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

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

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

• a detailed investigation of
  o the geological structure,
  o the hydrogeologic system and
  o the biology of the lake of his native country
  o Communicating the results to the local residents, especially to the youth

• The overall or long-term goal:
  o the creation of a multidimensional digital representation of Lake Altaussee
  o contributions from all water-related scientific disciplines
Partners and sponsors

- BOKU
- Universität Innsbruck
- Walter Munk Foundation for the Oceans
- Scripps Institution of Oceanography
- Explorers Club
- CHEOPS Privatstiftung Wien
- Institut Paul Ricard
- Aix Marseille Université
- Richard Lounsbery Foundation
- IXblue
- Deep Trekker

Erwin HEINE

FIG eWORKING WEEK 2021 20-21 June
Location
Hydro-geological key data

• karst mountain range

• Catchment area:
  o Karst mountain „Totes Gebirge“
  o 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)
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