Comment on esd-2021-57
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Community comment on "Climate change impacts on solar power generation and its spatial variability in Europe based on CMIP6" by Xinyuan Hou et al., Earth Syst. Dynam. Discuss., https://doi.org/10.5194/esd-2021-57-CC1, 2021

This is an interesting but problematic article because, in my view, it tries to do too much. I think the most important part of the article for ESD reviewers and commenters to focus on is the first stage of the calculations, namely whether the inputs that can be obtained from the CMIP6 model runs for climate change scenarios out to 2100 can be reasonably and accurately used as inputs to the GSEE model which calculates the output of PV cells throughout Europe. If this can be done well from the perspective of physics, then the rest of the article and calculations are fairly trivial and not very important for climate change mitigation policy since the computed differences between scenarios is small. But, again, the really important science occurs in the first stage of the calculations as noted above.

The basic methodology of the first stage calculations are spelled out in lines 70-75. There the four kinds of output parameters from the 28 CMIP6 models are listed. Without doing any modeling my guess as a physicist is that the change in cloud cover from one scenario to another (from the 2.6 to the 8.5 forcing scenarios) will have the most impact on the difference in the average PV output across Europe, but I may be wrong, of course. Anyway, what is missing in this research article is a clear and simple description of how these four kinds of output parameters from the CMIP6 models can be input to the GSEE model. And while the reader might have some trust in the reasonableness of using CMIP6 results for calculations of other kinds of parameters because the CMIP process is such a huge multinational multiyear research effort, the reader is not provided with any scientific rationale for believing that the GSEE model is accurate and useful for the purpose the authors are using it for. However, even the CMIP6 results have huge uncertainty ranges associated with them as described in the relevant CMIP literature, and calculations of cloud cover differ greatly from model to model and are generally considered to be highly uncertain from model to model, and, therefore, from climate change scenario to scenario.

Most importantly, though, before an article like this could be considered publishable material in ESD, it would have to clearly demonstrate that the GSEE model on which it solely relies can accurately translate the four inputs from the CMIP6 models into PV cell output in terms of performing the correct physical calculations. For example, reviewers of this article need to ask the authors to provide the exact equations in GSEE which take the four inputs and produce electricity from PV cells out. Since the results cited is this paper involve relatively small changes (a few percent) between the two scenarios modeled for PV output, as one would expect, the GSEE model would have to be far more accurate than
a few percent in its translation of each of the four input parameters separately into PV
electricity output. Can the authors make this case? I don't know but they must try to do
so if they want to put this research article on solid ground. The GSEE model is hardly a
well established and well validated model, as far as I know.

The are problems with the methodologies used in the remainder of the paper as well, but I
think the authors need to first convince the reader that the physics of the first stage
calculations are highly accurate for the rest of the paper to matter.