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Geoscientific Model Development Discussions

Interactive comment on "TheDiaTo (v1.0) – A new diagnostic tool for water, energy and entropy budgets in climate models" *by* Valerio Lembo et al.

Anonymous Referee #1

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The study 'TheDiaTo (v1.0) – A new diagnostic tool for water, energy and entropy budgets in climate models'Âăby Lembo et al describes Thermodynamic Diagnostic Tool (TheDiaTo), a new diagnostic tool that evaluates the energy budget, the hydrological cycle, the Lorenz Energy Cycle and the material entropy production. This is a very useful tool for evaluating climate models at global scale, as well as over land and ocean. The strength of this tool is its flexibility, so it can be run over a large multi-model ensemble (such as CMIP) and give a robust overview of the performance of the models. The paper describes the components of the tool and their results well. The figures and tables are clear.

Specific comments:

- Introduction: For energy and water budget studies using observations, please add

L'Ecuyer et al, 2015 and Rodell et al, 2015. For studies evaluating the energy and water budgets in climate models, please add Demory et al, 2014; Terai et al, 2017; Vanniere et al, 2018 (e.g. in P2 L29, P3 L22, P4 paragraph 1.2). These studies highlighted the need for more robust evaluation of these budgets in climate models.

- section 2 data and software requirements: are calculations performed on the native grid of the models or on a common grid?

- section 3: can the tool consider observational data, where available, to validate the models?

- section 3: can the tool also work with seasonal means?

- section 3.2 hydrological cycle: Assessing the water budget in climate models is particularly important to determine their conservation error and its evolution throughout the simulation. A model may have a conservation error but that remains stable over time, while another one may constantly lose/gain mass over time (as noted in Liepert and Previdi, 2012). In this study, this would be particularly important to understand what is happening in BNU. Is it possible to see the time evolution of the conservation error with TheDiaTo (Fig. 2 of Liepert and Previdi), and if not, would it be possible to add it? This would be beneficial for a thorough evaluation of the climate models.

- P15 L21: is there a reason for picking this period: 2441-2460?

- P18 L28 & L32: 'bias' generally refers to errors relative to observations. Here, it may be more robust to refer to 'imbalance'.

- Tables 8 and 9: specify that rows are for PiC, hist and rcp85.

There are several typos throughout the paper. I noted a few here, but there are surely others: - P1 L5: replace 'Top-of-Atmosphere (TOA)' by TOA, as defined just earlier - P2 L6: replace by 'cryosphere' - P2 L16: remove 'of things' - P2 L21: be more specific with 'the required standards mentioned above' so we don't have to jump back to recall these - P2 L23: same as above for 'enunciated above ideas' - P5 L5: same as above

for 'mentioned aspects' - P7 L18 & P15 L26: replace 'EB' by energy budget - P10 L 13: 'lhs' -> left-hand side - P12 L10: 'rhs' -> right-hand side - P17 L13 'edddy' -> 'eddy' - P20 L26: correct to 'orographically' - P22 L25: 'rato' -> 'ratio' - P22 L30: 'use' -> 'used' - P23 L17: 'effected' -> 'affected' - P24 L25: 'loking' -> 'looking' - P25 L15: 'vertcial' -> 'vertical'

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