

Interactive comment on “Detection and Attribution Model Intercomparison Project (DAMIP)” by Nathan P. Gillett et al.

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Review of Manuscript by N.P. Gillett and colleagues "Detection and Attribution Model Intercomparison Project (DAMIP)"

The manuscript provides a clear and comprehensive presentation of the design of the CMIP6-DAMIP exercise, i.e. the numerical experiment devoted to the Detection and Attribution questions within CMIP6. The main motivations underpinning Detection and Attribution and their historical background are nicely described, as well as the main features of previous Model Intercomparison exercises. The new design that is proposed here introduces new types of experiments that will enable or facilitate new analyses of both historical and future changes. In my view, historical AER-only, SOZ-only, and CO2-only experiments, and the extension of individual forcing simulation to the 21st

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Discussion paper



century are very attractive novelties. Most importantly, the manuscript provides a very accurate description of each experiment, with detailed information on many technical aspects that are needed to realise those experiments. Overall, this is a very useful contribution for the Detection and Attribution community, and the modelling groups that will take part to this MIP.

I have several specific comments, which can all be considered as minor comments which the authors are free to take into consideration or not, although two of them are more substantial.

Substantial comments

1. About event attribution. The paper provides a detailed enumeration of scientific questions for which DA experiments have been used in the past. Noticeably, the attribution of single weather / climate events has not been mentioned. I don't know if this was intentional or not. This area of event attribution has received much attention recently - maybe even excessively, I agree. What I would call the "dominant" method used to perform event attribution calculations involves large ensembles of forced atmospheric experiments - which are not DAMIP style simulations. But the counter-factual (ie NAT-only) SST are usually constructed using a common D&A analysis of long-term changes, in an ANT vs NAT decomposition. DAMIP like experiments are required here. Additionally, there have been efforts to assess how the final results (eg FARs) depend on the assumed (ANT and NAT) response patterns, which basically requires a MIP with histNAT simulations from different models. Overall, I think this is an important application, which requires DAMIP, and which could be mentioned.

2. Comprehensive list of external forcings and how they are clustered into subsets. The paper provides a very clear list of experiments, and in most cases, a clear list of forcing agents to be considered in these experiments. However, I suggest it might be useful to provide an "as exhaustive as possible" list of external forcings, and the individual forcing experiments in which they are supposed to be included (eg which are

classed as "Aerosols", etc). I think this might be useful for several reasons: - there might be some inconsistencies with AR5, e.g., with respect to what is called aerosols. According to, e.g., the AR5 Fig 8.17, aerosols do not include NO_x or NMVOC, while these species are included in the histAER experiment that is proposed here. The status of tropospheric Ozone with respect to GHGs was also somewhat unclear in CMIP5. - some external forcings are not included in any DAMIP individual forcing simulations. This applies to LU, which is being treated in LUMIP, but also to Tropospheric Ozone, and maybe other short lived gases like CO. An exhaustive list could make this clearer. - NetCDF files from CMIP5 were usually specifying a list of forcing agents explicitly (at least for GHG species, in my memory), so this work would have to be done at some point anyway.

Other minor comments

* p3 l15 and l17: I suspect that the appropriate reference is Ribes and Terray 2013, instead of Ribes et al. 2015 * p3 l21-22 "with those of ozone and land use changes": I suggest replacing by "with the response to other external forcings, most notably ozone and land use" or something of that effect, as I'm not sure that all forcings can be put into the categories GHG, AER, NAT, OZ and LU (see also comment 2). * p4 l2: "the other" is written twice * p5 1st paragraph: I suggest adding somewhere something like "The two approaches ["only" vs "all-but"] are equivalent if additivity holds, but might differ otherwise." * p5 Sentence l5-7: it is not clear to me that the "all-but" approach is more appropriate than the "only" one for the second question mentioned... Is it what the authors want to say? As an alternative, causality theory might be mentioned explicitly, as it seems to be the main motivation leaning towards an "all-but" approach. * p5 l14: "linear additivity" has been indeed commonly discussed in the literature but it seems to me that, strictly speaking, only "additivity" is assumed in the experimental design. "Linearity", in my view, is more related to the use of analysis techniques based on linear regression, like optimal fingerprinting. * p5 l21-22: Does this also apply to GHGs other than CO₂? * p6 histALL: This is probably well specified in other CMIP6

documents, but I think it might be useful to add a quick description of the NAT forcing recommended in SSP. To my knowledge, there were no clear recommendations in CMIP5 regarding the volcanic forcing. Additionally, at least one modelling center decided to run historicalExt experiments with no volcanoes (consistent with the observation of no major eruption when the run was realised in 2011/12), while the RCPs were run with a volcanic background. This led to historicalExt runs which differ from the corresponding RCP runs over their common period. My understanding of the description given here is that such a discrepancy should be avoided in CMIP6, and I think it would be useful to state this even more clearly.

- * p6 histGHG: To make the point even clearer, I suggest adding a sentence such as "Ozone (tropospheric and stratospheric) is excluded from GHG species [and is therefore supposed to remain roughly constant in these experiments]", eg at l21.
- * p7 l17: maybe add "(see Tier 3)" after ssp245NAT
- * Tiers 2 and 3: information on minimum ensemble sizes seems less precise for those Tiers if compared to Tier 1 - maybe it might be said somewhere that the general rule is at least 3 for historical, at least (only) 1 for SSP... Or maybe I missed it?
- * Lastly, I also suggest adding somewhere something like "Tropospheric ozone (and possibly other external forcings, if any) is not considered in any of the historical experiments driven by subsets of forcings which are proposed in DAMIP.". Consequently, quantifying the response to this forcing would require subtraction, with a possible confounding effect related to non-additive responses to other forcings. Note that this choice doesn't seem inappropriate to me, but just it would be useful to make it clear in order to prevent misinterpretation.

Hope this helps.

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