

Empirical Comparison of Shallow Water Bathymetry Data UAS MultiView Stereo Photogrammetry versus Single Beam Echo Sounding

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UAS Training San Diego
March 2011



UAS R&D @ Geoinformation

UAS Platforms



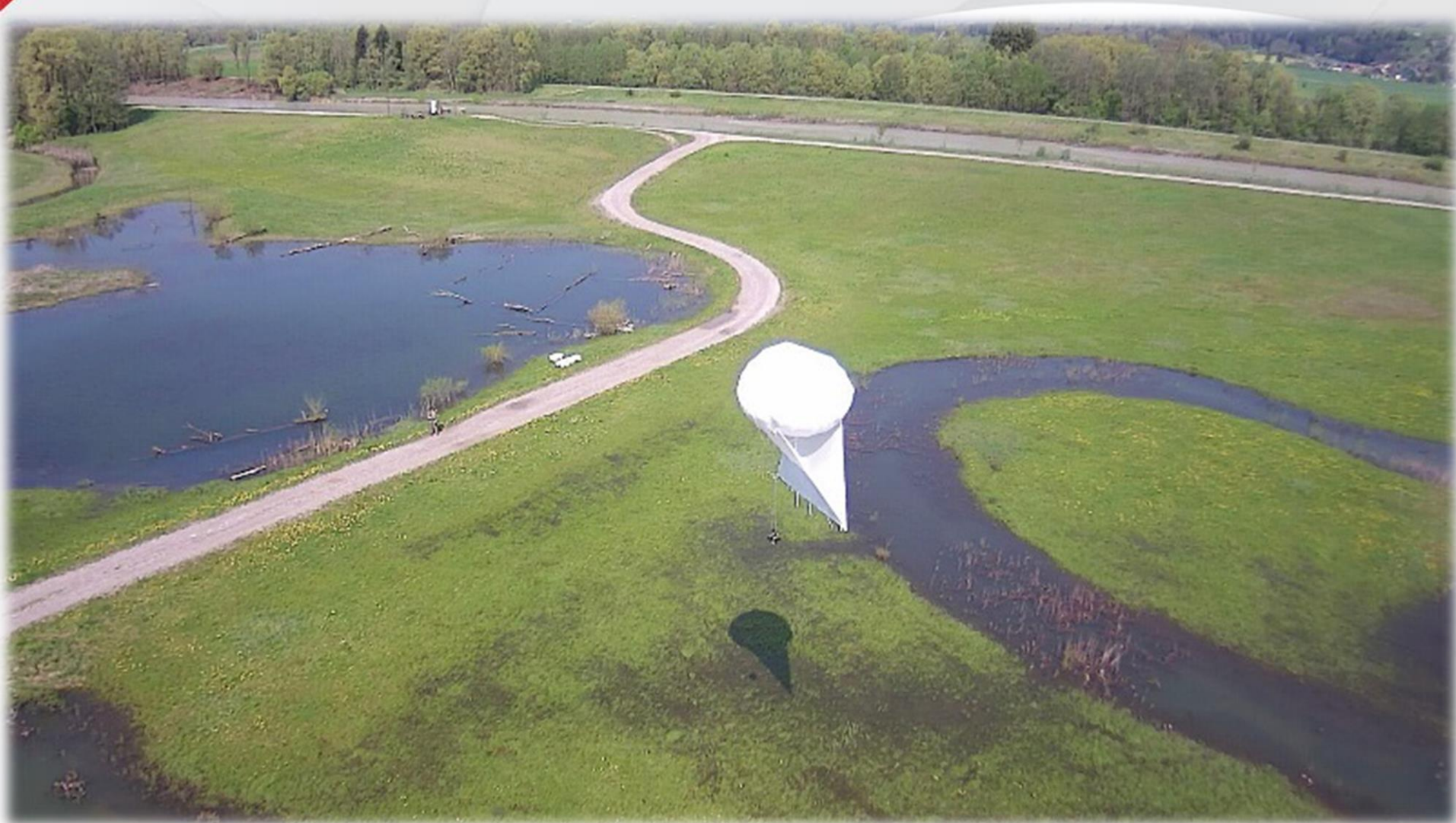
UAS R&D @ Geoinformation

UAS Platforms



UAS R&D @ Geoinformation

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UAS Platforms



UAS R&D @ Geoinformation Sensors

RIKOLA Hyperspektralkamera



Sony Alpha 6000 27 MP (RGB/NIR)



MicaSense Red Edge



FLIR Duo R Thermalkamera



"Wetterfrosch"
Meteorologischer Sensor



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Ground Truth



Leica
CS 20



Leica
MS 60

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UAS Mission Planning Support



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Welcome to Drone Zone Austria

A web portal that supports drone mission planning in Austria

www.dronezoneaustria.at

UAS R&D @ Geoinformation



UAS F&E Project volume 2014 - 2018 “+ 1Mill. €”

- **RPAmSS** – New environmental robotic services with a Remotely Piloted Aerial multi Sensor System - COIN
- **Drone Zone Austria** - Design of a Web Portal for Safe Drone Mission Planning in Austria - TakeOFF
- **Drone based Wetland Monitoring „Bleistätter Moor“**
2017 – 2021 – Research Cooperation Regional Government Carinthia, Dept. 8 Environment, Water & Nature Protection
- **FISHSTREAM** – Site Evaluation Fish Ladders– Key Indicators & UAS-based Analysis Tools Analyse tools – Verbund, flussbau iC, ViewCopter, BOKU
- **WÖRTHERSEE 3D** - „UAS-based photogrametric Analysis of Lake Shores – Example Lake Wörthersee“ – Research Cooperation Regional Government Carinthia, Dept. 8 Environment, Water & Nature Protection

Motivation
Problem Definition
Methods
First Results
Next steps



MOTIVATION

➤ EU Waterframework Directive

- 2000/60/EG (WRRL) requires an assessment of chemical and **ecological condition** of surface water bodies:
 - Biological, chemical and **hydromorphological quality components**

➤ 2017 Echo Sounding Campaign Wörthersee

- Last survey 1976 - 49 profiles, map with 10m isolines (1:25.000)
- New survey with Multi Beam (Deep water) & **Single Beam Echo sounding (Shallow water)**

Problem Definition

➤ Comprehensive capture of entire lake shore area

- approx. 150 m wide shore strip, Water-Land Transition Area, **46 km shore line**, 5.5 km²
- Low vegetation activity– Spring 2018



0 0.75 1.5 3 4.5 6 Kilometers

Methods - Overview

➤ Organisation & Planning

- Mission Planning & Control Points

➤ UAS – Missions

- Multicopter UAS (ViewCopter)

➤ Ground Truth

- DGNSS – Control Points (flussbau iC)
- Single Beam Echo Sounding (Dr. Döller Vermessung ZT GMBH)
- Water gauge Pörtschach: Water level

➤ Photogrammetric Analysis

- DSM, Orthophotomosaic

➤ Data fusion – Shallow water bathymetry

- Resampling, Integration, map sheets

Mission Planning



www.dronezoneaustria.at/map.html

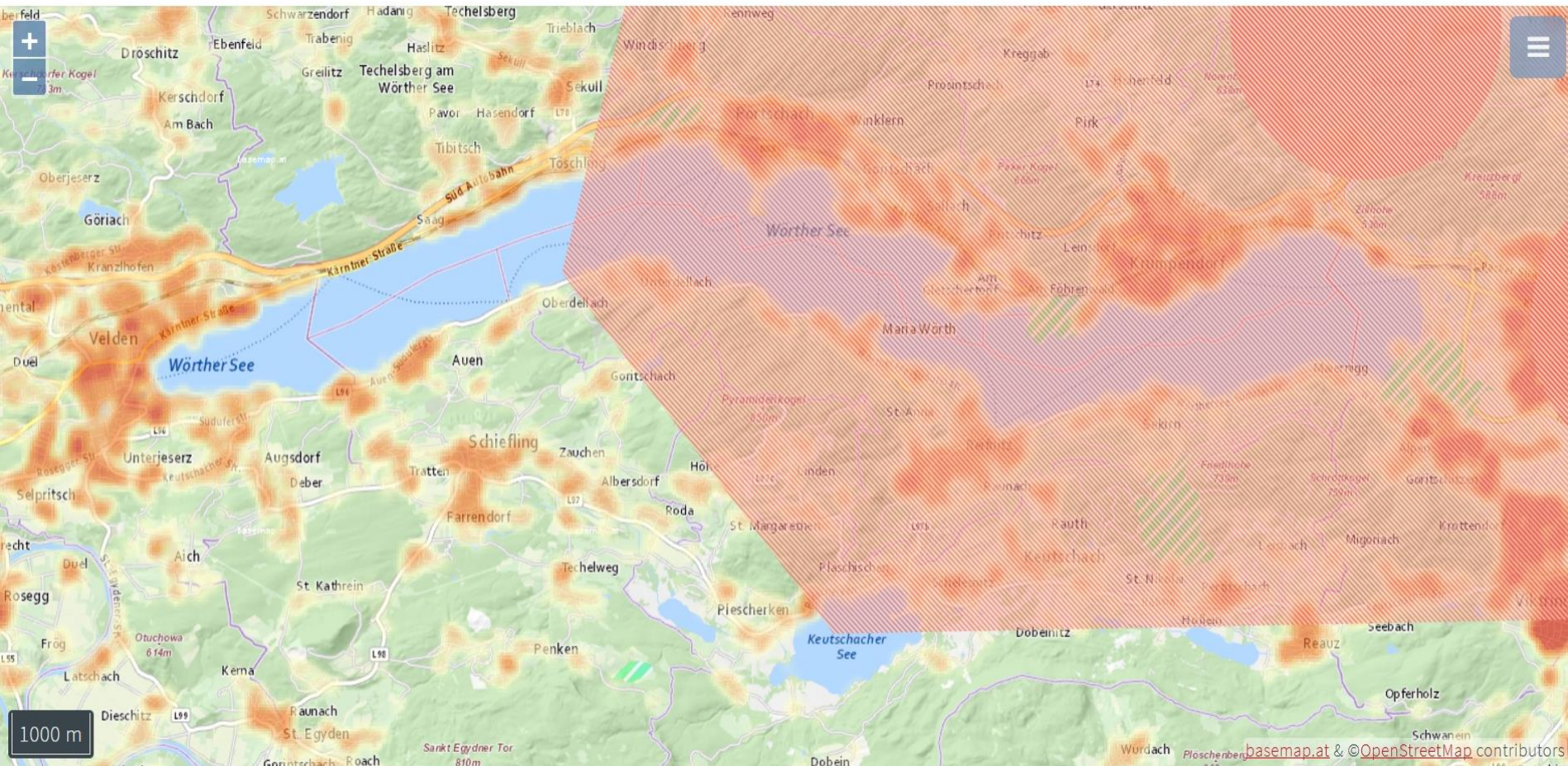


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UAS Missions

➤ UAS

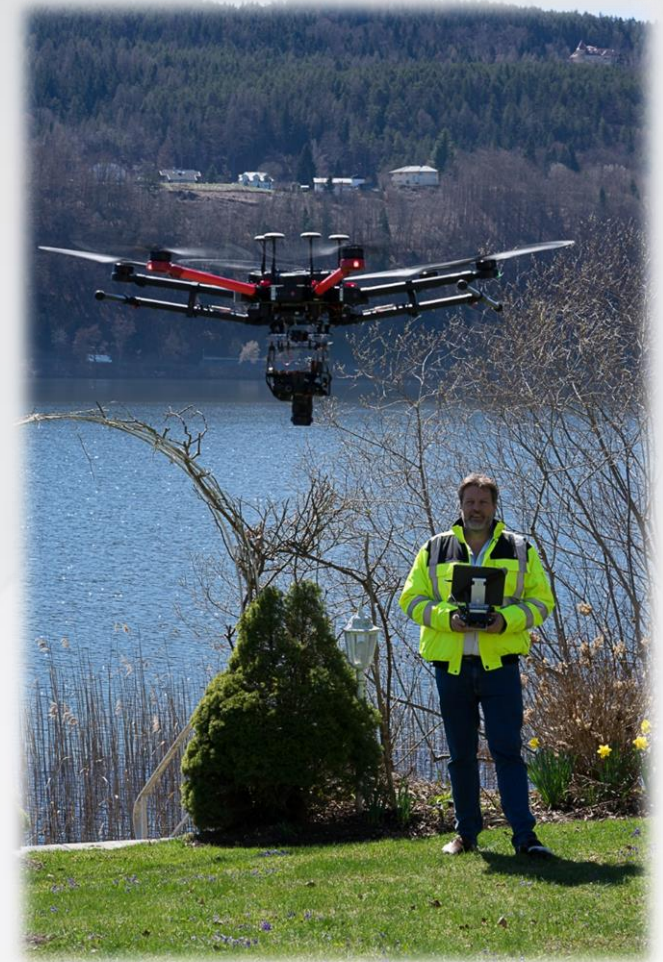
- Viewcopter V6H (adapted Hexacopter based on DJI Matrice 600 Pro)
- Class 1 - Category C flight permission
- Approx. 25 minutes Flight time

➤ Camera

- SONY ILCE-A7RM2 Full format camera, 43 MP, 28mm lens

➤ Period

- 27.March – 18. April 2018
- 11 Mission days



Photogrammetric Analysis



➤ Iterative Processing – Quality Control

- Phase I: Quick evaluation contemporary to UAS missions
 - Check overlap & image quality
- Phase II: Evaluation with high point density & manual control point allocation

➤ Hierarchic Bottom-Up Strategy

- 54 Flight segments
- Aggregation to 9 mission areas

➤ Software

- AGISOFT Photoscan Version 1.4.1.

➤ Hardware

- XEON Server with 24 Kernels, 4 GPU NVIDIA 20N Graphic cards & 128 GB RAM

Photogrammetric Processing

Data volume & Run times

UAS Survey Lake Woerthersee 2018 27.3.2018-18.4.2018 11 Flight Missions Photogrammetric Processing	Number Flight Segments	Number Images Total	Number Images Aligned	Flying Altitude m AGL	Ground Resolution cm/pix	Coverage Missi	RMSE X Control Points	RMSE Y Control Points (cm)	RMSE Z Control Points (cm)	RMSE Total Control Points (cm)
Mission Area 01	6	1899	1811	153			1.23		4.1	8.17
Mission Area 02	6	1893	1883	154			1.25		0.85	1.97
Mission Area 03	6	1952	1924	149			1.69		0.85	2.27
Mission Area 04	5	1667	1618				0.97		0.95	1.85
Mission Area 05	5	1686	1684				1.39		0.99	1.85
Mission Area 06	6	1907	120				1.69	1.43	0.56	1.68
Mission Area 07	7	2592					1.47	1.46	0.74	2.2
Mission Area 08	6	2105					2.07	2.26	1.81	3.57
Mission Area 09	7	18				26	1.24	0.99	1.33	2.07
	54					180	1.74	1.73	1.35	2.85
Total Sum						Total Sum	Mean	Mean	Mean	Mean

Data volume
Image Data: 605.54 GB
DSM: 25.44 GB
Orthomosaic: 76.06 GB

UAS Survey Lake Woerthersee 2018 Photogrammetric Processing Time	Cloud Generation	DSM Processing	Orthomosaic Processing	Total Processing Time (h)
Mission Area 01	78:00:00	0:18:48		95:41:57
Mission Area 02	33:00:00	0:21:54	2:22:00	51:24:48
Mission Area 03	39:00:00	0:25:54	2:24:00	67:07:50
Mission Area 04	26:00:00	0:21:39	2:37:00	39:27:26
Mission Area 05	49:00:00	0:20:09	2:34:00	71:53:15
Mission Area 06	42:00:00	0:13:06	1:31:00	59:55:03
Mission Area 07	59:00:00	1:21:00	7:39:00	93:31:25
Mission Area 08	154:00:00	0:26:11	3:38:00	535:42:10
Mission Area 09	43:00:00	0:28:39	2:30:00	66:00:17
Gesamt	523:00:00	4:17:20	25:15:00	1080:44:11
				45:01:50

Results



Results



Results



Results



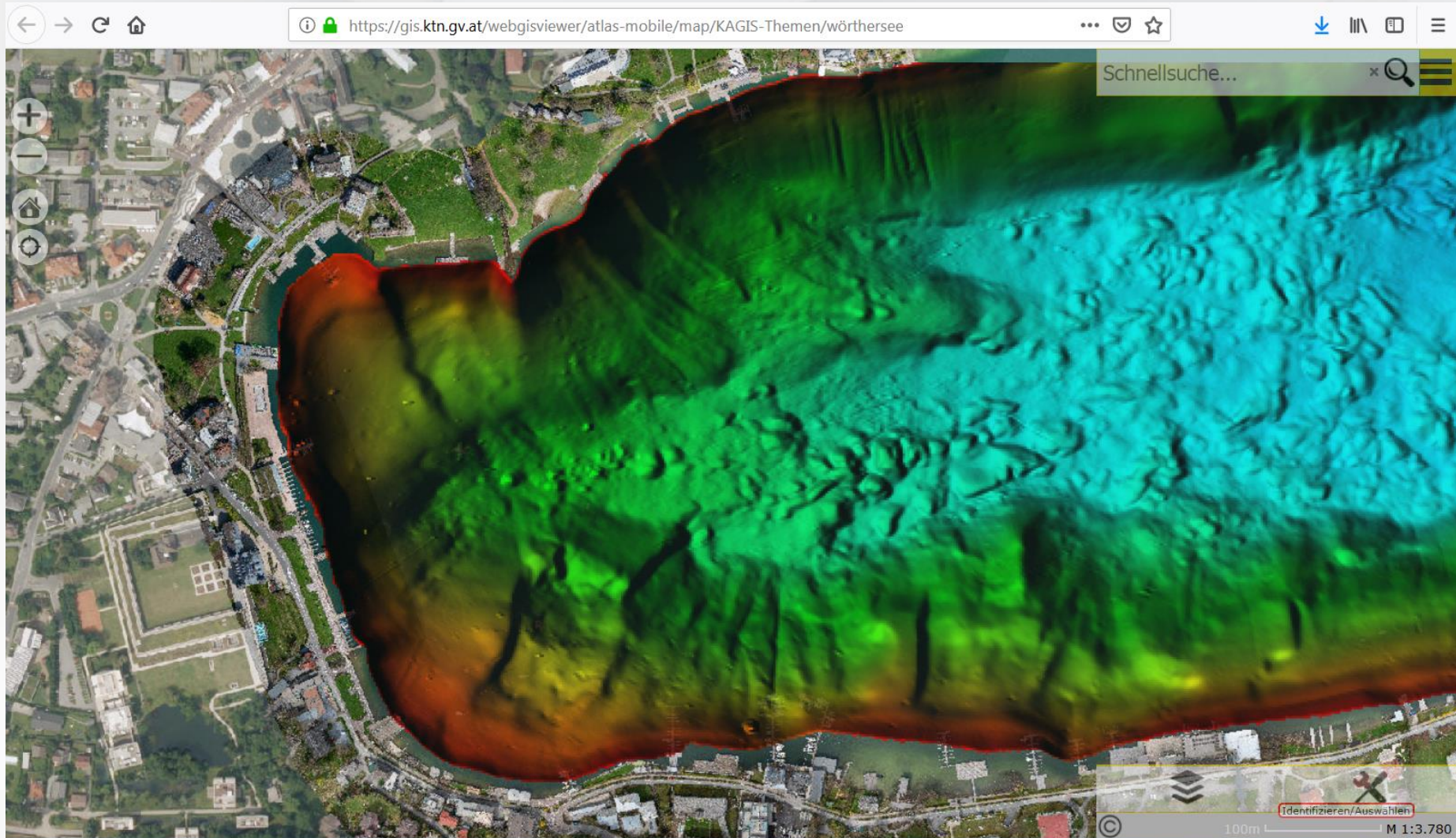
Results



KAGIS WMTS WebService

Blattschnitt: 1250m x 1000m

<https://gis.ktn.gv.at/webgisviewer/atlas-mobile/map/KAGIS-Themen/w%C3%B6rthersee>

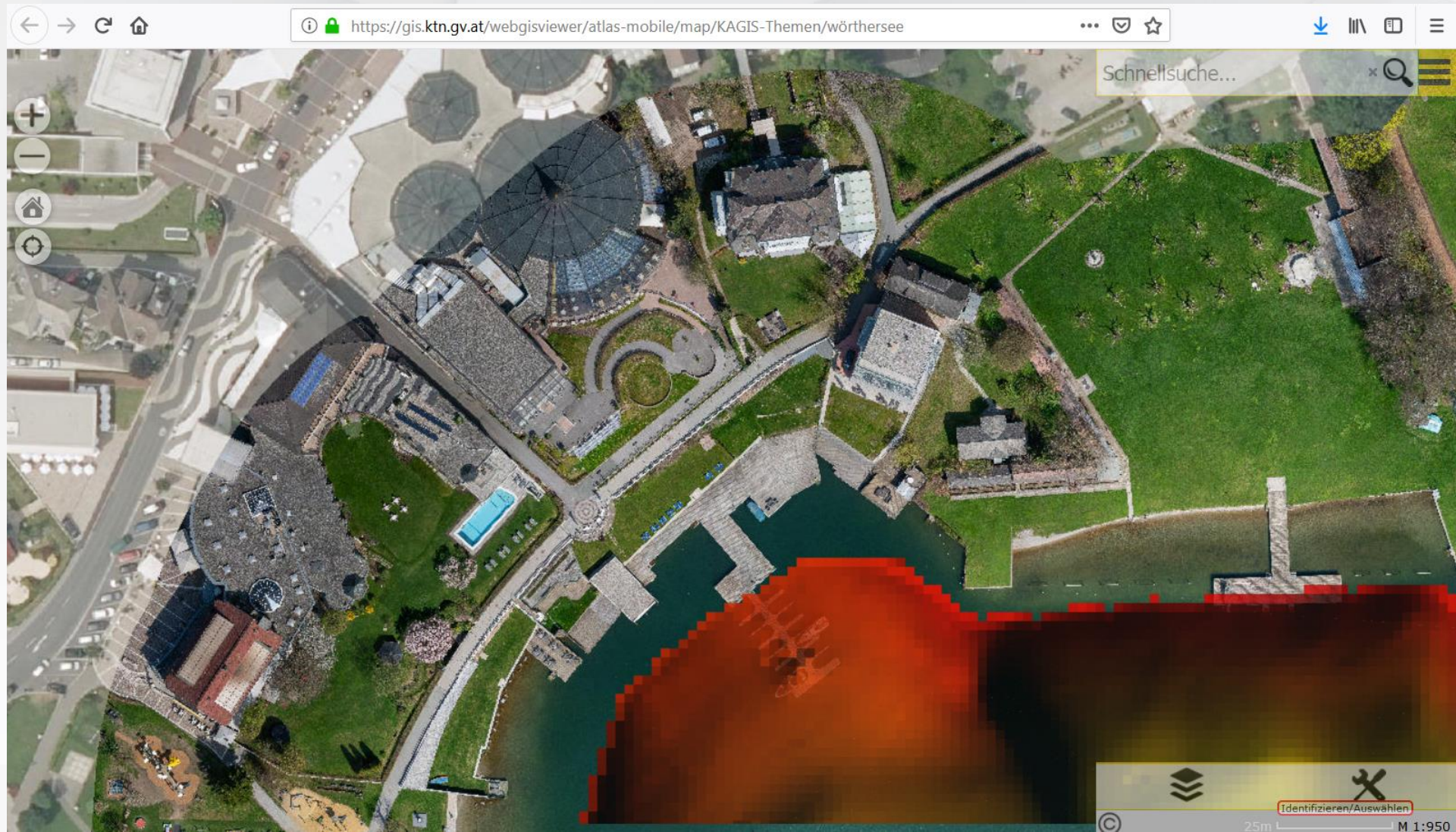


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UAS Shallow Water Bathymetry

Empirical evaluation UAS versus Single Beam Echo Sounding –
First Results

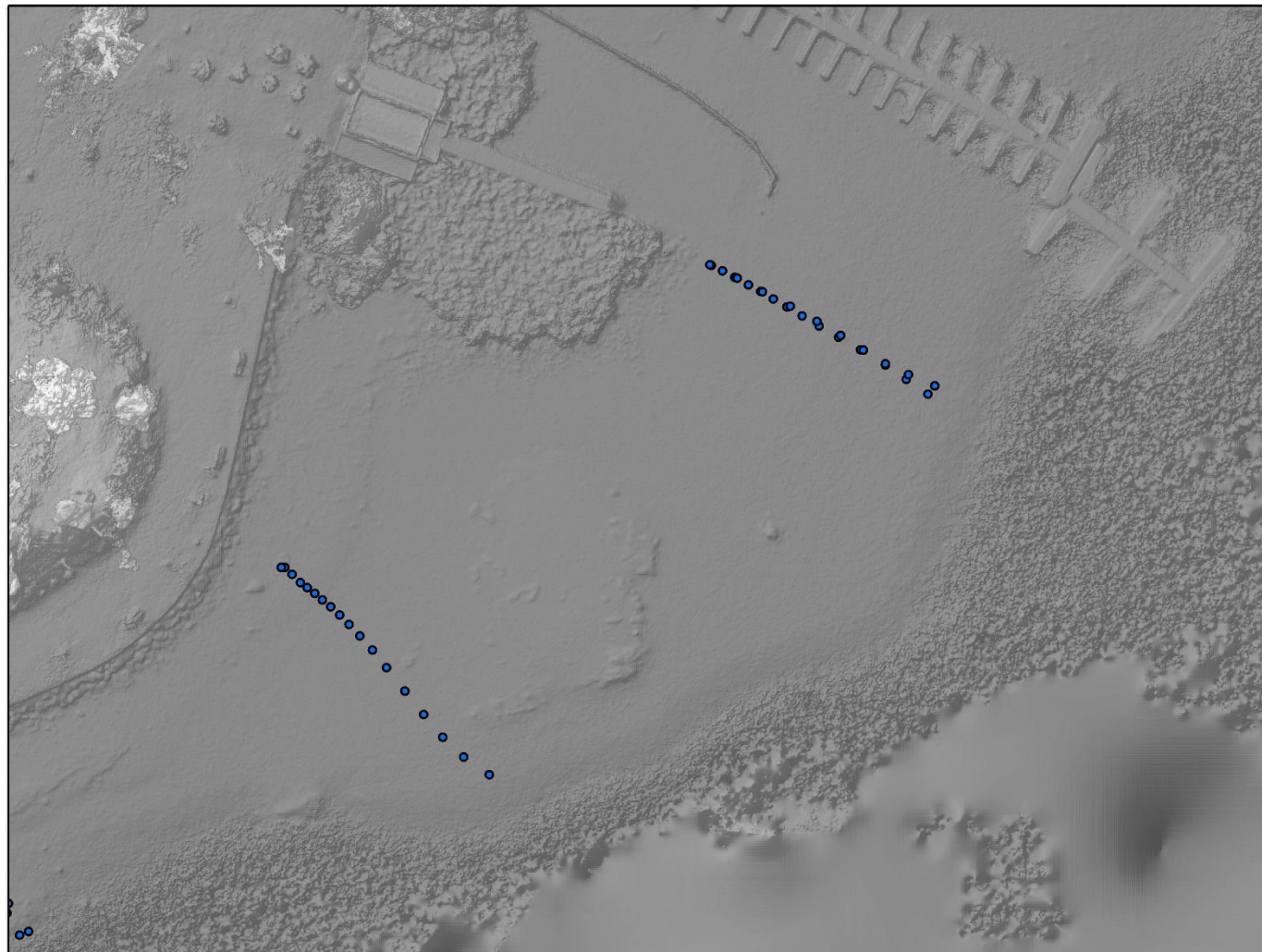


• Single Beam Echolot

10 5 0 10 Meters

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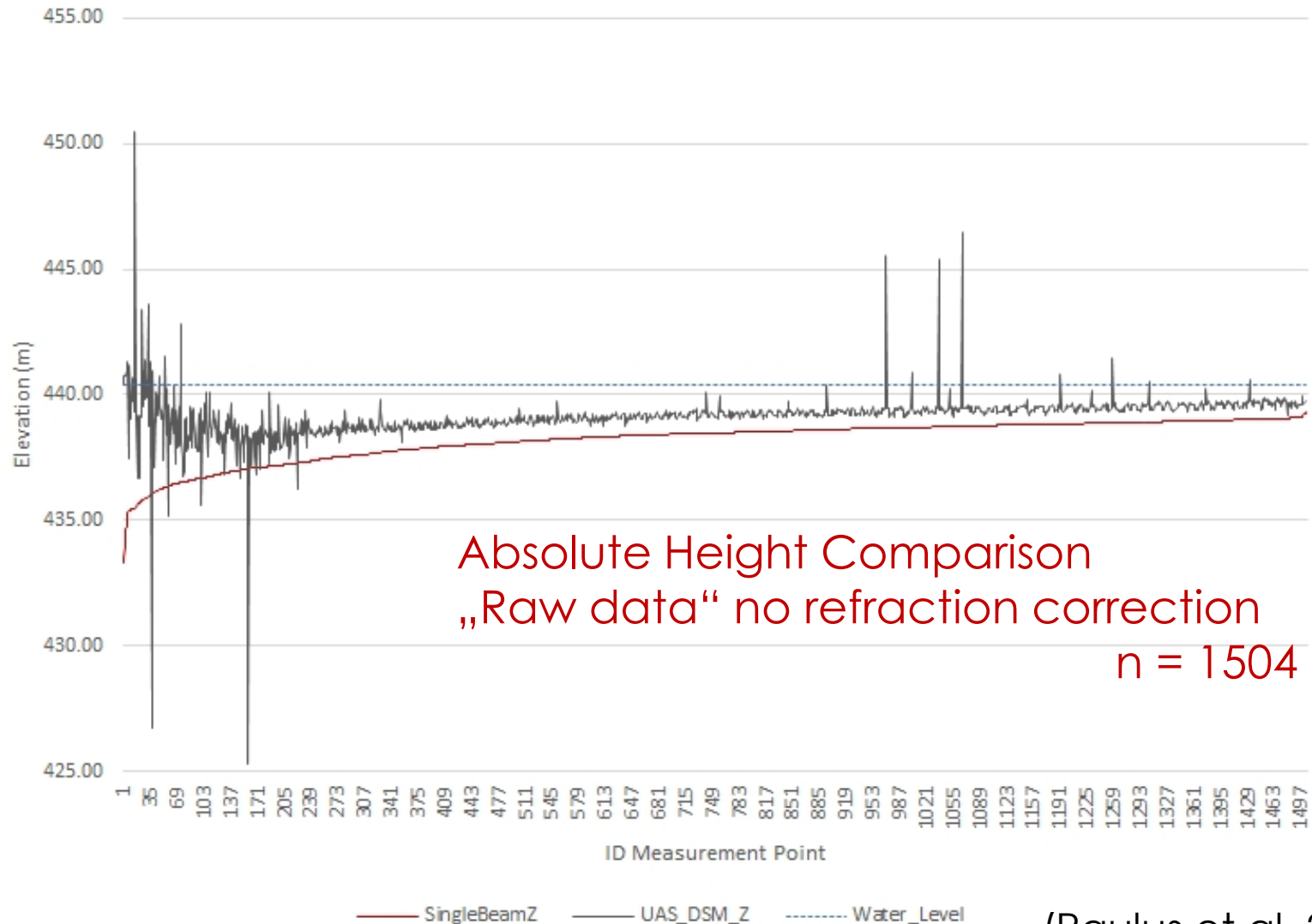
• Single Beam Echolot

10 5 0 10 Meters



UAS Shallow Water Bathymetry

Empirical evaluation UAS versus Single Beam Echo Sounding –
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(Paulus et al. 2019)

Next Steps

- **Statistical assessment total shallow water area**
 - Current: approx. 5.5 km shallow water – 1504 Single Beam reference points
 - Final: approx. 50 km - 8295 Single Beam reference points
 - Local versus global models
- **Consideration of accuracy/uncertainty Single Beam Echo sounding**
 - Lake bottom types?
- **Environmental influence?**
 - Calm water versus wind & waves?

„Drone Office!not Home Office“



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