



Working Group on Numerical Experimentation (WGNE)

41st Session of the WCRP Joint
Scientific Committee

Keith Williams and Carolyn Reynolds (co-chairs)

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What is WGNE?

Our Mission

WGNE fosters the **development of Earth system models (ESMs)** 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

Sensitivity to model formulation

Diagnostic Strategies & Tools

Systematic Errors

External Groups (GASS...)

Develop Solutions

Shared Knowledge

WGNE began under GARP in 1967
Re-established under WCRP & CAS in 1985
Moving under Research Board 2020

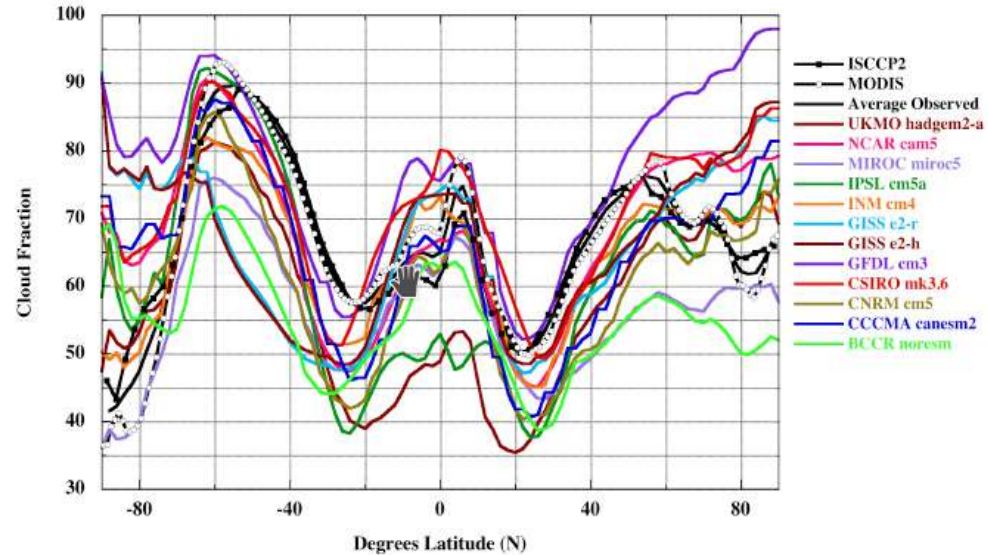


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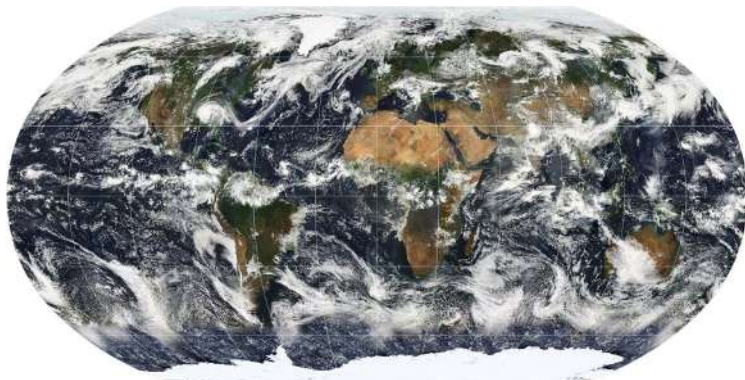
Understanding Systematic Model Errors

- Systematic errors often differ between modelling systems, but can sometimes be common.
- Mapping of errors to ESM components is difficult because of complex interactions.
- Model Intercomparison Projects (MIPs) a practical solution: WGNE supports many MIPs

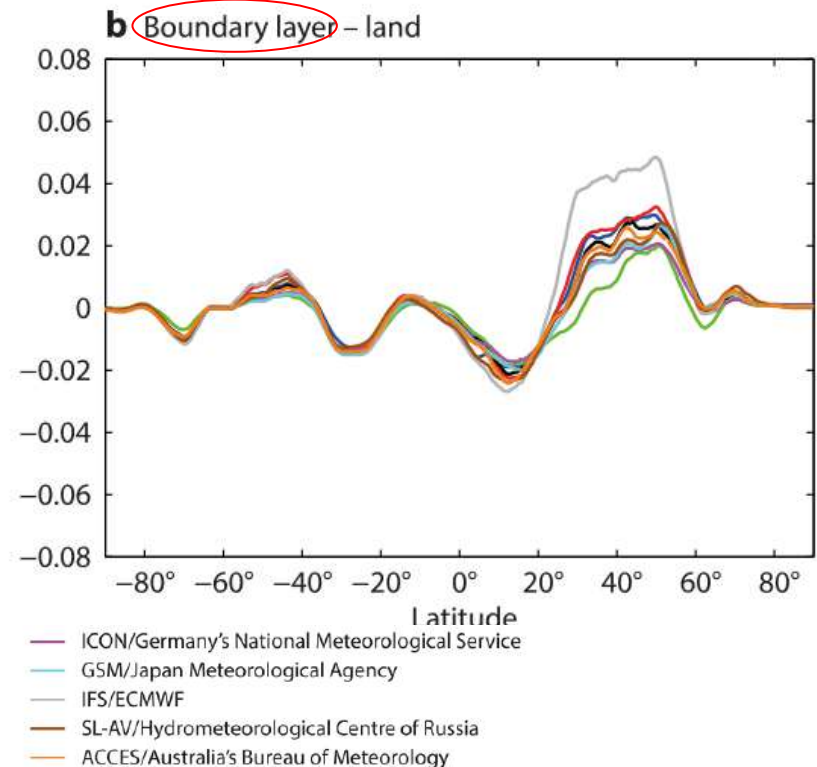
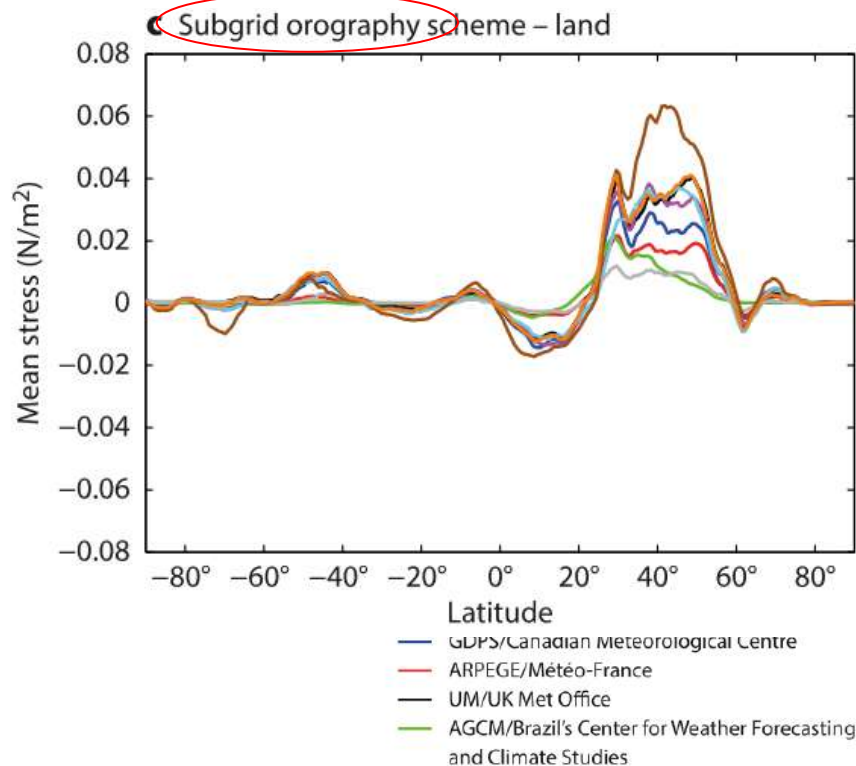


Above: Annual-average global cloud fraction (percent) for A-Train observed MODIS and ISCCP2, and 12 CMIP5 GCM hindcasts (from Frank 2019).

Left: Composite satellite estimate of global cloud cover on 11 July 2005, primarily from MODIS sensor (from NASA GISS).



An example MIP: WGNE drag project

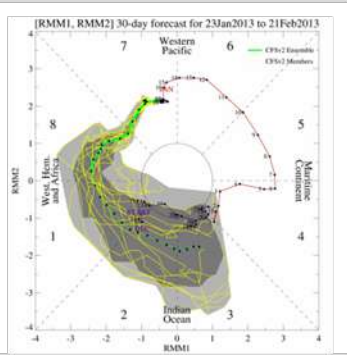
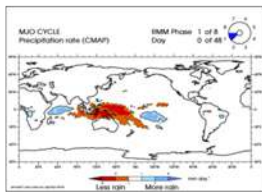


- Partitioning of drag varies between models – found to have notable impact on circulation
- Most CMIP models have too little drag (tends to cause Southward displacement of N. Atlantic jet)

Progress and Achievements: Highlights from the Past Year

MJO Task Force

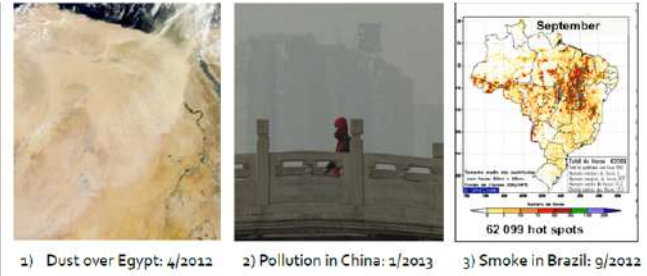
MJO - Task Force: Real time MJO Index forecast activity using 20 forecast models



Focusing on propagation over MC (levering YMC) and teleconnections

Aerosol Project (Joint with GAW, S2S)

Cases of strong or persistent events of aerosol pollution studied by the WGNE Aerosols project



Phase II protocol disseminated, contributions being collected.

Grey Zone (Joint with GASS)

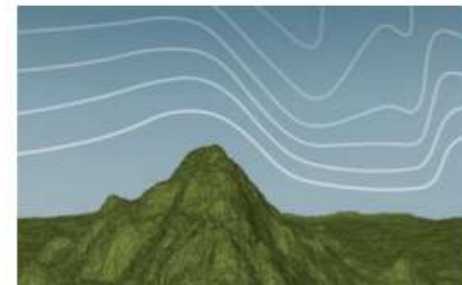
Gain insight into model behavior in grey zone and provide guidance for scale-aware parameterizations



GASS-WGNE Grey Zone II (leverage EUREC4A) white paper (Tomassini et al.)

COORDE Drag Project (Joint with GASS)

Investigating drag processes and their links to large-scale circulation

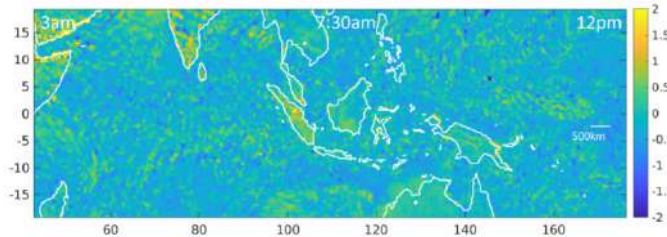


Evolving into GASS-WGNE momentum project (Sandu et al.), complementary to SPARC effort

Progress and Achievements: Highlights from the Past Year

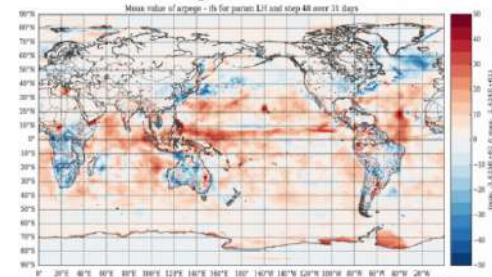
Model Uncertainty (Joint with PDEF)

Use single-column coarse graining experiments to obtain optimal stochastic forcing parameter value



Developing white papers on coarse-graining, model error diagnostics (may leverage DYAMOND)

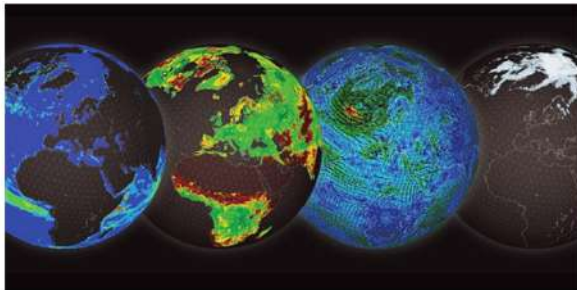
Surface Flux Intercomparison (with WDAC, GCOS/GOOS/WCRP OOPC)



8 centers contributed, initial evaluation has started.

Exascale Awareness

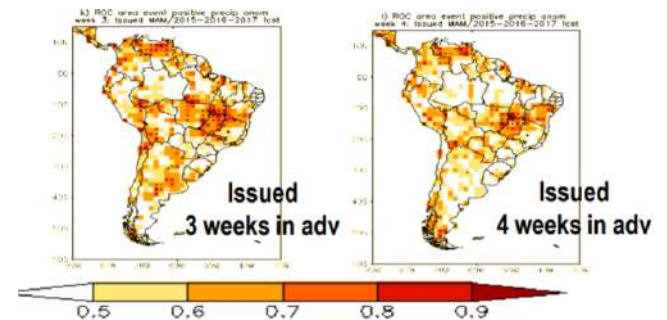
Assessment of trends and scalability of atmosphere and ocean models



Expand survey from atmos/ocean/sea-ice to chemistry/aerosols, biogeochemistry, etc.

JWGFVR (Joint with WWRP)

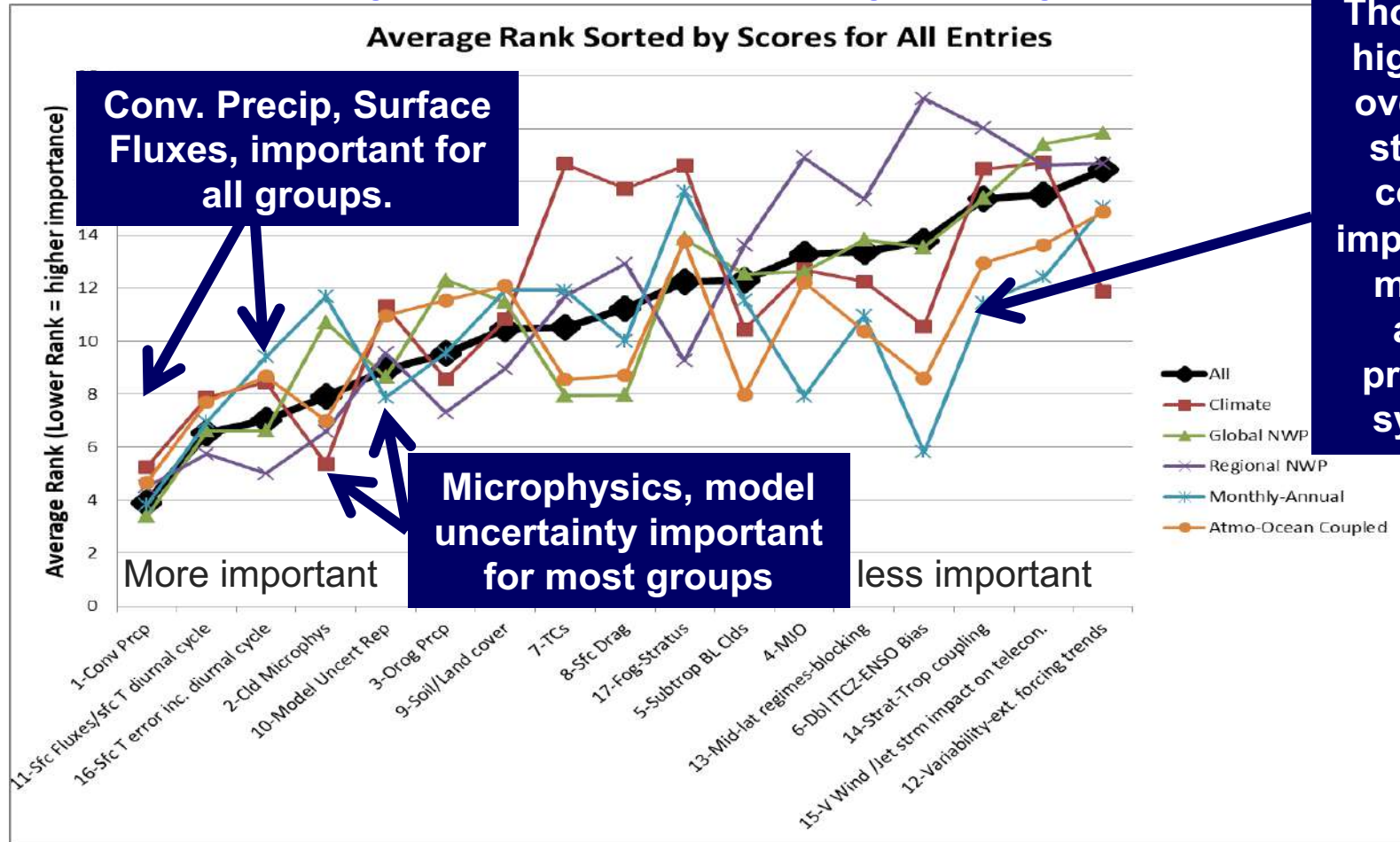
Assessment of precipitation anomaly forecast skill



Process-oriented verification white paper completed

WGNE Systematic Error Survey

Systematic Error Priority Survey Results



- 14 centers, 35 surveys contributed
- Full report on wgne.meteoinfo.ru
- Next steps under discussion

Future plans

Rank 1 from WGNE Systematic Error Survey - Convection:

Several independent activities underway (e.g. Delft workshop, UK ParaCon project, etc.).

- Joint WGNE-GASS grey zone phase II project based around EUREC4A and GATE III field campaigns.
- WGNE MJO-TF future focus on exploiting the Years(s) of Maritime Continent (including the propagation of MJO across MC).

Future plans

Rank 2 - Surface Fluxes:

- Continue surface flux intercomparison evaluation.

Rank 3 – Surface temperature: GLASS have several initiatives plus international modelling activities around field campaigns such as LIAISE.

Rank 4 – Microphysics:

Many national activities on cloud microphysics and aerosols. International activities around SOCRATES, LANFEX/Toulouse-fog, etc.

- Continue WGNE-GAW-S2S aerosols project

Rank 5 – Representing uncertainty:

- Continue development of PDEF-WGNE Coarse-Graining & initial tendency protocols (leverage DYAMOND).

Future plans

Other topics:

- Promote Exascale Awareness and share knowledge on code development for exascale architectures (assessment of trends and scalability of atmosphere and ocean models, extend to other components of earth system).
- Evaluate community progress and plans for AI/ML applications.
 - Emulation of existing parametrizations.
 - New parametrizations through obs/LES emulation.
 - Emulation of whole GCM's.
- Evolve WGNE to better represent Earth System Modelling:
 - Broader expertise of membership.
 - Extend Sys Errors survey to other ESM components.

Links to the WCRP Strategic and Implementation Plans

The need for accurate physical models fundamentally underpins at least the first three scientific objectives in the WCRP strategic plan:

1. Fundamental understanding of the climate system
2. Prediction of the near-term evolution of the climate system
3. Future evolution of the climate system
4. Bridging climate science and society

WGNE has led or contributed to planning documents

- Proposal for the role of WGNE in light of the WMO/WCRP reforms
- WCRP modelling groups positional paper for the implementation plan
- WCRP Task Team on Modeling (development and applications) and Computing Infrastructure
- WCRP Task Team on Seamless Data and Data Management
- Research Board document on Advancing Earth System Modeling & Exascale/AI



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Emerging issues

WGNE is now acting as a focal point for ESM development across timescales.

- Need to evolve membership so expertise exists on all ESM components, whilst keeping WGNE small enough that it can continue to be productive.
- A large number of groups across WWRP/GAW/WCRP want to link to the model development work of WGNE. We need to find an efficient way to share information without going to lots of other meetings.
- Some ESM processes remain only relevant on long climate timescales (interactive ice sheets, long-timescale carbon cycle processes). Should development of these lie in WGNE or another WCRP group?



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