

Review report of the manuscript "The effect of anthropogenic heat emissions on global warming," manuscript no. egosphere-2022-5

This study calculates atmospheric temperature rise from 1850 to 2018 due to anthropogenic heat emissions to the atmosphere, based on a three-dimensional heat distribution approach. This study concludes that the atmosphere's temperature is half of the observed global land-sea temperature rise, and anthropogenic heat emissions significantly affect global warming.

This study raises very crucial issues but with a weak approach. The introduction section lacks a clear explanation about why this study is necessary and what are gap areas this study attempts to fill. Line 53 depicts that "there are problems in models used in the previous studies," but it does not explain the details. Line 39 says, "there is no direct proof that CO₂ causes global warming" however, it does not explain this statement. Line 43 mentions the latest IPCC report but cites a 2013 paper. The introduction section should be constructively revised and clearly explain the gap areas and the detailed explanation of the need for this study.

Reply: I agree with most of the Reviewer's suggestions above, and they will be used to correct the manuscript.

The main assumptions of the model described in lines 62-66 are very theoretical. A details explanation is required for each assumption.

Reply: Additional text explaining the assumptions will be added.

Line 63 "the spatial and temporal distribution of heat and CO₂ due to convection is similar in the atmosphere". Here do you mean latent heat or sensible heat?

Reply: Here I have in mind sensible heat. That will be explained and corrected in the next version of the manuscript.

Sensible heat is energy that moves from one system to another, changing its temperature. The transport and distribution of CO₂ throughout the atmosphere are controlled by the jet stream, large weather systems, and other large-scale atmospheric circulations. A detailed explanation is required for this assumption.

Reply: I agree, and the explanation will be added to the revised MS.

Also, the authors consider only CO₂ in their assumptions; however, black carbon is found to influence the sensible heat very differently compared to other aerosols and greenhouse gases due to its strong atmospheric absorption

Reply: Black carbon affects the atmospheric temperature much less than CO₂. That is the reason not mentioning it here. New text will be added to clarify that point.

There are confusing statements in lines 67-69, e.g., the "main difference"...." The similarities"..... Please re-write with a clear explanation.

Reply: The text will be rewritten to avoid confusion.

Re-arrange section 3; there are un-numbered sub-sections, e.g., precision measurements and electric power plants. It is better to merge all sub-section in section 3.

Reply: I agree that numbering of the sections and subsections can be improved. That will be done in the corrected version of the MS.

The pieces of information in the sub-sections are not new and already known. Sections 3 and 4 are interrelated, so they may be merged into a single section.

Reply: In my view, the information in the sub-sections is new, as it shows the direct heat emissions to the atmosphere. To the best of my knowledge, such information does not exist in the available literature.

Table-1 shows global primary energy use and anthropogenic heat emissions in 2018. The data is from IEA, 2020. As this is an annual snap shop, it is suggested to use a long-term climatological mean of IEA data in table-1 and subsequently revise the figure.2.

Reply: Long-term IEA data were used in the calculations. They will be added to Table 1 in the corrected version of the MS.

Section-6 needs to be explained in detail. Part of the heat radiated to space and atmosphere need a detailed analysis. 0.02 W/m² was radiated into the space in 2018. It is advisable to calculate this as a mean using long-term data showing the trend of the heat radiated to the atmosphere.

Reply: A new graph was created, showing the amount of heat radiated to space due to anthropogenic heat emissions for the period 1850-2018. It will be included in the revised version of the manuscript.

Lind-338: "...nuclear, biofuels, fossil fuel power plants emit heat which has similar global warming potential...". I guess the global warming potential mentioned here is in the sense of CO₂?; if yes, then the CO₂ emissions from these plants are different in nature; if not, what is the global warming potential of anthropogenic heat (excluding CO₂ here)?

Reply: No. The global warming potential is defined here as the increase of atmospheric temperature due to the heat emitted to the atmosphere by these industries. Table 1 shows that the atmospheric heat emitted by biofuel, oil, natural gas and coal power plants per kWh electricity generated is almost equal. In nuclear power plants that number is somehow higher, but still similar. Therefore, these industries cause a similar atmospheric temperature increase per kWh electricity generated. That will be described in the revised version of the manuscript.

The author has made a good attempt to raise an important issue

Reply: Thanks.

however, the entire study is more theoretical in nature rather than experimental (by models and long-term observations).

Reply: I would not agree. The study is based on actual numerical data for the anthropogenic energy release and on long-term observational data for atmospheric temperature change. In my view actually model results are of theoretical nature.

Most of the pieces of information given in each section are already known.

Reply: The most important piece of information, the amount of direct anthropogenic heat emissions to the atmosphere, is new. It is the basis of this work.

Every section reads like an introduction and review of the topic. Abstract and Conclusions are very weak; they should be both quantitative and qualitative in nature.

Reply: As mentioned above, that will be rectified in the revised version of the manuscript.

The present form of the study is not suitable for publication EGU sphere and may be rejected.

Reply: Summarizing the above, the Referee's suggestions are almost entirely related to the revision of the text. I am ready to prepare a revised version of the manuscript, taking into account almost all of the Reviewer's comments. The important thing is that the Referee does doubt the results reported.