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Interactive comment on "Contribution of sea-ice albedo and insulation effects to Arctic amplification in the EC-Earth Pliocene simulation" *by* Jianqiu Zheng et al.

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I have read the manuscript titled "Contribution of sea-ice albedo and insulation effects due to Arctic amplification in the EC-Earth Pliocene simulation." by Zheng et al. This manuscript describes two simulations of the EC-Earth in pre-industrial (1850) and Pliocene climates. The authors use two statistically based techniques known as the equilibrium feedback assessment (EFA) and the climate feedback and response analysis method (CFRAM). I am not familiar with these techniques and so this might be part of my misunderstanding of the analysis. I believe this manuscript may be acceptable for Climate of the Past Discussions, however it does require substantial revision to get

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to this point. Here are my main issues:

1. The English language usage is problematic. While, it does not necessarily make the results incomprehensible, it still was difficult to interpret some of the results. It wasn't clear if it was the explanation from the authors or if it was a fundamental issue in the analysis. I started to correct some of the grammar, but it was taking too much time. So, I would encourage the authors to contact a native English speaker to check the usage.

2. One of my scientific issues is around the results in Figure 1. For one, the Y axis in panels (C) and (D) is different which provides the mistaken impression that the seasonal cycle of SST difference is much larger than it really is. Also, the discussion in the text does not make it clear why the seasonal cycle of SST difference is out of phase with the seasonal cycle of SAT. More is needed here.

3. Related to point 2, what is the variable in the model used to get SST? i.e. is this the first level of the ocean model? Is it the surface temperature in the atmosphere model? I am mainly concerned about the SST when there is ice present. This value should be very close to -1.8C when there is ice. Perhaps the authors could plot the absolute SST and SAT fields instead of the differences. I believe this might help explain part of the issue with the seasonal cycles being out of phase.

4. In Figure 2, I am very surprised that the Pliocene ice concentration is so low in the annual mean. You are using a present day value of CO2 of 400ppm I believe? Have you done the present day control to compare here? What is the top of the atmosphere imbalance in your runs? The sun still goes away in winter I presume, so I would expect more ice in the annual mean. Can you compare the seasonal cycle of extent in your Pliocene simulation to your pre-industrial and even perhaps a present-day control?I can't find the reference off hand, but Gerald Meehl has done some work looking at control runs versus transient runs.

5. As I mentioned, I am not familiar with the CFRAM/EFA techniques, so a bit more clarification here I think would be helpful for the readers of the journal. One concern

I have is how do you do the calculation when there is no ice? In other words, would your results change if you only computed the shortwave difference with respect to the sea ice difference at points where there was a nonzero ice concentration in both simulations? What about the relationship to the SST change?

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