EGU21-10654
https://doi.org/10.5194/egusphere-egu21-10654
EGU General Assembly 2021

Inhomogeneous surface of West Siberian peatland diagnosed by skin temperature distribution

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Skin temperature (Ts) plays a central role in shaping the land surface energy balance and is also widely available from remote sensing for model evaluation and data assimilation. Both offline land models and land–atmosphere coupled models still have difficulty in realistically simulating or predicting Ts. In the case of an inhomogeneous surface, under the same atmospheric conditions, there are patches of different skin temperature and different daily variability. This observational study reports variations of surface fluxes (turbulent, radiative, and soil heat) and ancillary atmospheric/surface/soil data based on in-situ measurements conducted at Mukhrino field station located in the middle taiga zone of the West Siberian Lowland. To measure the surface temperature, we used an infrared camera (TIR, ~8–14 mkm wavelength range) based on an unmanned aerial vehicle. This UAV-based system provides high-resolution multi-sensors data acquisition. It also provides maximal flexibility for data collection at low cost with minimal atmospheric influence, minimal site disturbance, flexibility in measurement planning, and ease of access to study sites (e.g., peatlands) in contrast with traditional data collection methods. e demonstrate that the temperature of the boggy surface has significant variability: depending on the time of day, temperature contrasts can reach more than 10 degrees, which is associated with different surface moisture and albedo. A technique has been developed for restoring the surface albedo from the data of IR measurements. Ground measurements have shown that the variations of temperature and humidity across the subsurface layer can be very large. Furthermore, these variations are directly related to the concept of a difference between the roughness length for momentum versus that for heat. Information about the ratio of z_0/z_{0h} is necessary in order to be able to use surface skin temperature from satellite remote sensing for the computation of surface fluxes. The relationship between the difference in skin temperature and soil contact temperature with the heat balance, especially with sensible heat fluxes and heat flux through the soil, is considered. The parametrizations obtained in this work can be used in Earth System models to represent wetland ecosystems.

The work was supported by RFBR grant 18-05-60126, by the Moscow Center for Fundamental and Applied Mathematics and within the grant of the Tyumen region Government in accordance with

the Program of the World-Class West Siberian Interregional Scientific and Educational Center (National Project "Nauka").