

Growing  
ideas  
through  
networks

# UAV/UWV applications for the detailed assessment of channel morphodynamics - A case study of Sajó River, Hungary



UNIVERSITY of  
DEBRECEN



TECHNISCHE  
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DRESDEN

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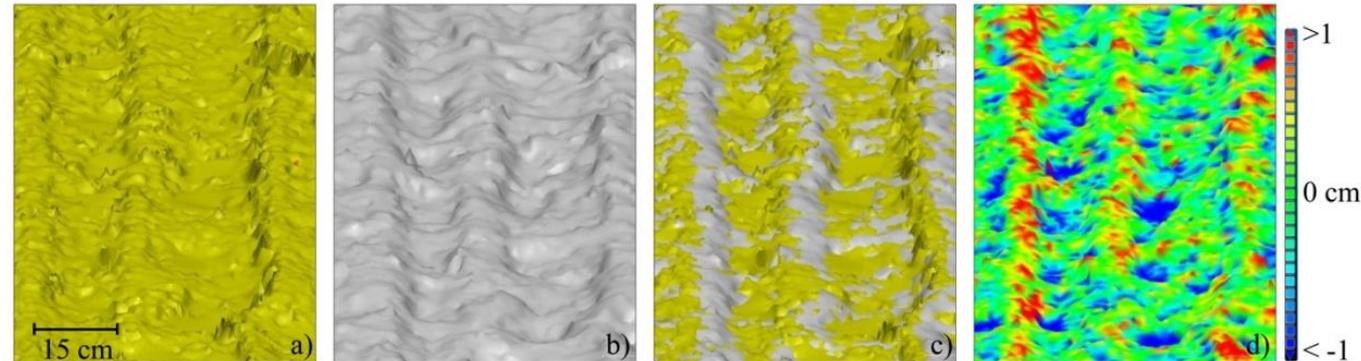
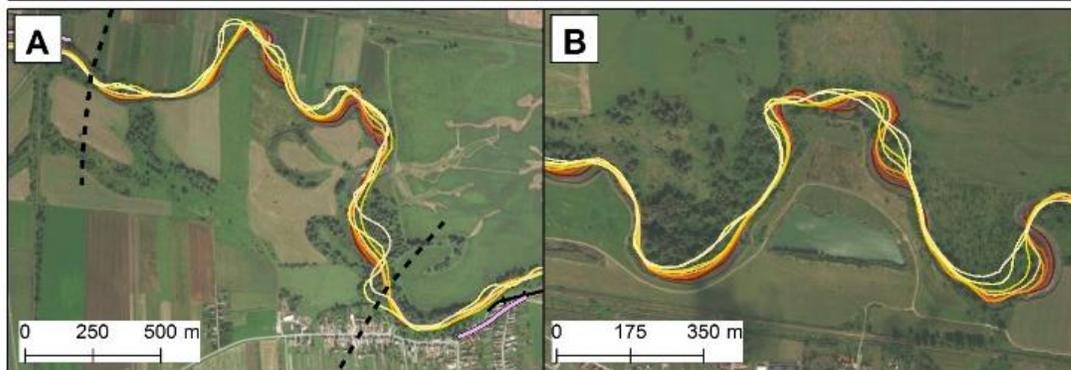


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# Scientific background of the two teams

University of Debrecen, Hungary	Technische Universität Dresden, Germany
Detailed assessment of spatial and temporal variations in river channel changes and meander evolution (fluvial geomorpholog, GIS)	Developing new <u>cost effective</u> methodologies for geoscientific analysis (geodesy, photogrammetry, GIS, UAV)
UAV-monitoring of river bank erosion (UAV)	Elevation modeling, soil erosion, hydrometry



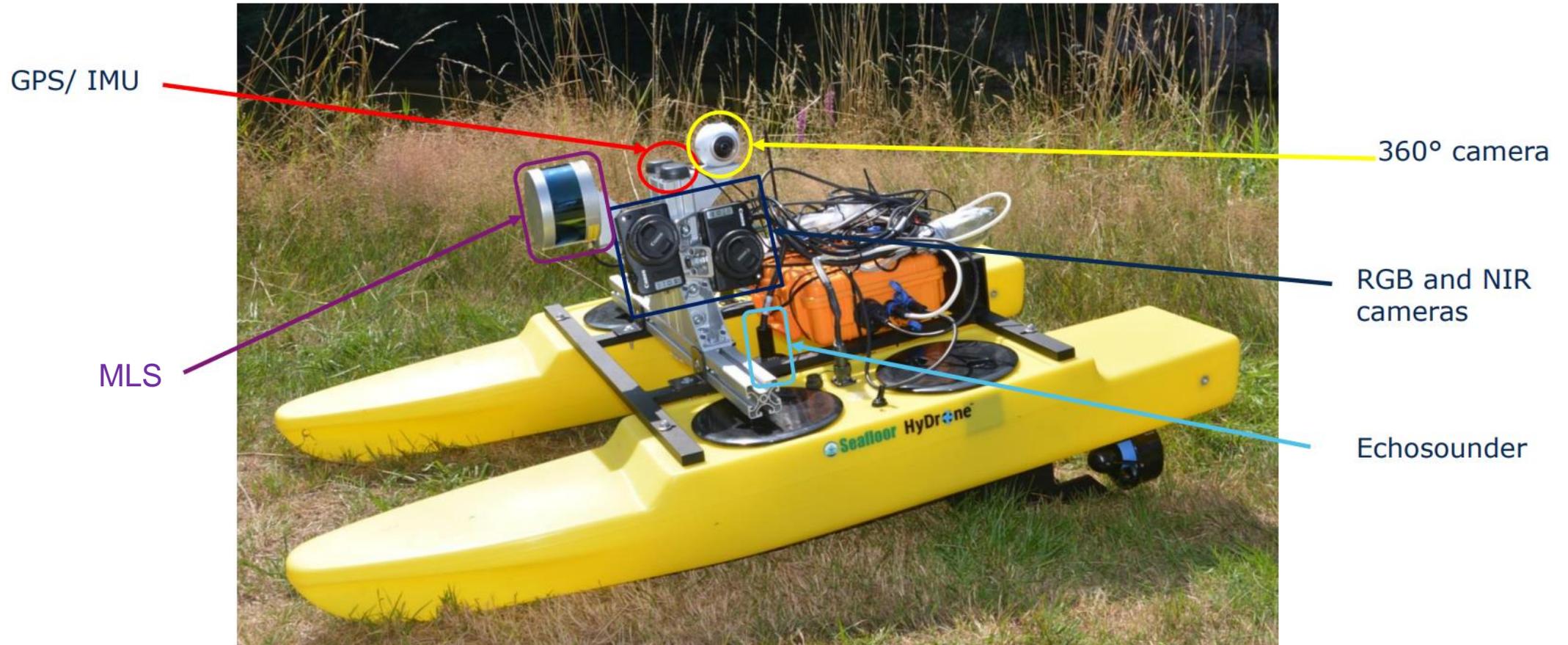
## The aim of our project

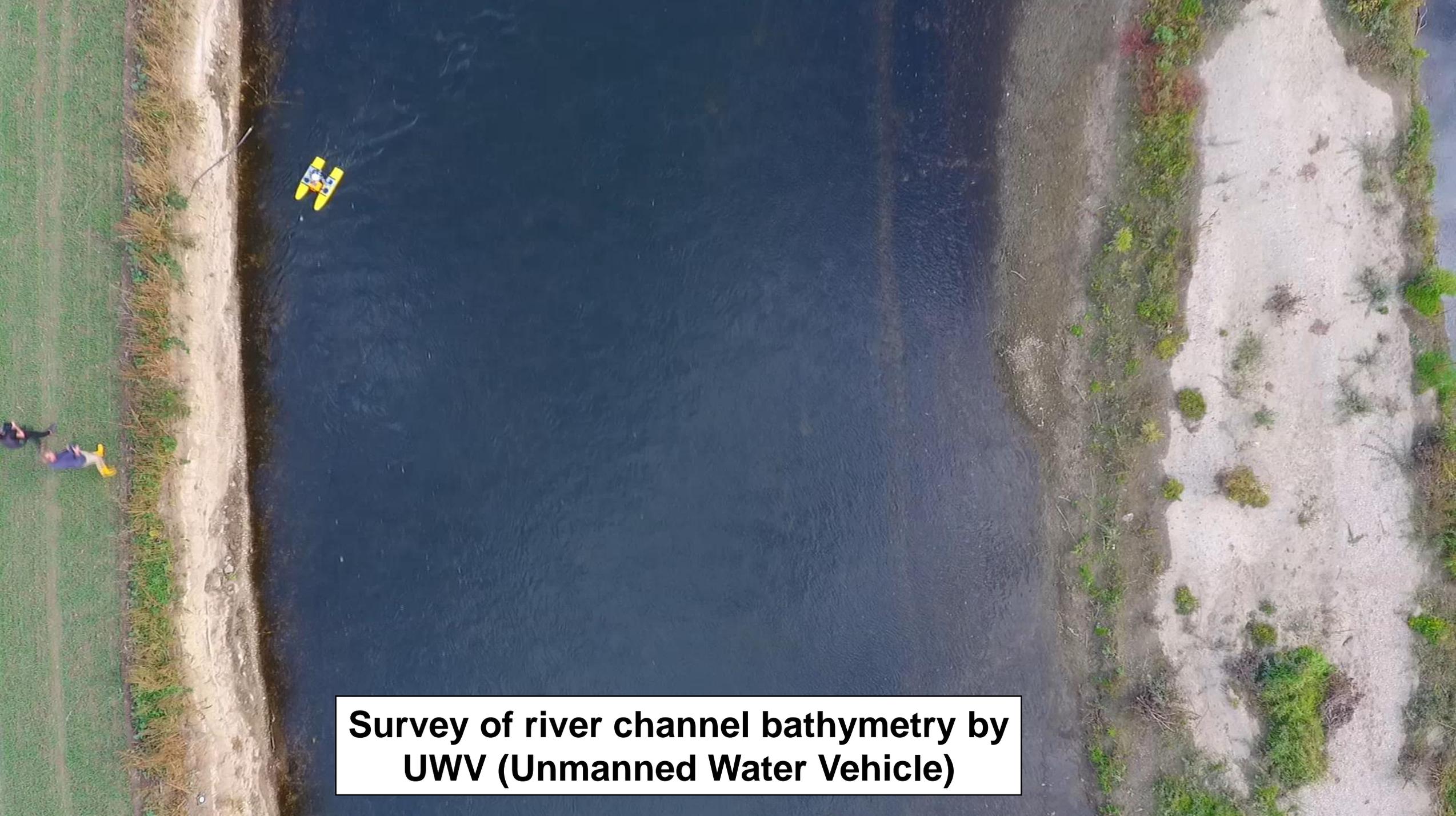
- perform multi-temporal field campaigns with river channel morphological surveys along the Hungarian section of Sajó River
- test several devices in order to improve the data density of river bank geometry and bathymetry
  - self-designed survey-boat integrated with laser scanner, single-beam echo sounder
  - UAVs equipped with RGB, multi-spectral and thermal cameras are used to test their suitability to measure surface flow velocities
- investigate the performance of the multi-sensor and multi-platform data is evaluated with reference data acquired by TLS and ADCP to test the achievable accuracy
- implementation of the newly acquired data in the hydrological modeling of selected meandering reaches of Sajó River to better understand seasonal as well as annual channel morphodynamics

**Hungarian survey boats are  
not suitable for small rivers**



## Unmanned Water Vehicle (UWV) as multi-sensor platform





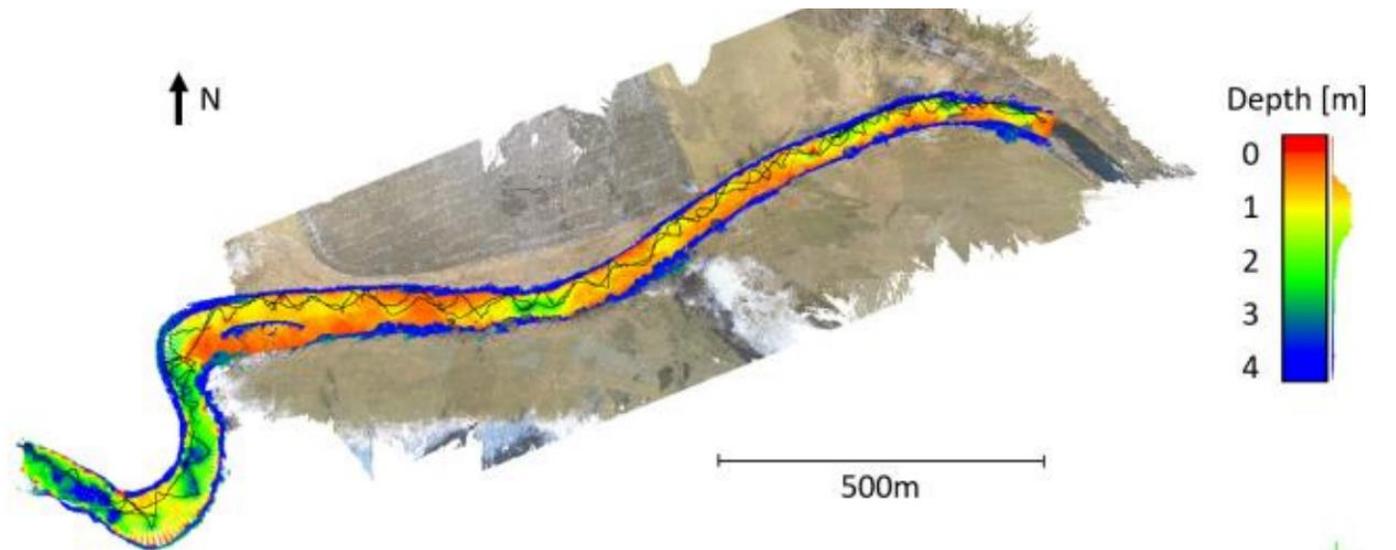
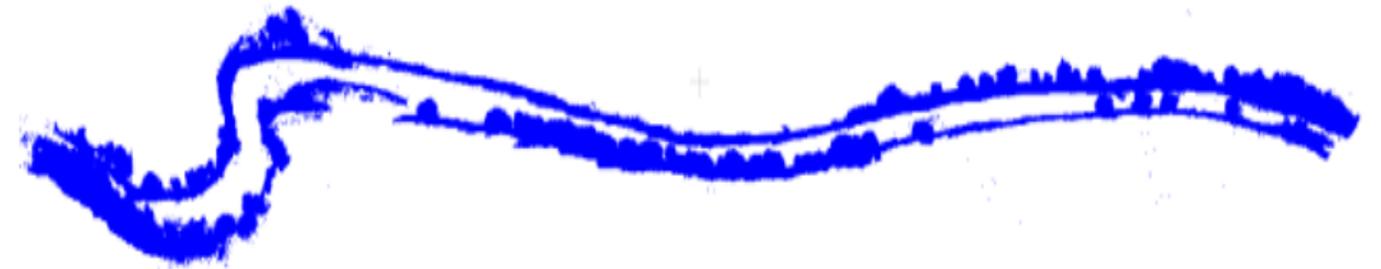
**Survey of river channel bathymetry by  
UUV (Unmanned Water Vehicle)**

2 x 180° panora cameras used to colorize MLS point cloud



# MLS point cloud of the river banks

great potentials for the estimation of roughness coefficients  
of future hydrological models

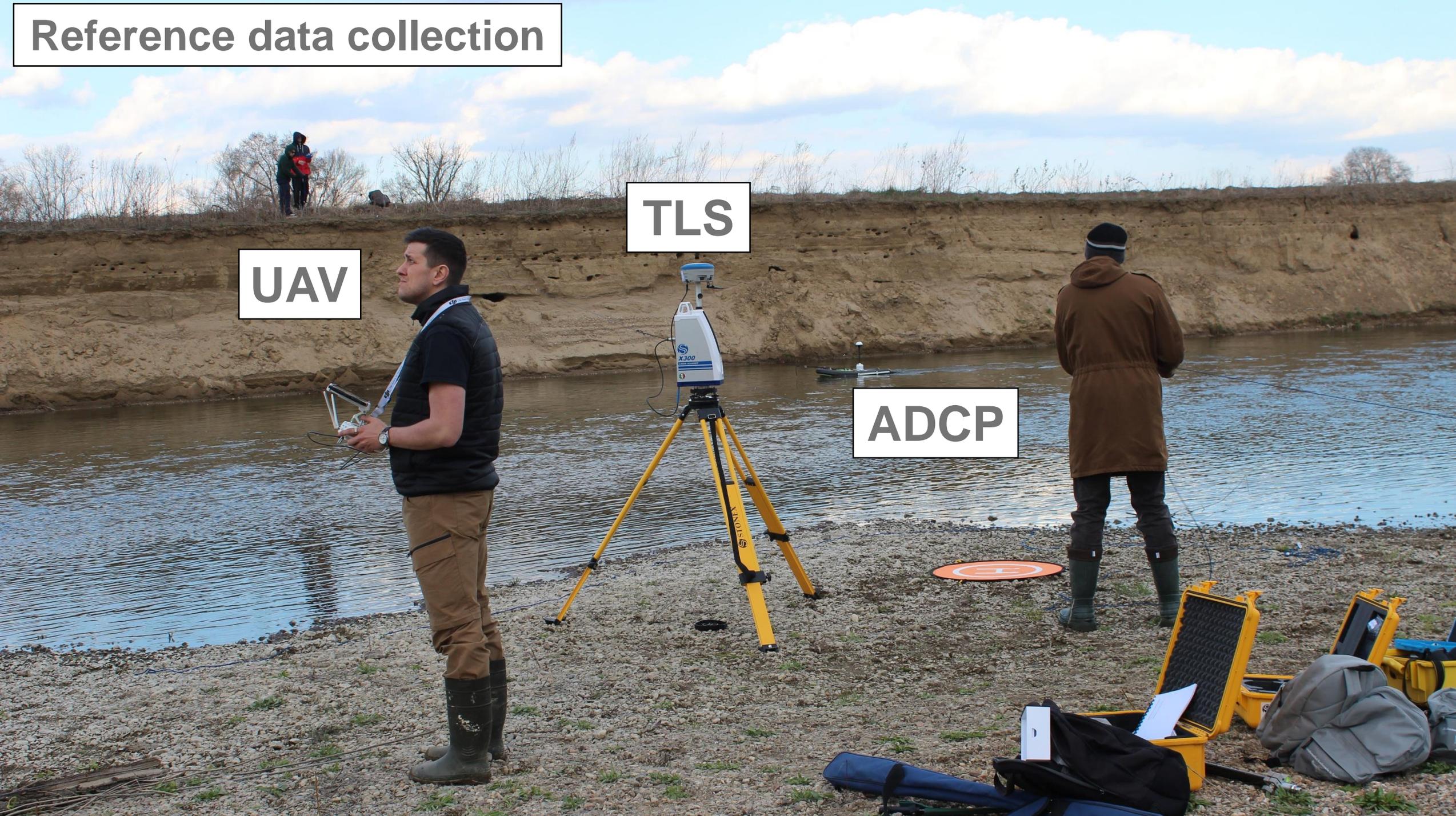


# Reference data collection

UAV

TLS

ADCP



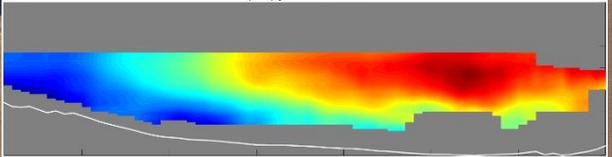
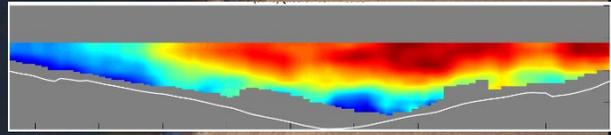
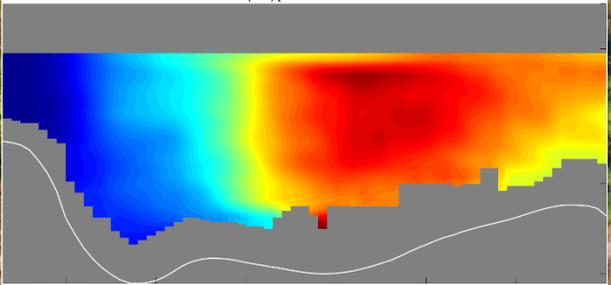
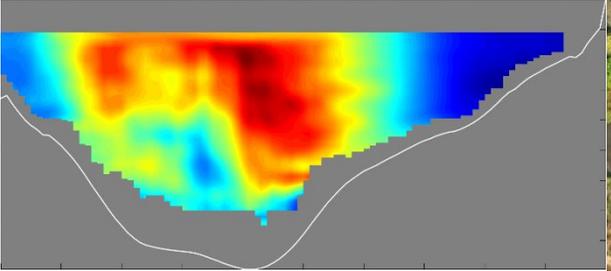
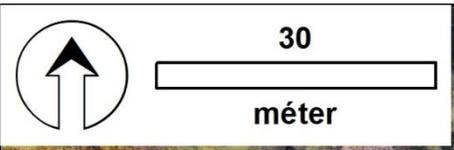


## UAV mapping equipment

- DJI Phantom 4
- DJI Matrice 210
- DJI Matrice 210 RTK
- Zenmuse X5S (RGB)
- Zenmuse XT2 (TIR + RGB)
- Goliath Octocopter XL
- FLIR A65 (TIR)

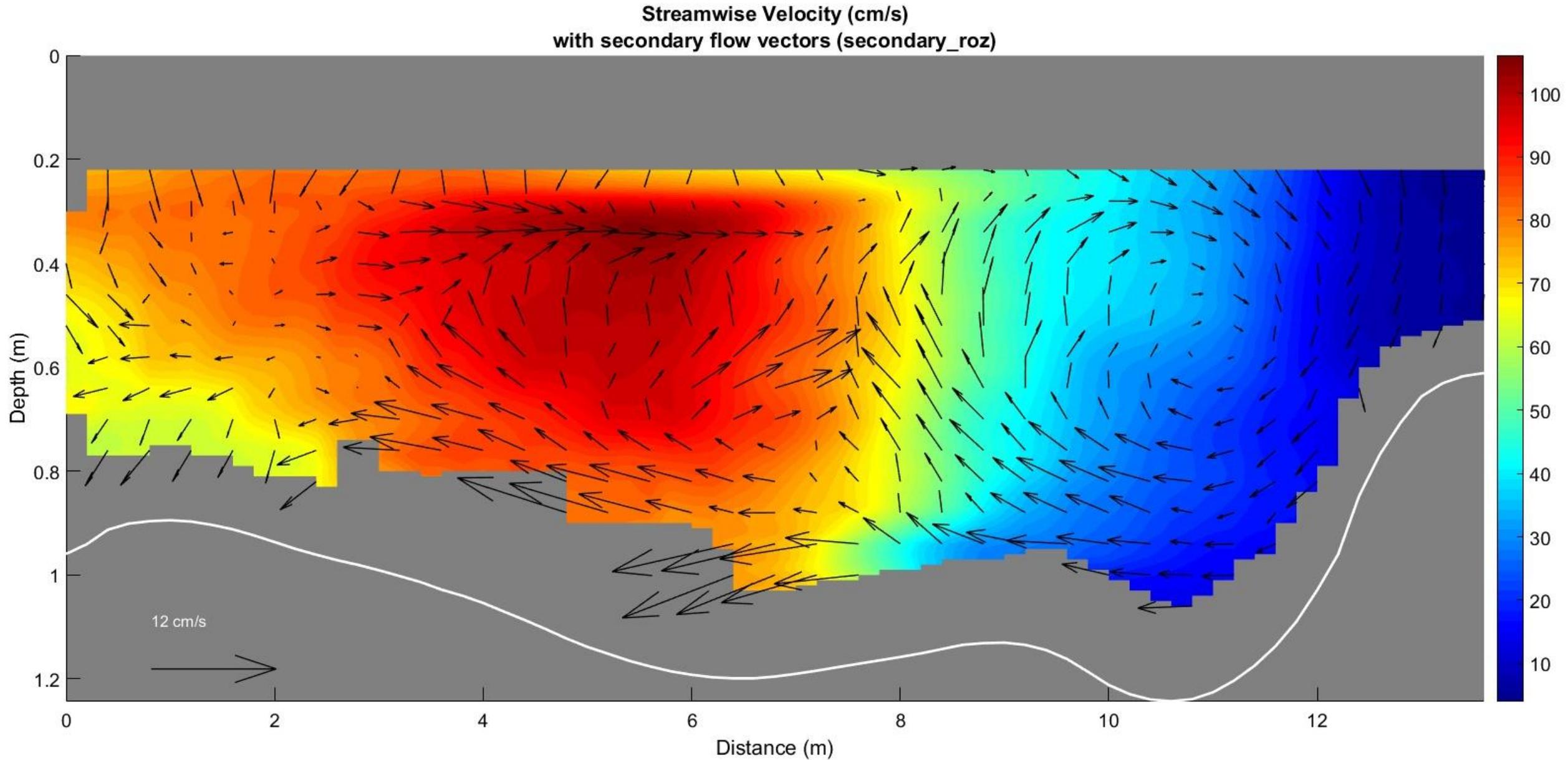






**ADCP-data processing with the Velocity Mapping Toolbox (VMT)**

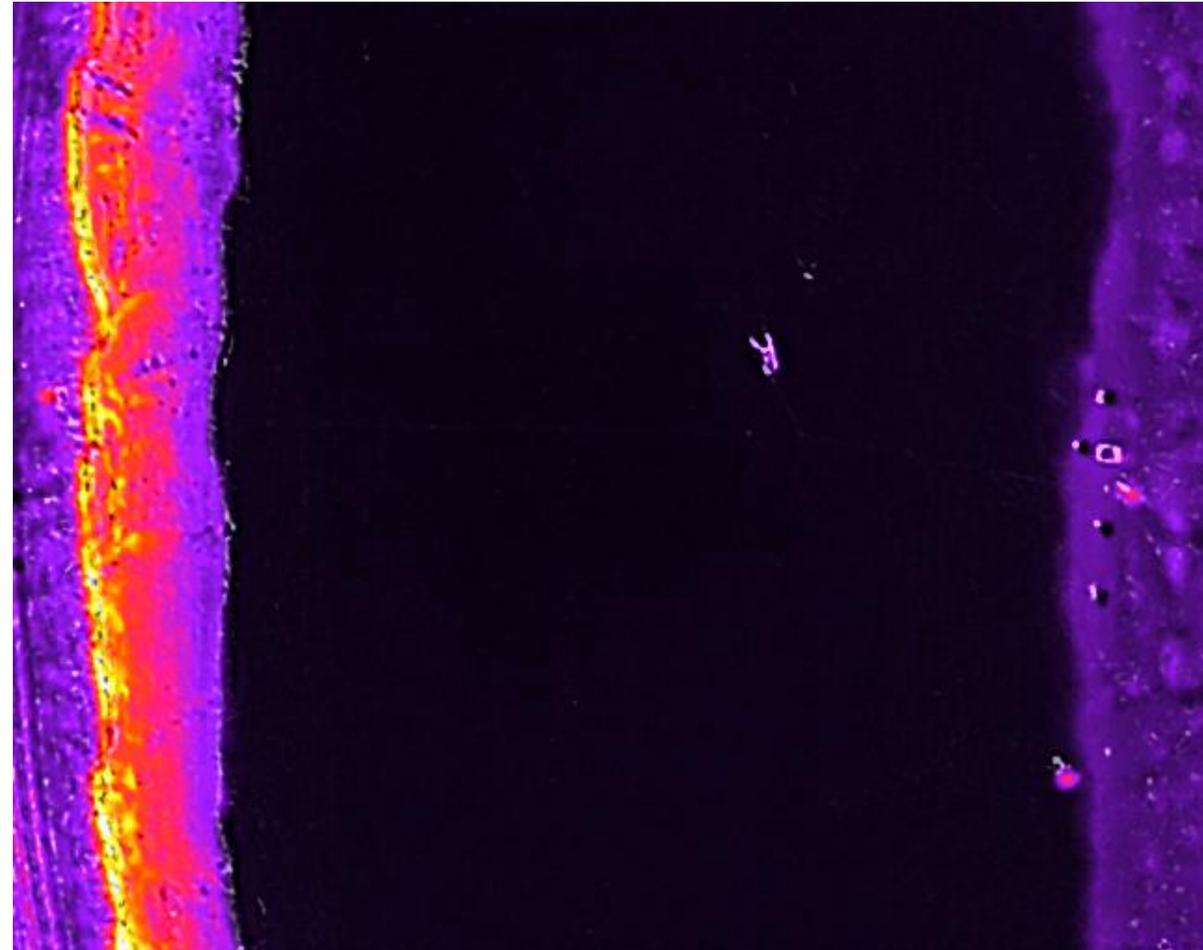
# Depth-averaged flow velocities and flow vectors





## Testing UAV thermal cameras for PTV

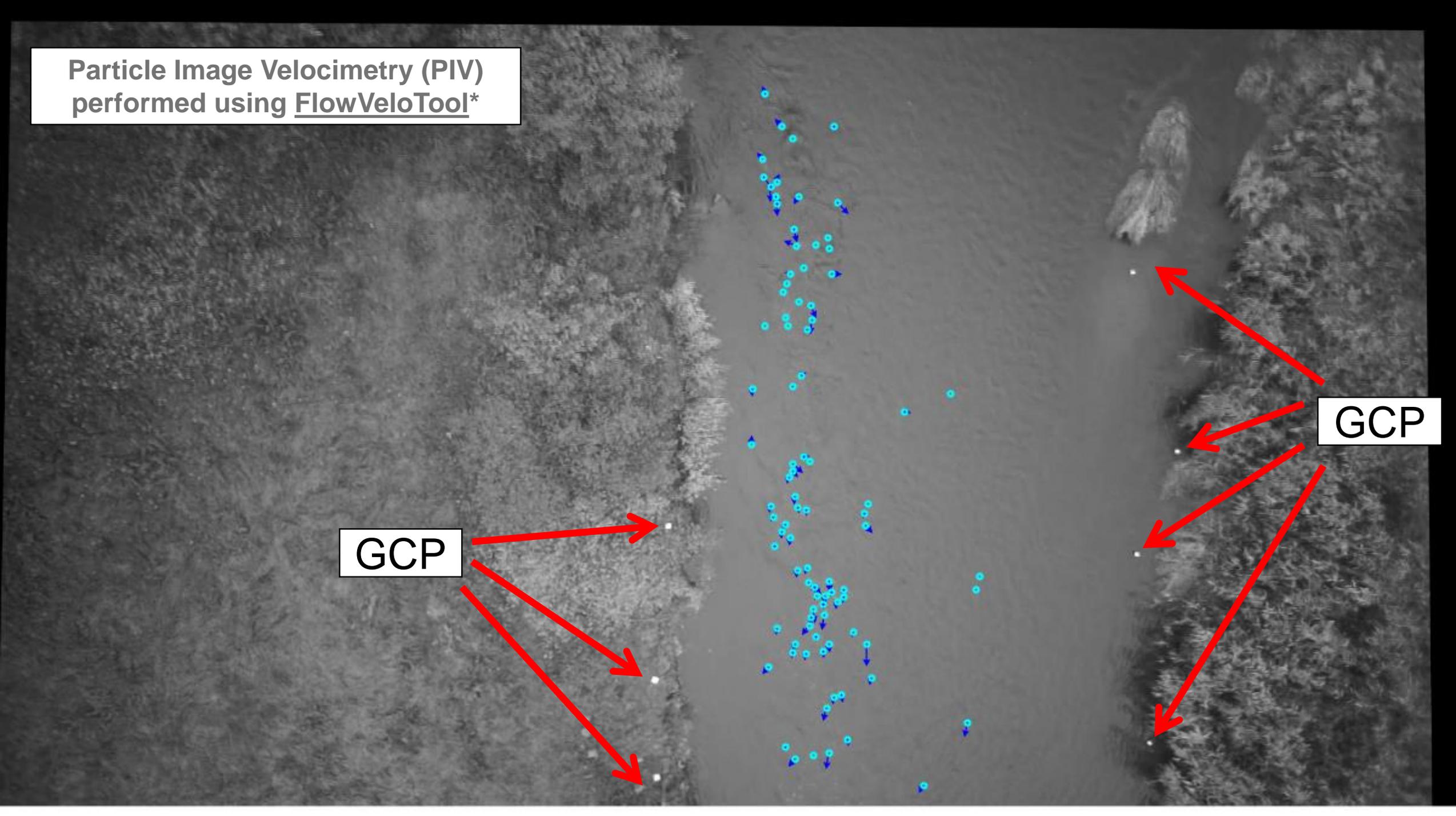
- Zenmuse XT2
- 9 mm focal length
- 336 x 256 pixel resolution
- <50 mk @ f/1.0 sensitivity (NETD)
- 9 Hz exportable frame rate
- Frame types:
  - ✓ 16 bit: RAW (Tiff sequence)
  - ✓ 8 bit: MOV, MP4
  
- FLIR A65
- 13 mm focal length
- 640 x 512 pixel resolution
- < 0.05°C @ 30°C (86°F) / 50 mK
- 30 Hz exportable frame rate



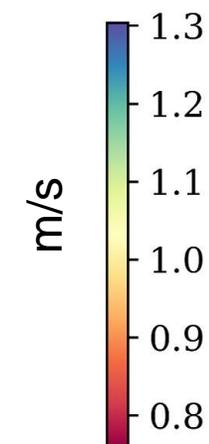
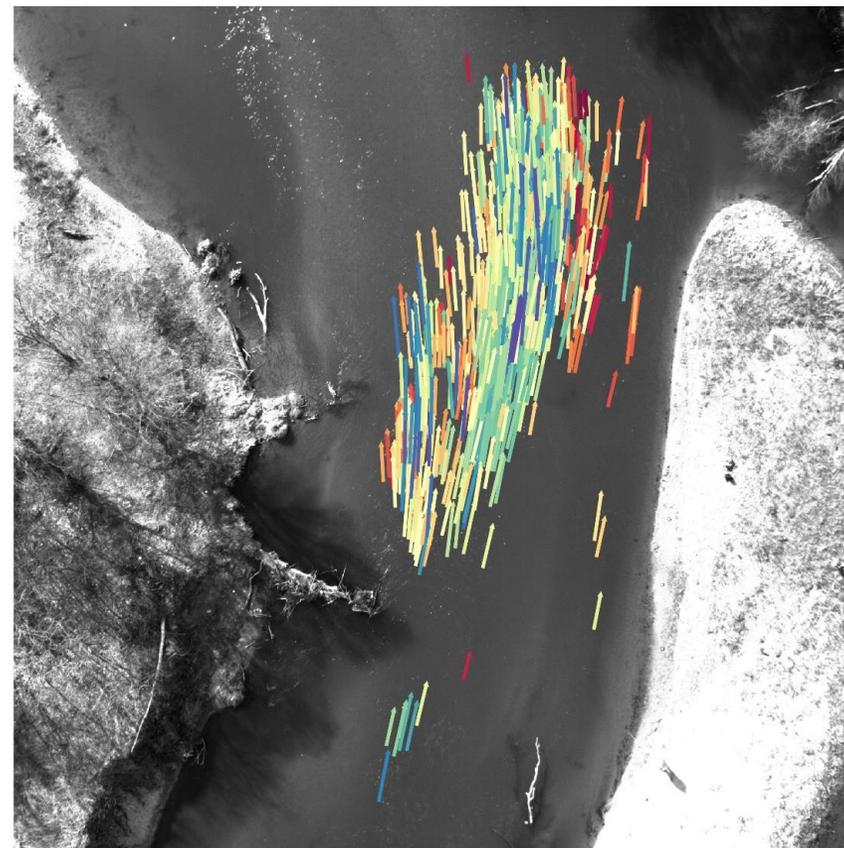
Particle Image Velocimetry (PIV)  
performed using FlowVeloTool\*

GCP

GCP

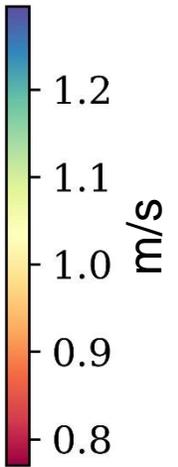
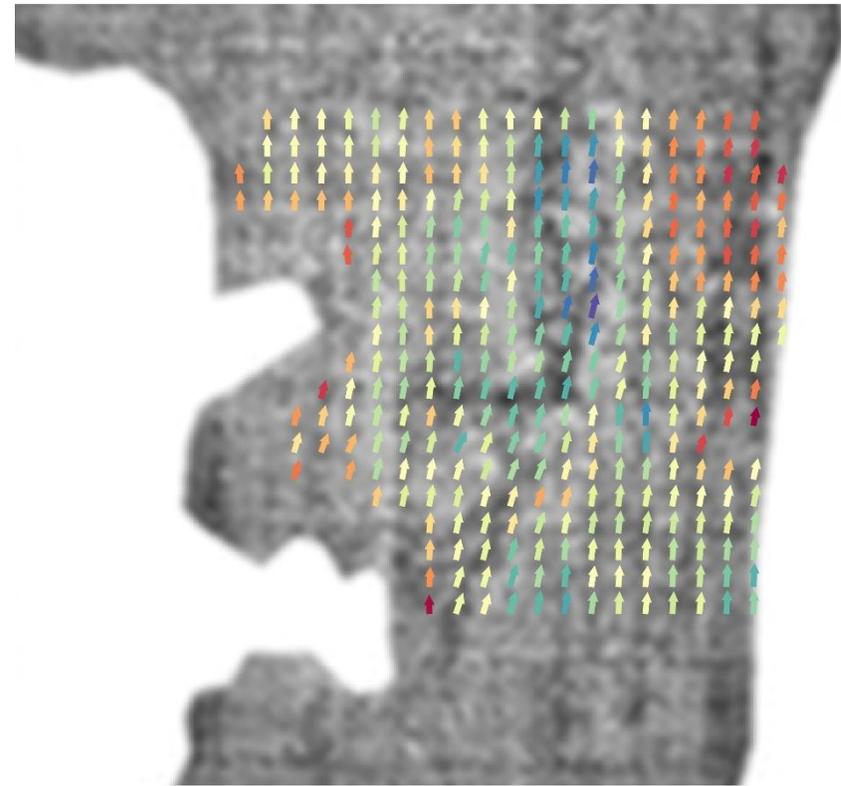
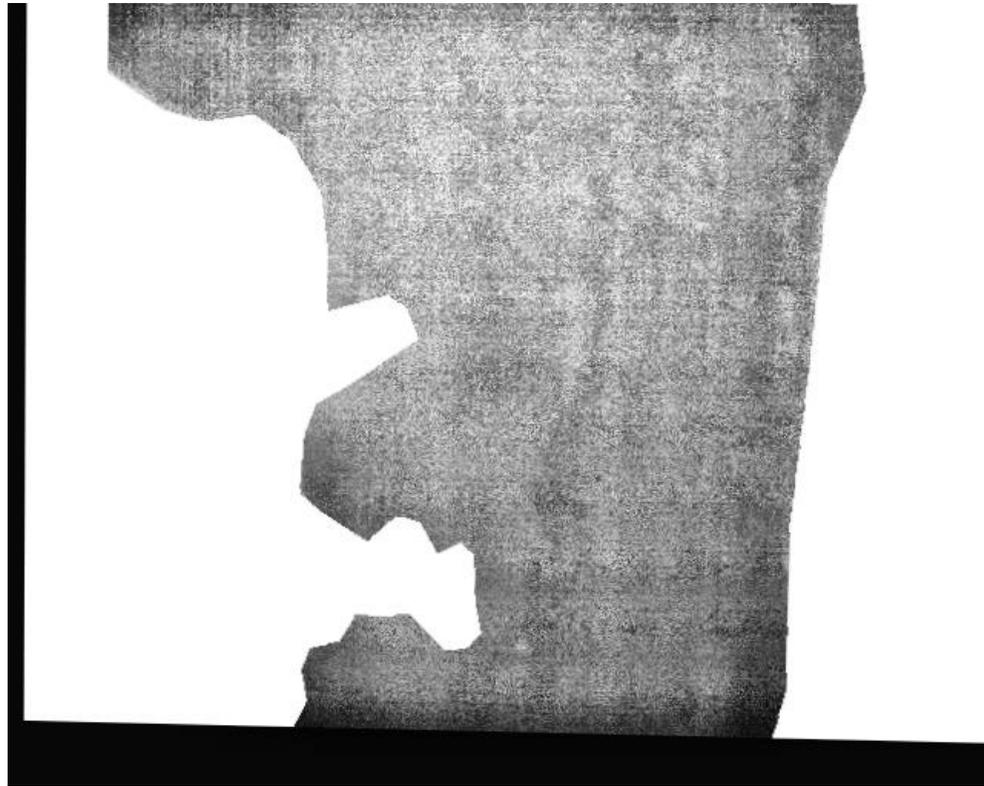


## RGB PTV results by FlowVeloTool\*



\*Eltner, A., Sardemann, H., and Grundmann, J. 2019: Flow velocity and discharge measurement in rivers using terrestrial and UAV imagery. Hydrology and Earth System Sciences (HESS) [in review] <https://doi.org/10.5194/hess-2019-289>

## Thermal PIV results by FlowVeloTool\*



## Task to be completed

- Accuracy assessment of FlowVeloTool (RGB, TIR) by ADCPs
- Accuracy assessment of SfM surveys for bank erosion by TLS
- Accuracy assessment of boat MLS by TLS
- Building of complex river channel model (bathymetry, channel and floodplain)
- Cross-section surveys for hydrological modeling

# References

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