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Introduction

In August 2020 the authors realized an interdisciplinary survey of 12 wrecks located and inventoried earlier, as a part of a project *Underwater ethnoarchaeology of the Lower Oder. Preliminary research on wrecks in selected sections of the river* (grant no. 2018/02/X/HS3/00475, National Science Centre, Poland). The hydrographers from the Maritime University of Szczecin and the ethnologist from the University of Szczecin established cooperation in this regard.

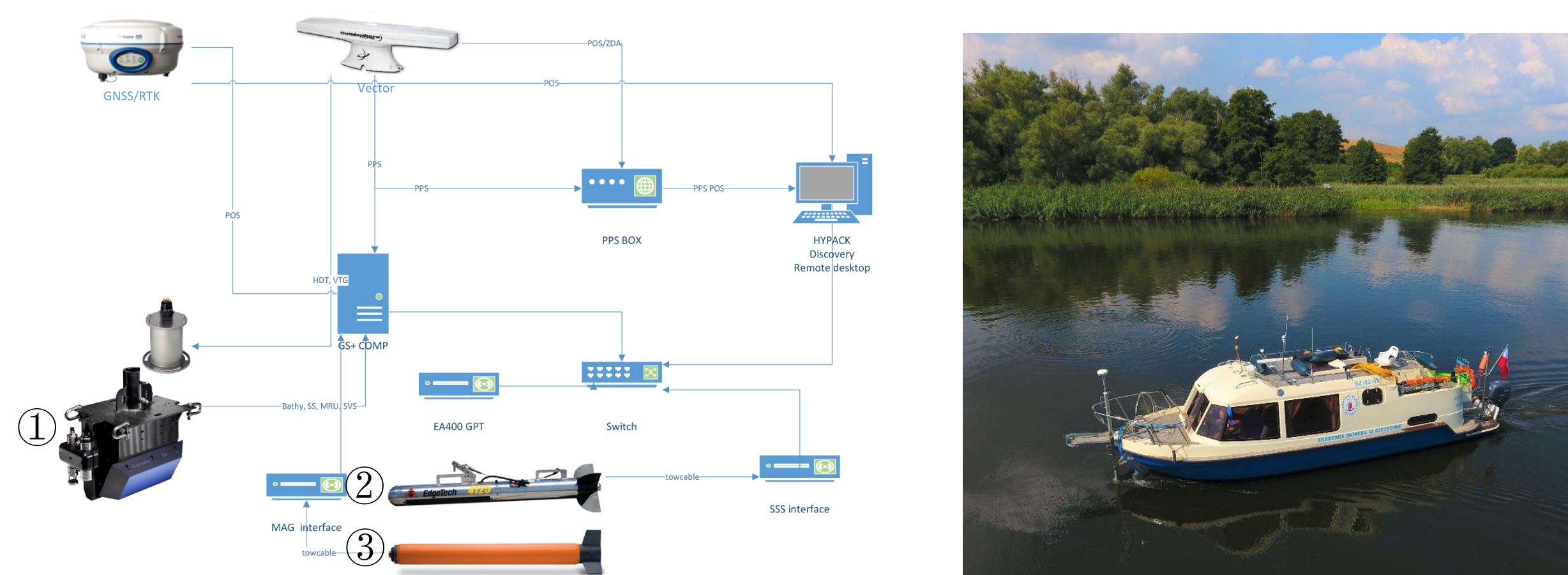
The survey was a part of the research on the geoclassification method of anthropogenic, ferrous, underwater objects based on magnetic anomaly maps. Data acquisition involved recording data with an interferometric echosounder, side-scan sonar, and marine magnetometer. The survey was done by the research vessel "Hydrograf XXI".

The results provided new datasets of examined wrecks. It also contributed to a better understanding of the underwater cultural heritage resources of the Oder River. Moreover, collected data was used to create the catalog of underwater ferromagnetic objects, which is the basis of geoclassification method.

Methodology

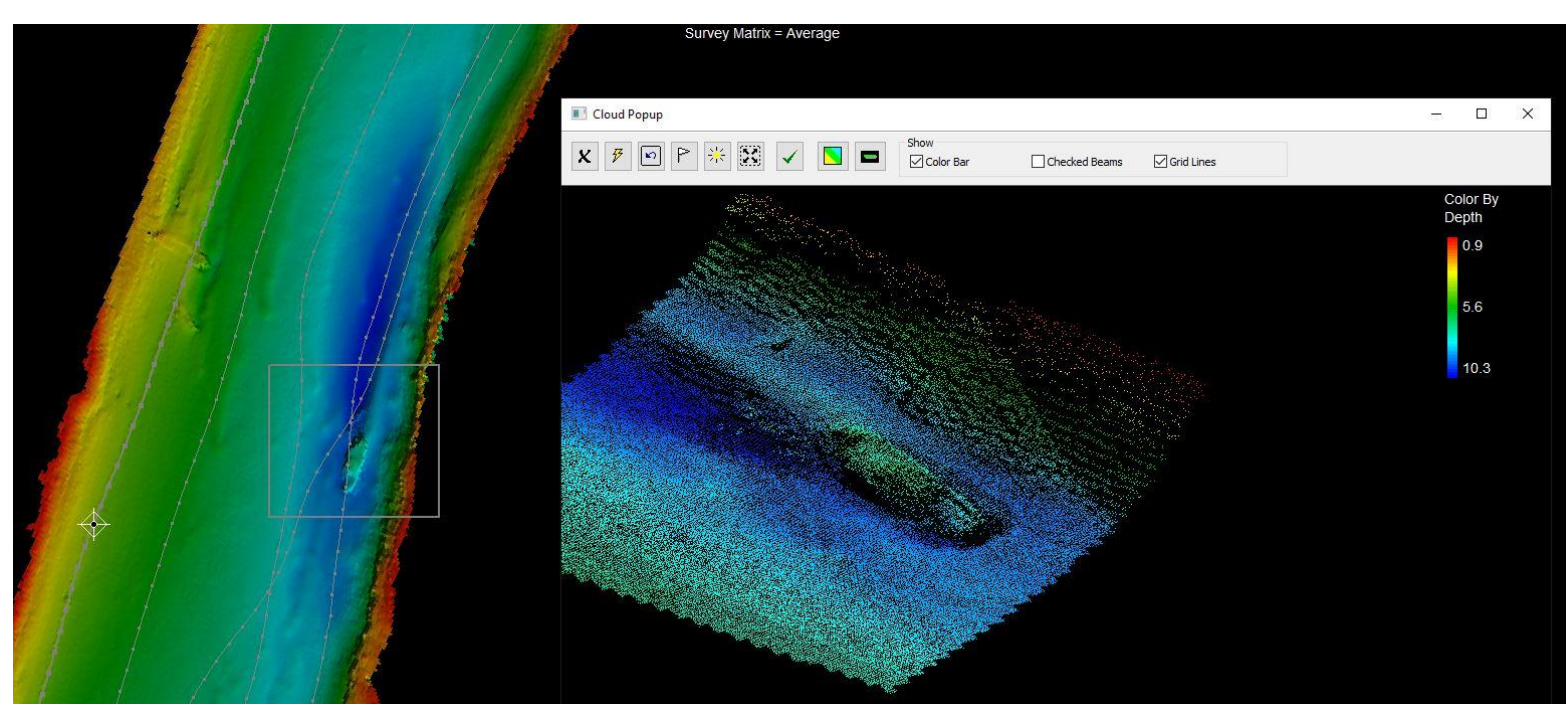
The survey campaign was carried out on the survey vessel "Hydrograf XXI" – the floating research laboratory – and the hydrographic equipment of the Maritime University of Szczecin:

- ① interferometric bathymetric system – GeoSwath Plus,
- ② side scan sonar – Edgetech 4125,
- ③ towed marine magnetometer – SeaSPY.



Data processing

The processing of hydrographic data is a very important step that leads to a proper interpretation of the objects lying on the bottom. Specialized data processing and visualization software was used in this study.

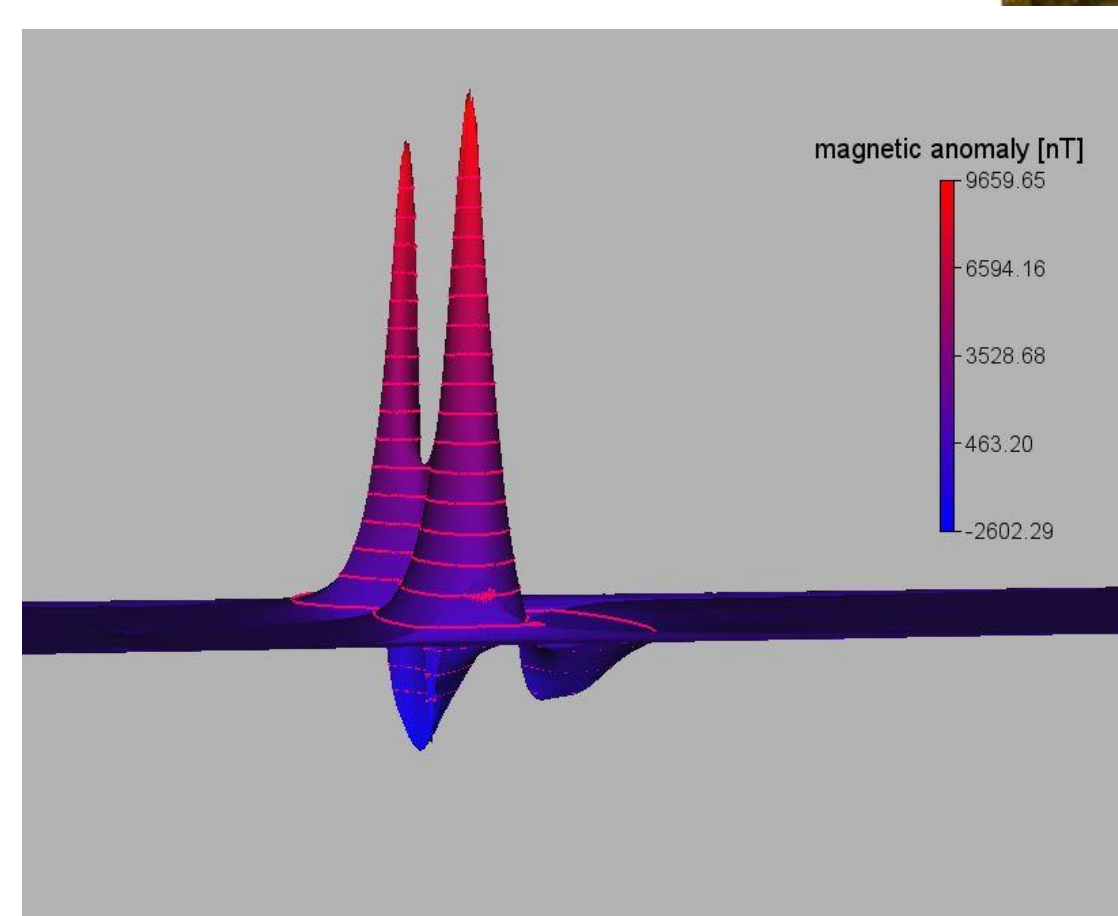
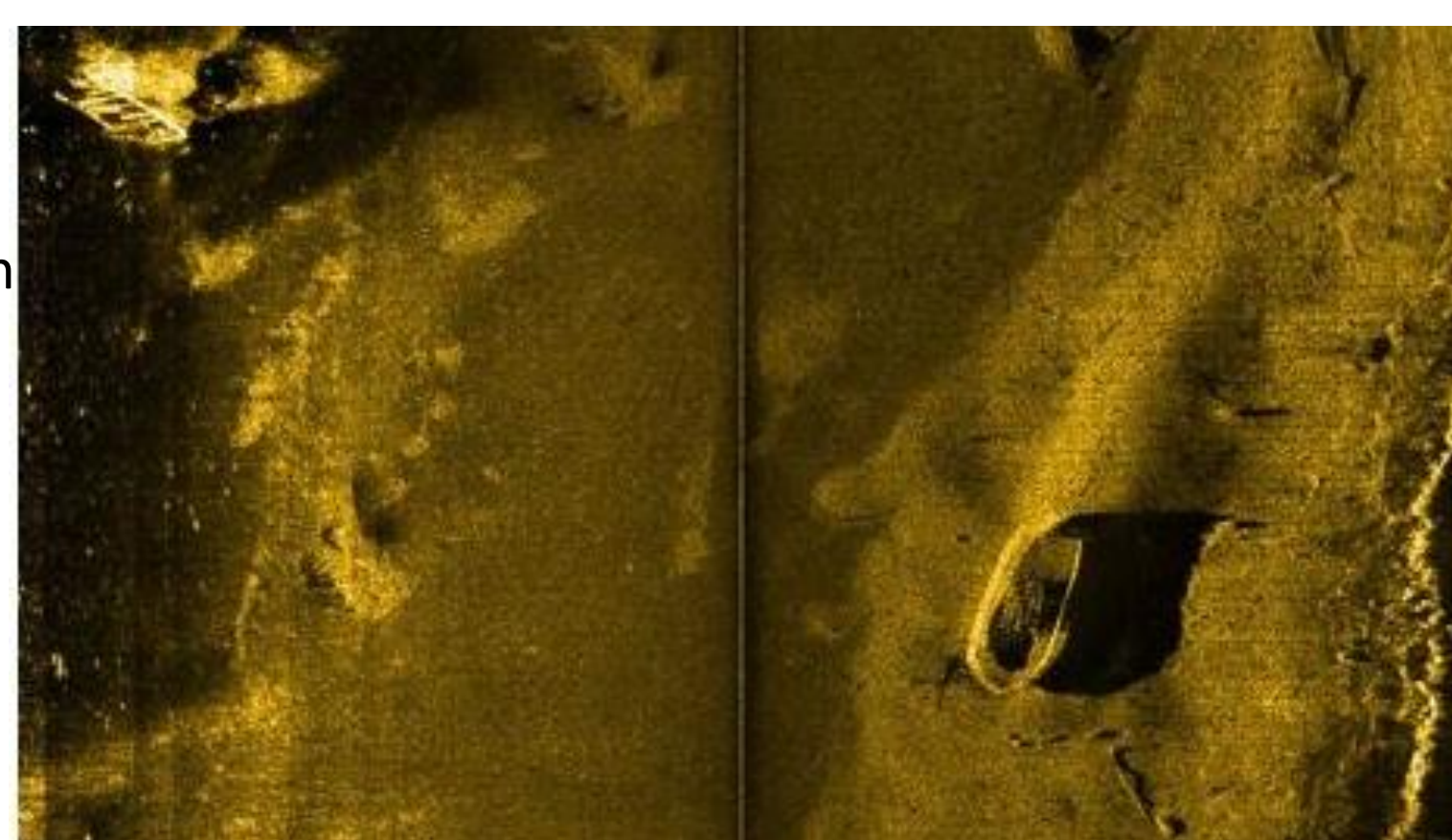


Bathymetry data

- data acquisition: Hypack 2020
- data processing: Hypack 2020
- data visualization: Voxler 4
- data format: .xyz

Sonar imagery

- data acquisition: Discover Edgetech
- data processing: Hypack 2020
- data visualization: Voxler 4
- data format: .jsf, .tiff

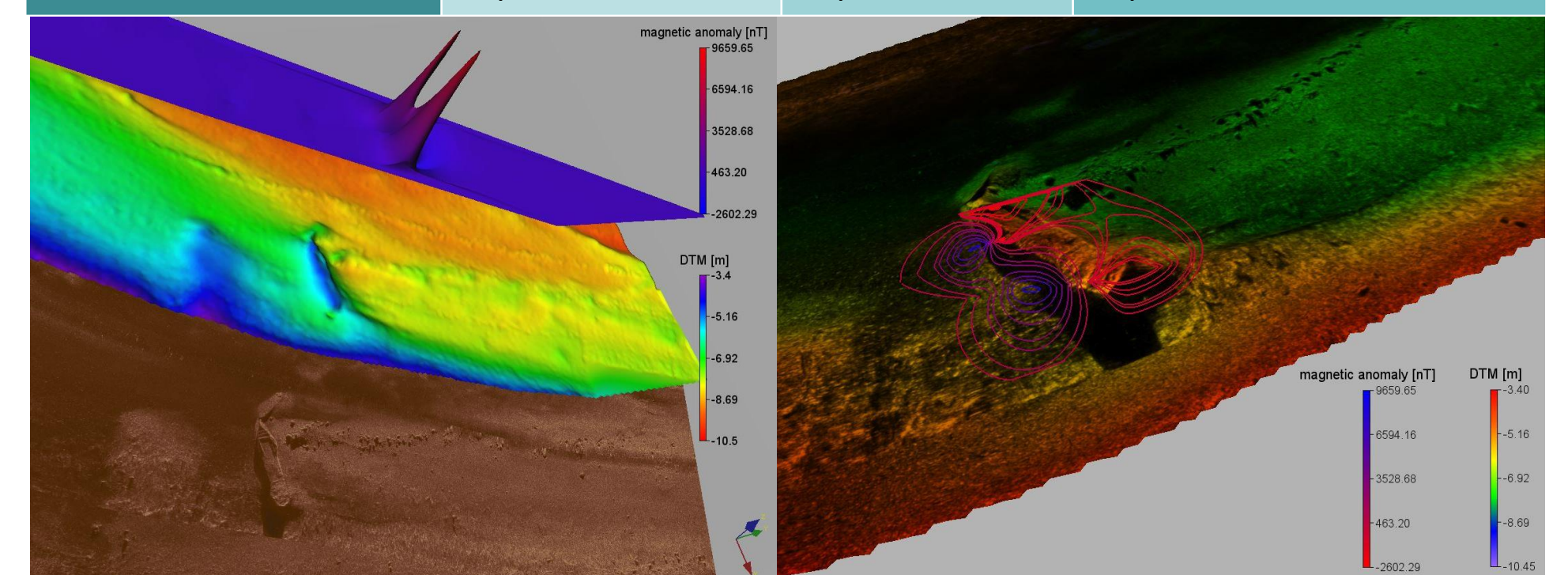


Magnetometry data

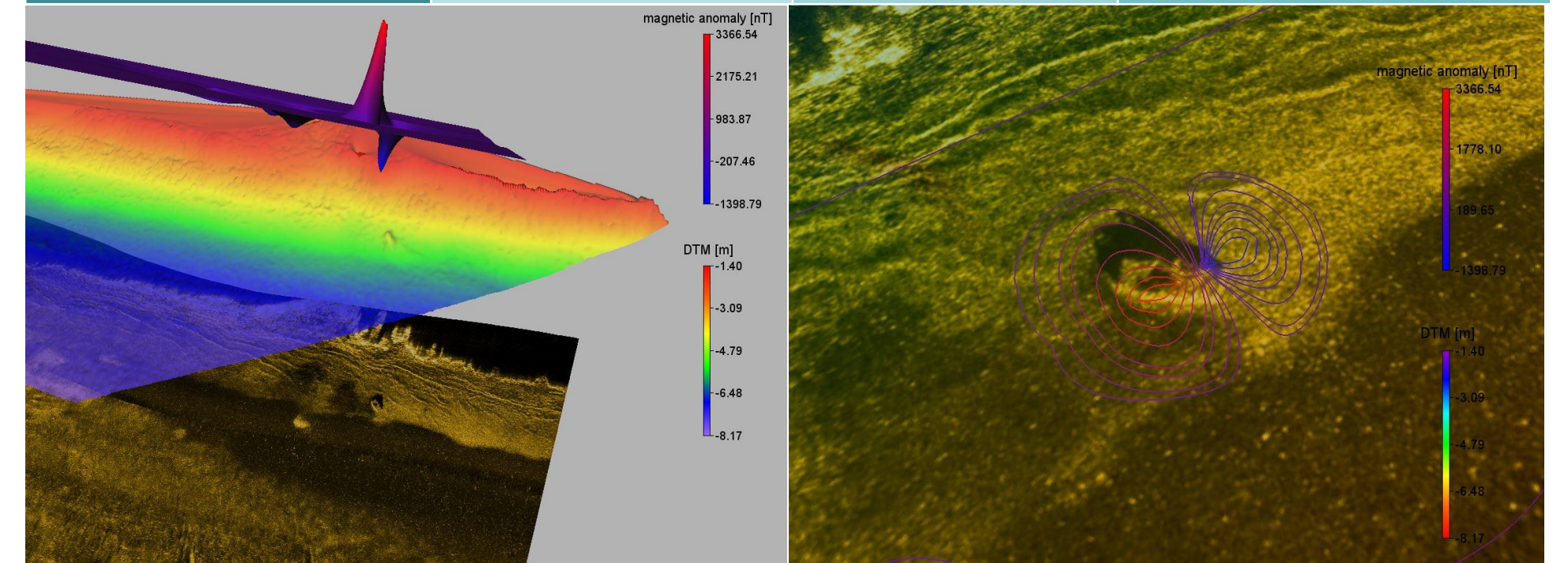
- data acquisition: Hypack 2020
- data processing: Hypack 2020
- data visualization: Voxler 4
- data format: .xyz

Results

object No. 1			
hydrographic sensor	side-scan sonar data	bathymetric data	magnetometric data
attributes	Edgetech 4125 length: 26.5 m width: 4.3 m height: 1.5 m	GeoSwath Plus depth clearance: max: -7.31 m min: -5.46 m mean: -4.76 m	SeaSPY MA(max): 9659, 65 nT MA(min): -2602,29 nT ΔMA: 12 261,94 nT
visual classification	shipwreck	shipwreck	shipwreck



object No. 2			
hydrographic sensor	side-scan sonar data	bathymetric data	magnetometric data
attributes	Edgetech 4125 length: 2.3 m width: 1.7 m height: 1.3 m	GeoSwath Plus depth clearance: max: -5.24 m min: -4.12 m mean: -4.64 m	SeaSPY MA(max): 3366,54 nT MA(min): -1398,79 nT ΔMA: 4765,33nT
visual classification	car wreck	car wreck	car wreck



Conclusions

The research and survey campaign were done within the cooperation of hydrographers from the Maritime University of Szczecin and the ethnologist from the University of Szczecin. Such cooperation was a creative experience, whose interdisciplinary value lay in learning about diametrically opposed research methods and techniques – in relation to the same object of research.

An aim of the research was to increase knowledge of the underwater cultural heritage of the Lower Oder. During the survey, 5 shipwrecks and 7 wrecks of cars were investigated and precisely described by hydrographic data such as a cloud of depth points, sonar imaging, and magnetic anomaly. The wrecks which the ethnologist once located on the basis of collected oral information have now been plotted by hydrographers on magnetic anomaly maps and 3D riverbed models.

For further works underwater vision inspection is provided using miniROV and underwater camera. In case of wrecks completely covered by bottom sediments a sub-bottom profiler should be used. These techniques would enable researchers to continue their study of the Lower Oder's underwater cultural heritage, which still needs to be better understood, effectively protected and consciously popularized.

Acknowledgments

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All the surveyed wrecks were previously inventoried during the project *Underwater ethnoarchaeology of the Lower Oder. Preliminary research on wrecks in the selected sections of the river*, carried by the University of Szczecin in the time period 2018–2019 and funded by the National Science Centre, Poland (grant No. 2018/02/X/HS3/00475) as a part of the MINIATURA 2 call.