Preliminary Observational Results of Land Surface Processes on Grassland of Nalaikh, Mongolia

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Key word:

Introduction

Mongolian territory is characterized by mountain and arid land permafrost, which is distributed in southern fringe of the Siberia permafrost occurrence. Increasing of active layer thickness 0.5 to 1.0 cm per year has been observed for last decade in high mountain region of Mongolia (Sharkhuu, 2001). Such changes might result in significant ground surface layer changes as massive buried ice melts, impacting on the surface hydrological process. A unique and important feature of hydrological in Mongolia associated with the long, cold winter is the presence of permafrost and a summer active layer. Permafrost limits the amount of subsurface water storage and infiltration that can occur, leading to abnormal capacity of water, unusual for a region with such limited precipitation. Active layer thickness and permafrost conditions are largely controlled by surface heat fluxes, coupling the hydrology to the surface energy budget so closely that they cannot be quantified separately. In summer, solar hating leads to repaid thawing of active layer, while in winter, a delicate balance between the thermal insulation of the snow cover and its high albedo control the rate severity of freezing.

In such inner continental region, the mechanism of precipitation- evapotranspiration is logically a dominant process of water cycle. Almost one third of the country is defined as a highly vulnerable region. Just 5.8% of water resource of Mongolia was estimated stored in river (Myagmarjav and Davaa, 1999). All rivers are seasonal; they have flow only during the rainy season. Hydrological records shows that in most of the area the annual discharge is less than 100 mm except in the alpine basin of northern and far western Mongolia. That means more than 70% of the precipitation is consuming on evapotranspiration and recycled. Therefore, better prediction on ground evapotransppiration will be important for the regional water cycle research and impacts on economics. In permafrost-dominated areas, the freezing and thawing of frozen soil is critical to the timing of plant growth and evaporation, infiltration, and runoff as well as variation of soil moisture. The processes investigating on hydrological consequence of permafrost and vegetation will provides useful techniques for such work.

To improve our understanding on water cycle process on such periphery part of Eurasian snow cover/frozen ground region, a series observation systems have been established under the project of "Observational study on the water cycle and thermal condition in periphery of Eurasian snow cover/frozen ground region in relation to climate formation and climate change impact study", which funded by Frontier

Observational Research System for Global Change. The performance of observation system are aim to: a) To dress the heat/vapor fluxes between atmosphere and ground surface in different time scale; b) To reveal the thermal/hydraulic condition in the ground surface layer; c) To investigate hydrological consequence of thaw-frost cycle; d) Plant (grass) dynamic climatology; e) Constructional study of permafrost; f) Snow covering process and its impact on water cycle; g) Control station for basin scale observational network—basin scale water cycle evaluation.

Table 1. Observation terms of observation in Nalaikh, Mongolia.

System	Observation terms	Installation	Start date	Observation interval
ACOS	Air temperature	0.5, 1, 2, 4m heiht	July 1, 2002	10 min.
	Air humidity			
	Wind speed			
	Wind direction			
	Ground surface temperature			
	Global radiation			
	Reflection			
	Lon-wave downward radiation			
	Lon-wave upward radiation			
	Downward PAR			
	Upward PAR			
	Net radiation			
	Air pressure	1 m height		
	Precipitation	Ground surface		1 hour
	Snow depth	1.5 m height		
SMS	Soil moisture	0, 0.2, 0.4, 0.8, 1.2, 2.4, 3.0 m depth		10 min
	Soil temperature			
	Heat flux	0.05, 0.2 m depth		
MGSO	Soil moisture	Within 70 cm depth		10 day
	Phyenology	Ground surface		
	Snow survey	Ground surface		
DBGOS	Soil temperature	Within 3 to 30 m depth by 1 or 2 m interval	Oct. 2002	1 hour
	Soil physical properties			
	Isotope	0 to 30 m depth		
	Ground water table	Within 7m depth		
SMOSB	Soil moisture	Within 7 m depth	Nov. 2002	1 month

Observation systems

The observation site is locate on smooth meadow in Nalaikh, where eastern of Ulan bator by 44 km. Sandy soil is covered by sparse grass with barren organic layer less than 10 cm thickness. The station has established since July, 2002, including Automatic Climatic Observation System (ACOS), Soil Monitoring System (SMS), Manual Ground Surface Observation (MGSO), Soil Moisture Observation by Shallow Borehole (SMOSB) and Deep Borehole Ground Observation System (DBST. Detail observation terms have been listed in Table 1.

Preliminary observational results

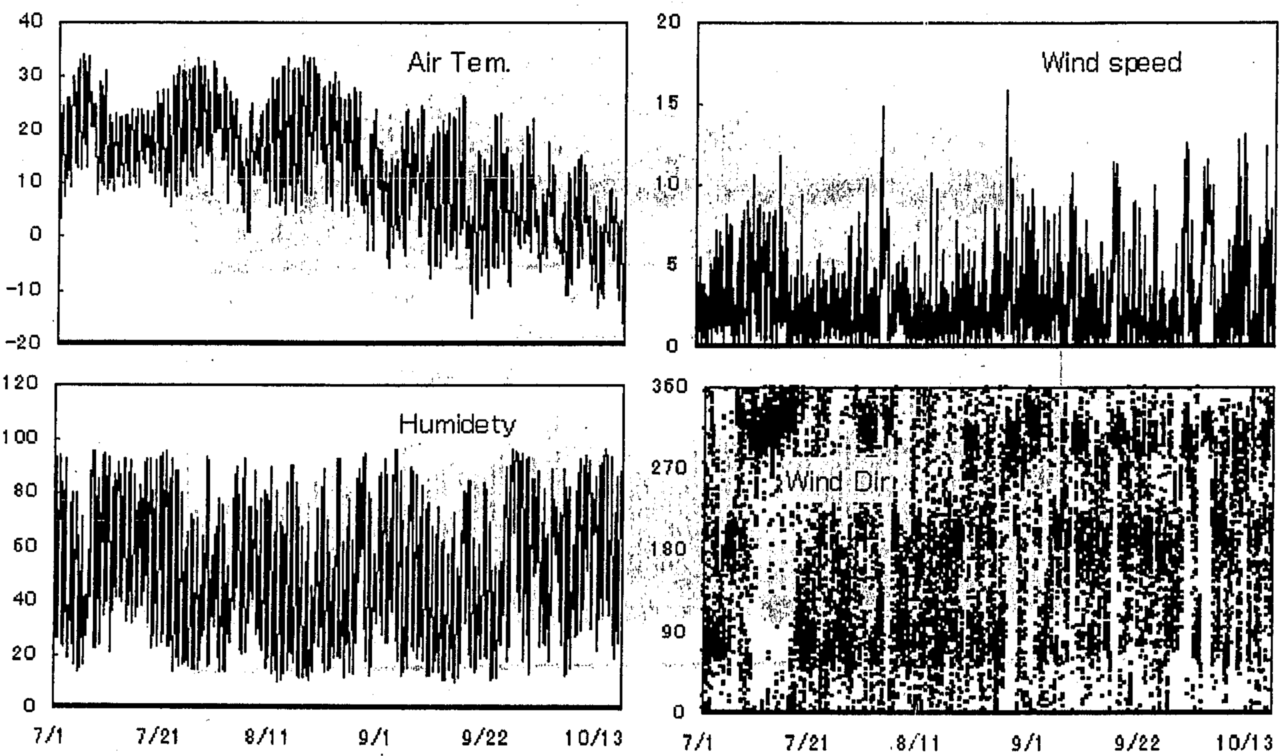

Figure 1. The variation of air temperature, relative humidity, wind speed and wind direction on observation site of Nalaikh, Mongolia, in the period of July 1 to Oct. 15, 2002.

The observation results of air temperature (°C), relative humidity (%), wind speed (m/s) and wind direction (degree), which achieved from ACOS on Nalaikh, has show in Figure 1 for the period of July 1 to Oct. 15, 2002. The air temperature varied intensively with daily range bigger than 10 °C. Maximum air temperature, occurred in July, reached 34 °C. Since late August, air temperature dropped to below 0 °C from time to time. By effect of air temperature, the ranges of relative humidity variation were big as well. The maximum relative humidity can be to be 92%, and minimum to 12% from the figure.

The extreme strong wind was occurred in late August with speed of 16 m/s, coupling to the air temperature start to drop to below 0 °C. Wind speed, however, was varied normal with wind speed less than 5 m/s. The prevailing wind direction cannot be read clearly from the figure.

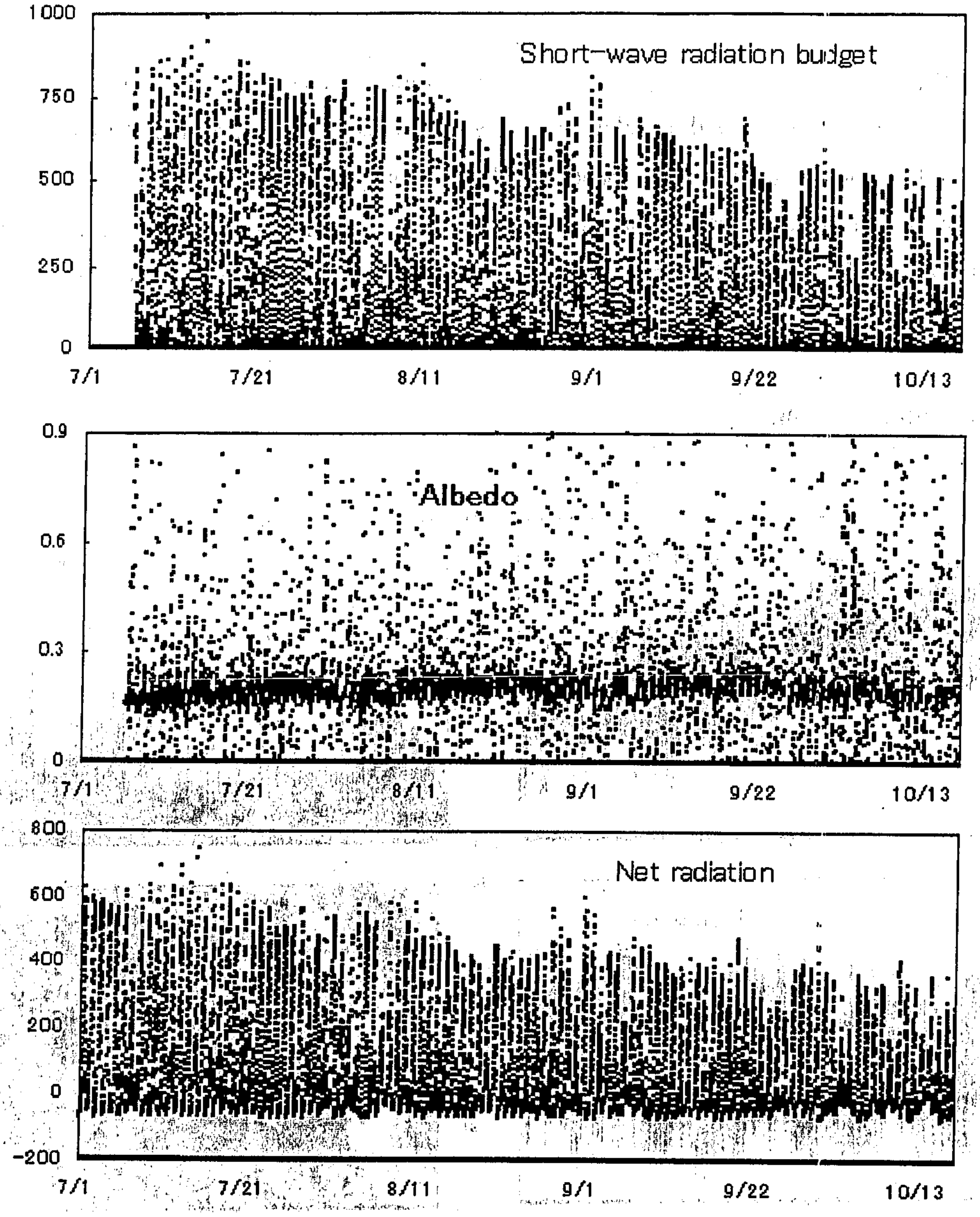

Figure 2. The variation of short-wave radiation budget, Albedo and net radiation on observation site of Nalaikh, Mongolia, in the period of July 1 to Oct. 15, 2002.

The observation results of short-wave radiation budget (Wm^{-2}), Albedo and net radiation (Wm^{-2}), which achieved from ACOS on Nalaikh, has show in Figure 2 for the period of July 1 to Oct. 15, 2002. The short-wave radiation budget on observation site was very large comparing to other region on the world. The maximum value was observed on meddle of July with value of 985.4 Wm^{-2}, which couple to global radiation of 1181 Wm^{-2} and reflection of 195.6 Wm^{-2}. Since beginning of September, the short-wave radiation budget decreased significantly less than 600 Wm^{-2}.

Having rejected disturb of solar incidence angle, the range of albedo can be read to be 0.20 to 0.25. The net radiation was decreased from 600 Wm^{-2} on July to 400 Wm^{-2} at middle of October, the value was large than other region on the world as well. It is interesting that the amplitude of negative net radiation, which occurs in nighttime, were similar. The fact implies that radiative cooling process through long-wave radiation emission may not vary so much.