



**WGCM-24, 8 December 2021**

*WGNE co-chairs: Carolyn Reynolds (NRL) and Nils Wedi (ECMWF). WCRP Secretariat: Nico Caltabiano*  
*Members: Tim Graham-Met Office (UK), Romain Roehrig-CNRM/MeteoFrance (France), Gunther Zangl-DWD (Germany), Peter Lauritzen-NCAR (USA), Fanglin Yang-NOAA/NCEP/EMC (USA), Masashi Ujiie-JMA (Japan), Ron McTaggart-Cowan-ECCC (Canada), Ariane Frassoni-CPTEC (Brazil), Oscar Alves-BOM (Australia), Elena Astakhova-Rushydromet (Russia), Jian Sun-CMA (China), Francois Engelbrecht-U. Witwatersrand (South Africa).*

# What is the Working Group on Numerical Experimentation?

## Our Mission

Sensitivity to model formulation

Diagnostic Strategies & Tools

Systematic Errors

Develop Solutions

Shared Knowledge

WGNE fosters the **development of atmospheric models** for use in weather prediction and climate studies on **all time scales**, and **diagnosing and resolving shortcomings**.

*WCRP Joint Scientific Committee (JSC)*



*Commission for Atmospheric Sciences (CAS)*



**Research Board**

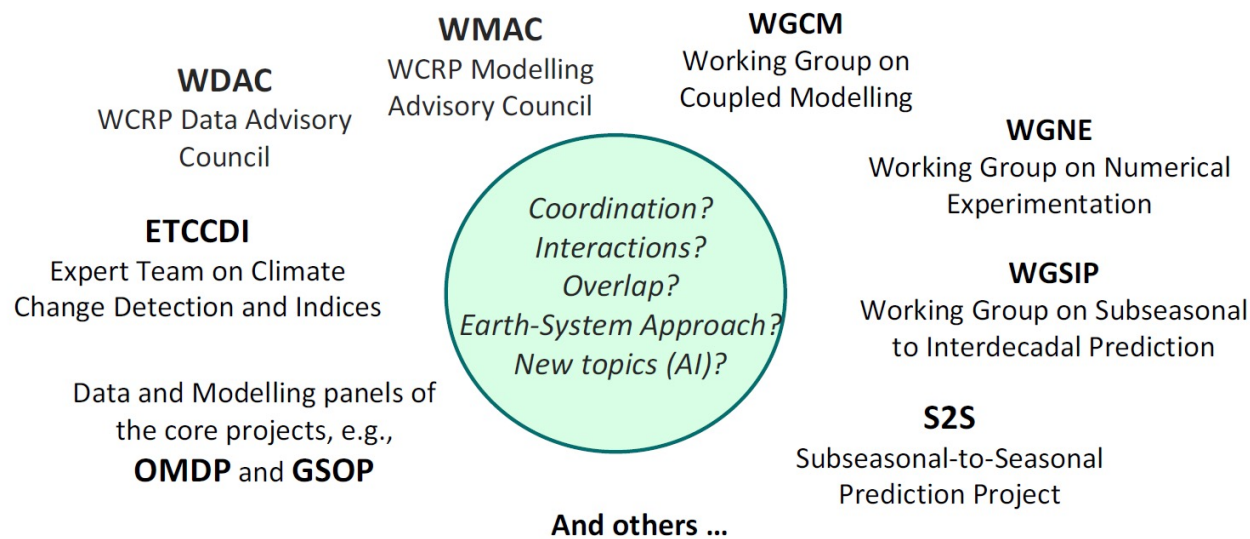
External Groups (GASS...)

WGNE began under GARP in 1967  
Re-established under WCRP & CAS in 1985  
*Under RB and part of new WCRP Earth System Modelling and Observations (ESMO) Home*

# ESMO: Earth System Modeling and Observations Core Project

A new core project to bring together Models, data and Observations

## Models, data and observations within the WCRP family



## The way forward

Decision at the last WCRP JSC meeting (41B) to start the establishment of the **ESMO core project in 2021**



## WGNE: Current and Future Activities

- **MJO Task Force:** Focusing on propagation over Maritime Continent, teleconnections
- **Joint (with WWRP) Working Group on Forecast Verification Research:** <https://community.wmo.int/activity-areas/wwrp/wwrp-working-groups/wwrp-forecast-verification-research>
- **Promote Exascale Awareness, share knowledge on code development for exascale architectures:** High performance computing (HPC) readiness and the road to Exascale white paper available compiled by Nils Wedi [http://wgne.meteoinfo.ru/wp-content/uploads/2020/12/WGNE\\_exascale\\_v2.pdf](http://wgne.meteoinfo.ru/wp-content/uploads/2020/12/WGNE_exascale_v2.pdf)
- **Organization of Systematic Error workshops**
  - 5<sup>th</sup> workshop in 2017 led to Systematic Error survey, identification of convection, surface fluxes, diurnal cycle, microphysics, model uncertainty priorities. [http://wgne.meteoinfo.ru/wp-content/uploads/2019/02/WGNE\\_Systematic\\_Error\\_Survey\\_Results\\_20190211.pdf](http://wgne.meteoinfo.ru/wp-content/uploads/2019/02/WGNE_Systematic_Error_Survey_Results_20190211.pdf)
  - 6<sup>th</sup> Workshop will be held 31OCT-4NOV 2022 at ECMWF ([events.ecmwf.int/event/241](https://events.ecmwf.int/event/241))
- **Work with DAOS (Data Assimilation and Observing Systems) and OMDP (Ocean Model Development Panel) to explore joint project on coupled data assimilation:** <http://wgne.meteoinfo.ru/activities/scoping-meeting-on-coupled-model-initialisation/>
- **Evaluate community progress and plans for AI/ML applications:** WGNE members contributing to the Research Board AI/ML Task Team, review community efforts at yearly meetings
- **WGNE “Blue Book”:** providing concise yearly updates on system development, available on WGNE web site <http://wgne.meteoinfo.ru/publications/wgne-blue-book/>
- **Leading or involved with joint model intercomparison projects**



# MJO-TF

Co-chairs: Daehyun Kim (University of Washington); Charlotte DeMott (Colorado State University)

## Major accomplishments

- **Review articles** on the MJO-MC interaction, MJO process-oriented diagnostics, moisture mode theory, and the MJO-QBO connection.
- Significant progress on the potential use of **Artificial Intelligence (AI)/Machine Learning (ML)** for modeling and prediction of the MJO.
- Development and application of various **process-oriented diagnostics**, especially those for MJO teleconnections.

<http://wgne.meteoinfo.ru/activities/on-going-activities/wgne-mjo-task-force/>

# WGNE-S2S-GAW Aerosol Project

Evaluating the impact of aerosols on Numerical Weather and Subseasonal Prediction

Ariane Frassoni, Angela Benedetti, Frederic Vitart, Francois Engelbrecht, Georg Grell, and Paul Makar

## Experiments - Direct effect

### Project Goals

#### Identify:

- *the importance of aerosols for the predictability of the atmosphere in a systematic approach*
- *the atmospheric model quality for air quality forecasting*
- *Analyse capabilities of NWP models to simulate the impact of aerosols on NWP and S2S*

Short-range Regional domains	S2S Global domain
<b>Period of simulations:</b> 2017-2019 (2016 optional)	<b>Hindcasts:</b> 2003-2019
<b>Forecast length:</b> 72h from 00:00 UTC	<b>Forecast length:</b> At least 32-day long simulations
<b>Time resolution:</b> 3h	<b>Time resolution:</b> 6h
<b>Configuration:</b> according with modelling groups capability	<b>Configuration:</b> Initialized by own analysis/re-analysis Minimum 5-member ensemble
<b>Aerosols:</b> Focus on different aerosol species according with region of interest Climatological vs interactive	<b>Aerosols:</b> Biomass Burning and Dust Climatological emissions vs prescribed observed emissions

<http://wgne.meteoinfo.ru/activities/on-going-activities/>

# Model Uncertainty Model Intercomparison Project (MUMIP)

Joint WGNE/PDEF project led by Hannah Christensen: [mumip.web.ox.ac.uk](http://mumip.web.ox.ac.uk)

## Welcome to the Model Uncertainty - Model Intercomparison Project (MUMIP)

An initiative of the WCRP Working Group for Numerical Experimentation and the WWRP Predictability, Dynamics and Ensemble Forecasting Working Group

### Introduction

MU-MIP is an international project which seeks to characterise systematic and random component of model error across many different climate models. This is the first coordinated intercomparison of random model error, and will be used to inform stochastic parametrisation development.

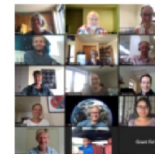
Some key questions:

- How should we best represent model uncertainty/random error using stochastic approaches?
- To what extent should this representation be model specific or a fundamental property of atmospheric models?
- Are current approaches justified? How can they be improved?
- Can a coarse-graining approach be used to validate and compare high-resolution simulations and their behaviour across scales?

### Contact

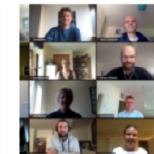
The MU-MIP team consists of scientists from 10+ institutes spanning three continents. Please get in touch by emailing [hannah.christensen@physics.ox.ac.uk](mailto:hannah.christensen@physics.ox.ac.uk) if you would like to get involved!

### News



Technical discussion meeting

26 August 2021



MUMIP Meeting 2

23 June 2021



Second MUMIP Team meeting scheduled

20 May 2021



Developmental Testbed Center funding for MUMIP work

24 March 2021



MUMIP Launch Meeting

24 September 2020



Hello world

22 September 2020

# Coupled Initialisation

Tim Graham (WGNE), Julie Deshayes (OMDP), Baylor Fox-Kemper (OMDP), Andy Moore (DAOS), Members of OceanPredict and S2S



## Background

- At WGNE35 all groups expressed an interest in some form of joint project on coupled model initialisation
- Initial action to hold a scoping meeting to suggest possibilities to look into.
  - Held in January
  - Presentations from each of the interested groups followed by discussion
- Follow up meetings have been held since
- Also reached out to S2S and TPOS2020 communities.

## Challenges

- Different timescales present different problems
  - Tending towards shorter timescales (up to seasonal) at the moment. Can we learn something about model spin-up using the DA?
- Few centres currently have any sort of coupled DA system. Will need to design a project that is easy for centres to buy into.
- Probably too early for a comparison of strongly coupled DA.

## Summary:

- Various ideas have been suggested for possible projects
- Also options to join/extend existing projects under Ocean Decade
- Challenging to converge on a single project
- Any suggestions would be welcomed



## WGNE36, 1-4 November 2021

(Most) Presentations are available at [wgne.meteoinfo.ru/meetings/wgne36-meeting-presentations/](https://wgne.meteoinfo.ru/meetings/wgne36-meeting-presentations/)

### Discussion/Action items relevant for WGNE-WGCM collaboration

- Verification: Want to expand verification to earth system models, and better coordination/leveraging of process-based diagnostics across timescales.
  - Expansion of Joint (with WWRP) Working Group on Forecast Verification Research (JWGFVR) to include expertise relevant for climate, will ask ESMO/WWRP to consider expansion.
  - Promote collaboration between JWGFVR and DOE Coordinated Model Evaluation Capabilities (<https://cmec.llnl.gov>)
- Collaboration with Digital Earths: setup a meeting where chairs/volunteers can discuss which topics of interest/open questions could be followed up with priority; e.g. WGNE could collect and maintain a list of “must-have” variables/parameters starting from previous MIPs ? (WGNE co-chairs/volunteers, Digital Earths co-chairs, others from ESMO? Volunteers needed)
- Input from WGCM on 6th Workshop on Systematic Errors, 31OCT-4NOV 2022, ([events.ecmwf.int/event/241](https://events.ecmwf.int/event/241))

# Joint Working Group on Forecast Verification Research (JWGFVR)

Barbara Casati (ECCC), Caio Coelho (CPTEC/INPE), Thomas Haiden (ECMWF)

## Joint Working Group in Forecast Verification Research

<https://community.wmo.int/activity-areas/wwrp/wwrp-working-groups/wwrp-forecast-verification-research>



**Mission:** JWGFVR plans and facilitates the development and application of improved diagnostic verification methods to assess and enable improvement of the quality of weather forecasts, including forecasts from numerical weather and climate models. It also collaborates on forecast verification with WGNE and WCRP, and engages in the plans and implementation of the verification component of WWRP projects from their outset.

### Promote good verification practices :

- Verification tutorials
- Verification web-page
- WMO recommendation reports and standards for operational centers
- Verification software

### Advance verification research:

- Spatial verification method intercomparisons
- International workshops on verification methods
- Verification challenges
- Special issues & publications



### Support verification activities in the other WWRP/WMO projects and Working Groups



## Future Plans (to the end of 2023, and hopefully beyond ... )



### Maintaining JWGFVR Legacy:

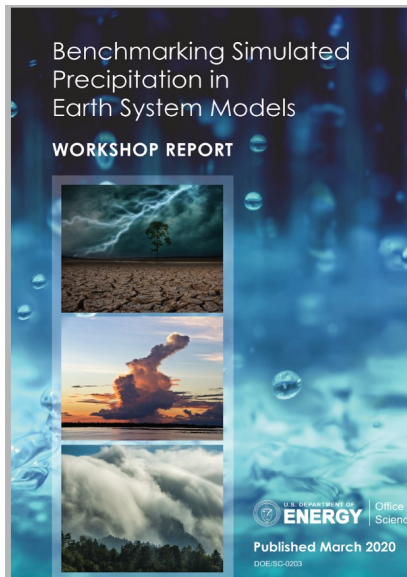
- Organize the 9<sup>th</sup> International Verification Methods Workshops (IVMW)
- Deliver verification tutorials
- Keep advancing **and operationalize** spatial verification methods (<http://projects.ral.ucar.edu/icp/>)
- Unify all **web resources** developed by the group in the past 20 years, as reference and legacy
- Keep supporting verification research activities in **WMO projects and WG** (PPP, HIW, S2S, Paris2024RDP, AvRDP2, Tropical Cyclones, ...)

### Re-newed Research Foci:

- **Processes diagnostics and ESM verification** (including the interaction of different variables and model components) in collaboration with modellers / WGNE and other WG (e.g., YOPPsiteMIP in PPP; Paris2024 for urban BL)
- **Verification for targeted downstream communities** (aviation, hydrology, urban)
- **Exploitation of data assimilation knowledge in forecast verification:** representativeness and observations uncertainty
- **Join efforts on model evaluation with the climate community** (both for upstream -modeling- and downstream -e.g. post-processing- use)

# A brief update on Benchmarking Simulated Precipitation in Earth System Models WGNE36

Min-Seop Ahn (LLNL), Peter Gleckler (LLNL-ret), Christian Jakob (U Monash), Jiwoo Lee (LLNL), Ruby Leung (PNNL), Angie Pendergrass (Cornell), Paul Ullrich (UCDavis), Michael Wehner (LBL) and many collaborators



## Baseline and exploratory metrics

- A limited set of routine or baseline metrics are being advanced for repeat use benchmarking via development of a quasi-operational capability
- Exploratory metrics are being investigated for a variety of characteristics lacking well-established performance tests (e.g., ARs, TCs)

[https://climatemodeling.science.energy.gov/sites/default/files/RGMA\\_Precip\\_Metrics\\_workshop\\_0.pdf](https://climatemodeling.science.energy.gov/sites/default/files/RGMA_Precip_Metrics_workshop_0.pdf)

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## Coordinated Model Evaluation Capabilities

<https://cmec.llnl.gov/>



### Goals

1. Develop robust **standards** for framing metrics and diagnostics packages.
2. Develop accompanying tools for **coordinated execution** of metric packages, and **visualization of / interaction with** metrics and diagnostics package output.
3. Build **connections across projects and agencies** related to model evaluation activities. Fostering interactions with multiple research groups and individual PIs.

**Notably:** CMEC is targeted towards outsourcing development activities to the evaluation developers, rather than taking ownership in-house

## WGNE37-WGCM25, NCAR, Week of 7 November 2022

- **Potential topics for joint sessions**

- Systematic error priorities in component and coupled systems
  - Could solicit updates from WGCM and WGNE members on model biases and their mitigation.
  - Perhaps leverage or summarize presentations from the Systematic Error Workshop that will be occurring the week before.
- Exascale challenges
- Digital Earths Lighthouse activity
- Applications of Machine Learning
- Verification examples and priorities
- Land-atmosphere interaction joint project (with GLASS?)



## Other Efforts of Potential Interest

- Other Model Intercomparison Projects

- 2nd phase of “Grey Zone” project: Scale-awareness, stochasticity and convective organization. Will focus on shallow convection, then deep convection. Led by GASS, leverage EUREC4A  
<https://www.metoffice.gov.uk/research/approach/collaboration/grey-zone-project/index>
- WGNE Surface flux intercomparison project: Focus on fluxes for short-term (5-day) forecasts from 10 modeling-centers, currently being evaluated by C. DeMott: <http://wgne.meteoinfo.ru/meetings/presentations-on-jwgfvr-and-wgne-informal-telecon-on-process-diagnostics-june-9/>
- DIMOSIC (Different models same initial conditions), led by Linus Magnusson, focus on evaluation of forecast divergence due to model differences out to 10 days.
- [WGNE Computational Table](http://wgne.meteoinfo.ru/nwp-systems-wgne-table/): Provides specifications on global and regional weather forecast models.  
<http://wgne.meteoinfo.ru/nwp-systems-wgne-table/>

Newest updates on these topics presented at WGNE36 are available on the WGNE web site