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Interception by sphagnum in a bog mire catchment of central West-Siberia.

Eco-hydrological research at the Mukhrinskaya Field Station (MFS)

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Abstract

The hydrology of mires (pristine peatland ecosystems) hardly has been analyzed quantitatively. The general idea, that mires can retain precipitation water ('sponge effect') has never been proved by real field data. Missing data for evaluation of these properties are actual evapotranspiration, water conductivity and interception of rainwater by peatland mosses and peat layers below.

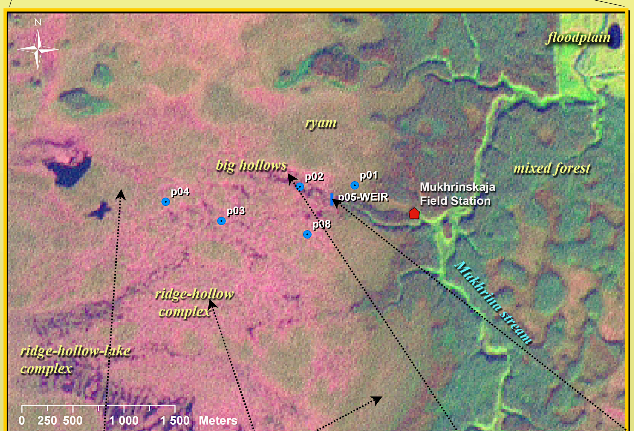
The newly opened Mukhrino Field Station, located in the centre of West Siberia at the margin of a giant mire complex gave the opportunity to start quantitative hydrological research. Water stage dynamics in mires has been recorded with pressure loggers in mires and in lysimeters to analyse the evapotranspiration, interception and the water balance. Air and water temperature and precipitation has been recorded simultaneously.

First results from data gathered in the summer of 2008 have been elaborated. By 1-Dimensional modelling interception appeared to be the most important water loss for mires. As expected, mostly snowmelt determined discharge dynamics of the studied peatland catchment area. Rainfall events resulted in relatively fast response in catchment discharge. The so-called 'sponge effect' of mire systems could not be verified this time.

The future research will focus on snowmelt effect on hydrographs. By 3-Dimensional modelling the relation between land unit type ('mire type') and discharge dynamics will be analyzed more thoroughly.

Goals for hydrological research at the MFS

- To estimate the seasonal water retention by mires
- To estimate parameter values for hydrological modeling: porosity, water conductivity, permeability and evapotranspiration
- To analyze and model water discharge dynamics by snowmelt, rain events
- To predict the possible effects of mire hydrology on (Irtysh and Ob) river stage and discharge dynamics



Mukrinskaja Field Station: research area
p0*: locations of water level recorders

Methods

Water discharge dynamics for the mire catchment area will be calculated by:

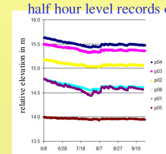
$$Q = \sum_{1}^{n} A_i*(P - f_i*E_o - I_i - S_i - G_i)*t^{-1} \qquad (m^3d^{-1})$$

Where: Q: water discharge, A: surface area of mire type (i),
P: precipitation was recorded with a rain gauge event logger (snow pack was not measured in 2008)
Eo: potential evaporation of open water was recorded with a pressure sensor in a lysimeter filled with water
f_i*E_o: evaporation of mire was recorded with a pressure sensor in a lysimeter filled with 'hollow' mire ecosystem
G: infiltration to groundwater was neglected
I: interception of precipitation water was calculated with:

$$S = (P - I - nt_cE_0)/a_ce^{-b*D} \qquad (md^{-1})$$

Where the denominator is effective porosity at depth D below the mire surface; nt: normalized temperature dependent correction factor; a and b are constants; S: storage change is known from stage change divided by effective porosity.

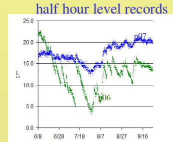
half hour level records of all sites



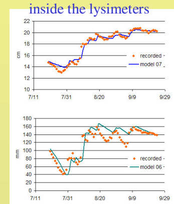
P07 lysimeter with water

P06 lysimeter with hollow vegetation

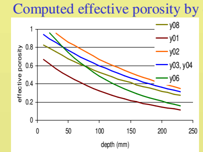
Lysimeters: half hour level records



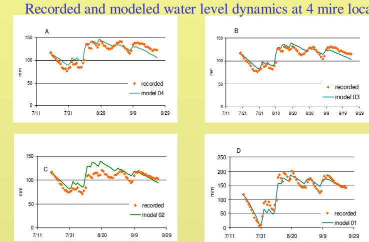
Recorded and modeled water level dynamics inside the lysimeters

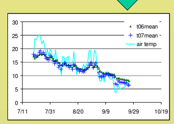


Computed effective porosity by depth

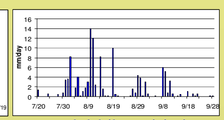


Recorded and modeled water level dynamics at 4 mire locations



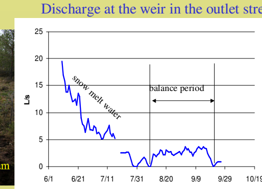


daily mean temperature in °C
t06: lysimeter p06 (hollow)
t07: lysimeter p07 (water)



recorded daily precipitation

Discharge at the weir in the outlet stream



Results

For the period 20/7 – 24/9 the average precipitation (P) was 1.69 mm/day.
Of this amount **92.9 %** was lost by **evapotranspiration**.
By **interception** (33.7 % of P) an average volume of **1.83 mm** was retained and subject to direct evapotranspiration.
The **effective porosity** in the wetted part of the acrotelm zone varied from **24% to 64%.**

The **dimensions of the mire catchment** area have been calculated from the discharge data of the 'balance period' from 10/8 – 21/9. The total discharge (m^3) should be equal to the product of net precipitation (m) in the catchment surface area (m^2) during this balance period.
The calculated surface area was **2.6 km²**. By excepting that point p04 is located at the watershed divide the dimensions of the catchment are 1.7 km length (E-W) and 1.5 km width (N-S). For exact location of the catchment boundaries additional elevation measurements (leveling) should be performed