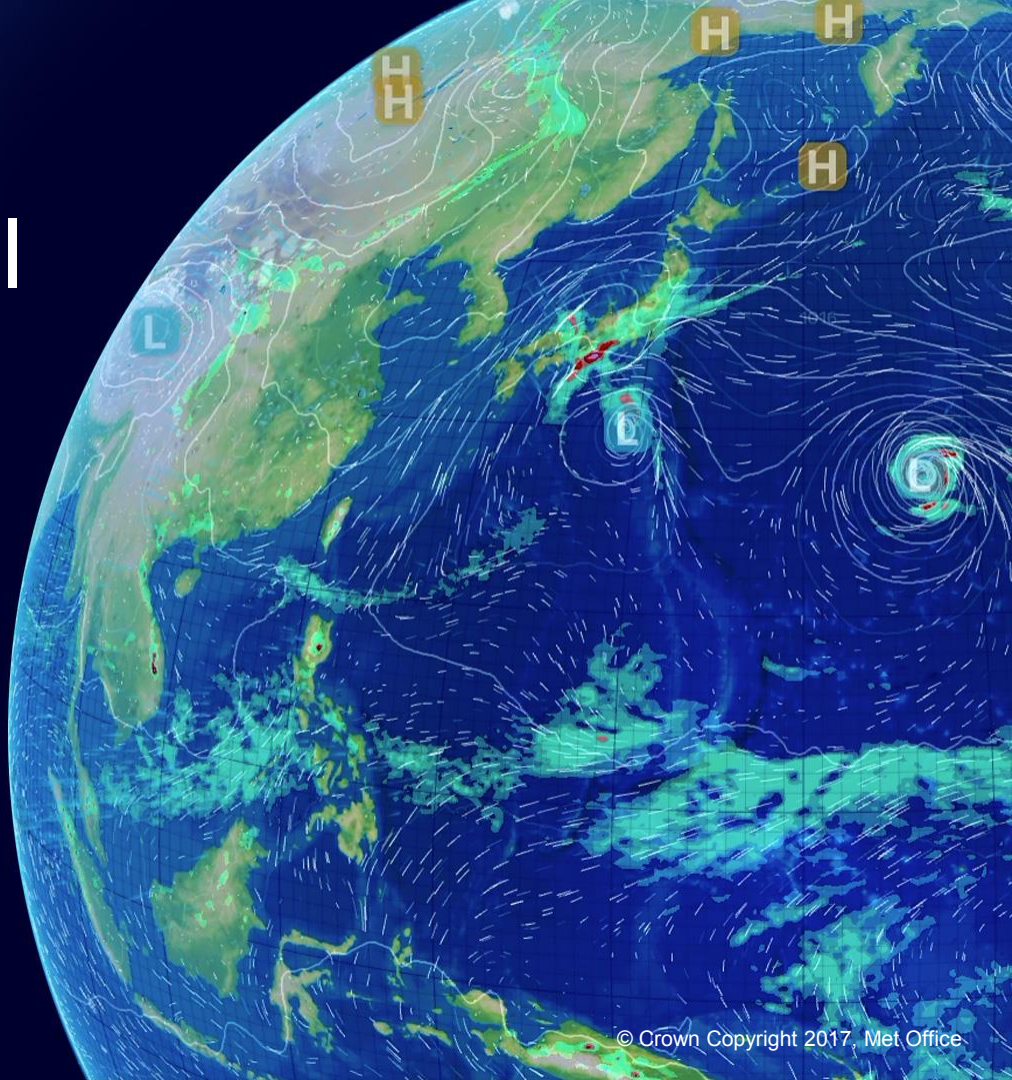
WGNE-PDEF Model Uncertainty Intercomparison Project

Keith Williams for Hannah Christensen

WGNE34, 14/09/19



Outline of protocol

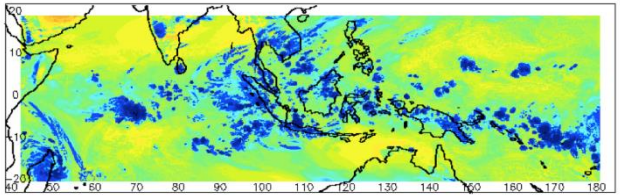
The intercomparison project will consist of four key stages.

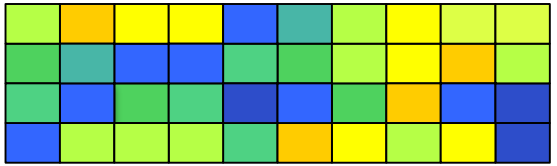
1. Produce limited area high resolution simulations to use as benchmarks. Validate fidelity of these simulations.
2. Coarse-grain these simulations to a chosen common resolution.
3. Use the coarse-grained dataset to drive a number of SCM.
4. Analyse model error characteristics through comparison of SCM with coarse-grained benchmark.

Timeline – Plan to publish the protocol around April 2020 and have the high resolution simulations started soon after.

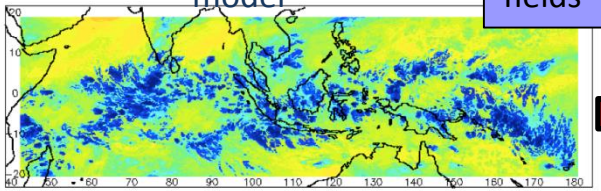
Use an existing high resolution dataset as ‘truth’

1. Coarse grain high resolution dataset to forecast model grid



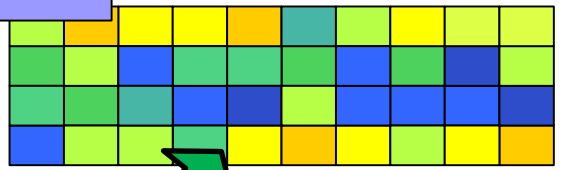


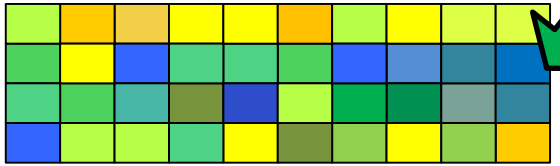
High resolution model



2. Use forecast model to step forward coarse-grained fields

Forecast model





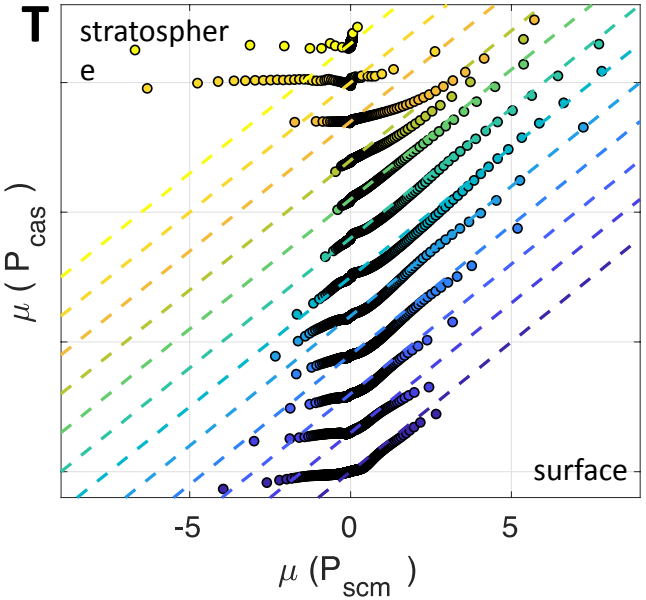
3. Compare at later time

Christensen et al, 2018, JAMES.
Christensen et al, (in prep)

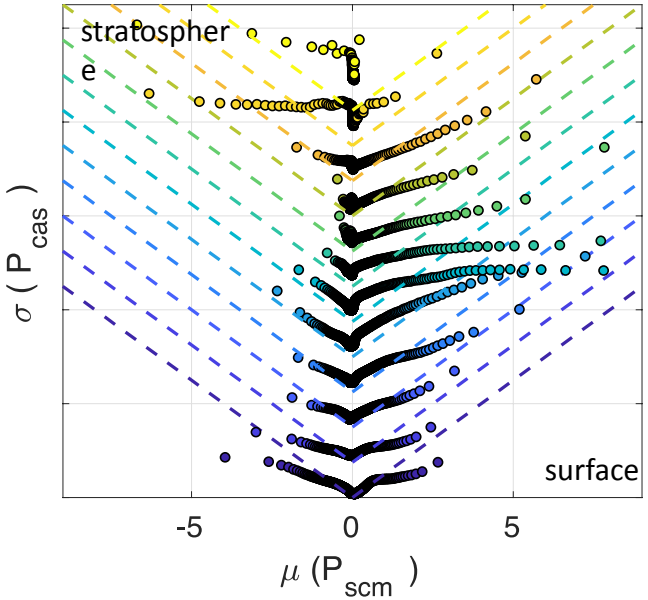
c/o Hannah Christensen

Consider T tendency

Mean tendency



Uncertainty in tendency



Data grouped by level.
Dark blue: levels 91—87 (ground—995 hPa)
Yellow: levels 32—36 (86—60 hPa)

c/o Hannah Christensen

High resolution simulations

Proposed regions (in order of priority):

1. Indo-Pacific Warm Pool (CASCADE domain)
2. North Atlantic
3. Summer Arctic
4. Southern Indian Ocean
5. Tropical Atlantic

Proposed analysis

1. Compare the characteristics of systematic ‘model error’ across a range of models, i.e. the difference between the forecast SCM and the coarse-grained benchmark simulation.

- Use knowledge about fidelity of the high-resolution simulations to ascribe this to deficiencies in the SCM, or to biases in the benchmark simulation.
- Attribute errors to specific model deficiencies using parametrised tendency information.
- Assess how systematic errors are affected by different geographic regions/ flow regimes.
- Depending on priorities, consider dependency of model error on resolution across a range of models.

Proposed analysis

2. Compare the characteristics of random model error across a range of models.

- Characterise degree of state dependency of random error (e.g. within SPPT framework: see Christensen (2019)).
- Assess stochasticity in other processes of interest specified by partners. E.g. for convective processes, consider variability in CAPE, CIN or updraft velocity as diagnosed by the SCM parametrisation. Discussion ahead of time will ensure the relevant benchmark simulation and SCM outputs are archived by all centres.
- To assess RP will require a set of SCM simulations in which parameters are perturbed for each SCM simulation. Searching over a large parameter space will be computationally expensive, but this could nevertheless be chosen as a priority.
- Assess how random errors are affected by different geographic regions/ flow regimes.
- Depending on priorities, also assess dependency on resolution.

Questions

- Which modelling centres are interested in participating in this activity (high res and/or SCM part)?
- What existing high-resolution simulations are available, and are they suitable for our purpose?
- Which modelling groups have the capability and inclination to produce new high-resolution simulations for this activity? How many days of simulation would be possible (in total) and at what resolution?
- For groups interested in running a SCM, what initial condition files and forcing fields are needed by their model and on what vertical grid?
- Where will the high-resolution data be stored? Can it be moved to where each SCM will be run? Or can other groups run their SCM where the data will be stored?
- Are there other research questions that we would like to consider? For example, are there other specific stochastic approaches that could be assessed (e.g. the Plant-Craig scheme)
- Any other feedback on the proposed framework?