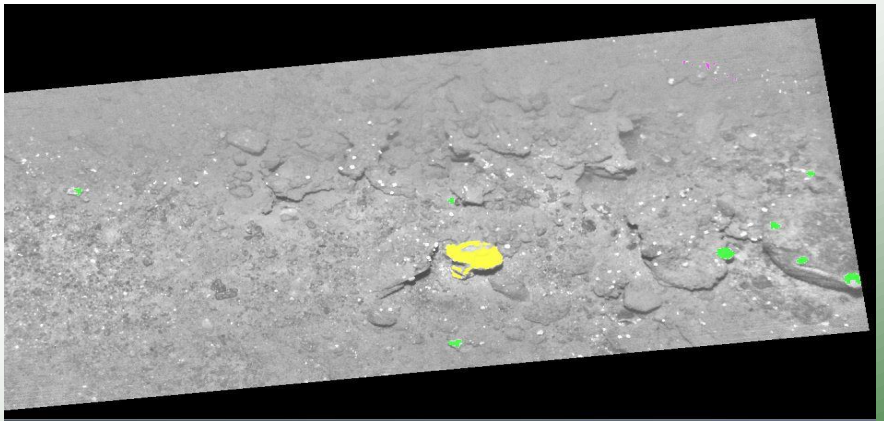
Seabed mapping project for Lundin Norway AS

Lundin Norway

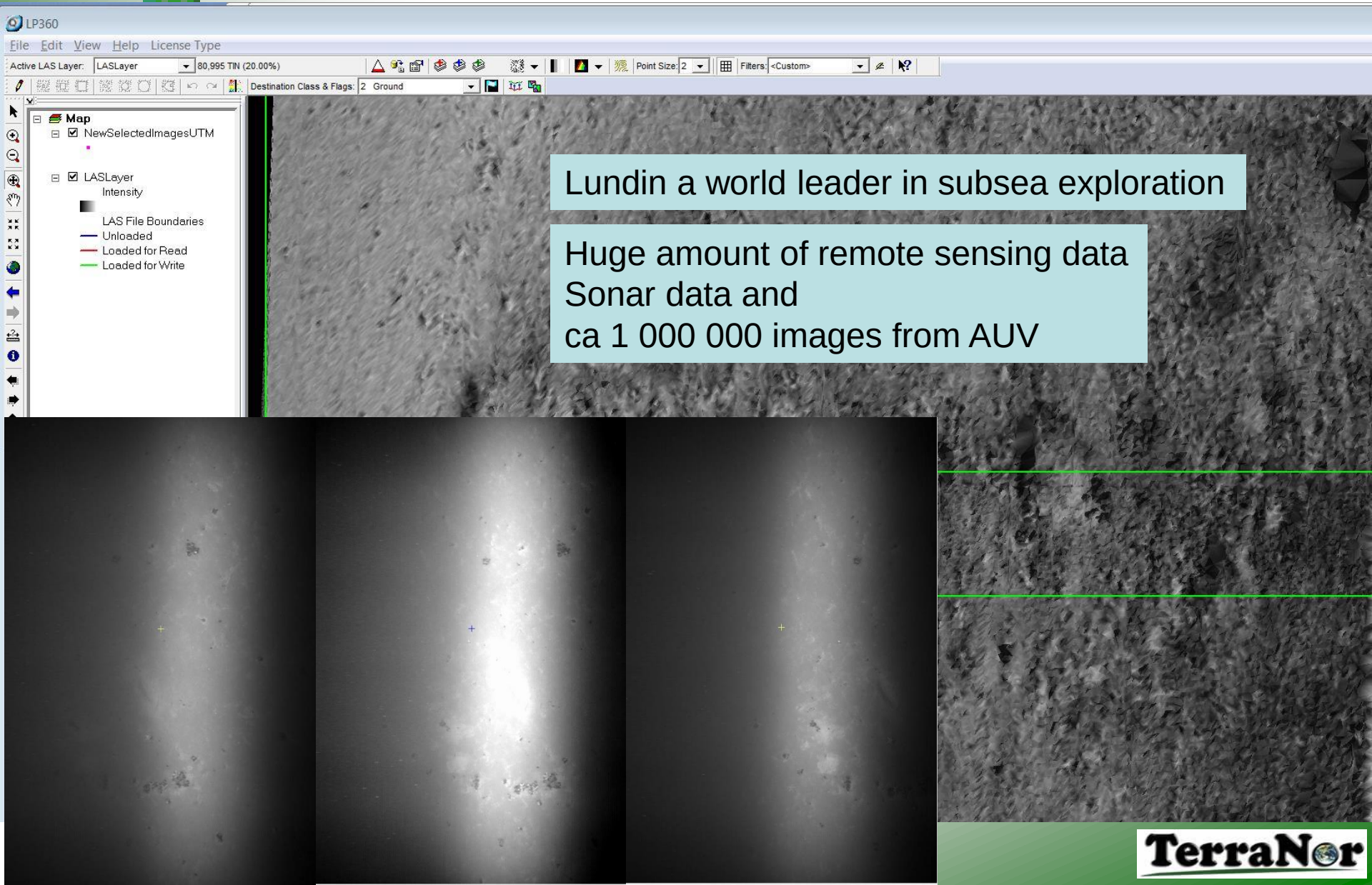
“Lundin sees the information that is gained through the extensive seabed mapping as relevant to the whole E&P value chain.

It provides us with detailed information about local and regional variations in the seabed environment, natural leakage of hydrocarbons from seabed, potential geohazards, and suitability of sea bottom for future seabed installations.”



TerraNor

Seabed mapping project for Lundin Norway AS



Lundin a world leader in subsea exploration

Huge amount of remote sensing data
Sonar data and
ca 1 000 000 images from AUV

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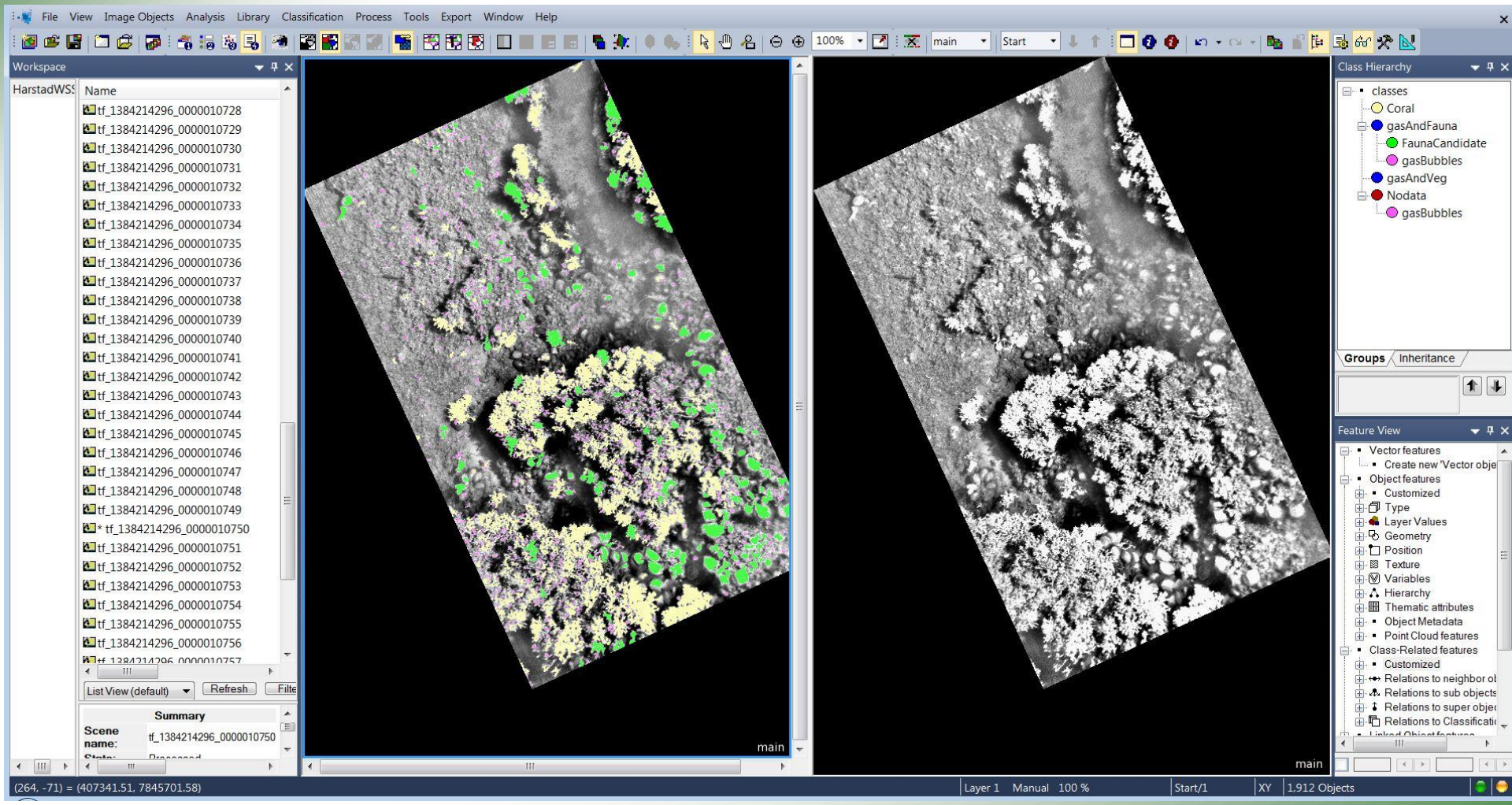
Environmental analysis of images from the seabed



What species will be affected by operational activities

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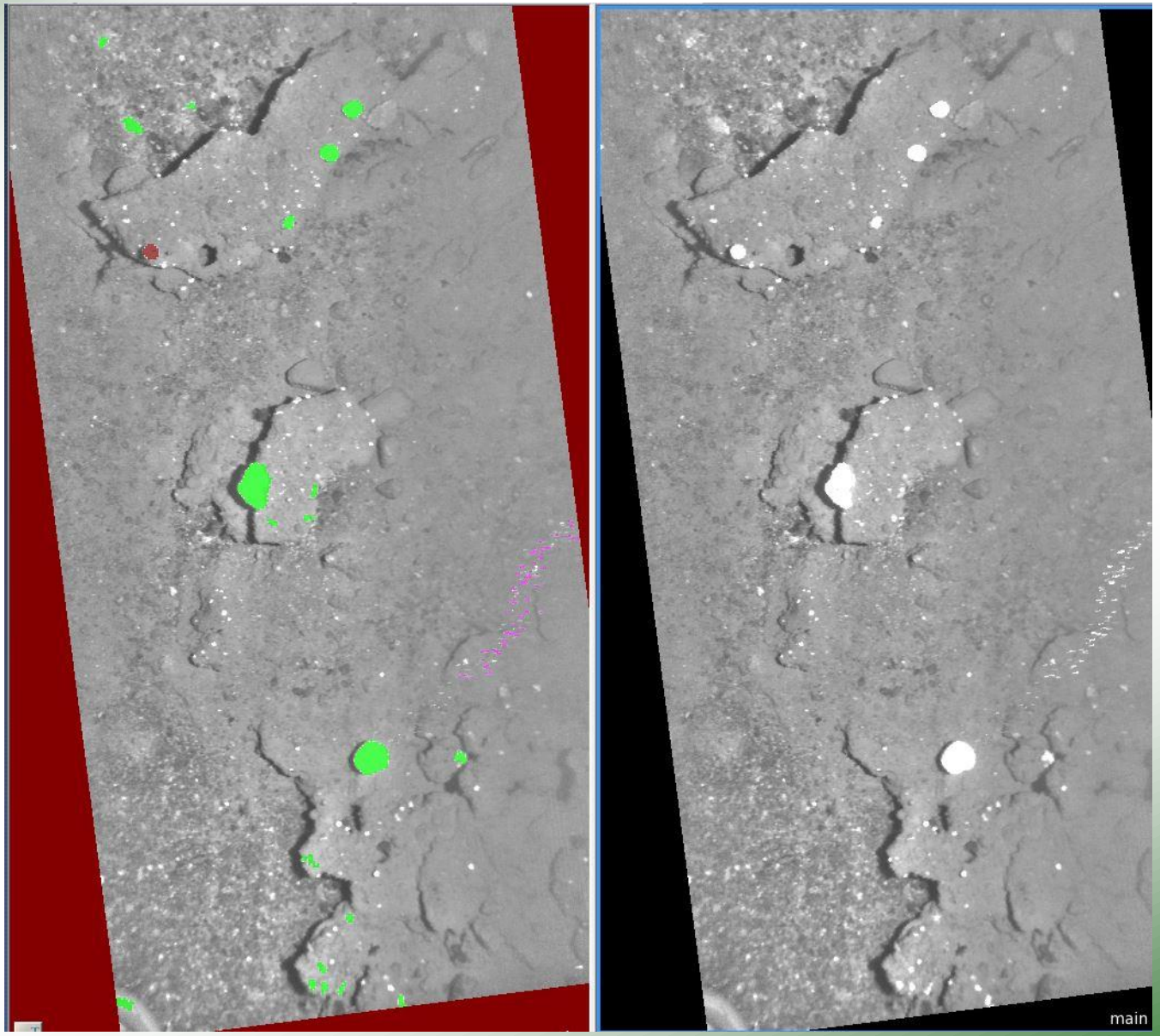
Hydrocarbones and fauna



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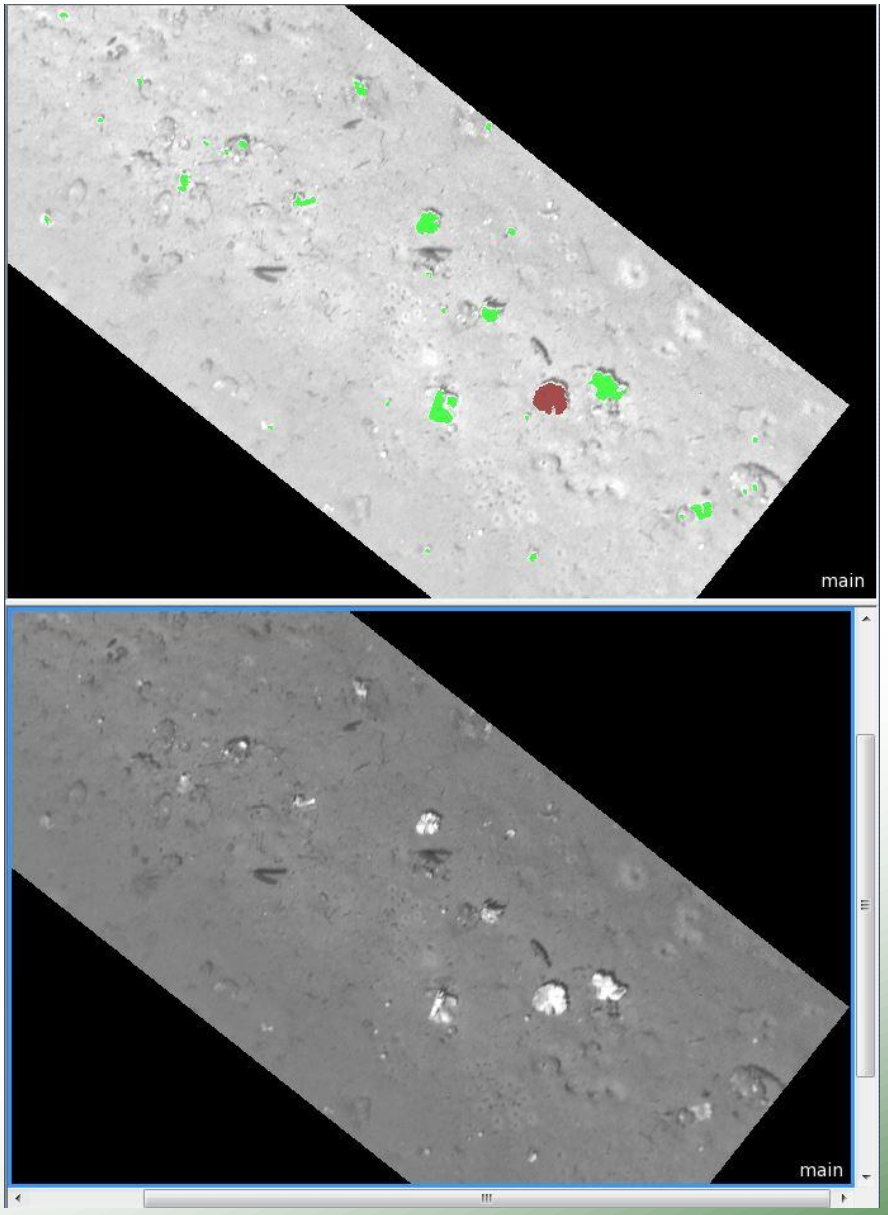
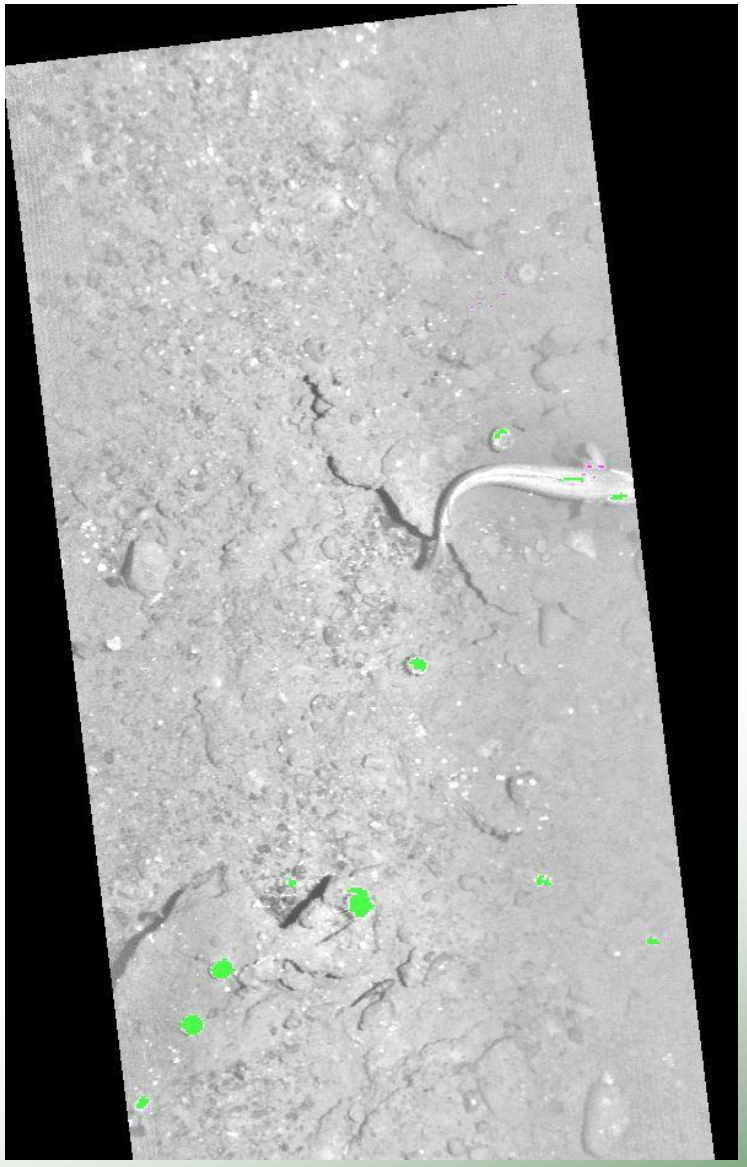
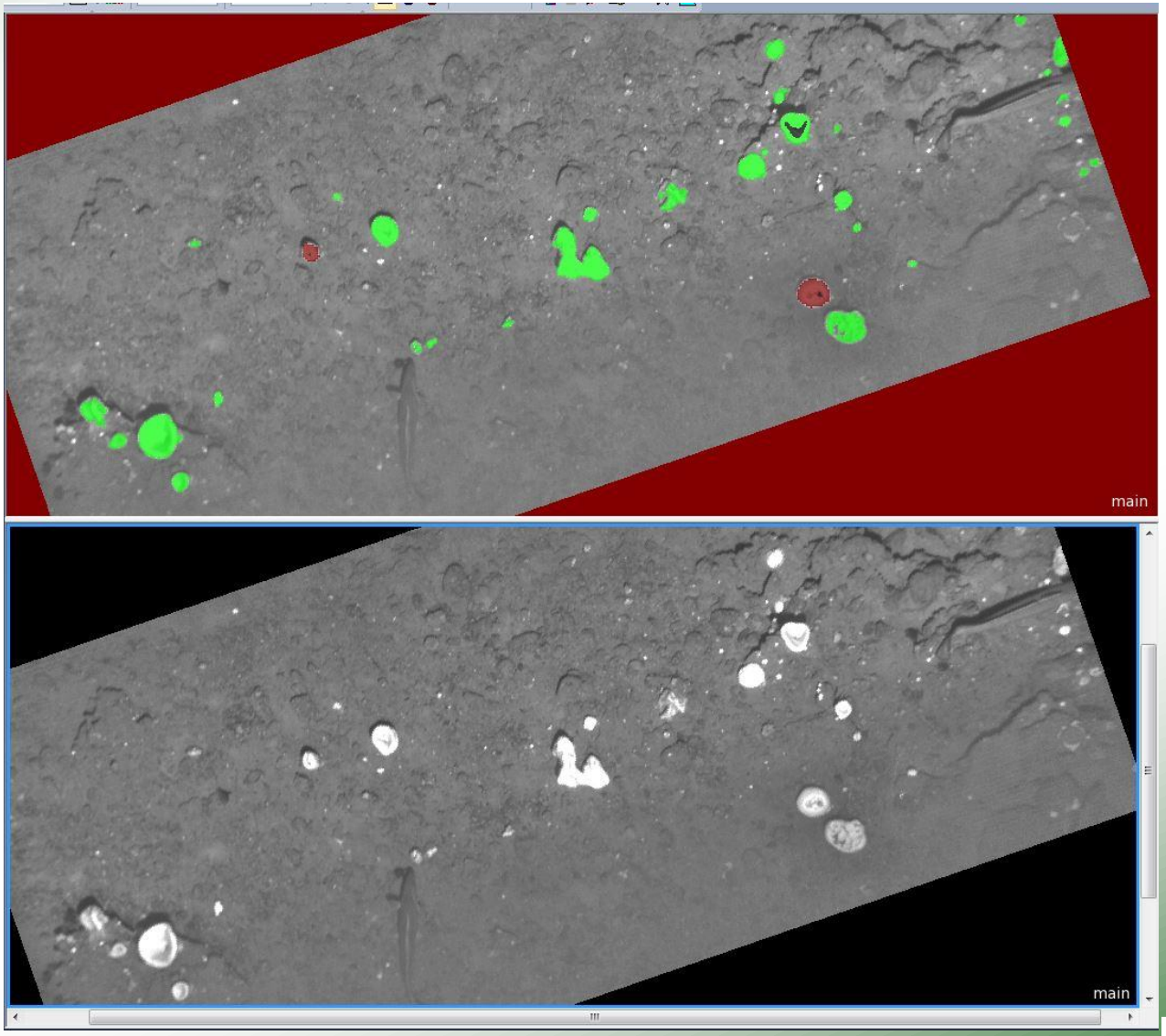
Anemones



Crust and gas



Sponges - Geodia



Coral and mussles

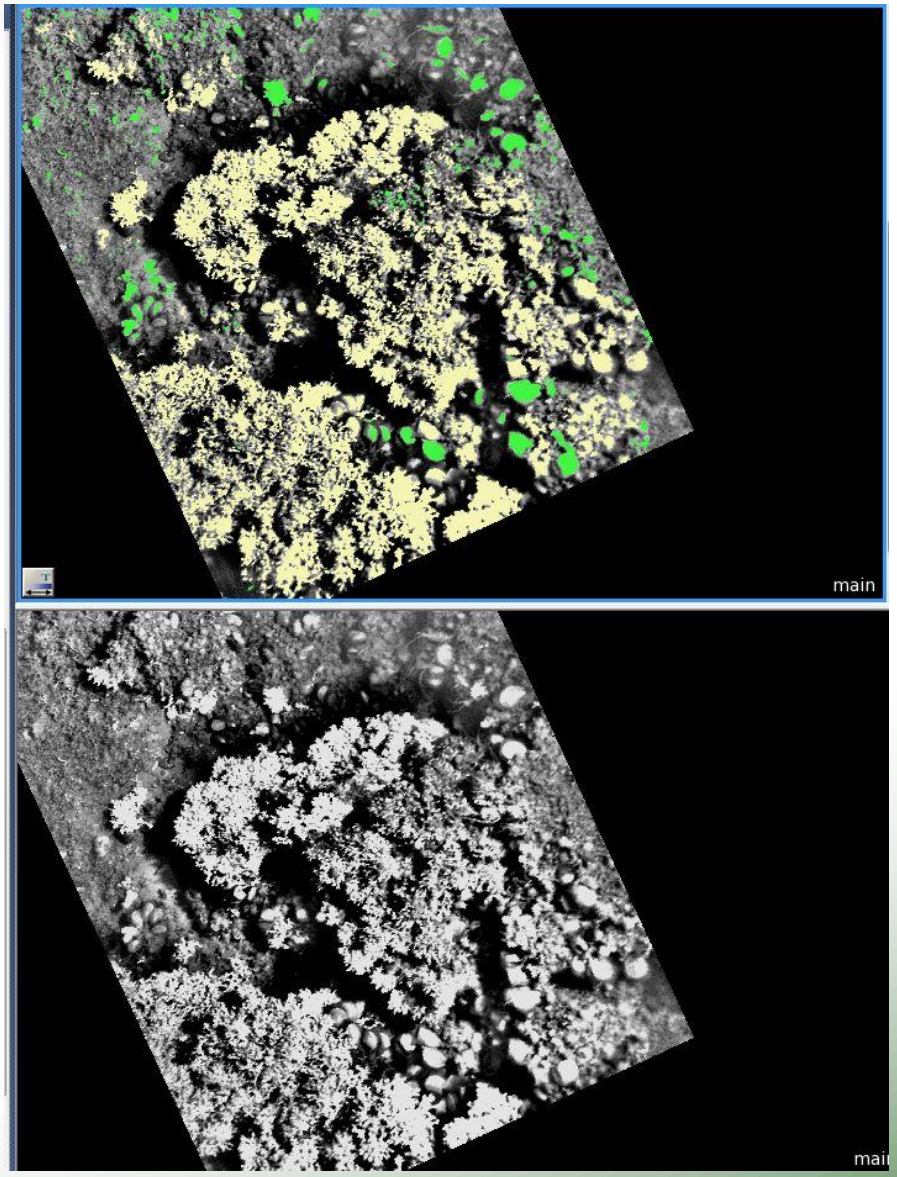
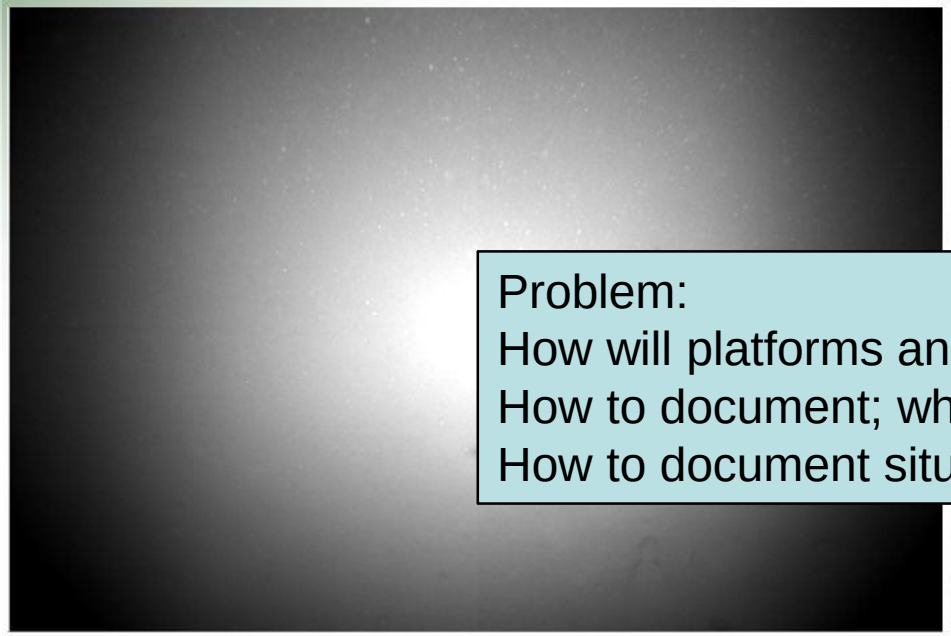
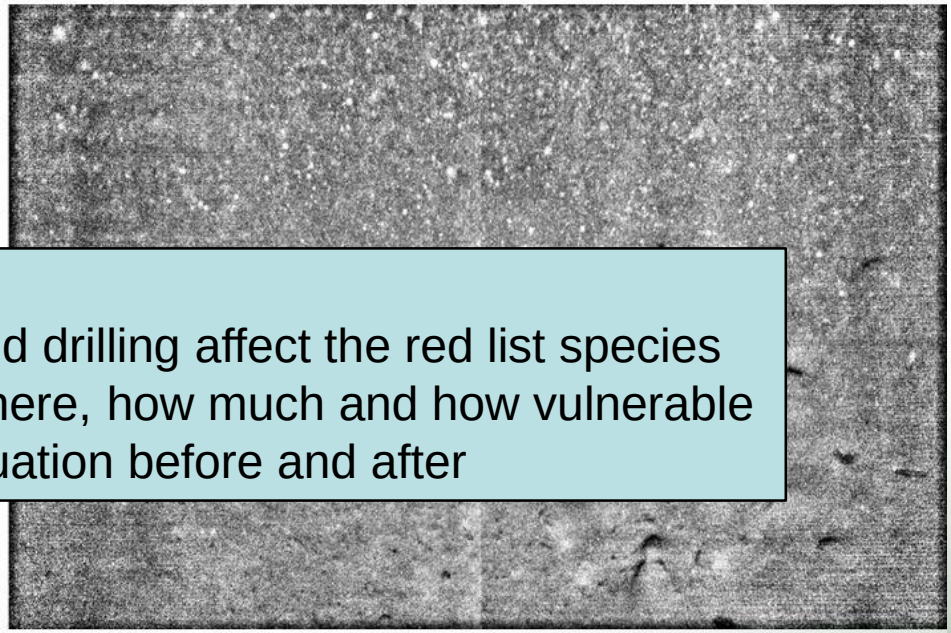


Image Light Compensation is important





Problem:
How will platforms and drilling affect the red list species
How to document; where, how much and how vulnerable
How to document situation before and after

120, 16 bit

120, 16 bit enhanced

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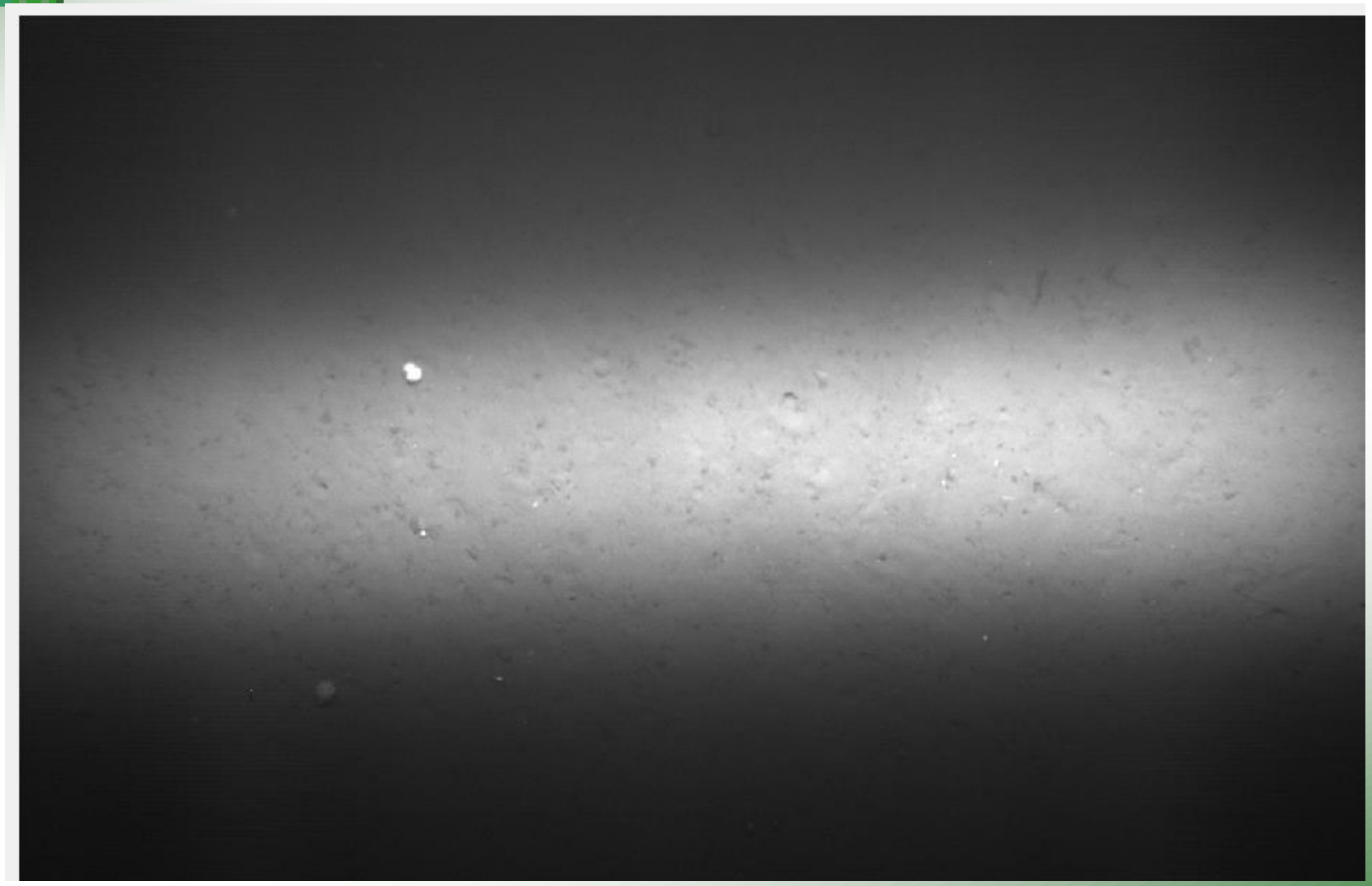
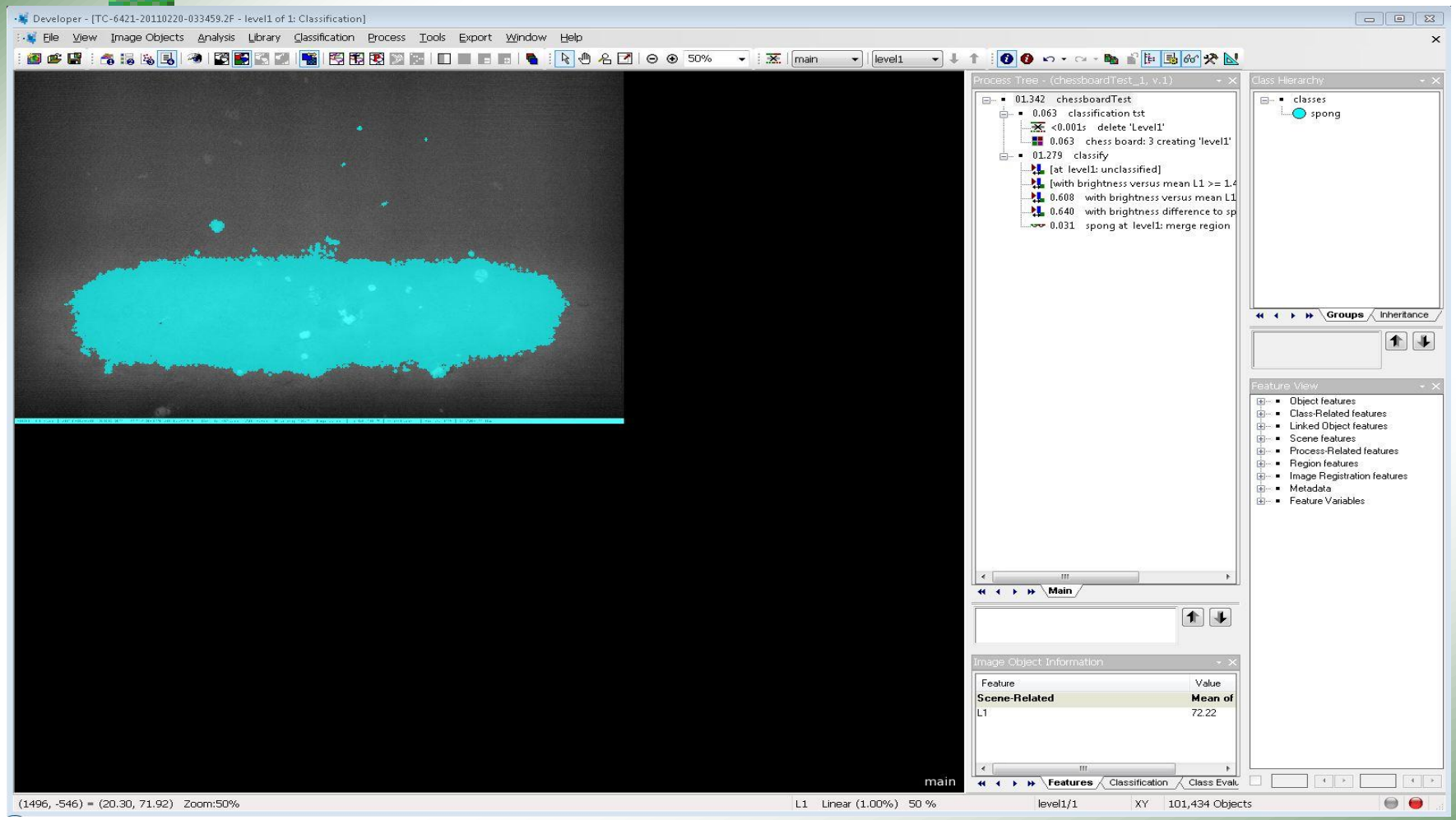
Artificial light a challenge



The light is strong in the centre
Less light to the sides

Automatic machine classification impossible



Objects to be classified will be different in the centre than to the sides. In this example the image became one light object …not very useful

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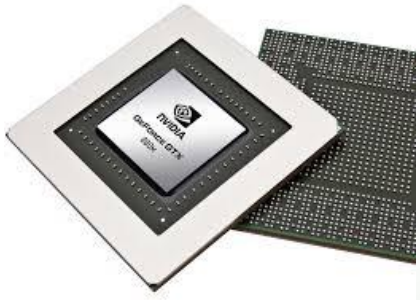
How we solved the problem

- No standard software in the market could handle the images
- TerraNor developed Image Light Compensation ILC software
- Solution: TerraNor ILC
  - **GPU** processing with **CUDA/OpenCL**
  - Automatic batch processing
  - High speed for 1 000 000 images
    - Compensation, orthorectification and new image format included



- Software process:
  - Different light conditions and distance to seabed
  - Perfect result without user interaction (no time for that)
  - Automatic orthorectification based on DEM or Distance to seabed
  - Standard image format out for use in other software (PCI, eCognition, ESRI)
  - eCognition Developer used to classify objects

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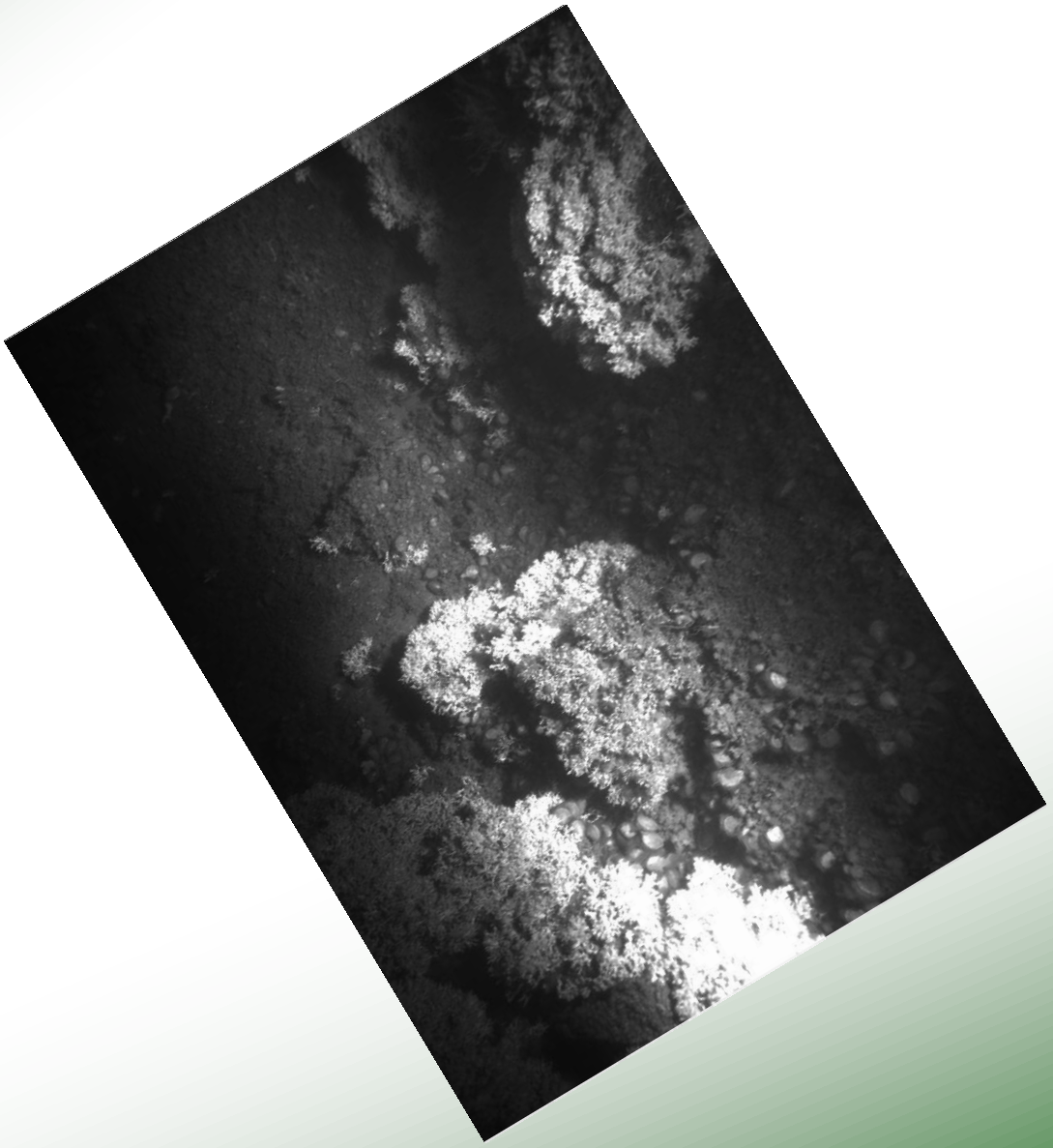
Original image coral



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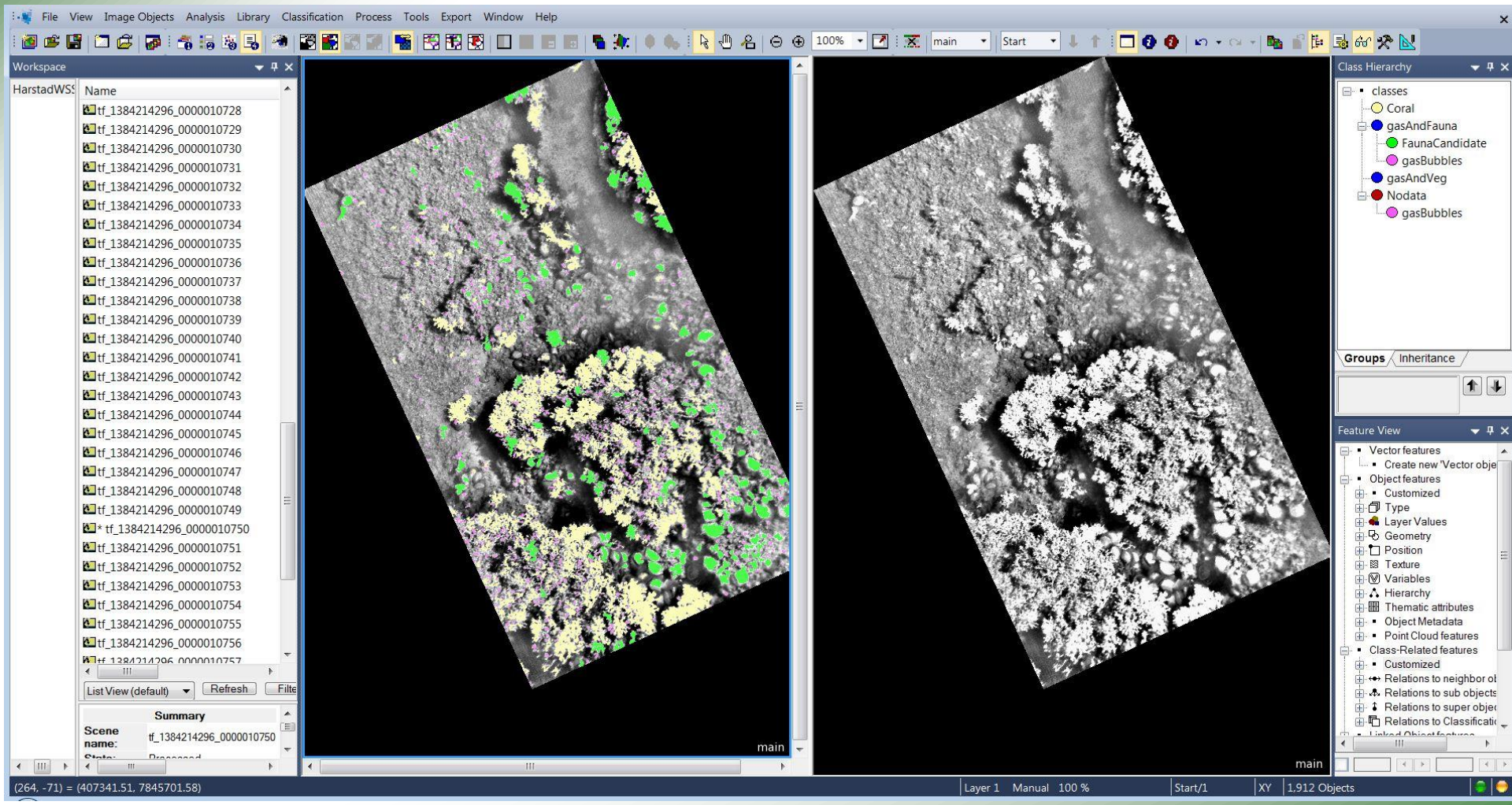
Compensated and classified image



eCognition developer workspace

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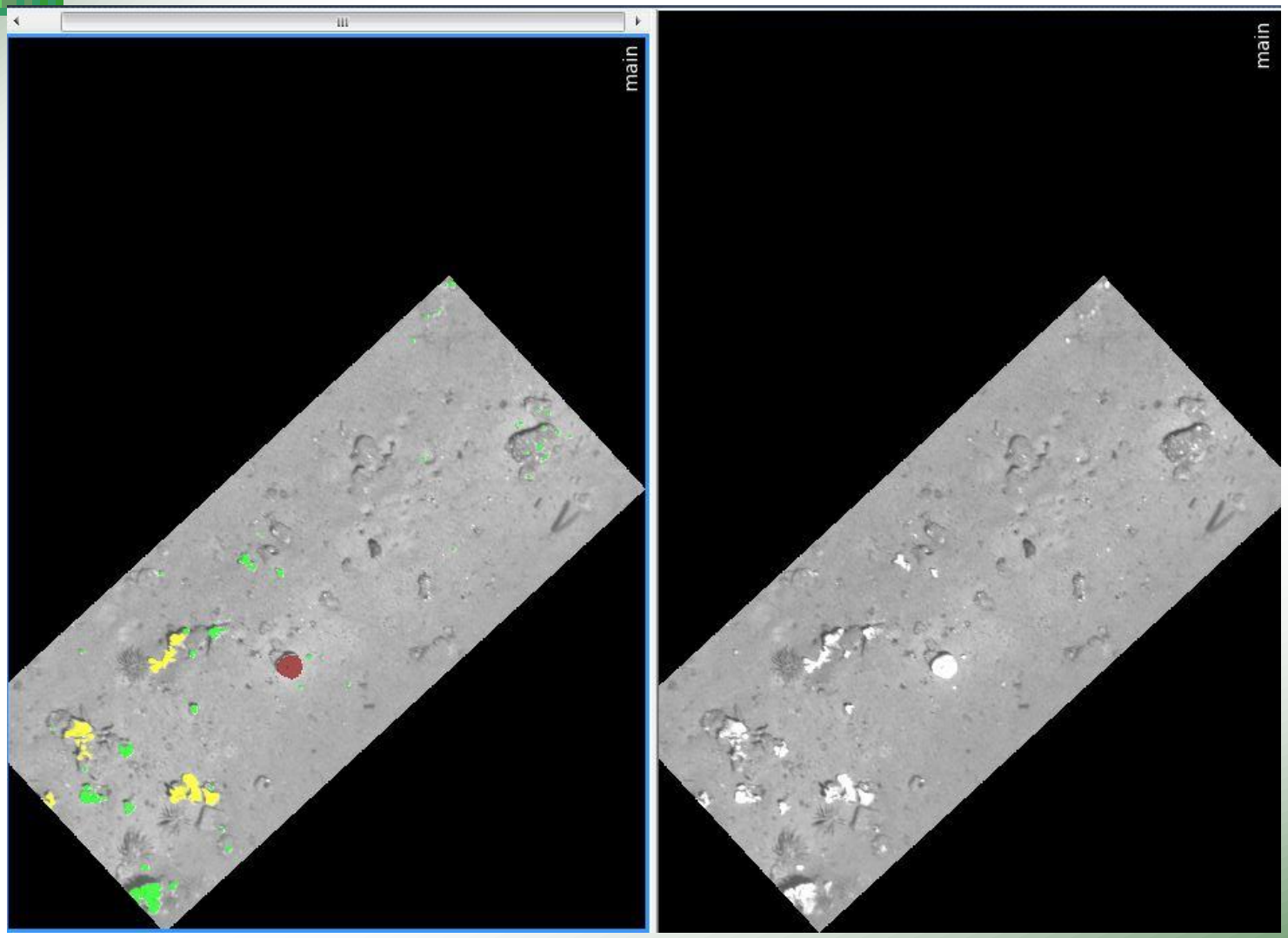
Anemone and feather + wrong classification



You cannot win them all…

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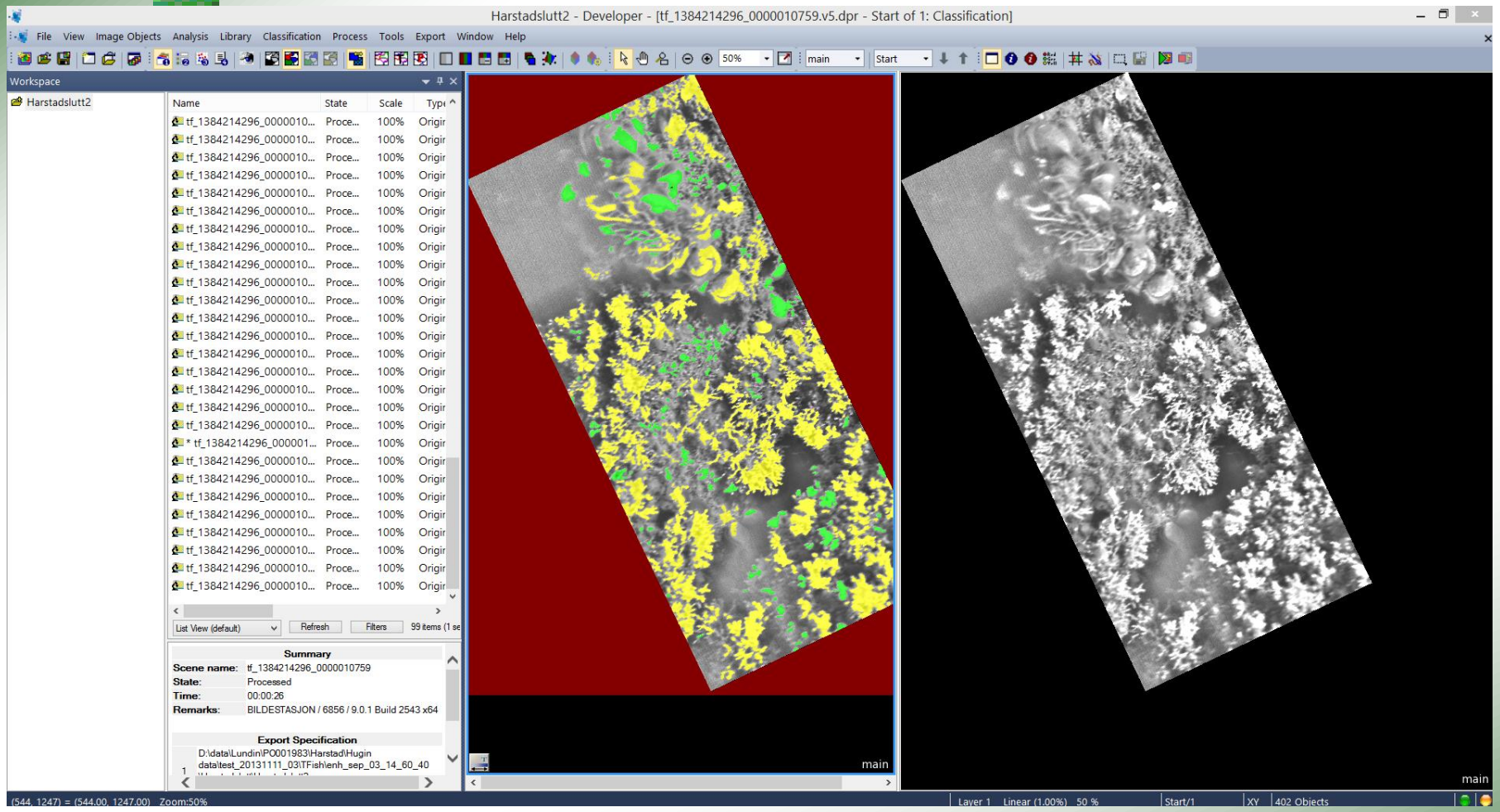
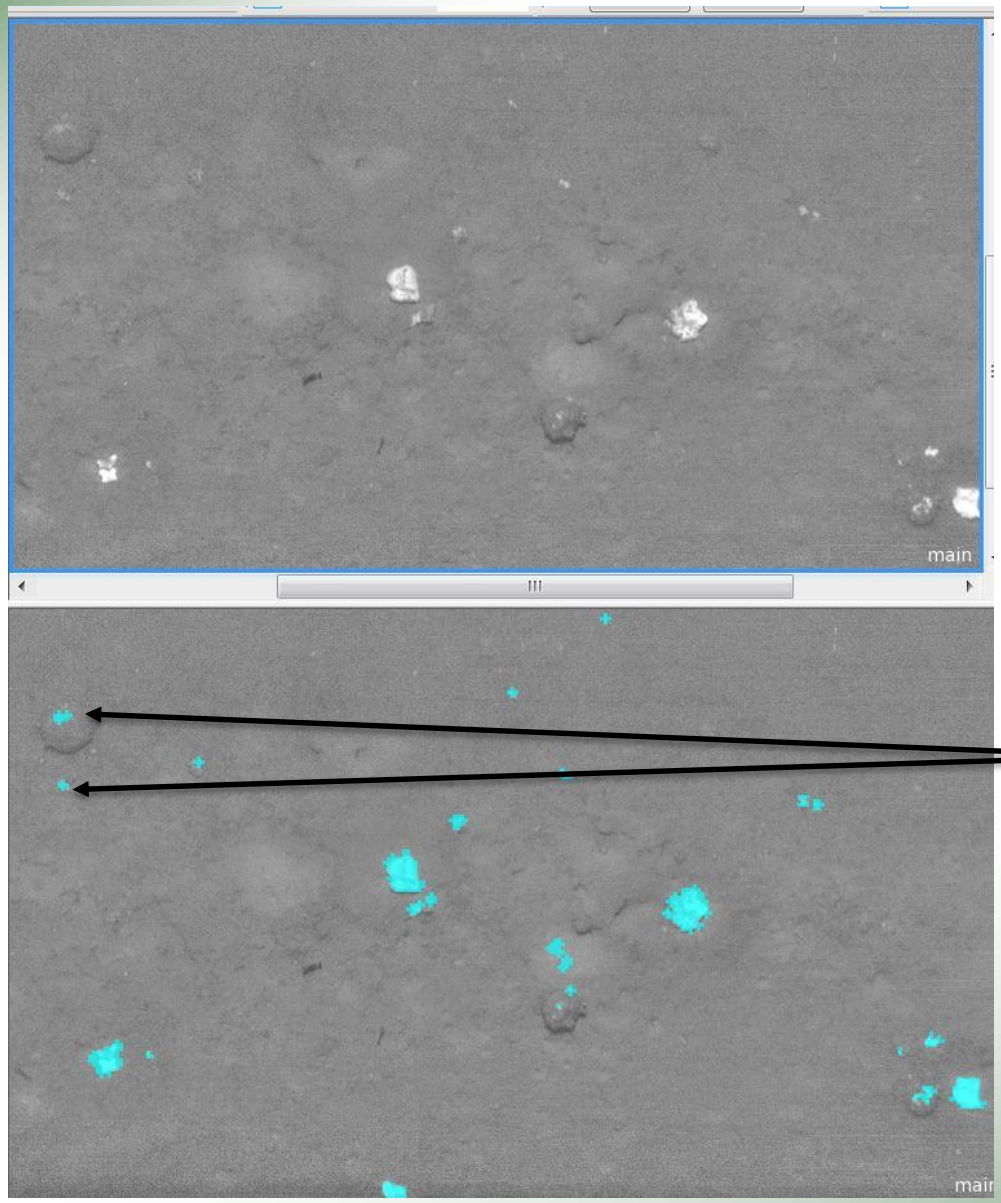
Workspace in eCognition



With images in geotiff format we can analyze images in batch in Trimble eCognition classification software.
Together with Lundin staff, TerraNor developed the rulesets.

Sponges



Notice the classified objects that are difficult to see manually

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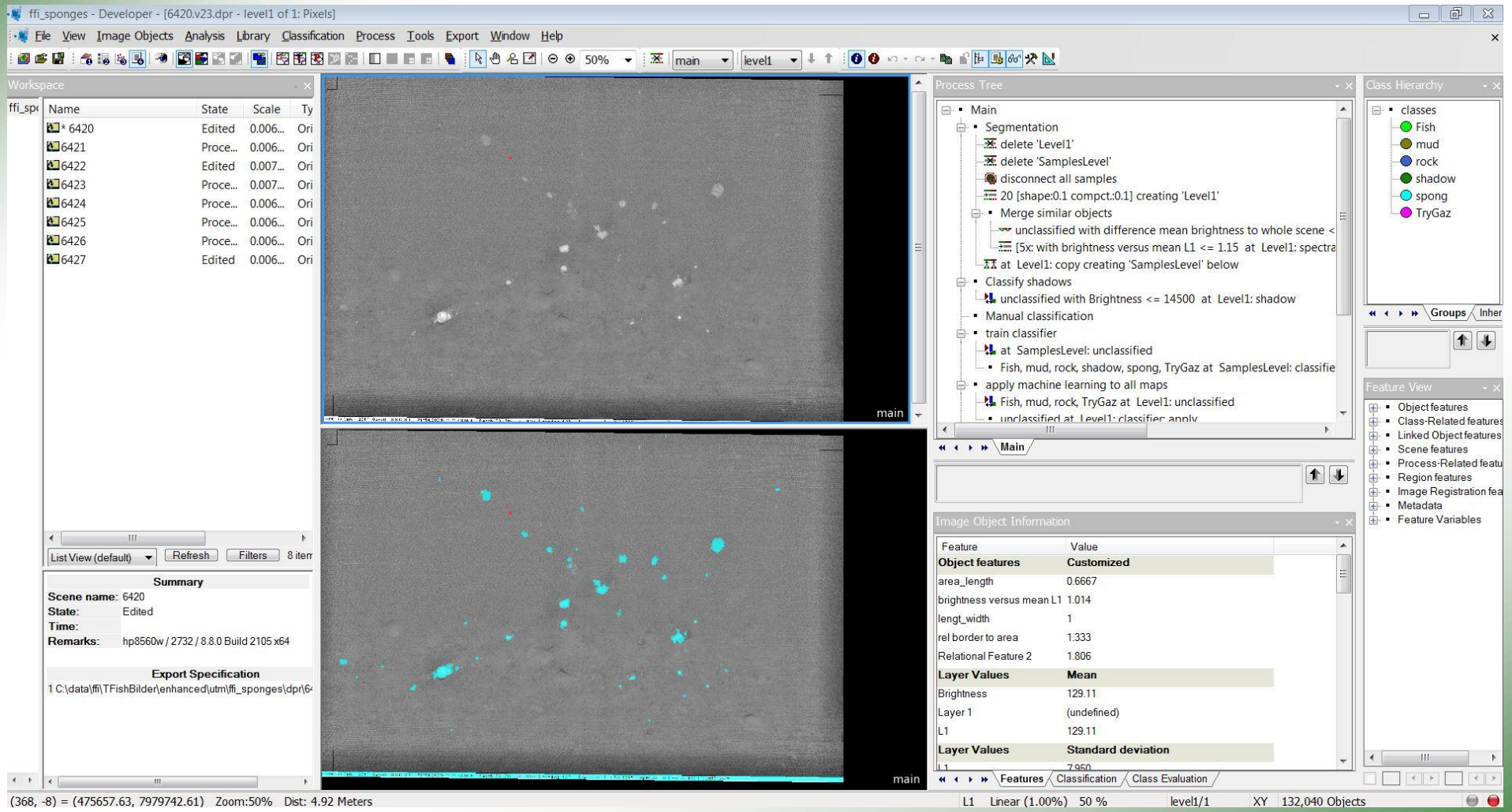
Production line



Rule set in eCognition and Workspace for batch processing

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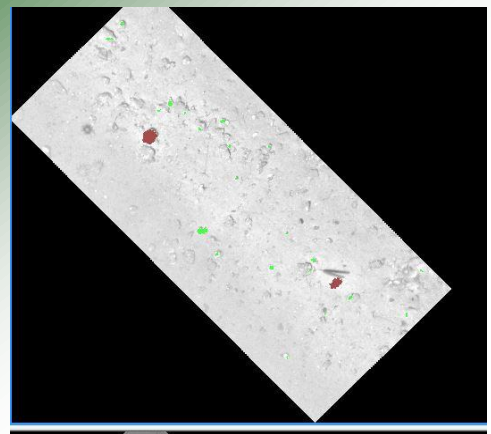
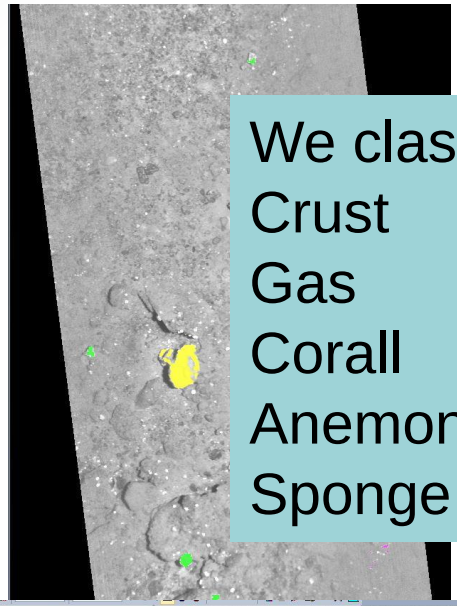
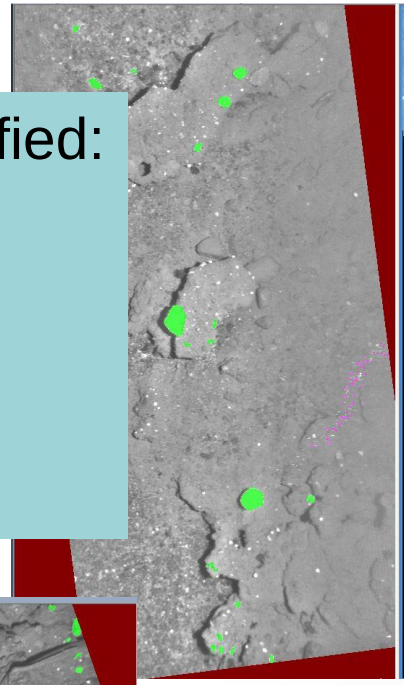
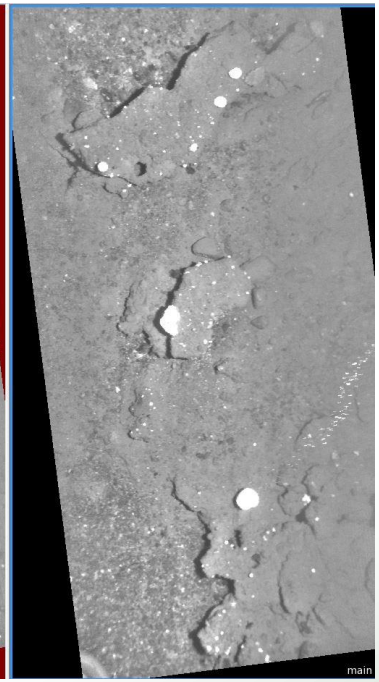
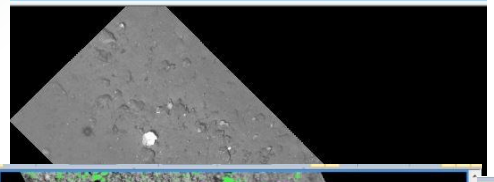
Classification of 50 000 single images

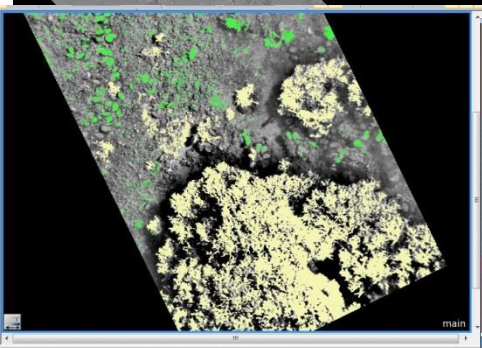


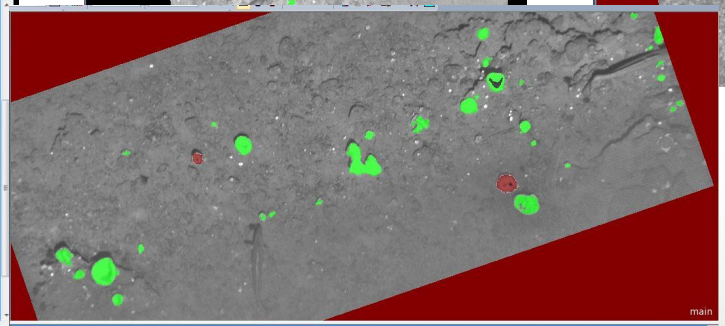


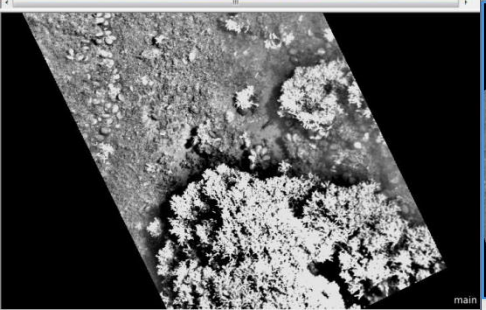


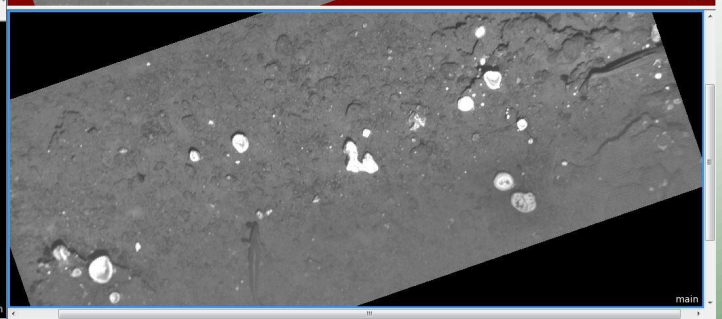












We classified:
Crust
Gas
Corall
Anemone
Sponge

All images with red list species were found.
Images without red list species did not show any classification.
False classification was not a problem.

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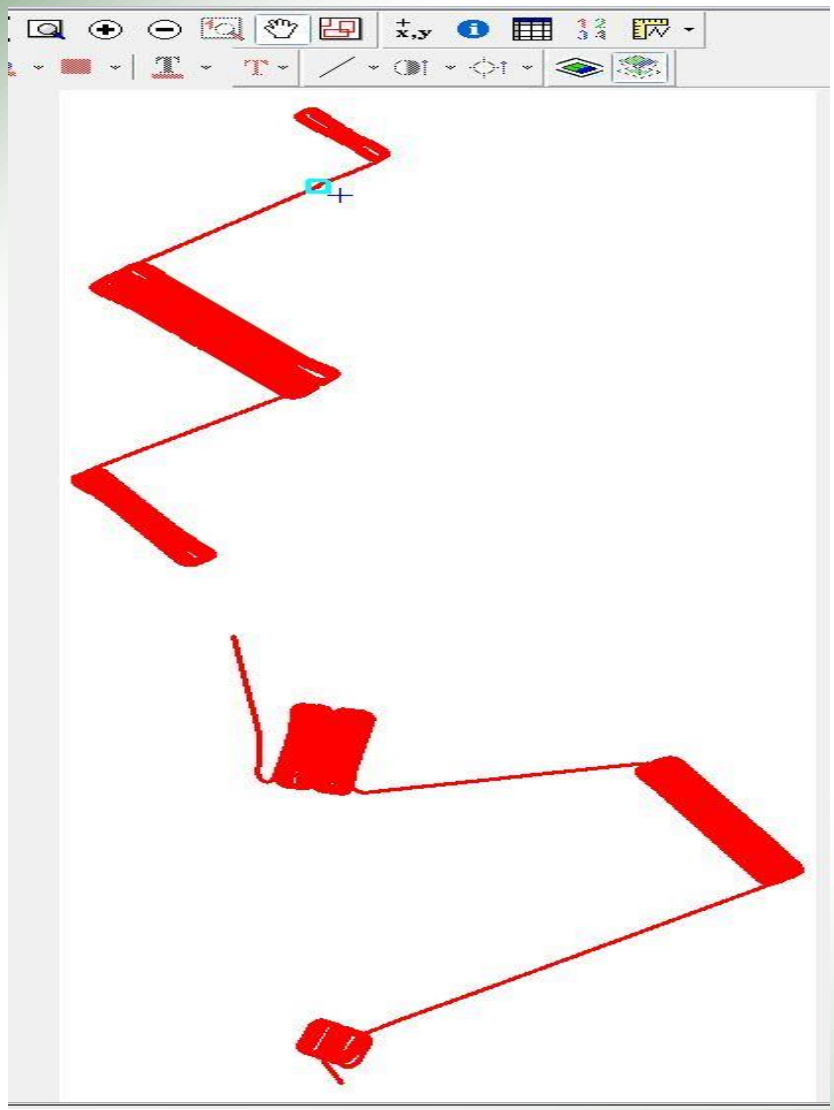
The numbers of images are HUGE



Each red dot is an image
Here: 50 000 images

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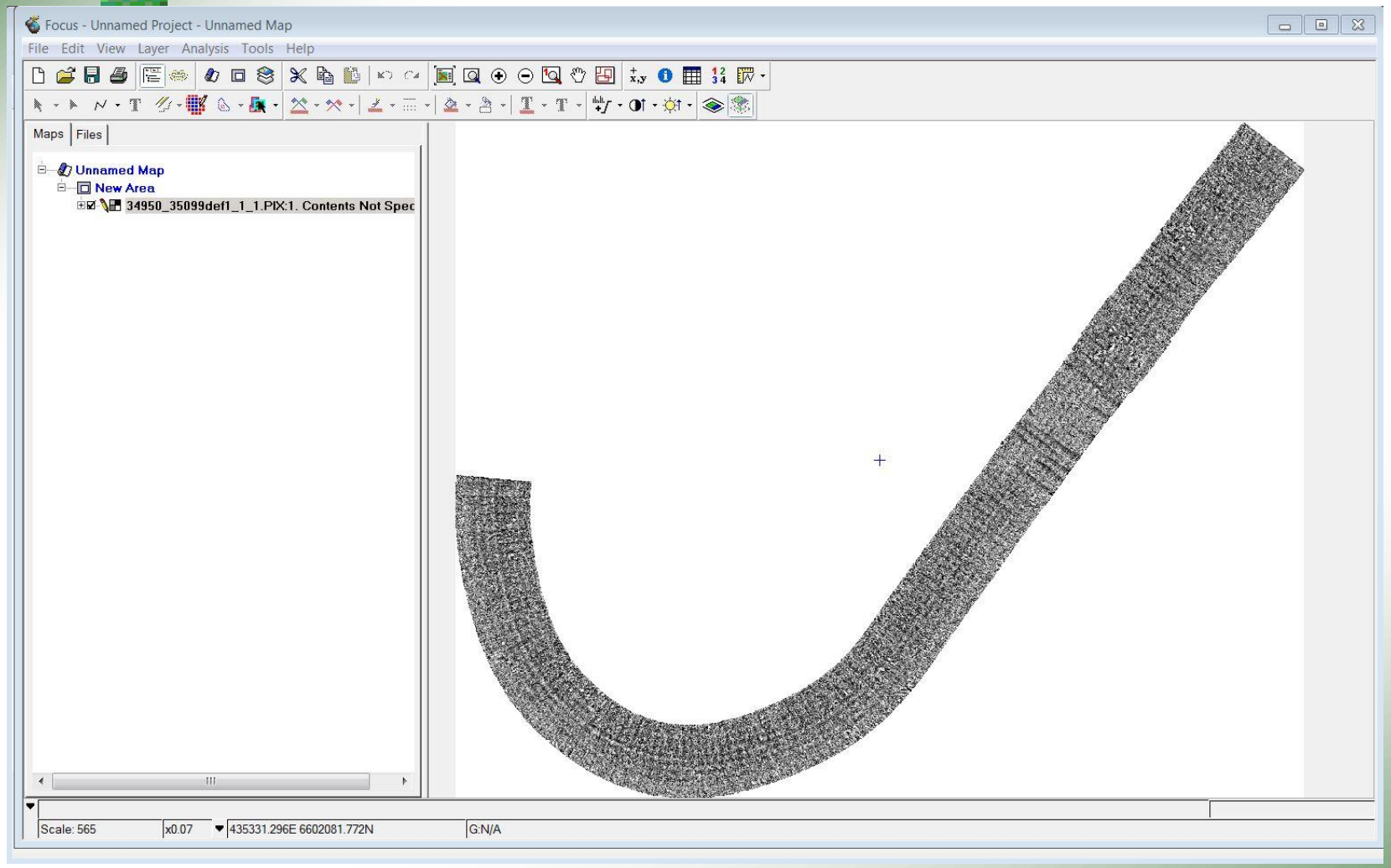
Orthorectified images can be mosaicked



PCI Geomatica software was used to mosaic images
with 150 images in each mosaick
All done in one large batch process using EASI. (Python possible)

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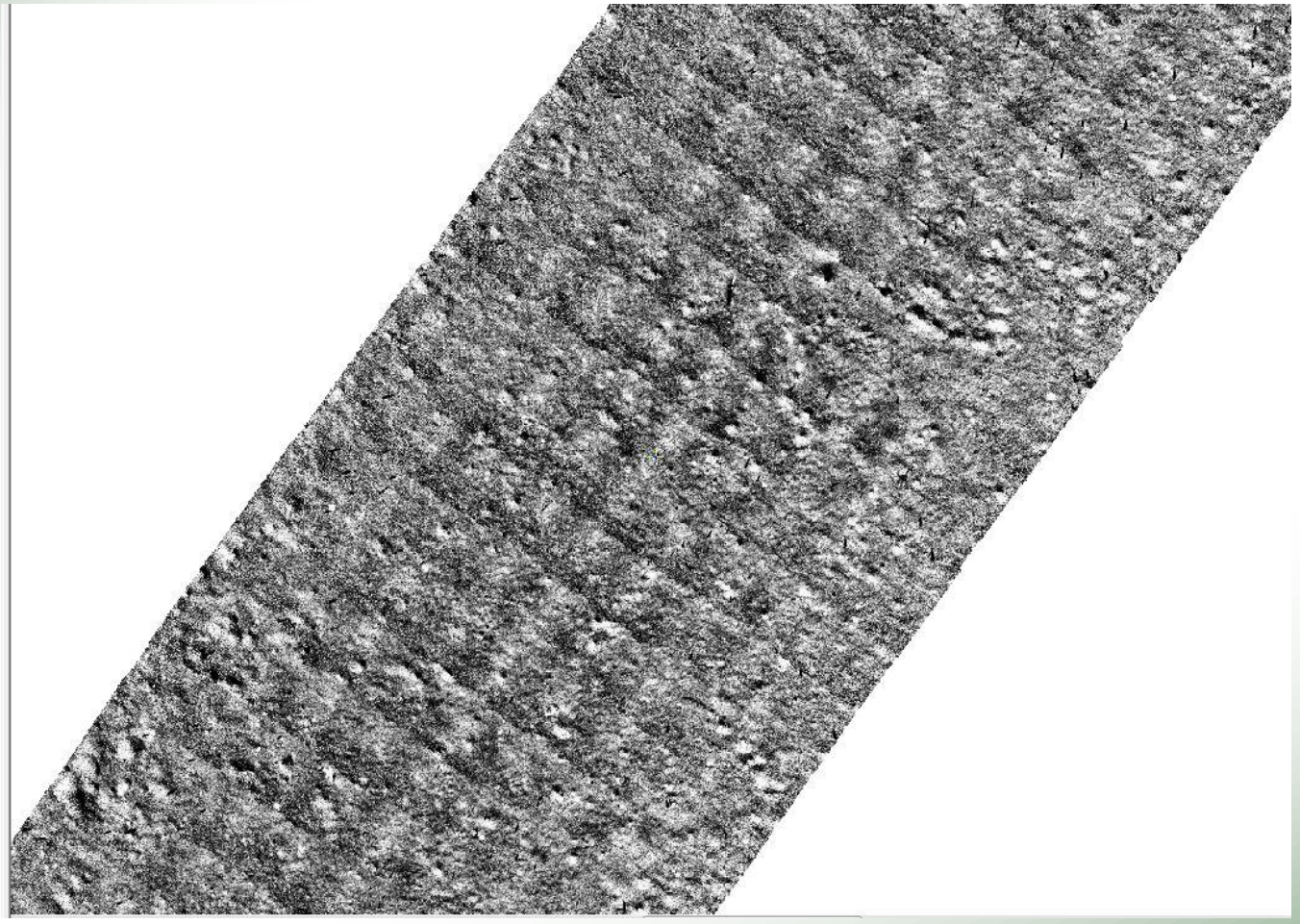
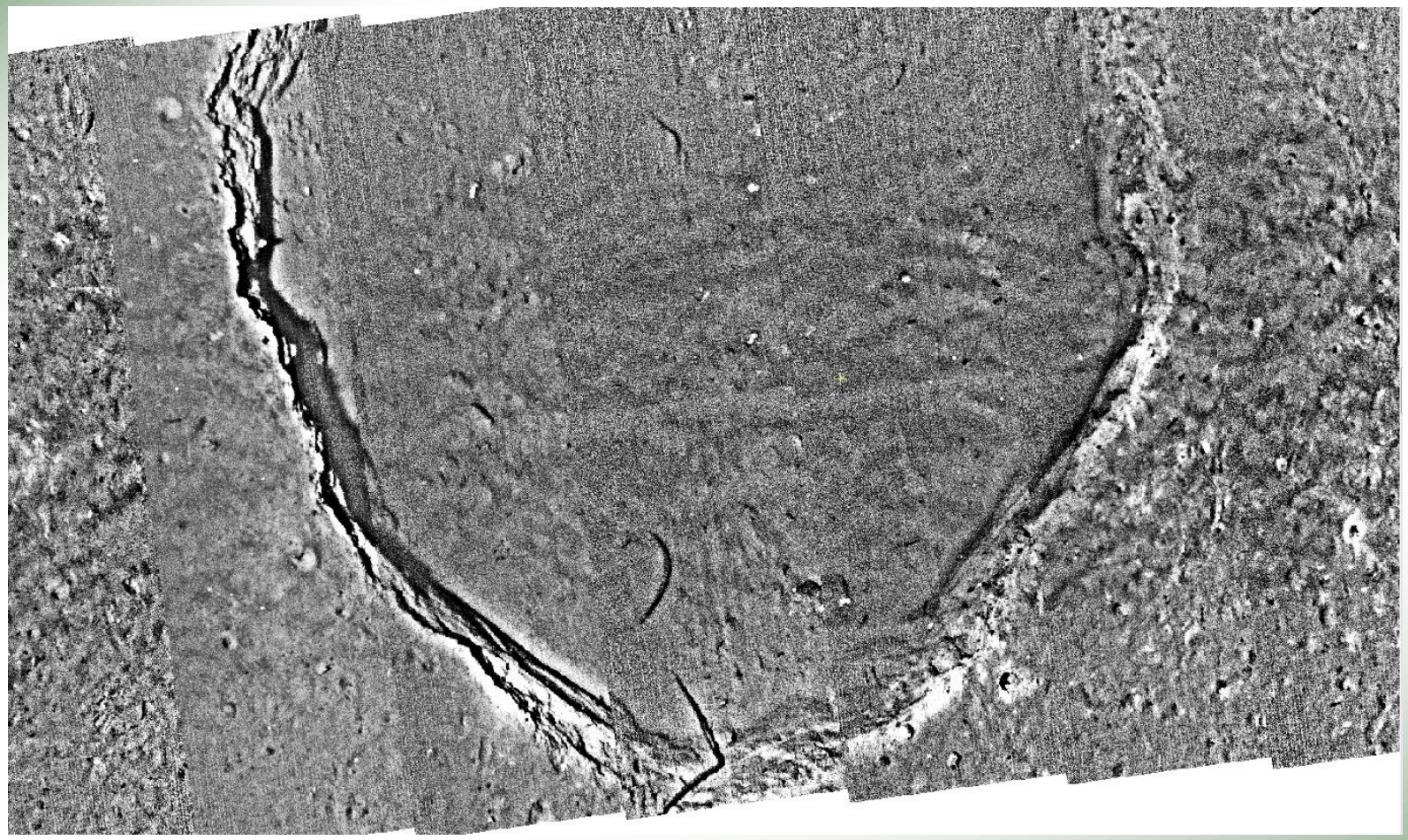
Mosaic zoom in



Color adjusted and geo oriented



Each image normally 7*5 m.
With overlap and masking: 6.5*3m
Resolution = 0.006m (6mm)
Lack of DEM makes the result ‘good enough’

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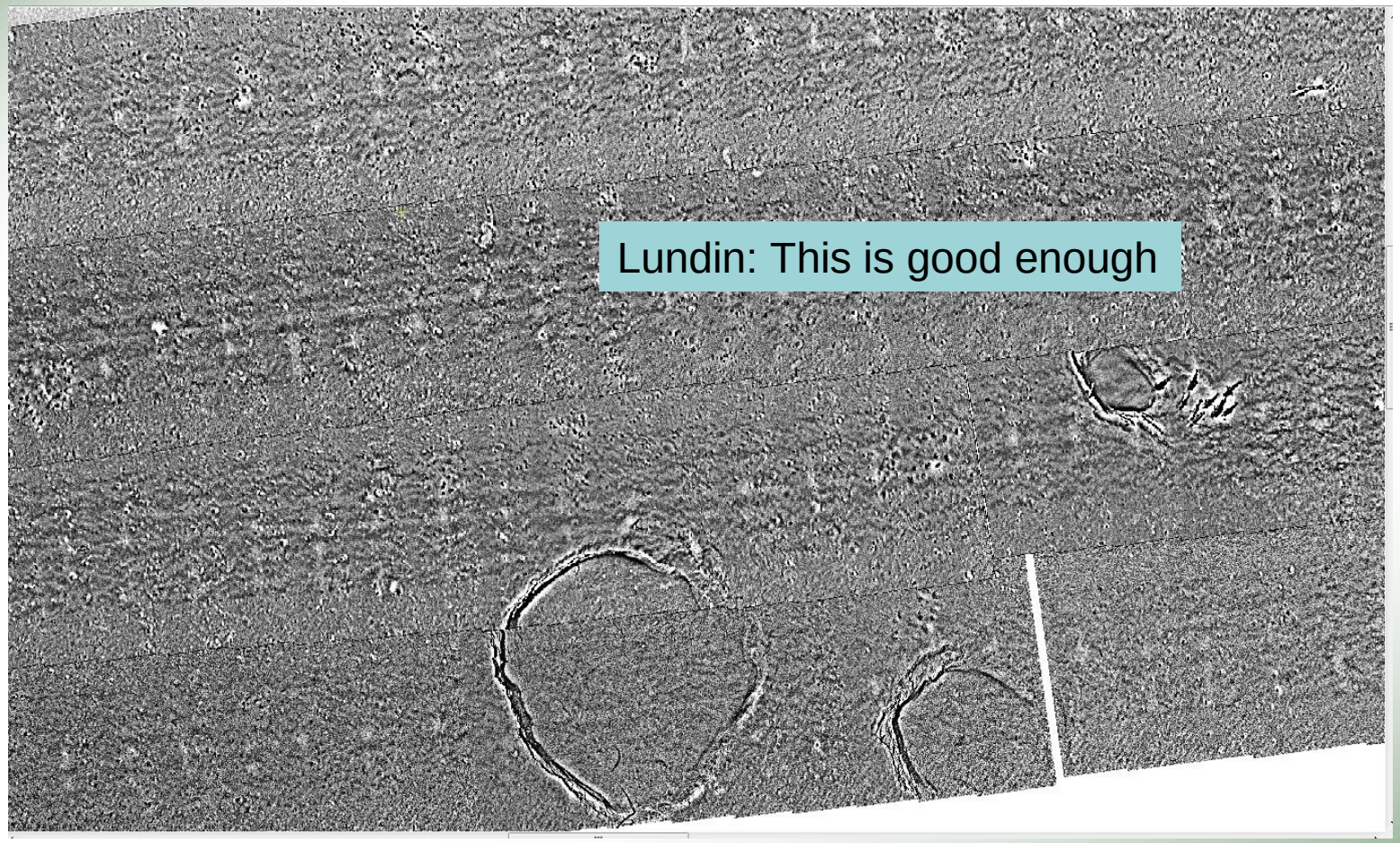
Mosaic several flight lines



Several flight lines can be merged to one image.
Absolut orientation is difficult.
AUV orientation is not good enough for exact merging of lines
Along one line images fit well together

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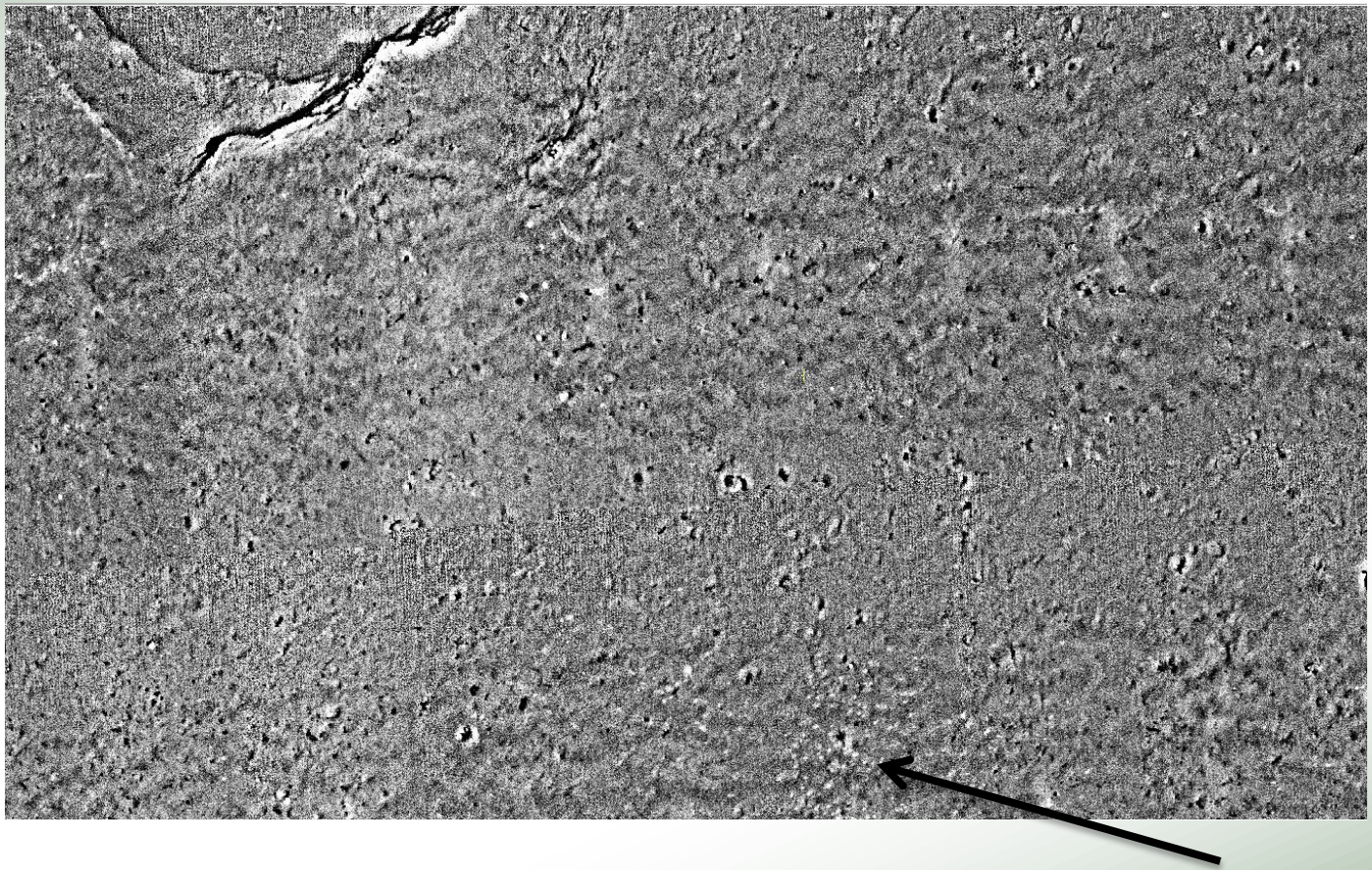
Seabed has little variation



You have to know what to look for

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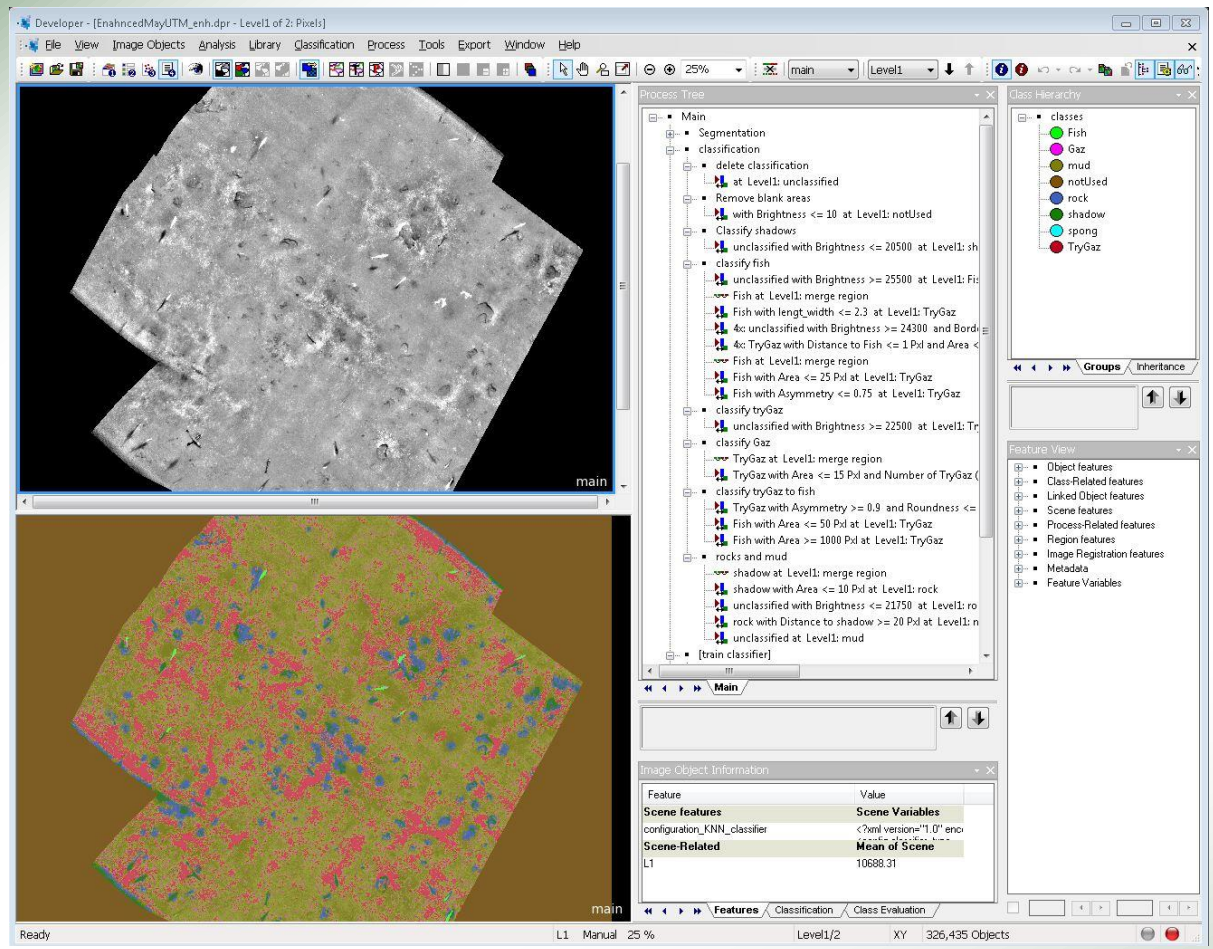
Large overlap between some images made it possible to use UAV software



It requires use of TerraNor Image Light Compensation, ILC, software

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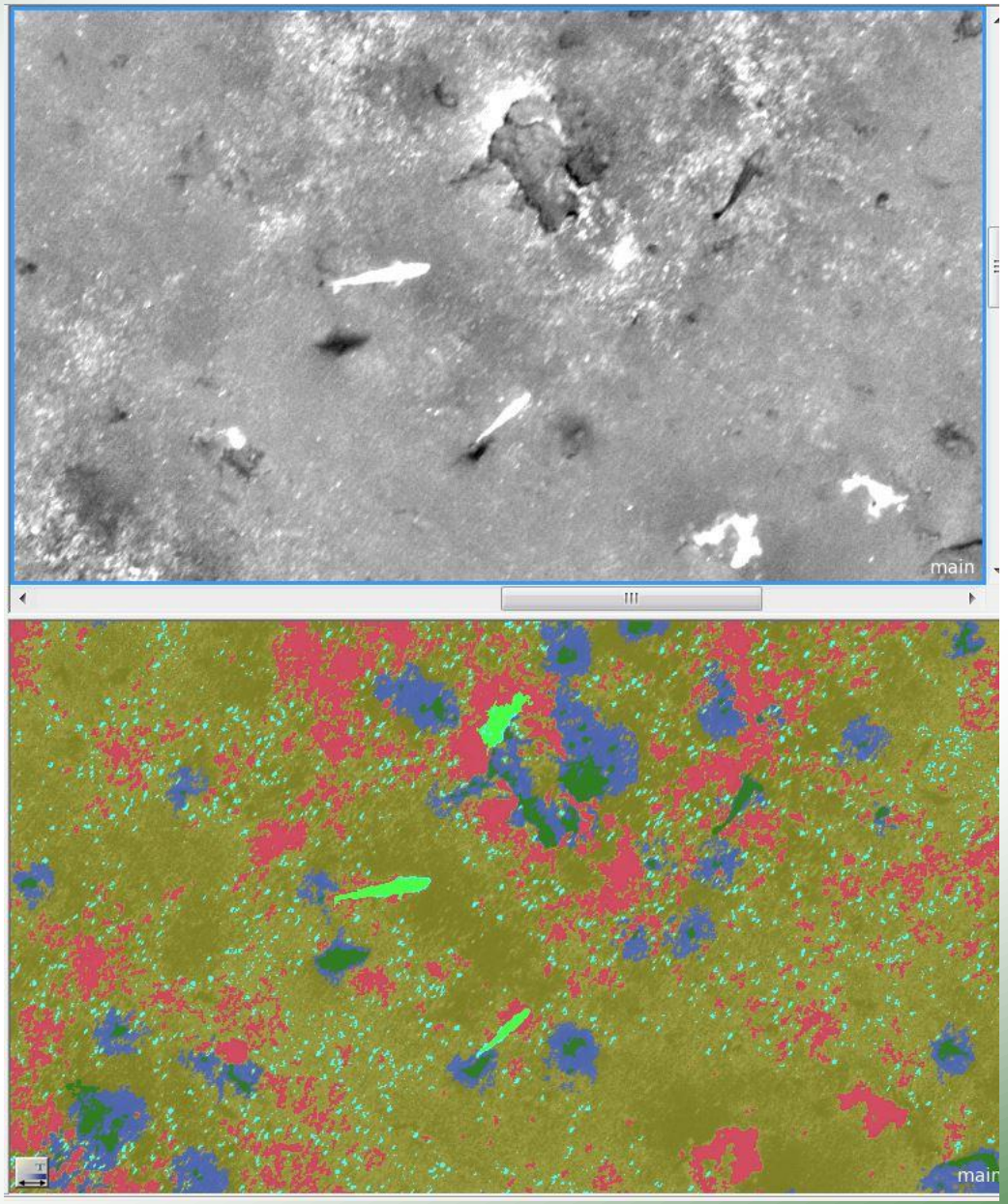
Classification seabed with eCognition



Next step: use of DEM

- Pipelines
- Constructions
- Fisheries
- Mining

- They all want better accuracy and to be able to fit images together

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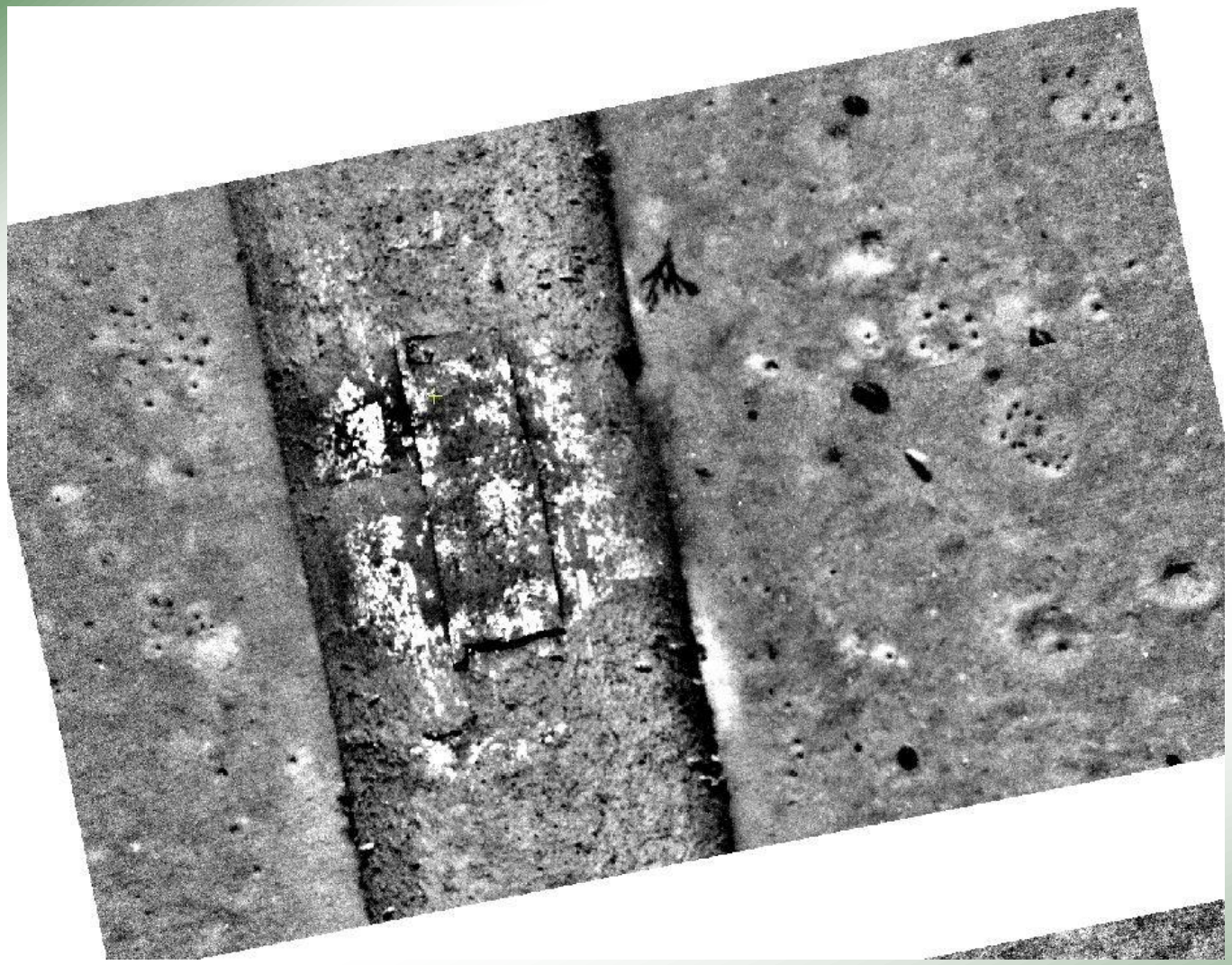
Original image pipeline

Same image compensated and geo-corrected



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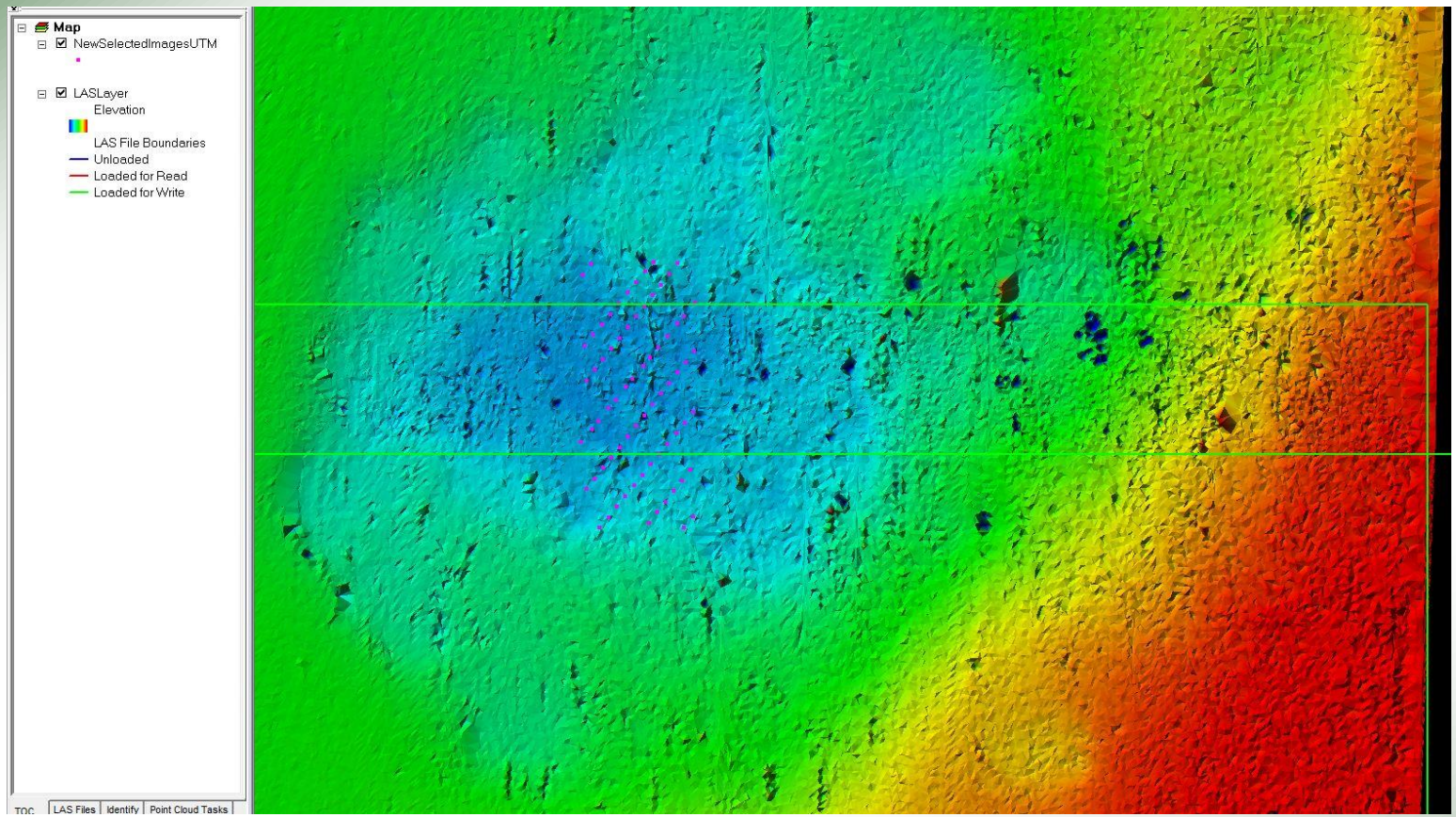
Mapping seabed using sonar



Hugin AUV from Kongsberg Maritime has built in sonar.
Images can be linked to the DEM and orthorectification will be better

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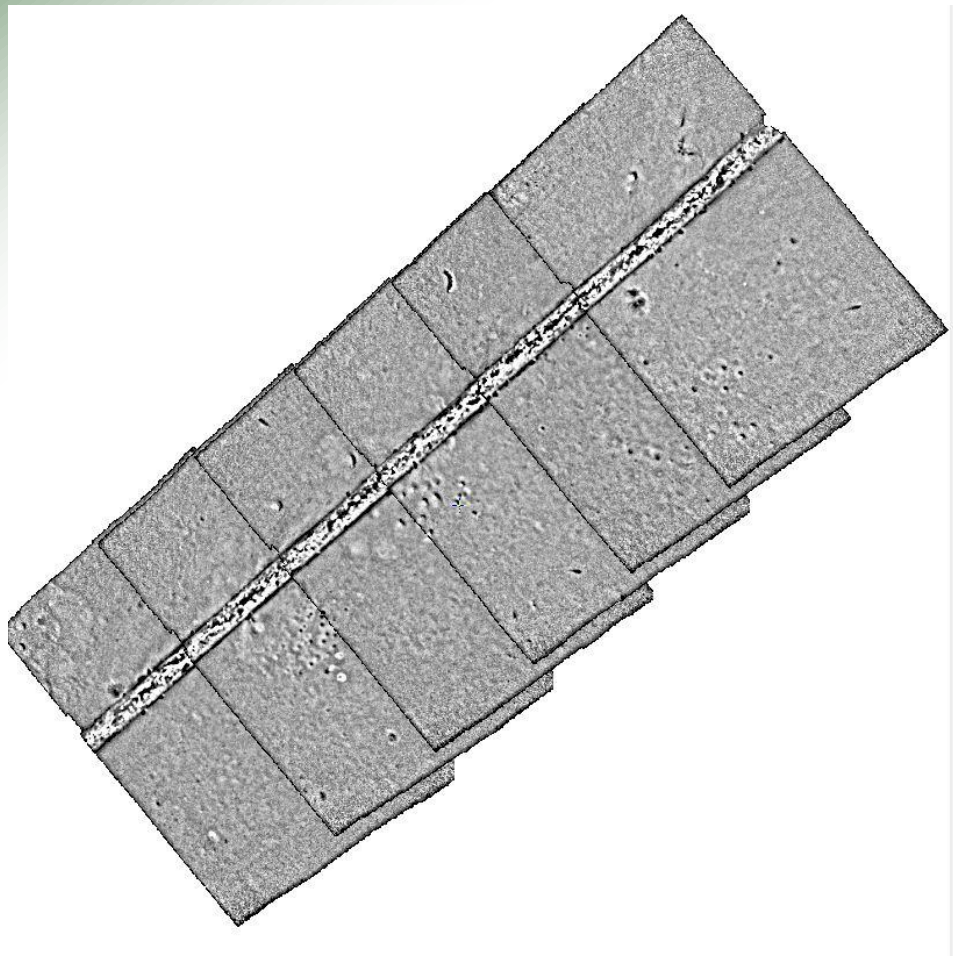
Pipeline images and DEM



Notice that the images are wider at one side. This is due to correction using DEM. GPU processing makes this fast.

Data from DOF Subsea

We used DEM + images captured on the same trip. The fit between images is good. The DEM is 20 cm and the images are 0.6 cm, so there is a small misalignement.

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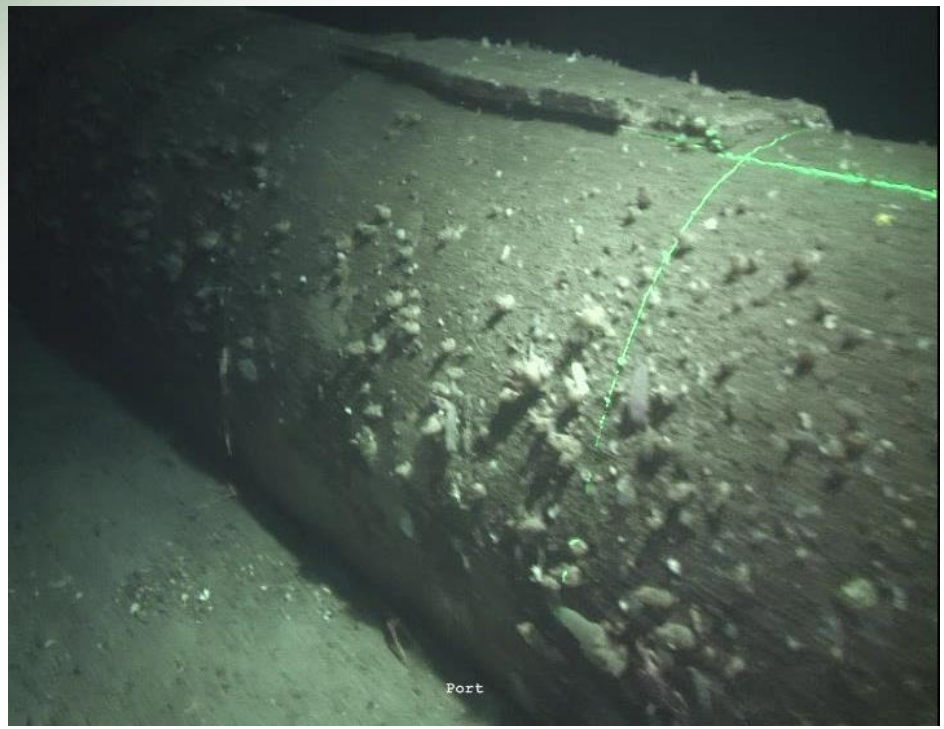
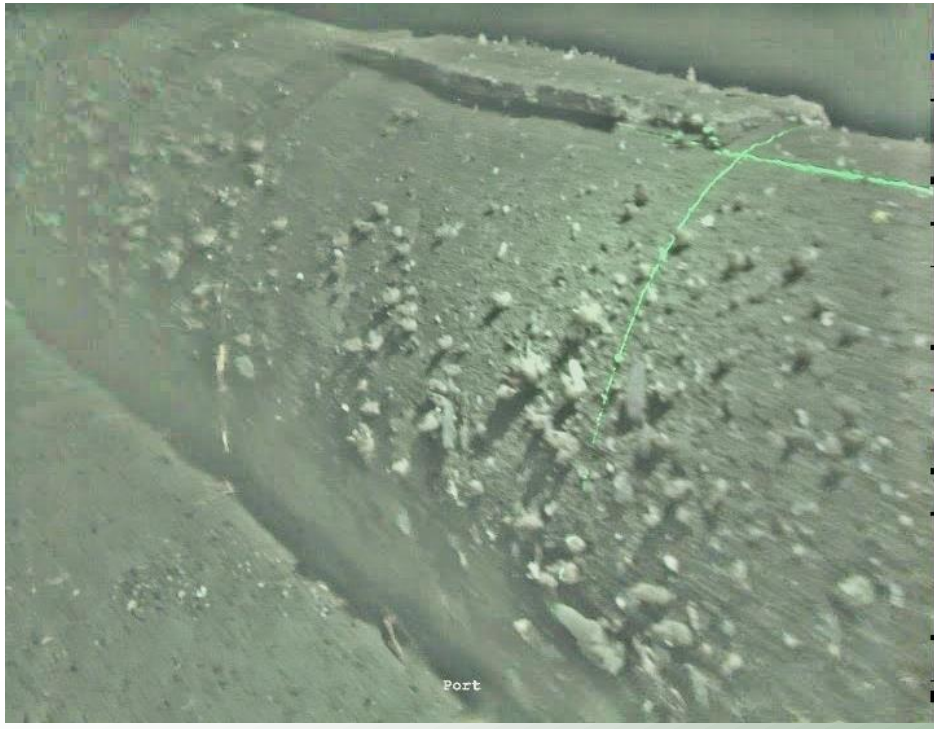
Another next step: color

- Underwater imagery is sensible for light
- Different colors will be reduced different over same distance
- Use of Image Light Compensation ILC will still work

Colour images from video





Original

Compensated

Example color image from video
DOF Subsea

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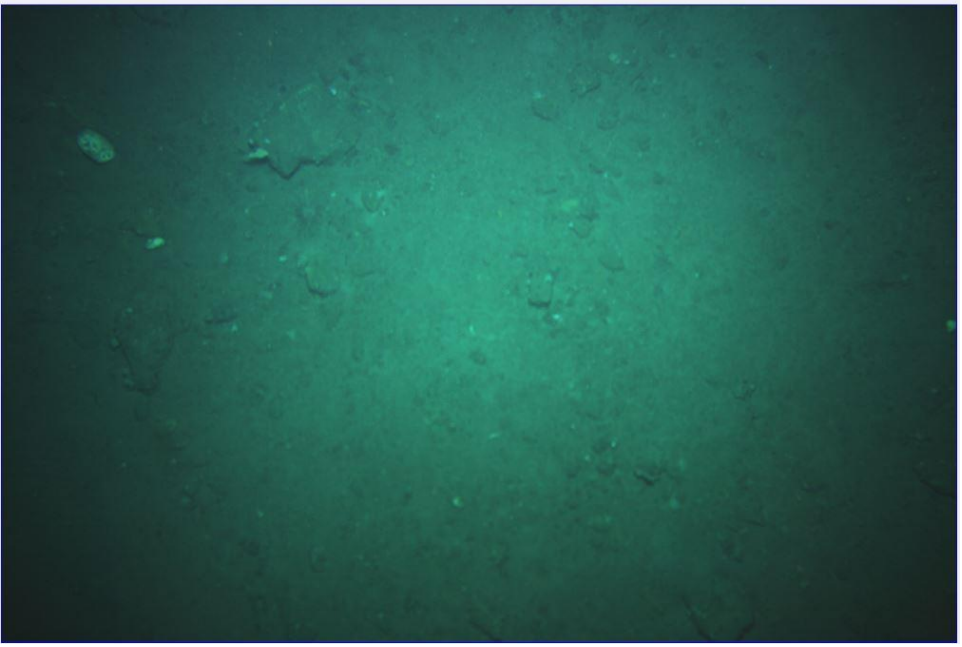
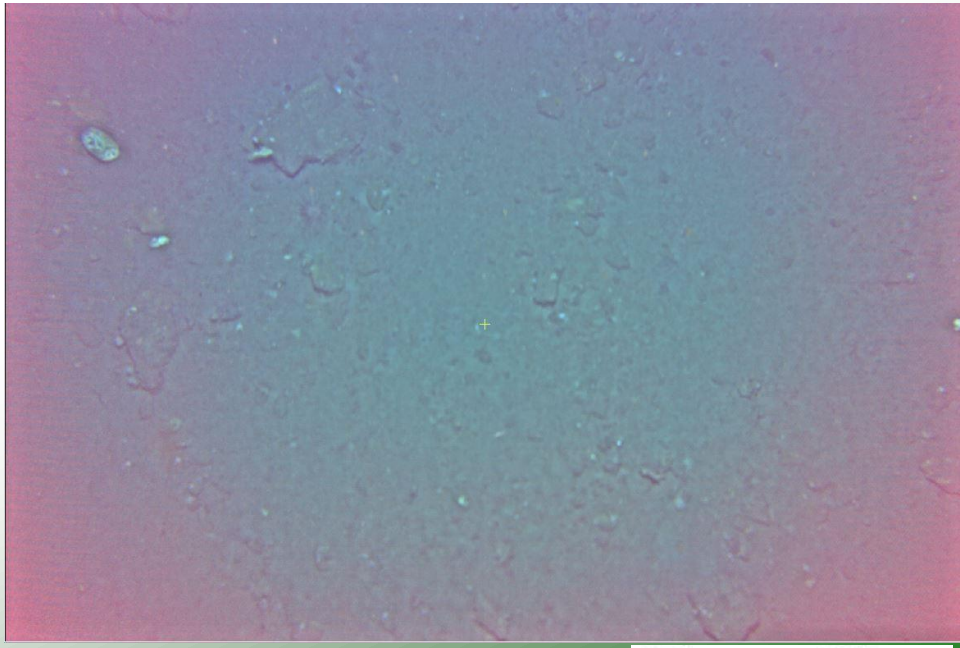
Color image from new camera



Original image

Compensated image



As expected different colors act differently. Red is compensated too much in the dark areas.

Distance from camera to seabed is important.

We will finish this part of the project with better source images.

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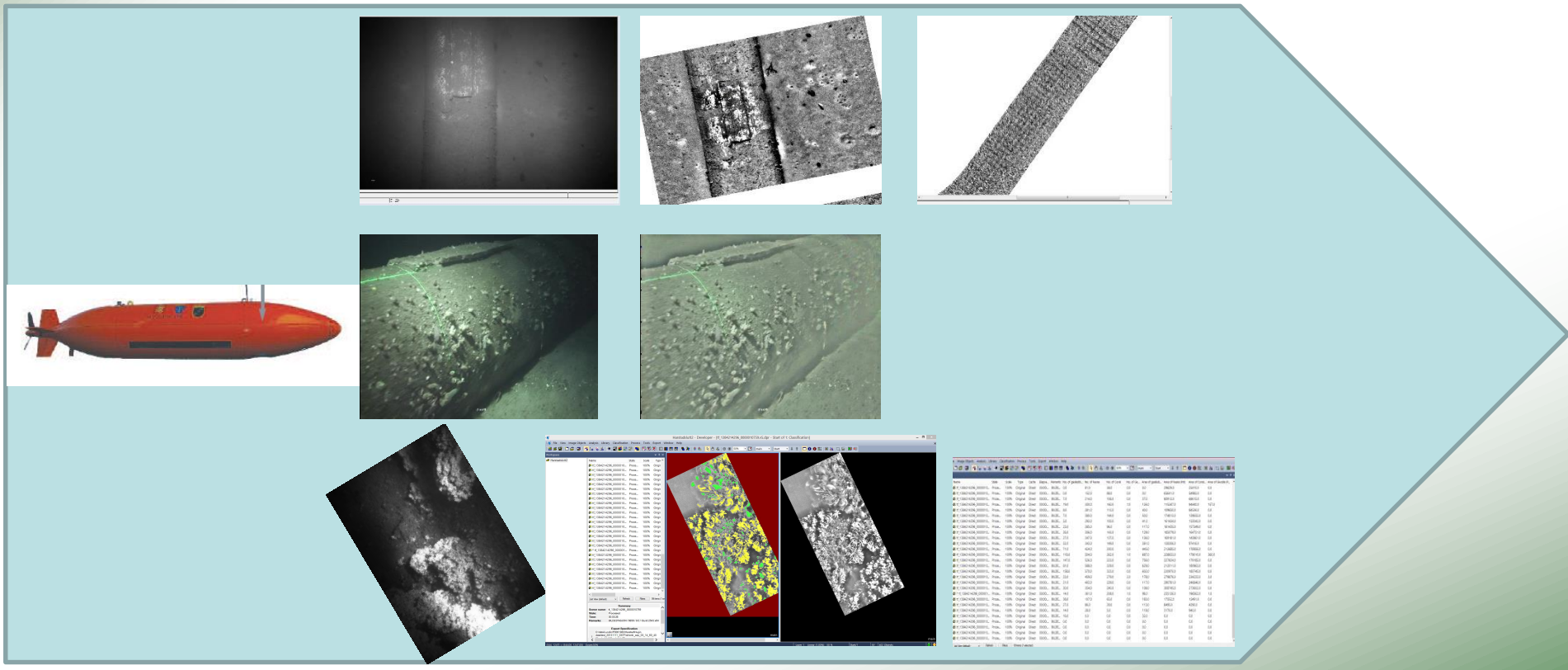
Production line

Capture

Raw image

Compensated and oriented

Mosaic



Raw image

Compensated, oriented and classified

Report

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How can we help you?

- Needs
- Requirements
- Time
- Sample data
- Eval project

- We can solve your problems!