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The effect of meteorological condition on energy and carbon budget on taiga-tundra boundary in North-eastern Siberia

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1. Introduction

In Arctic, temperature has increased almost twice the global average rate in the past 100 years. We aim to clarify the land-atmosphere interaction over the boundary between taiga and tundra in northeastern Siberia, where the climate change effect might be remarkable. We have started the energy, water and carbon fluxes observation as well as hydro-meteorological observation in northeastern Siberia, Sakha Republic, Russia in June 2013.

2. Material and methods

Our observation site is located at Kodack site (70.564 N, 148.267E, altitude 7m) about 100km south from East Siberian Sea in Arctic Ocean near Chokurdakh city in the North-Eastern Siberia, Sakha Republic, Russia. The Kodack site is belong to Indigirka river basin (drainage area: 324,244km^2) which flow to the East Siberian Sea. The annual air temperature and precipitation are -13.4 deg. C and 200mm respectively (1979-2008, Baseline Meteorological Data in Siberia (BMDS) Ver.5.0, Yabuki et al., 2011). The surface is covered by snow except July and August and the maximum snow depth is 40cm in April. In this region, the permafrost exits and the active layer depth ranges from 25cm to 40cm (van der Molen et al., 2007). The topography at the site consists of higher mounds and lower wet lands, where the difference of the height are about 50cm. At the higher mound, the shrubs and larches are dominant, while the sphagnum are prevailing at the lower wet land. The meteorological and flux observation has been carried out over the mound area.

The air temperature, relative humidity, wind speed and direction, air pressure, precipitation were observed at 1.5m height. The incoming and outgoing shortwave and longwave radiation were observed by 4-compnent radiometer at 1.37m height. The soil heat flux was observed by heat flux plate at 0.05m depth. The soil temperature was observed by platinum sensor at depths of 0.025, 0.05, 0.225, 0.425, and 0.625 m. The soil moisture was observed by capacitance sensor and frequency domain reflectometry sensor at depths of 0.035, 0.145, 0.335, and 0.535 m. The energy and carbon fluxes were calculated by the eddy covariance method from the observed values of the sonic anemo-thermometer at 2.55m height.

3. Results

The analysis results from 23 June to 27 October 2013 will be shown. The daily mean air temperature and relative humidity varied from 0.5 to 21.9 deg. C and from 53.9 to 90.0%, respectively. The total precipitation was 29.5 mm, and the maximum daily precipitation was 9 mm?day-1. The daily mean wind speed varied from 1.3 to 6.1 m s^{-1}. There was clear relationship between the daily mean air temperature and wind direction. When the wind direction was northerly (southerly), the air temperature was low (high). The soil temperature (Ts) at surface varied from 2.8 to 10.8 deg. C while Ts at deeper than 0.425 m kept below 0 deg. C, which implies the frozen soil. The Ts at depth of 0.225m increased from -0.4 to 1.8 deg. C. The soil water content (SWC) was higher than 50% in surface layer of wet land while SWC at dry mound was lower than 11%. The net radiation varied from 50 to 200 W m^{-2} and soil heat flux varied from 11 to 40 W m^{-2}. The daily mean latent heat flux (average during analysis period: 39 W m^{-2} was little higher than the daily mean sensible heat flux (26 W m^{-2}). The daily mean net ecosystem exchange (NEE) on 24 and 26 June was 0.32 and 0.41 g C m^{-2} day^{-1}, respectively, which implies the carbon was released from the surface to the atmosphere while the NEE of the other days was negative value which implies the carbon was uptaken from the atmosphere. The accumulated NEE during analysis period was about -64 g C m^{-2} day^{-1}, which was smaller uptake than the value observed at tundra (-92g C m^{-2} day^{-1}; van der Molen et al., 2007). As our observation was started about half month after the start of growing season (late May), further analysis using the next year observation is necessary.

Keywords: Taiga-Tundra boundary, Siberia, Energy and carbon budget