Response to RC2

This paper describes a novel use of model simulated brightness temperatures to compute a new metric to identify the timing of earliest snowmelt on Arctic sea ice. The paper compares the simulated brightness temperatures and earliest snowmelt dates with brightness temperatures and a melt onset data set from satellite data.

The paper is well written, and the study is clearly presented. I agree with comments from the prior reviewer and recommend that this paper is published pending a few additional clarifications as described in my comments below.

We thank the referee very much for their positive assessment and their constructive comments that will help us improve the manuscript. Responses to the comments are below.

1. L61: Why was 2003 selected as the sample year? Is it representative of a normal (non- anomalous) melt onset year? Or something else?
We selected the year 2003 to incorporate both DMSP and AMSR-E brightness temperatures, as AMSR-E begins in June 2002, and to avoid the anomalously low sea ice extent years of 2007 and 2012. This decision will be noted in the text and a figure showing a time series of annual average melt onset dates will be added to the Supplement for reference.

2. L73: Why is the Steele et al. 2019 dataset used instead of the Markus melt onset product directly? Are they not the same data?
It is correct that the melt onset dates from Steele et al., 2019 are the same as Markus et al., 2009. The Steele et al., 2019 dataset, which provides additional variables based on ice concentration, is used here for consistency and ease of comparison with past work on spring sea ice transition metrics (Smith et al., 2020). We will clarify this in the text.

3. L206-207: To what extent do you think error in the observations or in the simulated brightness temperature contribute to the divergence between the simulated and observed brightness temperatures in the central Arctic (i.e, Figure 3d) seen after the SIC declines? What might the physical reason for this big difference be?
Differences between the simulated and observed brightness temperatures after the SIC declines are likely related to differences in SIC between the model and observations at each grid cell. If the SIC declines faster in the model than observed, the brightness temperature will also decrease more quickly with the presence of more open water. Our focus on earlier melt processes reduces the impacts of these differences on our analysis. We will clarify this in the text.

4. L288: Please add proper names for the geographic locations that are considered “inflow regions”.

We will add proper names for the geographic locations.