

Interactive comment on “The E3SM version 1 Single Column Model” by Peter A. Bogenschutz et al.

Anonymous Referee #2

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This paper summarizes updates, features, and new test cases for the SCM within the E3SM model ecosystem. The paper is well organized and generally well written. One highlight is the nice suite of test cases and reference to SCM features and when they should be used. This paper is worthy of publication once several issues are addressed below.

1. Section 2.3

Line 103, for the current dynamical core for CESM, cite a paper or code documentation. Lines 105-7, the SCM provides the large-scale vertical transport or the full dynamical core does? Are you saying the Eulerian and SE dynamical cores calculate vertical transport differently? Maybe it's the phrase “dynamical core in the SCM” that is confusing because that doesn't make sense. Please make clear what the full 3D dynamical

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core calculates and what the SCM calculates and why that provides inconsistencies. Some explanation of how the codes are connected would be useful before delving into the details.

Line 109, forward in time is not specific enough. I think you should specify the scheme with an explanation as to why the differences in the dynamical core time integration matters for the SCM. For example, I can imagine that a staged explicit scheme will not mesh well with the leapfrog scheme because then the time step stages are at different times. In the same vein, why does the SCM have to use what the 3D dynamical core uses? Do they only share info at the outer final time step from a staged method?

Two paragraphs starting on line 112, the explanation of the SE grid needs more clarity. You need to explain how quadrilateral elements make up a sphere - a cube of faces that are then mapped to a sphere. You state that the SE grid must be initialized with a minimum resolution of points, I assume this is 1 per cube face? Do not use the HOMME/CAM-SE developers nomenclature of “ne4” unless you explain or cite. Then you can explain how you instantiate a low resolution version of SE and the SCM is only computed for one column (from one GLL point or for a point from the whole element?).

Rest of section 2.3, the advantages are just tacked on here. This should perhaps go somewhere else.

2. Lines 150-154, this sentence is repetitive and not clear. The SCM used the Eulerian dynamical core before you upgraded it, ok. So you are just saying that the SCM required files in the same Eulerian format or another strategy that is unclear. What does “it” at the end of the sentence refer to?

3. End of section 4: I was hoping for some idea of what was done to make SCM work within CAM-SE. Just code bug fixes? A bunch of little things? Were any scientific changes made?

4. Several paragraphs starting on Line 233, I am on board for annual bias not showing

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up for SCM, but the daily precipitation bias for SCM is worse and different than GCM and obs. The meaning of this is implied in the next paragraph, line 249, that SCM can replicate early onset precipitation. . . but in a different thread of discussion, so that connection should be made more clear. Line 244, I don't see that, so you will need to plot bias as well. The statement "largest discrepancies occur during most pronounced bias" is not useful. 5. Line 268, what do you mean by "cannot afford to offer?" Do you mean it would take a long time to develop or it would make the SCM too expensive? Or both?

Minor comments: Will SCM change within version 2 of the E3SM? The use of "version 1" in the title implies that it is version dependent.

One minor exception to the good writing is the use of "which" and "that" (e.g. line 28,98,126, 225, 228, there may be more?) throughout and the use of tense (e.g. line 49, the paper will be organized, lines 111- 112 was then is).

Lines 42-44 and 56-58 are virtually ID, remove/adjust one of them. It's awkward where placed in the second instance.

Line 95 "The idealization switches added to the E3SM SCM framework includes" should use "include"

Line 98: Just say that some cases have idealizations turned on by default and move mention of specific cases later in the paper when they have been defined and explained.

Line 147 "high degree" of accuracy is imprecise. Relative to what?

Line 174 first mention of nudging- should explain/define, and line 176 what are the impacts of nudging?

Line 179 Where was this already stated?

Line 204, did Xie19 implement or just describe this revised function? It is not clear from

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this description.

Line 255, once you have a fix you can see why the fix works. But what if you see a bias? How does it help you narrow down the source?

Line 298, Though -> Although

Line 318, what do you mean by observational guidance?

Line 332, "An example of this" should be "as an example of this"

Figure 4 caption: second sentence, you mean the 2nd through 4th rows?

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