平成２５年度　環境科学院　修士論文内容の要旨

Stochastic-based analysis of geographic factors determining permafrost distribution in the discontinuous permafrost, Mongolia

（不連続永久凍土帯モンゴルにおける永久凍土分布を決定する地理的要因の確率手法による解析）

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[Introduction]

Permafrost primarily is favor to develop under the cold climates, as distributed extensively over the Arctic. The areal coverage of permafrost decreases with lowing latitude. Mongolian permafrost, the southern boundary of Siberian permafrost, distributes mosaic-likely and depends on various local-scaled geographic factors such as altitudes, topographic concavity, forest coverage, soil wetness, and snow cover distribution in addition to the regional-scale climatic variables. Such ecosystem-driven permafrost (Shur and Jorgenson, 2007) would decay in the near future, because slight shift of climate variables and disturbance of local natures easily rise ground temperatures above 0 ^{o}C.

This study aims to discuss on the factors determining permafrost distribution in the discontinuous permafrost on the basis of stochastic analysis by which contribution and spatial dependencies of various geographic factors can be analyzed quantitatively.

[Regional setting and Method]

Study area is the central part of Mongolia (45°–52°N and 96°‐102°E), including the Hovsgol and Darhad regions in the north and Khangai Mts. in the south. Among this region, the coldest mean air temperatures, -8^{o}C, was observed in the high part of Khangai Mts. and northern Darhad depression. Annual total precipitation is above 360mm in the Hovsgol region, and it decreases to 240 mm at the southern slopes of the Khangai Mts., where forest cover is totally absent. Two regions were analyzed with different grid resolution of 90 and 900m as follows;

[I] 45–49 ^{o}N, 90m, [II] 45–49 ^{o}N, 900m, [III] 45–52 ^{o}N, 90m, [IV] 45–52 ^{o}N, 900m

The analysis used multi-logistic regression model, which calculate the probability of permafrost occurrence. The objective variables are 1m-deep ground temperatures taken at 77 points from 19 July to 6 August, 2012. Since 1m-deep is too shallow to identify permafrost existence, results of deeper ground temperatures monitoring at 28 borehole sites were taken in account. The accuracy of the analysis results were evaluated by an Akaike Information Criterion (AIC). The modeling results with small AIC value indicate the choices of highly accurate model.

[Results and discussion]

Lower AICs were found on the models with Latitude and Slope northness for [III] and [IV], and those with Altitude and NDVI for [I] and [II] analysis. Analysis for [III] and [IV] covers higher latitudes of cold and wet climatic settings, indicating that permafrost of this region easily develop despite of lower altitudes. On the other hand, the permafrost occurs at the higher NDVI sites rather than Northern slope for the southern regions as shown in analysis [I] and [II]. Areas with higher NDVI of Khangai Mts. correspond to those of greener pasture fed by wet soil. Accordingly NDVI representing soil wetness would be the dominant factor for permafrost existence in the southern regions.

I compared normalized coefficients calculated by models [I] and [II], and found that contribution of topographic concavity is great for the former, but convexity for the latter. This would be reflecting the different viewpoint of permafrost distribution, since the 900m grid resolution is useful for expressing larger geographical features such as broader valleys and mountains to controlling permafrost distributes. In summary, uses of 90m grids were suitable for estimating permafrost distribution in the south where the local wetness, topographic depressions would be more significant factor under climatically unfavorable conditions.