

## ***Interactive comment on “Hilbert problems for the geosciences in the 21st century – 20 years later” by Michael Ghil***

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Thank you very much for this thoughtful, in-depth and encouraging review.

The points raised at the end are well taken and will be obviously addressed carefully and thoroughly in the revised version of the paper.

At this point, I will merely try to elucidate the misunderstanding about the "counterfactual theory for necessary and sufficient causation" appearing on p. 8, ll. 1-2 of the paper's published preprint under discussion. This theory, as presented in particular in the now classical book of Judea Pearl on "Causality: Models, Reasoning and Inference" (CUP, 2nd edition, 2009), brought the author the ACM's 2011 Turing Award, known as the Nobel Prize of the Computer Sciences. It was obviously an error to

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assume that, as such, the theory would be known to the NPG readership at large.

The revised version of the paper will expand on the theory – which is at the same considered to be an important contribution to the Philosophy of Science, Statistical Theory and Methods, Statistics and Probability, and Philosophy per se – and explain in which way its requirements of necessity and sufficiency in causation criteria are distinct from the usual causation criteria applied in the climate sciences for detection and attribution of extreme events. The review paper below is open access and the reference will also be added to the revised version of npg-2020-13.

### Reference

Pearl, J.: Causal inference in statistics: An overview. *Statistics Surveys*, 3, 96–146, doi: 10.1214/09-SS057, 2009.

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Interactive comment on Nonlin. Processes Geophys. Discuss., <https://doi.org/10.5194/npg-2020-13>, 2020.

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