RPAS a digitální fotogrammetrie jako nástroj pro hodnocení břehové eroze

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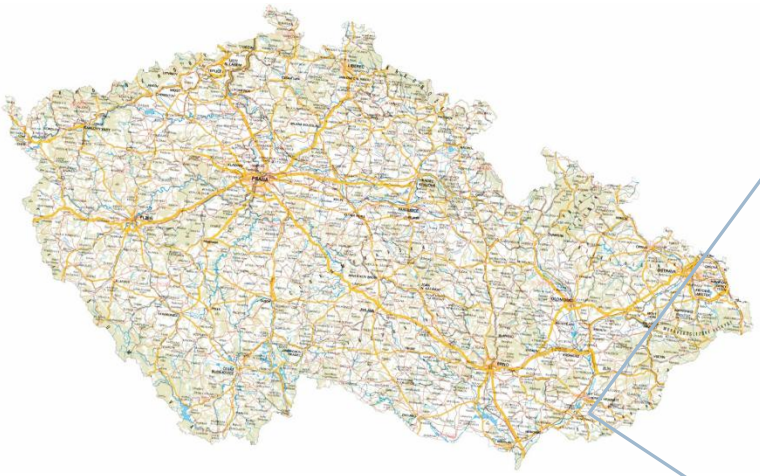
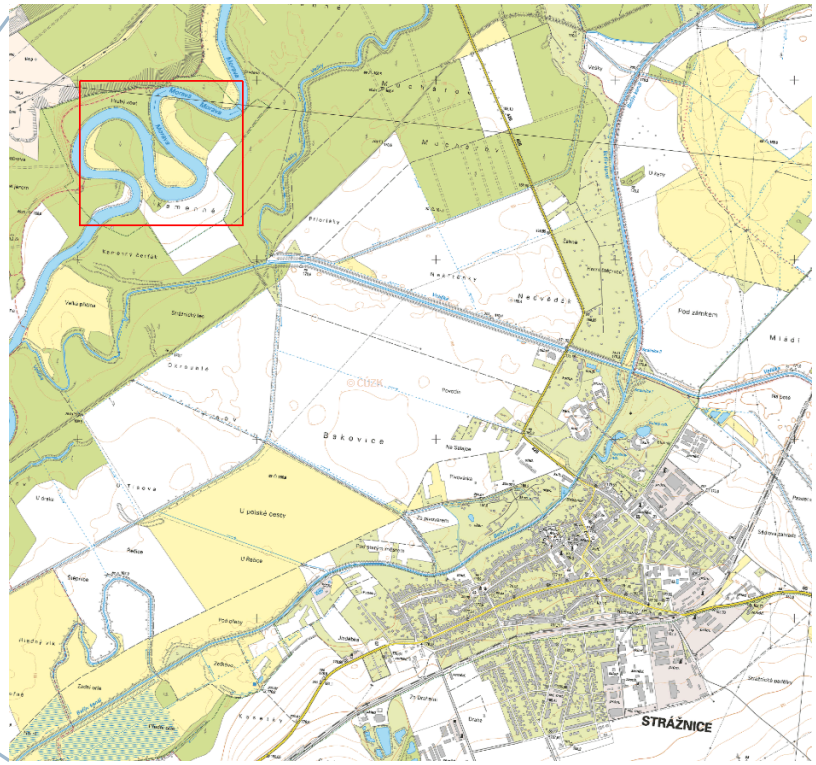
Short description

- Main aim is: Detailed aerial and terrestrial mapping and flood impact monitoring in the Morava River region (Litovelské Pomoraví Protected area, Osypané Břehy)
- Main target area are lowland regions and region of floodplains near active rivers.



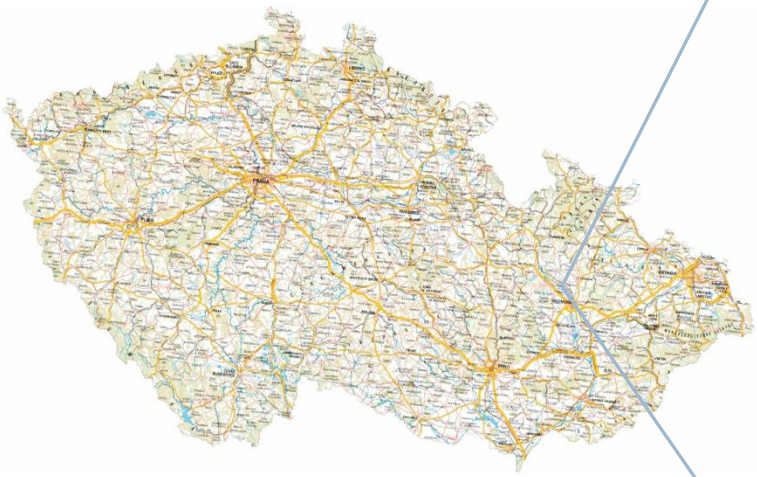
Source: Český úřad zeměměřický a katastrální

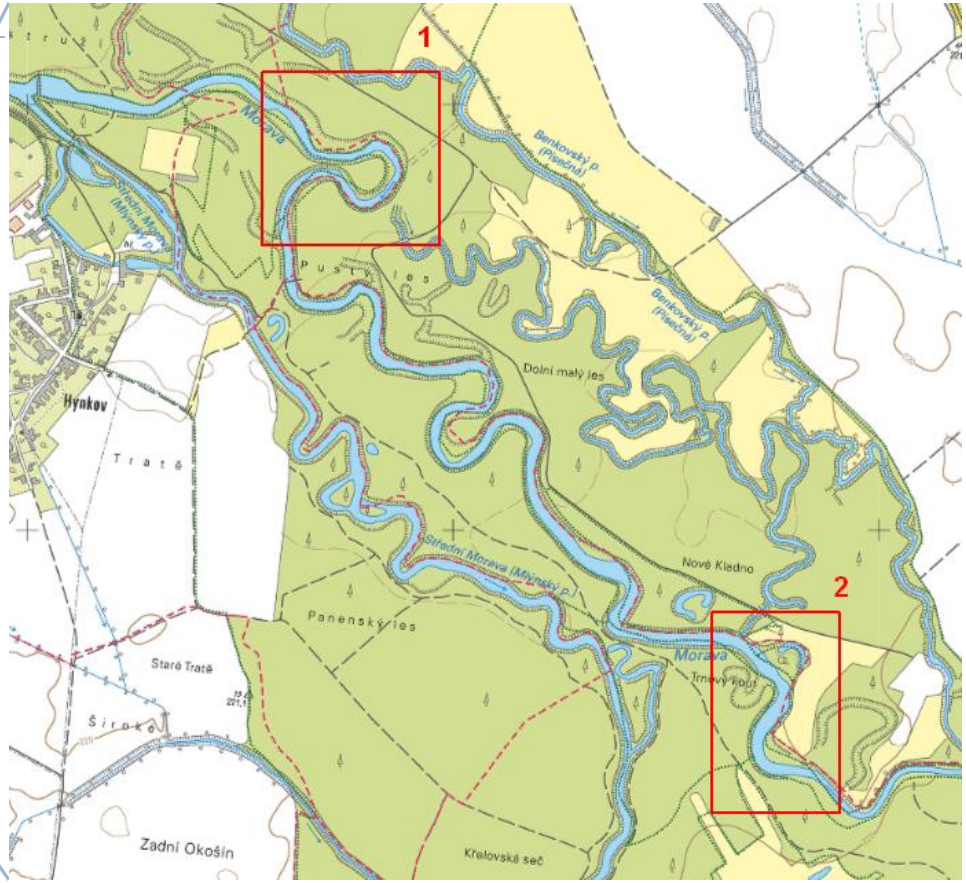


1. Meander in the Osypané břehy locality

Area of interest

Source: Český úřad zeměměřický a katastrální





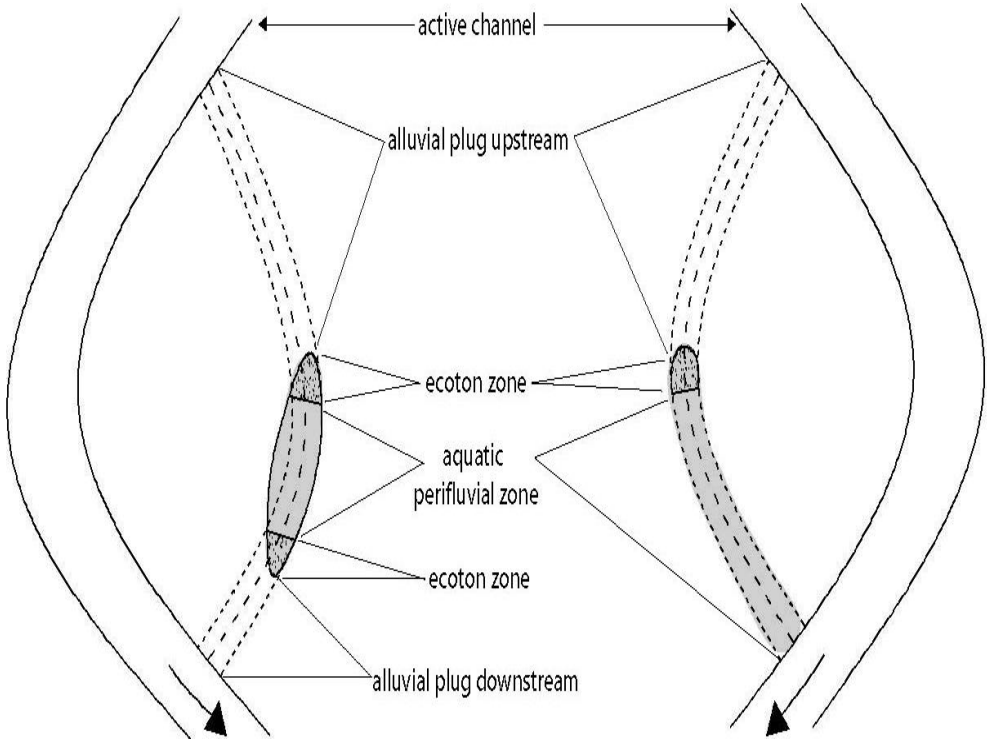
1. Kenický meander

2. river bank with lateral erosion

Floodplain lake

- A floodplain lake is an area of fluvial hydrosystem spatial delimited by an axis of ancient active channel.

- It is composed from two parts: humid perifluvial (aquatic perifluvial zone with ecoton zone) and terestric zone presented by an alluvial plug (Rollet, Citterio, Piégay, 2004).



Floodplain lake

- Floodplain lake is most of the year without water

Methodology

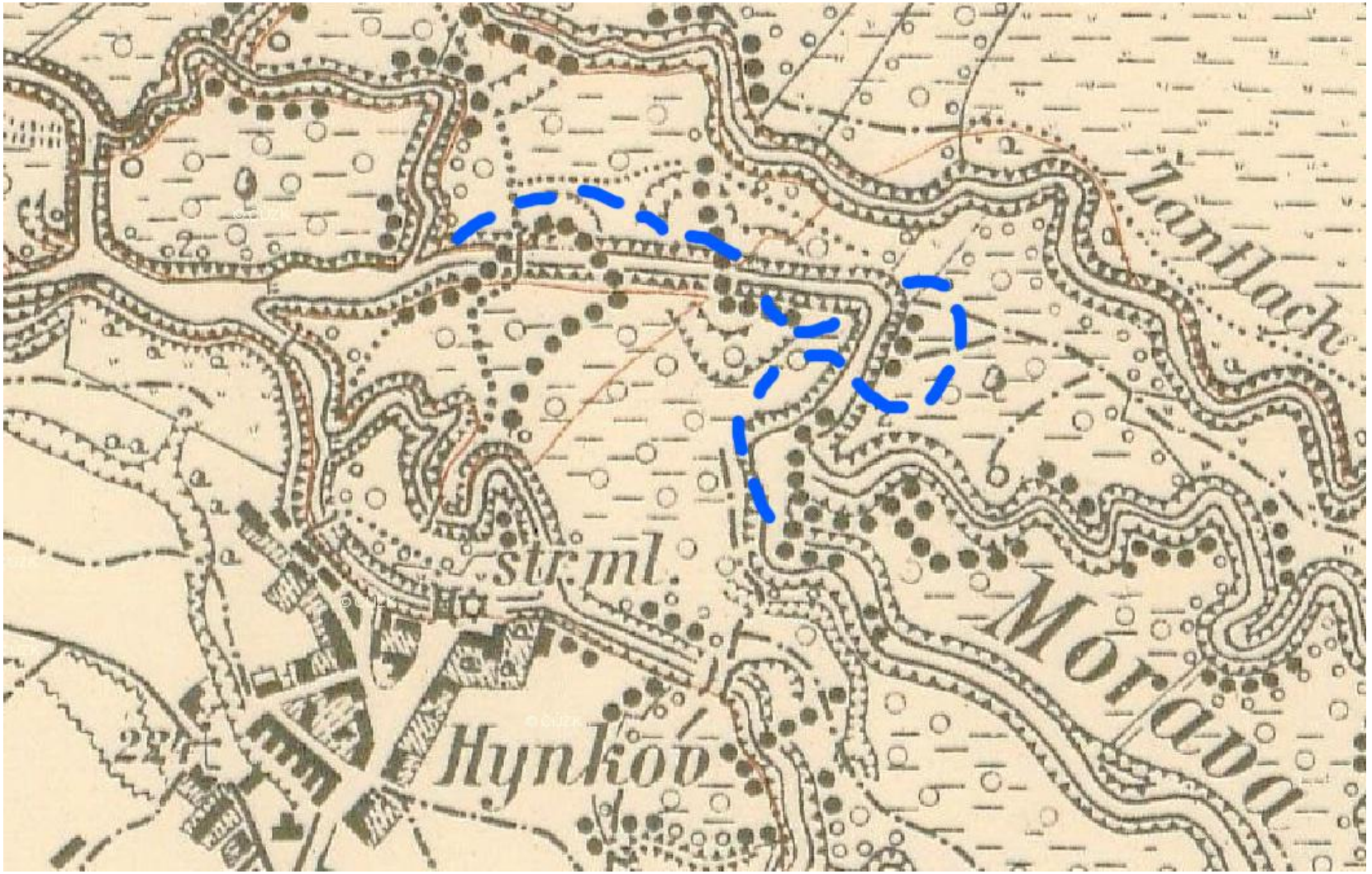
- From methodological point of view, we use the methodology of sediment survey established recently by Citterio & Piégay, 2008.
  - Two steps are considered:
    - The measurement of the sedimentation rates based on the ratio between the mean sediment thickness and the date of the revitalisation;
    - The statistical analysis of the relationships and inter-lake analysis (the characterisation of connection frequency and to define the life expectancy of former channels).

- For a UAV and aerial imaging we use methodology established by Miřijovský, 2013

- Additional measuring
  - Terrestrial photogrammetry
  - Geodetic measuring of the transverse profiles

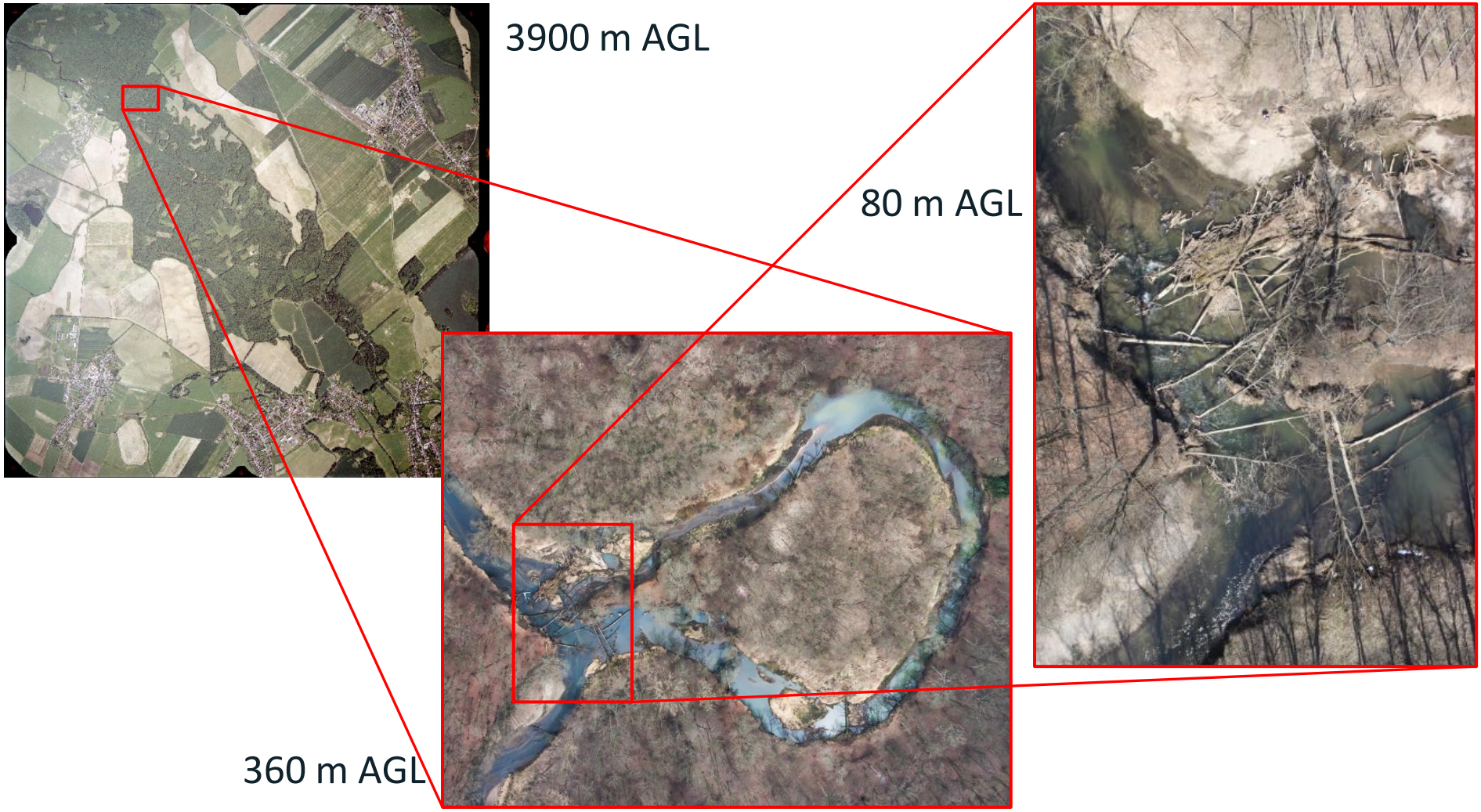
- Collaboration with Komenského University in Bratislava and Masaryk University in Brno

Dataset



Dataset

Dataset



Technical equipment

- Hexacopter XL, Cessna 172
  - RPAS with six propellers
  - Canon EOS 500D
  - 20 mm lens

- Cessna 172
  - Used to spatially extensive area imaging.

Technical equipment

- Camera, hydrologic and geodetic devices
  - DSLR camera with a prime lens.
  - Rain gauge
  - Levelogger, Barologger
  - Total station Topcon
  - Levelling instrument

Field work

- Installation of the levelogger

- Geodetic measuring – two sets of measuring (cooperation with students of Palacký University).

- Aerial imaging
  - Four flights above the Kenický meander
  - Three flights above the meander in Osypané břehy locality.

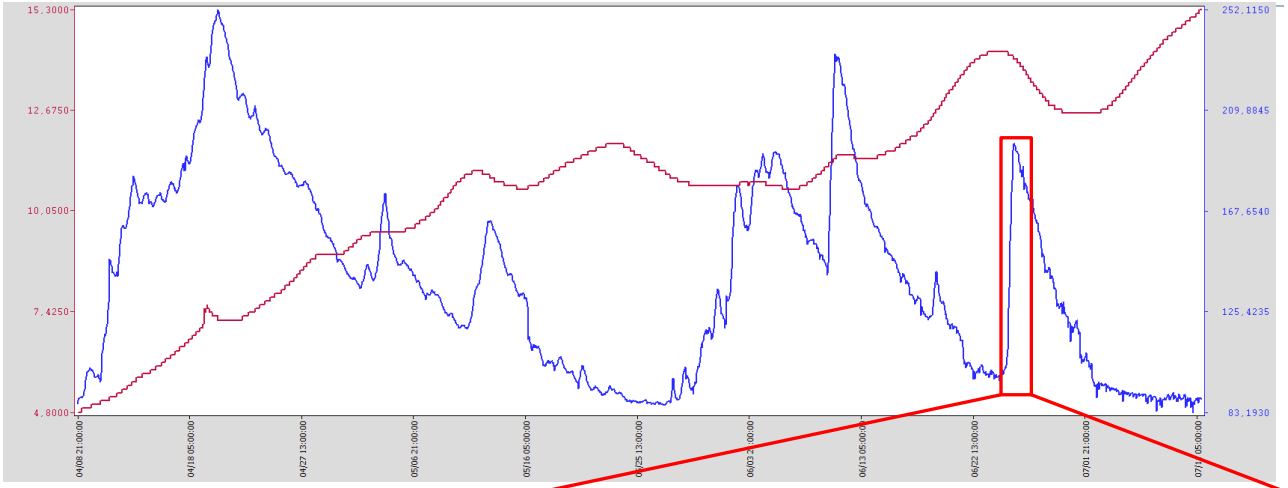
Precipitations, water level

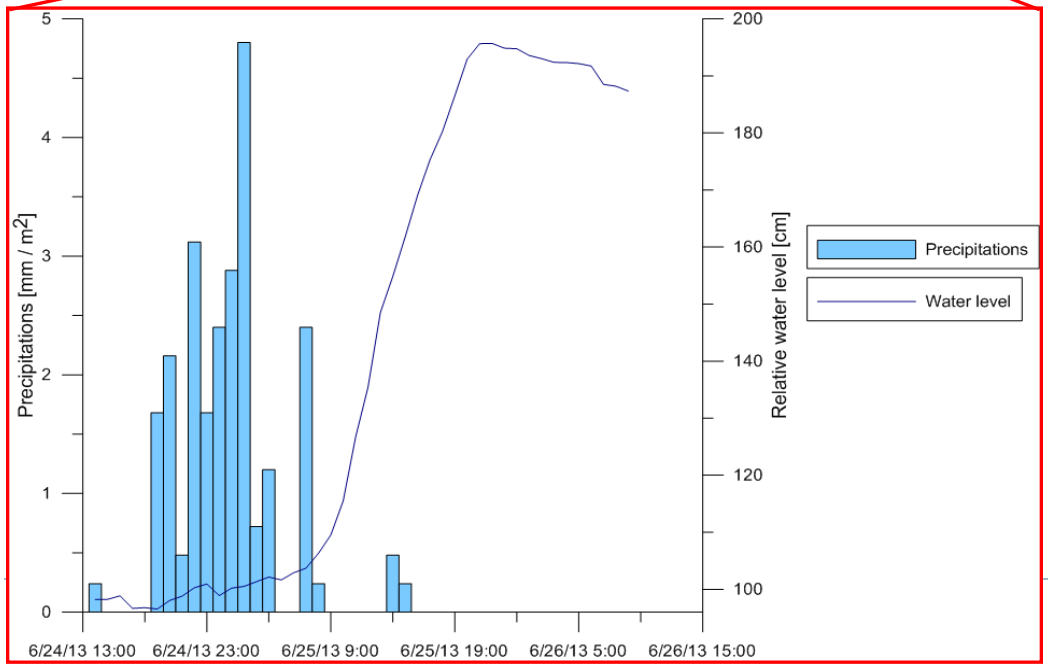
- Speed of the lateral erosion and sediments accumulation.

Rain ⟶ high water level

- Maximal erosion if there is riverbeds-forming flow

Precipitations, water level





RAW data from an aerial imaging

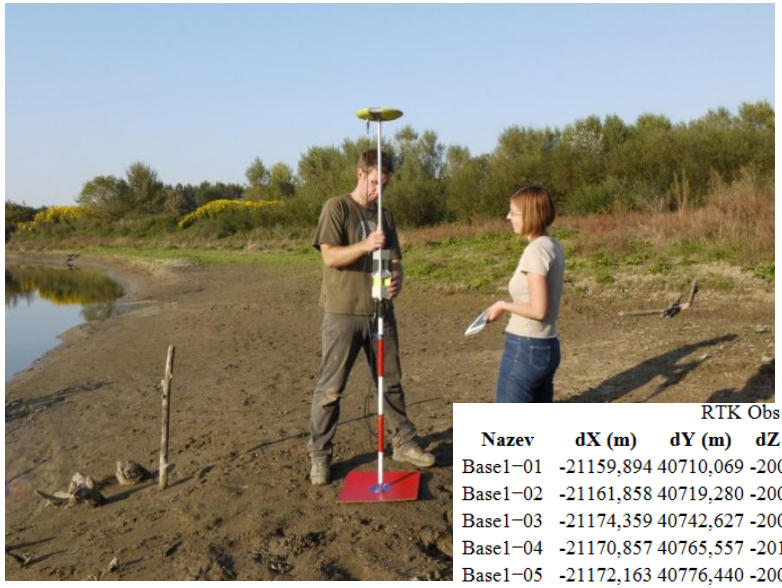
- Overlay 70 % – 90 %

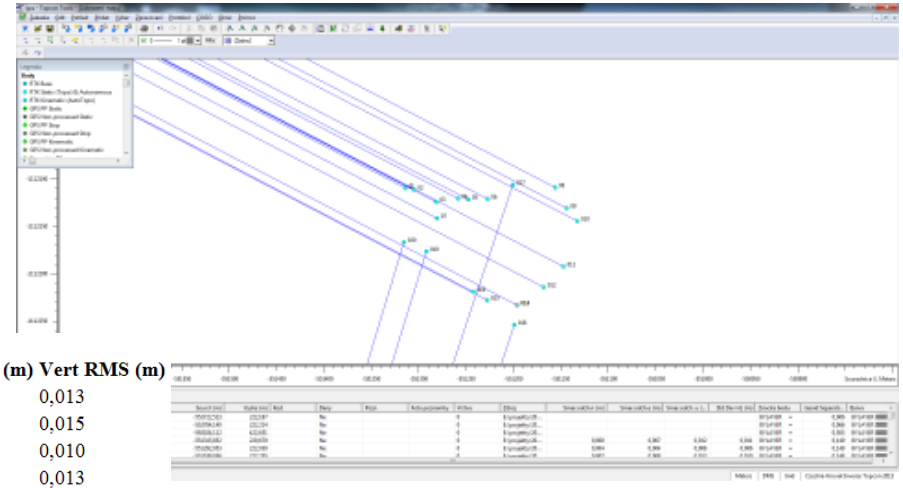
Very high detail

GCPs

Methods

- Interior and Exterior orientation
- Surveying methods
- Very accurate measuring of the Ground Control Points (GCPs), often in a difficult terrain morphology.



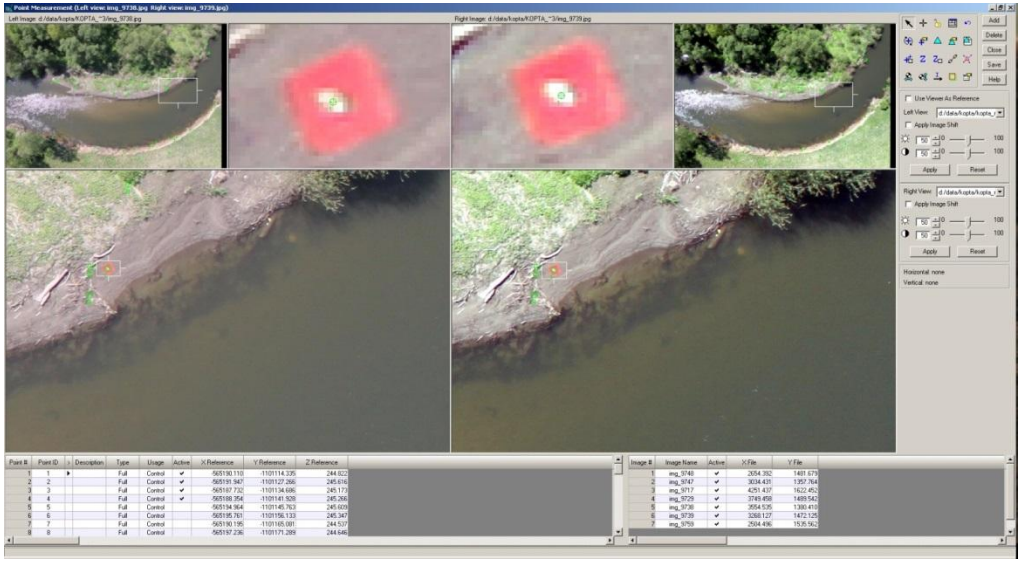


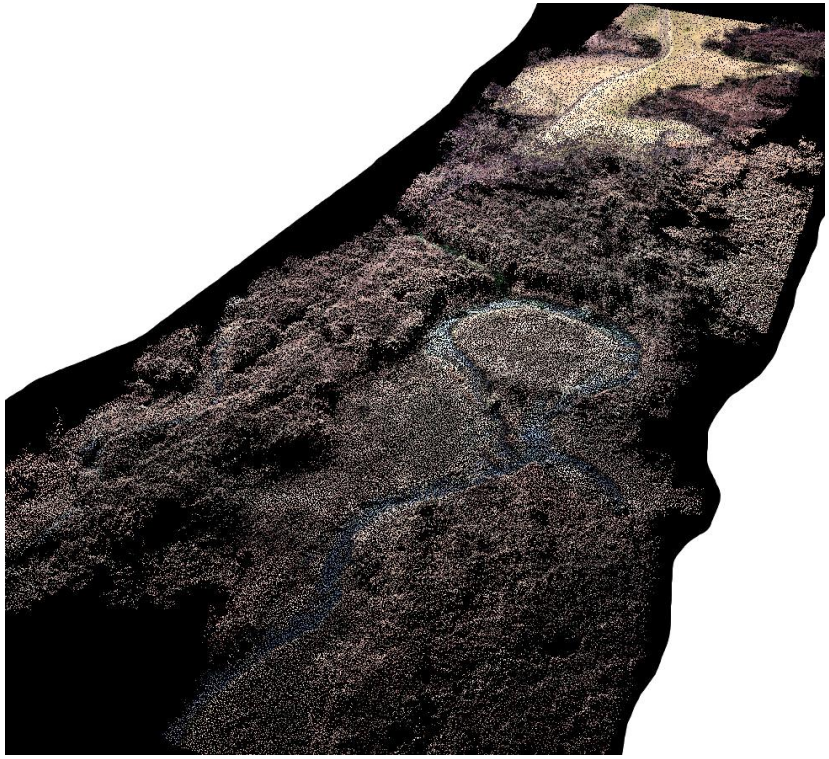
RTK Obs Quality

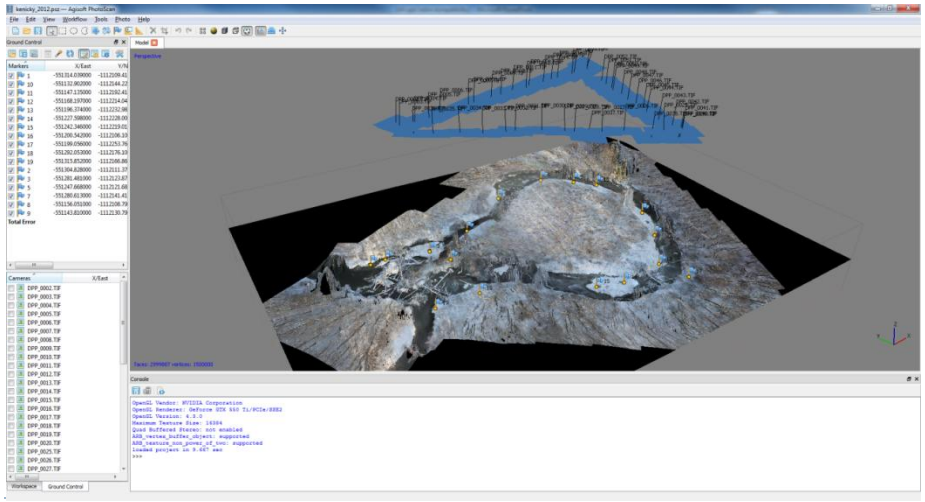
Nazev	dX (m)	dY (m)	dZ (m)	Horz RMS (m)	Vert RMS (m)
Base1−01	-21159,894	40710,069	-200,212	0,007	0,013
Base1−02	-21161,858	40719,280	-200,249	0,009	0,015
Base1−03	-21174,359	40742,627	-200,043	0,006	0,010
Base1−04	-21170,857	40765,557	-201,024	0,006	0,013
Base1−05	-21172,163	40776,440	-200,950	0,006	0,009
Base1−06	-21171,599	40796,682	-200,952	0,006	0,009
Base1−07	-21191,901	40743,495	-198,426	0,007	0,010
Base1−08	-21159,278	40868,057	-200,775	0,012	0,020
Base1−09	-21181,278	40880,298	-199,317	0,008	0,010

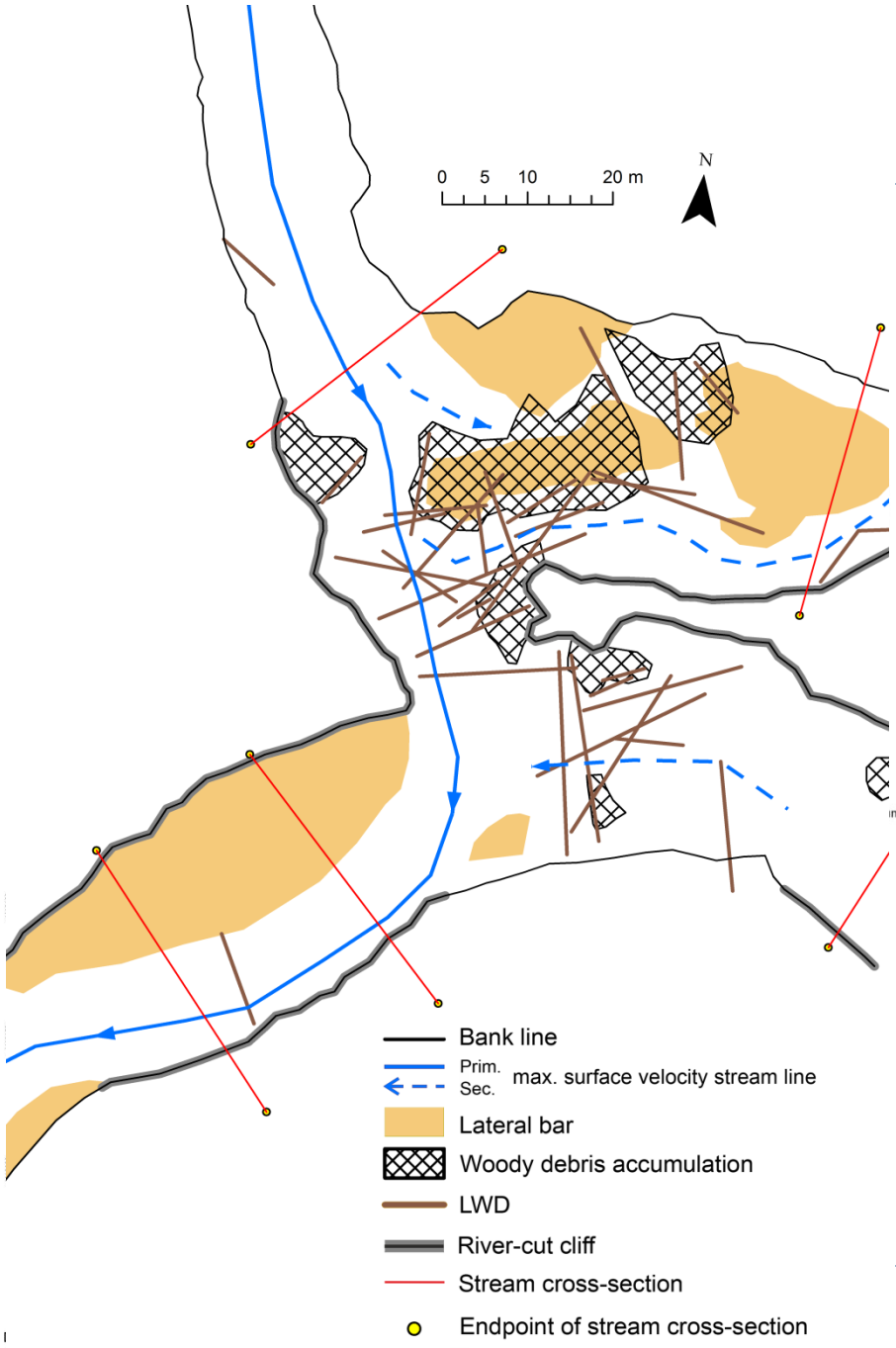
Methods

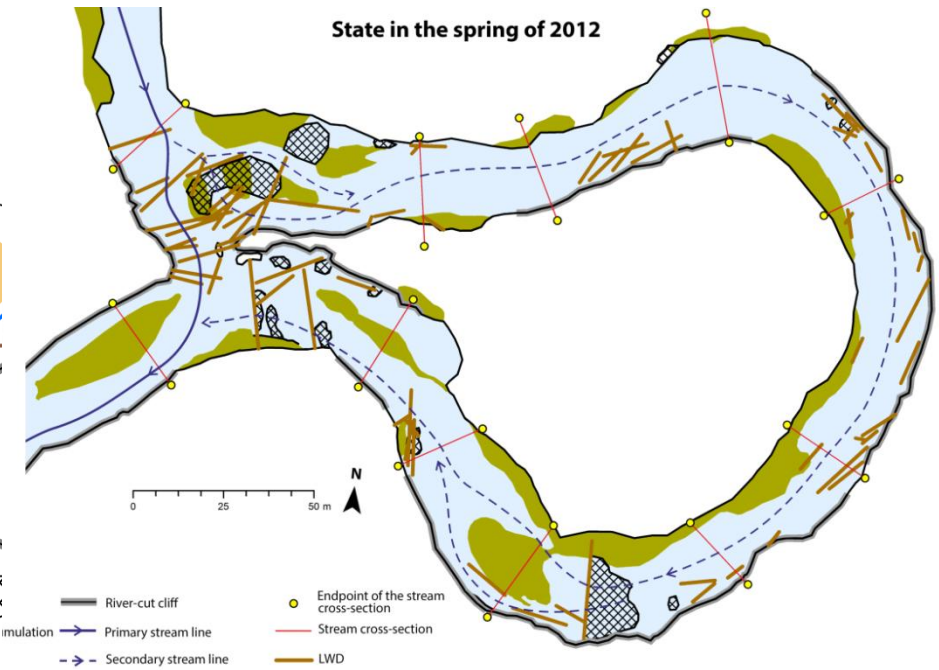
- Photogrammetry processing
  - Structure from Motion
  - Stereophotogrammetry



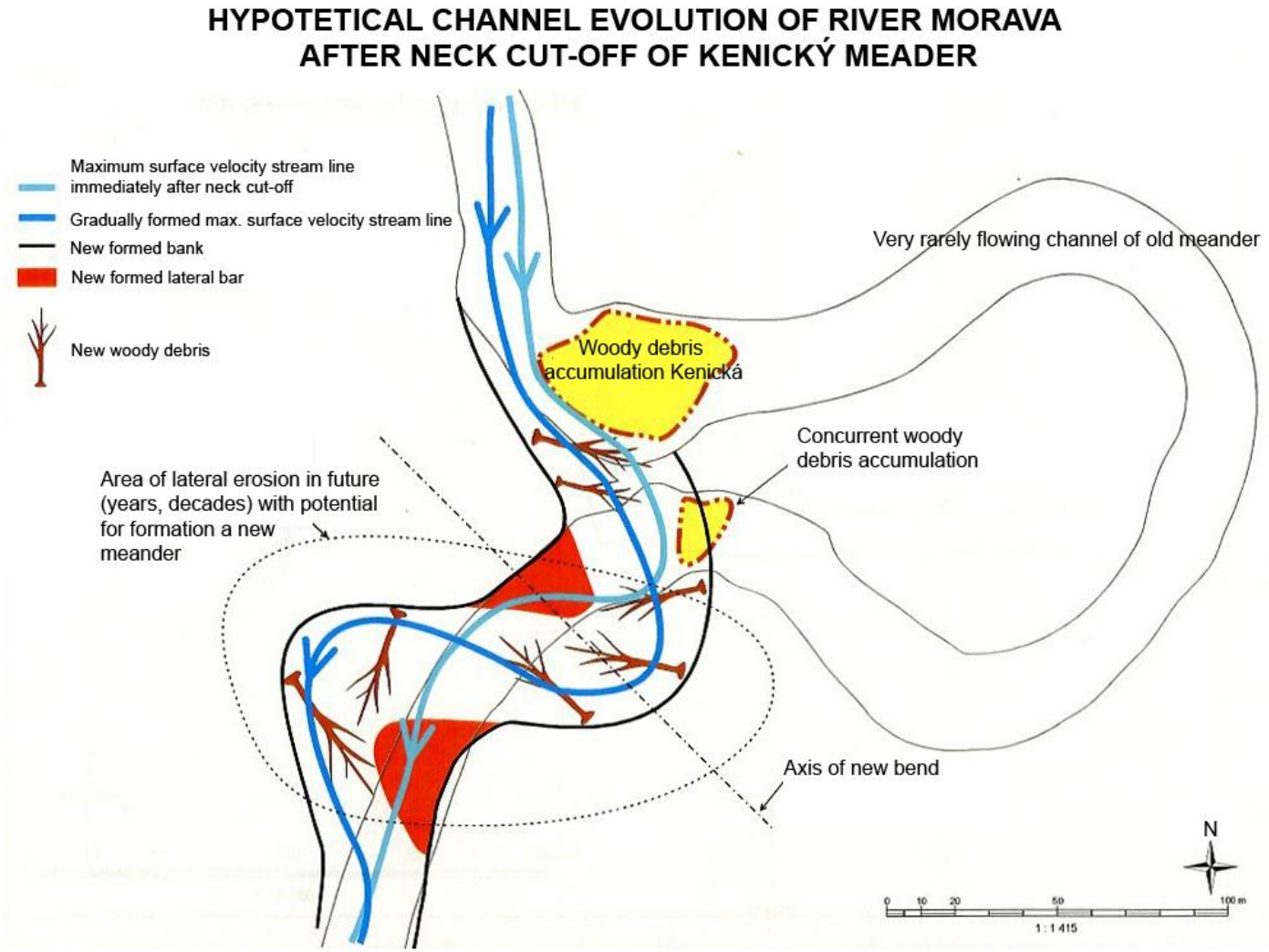





0 5 10 20 m
N
Bank line
Prim.
Sec.
max. surface velocity stream line
Lateral bar
Woody debris accumulation
LWD
River-cut cliff
Stream cross-section
Endpoint of stream cross-section


State in the spring of 2012
N
0 25 50 m
River-cut cliff
Primary stream line
Secondary stream line
Endpoint of the stream cross-section
Stream cross-section
LWD

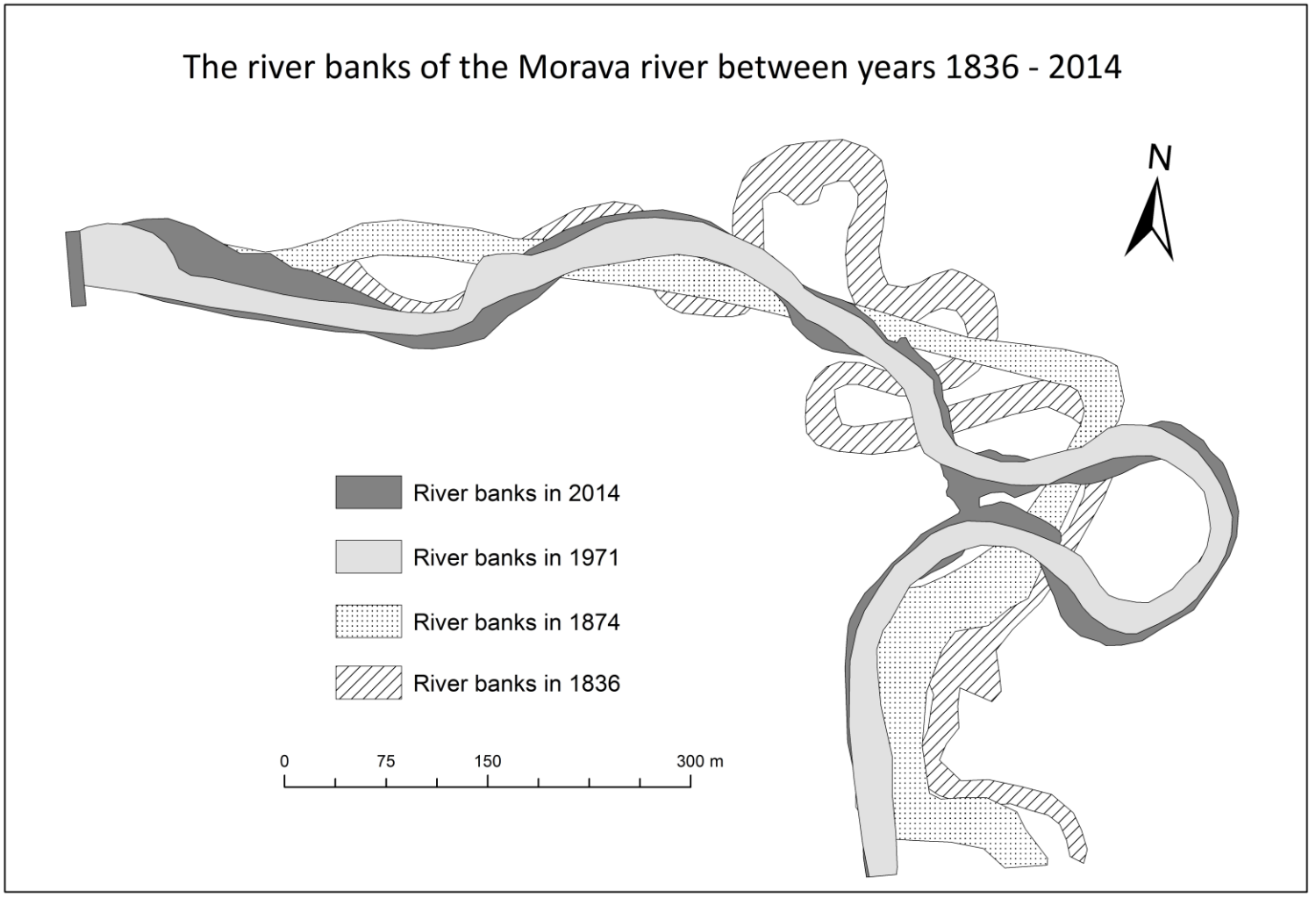
Results


HYPOTETICAL CHANNEL EVOLUTION OF RIVER MORAVA
AFTER NECK CUT-OFF OF KENICKÝ MEADER
Maximum surface velocity stream line immediately after neck cut-off
Gradually formed max. surface velocity stream line
New formed bank
New formed lateral bar
New woody debris
Very rarely flowing channel of old meander
Woody debris accumulation Kenická
Concurrent woody debris accumulation
Area of lateral erosion in future (years, decades) with potential for formation a new meander
Axis of new bend
N
0 10 20 50 100 m
1 : 1 415

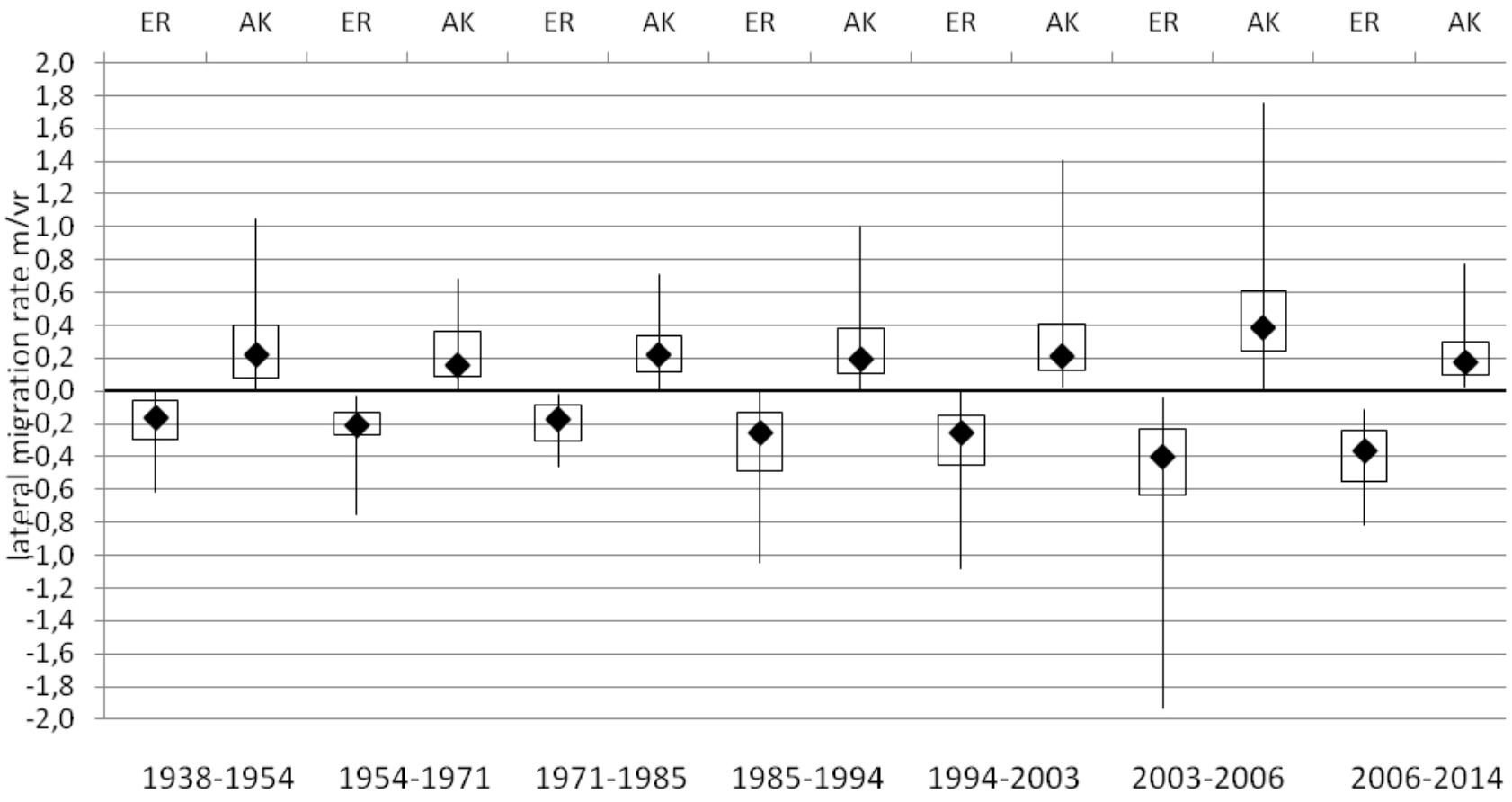
Results

Max. difference: 2 m

Results


The river banks of the Morava river between years 1836 - 2014
N
River banks in 2014
River banks in 1971
River banks in 1874
River banks in 1836
0
75
150
300 m

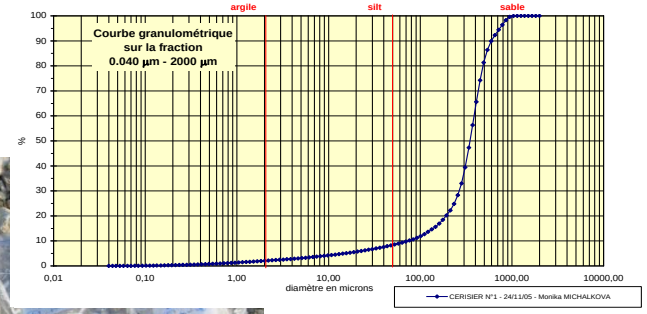
Results


ER
AK
ER
AK
ER
AK
ER
AK
ER
AK
ER
AK
ER
AK
2,0
1,8
1,6
1,4
1,2
1,0
0,8
0,6
0,4
0,2
0,0
-0,2
-0,4
-0,6
-0,8
-1,0
-1,2
-1,4
-1,6
-1,8
-2,0
lateral migration rate m/yr
1938-1954
1954-1971
1971-1985
1985-1994
1994-2003
2003-2006
2006-2014

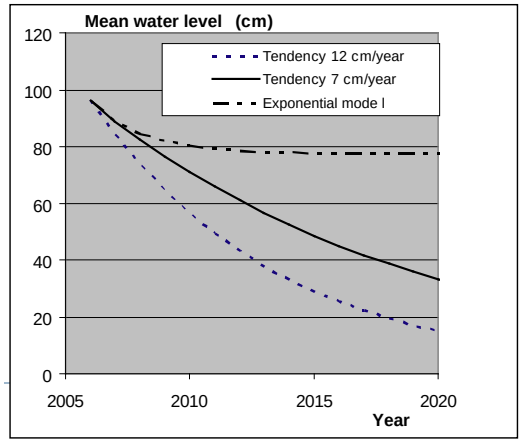
Future work

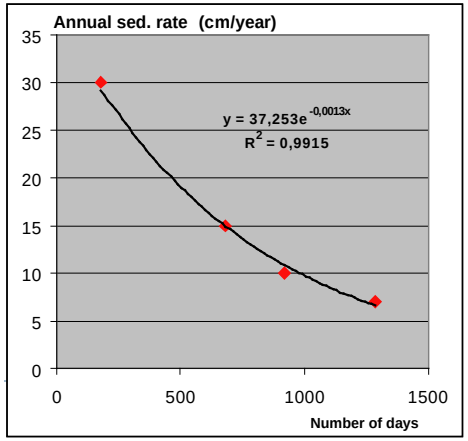
- Continuation in terrestrial monitoring
  - Hydrological data (precipitations, height of a water level, water flow).
  - Aerial data (RPAS and aerial imaging).
  - Terestrial measuring (transverse profiles)

- Obtaining of a new data
  - Data for granulometry



- Modeling
  - prediction of sedimentation. It is a function of overflowing discharge upstream and downstream





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