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Comment on 19-ERDD-01

Please see attached document.

Additional submitted attachment is included below.

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SCRIPPS INSTITUTION OF OCEANOGRAPHY 9500 GILMAN DRIVE DEPT. 0230
DIVISION OF CLIMATE, ATMOSPHERIC SCIENCES, AND PHYSICAL OCEANOGRAPHY LA JOLLA, CALIFORNIA 92093-0230

Dr. David W. Pierce
Division of Climate, Atmospheric Sciences, and Physical Oceanography
Scripps Institution of Oceanography, UCSD

Dear Commissioners,

Thank you for the opportunity to provide input on the EPIC Solicitation Workshop "Climate Scenarios and Analyses to Support Electricity Sector Vulnerability Assessment and Resilient Planning," Docket No. 19-ERDD-01. This is critical work to anticipate the impacts of climate change on the state's electricity sector as well as its residents and businesses, and it is gratifying to see California taking a lead position in such work.

Below please find comments on some of the discussion questions posed during the project workshop.

1. On the question of one single effort or two smaller efforts: Given how the research community is organized, there is a natural separation between the two desired parts of the project: a) Development of climate projections and identification of priority projections, and b) Engagement, analytics, and data platform development. Having two targeted funded efforts rather than one diffuse effort would be a better match to the existing research community.

2. There was significant discussion of the question of "what criteria or metrics should be used to evaluate the proposed downscaling methods" and, in a similar vein, a desire for "historically validated projections." In one sense, a straightforward answer to this is that the criteria/metrics a) should critically incorporate an evaluation of extreme events, since they have the predominant economic impact on the state, and b) recognize that the proposed method needs to be affordable enough to actually produce the requested data in the requested time, given multiple models, multiple greenhouse gas and aerosol emission scenarios, and high spatial resolution. The latter suggests that the bulk of the downscaled data will be produced by statistical downscaling techniques, given the funding level.

However I would additionally like to draw attention to one of the comments raised during the workshop, which is that different observational data sets do not agree on important measures of extremes, so caution has to be taken in simplemindedly comparing any downscaled data set against historical observations. Furthermore, every model simulation has its own realization of day-to-day weather that is independent of the real Earth's sequence of weather, and there is no reason why a model's depiction of, for instance, the most extreme weather value over the historical period should exactly match the observed value. A better way to evaluate the realism of the downscaled product is to determine if it is *statistically consistent* with the estimates of historical extremes, rather than being an *exact match* to observed historical extremes. This will require some changed habits on the parts of scientific researchers, stakeholders, and other end users who often assess the realism of a downscaled product by a simple comparison to the observed record, with any mismatch being deemed undesirable.

3. On the question of bias correction, and "should the fifth assessment require bias correction to help meet [the desire for simulations that match the observed record": Many important climate impacts on the state arise from non-linear processes, and the downscaled output must be bias corrected to be useful in examining those impacts. A simple example is runoff, and all that it portends for our state's highly managed water system. Many global climate models have systematic errors that produce overly wet conditions over much of the state due to not resolving California's topography, and if those unrealistically wet biases are not removed via a bias correction process, then future projections of runoff and flooding frequency will be unrealistic.

It is also worth noting that in many, perhaps most, statistical downscaling schemes, bias correction is an integral part of the process, and cannot be omitted during the procedure. With such methods it is not possible to produce *non* bias corrected data, since they are trained with observations. This can be unexpected given that in some prior California Climate Assessments, such as the 3rd California Climate Assessment, a method was used that had explicit bias correction as an optional process (although even then, there was an implicit bias correction). By contrast, in many of the common regression-based methods of downscaling, bias correction cannot be omitted. In the method used in the 4th California Climate Assessment, LOCA, bias correction also cannot be completely omitted.

4. On the question of coordination with other external projects in the culling of CMIP6 models, there is extensive activity on validating global measures of CMIP6 model quality through programs such as those coordinated via the Program for Climate Model Diagnosis and Intercomparison (PCMDI). Any effort for California should incorporate that existing work to avoid duplication of effort and eliminate models that do poorly on a global scale, since scoring poorly on global metrics suggests deficiencies in the climate model formulation. On the other hand, it is worth explicitly noting that many works have found that it may be possible to identify poorly performing models that can be culled, but it is much harder to identify the best performing model, as that generally depends on the evaluation metric considered. So the ongoing global efforts at evaluating CMIP6 models can eliminate the lower-scoring candidates, but additional targeted regional validation will still be required to determined a set that performs well over the State.

5. Regarding the question of data from multiple models (i.e., the 32 models available for the 4th California Climate Assessment): there was significant discussion in the workshop of the importance of estimates of uncertainty in the projections, which I wholeheartedly concur with. However, somewhat distressingly, there was also mentioned an implication that generating data from 32 models was overkill when only 4 models could be used. These two positions are self-contradictory, since one of the best ways of estimating uncertainty is by looking at a spread of model results, which requires a large number of model simulations. Saying one needs uncertainty estimates while simultaneously saying that only a few downscaled realizations are needed makes no sense. Hopefully this can be a topic in the ongoing discussions between the research community and the stakeholders.

Regards,

David W. Pierce

Comments herein are my own and do not necessarily represent the official position of the Scripps Institution of Oceanography