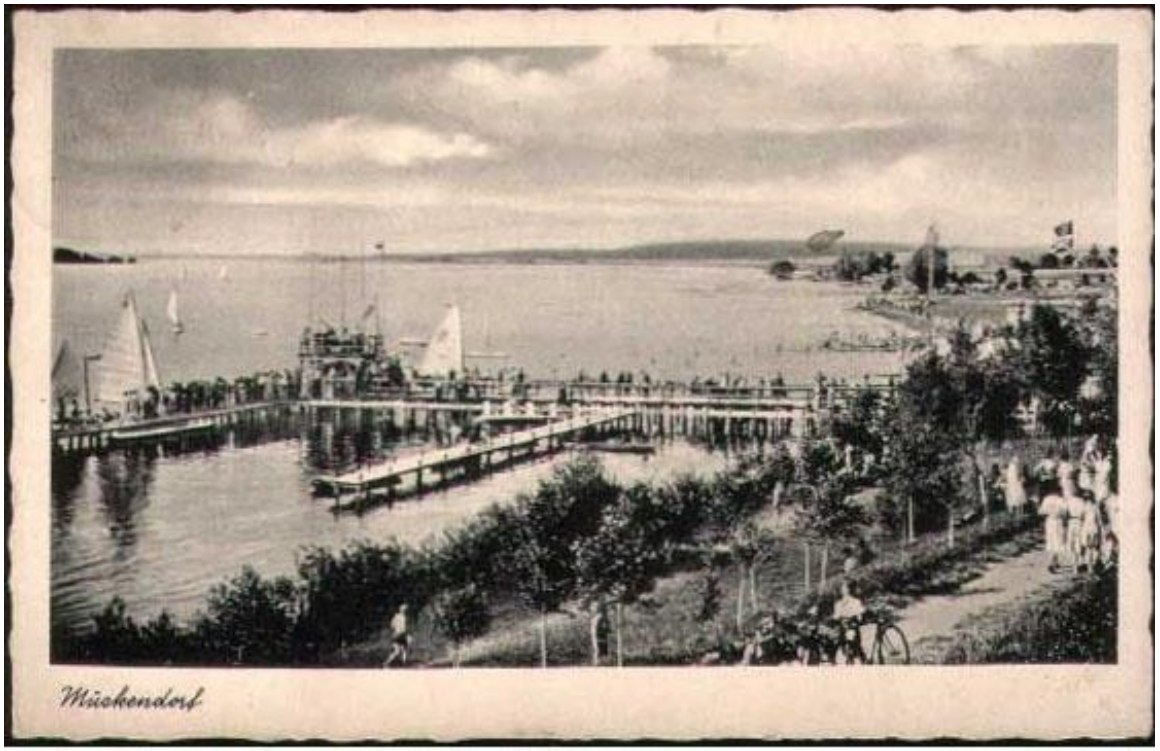
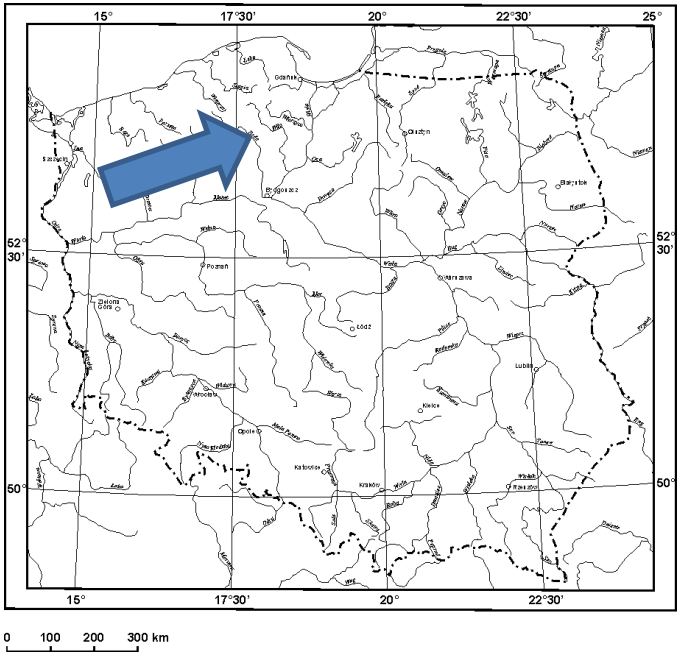
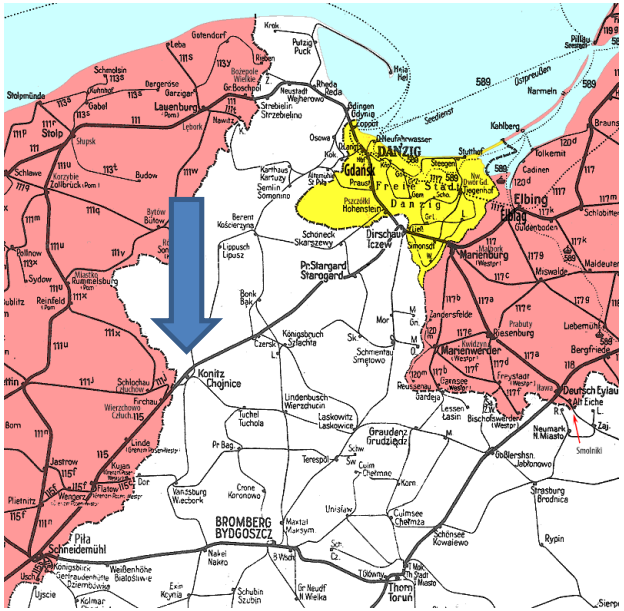
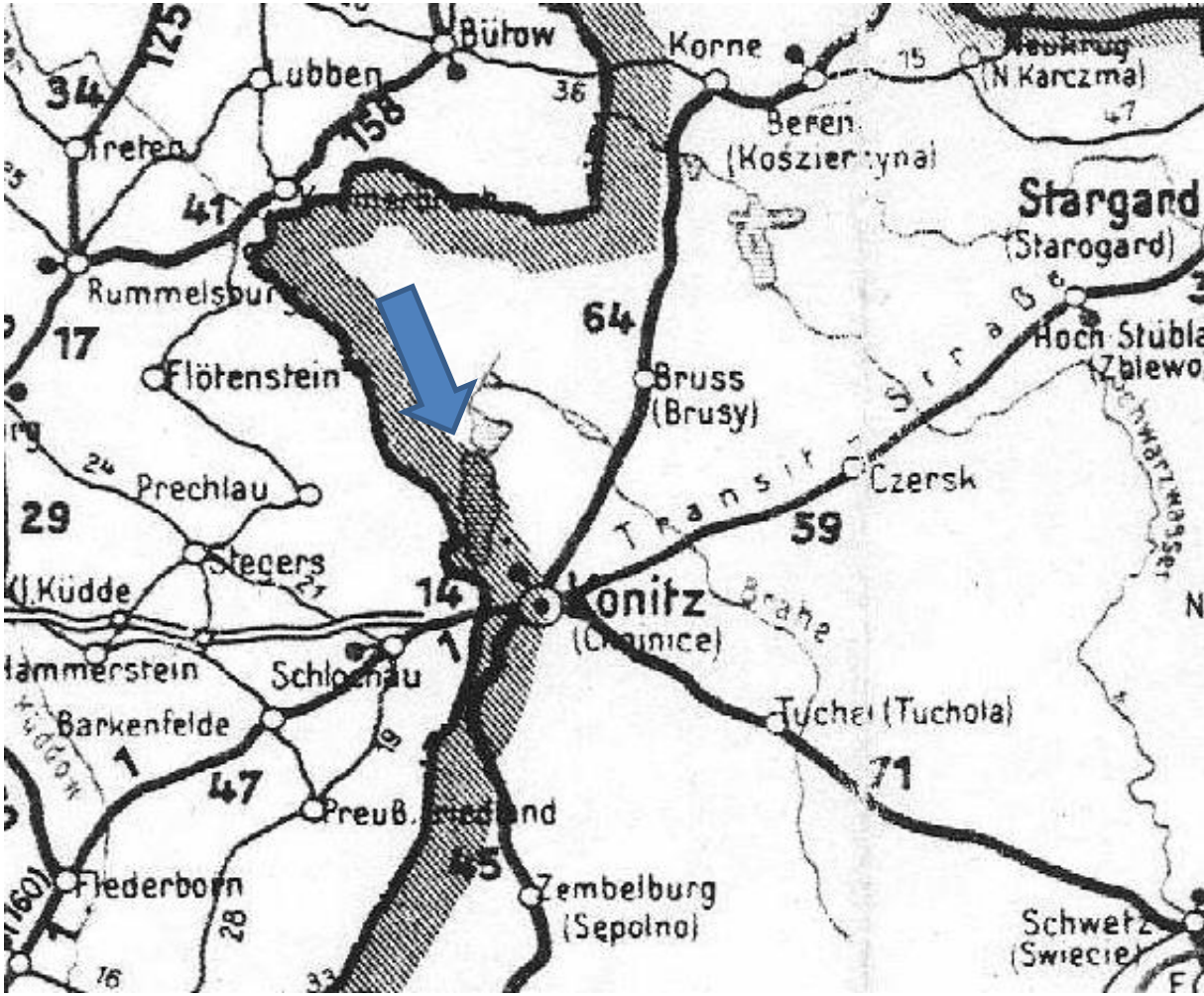
Flow between the sub-basins of Charzykowskie Lake – modeling and measurements



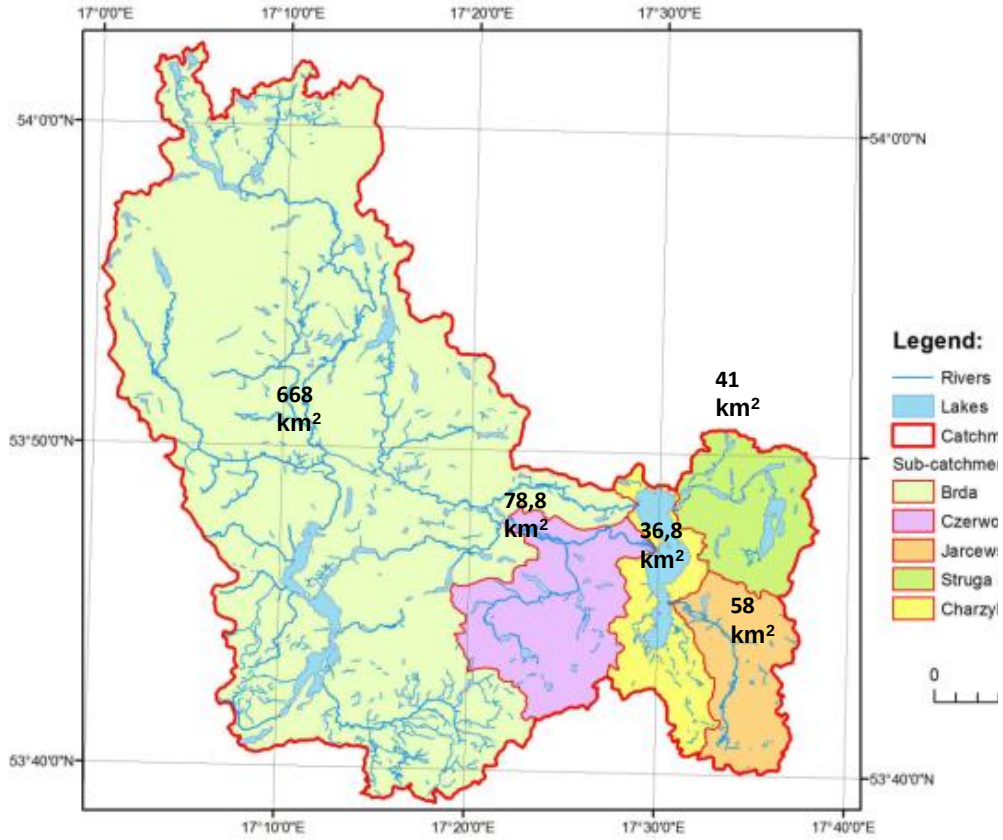
Artur Magnuszewski
Barbara Nowicka
WGSR UW

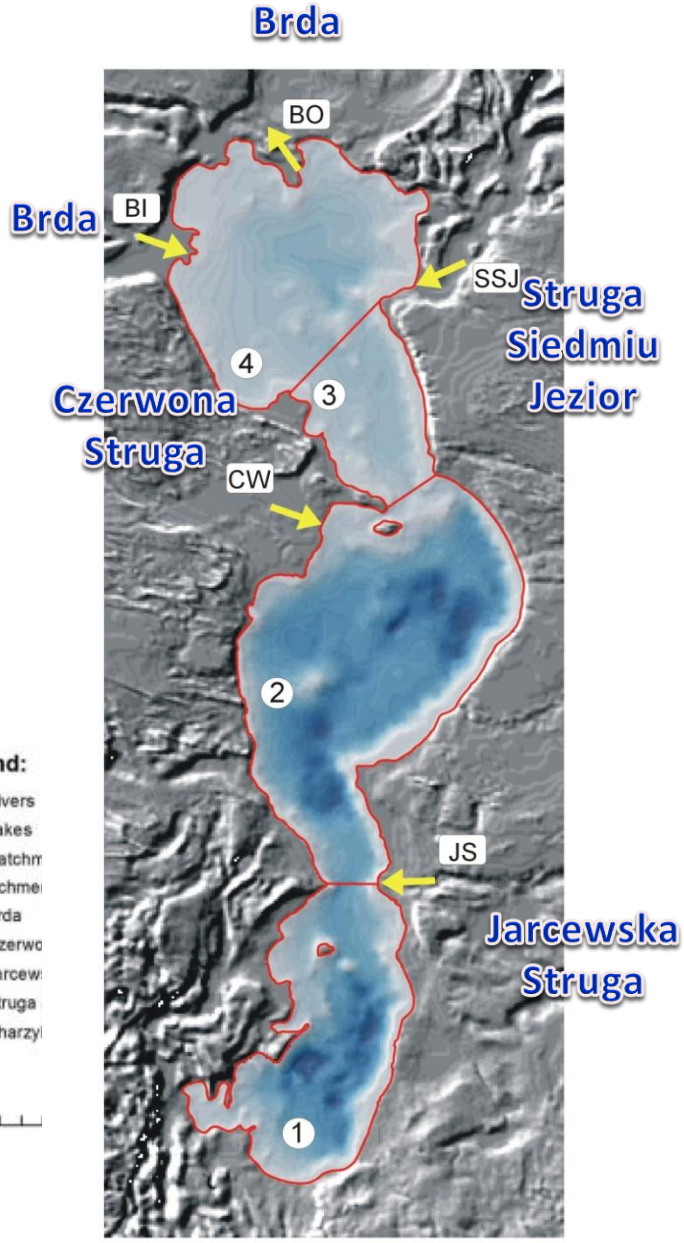

15°
17°30'
20°
22°30'
25°
52°30'
50°
0 100 200 300 km


DANZIG
Gdańsk
Elbing
Marienburg
Konitz
Chojnice
BROMBERG
BYDGOSZCZ
Thorn
Toruń


Bütow
Lubben
Korne
Stargard
(Starogard)
Rummelsburg
Flötenstein
Bruss
(Brusy)
Prechlau
Czersk
Stegers
Konitz
(Chojnice)
Schlochau
Tuchel (Tuchola)
Barkenfelde
Preuß. Friedland
Flederborn
Zembelburg
(Sepolno)

Sub-basin	Area km^2	Volume km^3	Average depth m
Southern	2.98	0.038	13
Central	5.49	0.083	15
Northern-2	1.36	0.010	7
Northern-1	3.69	0.026	7
Total	13.5	0.157	12

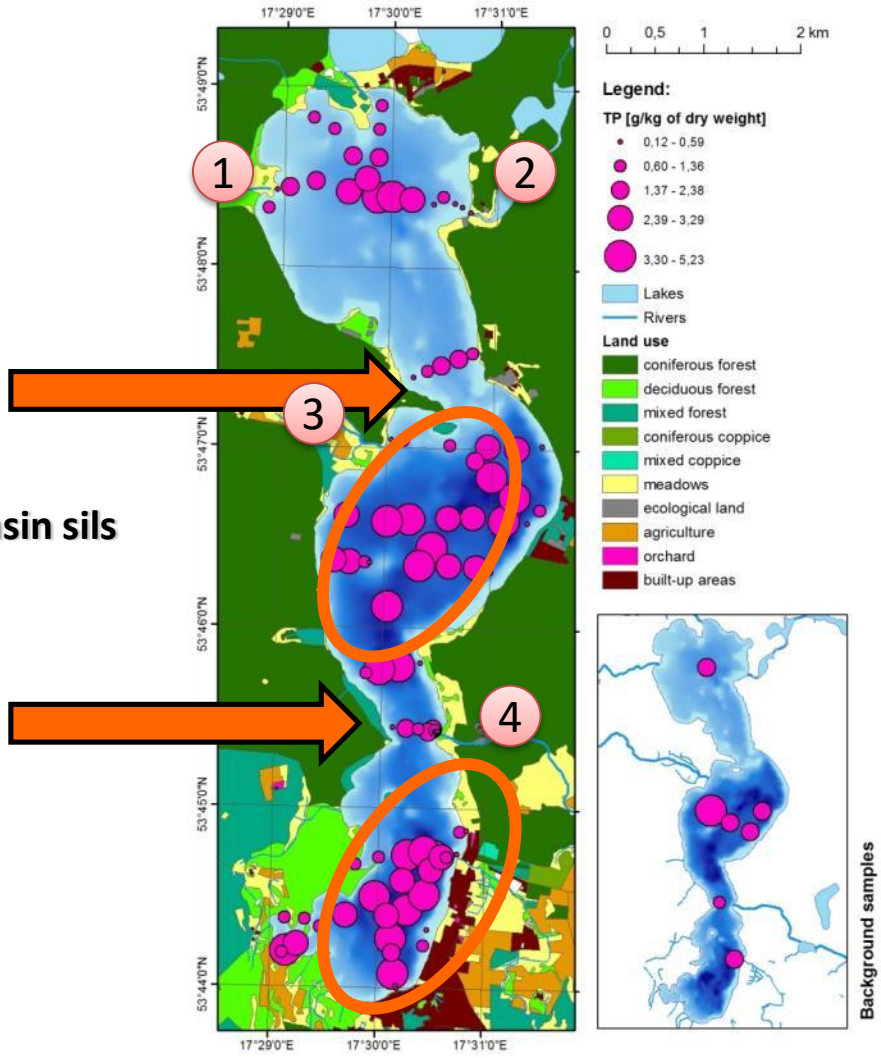




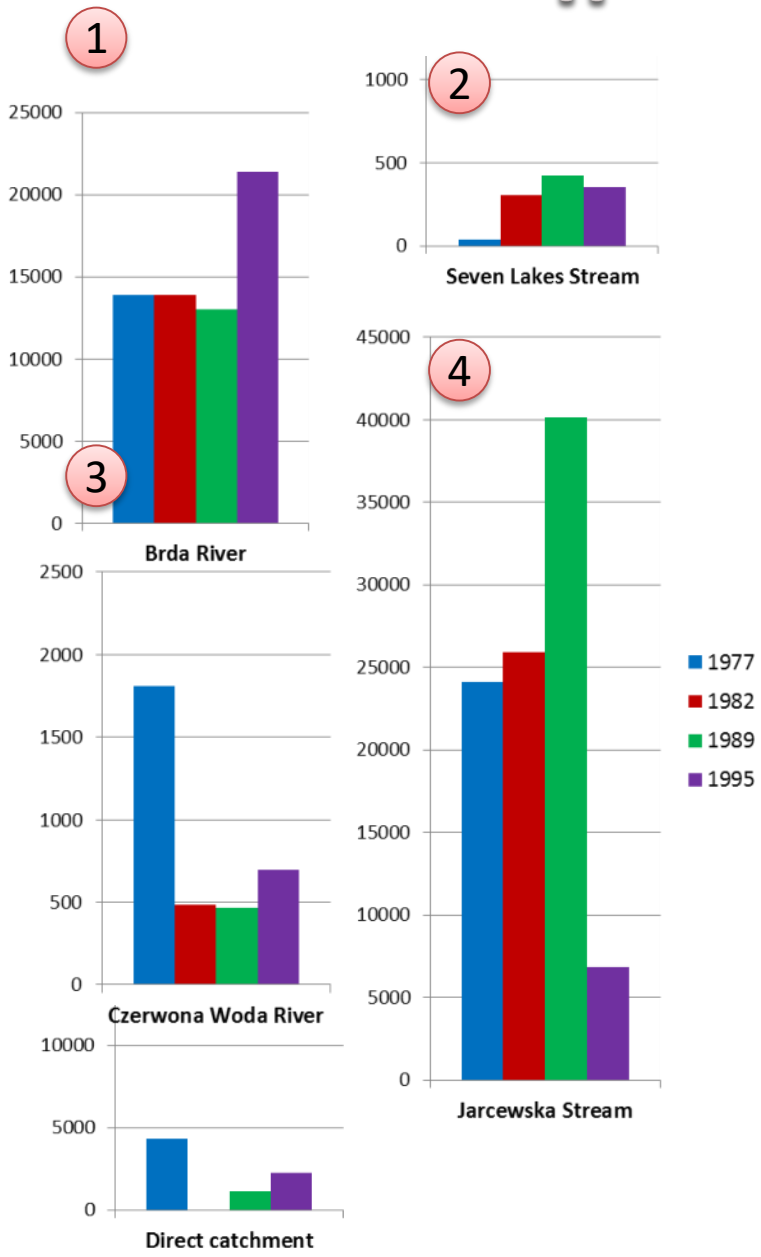
Parameters of the rivers in Charzykowskie Lake catchment

River (symbol)	Catchment area km^2	Discharge m^3s^{-1}			
		2015 08 21 field measurement	Mean low flow	Average	Mean high flow
		Inflow to Charzykowskie Lake			
Brda inflow (BI)	668	2.74	2.07	6.16	12.3
Czerwona Woda (CW)	78.8	0.05	0.00	0.20	0.41
Jarcewska Struga (JS)	58.0	0.12	0.11	0.42	0.64
Struga Siedmiu Jezior (SSJ)	41.0	0.26	0.05	0.21	0.33
		Outflow from Charzykowskie Lake			
Brda outflow (BO)	920	3.59	2.23	7.78	15.6
		Inflow – outflow difference			
Difference BO-(BI+CW+JS+SSJ)	36.8	**0.85**	0.16	1.62	3.30

Separation of the lake sub-basins



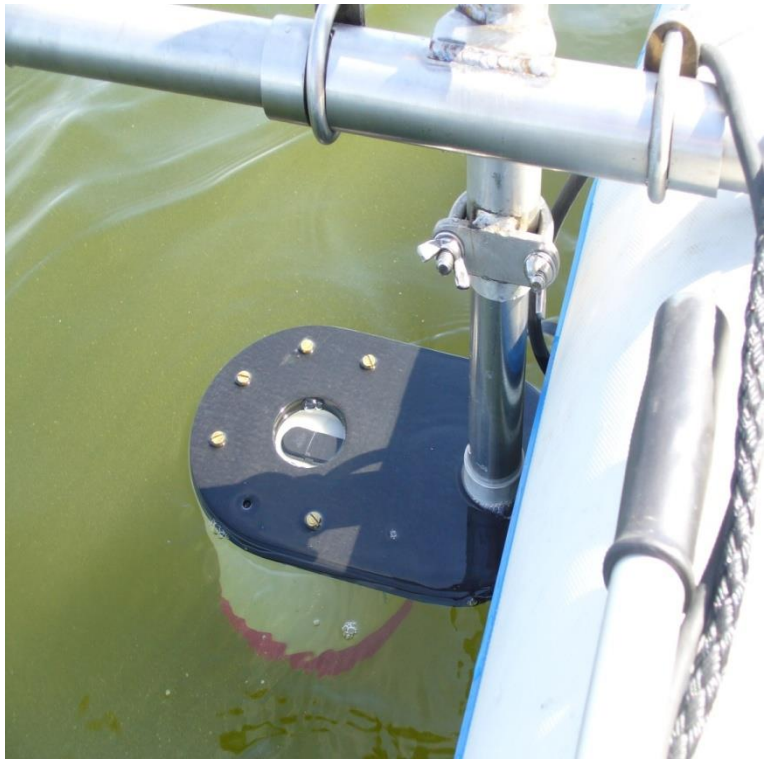
Inter basin sils



Wg Nowicka, Nadolna 2012

TELEDYNE
RD INSTRUMENTS
Everywhereyoulook™

The 1200 kHz RiverPro has been purpose-built to provide an ADCP designed specifically for shallow river applications (**20 cm to 25 m range**)



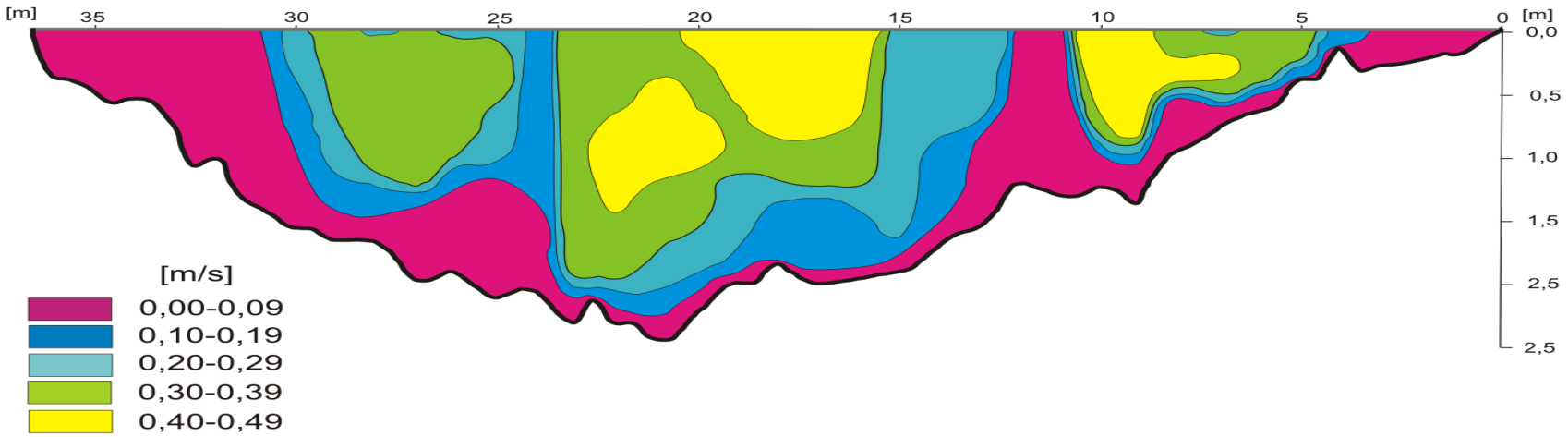
ASDCP mounted at zodiac rubber boat

ADCP, echosounder and chart plotter QGIS

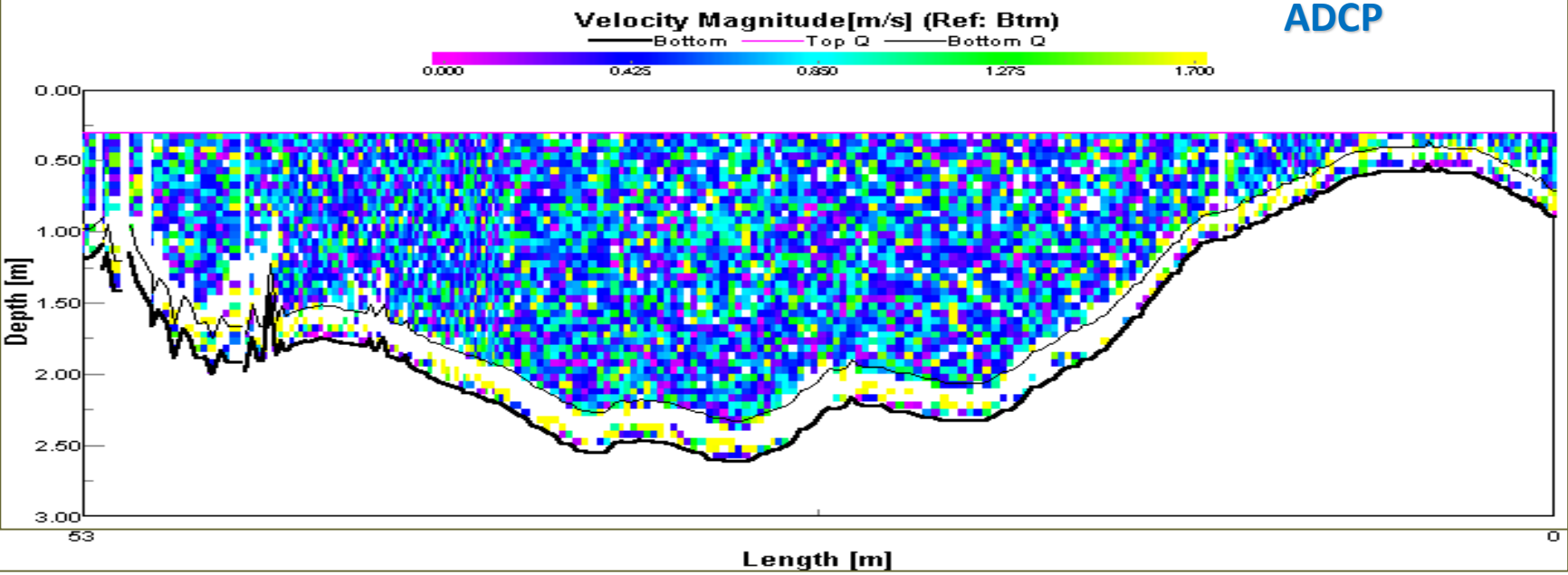
Rzeka: Brda Profil: Drzewicz

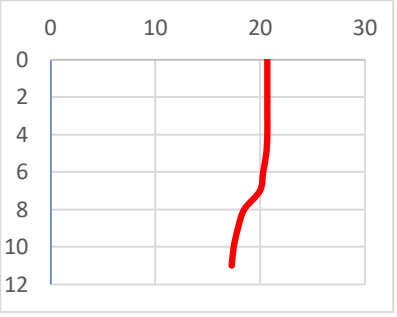
10.08.2005

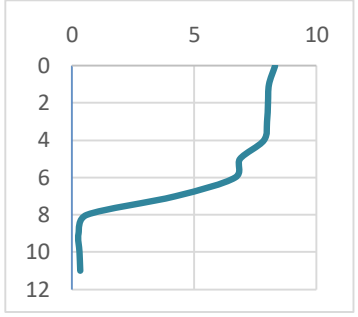
Current meter profile



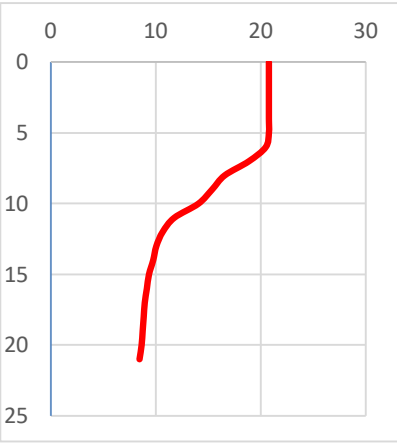
ADCP

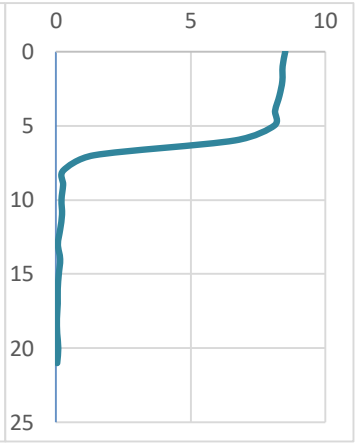




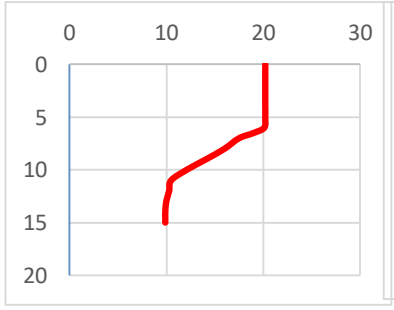


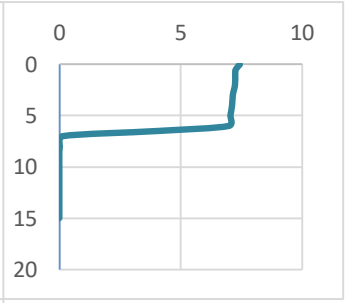
SD 1,56m



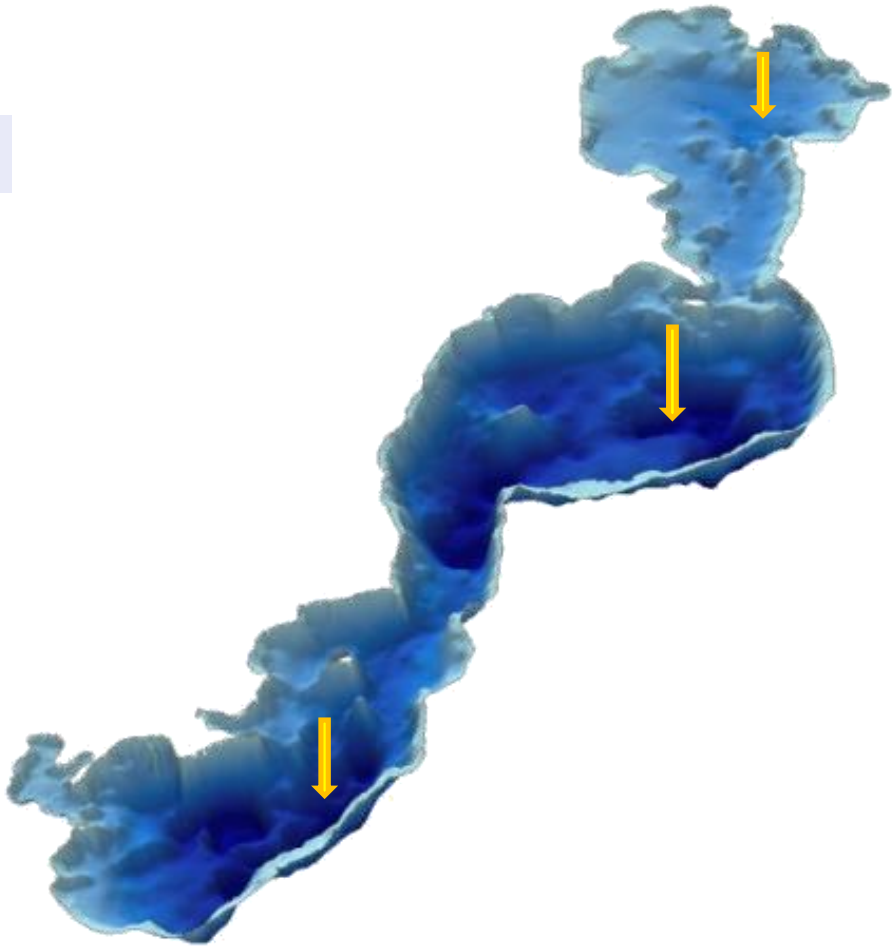


SD 2m



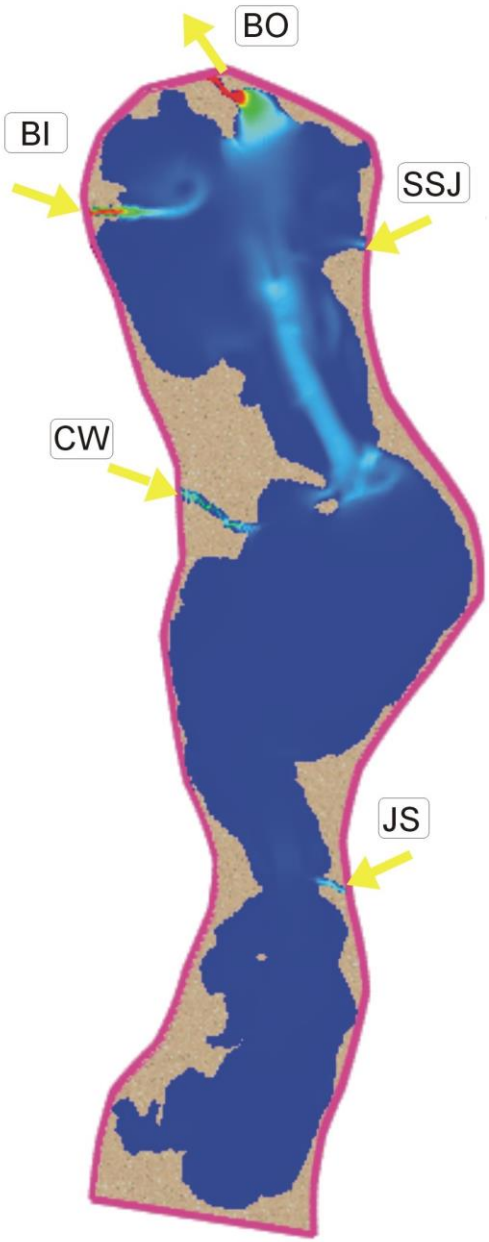


SD 1,75m



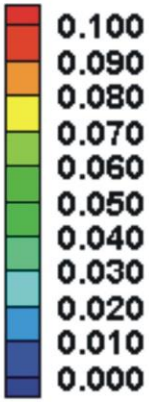
Temperature ^{O}C **DOC mg/l**

25 -26.08.2015

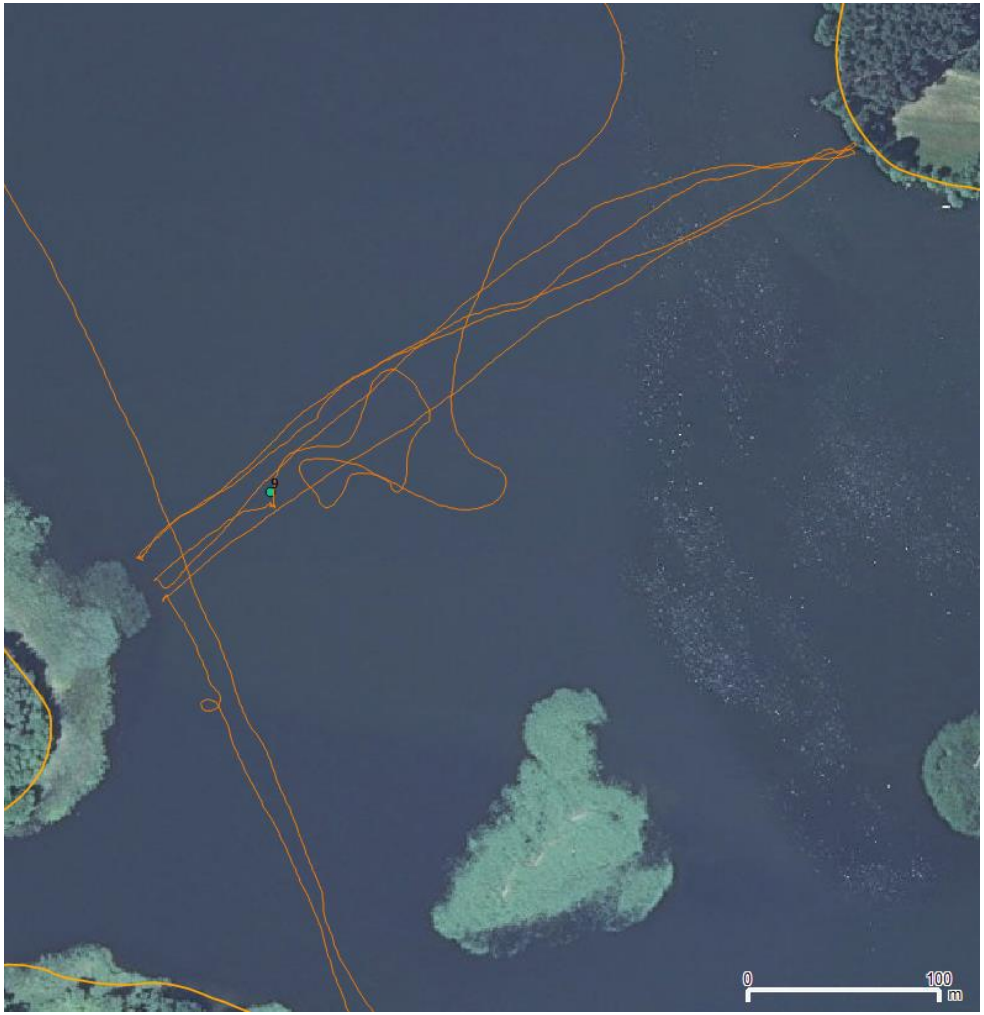


CCHE2D model
- computing mesh i=100, j=100
- average size of the grid 20x40 m

Velocity magnitude m/s

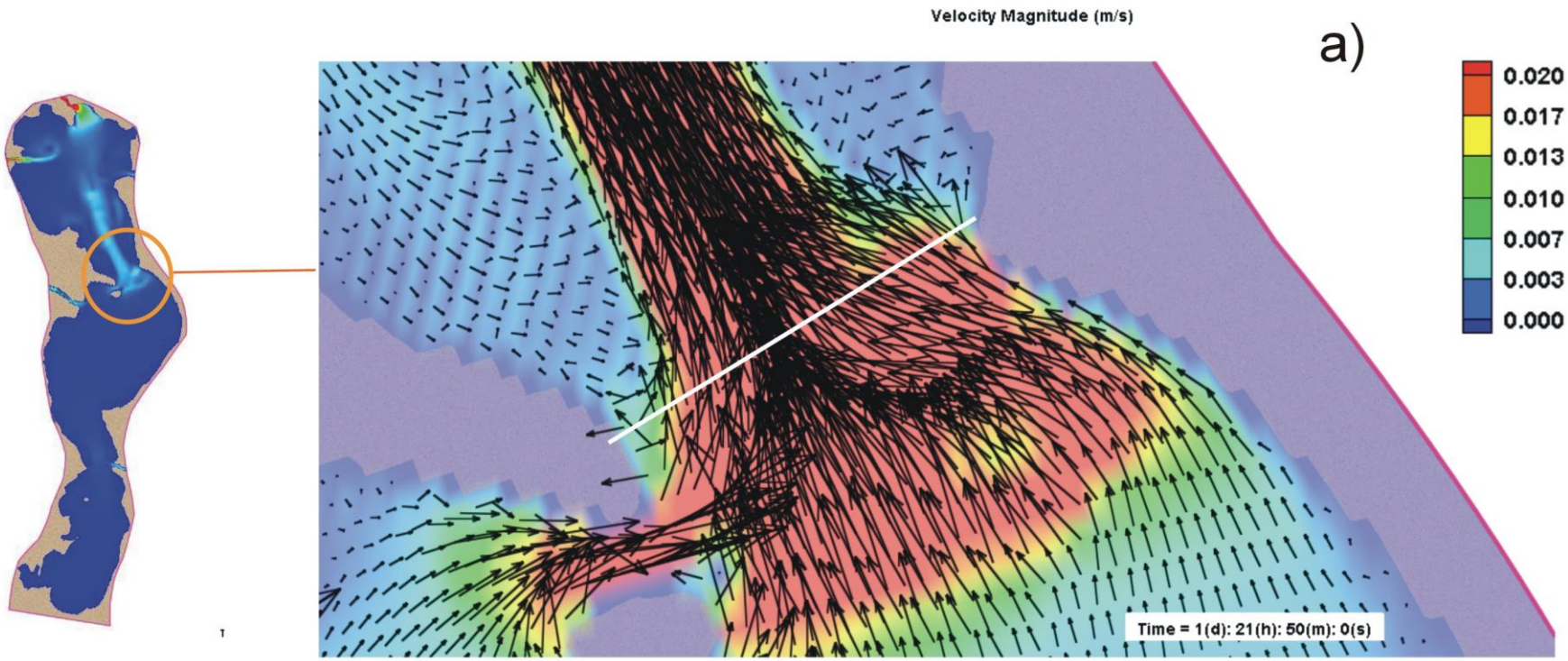


ADCP compass calibration
Quantum GIS + GPS Garmin



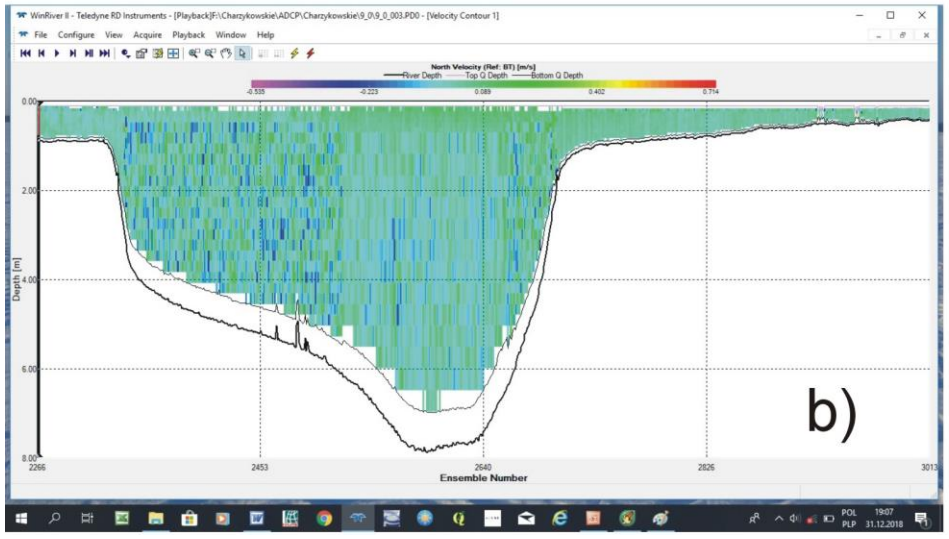
Results of ADCP measurements over the sill separating sub-basins Central and Northern-2 of Charzykowskie Lake performed on 2015 08 28

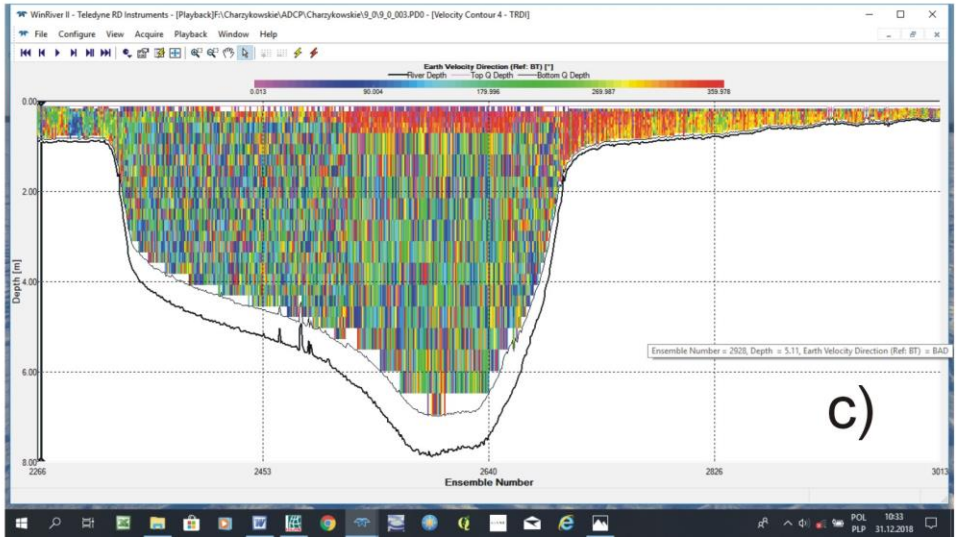
Passage No.	Width	Total Area	Top Q	Total Q	Flow velocity	Boat Speed
	m	m^2	m^3s^{-1}	m^3s^{-1}	$m\ s^{-1}$	$m\ s^{-1}$
9002	431.26	1612.34	0.026	3.216	0.005	0.974
9003	436.45	1638.29	0.858	**1.475**	0.013	0.906
9004	433.89	1588.13	0.152	1.634	0.004	1.025

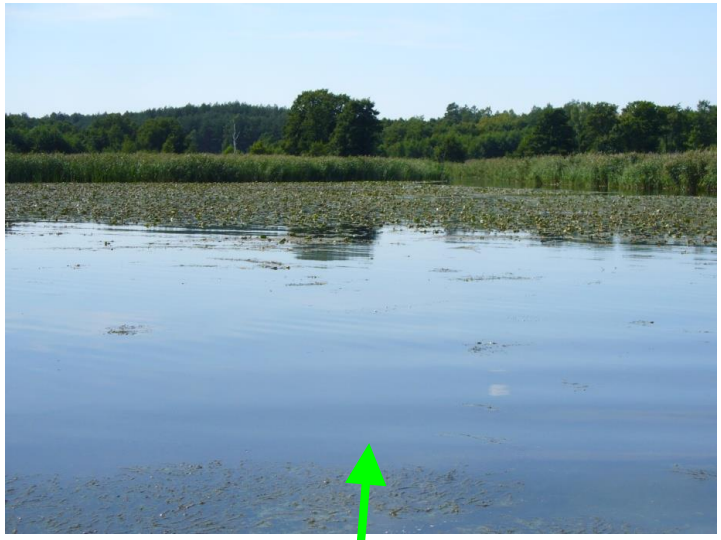


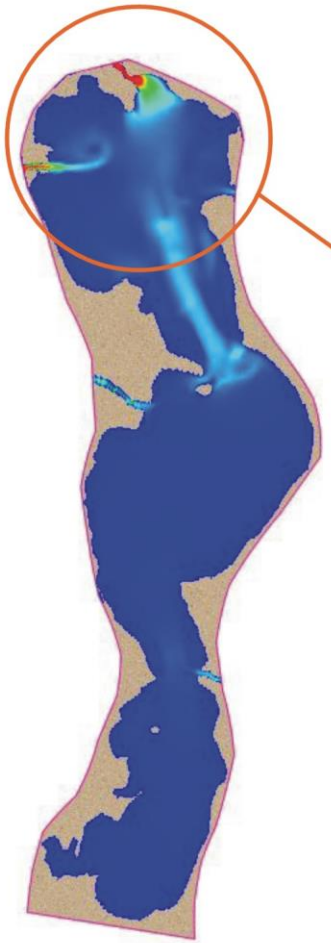
North velocity magnitude

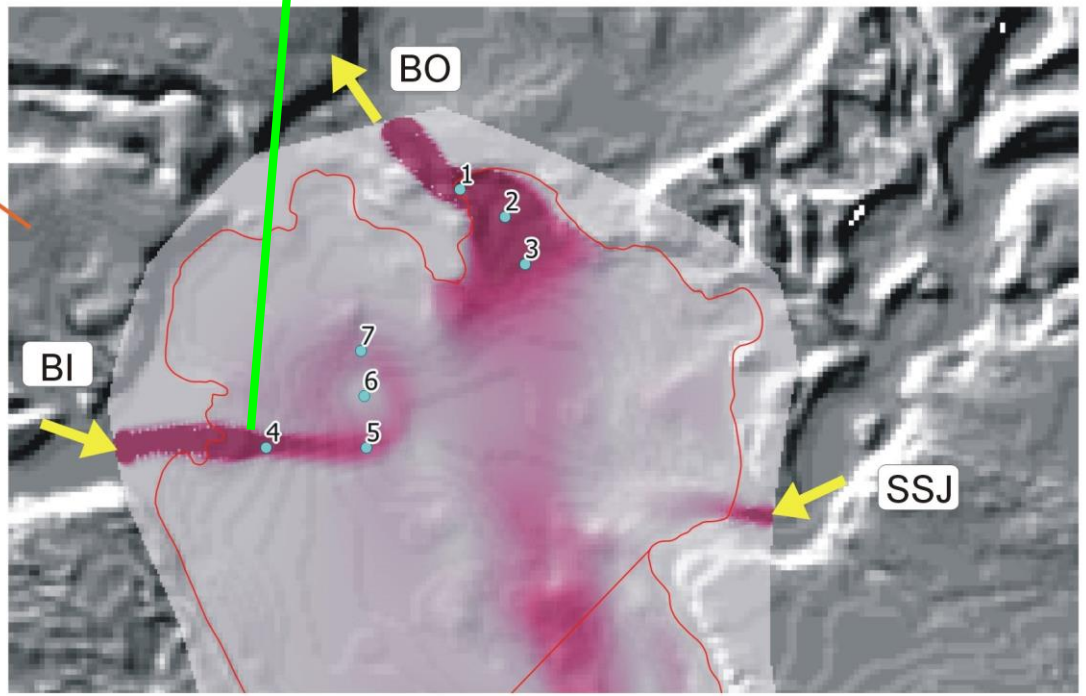
Direction of flow









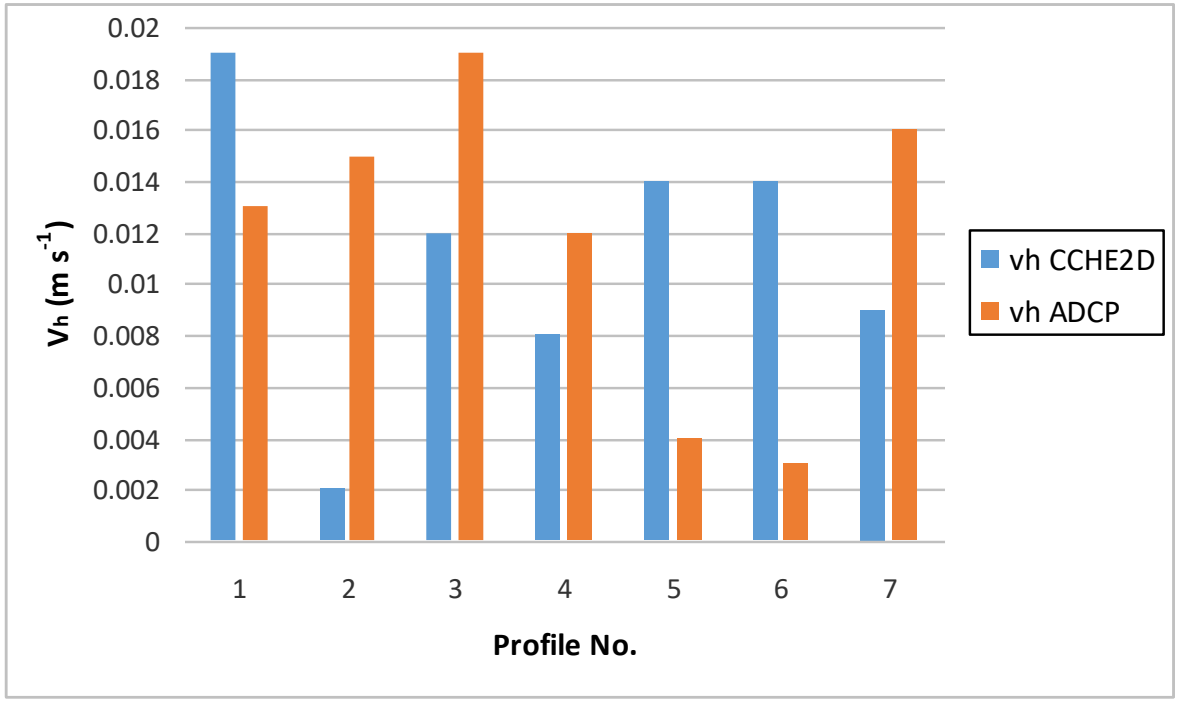


1
2

0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
0.020

m s $^{-1}$

0 100 m

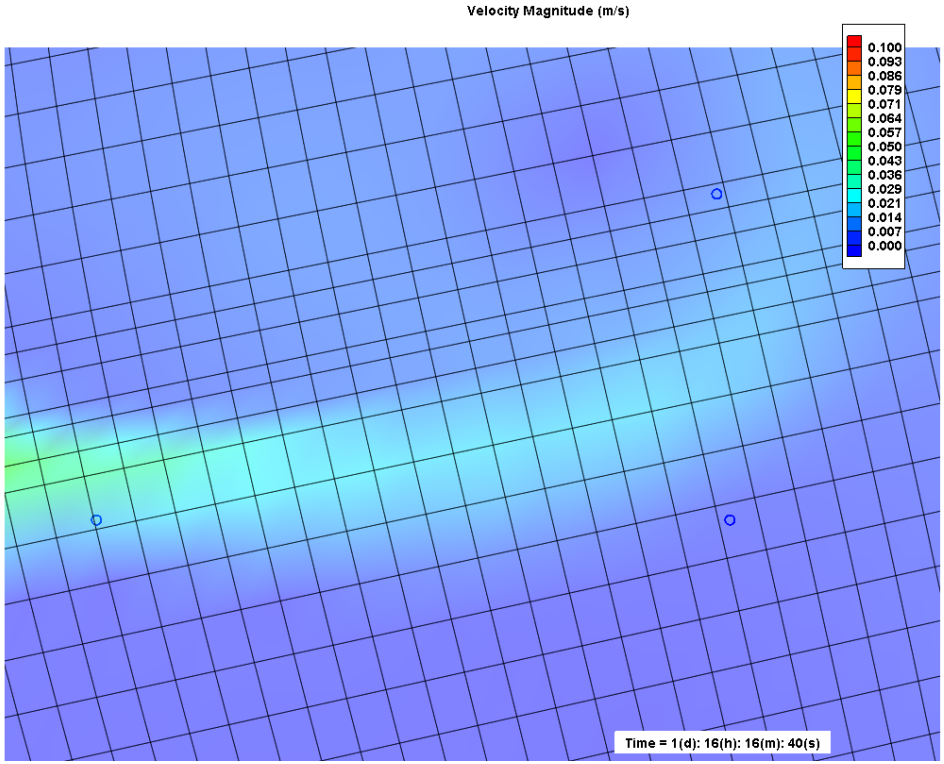


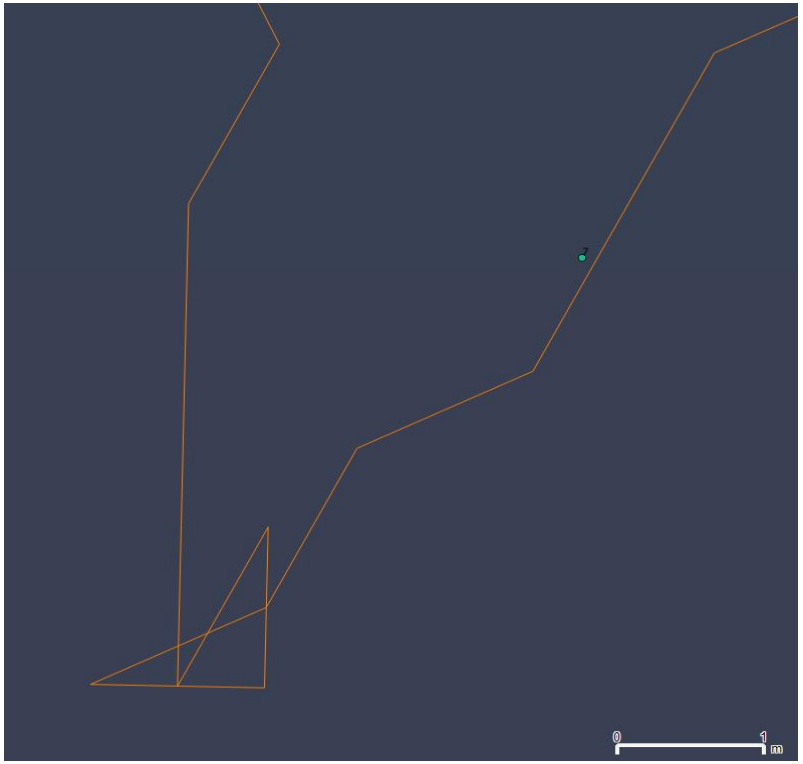
Velocity in verticals - calculated by CCHE2D model and measured by ADCP (section by section mode).

The average difference of performed ADCP measurements and CCHE2D results is only 0.002 m s-1, which confirms the proper estimation of model calculated velocities.

Precision of localisation in the field and on the model grid

- grid of the model CCHE2D 40 x 20 m
- Quantum GIS + GPS Garmin+/-5 m





Conclusions:

-CCHE2D modeling and ADCP verification of flow pattern had confirmed a water flux between the sub-basins.

-Discharge values between the sub-basin Central and Northern-2 are higher than calculated from mass balance based on field measurements. But they are close to mass balance difference for a long term average conditions.

- In a moving boat method ADCP instrument shows properly the magnitude of velocities and the pattern of reverse flow. This property of ADCP instrument make possible to use the measurements results for hydrodynamic model verification and helps to understand complex pattern of flow in lake with separated sub-basins.

- Measurements section by section do not show proper direction of flow but velocity magnitude is good

Thank you for your attention