FCFA webinar: How can climate models be improved over Africa? Investigating global models with local knowledge

Questions and answers

No.	Questions	Answer(s)
1	I am in East Africa and besides the Indian Ocean, I think the local topography does influence the climate. How well do the models incooperate the topography (auxilliary part of the model)?	The global models I was referring to generally have large gridspacing (on the order of 100km) which can inhibit their representation of topography. Sometimes adjustments are also made to topography to ensure that climate models remain stable. So the topography can vary quite a lot between models, and this is likely to be important for simulating East African climate. I do not know of any specific projects investigating the topography in CMIP5 models over East Africa, but some of my colleagues in the UMFULA project are examining the influence of model topography on southern African climate. I think it's an important research priority.
2	The MET Office Model you just presented showed a significant different (for example the westerlies vs easterlies over the India oceaan) as compared to reanalysis model! Can that be termed as poor estimator of climate/weather in Africa?? Why is that?	The difference between reanalysis and the Met Office model are large over the Indian Ocean, but this kind of bias is not very unusual compared to other coupled climate models. Ongoing work by Linda Hirons has shown that many other CMIP models show easterly winds in the equatorial Indian Ocean during the East African short rains season. The reasons for these easterly winds are unclear, but it does not seem to be entirely due to sea surface temperature biases, as some atmosphere-only models also show differences to reanalysis. As to whether this makes the Met Office model, or the models which show similar features, "poor" estimators of climate – this is a difficult question to answer. The challenge for climate models at this resolution, and running on such long timescales, is large. Climate modelling research has advanced dramatically in recent decades. There are still large biases and uncertainties in all models, but they are arguably one of the best tools we have available for projecting what might happen to climate in the next 50 or 100 years. We cannot say that any one of the models is "good enough" to trust it to predict the future, but if we disgard/label as "poor" any model with a large bias, we might have to reject all of them. In my opinion the better aim is to try to understand better how the models behave over Africa, and use this to inform assessments of the credibility of projected changes, on a case by case basis. So, for example, the analysis showed that the Met Office model has easterly winds in the Indian Ocean, and too much rain in East Africa, in the short rains season. If we label the model as "poor" it does not take us much further. But the knowledge that the model is overestimating precipitation, related to interactions with the Indian Ocean region, might inform development to improve the model, and might help us to understand future changes in precipitation as projected by that model, and assess their credibility.
3	Making data freely available to users is nothing new, it has been done for many years. The obstacles remain and are associated with ease of use, and how to link to impact/risk assessment models, and ultimately link the results to what adaptation soultions could be. Is Future climate Africa willing to directly support national teams developing adaptation plans to provide the necessary backstopping? ((Apologies if this was addressed in the talk, I missed the first part))	Agreed, there is nothing new about CMIP data being freely available: I believe we were discussing this in response to a question. What is new is the proposal (from a WCRP panel) to develop "CMIP DECK" infrastructure, to routinely output diagnostics across all of the models. i.e. As well as data being freely available, there would also be maps and graphs describing that data, and to evaluate that data. What we were proposing via this webinar was to develop diagnostics for Africa which could be part of that infrastructure. If we can achieve that, there would be freely accessible maps and graphs illustrating how models behave over Africa. This would certainly not address all of the many challenges you mention – in using the climate model data to inform adaptation options. However, it could provide an important scientific basis for that kind of work. If the maps / graphs / diagnostics were output by default, it would fast track efforts by scientists to assess the extent to which we can trust the models for applications (particularly scientists in regions where it is difficult to download/store the raw data). I completely agree with you that this is only a small part of the challenge. Work to explore climate impacts and risks, and adaptation options, is also fundamental, and certainly an important part of the ongoing research in the Future Climate for Africa (FCFA) programme. I believe there are future webinars planned which will tackle these issues. As to whether FCFA can support national adaptation planning, I cannot comment for the whole programme, but in our engagements in Malawi as part of the UMFULA project, there has been some interest in support for incorporating climate change projections in communcations to the UNFCCC, and we are exploring whether and how we might support this.
4	For Africa, shouldnt focus be on the downscaled model output evaluation (CORDEX), making CORDEX outputs more usable given our limited resources. And ofcouse CMIP model help drive RCMs.	This is a good point. Personally I think we need to evaluate any model which is being used, and that would include CMIP and CORDEX. I know there are already great efforts from the CORDEX Africa analysis groups to evaluate the CORDEX models in African regions. I think we need to evaluate the global models too, because (1) they provide forcing for the regional models, (2) they are sometimes used independently of the regional models for adaptation analyses and (3) it makes sense given model development efforts. In some modelling centres (e.g. UK Met Office) the global and regional models are quite physically consistent… so improvements to the global model might also support regional modelling. I'd be interested to discuss further. We are engaging with CORDEX Africa (several of the co-authors of the BAMS paper are also involved with the CORDEX Africa analysis groups. I think there could be nice synergies between global and regional model evaluation, and perhaps potential to share diagnostics and code.
5	The question why is African climate challenging? Could also be the little surface observational data going into the initial conditions to complement the satellite data?	Why is African climate so challenging to model? I think it is a combination of: (1) characteristics of African climate that make it inherently challenging to simulate with climate models: an important role for organised convection, land surface interactions, aerosols, ocean-atmosphere interactions, topography, and strong gradients in temperature and pressure; (2) limited observational data – as you mention this is important for initial conditions, but I think that on these timescales the observations are probably more important for validation and tuning than for initial conditions (which are more important on weather timescales; (3) a relative lack of previous research attention and focused model development efforts. Some of these issues are summarised (with references) in the introduction to the BAMS paper. You may also enjoy the previous webinar by Neil Hart which is designed as a beginner's introduction to central and southern African climate, including challenges in modelling these regions. https://www.youtube.com/watch?v=zYj8hlwRxa0
6	What is wrong with the current climate models that we need improvement? What specific aspects need to be improved?	This is a big question! In part it depends on the model, and these are complex models with interacting atmosphere, ocean, land surface, and atmospheric chemistry. Whilst there has been remarkable progress in climate modelling in recent decades, there are still many things which developers are working to improve in the models. For example, in the Met Office they are working to improve various issues such as biases in the Southern Ocean, and the Indian Monsoon. A common problem in many African and tropical regions is that there is too much light rainfall, too often, and too little heavy rainfall. The models also tend to rain too early in the day. Another common and well known problem is that sea surface temperatures in the Gulf of Guinea are generally too warm (with implications for West and Central Africa). However, in many cases there has been limited research to examine African climates in these models, so we still have work to do to understand where the problems lie. We hope that a model evaluation hub could fast track that work, and therefore inform work to try to improve the models.
7	How important is this in relation to disaster preparedness such as floods and el nino rains?	The webinar focused on models which are used to project future changes in climate on long timescales (approximately 30 years or more). For disaster preparedness, weather forecasts or seasonal forecasts are more important. Since these experiments are shorter, they can often be run at higher resolution, and the models can more easily be validated and improved over time. Therefore, some of the issues with climate models are less evident in weather forecasts or seasonal forecasts. Having said that, weather forecasting and seasonal forecasting come with their own set of demands, and are still challenging in some African regions and for some weather events. So, if you were to ask about the key challenges for climate modelling, versus the key challenges for weather or seasonal forecasting, you would get slightly different answers. Nevertheless, the work we are proposing, to better evaluate climate models over Africa, could potentially also lead to improvements in weather or seasonal forecasting, as there are some common issues, and in some modelling centres (including the Met Office) similar model physics is used across timescales, from weather to climate timescales.
8	How far have you gone with model you are proposing?	I assume this question refers to our progress to establish a model evaluation hub. At the moment we are very much in an early scoping phase, to gather feedback on the idea.
9	Are there papers that have been published from the project?	There are papers, some information is on the futureclimateafrica.org website. This particular talk is based on the James et al 2018 paper (https://journals.ametsoc.org/doi/full/10.1175/BAMS-D-16-0090.1).
10	Has CORDEX been ended?	CORDEX is ongoing – many of the experiments have already been run and are already available online, but as a WCRP framework and a community it is still ongoing, and with exciting future plans, including new experiments – you can find out more at cordex.org
11	Sorry, I stand to be corrected. But if there are less scientific tools to tell us how the model (CMIP and DECK) represents Africa model which is difficult to analyse as you stated earlier, how valid would the results be especially if the reuslt is for a specific region in Africa and not Africa in general?	We are in early phases but will communicate further with those who have shown interest today. Until then you can follow our work on the futureclimateafrica.org website and sign up to our newsletter for quarterly updates.
12	General comment	Focusing on processes from large to regional scale with improved deterministic representation: Dynamics and phsysics, moist profiles, and improved precip schemes well tested for high-impact extremes is focus of IMPALA work across the continent as a whole. We also have to get weather drivers VERY CORRECT to provide info for addressing current .
13	Who owns the models you are evaluating? How do you engage with these owners in order to improve their models? Would these owners be willing to financially support you?	I am not sure about official "ownership"... the models are developed by modelling centres e.g. UK Met Office, NASA, other met services and institutes. The initiative we are talking about here is led by one of these modelling centres (the UK Met Office), in collaboration with scientists at universities in the UK, Cameroon, South Africa, and Kenya. We have found this collaboration very fruitful and would like to help promote further collaboration between scientists and modelling centres, to support model improvement. As to whether the modelling centres would be willing to support the "hub" - my impression is that their funding is already quite stretched. As discussed in the Q&A, the modelling centres already provide the experiments to CMIP and this is a huge undertaking!
14	Hi, why african climate is so challenging for models, it is because of the lack model development in situ or it is due to african topography?	Good question! I think it's a combination of reasons (please see the fuller answer to q. 6).
15	I think there is aneed to seriousely invest in studying the impact of climate change in the dynamics ITCZ (the convective presentation in the models) cum Atlantic and India Ocean responces! Can this be investigated?	Within the FRACTAL project we are developing a method to identify the ITCZ.
16	How can communities in Africa benefit from Carbon Credits coins.	Thank you for your interest in the webinar and your eagerness to engage. ClimateCoin has not been a topic of investigation yet. If you are interested in the work of FCFA please explore our website and subscribe to our newsletter.