

## ***Interactive comment on “WCRP COordinated Regional Downscaling EXperiment (CORDEX): A diagnostic MIP for CMIP6” by William J. Gutowski Jr. et al.***

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Gutowski et al report on the activities within CORDEX1 and plans for CORDEX2, which do, in my mind, reflect the the past and current status. The report and the past suggest that most of the downscaling activities have involved the use of regional climate models (RCMs - also referred to as "dynamical downscaling"), however, a range of possibilities that empirical-statistical downscaling (ESD) has been missed out. Possible explanations for lacking progress in ESD and downscaling may be that it has been constrained in terms of strategy and the focus on data rather than information or answers to specific questions.

One proposition to future work is to start off with specific science questions under the  
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different WCRP "grand challenges". E.g. can we expect more frequent heat waves above a certain temperature threshold in the future in Paris? (related questions: Can we expect more frequent days with rainfall exceeding 50mm in Copenhagen; Will the likelihood of periods of dry spells lasting more than 50 days over Los Angeles increase with a global warming? Will the number of storms increase over the Barents sea in a warmer world? [1])

This type of question can be approached in different ways: (a) the traditional way is to simulate temperatures analogous to the observed records and then apply some analysis to the model results (e.g. RCMs and some traditional ESD approaches); (b) a statistical approach may be to simulate the shape of the probability distribution function and estimate the probabilities associated with exceeding a given threshold; (c) analyse how the number of events (random events are expected to follow the Poisson distribution) vary over time and identify how this number depends on large-scale conditions.

In other words, ESD involves a range of independent methods for predicting local climate variables based on large-scale information, which all makes use of different sources of information. Together with RCMs, they provide multiple lines of evidence. Furthermore, they can be tested and evaluated based on past observations (e.g. cross-validation) and model results (pseudo-reality).

Another aspect of ESD is their ability to provide diagnostics, e.g. identify patterns in large-scale variables which are connected with local variations. This aspect can be used to analyse RCM results and provide a comparison between inter-scale dependencies within the RCM/GCM universe. Hence, ESD provides an extra tool to analyse RCM results, also in terms of model validation.

Another aspect touched upon in the report was "bias correction" (a big dilemma), which merits more attention within the CORDEX framework. An interesting research question is what is causing these biases, and can the CORDEX experiments be designed in

such a way to shed light on the reason? There may be various hypotheses: (a) due to a mismatch between the parameterisation schemes in the GCM and RCM? (b) caused by a mismatch between the fluxes through the top and lateral boundaries of the RCM compared to the same surfaces in the GCM? (c) due to land surface representation or lack of coupling? (d) due to some types of parameterisation? (e) due to the different aspects that RCM results and observations represent? (e) that the observations are erroneous? ...

The question of added-value that Gutowski et al discuss is important, but it is still a bit general/abstract although it is very contextual [2]. CORDEX could make some effort into defining exactly what it entails and how it should be quantified. CORDEX could list some specific examples and protocols for doing that.

In summary, there is room for using a broader range of tools and ideas within the CORDEX community. It has been a good start so far, and I think future success may depend on the capacity of the CORDEX community to embrace fringe activity with alternative thinking (e.g ESD, statistics, Big Data).

references

[1] Benestad, Rasmus; Parding, Kajsa; Isaksen, Ketil, Mezghani, Abdelkader "Climate change and projections for the Barents region: what is expected to change and what will stay the same?", ERL-102170.R2.

[2] <http://www.realclimate.org/index.php/archives/2016/05/do-regional-climate-models-add-value-compared-to-global-models/>

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Interactive comment on Geosci. Model Dev. Discuss., doi:10.5194/gmd-2016-120, 2016.