated interactive digital information systems that provide information on the past, present, and future of our planet.

Explaining and Predicting Earth System Change (EPESC)

Mission: design, and take major steps toward delivery of, an integrated capability for quantitative observation, explanation, early warning, and prediction of Earth System change on global and regional scales, with a focus on multi-annual to decadal timescales.

3 main themes:

- Observing and modeling Earth system change
- Integrated attribution, prediction, and projection (including early warning and the potential for abrupt change)
- Assessment of current and future hazards

Concrete activities

1. Scientific coordination
   a. Meetings / workshops / expert meetings
      i. Periodic (e.g. ICR, numerical errors workshop, etc.)
      ii. Ad Hoc (e.g. coordination of a white paper..)
   b. Community papers (e.g. ocean spin-up)
   c. Coordination of measurement campaigns
   d. Intercommunity exchange platform
   e. Task teams establishment: short-term, focused goal
2. Lobbying coordination for forthcoming international calls (e.g. Jones at al. 2024)
3. Web presence & open access
4. Prices
5. Schools/training & capacity building (engagement with Global South)

Engaging in WCRP

Open to everyone !

Aiming at balanced and equitable panels:

- Career stage
- Gender
- Geographical representation
- Expertise

Members recruitment

Transparency effort and wide diffusion of membership openings:

- Recruitment through **Open Call**
- Communication on opportunities via newsletter, LinkedIn, mailing-lists, etc.

WCRP is committed to integrating EMCRs into its activities!

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Thank you!

wcrp-climate.org

wcrp-esmo.org