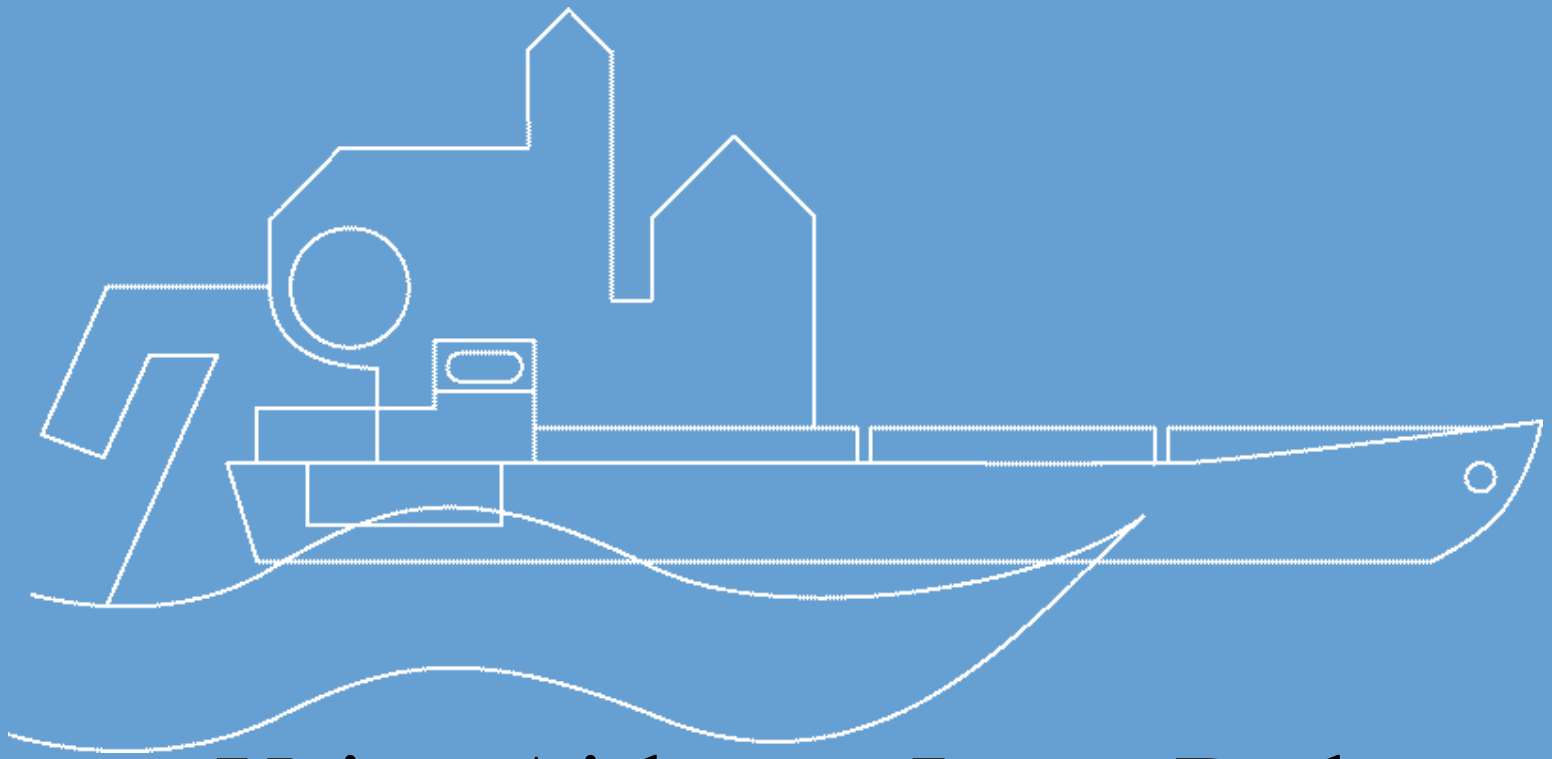


Using Airborne Laser Bathymetrie to map the river Elbe

Dr.-Ing. Robert Weiß
Department Geodesy, German Federal Institute of Hydrology

Dipl.-Ing. Katja Richter, Dr.-Ing. Patrick Westfeld
Institute for Photogrammetry und Remote Sensing, TU Dresden

Workshop Gewässervermessung aus der Luft
Wien, 11.-12. Februar 2016

Content

1. Current status and objectives
2. Characteristics of inland waterways
3. Project ALB Elbe/Klöden
4. Further activities
5. Conclusions

1. Current status and objectives

> Federal Waterways and Shipping Administration

> Responsible for the operation, upgrading and construction of the federal waterways

> Ensure smoothly flowing and safe shipping traffic

> Maintenance

> ……

> Modelling of inland waterways

> Digital terrain model with watercourse (DGM-W)

> River flow modelling

1. Current status and objectives

> Digital terrain model of the watercourse (DGM-W)

> Topography of the dry areas

> Conventional Airborne Laser Scanning

> Riverbed topography

> Echo sounder / sounding vessel

> Data gaps

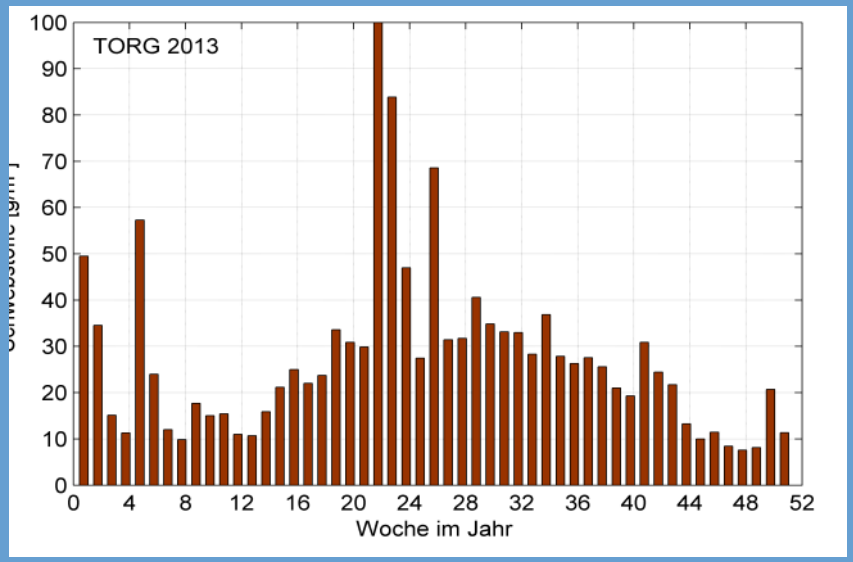
> Shallow waters

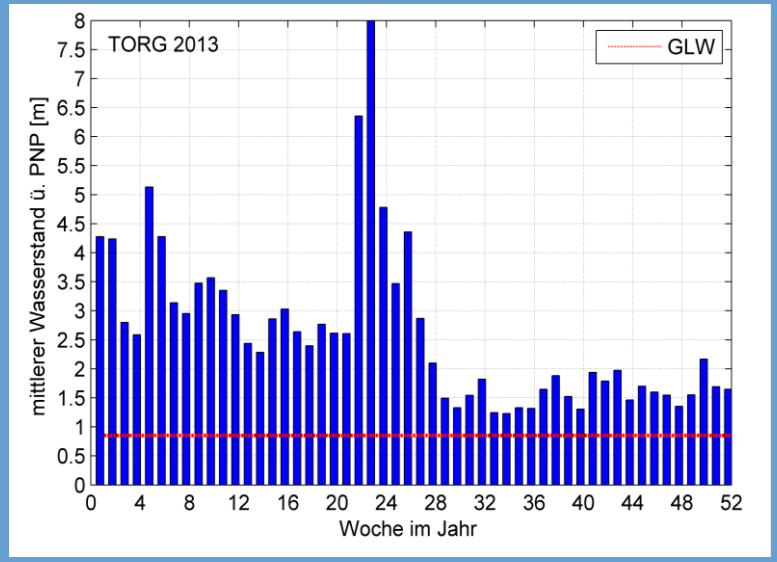
> Backwaters

Laser Bathymetry?

2. Characteristics of inland waterways

- Shipping channel
- Small waves
- Varying turbidity
- Varying water depths

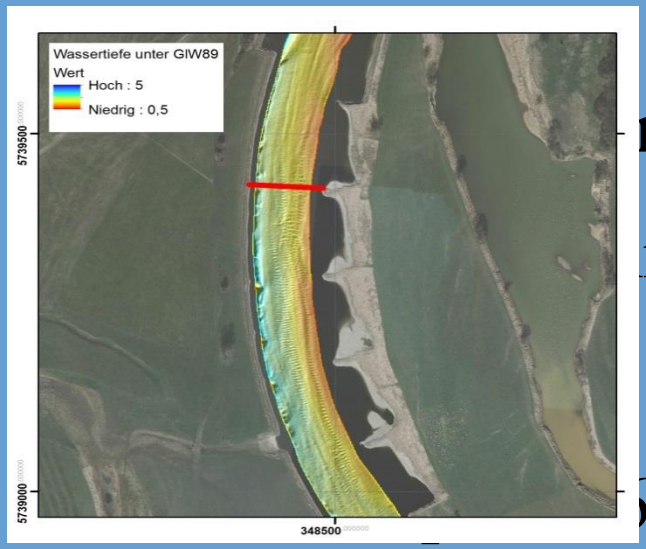


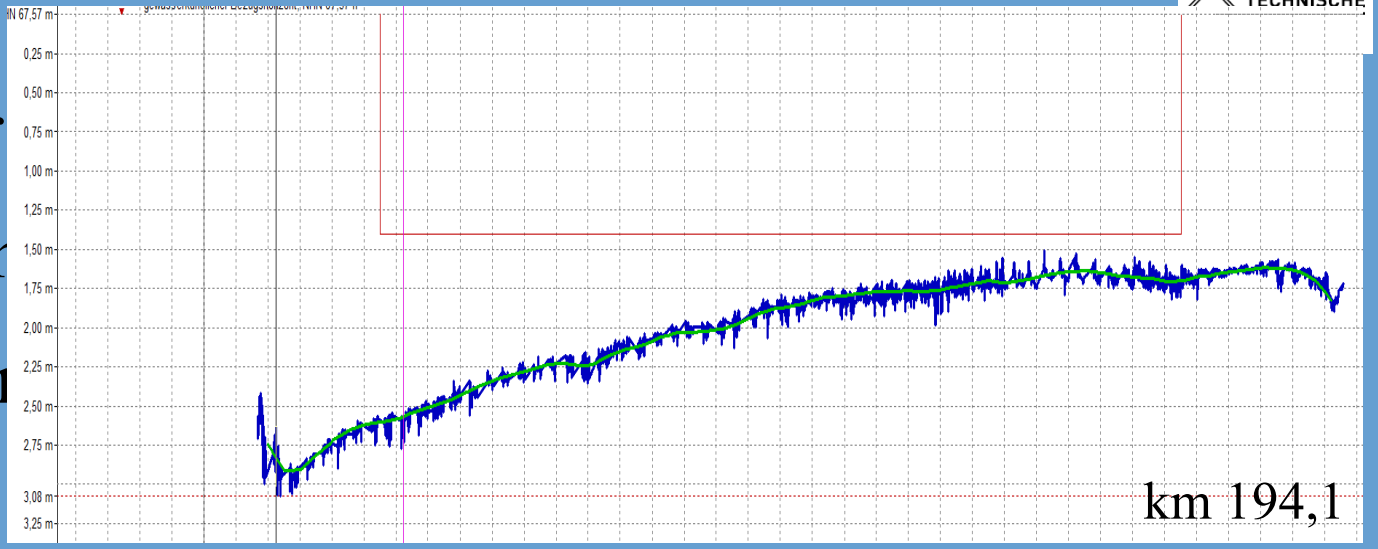


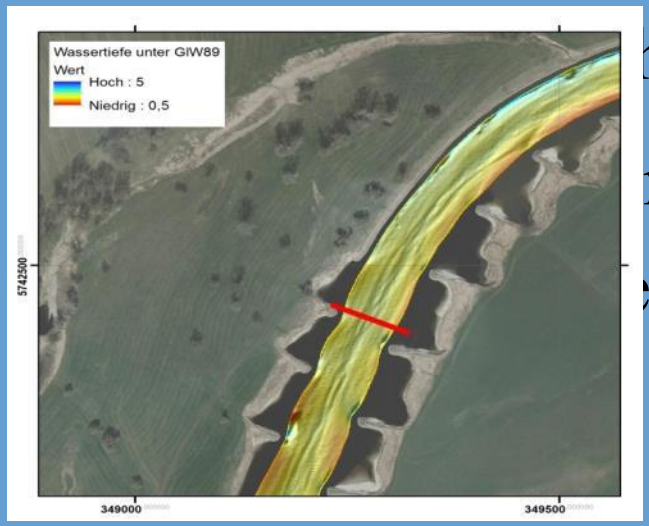
2. Characteristics of inland waterways

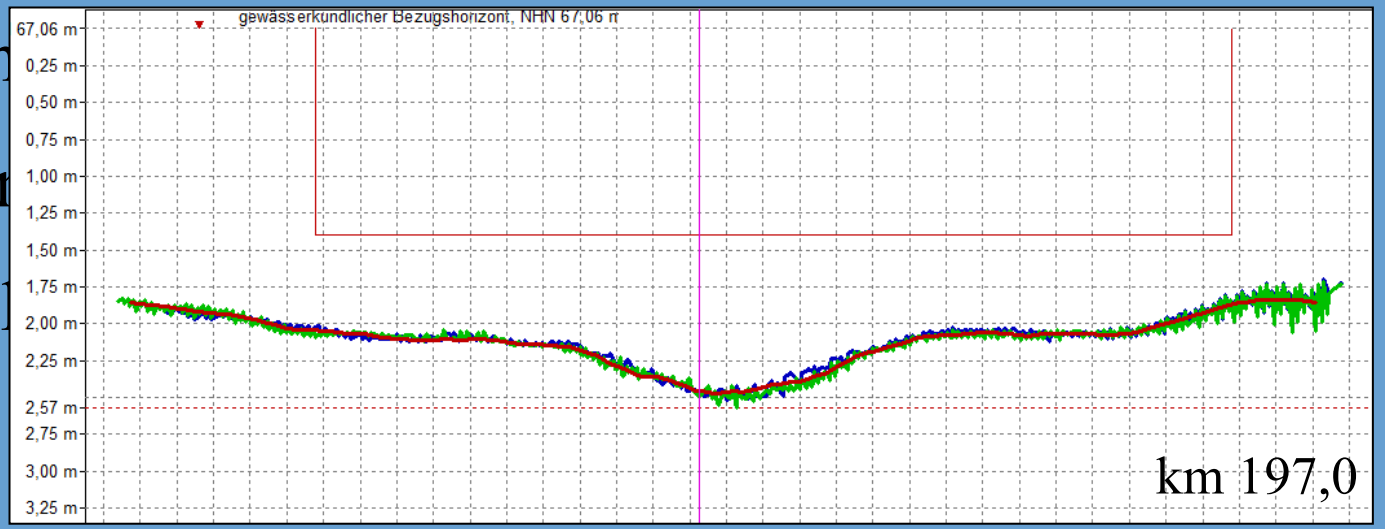
- Example: river Elbe (km184-205)
- Shipping channel
  - Width: 50 m
  - Depth: 1,6 m in relation to reference horizon
- Shipping channel / riverbed partly significant deeper

2. Characteristics of inland waterways

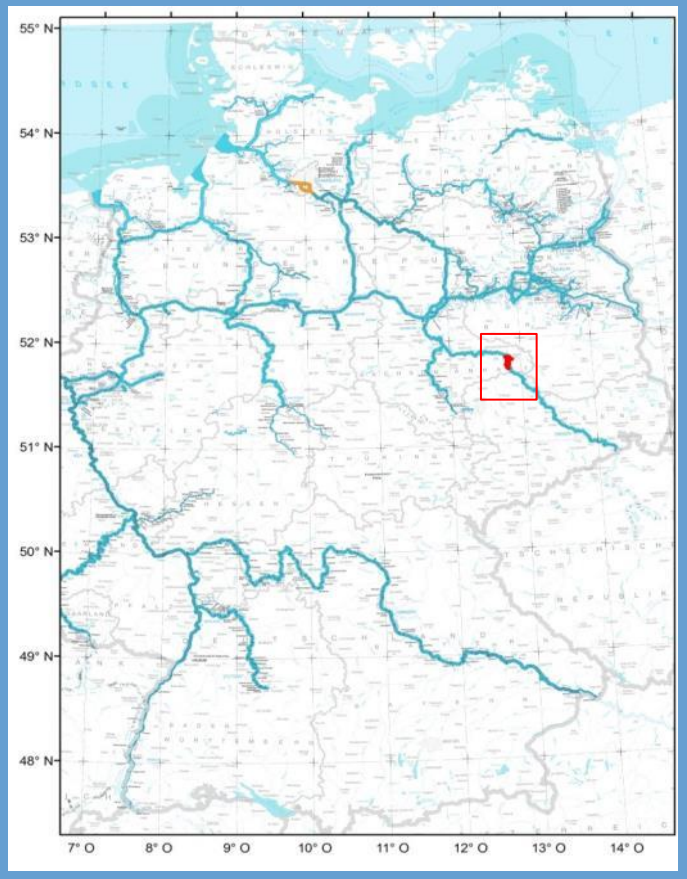


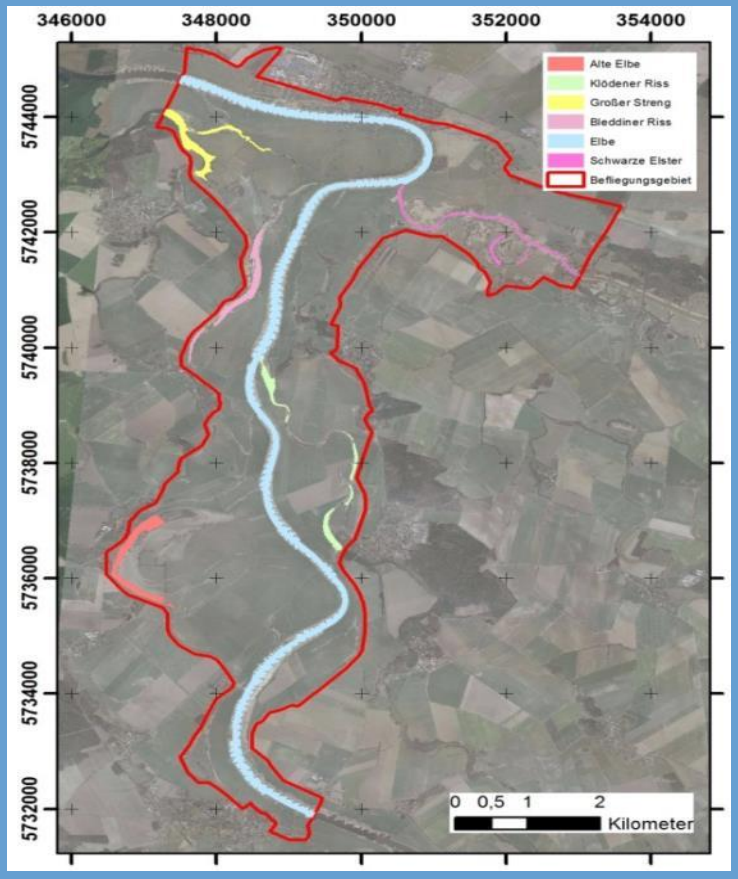






3. Project ALB Elbe/Klöden





> Close cooperation with Federal Waterways and Shipping administration / WSA Dresden

3. Project ALB Elbe/Klöden

> River Elbe

> Estuary (Schwarze Elster)

> Backwater areas

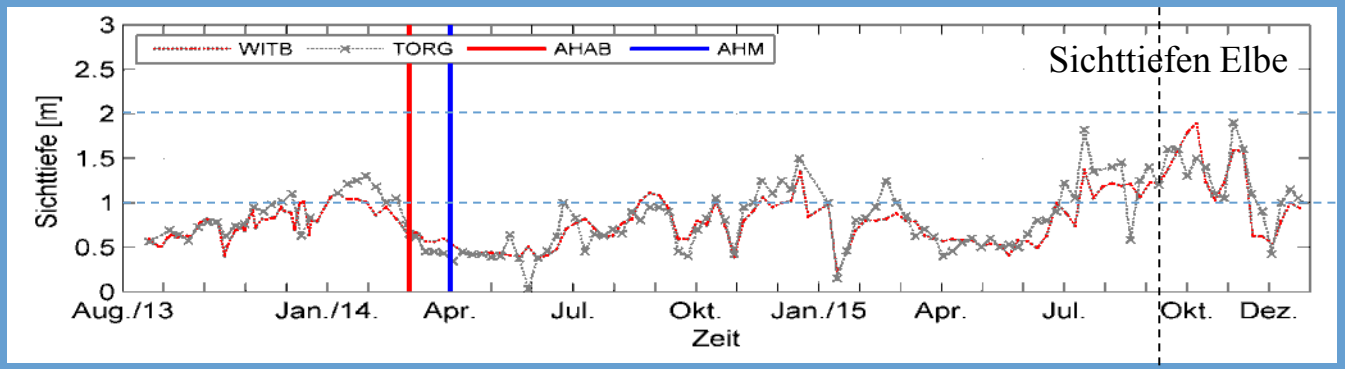
3. Project ALB Elbe/Klöden

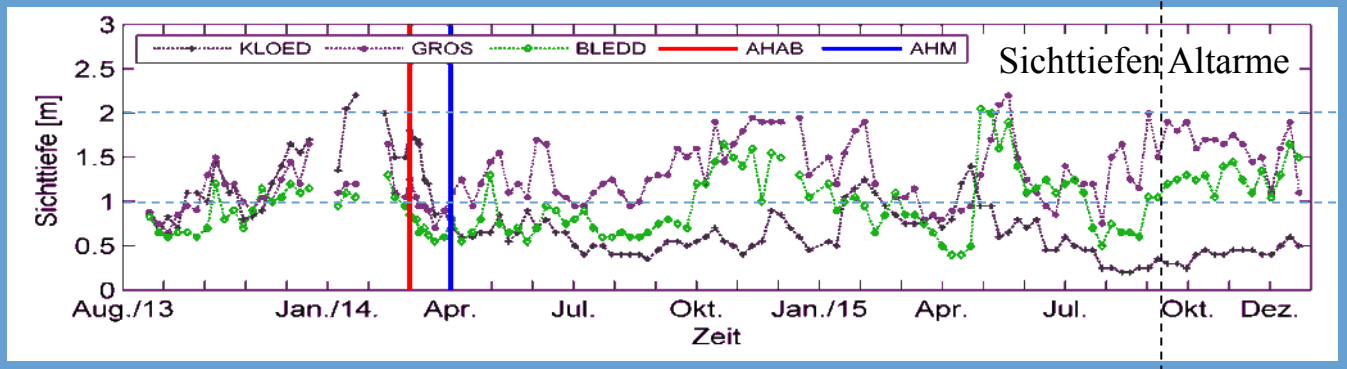
- Flight campaigns
  - AHAB CHIROPTERA (I) 01./02.03.2014
  - RIEGL VQ820G 01.04.2014
- Full-waveform recording
- Point classification

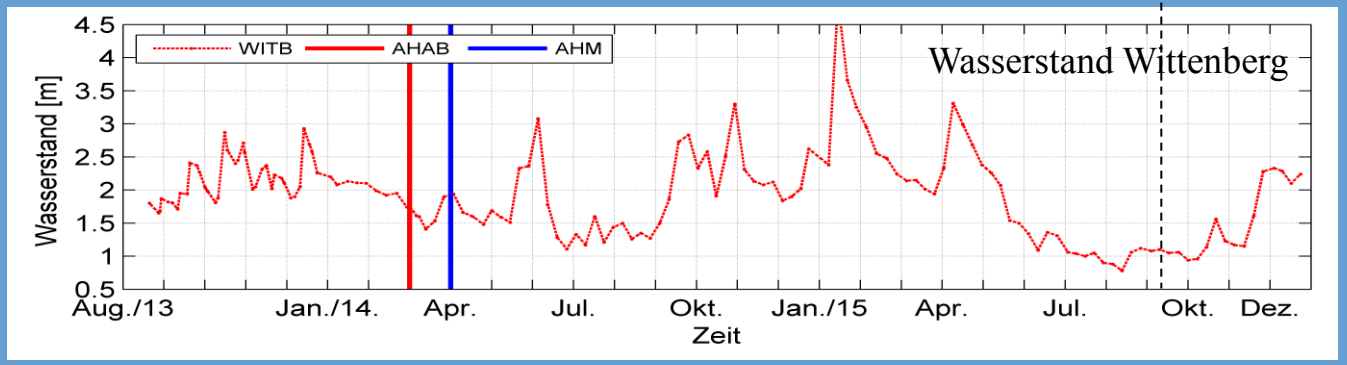
3. Project ALB Elbe/Klöden

- Complementary observations
  - Waterlevels
  - Suspended solids
  - Secchi depths (2x Elbe, 3x backwater areas)
  - …

3. Project ALB Elbe/Klöden







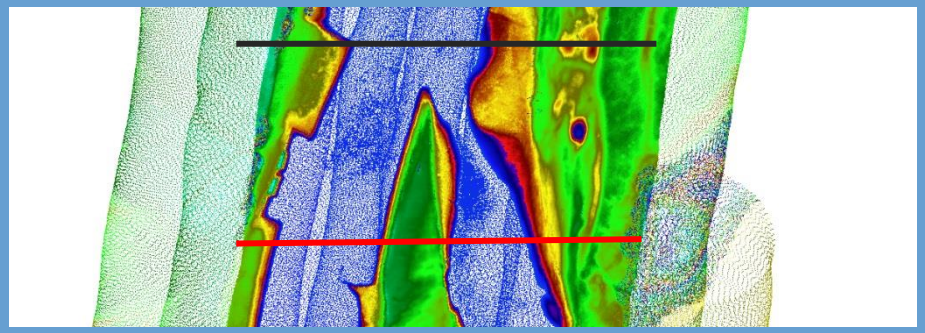
3. Project ALB Elbe/Klöden

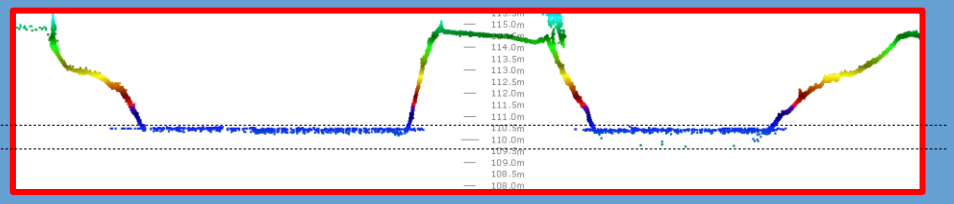
> Penetration depth

3. Project ALB Elbe/Klöden

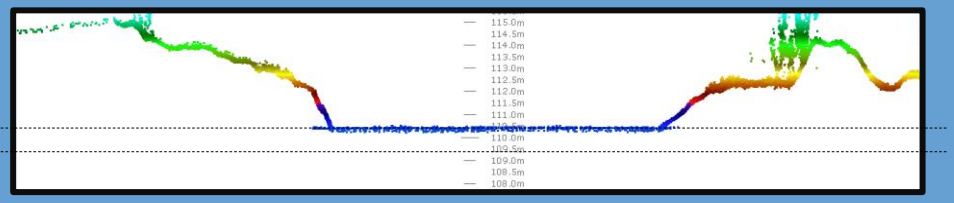
> Penetration depth (AHAB CHIROPTERA)

Elbe



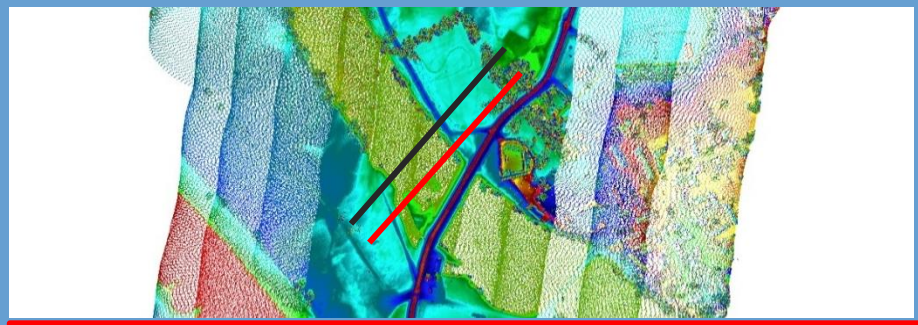


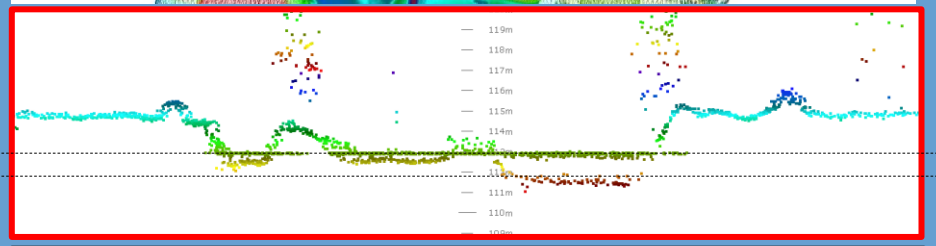
1m

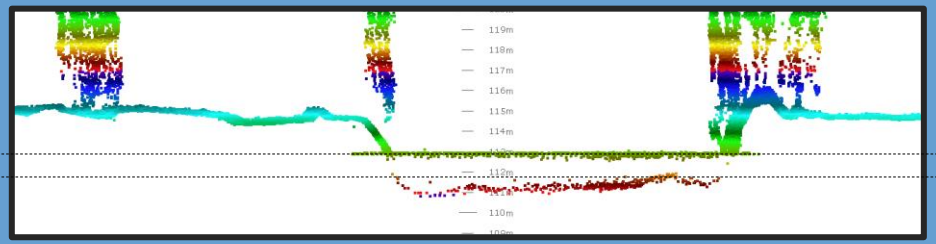


1m

Klödener Riss



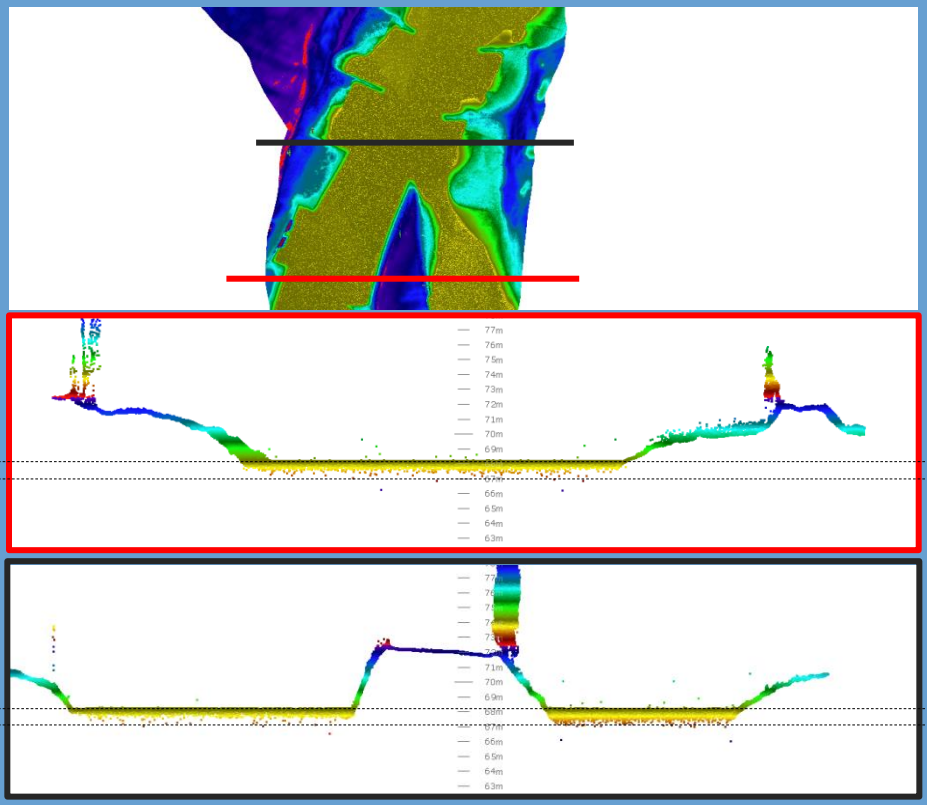




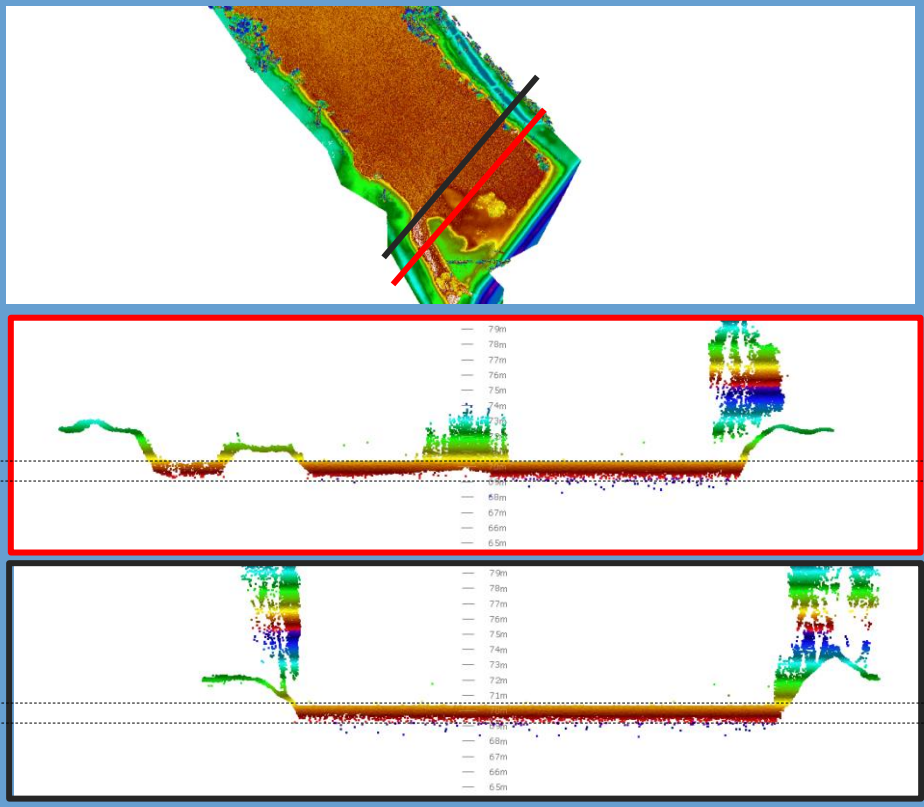
3. Project ALB Elbe/Klöden

> Penetration depth (RIEGL VQ820G)

Elbe



Klödener Riss

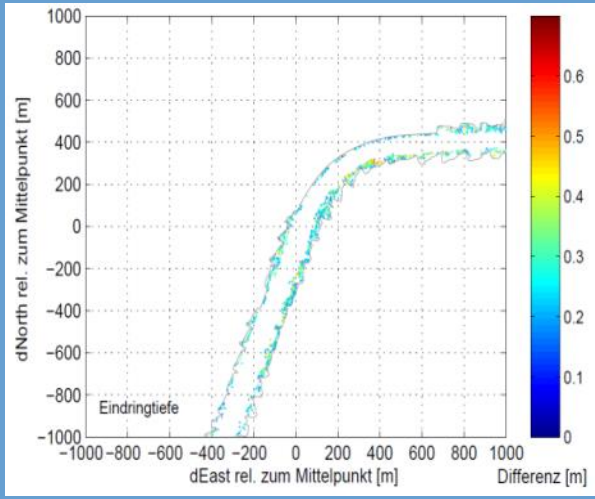


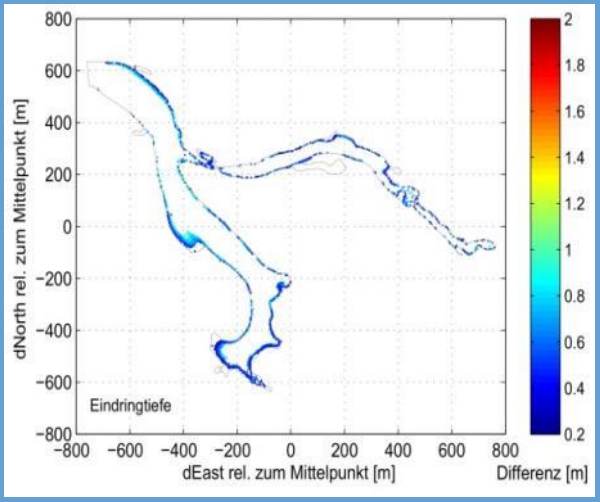
3. Project ALB Elbe/Klöden

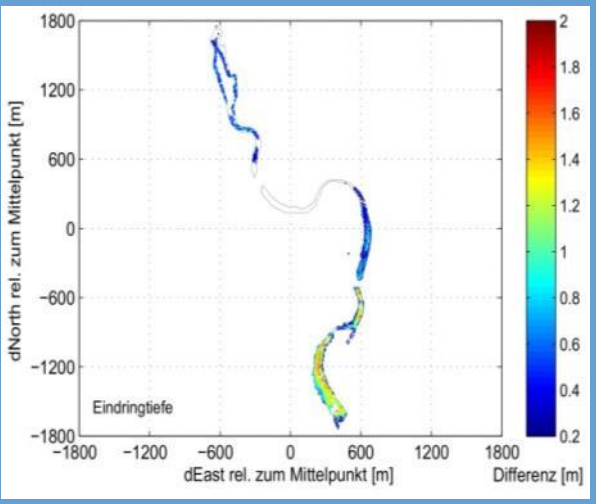
> Penetration depth AHAB CHIROPTERA

> Elbe: secchi depth ~0,5 m, penetration depth <0,4 m

> Backwater: secchi depth: up to 1,7 m, penetration depth max. ≤1,9 m*







* AHAB murky water algorithm

3. Project ALB Elbe/Klöden

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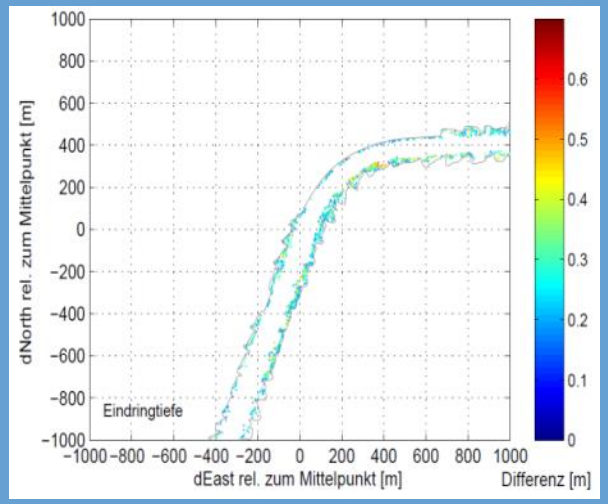
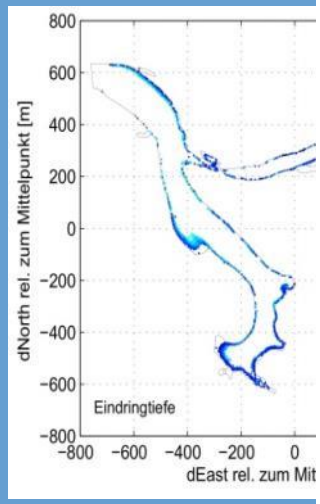
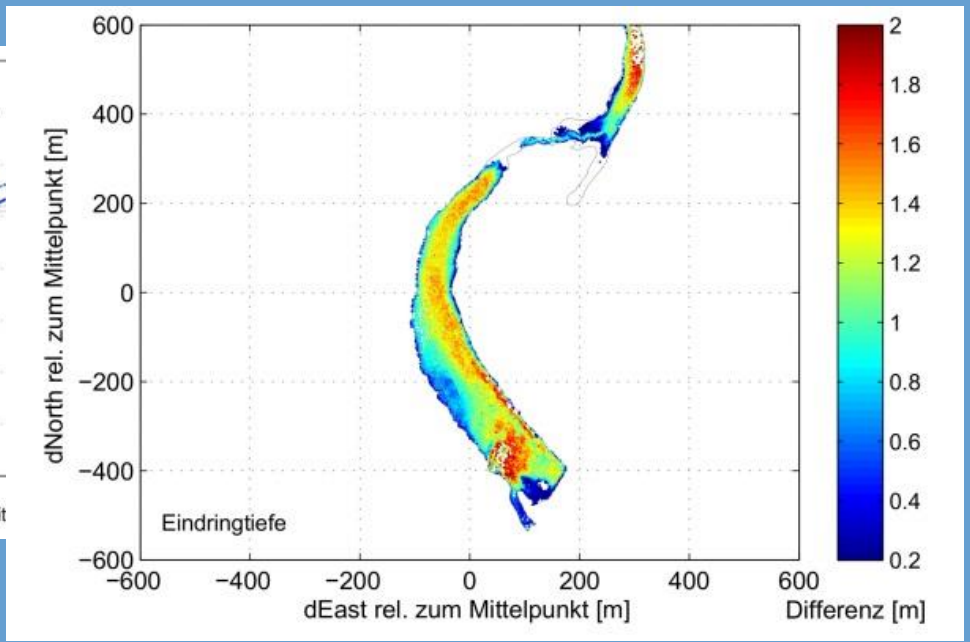






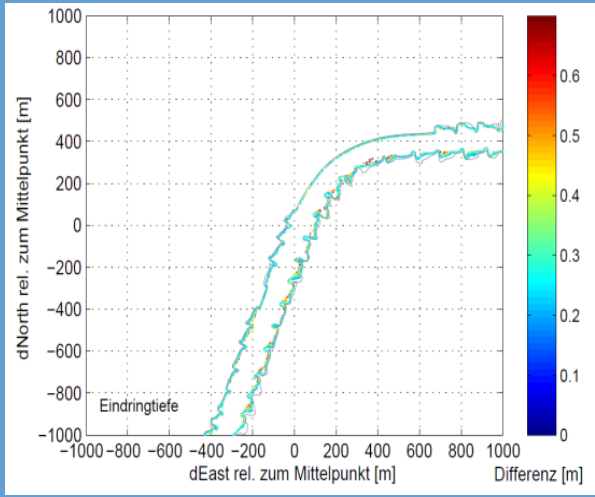
* AHAB murky water algorithm

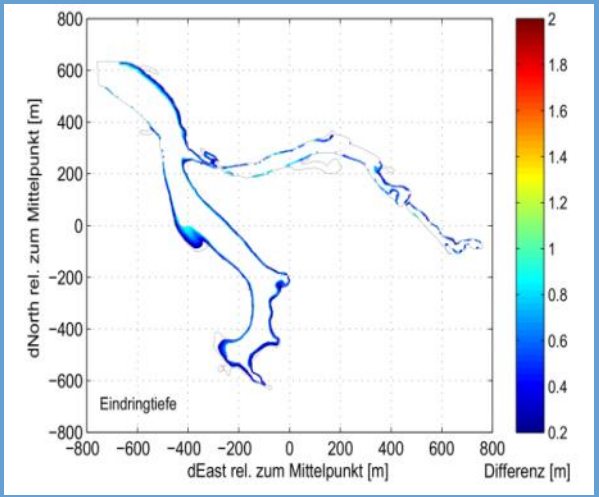
3. Project ALB Elbe/Klöden

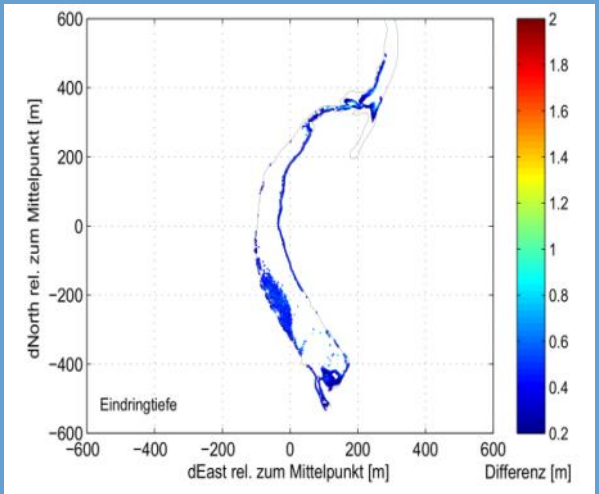
> Penetration depth RIEGL VQ820G

> Elbe: secchi depth ~0,5 m, penetration depth <0,4 m

> Backwater: secchi depth: ~1,0 m penetration depth ≤1,0 m







3. Project ALB Elbe/Klöden

> Penetration depth RIEGL VQ820G

> Elbe: secchi depth ~0,5 m, penetration depth <0,4 m

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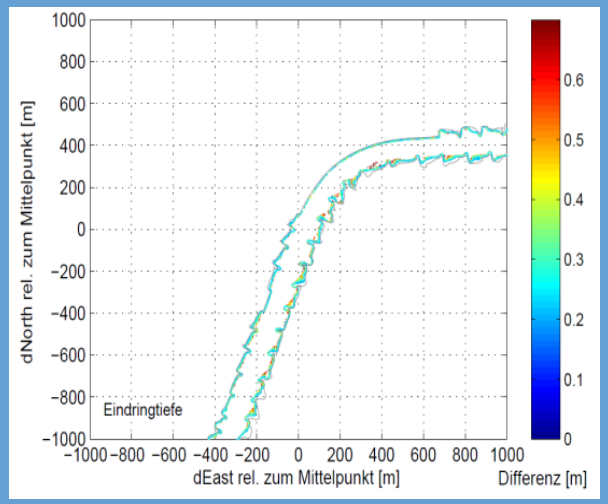
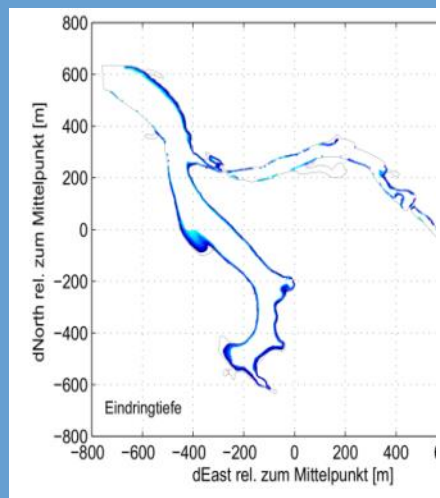
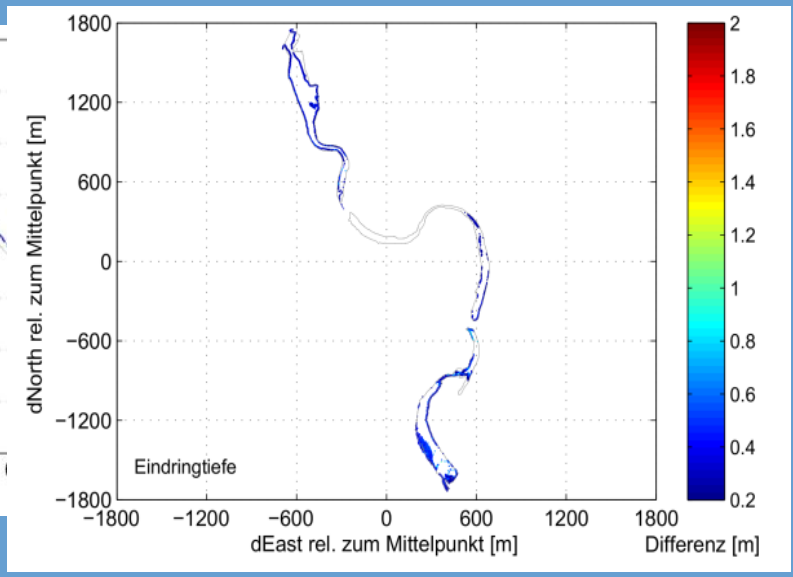
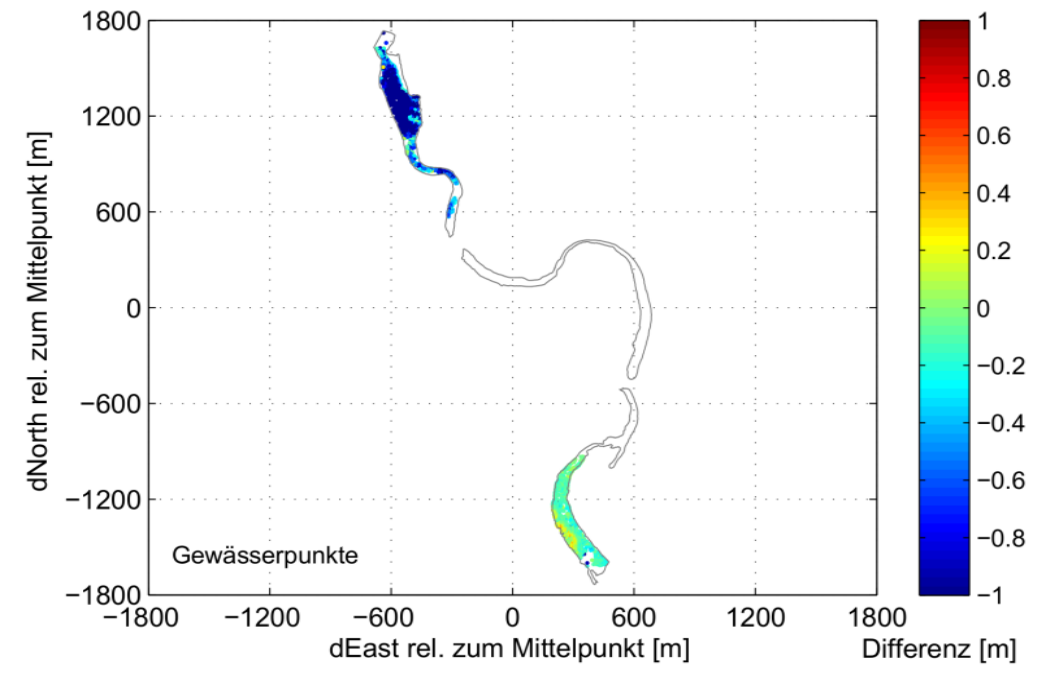






3. Project ALB Elbe/Klöden

> AHAB CHIROPTERA vs. single beam data



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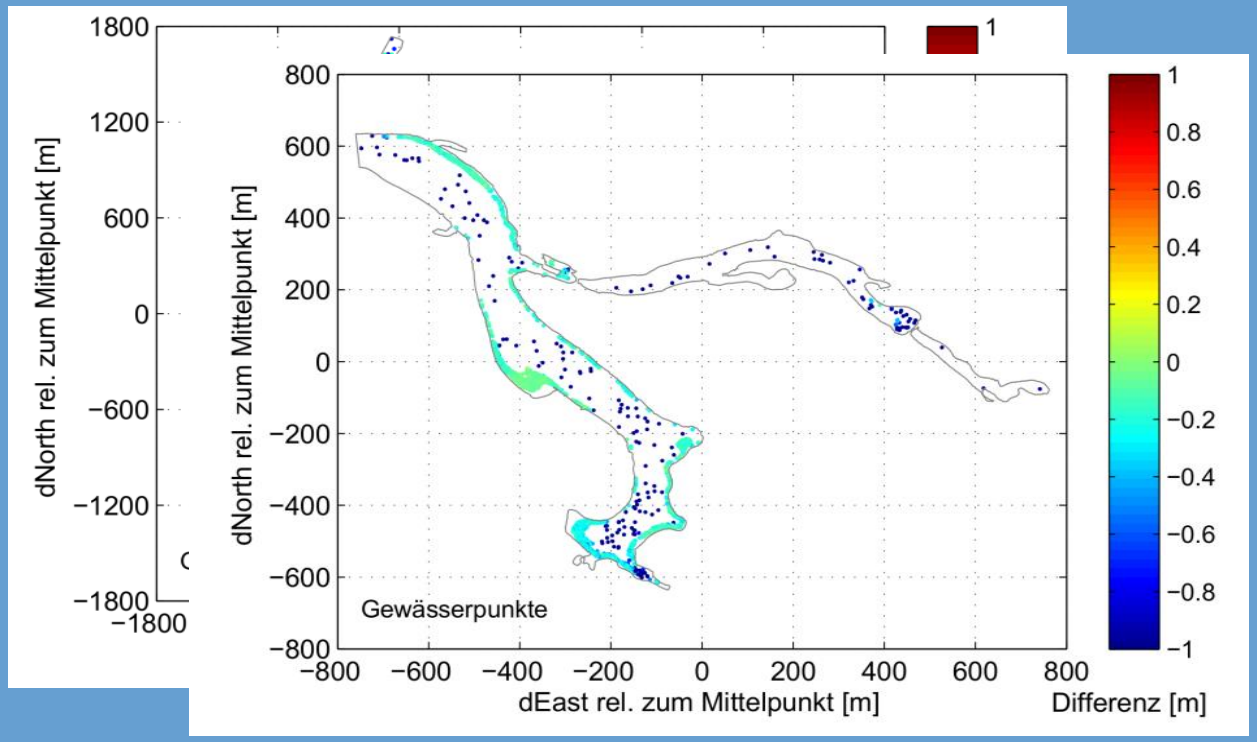

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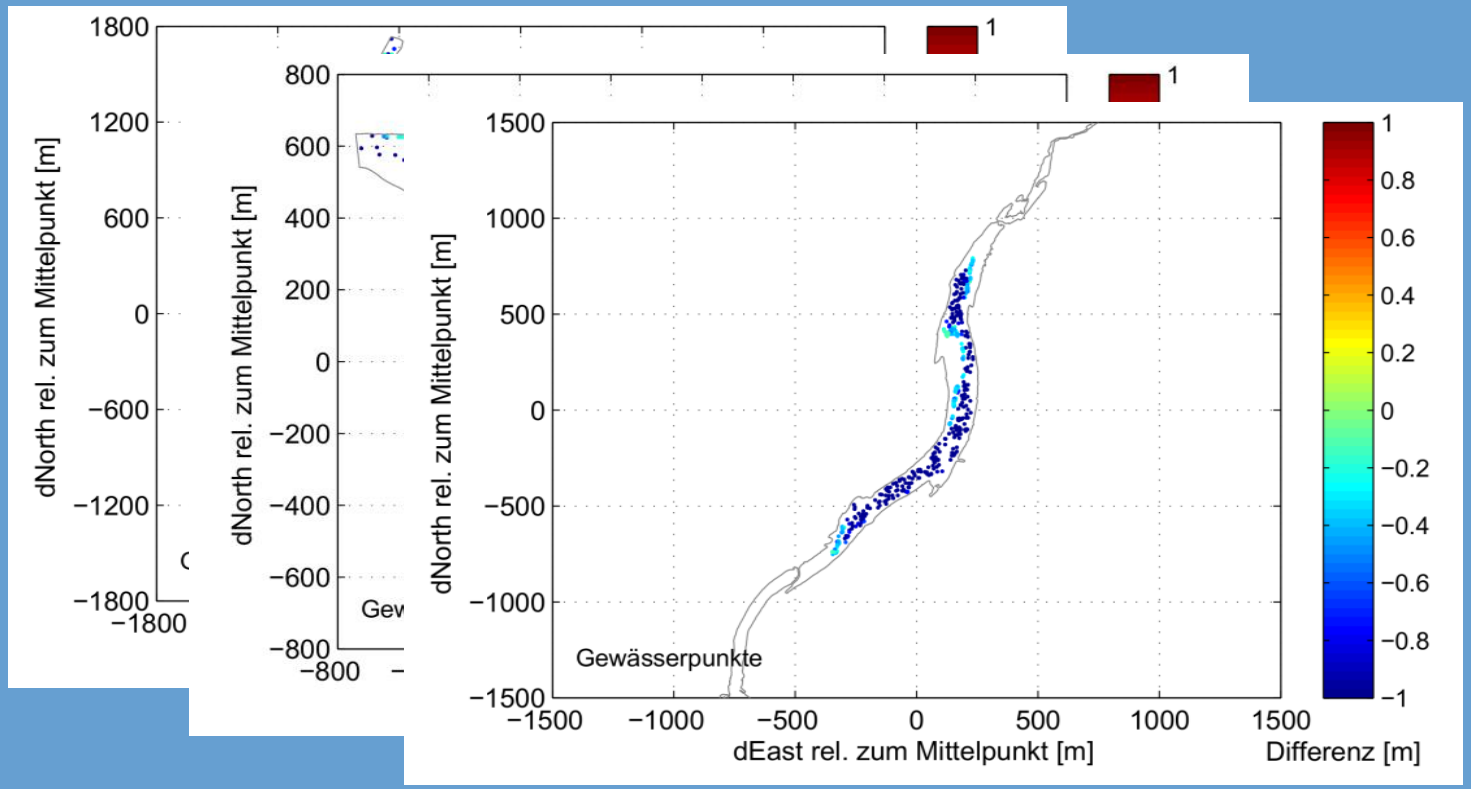


3. Project ALB Elbe/Klöden

> Accuracy (height)
  > Land
    > Mean differences -2 to -5 cm (points above reference)
    > Standard deviation 2 to 7 cm

  > Water surface:
    > 50m radius around gauge
    > Mean differences 2 to 7 cm (points below reference)
    > Standard deviation 2 to 4 cm

3. Project ALB Elbe/Klöden

> Accuracy bottom (height)

> Depends on the water characteristics

> Slope error

(Footprint 1,5 m, solpe 1:3 ➔ ~0,25 m)

> Underwater vegetation

> Flat areas (AHAB CHIROPTERA)

> 41% ± 0,1 m

> 88% ± 0,3 m

> **Improvements?**

> **Using Laser bathymetry in the North Sea?**

4. Further activities

> Research contract

> Reprocess Full-Waveform data (AHAB CHIROPTERA)

> Modelling signal attenuation

> Signal amplification

> Increase the number of bottom points

> Analyzing the impacts of waves

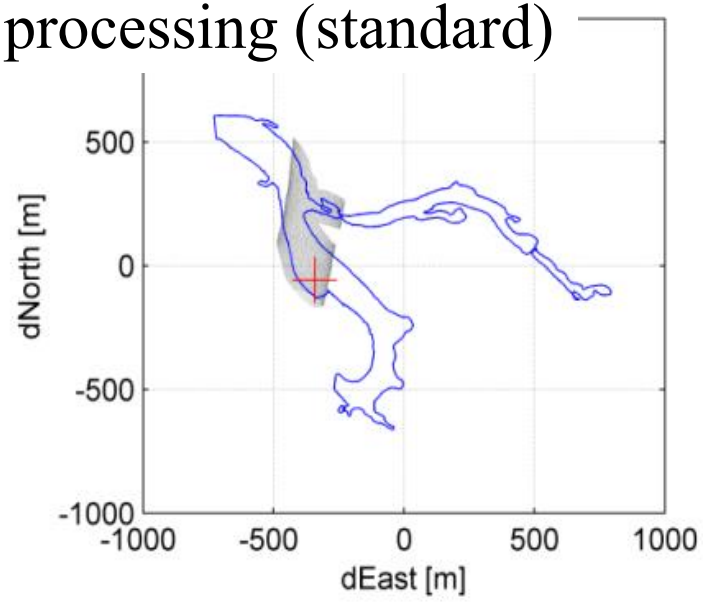
> Position discrepancy

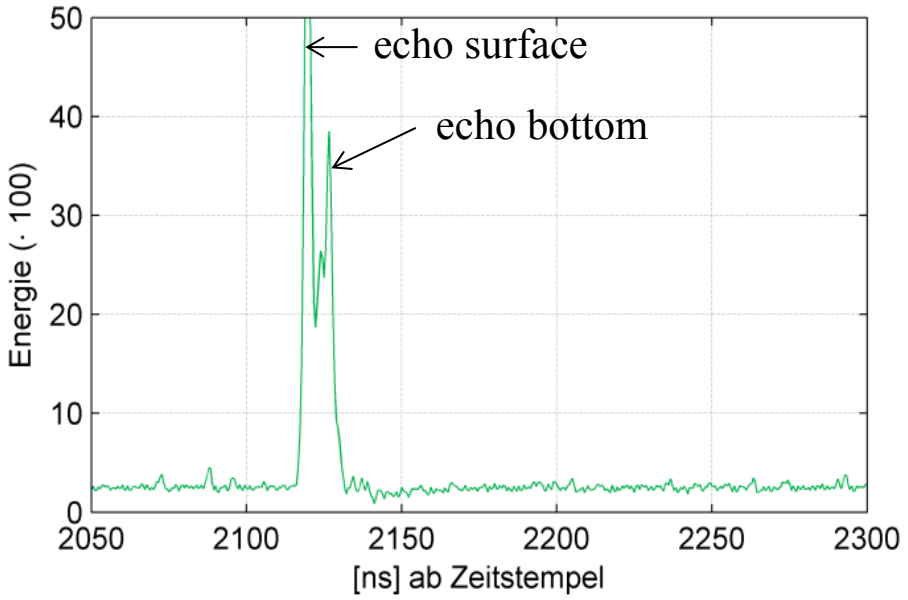
> Height discrepancy

4. Further activities

> Reprocessing full-waveform data

processing (standard)





4. Further activities

> Reprocessing full-waveform data

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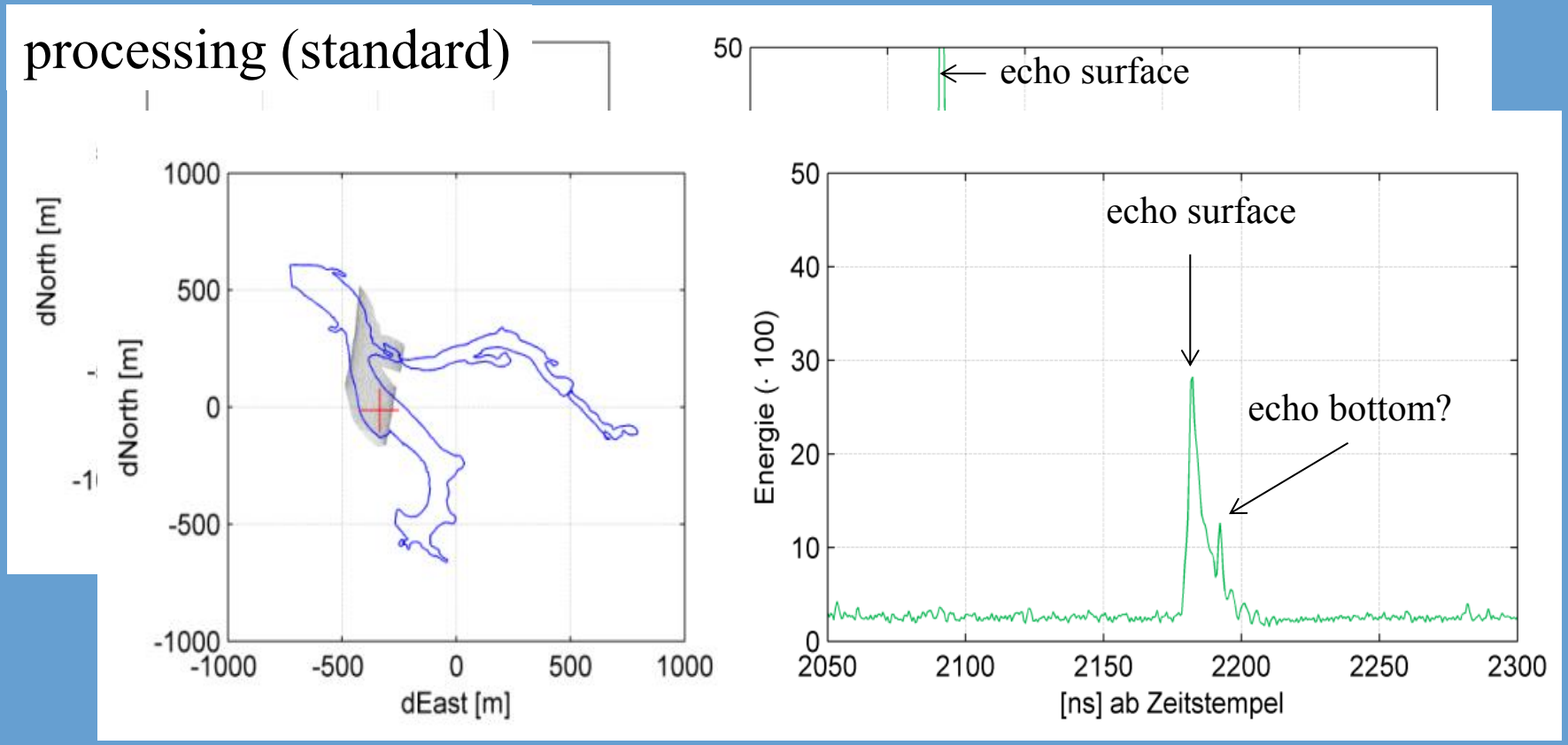

5. Conclusions

> Difficult enviromental conditions

  > turbity / bottom

> Penetration depth up to 2 m

> Only few observations in rivers

> Problems:

  > Underwater vegetation

  > Slope error

  > Footprint

  > Impacts of waves

5. Conclusions

> A priori analysis of
    > requirements
    > turbity
    > bottom characteristics
    > unterwater vegetations
    > waves
> Research contract
    > better results

Thank you for your attention

Dr.-Ing. Robert Weiß

Departement Geodesy
German Federal Institute of Hydrology
Am Mainzer Tor 1
56068 Koblenz

Tel.: +49 261 1306 5289
E-Mail: weiss@bafg.de
www.bafg.de

Dipl.-Ing. Katja Richter
Dr.-Ing. Patrick Westfeld
Institute for Photogrammetry und Remote Sensing
Technical University of Dresden
Helmholzstr. 10
01069 Dresden

http://photo.geo.tu-dresden.de