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Conference Paper · July 2017

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MONITORING AND THERMAL STATE OF PERMAFROST IN MONGOLIA

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Keywords: monitoring, boreholes, ground temperature regime, south boundary of permafrost

Permafrost distribution in Mongolia, which encompasses about 29% of the total land area, underlying the Altai, Khuvsgul, Khangai, and Khentii Mountains (Jambaljav et al. 2016), is mosaic-like because Mongolia is located at the southern boundary of the Siberian permafrost region (Dashtseren et al. 2014; Ishikawa, in press). The air temperature has increased by 2.07°C/70yr in Mongolia, and this increase has occurred more intensively in the mountain regions than in the Gobi and steppe regions (MARCC. 2014). Therefore, the permafrost in Mongolia can be vulnerable to climate and environmental changes. Permafrost acts as a water-resistant buffer against water penetration to sediments, playing an essential role in arid ecohydrological system and herders in Mongolia. For instance, the permafrost in Mongolia directly sustains the livelihoods of inhabitants because it produces locally wet soil conditions, even under a low annual rainfall (Dashtseren et al. 2014). Furthermore, the forests are distributed in a mosaic pattern and overlap considerably with permafrost regions, and river discharges originate entirely from the high mountains and northern territory where permafrost occurs extensively (Dashtseren et al. 2014; Ishikawa, in press). However, the characteristic of the Mongolian permafrost is not fully known due to widespread permafrost and less complex observation systems. To better understand the characteristic of the Mongolian permafrost, it is necessary to build up more monitoring sites over permafrost area.

In Mongolia, permafrost research has been conducted since the begging of 1960s. However, continuous measurements began mostly in the last decades. During the last several years, 180 permafrost monitoring sites (boreholes) were established in the different permafrost zones over Mongolia, and about half of the boreholes has equipped with HOBO U-12-008 temperature data-logger and TMC-HD temperature sensors. These boreholes were considered to be representative for the most landscape types in permafrost region. The depth of boreholes are ranged from 1.5 to 50 m, with the majority below 15 m. Also, some of these boreholes have a single temperature measurements from the late 1960s and early 1980s. Therefore, it is able to determine the changes of permafrost in some sites.

Monitoring of the ground temperatures over the past decades has indicated that the permafrost has been changing in the Mongolian territory. For example, mean annual ground temperature (MAGT) at 10-15 m depth increased by 0.02 − 0.03°C yr^{-1} in the Darkhad and Sharga depressions in the Khuvsgul Mountains, where ice-rich and cold permafrost occurs extensively. In the southern Khangai and Khentii Mountains with underlying warm permafrost, MAGT at the former depth increased by 0.01 − 0.02°C yr^{-1}. The increase in permafrost temperature is more pronounced in the cold permafrost than in the warm permafrost region. Active layer thickness varies between 1.8 – 2. 9 m in the Khuvsgul Mountains, 2.8 – 6.5 m in the Khentii Mountains, 2.1 – 7.8 m in the Alta mountains and 2.4 – 5.5 m in the Khangai Mountains, respectively.

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