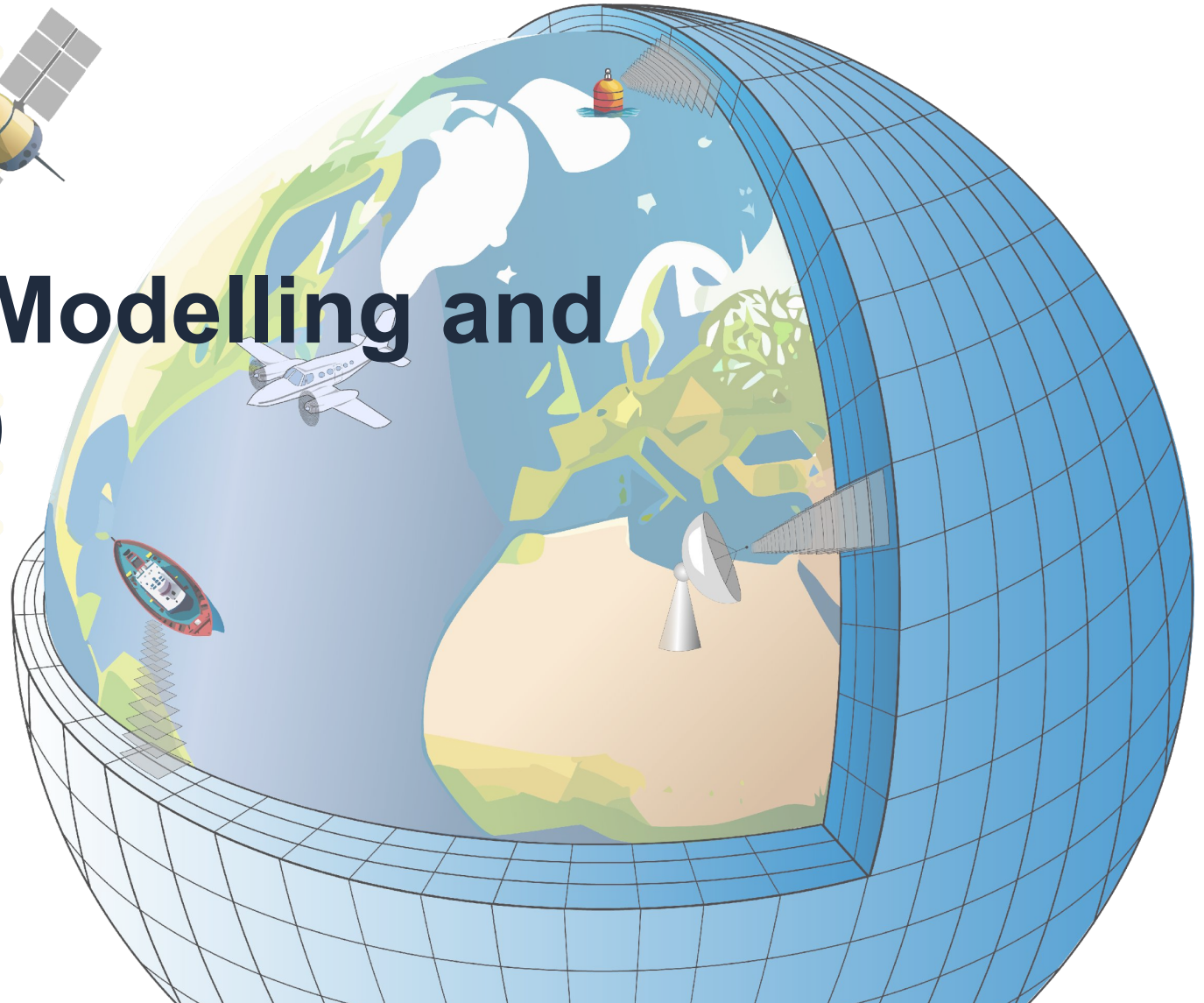
ESMO
Earth System Modelling and Observations

WCRP
World Climate Research Programme



WCRP Earth System Modelling and Observations (ESMO)

Coordinating modelling and observations to understand our climate

Susann Tegtmeier, ESMO co-chair
Fanny Adloff, ESMO IPO director

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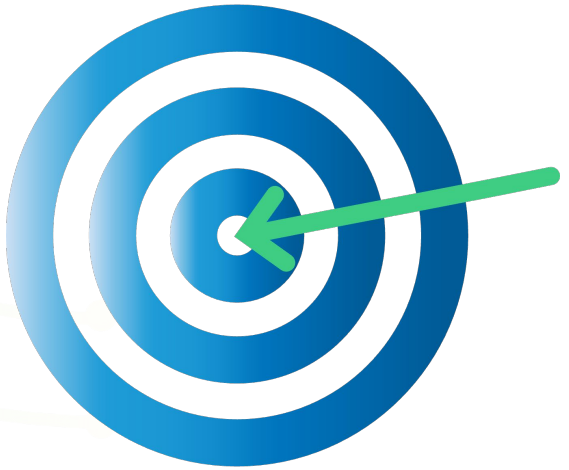
Our Objectives

Advancing predictions and projections of the Earth System

Improving monitoring, understanding and attribution of climate system changes and impacts

Advancing and harnessing emerging technologies



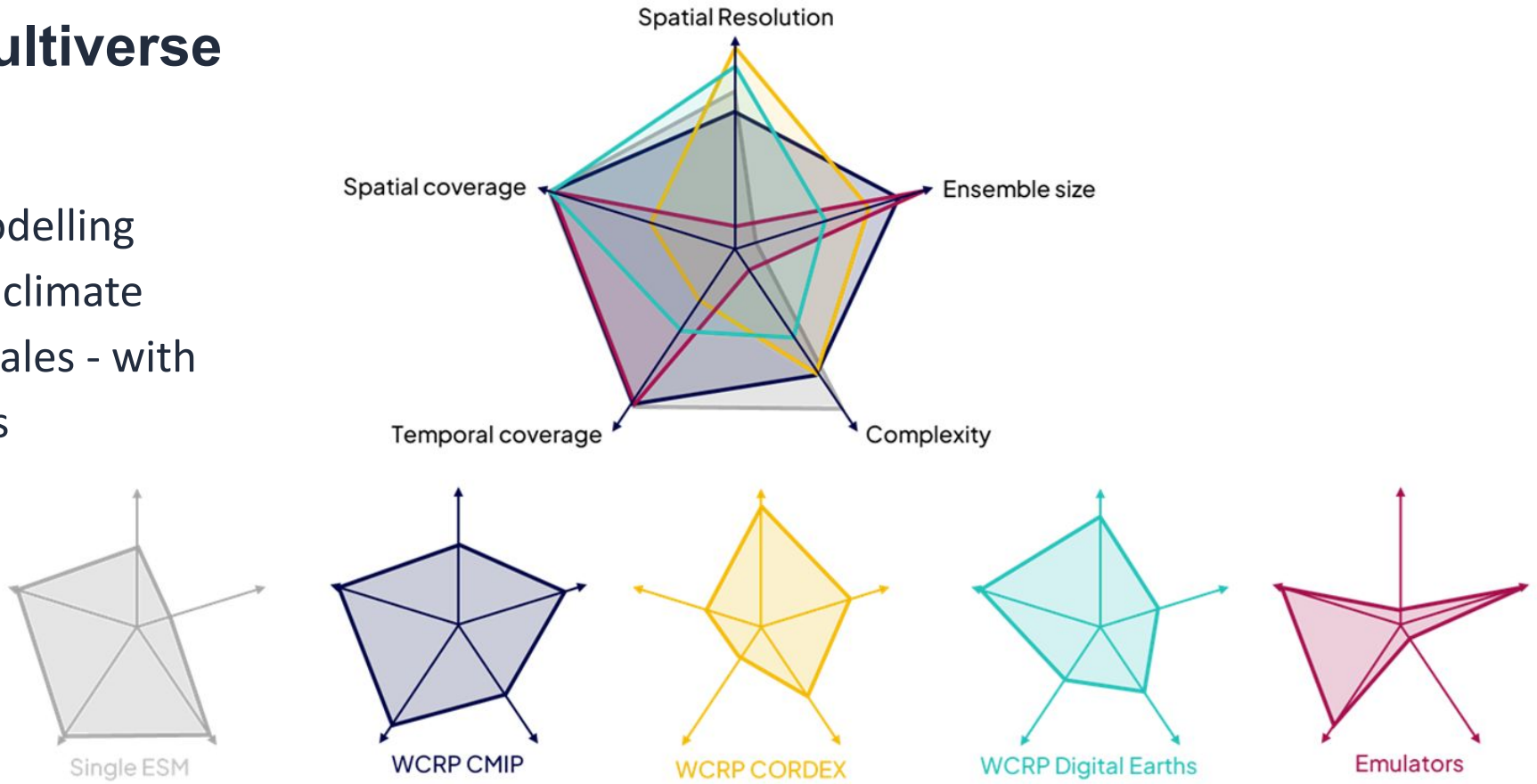
Mission

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.

The WCRP Modelling Multiverse

Challenges in climate modelling:
Accessible, reliable and useful modelling systems that simulate the Earth's climate system - across space and time scales - with demonstrable fidelity and process representation



Adapted from Dingley at al. 2023, https://zenodo.org/records/8047805

Approach: Explore all the dimensions of the modelling multiverse across WCRP activities and deliver the best tools to address current and future scientific and societal challenges.

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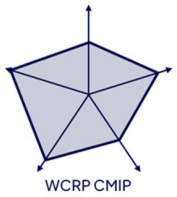
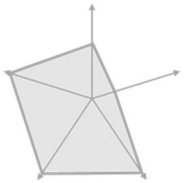
Modelling community within ESMO





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)

ESMO

Interactions

Coordination

Shared activities

Cross-cutting themes

New impulses

Coupled Model Intercomparison Project (CMIP)

- Understanding of past, present and future climate changes
- Model performance evaluation

Working Group on Subseasonal to Interdecadal Prediction (WGSIP)

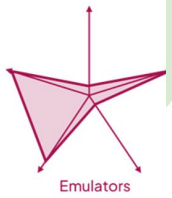
- Numerical experimentation for S2I variability and prediction

Decadal Climate Prediction Project (DCPP)

- Prediction of annual, multi-annual to decadal timescales

Task Team on Climate Emulators

- Brings together modeling experts interested in emulators
- Taxonomy paper in planning



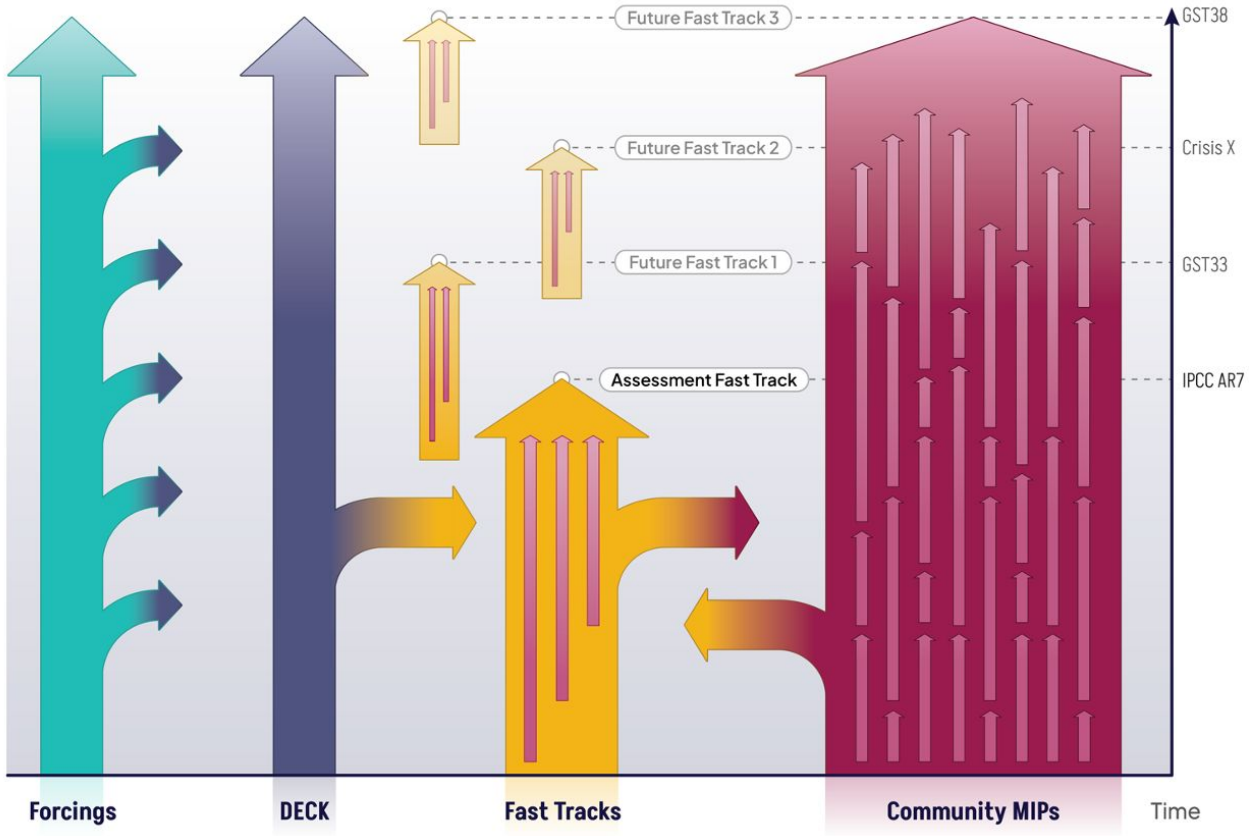
km-scale climate modelling group – joint with Digital Earth

- Foster a global research network in km-scale modelling of the Earth system and individual components
- Isolate common biases/issues and ideally develop strategies

Coupled Model Intercomparison Project (CMIP)

- More continuous approach with small targeted “Fast Track” experiments responding to climate assessment and service goals
- First **“Assessment Fast Track”** will deliver to the IPCC AR7
- **CMIP infrastructure, standards and tools** support ongoing science (Community MIPs) and assessment activities e.g., Global Stocktake (GST).
- Design reflects extensive **feedback** from the modelling centres and wider user community.

An evolving CMIP design



Courtesy CMIP IPO

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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 & GLASS
- GEWEX Global Atmospheric System Studies
- GEWEX Global Land-Atmosphere. System Studi

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

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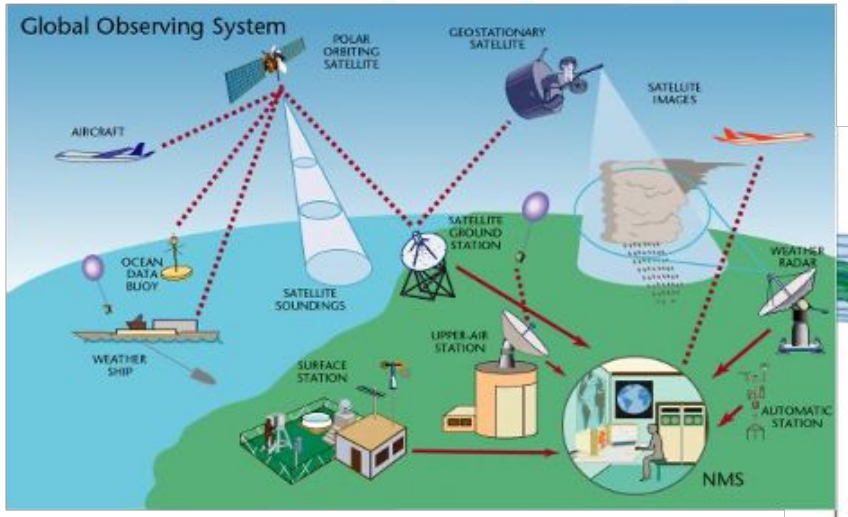
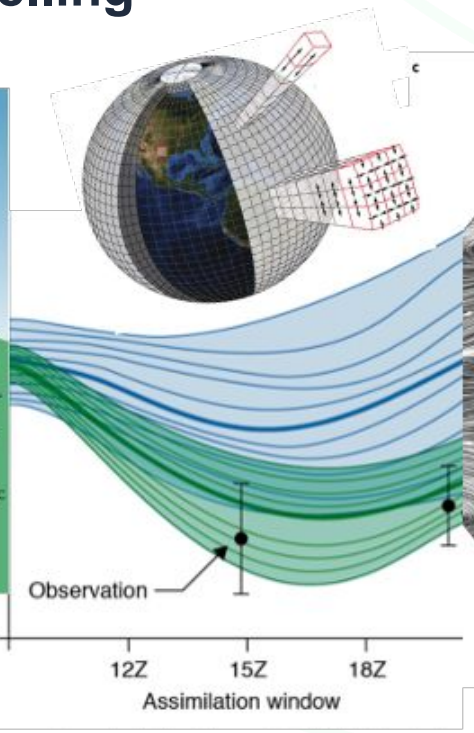
New challenges and opportunities for observation-model synergies

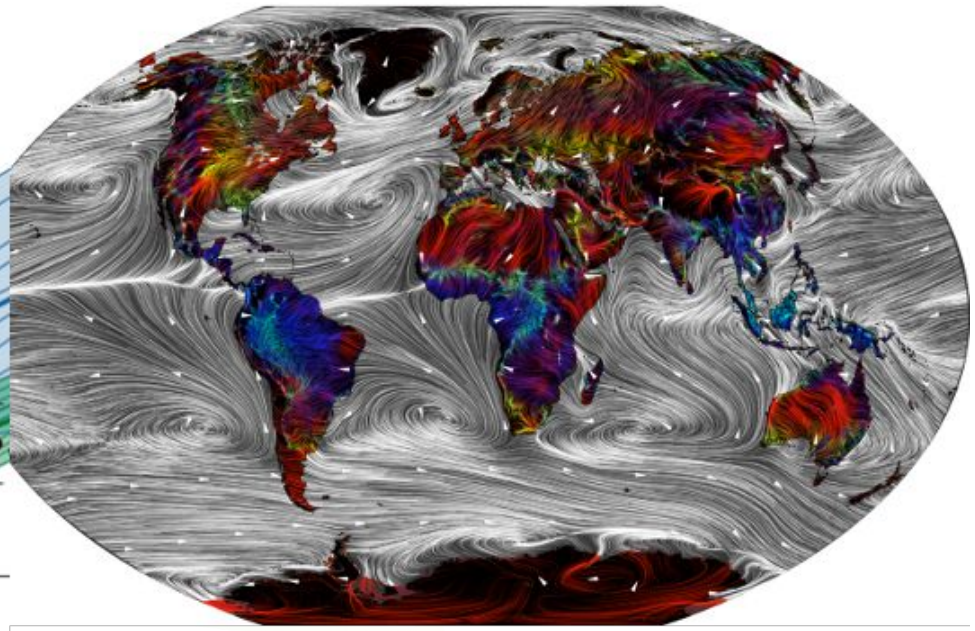
- Data-fusion for climate
- Emerging technologies
- Data-driven modelling
- Reanalysis and data assimilation



WMO Global Observing system



Cambridge University Press Climate Model and ECMWF Data Assimilation schematic



Kling and Ackerly, 2020

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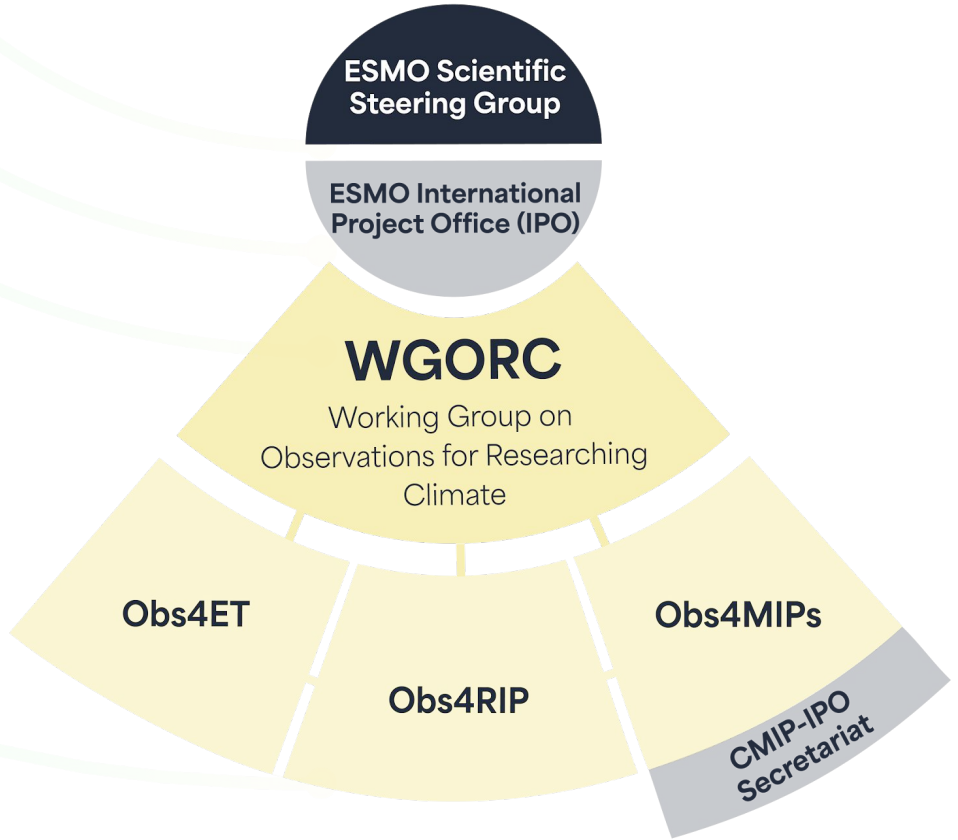
New **W**orking **G**roup on **O**bservations for **R**esearching **C**limate **(WGORC)**

- Identify and address **research gaps in climate observation data** and act as a facilitator for **collaboration across diverse research and industry sectors.**
- Focus on advancing both the use and development of **reanalysis, initialization, and prediction (RIP)** data to improve climate models and enhance future forecasting capabilities.
- Explore how **emerging technologies (ET)**, such ML, AI and km-scale models & observations, can enhance the use and application of climate data.
- **obs4MIPS** as WGORC panel enhances accessibility to observational data for climate model evaluation, development, and research by aligning datasets with CMIP standards.



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Get in touch!

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