

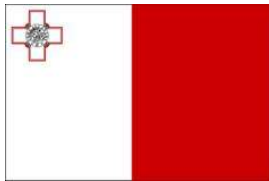
ERDF 156: Developing National Environmental Monitoring Infrastructure and Capacity 3D Data Deliveries

ERDF Seminar, MEPA, 15 January 2013

Dr. Saviour Formosa PhD

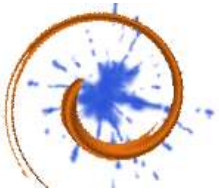
saviour.formosa@mepa.org.mt

saviour.formosa@um.edu.mt



Operational Programme I – Cohesion Policy 2007-2013
Investing in Competitiveness for a Better Quality of Life
Project part-financed by the European Union
European Regional Development Fund (ERDF)
Co-financing rate: 85% EU funds; 15% National Funds





Overview

Project Title Developing National Environmental Monitoring Infrastructure and Capacity

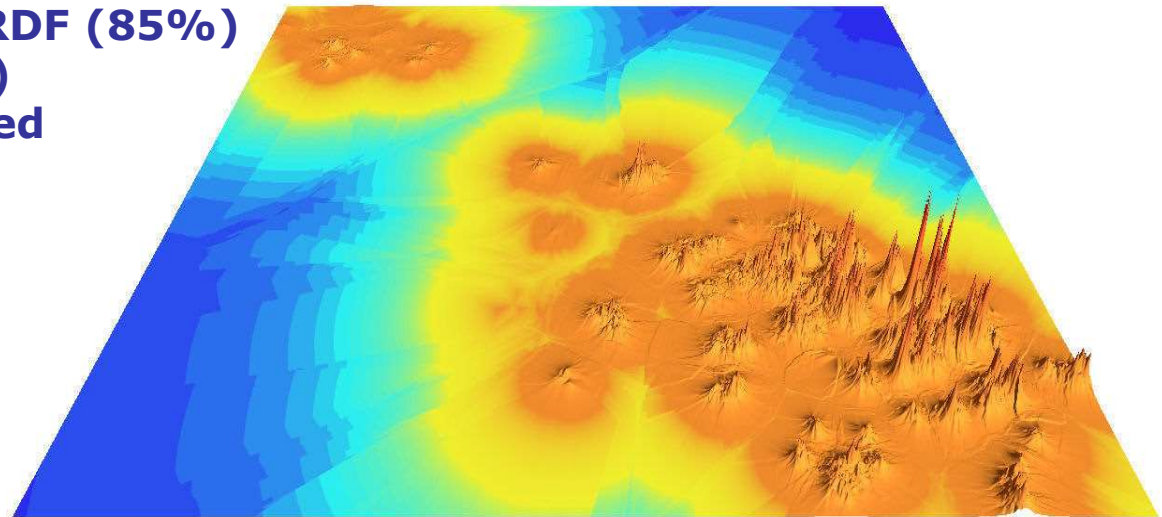
Beneficiaries Malta Environment and Planning Authority

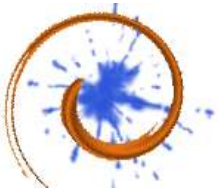
Budget Required € 4.8 M

**approx. € 4.6 m co-funded by ERDF (85%)
and national Government (15%)
approx. € 0.2 m MEPA co-financed**

Start date Q3 2010

Duration 3 years





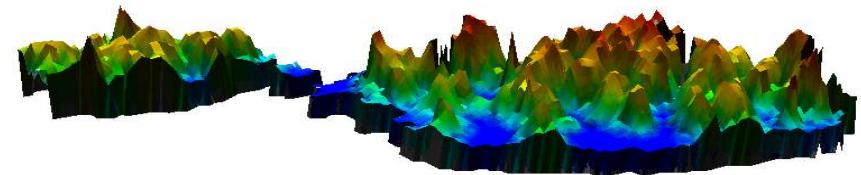
Overall Objective

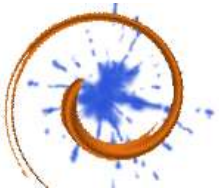
To develop the national environmental monitoring infrastructure and capacity for Malta, with the focus on monitoring 5 environmental themes:

1. air
2. water
3. radiation
4. noise
5. Soil

Environmental
Monitoring and
Reporting

IR Factor: Themes are integrated with Information Resources systems





Background

Due to the various national/EU environmental obligations, MEPA is committed to upgrade Malta's environmental regulatory capacity, including efforts to ensure full compliance with relevant Community Directives as well as national legislation.

However....

Environmental monitoring and reporting is hampered by:

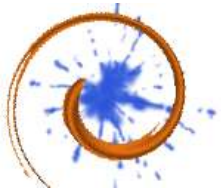
- incomplete monitoring strategy
- lack of baseline environmental data on ambient conditions
- lack of monitoring infrastructure & modern monitoring equipment
- limited human resources



Need....

Enhancement of national monitoring programmes in the five environmental themes through:

- Identification of information gaps in monitoring processes and filling data gaps
- Carrying out environmental baseline surveys
- Procurement of monitoring equipment & information management systems
- Training of staff



Project Results/Outcomes

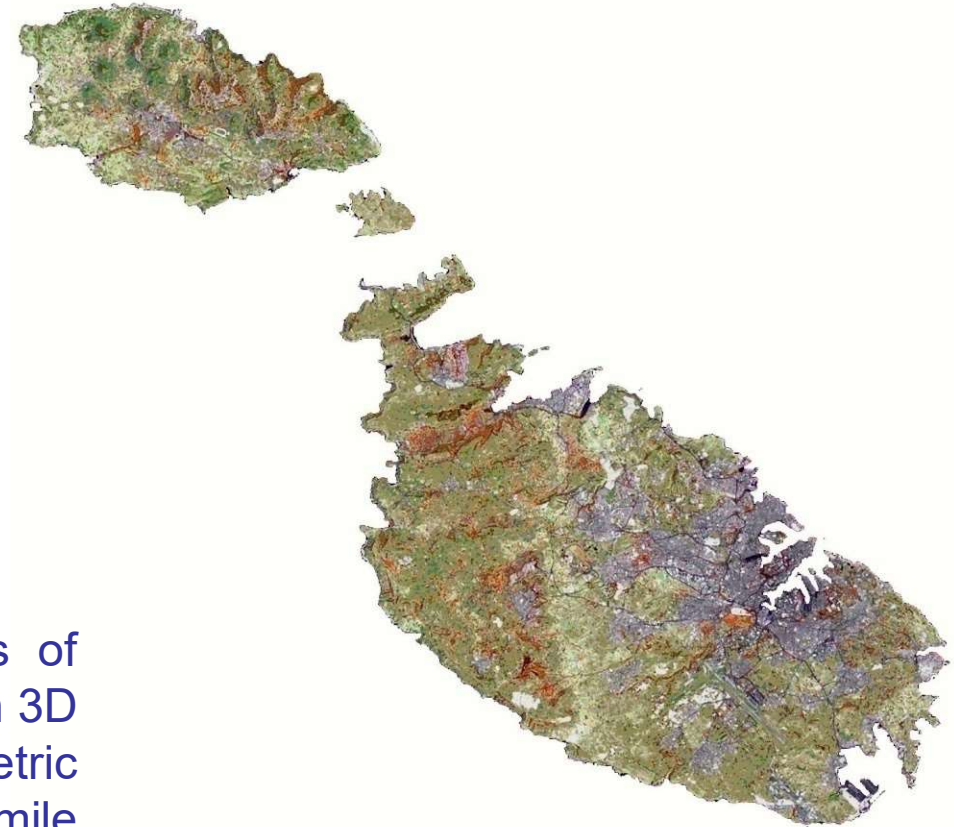
(1) Environmental monitoring requirements

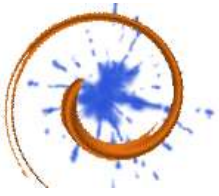
in the areas of air, water, radiation, soil, and noise assessed, an environmental monitoring strategy and detailed monitoring programmes designed and drawn up by mid-2012.

The strategy will be accompanied by detailed tender specifications for the procurement of equipment, systems, training and data collection requirements that could not be identified prior to the completion of the strategy;

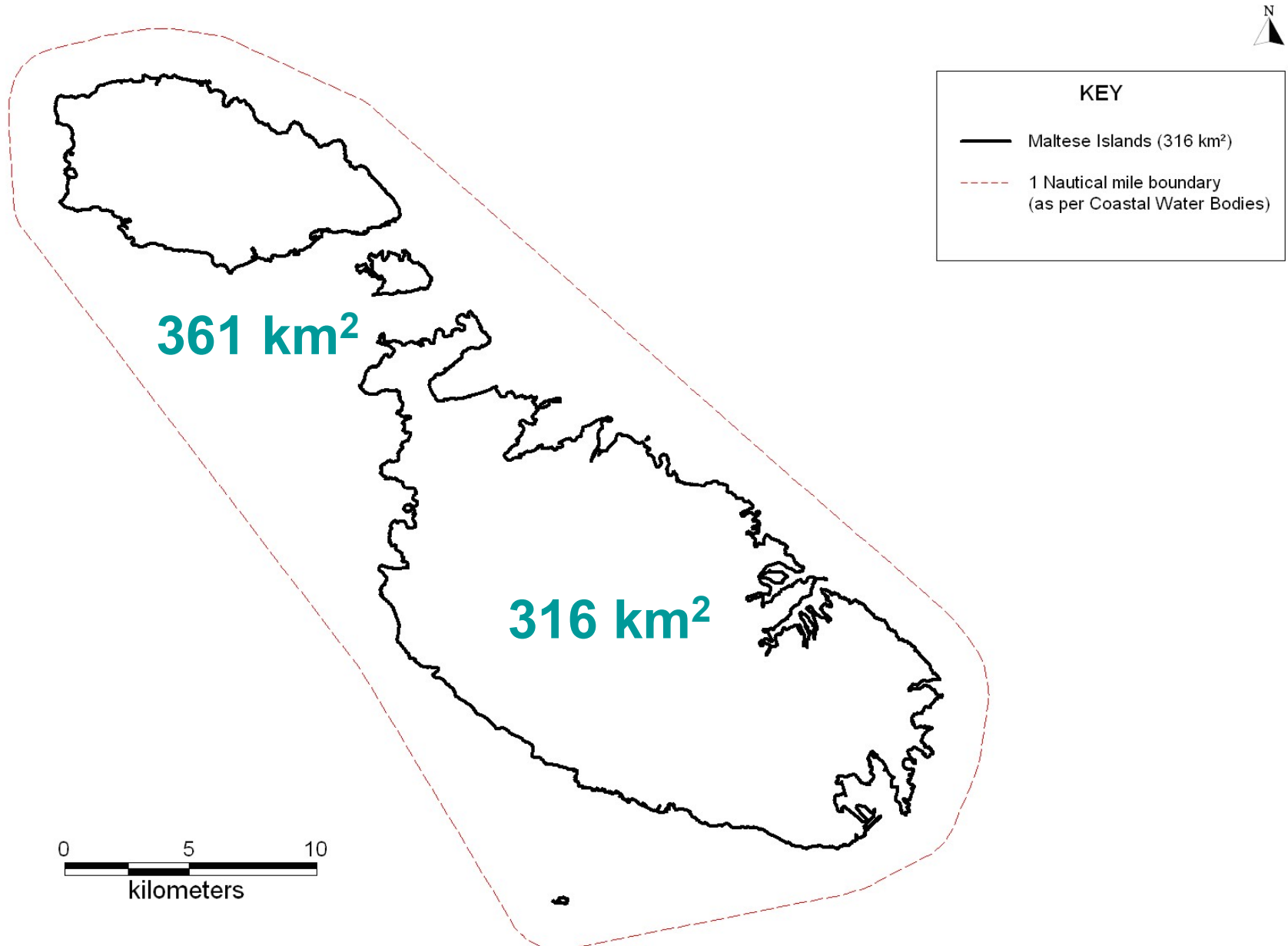
(2) Baseline studies

conducted in the areas of water, radiation, noise and soil, together with 3D terrestrial spatial surveys and bathymetric surveys of coastal waters within 1 nautical mile by 2012;





Area Coverage

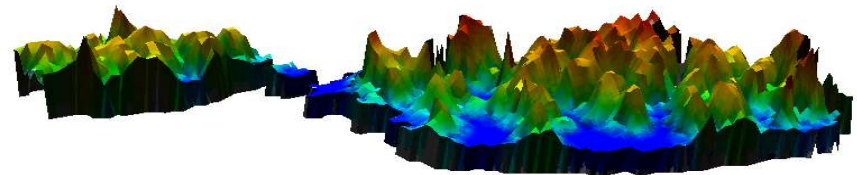


Project Phasing

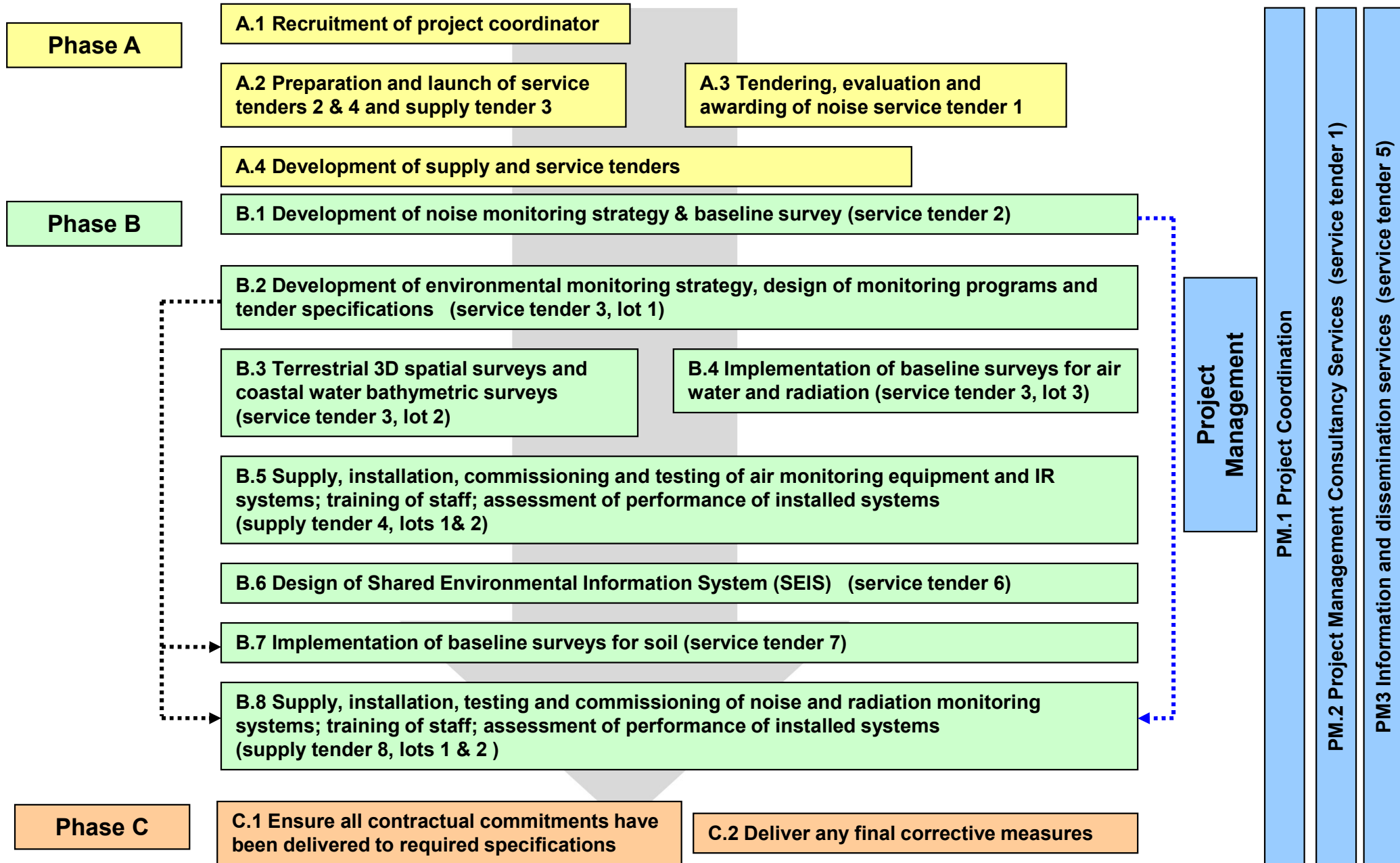
Project to be implemented in three phases:

- Phase A - Preparatory Phase
Q4 2008 – end Q4 2009
- Phase B - Implementation Phase
Q1 2010 – end Q1 2013
- Phase C - Closing off
• Q4 2012 – Q2 2013

Project management activities (project coordination and dissemination) to take place throughout the entire project.





Project Flow



Project Tenders & Lots

Tender No	Type	Lot No	Contract title	Total value (€)	Start tendering
1	service	None	Project Management Consultancy Services to assist in Project Preparation and Development	30,680	Q4 of 2008
2	service	None	Development of noise monitoring strategy & baseline survey	107,000	Q1 of 2009
3	service	1	Development of environmental monitoring strategy, design of monitoring programmes and tender specifications	330,000	Q1 of 2010
		2	Terrestrial 3D spatial surveys and bathymetric surveys of coastal waters.	1,350,000	
		3	Baseline surveys for air, water and radiation	914,000	
4	supply	1	Information Resources Systems – Supply, installation, commissioning and testing of GPS equipment, data management hardware and spatial data processing software and supply of satellite imagery	502,000	Q1 of 2010
		2	Supply, installation, commissioning and testing of Air monitoring systems	737,000	
5	service	None	Information and dissemination services	50,000	Q1 of 2010
6	service	None	Design of the Shared Environmental Information System (SEIS) and development of web-based GIS interface	354,000	Q3 of 2010
7	service	None	Soil baseline survey	48,000	Q1 of 2011
8	supply	1	Supply, installation, commissioning and testing of noise monitoring systems	115,000	Q1 of 2011
		2	Supply, installation, commissioning and testing of radiation monitoring systems	215,000	

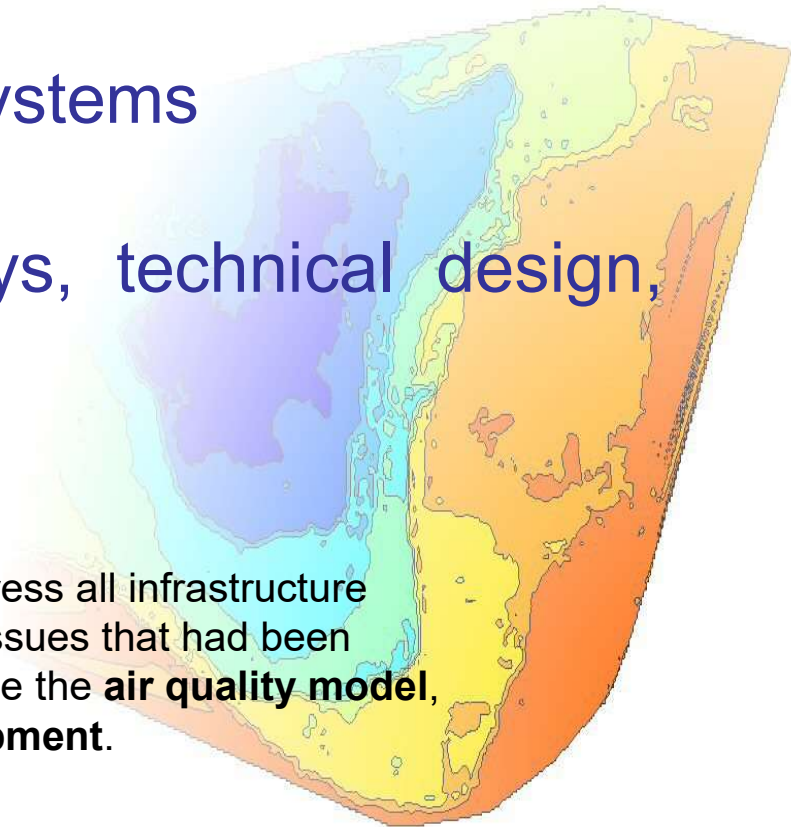
Legend:  Funded through EU co-financing
 Funded from MEPA funds

Budget Allocation

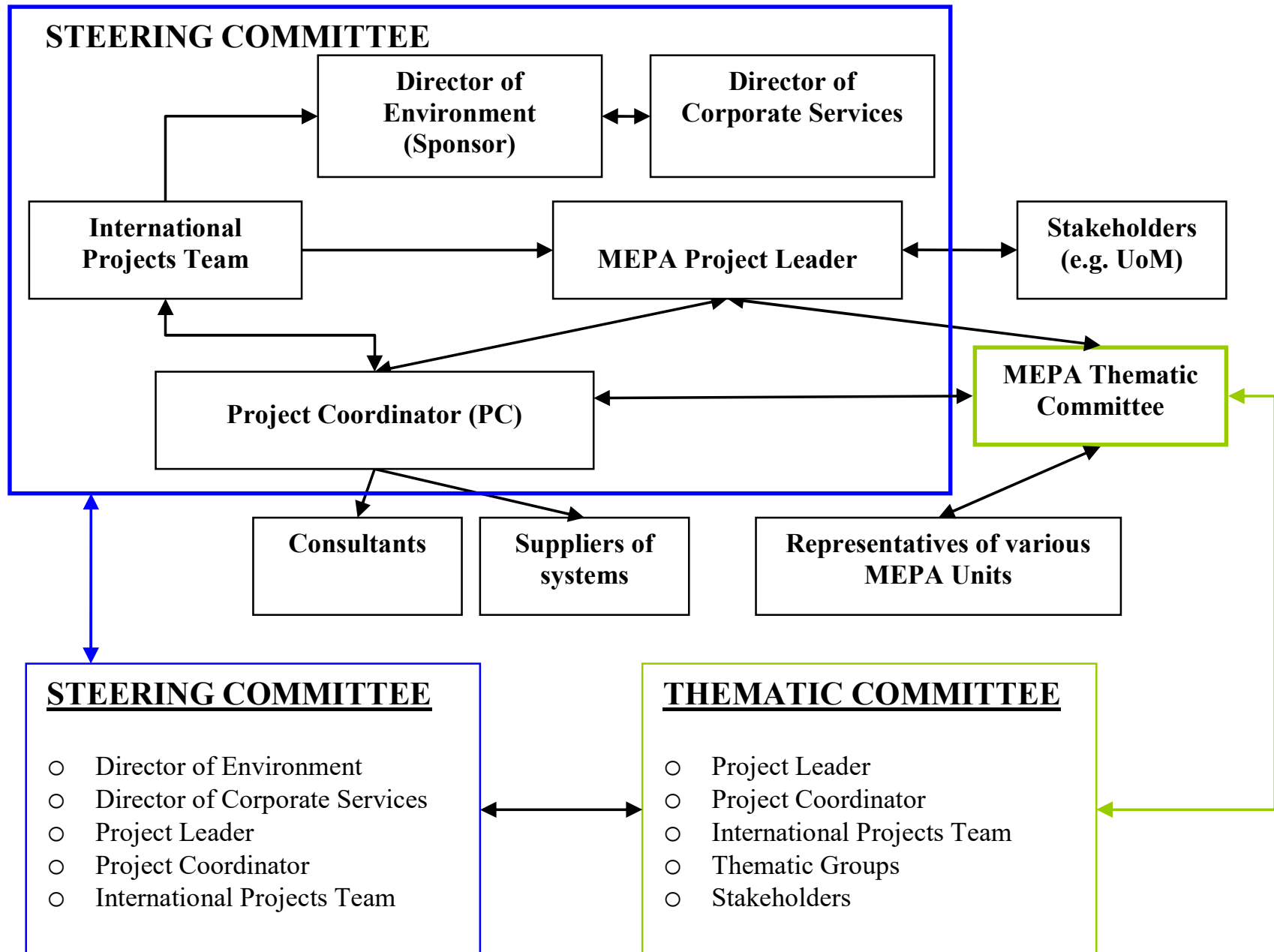
The project will require a total budget of € 5 million, of which:

1. c €200k – project management and dissemination
2. c €2m – supply of equipment and systems
3. c €3m – studies, baseline surveys, technical design, consultancy services

Note that it was not deemed possible for the project to address all infrastructure requirements due to budget restrictions set out by PPCD. Issues that had been included but were later taken out due to the €5million include the **air quality model**, which is a major cost item and the **water monitoring equipment**.
Other funds will have to be sought for these.



Project Organisation Structure

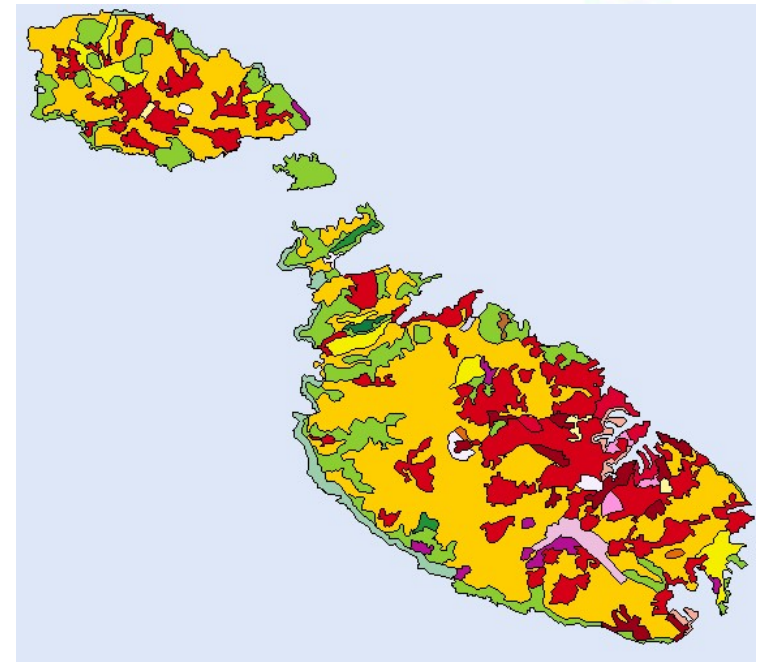
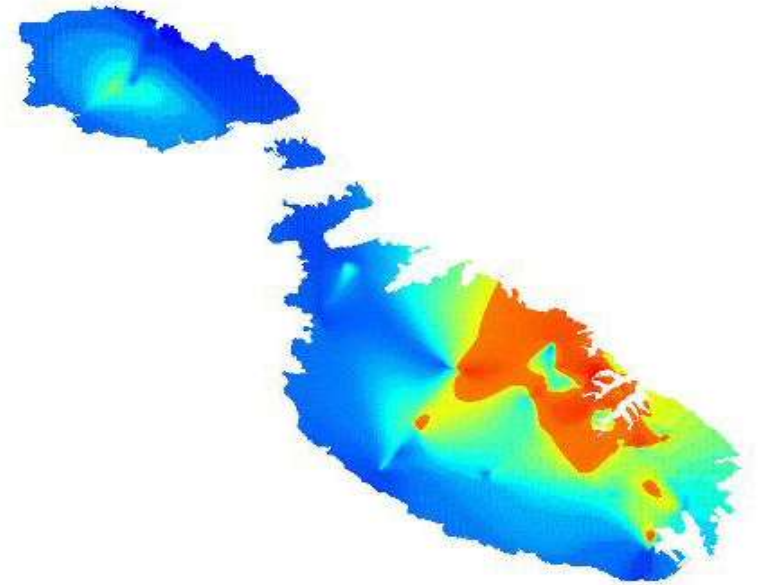


Project Results/Outcomes

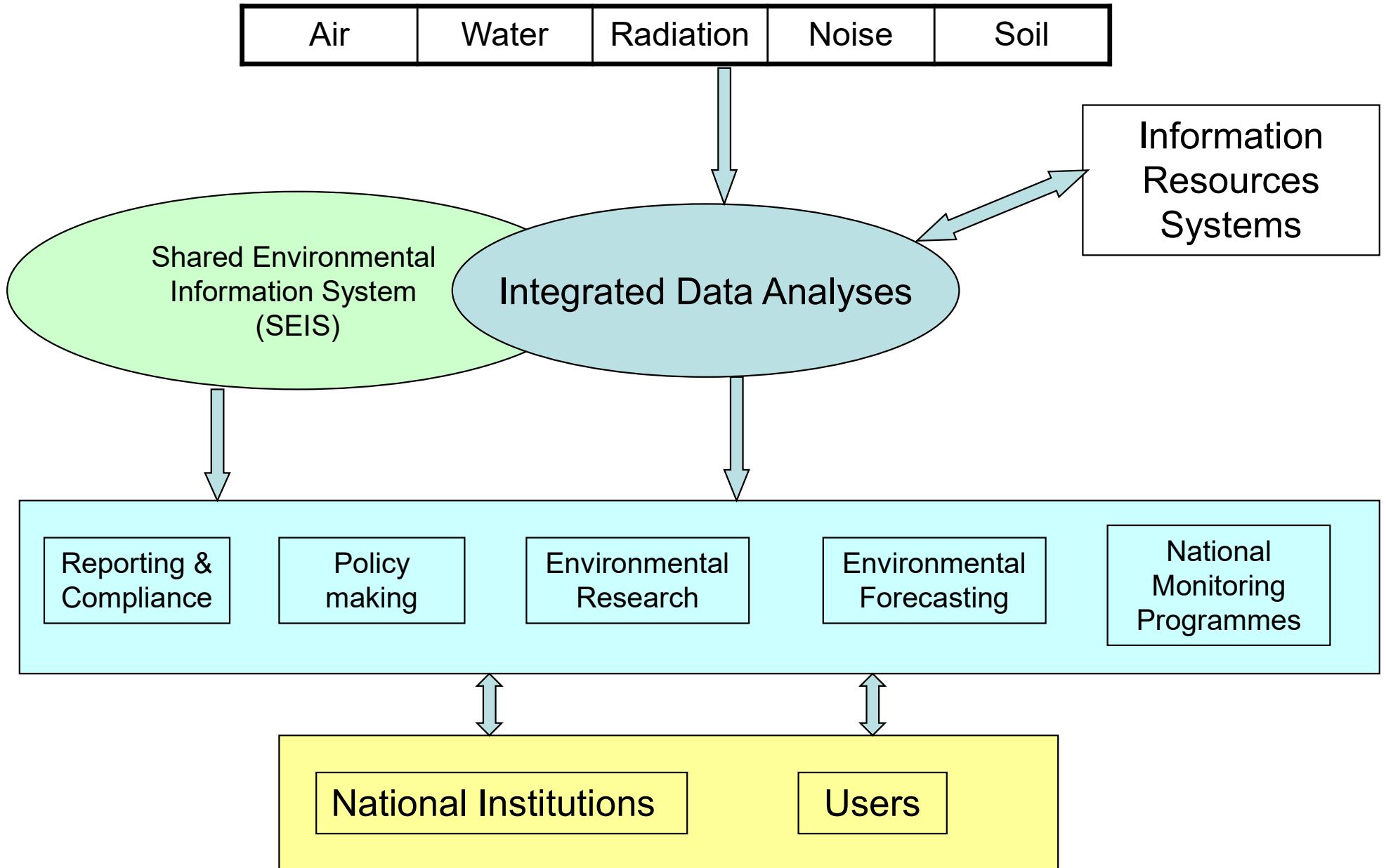
- (1) **Environmental monitoring requirements** in the areas of air, water, radiation, soil, and noise assessed, an environmental monitoring strategy and detailed monitoring programmes designed and drawn up by 2011. **The strategy will be accompanied by detailed tender specifications** for the procurement of equipment, systems, training and data collection requirements that could not be identified prior to the completion of the strategy;
- (2) **Air, water, noise and radiation equipment, information resources systems and infrastructure** procured, installed, tested and commissioned, and relevant MEPA staff trained in their operation by 2012;
- (3) **Baseline studies** conducted in the areas of water, radiation, noise and soil, together with terrestrial spatial surveys and bathymetric surveys of coastal waters within 1 nautical mile by 2011;
- (4) **Shared Environmental Information System (SEIS)** designed and implemented by end 2012;
- (5) Results of the project will be **disseminated** throughout the project to a wide range of stakeholders and the public through an information campaign.

Project Benefits

- (1) Compliance with EU obligations for environmental monitoring and reporting
- (2) Integrated national monitoring programmes
- (3) Cross thematic analysis
e.g. water-chemicals, noise-air-land use
- (4) Support for environmental policy making
- (5) Enhance Environmental research
- (6) Forecasting of environmental parameters
e.g. predictive air models
- (7) Statistical backing for experts – normative stats and spatial stats

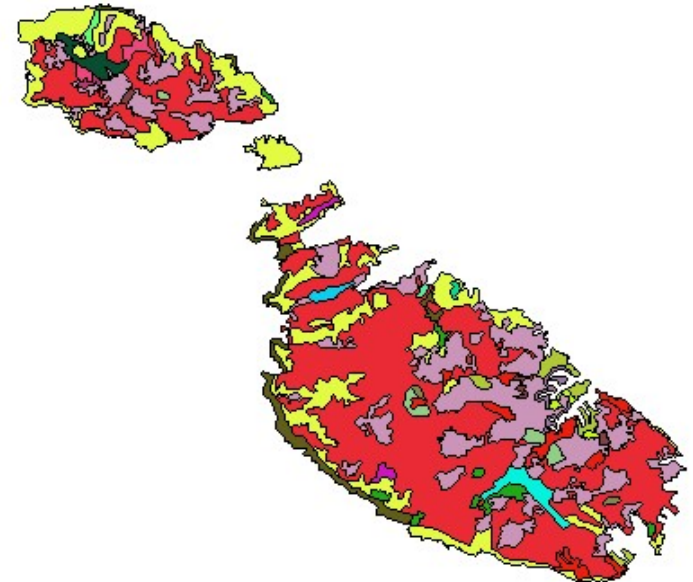
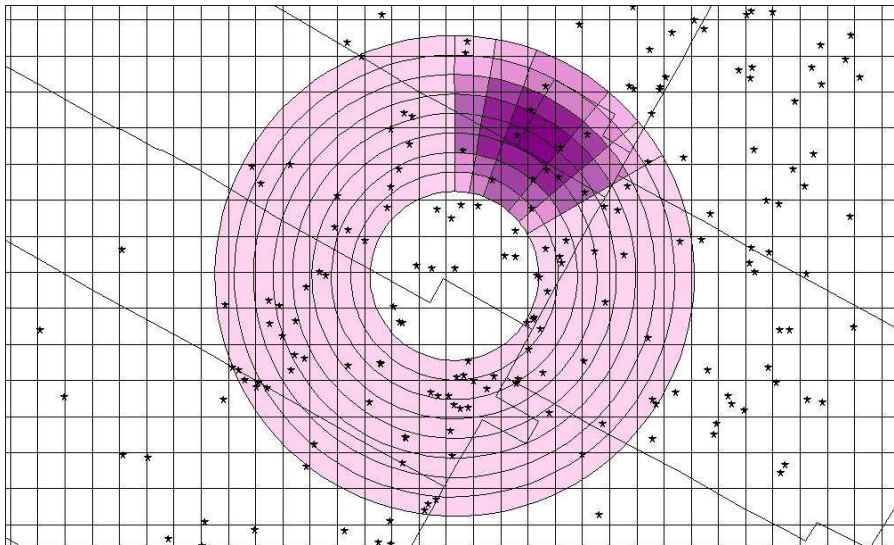


Integrated Model



Key Issues: Project Partners

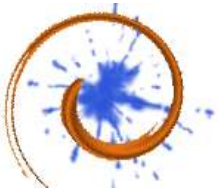
- Application Process has been concluded and project launched
- Partners Established as part of the process:
 - University of Malta
 - Malta Resources Authority
 - Dept. of Environmental Health
 - National Statistics Office



Interested Parties: Public

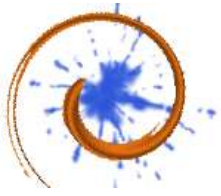
- Increased public awareness and enhancement of the **DIKA** (Data – Information – Knowledge – Action) process
- **Availability/Usage** of the data generated through the project's baseline surveys and through the operation of the environmental monitoring equipment acquired through the project
- Accessibility to high quality information through high-end **information resources** employing state-of-the-art technologies





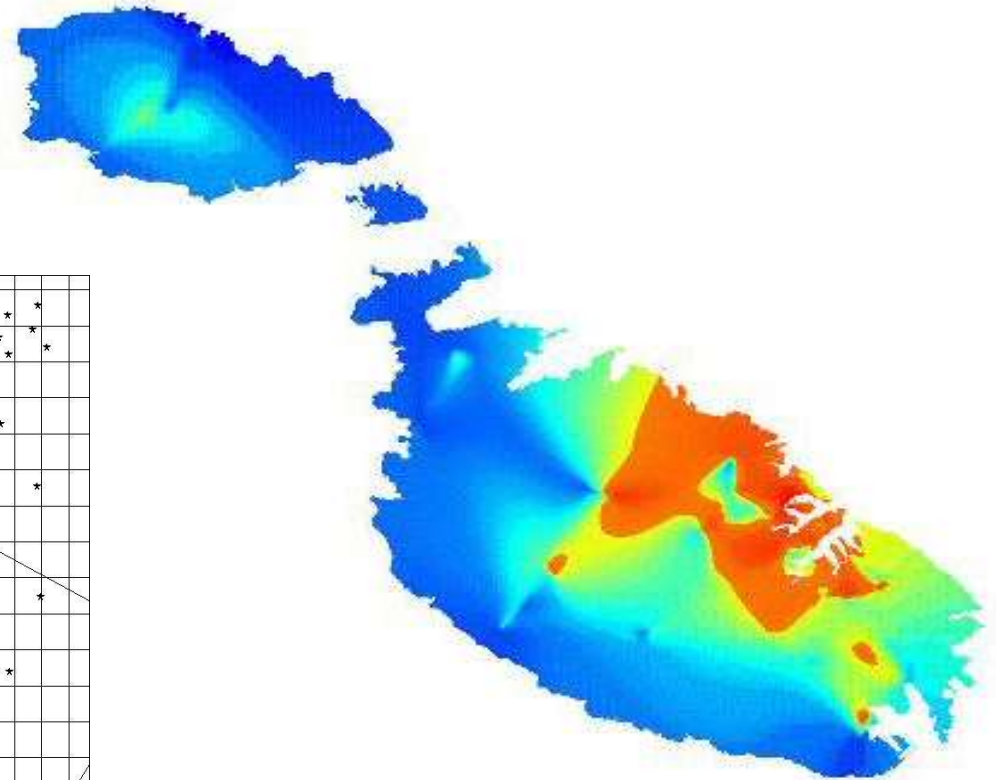
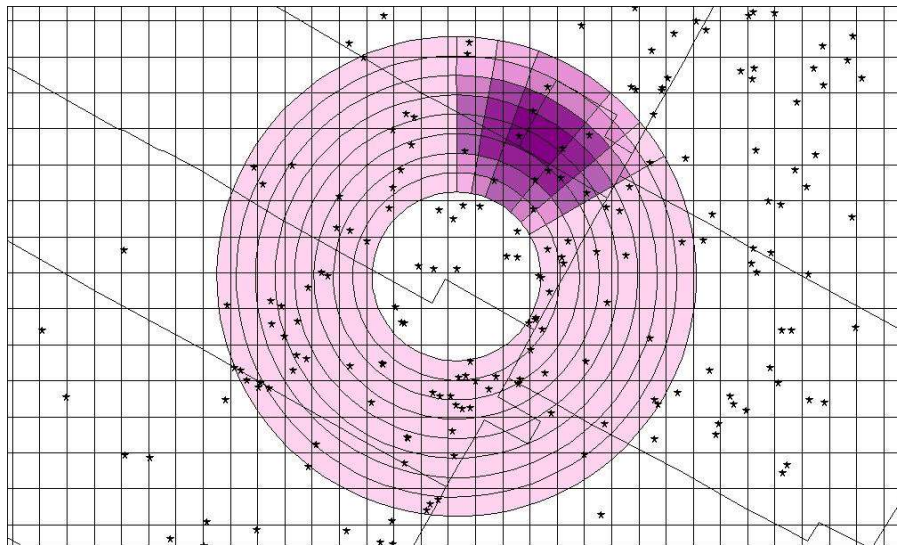
Partners

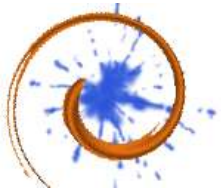
- University of Malta, Malta Resources Authority, National Statistics Office, Directorate of Environmental Health
- Participation in the meetings of the Project Steering Committee, when relevant
- Usage of the data generated through the project's baseline surveys and through the operation of the environmental monitoring equipment acquired through the project
- Provision of stakeholder input to the formulation of the environmental monitoring strategy to be delivered through the project
- Provision of stakeholder input to the interpretation of the environmental data acquired through the project, depending on partner requirements, capacities and needs, as and when required



Project Results/Outcomes

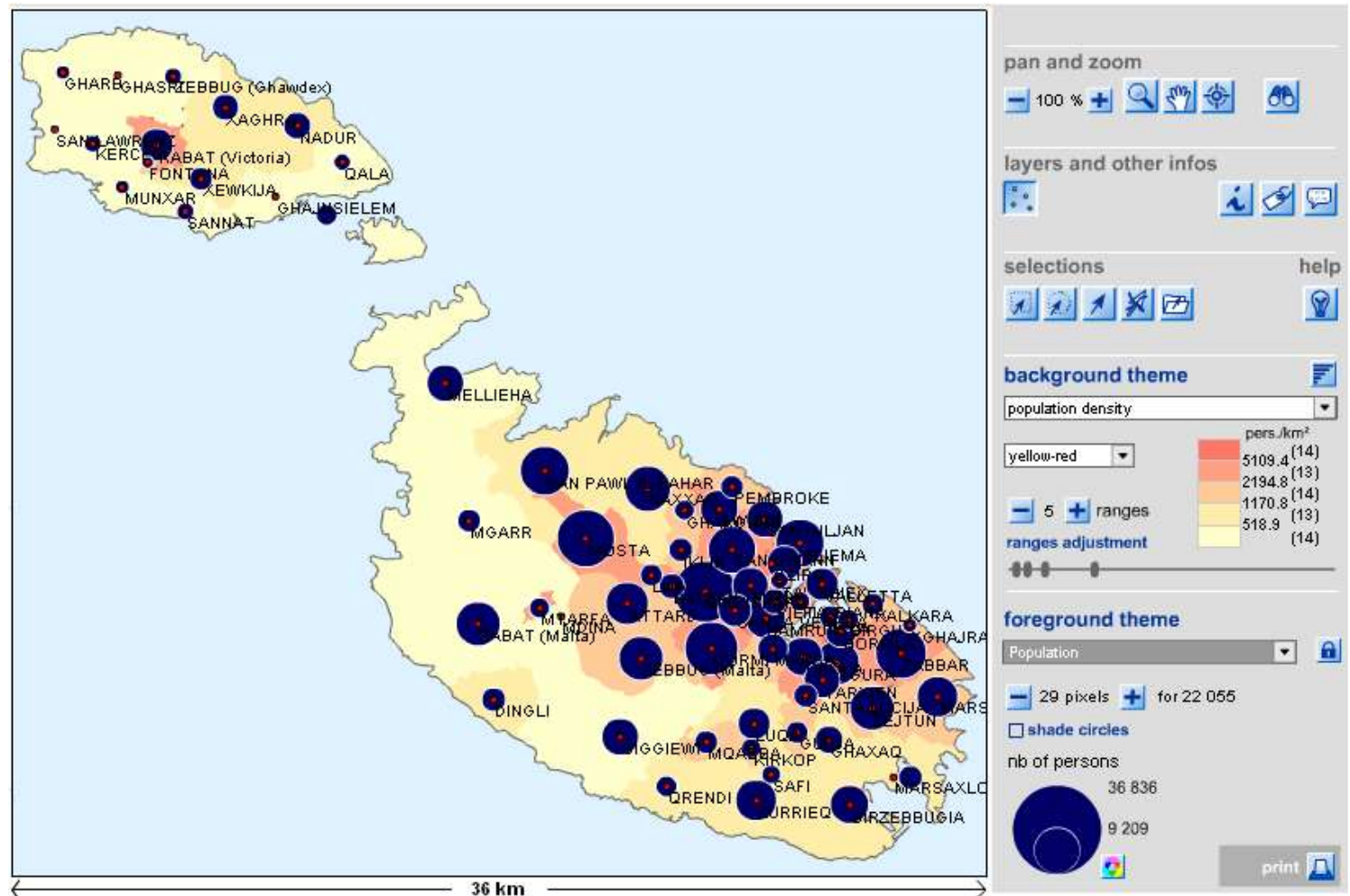
- (3) **Air, water, noise and radiation equipment, information resources systems and infrastructure** procured, installed, tested and commissioned, and relevant MEPA staff trained in their operation by 2012;

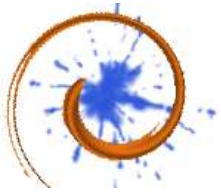




Project Results/Outcomes

(4) Shared Environmental Information System (SEIS) designed and implemented by 2013;





Project Results/Outcomes

- (5) Results of the project will be **disseminated** throughout the project to a wide range of stakeholders and the public through an information campaign.

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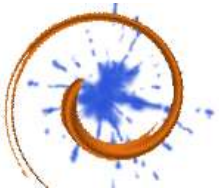
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news

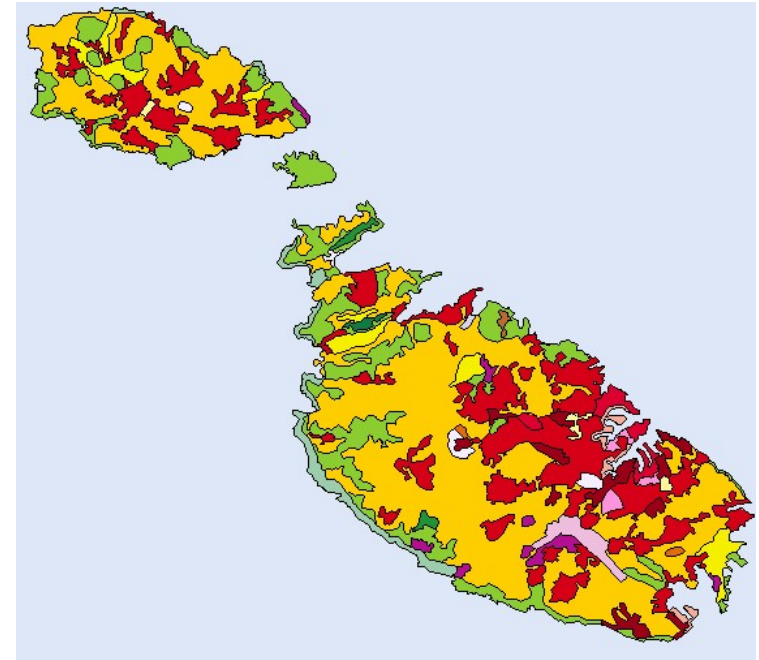
(30-Mar-2009)
[Launch of the Water Framework Directive Public Consultation Campaign](#)

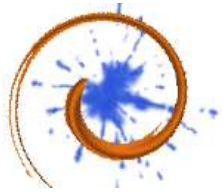
(27-Mar-2009)
[Water Framework Directive Key Stakeholder half-day workshop](#)



Project Benefits

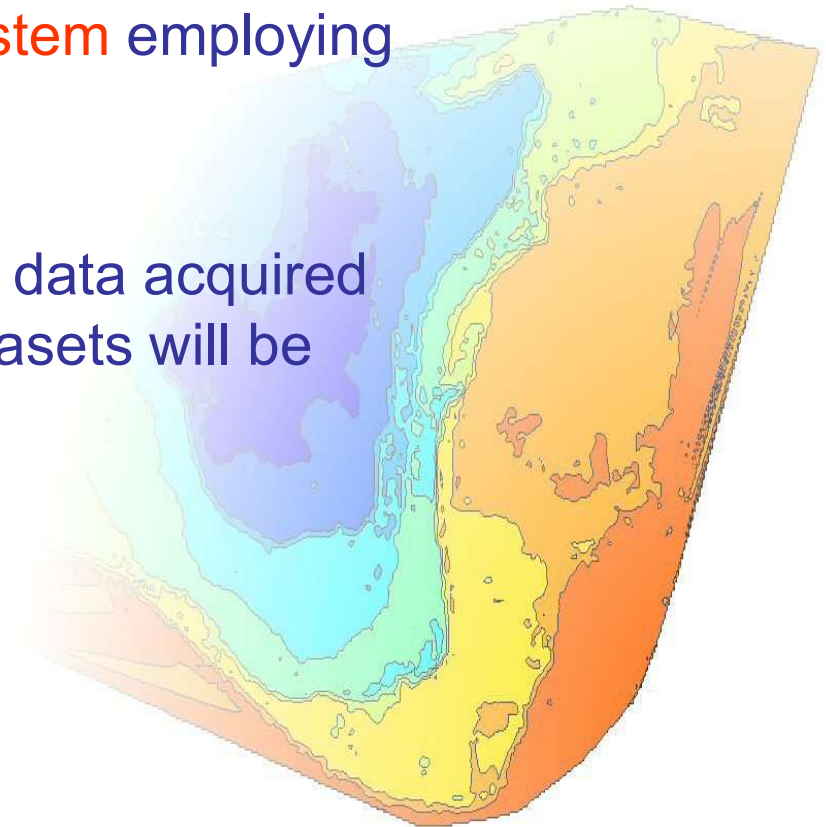
- (1) Partial and full compliance with EU environmental monitoring obligations under around 17 legislative instruments (Directives, Regulations, Decisions)
- (2) Integrated national monitoring programmes
- (3) Improved knowledge for better environmental protection
- (4) Support for environmental policy making
- (5) Cross thematic analysis
e.g. water-chemicals, noise-air-land use
- (6) Forecasting of environmental parameters
e.g. predictive air models
- (7) Statistical backing for experts – normative stats and spatial stats

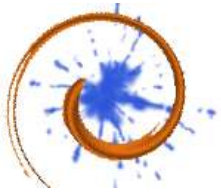




Benefits for the General Public

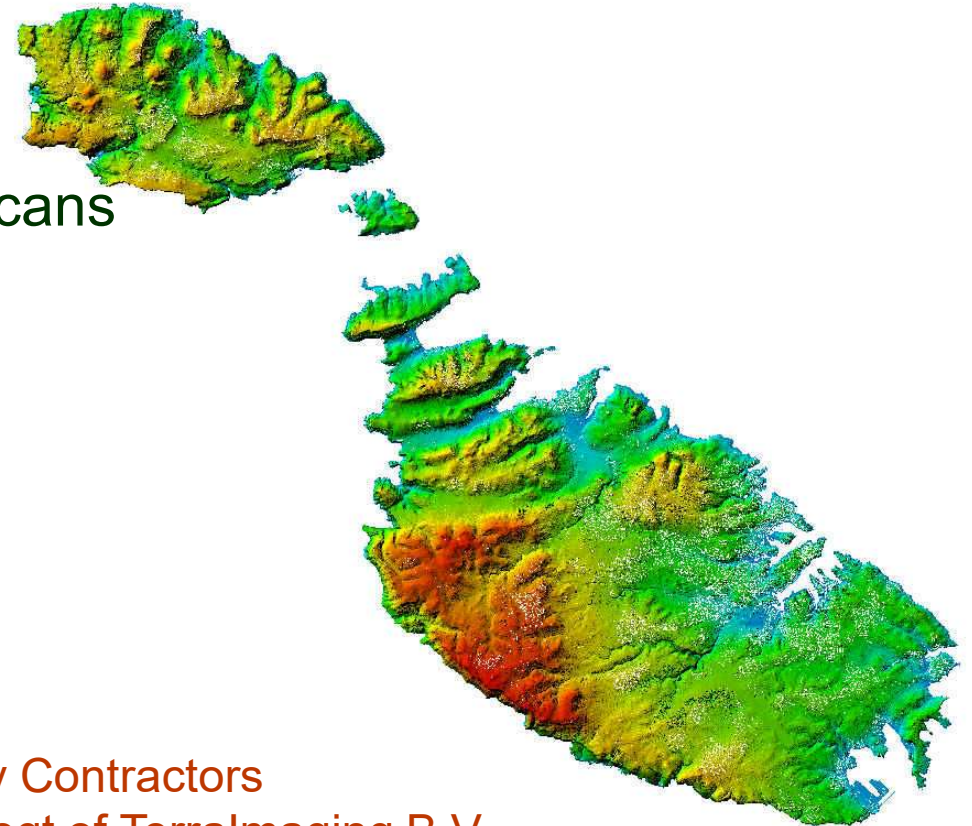
- Increased public awareness on the state of the environment
- **Accessibility** to high quality information through high-end **Shared Environmental Information System** employing state-of-the-art technologies
- **Availability/Usage of environmental** data acquired through project - all environmental datasets will be available for free





3D Data Delivery

- 3D Data delivery
 - Based on Tender 3 Lot 2 delivery
 - Terrestrial LIDAR
 - Bathymetric LIDAR
 - Bathymetric acoustic scans



Based on a presentation delivered to MEPA by Contractors
Dr. Andrea Hoffmann & Jan Willem van der Vegt of Terralmaging B.V.

» Defined Data Specifications

- In the tender documents the following specifications were defined:
- **Specifications of the LiDAR data**
- Point density 1 point/m²
- Post spacing 1m
- Height accuracy 10cm – 15cm
- Imagery resolution 25 cm GSD or higher
- Preferable LiDAR system with multipulse technology

» Data Acquisition

- Data acquisition was performed on Feb 17th
- One session: 5,5 hrs
- Conditions during the flight were very good; clear sky after long period of rain with a few high clouds (above 3800 feet) at the end of the flight.
- Image data was acquired simultaneously with the IGI Digicam



» Data Acquisition

Scanning system IGI Litemapper 6800 (Riegl 680i)

Flying height (average) 3100ft AGL (950m AGL)

Flying speed 115 kts (59.1 m/s)

Strip overlap 40%

Strip distance 675 m

Strip width 1100 m

Scan angle scanner (half) 30 degrees (60 degrees FOV)

Scanner pulse rate 200 kHz

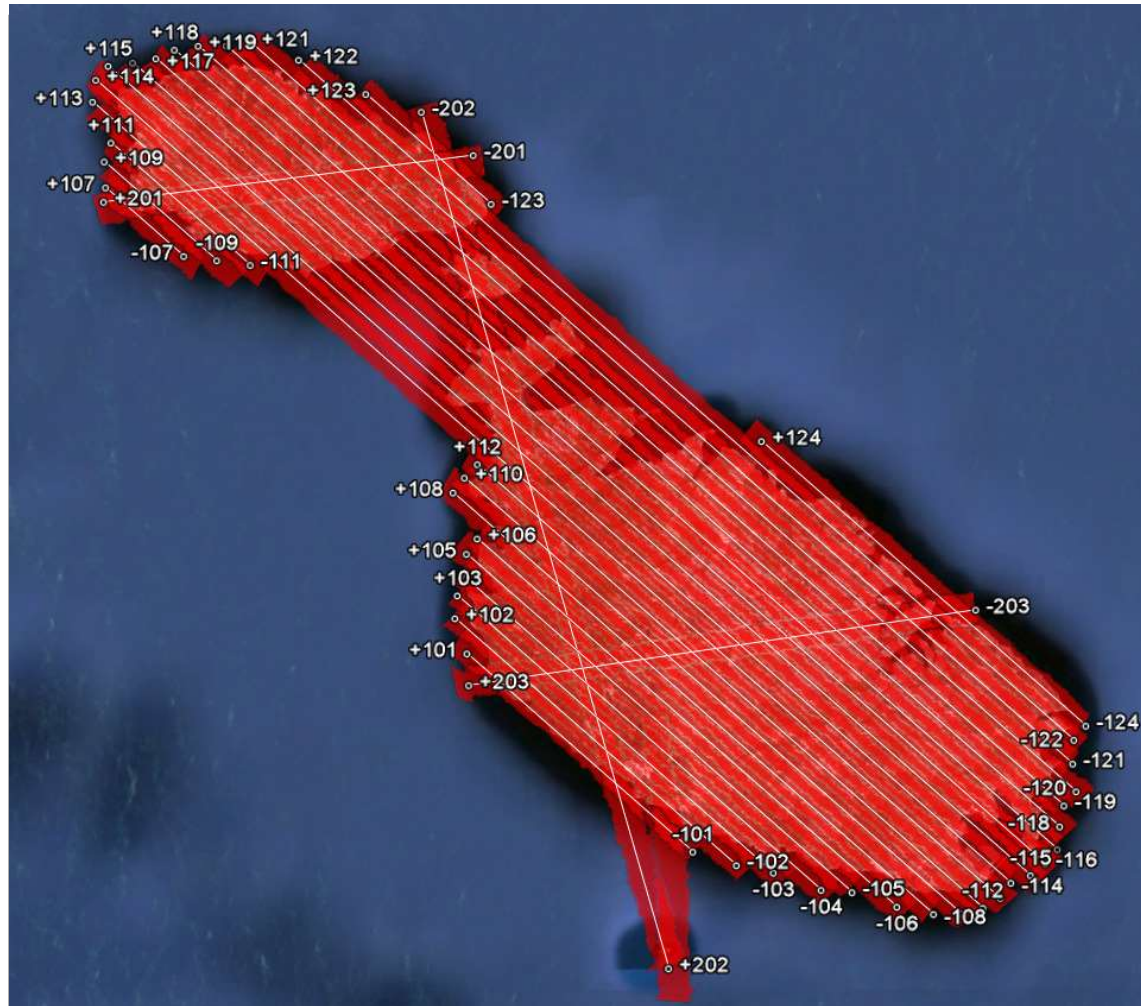
Point density 2 points/m²

Multipulse technology yes (4 pulses or more)

Image resolution < 25 cm

Base distance images 355 m

» Data Acquisition: Flight Lines



» Height Accuracy of the Data

Relative height accuracy

- The relative height accuracy of the strips is analysed by computing height difference grids between overlapping strips. This resulted in 98 overlap differences,
- **Statistics [m]**
- Max 0.048
- Minimum -0.045
- Average -0.002
- Standard deviation 0.018



» Height Accuracy of the Data

- **Absolute height accuracy of the Lidar data**
- is determined using height reference areas.
- “hard” flat surfaces (e.g. parking areas),
- raster of points that are measured terrestrially using GPS.
- Size: 10m x 10m, point spacing 1 x1m (= 100 points/area)
- In total three reference areas.

- For each reference area the average difference and the standard deviation is computed between the heights of the terrestrial points and the height of the LiDAR data

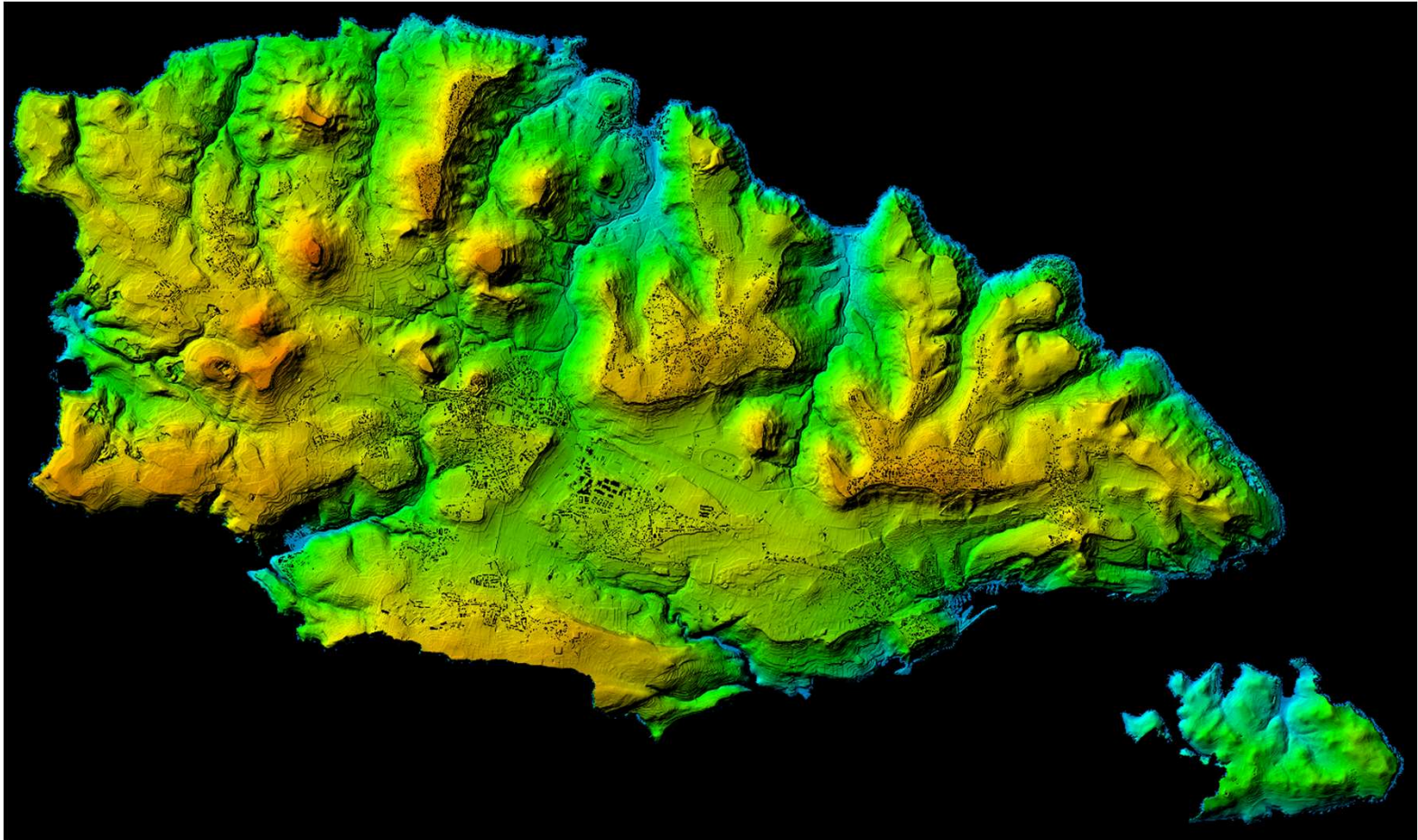
» Height Accuracy of the Data

•	Ref. Area	Location X	Location Y	Average (m)	St dev (m)	Nr points
•	01	456648	3971317	0.01	0.02	119
•	02	429389	3987625	0.00	0.01	121
•	03	444199	3968611	-0.01	0.01	125

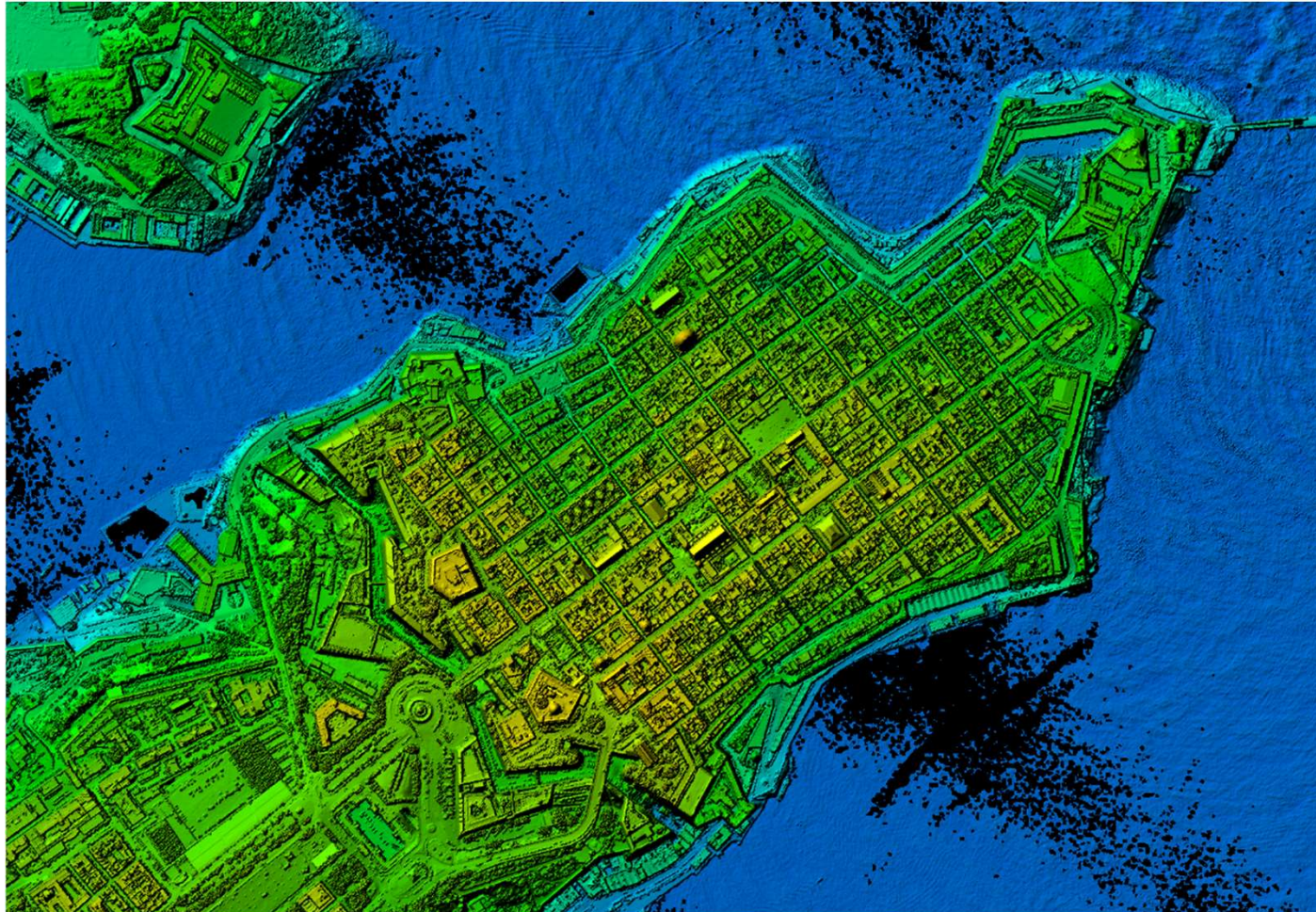
Differences between LiDAR data and reference areas



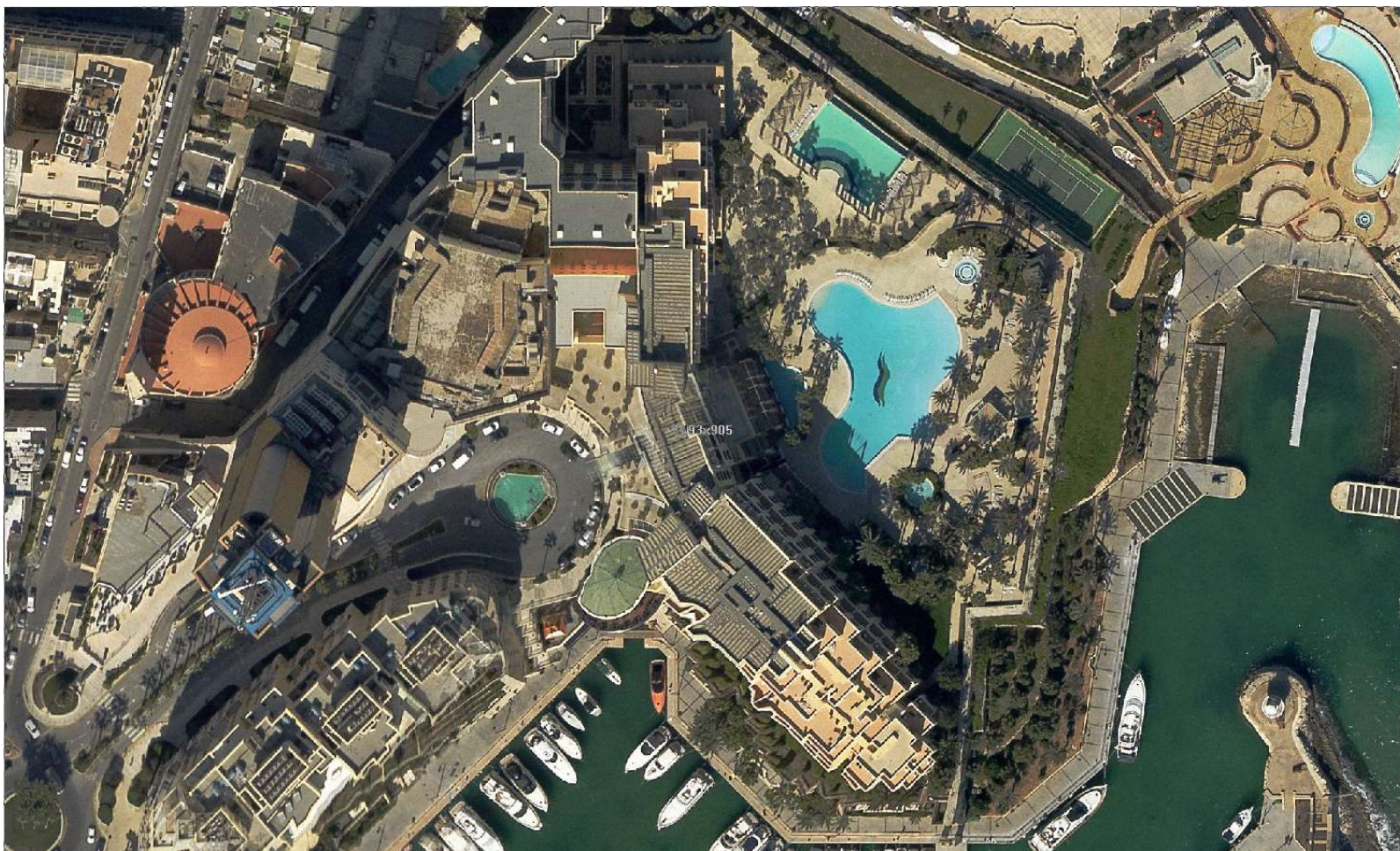
» Gozo



» Colourcoded Lidar Data Vailletta



» Image Data Acquisition



» Image Data Acquisition



» Image Data Acquisition



Image data has been acquired with a resolution of 16 cm

» Data Acquisition Parameters Camera

Camera IGI DigiCam

Sensor size 50 Megapixel

Pixel size 6,0 μ m

Image size 8176 x 6132 pixels

Maximum frame rate 1,6 sec

Focal length 35 mm

Analog to digital conversion 16 Bit

Average altitude above ground level 950 m

Pixel ground space distance 16 cm

Exposure time 6,3 s

Swad along track 1000 m

Swad across track 1330 m

Overlap along track 60%

Overlap across track 50%

Number of photos 2028

» Quality Images

Relative accuracy $dy = \pm 7\text{cm}$; $dx = \pm 8\text{cm}$;
Absolute accuracy $dy = \pm 11\text{cm}$; $dx = \pm 11\text{cm}$;

» What is on the Disc - Products

- Projection: UTM zone 33
- Datum: ED50
- Ellipsoid: Hayford International 1924
- Height system: Orthometric heights
- The products have been delivered in tiles of 1000 x 1000 m with the following naming convention:
- XXX_YYYY.*
- where XXX is the lower left X-coordinate in km and YYYY is the lower left Y-coordinate in km of the tile.

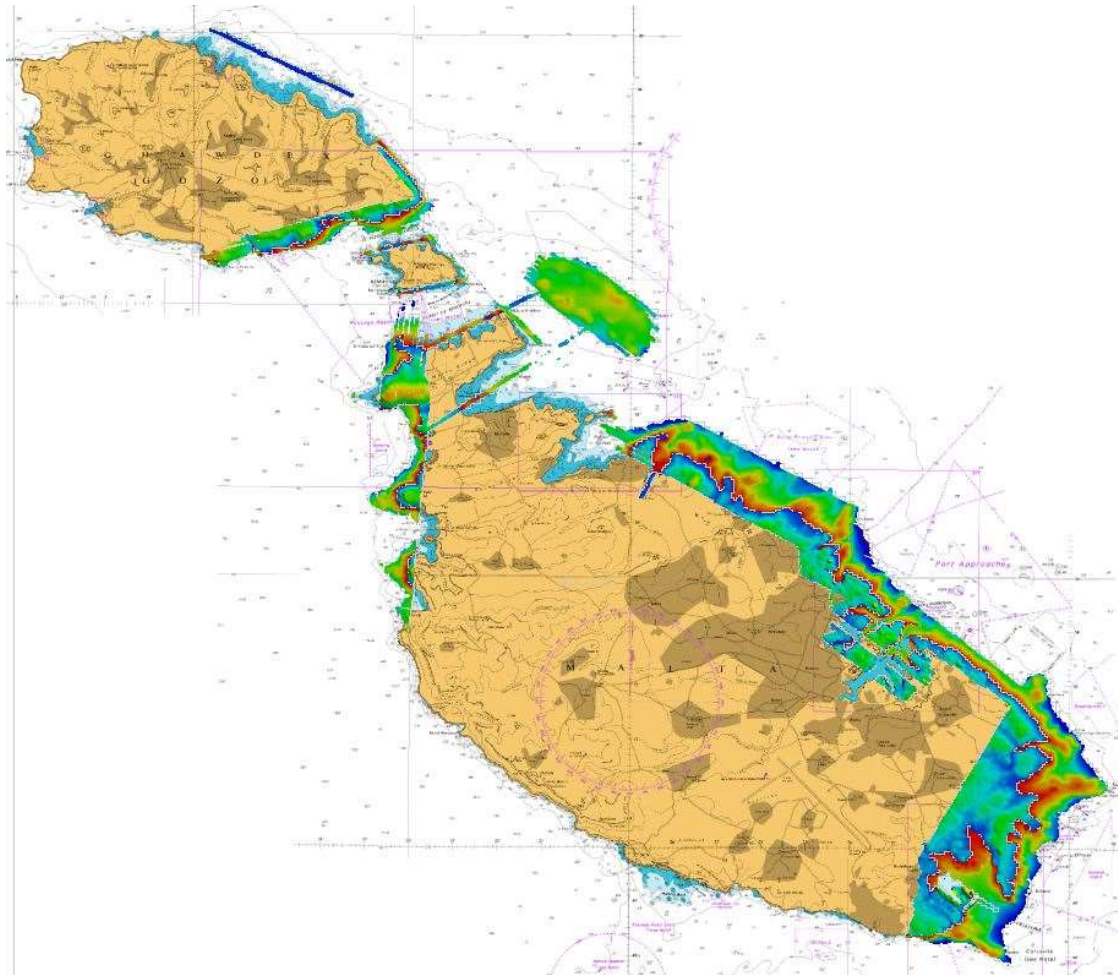
» What is on the Disc - Products

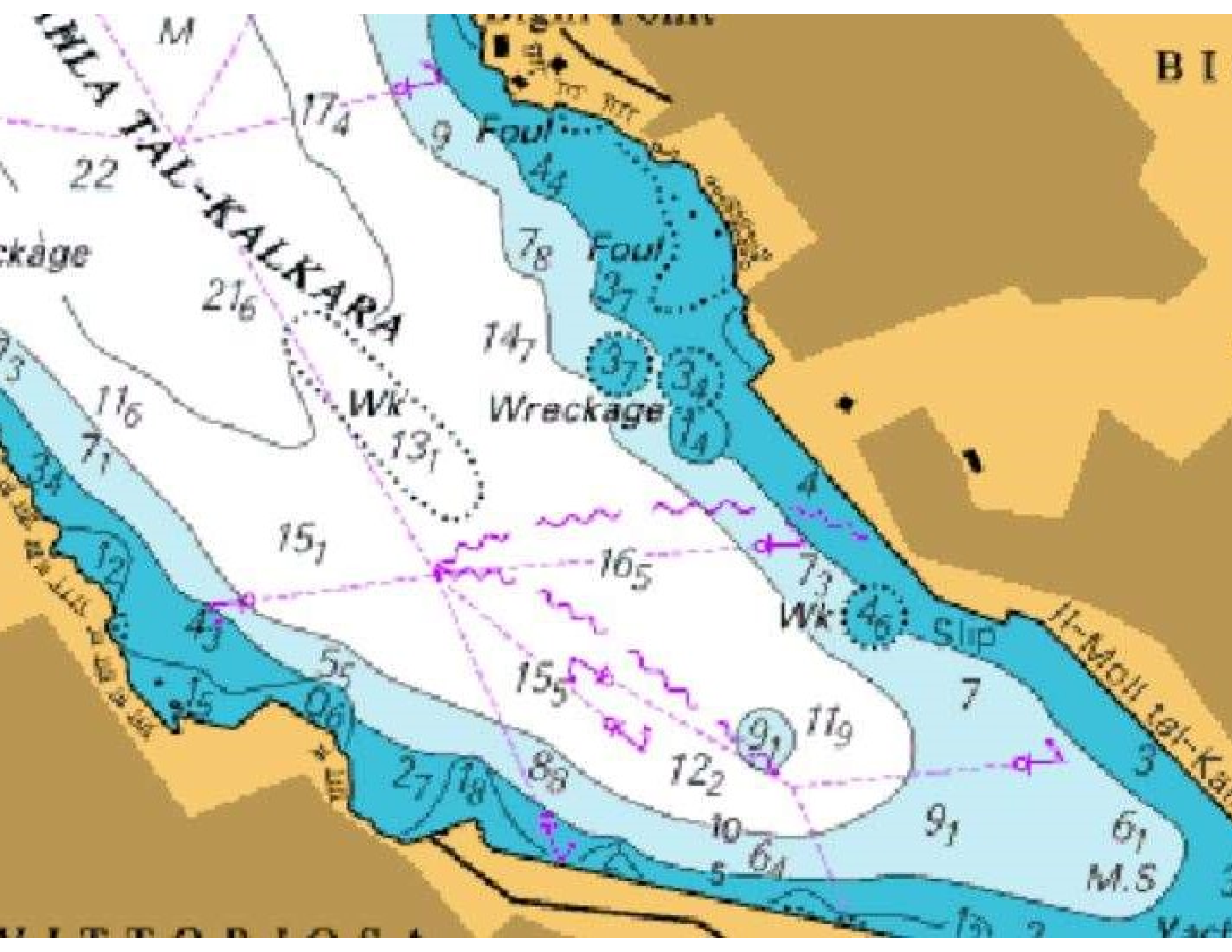
- **DTM and DEM**
- The Lidar data has been classified into ground and non-ground. This is done in three steps:
- 1. The LiDAR data is classified to ground, non-ground and outliers using an automated classification algorithm;
- 2. Removal of points on water areas that are classified as ground in the first step;
- 3. 100% manual check of gross errors in the ground classification.
- The DTM is derived from the points classified as ground, for the DEM all points except outliers are used
- The format of the DTM and DEM is ArcInfo Ascii grid (*.asc) with a sampling of 1 m.

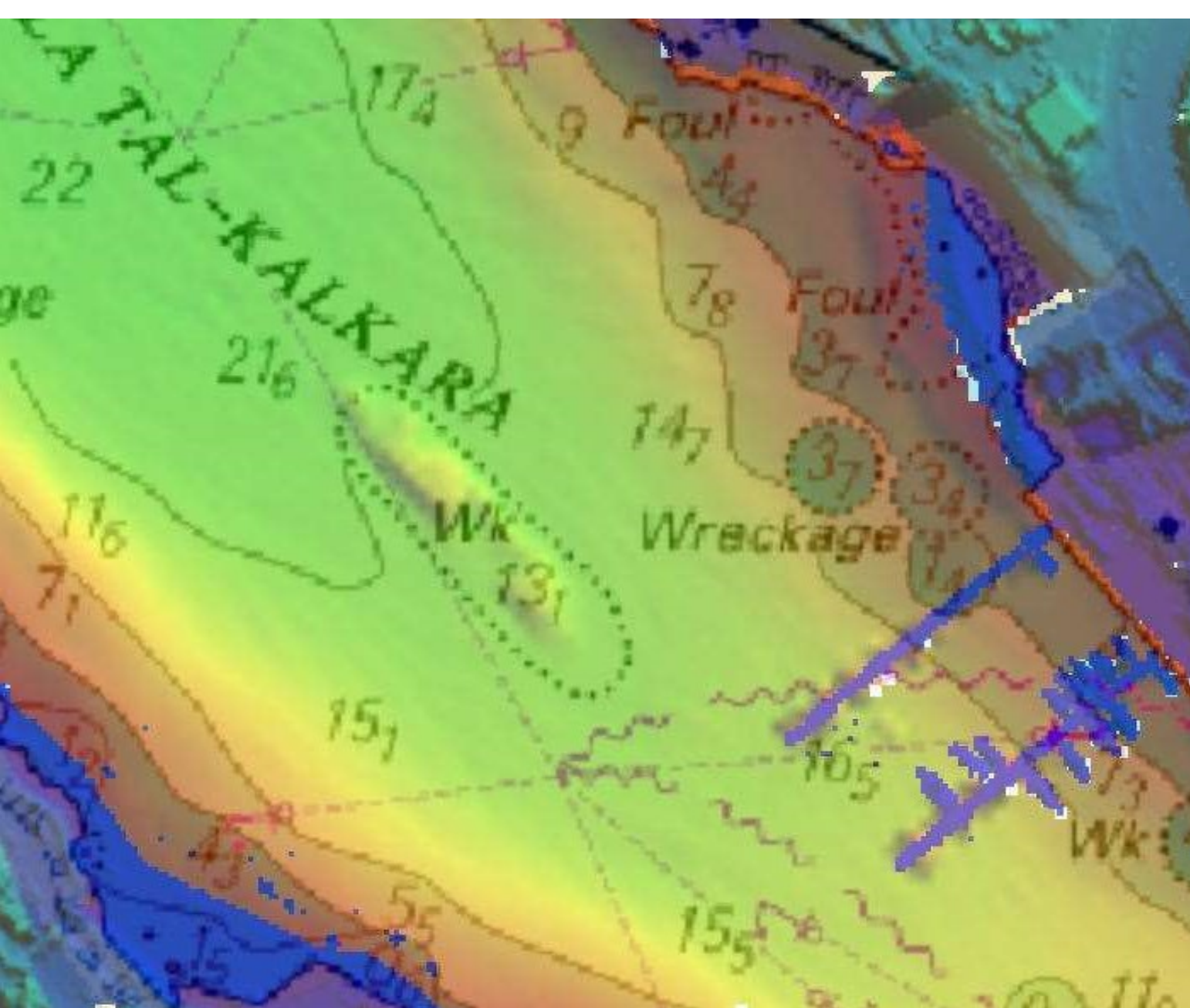
» Status Vessel operation

- Data acquisition started April 9th
- 40 % of the area will be finalised end of may
- issues with unstable weather, turbidity, high waves, wind (like yesterday)
- Data acquisition will be finalised within the next 2 months
- Samples are taken where the ground changes

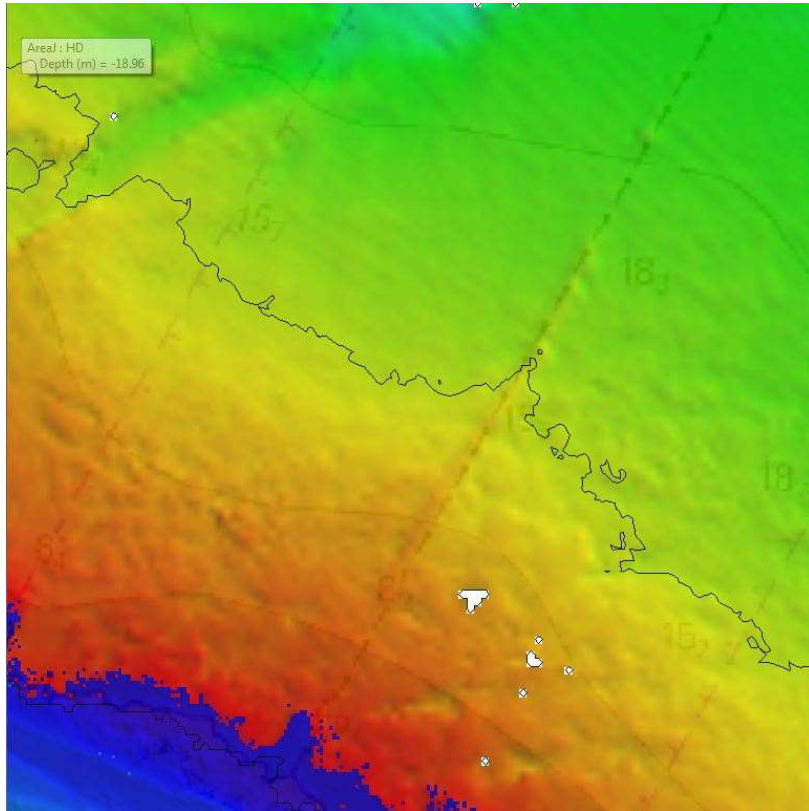
» Status Bathymetric Lidar



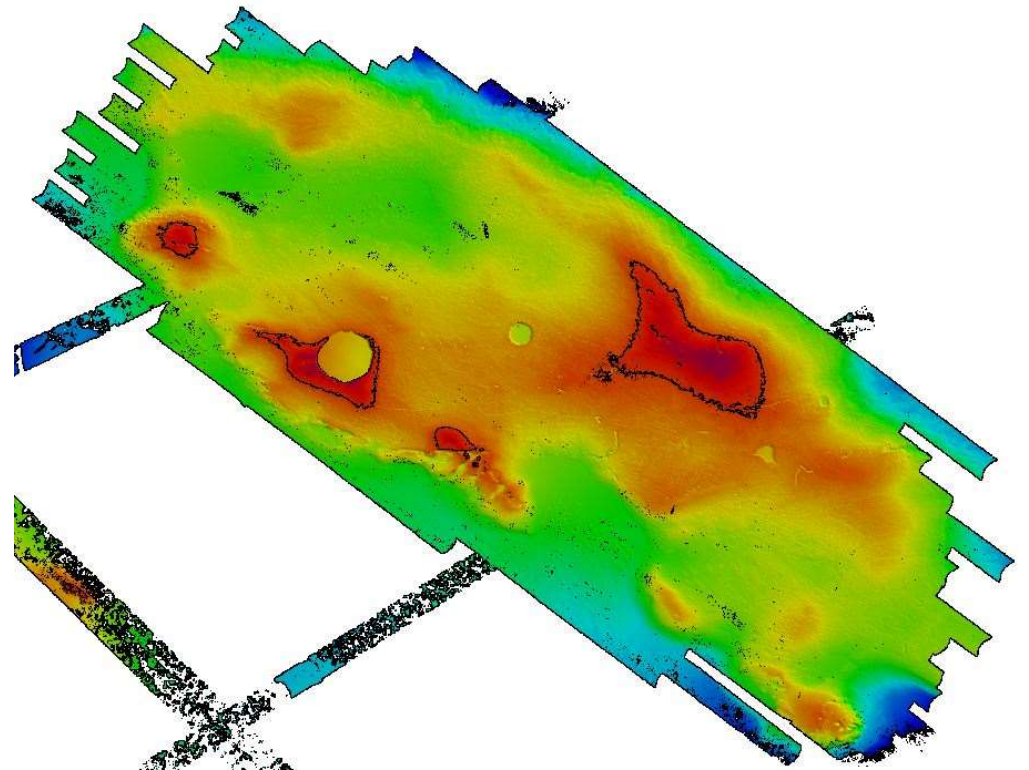




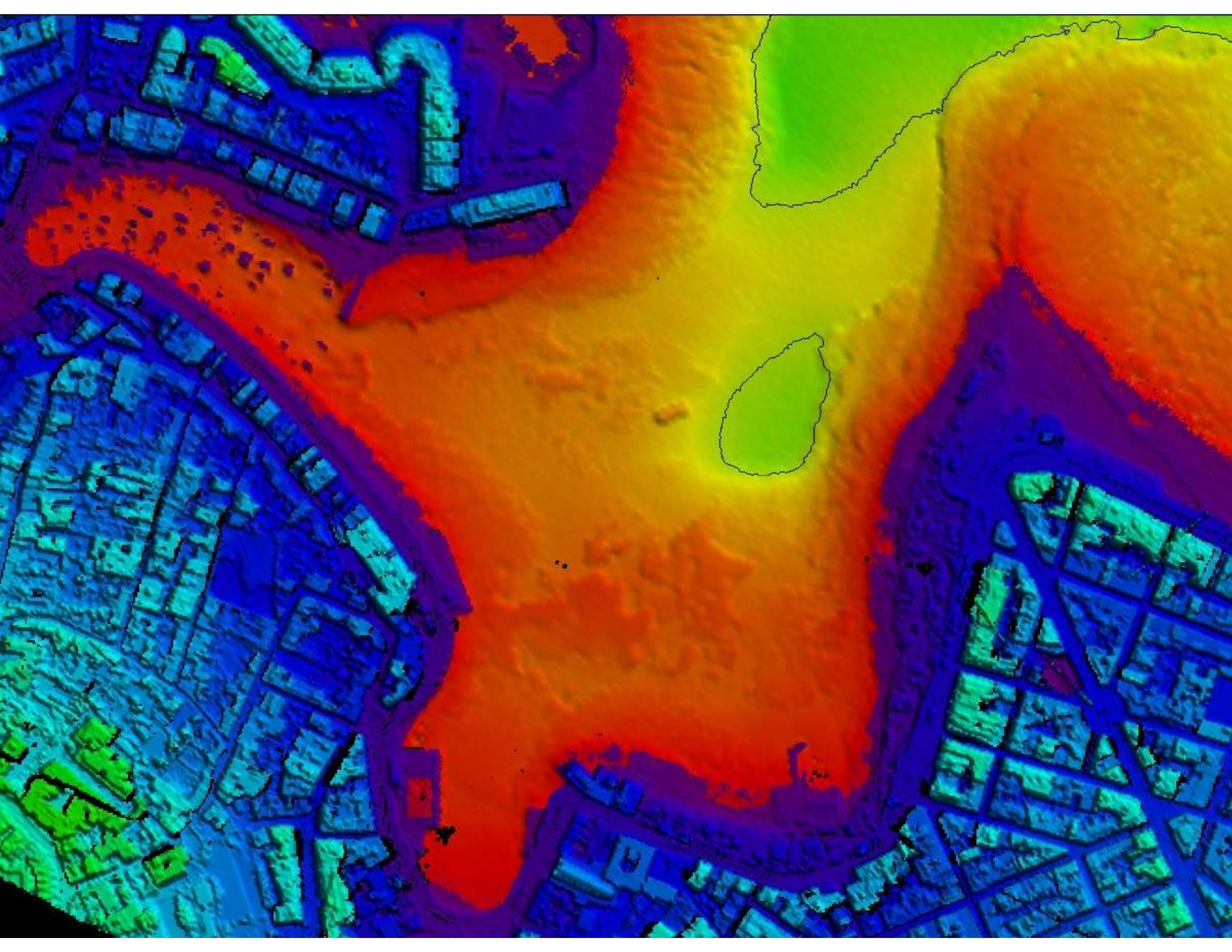
» Samples Bathymetry Lidar

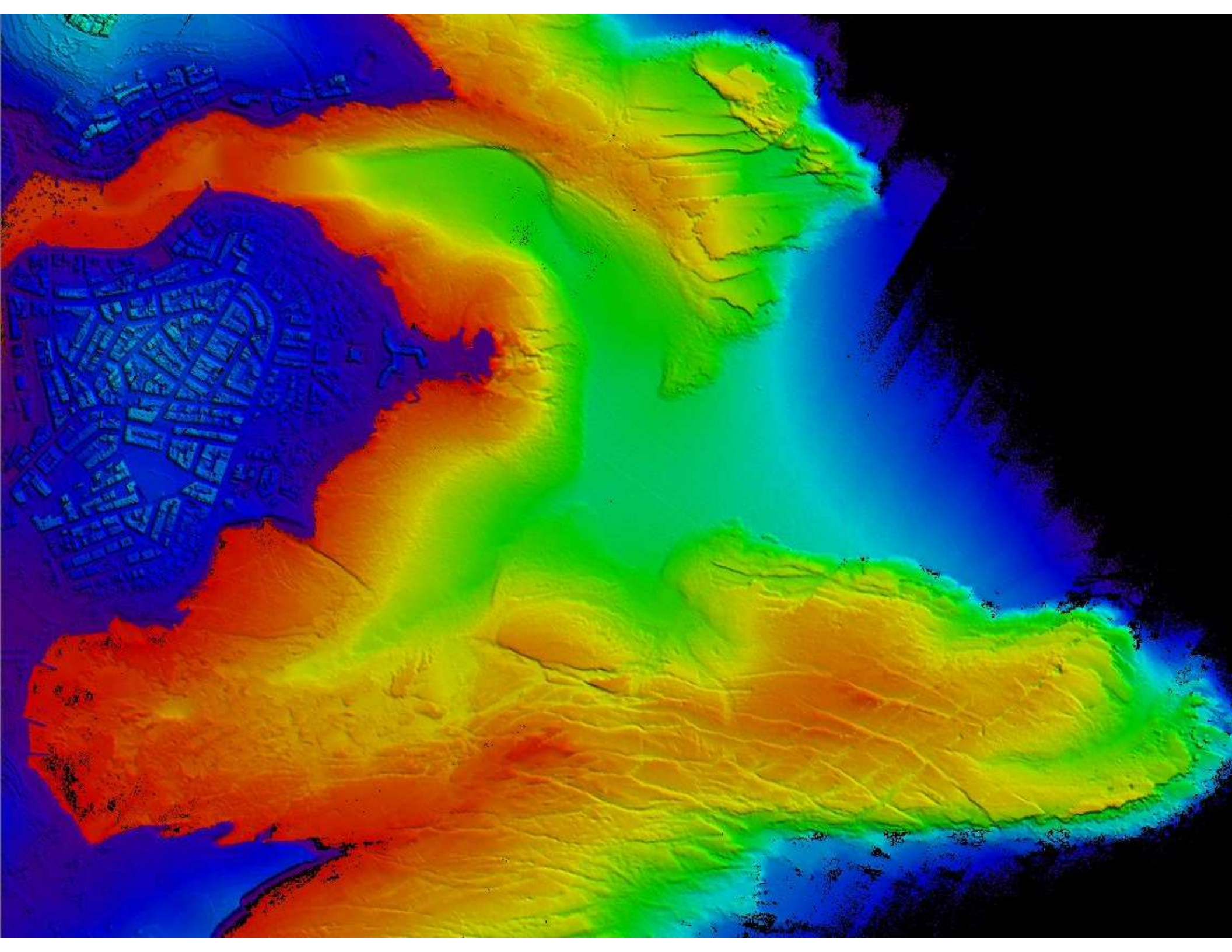


Pipeline



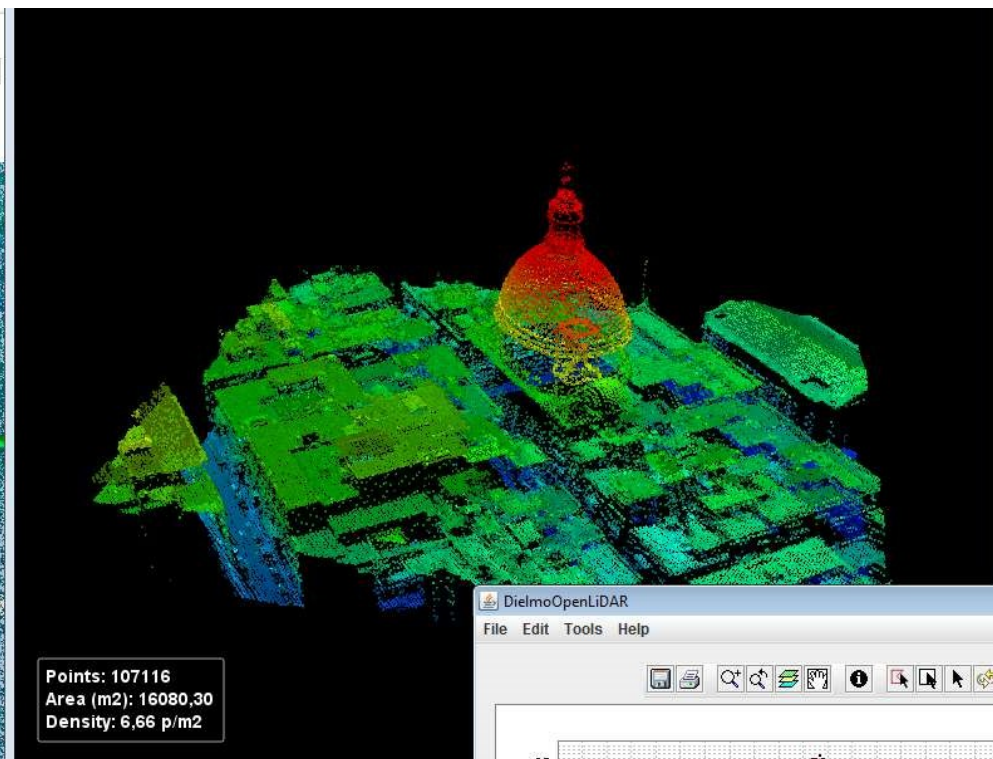
Sikka il Bajda



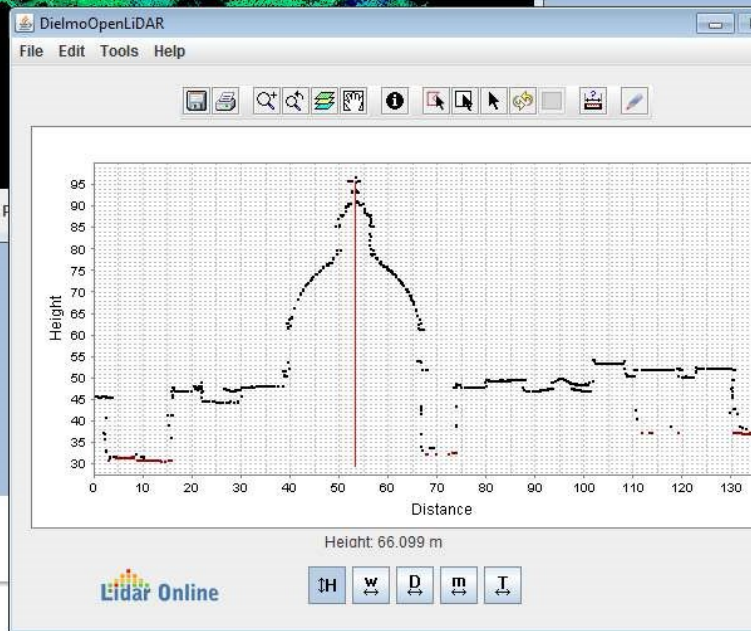


Overlay: MALTA by height and intensity (%) 100
Units: Meters 3D
Width: 1

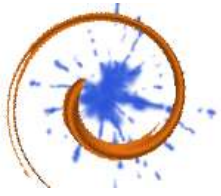
P2 Height 1.1
Get height: From max point ?



Coloring mode: Height and Intensity



ES [System tray icons]



Thank You



**ERDF 156:
Developing National Environmental Monitoring Infrastructure and
Capacity
3D Data Deliveries**

ERDF Seminar, MEPA, 15 January 2013

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