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Relationships between MODIS LST and hydrometeorological variables in a hemiboreal raised bog

Iuliia Burdun, Valentina Sagris, and Ülo Mander
Institute of Ecology and Earth Sciences, University of Tartu, Tartu, Estonia (iuliia.burdun@ut.ee)

Estimation of the variability of CH_4 and CO_2 emissions from boreal peat bogs under different environmental conditions is essential to understand their role in carbon sequestration. Carbon emissions from peat bogs are controlled mainly by water and temperature conditions. Information about these parameters can be obtained from remotely sensed data, particularly from remotely sensed land surface temperature (LST). Thereby, in our work we investigated relationships between ground-based hydrometeorological data and LST within three different temporal frameworks: 1) annual (2008-2016); 2) monthly (from May till September) over the 2008-2016 years; 3) study-period average. Data for nine years for the period from May till September were available, representing a wide range of environmental conditions of the growing season. We used data from the Männikjärve Bog, Estonia, which is a convex ombrotrophic raised bog with a hummock, ridge-hollow and ridge-pool complex. Data from May to September for the period 2008 – 2016 were used. Air temperature was measured at a height of 2 meters every 3 hours. Precipitation was measured once a day. Water vapour partial pressure was measured every 3 hours. Soil temperature at depths of 5, 10, 15, 20 cm together with surface temperature were measured every 6 hours. We used water-level data from the bog pool as well as in the soil. The MODIS LST product MOD11A1 from the sixth collection at a 1 km spatial resolution provides daily long-term measurements of LST and was used in this study.

The results revealed non-uniform relationships between LST and the field-measured hydrometeorological variables. The study found variation in correlation coefficients between LST and the field-measured hydrometeorological variables between years and months, while the correlation between LST and air temperature was the highest during different months and for the entire study period. The linear models with hydrometeorological variables could explain from 67% (in June) to 81% (in August) of variability in LST. Air temperature was the main factor of monthly changes of LST and could explain from 63% to 78% of LST variation. Altogether, these findings, while preliminary, show that the hydrometeorological conditions of a peat bog can influence the LST derived from MODIS product. The revealed and described relationships between hydrometeorological conditions and LST can be implemented in more accurate GHG emissions estimation from the northern bogs.