

Schleswig-Holstein. Der echte Norden.

Coastal protection

New techniques in capturing and modelling of morphological data

HYDRO 2016, Lutz Christiansen, Rostock-Warnemünde, 08 – 10 November 2016



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 - Results
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Introduction



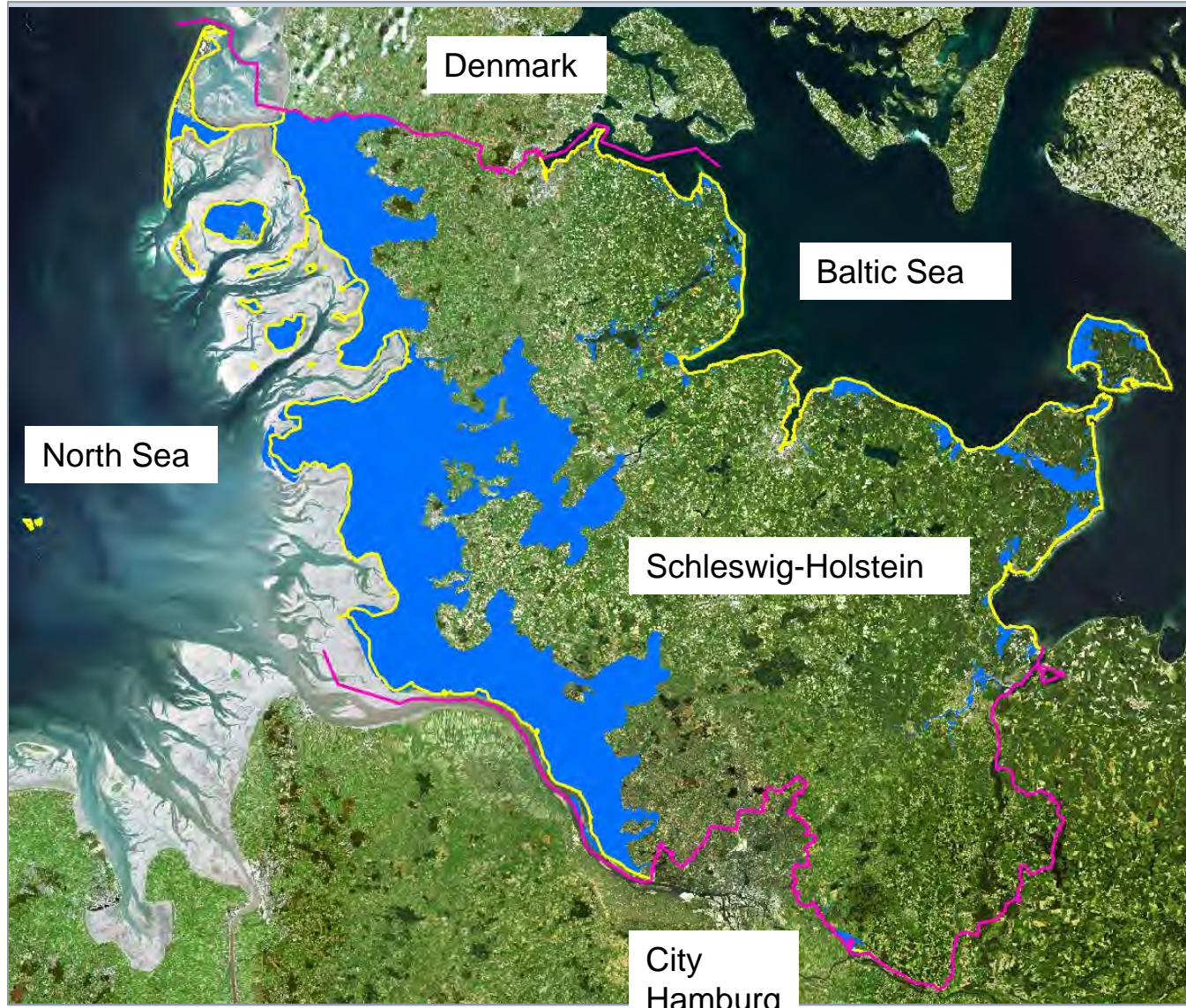
Schleswig-Holstein

**„the land
between the seas“**

Coastal protection is a
main task!



Features of coastal protection



Length of coastlines:

Baltic Sea ca. 640 km
North Sea ca. 560 km

Threat of storm surge and floods:

12% of the inhabitants
25% of the area

Areawide morphological
data is a main base for
coastal protection!



Features of the coastal areas



Baltic Sea:
Fjords and shallow
shore areas,
nearly constant
waterlevel (MSL)

North Sea:
Wadden Sea,
formed by two tides
daily,
variation of three
meters of the waterlevel

=> Conditions of
areawide survey

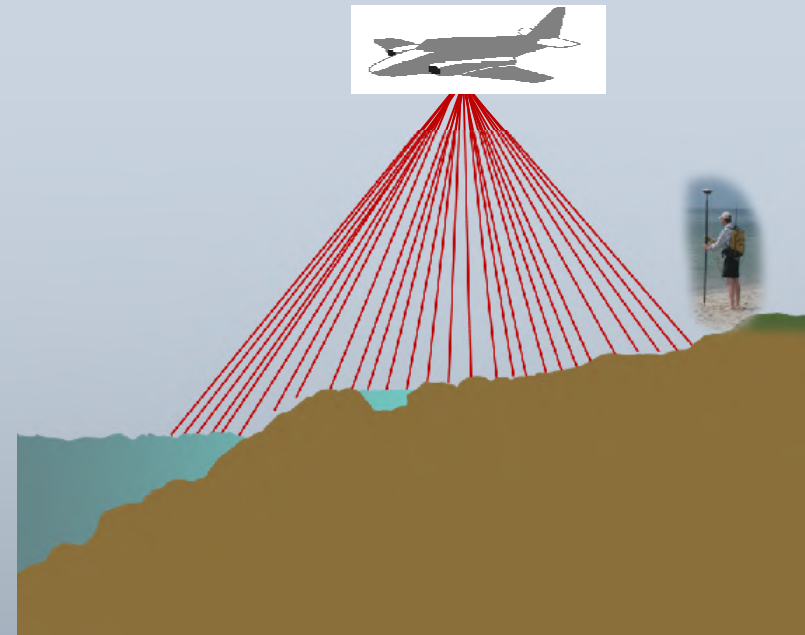


Previous kind of survey of the North Sea LKN.SH

Landesbetrieb für Küstenschutz,
Nationalpark und Meeresschutz
Schleswig-Holstein



Primarily
hydrographic survey
at high tide

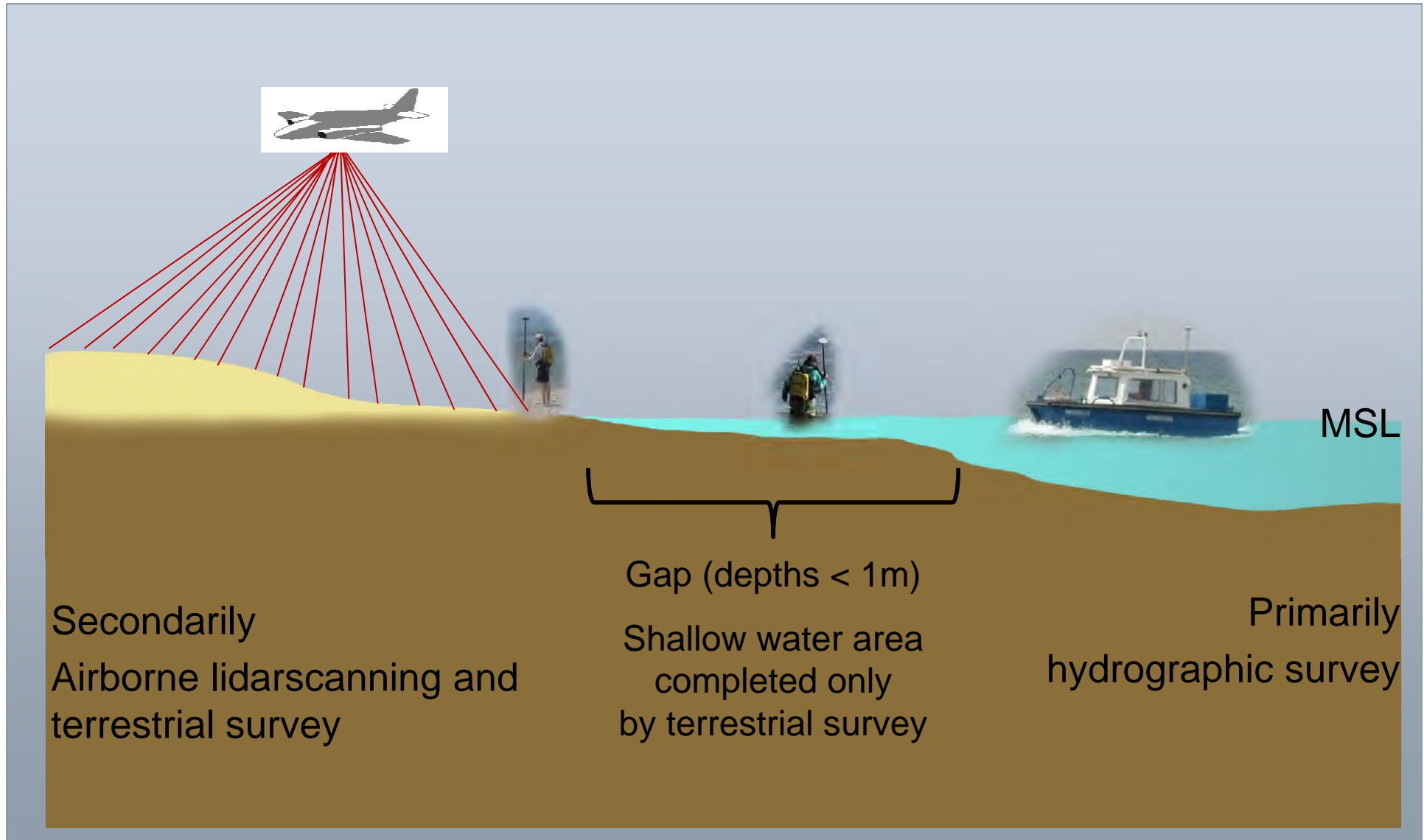


Secondarily
Airborne lidarscanning and
terrestrial survey
at low tide
as addition

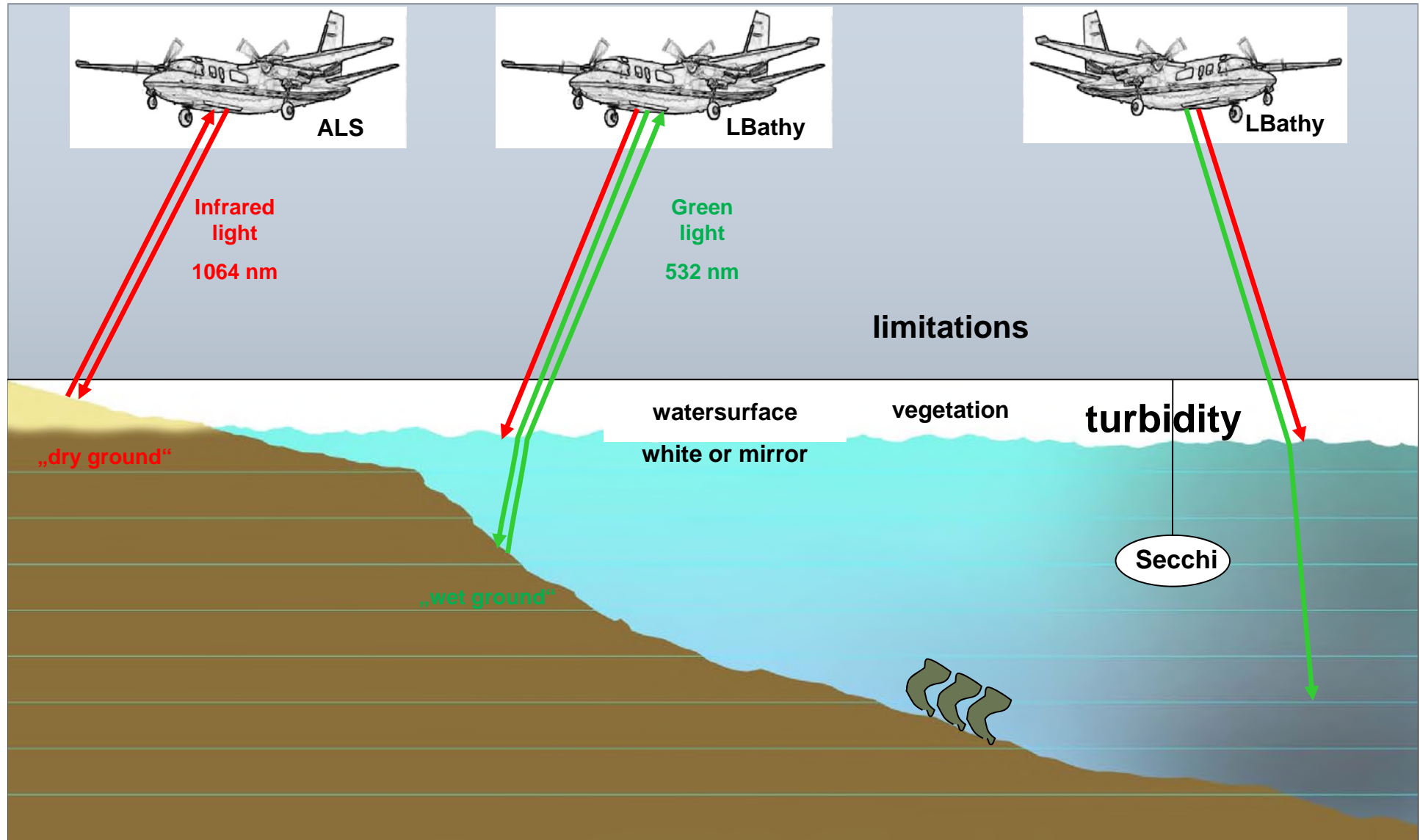


Previous kind of survey of the Baltic Sea LKN.SH

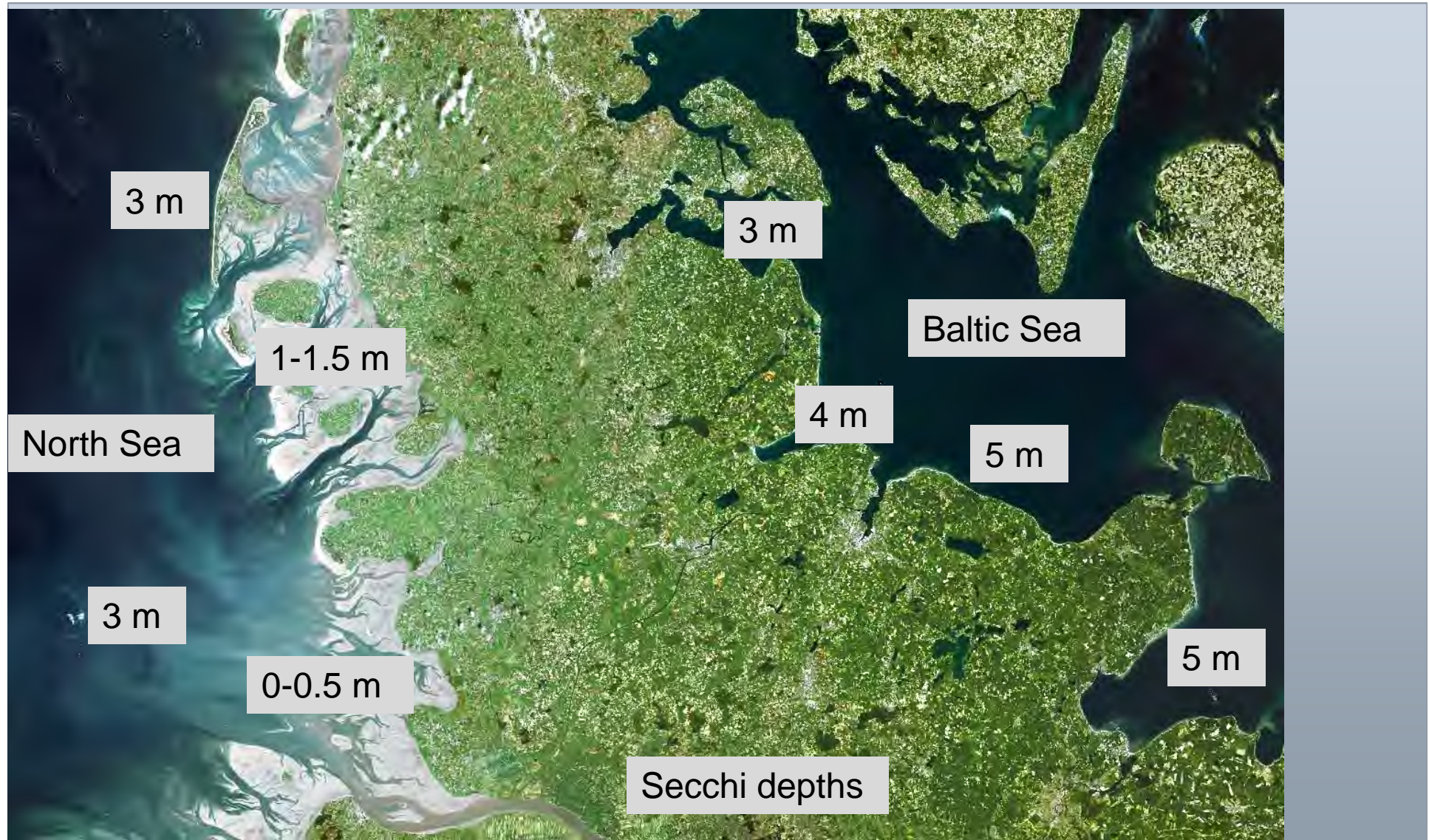
Landesbetrieb für Küstenschutz,
Nationalpark und Meeresschutz
Schleswig-Holstein



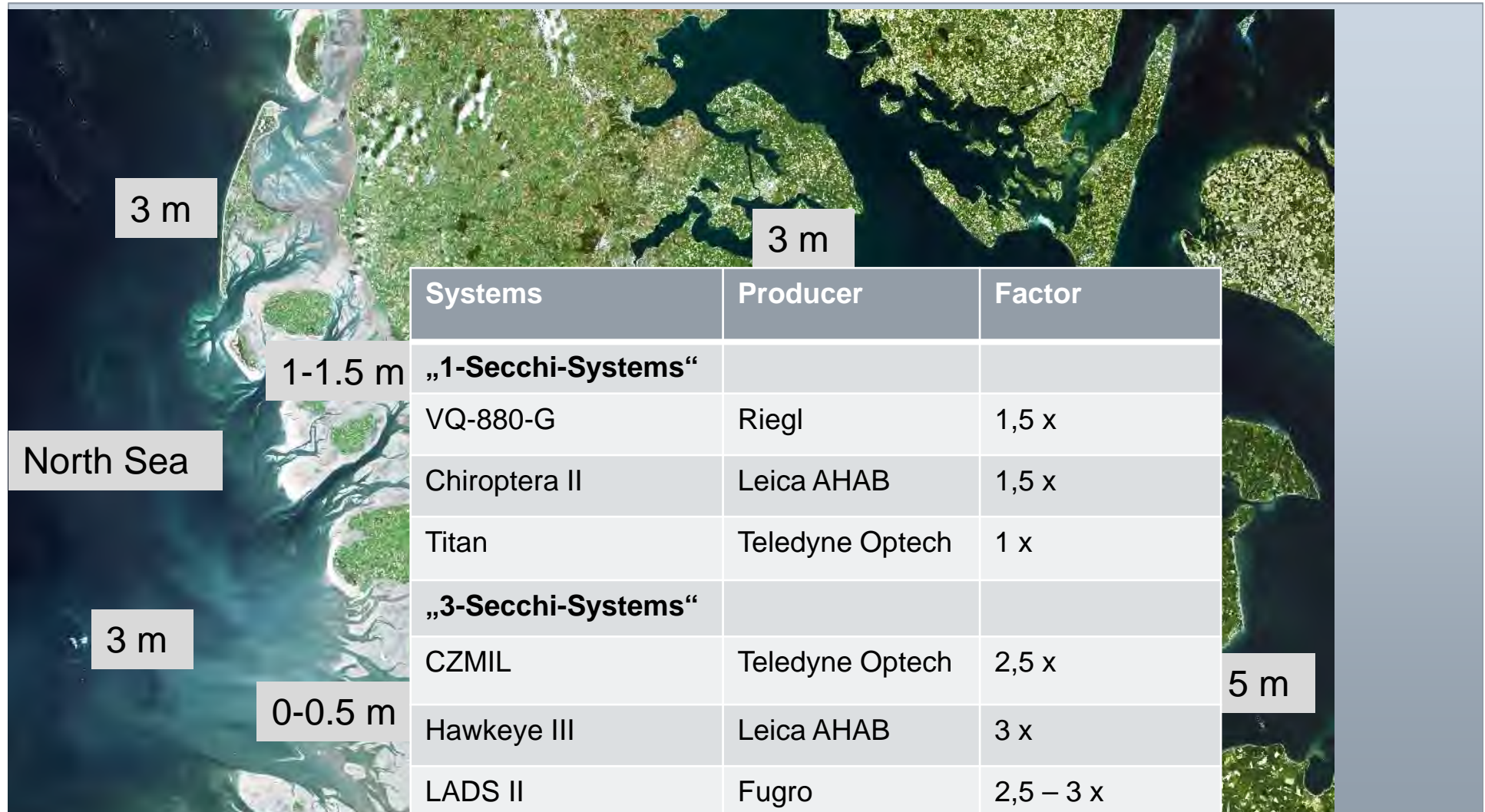
LIDAR bathymetry, principle and limitations



Secchi depths



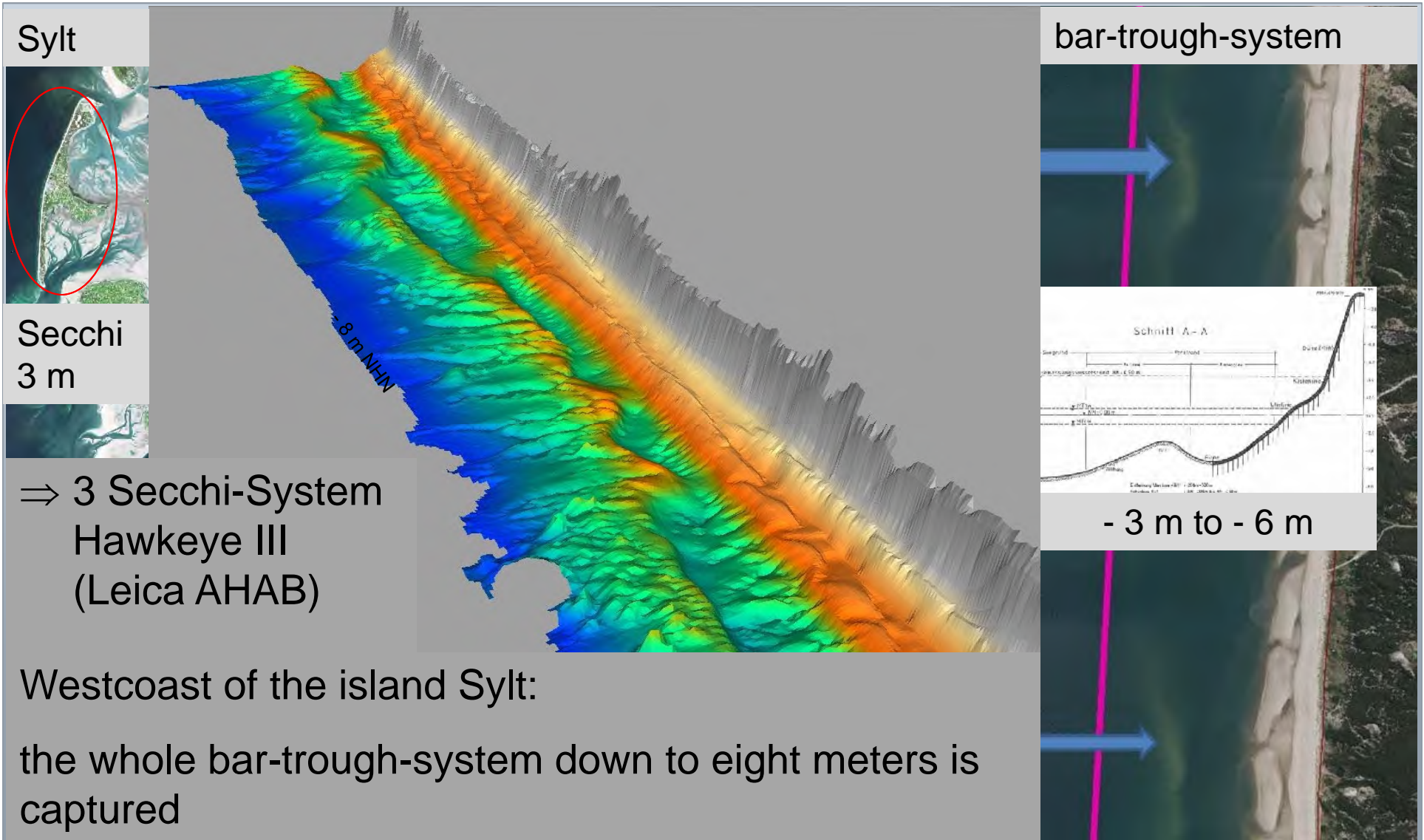
Expected depths



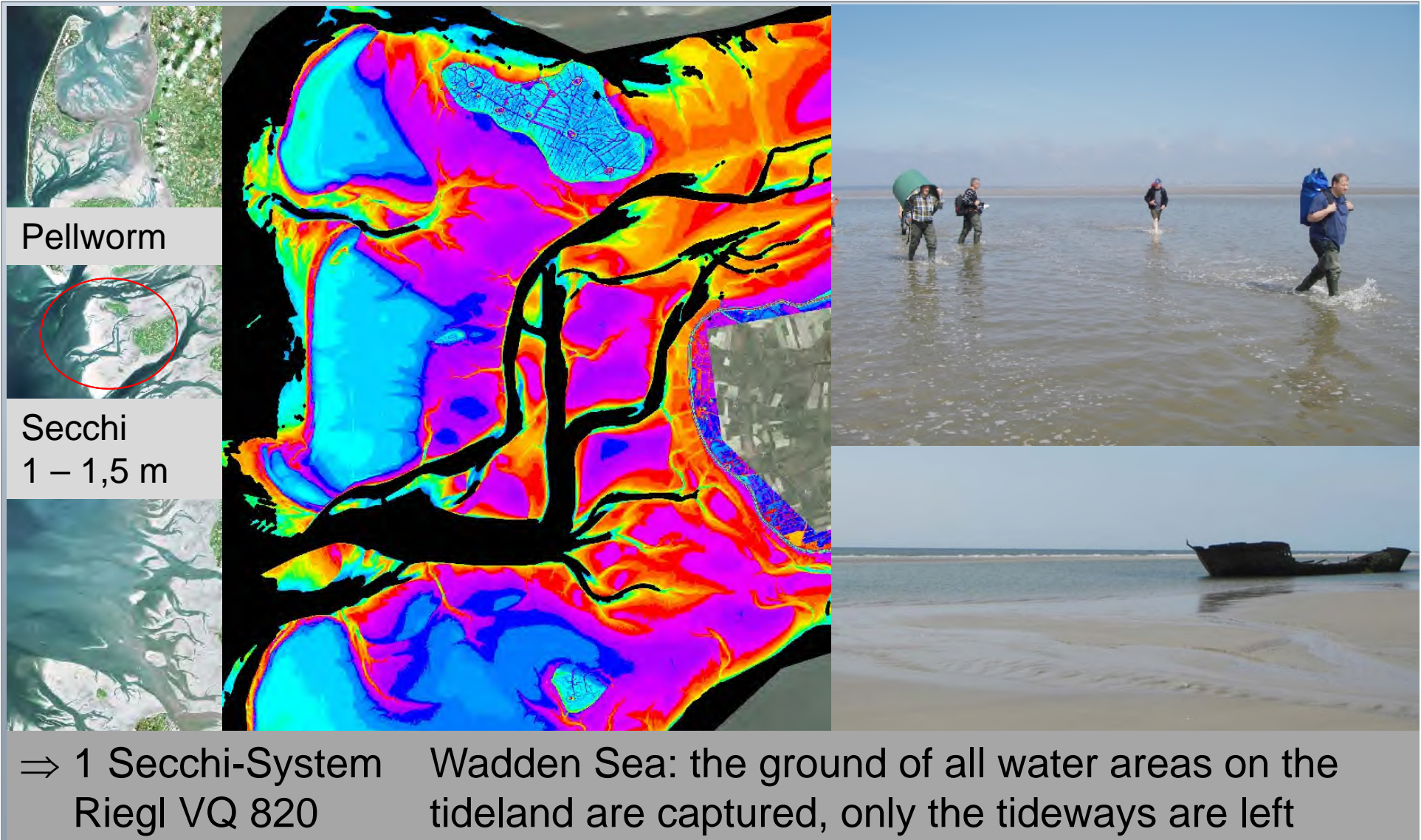
Expected depths of penetration = Secchi-value x factor



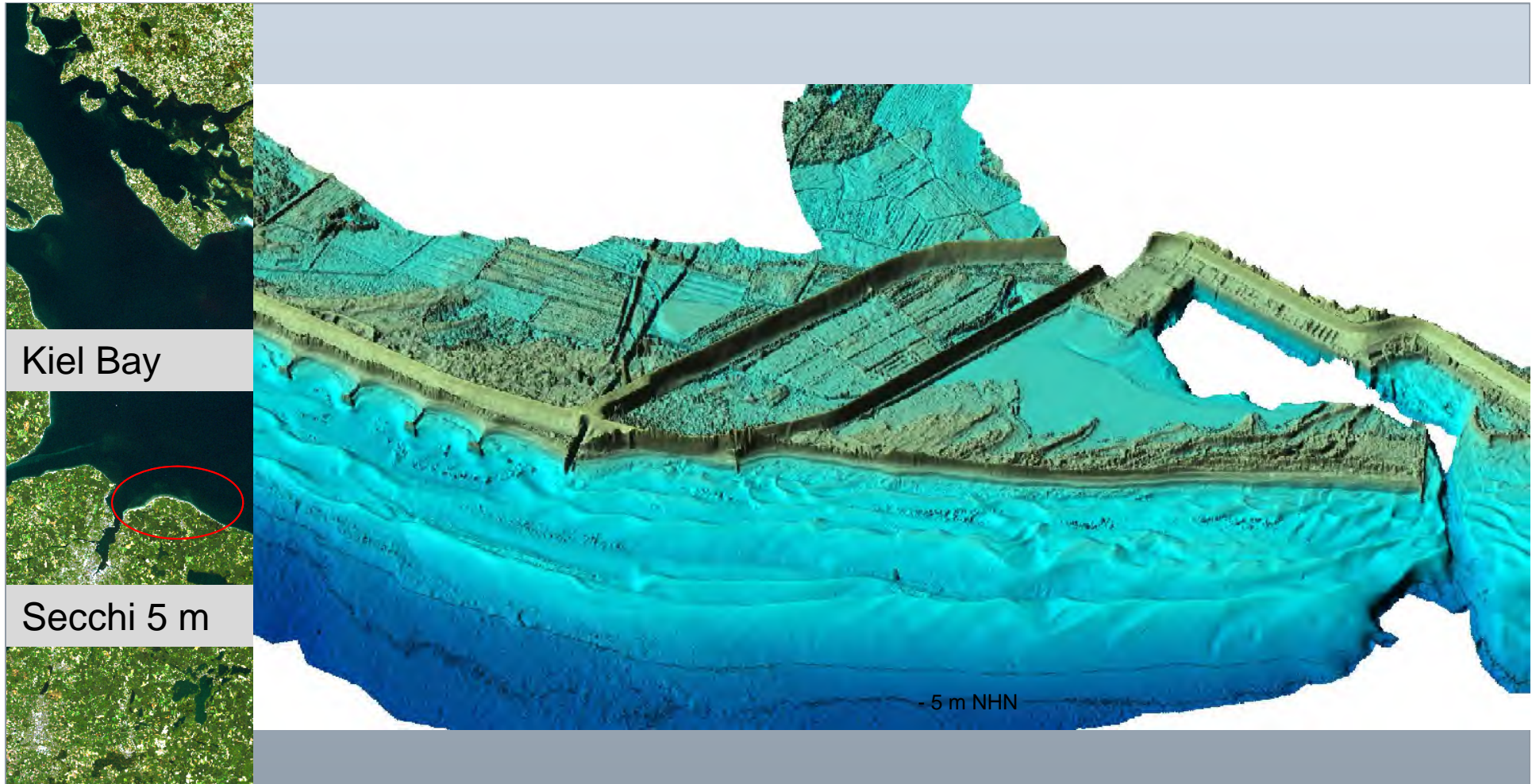
Results



Results



Results



⇒ 1 Secchi-System
Riegl VQ 820

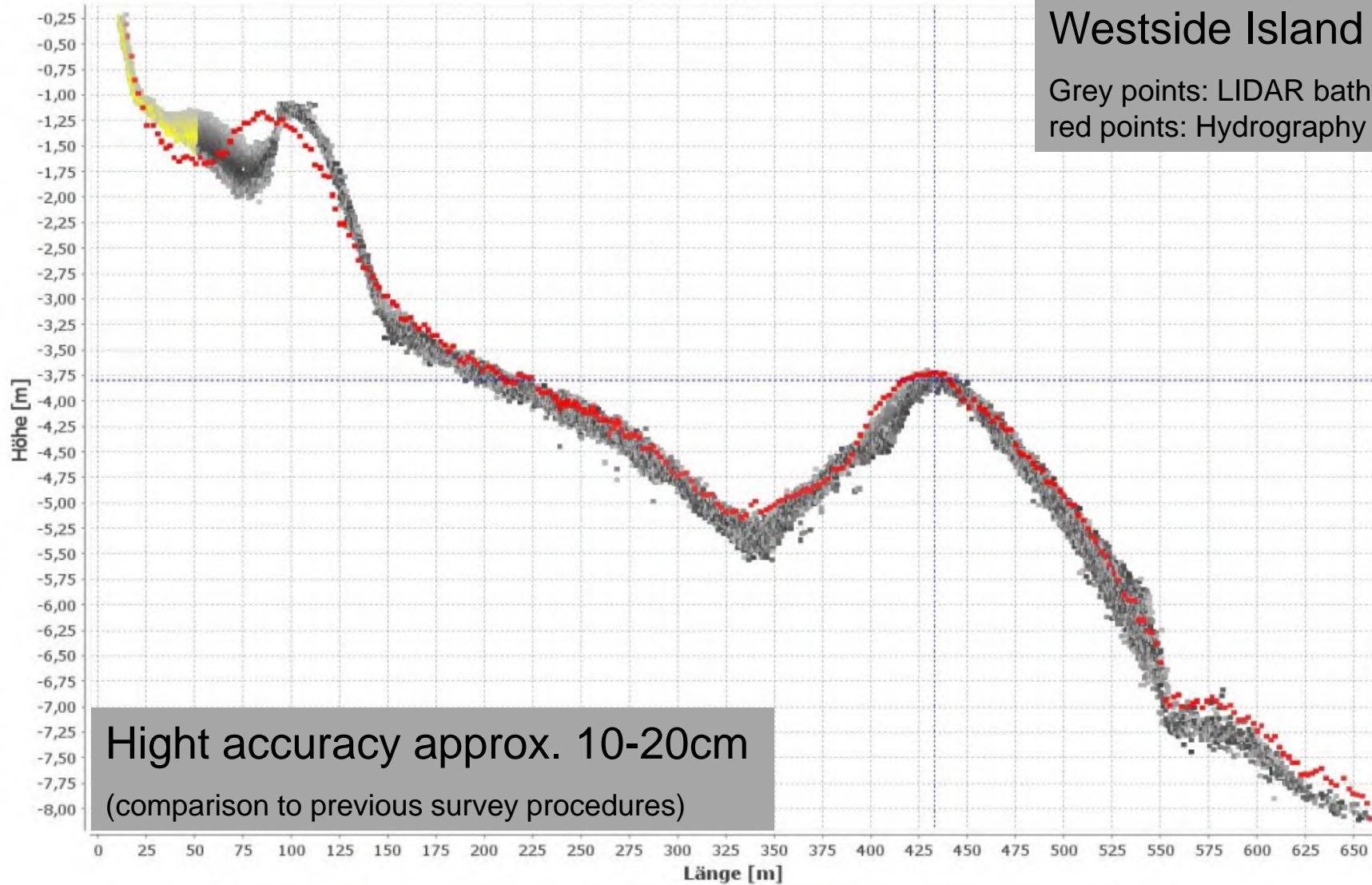
Baltic Sea: detailed under water structures down to
five meters are captured



Results

Westside Island Sylt

Grey points: LIDAR bathymetry,
red points: Hydrography



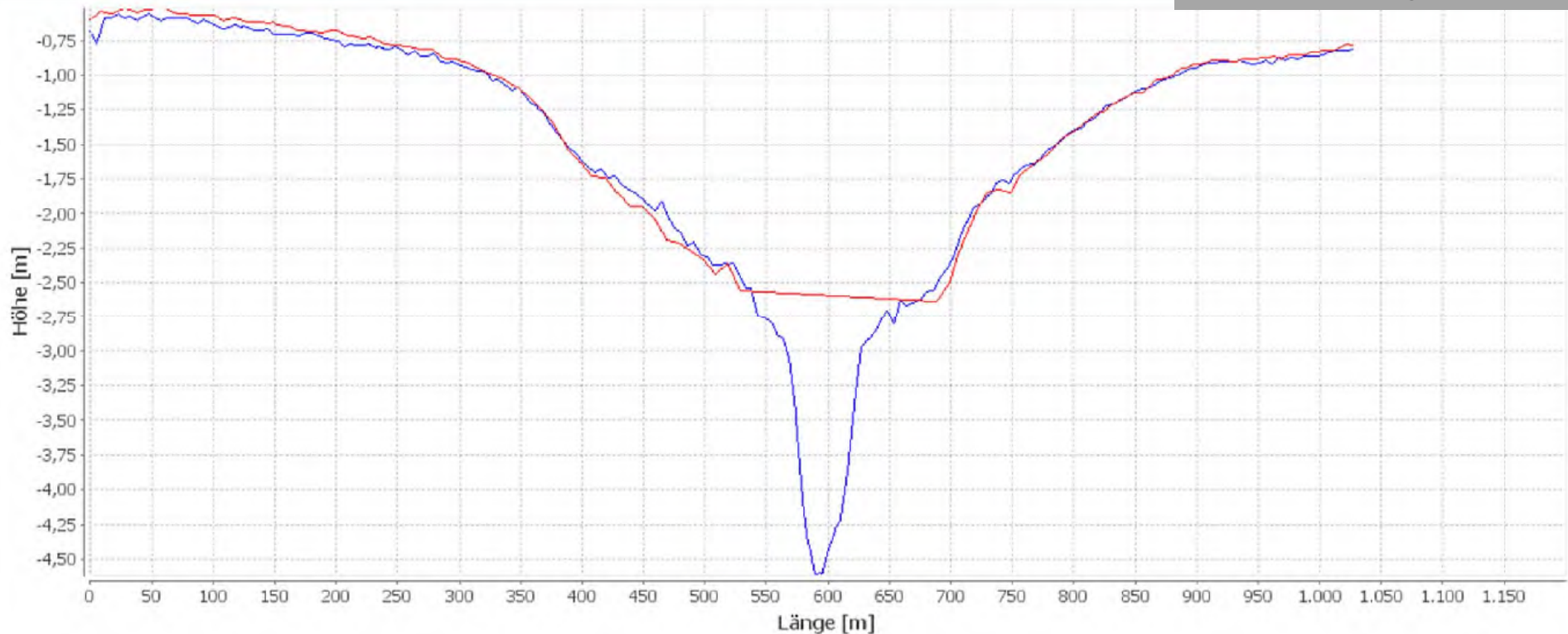
High accuracy approx. 10-20cm
(comparison to previous survey procedures)



Results

Wadden Sea

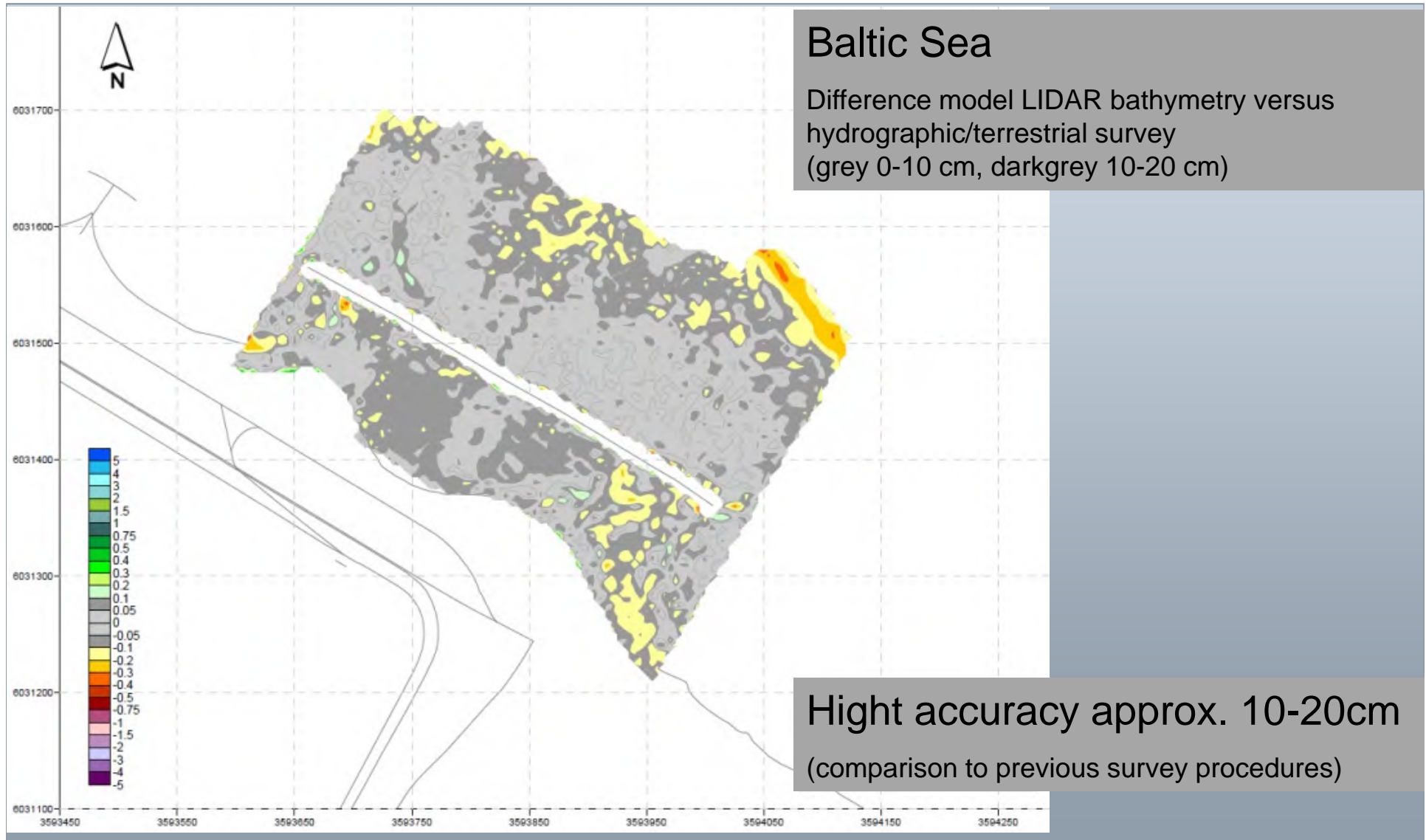
red line: LIDAR bathymetry
blue line: Hydrography



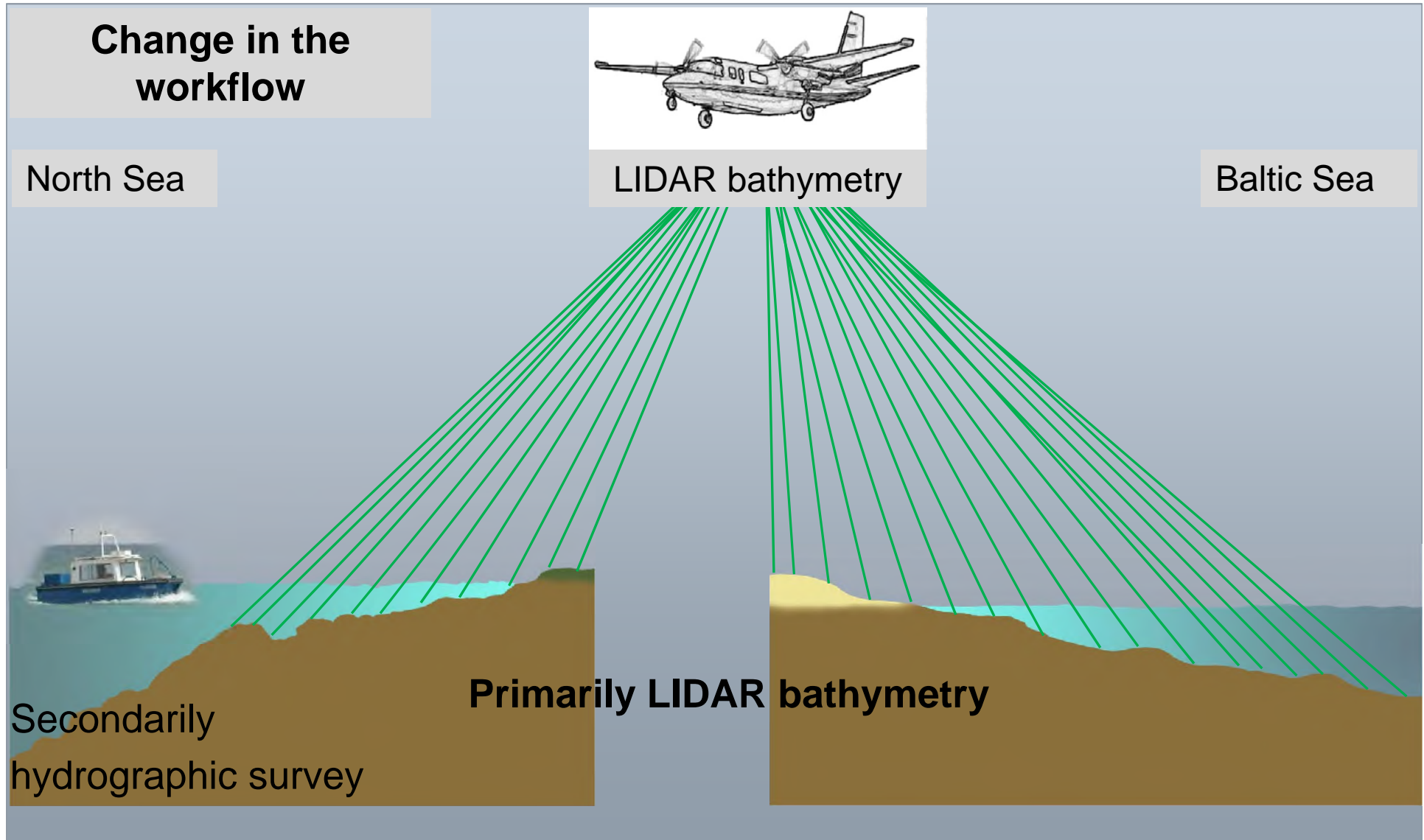
High accuracy approx. 10-20cm
(comparison to previous survey procedures)



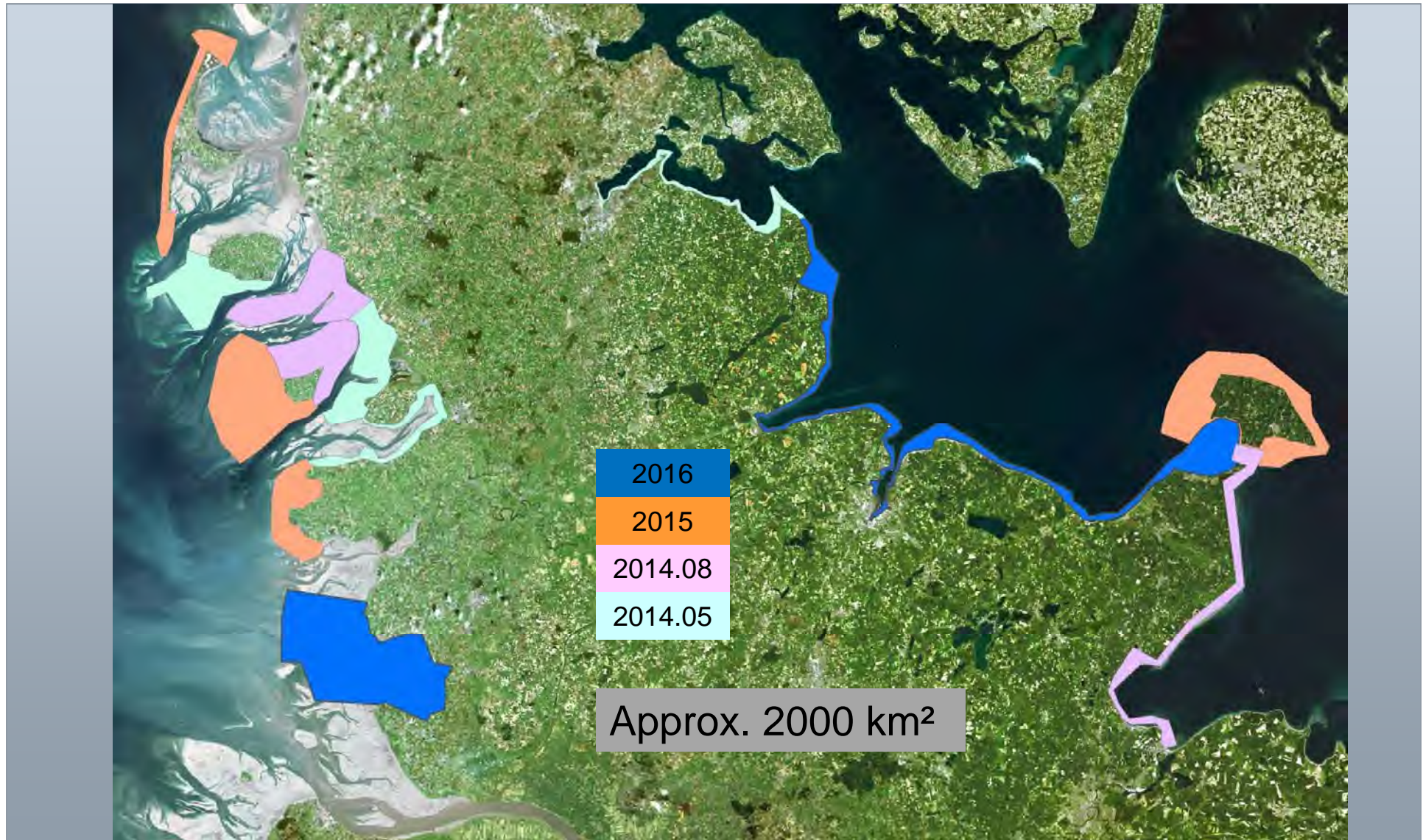
Results

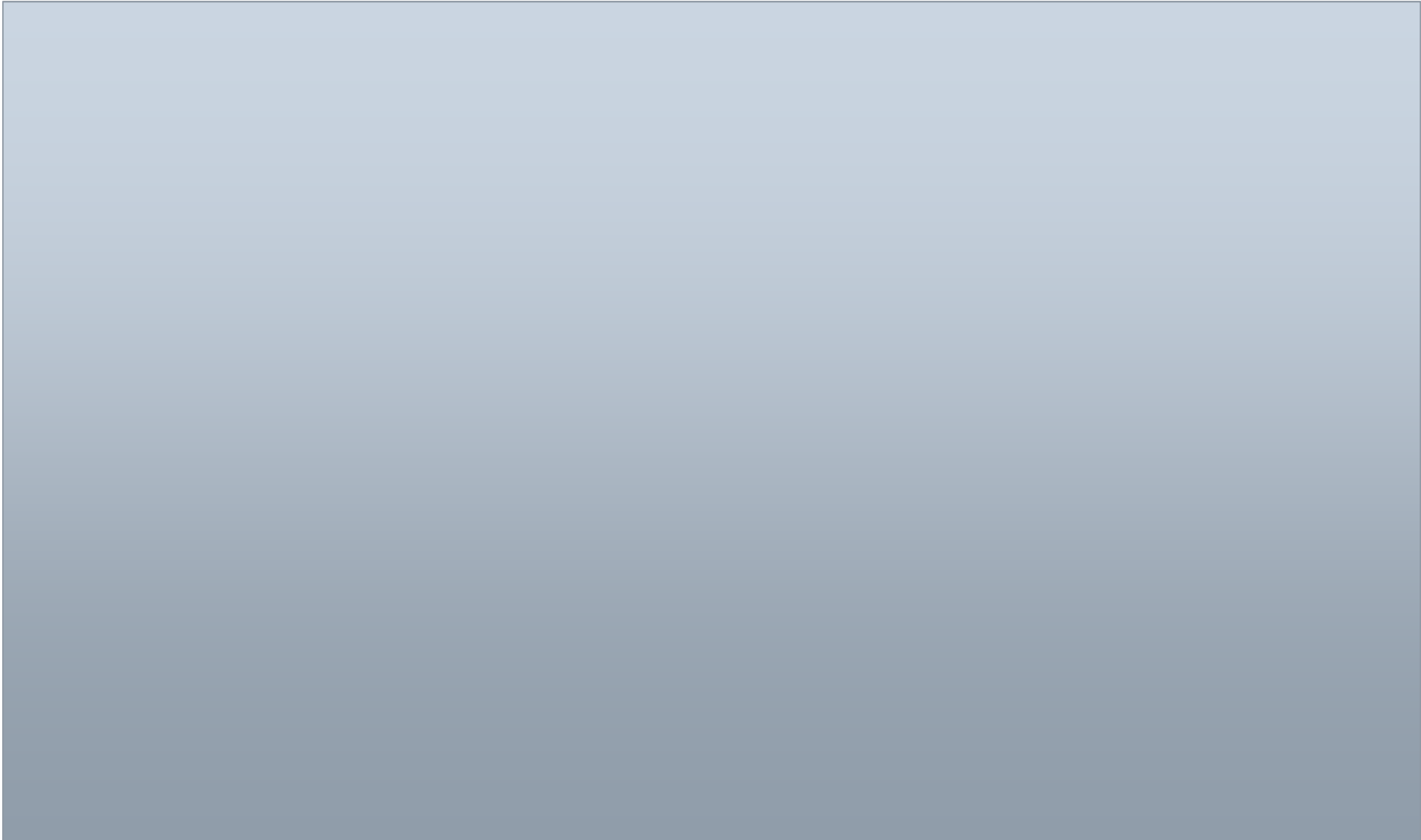


Results



Results



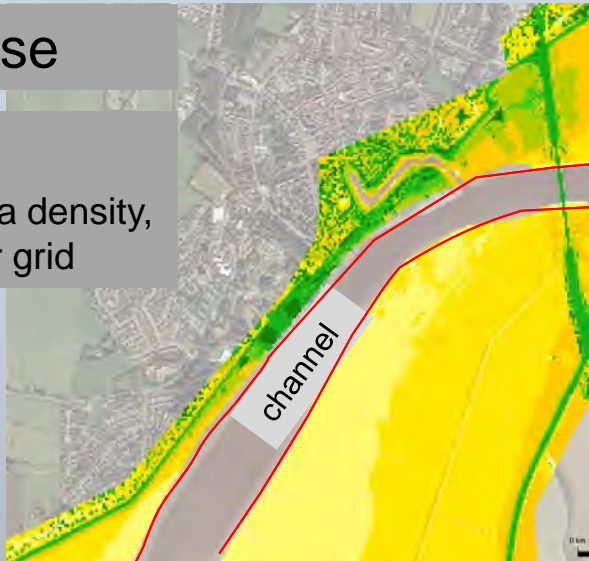


Data modelling

Data base

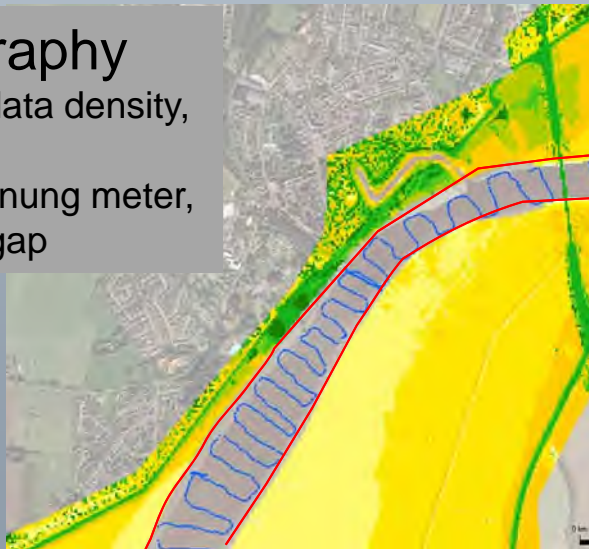
LIDAR

Regular data density,
e.g. 1 meter grid



Hydrography

Unregular data density,
e.g.
1 pt per running meter,
100 meter gap

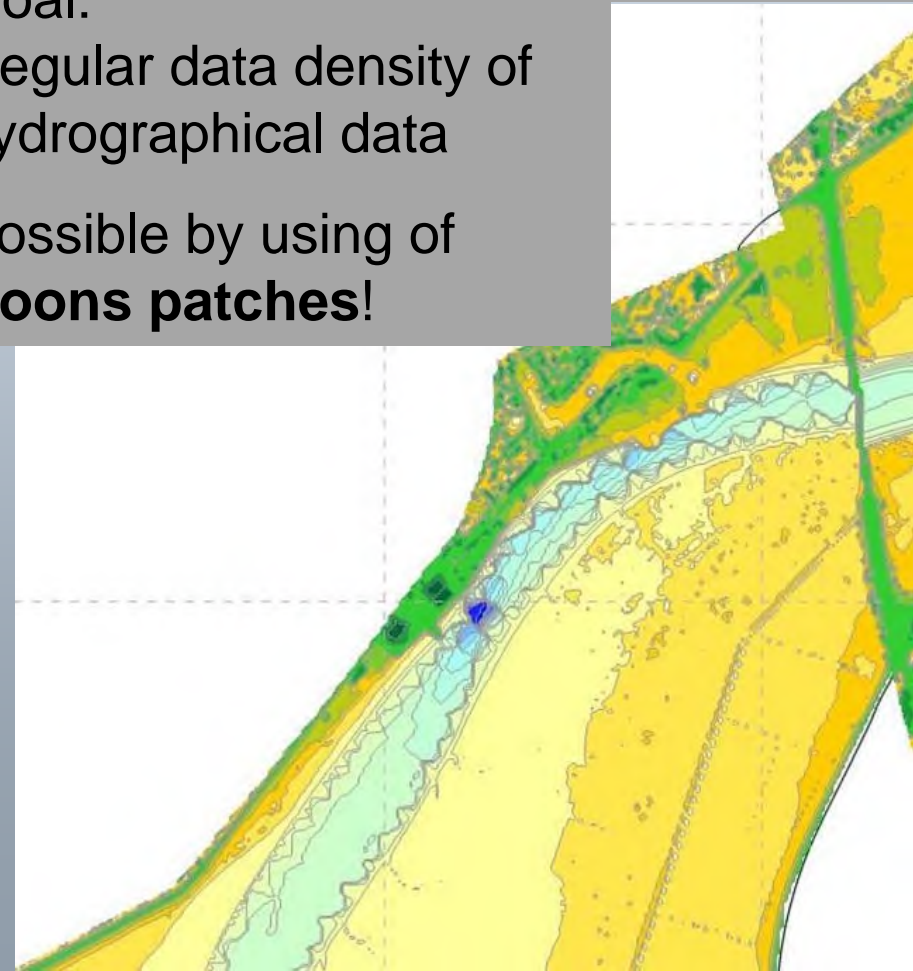


Problem of modelling: Data density

Goal:

Regular data density of
hydrographical data

Possible by using of
Coons patches!



Coons patches

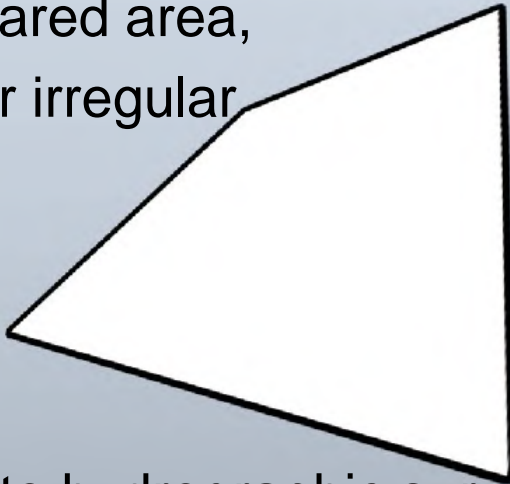
- Especially the car industry needs algorithm to generate free formed surfaces by CAD, e.g. for car bodies
- Approximation algorithms of Bézier curves and Bézier surfaces are known. These were developed by P. Bézier at Renault.
- Steven Anson Coons (1912 – 1979) was a pioneer of developments in computer graphics. He worked among others at Ford.
- His developed **Coons patches** are based on an **interpolation algorithm**.



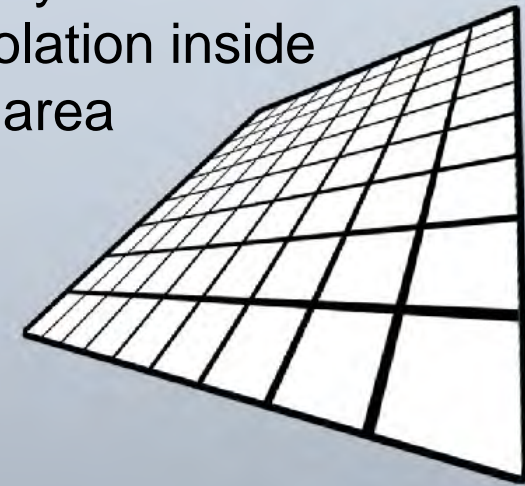
Coons patches

Base:

Four squared area,
regular or irregular
formed

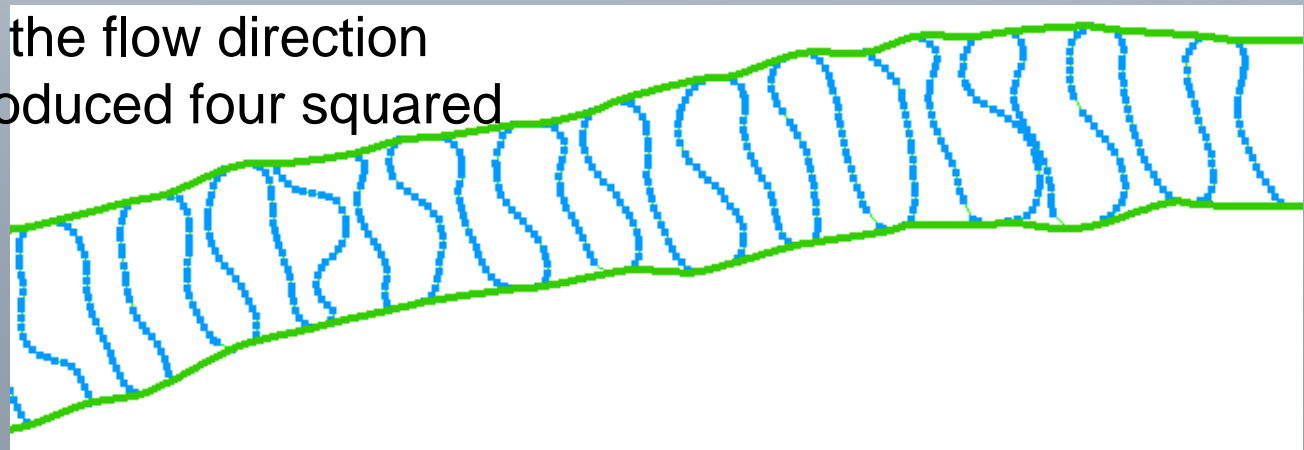


Higher data density
by bilinear interpolation inside
the four squared area



Transfer to hydrographic survey:

cross profiles vertical to the flow direction
together with the hull produced four squared
areas.

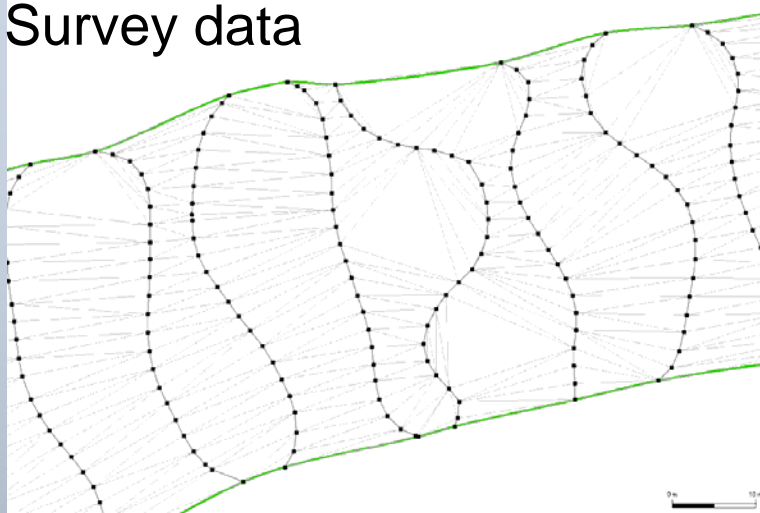


This structure allows
bilinear interpolation!

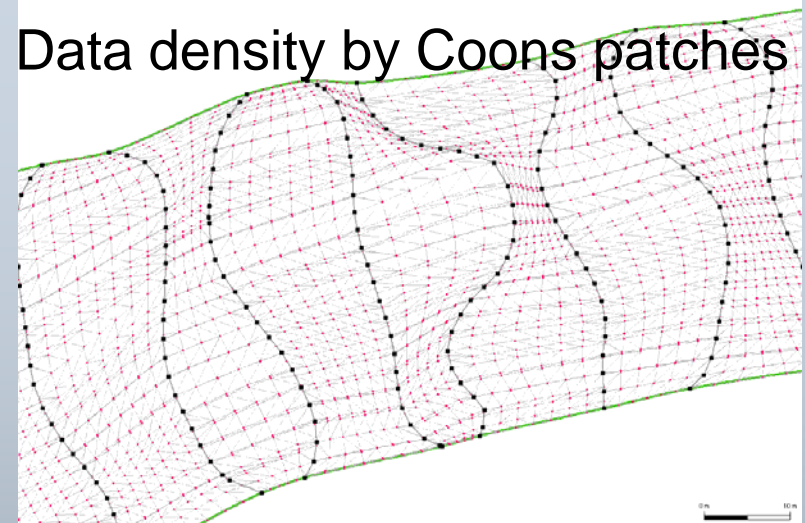


Results

Survey data

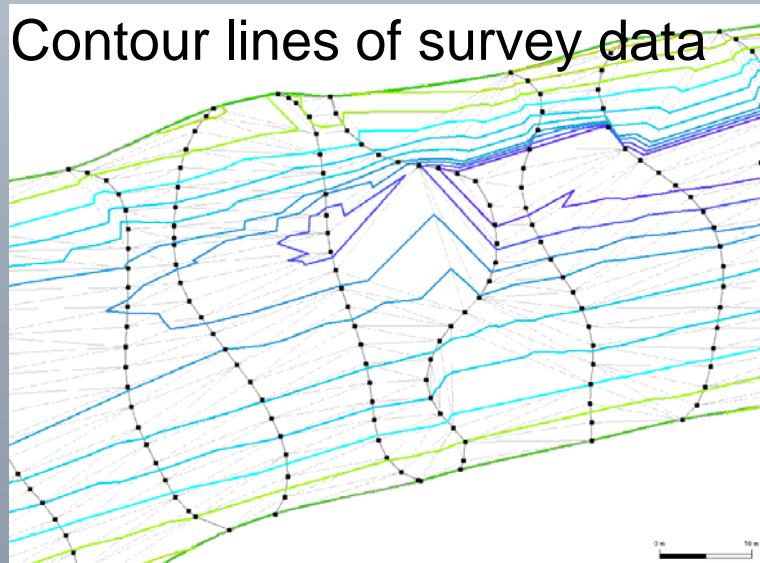


Data density by Coons patches

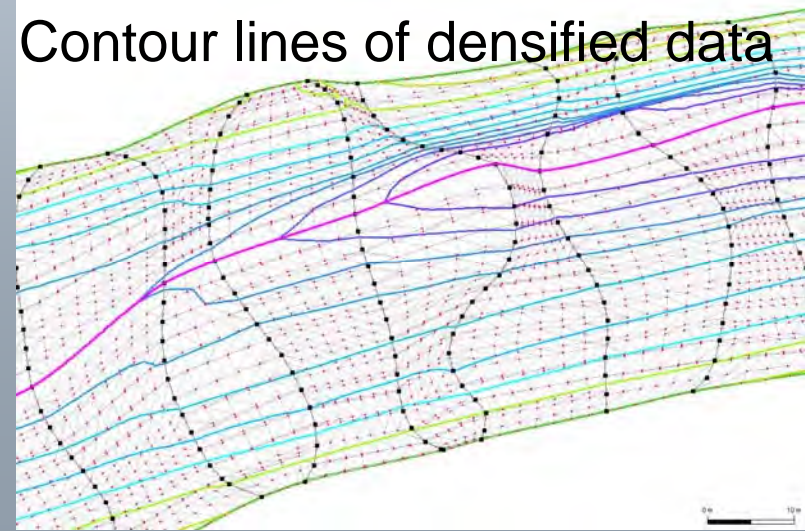


DTM
software

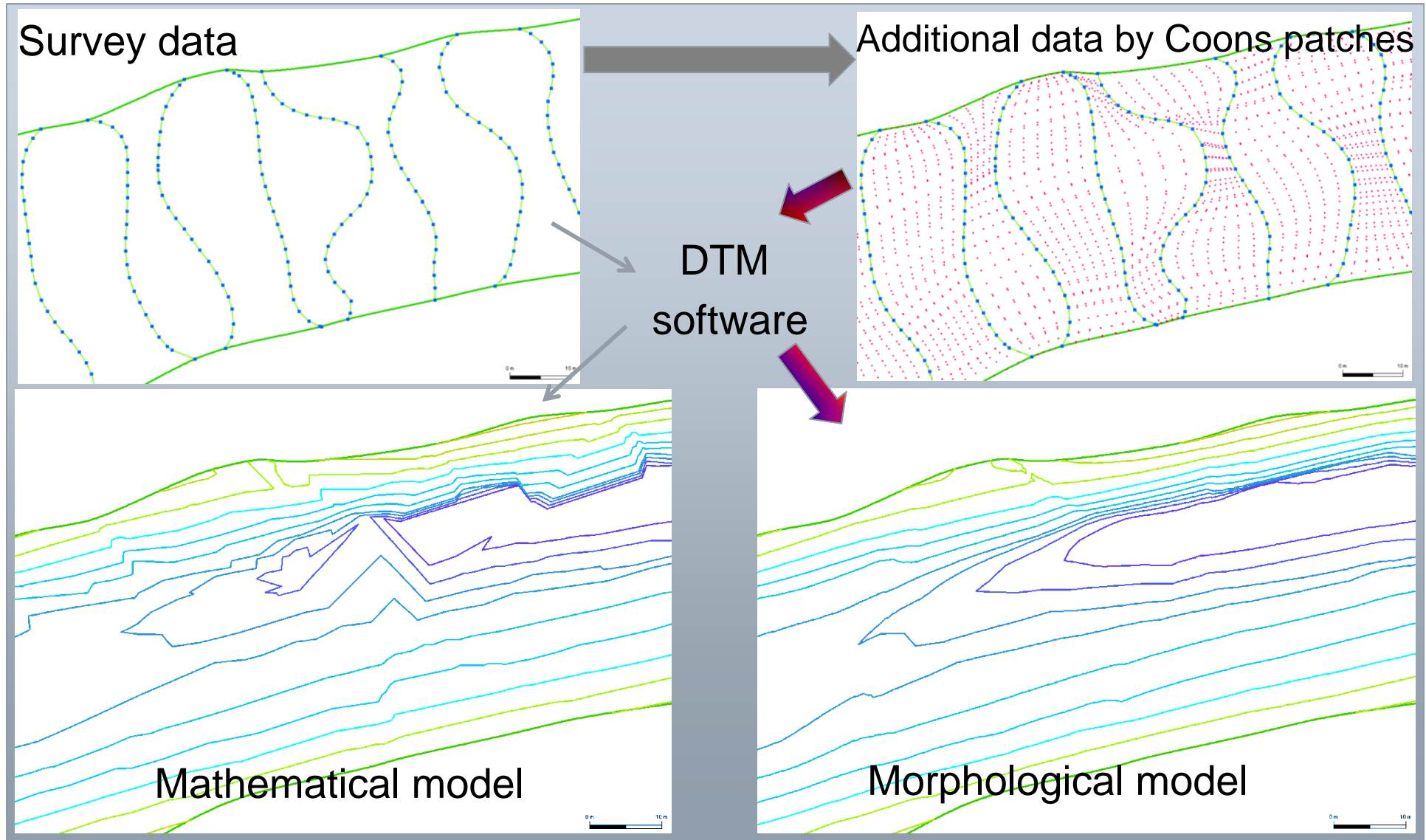
Contour lines of survey data



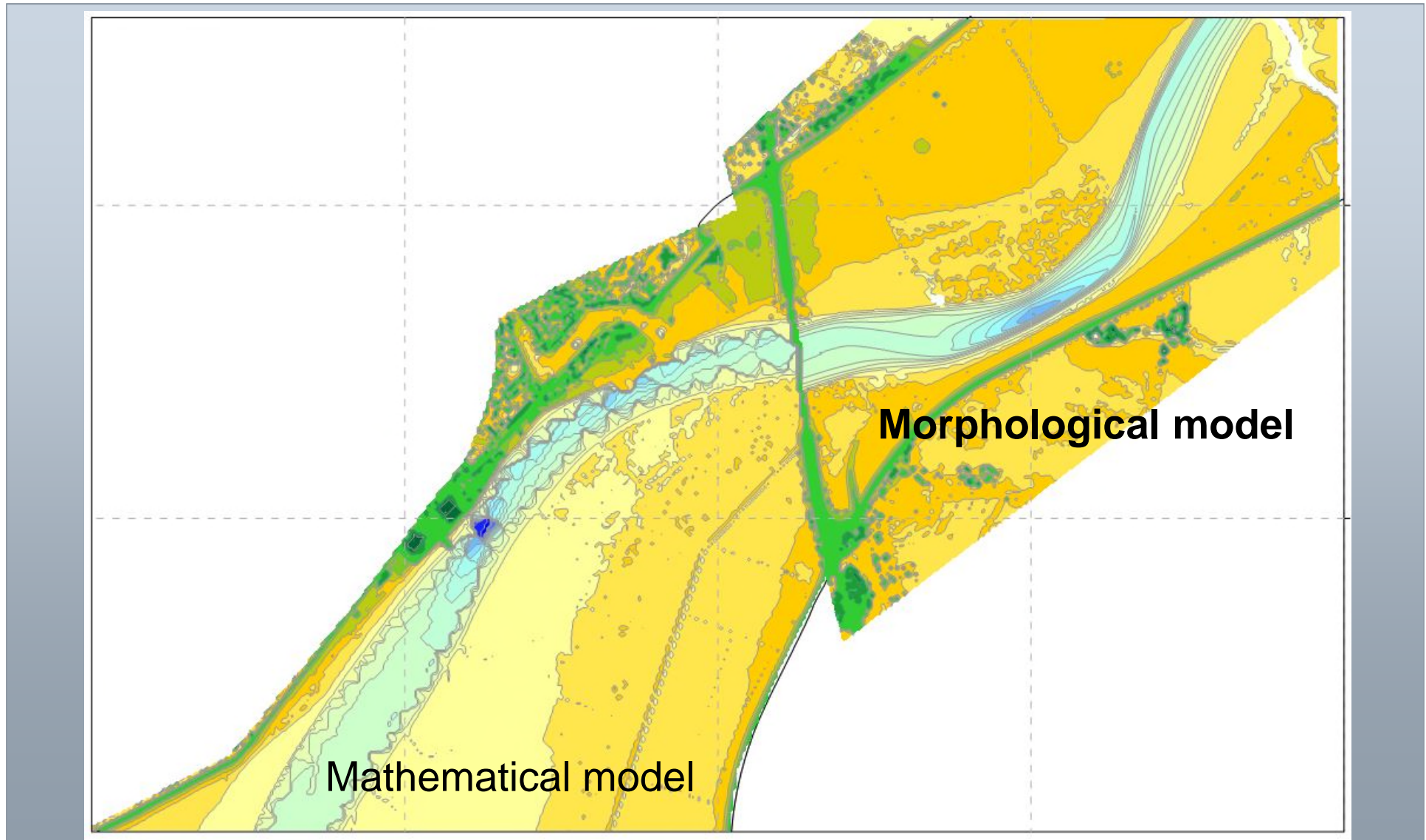
Contour lines of densified data



Results

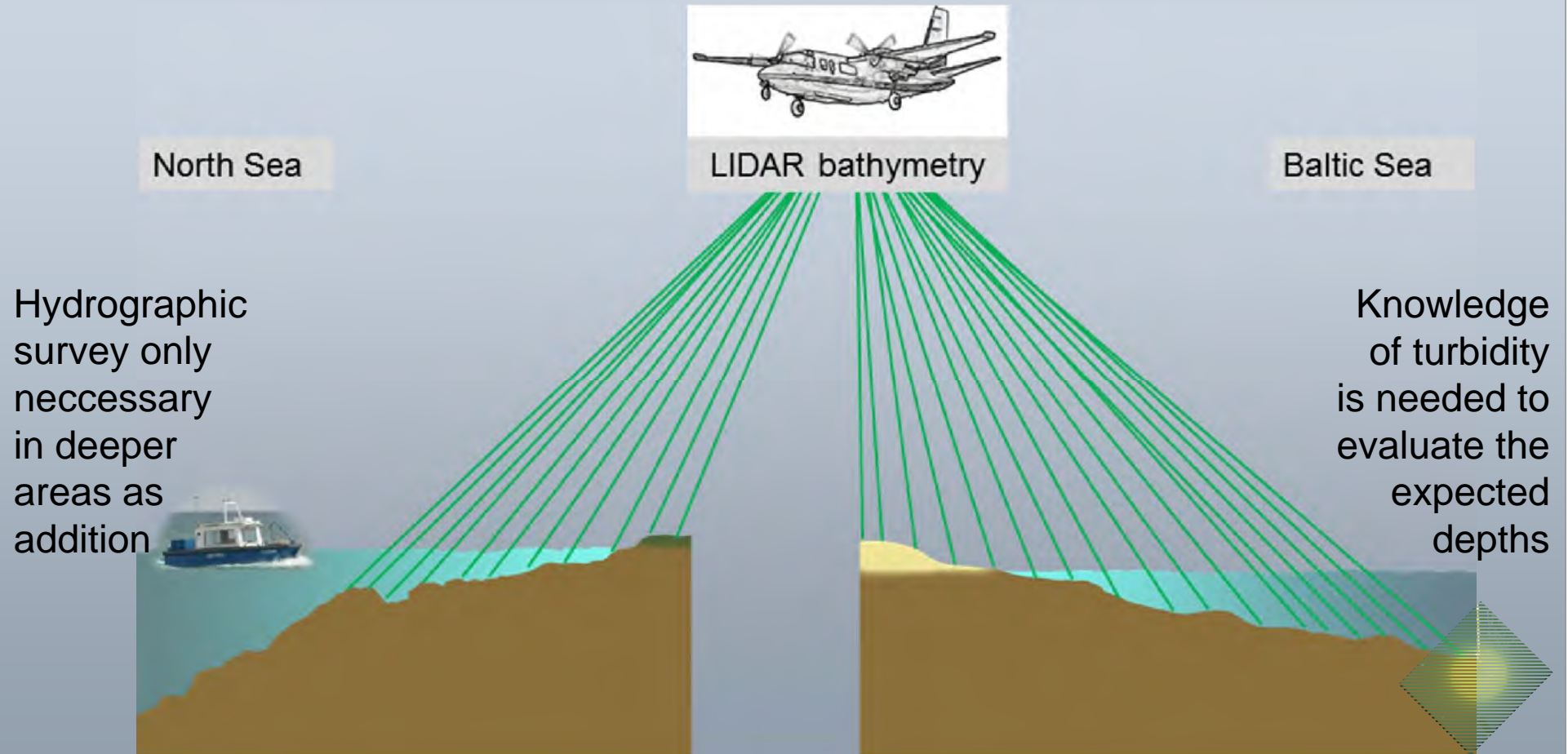


Results



Conclusions

Goal: Morphological model of survey data for coastal protection



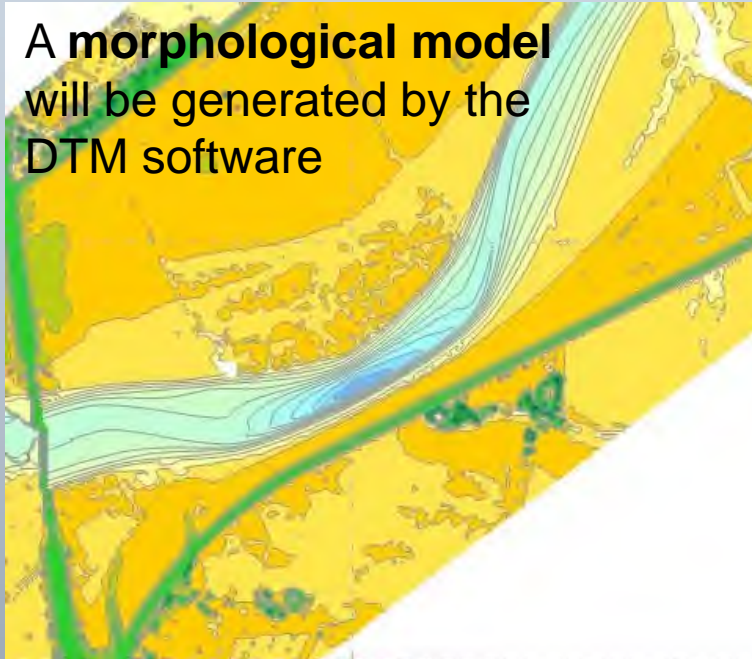
Technique of **LIDAR bathymetry** is effectively usable in the near shore and shallow water coastal area of the North Sea and the Baltic Sea



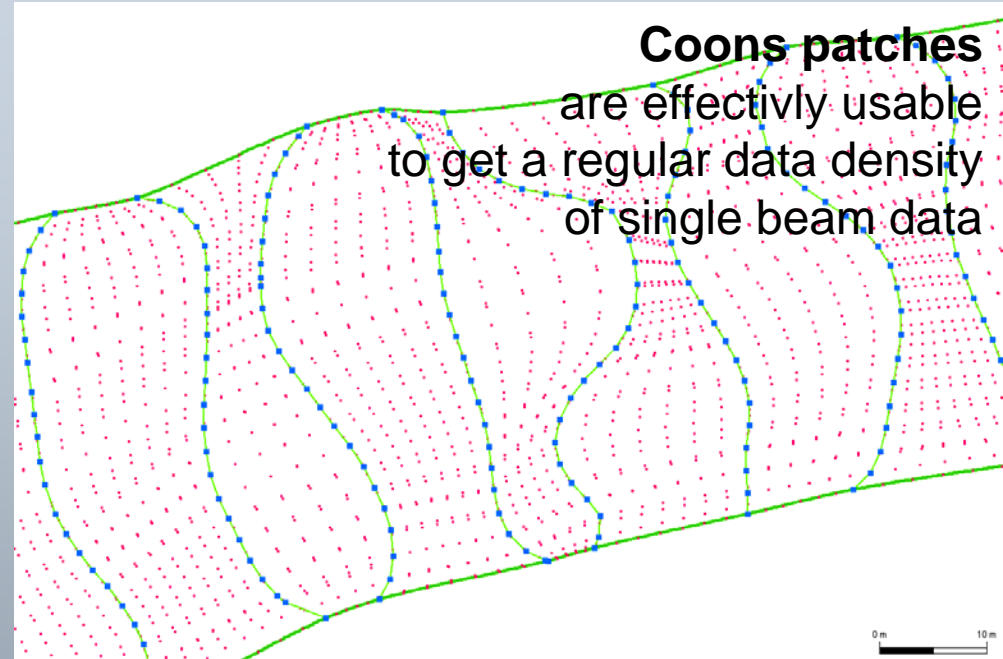
Conclusions

Goal: Morphological model of survey data for coastal protection

A morphological model
will be generated by the
DTM software



Coons patches
are effectively usable
to get a regular data density
of single beam data



Data of LIDAR bathymetry and additional single beam data
completed by data of Coons patches
gives a new quality of the morphological model
of the coastal areas of the North Sea and the Baltic Sea
needed for the task of coastal protection!



