

Review – ATTRICI v1.1 by Mengel et al.

This is a greatly improved version of the paper that was originally submitted – thank for. In my view, is nearly ready for publication. The main thing that I think remains to be done is to add some additional caveats that draw attention to nuances of interpretation that users will need to be aware of when applying the method and the dataset.

The following, therefore, lists a few additional comments and suggestions for the authors to consider. The comments are referenced by line number.

11: The meaning of “counterfactual” should be stated in the abstract so that readers perusing GMD abstracts will understand what the method described in the paper is intended to produce.

73-76: I find this statement problematic on a couple of levels.

First, ironically, the methods used to produce the counterfactual climate are Bayesian, indicating that the parameters relevant to constructing counterfactual climate scenarios are described probabilistically. Shouldn't the fact that the intent of a Bayesian treatment is to quantify uncertainty at each stage of an analysis and propagate it appropriately to the next stage signal that a probabilistic treatment of impacts attribution is also needed?

More fundamentally, this suggests that the impacts do not feed back onto the climate – but often they do, both by affecting the evolution of the forcing and thus the forced response of the climate and by affecting its internal variability, and thus altering the climate forcing that the impacted system is experiencing. Perhaps this only happens locally, but it could also happen on a large scale with potentially large implications for the evolution of the forced component of climate change (e.g., carbon cycle feedback from climate impacts on forest ecosystems). The impacts themselves are also likely subject to their own sources of internal (not forced by climate) variation that in turn might, or might not, affect the climate that is doing the forcing via feedbacks. One could think, for example, of a forest that is being impacted by the climate variations that it experiences, but that is also being impacted by insect disturbances, where insect population dynamics have their own internal variation that might not be entirely determined by climate. For these reasons, I would think that the attribution of impacts to climate would, in general, need to be treated in a probabilistic way, just as attribution of climate change to external forcing needs to be treated in that way.

I suggest, therefore, that a bit more work be done to carefully nuance this statement.

104-111: I think a few caveats are needed here. An implicit assumption is made here that an impacts model that is calibrated for the factual climate will continue to work equally well for counterfactual climates. That's not something that is necessarily a given. Consider, for example, a hydrologic model that is deployed on the Elbe River basin. Most hydrologic models of the Elbe would be carefully calibrated using observed

hydrologic quantities (streamflow, water temperature, etc) and observed meteorological drivers (air temperature, precipitation, wind speed and direction, solar radiation, etc) prior to using the model for prediction, historical reconstruction or future scenario development. This tuning is specific to the observational period that is used for calibration – with the result that the tuned model might not perform robustly in a different climate (e.g., with greater winter snow storage in the drainage basin in a cooler climate, or perhaps with greatly diminished snow storage in a future warmer climate). The point is that impacts models, just as climate models, are not entirely process based (as stated on line 119).

- 317-318: There are placeholders for subscripts that presumably should be removed.
- 319-320: There are many black and orange dots, so should “dot” be plural? Some explanation of the small dots and the single larger dot of each colour would also be in order.
- 333: Say what is meant by “physical bounds”.
- 349-351: I imagine that this process of randomly turning dry days into wet days will result in some physical inconsistency with other variables. Perhaps a few words drawing attention to that possibility would be in order.
- 372: Suggest using the IPCC AR6 regions, if possible.
- 491: It would be good to say something about what constitutes “attribution”. A calculation of the difference in impacts between factual and counterfactual climates (assuming that impacts can be determined with similar levels of confidence in both climates) would be a start, but attribution – drawing a causal connection and quantifying the change due to that cause – presumably requires careful arguments to rule out other confounding causes. At minimum, I think would need to be convinced a) that the change calculated with the impacts model is a reliable estimate of the change in the real world, b) that observed changes (to the extent that there is data) agree with the model simulated changes and c) that this similarity is not inadvertently due to confounding factors that affect the observed world but are perhaps not taken into account in the factual and counterfactual data used to drive the impacts model.