INSTITUTE OF GEOGRAPHY SLOVAK ACADEMY OF SCIENCES

COMENIUS UNIVERSITY BRATISLAVA

PHOTOSIEVING: DRONE IMAGING FOR GRAIN SIZE ANALYSIS OF SEDIMENTS

MD Ashraf

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Cartographic Society of the Slovak Republic

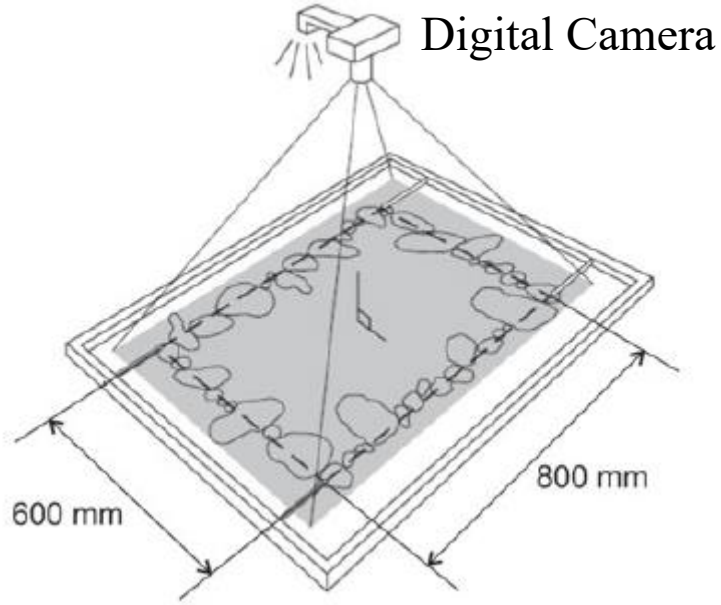
GEOKARTO 2024

Introduction

- River System
- Sieving → Photo sieving
- Sediment Size Analysis

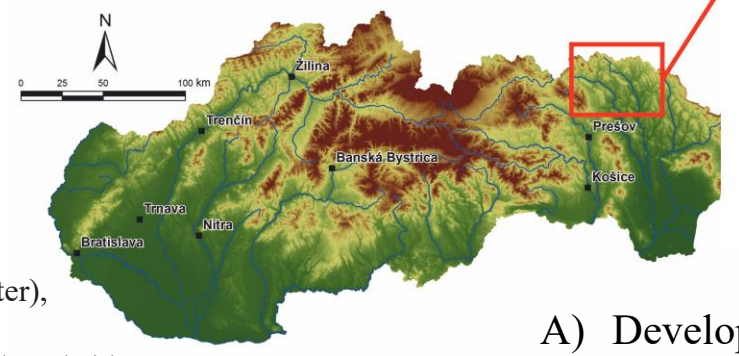
Characteristics of Particle size Distribution

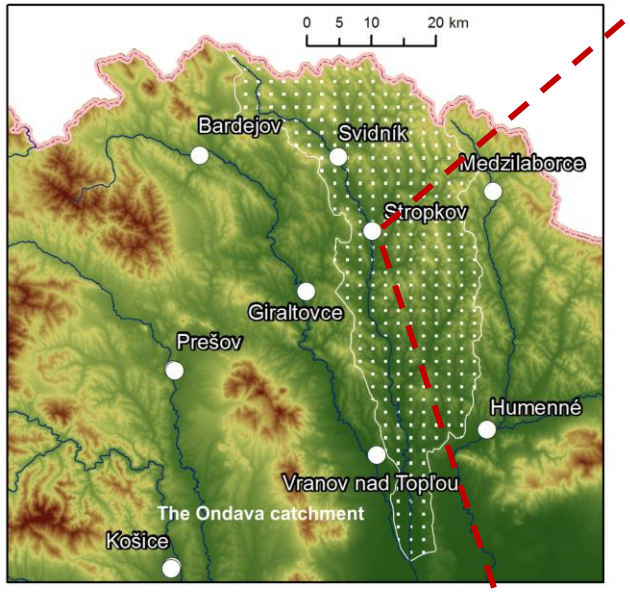
- Mean
- Standard deviation
- Skewness
- kurtosis



Study Area

- Previous Research
- Data Availability
- Validation
- Locality

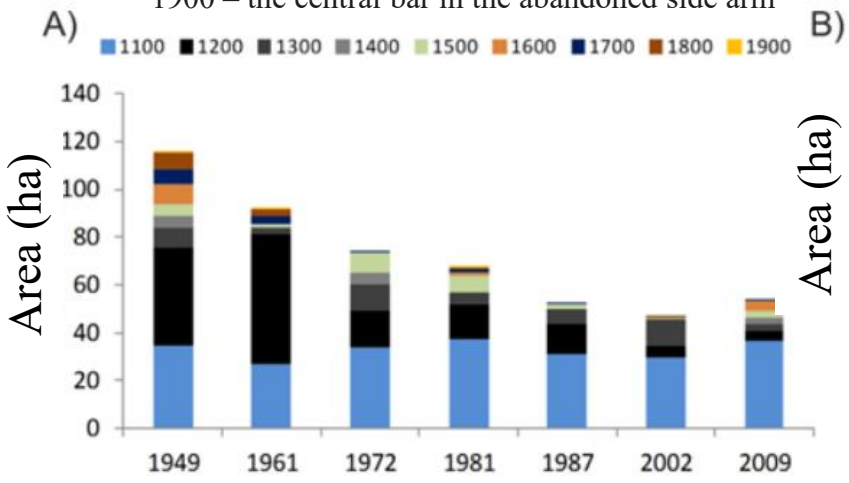


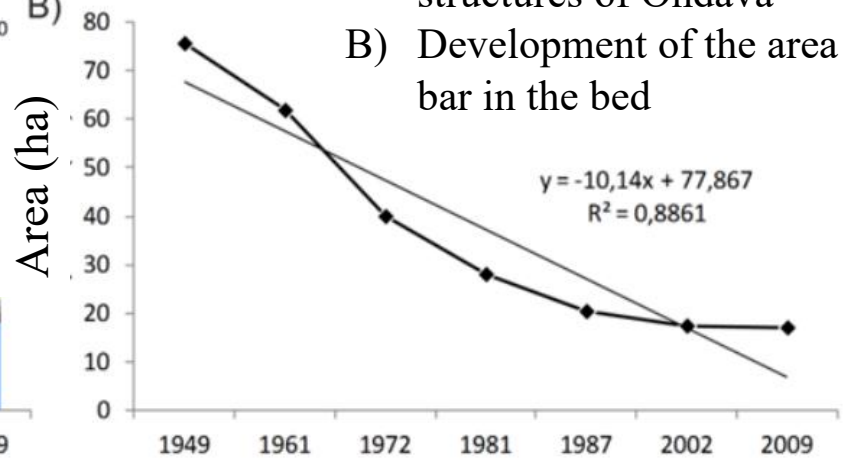


Legend

1100 - Water,
1200 – gravel bar,
1300 – Point bar,
1400 - Island attached bar,
1500 - Central bar,
1600 - Abandoned Side Channel,
1700 - Abandoned Side Arm (Water),
1800 - Cut-off Channel,
1900 – the central bar in the abandoned side arm

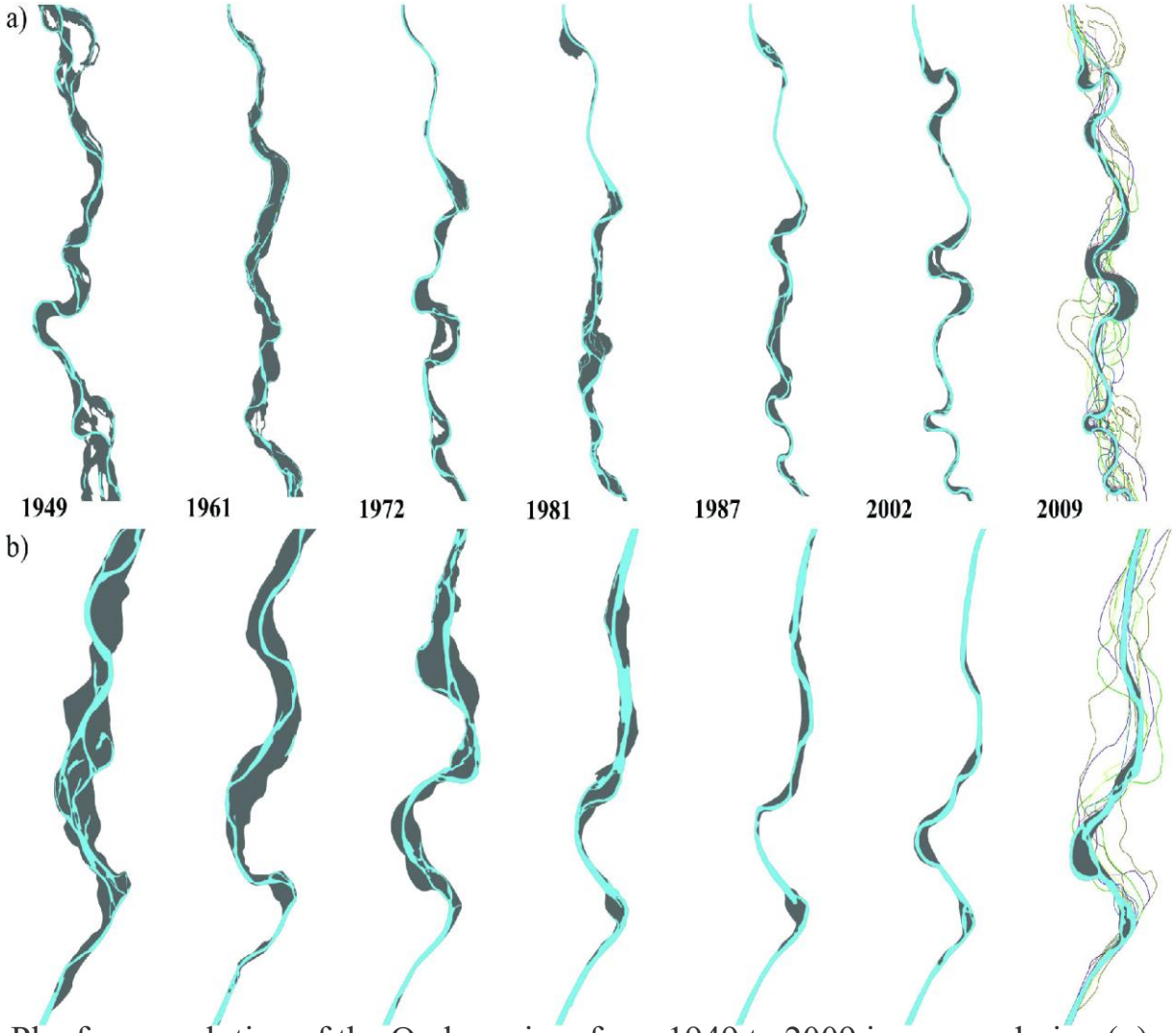
A) Development of the internal bed structures of Ondava
B) Development of the area of gravel bar in the bed



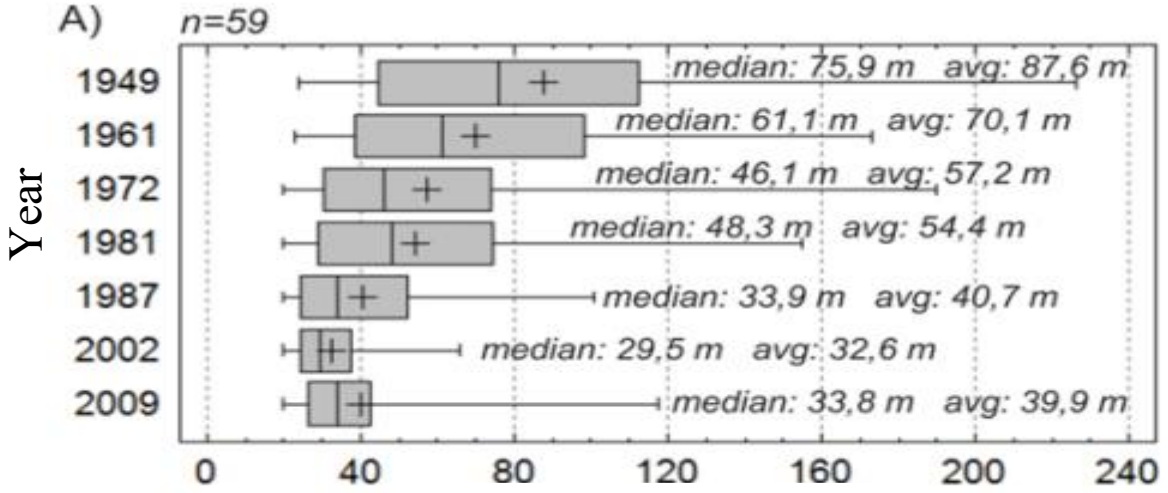


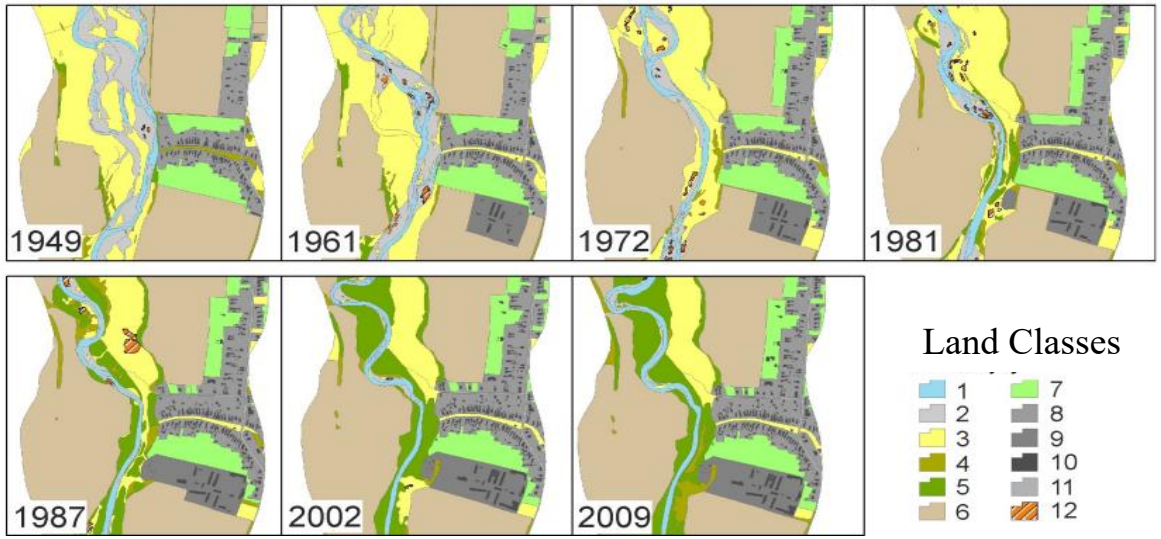
Rusnák, M., Kidová, A., Lehotský, M., Sládek, J. (2022). Fluvial Imprints in Flysh Valley Bottoms—Topľa and Ondava Valleys. In: Lehotský, M., Boltižiar, M. (eds) Landscapes and Landforms of Slovakia. World Geomorphological Landscapes. Springer, Cham. https://doi.org/10.1007/978-3-030-89293-7_16

Study Area



Planform evolution of the Ondava river from 1949 to 2009 in a meandering (**a**) and sinuous (**b**) channel section with historical position of channel plotted as for 2009



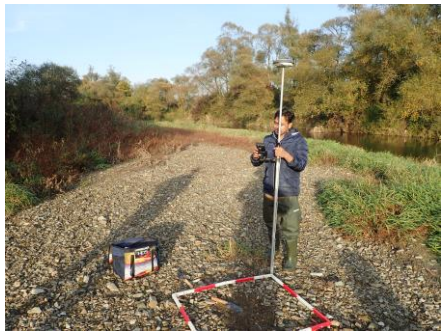


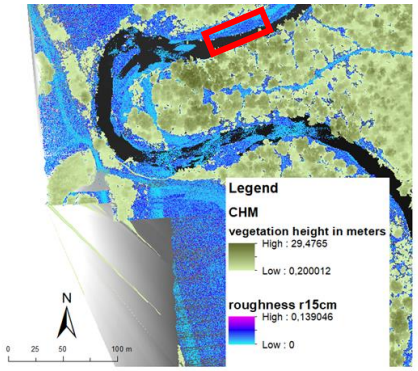
1 – water, 2–gravel bar, 3 – low vegetation, 4 – medium-high Veg, 5 –Forest, 6 – arable land, 7 garden, 8 – buildup area , 9 – industrial area, 10 – buildings, 11 – road, 12 – mining pit

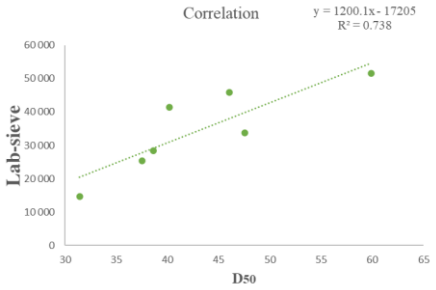
Rusnák, M., Kidová, A., Lehotský, M., Sládek, J. (2022). Fluvial Imprints in Flysh Valley Bottoms—Topľa and Ondava Valleys. In: Lehotský, M., Boltižiar, M. (eds) Landscapes and Landforms of Slovakia. World Geomorphological Landscapes. Springer, Cham. https://doi.org/10.1007/978-3-030-89293-7_16

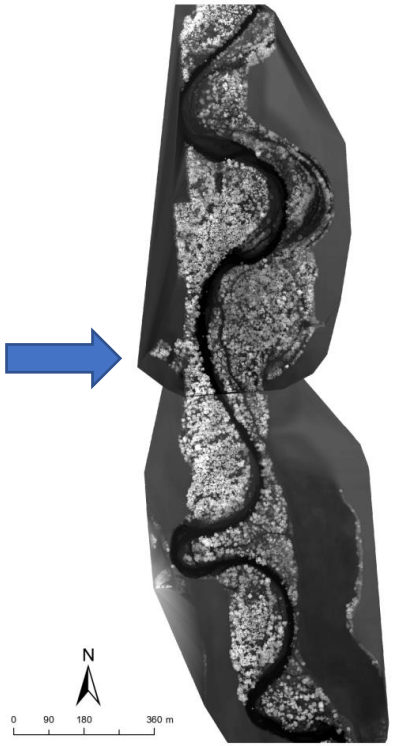
Main Aim

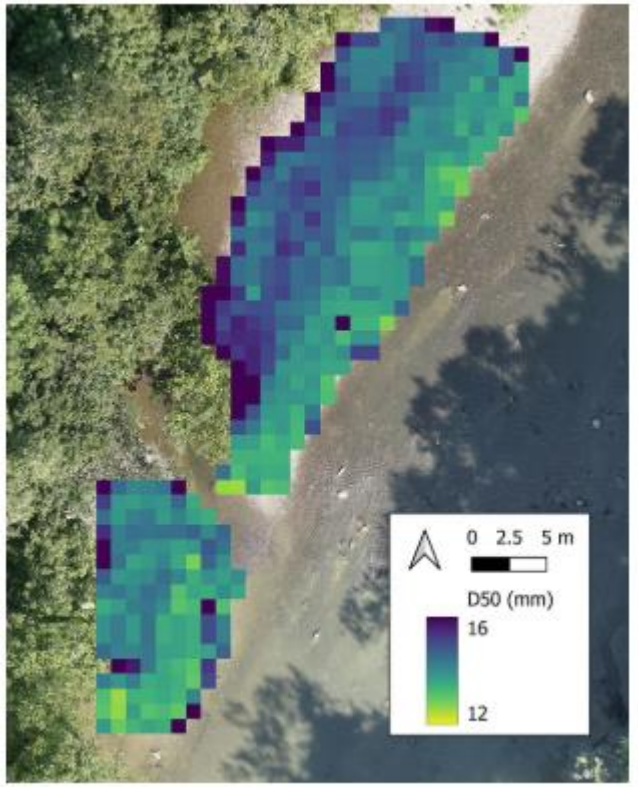
- **Using high-resolution UAV orthophotos / LiDAR for estimating grain size distribution in the river channel for long river sections (> 2 km)**
- **Regression model between field samples and properties of orthophotos and Lidar**
- **Application of model for whole river segment**











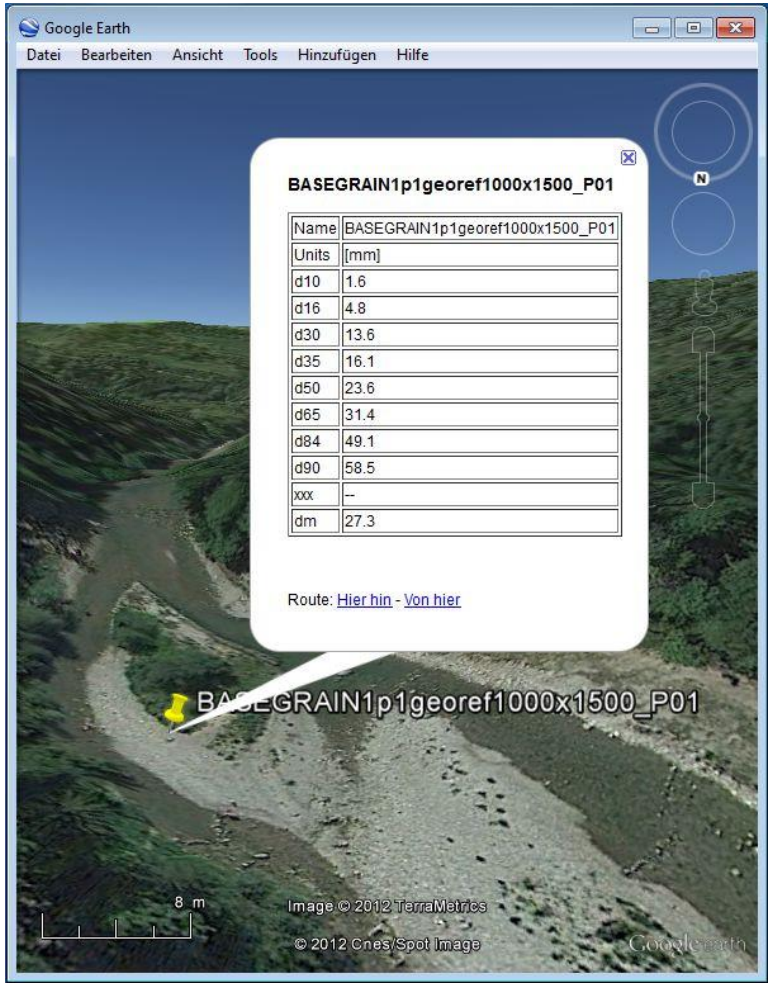
Wong, T., Khanal, S., Zhao, K., & Lyon, S. W. (2024). Grain size estimation in fluvial gravel bars using uncrewed aerial vehicles: A comparison between methods based on imagery and topography. *Earth Surface Processes and Landforms*, *49*(1), 374–392. https://doi.org/10.1002/esp.5709

Methodology





Data Aquisition	Tools & Compare	Data Processing	Model & Data	Results
Digital Camera/ Image	1. BASEGRAIN 2. PebbleCounts	Extract statistical Data	Create MODEL (statistical , regression, etc)	**MAP of Grain-size**
Drone/LiDAR Collected Data	Validation	Process in GIS	Clip raster rectangle with coordinates	
Orthophoto UAV	Grain-size field sampling in LAB	sample size (D_{50}) for analysis	Accuracy of data	
Collect Field sediment Grain		Get the properties from raster	Dataset	



Detert, M., Weitbrecht, V. (2013). User guide to gravelometric image analysis by BASEGRAIN. In: Advances in Science and Research, S. Fukuoka, H. Nakagawa, T. Sumi, H. Zhang (Eds.), Taylor & Francis Group, London, ISBN 978-1-138-00062-9, pp. 1789-1795.

Methodology

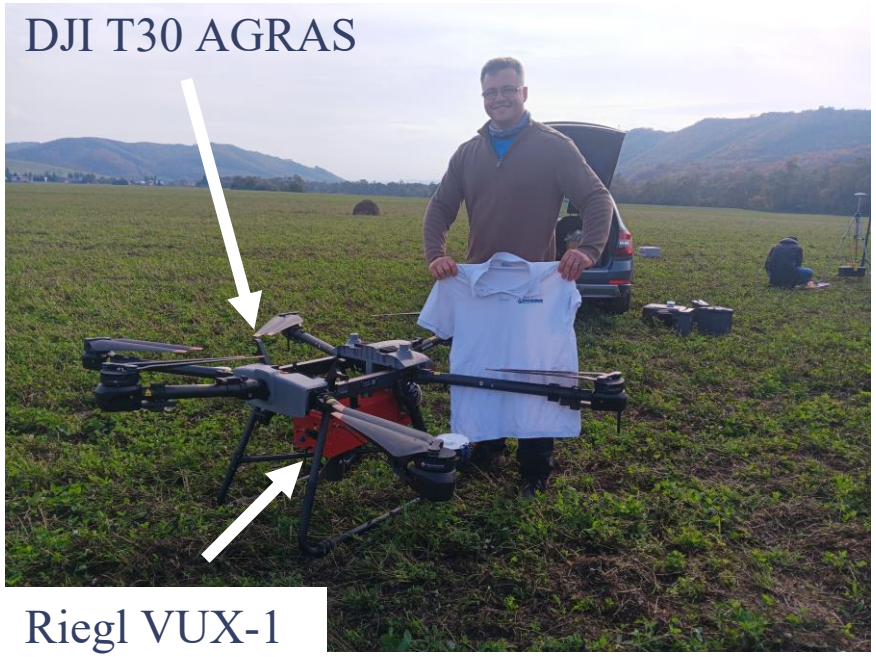
- Lidar Data Acquisition

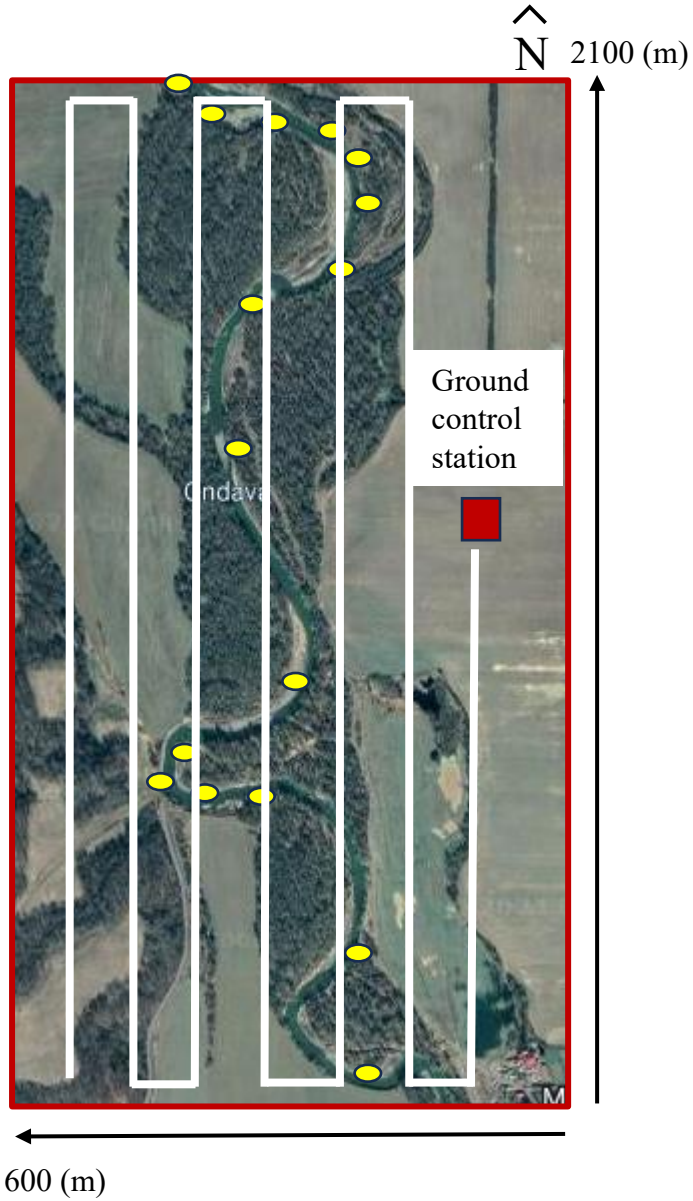
  Date of Acquisition :- 24.10.2023

  Type of UAV :- **DJI T30 AGRAS**

  Type of Scanner :- **Riegl VUX-1**

  Height of Flight :- 100 m





Collaboration: - **RNDr. Ján Kaňuk, PhD., Mgr. Ján ŠAŠAK, PhD.**

Institute of Geography Faculty of Science
Pavol Jozef Šafárik University in Košice

Sediment collection

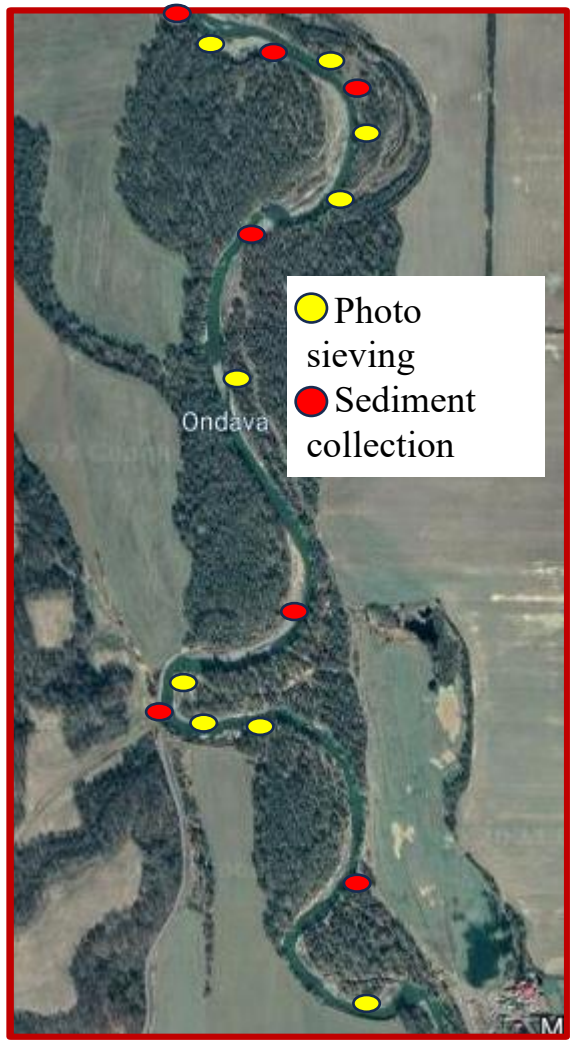
- Sediment sample collection
- RTK GPS
- Date 23.10.2023
- Lab-sieving
- photosieving

Sieving shaker

Retsch
Solutions in Milling & Sieving

PC

BASEGRAIN
ETH zürich
Laboratory of Hydraulics, Hydrology and Glaciology



Pebble Count

Based on pixel data and Image properties

Grain sizing algorithm for gravel bed river imagery

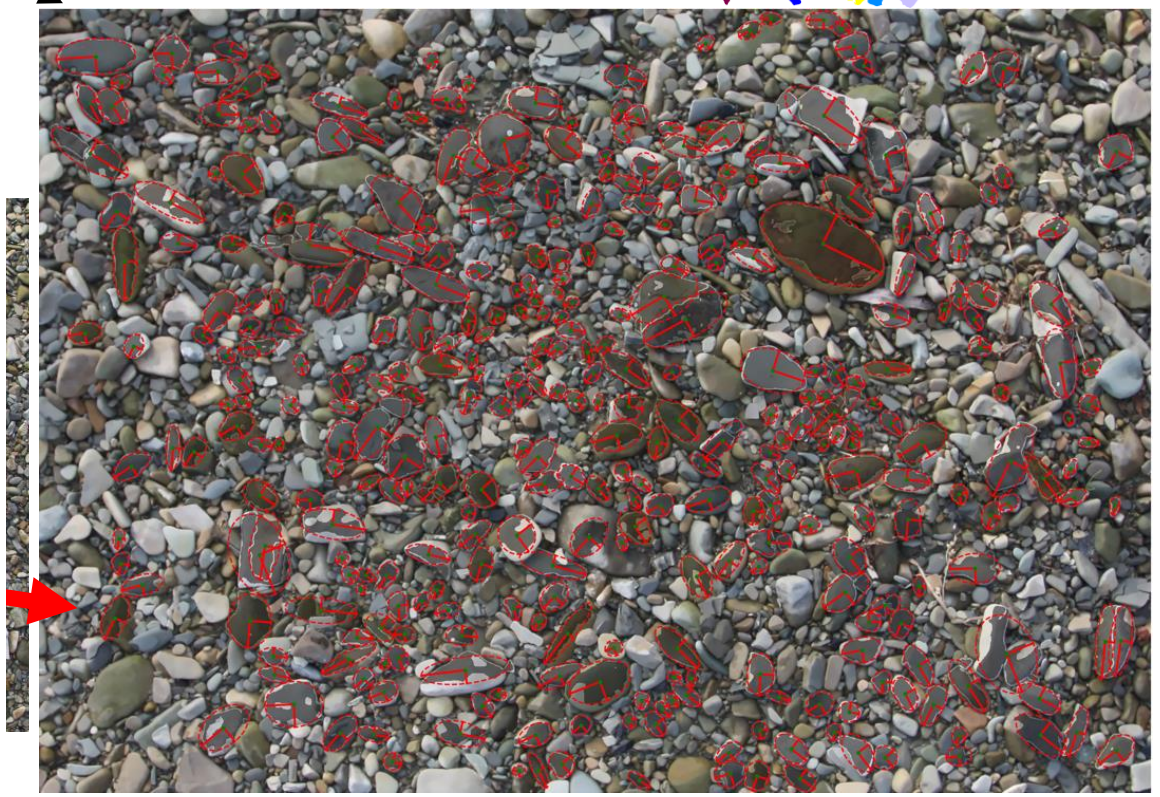
Ne

Ex

For I

pytho
senso

Automatic Image Filtering (AIF)

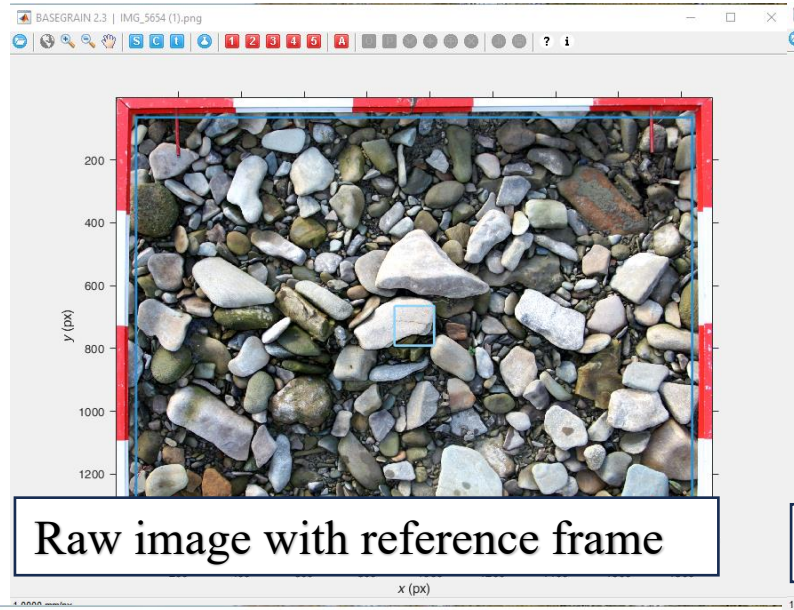


Colour Detection

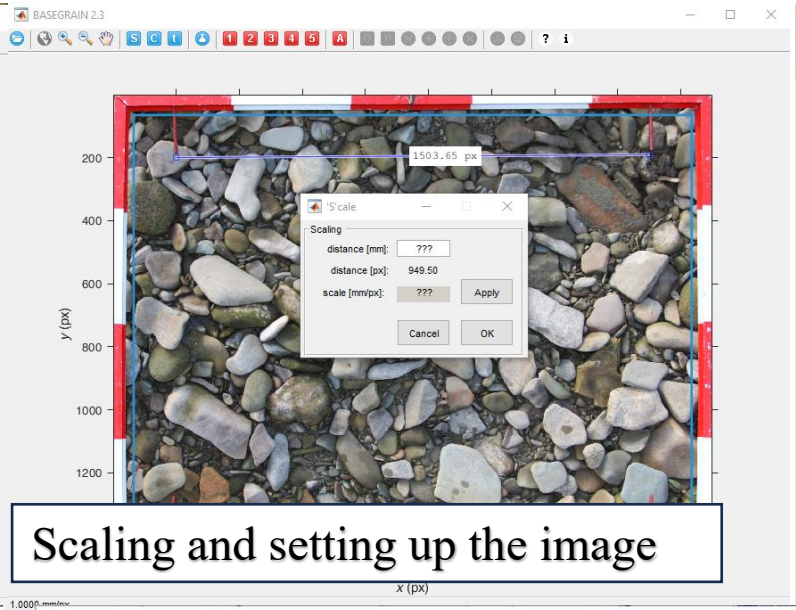
Workflow of optical granulometry image processing

BASEGRAIN

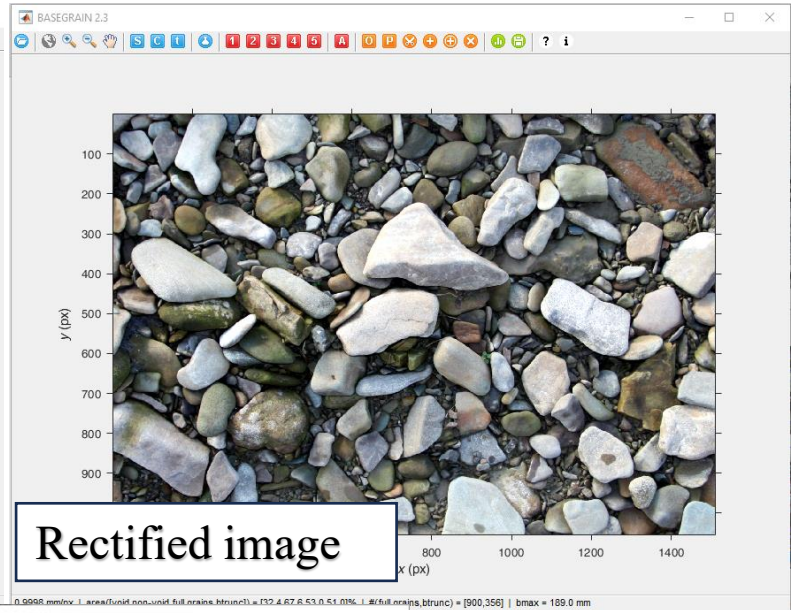
- Based on scaling
- Advanced Export data
- Simple to use just to adjust the parameters



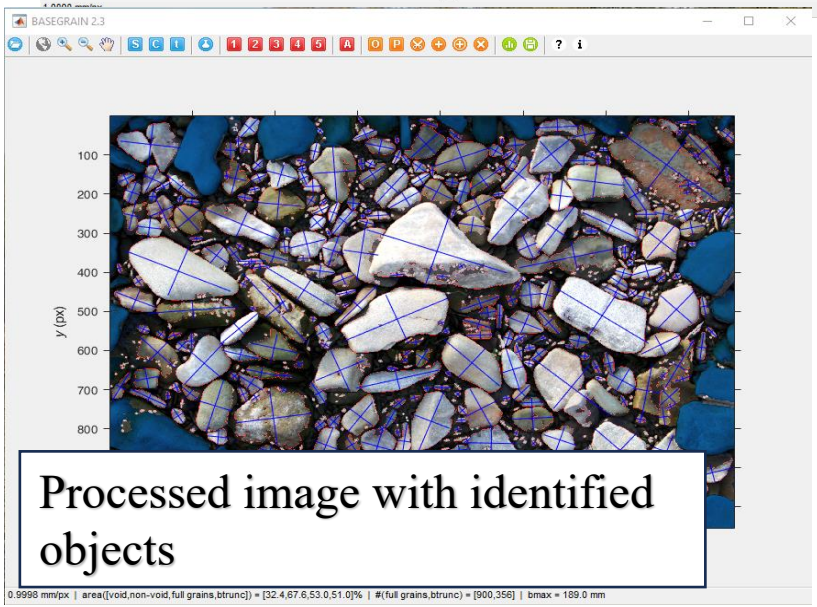
Raw image with reference frame



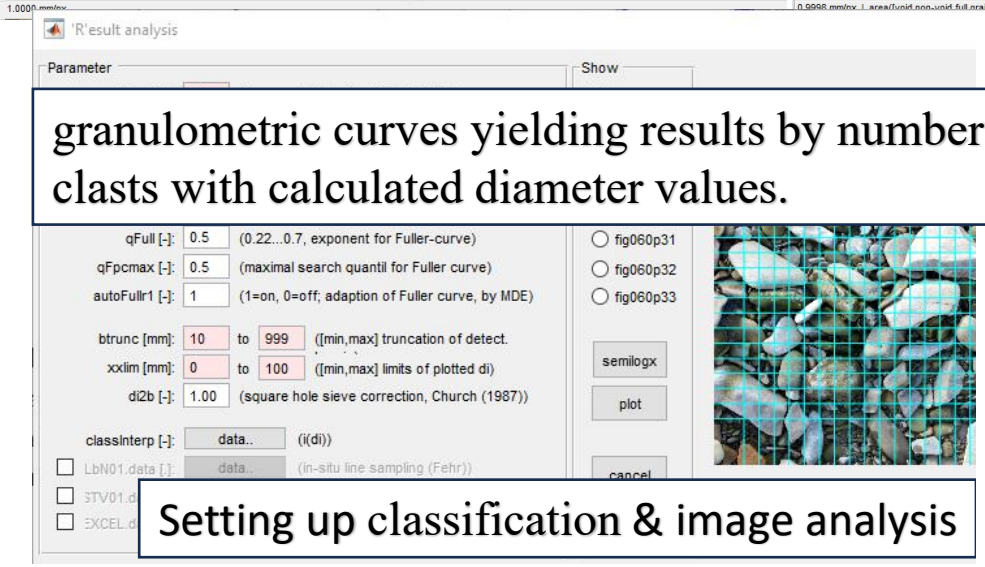
Scaling and setting up the image



Rectified image

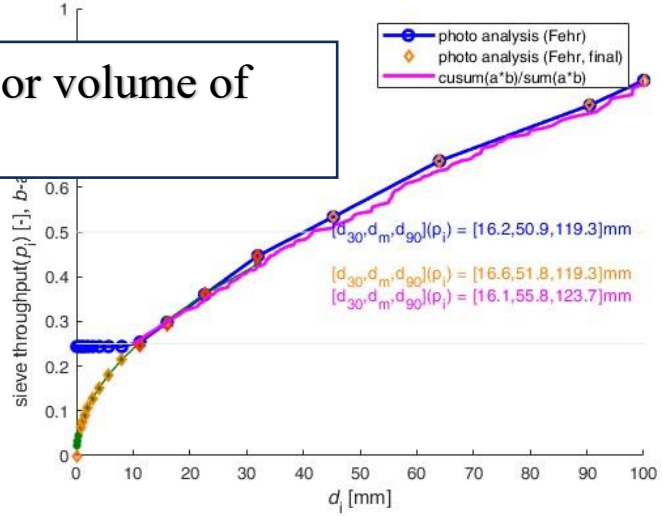


Processed image with identified objects



Setting up classification & image analysis

granulometric curves yielding results by number or volume of clasts with calculated diameter values.



Lab Analysis (Sieving)

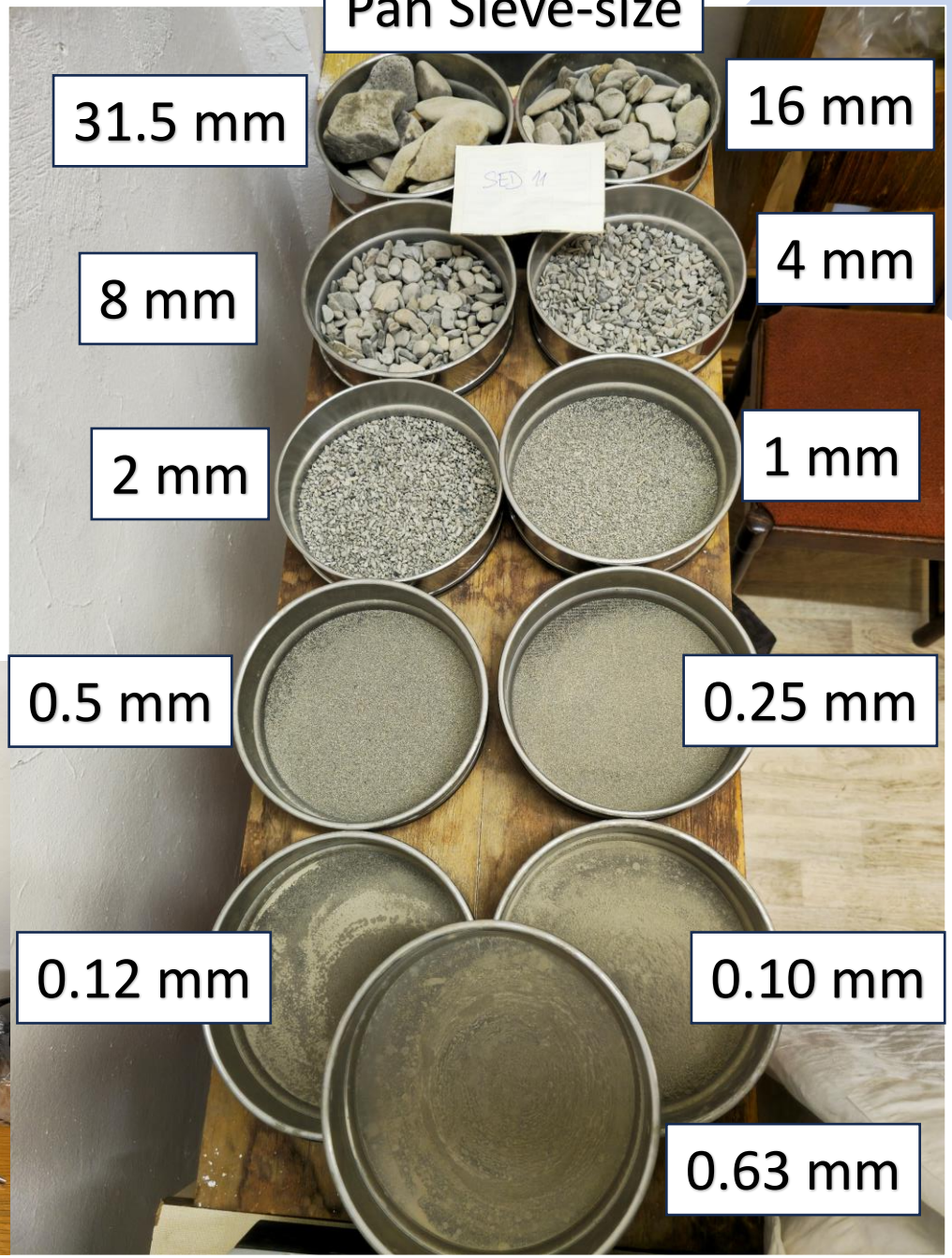
Based on Volumetric

Time consuming

Field Based

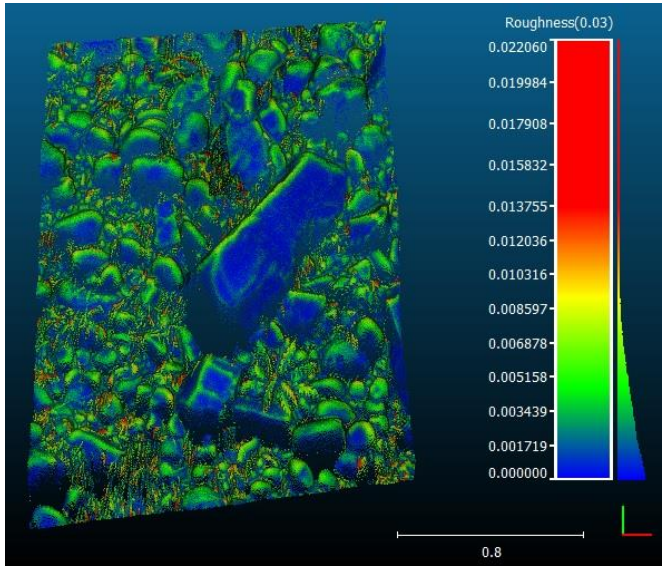
Validation

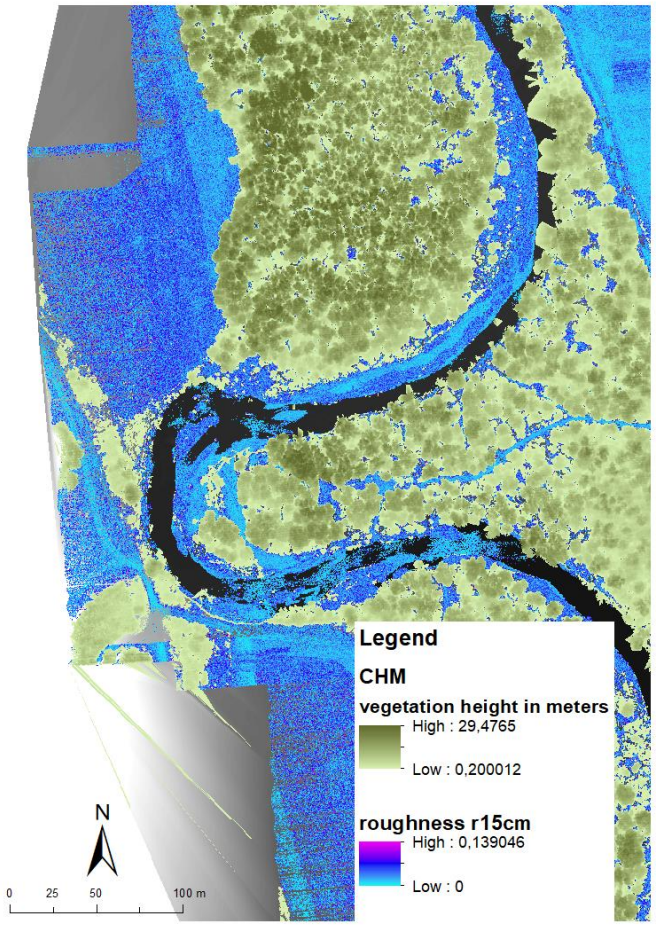
Sieving machine

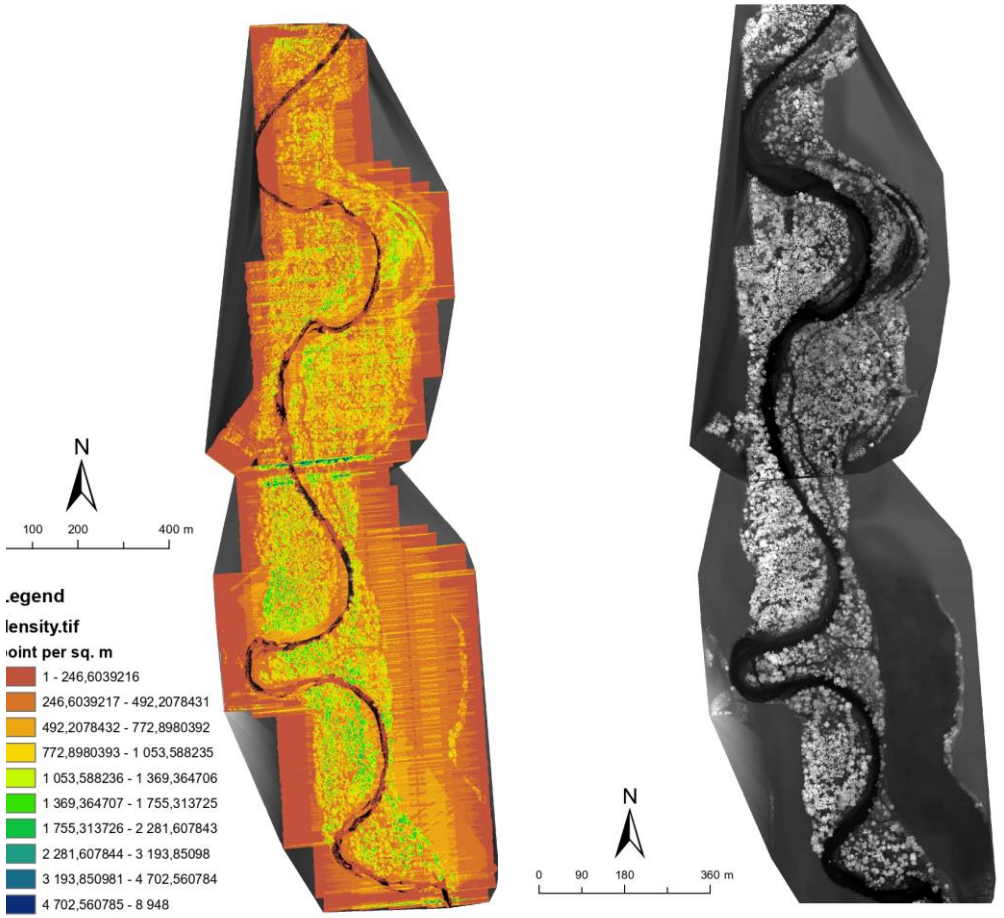


Lidar processing roughness

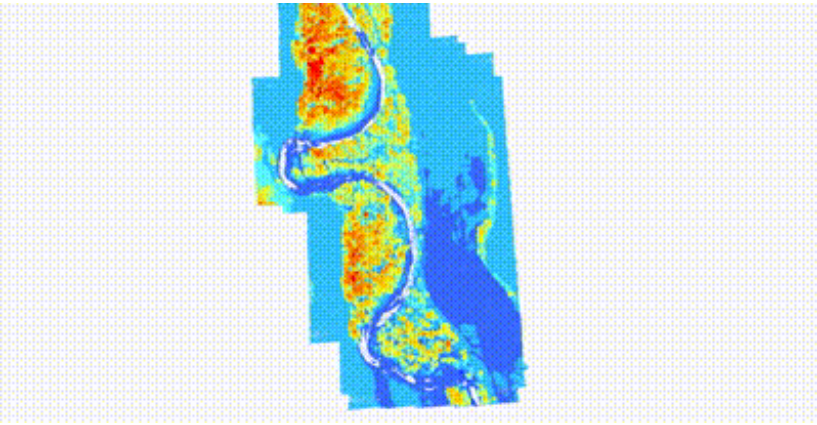
- 2 LAS datasets
- Number of point records: 395 671 882
- Point density: all returns 493. last only 355.88 (per square n spacing: all returns 0.05 last c 0.05 (in meters)
- Lasground
- Cloud compare
- QGIS – To extract properties
- Zonal statistics





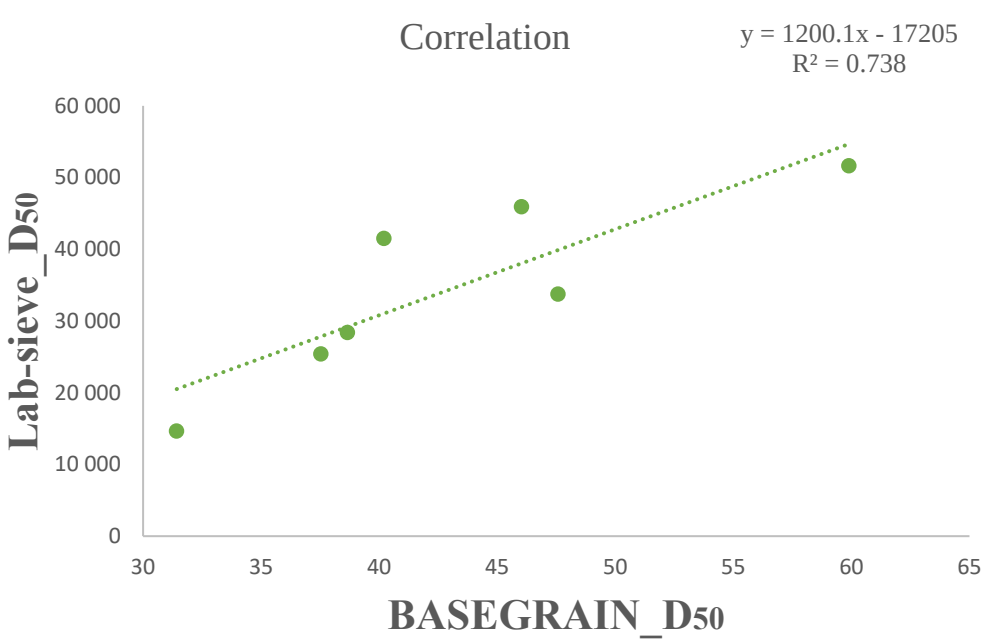


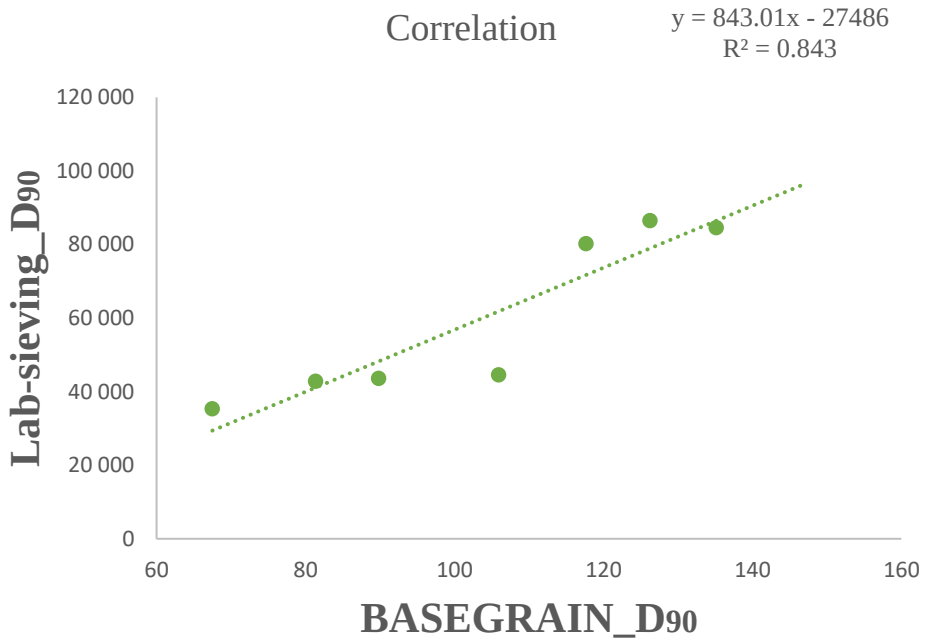
rapidlasso



Result

BASEGRAIN and Lab-sieving

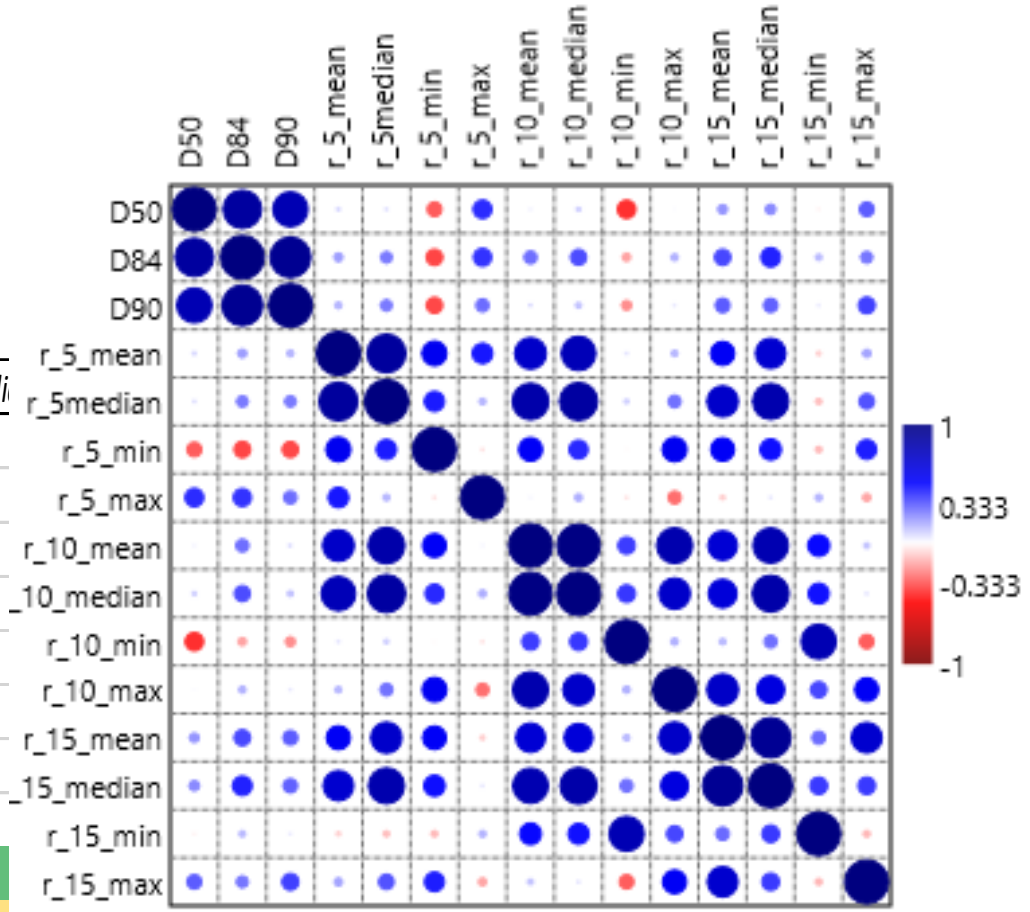




Result

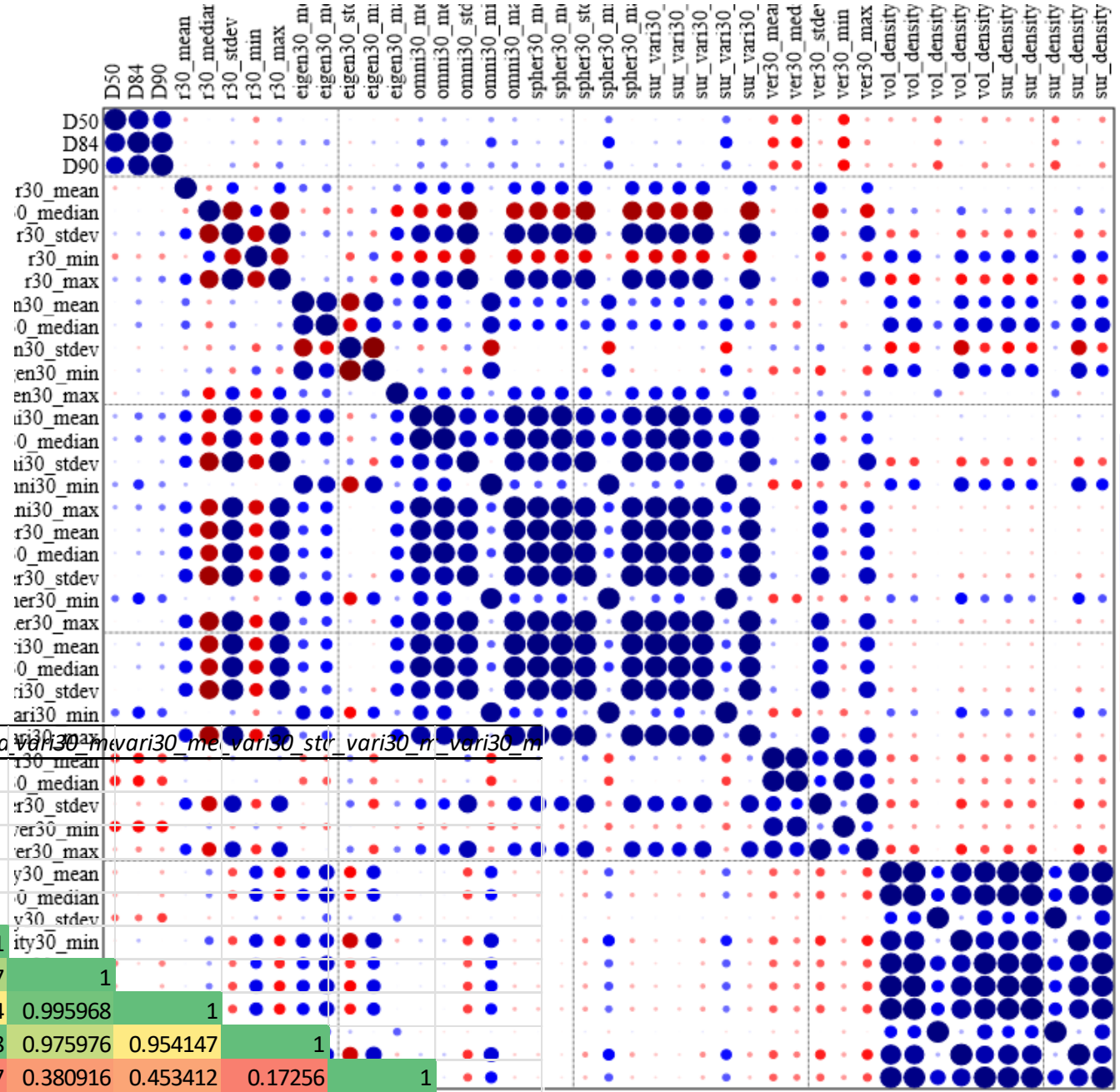
Correlation between BASEGRAIN and roughness parameters

	D50	D84	D90	r_5_mean	r_5_median	r_5_min	r_5_max	r_10_mean	r_10_medi
D50	1								
D84	0.885071	1							
D90	0.792606	0.942428	1						
r_5_mean	0.072505	0.190304	0.145519	1					
r_5_media	0.055928	0.25941	0.259771	0.87960899	1				
r_5_min	-0.32059	-0.36379	-0.35779	0.55643079	0.448250455	1			
r_5_max	0.414326	0.401212	0.286545	0.45636116	0.142323037	-0.05341502	1		
r_10_mea	0.099631	0.298904	0.153336	0.71455807	0.831663446	0.53280508	0.022626058	1	
r_10_med	0.168627	0.376092	0.209792	0.77929822	0.864440106	0.42078076	0.160549459	0.973553746	
r_10_min	-0.40076	-0.20946	-0.20231	0.04963008	0.092823779	-0.00545987	-0.05159571	0.269661499	0.28517
r_10_max	0.053192	0.135933	0.094421	0.14015453	0.278125292	0.55188738	-0.28395684	0.754699454	0.6131
r_15_mea	0.224707	0.354282	0.340026	0.53729056	0.703966742	0.52814778	-0.09573644	0.721136958	0.68581
r_15_med	0.265128	0.43195	0.348845	0.68560915	0.814563125	0.47435245	0.043638645	0.824551109	0.85401
r_15_min	0.005953	0.119175	0.074924	-0.0882367	-0.12691295	-0.13605153	0.14734252	0.373838995	0.352966303
r_15_max	0.310247	0.280804	0.364546	0.17930039	0.338316372	0.44140899	-0.17334861	0.257625798	0.156915779



Result

Moderate but not strong



	D84	her30_me	r30_med	her30_std	her30_mi	her30_ma	vari30_me	vari30_std	vari30_m	vari30_m
D84	1									
spher30_mean	0.124317	1								
spher30_median	0.162826	0.995158	1							
spher30_stdev	0.00898	0.97606	0.954483	1						
spher30_min	0.511451	0.364237	0.42768	0.147379	1					
spher30_max	0.018745	0.982164	0.961535	0.998893	0.178922	1				
sur_vari30_mean	0.127894	0.999931	0.995962	0.976374	0.354076	0.981747	1			
sur_vari30_median	0.167432	0.995638	0.999887	0.954623	0.425735	0.961414	0.995968	1		
sur_vari30_stdev	0.0086	0.97616	0.953994	0.999974	0.145399	0.998718	0.975976	0.954147	1	
sur_vari30_min	0.526761	0.380131	0.454186	0.174378	0.994402	0.204297	0.380916	0.453412	0.17256	1
sur_vari30_max	0.021352	0.981705	0.961055	0.99893	0.175754	0.999856	0.98139	0.960961	0.998843	0.201838

Result

- We obtained very good results from sieving, both manually and using software, in comparison
- In comparison with the characteristics of the LiDAR properties, with the different parameters we found a very low or moderate relationship.
- The highest observed value is appro. 53.

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RESEARCH ARTICLE

ESPL WILEY

Grain size estimation in fluvial gravel bars using uncrewed aerial vehicles: A comparison between methods based on imagery and topography

Tyler Wong[1] | Sami Khanal[2] | Kaiguang Zhao[1] | Steve W. Lyon[1,3]

- In this paper we found the roughness correlation up to 0.65.
- Our results show much lower in comparison.
- The point cloud density is very high 2.0 Ÿ 10^7 points/m^3
- The paper analyzed only single gravel bar.
- This is our preliminary result, and we are continuing to work on it
- In future, we plan to compare additional parameters

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THANK YOU FOR YOUR KIND ATTENTION

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Cartographic Society of the Slovak Republic

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