Geoscientific
Model Development
Discussions

Interactive comment on "A simulator for the CLARA-A2 cloud climate data record and its application to assess EC-Earth polar cloudiness" *by* Salomon Eliasson et al.

Anonymous Referee #2

Received and published: 8 October 2019

This paper documents a new simulator for the CLARA-A2 record, and shows its potential to the study of polar cloudiness. It focusses on the main difference between this simulator and existing simulators: the method to derive the cloud mask. It introduces a new method that outperforms the simple optical depth threshold used in existing simulators, with the largest benefits felt in the polar regions. The paper shows that we now have an observational record and a simulator methodology that can be used to evaluate models in the polar regions with more confidence than before, and this is a very nice contribution to the model evaluation topic. The paper is well written, and I would recommend publication. I recommend some changes below. The changes requested are minor in the sense that they do not target any fundamental aspect of the

methodology, but moderate in the impact on the material presented.

GENERAL COMMENTS

Given that this paper will become the main documentation reference for this simulator, I think it would benefit from some discussion and results on the impact of the different methods (mainly #1 vs #3) on other variables listed in Table 1, not only cloud fraction.

The message regarding benefits of method #3 with respect to previous analyses needs to be more specific (e.g. in L385-390). The largest differences between methods occur in the polar regions, with much smaller differences in the rest of the globe. In some places, the paper gives the impression that previous studies where flawed, when in reality many of them did not use data polewards of 60 deg latitude to avoid large uncertainties.

Section 4.2. The observational pattern of trends is regionally inhomogeneous, and therefore Figure 9 is not very informative. Does EC-Earth show smaller trends due to compensation of regional patterns? It would be interesting to show the regional patterns from EC-Earth, perhaps replacing Figure 9 by a figure like Figure 8 but for EC-Earth.

SPECIFIC COMMENTS

- L36-41. This sentence is hard to read, please rewrite.

- L141-142. What's the difference between gridbox size and area?

- L148-150. This statement is slightly optimistic. Only subtropical deserts show PODs below 0.4 like most of the Arctic region. Most of the continental regions show larger PODs than the Arctic, and comparable or larger than the Antarctic region.

- Caption Table 1. Please can you clarify why the average cloud water phase is not a relevant quantity?

- L174. its' -> its.

- L187-183. There is no need to give details of the methods here, all that information is given in the subsections below.

- L200-205. It would be worth to point out that the COSP simulators only do the retrievals in sunlit conditions.

- Figure 2. The colour scale is very confusing, I would suggest a monotonic colour scale.

- Section 3.2. The POD maps used in method 3 depend on the distribution of clouds in the real world. These maps won't be optimal for models with cloud distributions that differ substantially from reality. It would be good to add a sentence mentioning this, and a brief discussion about the possibility of developing PODs that are not linked geographic positions.

- Figure 5 and 6. The labelling of the subplots is unusual. The top subplot should also have a label/letter so that it can be properly referenced.

- L352. The trends calculated in this section are not decadal trends. I believe that what you are trying to say is that they are trends over the entire record, expressed in units of %/decade.

- L354. Please use the correct units (%/decade). Same for figures 8 and 9. I would even suggest to change the units to 1/decade, as changes in % can lead to confusion in its interpretation (absolute percent change vs relative change).

- L366. is run -> run is