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Biogeosciences Discussions

Interactive comment on "Contrasting radiation and soil heat fluxes in Arctic shrub and wet sedge tundra" *by* I. Juszak et al.

Anonymous Referee #1

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General comment: This study focus on the issue of the heat exchange between the land surface (Tundra ecosystems) and atmosphere over the Altaic region. The authors conducted this study by comparing the surface energy budget at the sedges site and the shrub site. The design of this study is quite straight forward to justify environmental drivers to contrasting the energy into the permafrost soil layer. The authors concluded that the surface background effect (soil albedo) is more important than the shading effect contributed from vegetation covers, while the most of energy was transferred into the soil layer due to the heat conduction (from warm air to cool soil) instead of the radiative absorption by the vegetation cover itself. This is an interesting finding for evaluating the land-atmosphere energy exchange under warm overlying air, high wind speed, weak radiation, and frozen soil conditions. The result would be useful for the future SVAT modelling over the Artic region, which is a recent theme of the

Biogeoscience research in relation to the topic of the climate warming. I suppose that this manuscript could be publish in the journal finally.

However, the information of long-wave radiation did not well presented in this manuscript, I recommend the authors can analysis the long-wave radiation balance\budget during daytime and nighttime. I would also like to understand the diurnal course of temperature gradient between the soil and overlying air parcel to elucidate the direction of sensible heat flux. Besides, I noticed that the authors mentioned the soil moisture condition at sedges site was always under the saturated condition, but the evapotranspiration at the sedges site was suggested to be higher than that at the shrub site. This implies that the soil moisture at sedges site was replenished/affected by lateral water flux, which could also transport heat from other regions such as upland area with the shrub vegetation cover. I recommend that the authors can cite relative studies regarding to the lateral water flux and heat transport at top soil layer over this region or the authors can add an extra analysis of soil moisture by using the soil moisture depletion approach.

Specific comments:

P1 line7: How to define the active layer thickness in this study?

P1 line14 to 15: The authors should provide the evidence such as soil moisture information, soil albedo to support this conclusion. I can't find the approach that the authors conduct the observation of soil albedo measurement throughout the manuscript. Would you please indicate that how to measure the soil albedo? Does it also parameterize as a function of soil moisture change or solar zenith angle?

P3 line26: Please remove "e.g." for the consistence.

P4 line4: Would you please also provide the information of above ground biomass at the sedges and shrub sites? It would be nice to show this information to readers for the comparison.

P4 line9 & line 10, P5 line2-3; P17 line10-11 Please check the unit of the thermal conductivity and heat capacity, is it correct?

P12 Figure 7 and Figure 8: The information contains in the Figure 8 which is largely repeated from the Figure 7, thus I recommend to remove the Figure 8.

P13 line14: “Depended on soil properties”, What kind of soil properties, thermal conductivity, porosity, or soil moisture?

P13 Figure 9: Would you please apply the soil moisture depletion approach (Michelakis et al. 1994) to calculate the reference evapotranspiration rate or apply the Priestley - Taylor approach (Priestley and Taylor 1972) to calculate the evapotranspiration rate limited by a correction function based on LAI or soil moisture conditions?

Reference: Ref1: Michelakis, N.I.C., Vouyoucalou, E. and Clapaki, G. 1994. Soil moisture depletion, evapotranspiration and crop coefficients for olive trees cv. kalamon, for different levels of soil water potential and methods of irrigation. Acta Hortic. 356, 162-167 Ref2: Priestley, C.H.B., and R.J. Taylor. 1972. On the assessment of surface heat flux and evaporation using large-scale parameters. Mon. Weather Rev., 100:81-82

P15 line18: I was confused by this sentence, ”strong cloud impact on albedo masked other temporal trends within growing season . . ..” To my knowledge, the calculation of surface albedo (vegetation + soil background) can be separated into two parts (visible + near infrared). The reflectance (albedo) from near infrared is more sensitive to the canopy structure (Otte et al. 2014), and albedo are often parametrized as a function of solar zenith angle in the radiative transfer process. Would you please use this concept to explain your finding in a logic way?

Reference: Otte et al., 2014: Forest summer albedo is sensitive to species and thinning: how should we account for this in Earth system models? Biogeosciences, 11, 2411–2427.

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