

## ***Interactive comment on “Seasonal transition dates can reveal biases in Arctic sea ice simulations” by Abigail Smith et al.***

**Anonymous Referee #1**

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In this study, the authors evaluate climate model performance for describing the Arctic sea ice seasonal cycle with a series of metrics that describe stages of the melt and freeze-up periods. Modeled sea ice concentrations and surface temperatures are used to approximate significant dates of the melt and freeze cycle obtained from passive microwave satellite observations. The authors find that the models capture a similar asymmetry in the melt/freeze cycle where the melting period is longer than the corresponding freeze-up period as seen in observations. Overall, the models generally agree with observations on the timing of spring melt, but several show delays in the timing of the freeze-up period relative to the observations. The differences between models for these variables exceed expected differences due to internal variability of the model, thus, the authors propose using the seasonal sea ice transition metrics to

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evaluate climate model performance. I find that the paper is very well written, interesting, and thorough in reporting the results of the study. I have a few very minor comments that the authors should address before publication as outlined below.

### **Minor Comments**

L 205-206: I'm not sure exactly what you mean by the model spread shifting "earlier toward the satellite data". Can you please expand or rephrase this in the text?

L 206: Inflow regions are not specifically defined anywhere in the paper. It would be worth it to state where these are (e.g., Bering Strait, etc.).

L 249: It would be beneficial to expand a bit on the ice concentration metric used by Markus et al. (2009) when the algorithm does not detect a clear freeze onset signal from the brightness temperatures. Specifically, that the threshold used by Markus is 80% SIC, which in theory makes some unknown quantity of the satellite freeze onset dates more comparable to the closing dates, than freeze-up dates. This is likely contributing to the instances where the freeze transition dates are out of order (e.g. as you state in lines 247-248).

Figures 3-8: Since Jan – Mar are repeated twice in the color scale, it would be easier for readers to see that the repeated dates in the blue colors are for the following year if this was denoted on the scale markings somehow.

### **Technical Corrections**

L 30: Typo – Melt ponds decrease the albedo of the surface

L 328: Typo – the former through the formation of...