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Earth System Dynamics
Discussions

Interactive comment on "Assessments of the north hemisphere snow cover response to 1.5 °C and 2.0 °C warming" *by* Aihui Wang et al.

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Anonymous Referee #2

General Comments This paper explores the changes in snow extent in the Northern Hemisphere projected under 1.5C and 2.0C warming. The snow cover fraction (SCF) for pre-industrial and end of century periods are analysed and compared. Furthermore, the role of surface temperature in diminishing snow cover extent is examined. This paper uses simple comparison techniques, including spatial and temporal correlations and trend analysis to determine the changes in SCF. Whilst these methods are appropriate for this work and the results are robust, the presentation of this paper is significantly lacking refinement and the results do not provide significant new information

to the literature. Grammatical mistakes are common and general use of the English language is poor. R: We are thankful the reviewers' comments and suggestions. We have made efforts to improve the manuscript. The English writing has been edited. We have also made additional analyses, and the corresponding texts have been added in the manuscript.

Specific Comments Many of the early figures seem unnecessary, this manuscript could be significantly condensed by removing these figures and making more appropriate use of the literature. For example, Figure 7a and b are repetitive. R: Thanks. Figure 7b are removed.

In the analysis of variability in section 5: - Pg 10, line 1-4: do you mean trends or variability – the variability in the period you are talking about does not seem to change, whilst there is a slight decreasing trend. Please check your terminology. R: Thanks. We have corrected the misunderstanding expression. The variation can be represented by the standard deviation. Here we mean the linear trend.

- Is Figure 4 necessary – many studies have shown that the increase spread of the CMIP5 ensembles is due to model spread. A more informative discussion would be around the uncertainties within the CESM-LE model. This also raises the question as to whether or not the CMIP5 models provide any additional value to this manuscript? R: Indeed, there have been discussed in many studies, which focused on the precipitation and temperature, and their derivation. We persist remaining Figure 4 and the reasons are: 1) in this manuscript, we discuss about land snow cover area (SCE) which has not been extensively investigated under different warming scenarios, in particular, CESM-low warming scenarios. 2) those curves give the temporal variations of SCE spread due to inter-model spread or internal climate variability from historical period till 2100, and 3) because we analyze the snow cover from multi models, it is necessary to quantify the spread of the ensemble. In the revision, we have added texts to emphasis above reasons. To investigate the dependence of SAE change on LSAT, we regressed annual SAE anomaly to LSAT anomaly in each CESM simulation and each

CMIP5 model, and then we computed the ensemble mean of regression coefficient and its corresponding standard deviation, respectively. For 2006-2100, the regression coefficient (unit: 106km2/ïĆřC) is -1.37ïĆś0.56 (1.5ïĆřC), -1.12ïĆś0.07 (2.0ïĆřC), -1.18ïĆś0.19(RCP2.6), and -0.97ïĆś0.44 (RCP4.5), respectively. For 1920-2005, the regression coefficient is -0.79ïĆś0.42 (CESM-LE), and -0.84ïĆś0.22 (CMIP5). The about values do not show obviously that the dependence of SAE loss on the warming rate in CMIP5 is greater than that from the simulations in CESM. However, based on both Figure4 and Figure S1, we argue that the inter-model diversity of CMIP5 is probably responsible for the increasing in the spread of both SAE and LSAT.

Please provide some discussion of the caveats associated with this work and how future work may address these issues, for example, satellite biases, climate model biases. R: Added.

It would be useful to present the results in a table (like Table 1) and when discussing area change, use percentage change as well to provide meaningful comparison. Some area averages (eg. North America, Europe, Asia) would also help aid this discussion. R: Thanks. We computed the SAE changes between 2071-2010 and 1971-2000 in annual and four seasons from four scenarios. A table (Table2) is added to present about above results.

You have discussed the role of LSAT on snowfall, and found it to be contributing to between 10-55% of changes in snow cover, depending on seasons. What else could be contributing? Changes in atmospheric circulation, precipitation trends? Please provide some discussion around this. R: We have added the texts to explain possible contributors on the seasonal variation of snow cover.

Technical Comments There are too many grammatical mistakes/English language problems in this paper to list individually. Some common mistakes are: SNR stands for Signal to Noise Ratio, CD for coefficient of determination or (R2), please make sure your terminology is correct R: Corrected.

Use of tense – please use either past or present tense consistently throughout the Paper R: Done.

Please review the structure of all sentences. To ensure clarity in writing, put the subject of the sentence at the beginning R: Done.

Please ensure you know the meaning of the words you are using, and you are using them in the right manner. For example: initialled, annual (I think you mean interannual),consensus, reproductions. Please make sure you are using adjectives and adverbs appropriately. R: Corrected.

Please ensure all content is relevant, I think this manuscript can be significantly shortened R: Thanks. We have deleted some unnecessary texts.

Please be more specific throughout, for example: Page 2, line 17: Rate of what? Page 3, line 14-15: What scientific gaps? Page 4, line 18: m is a parameter of what? Page 5, line 24: Different evolutions how? R: Done.

Please also note the supplement to this comment:
https://www.earth-syst-dynam-discuss.net/esd-2017-91/esd-2017-91-AC3-supplement.pdf

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