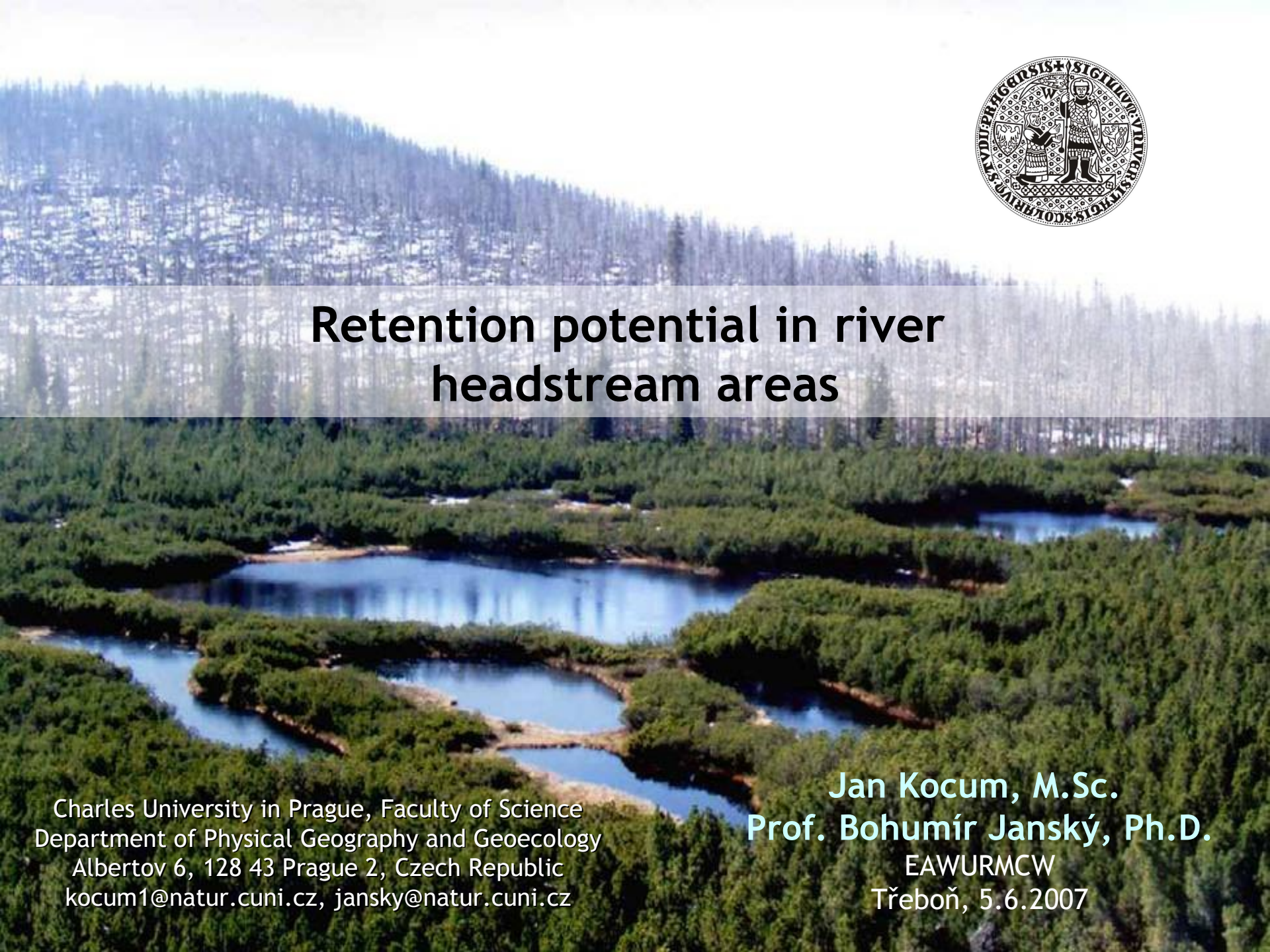


Retention potential in river headstream areas

Charles University in Prague, Faculty of Science
Department of Physical Geography and Geoecology
Albertov 6, 128 43 Prague 2, Czech Republic
kocum1@natur.cuni.cz, jansky@natur.cuni.cz

Jan Kocum, M.Sc.
Prof. Bohumír Janský, Ph.D.

EAWURMCW
Třeboň, 5.6.2007

Introduction

- river headstream areas in our border mountain ranges – peat bogs
- relationship to the project GA ČR „Atlas of lakes in the Czech republic“
- catastrophic floods and extreme droughts in recent years - flood protection issues and measures leading to discharge increase in dry periods - untraditional practices - gradual increase of river catchment retention capacity including the realization of measures as runoff retardation and water retention increase in headstream areas
- integrated flood protection (mainly in headstream and midstream parts of catchments)
- All sanitational measures could be connected to each other
- full flood protection is impossible, especially during extreme hydrological situations - not full but advanced flood protection
- analysis of peat bogs hydrological function - detailed comparison of hydrological regimes in two subcatchments with very different peat land proportion
- study area – **upper Otava River catchment** representing a basin with frequent occurrence of flood events
- affecting of water quality, respectively to ionic structure of water in periods of high or low discharges

Introduction

- 3 factors of headstream retention capacity enhencement:
  - renovation or torrent control of original drainage channels
  - recovery of vegetation health state
  - renovation of former accumulation reservoirs (role of dry (green) polders)

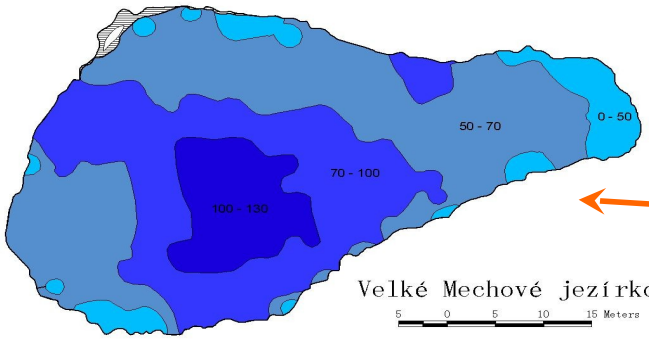
- peat bogs hydrological function questions – „theory of fungi“ vs. present opinions

• increase of peat bogs retention capacity – ground water level lowering by means of drainage

• results of studies – negative influence of peat bogs on hydrologgical regime – floods, droughts

• peat bogs negative influence on water quality in water courses (intensity related to its area and volume in catchment (Fláje reservoir)

Organogenous lakes

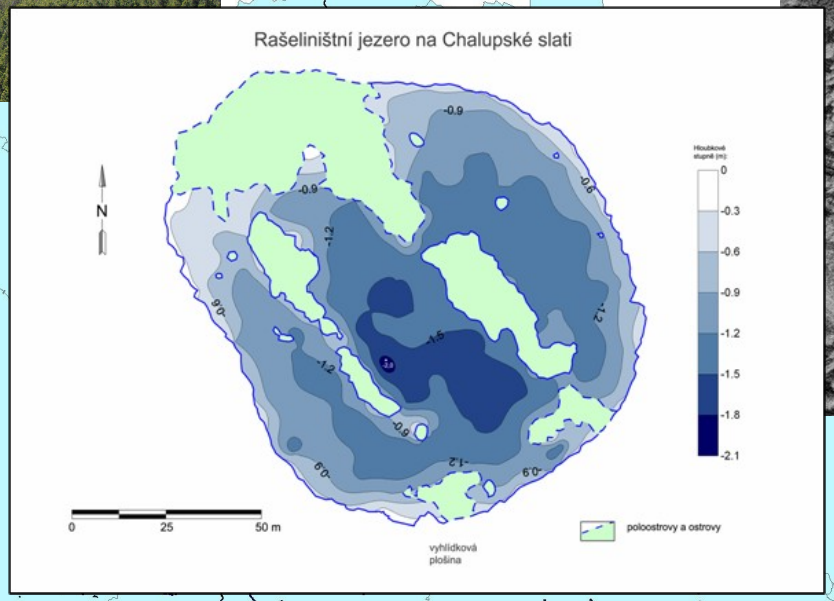


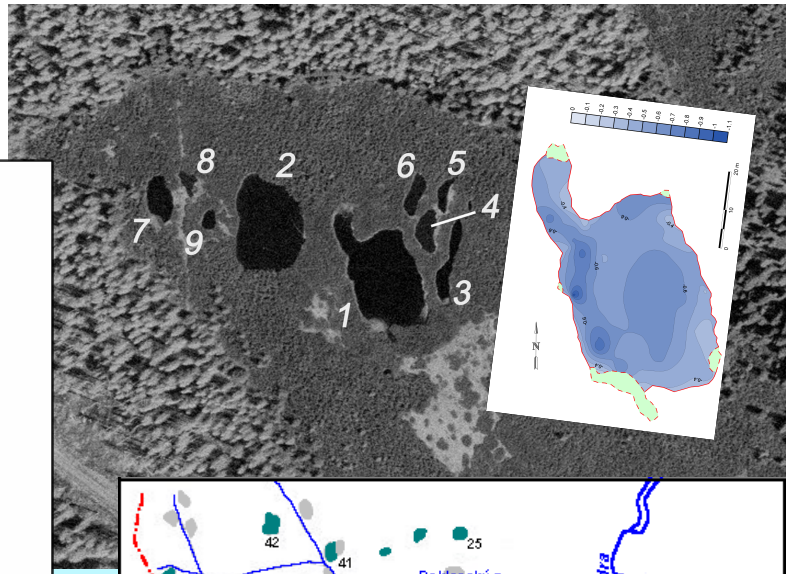
Lakes of organogenous origin originate by retention of the rainfall or underground water in the shallow depressions under the participation of moor lands or peat bogs formation.

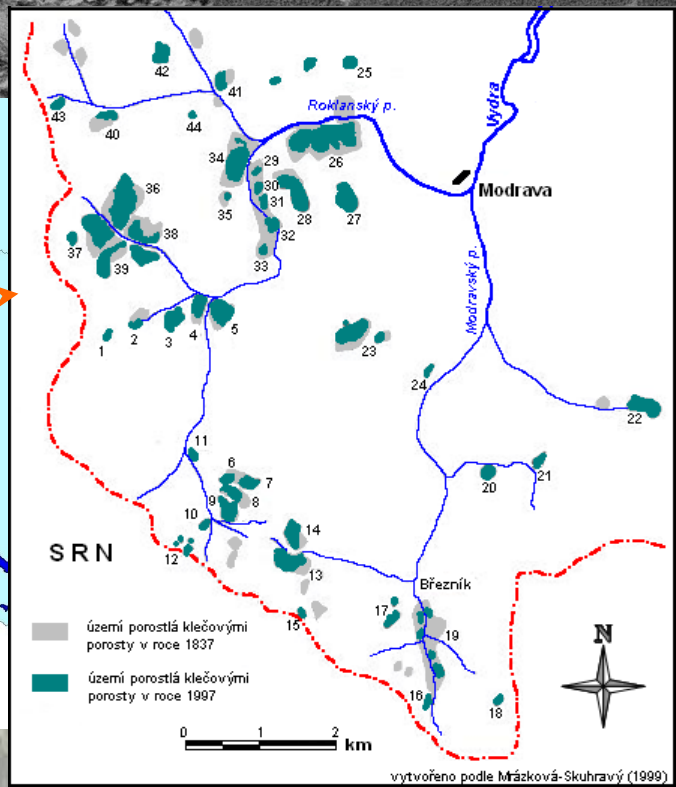
Moor lakes occur in the lower altitudes on the springs of the underground water or in the areas of occurrence of the deserted river arms in the advanced stage of land-filling.

By contrast, **bog lakes** are generally of small dimensions and occur almost in all our border mountain ranges.

Organogenous lakes – Bohemian Forest







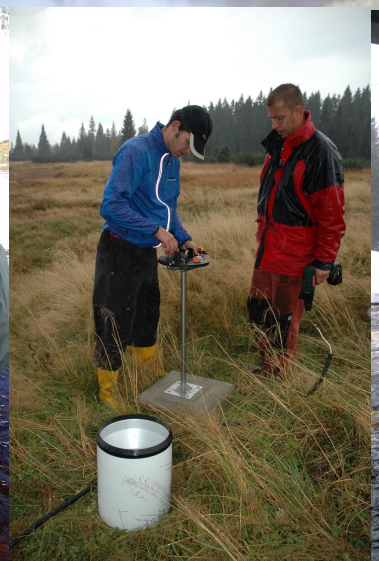
Present field survey

1. Water level and discharge monitoring (hydrometric propeller) in chosen profiles – by now totally 14 measurement profiles
   - 4 profiles within the CHMI basic limnigraphic station network including station Rejštejn (daily data)
   - our own profiles: including 7 automatic water-level gauges (continual water level observation, ultrasound)
   - totally done meanwhile about 180 discharge measurements -> consumption -> corresponding Q
   - during three different precipitation situations made in one day course about 30 Q measurements of tributaries -> assessment of each tributary share on the total outflow constitution

7. Precipitation monitoring – meanwhile two shuttle precipitation gauges (Rokytka Brook, Zhůřecký Brook)

9. Detailed ground plan measurements of organogenous lakes in the Modravské slatě region and lake basin depth conditions description






Measurement profiles

- totally 7 ultrasound water-level gauges - 4 Vydra catchment, 3 in Křemelná catchment
- Rokytka Brook, Ptačí Brook – 10 months rank of values; other profiles – 7-8 months ranks


Ptačí Brook (Vydra River)


Rokytka Brook (Vydra River)

Automatic water-level gauges

- measuring set from Fiedler-Mágr Company – registering and controlling unit of M4016 type + ultrasound sensor + GSM module for data transmission by means of GPRS network

  \+ advantages: water level, resp. Q determination with 1 mm accuracy

  continual measurement from 1 minute interval
  independent on CHMI data
  possibility of warning sms sending in case of extreme hydrological situations - limiting alarm, gradient alarm

  \- disadvantages: higher price

  shorter battery lasting

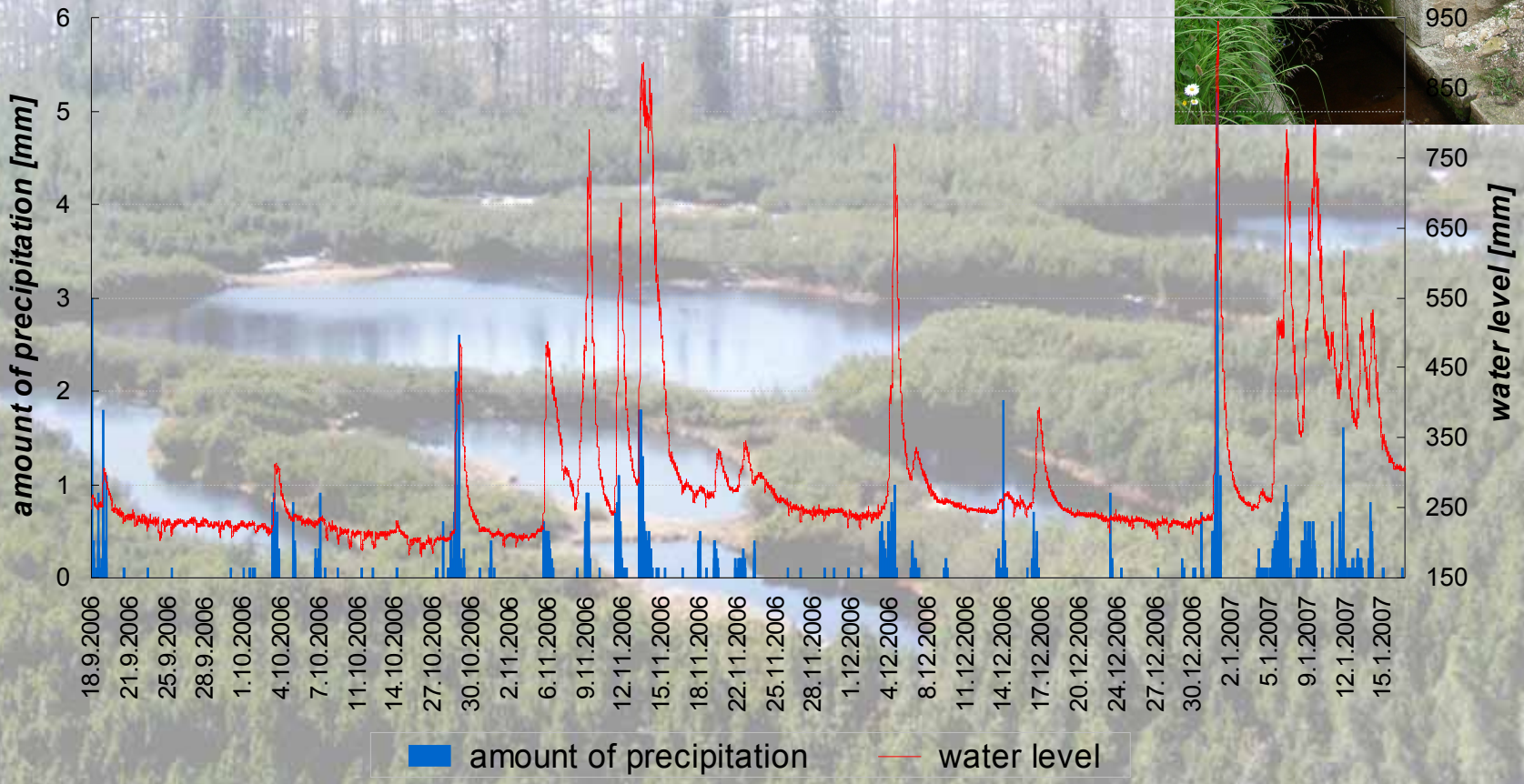
- daily data transmission using GPRS network – progress observing on the company server (datahosting) – operative solution of actual situation



Automatic water-level gauges – partial outcome I.

- **Rokytka Brook (Vydra River headstream area)**

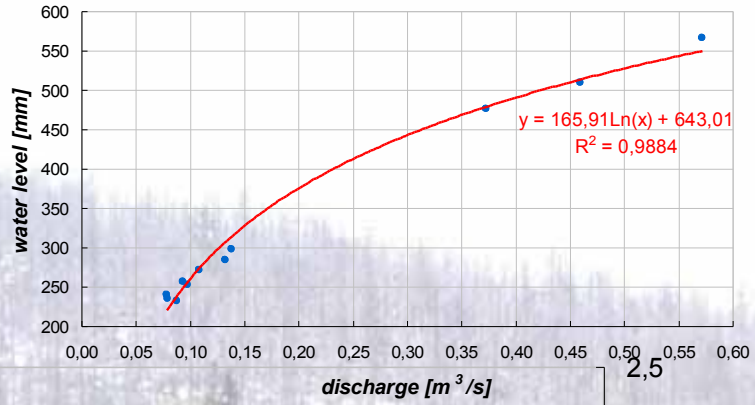
Rokytka Brook water level fluctuation in relation to amount of precipitation between 18.9.2006 and 17.1.2007

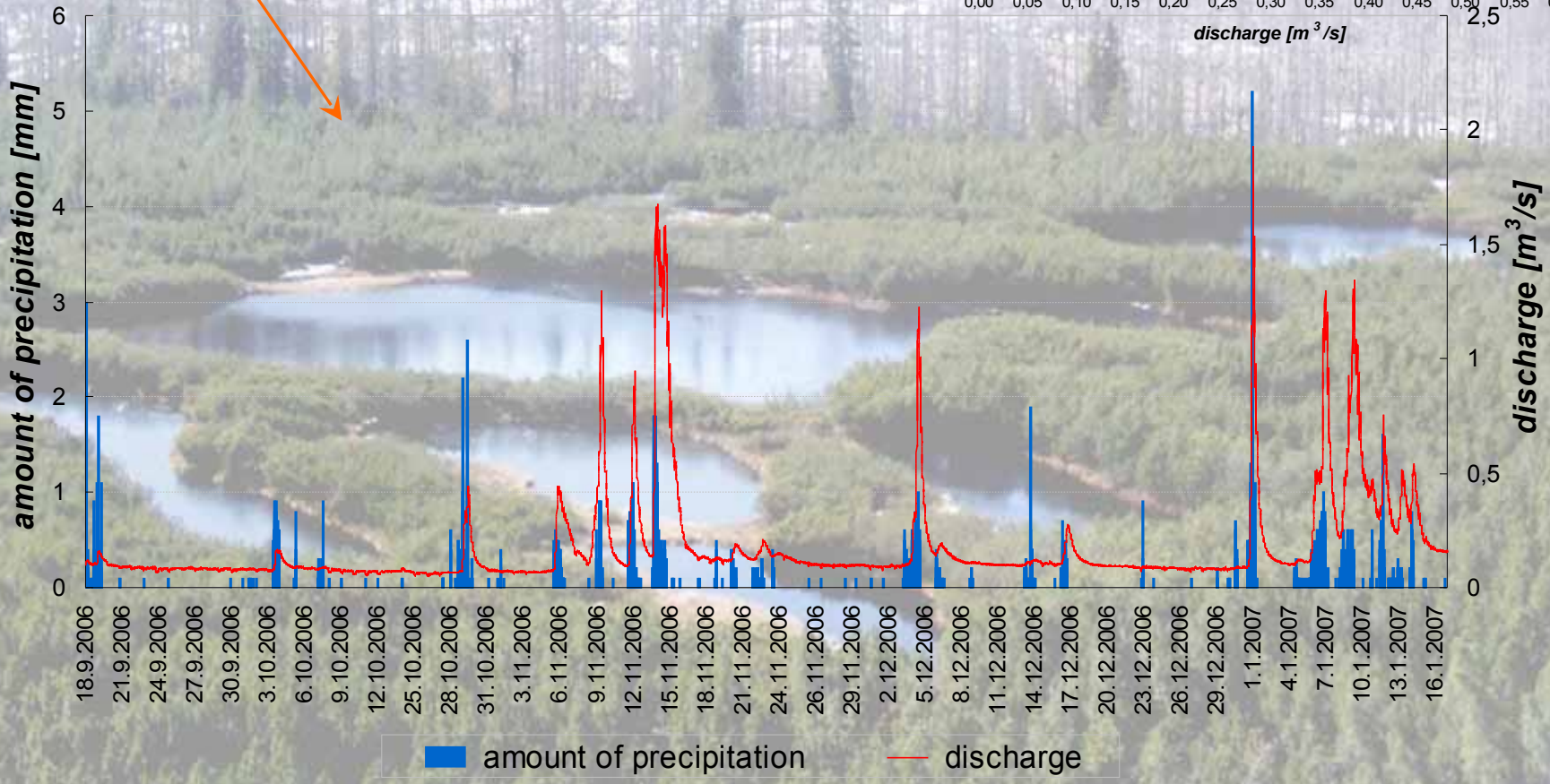


Automatic water-level gauges – partial outcome II.

- **Rokytka Brook (Vydra River headstream area)**

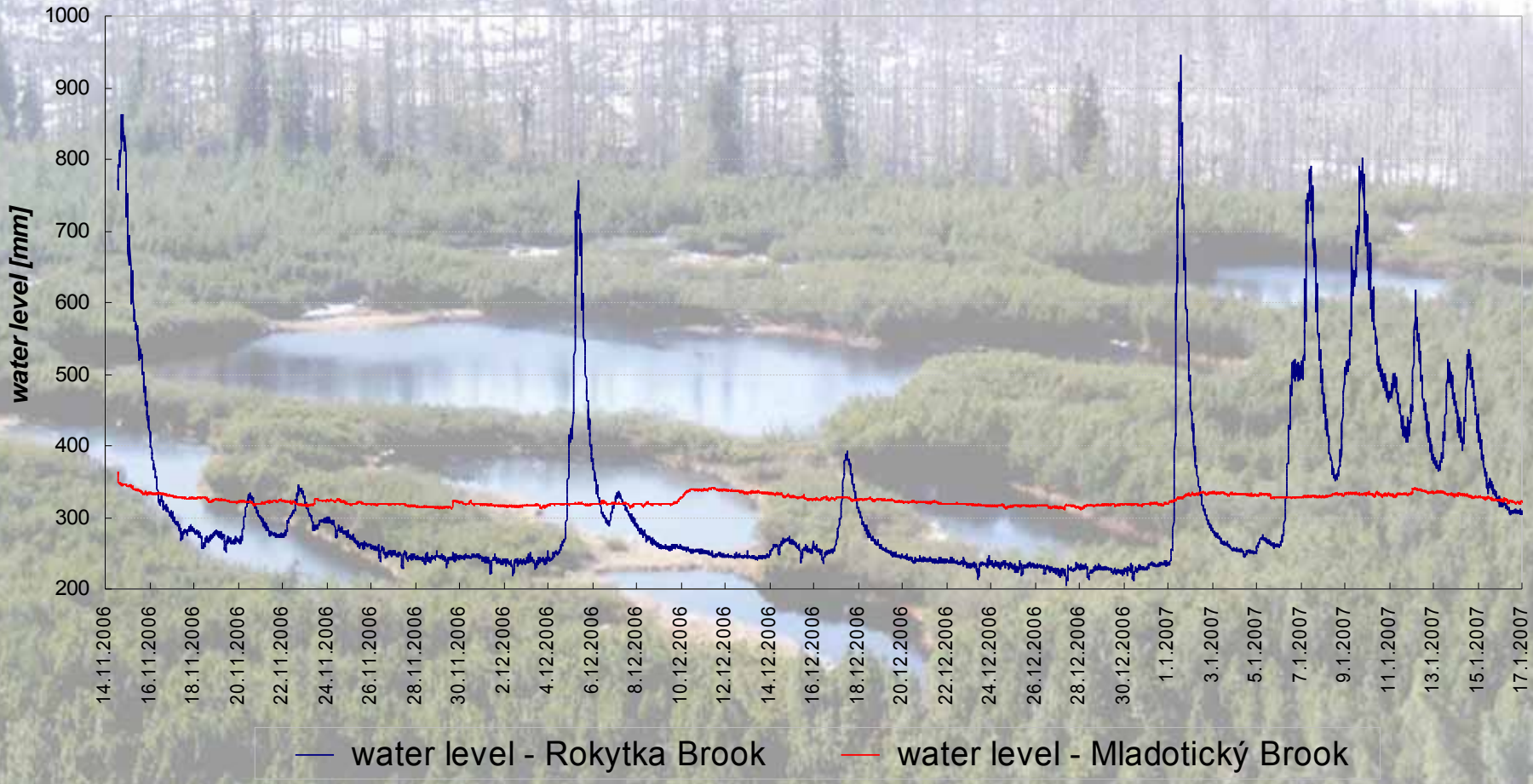
Consumption curve for the Rokytka Brook profile and discharge fluctuation in relation to amount of precipitation between 18.9.2006 and 17.1.2007





Automatic water-level gauges – partial outcome III.

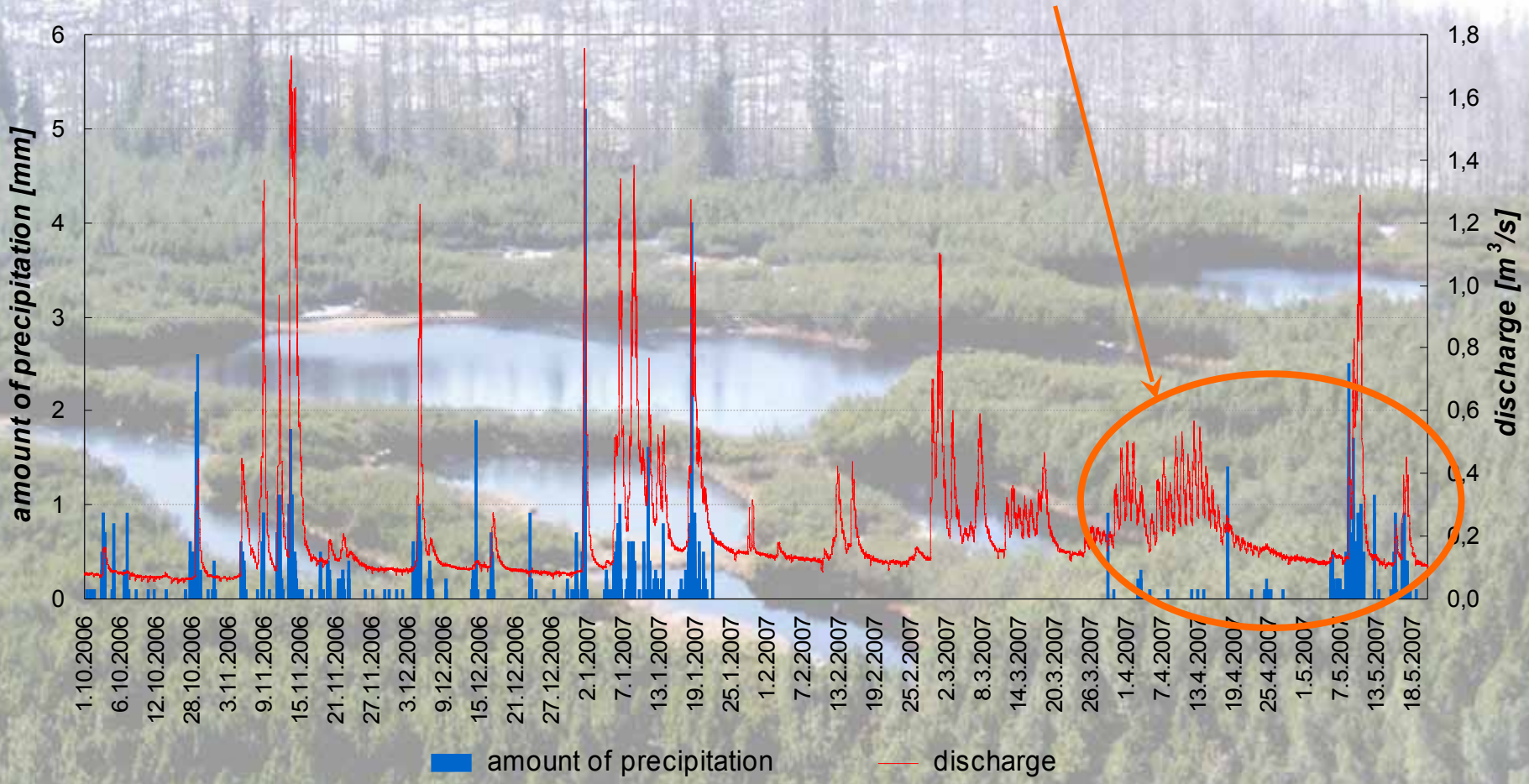
Comparison of Rokytka Brook and Mladotický Brook water level fluctuation between 14.11.2006 and 17.1.2007 -> strong influence of Mladotické Lake on hydrological regime of Mladotický Brook catchment => high accumulating and retention capacity of the lake basin and its catchment, discharge variability in river headstream areas



Automatic water-level gauges – partial outcome IV.

• Partial outcome from automatic ultrasound water level gauge and shuttle precipitation gauge – runoff reaction on causal amount of precipitation in Rokytka Brook profile (Vydra River headstream area) in October 1, 2006 – May 20, 2007 period (in January 1, 2007 – March 28, 2007 period precipitation gauge was out of service)

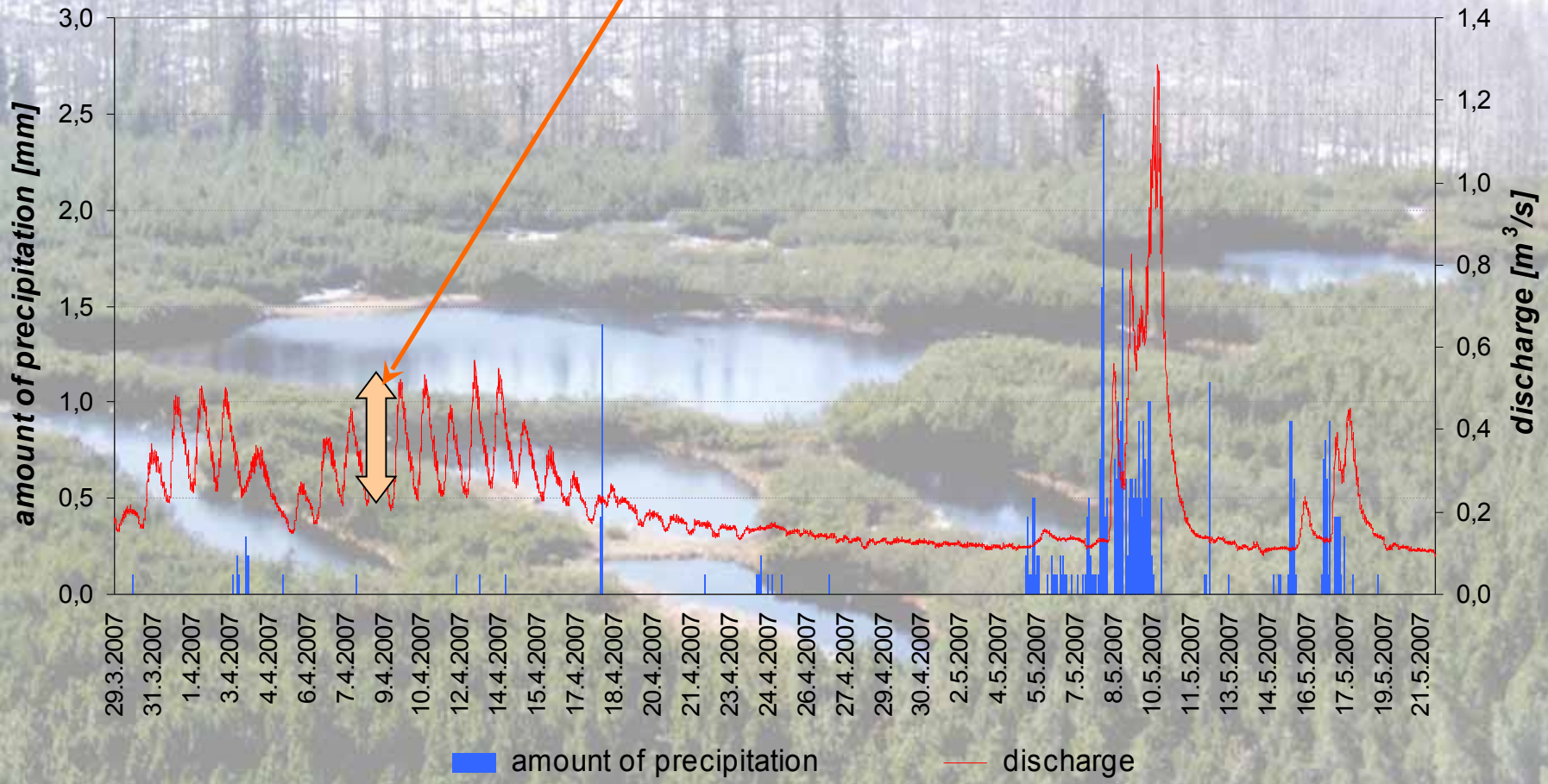
• **significant discharge increase during spring period – snow melting process**



Automatic water-level gauges – partial outcome V.

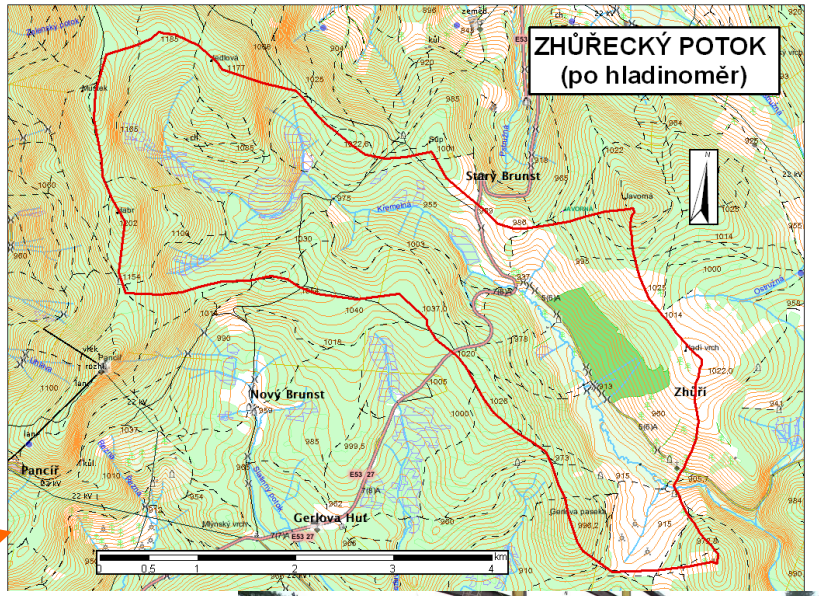
- Partial outcome from automatic ultrasound water level gauge and shuttle precipitation gauge – runoff reaction on causal amount of precipitation in Rokytka Brook profile (Vydra River headstream area) in March 29, 2007 – May 21, 2007 period

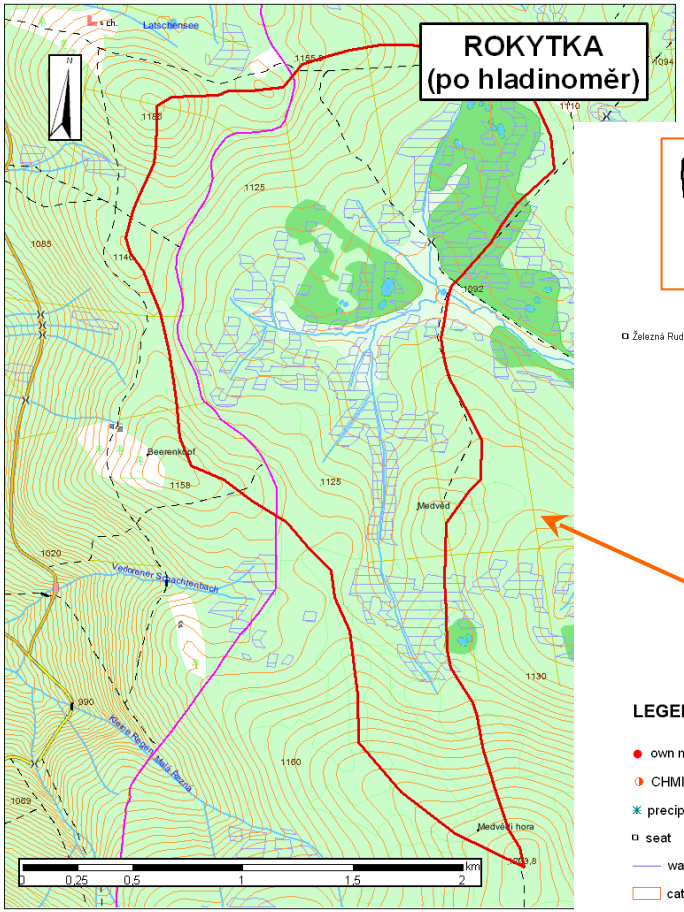
- **striking runoff fluctuation within the day**

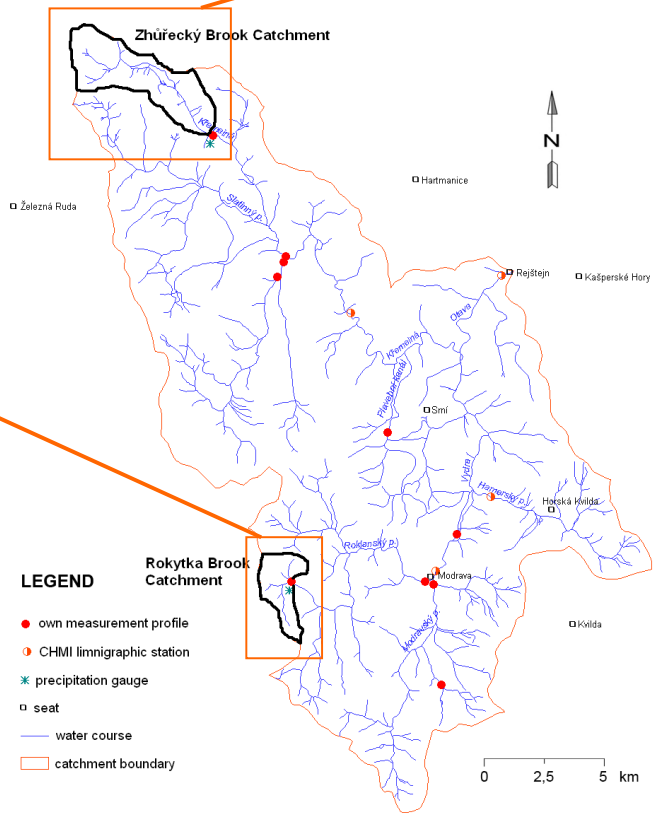


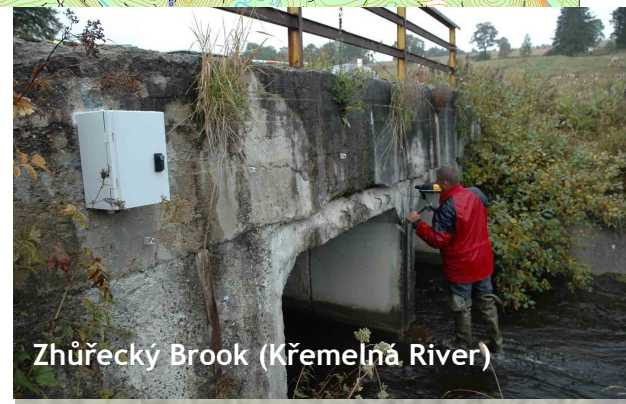
Experimental catchments location

- **Zhůřecký Brook Catchment** (Křemelná River Catchment) – low peat land proportion
- **Rokytka Brook Catchment** (Vydra River Catchment) – high peat land proportion









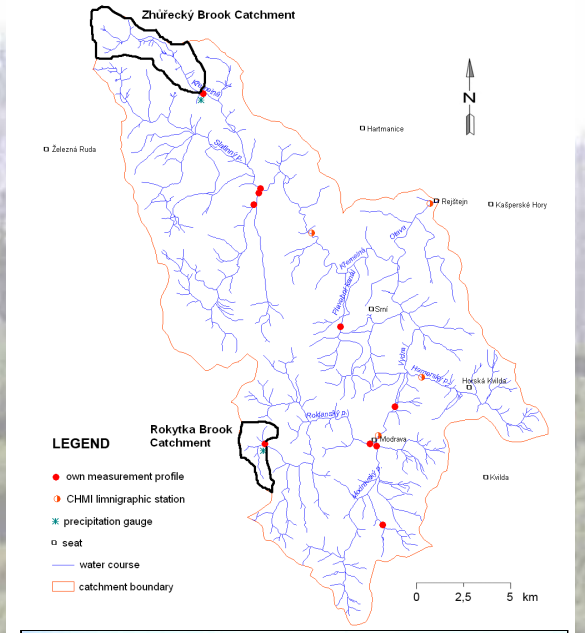
Experimental catchments characteristics

- Zhůřecký Brook Catchment (Křemelná River Catchment) – low peat land proportion

X

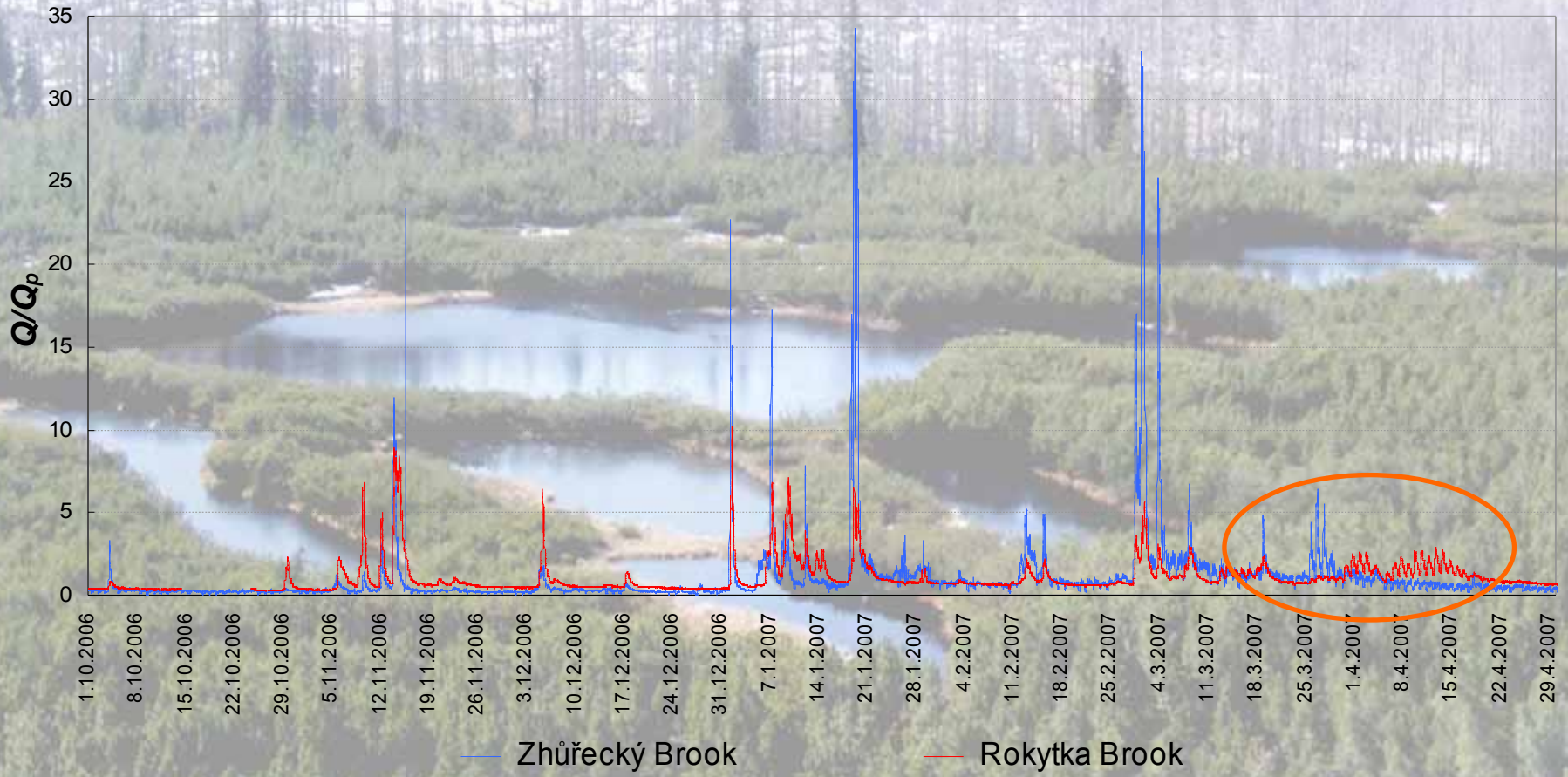
- Rokytka Brook Catchment (Vydra River Catchment) – high peat land proportion

Catchment	Rokytka Brook	Zhůřecký Brook
Catchment area [km²]	3,721	13,946
Peat land proportion [%]	**cca 45**	**cca 6**
Forestation [%]	**84**	**80**
Catchment max. altitude [m a. s. l.]	1223	1233
Catchment min. altitude [m a. s. l.]	1090	890
Catchment mean slope [‰]	68,948	91,848
Catchment boundary length [km]	10,013	20,475
Gravelli´s coef.	1,464	1,547
Catchment mean width [km]	1,407	1,921
River network density [km/km²]	1,465	1,333
Water course length [km]	2,177	7,458
Total length of water courses [km]	5,45	18,591
Spring altitude [m a. s. l.]	1145	1070
Water course descent [m]	55	180
Water course mean slope [‰]	25,264	24,135



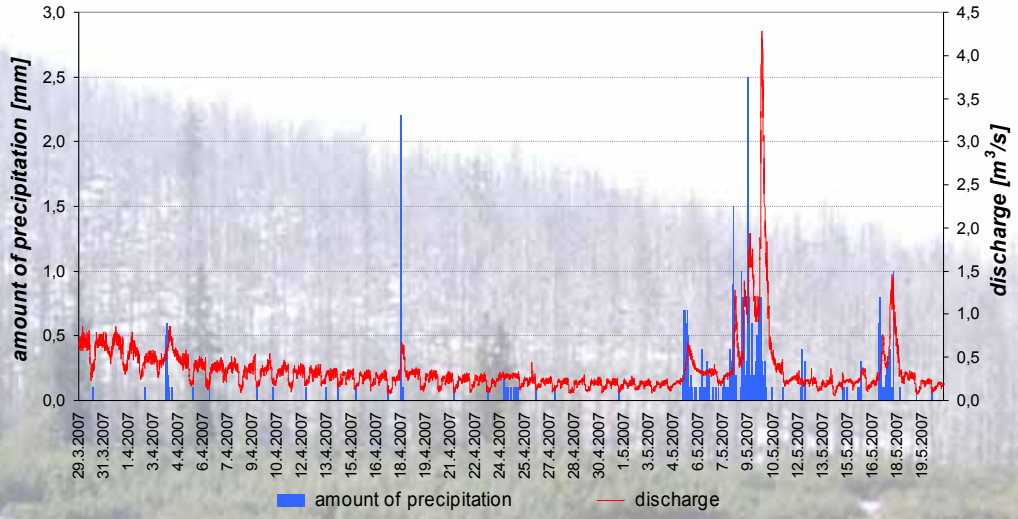
Runoff variability

- Comparison of runoff variability in two catchments with different peat land proportion (Rokytka Brook, Zhůřecký Brook) in October 1, 2006 – April 30, 2007 period
- different rate of discharge —> Q/Q_p ratio
- higher number of peak flows in Rokytka Brook profile



Runoff reaction on causal rainfall

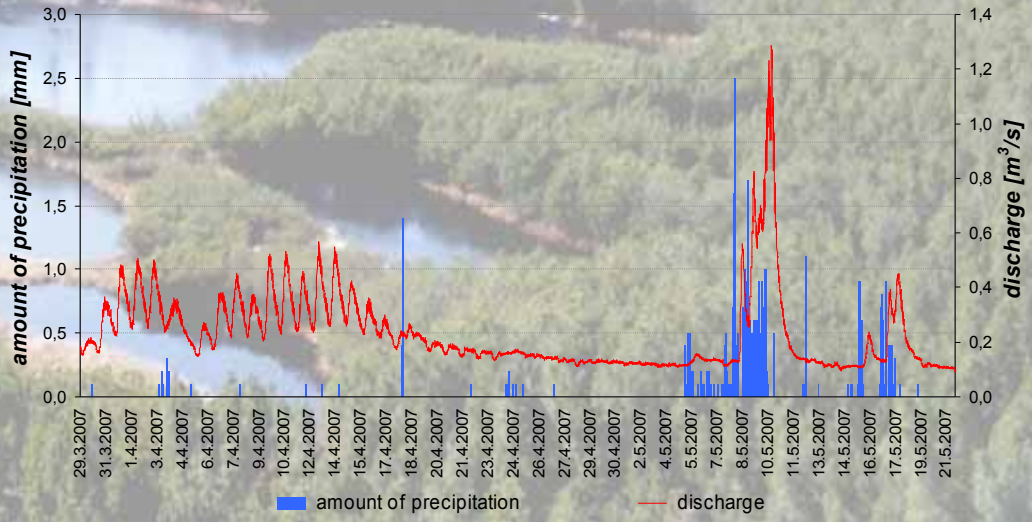
Zhůřecký Brook



- detailed analysis of runoff ascending and descending phases during several rainfall situations within the monitoring period

- more significant peak flow retardation in Zhůřecký Brook profile(about 4:40 hours) compared to Rokytka Brook profile (about 3:20 hours)

- higher water retention potency in the catchment with distinctively lower peat land proportion



Rokytka Brook

Planned survey

- obtaining and analysis of all entry data and source materials
- continuation in water level, resp. Q monitoring
- continuation in mapping of investigation localities of organogenous lakes and peat bogs probing (methodology of Research Institute of Ameliorations and Soil Conservation Prague) -> determination of mountainous peat bogs retention potential
- consumption of water samples in 1 months interval in chosen profiles and soil samples -> analysis
- progressive analysis of hydrological, climatic and quality characteristics time ranks
- assessment of peat bogs revitalizing measures influence on its hydrological regime change
- mathematical modelling for rainfall-runoff processes simulation by means of suitable models
- comparative analysis of hydrological regimes of each experimental catchments (exceeding lines, double summing lines, etc.)
- suggestion of measures leading to reduce of extreme flood phenomenons consequences and to increase water resources during dry periods
- comparative analysis and follow-up determination of peat bogs influence on hydrological regime

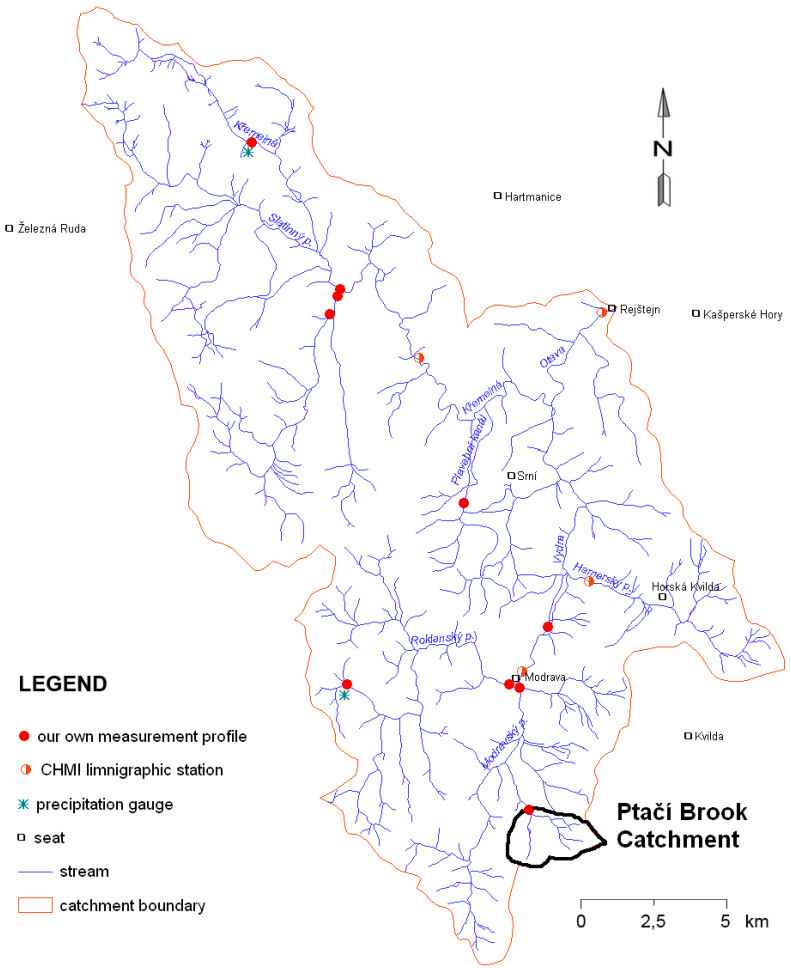
Snow conditions analysis

- snow conditions - significant element of rainfall-runoff process in czech headstream areas

- February 2007 - track shots in experimental subcatchments within Vydra and Křemelná River catchments – point measurements of snow cover height and snow water equivqlent (SWE) – factors: altitude, exposition, slope and vegetation cover

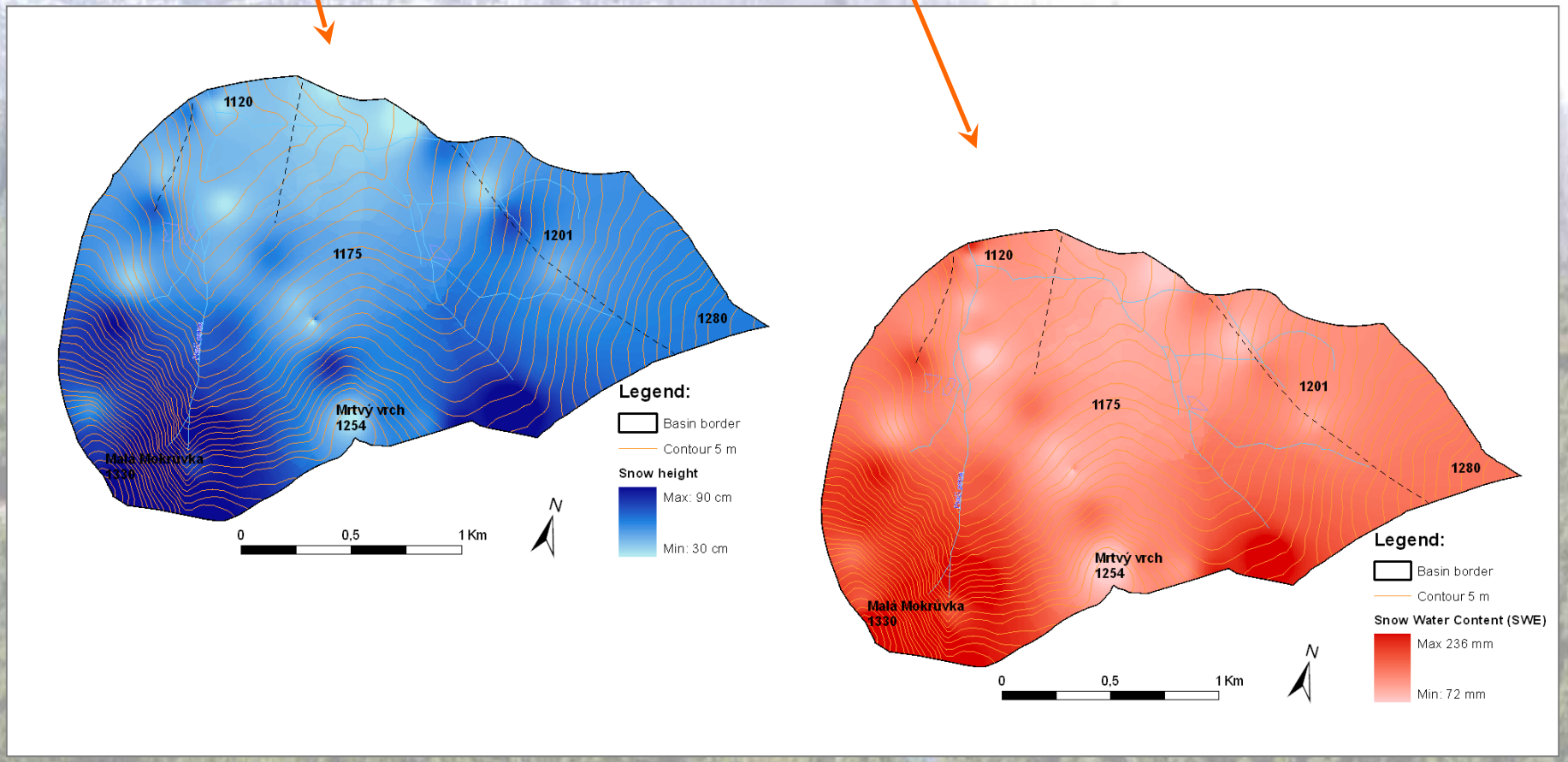
- snow hydrometer SM 150-50, GPS60, GPS60CS a GPS Leica

- digitalization and interpolation using suitable methods in GIS software (ArcGis, MapInfo, Surfer)
  aerial photogrammetry – winter period 2008



Snow conditions analysis – partial outcome

Snow cover height (on the left) and snow water equivalent (SWE) in Ptačí Brook catchment (Vydra River headstream area)



—> high variability of snow reserves depending on altitude

Partial conclusions

• all of the issues related to various possibilities and measures leading to river headstream areas retention capacity increase should be discussed by experts in various fields taking into account objectives and priorities of a regional and local significance

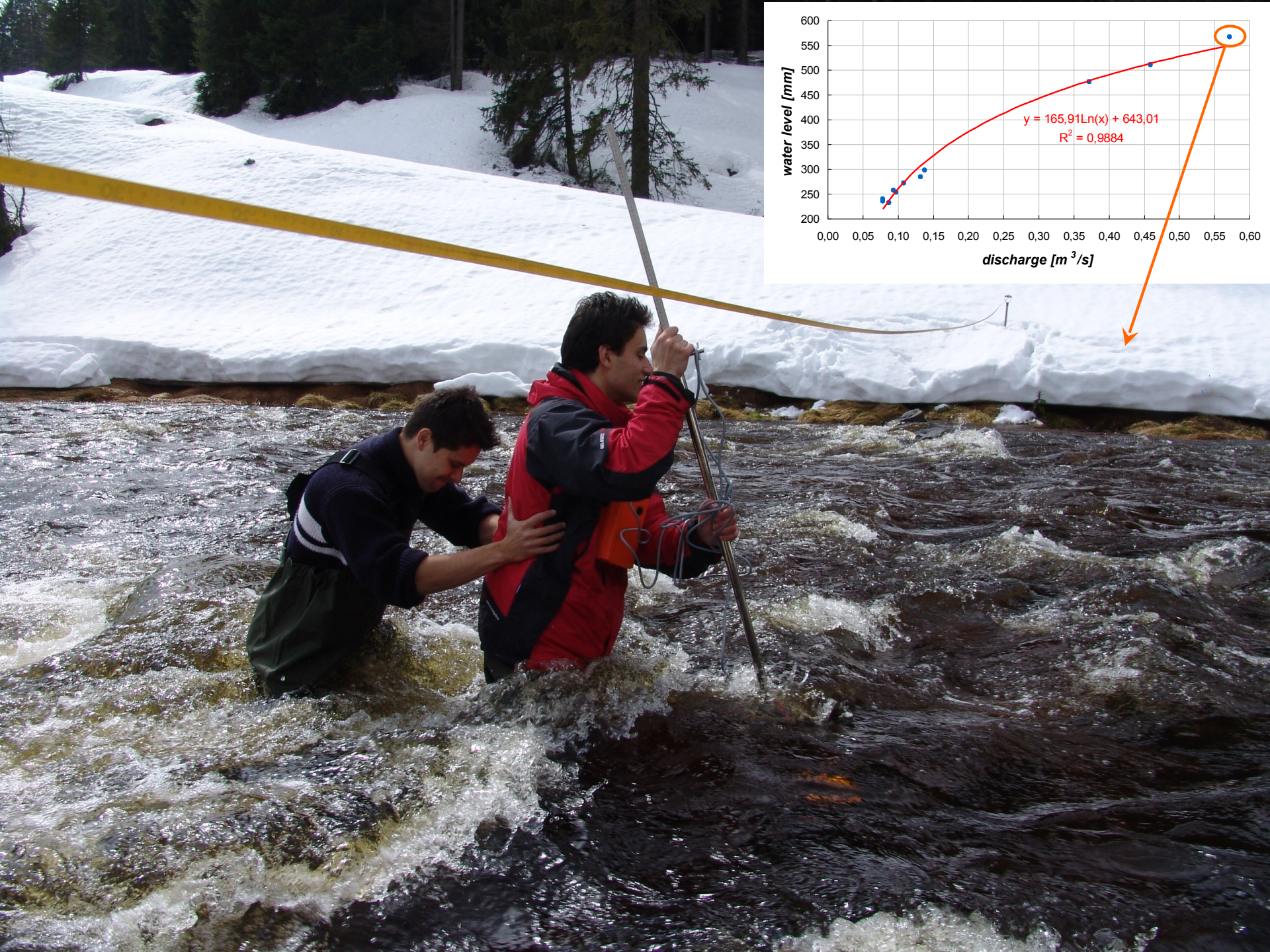
• data measured by automatic ultrasound water level gauges make it possible to assess peat bogs hydrological function very in detail - continual records offer an extraordinary database for detailed analyses of flood waves ascending and descending phases

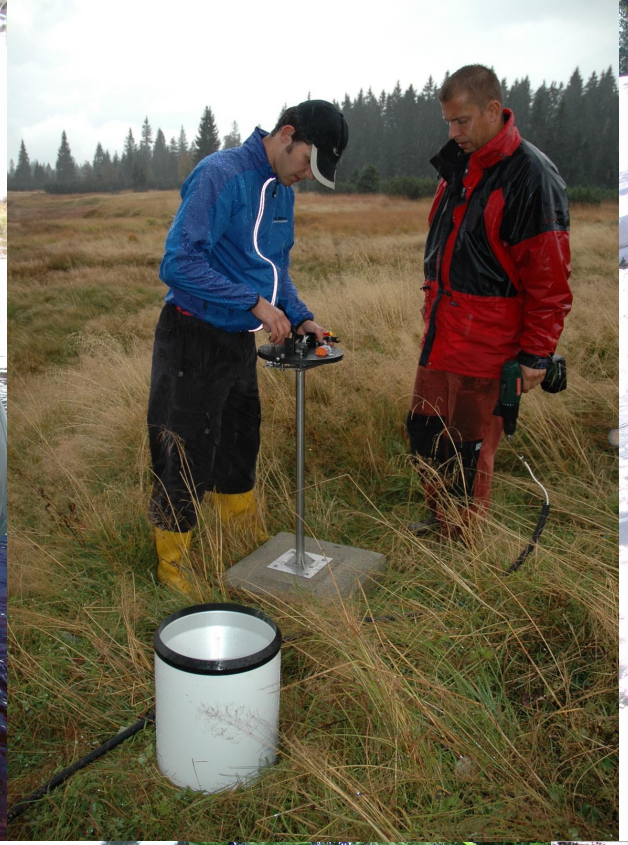
• qualified conclusions from field survey can be formulated after analyses of data from at least one hydrological year

• nevertheless, partial outcomes quite conclusively present **more distinct runoff variability in profile closing catchment with very significant peat land proportion**

• comparison of runoff reaction on causal rainfall total in both experimental catchments - **negative effect of peat bog localities on river headstream area hydrological regime**

• snow conditions analyses - quite high snow reserves variability in relation to the altitude; more detailed field survey next winter period 2007/2008


water level [mm]
600
550
500
450
400
350
300
250
200
0,00
0,05
0,10
0,15
0,20
0,25
0,30
0,35
0,40
0,45
0,50
0,55
0,60
discharge [m 3/s]
y = 165,91Ln(x) + 643,01
R2 = 0,9884




Literature

BUČEK, A. et al. (1998): Analýza povodňových událostí v ekologických souvislostech. Unie pro řeku Moravu, Brno, 81 s.

FERDA, J. (1960): Hydrologický význam horských vrchovištních rašelinišť. Sborník ČSAZV – Lesnictví, č. 10, Praha, s. 835-856.

FERDA, J. (1963): Hydrologický význam rašelinišť. Vodní hospodářství, č. 5, Praha, s. 162-165.

FERDA, J., HLADNÝ, J., BUBENÍČKOVÁ, L., PEŠEK, J. (1971): Odtokový režim a chemismus vod v povodí Horní Otavy se zaměřením na výskyt rašelinišť. Sborník prací HMÚ, sv. 17, HMÚ, Praha, s. 22-126.

FIALA, L., SLÁDEČKOVÁ, A. (1961): Jakost vody v údolní přehradě Fláje v prvém roce napouštění. Vodní hospodářství, r. 11, č. 5, s. 221-225.

HUIKARI, O. (1963): Über den Einfluss der Grabenabstände auf den Wasserhaushalt der Torfboden in Sphagnum-Mooren, Verdunstung und Abfluss des Wassers. Ref. Intern. Torfkongress, Leningrad.

JANSKÝ, B. (2006): Water Retention in River Basins, AUC Geographica, 38, č. 2, s. 173-183.

KNAPP, R. (2000): Protipovodňová ochrana. Zátopová území řek Moravy a Bečvy. Geoinfo, 7, č. 6, s. 28-32.

KOL. (1996): Fluss und Landschaft - Ökologische Entwicklungskonzepte. DVWK, Merkblätter zur Wasserwirtschaft Nr. 240, Bonn, 285 s.

KOLEJKA, J. (2003): Geoekologické aspekty zmírňování povodňových škod. Geografie – Sborník ČGS, roč. 108, č. 1, Praha, s. 1-13.

KOVÁŘ, P., SKLENIČKA, P., KŘOVÁK, F. (2002): Vliv změn užívání krajiny na její ekologickou stabilitu a vodní režim. In.: Extrémní hydrologické jevy v povodích. ČVUT a ČVVS, Praha, s. 99-106.

MACOUN, Z. (1997): Možnosti protipovodňové ochrany v horských oblastech. In.: Povodně a krajina 97. ICID-CIID, Brno, s. 13-19.

MAŘAN, B., LHOTA, O. (1953): Mikroklima a povrchové odtoky na rašeliništi a v lese. Sb. ČSAZV – Lesnictví č. 1, ř. B. r. 26.

MAŘAN, B., LHOTA, O. (1955): Příspěvek k hydrologickému významu rašelinišť. Sb. ČSAZV – Lesnictví č. 1.

NOVÁK, M. (1955): Huminové vody ve vodách údolních nádrží. Vodní hospodářství č. 4, s. 127-128.

NOVÁK, M. (1959): Výzkum kvality vody v údolní nádrži Lipno. Vodní hospodářství, r. 9, č. 9, s. 378-383.

ONDERÍKOVÁ, V., ŠTĚRBOVÁ, A. (1956): Prispevok k biologii a chemizmu Oravskej nádrže. Vodní hospodářství, r. 6, č. 2, s. 46-51.

OULEHLE, F., JANSKÝ, B. (2003): Limnologie a hydrochemismus v NPR Rejvíz. In.: Jezera České republiky (Současný stav geografického výzkumu). Monografie na PřFUK Praha, s. 93-108.

ROBERTSON, R. A., NICHOLSEN, I. A., HUGHES, R. (1963): Studien über den Abfluss eines Moores. Ref. Intern. Torfkongress, Leningrad.

ŘÍHA, V. (1938): Jihočeské rašeliny, jejich vztah k lesu a okolí. Sborník MAP, roč. 12, Praha.

SCHREIBER, H. (1927): Moorkunde. Parey, Berlin.

SITENSKÝ, F. (1886): O rašelinách českých. Archiv pro přírodovědné prozkoumání Čech. Praha.

VIDAL, H., SCHUCH, M. (1963): Ergebnisse vergleichender Abfluss und Grundwasserbeobachtungen auf einer unberuhrten bzw. kultivierten Hochmoorflache in den sudlichen Chiemseemooren im Abflussjahr 1962. Bayer. Landw. Jahrbuch 40, H. 6 , s. 721-736.

Contact information

Jan Kocum, M.Sc. ..... kocum1@natur.cuni.cz
Prof. Bohumír Janský, Ph.D. ..... jansky@natur.cuni.cz

Charles University in Prague, Faculty of Science
Department of Physical Geography and Geoecology
Albertov 6, 128 43 Prague 2, Czech Republic
Tel.: +420221951350

Presented research is supported by Charles University Grant Agency Project No: 182/2000/B-GEO/PřF, Czech Republic Grant Agency Project No: 205/03/1264, research project of Czech Ministry of Environment VaV-SM/2/57/05 and Charles University Grant Agency Project No: 2371/2007