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Hydrology and Earth System Sciences Discussions

Interactive comment on "The influence of constrained fossil fuel emissions scenarios on climate and water resource projections" *by* J. D. Ward et al.

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1 Summary

The paper brings up an important, usually overlooked point: that there probably isn't much fossil fuel left to burn, and therefore the usual emission scenarios overestimate the emissions. The paper is thoughtful, well-researched, and useful. It is publishable as is; however, I strongly recommend to the authors to put some effort into some modifications concerning the points I make below; I think that their paper will benefit

greatly.

2 On uncertainty

There is the intrinsic uncertainty (also called ontic, aleatory, or structural), and the epistemic uncertainty. When you throw a balanced die on a flat surface, you don't know which number will show up, and this uncertainty is intrinsic. If you try to predict which number will show up, you cannot tell anything more than that any number has a 1/6 probability. Any deterministic model that tries to simulate the throwing of the die will fail to do anything better. Now if your knowledge of the initial velocity of the die is improved, this might be said to reduce your epistemic uncertainty; however, it does not improve your prediction at all. This means that the intrinsic uncertainty in this system is such that any improvement on the epistemic uncertainty does not improve the overall uncertainty.

According to my understanding of Koutsoyiannis, something similar happens in the climate: there is no distinction between climate and weather, and, since the system is chaotic, it is deterministically predictable only in the short term (for a few days, sometimes one or two weeks). When we are talking about climate in 2020 (let alone 2070), then the intrinsic uncertainty is such that deterministic predictions are pointless and cannot be improved by improving our knowledge of the conditions affecting it.

If Koutsoyiannis is right, then the overall uncertainty is not a combination of the intrinsic uncertainty and the epistemic uncertainty, and therefore the following phrases in the paper are wrong or meaningless: "reduce some of the uncertainty" (P2630L6), "dominance of model uncertainty in long-term precipitation uncertainty" (P2634L1), "most obvious source of uncertainty is from model differences" (P2634L28-29), "reducing the spread of emissions scenarios would help to reduce overall uncertainty in climate projections" (P2646L2-3), and a part of the abstract (P2628L2-8).

In the introduction to their paper (the paragraph starting at P2629L12), the authors mention the research of Koutsoyiannis and admit its importance. Understandably, they avoid taking a position; instead, they say: "While recognising these significant ongoing issues..., ... we will show that: (a) the current wide range of ... scenarios presents a significant source of uncertainty...; and (b) there is significant scope to reduce this range, and thereby reduce some of the uncertainty." (P2630L1-6). I understand this statement as a claim that the arguments of the authors hold whether Koutsoyiannis is right or wrong; however, as I explained above, I think that the current version of the paper makes sense only if Koutsoyiannis is wrong. So, if the authors do not wish to take a position on Koutsoyiannis, they could explicitly write something along the lines that they assume Koutsoyiannis to be wrong for the purposes of this paper; or that even if he is wrong then the IPCC and the mainstream climate scientists are still wrong; or simply stick to explaining why the emissions scenarios are unrealistic and not draw any conclusions on the effects of this on the uncertainty.

I also recommend to the authors to read the very short presentation by Christofides and Koutsoyiannis (2011). Given that they have been reading other works by Koutsoyiannis, it might not be very novel to them, but it could help clarify that the notion that climate change has specific causes (P2629L6-8) is neither obvious nor unchallenged.

3 Other issues

While it is clear, in P2630L4, why the word "plausible" is in quotes, it is not clear in P2632L24, unless, when the reader reaches the latter point, he remembers the previous occurrence, which is not likely. A phrase such as "what the IPCC consider to be" before '"plausible"' would solve the problem.

In P2633L17, the authors say: "Nakicenovic and Swart (2000) explicitly state that all scenarios have equal likelihood". If Nikicenovic and Swart really state that, I would

be interested to know how they justified this conclusion. Is this a defendable scientific statement, or is it untestable?

P2640L20: "It is important to note that low emissions do not guarantee a future free of significant climate change." I don't think that anyone can guarantee anything like that. In addition, what is "significant" climate change?

P2639L4: In 2007, WEC revised their estimates of recoverable fossil fuels to "one quarter" of their 1998 estimated value? Wow! And SRES is based on the 1998 estimates? Maybe this information should be made to stand out, for example by repeating it in the conclusions.

In my opinion, the last paragraph of the paper does not make a strong enough point. I think that it is a tragedy, for want of a better word, that the world is dealing with nonexistent problems when we are running out of energy while our economic system is failing. Of course, this is a scientific paper, so the authors are right in avoiding vague generalizations such as what I'm here taking the freedom to do. Still, stating that "the lack of energy for pumping and treating water ... may be a significant source of future vulnerability" looks too much of an understatement to me.

4 References

Christofides, A., and D. Koutsoyiannis, Causality in climate and hydrology, European Geosciences Union General Assembly 2011, Geophysical Research Abstracts, Vol. 13, Vienna, EGU2011-7440, European Geosciences Union, 2011; available at http://itia.ntua.gr/1130/.

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