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現在の永久凍土深分布からシベリア東部の最終氷期気温を制約する試み
An attempt to use current permafrost thickness to constrain the Last Glacial Maximum temperature in eastern Siberia

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The thickness of permafrost changes in responding to changing climate conditions. Since this process takes place as a result of thermal conduction from the surface, its response time becomes much longer for thick permafrost, compared with the timescale for climate change (Lachenbruch et al, 1982). The goal of the study is to constrain the ground temperature history using this characteristic of permafrost.

Genral circulation models (GCMs) has been used to calculate LGM climate, prescribing the reconstructed forcing conditions (i.e. orbital patameters, trace gases, topography, etc). Using temperature outputs from those experiments and assuming that the pattern of the climate history over last glacial cycle is basically follows the ice-core based temperature reconstruction, we ran a one-dimensional permafrost model to calculate the temperature profile variation for the north and central Siberia. Here, only spatially averaged characteristics of permafrost, such as permafrost thickness of the region or ground thermal properties, are discussed, to constrain the general temperature pattern over Siberia.

A series of 1-D experiments for ground temperature profiles are conducted to calculate temperature profile history in Siberia over last glacial cycle and to give the present (i.e. 0ka) value of permafrost thickness. The pattern of the climate history is assumed to be same, while the strength in LGM cooling is treated as a parameter for these experiments. Reflecting the long response time, the calculated 0ka permafrost thickness is strongly dependent of LGM temperature condition for such deep-permafrost area, varying from 200m to 600m for given conditions.

1-D ground temperature experiments suggest that strong cooling is required to explain the current deep permafrost thickness in eastern-central Siberia. Results from climate models, in which the difference in surface temperatures between LGM and present are larger in inland Siberia than arctic coast region, are consistent with the present permafrost thickness distribution.

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