The variation of the permafrost thickness under the climate change after the LGM

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The permafrost is ditributed over the wide area of the high latitude. Its distribution changes with the climate condition, but it has the feedback to the climate system as well. Therefore, it is important to understand the response of the permafrost to the climate change for the study of the climate system.

In this study, we use the one dimensional permafrost model, and compute the change of the permafrost thickness for the climate change after the Last Glacial Maximum.

From the present permafrost distribution over east Siberia and north America, we constrain the past climate condition of those areas. East Siberian permafrost distribution is reflecting the severe cooling during LGM, due to the lack of ice sheet, and that of north america requires the existence of the thick ice sheet.

The permafrost is ditributed over the wide area of the high latitude. Its distribution changes with the climate condition, but it has the feedback to the climate system as well, through the gegneration of the latent heat or the effect on the soil moisture. Therefore, for the understanding the property of the climate system, it is important to clarify the response of the permafrost to the climate change. The change of permafrost distribution is mainly controlled by the thermal conduction of the ground, hence it has a quite long time scale comparing with that of climate change. It means that the permafrost distribution reflects the past cliamte condition

In this study, we have examined the thermal stability and the response to the climate change of permafrost. From overviewing the spacial distributions and cross section of the present permafrost, it is suggested that the permafrost in north America is in equilibrium with the present climate, otherwise the permafrost in Siberia is not. Siberian permafrost is extremely thick at the central part, and extends to south crossing the contour of annual meat temperature 0. We use the one dimensional permafrost model, and compute the change of the permafrost thickness for the climate change after the Last Glacial Maximum.

From the present permafrost distribution over east Siberia and north America, we constrain the past climate condition of those areas. It was suggested the possibility of intense cooling at inland Siberia for the conditions of LGM. The thickness calculated by our model is depend on the soil properties, thus the value itself can vary. However, the features we focused in this study, that is the difference of cross section between the continents, or the existence of thick permafrost in central Siberia where the climate is warmer than the north, are that of in large-scale. Therefore, these features are explained by the global and averaged conditions, not by the local factors. Since both of continents we argued are stable, and the variation of heatflow is small, we consider that the climatic condition was most important to produce present distribution of permafrost.

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Up to the present, the permafrost distribution of Siberia is simply regarded as the relics of the past climate change. Now we would say, that this argument is partly valid, but not in totally. It is safe to argue in this context, for the distributions of the thickness, especially the existence of thick permafrost in central Siberia, that it is a result of past colder surface condition. However, as for the spacial distribution, that is, the extent to south in Siberia, is impossible to be regarded as the relics. It is clear from simple consideration, that thin permafrost layer cannot survive under the warm climate (i.e. TS > 0C).

Therefore, we point out that the extent and thickness of permafrost should be argued separately.