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Interactive comment on "Replicability of the EC-Earth3 Earth System Model under a change in computing environment" *by* François Massonnet et al.

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This paper addresses an important topic in Earth System Modelling dealing with the reproducibility of the results when changing the HPC environment (hardware and software). In some way this can derive to how reliable and well written are the models developed. However this is not a new idea in this area. It is well known that different compilers, hardware, options in the compilers, etc... produce different results in the floating point operations, even when using the IEEE754 standard. How significant these results are, is what has to be well analyzed and it is important that the research community is aware of this topic, as it is well presented here.

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Discussion paper

This paper highlights how a bug or bad coding practice derives in different results depending on the compiler used or flags used in the compiler. Obviously we expect some minor differences in results but not as to being statistically different. Anyway the results show that special care should be taken in the development of the codes and testing of the results. If the hypothesis about the bug in version 3.1 of the code is correct, even two executions of the same model version 3.1 on the same system could provide different results.

The conclusions that "Our results and experience with this work suggest that the default assumption should be that ESMs are not replicable under changes in the HPC environment, until proven otherwise." implies that the codes should be first well tested and evaluated before trying to replicate results in different HPC environments. Anyway testing results in different HPC environments and providing "significant" different results could be a way of demostrating that the code is not well written or developed as presented in this manuscript.

The recommendations about taking care when compiling the code and the flags used (specially the most agressive ones to improve performance) should be extended to other compiler options and special care should be taken before using them. When providing the code and giving results about the code used, a clear description of the version of the code, the system used, compiler version and options used to compile should be provided, along with the operating system used.

The manuscript is very well written and has no major typos or errors

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