

# ***Interactive comment on “First Assessment of the Earth Heat Inventory Within CMIP5 Historical Simulations” by Francisco José Cuesta-Valero et al.***

## **Anonymous Referee #2**

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Overall comments: The manuscript reports on an analysis of the ability of thirty CMIP5 models to simulate the distribution of heat within the Earth’s energy reservoirs for the period 1972-2005. The manuscript calculates the total heat content as it is partitioned in the ocean, continental subsurface, cryosphere, and atmosphere and relates it to the TOA imbalance. The findings indicate that models overestimate the heat stored in the oceans and underestimate it in the continental and cryosphere. There are limitations in what the CMIP class models can represent – and that is reflected in the fact that the cryosphere component calculations do not account for the glaciers and ice sheet melting losses adequately and to some extent the continental component. So, the results have to be interpreted in that context. The manuscript is an important contri-

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tribution towards understanding how well they represent the energy imbalance and the partitioning of heat energy within the earth system. Some comments listed below may be addressed to improve clarity.

Detailed comments: 1. Line 70: Does “consistently” here mean same period as observations? 2. Line 73: How about Von Schuckmann? What period are those results from? 3. Lines 73-74: How is this scaled? Linear or some other? If there is an increasing rate of storage, a linear may not be appropriate. This needs a little more elaboration. 4. Lines 127-130: This is not satisfactory and not really a good approximation. There really is no direct way to calculate the heat absorbed by melting glaciers / ice sheets in the CMIP5 class models - except using offline models. Perhaps this needs to be discussed in the paper a bit more. The way this is presented in subsequent sections, it appears to be estimated with the same level of confidence as the other components. 5. Line 151: What kind of trend from the piControl is removed? Linear or some other trend? 6. Lines 246-248: This is not really clear. There are no real outliers in figure 2. So if there is a point to be made about the discrepancy of specific models, they need to be identified (on fig 2) which they currently are not. 7. Lines 319-320: What does this mean? Leaving terrestrial cryosphere out of the ocean heat? Needs to be rewritten. 8. Lines 325-328: The ISMIP6 project (Nowicki et al., 2016) is a contribution to CMIP6 designed to quantify and understand the global sea level that arises due to past, present and future changes in the Greenland and Antarctic ice sheets, along with investigating ice sheet–climate feedbacks. It is not necessarily to reproduce ice Greenland and Antarctic sheets.

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