



EGUsphere, referee comment RC1
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Review of egusphere-2022-706

Anonymous Referee #1

Referee comment on "Nudging allows direct evaluation of coupled climate models with in situ observations: a case study from the MOSAiC expedition" by Felix Pithan et al., EGU sphere, <https://doi.org/10.5194/egusphere-2022-706-RC1>, 2022

Review of "Nudging allows direct evaluation of coupled climate models with in-situ observations: A case study from the MOSAiC expedition" by Pithan et al

This manuscript describes evaluation of two coupled climate models and one general circulation model against detailed in-situ and remote sensing observations in the Arctic. The manuscript is generally well written, and the topic is appropriate and interesting for EGU sphere. The methods for nudging the coupled system are interesting and will be useful for others. I think the manuscript should be publishable subject to minor revisions, detailed in specific comments below.

Generally, I think some parts of the text could be more specific in the treatment of the different models. Also, some of the figure presentations could be improved or clarified.

Page 1, L12: what does CAM6 show?

Page 2, L42: Add Gettelman et al 2020, since they also used CAM6 in the S. Ocean.

Page 3, L88: If CAM6 is nudged, you also need to cite Gettelman et al 2020 who nudged CAM6 and looked at the S. Ocean.

Gettelman, A., C. G. Bardeen, C. S. McCluskey, E. Järvinen, J. Stith, C. Bretherton, G. McFarquhar, C. Twohy, J. D'Alessandro, and W. Wu. "Simulating Observations of Southern Ocean Clouds and Implications for Climate." *Journal of Geophysical Research: Atmospheres* 125, no. 21 (2020): e2020JD032619.

<https://doi.org/10.1029/2020JD032619>.

Page 5, L107: CAM6 cloud fraction?

Page 5, L126: This is confusing. Did you use 1 hour or 24 hour for CM3? Also, the all wavenumber case for CM3: was that 1 hour or 24hour?

Page 6, L137: what is the nudging timescale in CAM6?

Page 9, Figure 3: Describe model lines and gray line in 3d in caption.

Page 10, L216: CAM6

Page 10, L218: is the CAM6 albedo shown in Fig 3e? I cannot see it.

Page 10, L230: Can you put then an estimate of observed cloud cover on Figure 3f? Or is it 100% since the radar has cloud condensate all the time?

Page 10, L231: would the models detect such a cloud?

Page 11, L233: is there condensate in CM1?

Page 11, Fig 6: why no CM1 and CAM6?

Page 12, L249: What about CAM6? If it gets the radiation right, does it get the condensate right too? Please be consistent in the treatments here (e.g. CAM6 is on Figure 7 but not Figures 5 & 6, why?)

Page 12, Figure 7: its hard to distinguish the gray dotted lines from the model dotted lines. Perhaps use a shaded region for the standard deviation.

Page 12, L255: why are they not equal? Change of temperature of the ice itself?

Page 13, L275: shouldn't the relationship be tighter than in figure 8 if it represents a coefficient in the models?

Page 14, L286: Dark green triangles.

Page 14, L307: Why not include CAM6?

Page 15, L311: These models are nudged all the way to the surface. How much does that matter? What does CAM6 (not nudged below 690hPa) do? Does the spectral nudging matter?

Page 15, L318: can you refer to Fig 6 and put a line for the time of the sounding to guide the reader here?

Page 16, L358: what does CAM6 do for liquid water? Gettelman et al 2020 showed overestimations of supercooled liquid in the S. Ocean.

Page 16, L361: Can you say anything about the type of nudging? E.g. spectral v. Full nudging, and vorticity/divergence v. Winds & Temps. Does it matter? What is better? How can you tell?