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Editorial: Global warming is due to an enhanced greenhouse effect, and anthropogenic heat emissions currently play a negligible role at the global scale

Axel Kleidon[1,i], Gabriele Messori[2,3,i], Somnath Baidya Roy[4,i], Ira Didenkulova[5,i], and Ning Zeng[6,i]

[1]Biospheric Theory and Modelling Group, Max-Planck-Institut für Biogeochemie, 07745 Jena, Germany
[2]Department of Earth Sciences and Centre for Natural Hazards and Disaster Science, Uppsala University, Uppsala, Sweden
[3]Department of Meteorology and Bolin Centre for Climate Research, Stockholm University, Stockholm, Sweden
[4]Centre for Atmospheric Sciences, Indian Institute of Technology Delhi, New Delhi, 110016, India
[5]Department of Mathematics, University of Oslo, Oslo, Norway
[6]Department of Atmospheric & Oceanic Science, University of Maryland, College Park, MD, USA
[i]ESD chief editor

Correspondence: Axel Kleidon (akleidon@bgc-jena.mpg.de)

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1 Introduction

From time to time, we receive submissions at *Earth System Dynamics* claiming that global warming, or at least a significant part of it, is caused by factors other than the direct and indirect effect of anthropogenic greenhouse gas emissions. A number of these submissions claim that the increase in observed temperatures is due to the emission of heat from human activities. They often include some thermodynamic analysis resting on studies published in journals outside the climate community, presumably with some form of peer review (e.g., Swedan, 2023; Woodcock, 2022). Such submissions would not have passed peer review in *Earth System Dynamics* as they ignore basic textbook knowledge and would indeed typically be rejected prior to entering the open-discussion peer review phase.

The reason for this clear rejection policy is not a lack of scientific openness of the journal and its editors but rather the extremely well-established scientific basis of how the Earth's atmospheric greenhouse effect works, how it affects surface temperatures, and how it is altered by anthropogenic emissions of greenhouse gases. A quick look at the global surface energy balance illustrates this clear picture: human primary energy consumption amounted to 595 EJ in 2021 (BP, 2022), which translates into an average heat release of 18.9 TW. When averaged over land, this yields $18.9\,\mathrm{TW} / (29\,\% \times 510 \times 10^{12}\,\mathrm{m}^2) = 0.13\,\mathrm{W\,m^{-2}}$ (as in Jin et al., 2019), while globally, this yields $0.04\,\mathrm{W\,m^{-2}}$ when evenly distributed over the Earth's surface. This heat release is minute compared to the downwelling flux of longwave radiation of $346\,\mathrm{W\,m^{-2}}$ (Stephens et al., 2012) and the observed radiative forcing change at the top of the atmosphere of $2.7\,\mathrm{W\,m^{-2}}$ that can clearly be attributed to the increase in greenhouse gases (Forster et al., 2021). The greenhouse gas forcing can then explain very well the increase in global mean surface temperature of over 1 °C since preindustrial times (Eyring et al., 2021). This basis represents the wide scientific consensus reflected in the series of IPCC reports (which can be found at http://www.ipcc.ch, last access: 10 February 2023, with the latest comprehensive assessment of the physical science being IPCC, 2021), a basis that extends much further back to more than 50 years of scientific publications, even including internal scientific reports within the fossil fuel industry, as recently evaluated by Supran et al. (2023).

On the other hand, it is also well known and established that anthropogenic heat emissions can affect local climate (e.g., Block et al., 2004; Forster et al., 2007), especially in urban and highly populated areas, resulting in the urban heat island effect. Gridded datasets are available that show

the magnitude of this heat release (Flanner, 2009; Jin et al., 2019). Studies that incorporated this effect in climate models showed little, if any, effect on global climate (Flanner, 2009), consistent with the energy balance estimate described earlier. That human activity releases heat into the atmosphere is therefore not a new insight.

Our decision to generally not let such submissions enter the peer review phase is grounded in this well-established understanding. After all, the purpose of the peer review process, which includes considerable time and voluntary efforts from editors and reviewers, is not to point authors towards well-established knowledge from introductory climatology textbooks or to perform the literature review on behalf of the authors.

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References

Block, A., Keuler, K., and Schaller, E.: Impacts of anthropogenic heat on regional climate patterns, Geophys. Res. Lett., 31, L12211, https://doi.org/10.1029/2004GL019852, 2004.

BP: Statistical Review of World Energy 2022, 71st Edn., https://www.bp.com/content/dam/bp/business-sites/, (last access: 2 February 2023), 2022.

Eyring, V., Gillett, N. P., Achuta Rao, K. M., Barimalala, R., Barreiro Parrillo, M., Bellouin, N., Cassou, C., Durack, P. J., Kosaka, Y., McGregor, S., Min, S., Morgenstern, O., and Sun, Y.: Human Influence on the Climate System, in: Climate Change 2021: The Physical Science Basis, Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, edited by: Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S. L., Péan, C., Berger, S., Caud, N., Chen, Y., Goldfarb, L., Gomis, M. I., Huang, M., Leitzell, K., Lonnoy, E., Matthews, J. B. R., Maycock, T. K., Waterfield, T., Yelekçi, O., Yu, R., and Zhou, B., Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 423–552, 2021.

Flanner, M. G.: Integrating anthropogenic heat flux with global climate models, Geophys. Res. Lett., 36, L02801, https://doi.org/10.1029/2008GL036465, 2009.

Forster, P., Ramaswamy, V., Artaxo, P., Berntsen, T., Betts, R., Fahey, D. W., Haywood, J., Lean, J., Lowe, D. C., Myhre, G., Nganga, J., Prinn, R., Raga, G., Schulz, M., and Van Dorland, R.: Changes in Atmospheric Constituents and in Radiative Forcing, in: Climate Change 2007: The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, edited by: Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K. B.,Tignor, M., and Miller, H. L., Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2007.

Forster, P., Storelvmo, T., Armour, K., Collins, W., Dufresne, J.-L., Frame, D., Lunt, D. J., Mauritsen, T., Palmer, M. D., Watanabe, M., Wild, M., and Zhang, H.: The Earth's Energy Budget, Climate Feedbacks, and Climate Sensitivity, in: Climate Change 2021: The Physical Science Basis, Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, edited by: Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S. L., Péan, C., Berger, S., Caud, N., Chen, Y., Goldfarb, L., Gomis, M. I., Huang, M., Leitzell, K., Lonnoy, E., Matthews, J. B. R., Maycock, T. K., Waterfield, T., Yelekçi, O., Yu, R., and Zhou, B., Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 923–1054, 2021.

IPCC: Climate Change 2021: The Physical Science Basis, Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, edited by: Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S. L., Peìan, C., Berger, S., Caud, N., Chen, Y., Goldfarb, L., Gomis, M. I., Huang, M., Leitzell, K., Lonnoy, E., Matthews, J. B. R., Maycock, T. K., Waterfield, T., Yelekcį, O., Yu, R., and Zhou, B., Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2391 pp., 2021.

Jin, K., Wang, F., Chen, D., Liu, H., Ding, W., and Shi, S.: A new global gridded anthropogenic heat flux dataset with high spatial resolution and long-term time series, Sci. Data, 6, 139, https://doi.org/10.1038/s41597-019-0143-1, 2019.

Stephens, L. G., Li, J., Wild, M., Clayson, C. A., Loeb, N., Kato, S., L'Ecuyer, T., Stackhouse Jr., P. W., Lebsock, M., and Andrews, T.: An Update on Earth's Energy Balance in Light of the Latest Global Observations, Nat. Geosci., 5, 691–696, https://doi.org/10.1038/NGEO1580, 2012.

Supran, G., Rahmstorf, S., and Oreskes, N.: Assessing ExxonMobil's global warming projections, Science, 379, eabk0063, https://doi.org/10.1126/science.abk0063, 2023.

Swedan, N. H.: Thermodynamic analysis of climate change, Entropy, 25, 72, https://doi.org/10.3390/e25010072, 2023.

Woodcock, L. V.: Global warming by geothermal heat from fracking: energy industry's enthalphy footprints, Entropy, 24, 1316, https://doi.org/10.3390/e24091316, 2022.