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Bathymetry and lakebed mapping of Lake Altaussee using Multibeam Echo Sounding, UAV photogrammetry and underwater ROV imagery



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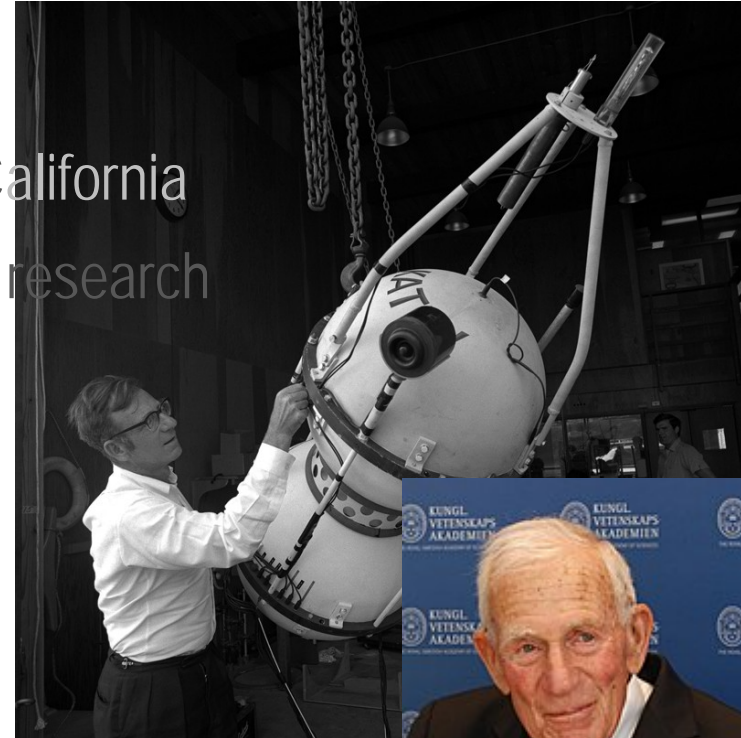
Content



- Introduction
- Conception and aim of the work
- Multi Beam Echo Sounding: Bathymetry, lake floor classification ...
- shallow water zone mapping with UAV and SfM photogrammetry
- validating and classifying underwater objects by ROVs
- Outlook and further research

Introduction

- The research project „Altauseer See“
- initiated by Walter Munk 2018
 - Scripps Institute of Oceanography, California
 - 70 years of his life to oceanographic research
 - on human impacts on oceans and aquatic ecosystems



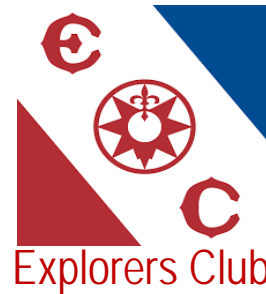
Goal

- a detailed investigation of
 - the geological structure,
 - the hydrogeologic system and
 - the biology of the lake of his native country
 - Communicating the results to the local residents, especially to the youth
- The overall or long-term goal:
 - the creation of a multidimensional digital representation of Lake Altaussee
 - contributions from all water-related scientific disciplines

Partners and und sponsors



Universität für Bodenkultur Wien
University of Natural Resources
and Life Sciences, Vienna




CHEOPS
Privatstiftung Wien



Location



Map source:  Austrian Map
BEV - Bundesamt für Eich und Vermessungswesen



Hydro-geological key data

- karst mountain range
- Catchment area:
 - Karst mountain „Totes Gebirge“
 - 54 km²
- only small tributaries on the shores of the lake
- most significant water inflow from submarine springs
- uncertain how many other submarine spring pits exist
- not sufficient reliable information about their discharge

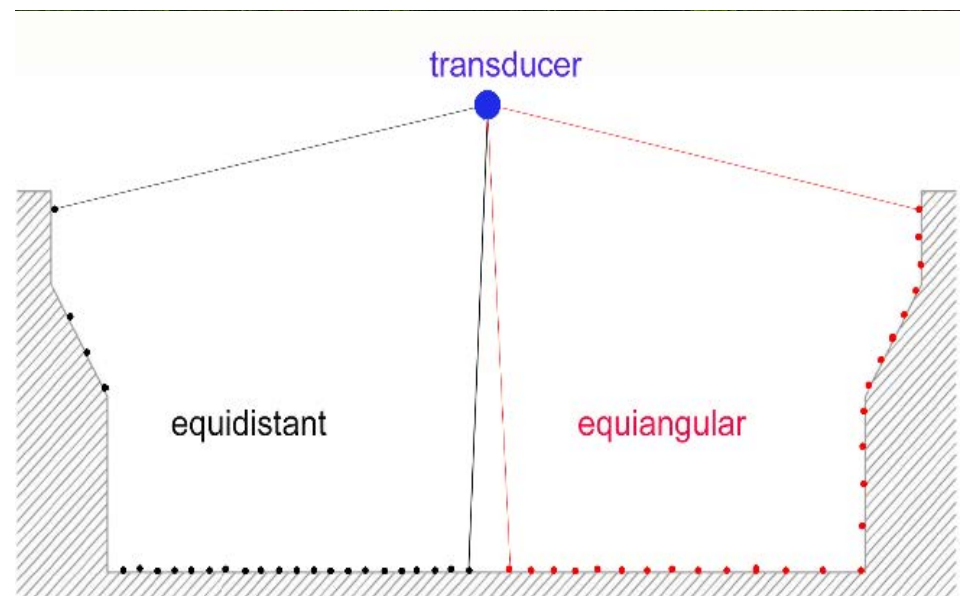


Multibeam Echo Sounding - Bathymetry

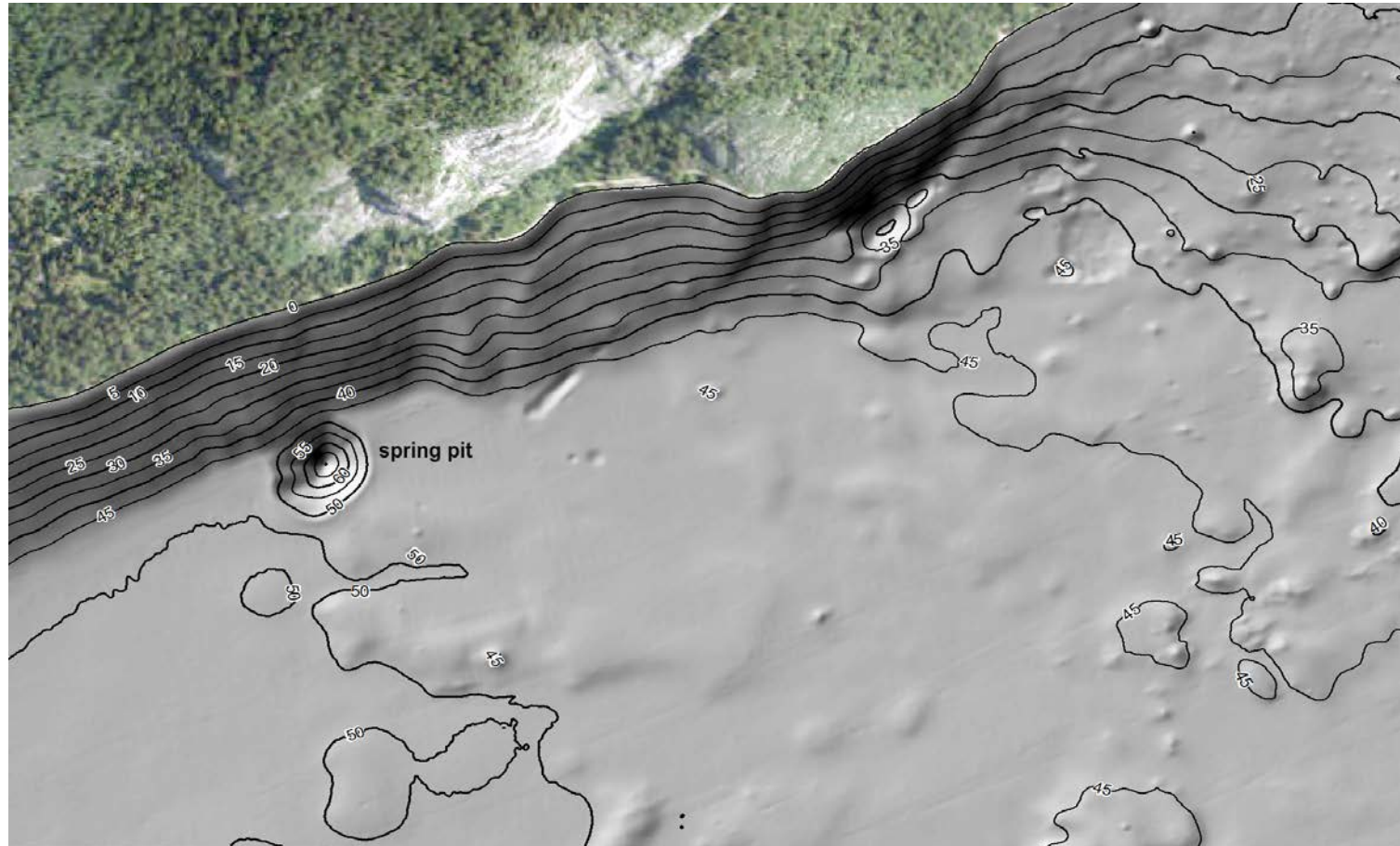
- Multi Beam Echos Sounder (MBES)
 - dual head transducer system
 - inclined arrangement of the transducers
 - possibility to record steep banks up to a few decimeters below the water level

- equiangle mode:
very steep shore zones

- equidistant mode:
slightly sloping bottom



MBES - Bathymetry



- Shaded relief of the lakebed DTM (0,5m x 0, 5m)
- High-resolution bathymetry of the submarine spring area

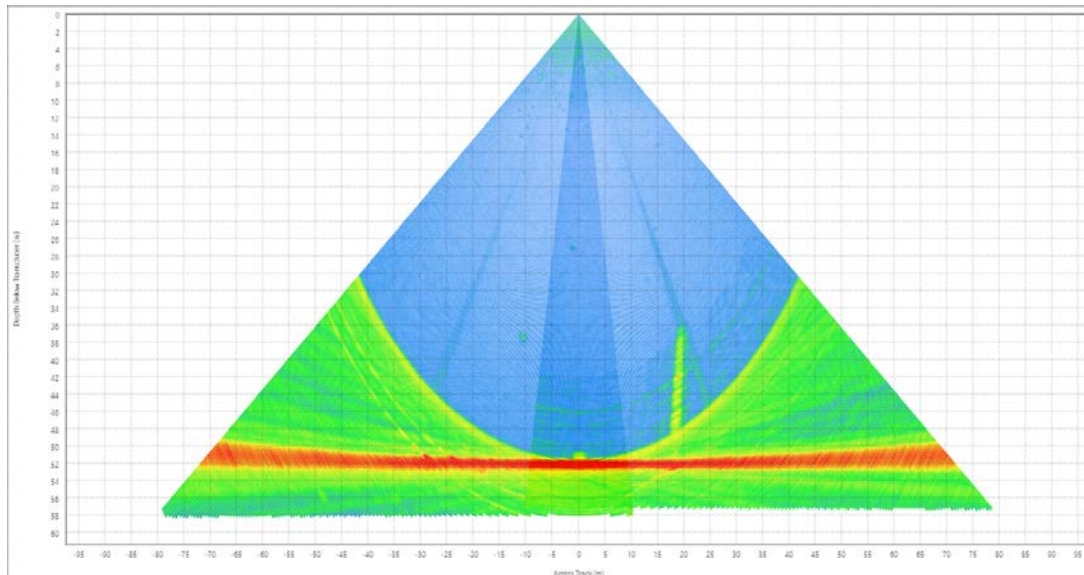
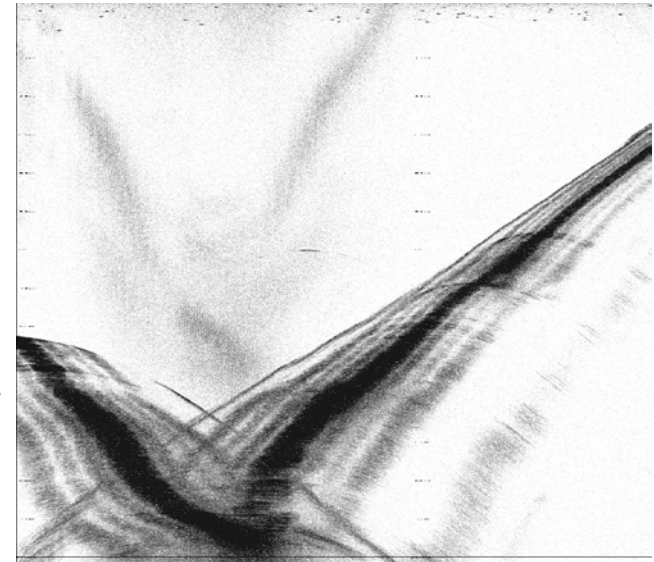
MBES - backscatter data for bottom classification

- "backscatter" strength (backscattering energy)
 - additional information about the structure of the seafloor, like sediment type, vegetation cover...

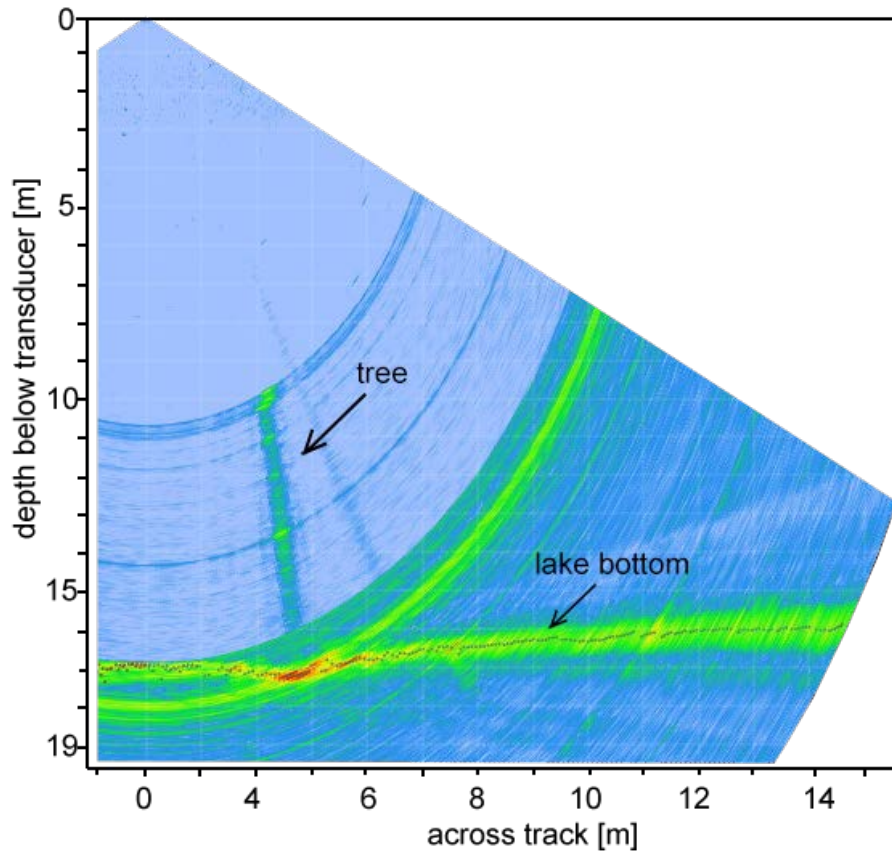


MBES – water column imaging for object detection

- water column imaging (WCI)
 - gas plumes (methane gas seeps)
 - submarine spring discharges
 - submerged trees



MBES – water column imaging for tree detection



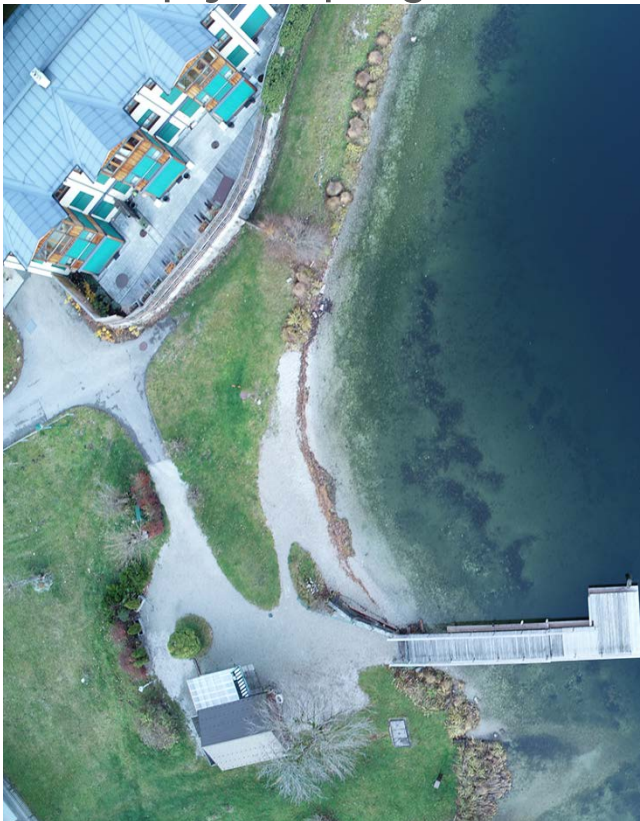
MBES WCI data showing a 7 m high submerged tree at 18 m water depth



Photo of a submerged tree taken by a remotely operated underwater vehicle (ROV)

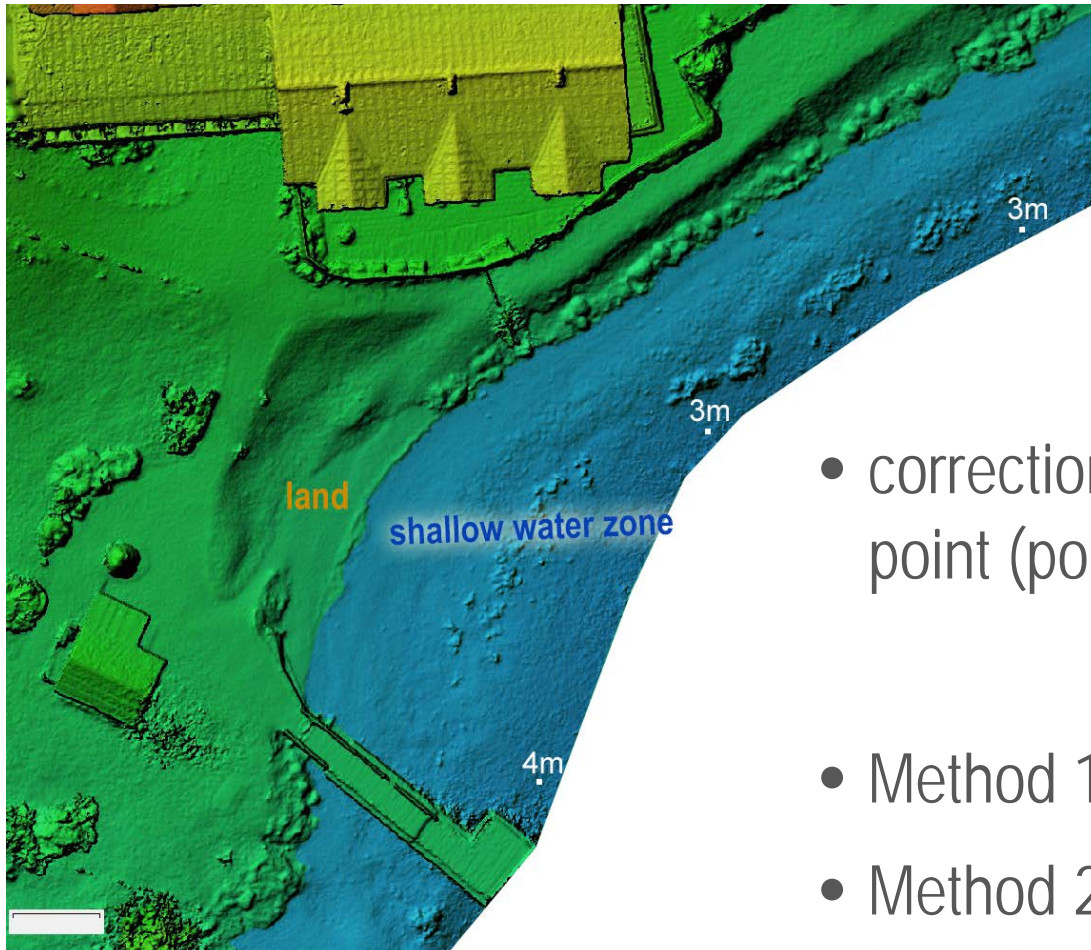
UAV photogrammetry of shallow water and shore zones

- Shallow water zones with water depths less than 1.5 m
- Steeply sloping shore zones



- UAV: DJI Phantom 4-RTK
- 3 stripes along the 5 km shore
- 70% transverse coverage
- water clarity of almost 10 m (Secchi depth)

Structure from Motion (SfM) for submerged areas

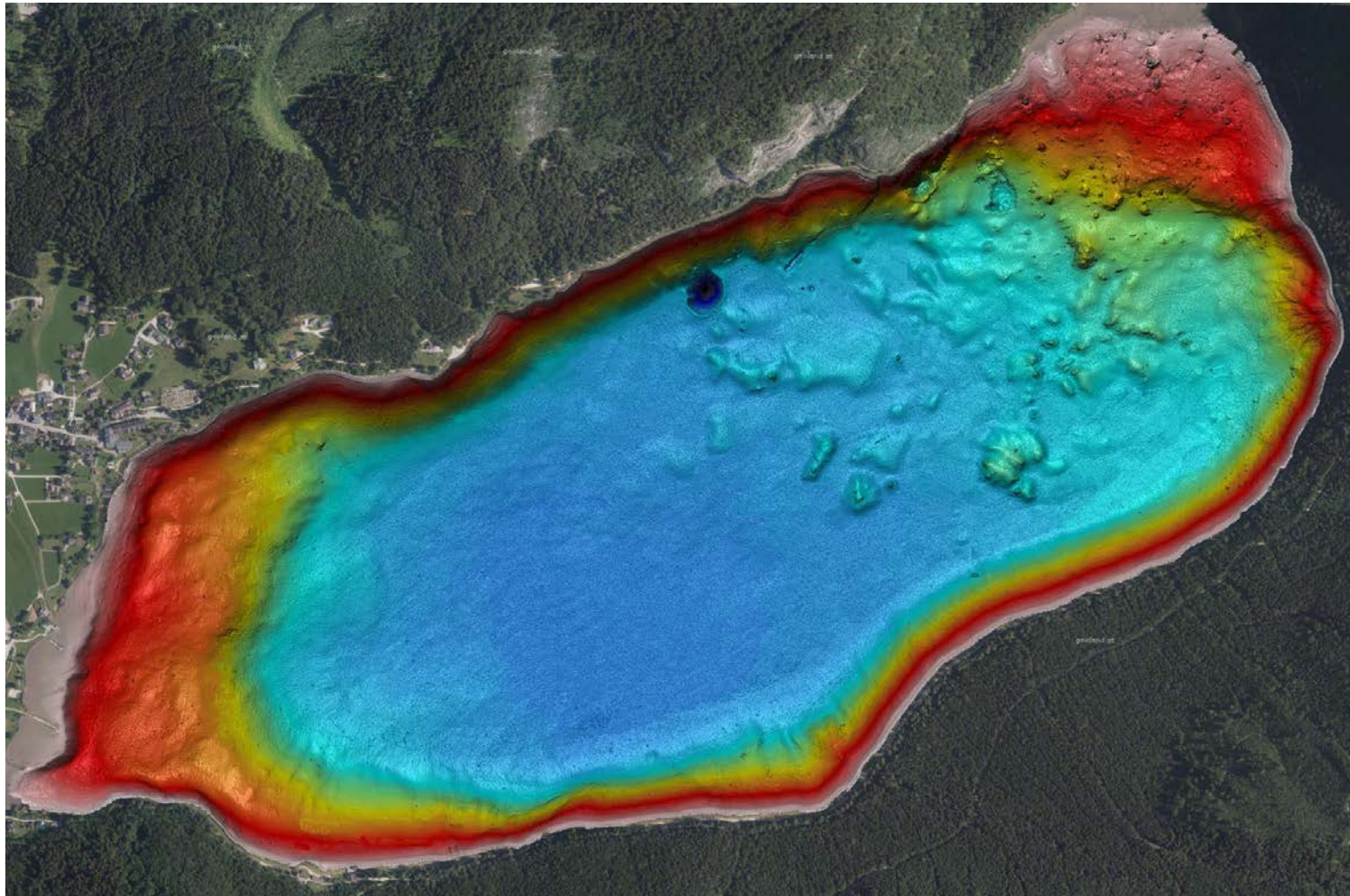


light refraction at the
air-water interface



- correction of the underwater object point (position / height)
- Method 1: empirical correction factor
- Method 2: SfM plug in for QIMERA based on the Dietrich Method for refraction correction

Bathymetry of Lake Altaussee



Object verification and mapping using ROV

Investigate the

- submerged trees and the
- huge spring pit at the lake bottom at 70 m depth

Repeated dives during the long term monitoring period with professional divers results in very complex and costly mission



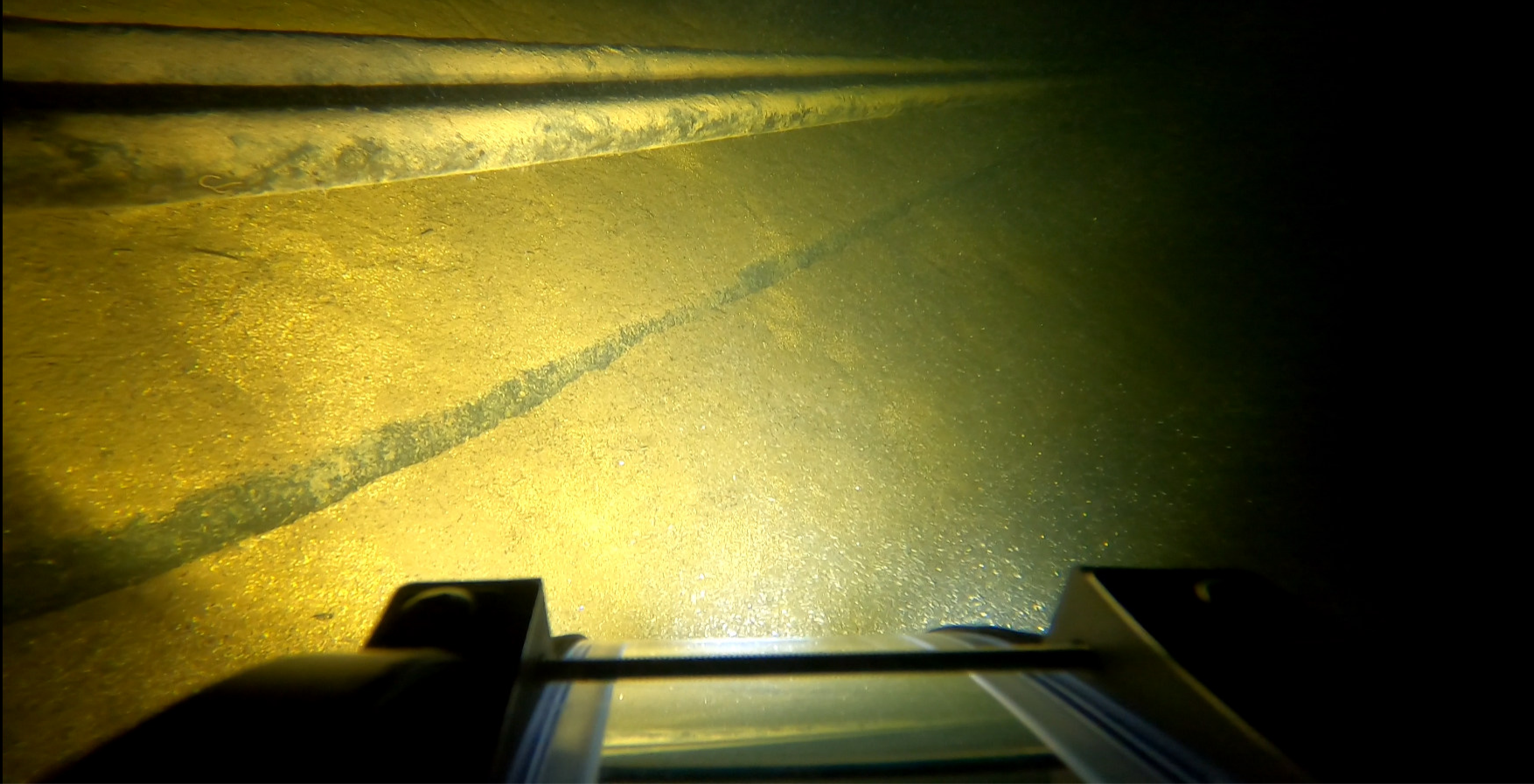
ROV DTG3 from
Deep Trekker, Canada

Submarine spring pit (50m - 72 m)

GH030037.MP4 - VLC media player

Medien Wiedergabe Audio Video Untertitel Werkzeuge Ansicht Hilfe

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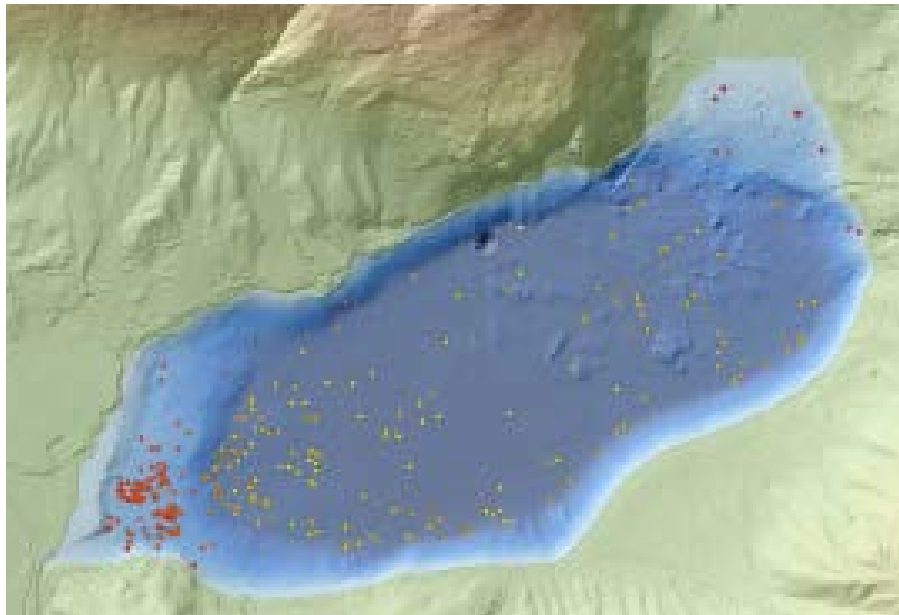
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89%

Verification of submerged trees

- Special attention was given to the verification and documentation of submerged trees
- identified using backscatter and WCI data from the multibeam echo sounding



pair of trees at 44m water depth

Conclusion

Based on

- multibeam echo sounder measurements,
- photogrammetric restitution of UAV images and
- underwater ROV video recordings,

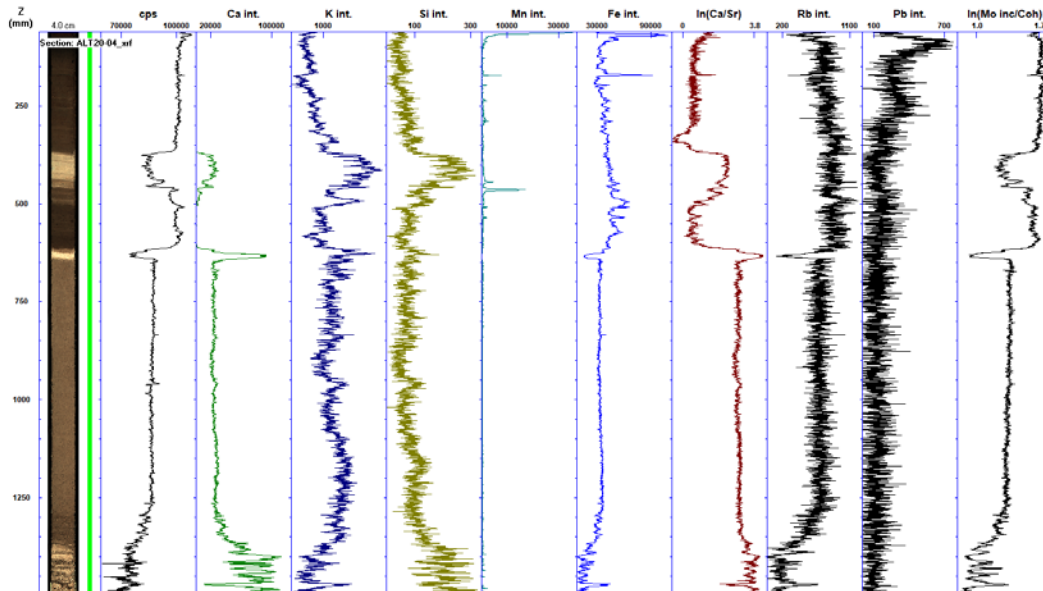
this model represents a comprehensive and precise information source of the lake basin.

Thus enable more precise statements to be made about the hydrobiology, water quality and water exchange in the lake with the surrounding karst system.

Outlook and further research (1)

September 2020 the second phase of the Walter Munk project "Lake Altaussee" started with the focus on the geological formation of the lake

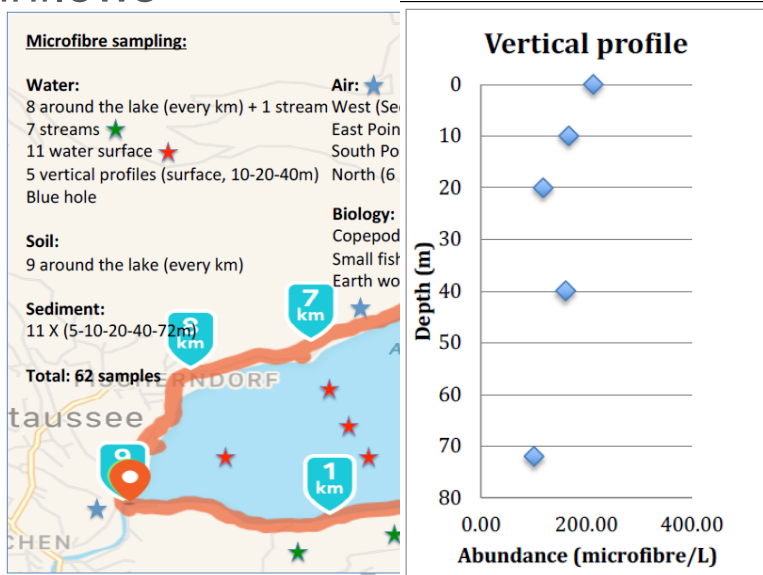
- research cooperation with the University of Innsbruck "Sedimentary Geology Working Group"



Outlook and further research (2)

Deheyn Lab

Microplastic and microfiber investigations of the water body and its inflows



Local „junior scientist“ at work

Meet us

University of Natural Resources and Life
Sciences (BOKU) Vienna, AUSTRIA

Walter Munk Foundation for the Oceans
La Jolla, CALIFORNIA