The energy budget of West Siberian wetland in summer time

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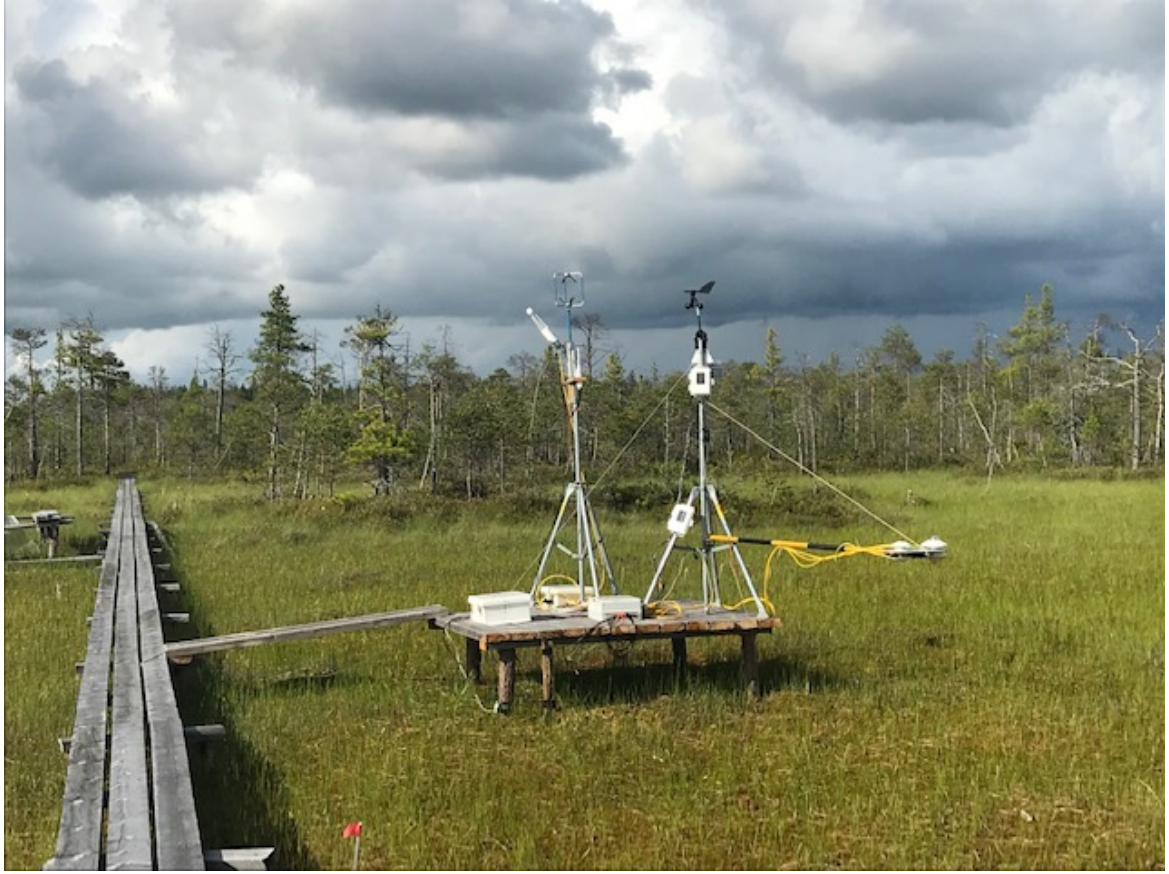
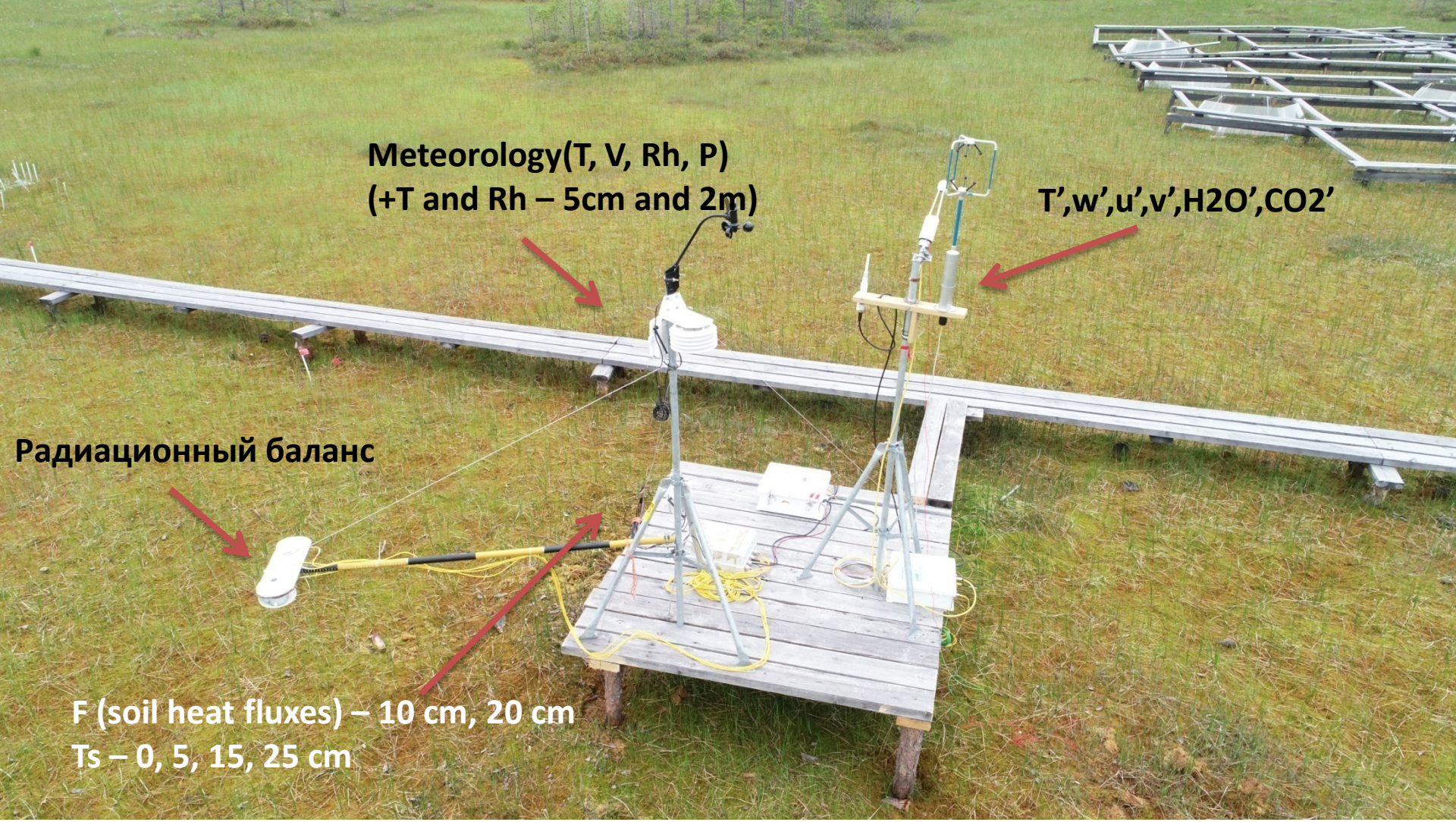
Motivation

1. Boreal peatlands, covering a large fraction of the Northern Hemisphere, are an important terrestrial carbon pool. Photosynthesis and respiration of plant and microbial communities regulate the size of this pool. However, peatlands are also prone to rapid ecological changes related to climate, which modify the interaction between hydrology, carbon cycle, vegetation cover, and microtopography.
2. This observational study provides variations of surface fluxes (turbulent, radiative, and soil heat) and other ancillary atmospheric/surface/soil data based on in-situ measurements made at Mukhrino field station located at in the middle taiga zone.



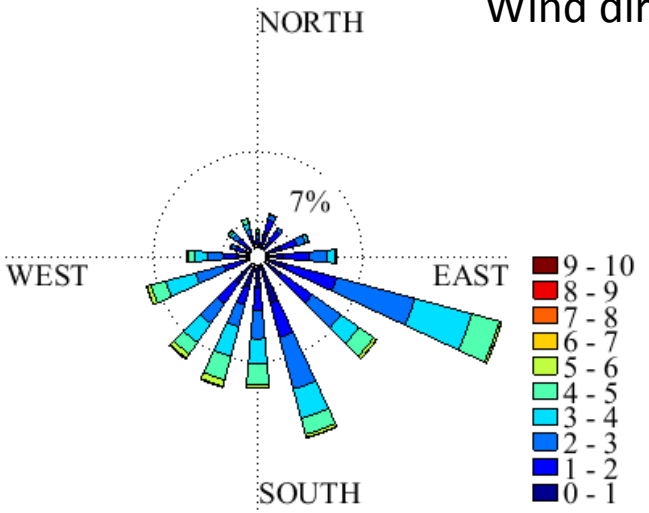
The experiment was conducted from July 5 to July 21, 2019 and we estimated of carbon dioxide flux and energy budgets in a typical wetland of the western Siberian

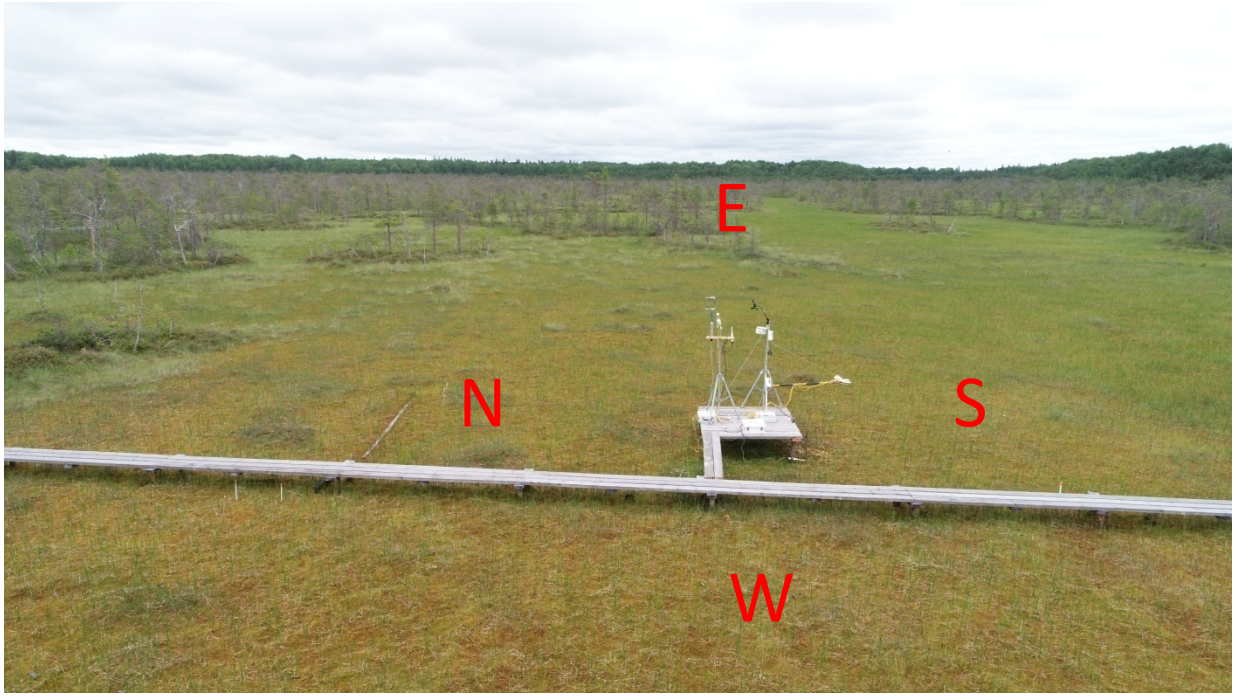


Turbulent fluxes of momentum, sensible and latent heat, and CO2 were measured with the EC technique. Measurements in the atmosphere were supplemented by measurements of heat flux through the soil, radiation balance and soil temperature at several levels.

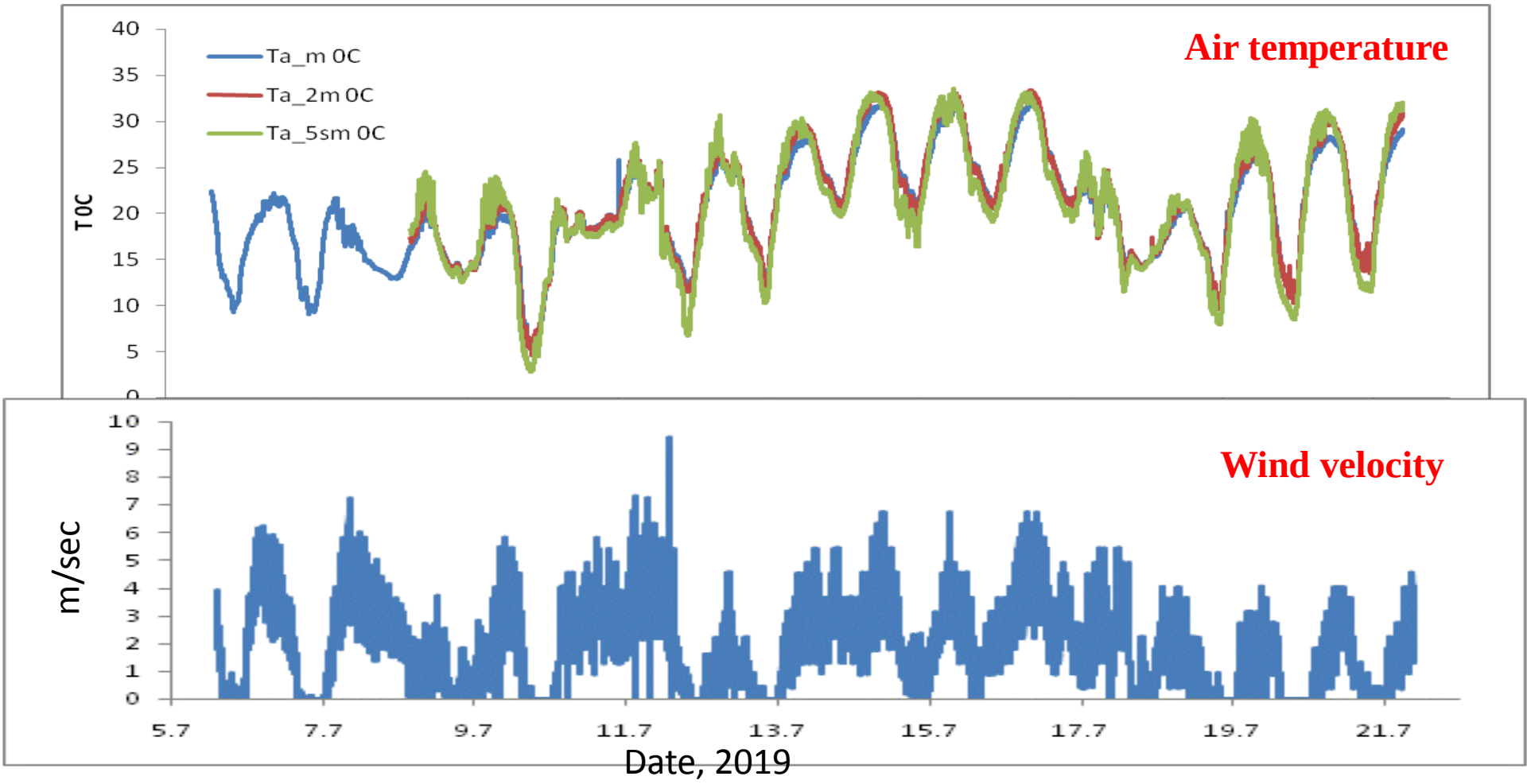
Surface

Wind direction

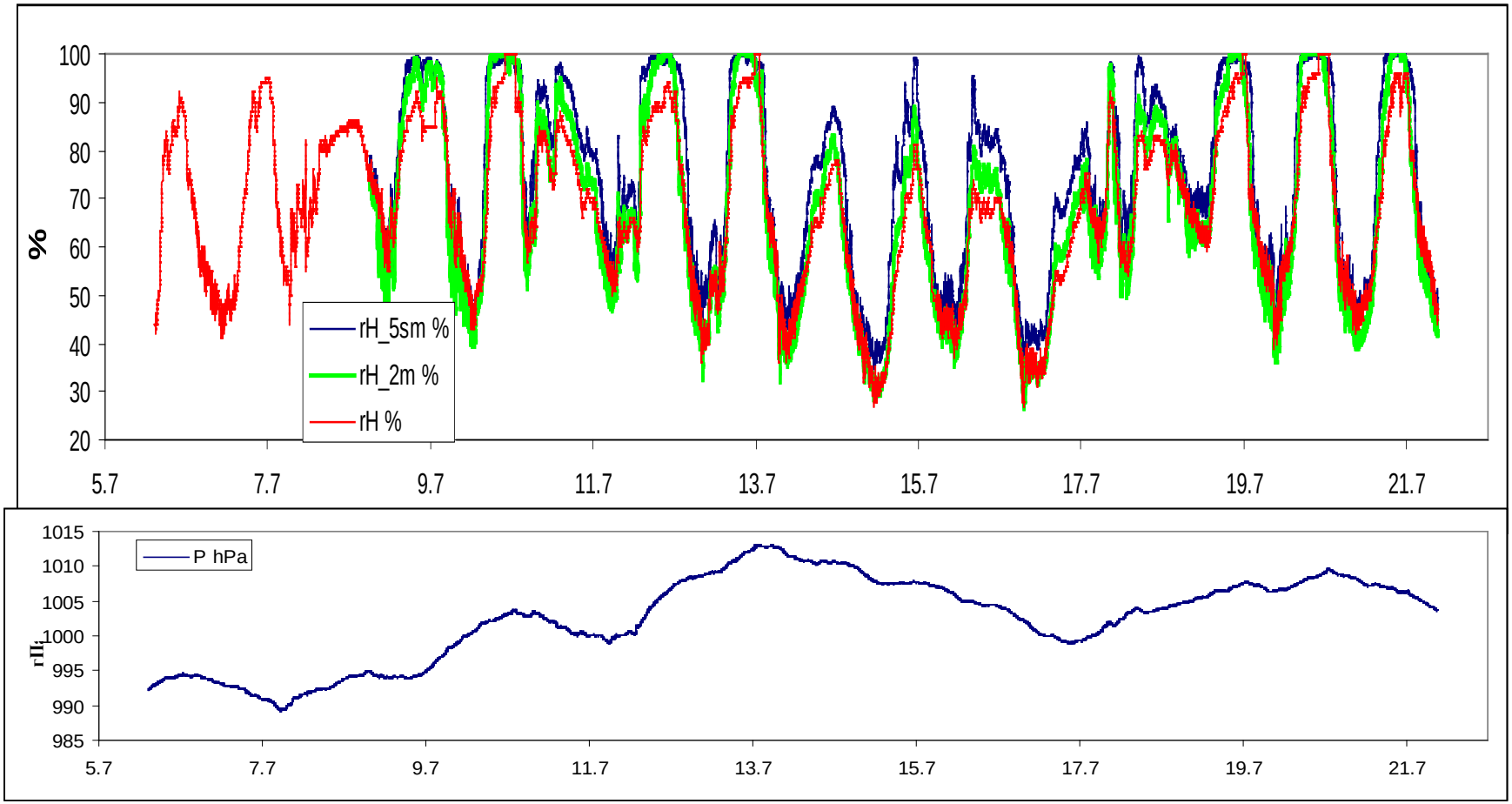




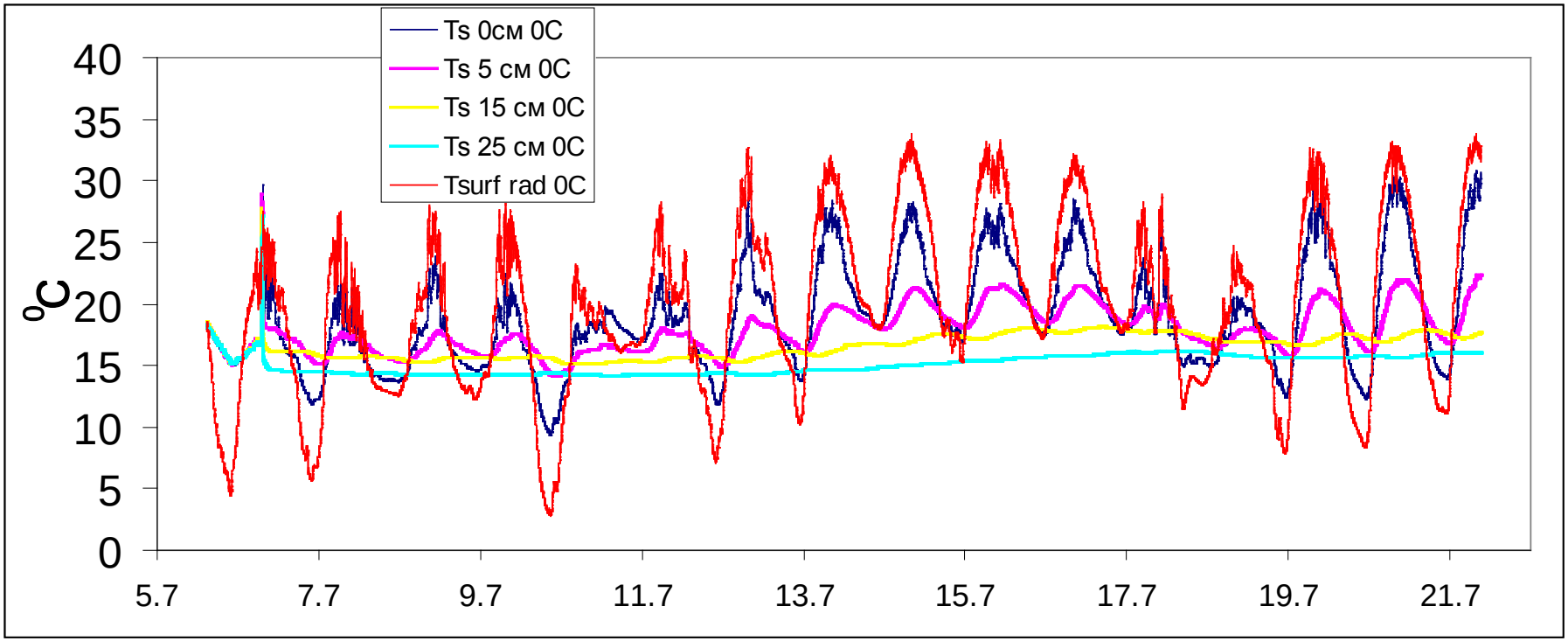
The footprint of measured fluxes consisted of a homogeneous surface with tree-covered ridges and smooth moss-covered surface.



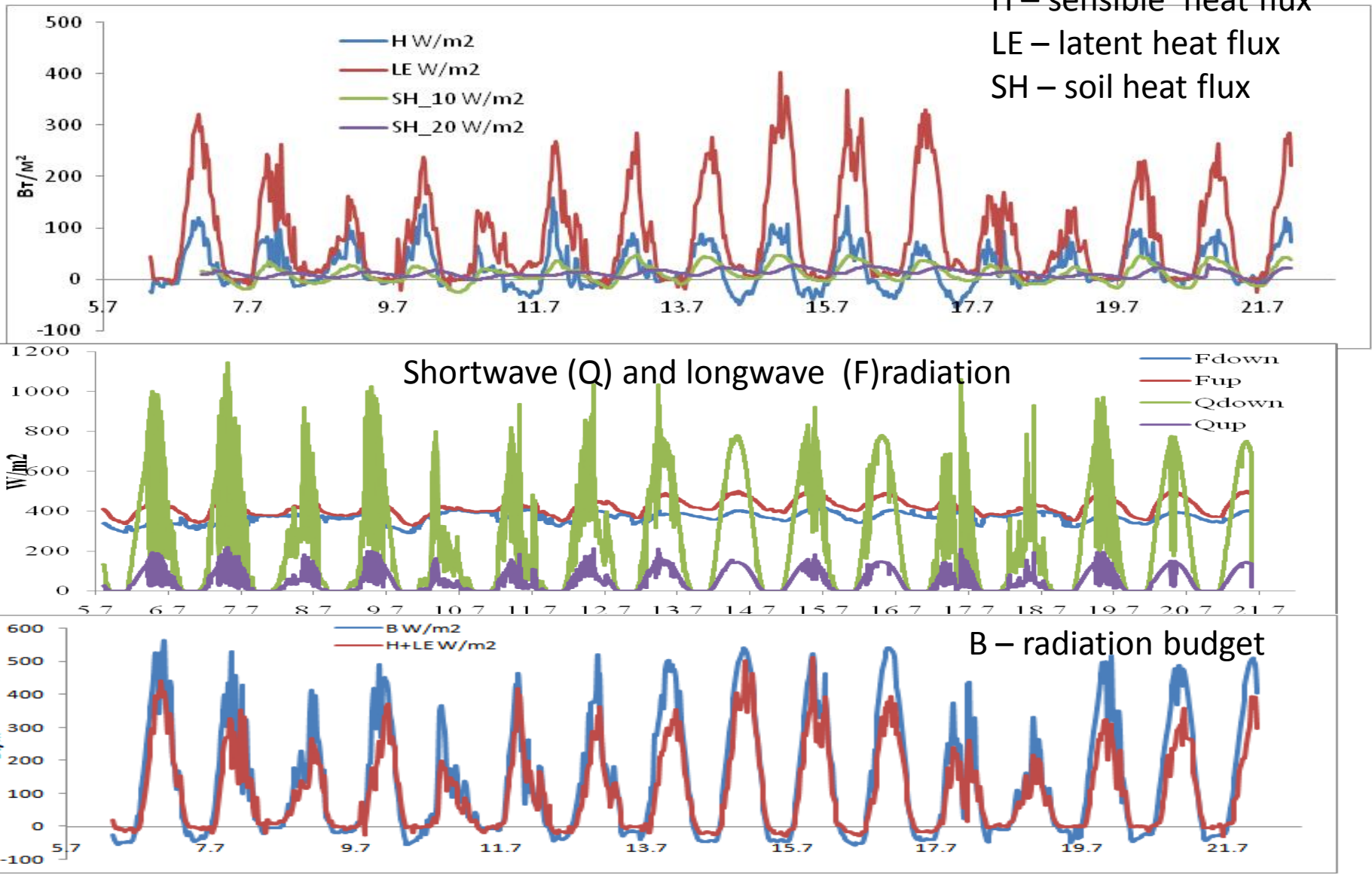
During the measurement period, a diurnal variation in air temperature and wind speed was observed. At night, calm conditions prevailed with cooling of the surface air layer.



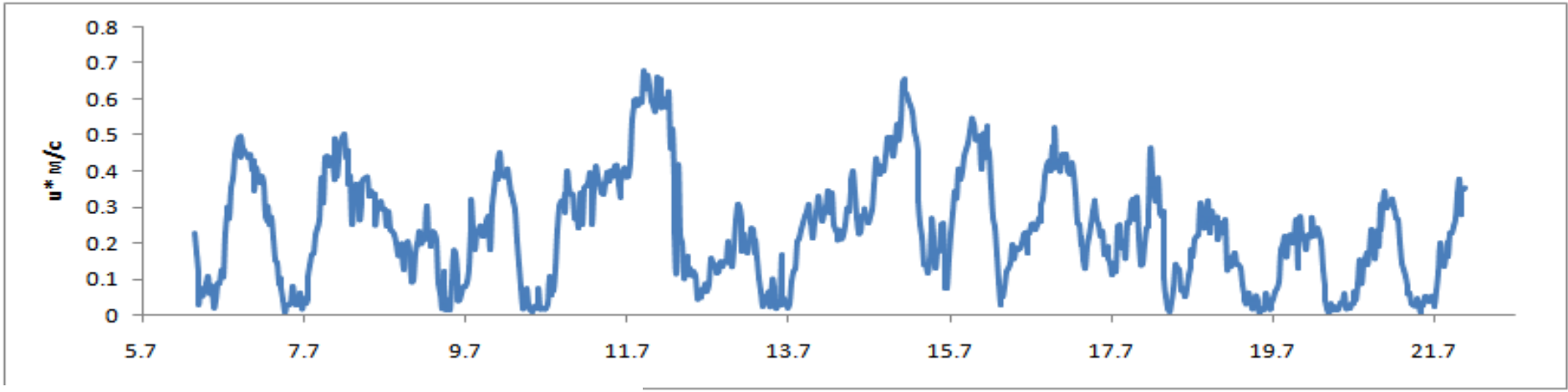
Humidity also had significant daily variation and varied with height

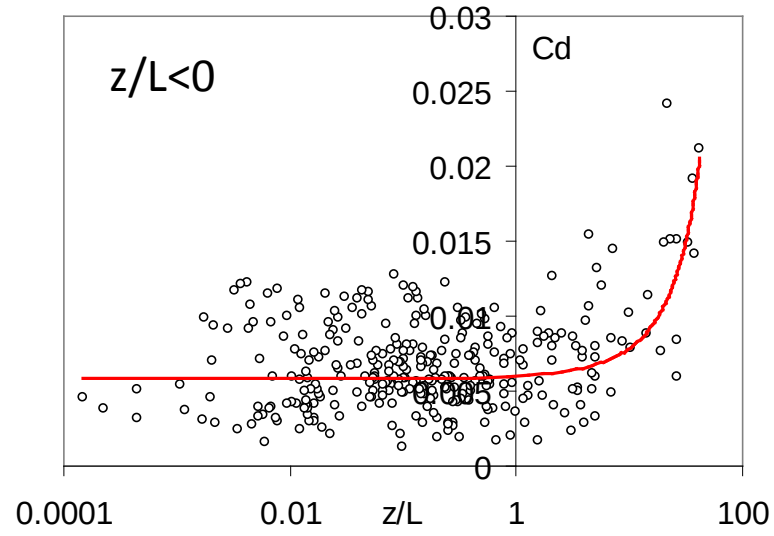


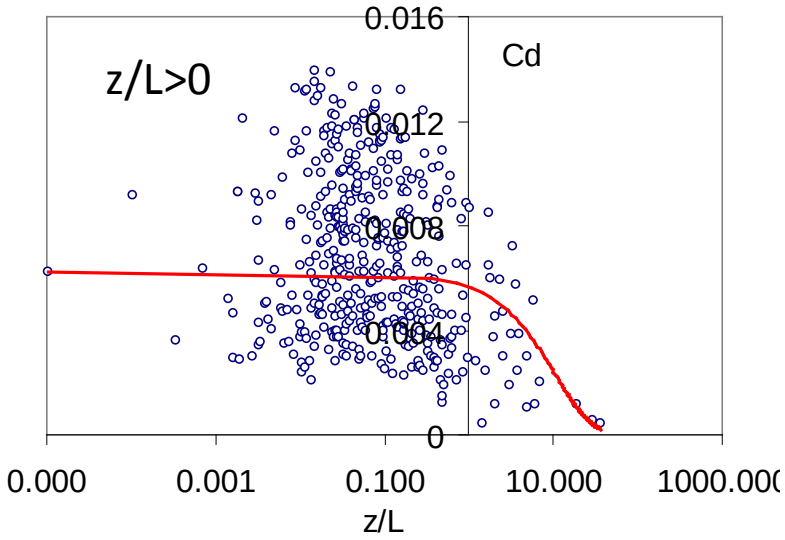
The daily temperature variation practically disappeared at a depth of 15 cm. A significant difference was observed between the surface temperature measured by a radiometer and a contact sensor, which indicates the existence of a skin layer.



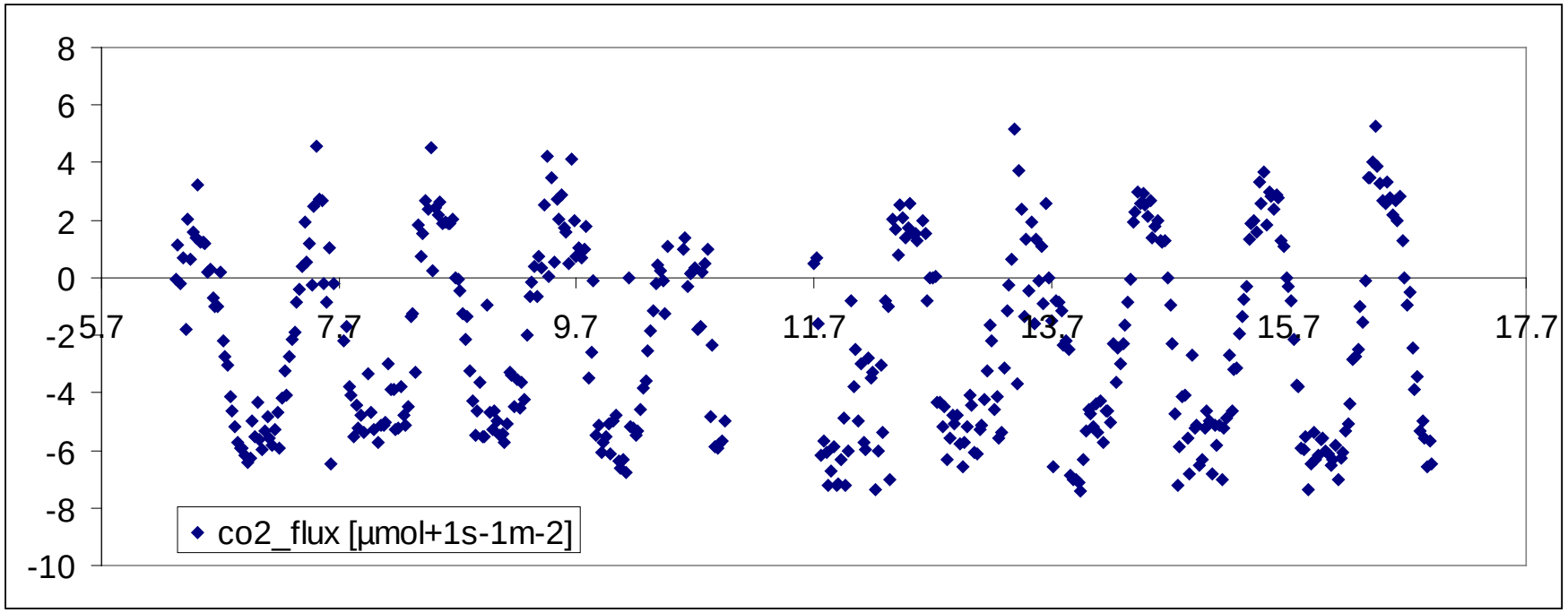
Turbulent heat fluxes (sensible and latent) show a diurnal variation typical of land ecosystems, being in phase with radiation balance. Most of the available energy is released as latent heat flux, while maximum sensible heat fluxes are more than 3 times lower.







The friction velocity also had a diurnal course, but at night it did not reach zero. The drag coefficient depended on stratification, which is consistent with theory.



Net CO2 sink was comparatively high but was typical for a wetland area.

Conclution

This study provides the results of direct and continuous measurements of surface energy balance components and CO2 flux at the Mukhrino bog site in the western Siberian middle taiga.

The observed magnitudes and diurnal course of sensible and latent heat fluxes were generally in agreement with previous bog studies. The latent heat flux was about 3 times larger than the sensible heat, short-term variations related to heavy rainfall events were observed.

Carbon dioxide exchange was typical of a raised bog, but within the range of previous observations

The influence of moss cover on the temperature regime of soil is considered. Of the base of experimental measurements the thermal conductivity of moss was estimated. The thermal and dynamic roughness length of the moss-covered surface in the summer were also studied. The dependence of the dynamic roughness length on the atmospheric stability is established, and the coefficients relating the ratio of thermal and dynamic roughness length to the Reynolds number are determined.

$$\ln\left(\frac{z_{0u}}{z_{0T}}\right) = 3.01\,\mathrm{Re}^{1/4} - 1.8$$