Acoustic versus Optic – remote sensing in hydrography

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Acoustic versus Optic – remote sensing in hydrography

14 November 2013

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- Using all senses
- Acoustic versus optic
- Laser Bathymetry
- Satellite derived Bathymetry (SDB)
- Evaluation

Download: www.innomar.com/seabed-acoustics-2013.php

Using all of our senses

Which senses could be used in hydrographic surveying?

Hear	hear the depth
Feel	investigate by a diver
Smell	approaching land
Taste	categorize the sediment
See	Laser, imagery

Acoustic versus Optic

Remote sensing

To use hydroacoustic means is one kind of remote sensing.

Why not extend „remote" further and don´t bother with seagoing platforms whatsoever?!

Comparing the costs of hydrographic surveys:

LIDAR	: Echosounders	1:10
SDB	: Echosounders	1:100

Have a deeper look into the optical techniques

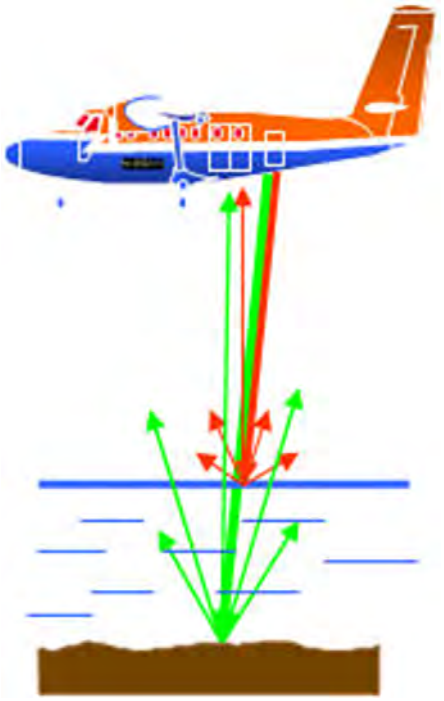
Laser Bathymetry

Laserbathymetry (LIDAR) is in use in hydrography for quite some years, especially in very clear waters.

A test in the german waters several years ago led to unsufficient results.

New developments in technology

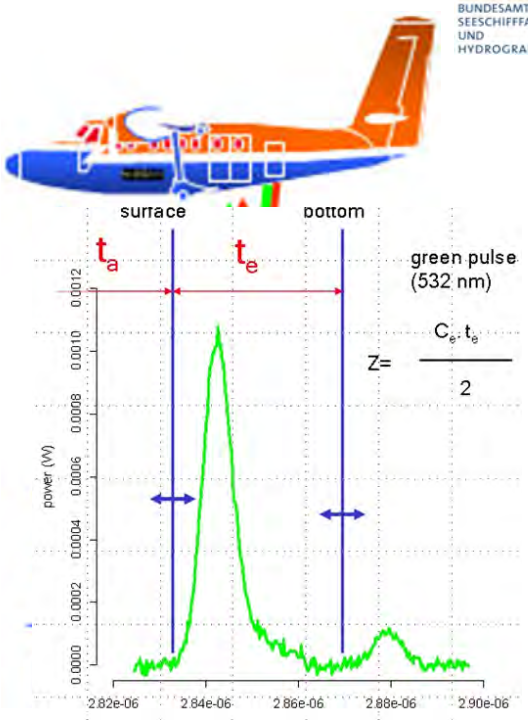
- Full waveform analysis
- Higher resolution
- Single colour laser



Laser Bathymetry

Principle of LIDAR

- Two colour laser
  - NIR (wavelength = 1064 nm)
  - Green (wavelength = 532 nm)
  - Time difference between the signals results in water depth
- One colour laser
  - Green
  - Full wave form analysis



Download: www.innomar.com/seabed-acoustics-2013.php

Laser Bathymetry

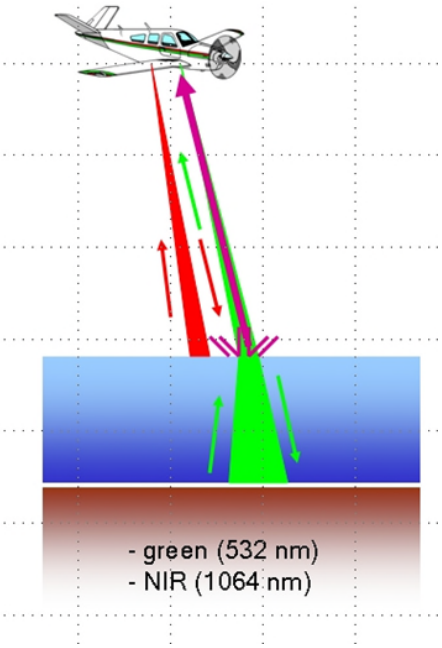
Technical aspects:

•Large footprints due to beam divergence,

½ water depth

•High resolution versus high penetration of water column

i.e. 138 kHz – 4 kHz



Laser Bathymetry

BSH started a project in 2012 to investigate the usability and limits of LIDAR for German waters.

The main goals are

•To derive clear and detailed figures of the quality depending on a.o.:

- visibility
- topography
- sea floor conditions
- time of year
- weather conditions
- influence of operating altitude

Laser Bathymetry

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And to find answers to the questions

- To what extend objects can be detected
- What the maximum and minimum depth is
- Whether a coastline can be derived
- What systems are available on the market
- How expensive is such a survey

Finally, to identify the areas in which that technology can be used economically, especially in cooperation with other users.

Laser Bathymetry

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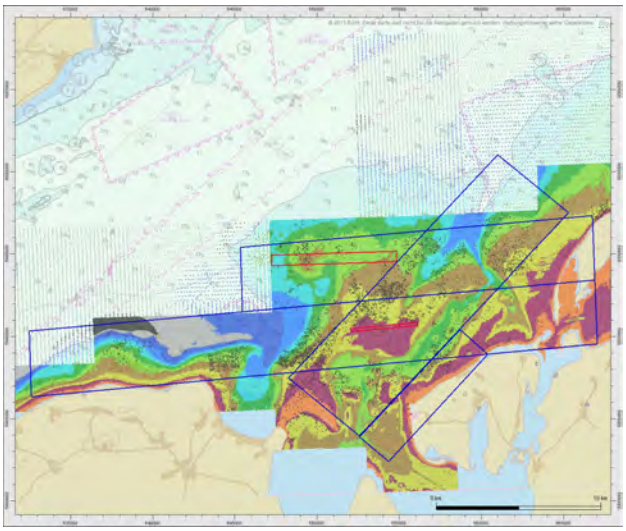
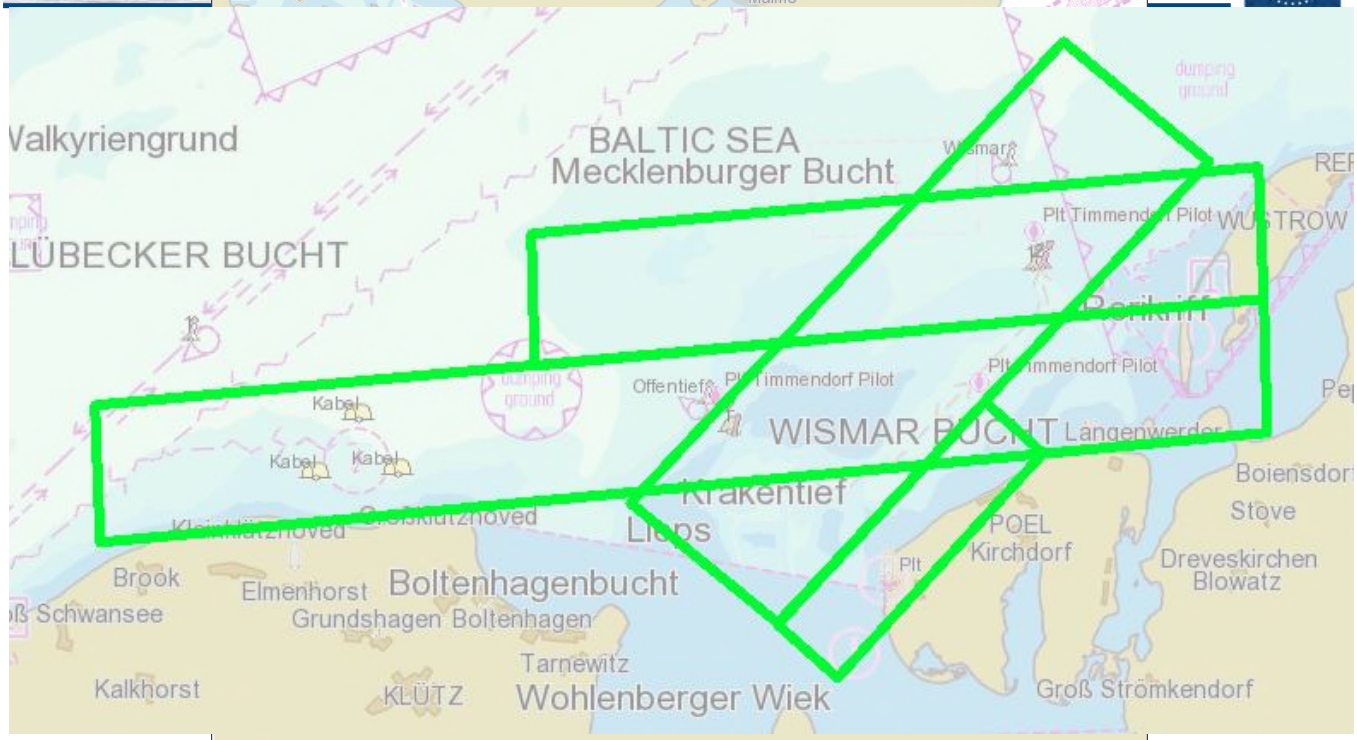
- Duration from 2012 to 2014;
- Contracted partner is the Leibnitz University in Hannover (IPI);
- Three independend flights (November 2012, September 2013, Spring 2014)
- Comparison with regular surveys;
- Associated partners support with their know-how;
- One test area;
- Different operating heights.



Laser Bathymetry



Laser Bathymetry

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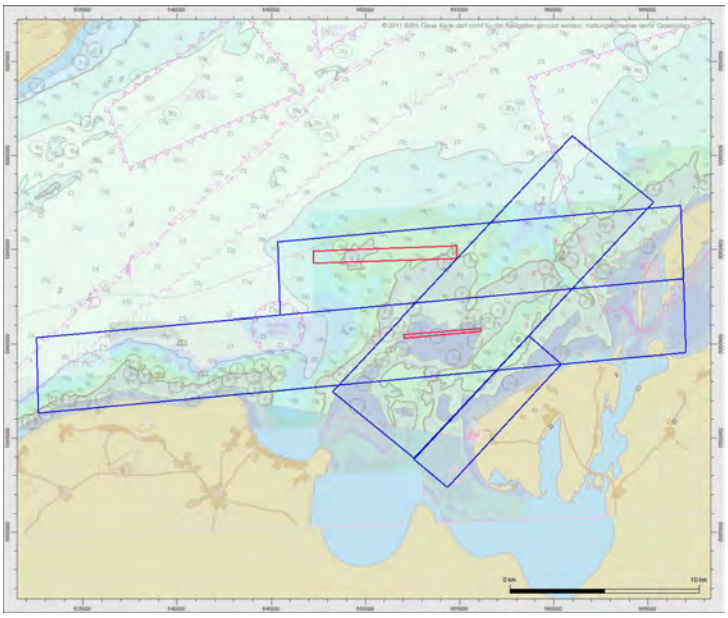
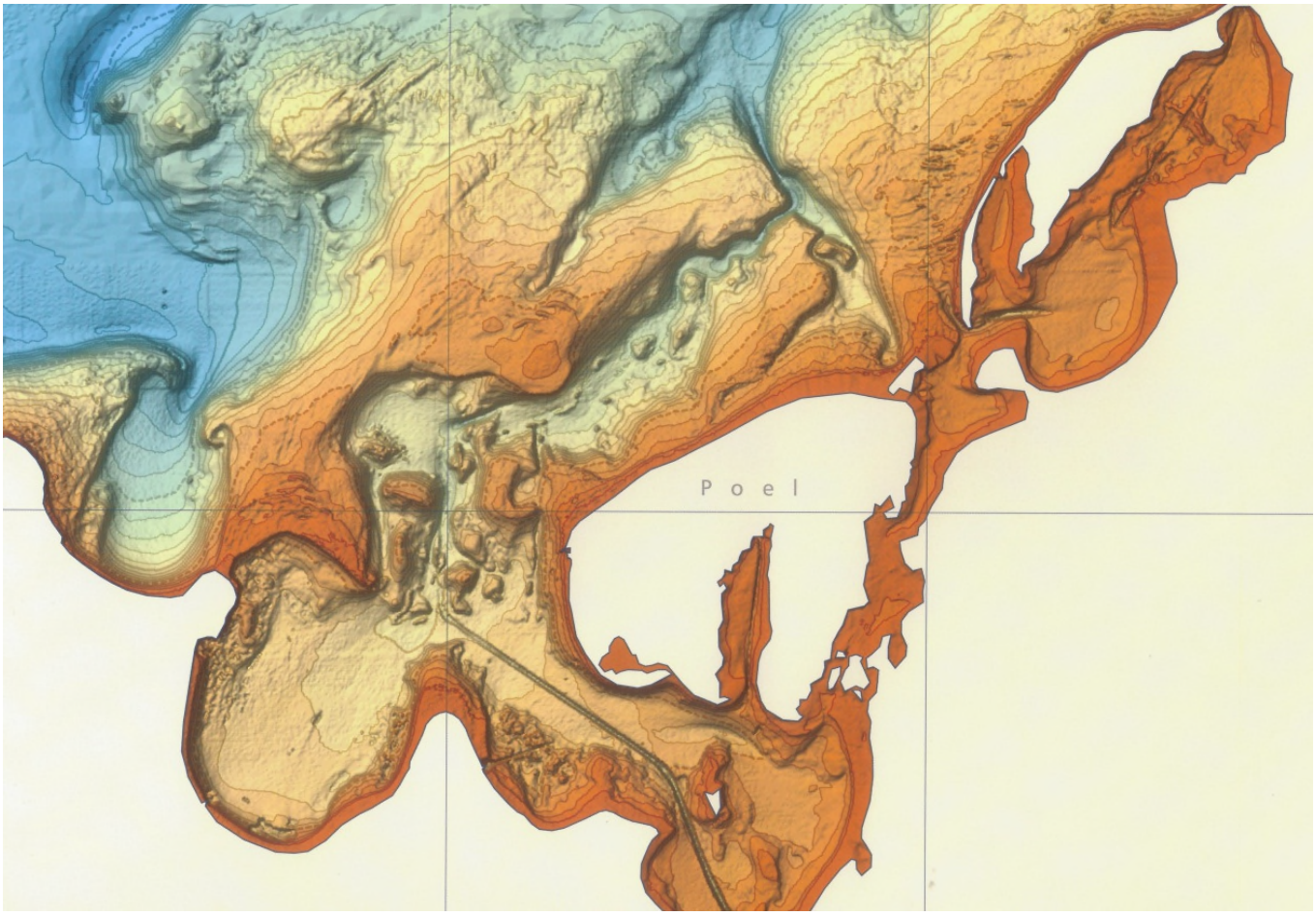
Test Site:

- 345 km²
- 4 overlapping areas
- Different flight directions
- Wrecks and obstructions
- Waterdepth 0 to 20 m
- Land area included
- Rough topography
- Boulders
- different sea floor characteristics
- Measured Secchi-depth





Current status

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Systems used

•A first flight took place in November 2012, where the system "Riegl VQ-820G" was used.

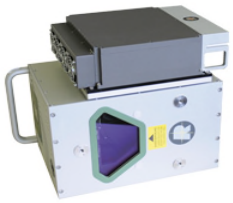
•In the second campaign in September 2013 the AHAB systems "Chiroptera" and "Hawk Eye II"were used.

•In spring 2014 a third and final flight is planned. Different sub-contractors and a variety of systems will have been used.

Flight altitudes:

- Flights in 300, 400, 500, 600 and 700 meters
- Some limitations due to laser class

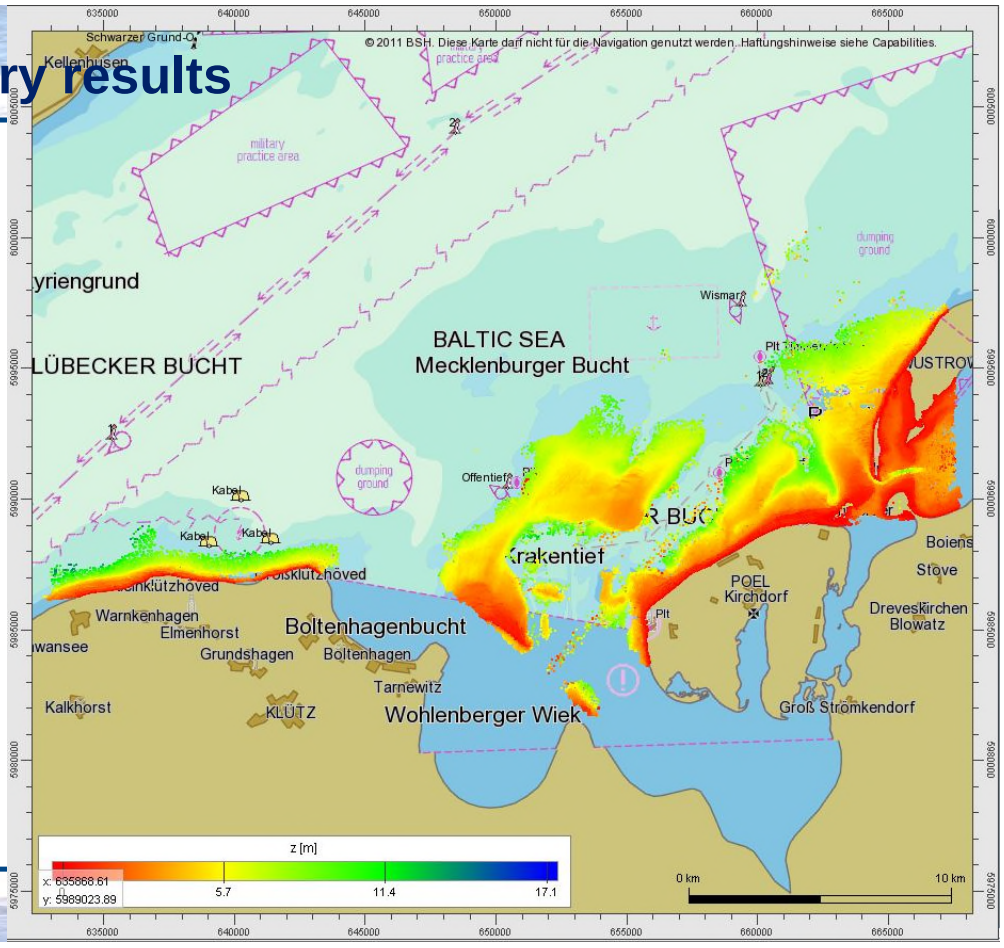
Laser Bathymetry




Providers Information	Riegl VQ-820G	AHAB Chiroptera	Fugro LADS Mark III	AHAB HAWK EYE II
Maximum depth	10 m 1 x Secchi	-	80 m 2,5 x Secchi	70 m 3 x Secchi
Pulse frequence	138 kHz	35 kHz	1,5 kHz	4 kHz
Vertical accuracy	0,025 m	0,15 m	0,5 m	0,25 m
Pulse length	4 ns	3 ns	-	5 ns
divergence	1 mrad	3 mrad	-	2-15 mrad

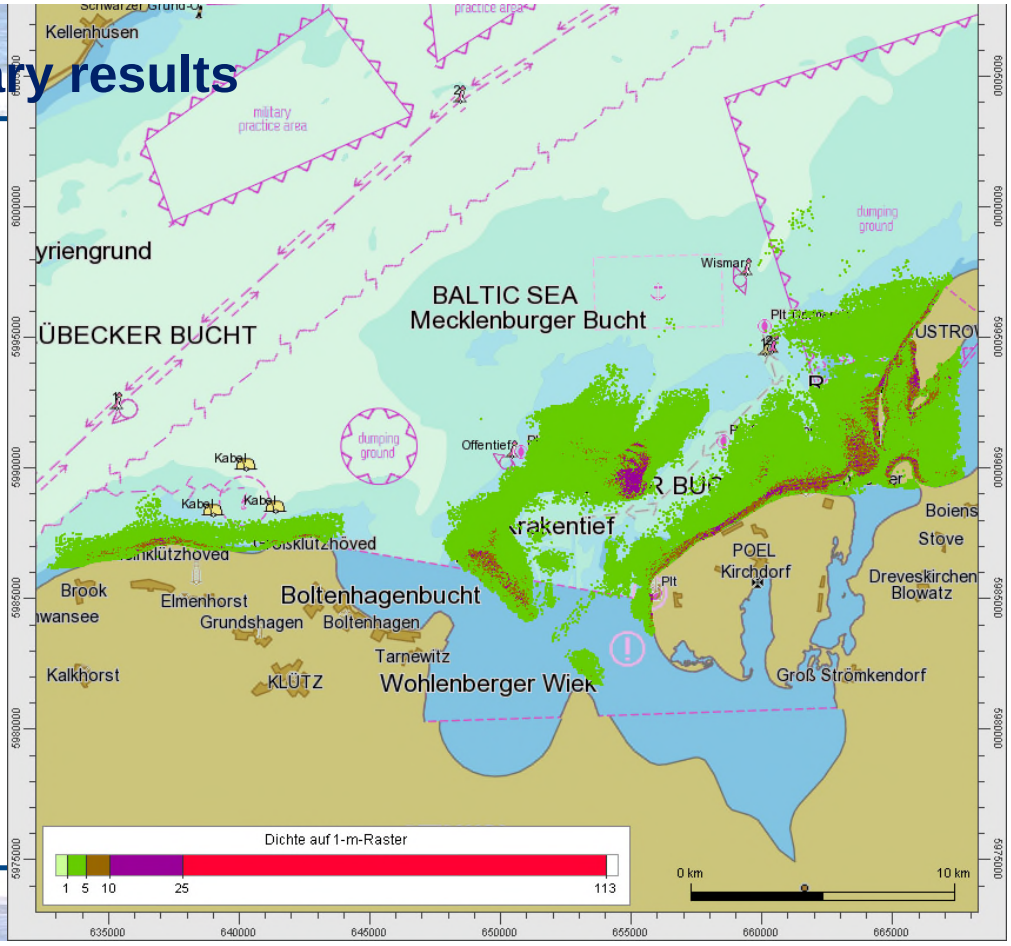
Preliminary results

LIDAR
Depth information



Preliminary results

Density of depths per m²



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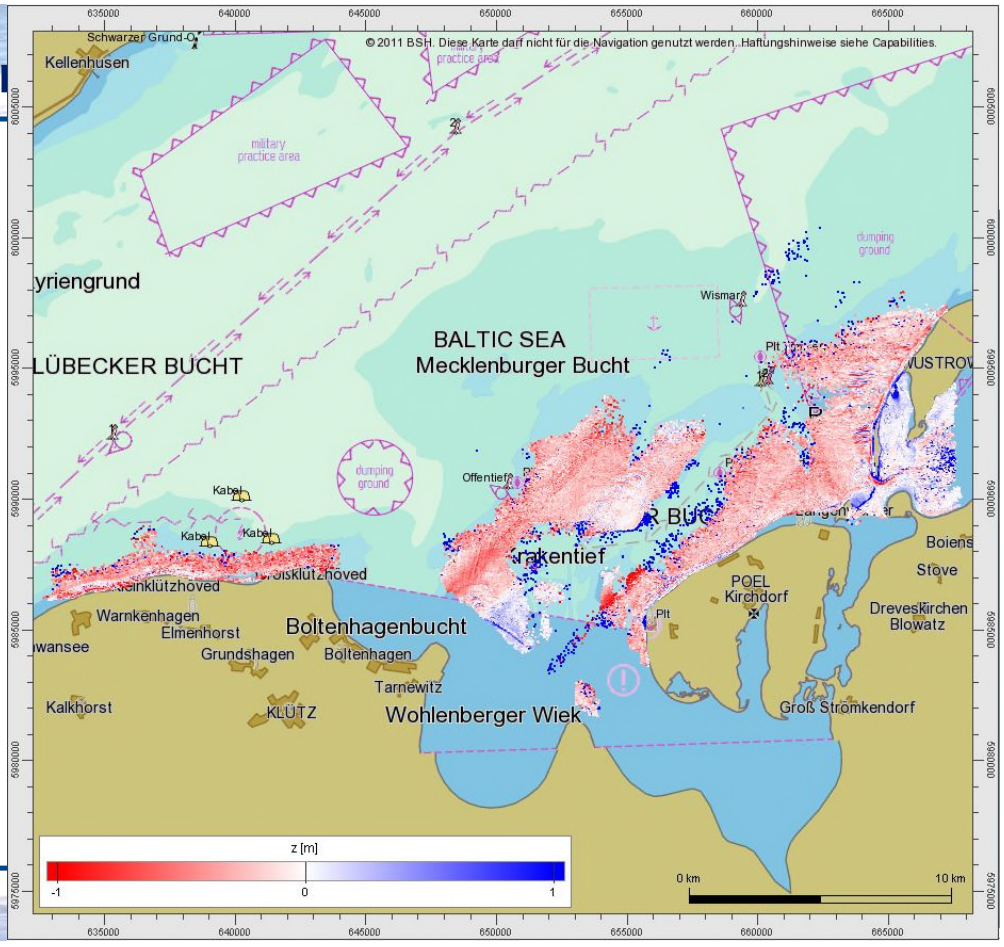
Preliminar

DTM

Difference between LIDAR and regular survey



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Preliminary results

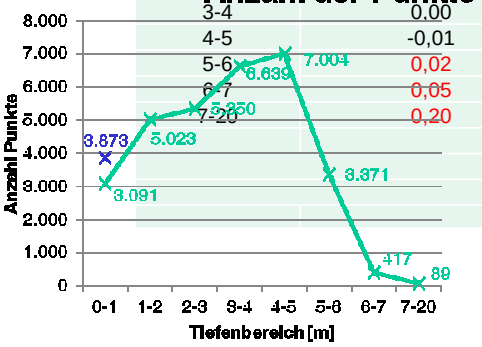
DTM

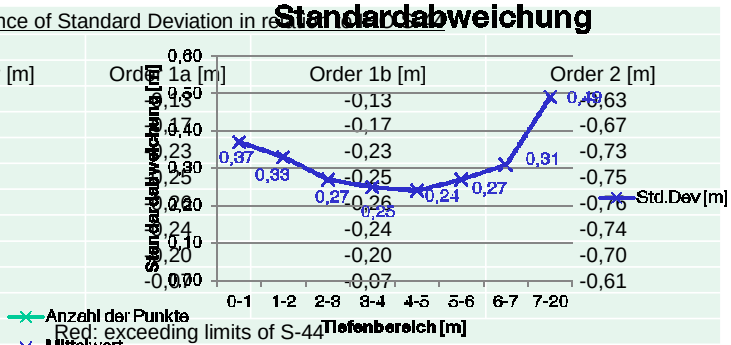
Difference between LIDAR and regular survey

Table xls

Difference of Standard Deviation in regular survey

Depth area [m]	Special Order [m]	Order 1a [m]	Order 1b [m]	Order 2 [m]
0-1	0,12		-0,13	-0,63
1-2	0,08		-0,17	-0,67
2-3	0,03		-0,23	-0,73
3-4	0,00		-0,25	-0,75
4-5	-0,01		-0,26	-0,76
5-6	0,02		-0,24	-0,74
6-7	0,05		-0,20	-0,70
7-20	0,20		-0,07	-0,61





Red: exceeding limits of S-44

Green: within limits of S-44

Preliminary results

The current findings are premature:

- Secchi depths 5-6 meters. A good resolution has been obtained down to this depth (5 points/m²).
- Costs: depending on shape and size of the area, flight altitude and availability, in our case: roughly 300 to 350 €/km².
- It is a too early stage of the project to give precise information on the accuracy; it seems to be very difficult to detect objects on the sea floor.
- Anyway, for the investigated Western Baltic Laser bathymetry can only be a supplement to the ship based hydrographic surveys in very shallow areas, where vessel operations are especially difficult.

Satellite derived bathymetry

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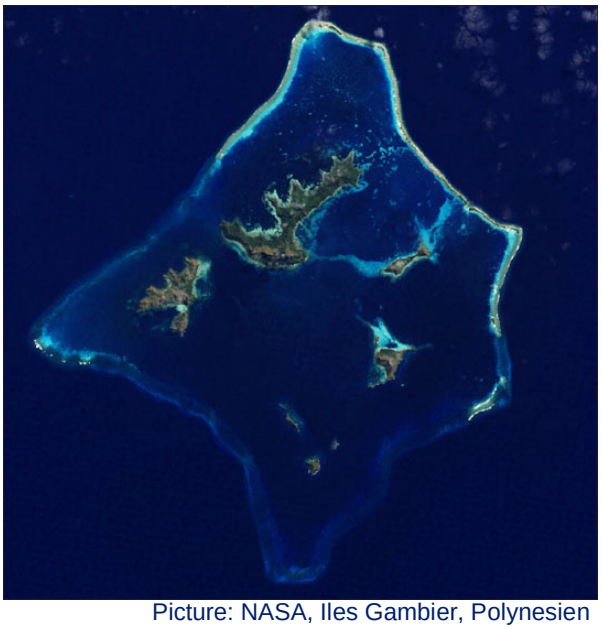
Shallow water bathymetry derived from multispectral imagery is not new, but it hasn´t been considered as a potential technology for depths in nautical charts.

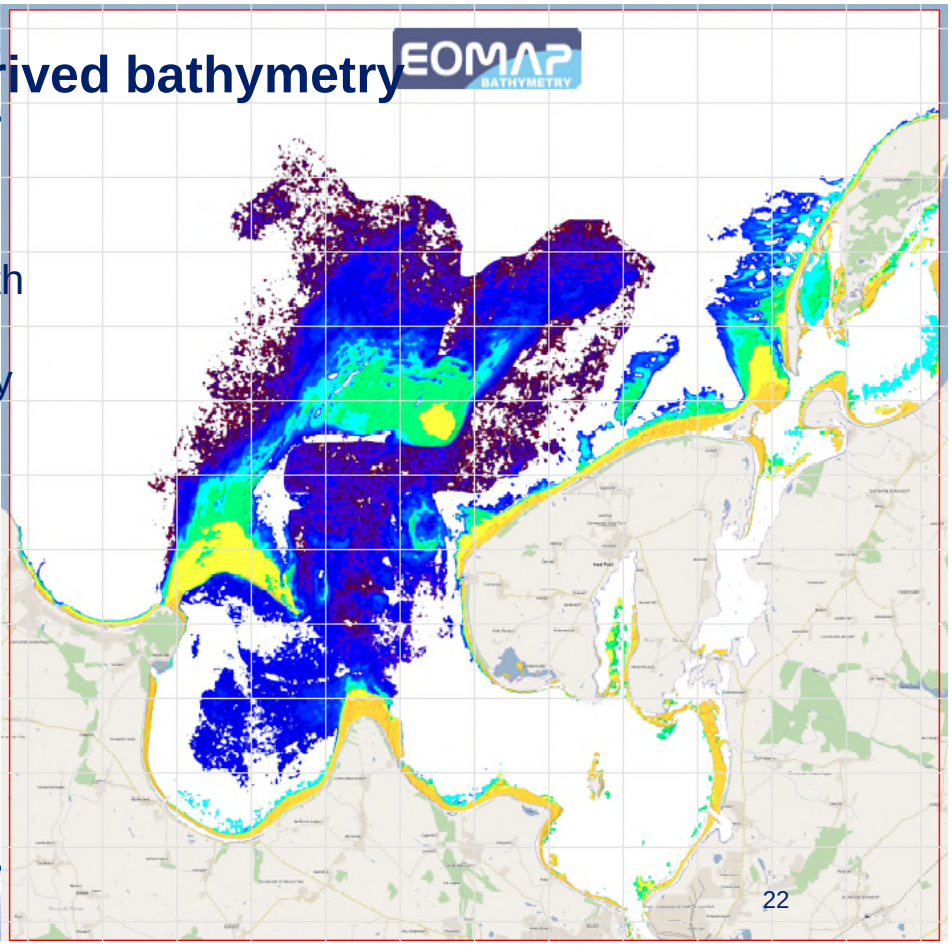


Picture: NASA, Iles Gambier, Polynesien

Satellite derived bathymetry

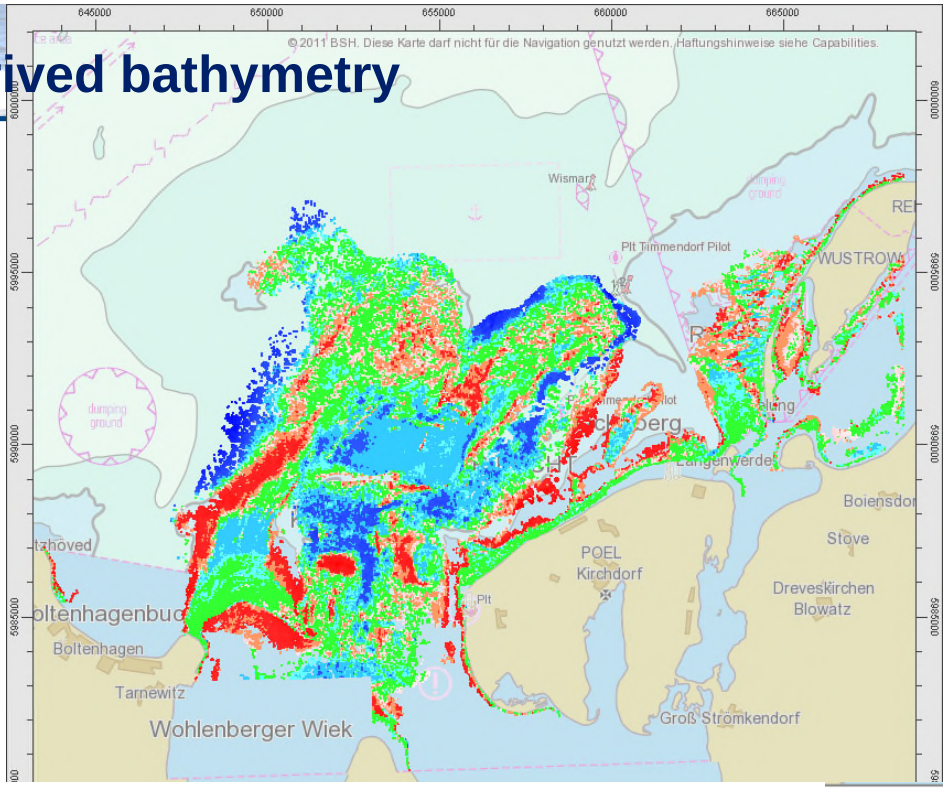
EOMAP BATHYMETRY

- Test in Germany
- RapidEye (optic) 5th May 2011
- Processing done by EOMAP
- Result: 5m grid
- Better coverage
- Depths >10 m



Satellite derived bathymetry

Differences exceed standards significantly.



Difference between regular survey data and SDB data

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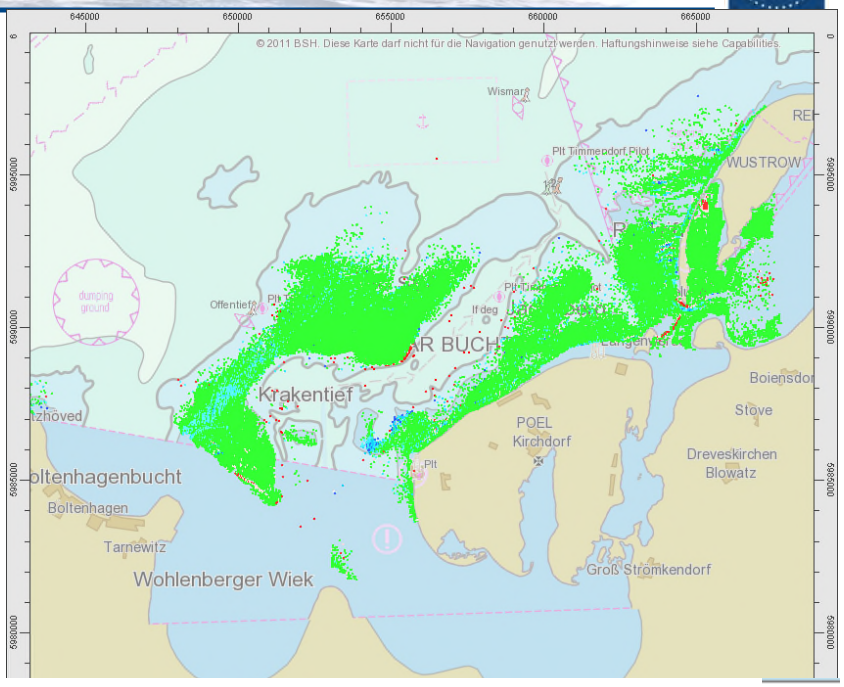
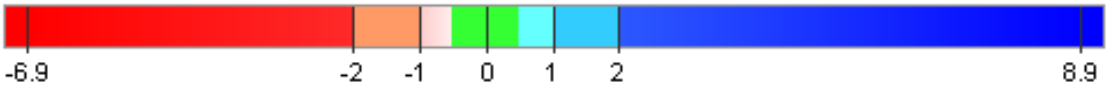
Satellite derived bathymetry

In comparison: LIDAR



Difference between regular survey data and LIDAR data



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Satellite derived bathymetry

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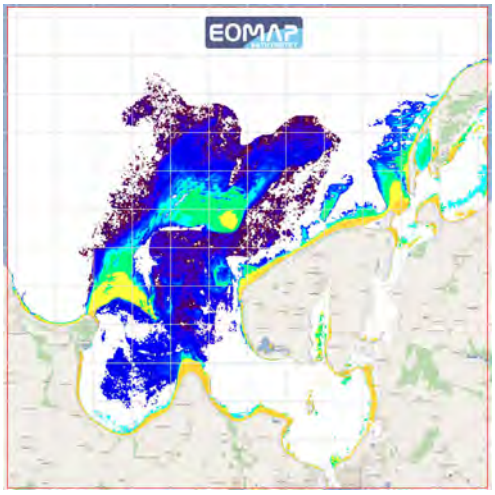
Potential of SDB

- Relatively cheap;
- Worldwide coverage of images;
- Can improve information in areas where existing surveys are poor or non-existent and where there is little prospect of obtaining sufficient ressources for regular surveys according to S44.
- May help in deriving potential changes in seafloor topography and thus may support planning of surveys.



Evaluation

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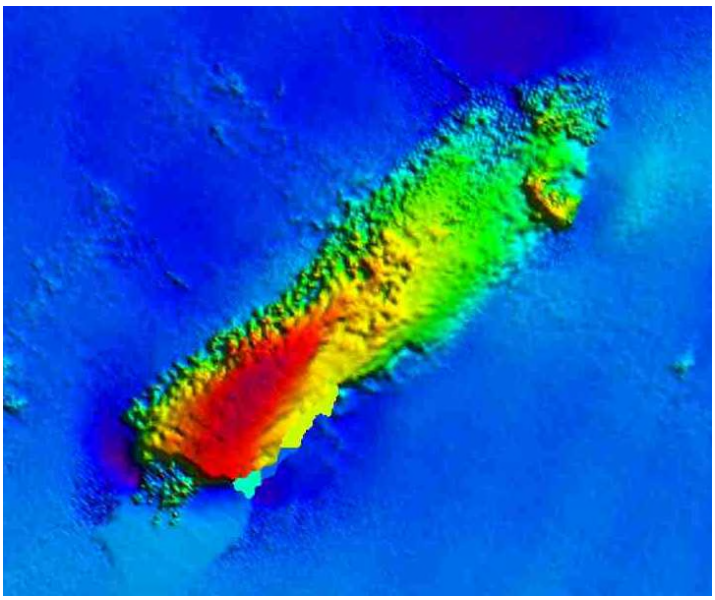
The demands for the quality of hydrographic surveys are growing faster and faster. Especially quality in the sense of

- accuracy,
- reliabilty,
- up-to-dateness,
- density/resolution,
- seamlessness,
- coverage …

Alternative methods are gaining practical market share and are under constant further development.



Evaluation

The acoustic methods will play its important and major role in the future as well as today.

The alternative means will provide additional capacities in a promising market, that is constantly growing

and the resulting information/data will be needed by a much wider range of users.

So it is not about Acoustic versus Optic, but about a fruitful co-operation and integration of the different systems.