

Interactive comment on “Dangerous human-made interference with climate: a GISS modelE study” by J. Hansen et al.

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This paper addresses the crucial issue of future climate change and try to estimate if the anthropogenic activity already has a dangerous interference with the climate. The paper first describes the model, the forcing used and gives global results, then it focusses on 3 key topics, and then discusses the future growth rate of CO₂ and non-CO₂ forcing in order to stay below a dangerous interference level. I really liked that paper as it goes beyond the usual description of model results. Here, the authors clearly try to estimate whether we already have a dangerous impact on the climate system, if not, whether this is likely to append soon, depending on the future emission scenario, and finally wheter it is feasible to have future emission below such a dangerous level. I strongly encourage publication of the paper. However, I have a couple of remarks that

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I hope the authors could easily address in order to further improve the paper.

A) The paper essentially deals with the future climate change, the historical part being evaluated in a companion paper (initially submitted together as a single paper). This is what the authors claim in section 3 and show in figure 4 for example. However, the topics on arctic climate change actually built on the historical simulations and the confrontation with observation. The future simulations are not really used here. The authors, realistically acknowledge that more future simulations (with separate forcing) would be needed to more accurately address the issue of arctic warming for example. In a sense, it would make more sense for this topic to be in the historical paper, under a detection/attribution section. However, I understand that, having already spent time to make two papers out of one paper, the authors won't like the idea of reshuffling everything. I think an easy way around is to put it in the perspective of the future simulations : first show observations, all forcing, CO₂ only, O₃+CH₄+BC+OC as done in fig 5, but then also show the all forcings results for the future scenarios (for 2050 ?) (as is done for the tropical climate in figure 6). The text could also more clearly give numbers for the future arctic warming for the different scenarios. Also, it could be helpful to show polar projections to enhance visibility of greenland and polar region, rather than the global figures.

B) The tropical climate change section, to a lesser extent also suffer from the same weakness. Only one paragraph deals with future tropical climate change. Similarly, I like the first part describing “where we are now” but it would be good to be more quantitative for the near future as well. Showing zooms over tropical SSTs (Tropical Atlantic ?), and estimating present-day warming versus future warming averaged over the region could help to convey the message.

The main point here is: Did we already pass a tipping point ? If not, will we pass it in the future for the different scenarios? As it is, the paper addresses the first question, but leaves the reader (reviewer here) wanting more.

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C) Figure 9. First of all, there is little new information here, all these data are on the CDIAC web site, the main point here being : emissions are still increasing exponentially and the US is still the number one contributor (total and per capita). Figures 9(c) (d) (e) and (f) are not even described in the text. They add very little information from (b). I would actually prefer to see a time serie plot as (b) but with cumulated emissions rather than the pie shown in (c). At least that would be new to me. Also the airborne emissions in 2005 shown in (d) has little meaning. I suspect it is calculated for each regional source using the Bern model, but one could argue that the real system is much more complicated as each country/region will contribute differently to the “global” airborne fraction. For example, one could claim that US has a lower airborne fraction than Australia as US has large regions with growing forests... This is the all point of the Kyoto protocol, and I would not encourage the authors to open that door with such a simple pie chart.

D) Page 16, First two paragraphs : The Bern model is used here to estimate the future atmospheric CO₂ increase for given amount of fossil fuel reserves. Figure 10 a clearly shows that the airborne fraction changes (reduces) with time, as the ocean keeps absorbing the anthropogenic perturbation. Hence, the 450 ppm value given page 16 for the full exploitation of oil and gas has little meaning without any time frame. Is it the estimated atmospheric CO₂ at the end of the 21st century? Also, figure 10b shows emissions in GtC (left axis) and in ppm (right axis). As it is explained page 16, one could interpret the right axis as the airborne fraction of the emitted CO₂ given on the left axis. However, it looks like the right axis is only the left axis divided by 2.12, that is simply the emissions expressed in ppm (i.e. airborne fraction of 100%). Could the authors clarify in the text and in the figure what they calculate and show. I would suggest to define a time window (ex. 2100) at which the atmospheric CO₂ is calculated in the text and in figure 10b.

Minor remark: There is no caption for figure 3

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