平成30年度　環境科学院　修士論文内容の要旨

InSAR analysis of changing microtopography around thermokarst lakes in southern fringe of Siberian permafrost, Mongolia

（干渉合成開口レーダーによるシベリア永久凍土南限モンゴルにおけるサーモカルスト湖縁辺部の微地形変動解析）

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[Introduction]

Mongolian permafrost show highly heterogeneous features in space. Along with climatic transition, continuous permafrost underlies the northern territories and high altitudes, which are surrounded by discontinuous, sporadic and isolated permafrost. At the local scale, hydro-thermal states of permafrost are dependent on the local geographies such as topography, ground wetness, and vegetation cover. Permafrost warming has been reported in several works of literature, but there is no report on ground ice dynamics. Thawing and disappearance of ground ice are represented in destabilization and subsidence of ground surface. Observing topographic deformation by Differential Interferometric Synthetic Aperture Radar (D-InSAR) technique, capable of detecting ground deformation in several centimeter orders, would provide us some insights for invisible dynamics of ground ice.

[Study areas & Methods]

Study areas are Darkhad depression (51°7'N~51°37'N, 99°11'E~99°48'E) and Chuluut river valley (48°2'N~48°5'N, 100°19'E~100°22'E) with continuous permafrost, and Galuut canyon (46°26'N~46°36'N, 99°57'E~100°13'E) with isolated permafrost. ALOS PALSAR image (June to September, 2007 to 2010) and ALOS-2 PALSAR-2 image (June to September, 2014 to 2017) were used to detect yearly-displacement of the ground surface. Shuttle Radar Topography Mission Digital Elevation Model was used as a reference to eliminating the phase shift caused by elevation. For climatic and geographic references, I used annual maximum normalized difference vegetation index (NDVI), mean annual air temperature (MAAT) and total annual precipitation (PR) from the NOAA ESRL. This study aims to quantify topographic deformation around thermokarst, the most apparent stages of altering ice-rich permafrost. The discussions highlight the spatiotemporal differences among the three study areas from north to south Mongolia, considering variations of climatic and local geographic settings.

[Results & Discussion]

The overall yearly change detected by InSAR (subsidence and uplift across an individual interferogram) is between ±3 cm in three areas. Geospatial Kernel density analysis indicated that subsidence and uplift occurred more likely in water- rich environments where ground ice would be well developed. Thaw settlements of the active layer and the thawing of ice-rich permafrost near the permafrost table cause the ground subsidence. Uplifts, on the other hand, are related to the formation of new ice-lens. In Darkhad, the statistical analysis suggested that MAAT and PR negatively correlated with the rate of deformation. This correlation was not found in Chuluut and Galuut.