

# Multibeam Imaging Sonar


Expectation vs. Reality

A Case Study from Troll B

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DeepOcean AS

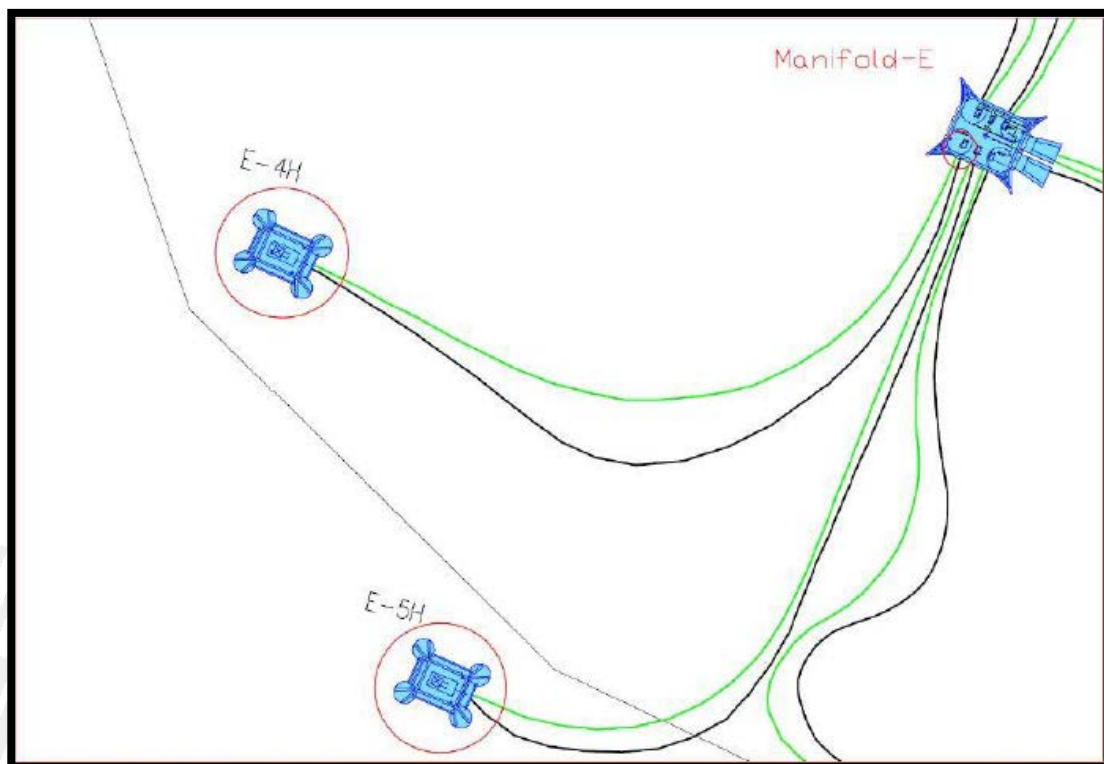
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03 September 2014

## INTRODUCTION

- Multibeam Imaging Sonar Expectation Versus Reality
  - Case Study from Troll B – Survey of E4, E5 & E Manifold
  - Expectation vs Reality
  - What is «**expected**» may not be what both parties think was «**Agreed**»
- 
- A decorative graphic at the bottom of the slide consisting of numerous thin, parallel diagonal lines in a light gray color, creating a textured, wave-like effect that spans the width of the slide.

## BACKGROUND

- Survey Objective
  - «Collect missing or insufficient data required for future operations»
- Blueview Scanning at three locations
  - E4 Satellite
  - E5 Satellite
  - E Manifold
- Client expectation
  - 3D model suitable for use in future engineering design
- Data Delivery failed to meet these expectations



## TIMELINE

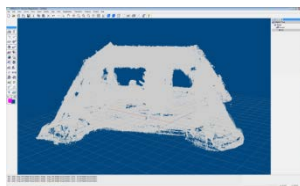
Nov 2012 – Planning Starts



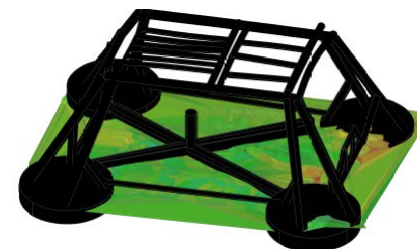
7-9 January 2013 – Offshore Operations Edda Flora



18th February 2013 –  
First x,y,z files from  
StarNet Geomatics



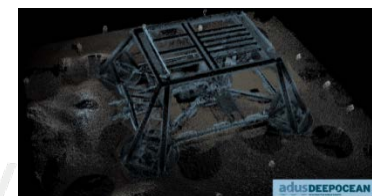
25th May 2013 – 3D  
Drawings from StarNet  
Geomatics



7th June 2013 –  
Contact made with  
ADUS



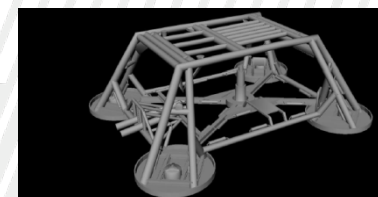
August 2013 – First  
Cleaned 3D Point Cloud  
from ADUS



24th October 2013 –  
Wrecksite Model from  
ADUS

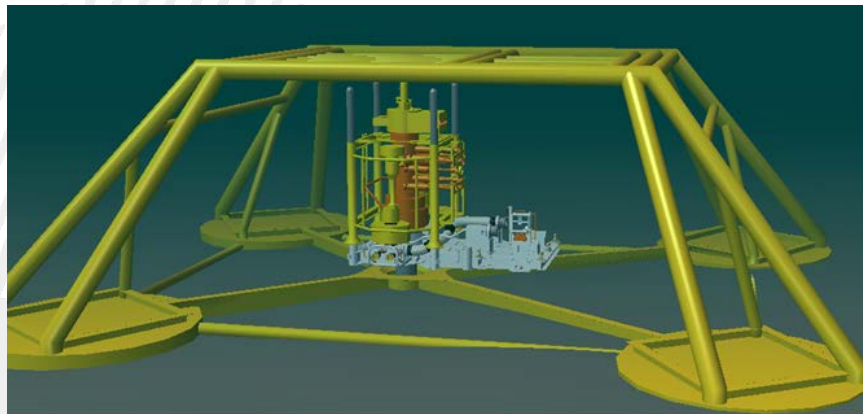


7th November 2013 –  
3D Solid from ADUS

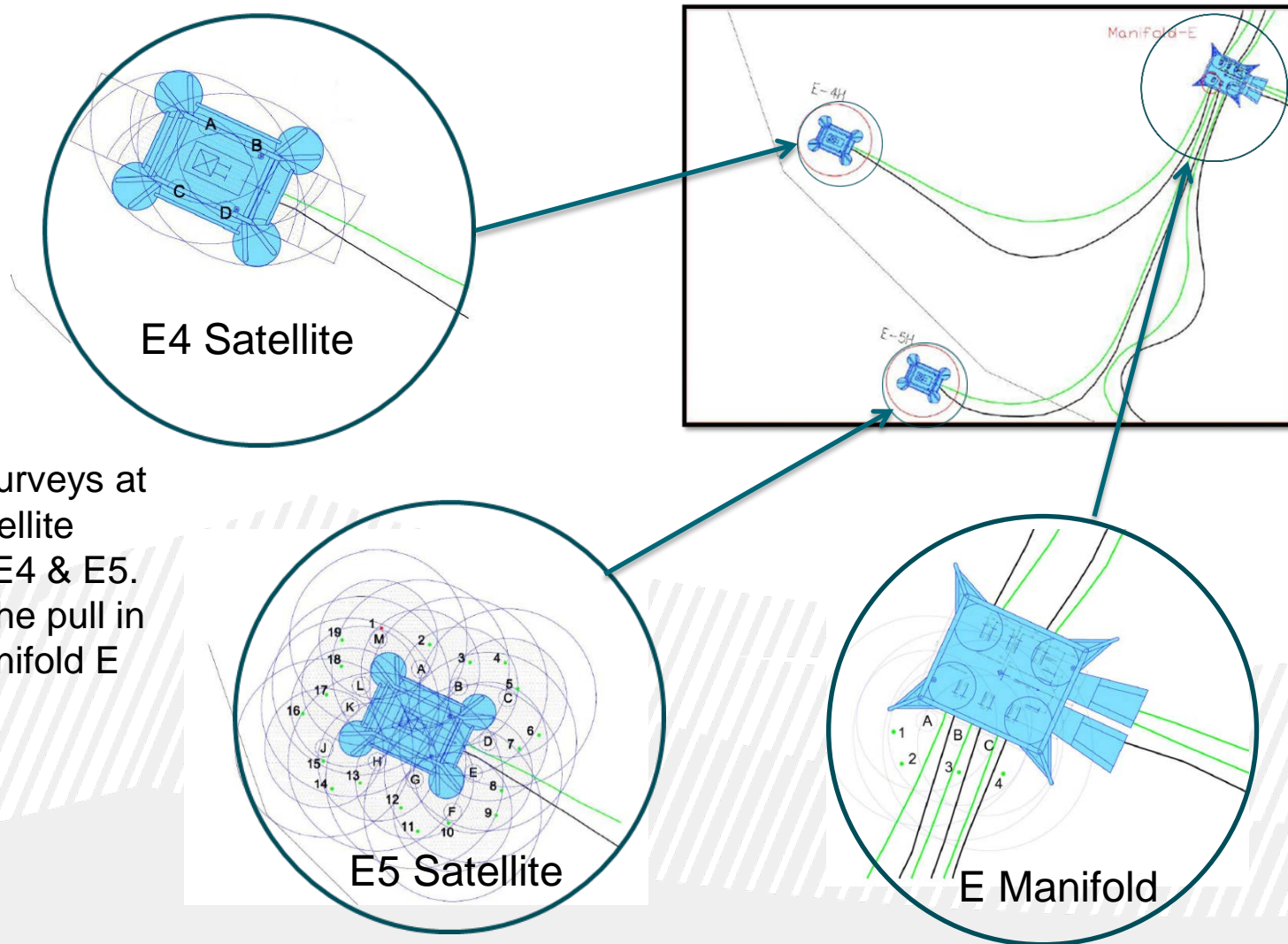


## PRESENTATION OBJECTIVES

- Examine Timeline
  - Preparation
  - Offshore Execution
  - Results from Initial Processing
  - Involvement of ADUS
- ADUS Methodology to clean data set
- Look at some of the reasons for disappointing initial results



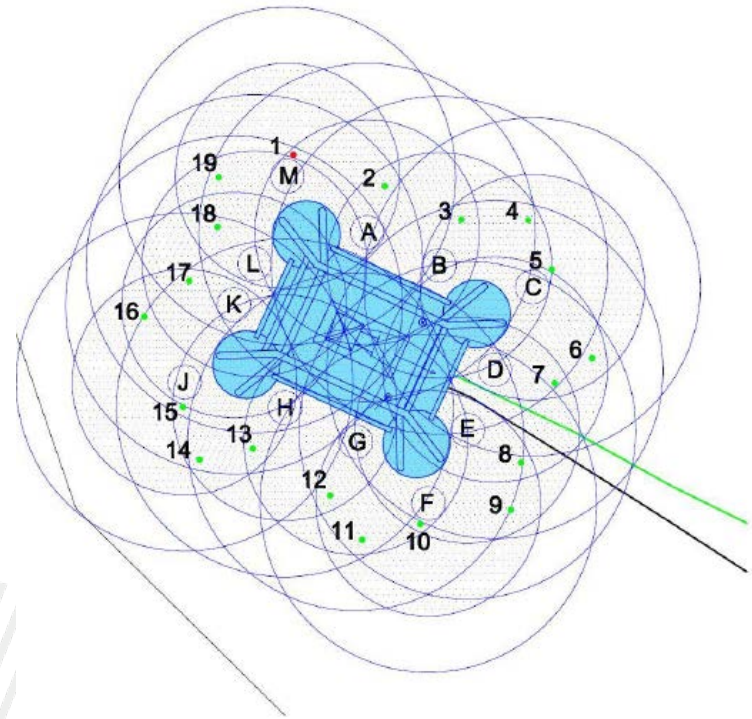
# OFFSHORE OPERATIONS



- Blueview surveys at the two satellite structures E4 & E5.
- Survey of the pull in area at Manifold E

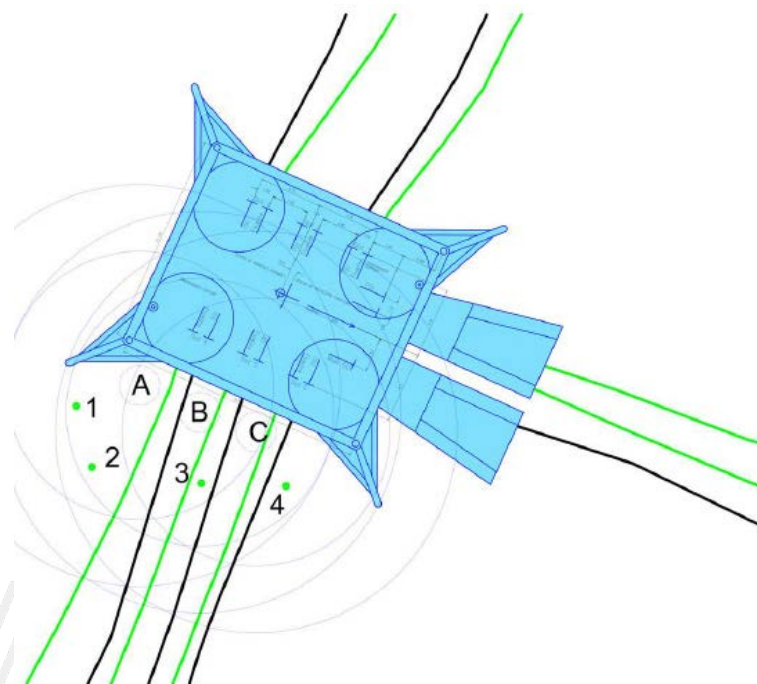
## E5 SATELLITE

- Satellite E5 complete scanning around base of Structure from a total of 12 locations
  - 20m range settings
  - All setups 360 degree horizontal plane
  - Setup on faces had 0.5 degree data rate and setups at corners had 1.0 degree data rate.
  - Three tilt settings used -15, +15 & +45 Degrees



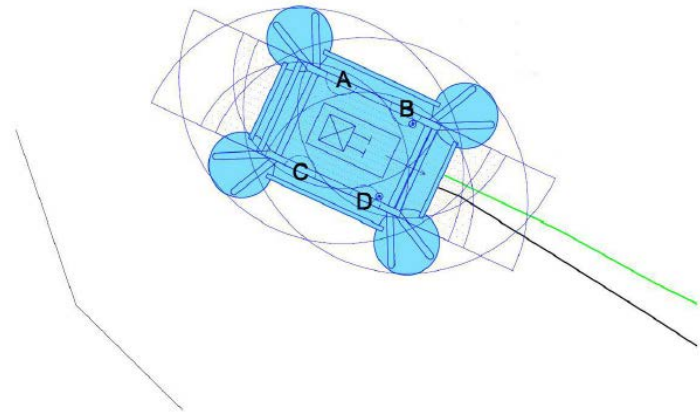
## E4 MANIFOLD

- Manifold E – Scanning of the South West face of the manifold from 3 locations
  - 20m range settings
  - All setups 360 degree horizontal plane
  - All setups had 0.5 degree data rate
  - Three tilt settings used -15, +15 & +45 Degrees



## SATELLITES E4 & E5

- Satellites E5 & E4 scanning on top of the Subsea Protection Structures from 4 locations on each satellite protection structure.
  - 15m range settings
  - All setups 180 degree horizontal plane
  - All setups had 0.5 degree data rate
  - Three tilt settings used -15, +15 & +45 Degrees
- The planned scanning round the base of E4 in a similar manner to E5 was not carried out due to time constraints and the assumption that both the structures were the same.



## PRELIMINARY RESULTS – STARNET GEOMATICS

- Data Verified Offshore
- Final Registration & Processing onshore
- Registration Errors

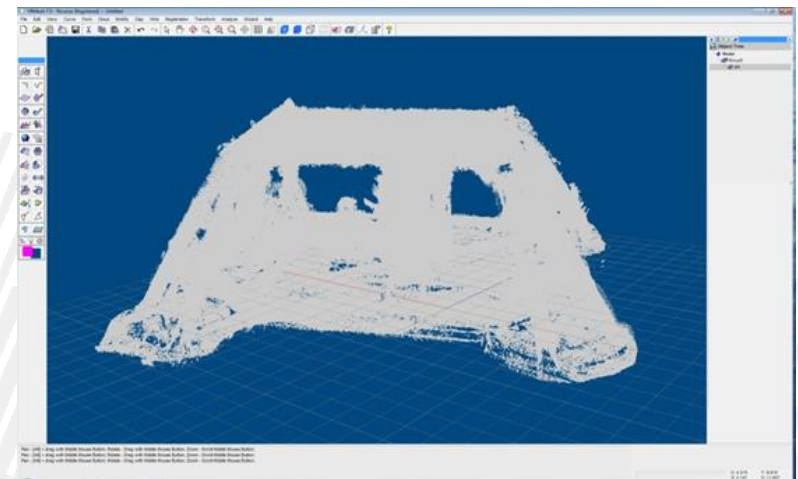
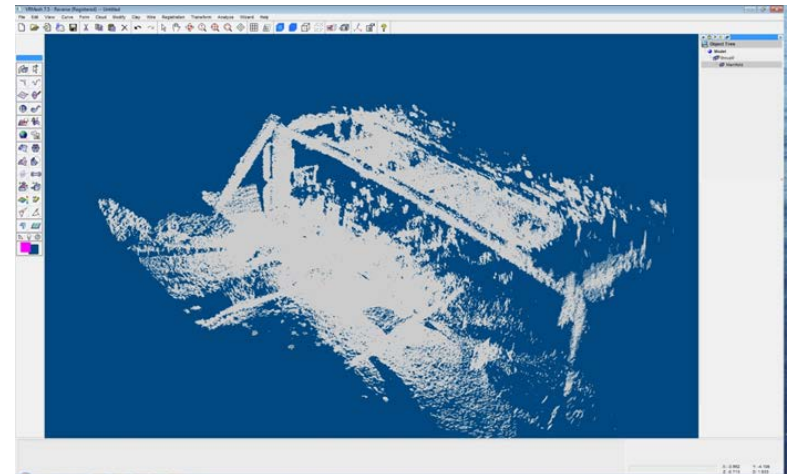
### Manifold Survey

Spherical Target Error 0.026m  
Overall network Error 0.065m

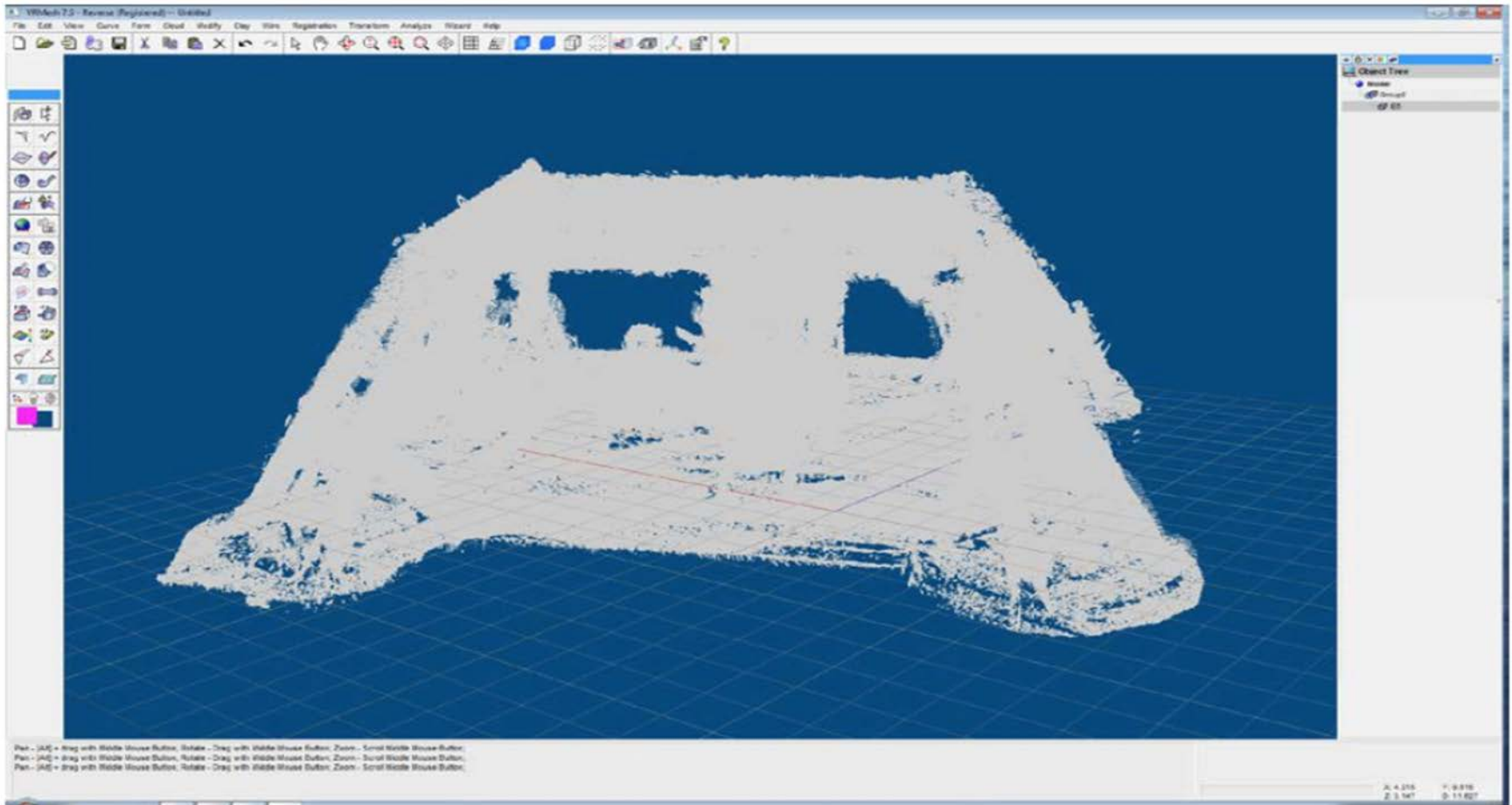
### E5 Base Survey

Spherical Target Error 0.043m  
Overall Network Error 0.085m

- Delivery of first x,y,z point cloud on 18<sup>th</sup> February 2013
- DeepOcean concerned over noise in the data set

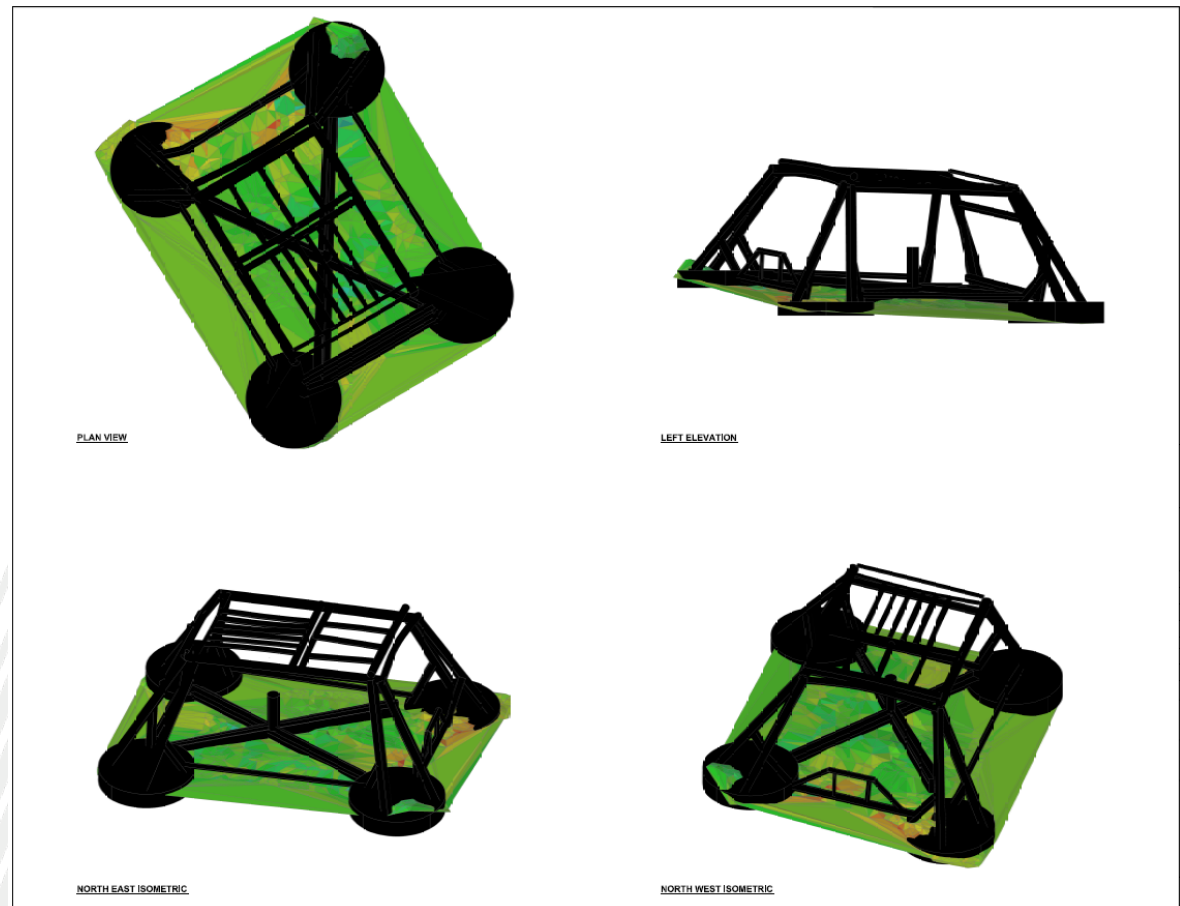


## NOISE IN THE DATASET

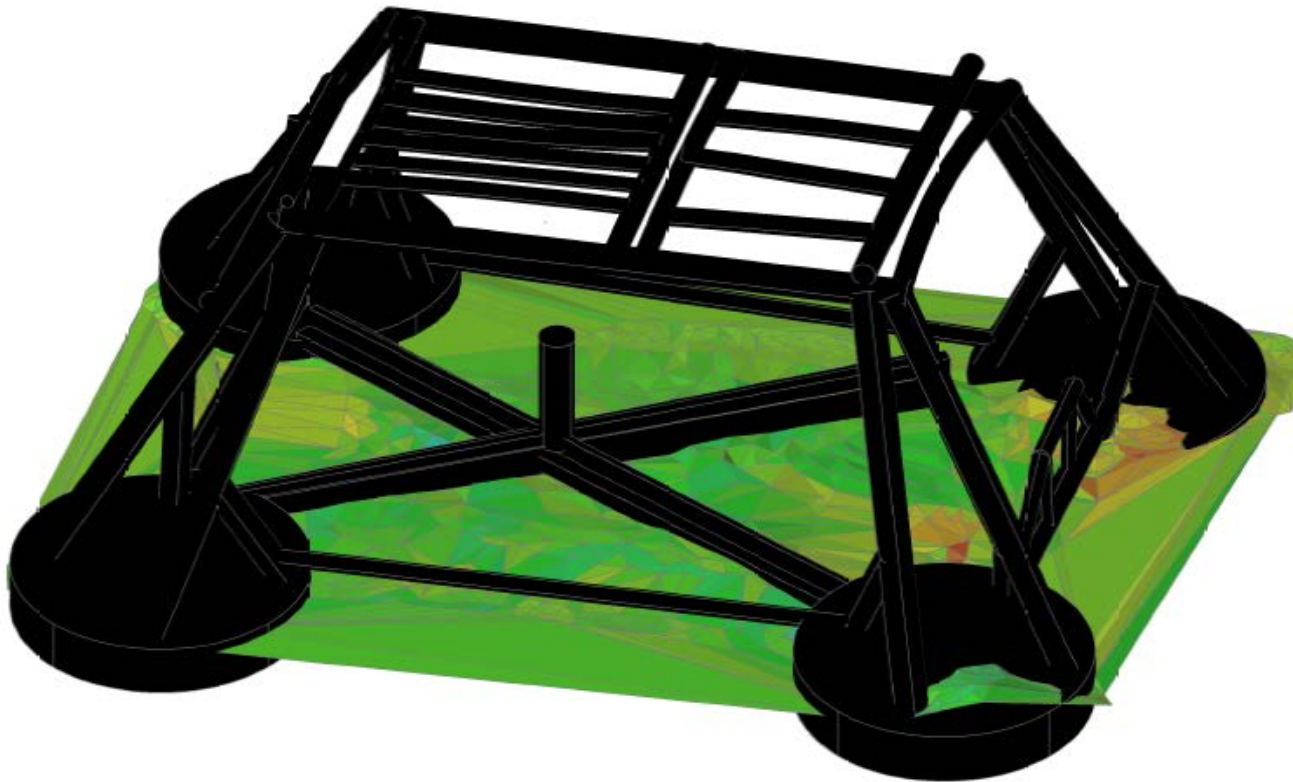


## STARNET GEOMATIC – 3D MODEL

- StarNet supplied 3D Drawings on 25th May 2013
- StarNet felt that what DeepOcean was requesting went beyond what Starnet understood was their original remit i.e The delivery of xyz file
- Although clearly reluctant they agreed to attempt to construct 3D Model from dataset
- There were clearly issues with supplied drawings



## STARNET GEOMATIC – 3D MODEL



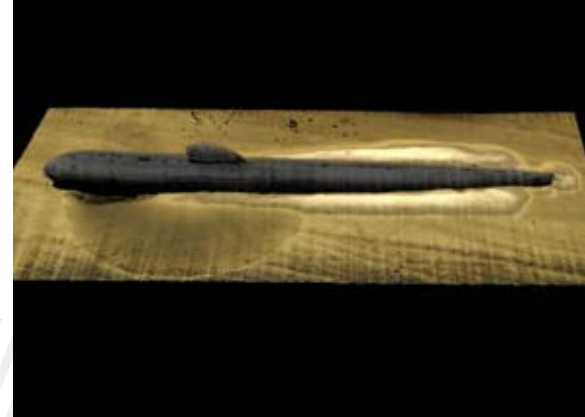
## STARNET GEOMATIC – 3D MODEL

- DeepOcean Queried Supplied 3D Model
- StarNets Reply
  - Original request was for metrology purposes – this is primary use of Blueview
  - It is not equivalent to terrestrial laser scanning
  - The noise in the data set is what would be expected from any Blueview data
  - Survey was completed exactly as originally requested
- Discrepancy between DeepOcean / Statoil and StarNet's understanding of:
  - System capabilities
  - Data quality
  - Intended Deliveries

## REPROCESSING BY ADUS

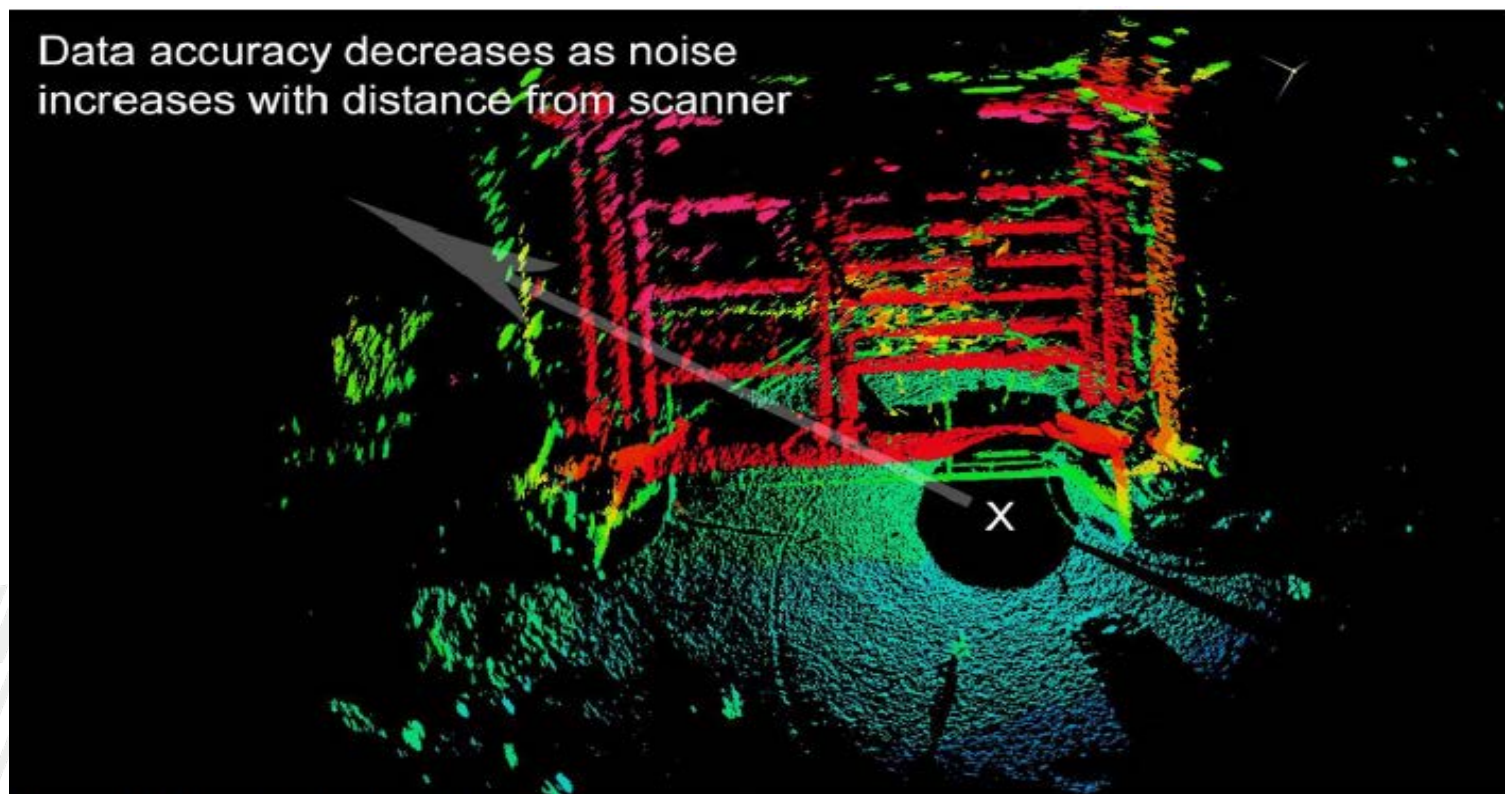


- DeepOcean contacted ADUS 7th June 2013
- DeepOcean have 50% holding in ADUS (based in Dundee)
- ADUS specialises in high-resolution multibeam sonar surveying and visualisation
  - Projects Include
    - Costa Concordia
    - DeepWater Horizon
- The following data was supplied to ADUS
  - ROV Video files: Showing the well head structure
  - E4 Combined point cloud (E4.xyz) approx. 774 mb
  - E5 Combined point cloud (E5.xyz ) approx. 919 mb
  - Manifold Combined point cloud (Manifold.xyz) approx. 589 mb



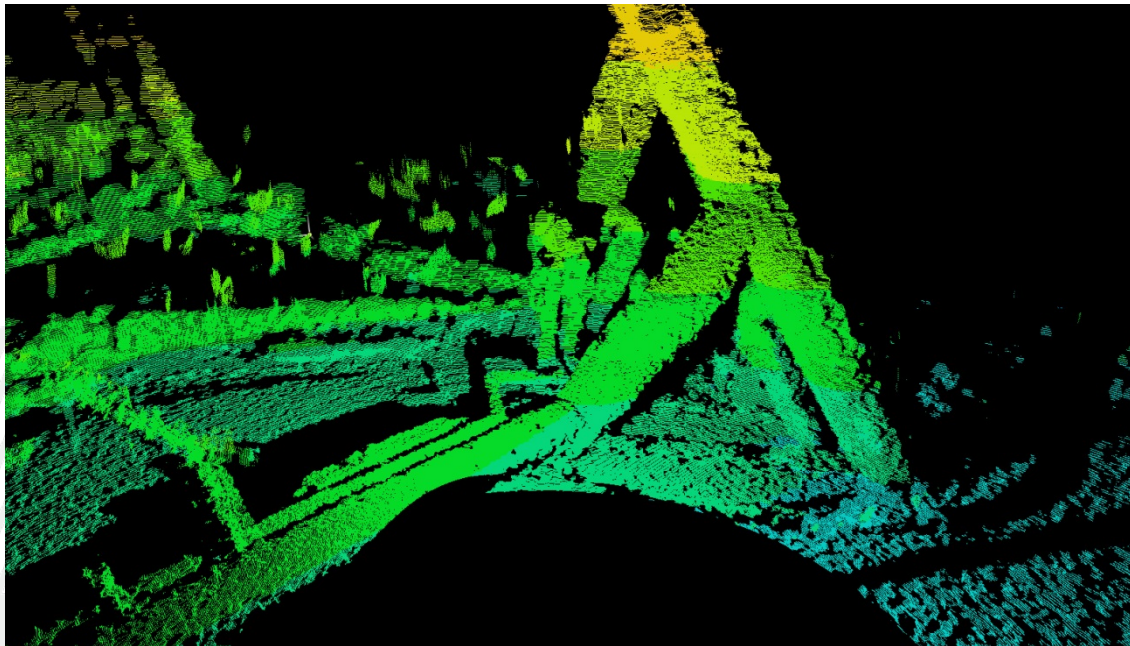
## ADUS METHODOLOGY

- ADUS determined that accuracy diminished rapidly as distance from scanner increased

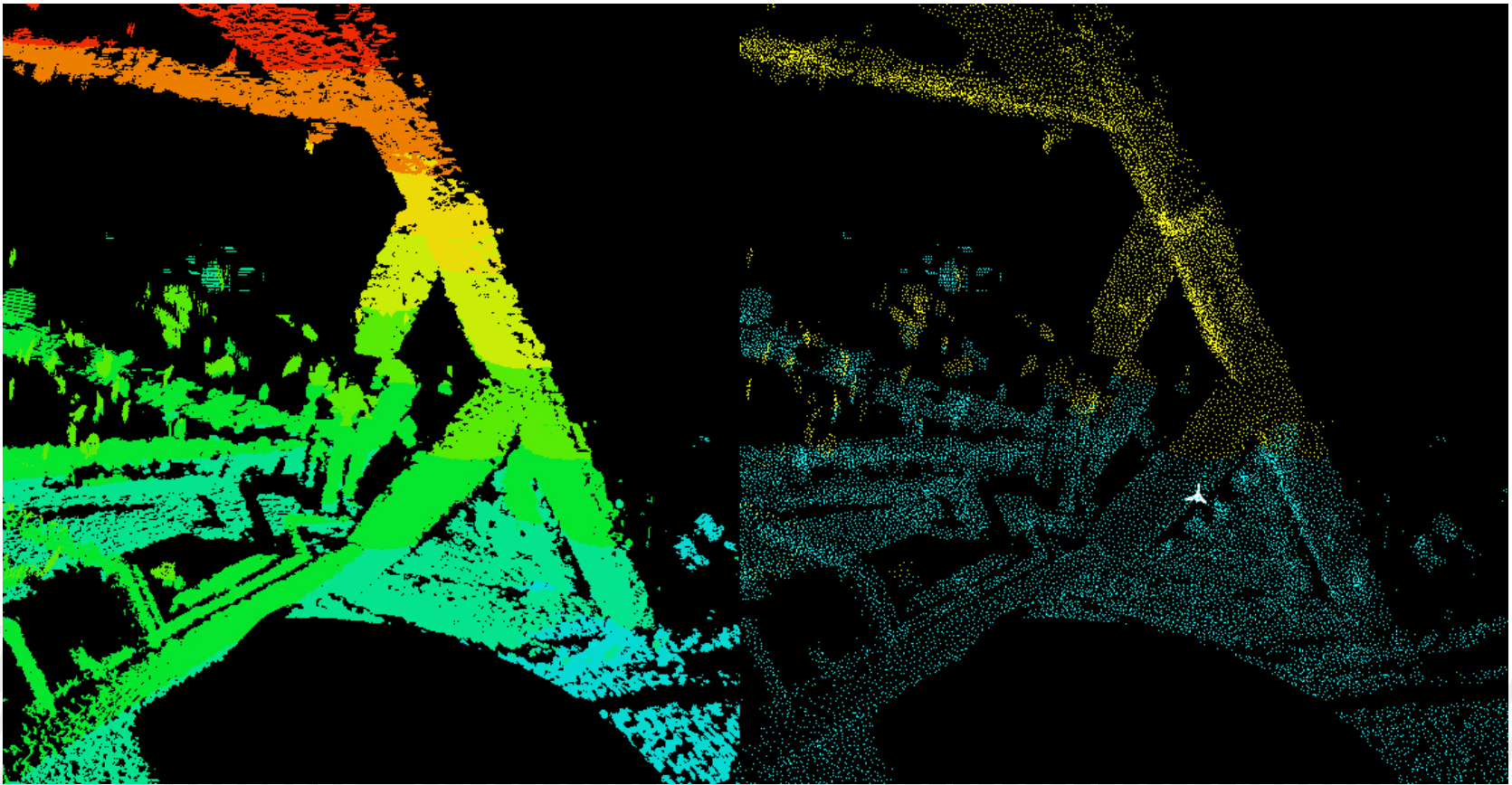


## ADUS METHODOLOGY – NOISE REMOVAL

- By combining all 16 of the E5 survey scans, noisy data from opposite sides of the structure was obscuring “good data” gathered in close proximity to the scanner position
- Distance threshold was set at approx. 10 meters from the scanner location for each survey scan position



## ADUS METHODOLOGY – SUB SAMPLING



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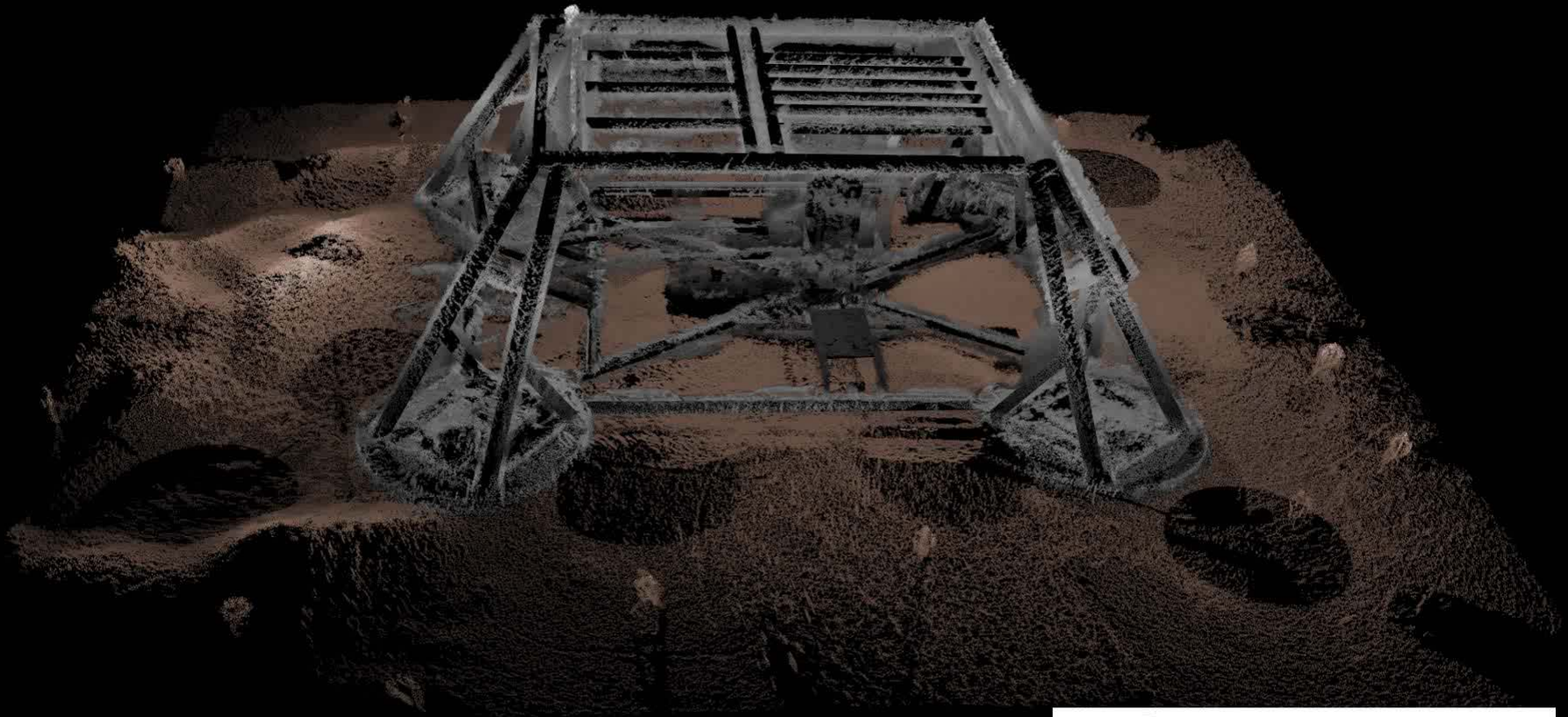
## ADUS RESULTS – ALIGNING CLEANED POINT CLOUD WITH 3D MODEL

E4 Data

Subsampled to 1,000,000 Points

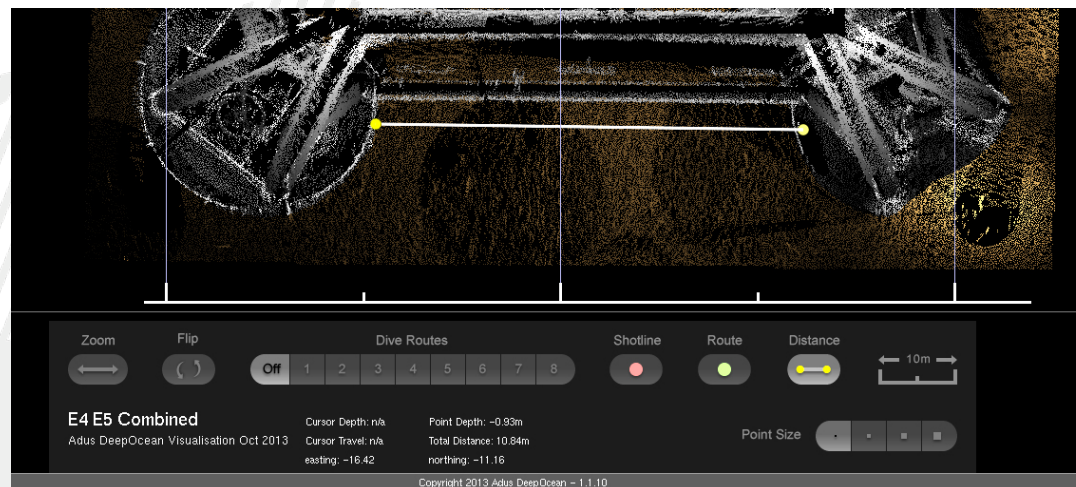
Starnet model imported and aligned with upper frame.

## ADUS RESULTS – 3D VISUALISATION

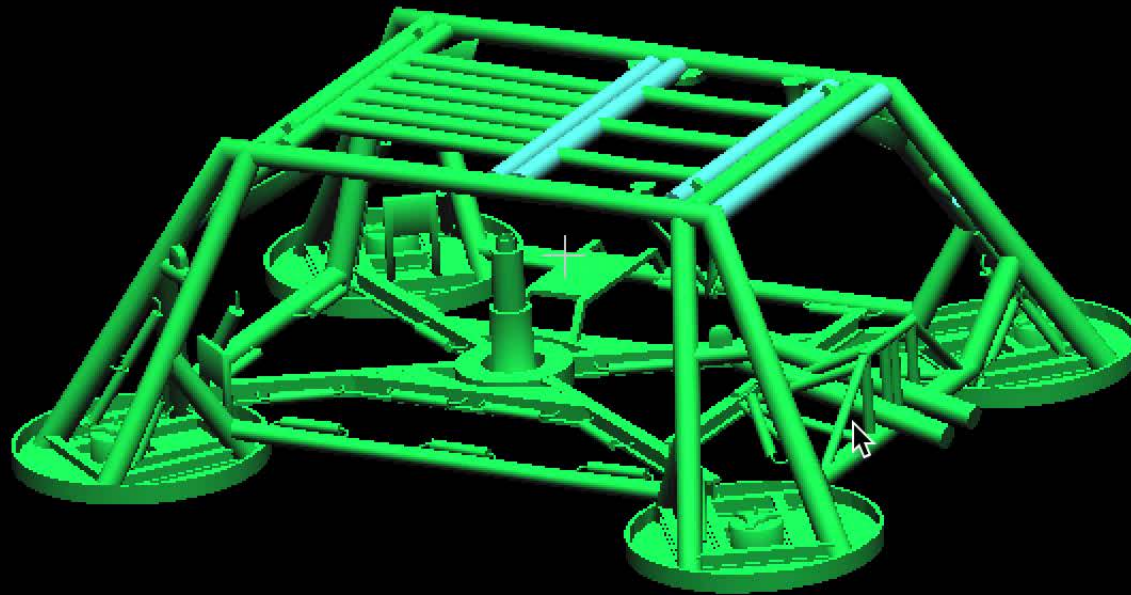


## ADUS RESULTS – COMBINATION OF E4 & E5 DATA SETS

- Primary interest (from the client) was in the E4 structure.
- Data supplied for E4 was limited to four survey scan positions.
- These were gathered with the scanner placed above the structure with the top gates opened to allow access to the subsea tree.
- Data from the protective outer structure was limited and of low quality due to the noise/distance issues previously described.
- 
- Outer structure was extracted from the E5 data and combined with the inner data from E4.
- The two datasets fitted together very well did not require any re-alignment or scaling.
- Combined E4 / E5 data was visualised using ADUS Deepocean's *Wrecksight* application to allow interactive exploration and measurements to be taken.

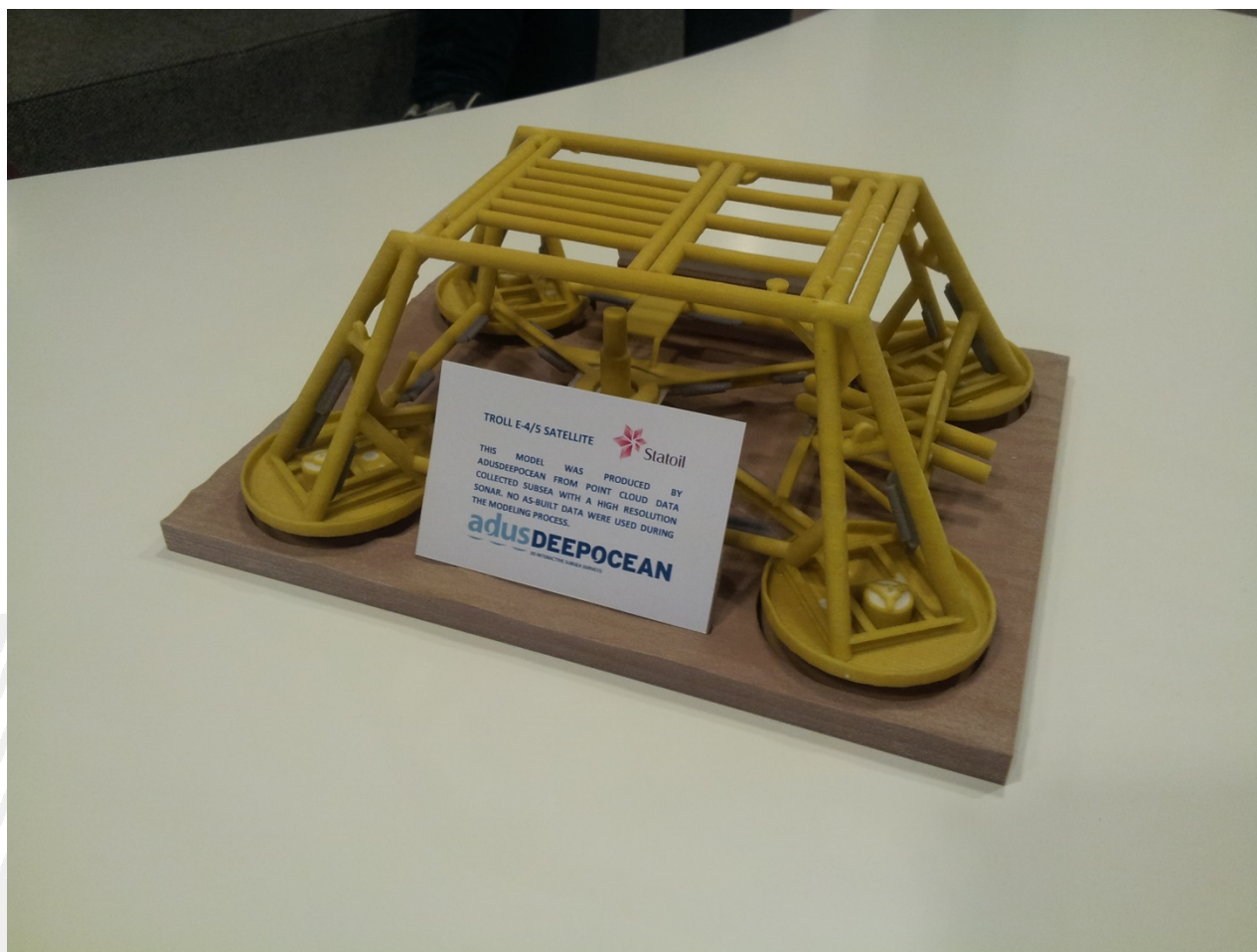


## ADUS RESULTS – 3D SURFACE MODEL

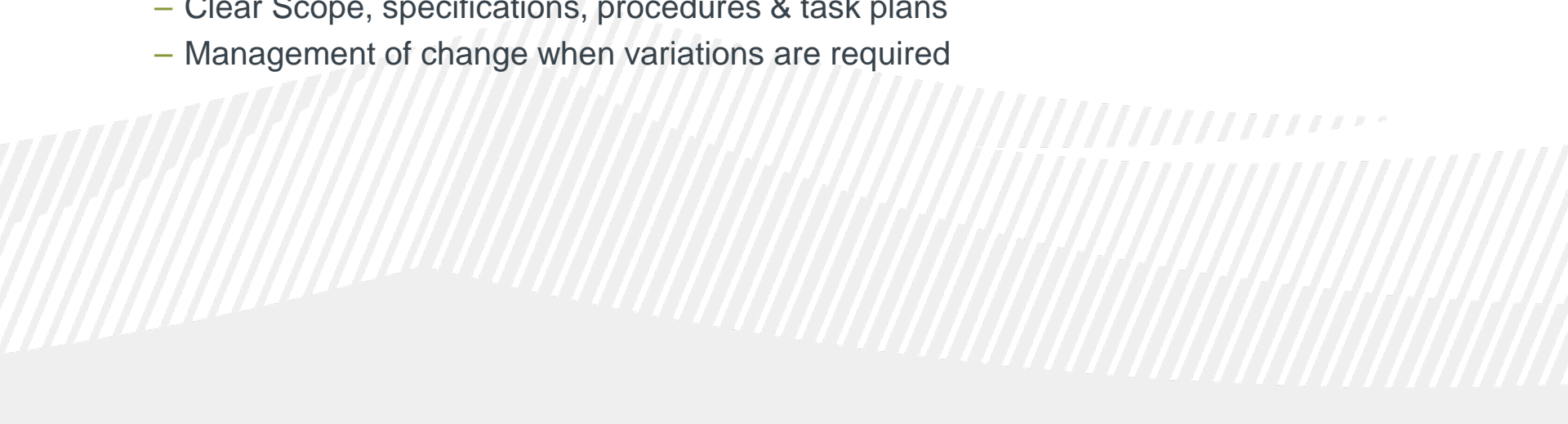


## 3D PRINTED MODEL

- 3D Model Printed in DeepOcean Office Haugesund – from Model Generated by ADUS



## CONCLUSIONS AND FINAL REMARKS

- We are all experts in our field – make sure to understand possibilities and limitations of new or different technology.
  - Keep communication lines short and clear.
  - Document important discussions and decisions – onshore and offshore.
  - Common understanding of goals and objectives from top to bottom.
    - Clear Scope, specifications, procedures & task plans
    - Management of change when variations are required
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- A decorative graphic consisting of numerous thin, parallel diagonal lines in a light gray color, arranged in a fan-like pattern that originates from the bottom left and extends towards the right side of the slide.

## ACKNOWLEDGEMENTS

- **DeepOcean**
  - Jone Vikingstad – IMR Operations Manager
- **ADUS DeepOcean Ltd.**
  - Chris Rowland
  - Mark Lawrence

[www.adus-uk.com](http://www.adus-uk.com)

A decorative graphic consisting of numerous thin, parallel diagonal lines in a light gray color, originating from the bottom left and extending towards the right, creating a sense of movement or a stylized horizon.

## To Finish

- Thank You
- Questions?