



AGH

RESEARCH
UNIVERSITY
EXCELLENCE INITIATIVE

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Automation of Land Displacement Determination Using UAV Photogrammetric Data

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XXVII FIG Congress, 11-15 September 2022, Warsaw, Poland

Study data



Series of measurements:

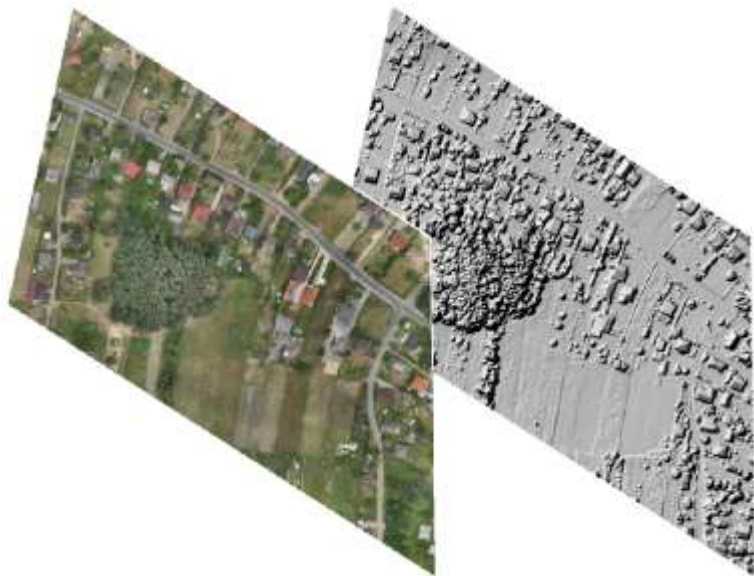
- 2020 November (base series)
- 2021 March
- 2021 June
- 2021 November

Study data

UAV photogrammetry products



Orthomosaics + DEM
2.5D



Point clouds
3D



Methods

Horizontal displacements on the basis of orthomosaics



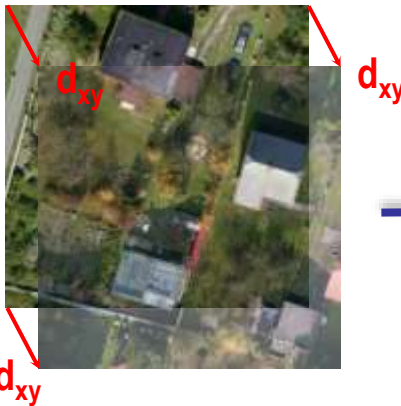
1st series



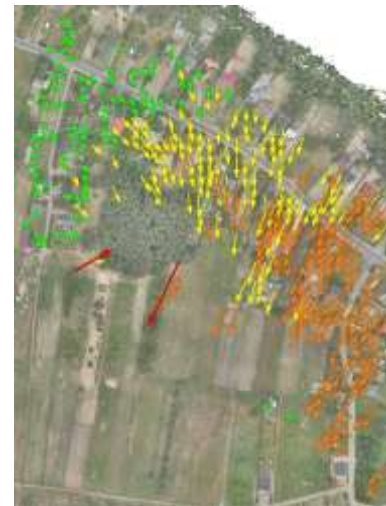
2nd series



Input data



Matching of
orthomosaics fragments



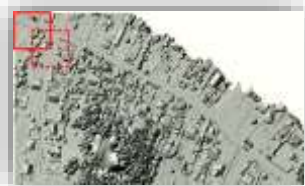
Map of displacements

Methods

Vertical displacements on the basis of DEMs



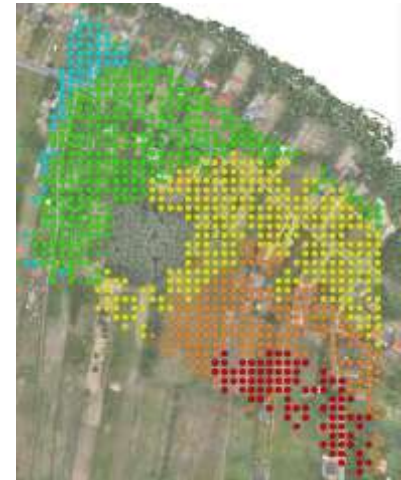
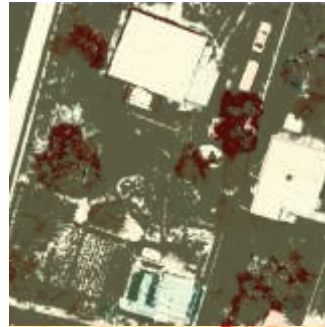
1st series



2nd series



Input data

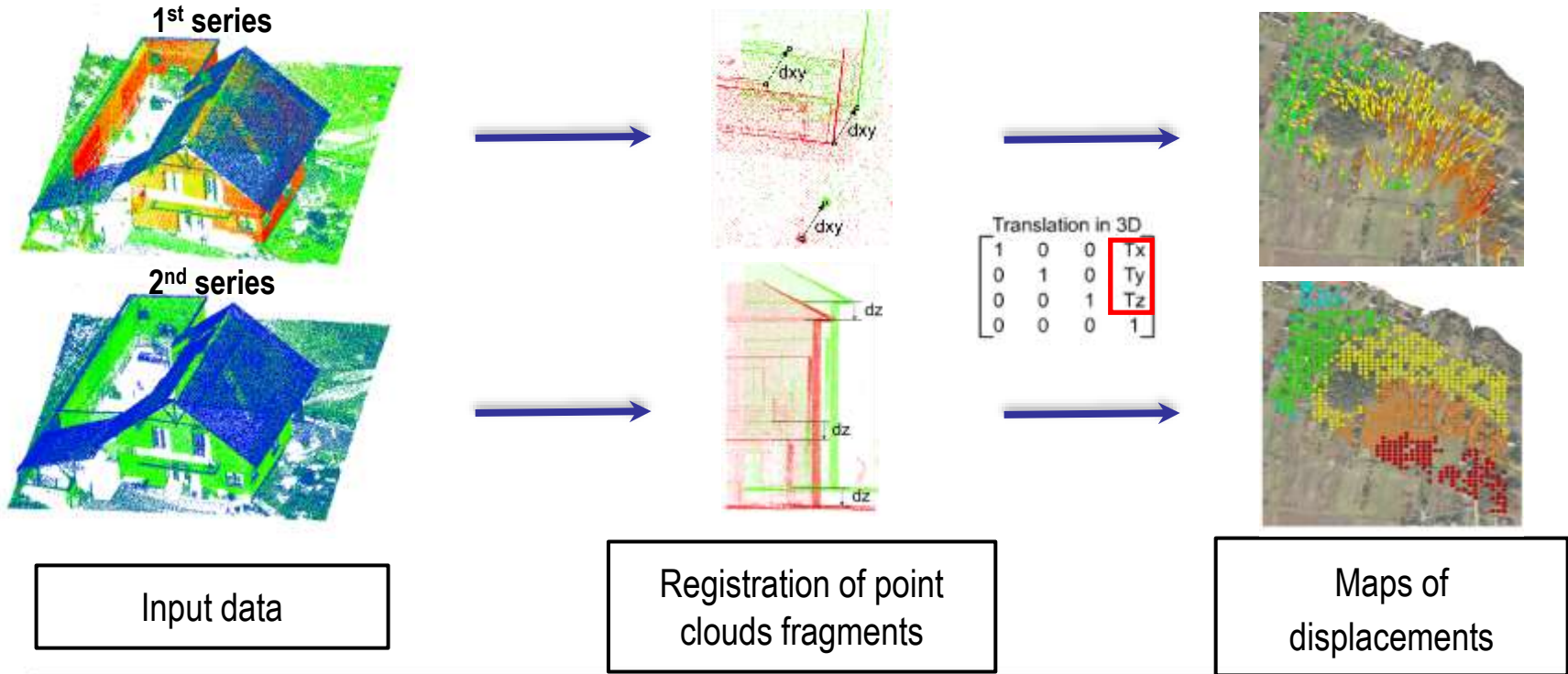


Shifting and subtracting
of DEMs fragments

Map of displacements

Methods

Spatial displacements on the basis of point clouds



Results

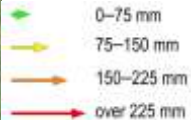
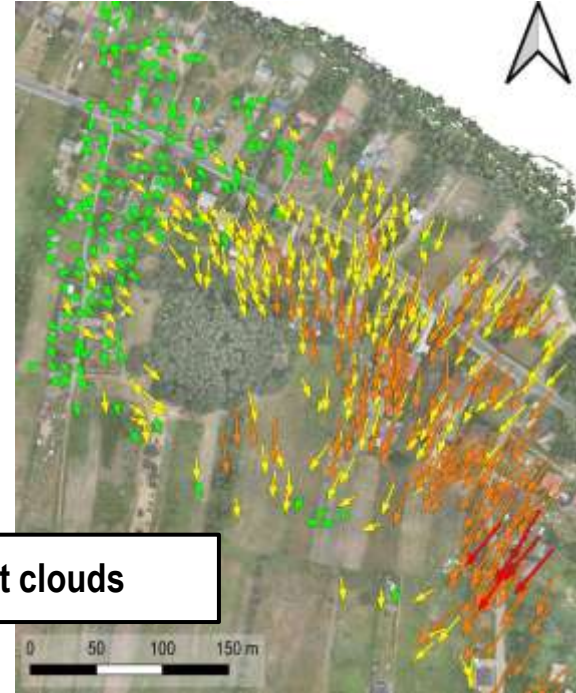
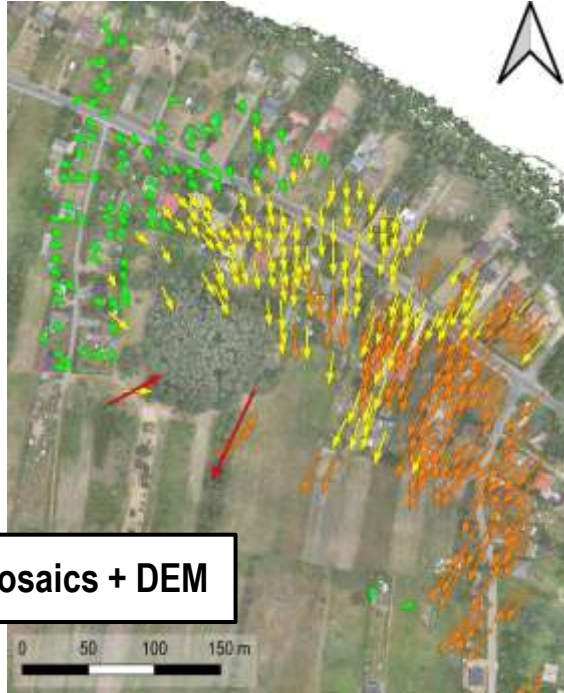
Determined horizontal displacements



Consistency
of results:

$$\sigma_{dX} = 23 \text{ mm}$$

$$\sigma_{dY} = 22 \text{ mm}$$

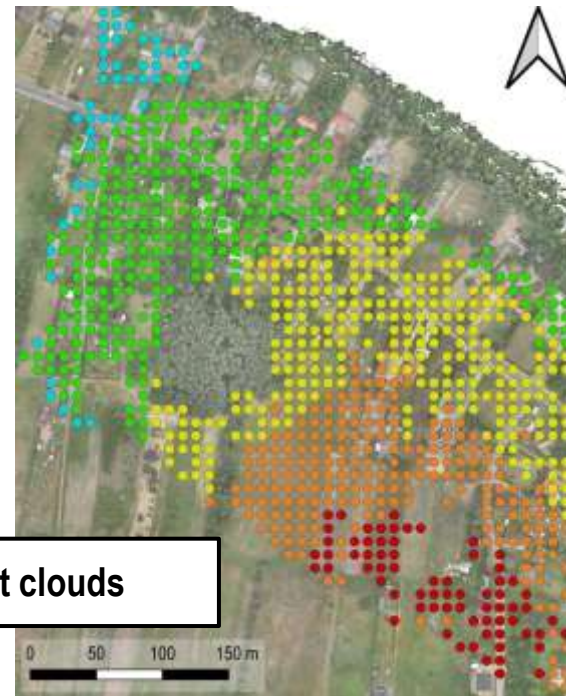
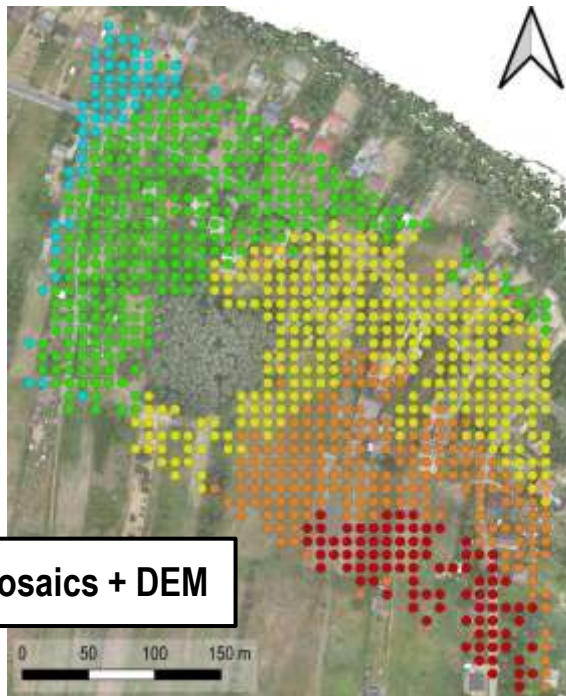


Results

Determined vertical displacements



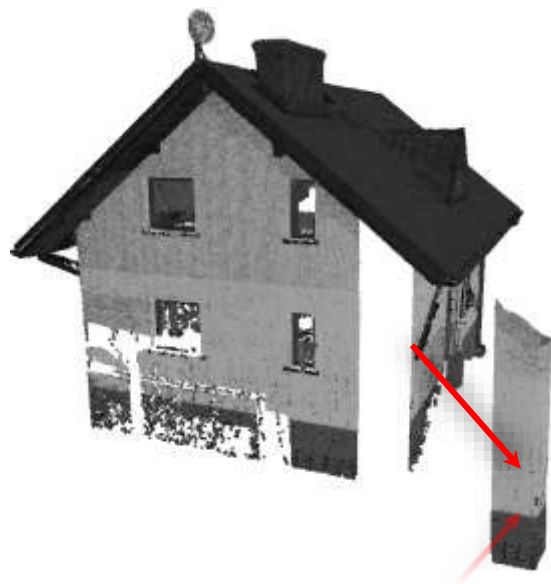
Consistency
of results:
 $\sigma_{dH} = 17 \text{ mm}$



- from 0 to 100 mm
- from -200 to 0 mm
- from -400 to -200 mm
- from -600 to -400 mm
- below -600 mm

Reference data

Terrestrial laser scanning



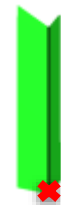
1st series



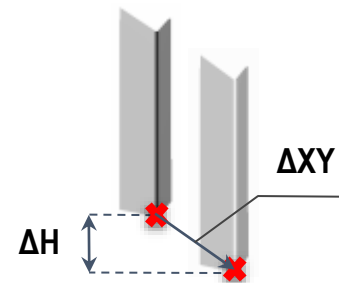
(X_1, Y_1, Z_1)

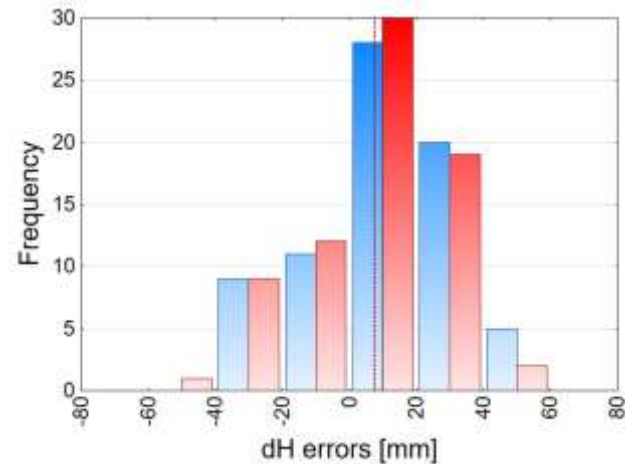
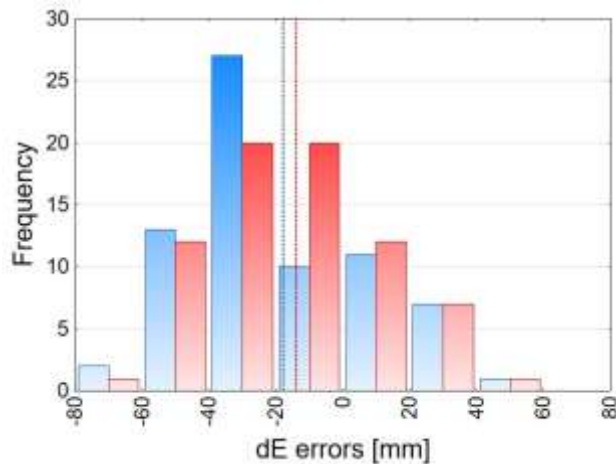
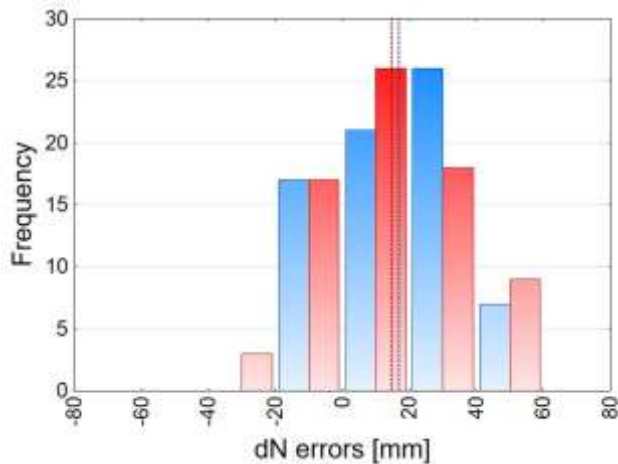


2nd series



(X_2, Y_2, Z_2)





RMSE [mm]	Orthomosaics + DEM	Point clouds
dN	25	25
dE	32	29
dH	23	22

■ errors of orthomosaics- and DEMs-based displacements
■ errors of point cloud-based displacements
⋯ mean error of orthomosaics- and DEMs-based displacements
⋯ mean error of point cloud-based displacements

Results

More information in publications



Application of UAV-based orthomosaics
for determination of horizontal
displacement caused by underground mining



Determination of underground mining-induced
displacement field using
multi-temporal TLS point cloud registration