

Geosci. Model Dev. Discuss., referee comment RC1  
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## Comment on gmd-2021-331

Anonymous Referee #1

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Referee comment on "CondiDiag1.0: a flexible online diagnostic tool for conditional sampling and budget analysis in the E3SM atmosphere model (EAM)" by Hui Wan et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-331-RC1>, 2021

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The manuscript presents a novel developed tool "CondiDiag1.0" in the E3SM atmosphere model version 1 (EAMv1) for conditional sampling and budget analysis. The authors present a conceptual outline of their diagnostic tool, its features and its implementation into the EAMv1 model. The tool provides methods (controllable by the user via namelists) to sample model variables (and derived variables) at different points during the model's time stepping in a flexible manner. The sampled fields can contain instantaneous values, increments (tendencies), vertical integrals of quantities. Furthermore a conditional sampling method, based on evaluating variable fields against threshold values (and ranges) and selecting sampling variables, checkpoint and validity is presented. A user's guide exemplifies a general workflow and describes necessary namelist settings. The diagnostic tool is applied in a model use case and three different example applications for budget analysis, analysis with different sampling conditions, and increment analysis with sampling conditions. The tool is useful to study different processes in the complex model system but also for debugging purposes during model development. Although the tool is developed for EAMv1, CondiDiag can easily be ported to relatives in this model family, and already was included in EAMv1's descendants.

The manuscript is very well written and structured. Even for readers with no knowledge of the EAM model system, it is easily understandable, also due to portability of the tool and the general description. Although, the general concept of (conditional) sampling and recording tendencies is not new, the provision of a modularized and lightweight diagnostic tool with easy to implement hooks in the model system facilitates the work of modelers and atmospheric scientists. The technical description of the diagnostic tool, the description of its implementation and application, completed by detailed examples including the necessary user inputs fits into the scope of GMD. The manuscript should be published, subject to few minor revisions.

ll. 181 ff.: If I understand this sentence correctly, it states, that some quantities are calculated at discrete points and become inconsistent with the model's prognostic state (at

least as long as the variable field is not updated). Maybe the authors could clarify, that the values consistent with the prognostic state evolve within the time step, but the field values are not updated (only at the points of calculation).

I. 346: For readers familiar with EAMs structure and calling sequence it might be clear when (in the model's time stepping) the two subroutines `tphysbc` and `tphysac` are called, and it is even written in the manuscript (in the descriptions of Table B1 and B2), but it may be worth to mention the point in the calling sequence here (before/after coupling), which also explains the naming.

II. 350 f.: All the implemented checkpoints are listed in Tables B1 and B2. However, at some point later in the manuscript (~l. 514) I got lost, as it was not clear to me where to find all the checkpoints and their calling sequence. Maybe the authors could clarify. Suggestion: "All checkpoints added to the EAMv1 subroutines `tphysbc` and `tphysac` are listed in Tables B1 and B2, respectively. Most of the checkpoints are implemented by inserting code like..."

I. 539: "model sub-cycling": Is it the sub-cycling in the model's parameterizations?

#### Technical corrections

I. 111: "5 hypothetical processes label" -> "five hypothetical processes labeled"

II. 180 f.: "sequential method" -> "sequential splitting method"

I. 267: Could a link to Zenodo be inserted here?

I. 386: "carry" -> "carry out"

I. 431: add ")" after "checkpoint"

I. 529: "3 wind speed" -> "three wind speed"