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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Attribution of the Australian bushfire risk to anthropogenic climate change" *by* Geert Jan van Oldenborgh et al.

Geert Jan van Oldenborgh et al.

oldenborgh@knmi.nl

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This paper addresses a challenging issue, and provides lots of interesting details. I consider the conclusions drawn from the analysis valid and significant, and eventually the paper must be published.

However, the paper has the character of a technical report. Many technical details make it a barrage of not always relevant information, leaving the reader tired.

We thank the reviewer for their review and acknowledge that the text in particular was not easy to read. This is a comment common to all the reviews received, so it justifies and motivates a thorough revision and restructuring of the text, which we will undertake.

For instance, the section 7 is certainly interesting but irrelevant for the issue at hand

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— which is attribution. It may be relevant in linking the potential for fire to actual fire — but the section is not discussing this limitation of the overall result, but for instance emergency matters.

Thank you for highlighting this. Generally, many studies conducted by the World Weather Attribution group include a section on vulnerability and exposure, as some of the co-authors work in this field and help us put the physical results (often focused on ocean-atmosphere processes) into context of impacts on the ground. We consider that a disaster is not only caused by extreme meteorology (that may be influenced by anthropogenic climate change), but also by how exposed and vulnerable people are. Trends in those factors may be harder to quantify but also contribute to the overall change in risk. They are also where some of the solutions can be found as society has clearly chosen a path of both mitigation and adaptation. We therefore would like to keep the content. However, we recognise that Section 7 is too long, in particular given the length of the rest of the paper. Therefore, we will condense Section 7 and attempt to cross-reference it better in the rest of the paper.

The authors do not provide a clear roadmap of what they do and why. For instance, the attribution to global warming is not really related to the issue of other drivers. What is the idea of attributing how much to global warming, and how much to, say, IOD? Is there an issue with climate change due to changing concentrations of aerosols?

The method we use to attribute the increase in fire weather risk to anthropogenic climate change (documentation to appear as Philip et al. (2020)) includes all pathways, including through shifts of modes of variability such as the IOD. Everything but the trends is considered 'noise', including the unforced variability of potentially forced changes of these modes. Splitting up the trends or noise into modes and other factors is a scientifically interesting question, but is not relevant for the overall attribution statement we derive in this analysis.

Concerning aerosols, these are also included in the analysis as part of the anthro-

pogenic forcing if they give rise to changes in event probability from one time period to another. Generally, these effects are much smaller in the southern hemisphere compared to the northern hemisphere. The ozone forcing has a stronger impact, but again has been included in the model runs we use.

Another reviewer suggested to better justify, but also shorten the section on modes of variability and so we will revise this section to be clearer and more concise, including answers to above questions.

Also, the different data sets — the authors begin with a large list, and then every now and then, one of the data sets is removed (a little like in Agatha Christie's 'And then there were none'). The should say: 'we use the sets A,B,C..., because they have passed the following quality checks.' And they should use these data sets for all strands of attribution.

This comment is indeed consistent with the review comment by Antje Weisheimer. We will revise the data set discussion to make it easier to see what we used and why. However, we added century-scale daily temperature and monthly precipitation datasets to be able to give much more reliable statements on trends in heat extremes and drought than would be possible on the basis of just the 1979–2018 period, which is the period over which we can reliably compute the Fire Weather Index. So there are some justifiable deviations from using a fixed collection of datasets for all strands of the analysis. Limiting ourselves to a consistent collection of datasets would possibly greatly reduce the robustness of the conclusions for some attribution statements, which are currently based on multiple datasets and lines of evidence on multiple time scales.

The PR is referring to two time horizons, this should be made clear by using a term like PR(1900,2020) or so. How are the significance tests other trends done? Often the figure legends are incomplete.

We have made sure in the revised text that the time horizon is always included with the PR.

The significance tests are done using a 1000-member non-parametric bootstrap method, just taking the 2.5% and 97.5% percentiles as representing the 95% confidence interval.

We have gone through the figure captions to make sure they are more complete.

Going into further details is not worth it at this time.

We hope that by addressing these comments and those of the three other reviewers plus the two comments we have addressed all the concerns of the reviewer.

My advice: shorten the body of the paper to 10 pages; have necessary purely technical detail in appendices; do not write it as a progress report, which includes dead end streets like the usage of Berkeley Earth, but build a story which demonstrates that the upfront noted results are plausible. Avoid in-group slang. (Maybe a short summary, of how the regional as well as the global public took the events as manifestation of global climate change, and how the new results fit to these public attributions.)

We have taken this comment to heart and will revise and restructure the paper with a main part and supplementary information.

Philip, S. Y., Kew, S. F., van Oldenborgh, G. J., Otto, F. E. L., Vautard, R., van der Wiel, K., King, A. D., Lott, F. C., Arrighi, J., Singh, R. P., and van Aalst, M. K.: A protocol for probabilistic extreme event attribution analyses, Advances in Statistical Climatology, Meteorology and Oceanography, accepted, 2020.

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