

MUIP Kick-off Meeting

22 September 2020, Microsoft Teams

Attendees: Lisa Bengtsson (NOAA), Ligia Bernardet (NOAA), Judith Berner (NCAR), Hannah Christensen (U. Oxford), Grant Firl (NCAR), Daniel Klocke (HErZ, DWD), Martin Leutbecher (ECMWF), Mark Rodwell (ECMWF), Nils Wedi (ECMWF), Keith Williams (Met Office)

Apologies: John Methven (U. Reading)

Summary:

Those in the meeting were happy with the proposed protocol making use of existing high-resolution simulations and single column models. A key focus will be on comparing statistics across different SCM.

We decided that the ICON Dyamond simulation would be our first benchmark, which we would coarse grain to a weather forecasting model resolution – say 10-20 km. Further down the line, we would aim to coarse grain ICON to a coarser resolution, say 1 degree, as well as choosing a second high-resolution benchmark coarse-grained to 10-20km.

We decided that we would start with a tropical ocean domain (specific domain TBC – no particular preference for Pacific or Atlantic). A possible second domain would be over extratropical ocean.

Each party present indicated their anticipated participation in the project. Hannah Christensen will perform the coarse graining and provide input files in the DEPHY format, as well as software to facilitate running the SCM. There are three different SCM groups who hope to participate, resources permitting: UKMO (Keith Williams), ECMWF (Nils Wedi?), NOAA/NCAR (Ligia Bernadet/Grant Firl/Judith Berner). Other participants expressed interest in translation of results to inform stochastic parametrisations (Lisa Bengtsson, Martin Leutbecher) and linking up existing approaches with this new analysis (Mark Rodwell).

Action items:

Hannah Christensen – arrange follow up meeting

Hannah Christensen/Judith Berner – discuss other groups, and extend invitation of participation

Hannah Christensen – send round some sample coarse-grained SCM inputs

Hannah Christensen – decide on initial domain after soliciting further input as necessary

Daniel Klocke – email contributions to discussion after reading the minutes if desired

Mark Rodwell – email HC names of potential French researchers to invite to join project (from Warm Conveyor belt workshop)

Bengtsson/Bernardet/Berner/Firl – arrange Boulder get-together to co-ordinate contribution and preliminary work, and future grant opportunities.

Full Minutes

Introductions:

PDEF perspective: top priority is MU representations

WGNE perspective: Model intercomparisons key part of WGNE mode of working – identify systematic issues. 2017 WGNE systematic errors workshop - participants were polled on current issues in models. Representing model uncertainty was ranked in the top 5, independent of whether climate or NWP centre.

General discussion:

Nils Wedi: driving SCM from very high resolution forecast assumes forecast is 'the truth'. But ECMWF current model has better mean state than high-res version with convection scheme off. So could we design a complimentary approach where we drive SCM using the mean state from current parametrised models. Compare to driving the same SCM with input from the high-res models with deep convection off. Increment shows what high-resolution models are missing. For example for models which are not fully resolving the deep convection. Note that this will be a cleaner comparison than looking at tendencies from within a standard run of the model, because the standard run allows feedbacks between the physics and dynamics. Experience from DYAMOND runs is that there is a lot less deep convection than actually observed. Know that SPPT heavily relies on tendencies from deep convection.

Judith Berner: PDEF WG meeting discussed model error in convective resolving models – to what extent is it the same or different to model error in parametrised convection models. Trend towards perturbed parameter approaches in convection resolving models, and SPPT/SKEB/analysis increment approaches in lower resolution models. Regarding Nils's suggestion – how will this inform stochastic parametrisation development? Other research directions may take priority?

Nils Wedi: Everyone from the bigger centres has an operational forecast, so easy to create tendencies and use to drive SCM. Not a major overhead.

Keith Williams: Agree that high-resolution simulation is not truth. Better in many aspects, but not all. But key question is are they better at getting sub-grid variability correct? Our priority would be trying different high-resolution models to test this assumption.

Lisa Bengtsson: Key advantage of this group is the intercomparison nature – ability to compare different models.

Judith Berner: Choose priorities by first choosing science question we want to address. E.g. consider particular parametrisation that models have problems with and then focus on the cross-centre component for that parametrisation.

Hannah Christensen: e.g. if we want to address issues to do with scale awareness, we'd need to prioritise coarse graining to different resolutions

Lisa Bengtsson: An example is sub-grid variability in each parametrisation in turn different across different institutes - depends on scheme? Depends on forcing? Assess different moments?

Keith Williams: agreed

Hannah Christensen: agreed – even if we choose just one benchmark, one domain and one resolution we could address this. Let's start by coming to a consensus regarding these choices.

Discussion of specific choices

Nils Wedi: Regarding domain, ICON has a lot of data over Tropical Atlantic – as part of various campaigns. So plenty of data there, at a range of resolutions.

Keith Williams: A tropical domain is top priority (doesn't matter if it's the warm pool or Atlantic). Followed by extratropical domain.

Martin Leutbecher: Could we include one or two regions over relatively flat regions of land? So we don't draw general conclusions from studies just over the ocean. No particular suggestion of region, but could be considered down the line (e.g. before next meeting).

Keith Williams: But as well as complex orography issue, there are other complications over land – initialising soil moisture etc. A harder challenge – will require some thought. For full models, general wisdom is to NOT initialise with someone else's soil moisture.

Hannah Christensen: conclusion - start with a tropical ocean domain - happy with Atlantic or Pacific.

Judith Berner: Regarding resolution – I want to inform NCAR model, which we run at one degree. So a coarser resolution would be relevant for climate models.

Lisa Bengtsson: Could we consider several resolutions – a particularly interesting aspect of the study? 1 degree vs quarter degree or higher. Our operational model is 13km. Also NOAA GFS (“GFDL physics”) have participated in DYAMOND – if you need more high resolution simulations. Can look into it.

Hannah Christensen: Main qualities of DYAMOND run that I'm interested in is hourly dumps of data, and issues to do with whether the model had the convection schemes on or off.

Nils Wedi: Echo Lisa - Range of resolutions great. While 100km would be very interesting, DYAMOND runs generally run at 2-4km, and considering 4-6 delta x so 10-15km would be very interesting. A stepping stone – could then go another 4x coarser.

Hannah Christensen: So shall we start by prioritising a weather forecasting resolution – 15km – or a climate model resolution – 100km

Nils Wedi: bias towards weather ...

Keith Williams: I have to do both! And we should do both. At coarse resolution (1 degree) exclude NWP centres. But higher resolution is climate resolution of the future. Suggest one resolution in 10-20km range for primary benchmark. Consider second resolution (1 degree) in that benchmark. And also look across benchmarks at that fine resolution

Indication of commitments

Nils Wedi: high resolution simulations. Could possibly run SCM (though nobody has been earmarked for that task). Personal contribution could involve some of the SCM simulations

Martin Leutbecher: At this stage primarily commenting, observing, expressing a willingness to collaborate at later stage once data indicates directions in which MU representations should move. Collaborate in studies which assess existing MU representations within the framework of this study. Exploit ideas which point us in new directions. Not clear if this project will make it easier, or if current development approaches are sufficient. Interesting but high-risk activity.

Mark Rodwell: keen to link with existing approaches e.g. work running ECMWF ensemble for two days, making systematic changes (e.g. turning off stochastic physics, increasing resolution, ...) to assess impact on uncertainty at day two. Find that changing resolution can impact ensemble spread in very different places to turning off stochastic physics. Could envisage driving SCM from short forecasts.

Looking into DA – know consistency of spread within DA. Perform these kind of experiments, drive SCM with these very short range forecasts with different modifications, impact on spread of tendencies compared to spread within DA

Personal contribution – linking past approaches with this project

Ligia Bernardet and Grant Firl: Unfunded, so would need to understand timelines and apply for resources. At least, try to squeeze existing resources to allow for production of SCM runs. Planning and analysis. SCM has different physical parametrisations and suites.

Judith Berner: Representing research centres. Aim is to do some initial work, then apply for a grant – join up with NOAA. Existing SCM with CESM and WRF, but not MPAS. Since MPAS

contributed to Dymond, could envisage doing a targeted later high-res simulation with MPAS. Potentially develop MPAS SCM

Keith Williams: Will do SCM runs. Unclear how much time will be available to do analysis.

Lisa Bengtsson: Contribute to analysis, and link up with future developments of stochastic parametrisations. Will join forces with Ligia, Grant and Judith

Hannah Christensen: will provide coarse grained files, provide software to assist with running SCM. Time permitting, may be able to run OpenIFS SCM. Re, timescales: new coarse-grained datasets (DEPHY format) available in the new year. Limited area examples available before then. Fields needed to run IFS available now.

Further comments and questions

Hannah Christensen: Strongly encouraged to adopt DEPHY format, as then will only produce one set of input fields which all can use. Mainly standardises naming of variables, co-ordinates etc.

Judith: Perhaps we can extend invitation to groups involved in DEPHY - explore offline

Ligia: We are planning to adopt DEPHY – Grant currently working on it.

Grant: MPAS physics will be put into common physics package, such that existing SCM will soon be able to run MPAS physics.

Nils: How do you blend general information from coarse graining with model specific information needed by e.g. the IFS SCM (surface fields etc)? All fields need to be initialised

Hannah Christensen: Currently working with Richard Forbes to get IFS working with DEPHY. General questions about how to initialise fields that are not available in DEPHY runs. Want to be able to share SCM driving fields from across different field campaigns, LES runs etc, which might not have these fields.

