This study focuses on spatial variations of seasonal soil freeze depth (SFD) and understanding of the environmental (non-climatic) factors contributing to the SFD variability and development in respond to climate change in China. I would suggest to change the 'non-climatic factors' to 'environmental factors' everywhere in the manuscript. This study addresses the importance of SFD as an indicator of climate change. The current version of the paper requires further improvements in language, flow and science. I enjoyed the discussion on snow depth and vegetation and was disappointed that discussion on soil moisture and soil organic matter relationship with SFD was missing. Using the fact that soil moisture and amount of organic matter play a significant role, in particular in Tibetan Plateau, it will be extremely important to include these environmental factors as well. Please find more detailed suggestion on how this paper could be improved. I would recommend this paper for the publication when suggested changes will be applied to the manuscript.

1. Introduction

L32. Out of 24% of permafrost affected soils in Northern Hemisphere how many falls in Tibetan Plateau? How much of the area in Tibetan Plateau permafrost-affected (i.e. has an active layer) and how much is seasonally frozen ground (i.e. no permafrost)?

L56. …feedbacks to climate change… please cite Abbott et al., (2016).

2.Data and Methods

Overall the flow in the Data and Methods section needs to be improved. Authors used different datasets (air temp., DEM, snow, etc). All these datasets are in different spatial resolutions. It is not clear to me what was the resolution of the final product and how authors dealt with all these different resolutions.

L78-80. Provide a web-link (reference) to the CMA dataset.

L95-103. Is it possible to divide the entire domain to several classes (subregions) with somewhat similar temperatures?

L104-107. DEM is finer resolution than MMGAT. Was it extrapolated to 0.5 deg or 0.5 deg was interpolated? Please clarify.

L109-112. Is the snow depth (SD) dataset available online? Provide a reference. More description is required. What is an overall snow distribution/max depth? How the SD was extrapolated? How accurate is that extrapolation (include uncertainties)? Where there more snow where is less? It would ice to know how this SD compares with MODIS or Globsnow products?

NDVI. Provide a description similarly to the SD (see previous comment). Note, the Resolution is 8km. How it was used (extrapolated interpolated)?

L118-120. Provide an uncertainty number associated with the interpolation.

L124-125. Did you use 2 DEM datasets? Previously it was 30m, here 1 km?

L131. More than 800 sites should go to the description of the monthly gridded air temperature

L137. Need to improve flow and rearrange. Repeating the met. station description. Move this sentence to the 2.1.3.

L141-143. Snow description should be moved to the 2.1.5. What about snow thermal properties?

L148. Provide a formula for FI_a.

L149. What dataset was used for soil thermal conductivities? Are they all constant and a one number or they change based on region and soil type?

L152. Similarly, to conductivities, which dataset was used for soil moisture content?

L154-156. Complex sentence. I suggest to simplify it or split to two.

L162. This is an important factor that has been referred in afterwards in the paper. State more clearly why it is important and what it tell us about SFD or permafrost.

L162-211. Make a workflow chart and refer to it while describing the workflow.

L205. …Stefan method – reference the equation.

Results.

L215. …Figure 4. What are the corresponding uncertainties?

L232. By calculating the anomalies for the whole region you average a lot of data. That is why it would be nice to divide the region on several classes, as I suggested above, and calculate anomalies for each subregion separately.

3.2. Section. Again within the subregions it could be easier to quantify changes in spatial variability.

L263-264. Belongs to discussion. Results section should only include the results description.

Discussion

L310—311. Rewrite that sense.

L314. What are pros and cons of using Stefan method?

L317-319 Combine two sentences for better flow.

L336. I would not say that TI can influence the ground temperature, because TI is an indicator rather than a factor.

L340. “snow structure” do you mean snow metamorphism?

L343. Authors did not find any relationship between SND and SFD. This confirms other findings, similarly Jafarov and Schaefer (2016) did not find any correlation between SND and ALT.

L344. Do not need ‘the’ before snow depth.

L344-350. Consider drawing plots of thermal offset (T_surface-T_air) vs. SND. This could reveal the relationship between offset and snow depth.

L351. Consider adding a plot of negative correlation of NDVI and SFD.

L355. …via different physical mechanism. Which mechanism?

Conclusion

Some of the conclusion could be moved to the abstract, especially statistics. If you divide your domain on subregions then you could better quantify the variability, and departures from mean in each subregion. This could improve the conclusion. Also which of the non-climatic or environmental factor influences SFD at most, and which one influences at least? Bringing in the influence of soil moisture and organic matter could strengthen the overall message.

Figures

Figure 2. Why the linear relationship was chosen? It looks quadratic or exponential to me.

Figure 3 c and d. Change y axis 'station number' to 'number of stations'

Also it would nice to see the relationship between SFD and elevation and SFD and latitude.

Figure 6 spatial variability. I suggest to choose different color bar (BlueWhiteRed), where 0 is blue, white in the middle, and red is 4.5m. This should improve the contrast and make it visually easier to understand.

Figure 7 is that the rate of change or a total change?

Figure 8. If the goal is to show the correlation, consider plotting SFD vs. MAGST and then MAAT, and so on.

Figure 9 and 10. Change y axis 'station number' to 'total number of stations'. Similarly, to Fig. 8 consider SFD vs. SND and NDVI and then you can colormap those points that will have the best correlation and analyze which years are those.

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