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Terrestrial Laser Scanner High Station to Control the Quality of DEM Data

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Research areas: Digital Elevation Models, Quality, Scanner Laser, Photogrammetry, Heritage

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Introduction

Acknowledgment

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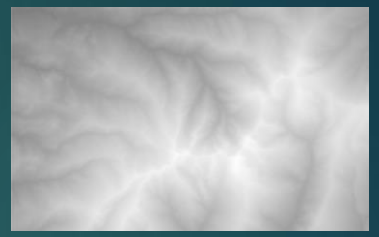
Introduction

Factors influencing the Digital Elevation Model (DEM) quality:

- Data source
- Capture method
- Data processing: e.g. resampling methods like the nearest neighbor, bilinear, bicubic interpolation
- Cell size



Most important capture methods to derive DEMs:

- Photogrammetry
- LiDAR

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Introduction

Traditional Assesment of DEMs:
- Vertical dimension
- Points samples
- Assesment standard-based: NMAS and ASPRS positional accuracy

Assesment proposed by **FQ4DEM** research project:
- Principle: Surface nature of a DEM should be assesed by surface samples
- **Patch** samples (square shape)

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Functional Quality of Digital Elevation Models in Engineering (FQ4DEM)

FQ4DEM Objectives:

- Main: Determining the Functional Quality of a DEM depending on several use cases
- Secondary: Developing a patch-based method to assess the DEM quality

KEY activity in the FQ4DEM Project

Quality control of a high density LiDAR flight (hd_LiDAR_flight):

- LiDAR density: 14 poins per square meter
- Altimetric RSMEZ = 0.15 m (Technical specifications)
- Area covered by the hd_LiDAR_flight: Navarra, Spain, 10391 km^2

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Functional Quality of Digital Elevation Models in Engineering (FQ4DEM)

Quality control of a high density LiDAR flight (hd_LiDAR_flight):

- hd_LiDAR_flight is considered the product to be assessed (PCpro)
- The reference data will come from a more accurate terrestrial scanner laser registration (PCref)
- The PCref will be captured by the FQ4DEM research team by a campaign on the ground


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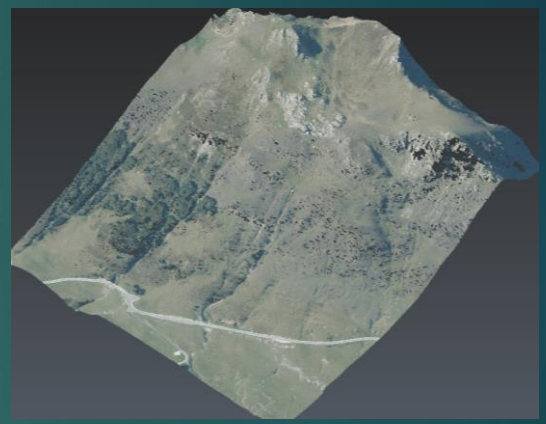

PCpro


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PCref

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Capture device for the PCref patches

- Capture method for the patches: terrestrial laser scanner BLK360
- Design device: hanged inverted BLK360 on a pole (7 m tall ability)
- Large tripod (4.5 m extension ability) supporting the pole

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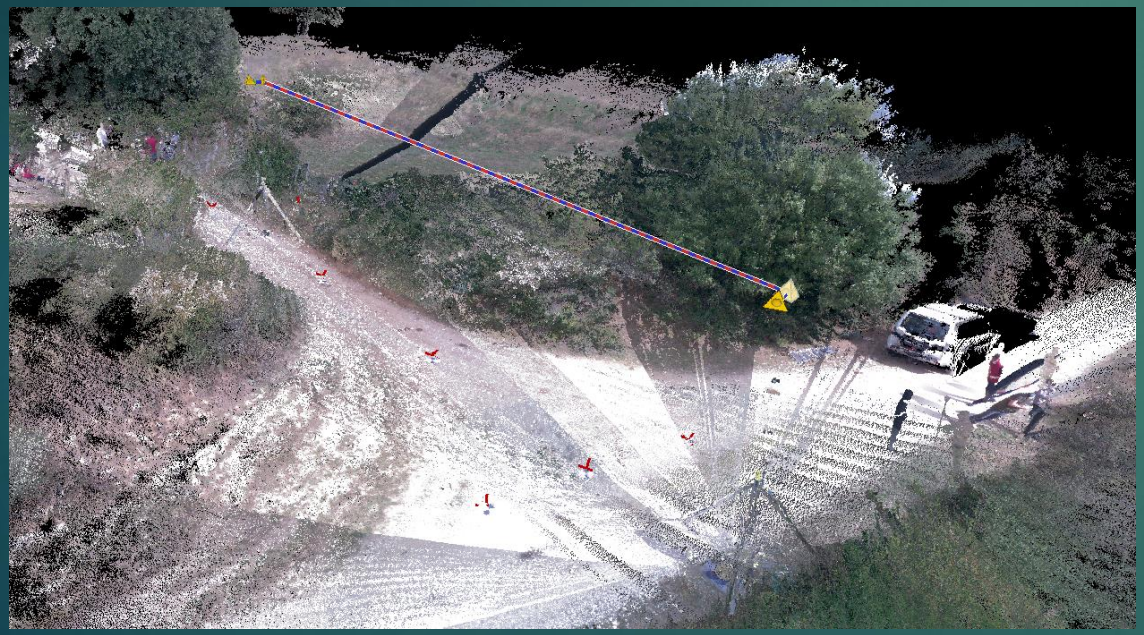
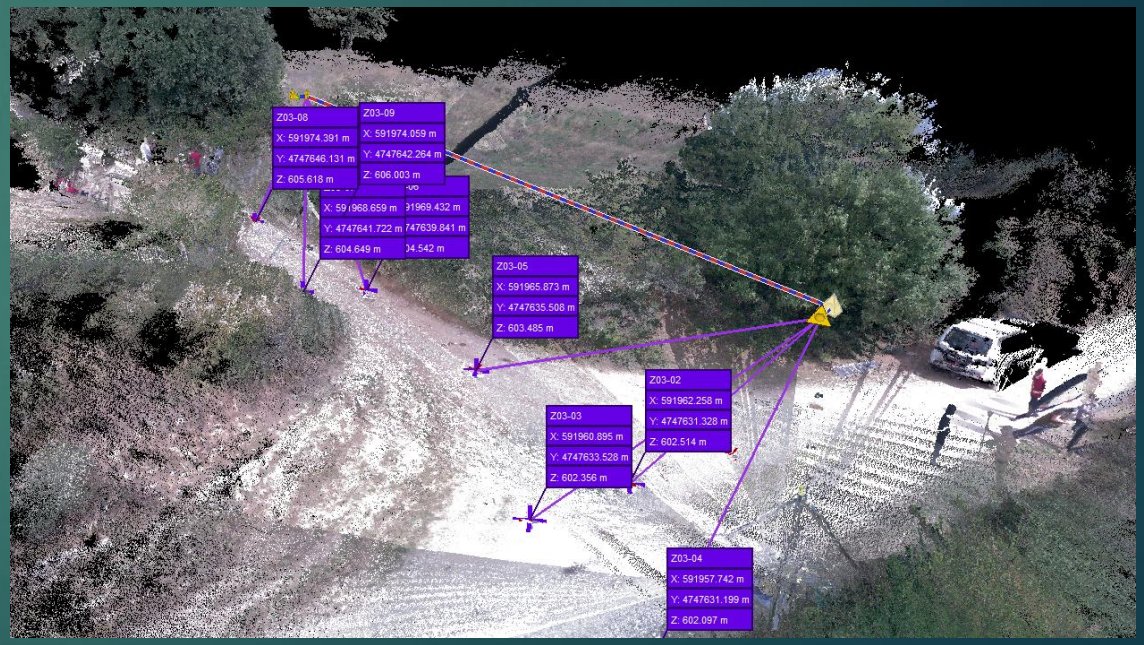
TLS patch settings

- 4 scan stations per patch grouped by 2 and each group separated by 20 m
- Scan registration by Cyclone Register 360
- Georreferencing: 9 control points distributed according figure
- Patch dimensions 50 m x 50 m





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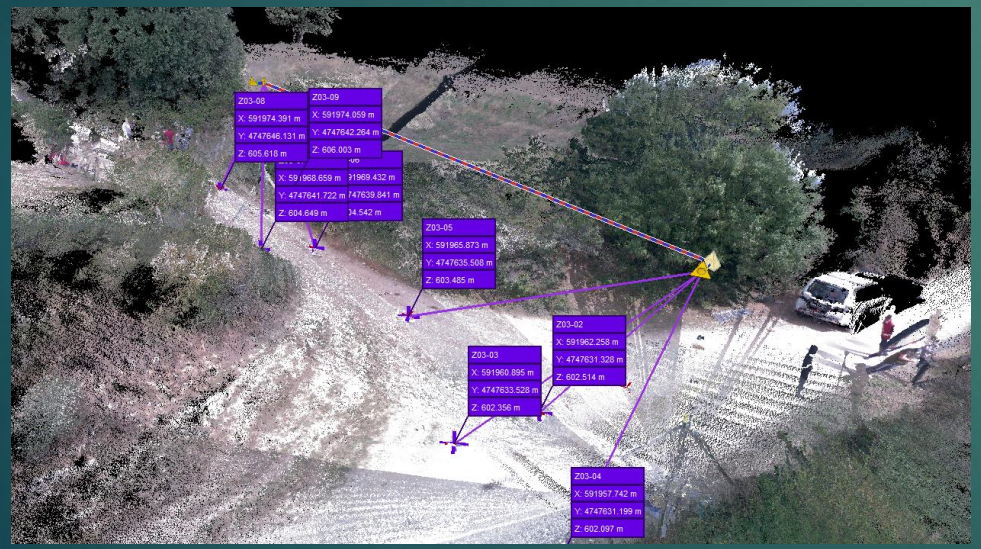
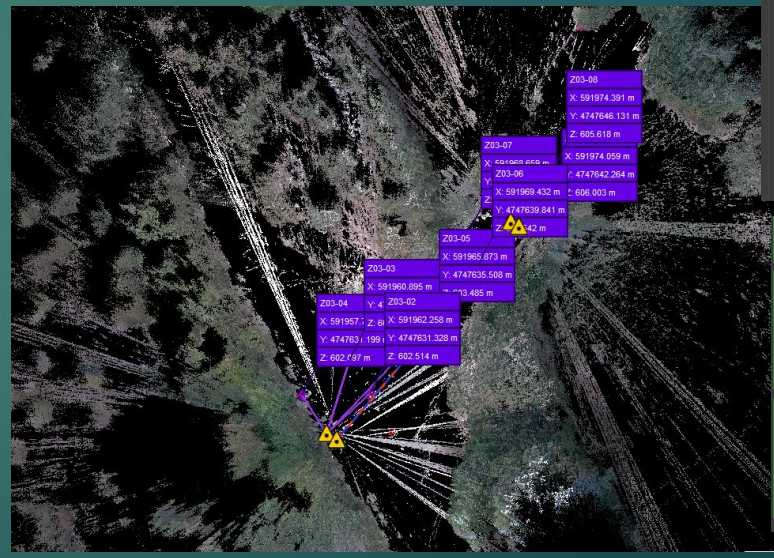
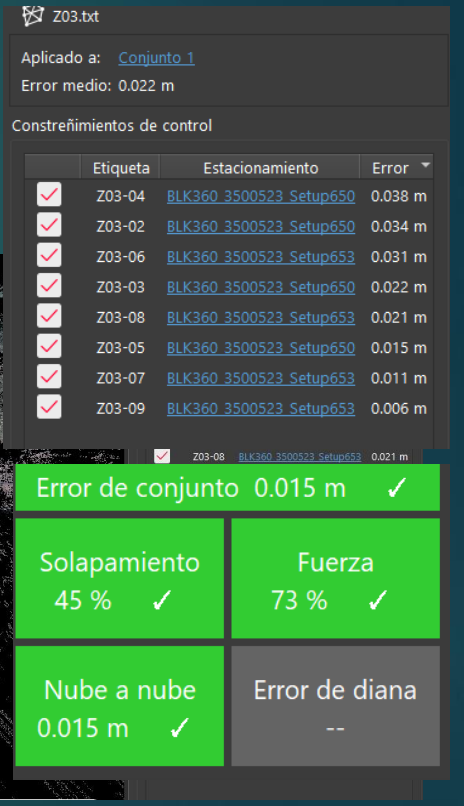
TLS registration process

- Set error in every registration is smaller thant 0.03 m
- and RSME for control points is smaller than 0.04 m in all zones
- Because PCref RSME <0.04 m and PCpro RSME = 0.15 m our TLS data (PCref) can be used as reference model.







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Criteria selection

GNSS georeferencing

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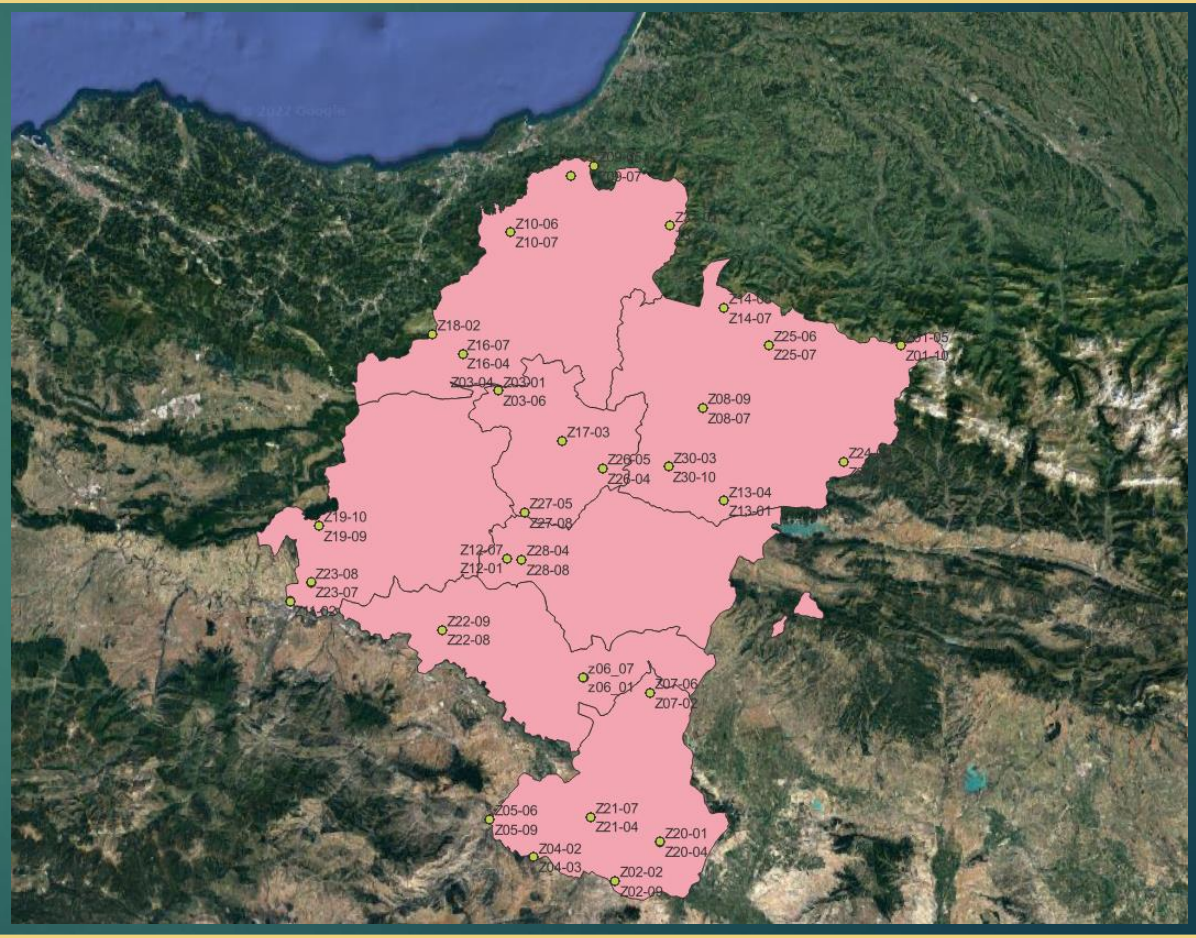
Patches criteria selection: location, quantity and topographic features

After consulting experts the requirements for patches were the following:

- 30 zones covering the whole Navarra region
- Ground: bare earth as much as posible
- 3 types of topography equally represented: upland, hill and mountain
- Not too difficult ccesibility



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- Navarra Goverment and
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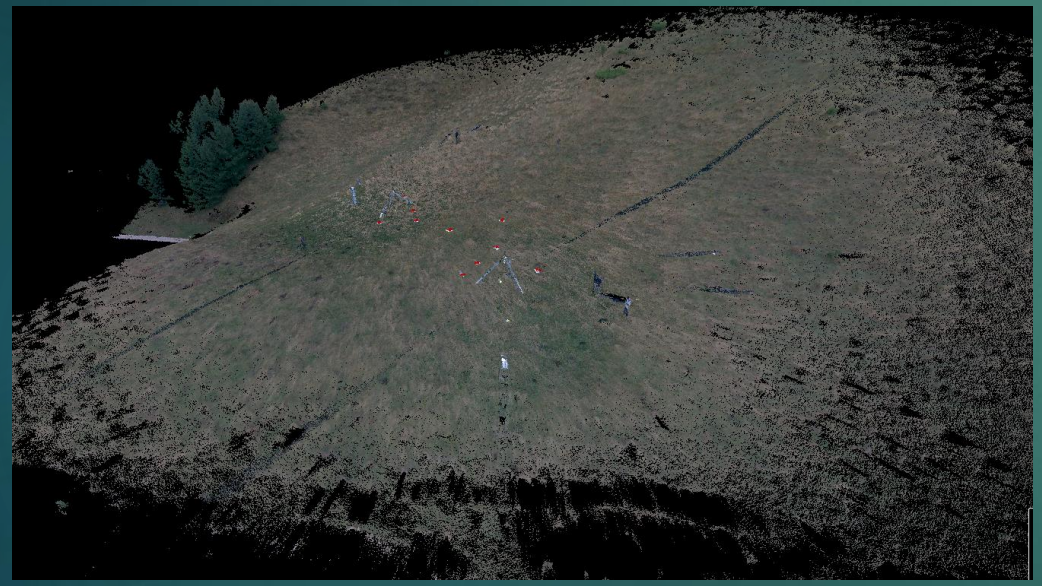
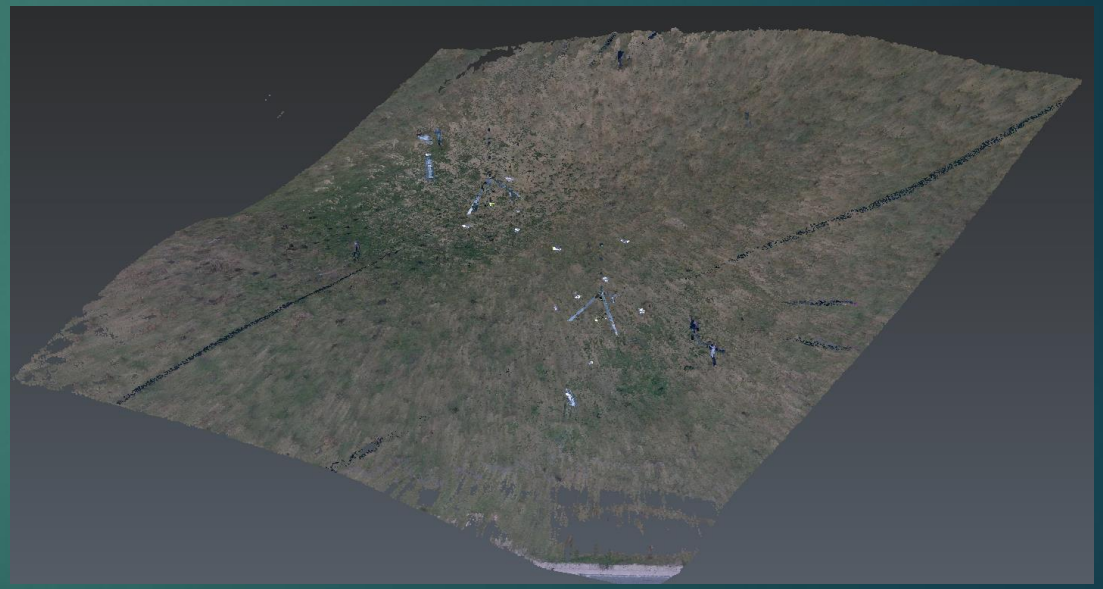
Post-processing tasks: clipping 50 m x 50 m patch

Not clipped PCref after registration



Clipped PCref after registration



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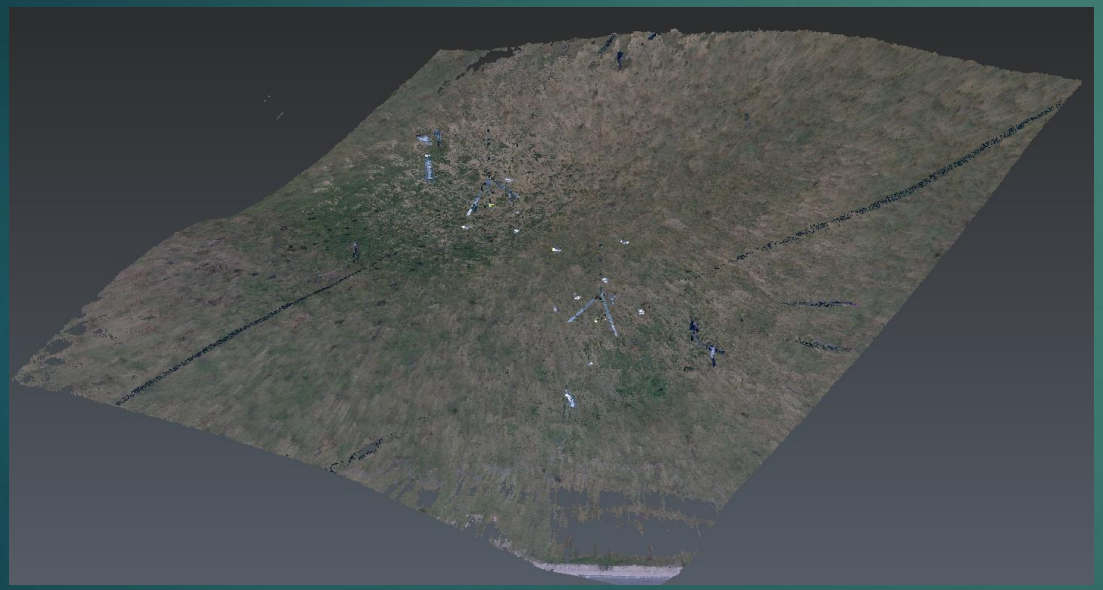
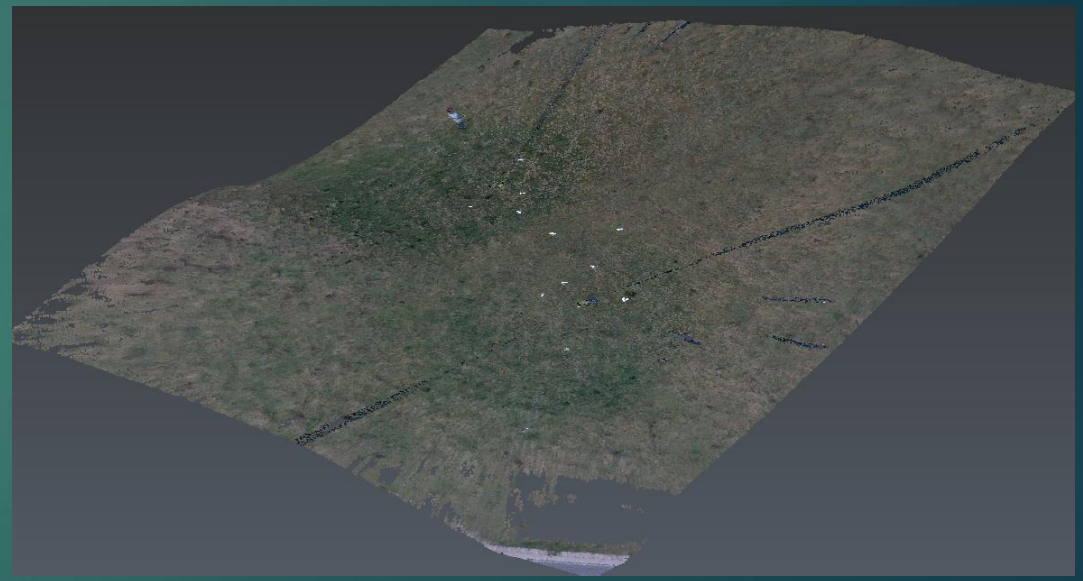
Post-processing tasks: Filter (cleaning objects and vegetation)

Not filtered PCref
(23425113 points)



Filtered PCref
(18377804 points)



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Post-processing tasks: cleaning objects and vegetation

Not filtered Pcref
(tripod and person)

Filtered Pcref
(tripod and person deleted)

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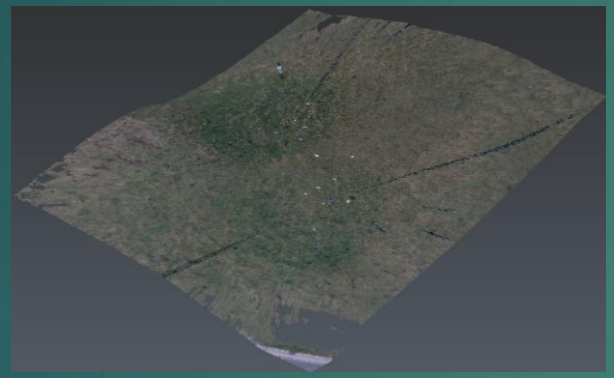
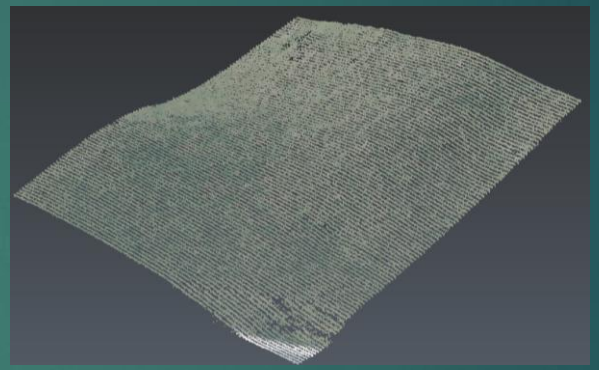
From Point Cloud to DEM and Statistical analysis

PCref-DEMref

Resample point cloud to 1 cm point-separation
Point cloud (PCref) to DEM (DEMref):

- Bilinear interpolation resampling method
- DEMref cell size 10 cms





Filtered Pcpro-DEMpro

- Point cloud density 14 pt/m^2 from LiDAR
- Point cloud (PCpro) to DEM (DEMpro):
  - Bilinear interpolation resampling method
  - DEMref cell size 10 cms

DEMref

Comparing

Statistical analysis

DEMpro

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Conclusions

- Quality control of a high density experimental LiDAR flight (Pcpro)
- The superficial nature of the models requires patch samples to apply statistical analysis
- The reference model (Pcref) to control the PCpro was captured by a TLS device
- 30 areas covering the whole Navarra region where selected
- Post-procesing tasks were necessary to derive the DEMs from de PCs: clipping, filtering and point cloud resampling.

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