

## ***Interactive comment on “Modeled changes in 100 year Flood Risk and Asset Damages within Mapped Floodplains of the Contiguous United States” by Cameron Wobus et al.***

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This is an interesting paper, combining several modelling approaches to give order of magnitude estimates of economic losses related to 1% flood events increasing with climate change over the 21st century. I enjoyed reviewing it and broadly speaking I think the paper can be published with minor revisions, principally around tightening up some of the language to convey precise meanings. In short I'd recommend the methods are fine as they are, but the discussions need to take extreme care around how far the results can be extrapolated. This is especially important given that the results could have wider public, policy and media interest, and from that perspective it is perhaps even more important to make sure someone reading the paper without all special-

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ist knowledge/training will not potentially misinterpret some of the findings/discussion. Specifically, I think the fact the study is delivering order of magnitude estimates and should be considered a 'first pass' at answering the question of future flood hydrology/risk and damage need to be incorporated into the discussion a little more. Even more importantly this needs to be covered in the abstract for the reasons above.

I should add the caveat that I do not consider myself competent to review all technical aspects of downscaling of GCMs and so would defer to the other reviewers and editor on those aspects of the paper.

Detailed comments: Abstract

10 – The two clauses in the opening sentence don't directly follow from each other. The first part makes link between flood occurrence and extreme weather and says extreme weather events will increase. The second part says therefore flood DAMAGE will increase. Not directly supportable to link increased frequency with increased damage in a general sense. This would need to be amended (at the least) to say “thus [potentially] increasing flood damage.” Or alternatively use a more general concept like increasing risk or exposure.

13 – (and elsewhere – pg 3, line 3). I'm not sure about the terminology of referring to them as “locations”, would “reaches” or “catchments” convey this better?

19 – Care in language needed here (and elsewhere). Paper is specifically talking about flood damage, but here talks about flood risk. Not same thing. Would be better to be consistent throughout to avoid confusion.

22 – This sentence needs rewording and maybe more caveats adding. At the moment the argument is somewhat tautological when it's boiled down – “we think we are being conservative, therefore our conclusions are conservative”. I think this needs be stated in a way which does not seem to infer what the findings of future work would be! A key issue is that the result is an order of magnitude estimate; there are many assump-

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tions made in the methods (either in choices or models) which are assumed to give uncertainty of an order of magnitude less (hence order of magnitude estimate), but for many of these we don't know whether they are over or under. I think what you are trying to say here is that more advanced techniques can constrain this uncertainty for future work. It's almost a separate point to say that you feel you've made methodological choices which would tend towards underestimating total damage. Indeed it may be worth separating out these two ideas/statements.

Intro 26 – I don't follow this statement I'm confused how an annual average can have a range, or how annual damage can be an average? – I.E. if annual damage is averaged over 100 years it is a single number? Does this mean just the measured annual damage ranges between x and y, or is it estimated from different sources? Or perhaps decadal/regional averages? Clarify.

28 – clarify the “damage” here; is this estimated economic costs, actual rebuild costs, including all economic losses not just physical ones? Important as this relates directly to paper findings so important to know.

29 – Care with language. This flooding is “historical” in what context? Largest ever? Or do you just mean “large flood events”?!

PG2. 1-7 – I think this paragraph could be framed better. I recommend rewording slightly as the three sentences don't seem to exactly follow on, one from the other. In the first it says challenging to understand events to climate change. Then says this is advancing, as well as attributing extremes in general to warming. Then finally says long term trend forecasting is important for stakeholders. At this point you are first making the case for why you would do this work, so I think it would be more powerful to suggest why the approach in the first two sentences is not fit for purpose and so therefore why the trend approach used later on is better/necessary/more useful in an explicit sense. Would be an early marker as to why this is all important and sell it to the reader(s).

12 – be explicit here whether you are talking about the mean damage in the 1% event

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per year, or the cumulative damage of all such events over the time span.

15 – I’m uncomfortable with the paper claiming a “deep body of previous work” but not citing any! Is there at least 2-3 review papers that could be cited in terms of “(see A et al, 2006, B & C, 2010. ...)”

22 – reference(s) for inconclusive studies needed.

23 – references for significant interest, or be more explicit about the source of this if not based on literature.

30 – Use of “flood risk” here, but this time to apply to (I think) the frequency of flood events. If so this is more broadly how I would understand the term, but clashes with usage elsewhere. This needs to be more explicit in this context, or alternatively could define flood risk as a term for purposes of this paper.

PG4. 5 – This needs to be less definitive I think – “are likely to be conservative” rather than “are conservative”, unless this is supported with methodological references.

PG5. 20 – reference to the tool needed – ideally to some form of report/paper/website. And also the name of the tool needed.

PG7 23 – this is an interesting use of the word “modest” to refer to \$1bn! I take the point, but recommend changing.

PG8 10 – Not sure about “calculate” here, think “estimate” or something similar is more accurate.

PG9 5 – I’m not convinced by the way this is framed. I agree that larger floods can be more damaging, but not necessarily that they always ARE. Likewise, small, more frequent floods can also cause damage, but not always. This will be very catchment and site specific and depend on the floodplain topography and siting of assets. In some cases, it may be that the 1% event floods all assets in a location, and therefore a bigger flood makes no additional difference. I’m therefore a bit uncomfortable with the

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certainty that all the estimates are underestimates of damage, particularly given levels of uncertainty in the methods anyway. I'd recommend this section is reworded to be less explicit in predicting the results of refining the methods! Perhaps just highlighting the absence of the frequent small floods and the potential effects of larger events in some (most? many?) catchments and saying it will invariably effect the damage estimates, rather than specifically state your estimates are definitely underestimates of damage in all cases.

Figure 3 – I'm not sure about the p-value reported in the caption. The purpose of a p-value is only to show that it is less than the alpha value set for significance, which is normally 5% or 1% in natural sci. The value of  $<0.00000001$  reported is unnecessary as it doesn't give any more info than something like  $p < 0.001$  (0.1%) and may incorrectly imply an incredibly high level of significance is being looked for (as alpha is not explicated stated elsewhere)

Figure 8 – I am perhaps admitting my ignorance of US geography here! But I was not able to easily visualise what the different labelled regions coincided with, particularly given it is being published in a European based journal (albeit an international one) it may be worth adding a map of where you divide up the regions, perhaps this could be incorporated into one of the existing map figures as a background layer to save adding another figure?

Addendum: After typing my report I read the other review comment and noted they have recommended a little more discussion of some of the regional based results. In light of that I really think a map reference of some kind to guide the reader through, as suggested in my figure 8 comment above, would be very helpful.

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