Dear Reviewer,

We would like to thank you for your constructive and helpful comments, which helped us to improve our manuscript. Significant changes have been made according to your comments and suggestions.

The following is our point-by-point response. The reviewer's comments are shown in ***blue italics***. Our responses are provided in **black**. The revised text is in **red**.

Sincerely,
All of the authors

Reviewer #1

Intraseasonal variation of snow cover over Tibetan Plateau is very important for the prediction of surrounding and downstream regions. Recognizing the subseasonal prediction skill of TP snow cover in the current models are crucial for correcting and improving subseasonal prediction. Snow cover's S2S skill is scarcely studied, which is worthwhile to investigate. However, the current version has large space to improve. I suggest the resubmission after reframing the writing and clarifying the following points.

1. The writing frame should be modified. e.g., a. a method part should introduce the major method how to evaluate the S2S skill; b. the numerical experiment design and modeling introduction should be put earlier in this manuscript.

Response:

Good suggestions. Your suggested writing frame looks much more logic and clear. In the revised manuscript, Section 2 is now "2 Data and method", which contains "2.1 S2S forecast models", "2.2 Validation data and method", "2.3 Numerical model and experimental design".

2. The evaluation method of S2S skill is conventional and simple. To me, the major contribution of this study is intentionally S2S evaluation. therefore, please give some quantitative evaluation rather than only TCC.

Response:

Following your suggestions, three evaluation metrics, including the temporal correlation coefficient (TCC), the root-mean-square error (RMSE), and the mean bias are used to quantify the subseasonal forecast skill of TPSC in the state-of-the-art S2S models in the revised manuscript. In addition to these simple metric assessments, a composite analysis for increasing and decreasing TPSC cases is performed to further understand what leads to the forecast biases, which is crucial for model developers and users. Spatial pattern of systematic biases of TPSC for each grid points have also been provided in the revised manuscript.

3. What season of this study is focused on? I cannot find any information for this. Meanwhile, I guess the S2S prediction skill should have large seasonal dependence even monthly dependence. Please check.

Response:

Many thanks for your comments. This issue was also raised by Reviewer #2. We actually intended to focus on TPSC assessment in boreal winter, but our presentation in the original manuscript might not be clear and cause some confusion. Unlike the systematic biases of wintertime TPSC revealed by the S2S models, the forecast errors in summer are not consistent and show complex structures among different models. Thus, we focus on only the winter season in the current study and will leave the issues about summertime TPSC prediction for our future work.

4. Regional modeling portion, I cannot understand it very well. To me, one is the predicted lateral boundary layer, the other is observational boundary layer, of course the latter is better than the former. I don't know which point does this study want to present through the numerical modeling.

Response:

The relationship between snow cover and the atmosphere is a two-way coupling connection. Model sensitivity experiment is a good tool to clarify cause and effect. By designing and conducting the model experiments, we attempted to verify whether the cold SAT biases predicted by S2S models were caused by the overestimation of TPSC (instead of the opposite condition that the cold SAT leads to overestimated TPSC). Therefore, we used the predicted TPSC as boundary condition in CTL runs (with overestimated TPSC), while observational TPSC in

GDAS was used as boundary condition in EXP runs (without overestimated TPSC). We clarified the purpose why we carried out the numerical experiments in the revised manuscript.

"To reveal the causality of the systematic bias of the TPSC-induced regional SAT bias, numerical experiments are performed." (in the revised Section 2)

"Through the results in Sections 4.1 and 4.2, we find that the local SAT over the Tibetan Plateau becomes colder with increasing forecast lead time. We assumed that the cold SAT biases are induced by the overestimation of TPSC. However, the relationship between snow cover and the atmosphere is a two-way coupling connection. The assumption should be tested by numerical experiments (see Section 2.2 for details about the numerical model and experimental design). Otherwise, one may suspect that the cold SAT induces an increasing TPSC other than the TPSC influence on SAT. Therefore, we used the predicted TPSC as boundary condition in CTL runs (with overestimated TPSC), while observational TPSC in GDAS was used as boundary condition in EXP runs (without overestimated TPSC). The difference between CTL and EXP is considered to represent the response or the sensitivity of the SAT to the overestimated TPSC." (in the revised Section 4)

5. To fit "Cryosphere", which is high-quality journal, at least, some physical analysis are needed. e.g., land-air budget analysis (surface fluxes) should be added to interprete the linkage between snow cover and surface temperature.

Response:

Excellent comments. We diagnosed the surface energy budget equation (Fig. 11c in the revised manuscript), the results of which indeed provides insightful explanations of TPSC-SAT relationship.

"By checking the land surface energy fluxes over the TP between CTL and EXP (Fig. 11c), we found that the overestimated TPSC strongly increases the upward-reflected shortwave radiation due to the snow-albedo affect. This difference in the solar surface energy leads to a decrease in the absorbed solar radiation. Thus, the net shortwave radiation is decreased (−10.2 W m^{-2}), while the response of the net longwave radiation is much smaller than that of the net shortwave radiation. The decreased absorbed solar radiation is mainly emitted by the land surface as sensible heat flux (−8.1 W m^{-2}). In contrast, the differences in the latent heat flux and ground heat flux are low. The overall responses of the surface energy to the overestimated TPSC lead to an incorrect cooling shift." (in the revised Section 4)

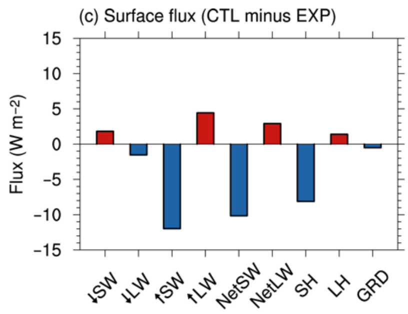

Figure 11c in the revised manuscript. Sensitivity of surface energy balance to TPSC biases in the numerical experiments. The difference in the surface energy balance between the CTL and EXP (CTL minus EXP) at 3 weeks in the numerical experiments. The terms from left to right are downward shortwave radiation (↓SW), downward longwave radiation (↓LW), upward shortwave radiation (↑SW), upward longwave radiation (↑LW), net shortwave radiation (NetSW), net longwave radiation (NetLW), sensible heat flux (SH), latent heat flux (LH) and ground heat flux (GRD) at the surface over the TP, respectively (unit: W m^{-2}).