Geosci. Model Dev. Discuss.,
https://doi.org/10.5194/gmd-2017-293-RC1, 2018

Geoscientific Model Development Discussions
Open Access
EGU

Interactive comment on "Impact of numerical choices on water conservation in the E3SM Atmosphere Model Version 1 (EAM V1)" *by* Kai Zhang et al.

Anonymous Referee #1

Received and published: 14 February 2018

The authors of this paper found the sources of water conservation error in E3SM atmosphere model that leads to long-term sea level rising and proposed the remedies to resolve them. This paper describes the error sources and fixing methods, as well as provides the sensitivity analysis of the water conservation error to model resolutions. Conservation is one of the most important issues scientists should pay attention to when developing the model. It is a hidden threat to long-term simulation. Although the fixing methods in this manuscript are somewhat remedies and bugfixes instead of root cures, the contribution this manuscript represents is an important achievement to E3SM development. The solution this manuscript proposed can be applied to any other model. The manuscript is well-organized and the conclusion is convincing. I

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Discussion paper

would suggest accepting with revisions based on the following comments.

Specific Comments

In the introduction section, there is little to no evidence/literature showing the relationship between water conservation error and sea level rising. The literature mentioned is too weak to support this connection. The authors may need to provide some strong evidence on it.

Equation (6): The meaning of "W" is vertically integrated total atmospheric water with a unit of kg/mˆ2. After multiplying "A", the grid cell area, and dividing by liquid water density, the result should be volume, but not height. I think the area of ocean is missing in the equation. Assume this equation is corrected. It is possible that some local spurious water source/sink stay in the atmosphere, leading to less sea level rising. So, it may not have that large effect on the actual sea level rising.

Technical Corrections:

Line 18: I am not sure whether you can cite an unpublished paper: Rasch et al, 2017.

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