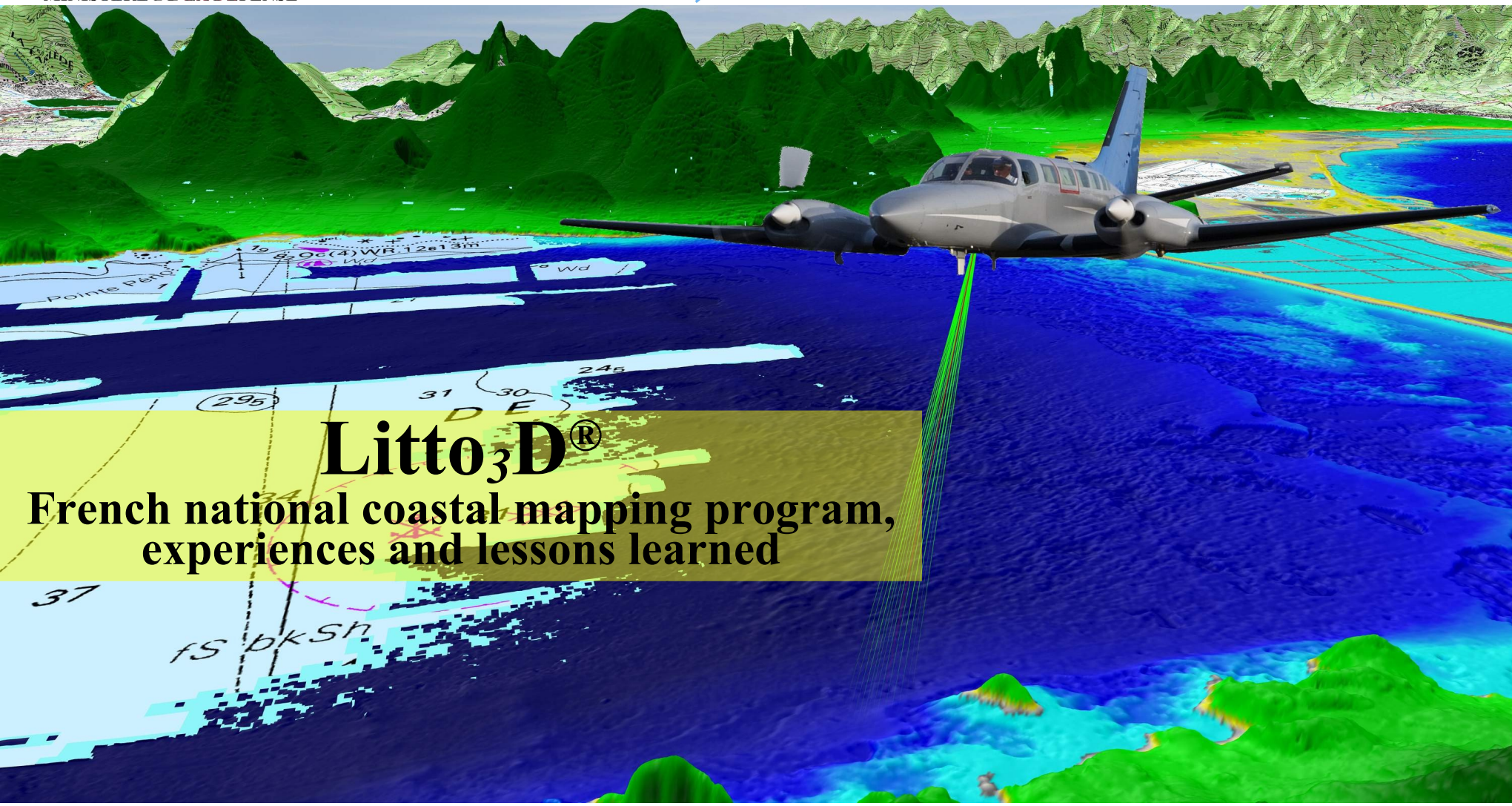
Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE
MINISTÈRE DE LA DÉFENSE

SHOM
L'océan à la carte



Litto3D®

French national coastal mapping program, experiences and lessons learned

⚓Few words about SHOM

SHOM is the official Hydrographic Office for France

1693 : publication of the nautical atlas, the Neptune François

Navy department

… 2007 : Public establishment (multisource funded)

- One vocation
  - To ensure the quality and the availability of the physical maritime, coastal and ocean environment information, in order to meet public requirements, both civilian and military, at the lowest possible cost.

- Three main missions …
  - National Hydrographic Service
  - Defence Support
  - Support to maritime public policies

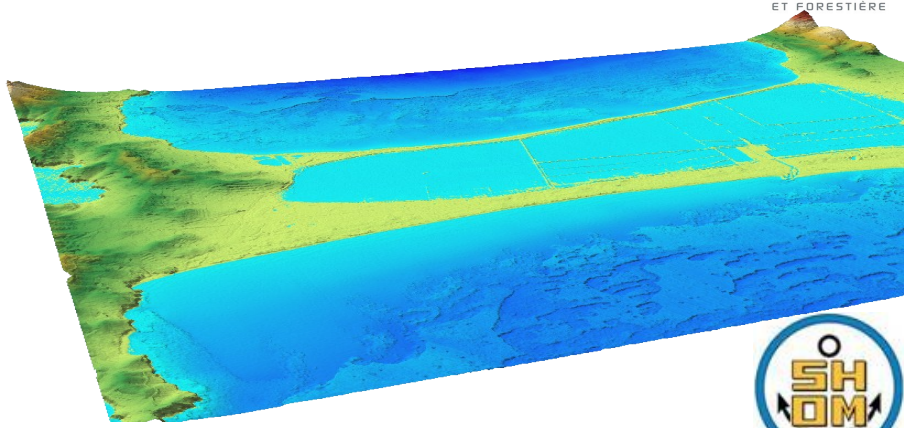
Litto$_3$D® project

Litto3D®

Goal

High-resolution seamless elevation model along French shorelines (metropolitan France & overseas) for coastal zone management, risk prevention, habitat mapping…

IGN
INSTITUT NATIONAL DE L'INFORMATION GÉOGRAPHIQUE ET FORESTIÈRE



Co produced by SHOM and IGN

SHOM

Area of interest

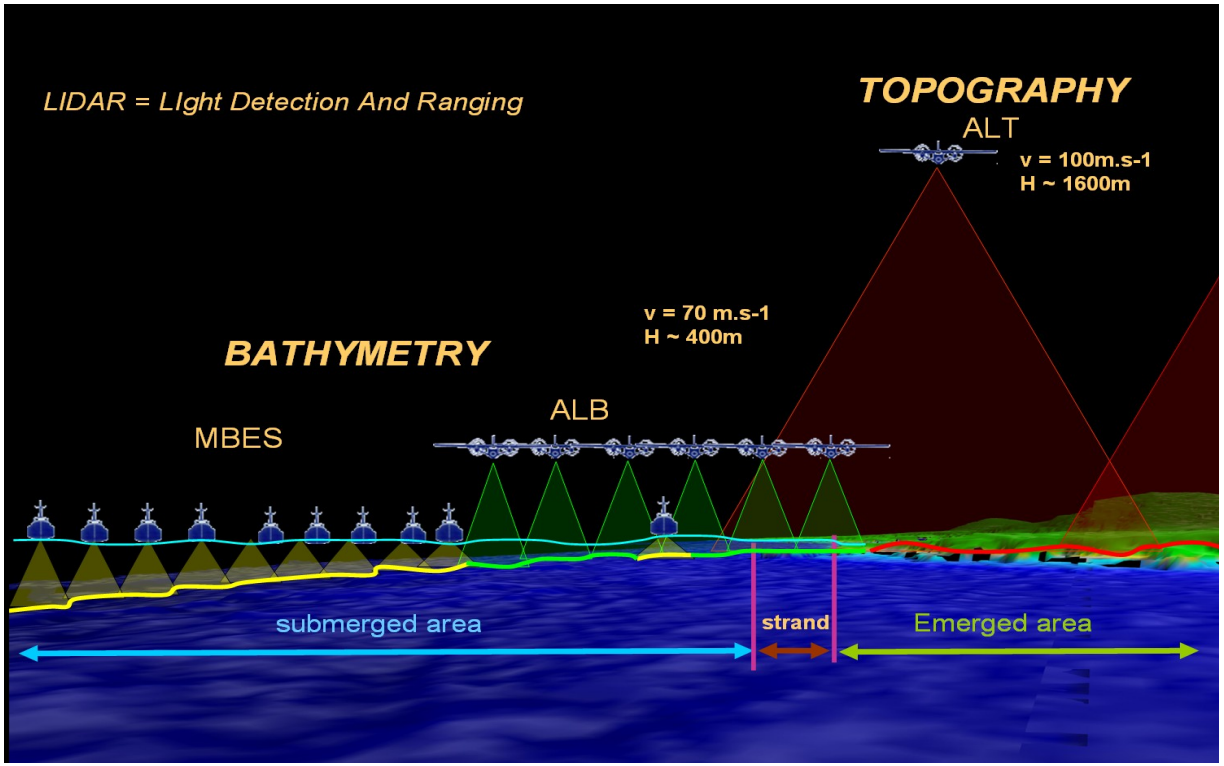
Landwards : up to +10m height and at least 2km inland

Seawards : to the 10m isobaths (or more depending on water clarity)

Litto$_3$D® project

Historical data irrelevant to build this model

→ Large scale surveys conducted along French coasts using state of the art technologies



Litto$_3$D® project

SHOM and IGN were appointed to elaborate this seamless altimetric model but only partly funded !

Need to establish upstream financing with the Government, local authorities and European funding for each territories

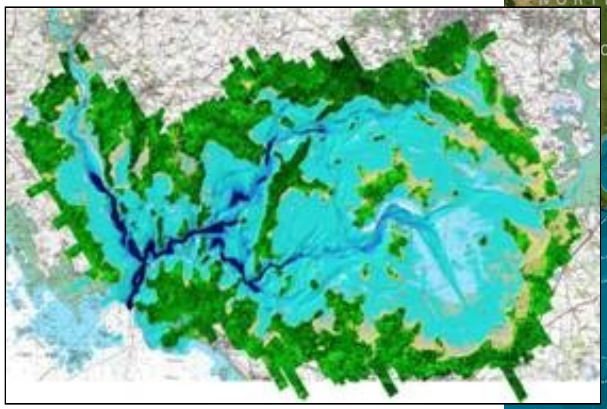
Step by step project, territories by territories

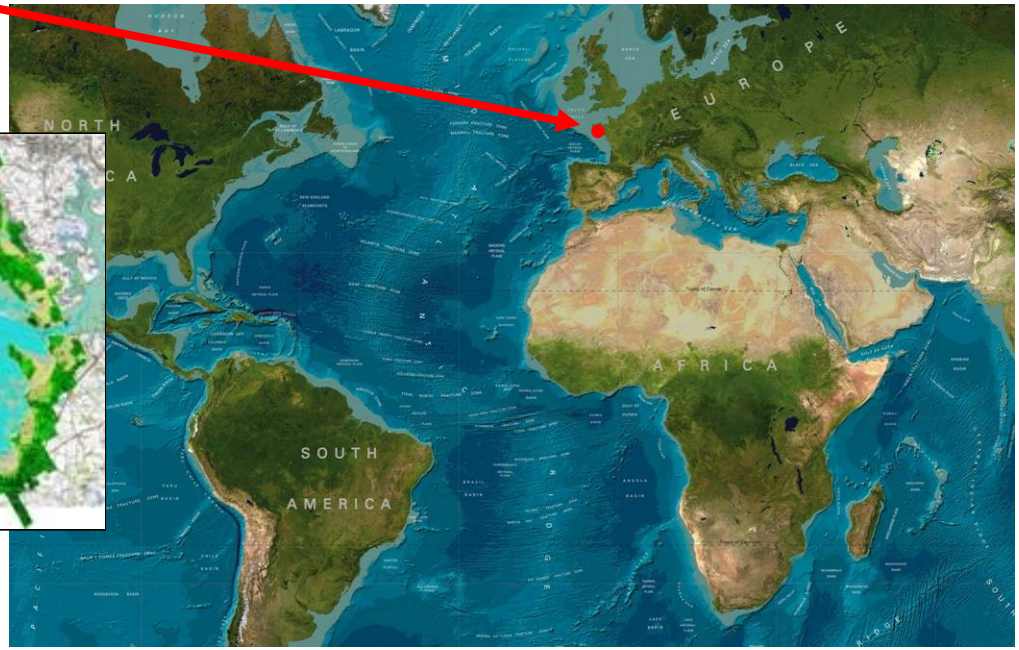
→ SHOM does not own his own LiDAR capability
Surveys subcontracted for each partnership

Surveys to meet IHO Order 1B

Litto$_3$D® progress

Golfe du Morbihan
2005
SHOALS 1000T
(Optech)



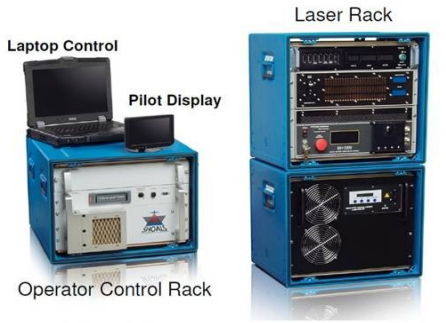


Actimar
OCÉANOGRAPHIE OPÉRATIONNELLE

FUGRO
Fugro Pelagos

Optech

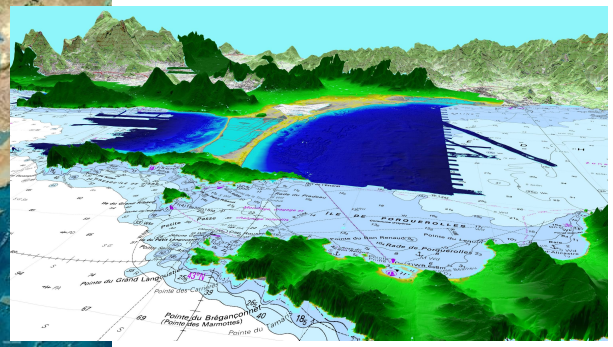
Litto$_3$D® progress



Optech Sensor

Total System Mass:
~ 180 kg
Power: ~ 1600 W

Toulon - Giens
2007
SHOALS 3000
(Optech)

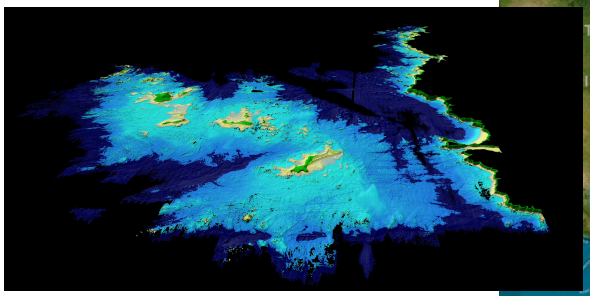


EUROSENSE®

Optech

Litto$_3$D® progress

Finistère
2010
HawkEye IIa
(AHAB)

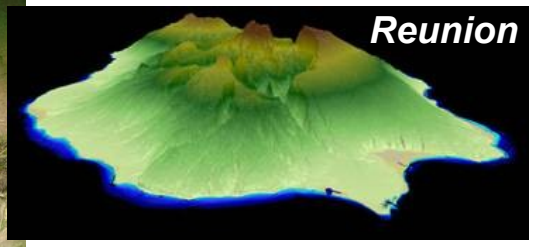


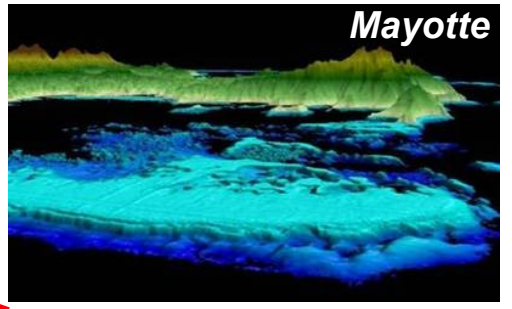
AHAB
Airborne Hydrography AB

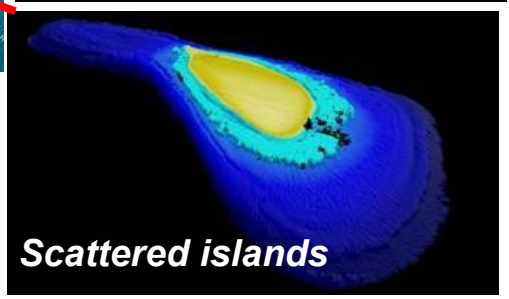
BLOM
IMAGING THE WORLD

Actimar
OCÉANOGRAPHIE OPÉRATIONNELLE

Indian Ocean
2009-2010
HawkEye IIa
(AHAB)

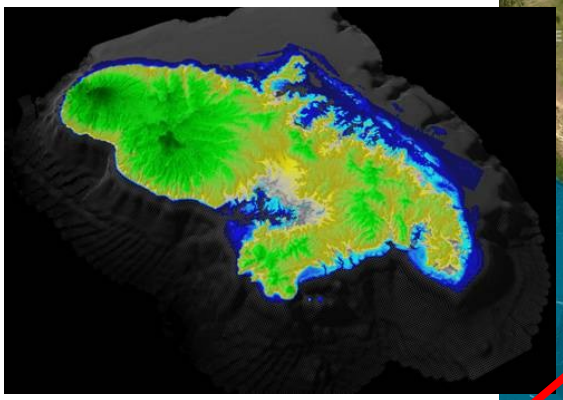




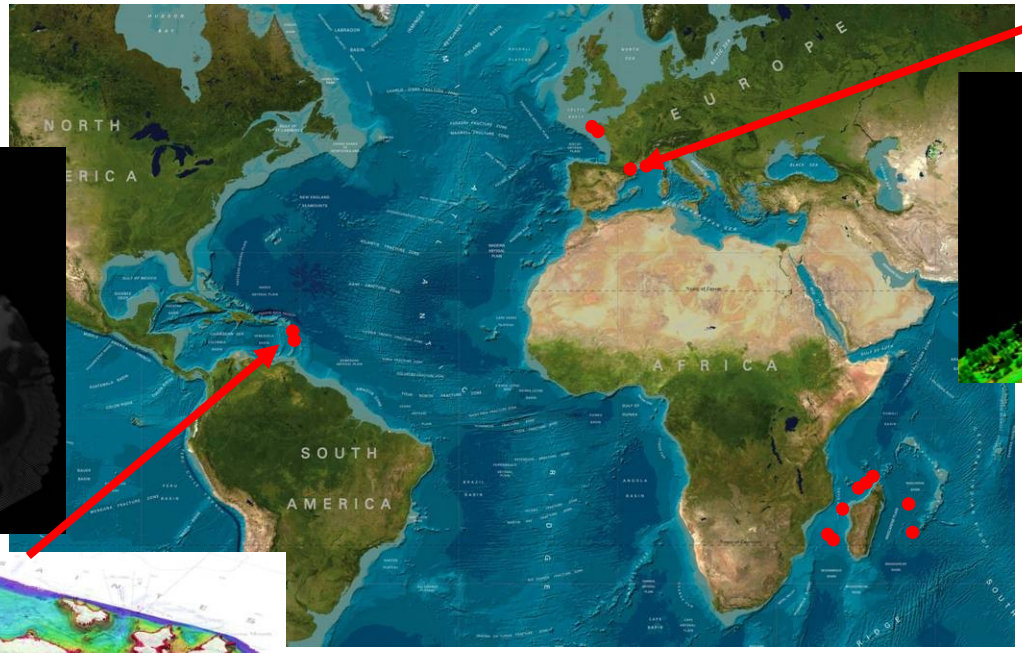


Litto$_3$D® progress

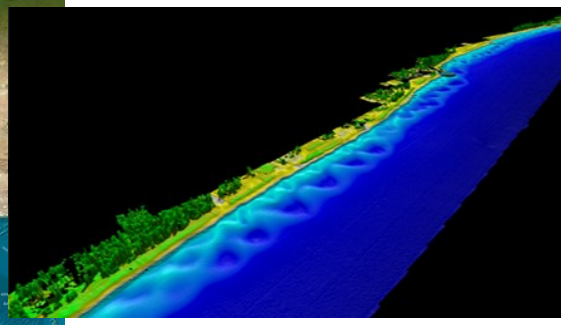
French West Indies
2010-2011
LADS MkII
(Fugro LADS)



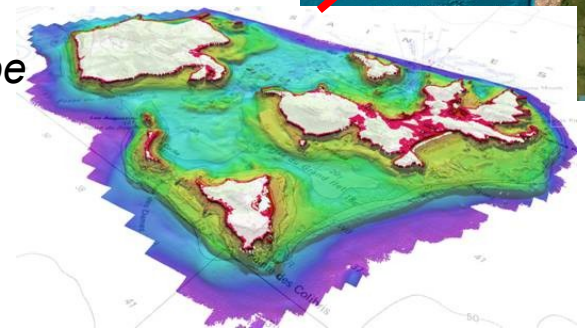
Fugro LADS Corporation



Languedoc-Roussillon
2009
LADS MkII
(Fugro LADS)



Martinique
Guadeloupe



Fugro LADS Corporation

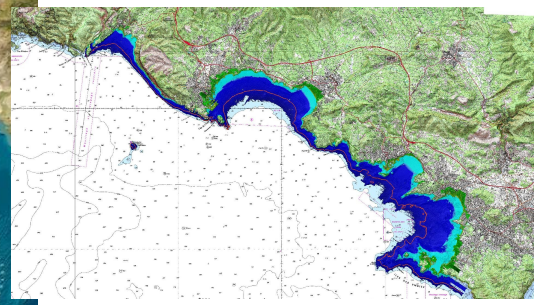
Litto$_3$D® progress

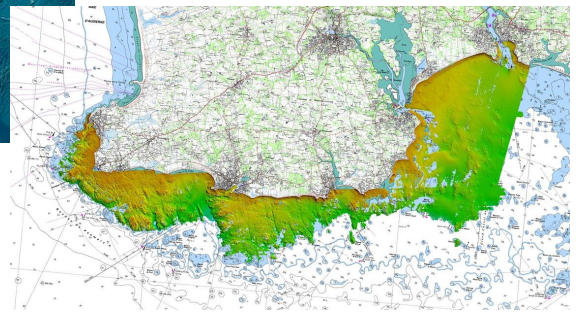
Pelydryn

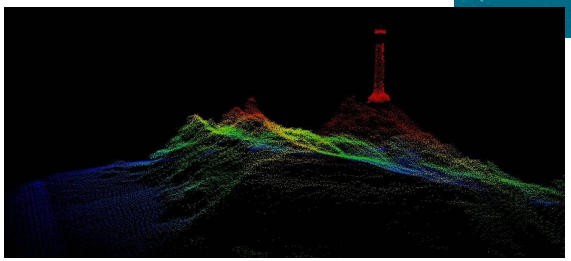
GEOMATICS DATA SOLUTIONS

AHAB Airborne Hydrography AB

Var 2010
Finistère 2011
HawkEye IIb
(AHAB)







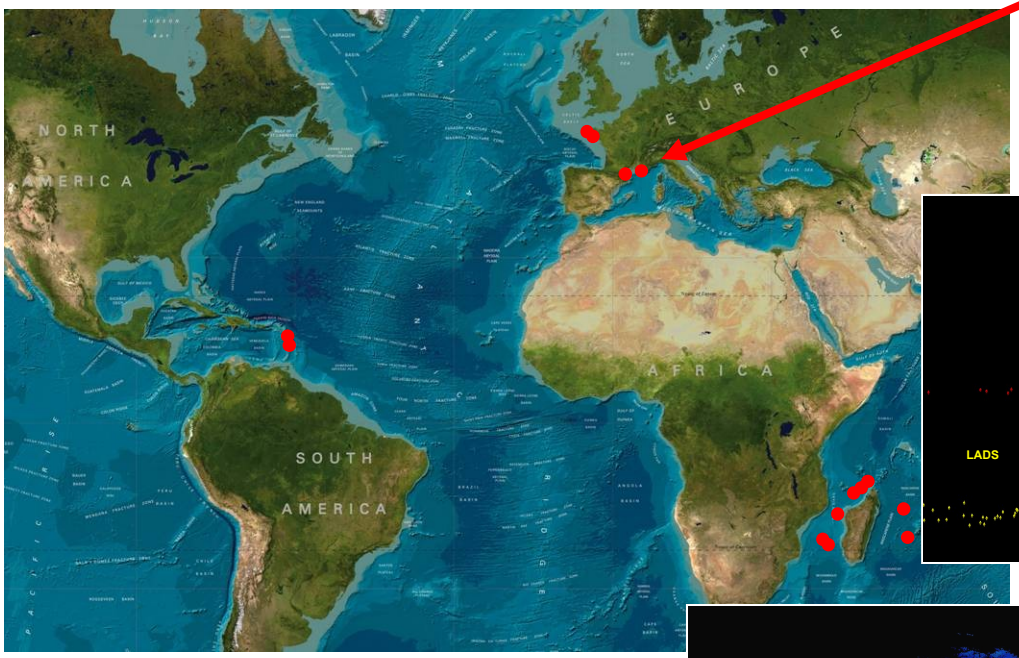
Litto$_3$D® progress

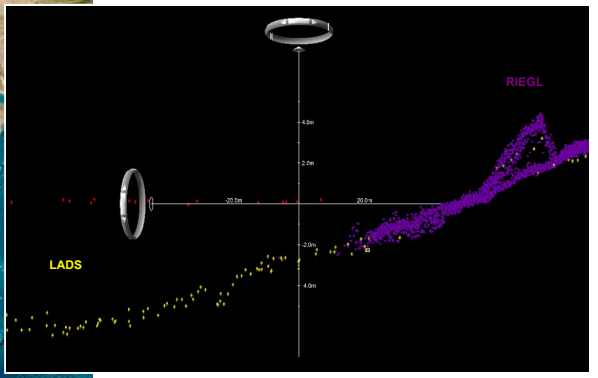
Languedoc-Roussillon 2011
LADS MkIII
(Fugro LADS)

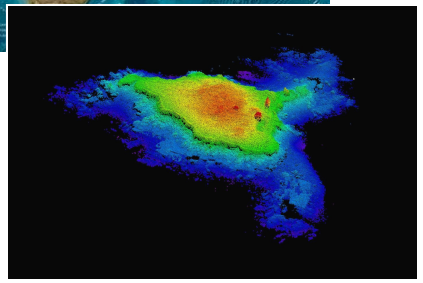
PACA & Finistère 2012
LADS MkIII
(Fugro LADS)
VQ-820-G
(RIEGL)

FUGRO
Fugro LADS Corporation

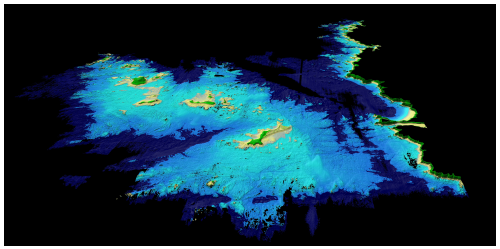
RIEGL
LASER MEASUREMENT SYSTEMS

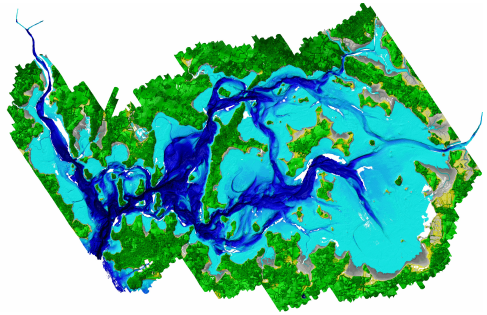


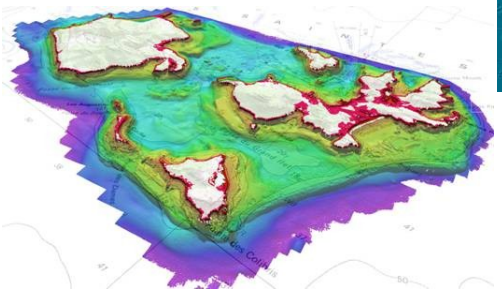


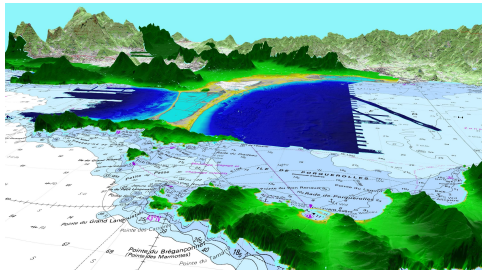


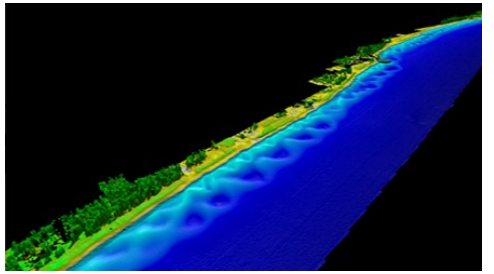
Litto$_3$D® - Lessons learned

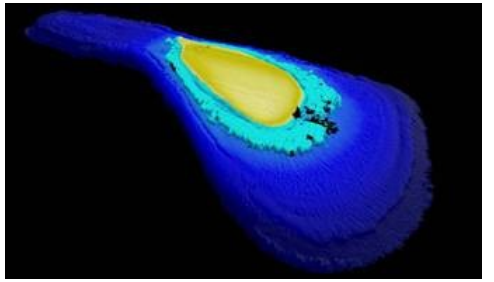


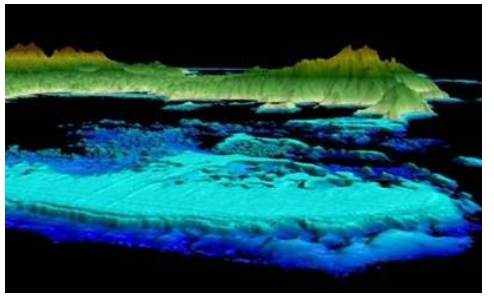






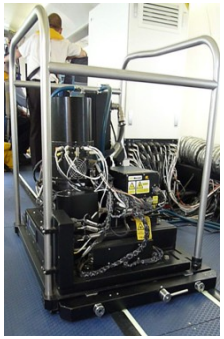






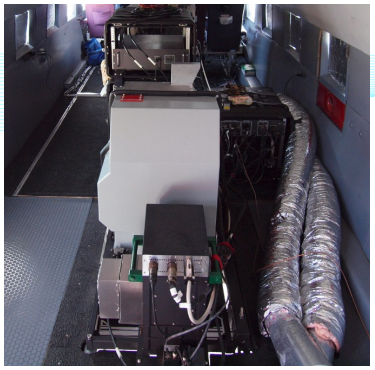
14 surveys since 2005…

Litto$_3$D® - Lessons learned



Fugro LADS Corporation

RIEGL LASER MEASUREMENT SYSTEMS



Optech

AHAB
Airborne Hydrography AB

Most of the systems used :

- ***7 for Litto3D surveys***
- ***2 for tests***

Litto$_3$D® - Lessons learned

Fugro LADS Corporation

Actimar
OCÉANOGRAPHIE OPÉRATIONNELLE

Optech

Fugro Pelagos

Pelydryn

GEOMATICS
DATA SOLUTIONS

EUROSENSE®

BLOM
IMAGING THE WORLD

Surveys sub-contracted with most of the companies…

Litto$_3$D® - Lessons learned

Sub-contracted surveys never go smoothly
→ tenders technical requirements are now quite robust

Tempo of operation :

Importance to assess in (near) real time the survey progress
→ well trained and qualified people
→ well defined and mastered methods
→ appropriate software

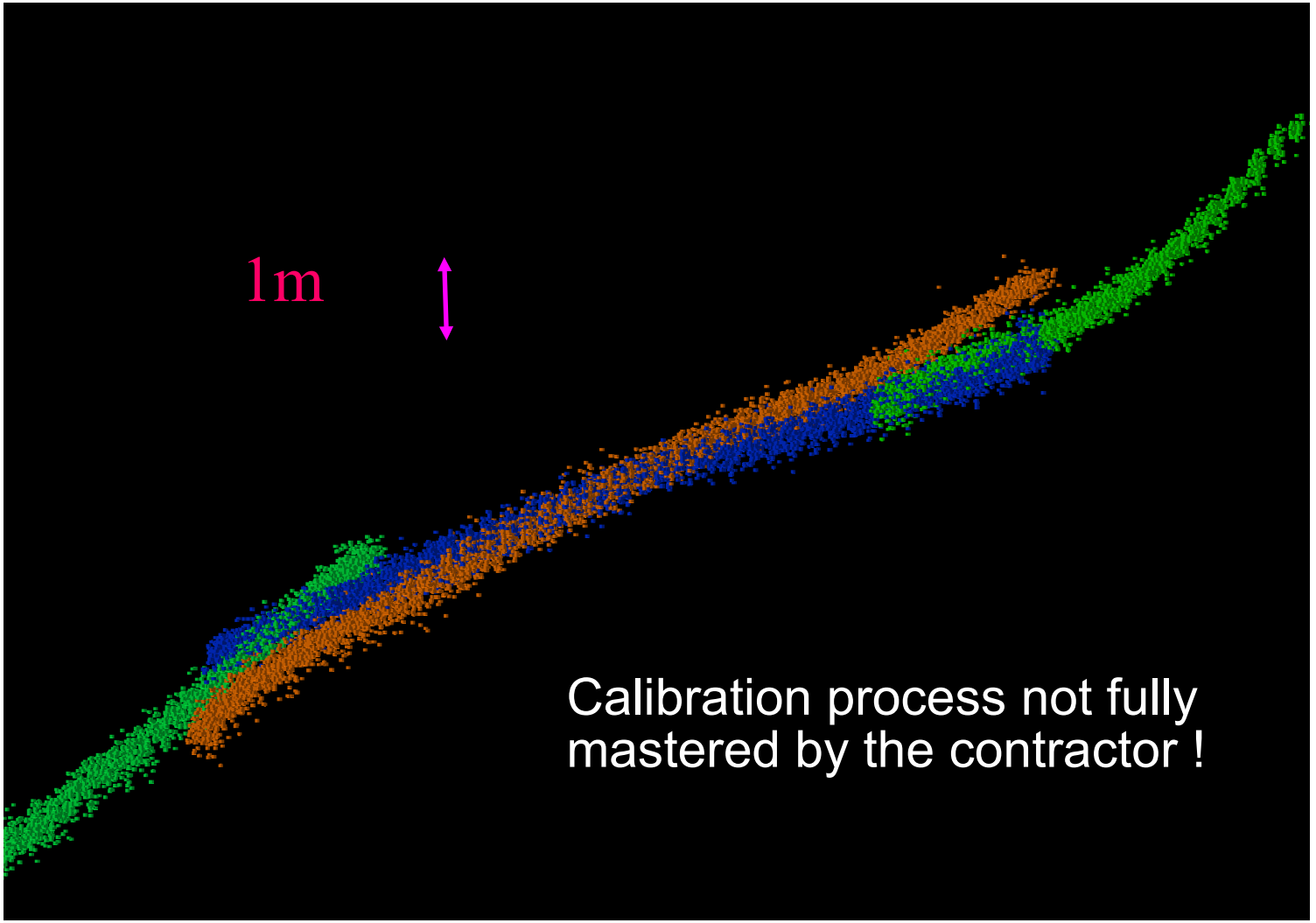
Litto$_3$D® - Lessons learned

Survey quality assessment :

SHOM has built a team of engineers and technicians (contractors) in charge of the survey QC

Survey QA

Calibration check



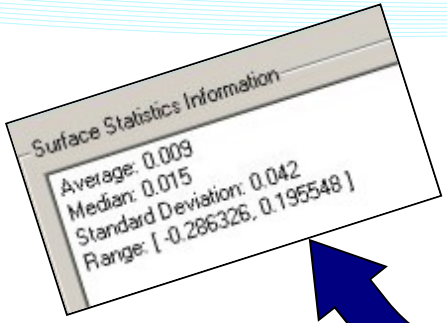
Litto$_3$D® - Lessons learned

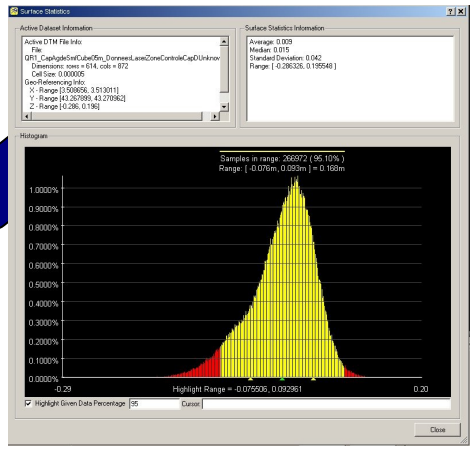
Survey quality assessment :

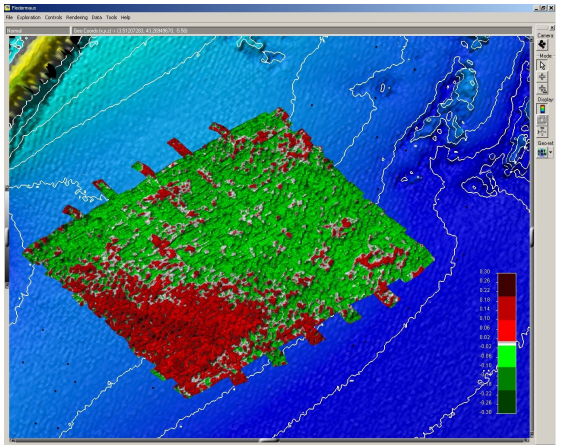
SHOM has built a team of engineers and technicians (contractors) in charge of the survey QC

Importance of the benchmarks and the crosslines. Costly but necessary to assess and prove the survey accuracy

Survey QA

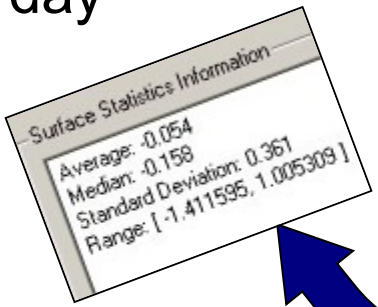


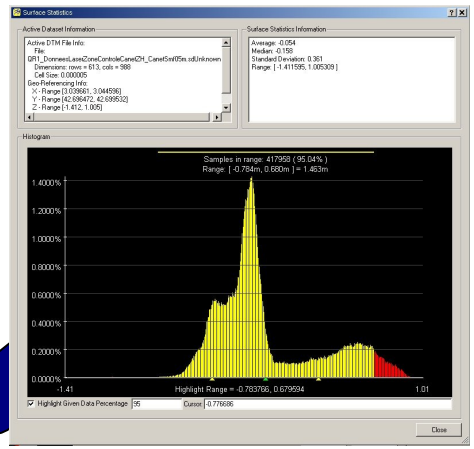


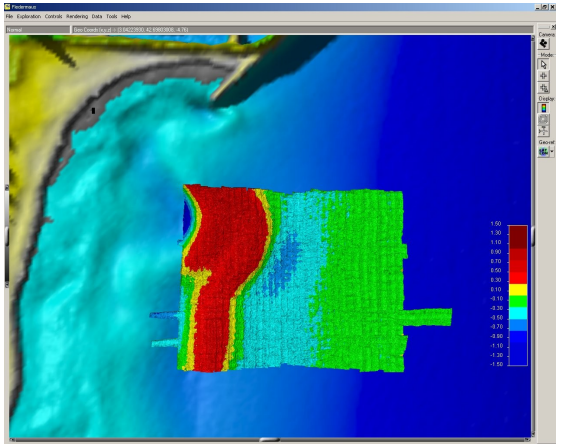


Sea control areas
Reference MBES / SBES surveys systematically conducted by SHOM within the survey area
Contractors have to fly these benchmarks every day

Better than 9cm (95%)



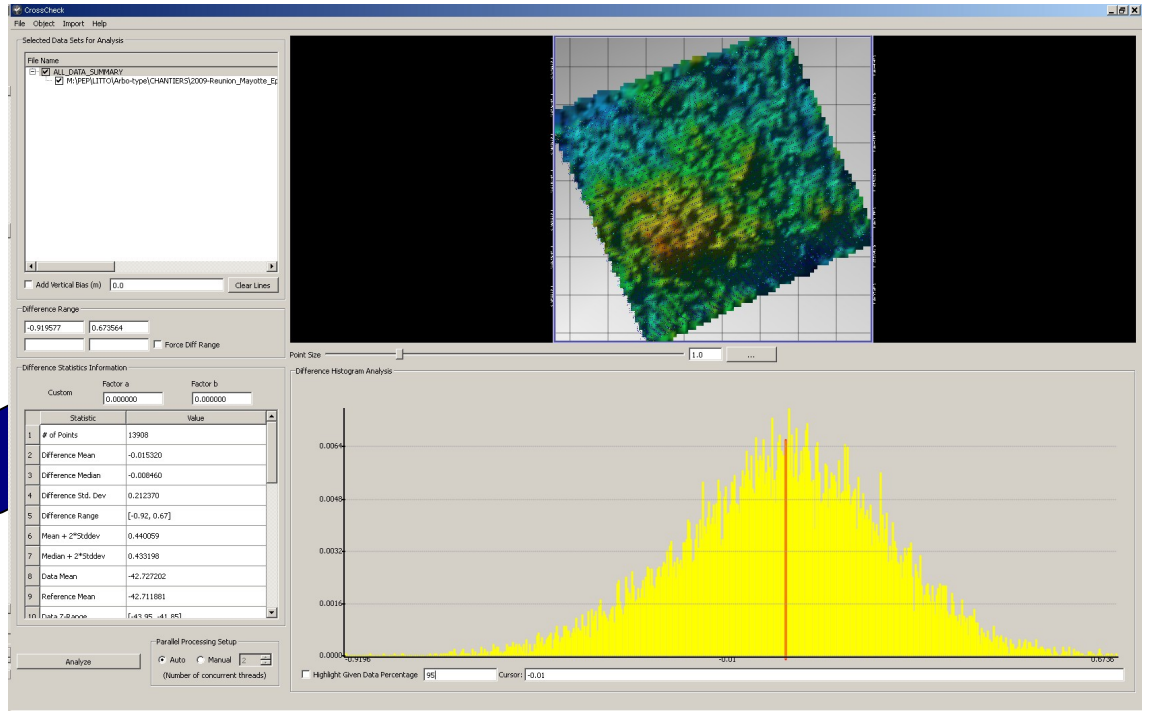




Comparison not relevant > need to update the SCA

Survey QA

# of Points	13908
Difference Mean	-0.015320
Difference Median	-0.008460
Difference Std. Dev	0.212370
Difference Range	[-0.92, 0.67]
Mean + 2*Stddev	0.440059
Median + 2*Stddev	0.433198
Data Mean	-42.727202
Reference Mean	-42.711881



Crosscheck
Regularly spaced crosslines are part of the technical requirements

Crosslines vs mainlines comparison

Litto$_3$D® - Lessons learned

Survey quality assessment :

SHOM has built a team of engineers and technician (contractors) in charge of the survey QC

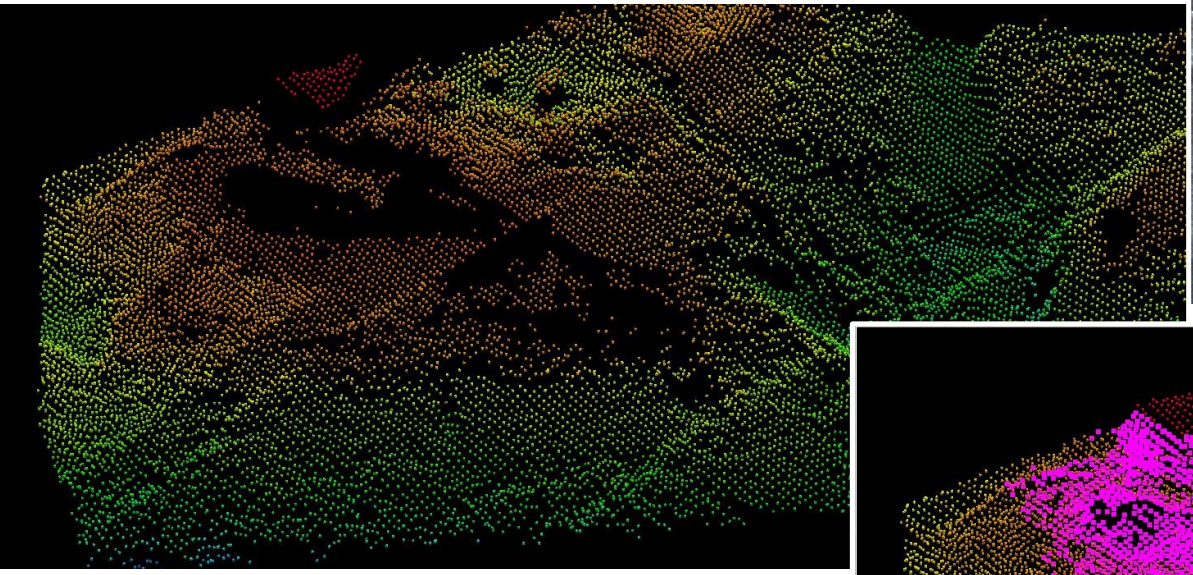
Importance of the benchmarks and the crosslines. Costly but necessary to asses and prove the survey accuracy

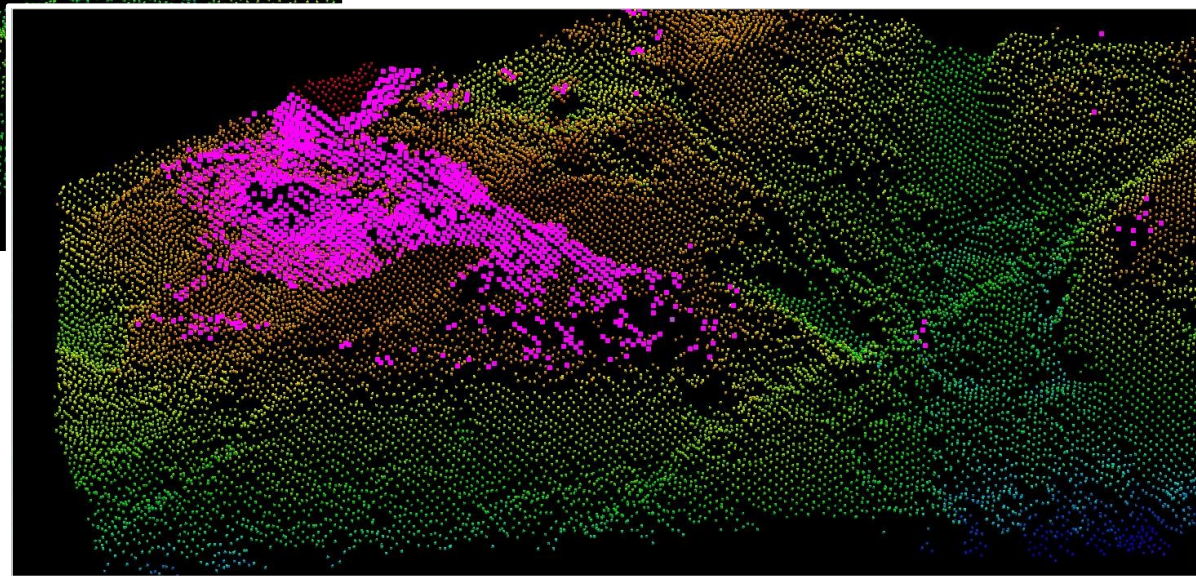
Data cleaning :

- sub-contractors processing generally OK in easy areas
- more diverse in challenging areas (when it becomes more time consuming and costly…)

Survey QA

Data cleaning
Very shallow water areas



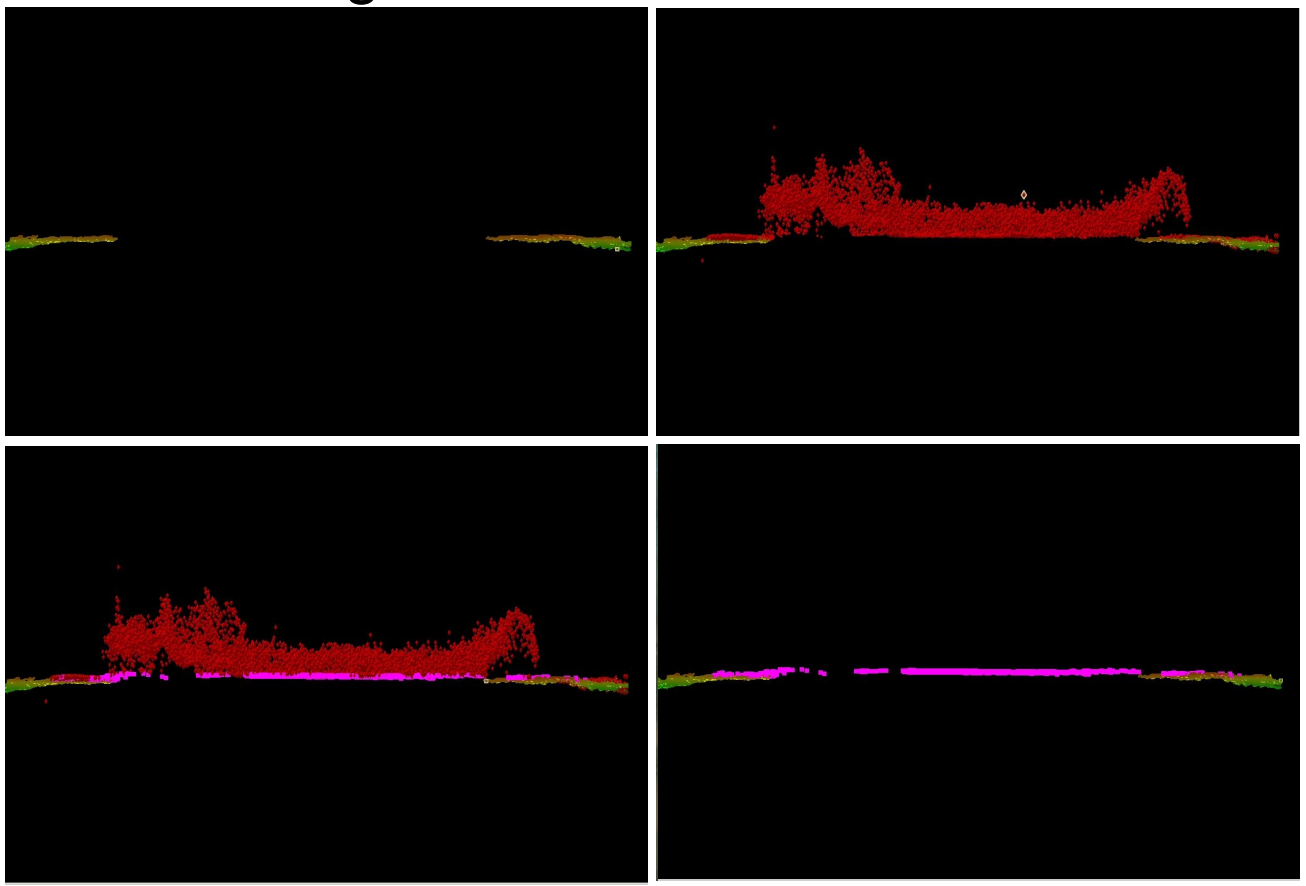


When it becomes time consuming…

Survey QA

Data cleaning

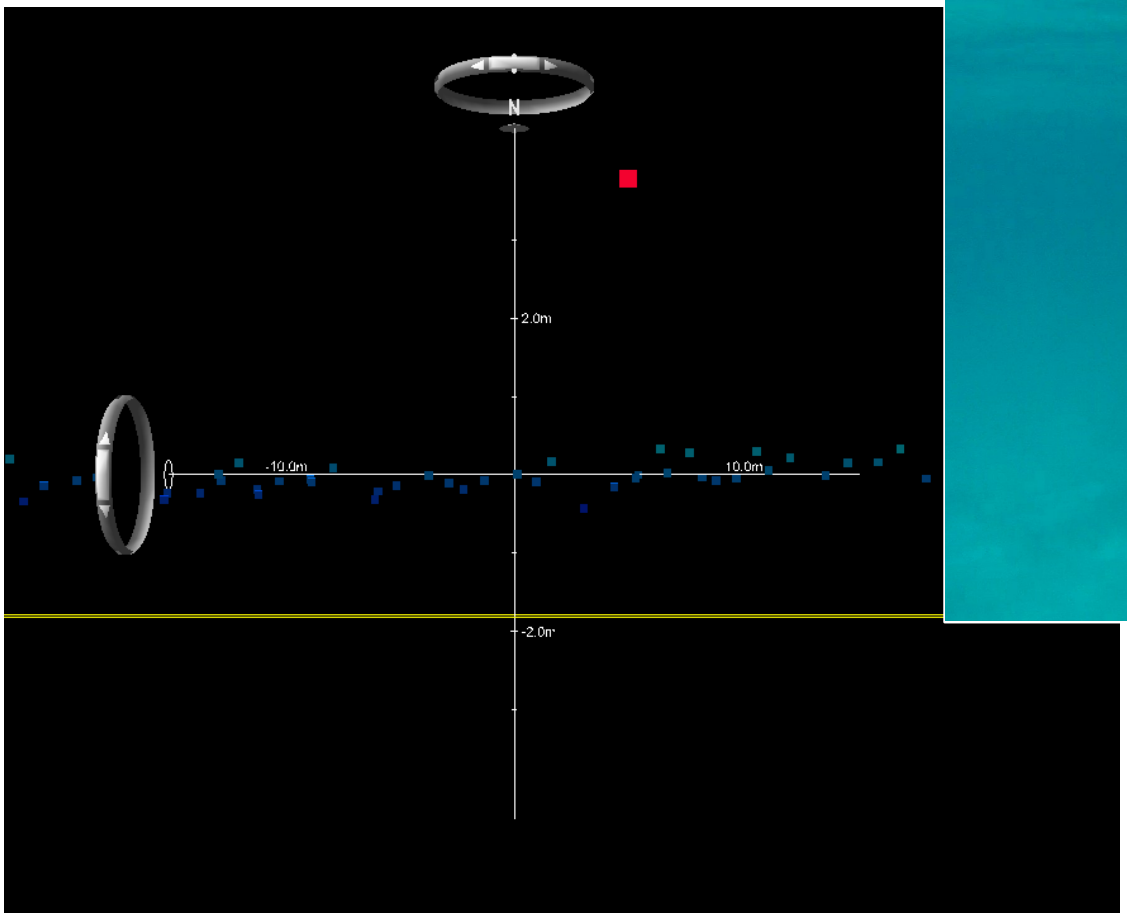
Work in complex areas – ex. mangrove

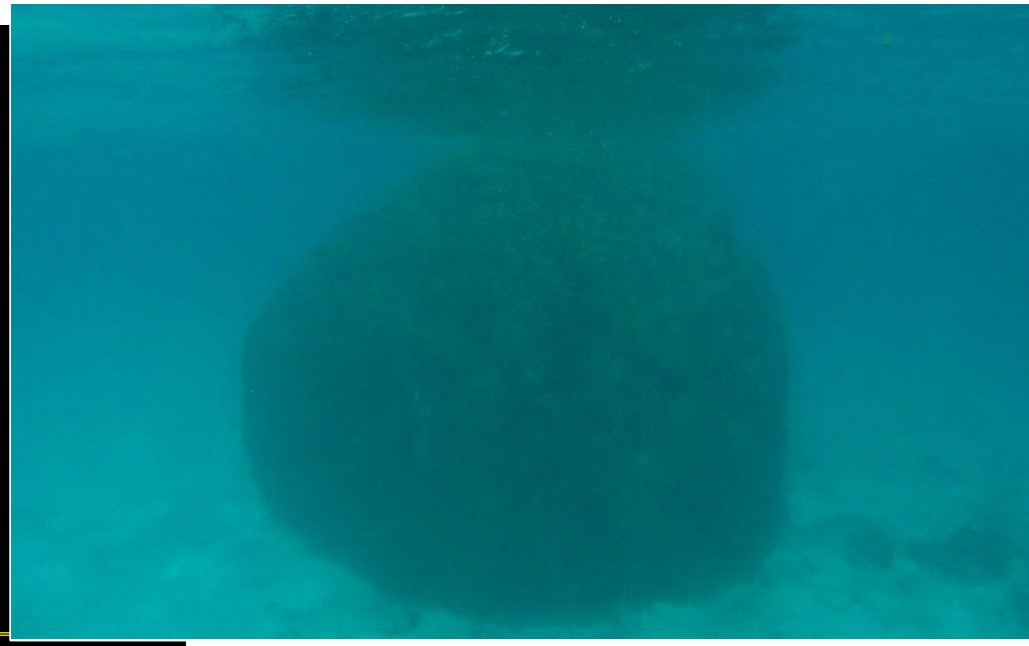


Needs a lot of manual editing to retrieve the bottom…

Survey QA

Data cleaning
Work in complex areas – ex. Coral heads

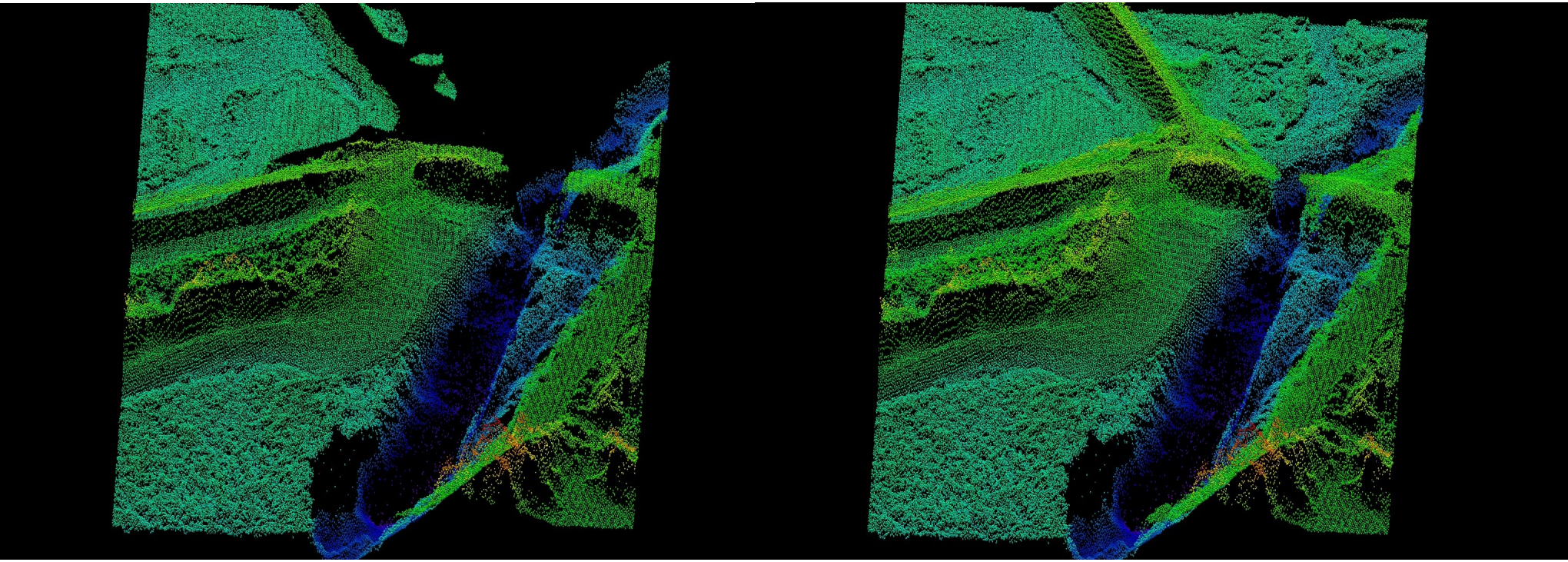




Sounding rejected by the survey contractor

Survey QA

Data cleaning
Work in complex areas – ex. Salt marshes and



Cleaning by the survey contractor

Data retrieved by SHOM team

Litto$_3$D® - Lessons learned

Combined LiDAR & Hyperspectral surveys

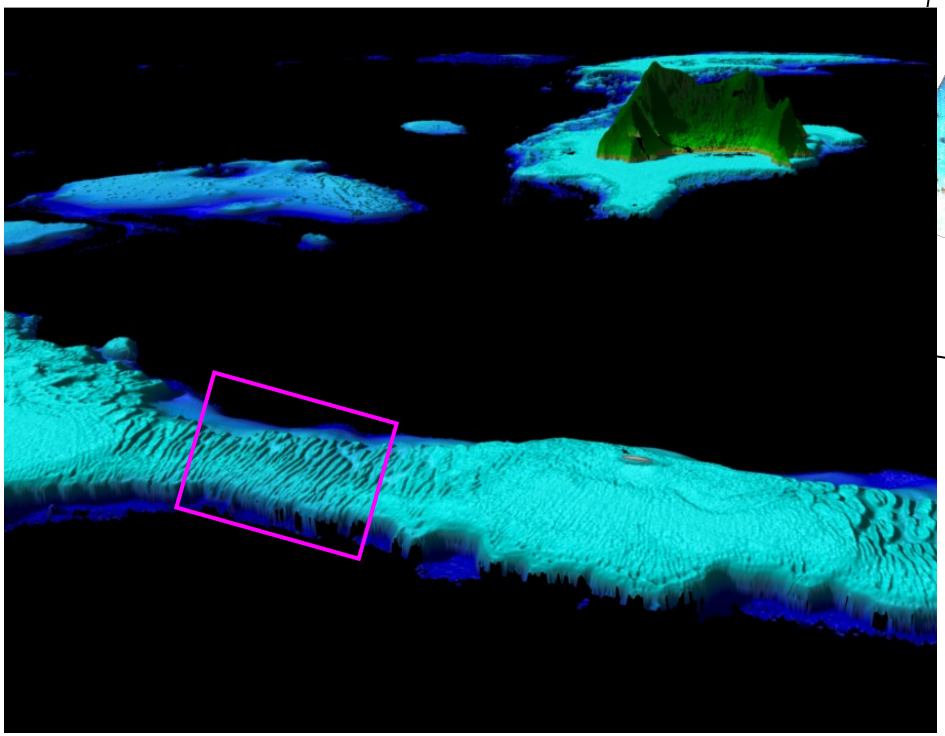
5 surveys conducted with both sensors for habitat mapping purposes

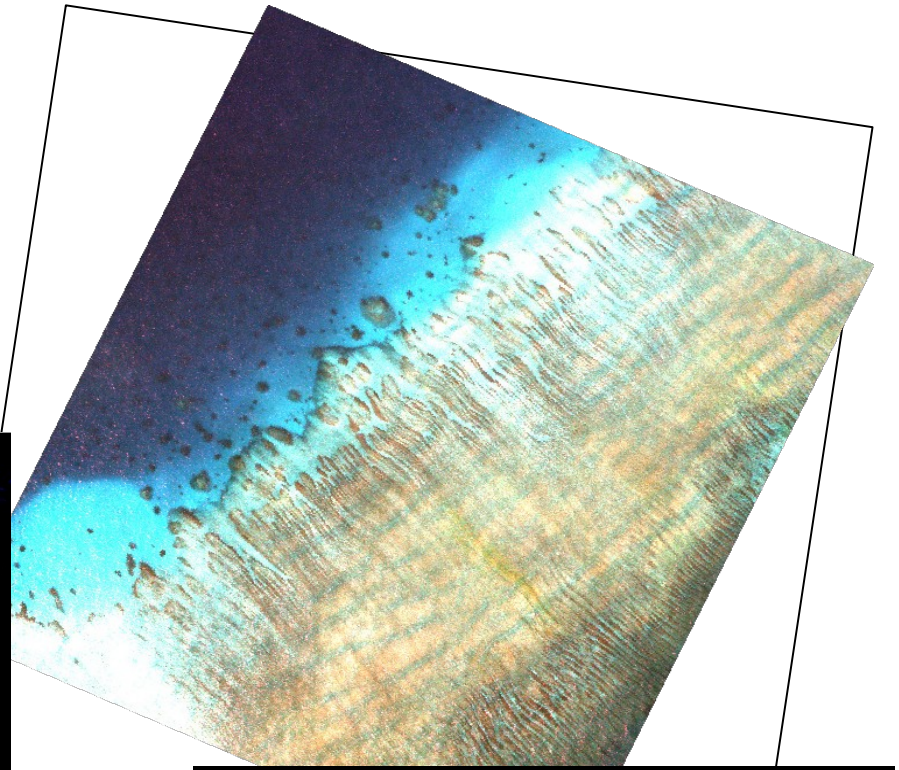
- specific environmental constraints for each sensors make the survey planning and management very complex and $$

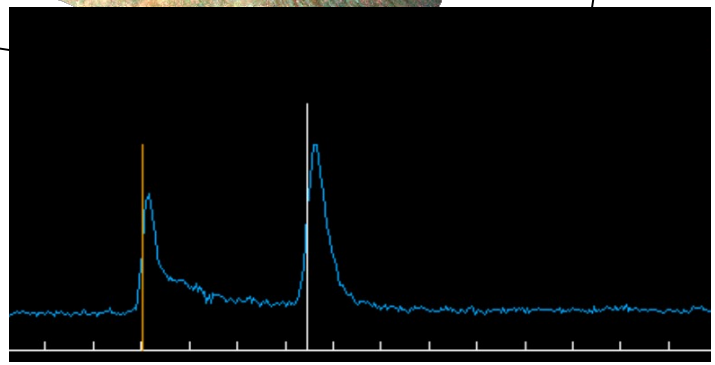
- simultaneous LiDAR + HS optimized for LiDAR capture → poor HS data

- lack of operational tools + ground truth needs
  Still difficult to extend in a mass production program

Combine Hyperspectral & Lidar







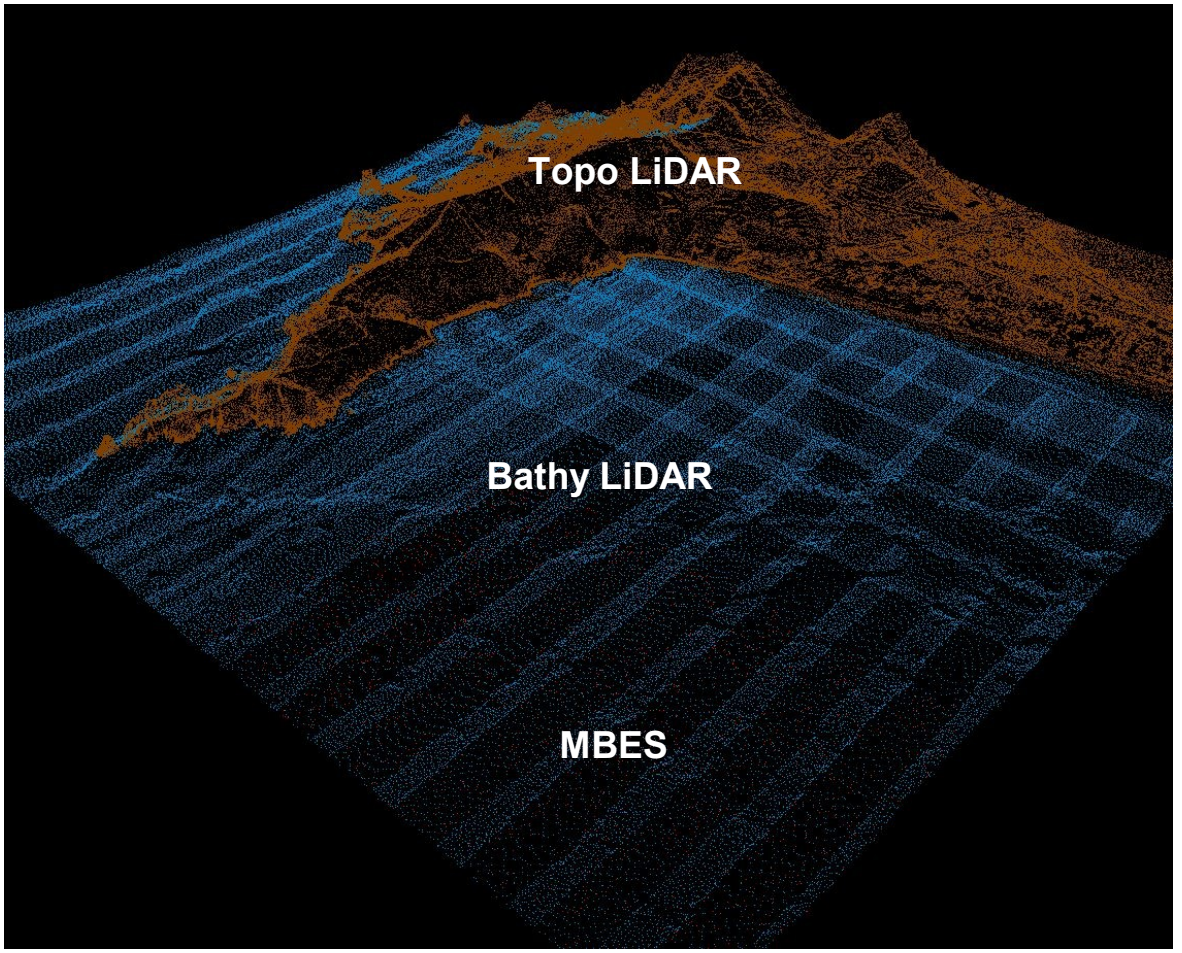
Litto$_3$D® - Lessons learned

Data fusion

≠ sensors

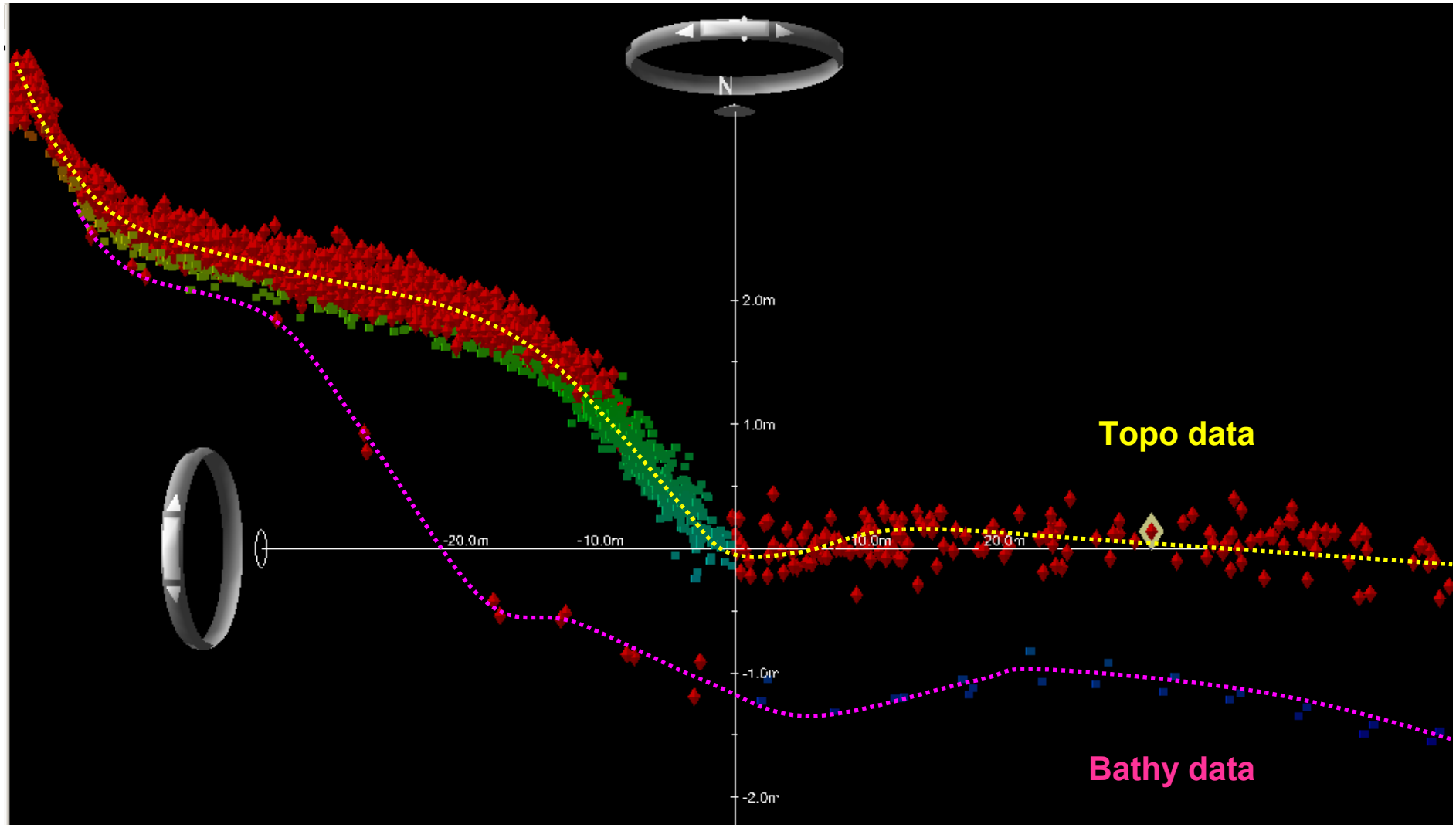
≠ resolutions

≠ survey periods

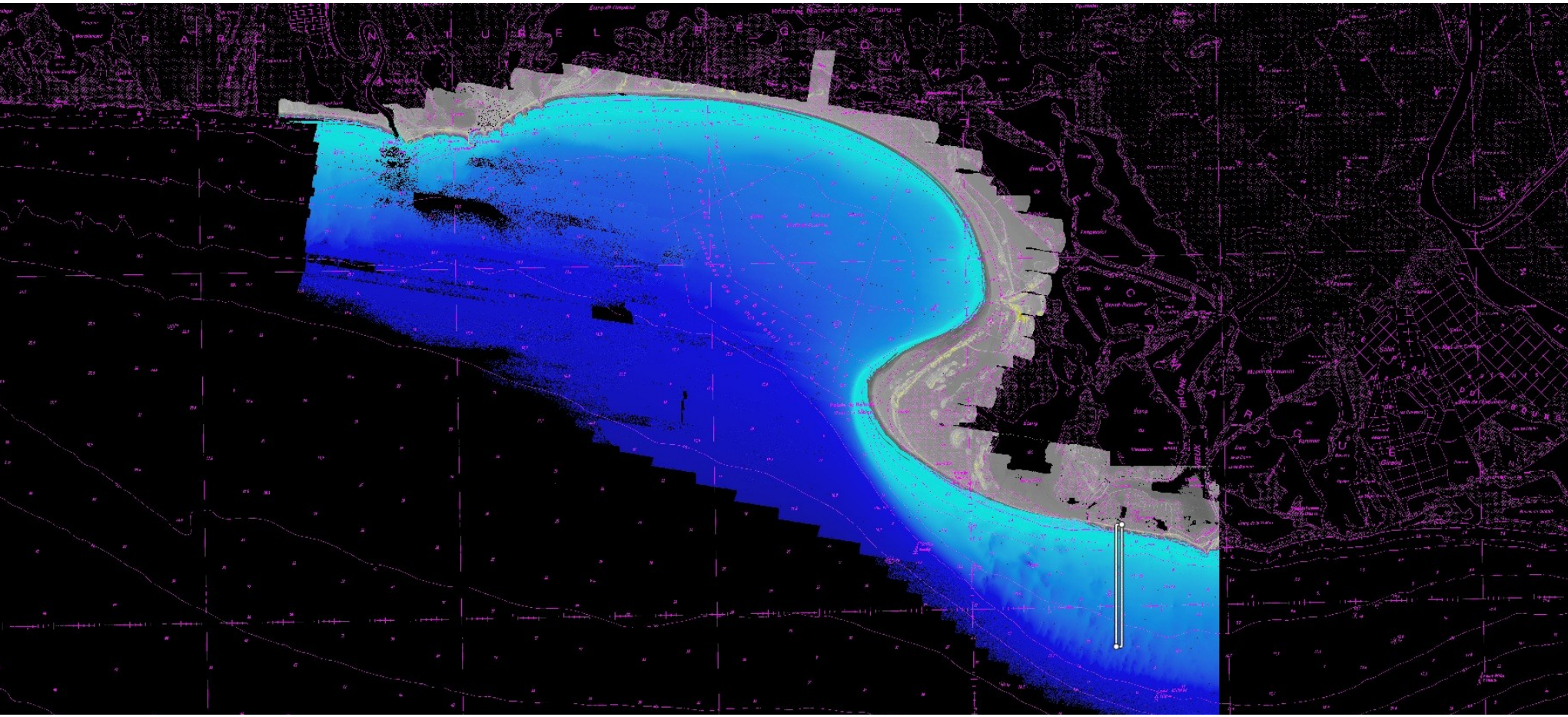


➢ IGN & SHOM have developed specific data fusion methodology

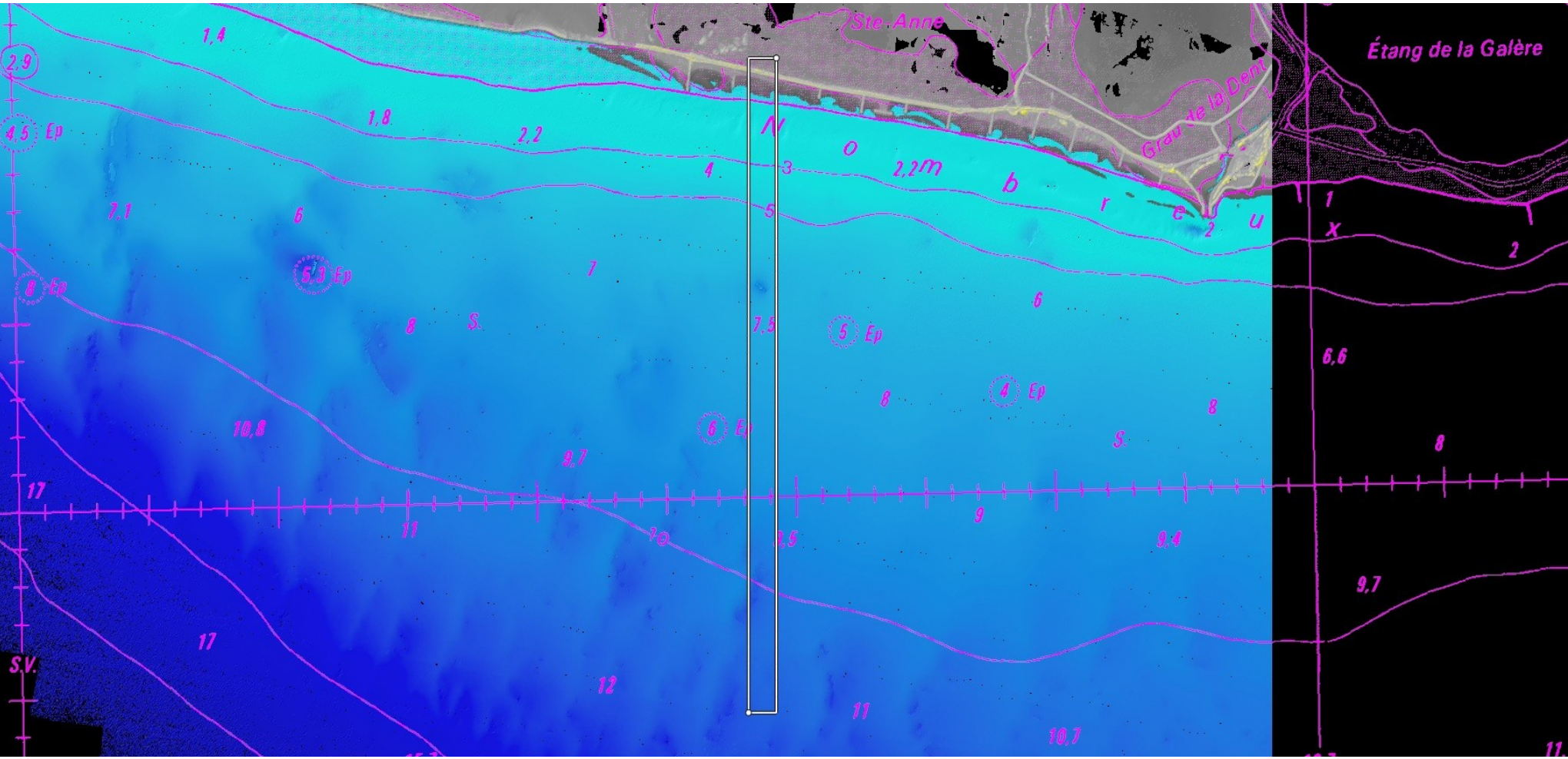
Data fusion



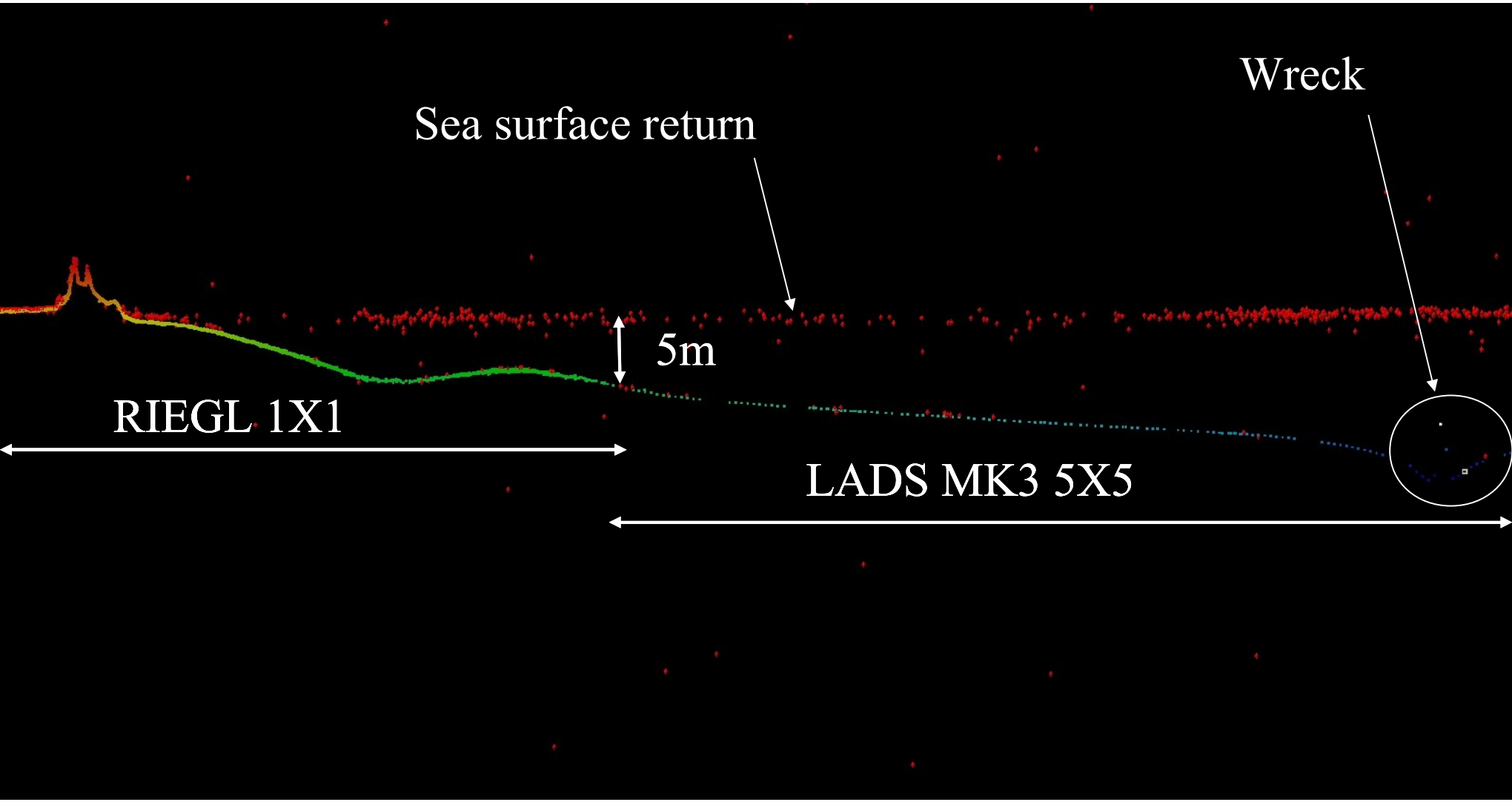
Data fusion



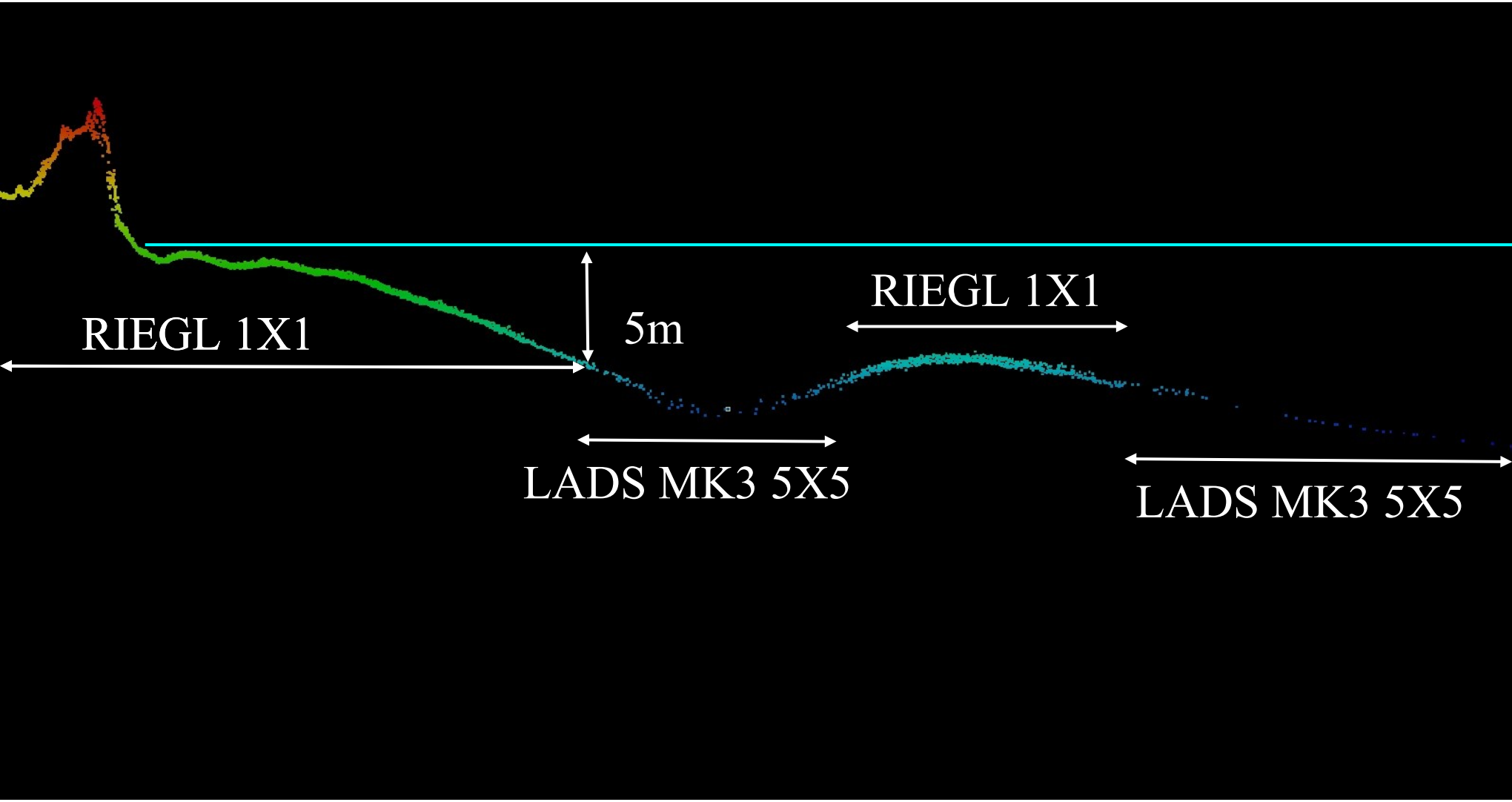
Data fusion


Ste Anne
Étang de la Galère
Grau de la Dent
Narbonnaise
2,2m
1,4
2,9
4,5 Ep
1,8
2,2
7,1
5,3 Ep
8 Ep
7,5
5 Ep
6,6
4 Ep
10,8
6 Ep
9,7
9,4
9,7
S.V.
10,7

Data fusion



Data fusion



LiDAR evolutions & SHOM wishlist

Improved performances

- Less sensitive to environmental conditions :
  - turbidity
  - glassy seas : *“too good conditions”* can’t be an excuse !

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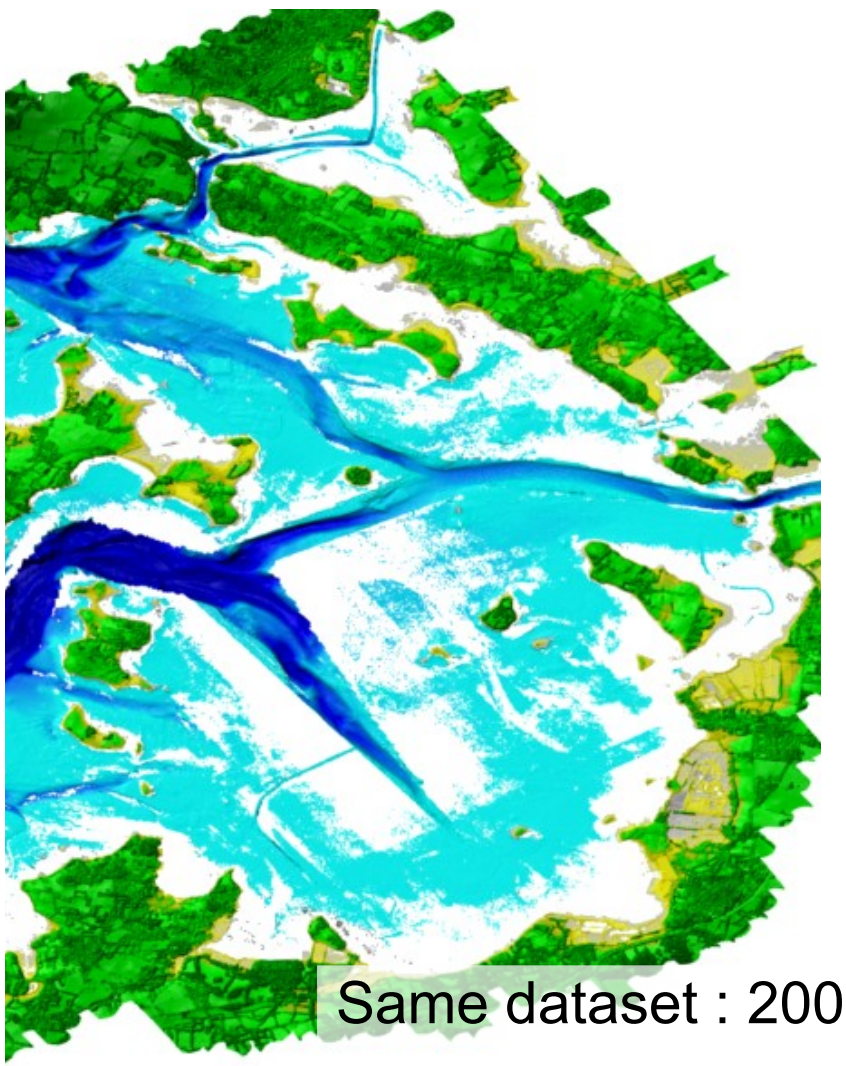
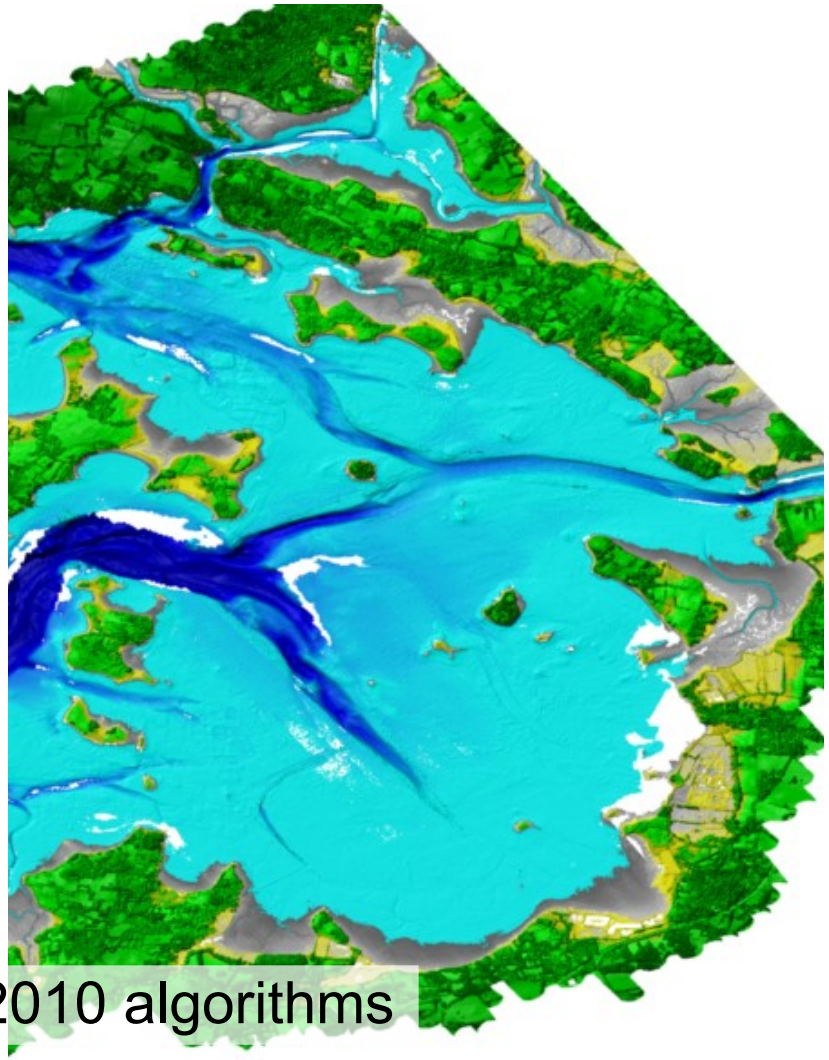
→ Technical improvements :

- hardware & software

Improved processing





Same dataset : 2005 vs 2010 algorithms

LiDAR evolutions & SHOM wishlist

Improved performances

- Less sensitive to environmental conditions :
  - turbidity
  - glassy seas : *“too good conditions”* can’t be an excuse !

→ Technical improvements :

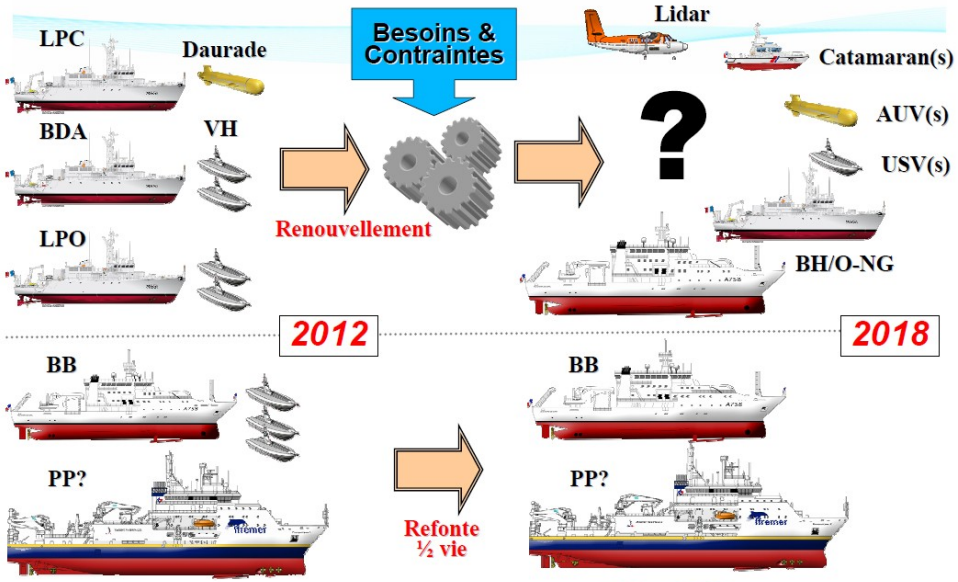
- hardware & software but physical limitations
- but also improved Man Machine Interface (real time feedback) and operators training

Conclusion

SHOM's intentions

SHOM intends to continue to act as a major bathy LiDAR user in the coming years :

- either trough sub-contracted surveys (but process by SHOM)
- or directly by acquiring our own LiDAR capability

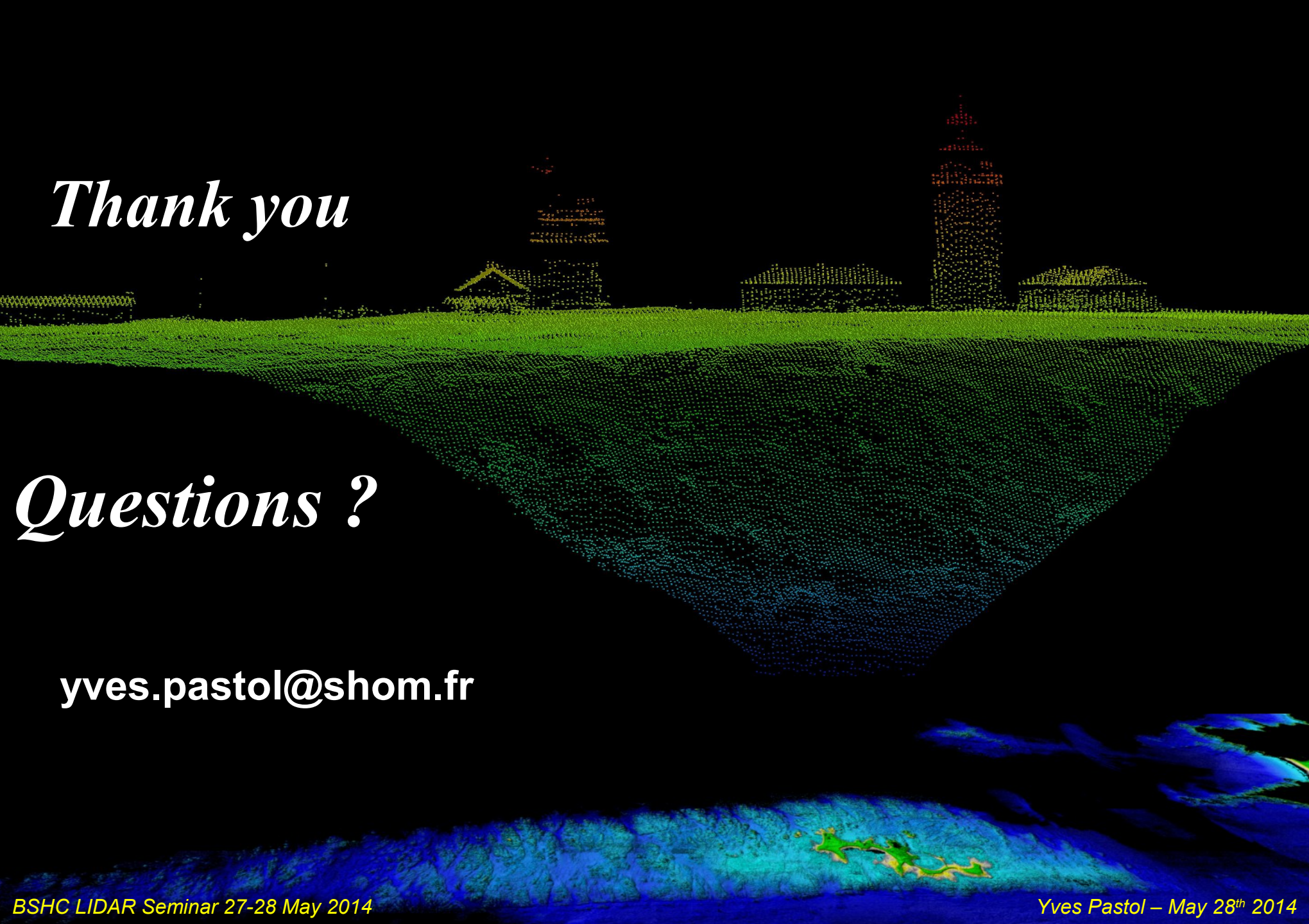


Conclusion

New systems

LiDAR market very active in the last 2 years with many new systems (CZMIL, Chiroptera, Aquarius, VQ-820-G, LADS mkIII)
→ current offer gets close to our wishlist ("letter to Santa")

New "low cost" LiDARs open new markets, especially to non hydro users
But "*Bathy LiDAR is not Topo LiDAR in the water*"
Need for the manufacturers to really focus on the whole capability and not only on the hardware performances
→ system reliability and maintenance
→ processing system
→ operators training (hydrographers !) …


Thank you
Questions ?
yves.pastol@shom.fr