Evaluation of ULS Bathymetry for Hydrodynamic Modelling

3D Underwater Mapping from Above and Below

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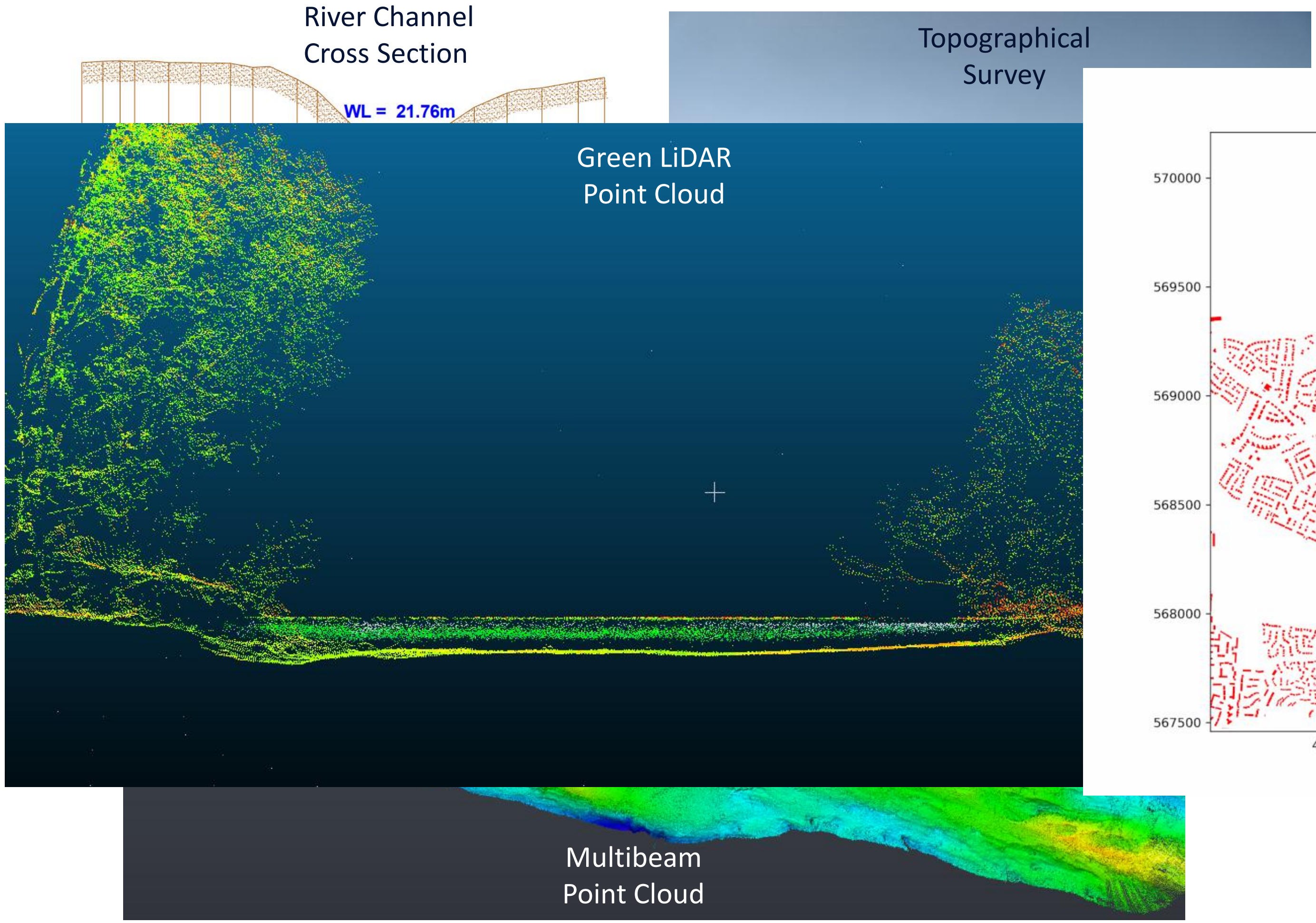
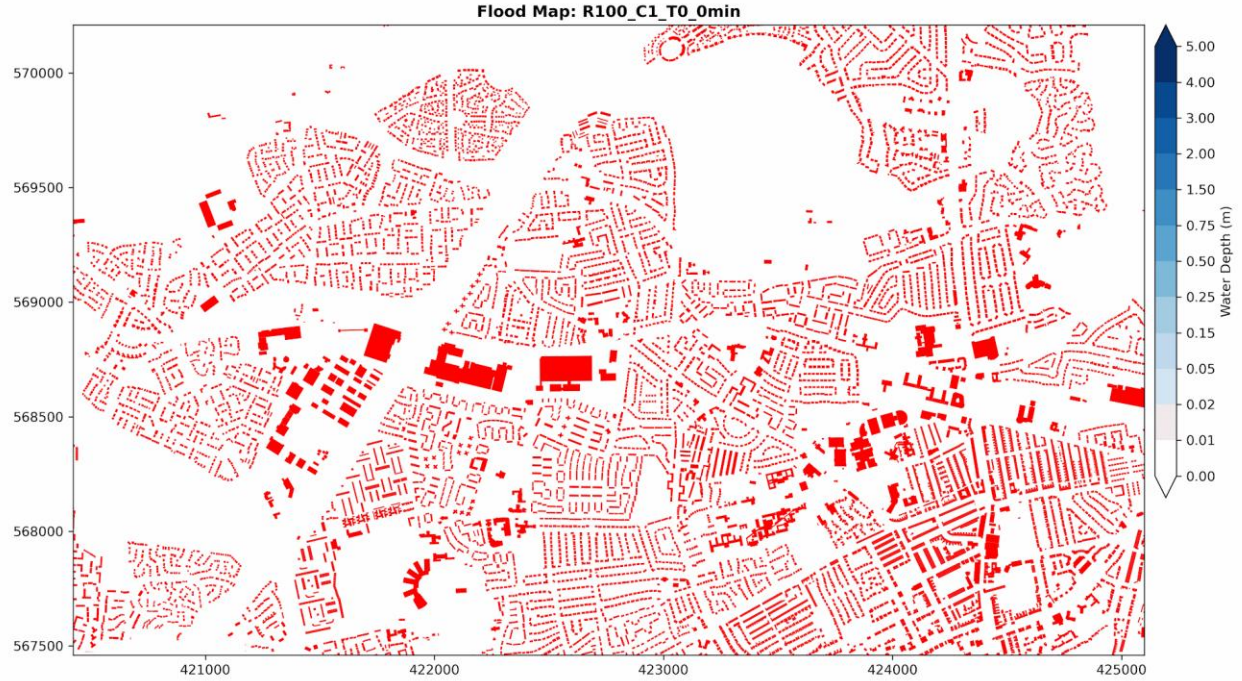
What is the Problem?



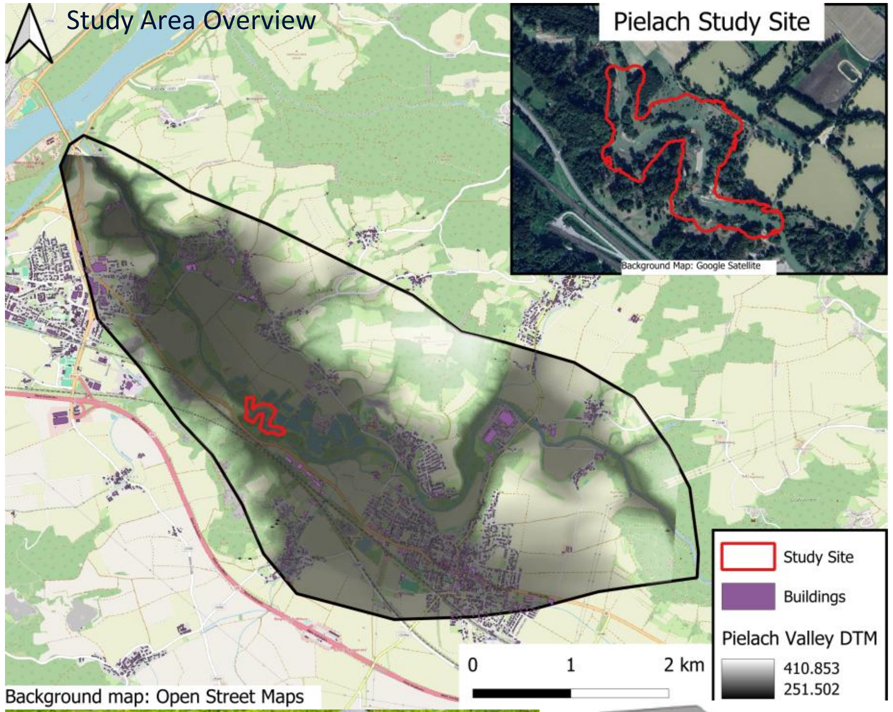


Hydrodynamic Model of
Newcastle upon Tyne

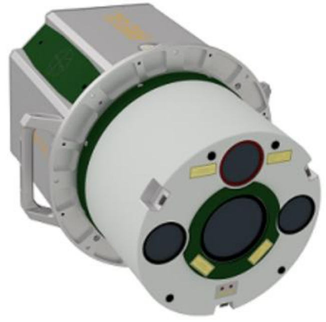
Magdalena, I., Imawan, R., Nugroho,M.A., 2024. Numerical investigations for water flow in an irregular channel using Saint-Venant equations. J.King Saud Univ. – Sci.36, 103237. https://doi.org/10.1016/j.jksus.2024.103237

The Study

- Based on previous research for Mandlburger et al., 2025 of the Pielach River, Austria.
- Aim: Determine how bathymetry effects water flow in a hydrodynamic model.
- Three 1 m spatial resolution DTMs created for separate simulation.
    1. Topographic publicly available from Federal Office of Metrology and Surveying (BEV) .
    2. BEV with Airborne Topo-Bathy LiDAR (ALS).
    3. BEV with UAV based Topo-Bathy LiDAR (ULS).



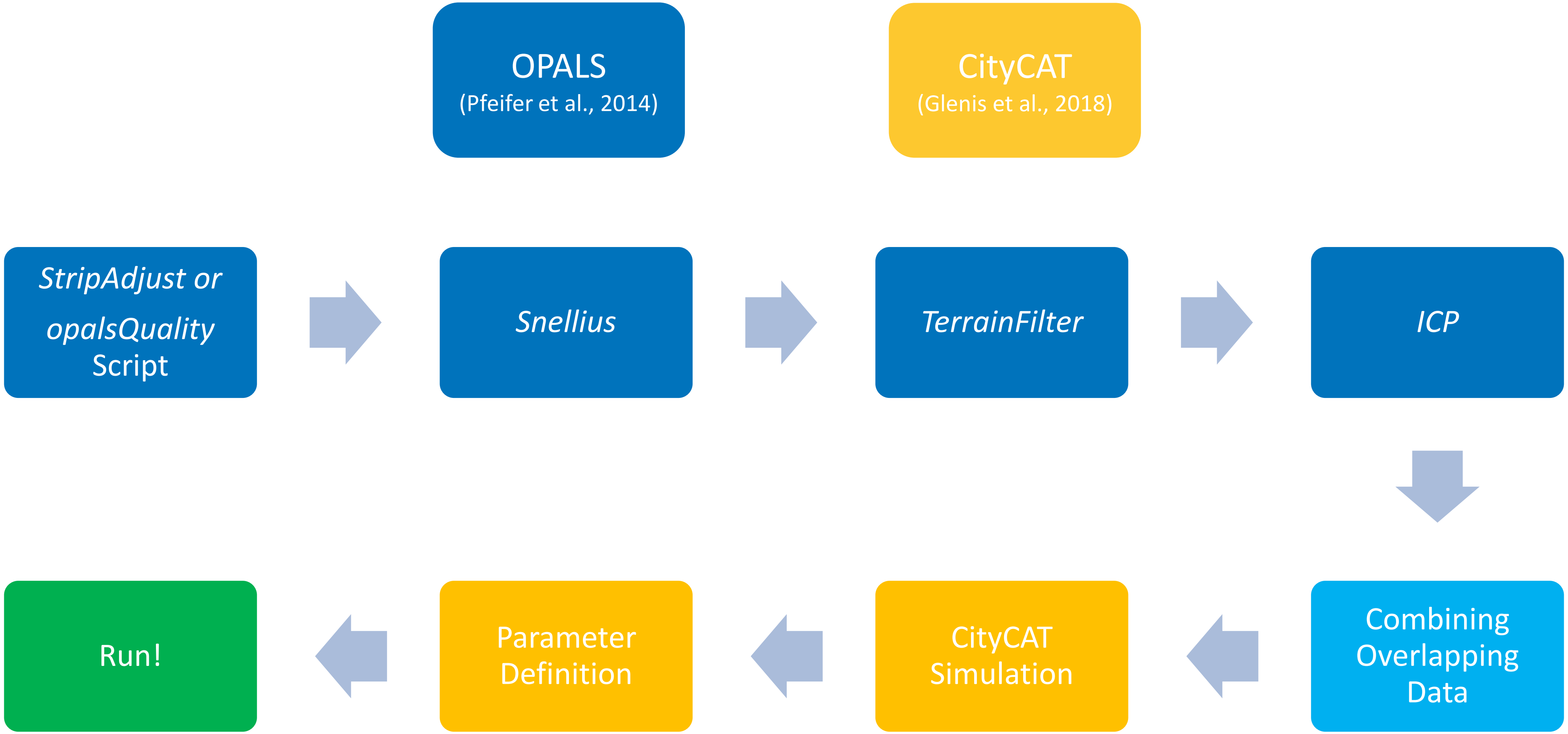
ULS System with RIEGL VQ-840 GL Sensor.
Photo: Jan Rhomberg-Kauert



RIEGL VQ-880-G II
Photo: RIEGL LASER MEASUREMENT

Mandlburger, G., Rhomberg-Kauert, J., Gueguen, L.-A., Muslow, C., Brezovsky, M., Dammert, L., Haines, J., Glas, S., Himmelsbach, T., Schulte, F., Amon, P., Winiwarter, L., Jutzi, B., Maas, H.-G., 2025. Mapping shallow inland running waters with UAV-borne photo and laser bathymetry. Hydrographische Nachrichten 42–54. https://doi.org/10.23784/HN130-06

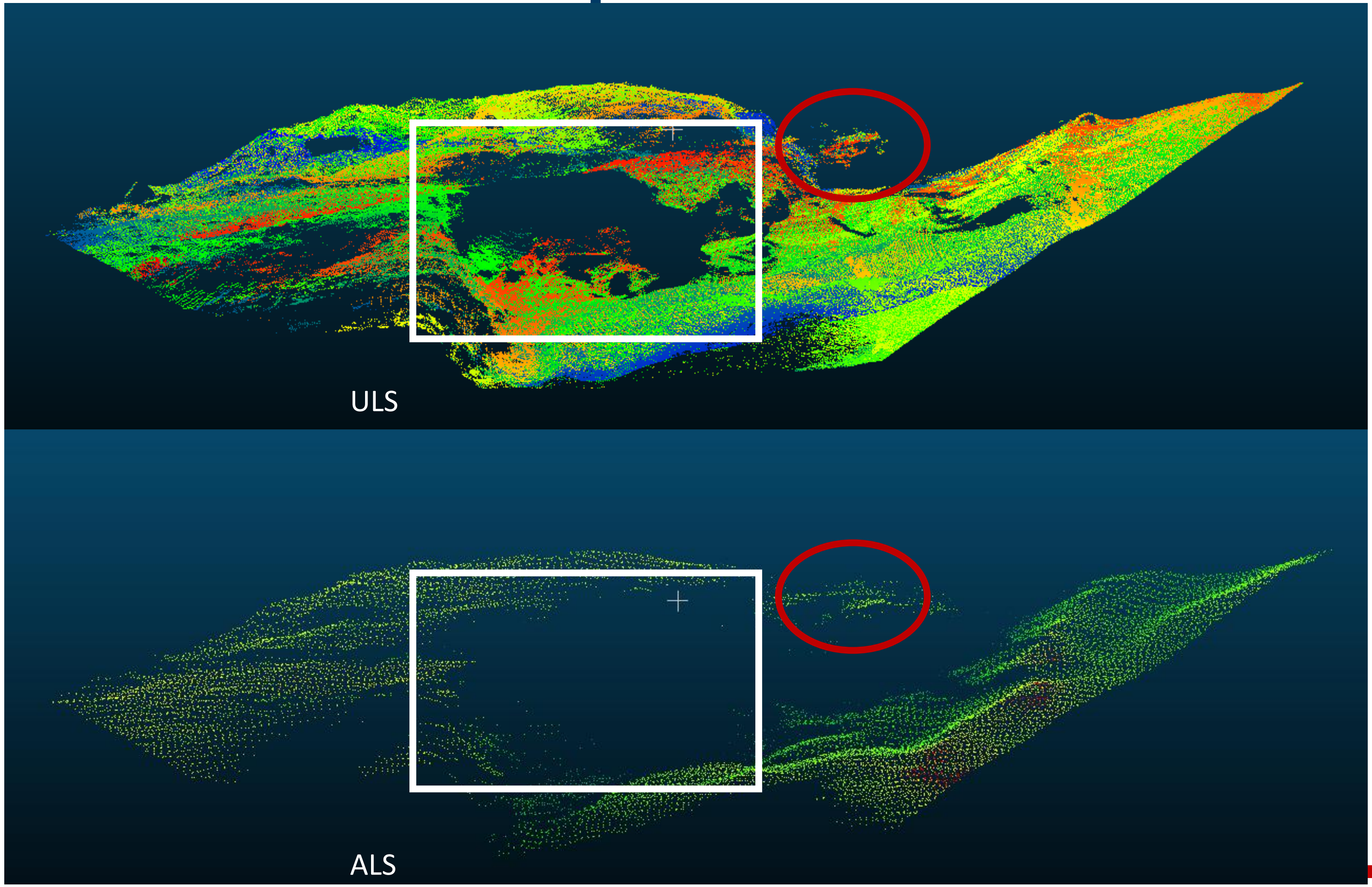
DTM Generation and Hydrodynamic Modelling



Glenis, V., Kutija, V., Kilsby, C.G., 2018. A fully hydrodynamic urban flood modelling system representing buildings, green space and interventions. Environmental Modelling & Software 109, 272–292. https://doi.org/10.1016/j.envsoft.2018.07.018

Pfeifer, N., Mandlburger, G., Otepka, J., Karel, W., 2014. OPALS – A framework for Airborne Laser Scanning data analysis. Computers, Environment and Urban Systems 45, 125–136. https://doi.org/10.1016/j.compenvurbsys.2013.11.002

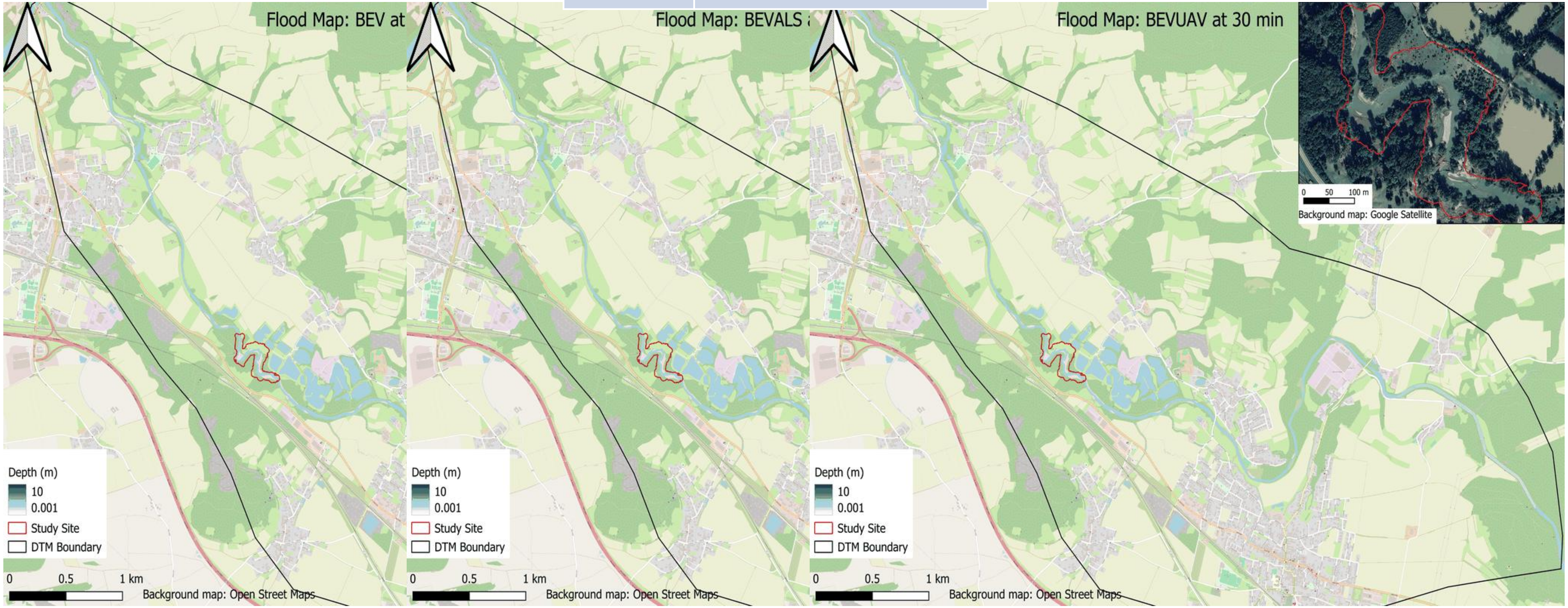
Point Cloud Comparison



Point Cloud	Flying Altitude	Spatial Res.
ULS	~60 m	~0.1 m
ALS	~600 m	~0.6 m

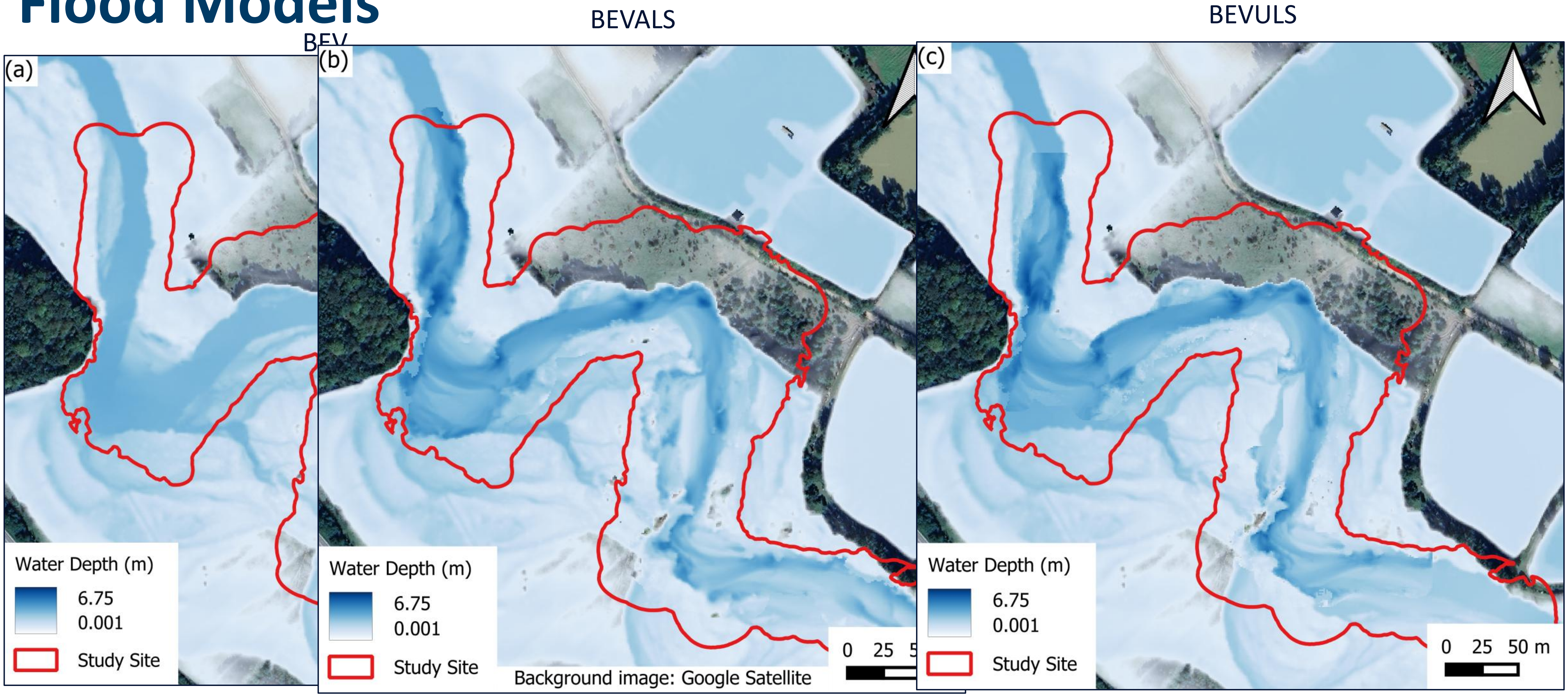
Flood Models

Model	Simulation Length (hrs)
BEV	7.5
BEVALS	7.5
BEVULS	6.5



From Newcastle. For the world.

Flood Models

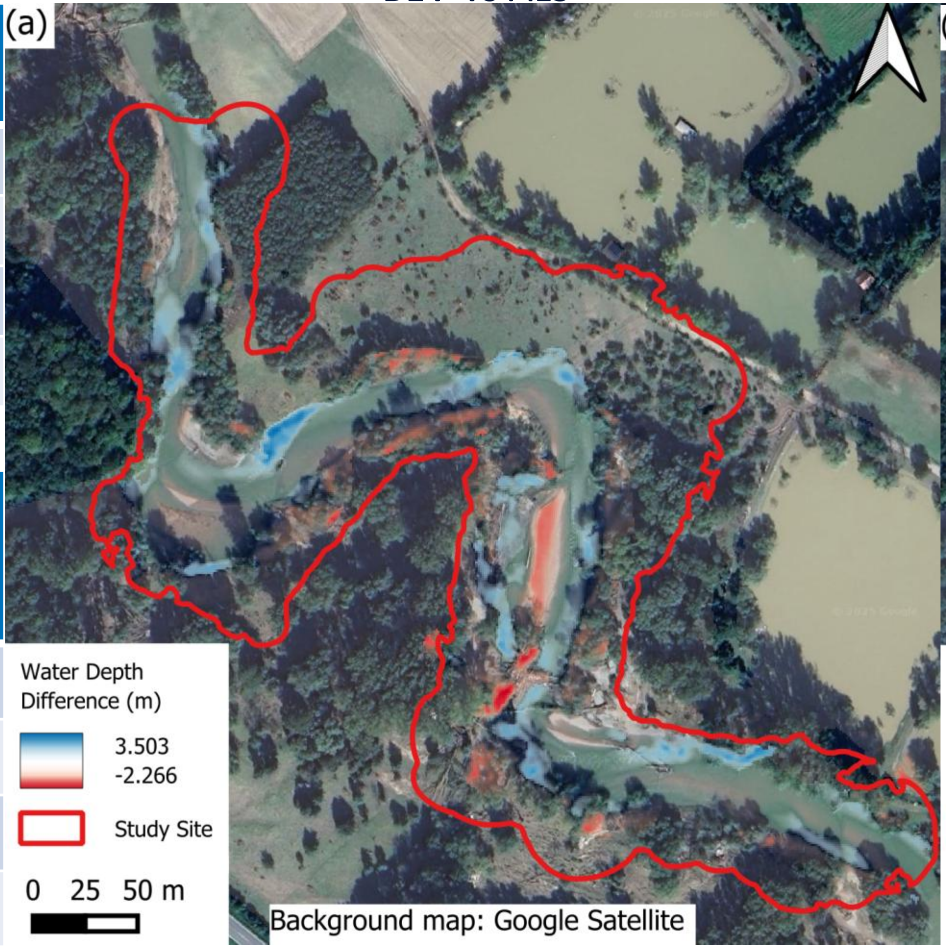


Flood Depth Differences

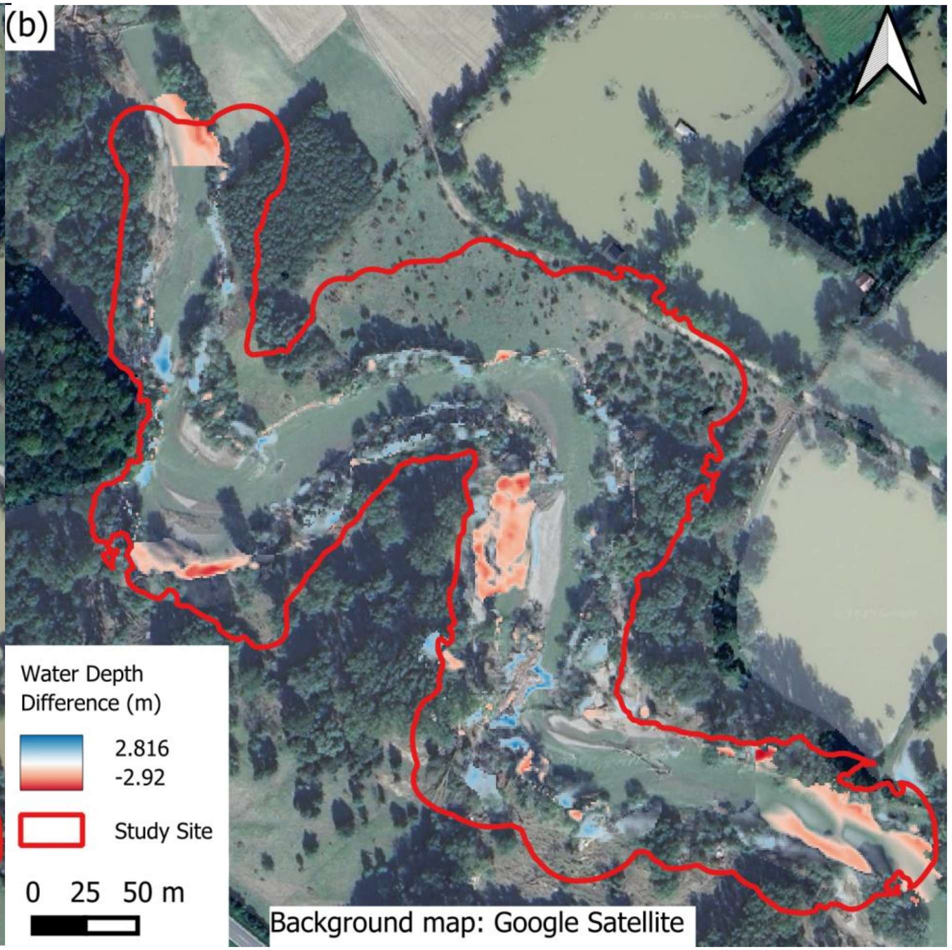
a) BEV Vs ALS (+ve ALS deeper than BEV)	Depth (m)
Max	3.50
Min	-2.27
Mean	0.005
Std. Dev	0.091

b) ALS Vs ULS (+ve ALS deeper than BEV)	Depth (m)
Max	2.81
Min	-2.92
Mean	0.000
Std. Dev	0.053

BEV Vs ALS



ALS Vs ULS



Reflections

- Topo-Bathy LiDAR & CityCAT.
- ULS produces good classification and DTM quality.
- Spatial coverage of ALS a benefit for hydrodynamic modelling.
- Limitations:
  - Computer power.
  - Simulation time.
  - Vegetation filtering.
- Future work:
  - Improving workflow.
  - Utilising full ALS bathymetry.
  - Validation.

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