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Long-term hydrometeorological, ecological and dendrochronological monitoring at larch forests on permafrost of Mongolia

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1. Introduction

The larch forest of Mongolia is located at the southern edge of Siberian Taiga forest. The 80% of forested area of Mongolia is dominated by larch forest (*Larix sibirica*). In Mongolia, the forest is dominant on north-faced slope where the permafrost is located underground while the steppe grassland is dominant on south-faced slope area without permafrost. The disturbances on the forest such as fire, logging and pest out break are important factor for predicting future change of forest. The climate change becomes remarkable such as increase of the air temperature (1.8 degrees in recent 60 years) and change of precipitation (7.5% decrease in summer and 9% increase in winter) in Mongolia. These changes of climate condition and human impacts might affect the ecosystem of Mongolia especially for forest distribution.

The purpose of our study is to investigate the heat, water and carbon exchange process, and dynamics by comprehensive approach. In this paper, we show the observation method, data and preliminary results.

2. Observation method and data

We have started long term monitoring of hydro-meteorological, ecological and dendro-chronological observations at the 25-m height tower and forest around the tower in the Udleg (48 15 43.7 N, 106 50 56.6 E, altitude 1264m) over the larch forest in Research Forest of National University of Mongolia in Udleg village, Batsumber district, Tuv province of northern Mongolia since 2009. As for the hydrometeorlogical observation, we have been observing the air temperature, relative humidity (at 2m and 25m), air pressure (25m), wind speed and direction (25m), precipitation (25m), snow depth, short wave and long wave radiation (5m, 25m), photosynthesis active radiation (PAR; 5m, 25m), soil temperature (0, -0.2, -0.4, -0.8, -1, -2, -3, -4, -6, -8, -10m) and soil moisture (-0.1, -0.3, -0.5, -0.7, -0.9, -1.3, -1.8, -2m) and sensible heat, latent heat, momentum and carbon dioxide fluxes (by eddy-covariance method using sonic-anemometer-thermometer and infrared gas analyzer at 27.5m). As for the ecological observation, we have carried out the growth of diameter at breast height (DBH using dendrometer), sap flow (Granier method), vegetation and surface condition measurements. The dendro-chronological observation has been carried out for the age of each tree, growth rate, drought and fire histories. The average height and DBH of larch tree were 18.3m and 33.2cm, respectively.

3. Results

The annual range of air temperature and annual mean air temperature were about 60 degree C (+25 to 27 degree C in June and July as the annual maximum, and about -30 degree C in January and December as the annual minimum) and -1 degree C, respectively. The annual precipitation was about 250 mm with about 90% of it from May to September. According to the image analysis of in situ camera, we clarified the seasonal variation of surface condition and phenology of larch forest. From January to March, November and December, there was continuous snow cover on the surface when the surface albedo was about 0.2 to 0.3. In early May the leaf of larch emerged and attained the mature growth in July, and then the leaf senescence occurred in early October. The PAR albedo shows abrupt decrease in early May and abrupt increase in early October that coincides with the image analysis. The soil moisture at 10 cm depth was less than 10% before April, then it gradually increase in May to 20% in August, after that it decreases to less than 10% from October. The temporal variation of soil moisture matched to the variation of rainfall. The soil temperature below 3m was about -0.2 degree C in all year round that suggests that there is the permafrost.

Keywords: Mongolia, Larch forest, Heat, water and carbon balance, Soil moisture, Permafrost