SHADOWS **MAPPING SONAR**

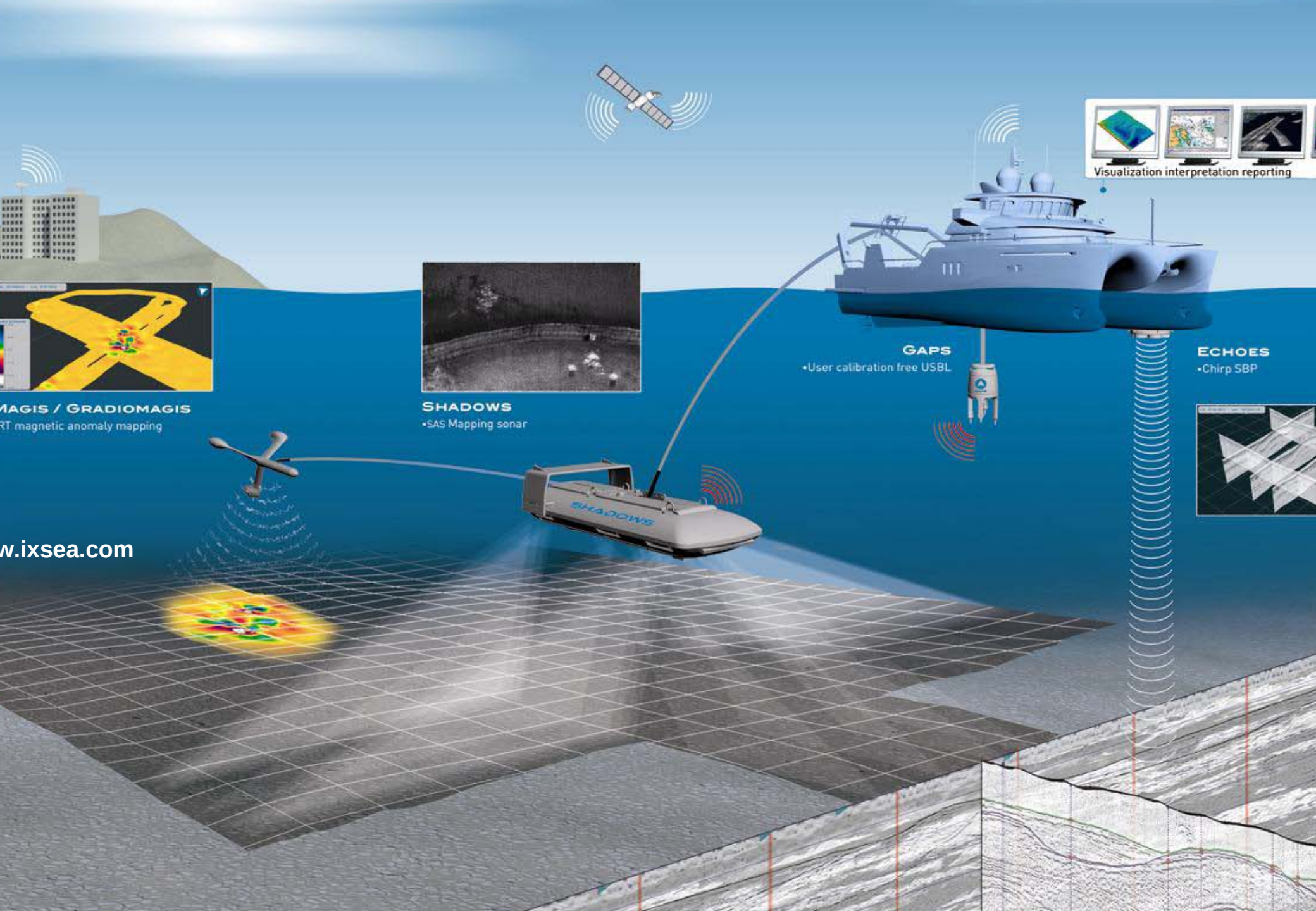
A new tool for the Hydrographers, Oceanographers and the Survey Industry

4th GEBCO Science Day

BREST 29th, September 2009 – Emmanuel SGHERRI

TO SAIL • TO SOUND • TO ANALYZE

IXSEA


Visualization interpretation reporting
GAPS
•User calibration free USBL
ECHOES
•Chirp SBP
SHADOWS
•SAS Mapping sonar
MAGIS / GRADIOMAGIS
RT magnetic anomaly mapping
SHADOWS
w.ixsea.com

Seafloor Mapping : traditional & new missions

- Traditional missions :
  - Hydrographic & Oceanographic, scientific, marine archeology
  - EEZ mapping, environmental
  - Debris surveys, Route surveys (cable, pipe-line…), pre-seismic surveys, pre/post dredging, …
  - Commercial Surveys
  - Management of Emergency situations

- “New missions” :
  - **Continental shelf extension, Law of the Sea, Marine boundaries Delimitations**
  - **Habitat Mapping, Marine protected areas**
  - **Extension of Coast Guards missions (shallow waters); Safety monitoring, Subsea surveillance (strategic assets on the seabed)**

Seafloor Mapping : Need for higher productivity tools

- increased workload
  - New missions, New areas, new standards
  - updating old areas up to new standards (only 50 to 60 % covered in the most advanced countries UK and USA*) (*Hydro-08 Liverpool)
- … and limited resources
  - Budget and financial constraints
  - Vessel cost, lack of Human resources
  - Public organizations to private companies
- Need for higher productivity tool adapted to the information age
  - ***"I am interested in any tool which will give me more line kilometer per Pound" (UKHO)***
  - Elimination of low value/time consuming tasks (navigation processing)
  - Concentrate on hi-value : mapping, data management, interpretation, reporting

➔ ***The 4th generation Side Scan Sonar***

4th Generation Side Scan Sonar : the geo- information age

G4 generation

4th Generation : Mapping Sonar
SHADOWS , ...

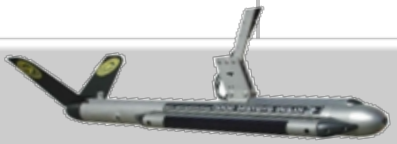
Benefits : Geospatial Information
Full swath, constant resolution
More pixel per hour
Web based architecture

G3 generation

3rd Generation: Digital Multiping / SAS

G2 generation

2nd Generation: Digital SSS



G1 generation

1st Generation: Analog SSS

70's 80's 90s 95 98 2000's 2006 TODAY TOMORROW

IXSEA

Sonar Absolute Positioning / Target Localisation

Relative Positioning

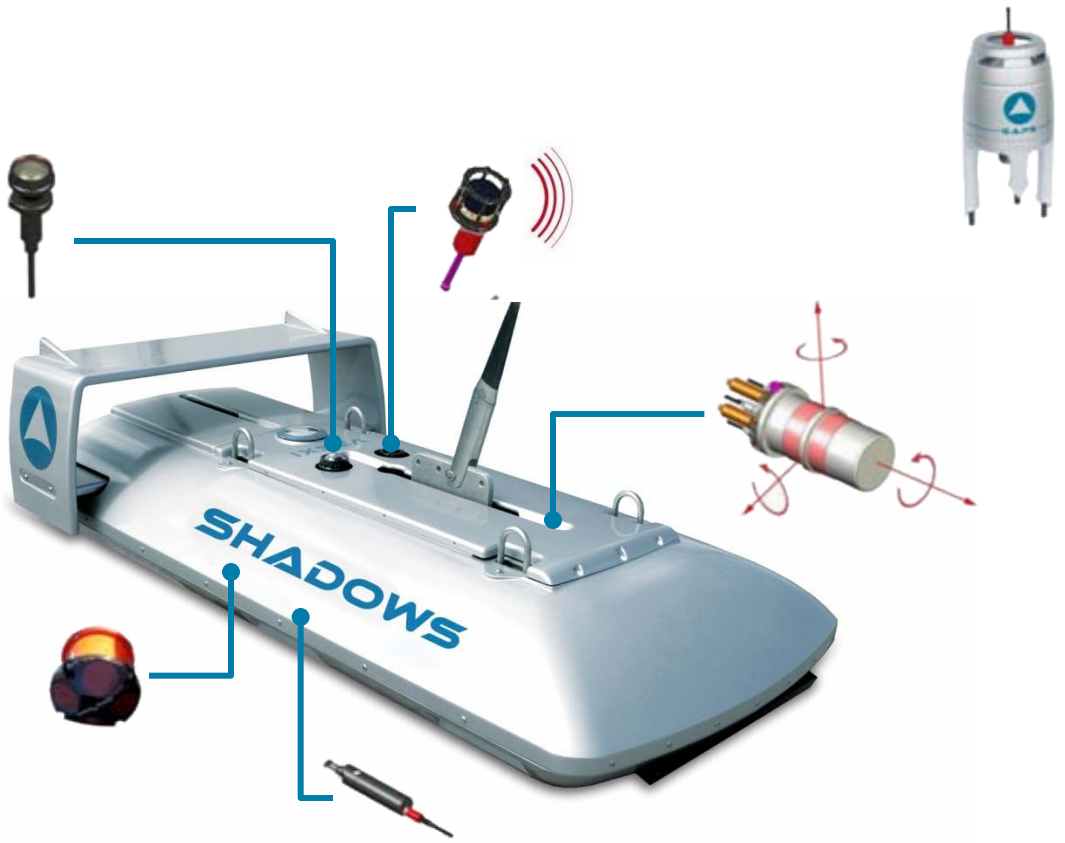
A FOG Inertial Navigation System provides:

- Accurate Attitude
  - o P ±.01deg
  - o R ±.01deg
  - o H ±.02deg
- And Relative Positioning

Absolute Positioning

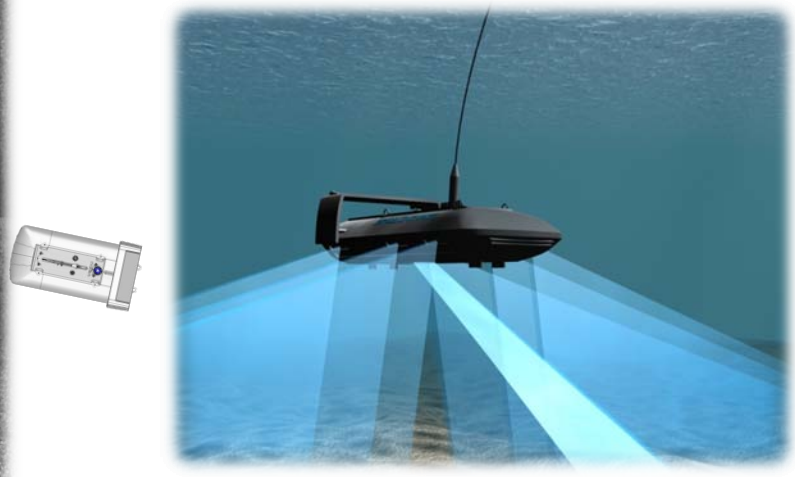
INS is aided by:

- GPS initialization
- Depth Sensor
- DVL: X, Y speed above ground
- GAPS USBL providing Lat, Long and Z to the INS



Full Swathe ortho-rectified 15cm resolution imagery

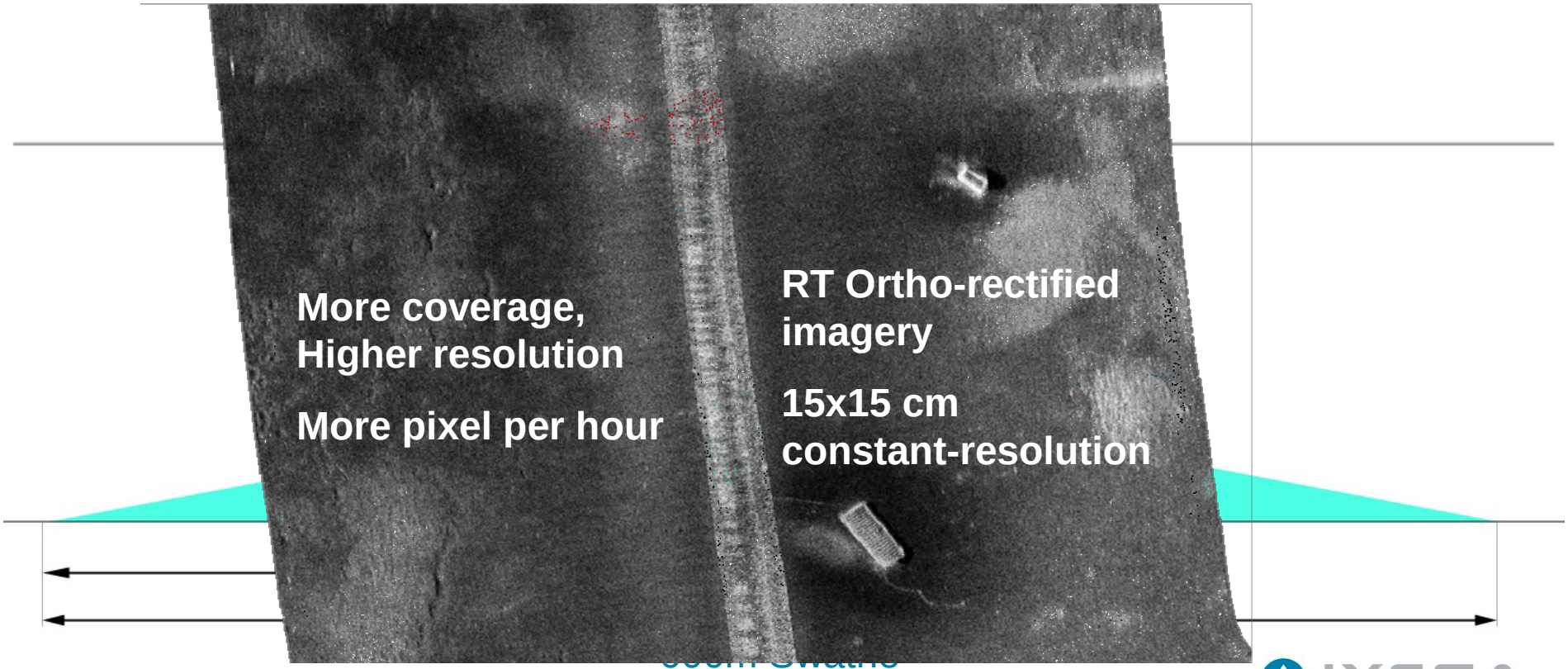
- How to obtain a full swathe image (ie : with no blind zone ?)
  - All side scan sonars look on the side, and cannot see objects in the center
  - Shadows is a side-scan sonar equipped with ...
- A Gap Filler which can map the blind zone
  - 20 to 80 m depending on fish altitude above ground, resolution 15 to 40cm,



Full Swathe Ortho-rectified 15cm resolution imagery

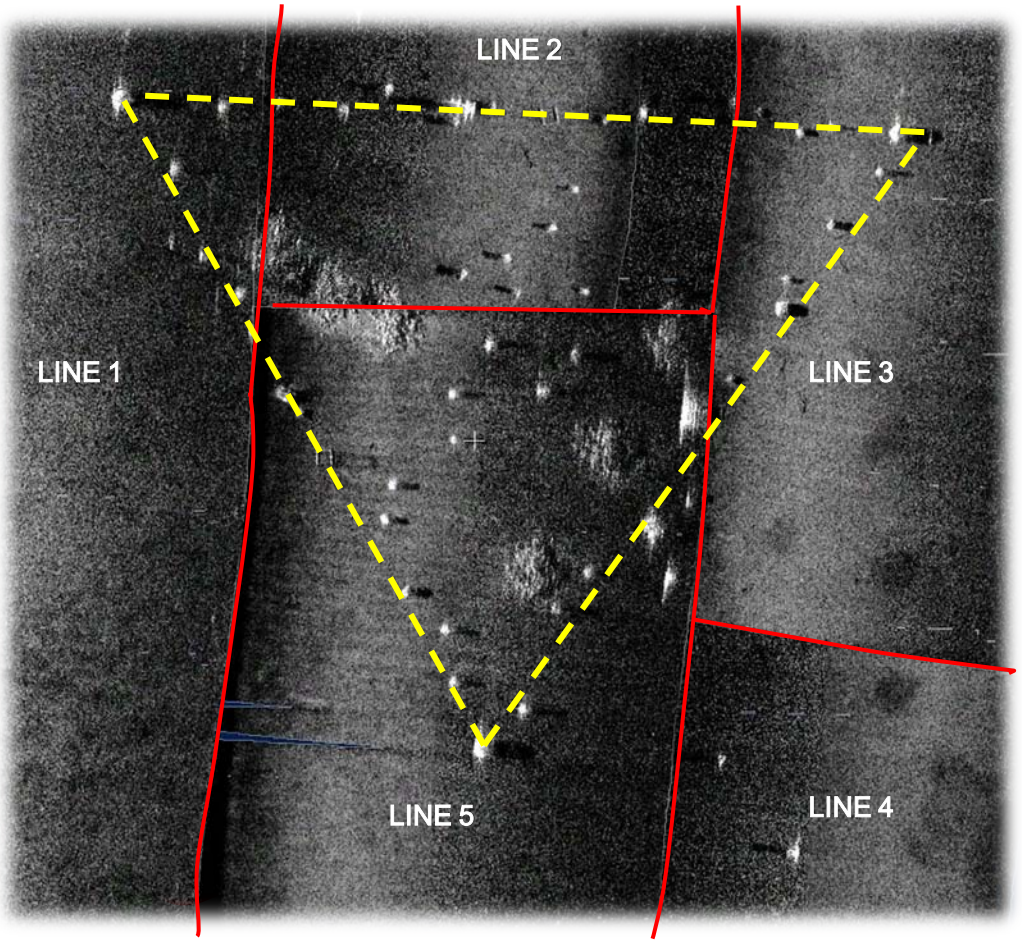
REAL TIME REAL WORLD

- Coverage : 600m true swath with no blind zone
- It's a map ! Generated automatically by the sonar, from the sonar position, in Real Time



Integrated inertial aided positioning « *TARGET LOCALISATION* »

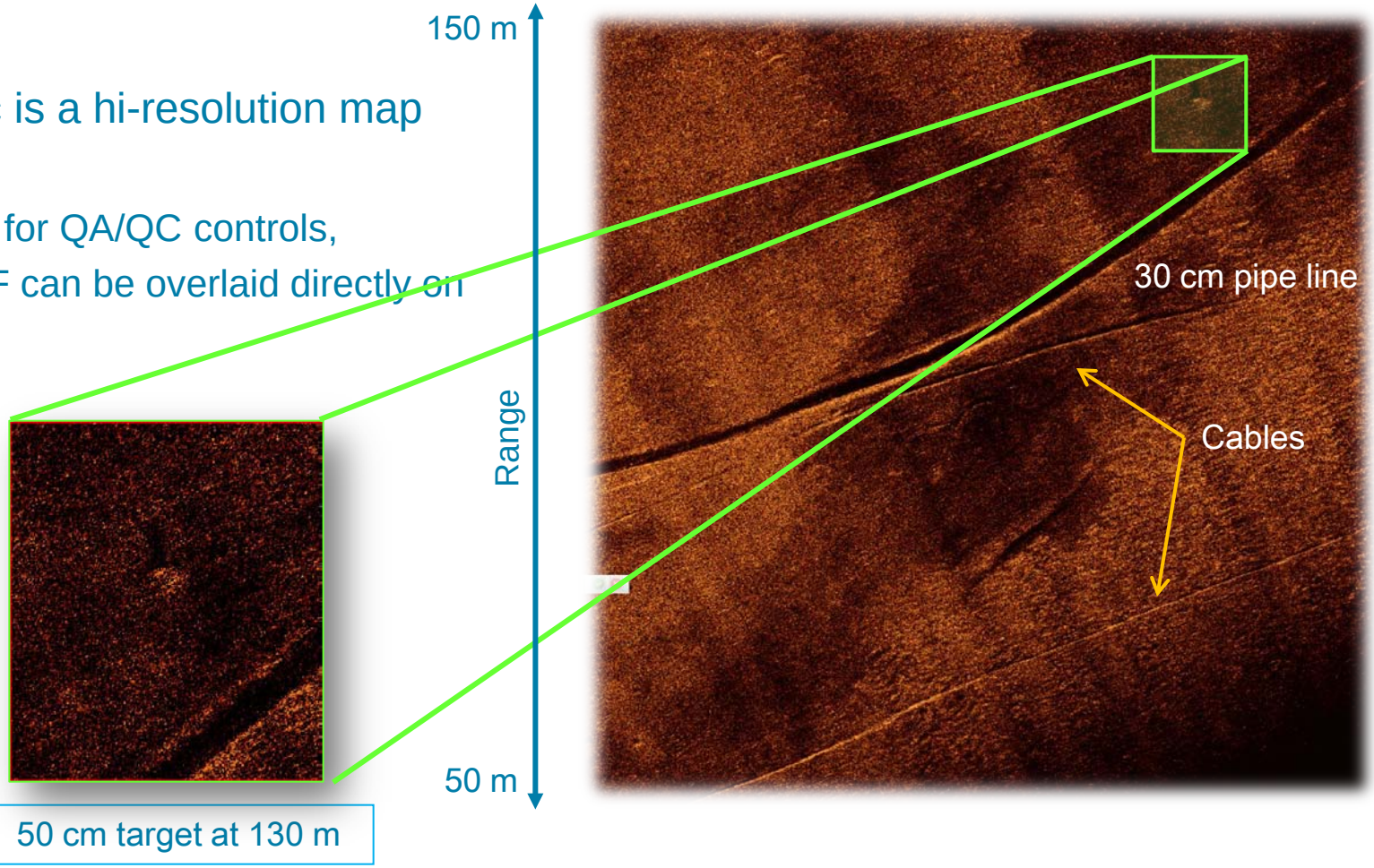
- Accurate positioning and RT Mapping :
  - No need for “boxing” in order to obtain the correct position
  - Quick access to data
- Target localisation
  - Immediate understanding of the local and general situation :
  - Individual objects at high resolution
  - Constellation of objects appear clearly
- Applications
  - Debris surveys, Search & Rescue, environmental,
  - Navigation matching (AUV)



Integrated inertial aided positioning «LINEAR FEATURE *LOCALISATION* »

The survey mosaic is a hi-resolution map

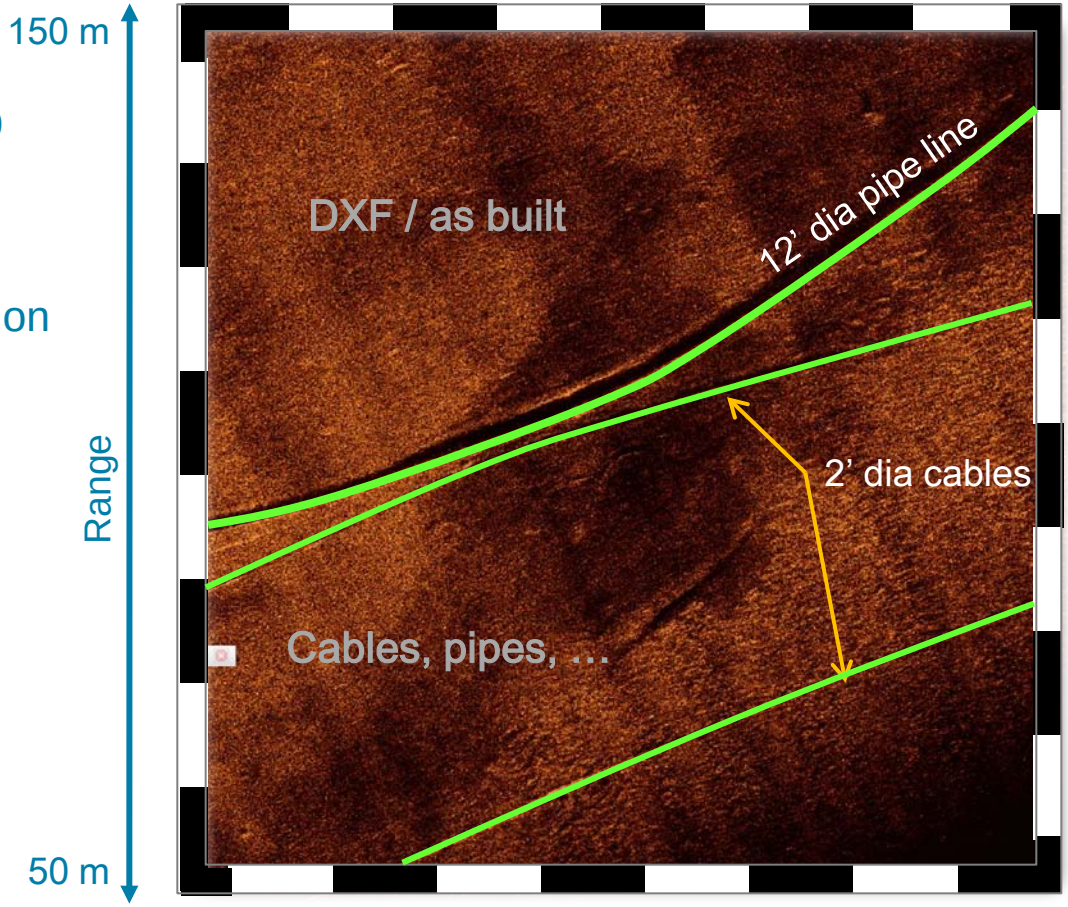
- - a new tool for QA/QC controls,
- As-laid, DXF can be overlaid directly on the map



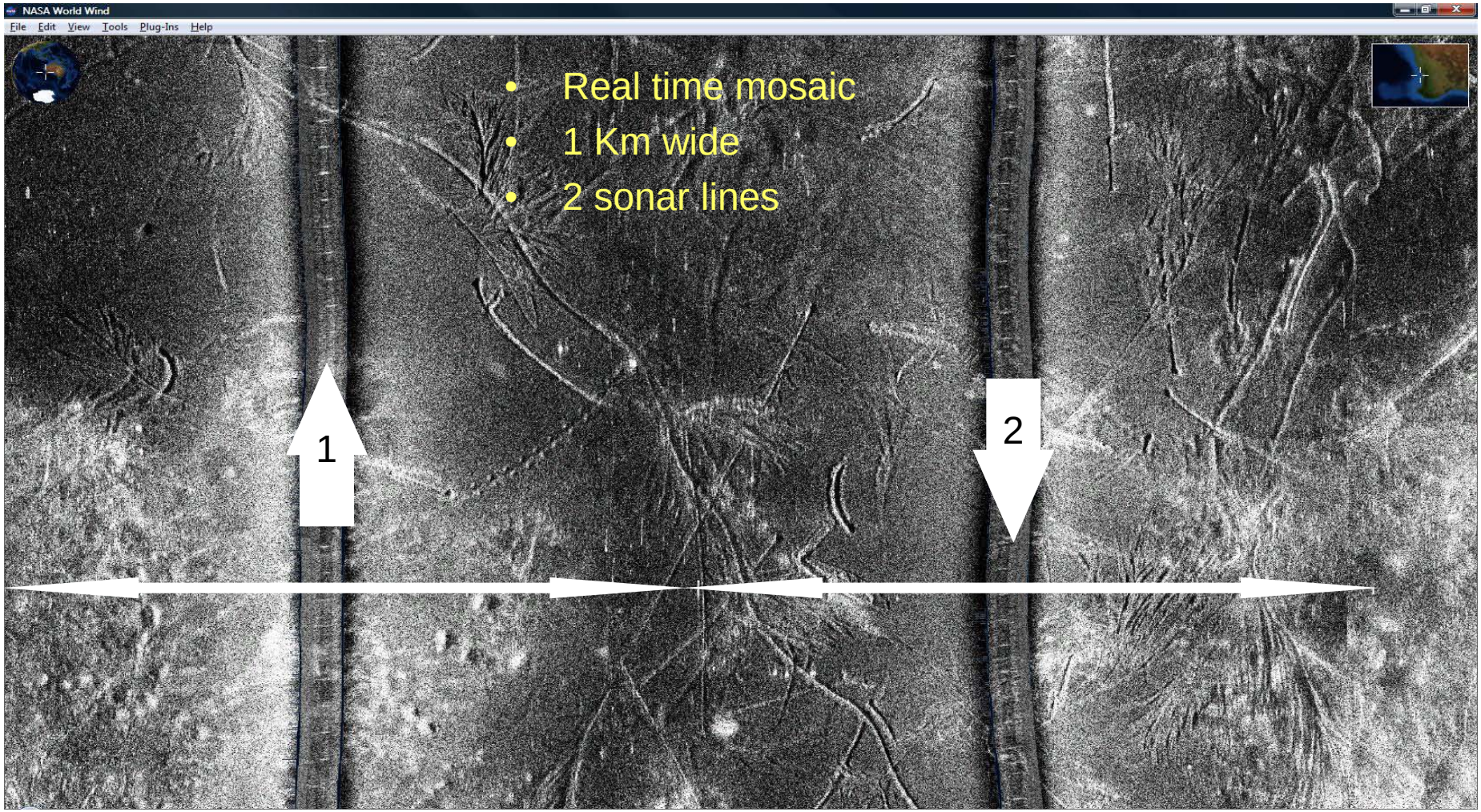
Integrated inertial aided positioning «LINEAR FEATURE *LOCALISATION* »

The survey mosaic is a hi-resolution map

- - a new tool for QA/QC controls,
- As-laid, DXF can be overlaid directly on the map
  - DXF plan
  - As Built



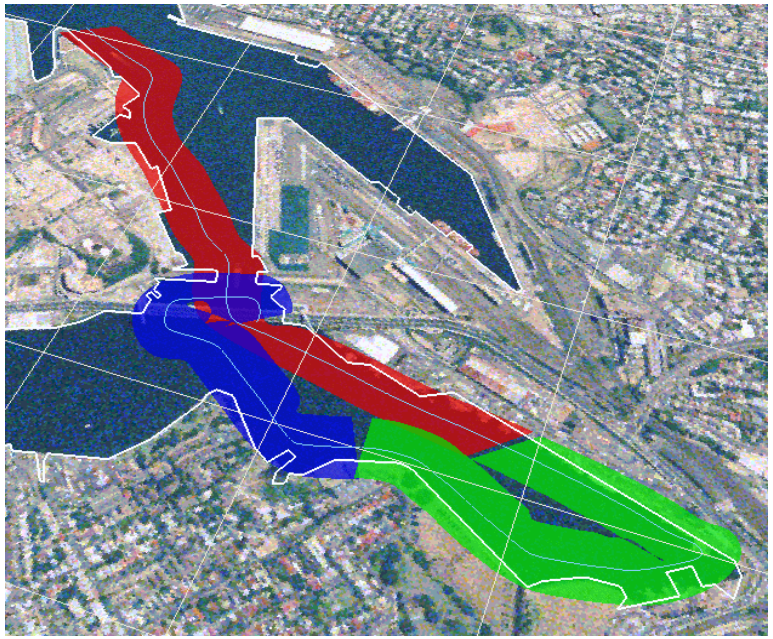
Real Time Mosaic «TARGET *LOCALISATION* »



Integrated inertial aided positioning «Target detection »

- Safety solution : port / waterway monitoring

Repetitive navigation path
(1/hour, 1/week, 1/month, ...)

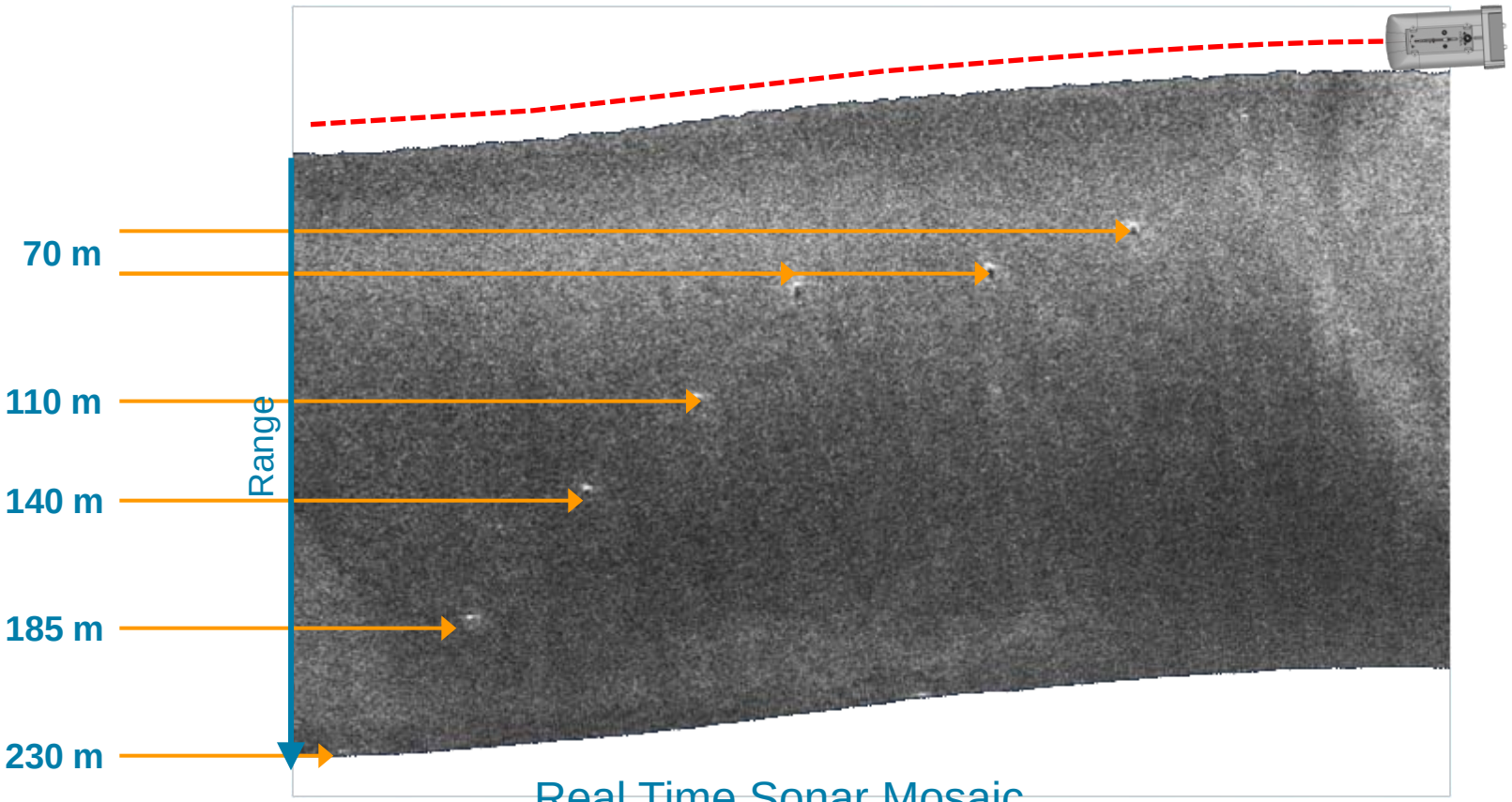


Mosaic comparison tool
for recent changes detection

Previous image
(last passage)

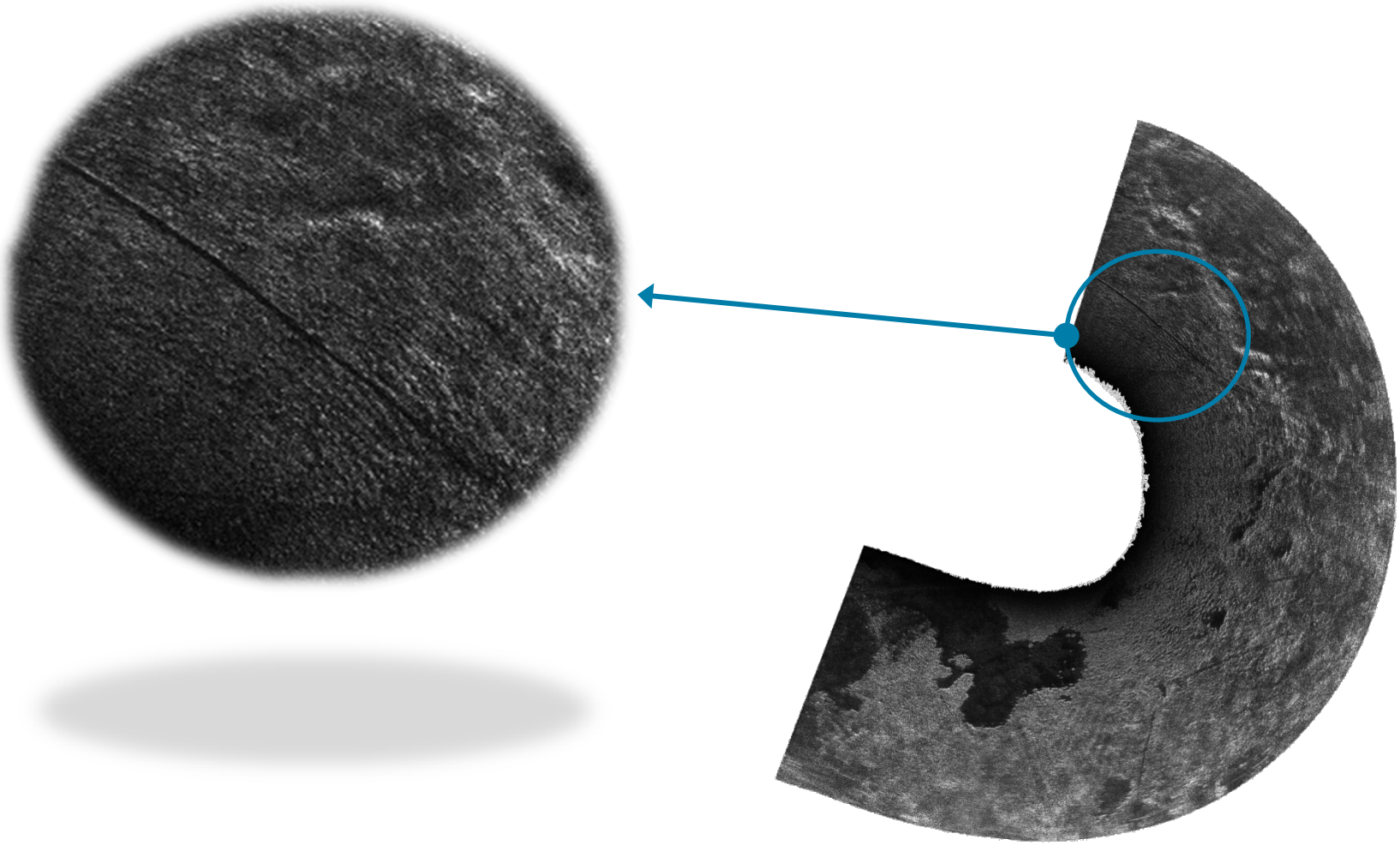
Today's image
(real-time building)

Constant resolution along track & across track

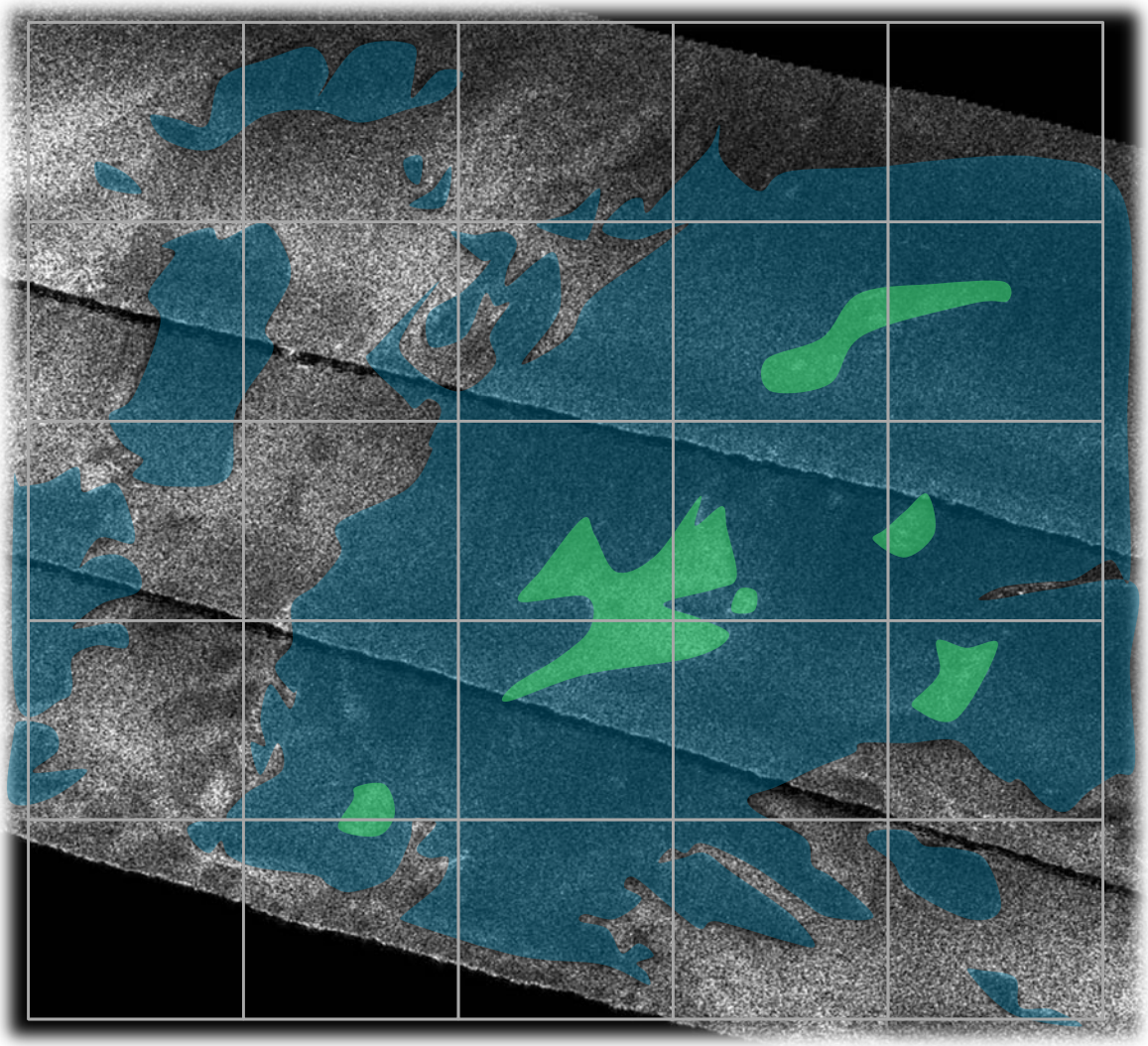


Real Time Sonar Mosaic
Hi-resolution (15x15cm)
Hi-accuracy positioning

Continuity in turns



Georeferencing build in the system

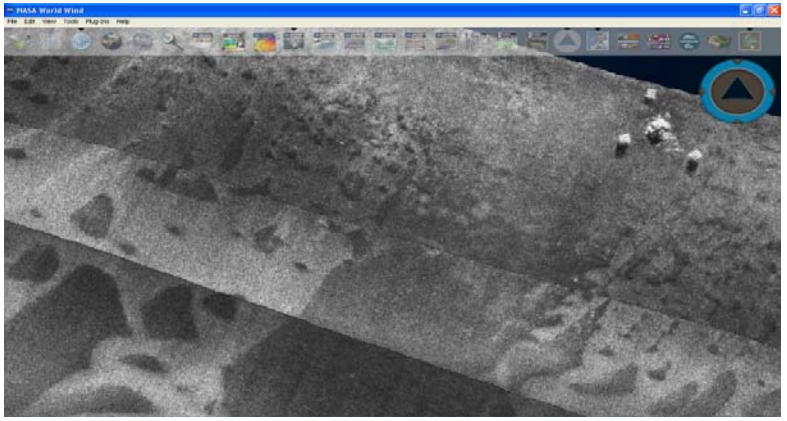


Shadows Sonar Mosaic

- Data Display : **sonar mosaic is built in real time and displayed directly in a GIS (Geographical Information System)**

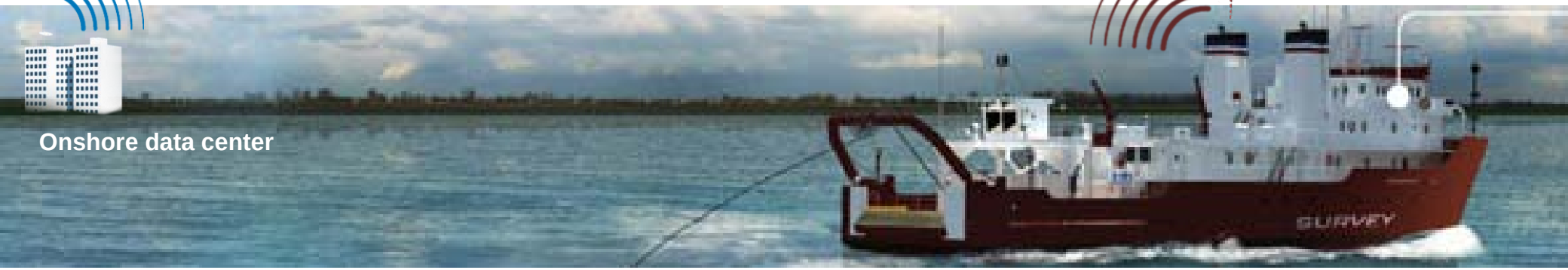
- To do the focalization we need a grid
  - So we use the geographical grid
  - So the data is geo-referenced !
  - The mosaic is built tile by tile in Real Time

- **The quality of the georeferencing makes the use of standard mosaicing tools obsolete**



Web Based Architecture

DATA ACCESS & DISSEMINATION, LOCAL or REMOTE



Gigabit dedicated Network

Storage computer

Raw data

Gigabit dedicated Network

Processing computer

Processed data

XTF format

geoTIFF format

Gigabit local Network

User computer

User computer

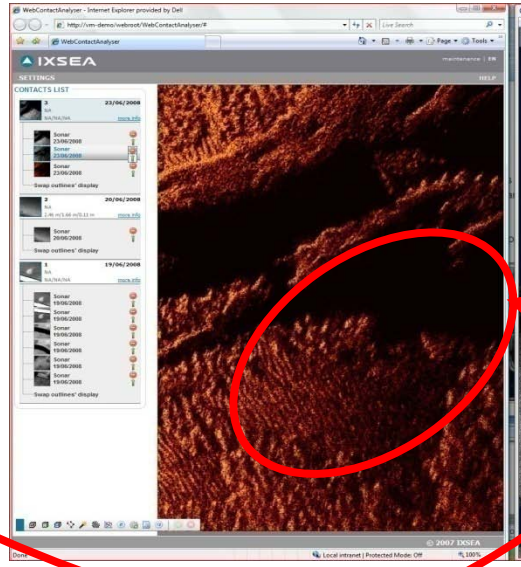
Sonar Control / Command Visualisation

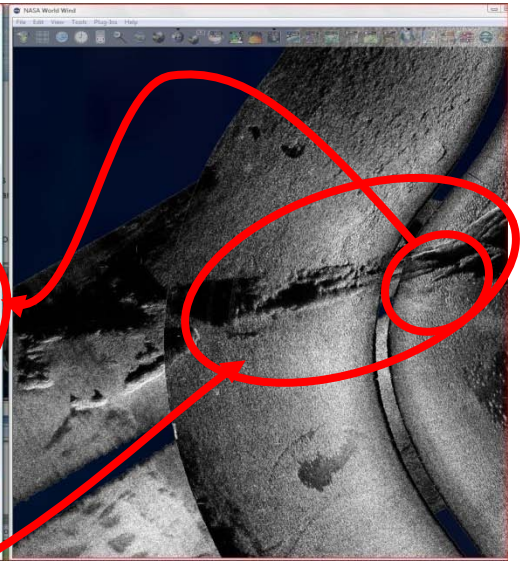
User computer

Processing / Interpretation

Data access

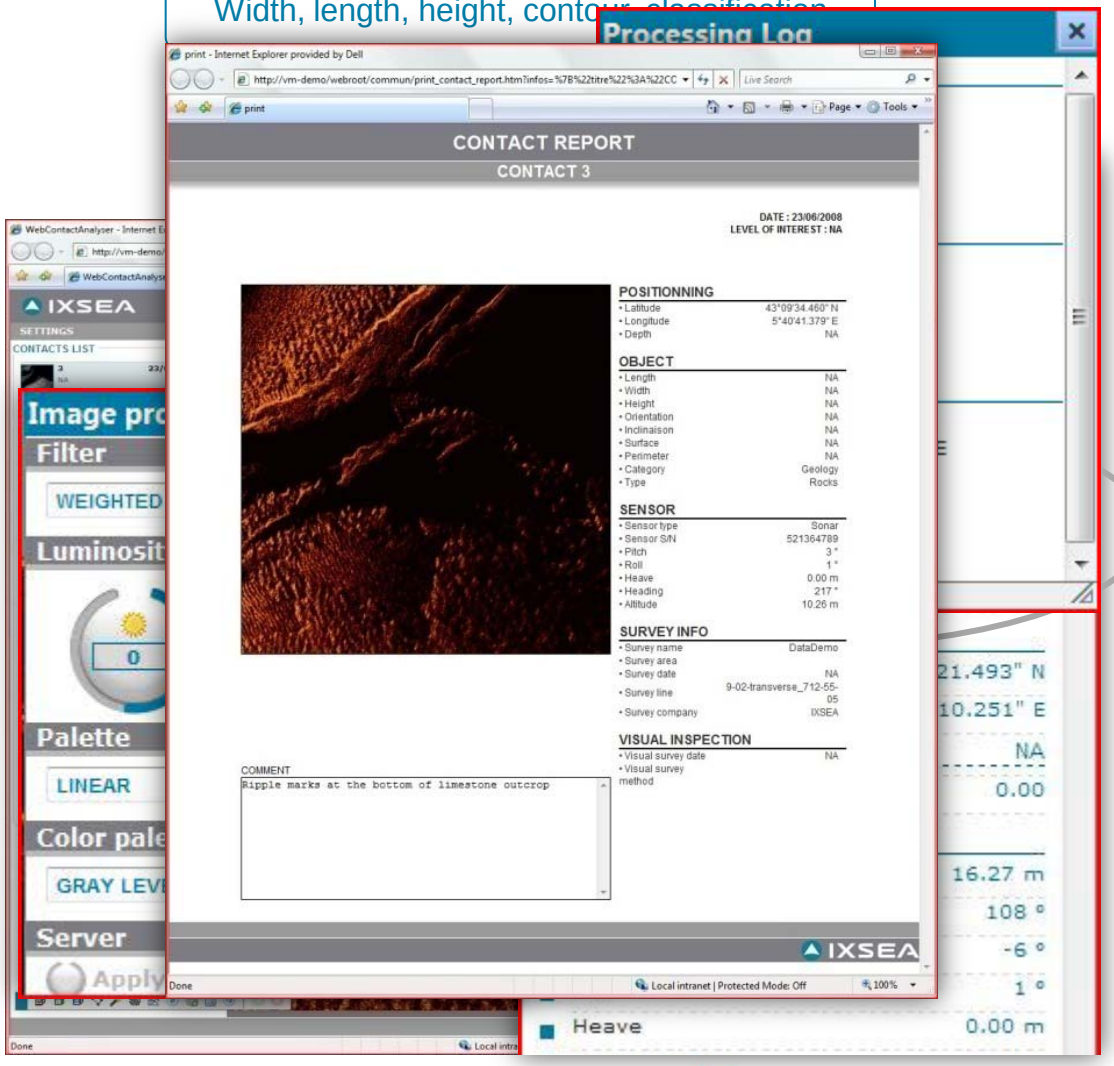
- Through Web tools
  - Contol command interface
  - Data display
  - Data analysis
- One data set multiple users
  - Data sharing



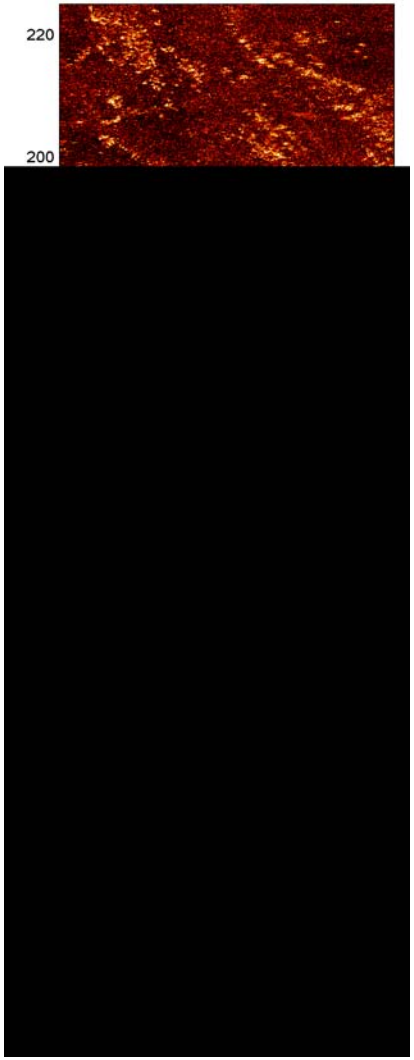


Data analysis and reporting tools

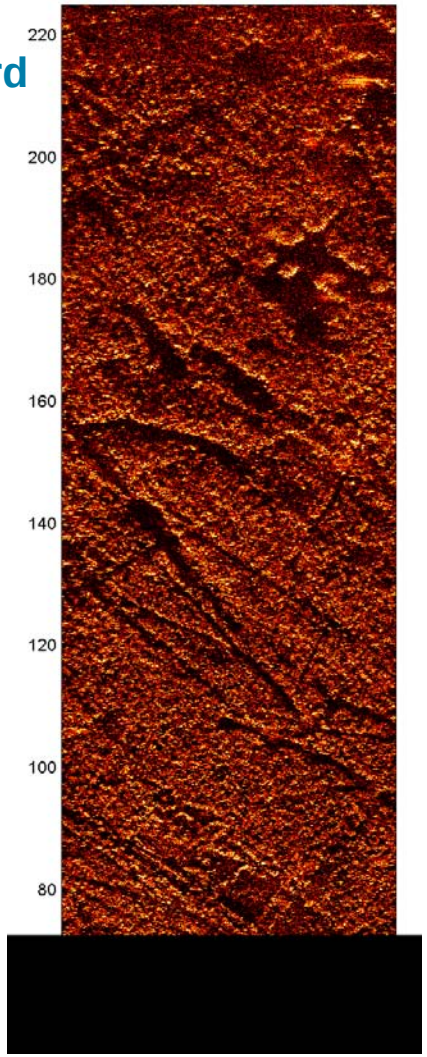
- CAD/CAC functionalities
  - Target measurements
  - Target classification
- Data re-processing
- Import export tools
- Reporting tools



Port



Starboard

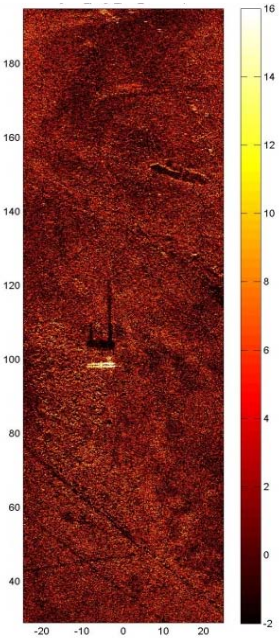


Water depth 23 meters

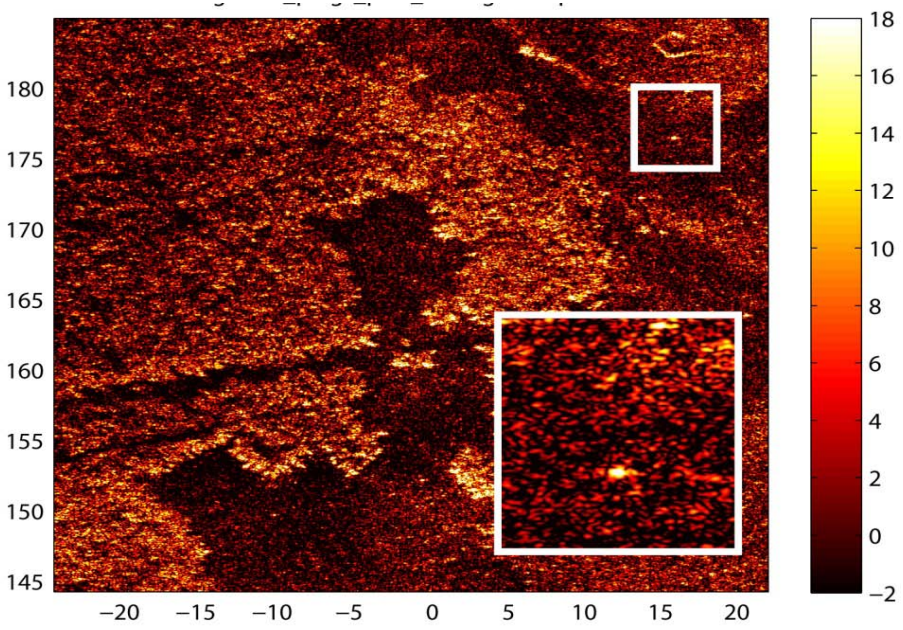
Fish altitude 17 meters

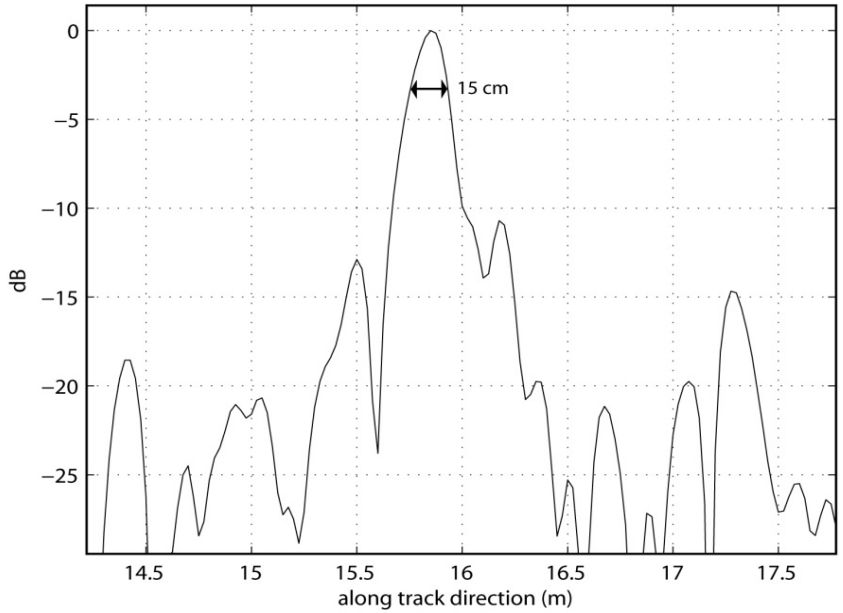
Speed 5 knots

Range 220 meters



- 15 cm detection with -11 dB side lobes at 175 m range





Wide coverage high resolution, *MORE PIXELS PER HOUR*

- Which quantity of information do I get for my money ?
  - Wide coverage = more square km per USD
  - Hi-res = more quantity of information per USD

- Which quantity of pixels do I get ?
  - Per unit of time ?
  - Per KUSD ?

- The NEW equation : Shadows Mapping Sonar
  - *Better :* hi-res + hi-accuracy positioning
  - *Faster :* Real-time + wide coverage per unit of time
  - *Cheaper :* more information for less

Changing the economical equation : CAPEX / OPEX / CFP

Economic simulation

500 x 20 Km debris survey

Vessel daily rate = 15€ K + Fuel

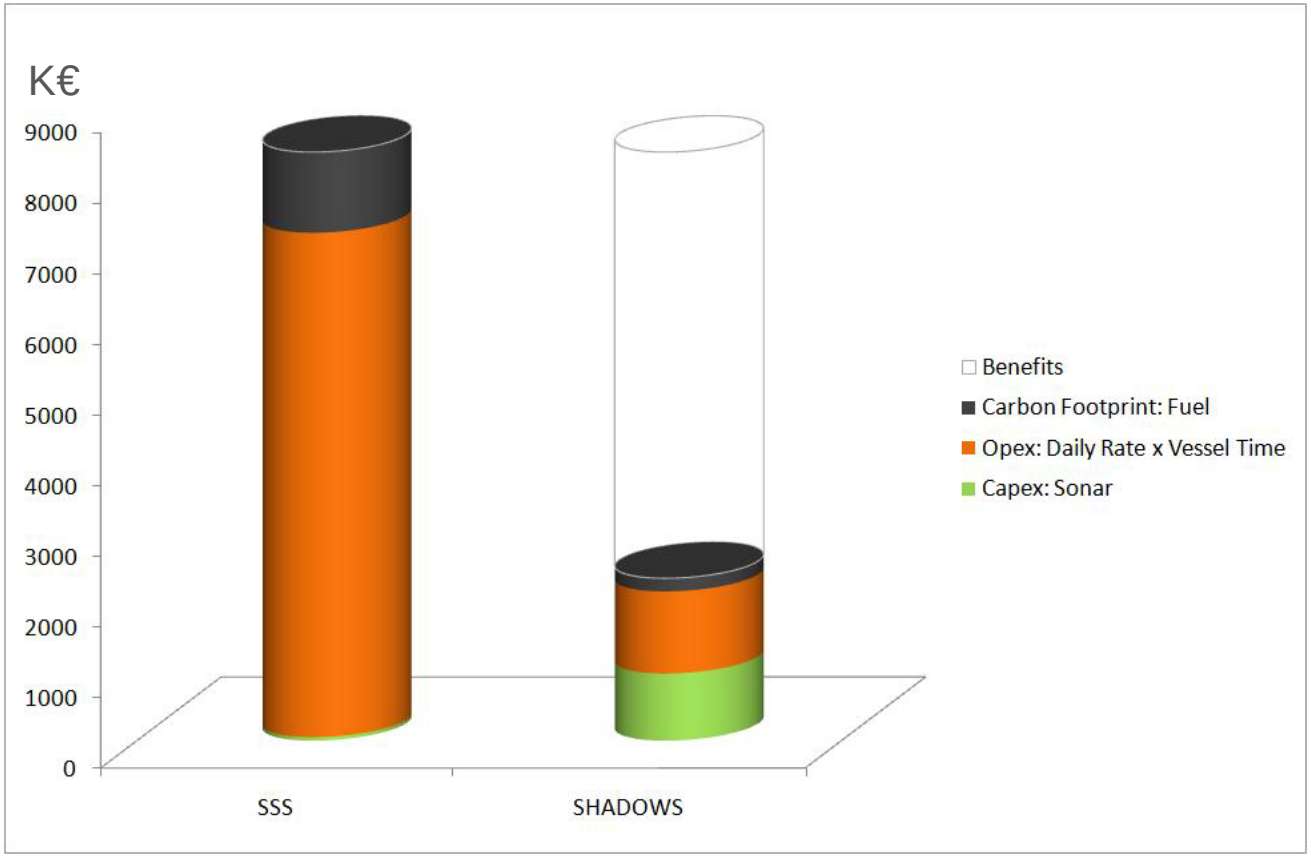
SSS = 100m line spacing,
500m cross line checking
Coverage = 14 sq Km/ 24 hrs
Cost = 8.337 K€

SHADOWS + GAPS + training

500m line spacing, no cross lines
Coverage = 86 sqkm/ 24hrs
Cost = 2.300K€

Benefits : Majors Savings, higher productivity, higher profits,

Carbon Foot Print reduction, and much better quality data

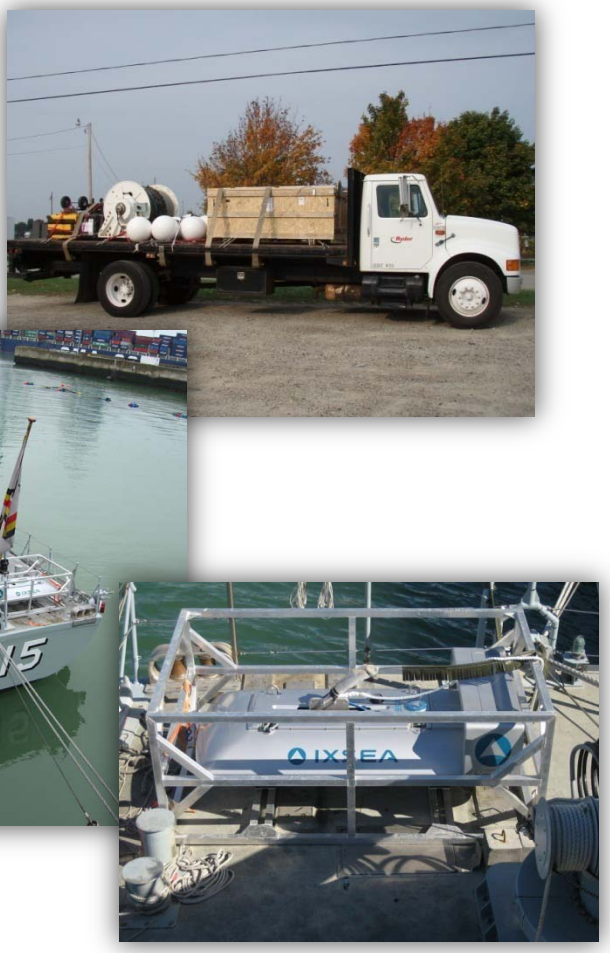


SHADOWS Main Benefits

- Coverage :
  - Seabed coverage rate = 1,65 square nautic miles / hour.
  - 600m swath (5 knots tow) or 300m swath (10 knots tow)
- High Resolution
  - Hi-Resolution Automatic Geotiff mosaic in Real Time
- High Positioning accuracy
  - The mosaic is built from the sonar position
  - The sonar position is initialized by by GPS,and maintained INS aided by DVL, USBL
- Data dissemination, data mining
  - Real-time and off-line data analysis capability
  - Web based architecture.

SHADOWS Main Benefits

- Easy to mobilize
  - Containerized Turnkey solution
  - Including LARS, data acquisition & interpretation
- Easy to deploy
  - Hydraulic arm or A-Frame
  - No cable lay out, no calibration
- Easy to use
  - mosaic is generated from sonar fish position
  - Plug-and-play setup and use.
- Easy to maintain
  - Operational depth : 300m, survival depth : 400m.
  - LRU maintenance concept.



Survey with Shadows

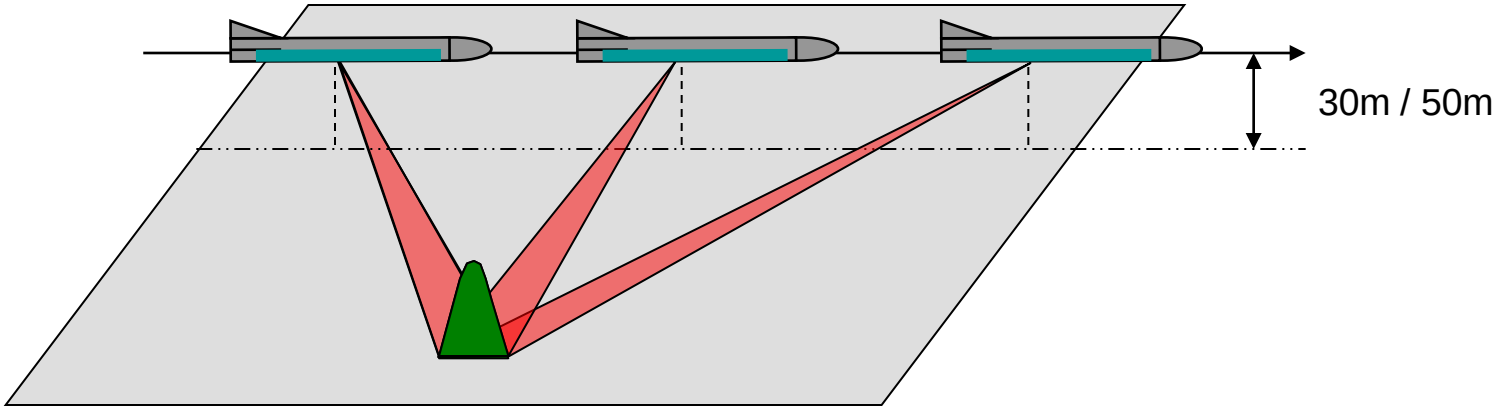
Survey with Shadows

Survey with Shadows

SHADOWS with Interferometric bathymetry

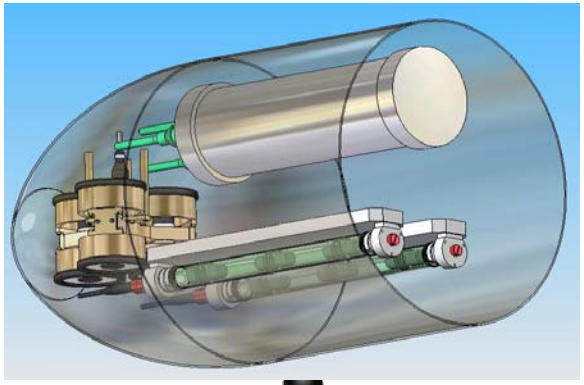
Planned, waiting for specific project requirements

- **Engineering Bathymetry including at nadir**
- **Wraping of the sonar mosaic on the DTM**



SHADOWS Deep Tow/ multiple sensors

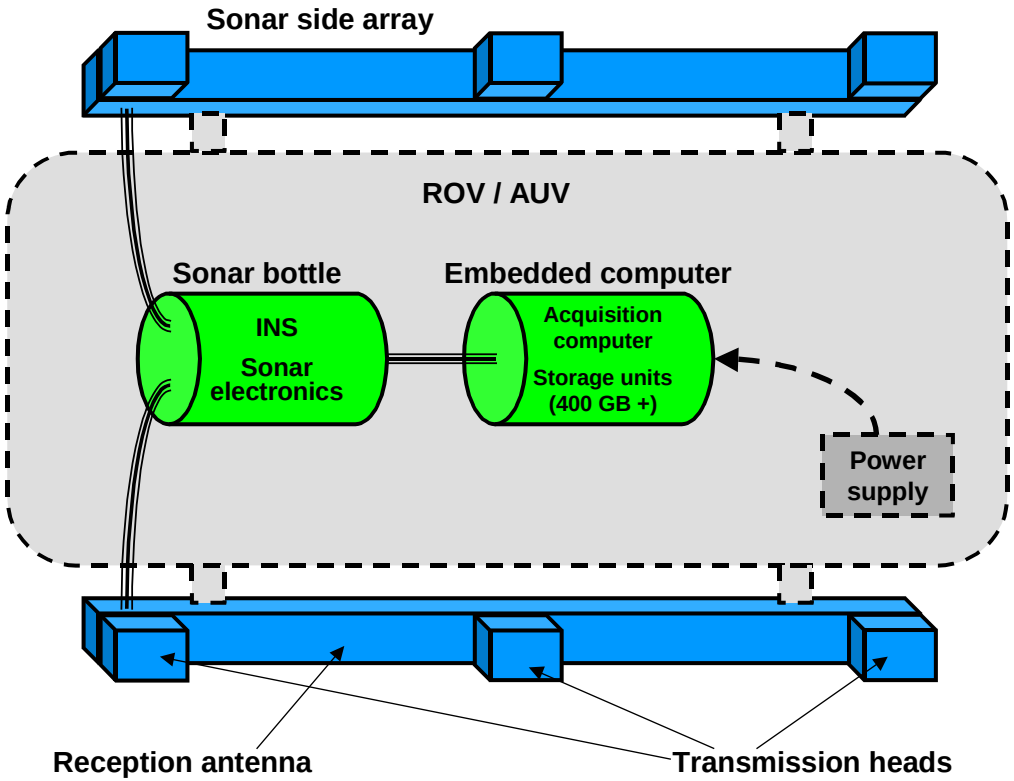
tailor made solutions on a project basis (I)



- **3000m Deep version all in one (sonar/SBP)**
  - **SHADOWS Sonar and Gap Filler**
  - **ECHOES SBP : wide band 1.8KHz to 7.5KHz Hi-res CHIRP**
  - **MAGIS Magnetometer or Gradiometer**
  - **SHADOWS-ECHOES DT includes by design INS, motion sensor, pressure sensor, CTDV, acoustic positioning**
  - **Preliminary studies/ installation/ integration on a project basis**

AUV/ROV applications

tailor made solutions on a project basis (II)



- **AUV / ROV : 2 transducer arrays, INS, calculator, data storage solution**
- **Boat : data processing PC + user workstation.**
- **Installation / integration assistance service**

- *Advantage : the INS of SHADOWS can be used for AUV Navigation*

Survey Systems Integration :
IXSEA Solution based around SHADOWS + GradioMAGIS + integration of 3rd party multibeam

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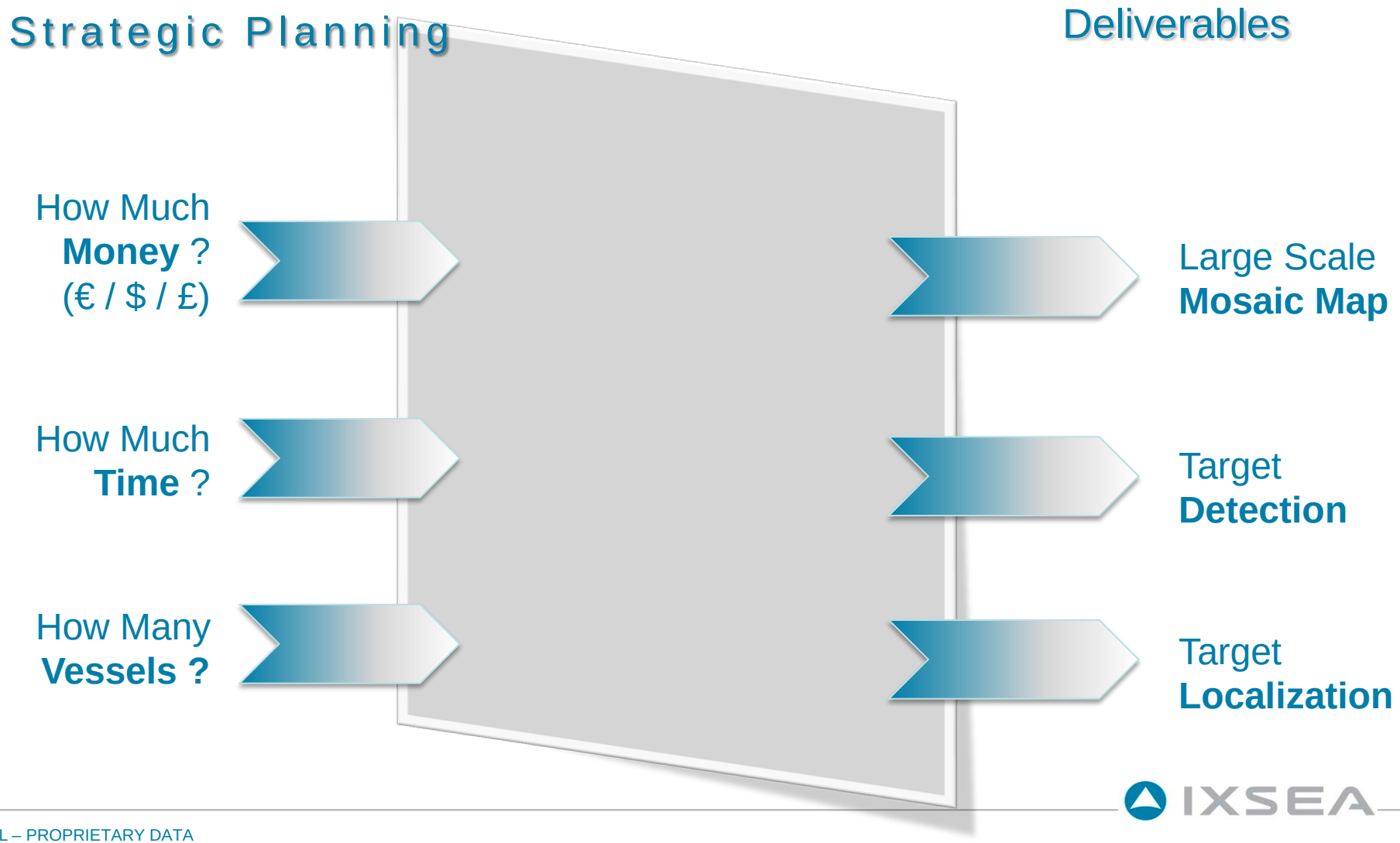
IXSEA Solution based around SHADOWS + GradioMAGIS + integration of 3rd party multibeam

Conclusion

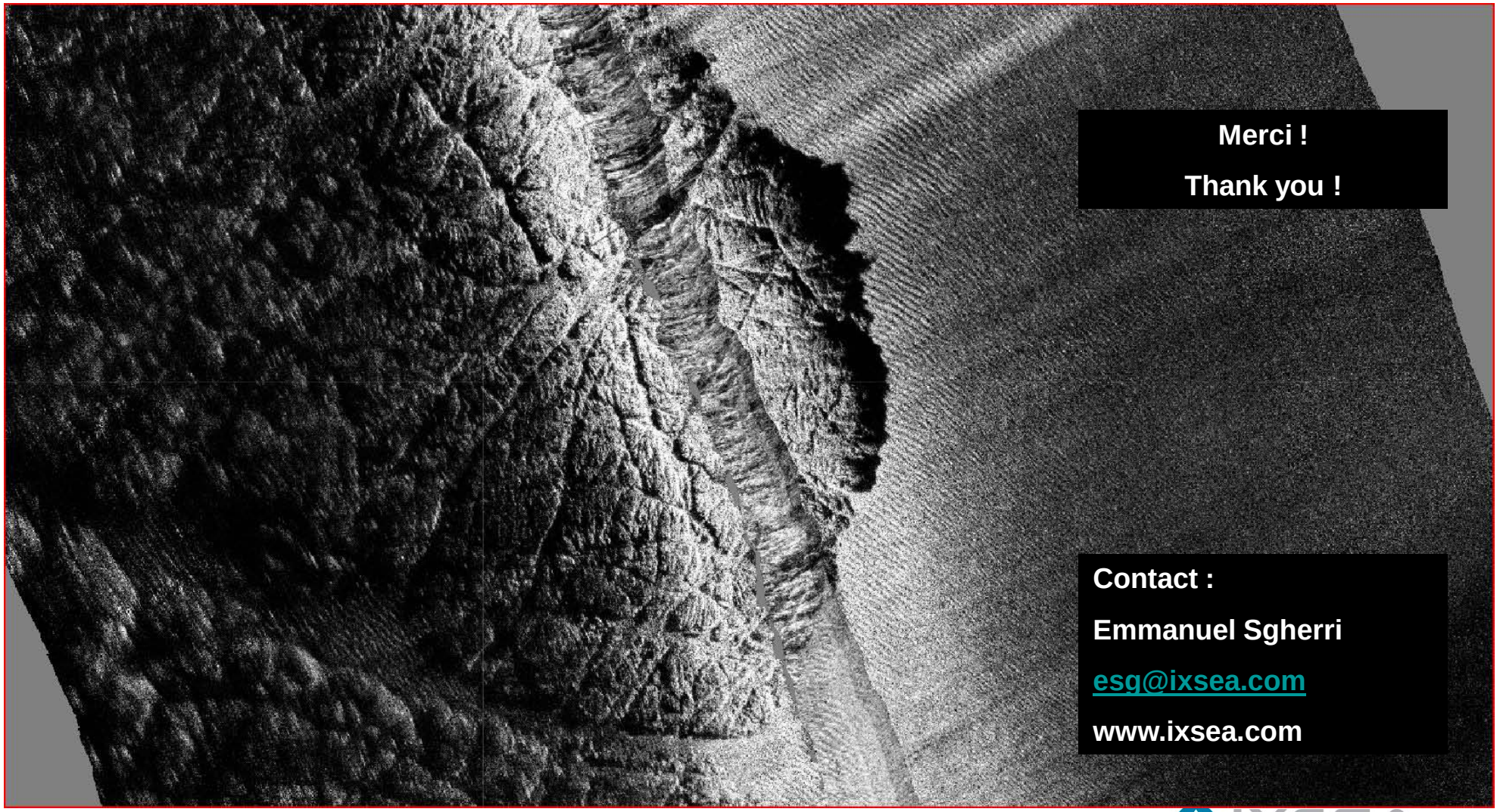
- SHADOWS main applications:
  - EEZ Mapping, Hydrography
  - Safety Monitoring, subsea monitoring
  - Coastal & Environmental surveys (Habitat mapping, debris search, etc.)
  - Route survey **(pipeline & cable route), offshore surveys**
  - **Deep Tow version, AUV version : upon request**

Conclusion


Strategic Planning
Deliverables
How Much
Money ?
(€ / $ / £)
How Much
Time ?
How Many
Vessels ?
Large Scale
Mosaic Map
Target
Detection
Target
Localization

Conclusion : bringing down the pixel cost

Shadows Geotiff Map



Survey Systems Integration

Turnkey solution based around IXSEA Imaging systems, Inertial navigation and acoustic positioning