Benaco laser export instructions

v74, last updated 2025-06-27

This document describes how to export data from common laser scan and photogrammetry software for use with Benaco.

Table of contents

Prerequisites and points cleaning (read this first)

Both RGB point clouds and RGB panorama images are needed for Benaco to process your data. We cannot process datasets with only point clouds at the moment.

The displayed export methods ensure that Benaco understands which points were seen from which scan position, and that the associated RGB photos are included in the export.

You should clean the point clouds first in the programs of your choice.

Benaco can also display (drone) photogrammetry results exported as textured meshes.

In case of questions

If you have question, or find that the instructions or screenshots no longer agree with the current version of your software, please use the support chat on the benaco.com or email support@benaco.com

Faro SCENE

Provide Benaco with an export folder containing the following:

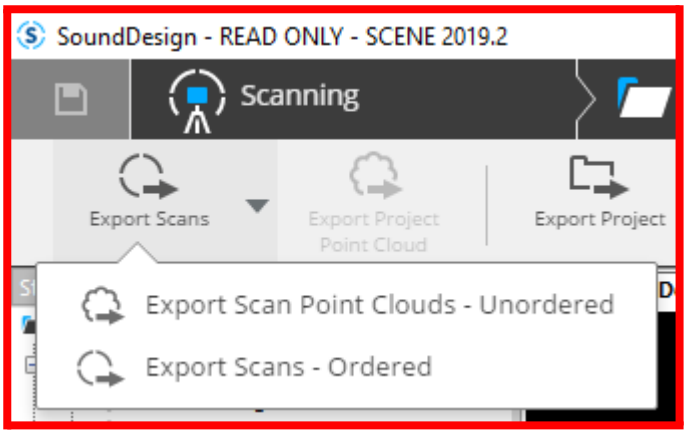
1. The point cloud in E57 format, into subfolder "`pointclouds`":
    a. In SCENE's **Export** tab, click the **Export Scans** button; from the dropdown choose **Export Scans - Ordered**.
    b. Choose **E57** as the format.
    c. Tick the checkbox [✘] **Export each scan into a separate file**.
    d. Tick the checkbox [✘] **Full Color Resolution Panorama Image**.
        - If this checkbox is missing **or** if you have some scans that were scanned without colour, go to Exporting full resolution panos from SCENE.
        - If you use the Faro + Ricoh Theta integration instead of the builtin scanner RGB camera, go to Exporting Ricoh panos.

    Do not submit "Unordered" point clouds or "Project Point Clouds", as these do not contain the original scanner positions.
2. Highly recommended:
    The Project Point Cloud as E57 into subfolder "`coloring-pointclouds`".
    SCENE's Project Point Cloud with Color Correction enabled makes for much better colors. Unfortunately they do not retain scanner positions, which is why they are needed *in addition* to the "Ordered Scans" export.
    a. Disable all clipping boxes to ensure the project point cloud is not truncated.
    b. In SCENE's **Explore** tab, click the **Project Point Cloud** button; from the dropdown choose **Create**.
        - Tick the checkbox [✘] **Apply Color Balancing**.
        - (Optional but recommended): Tick **Homogenize Point Density**. Choose a **Cell Size** of **2mm**.
    c. In SCENE's **Export** tab, click the **Export Project Point Cloud** button.
        - Choose **E57** as the format.

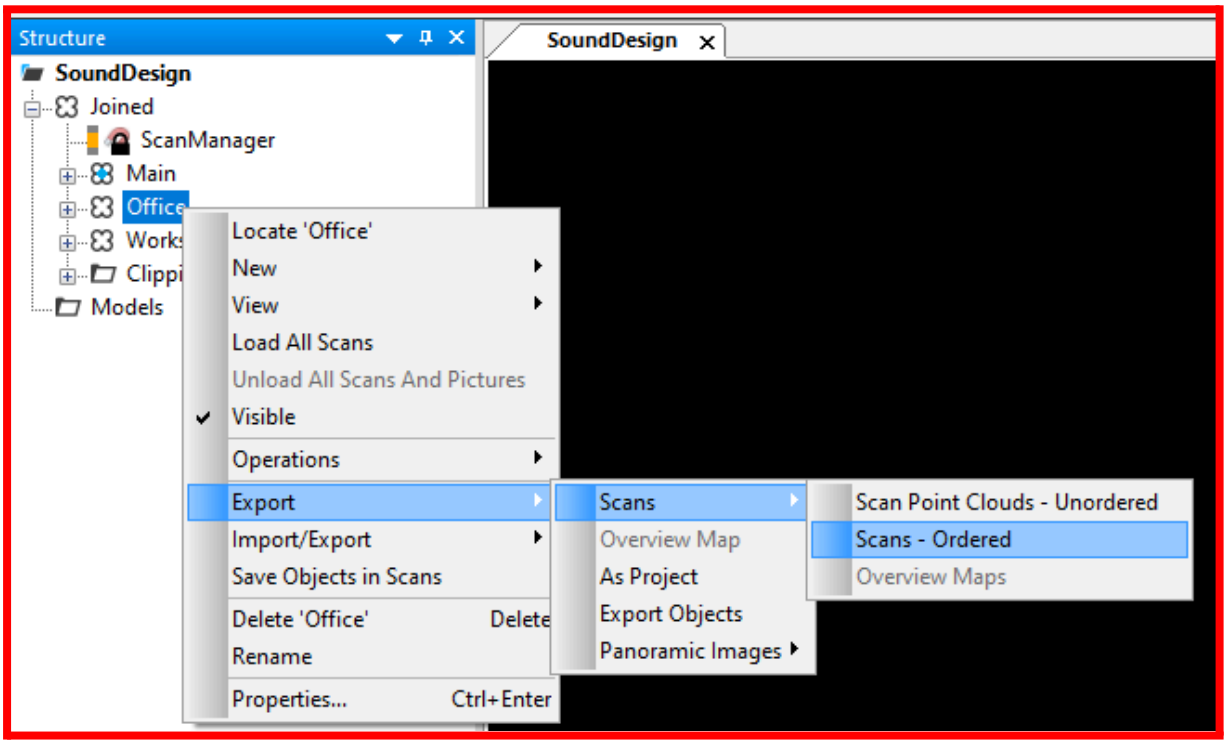
Double-check that the number of files in the export folder is as expected.

You can find a screenshot of what the final export folder should contain in the section Reviewing a SCENE export.

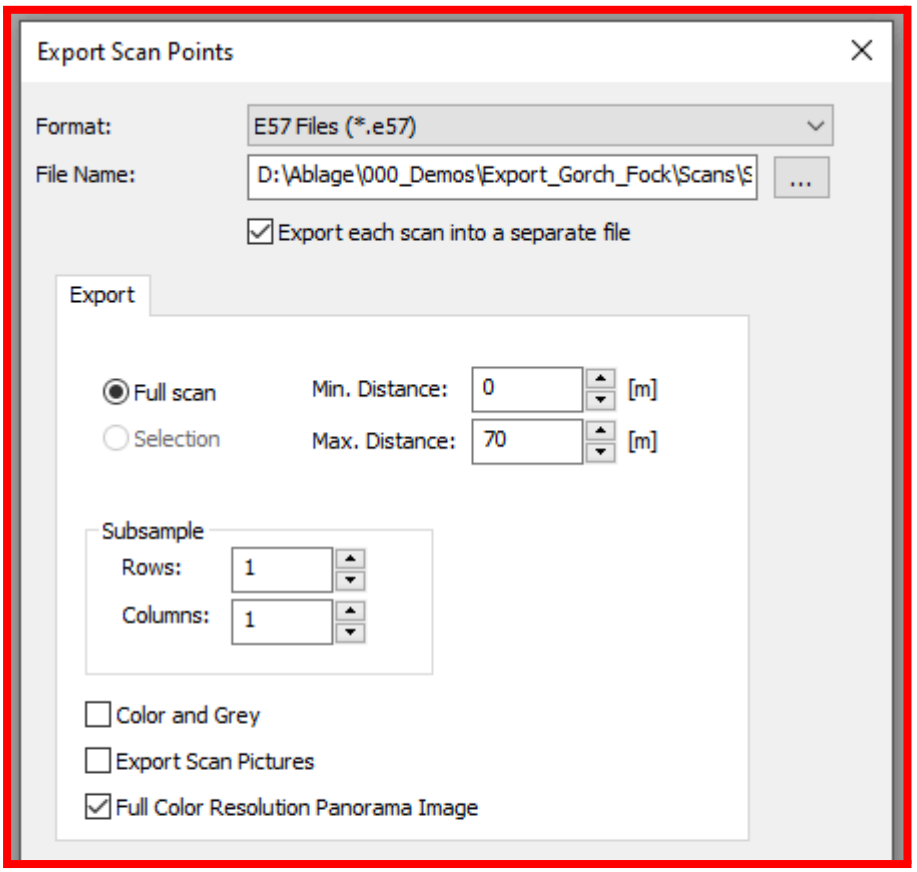
*Step 1: Exporting **ordered** Scans via the Export tab:*



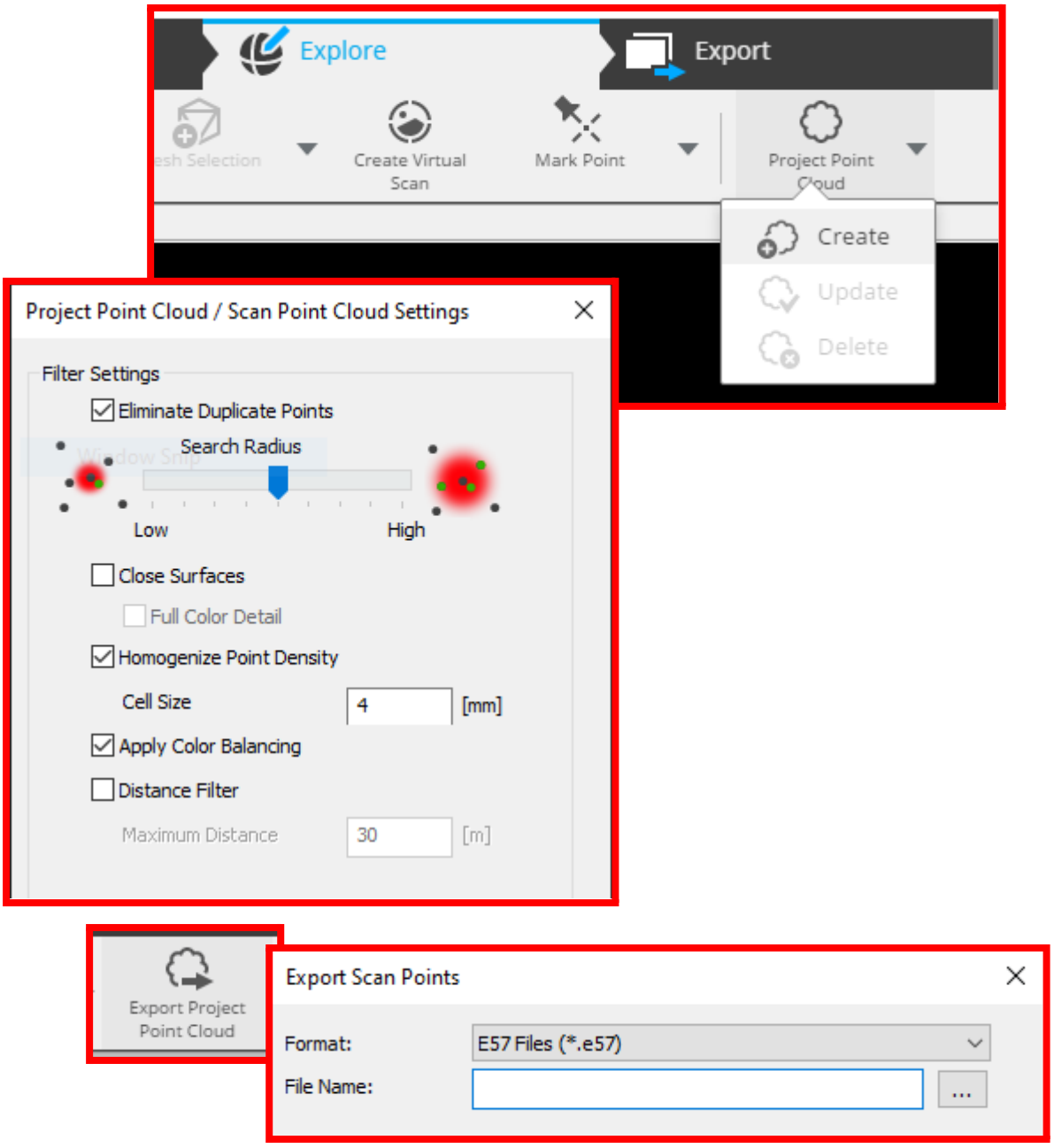
*Step 1 (alternative): Exporting a subset of the project as **ordered** scans via right-click in the project structure:*



*Steps 1 (b),(c),(d): Choosing the **E57** file format, enabling **separate** files and **pano images**:*



Step 2: Creating and exporting a color-corrected Project Point Cloud:



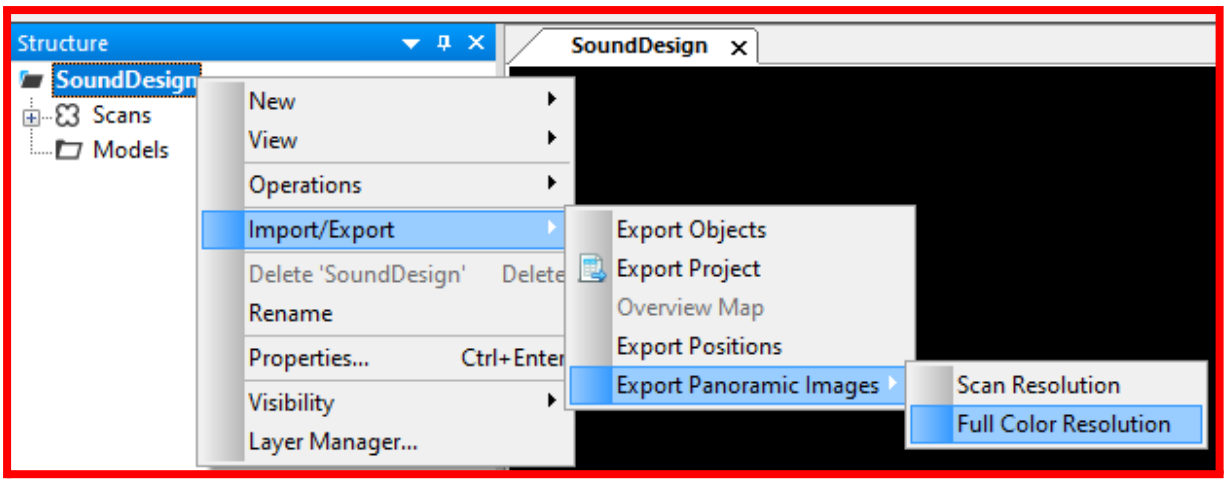
Exporting full resolution panos from of SCENE

You should follow the steps in this section if either:

- your version of SCENE is too old to have the checkbox [✘] **Full Color Resolution Panorama Image** to embed the panos into the E57 files, or
- you scanned some scans without colour and you want to display them in grayscale in Benaco (SCENE cannot currently embed grayscale panos into E57 files); in that case choose option (b) below.

Then you should export the panos as separate files:

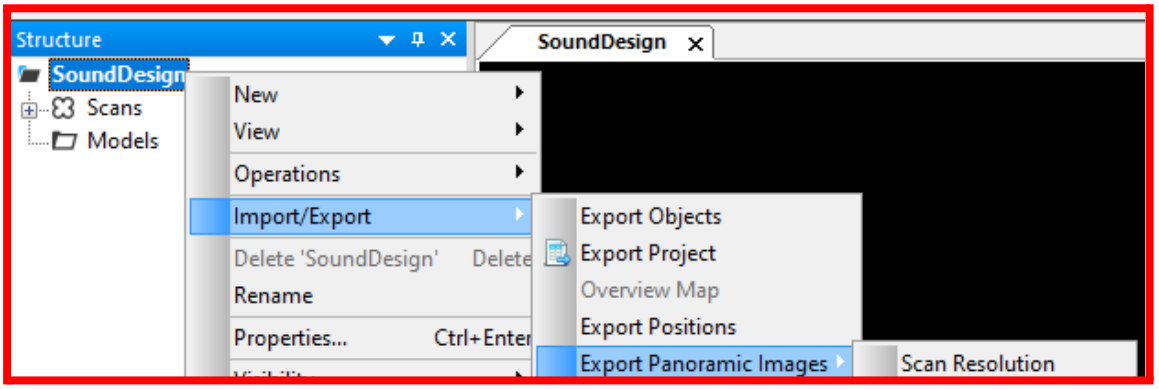
- Export the RGB image data, into subfolder "**panos**".
  You have two choices:
  a. Full-quality panoramas **(recommended)**:
     Right-click on the desired Project or Cluster, and choose **Export**,
     Export Panoramic Images, **Full Color Resolution.**
  b. Downsampled quality panoramas (not recommended, but faster and smaller):
     Choose **Scan Resolution** instead of **Full Color Resolution.**
     This will allow you to choose the image file type.
     Prefer **PNG** (a lossless format) over JPEG (a lossy format).



Exporting Ricoh panos from SCENE

Only if you use the Ricoh Theta camera integrated with the Faro scanner as a *replacement* of the Faro internal RGB camera, you cannot use "Full Color Resolution Panorama Image" because the Ricoh images do not count as "full resolution".
Instead:

- In newer versions of SCENE (at least >= 2023.1), ensure each scan has a matching "PanCam Scan" otherwise, only grayscale intensity panos will be exported in the next step.
  If they do not exist yet, right-click your project and choose **Operations, Create PanoCam Scans.**
- Into subfolder "`panos`", export the Ricoh images that SCENE reprojected onto the laser origin (noticeable as it creates white outlines around the edges of objects).
  Right-click on the desired Project or Cluster, and choose **Export**,
  Export Panoramic Images, **Scan Resolution.**



- Optional, but very recommended:
  Into the subfolder "`external-panos`", save the original Ricoh RGB photos.
  You cannot retrieve them from SCENE, but instead from the scanner's SD card, from the folder of each scan ("fls") in the subfolder "PanoCam".
  Note these images need to be in **equirectangular, not double-fisheye** format.
  Benaco can currently only process equirectangular Ricoh panos in this step.
  If your panoramas are double-fisheye, you can skip this entire optional step.
  If you provide these images, Benaco can register them against the SCENE-reprojected images above, so that they are shown in the tour as well.
  Please check that these images are stitched equirectangular photos, not double-fisheye circles.
  Any double-fisheye circle photos need to be stitched into equirectangular first.

See Reviewing a SCENE export for the expected folder structure.

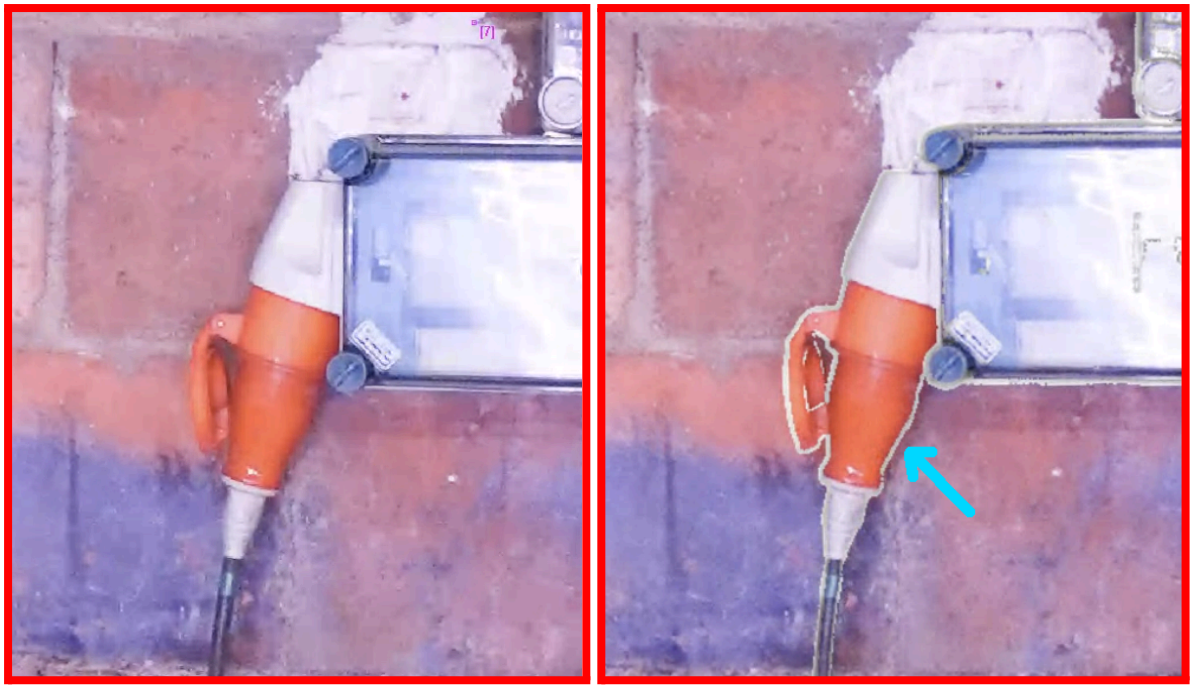
Exporting images from a non-Faro camera

SCENE optionally also supports importing photos that are made not by the laser scanner itself, but by a different camera mounted onto the scanner tripod in the same or a close-by position. It can colorize the scans using this external imagery.

You may want to use this external imagery in your Benaco tour.
In this case, the export steps remain the same, but you need to additionally provide the external imagery into a folder: `external-panos`

Be aware that if you have used external imagery for colorization, the **Export Panoramic Images** functionality in SCENE will not export the external imagery, but re-colorized laser scans. You can recognize this by black or white outlines around objects:

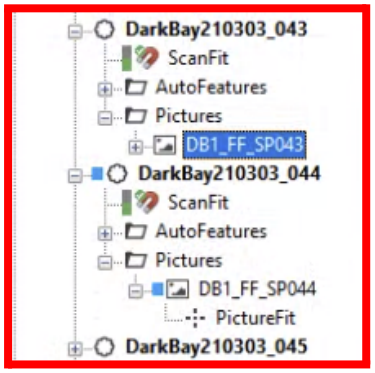
Comparison between original external image vs.
exported colorised scan panorama with outline:



It would be desirable to show only the original imagery in the Benaco tour, using the image positions that SCENE has already computed ("PictureFit"). However, to our knowledge, SCENE does not provide a way to export the exact pose data of the original images. Their positions can be slightly offset, and the images will usually be placed with an arbitrary rotation around the laser's vertical rotation axis.
In absence of an export method, you can provide Benaco with the original images, and we will use photogrammetry to register (place) them automatically against the colorized scans you provided.

- If your original panoramic images (must be in equirectangular format) are managed outside of SCENE (preferable), simply copy them into the `external-panos` folder.
- If you can access them only through SCENE, re-export them by expanding the **Pictures** section of each Scan in the Structure view, Right-click on the image file -> **Export**, and choose preferably a lossless format (e.g. PNG).

Exporting original imagery that was imported into SCENE:

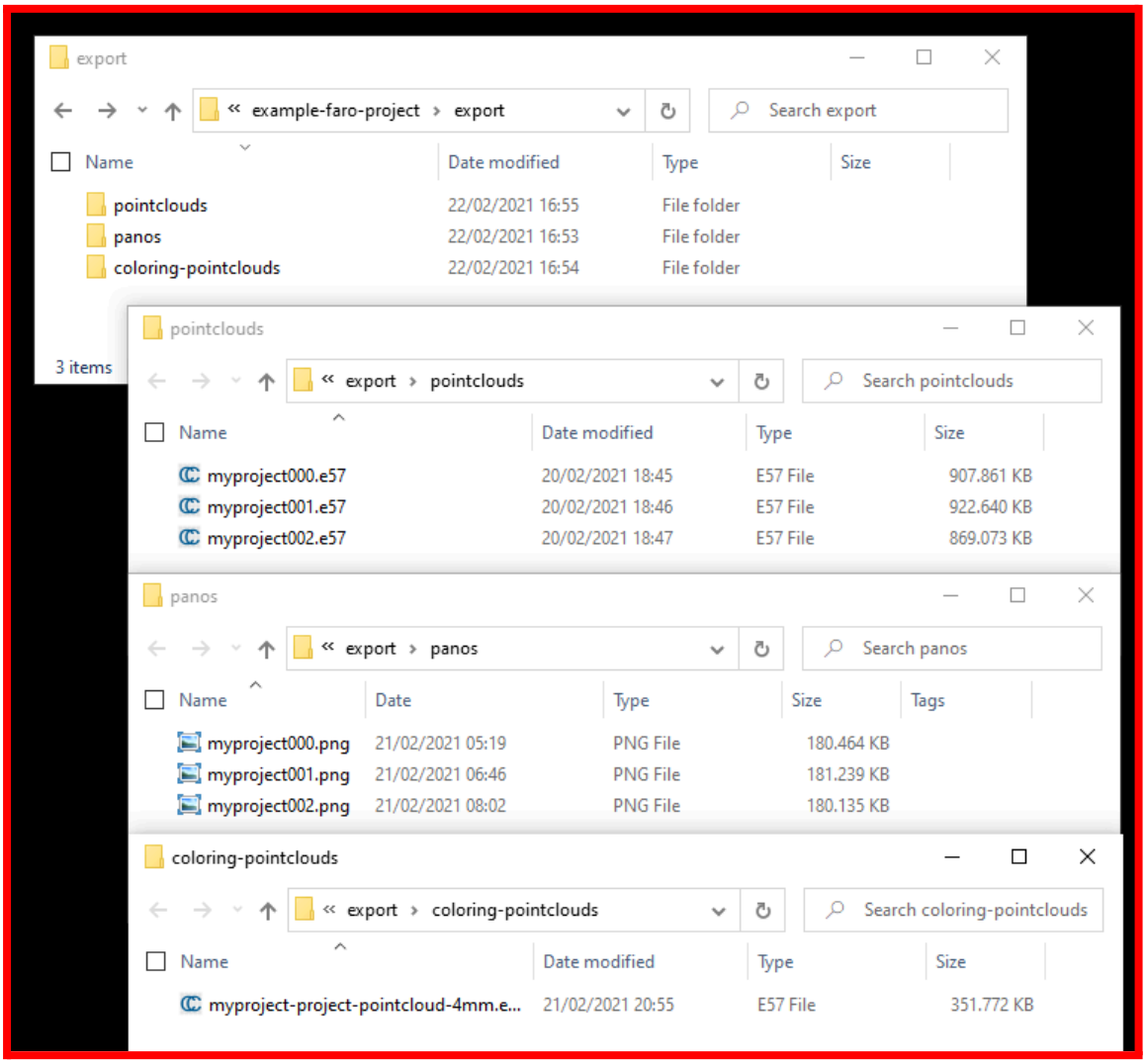


Reviewing a SCENE export

When you are done, the export folder should look as follows:

- `name-of-your-export-folder`
  - `pointclouds`
    - `myproject001.e57`
    - `myproject002.e57`
    - `...`
  - `panos` (only if your SCENE version cannot embed them into the .e57)
    - `myproject001.png`
    - `myproject002.png`
    - `Pano_FARO_Scan_000.jpg` (if you use the Faro-Ricoh integration the files are named this way instead)
    - `...`
  - `coloring-pointclouds`
    - `myproject-project-pointcloud-4mm.e57`
  - `external-panos` (if you use the Faro-Ricoh integration or make additional panocam shots; must be equirectangular)
    - `R0011533.JPG` (named this way if you got the Ricoh equirectangular photo directly from the Faro SD card)
    - `...`

Screenshot of the export folder and its subfolders:



Leica Cyclone REGISTER 360

Provide Benaco with an export folder containing the following:

1. In the **Report** stage tab, choose subtab **Properties** -> subtab **Publish options.**
2. Tick the box **[x] E57 (as separate files)**.
3. Conditional:
   If you scanned the entire project without colour, additionally export grayscale image panoramas by ticking the box **[x] Pano images**.
4. Click "Publish".

If you scanned with colour, you do not need to export panorama images separately; the E57 files already contain them.

When you are done, the export folder should look as follows:

```
name-of-your-export-folder/
      BLK360_3501552_Setup3.e57
      BLK360_3501552_Setup4.e57
      ...
```

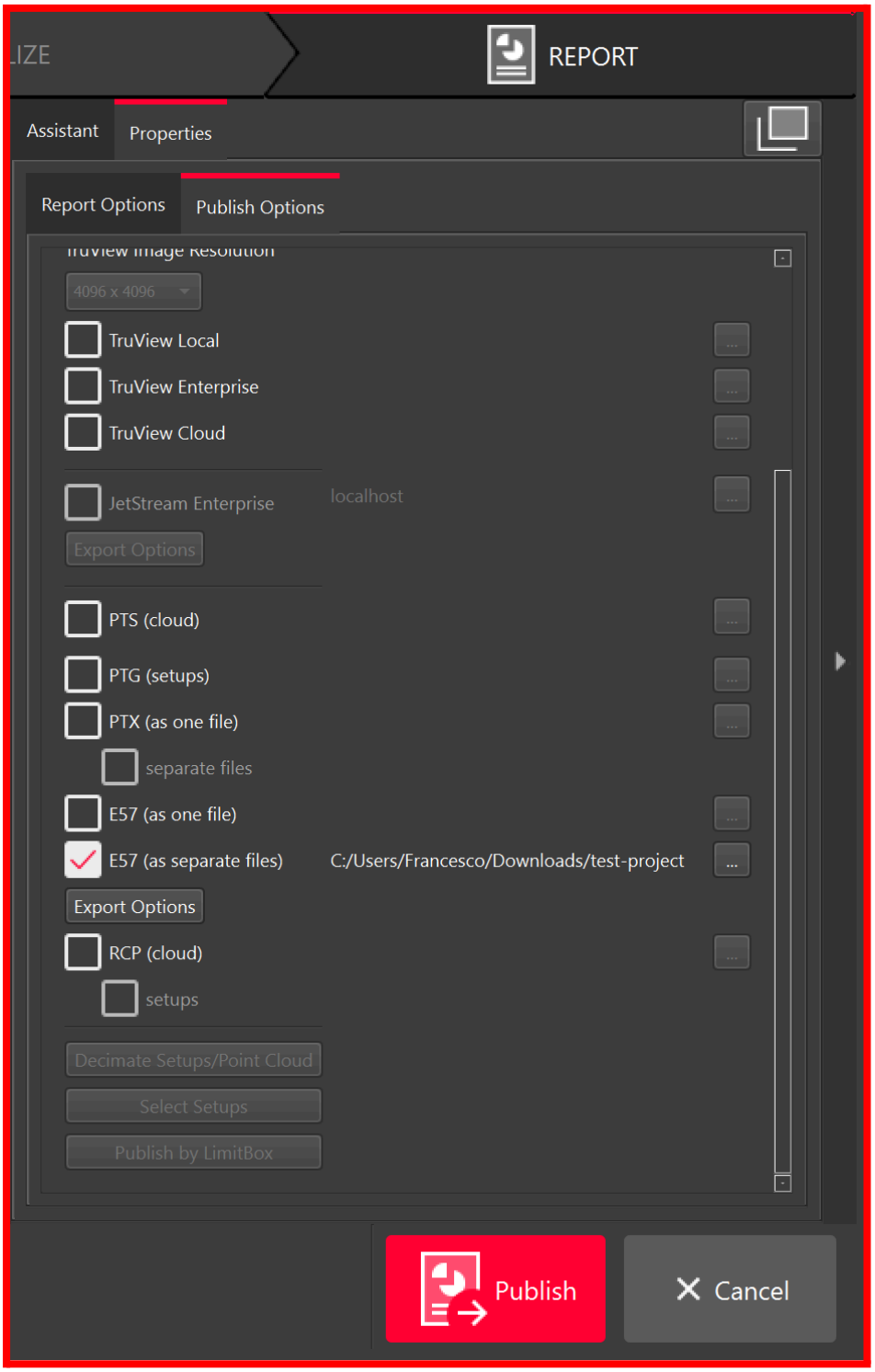
Settings for best quality

1. **Before importing** your scans ("setups") into REGISTER 360, in the **Settings**, change the **Pano image** dropdown to the highest resolution.

   This is optional. It will increase the import time, but also the photo resolution.

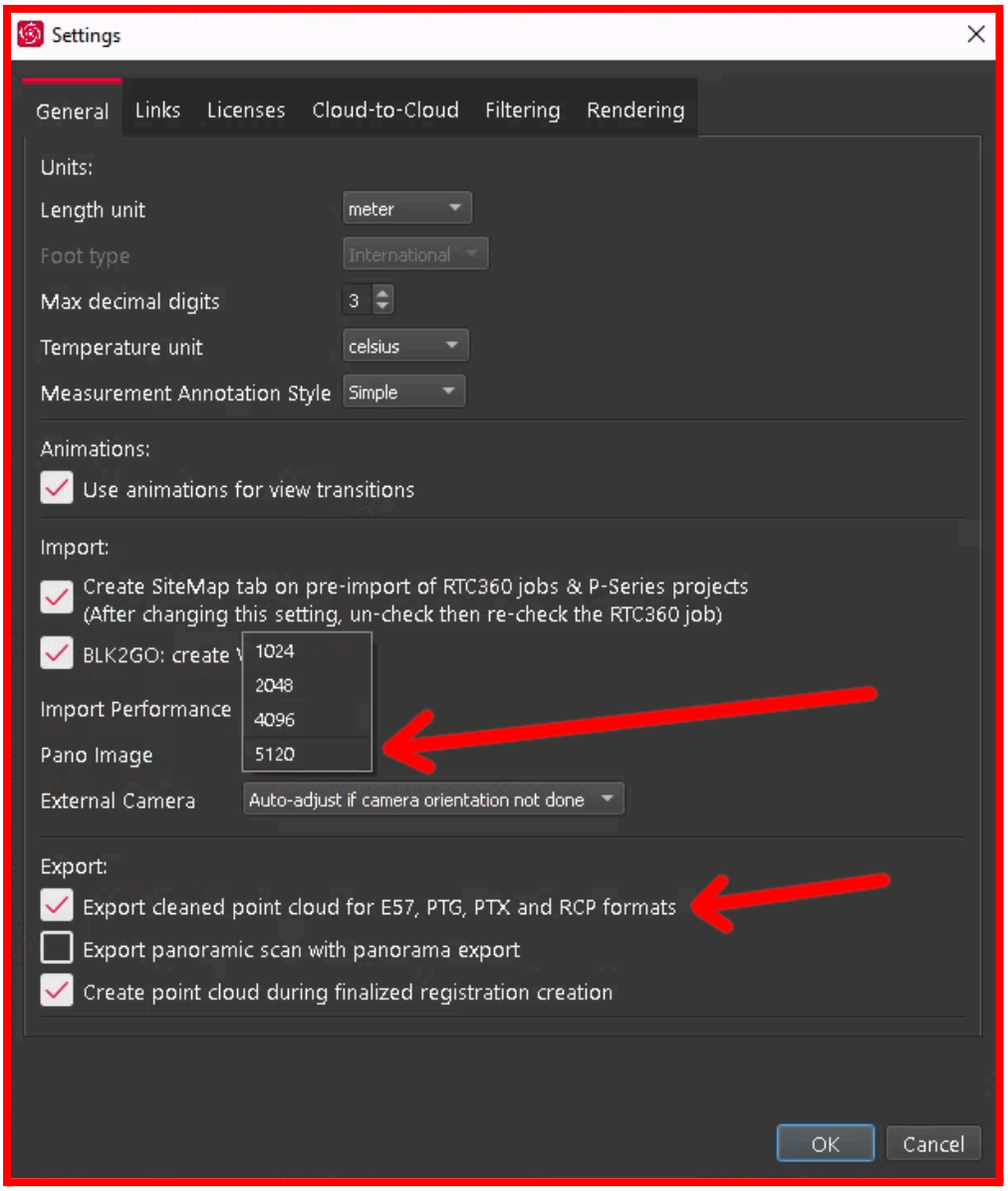
2. Also in the Settings, tick the checkbox **[x] Export cleaned point cloud...** such that your point cloud cleaning reflects in the export.

Screenshot of the E57 publishing options:



Screenshot of the Pano images publishing option; tick this for grayscale-only projects:

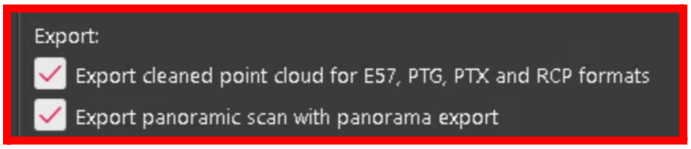
Setting import and export options:



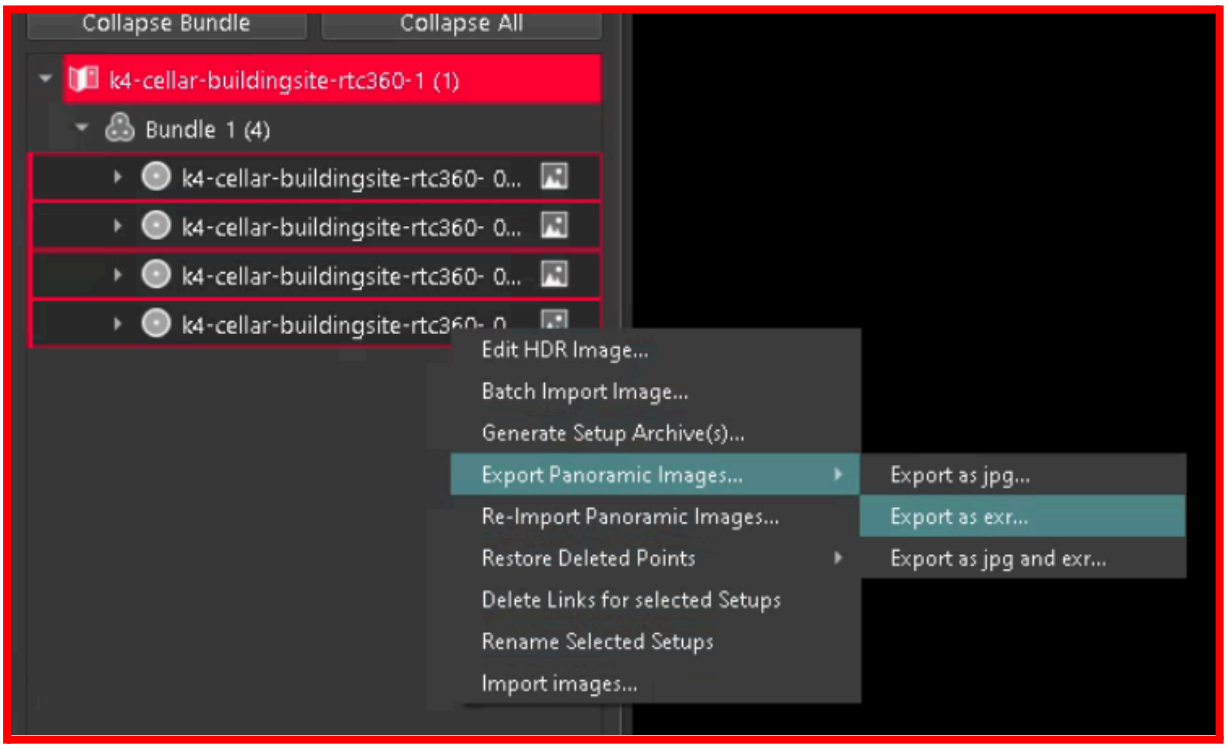
Exporting Cyclone REGISTER projects without colour

If you want to show scans that were scanned without colour (laser intensity only) in Benaco, you need to use the following workaround to extract laser intensity renderings from Cyclone REGISTER 360.

In the Settings, enable "**[x] Export panoramic scan with panorama export**".

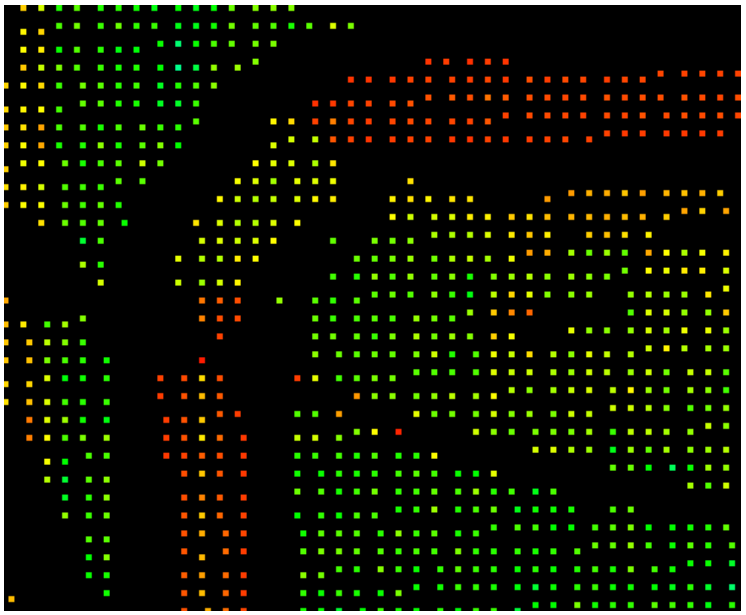


In the Setups list on the left, select all Setups, right-click, and choose **Export Panoramic Images... -> Export as jpg...**



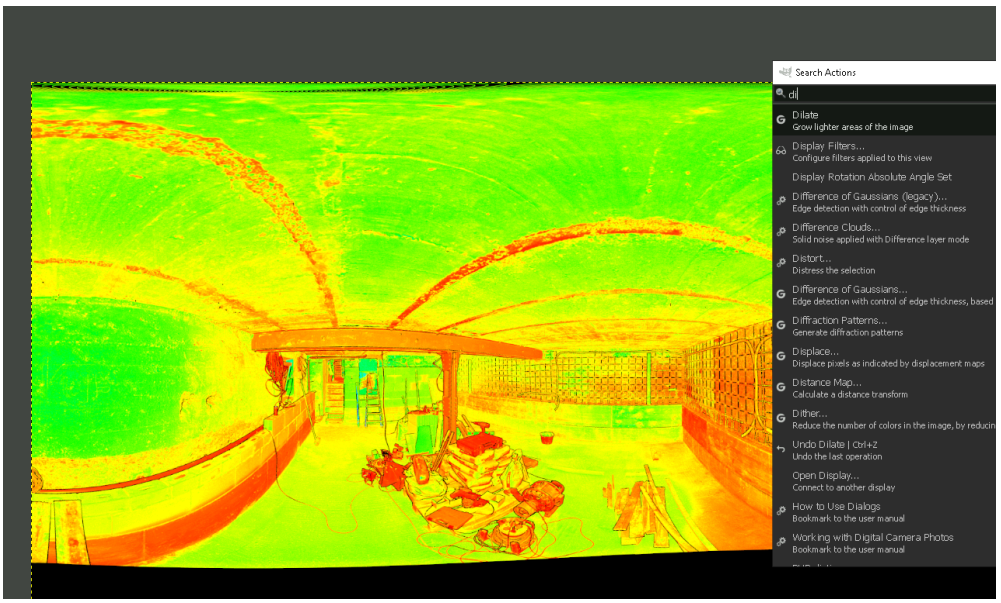
This creates (next to each exported JPG image) a PNG image with intensity values, in the resolution of the imported image (e.g. 5120 if that's what's configured in the settings), but only with those pixels filled in that are in scan resolution.
Thus, we have sparse pixels on a black surface.

This makes the image appear almost black until we zoom in:



The almost-black images are not yet suitable for Benaco.

You need to process them for normal display, using e.g. GIMP's "Dilate" filter, e.g. applying it twice for the above; this fills in the black parts:



You have to do that for all PNG files, ideally automatically.
You can do that e.g. with GIMP's batch scripting functionality.
It is recommended to export the improved photos as JPG instead of PNG for faster uploads.

You may optionally turn the colours into greyscale with GIMP, if you prefer that over Cyclone's green/red colour renderings.

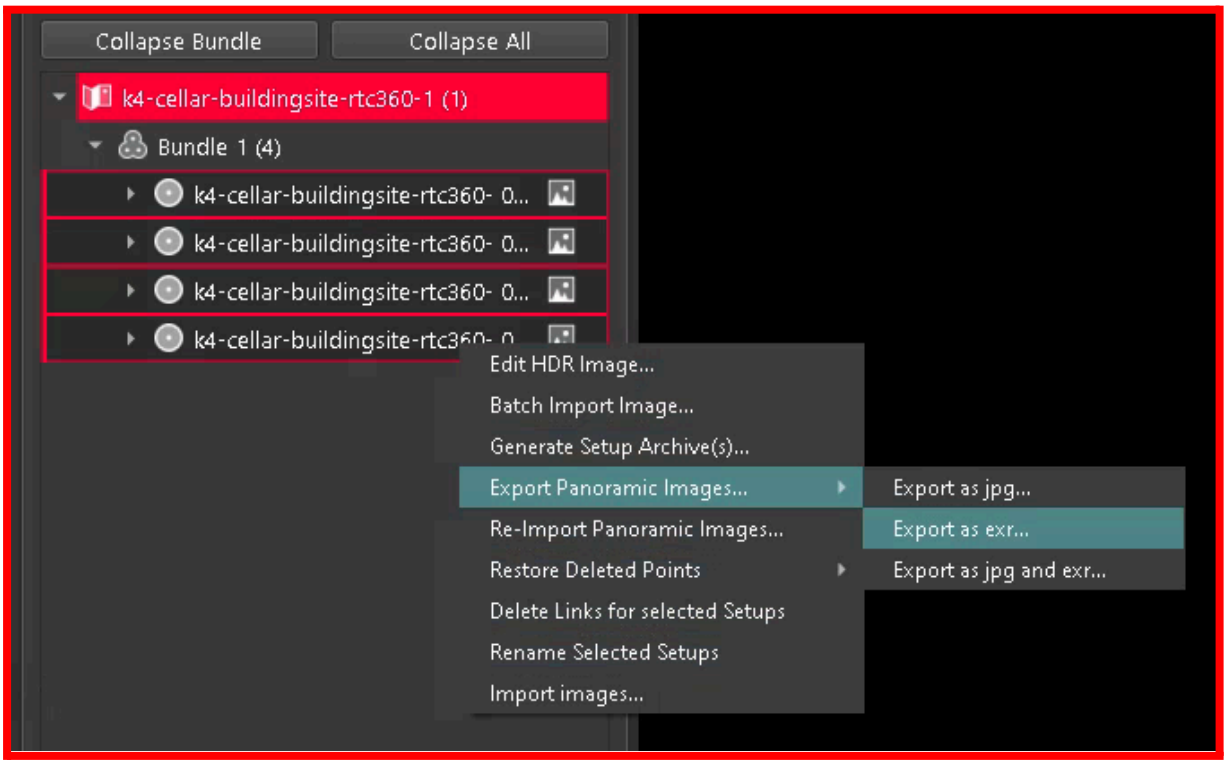
Then you can upload those images into a "**panos**" folder along with your normal E57 upload. If your uploaded improved files are named like your scan files (but with **.jpg** or **.png** instead of **.e57**), our processing will pick them up.

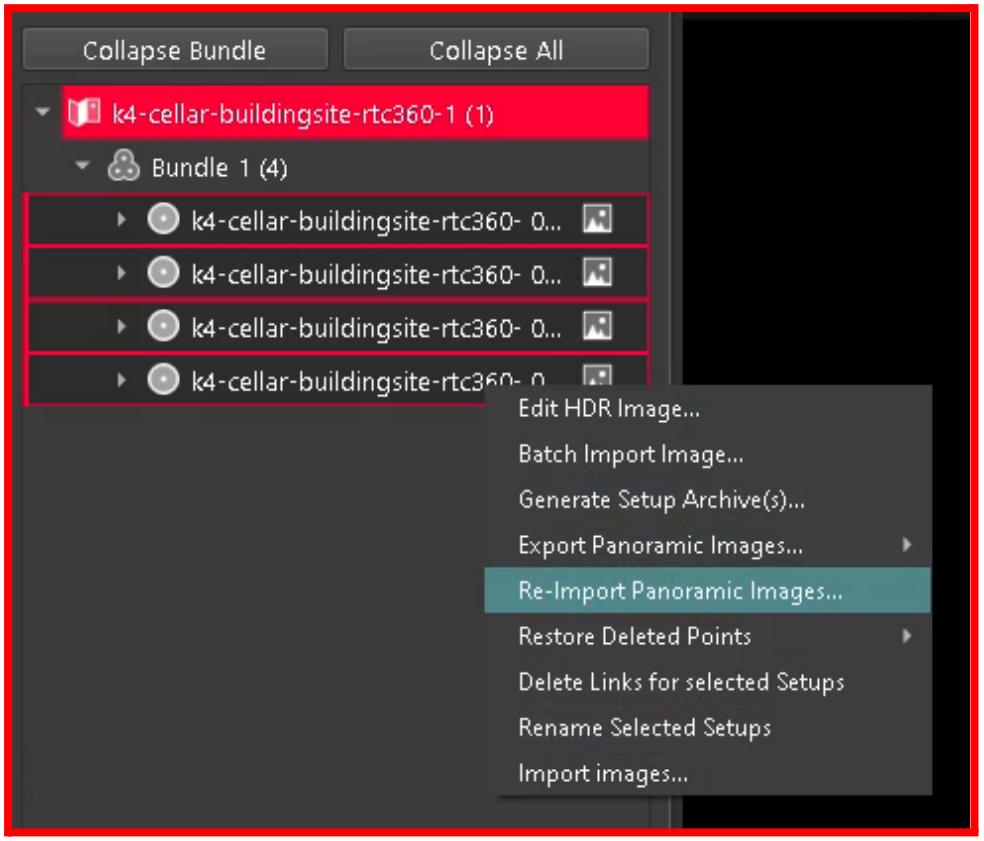
Adding higher-resolution Cyclone photos later

If you are working with a project where the "Pano Image" resolution setting was set low during import, and you want to upgrade their the resolution after the import, you can use the following workflow:

a. Ensure you have a "Cyclone PUBLISHER Pro" license, otherwise the required context menu items will be missing.
b. Create a completely new project, importing the original source data with the highest resolution setting (takes a while).
   Do not perform any registration in the new project.
c. In the workflow tab "REVIEW AND OPTIMIZE", select all setups in the setups list, **Right click** -> **Export Panoramic Images...** -> **Export as esr...**, into a temporary folder.
d. Switch back to the registered project that has the low-quality photos.
e. Select all setups in the setups list, **Right click** -> **Re-Import Panoramic Images...**, from the temporary folder.

*Re-importing higher resolution images for a project whose **Pano image** resolution was set lower than desired at original import time:*



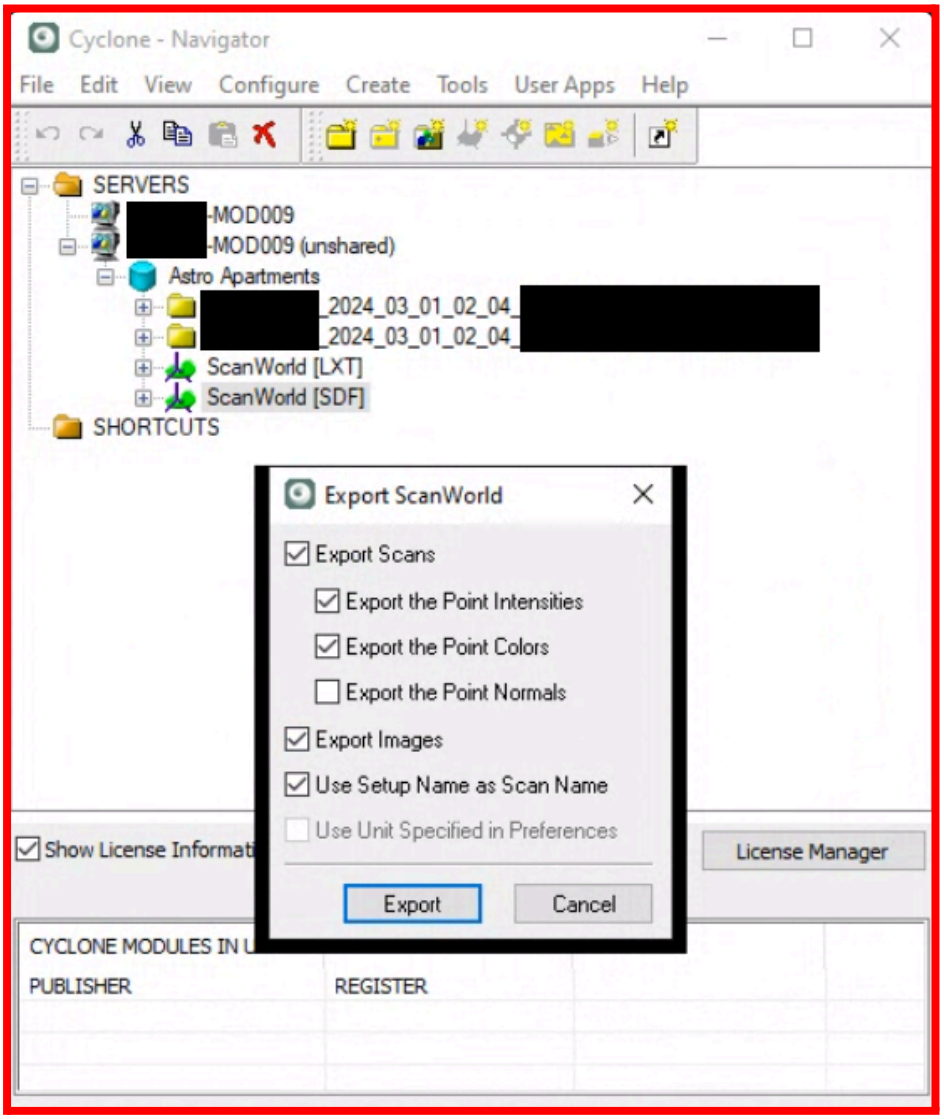


Leica Cyclone CORE

Proceed analogous to the section "*Leica Cyclone REGISTER 360*", with the following special settings:

1. Check **[x] Use Setup Name as Scan Name**
   (Otherwise your scans will be named "Scan 1", "Scan 2", ... instead of their semantic names.)

Step 1: Enabling "Use Setup Name as Scan Name"

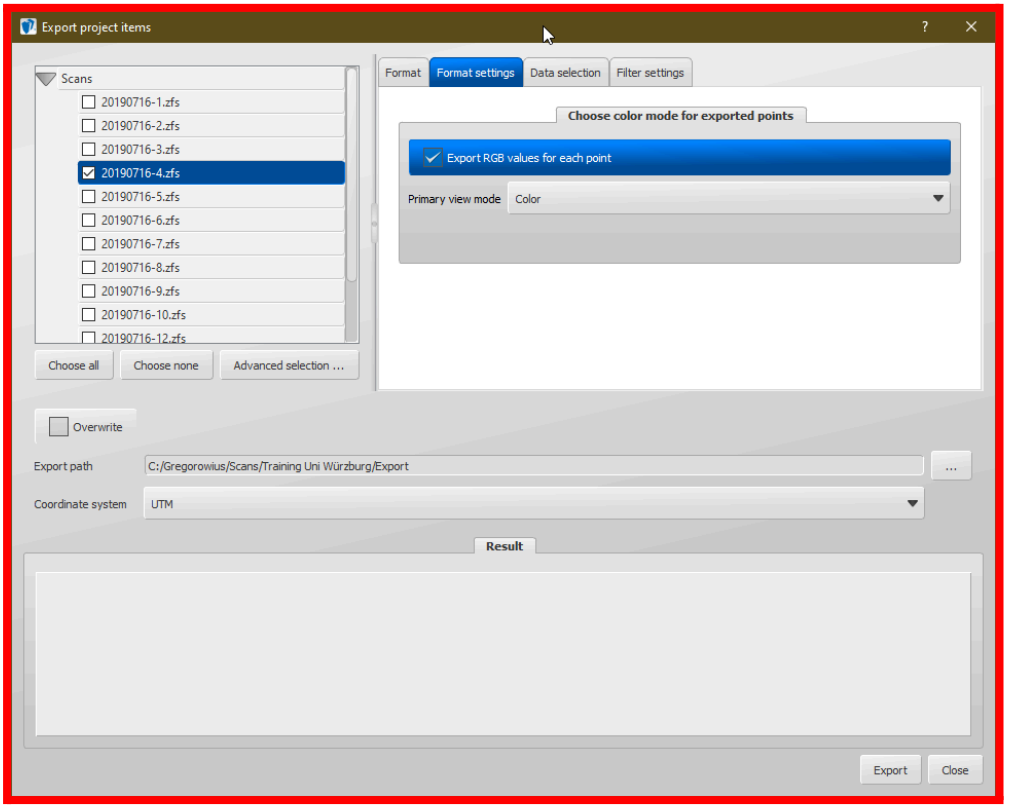


Z+F Laser Control (terrestrial)

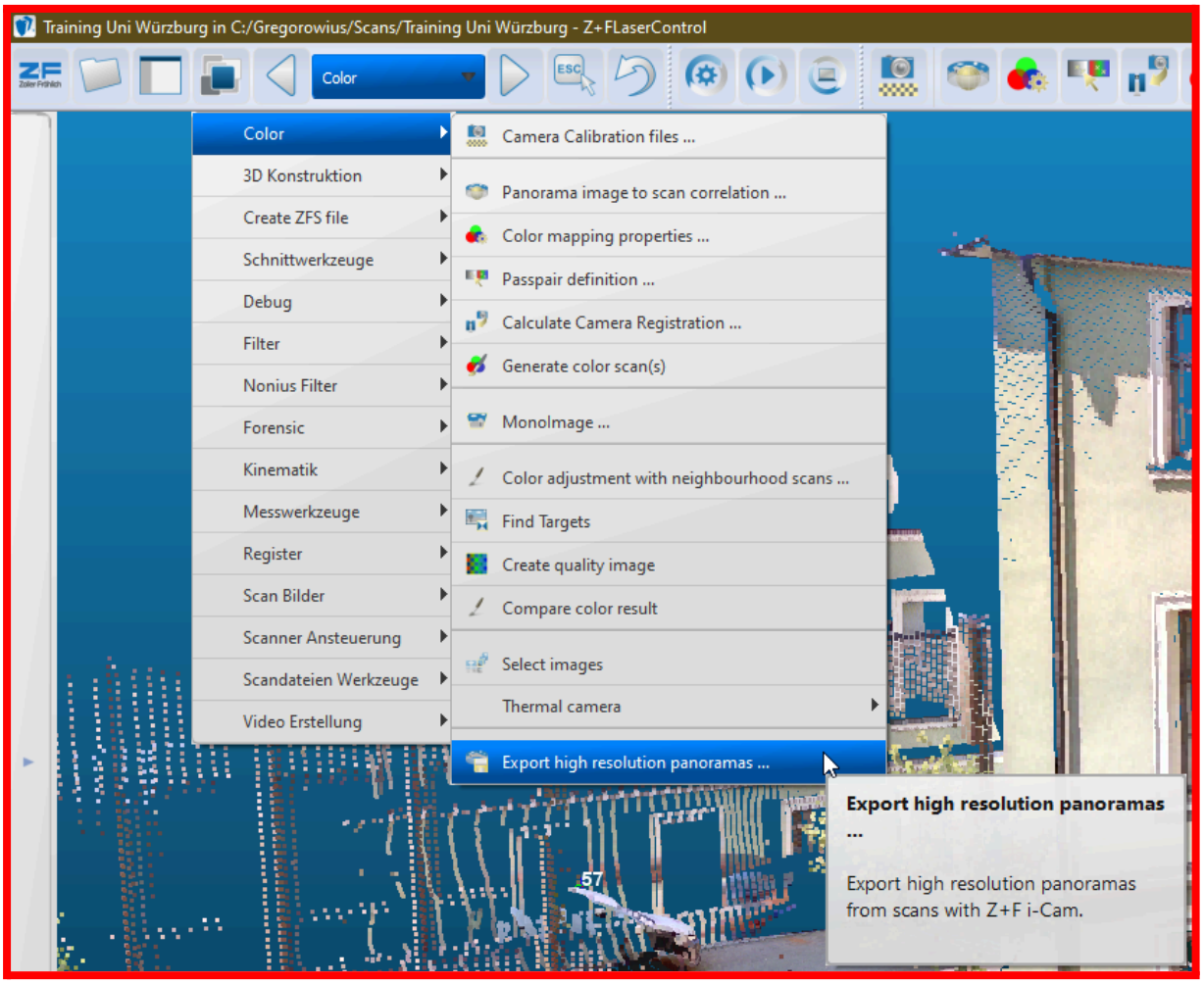
Provide Benaco with an export folder containing the following:

1. Optional (but recommended):
    a. Perform color correction for more consistent colors.
        - Use **Color > Color adjustment with neighbourhood scans**.
    b. Thin out the scan for a more equal point distribution.
        - Use **Processing filters**, enable the **Thin filter**, and set **Distance = 0.001 m** (1 mm)
2. The point cloud in E57 format, into subfolder "`pointclouds`":
   Use the function **Export scan**.
    a. In the tab **Format**, choose **E57.**
    b. In the tab **Format settings**:
        1. Tick the checkbox [✘] **Export RGB values for each point**
        2. Set the dropdown **Primary view mode** to **Color**.
3. The RGB image data, into subfolder "`panos`".
   Use the function **Color > Export high resolution panoramas**.
    a. Set the **Image type**:
       Prefer **PNG** (a lossless format) over JPEG (a lossy format).
    b. Set the resolution to the highest possible.

Step 2: Export format settings to ensure color is present:



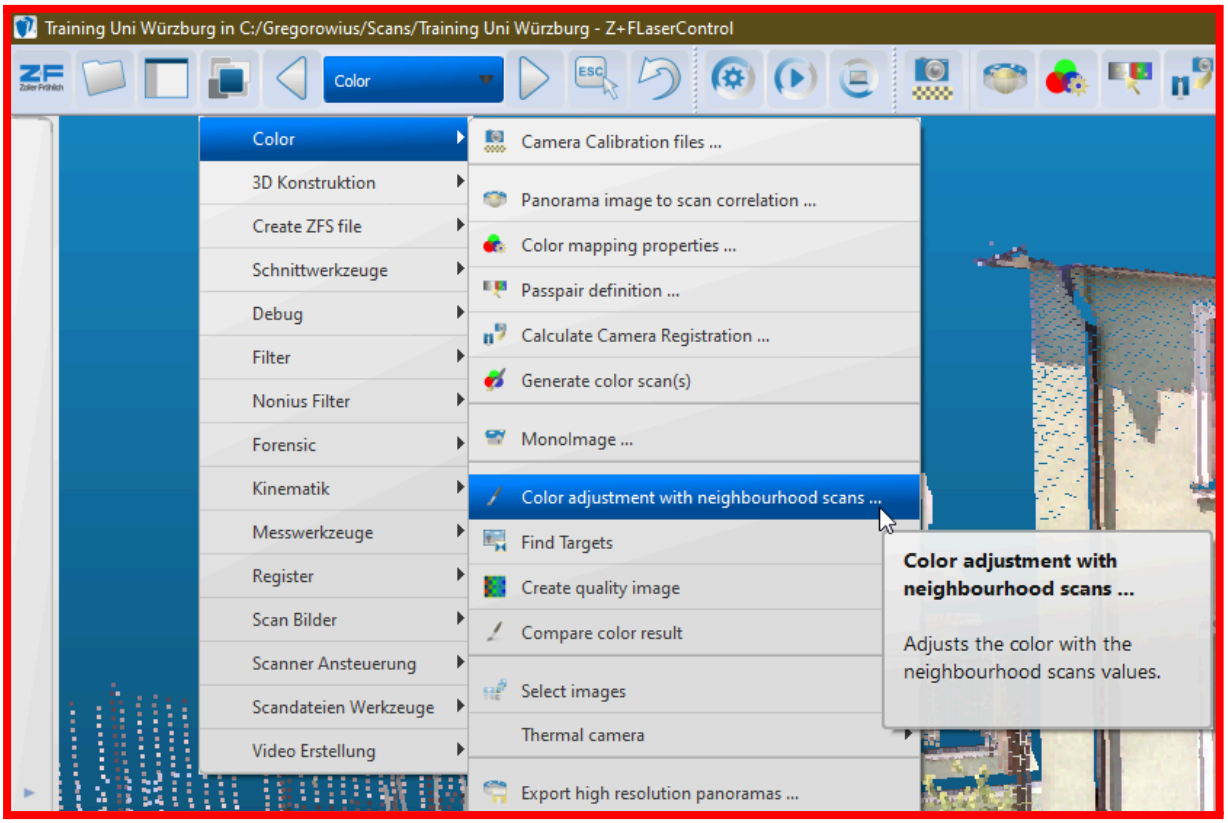
Step 3: Opening the "Export high resolution panoramas" function:



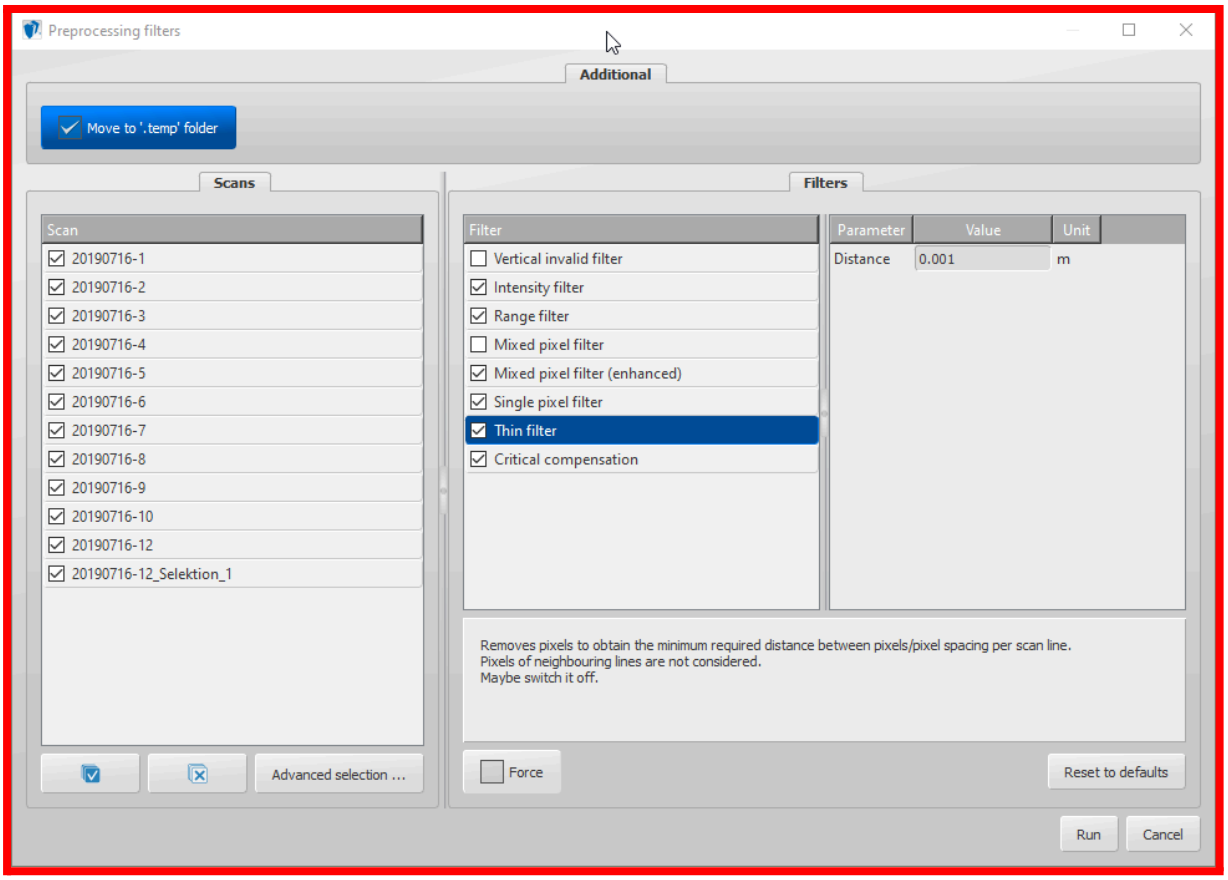
When you are done, the export folder should look as follows:

```
name-of-your-export-folder
    pointclouds
        myproject_1001.e57
        myproject_1002.e57
        ...
    panos
        myproject_1001.col-panorama_sh.png
        myproject_1002.col-panorama_sh.png
        ...
```

Optional Step 1: Opening the "Color adjustment with neighbourhood scans" function:



Optional Step 1: Applying a "Thin filter":



Trimble RealWorks

For all operations, first **select your project** (it is the child of "WorkSpace" in the "Scans" project tree explorer). For large projects, you need to wait a few seconds after this.

Provide Benaco with an export folder containing the following:

1. The point clouds in E57 format, into subfolder "`pointclouds`".
   From the **Home** tab, choose **Export** and **Export TZF Scans of Selected Stations (Structured E57, ...)**.
   For older versions (< 2024.00), this option is called **Convert to E57**.
   In the dialog, choose **E57**.
2. The equirectangular panorama images, into subfolder "`panos`".
   a. For current versions of RealWorks (>= 2024.00):
      1. From the **Imaging** tab, choose **Export Panorama with Location and Orientation**.
   b. For versions >= 12.4.2 but < 2024.00:
      1. From the **Home** tab, choose **Export** and **Export TZF Images**.
   c. For older versions of RealWorks (< 12.4.2):
      1. From the **Edit** tab, click **Create Station Images from TZF Color.**
         (If this button is greyed out, see Exporting laser-intensity panos from RealWorks.)
         This generates cube maps and ensures they are in the RTF below.
      2. For each scan station separately, click it in the upper "WorkSpace" panel, select all 6 cube sides from the lower panel (e.g. "Scan 1_front", "Scan 1_top" etc.), and in the **Home** tab click **Export** -> **Export Images**, which pops up 6 save dialogues.
         This workflow is a bit tedious (takes a few seconds per scan station); we recommend upgrading to RealWorks >= 12.4.2 if possible.
3. The poses of the images, into the top-level folder.
   a. For current versions of RealWorks (>= 2024.00):
      1. Move the file "`panos\*.csv`" to the top-level of your folder, and rename it to "`trimble-cameras.csv`".
      2. From the **Home** tab, choose **Export** and **Export Station Positions to CSV File**.
         Save the file as "`trimble-positions-mm.csv`".
         In the popup, set **Unit** to **Millimeters**.
   b. For versions >= 12.4.2 but < 2024.00:
      1. Select your project (it is the child of "WorkSpace" in the "Scans" project tree explorer).
      2. From the **Imaging** tab, choose **Export** and **Export Location and Orientation**.
         (If this button is greyed out, see Exporting laser-intensity panos from RealWorks.)
         Save the file as "`trimble-cameras.csv`" with **CSV** format.
         Open it with a text editor and verify that it has the format "`filename,x,y,z,qx,qy,qz,qw`".
   c. For older versions of RealWorks (< 12.4.2):

1. Increase the pose precision by going into the RealWorks:
   In the **Preferences**, go to **Units** and change **Decimal Places** to "**8**".
2. From the **Home** tab, choose **Export** and **Export Object Properties**.
   Save the file as `"trimble-poses"` with **RTF File Format**.

If you use RealWorks < 12.4.2, please upgrade. The older format is a pain to maintain and not very reliable to use. It will also cause you lots of manual clicking.

Note we are aware of a bug in Trimble RealWorks that makes the export of `"trimble-cameras.csv"` fail, producing an almost-empty CSV file if scan station names contain non-English (non-ASCII) characters. As a workaround, each station name can be renamed individually in RealWorks.

When you are done, the export folder should look as follows:

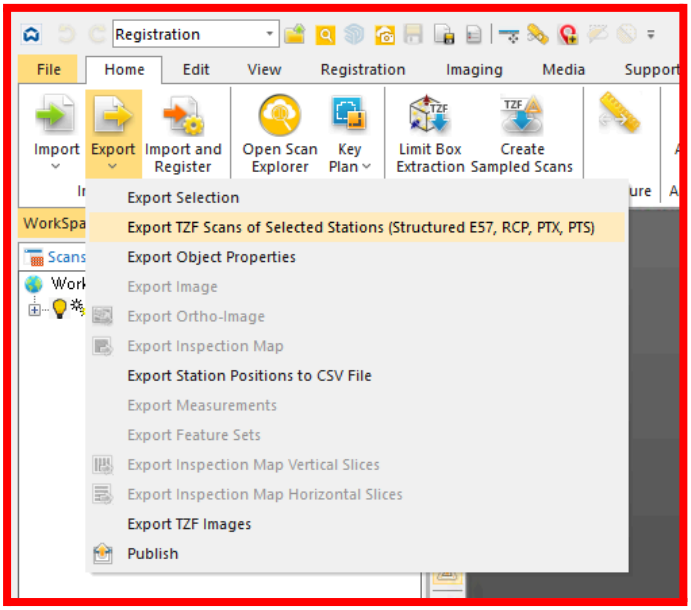
For **current** versions of RealWorks:

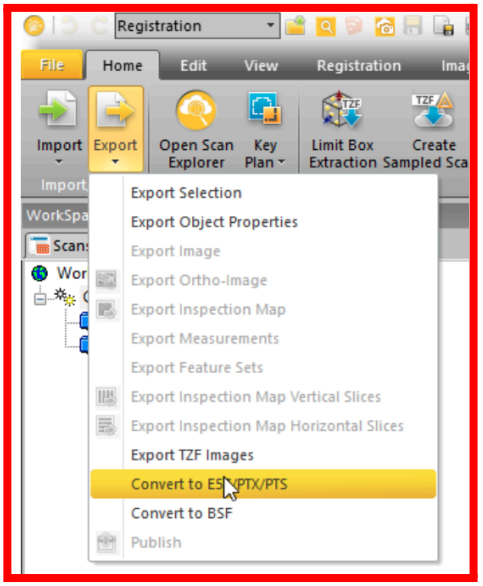
```
name-of-your-export-folder
      trimble-cameras.csv
      trimble-positions-mm.csv      ⬅ if you use RealWorks >= 2024
      pointclouds
            Station_1.e57
            Station_2.e57
            ...
      panos
            Station_1_Color.jpg
            Station_2_Color.jpg
            ...
```

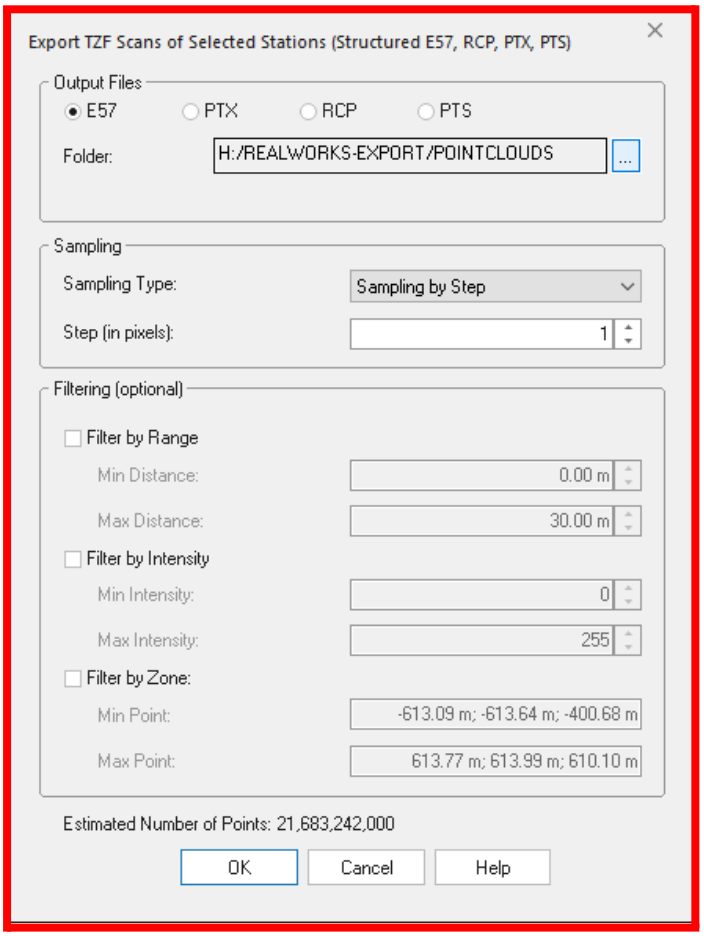
For **older** versions of RealWorks (< 12.4.2)::

```
name-of-your-export-folder
      trimble-poses.rtf
      pointclouds
            Station_1.e57
            Station_2.e57
            ...
      panos
            Scan 1_back.jpg
            Scan 1_bottom.jpg
            Scan 1_bottom.jpg
            Scan 1_front.jpg
            Scan 1_left.jpg
            Scan 1_top.jpg
            Scan 2_back.jpg
            ...
```

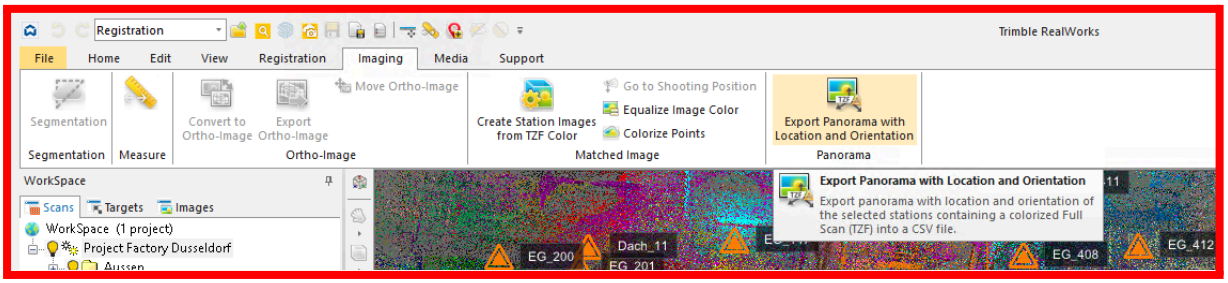
Step 1: Exporting scans via the Export tab (for various RealWorks versions):



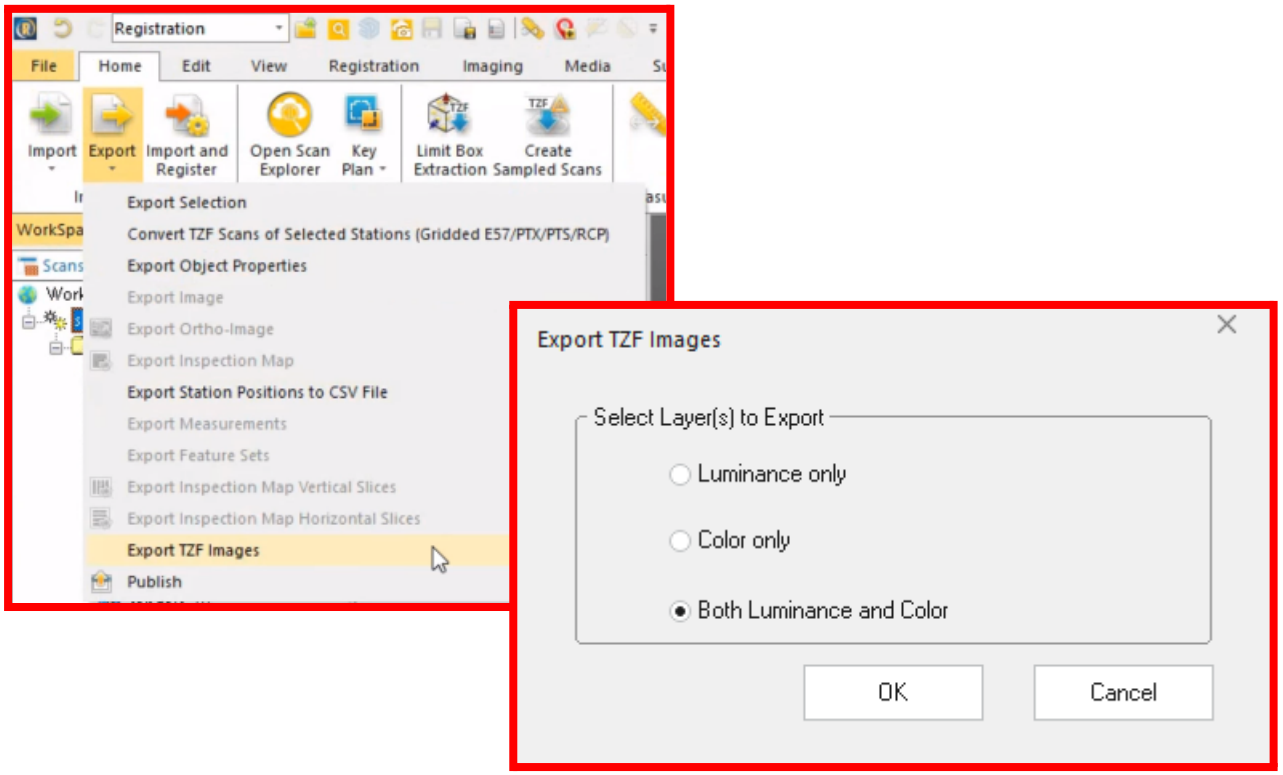




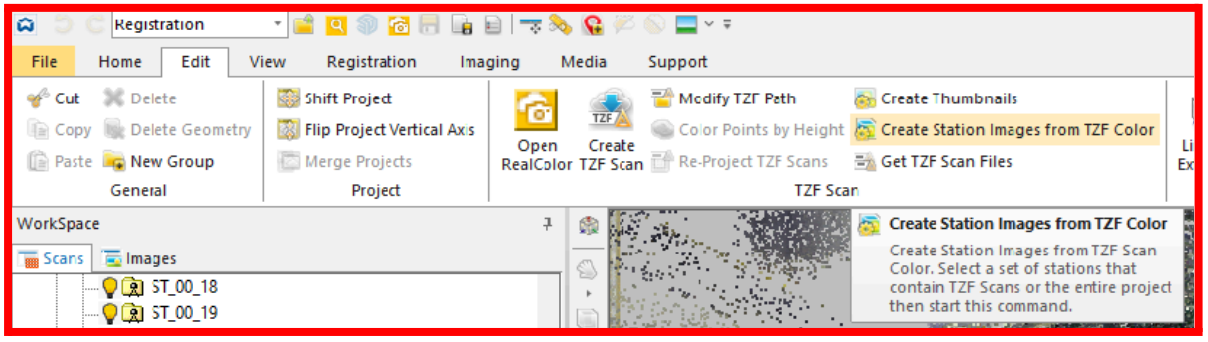
Step 2a1: Export Panorama with Location and Orientation:



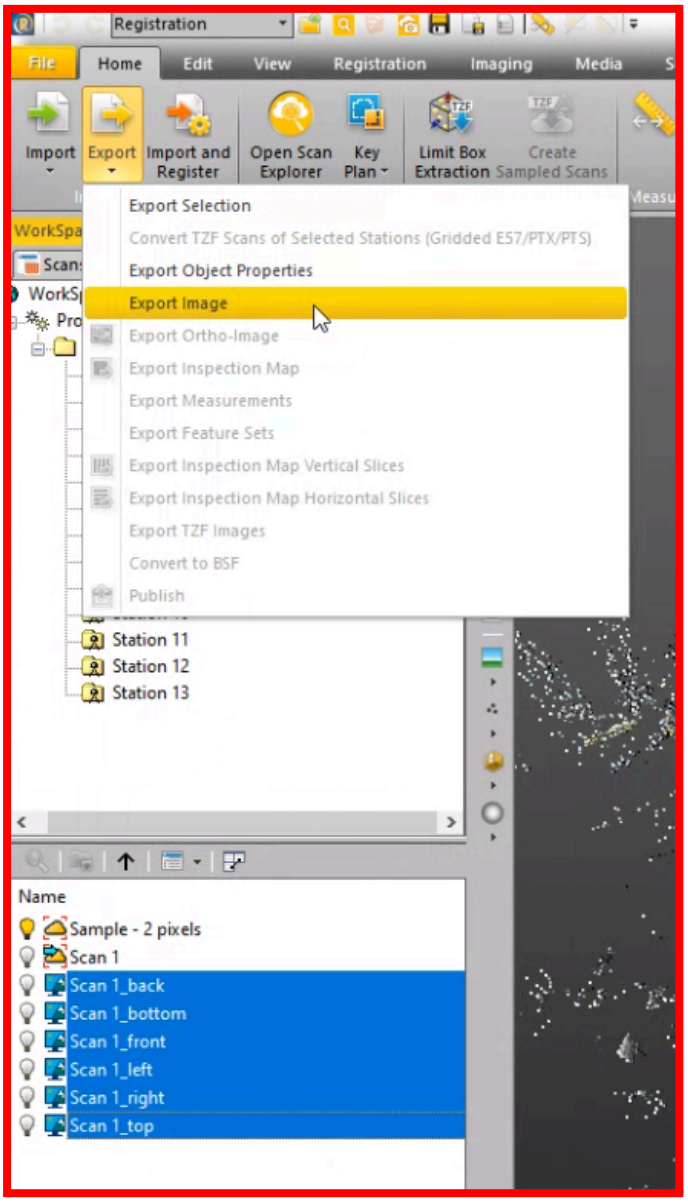
Step 2b1: Exporting pano images as TZF:



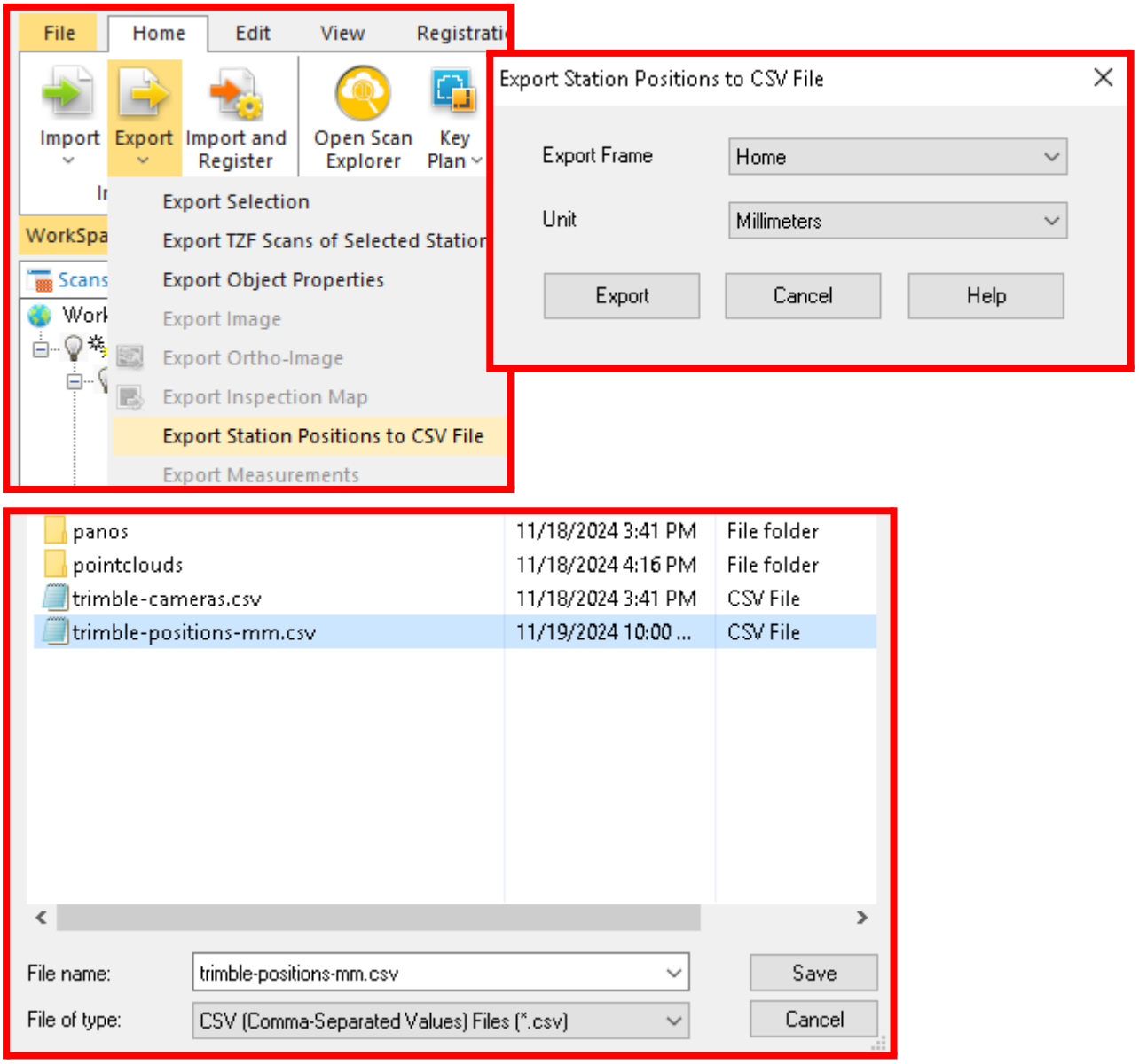
Step 2c1: Creating Station Images:



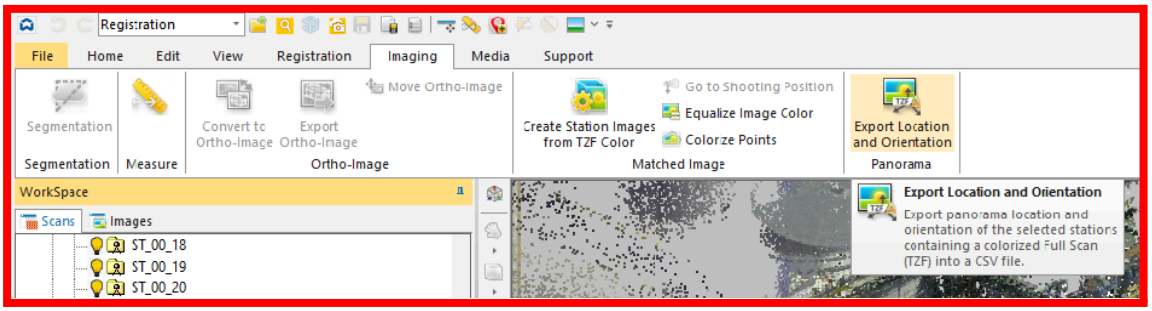
Step 2c2: Exporting cube side images:

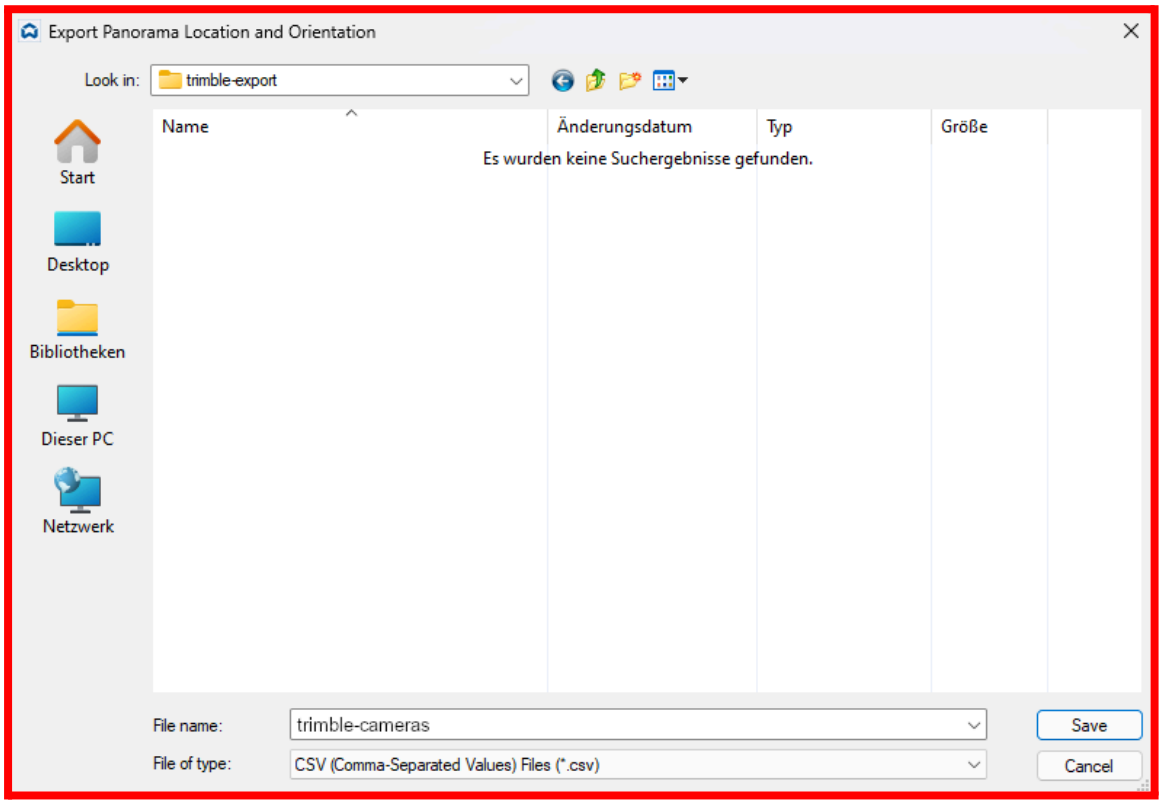


Step 3a2: Exporting station positions as CSV:

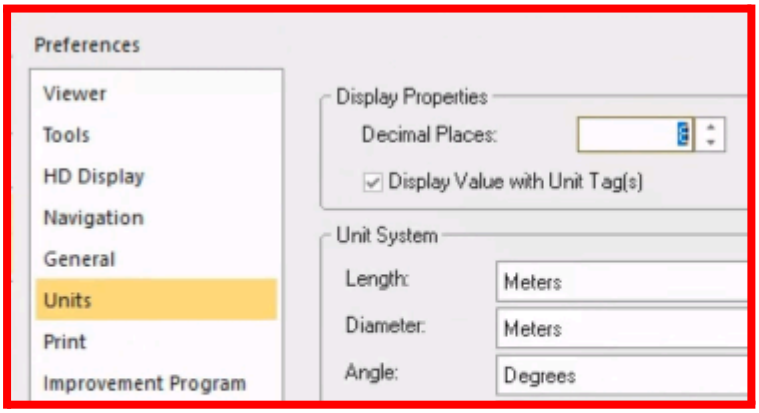


Step 3b1: Exporting pano images as CSV:

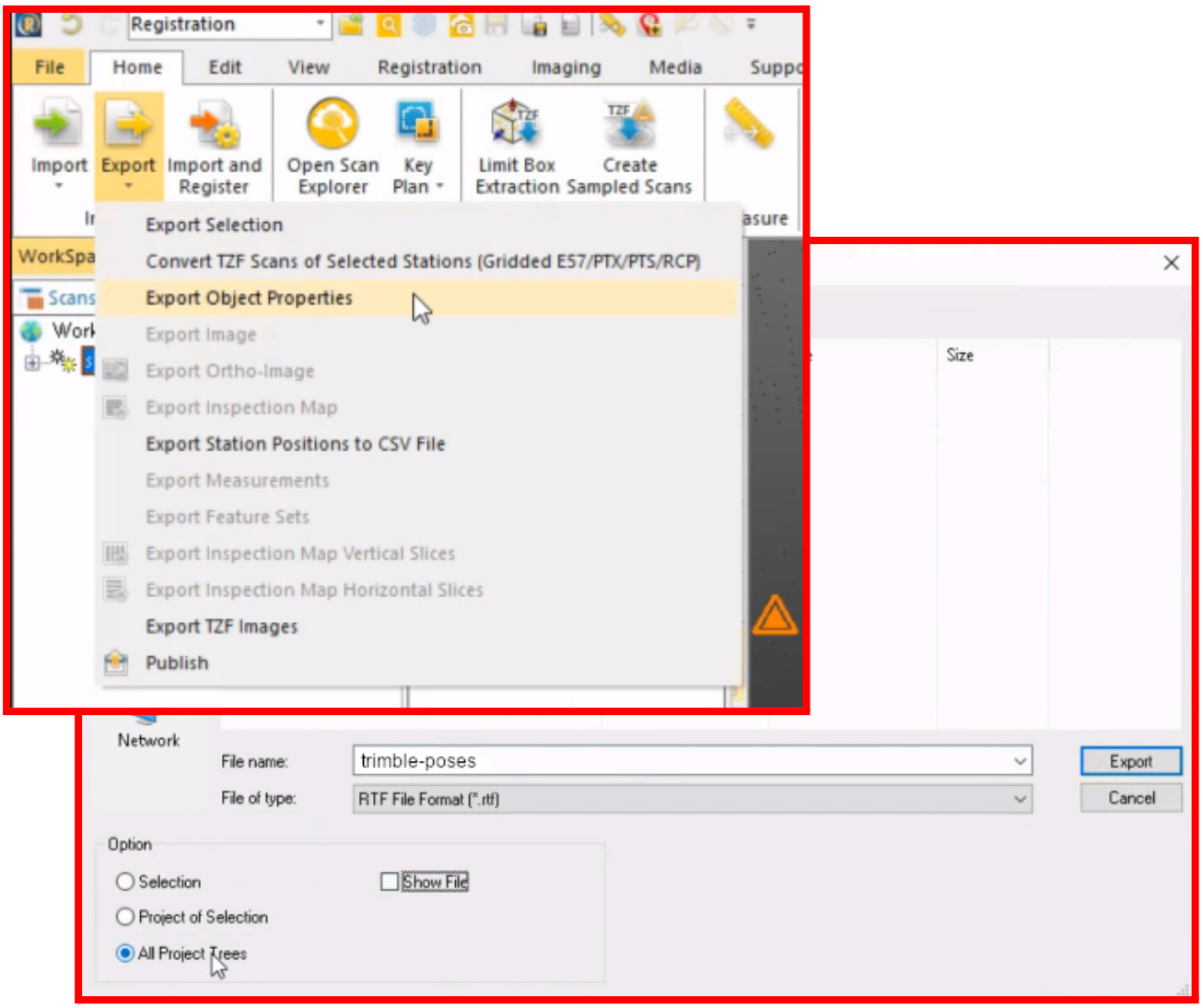




Step 3c1: Setting decimal places high:



*Step 3c2: Exporting **trimble-poses.rtf**:*



Exporting laser-intensity panos from RealWorks

RealWorks cannot currently directly export uncoloured scans as panorama photos.
Some important buttons, such as "**Create Station Images from TZF Color**" and "**Export Location and Orientation**", will be greyed out.

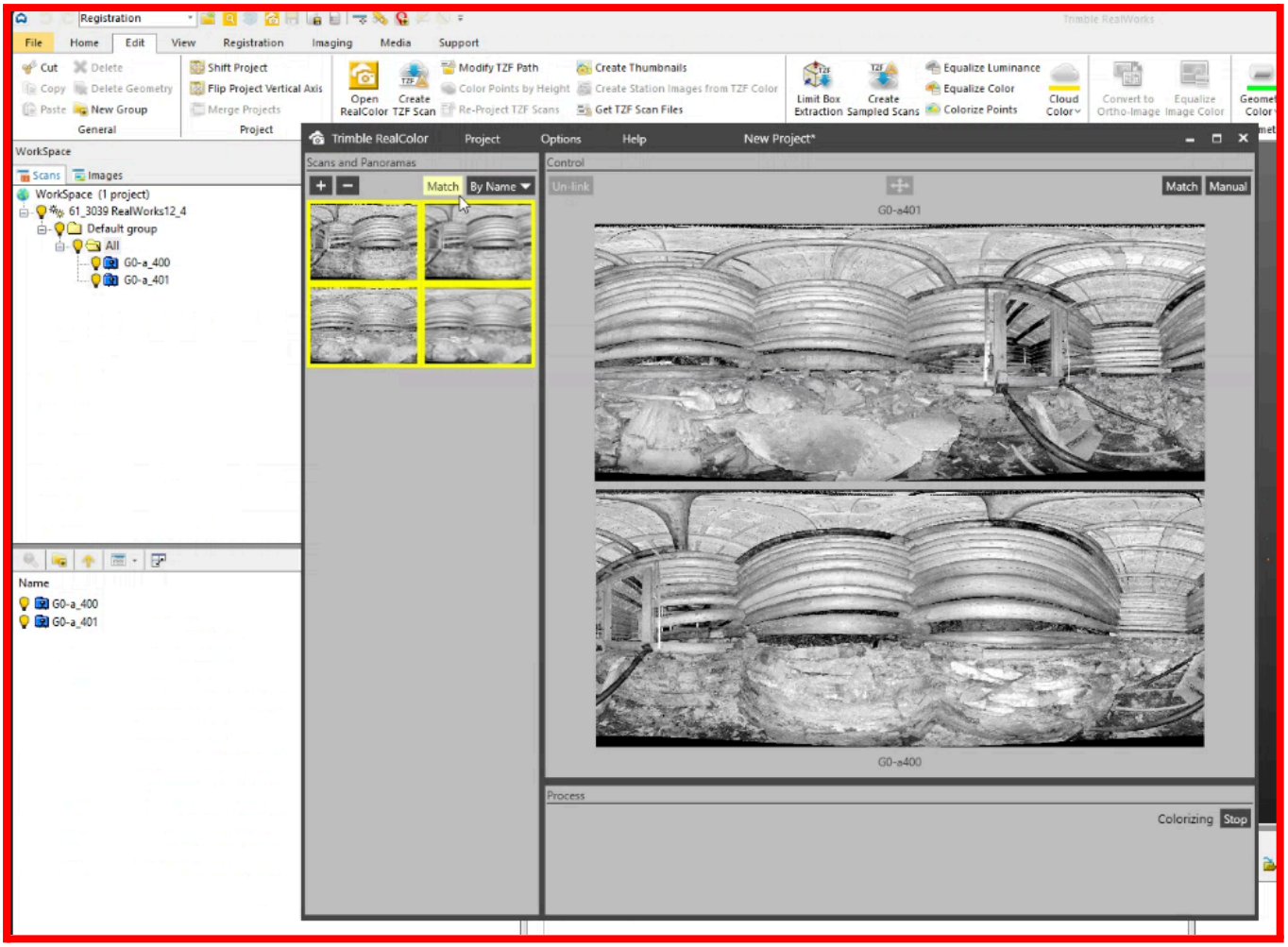
If you wish for Benaco to show grayscale intensity laser panoramas in Benaco for situations where you scanned without colour, you need to use the following workaround:

Export laser intensity panos from RealWorks and re-import them; then RealWorks will treat the greyscale images as RGB images, and make the above needed buttons available.

Steps:

1. Export all greyscale panoramas as JPG into a folder via
   Home -> Export -> Export TZF images.
   These images are not useful for Benaco, do not upload them to Benaco.
2. **Edit -> Open RealColor**.
3. Drag-drop in the JPGs you exported in step 1.
4. In the RealColor GUI, order the images by Name, ensure images match in the left column.
5. Select all images with the mouse. Click **Match**.
6. **Save** the project, close the RealColor GUI.
7. Delete (in Windows Explorer) the greyscale panoramas folder you created in step 1.
8. Proceed to export normally as per our instructions in section Trimble RealWorks.

Re-importing intensity-only panos into RealWorks to make them RGB panos:



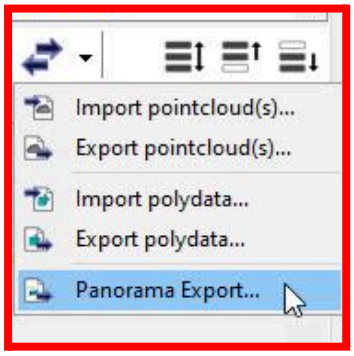
Riegl RiScan

Provide Benaco with an export folder containing the following:

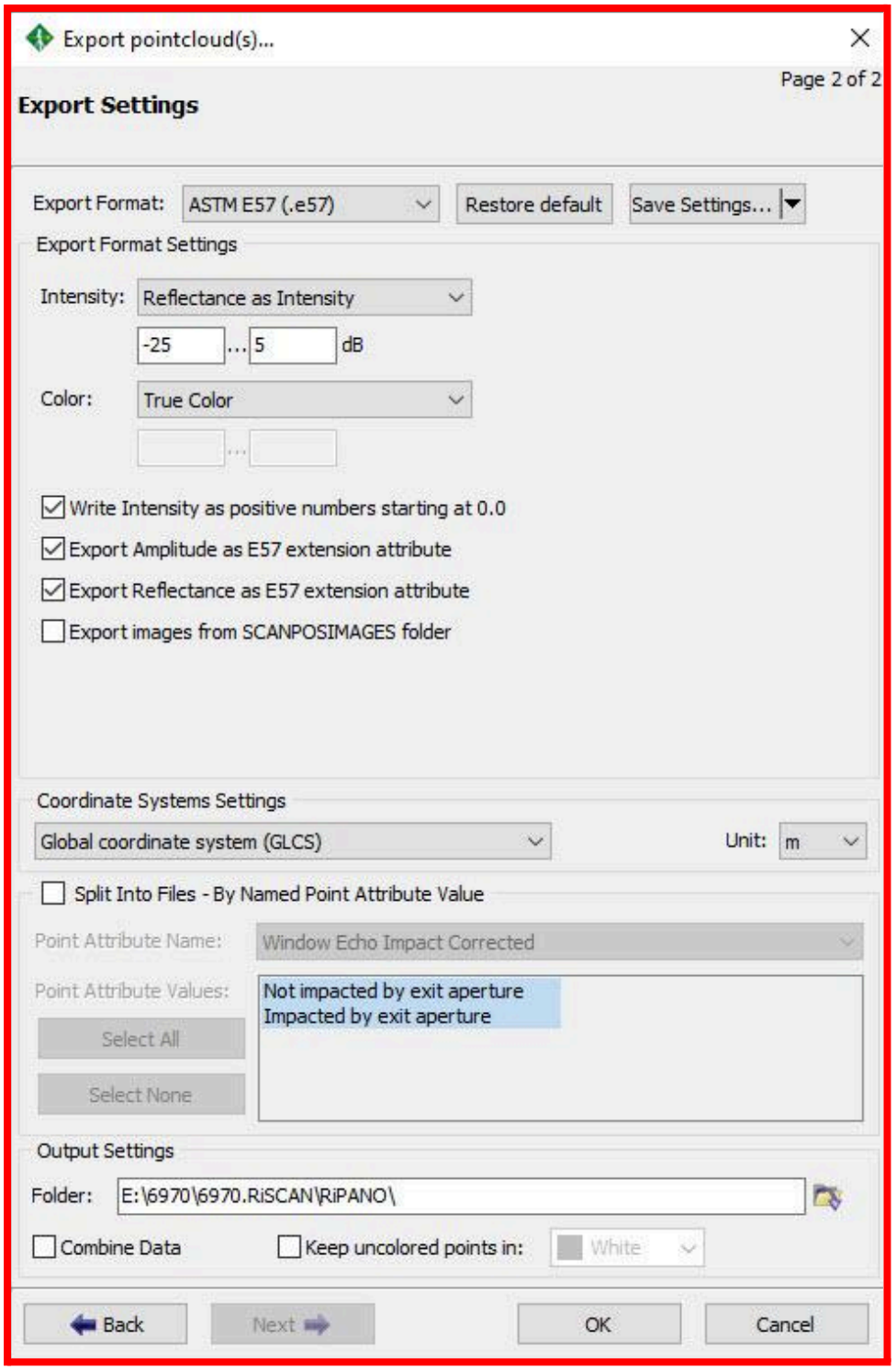
1. The point clouds in E57 format, into subfolder "`pointclouds`".
   Select all scans, choose **Export pointclouds** and select **ASTM E57 (.e57)** as format.
   a. Set "Color" to **True Color**.
   b. Untick the checkbox **[ ] Keep uncolored points in**.
   c. Under **Coordinate System Settings**, choose your coordinate system:
      i. If you do not wish to use any geo-referencing, choose **Project Coordinate System (PRCS)**.
      ii. If you wish to use a specific coordinate system, choose it from the settings icon, and place in your export folder a text file "`source-crs.txt`" containing as a single line the EPGS name of the coordinate system, for example: `EPSG:2056`
      iii. If you do not care which coordinate system shall be used for geo-referencing, choose **Global Coordinate System (GLCS)** (which is WGS 84), and place in your export folder a text file "`source-crs.txt`" containing as a single line: `EPSG:4978`
   d. **Optional:**
      You may enable **Export Amplitude as E57 extension attribute** and **Export Amplitude as E57 extension attribute**. They are currently unused but Benaco may be able to display them in the future.

   You may choose to **Save settings...** to easily re-use these settings.
2. The equirectangular panorama images, into subfolder "`panos`".
   Select all scans, choose **Panorama Export**.
   a. Untick the checkbox **[ ] Autocrop panoramas**.
   b. Tick **[✘] Photo panoramas** and choose image quality **Very high**.

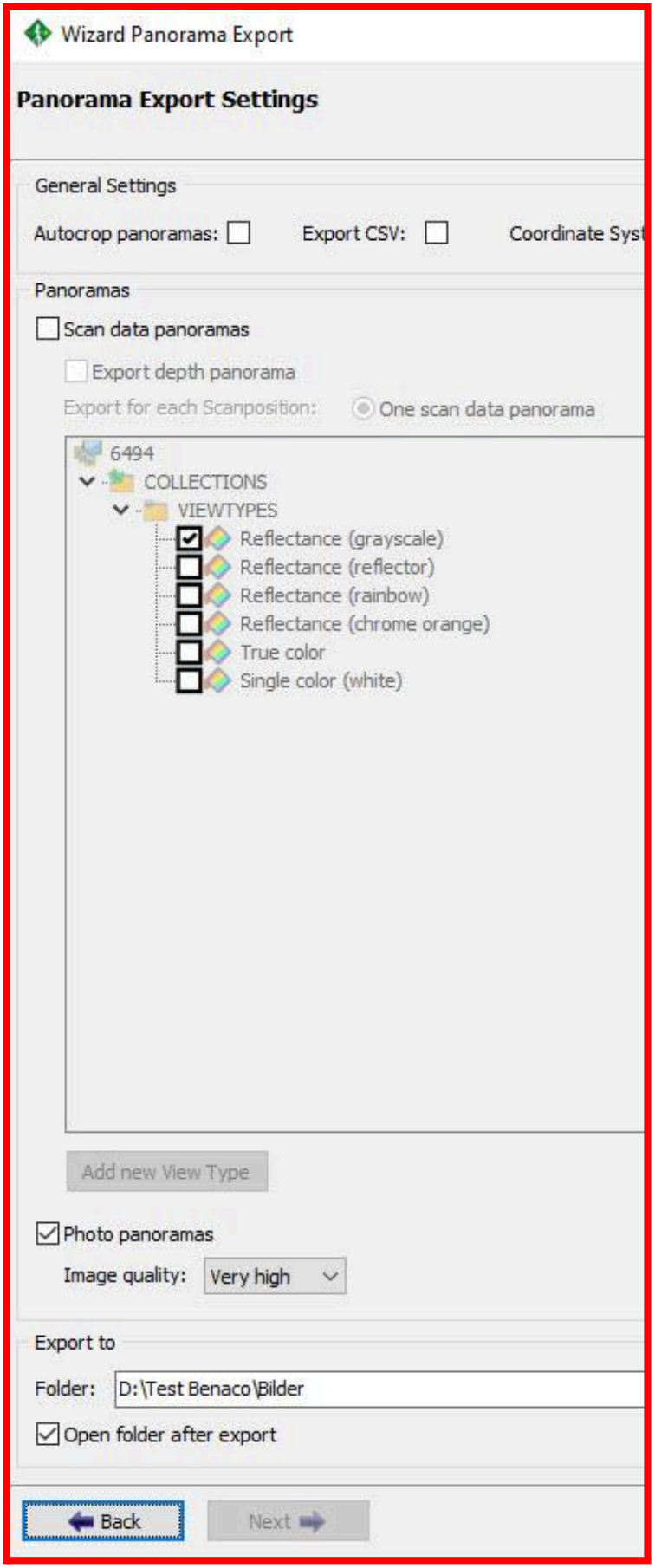
Paths to steps 1 and 2: The export button:



Step 1: Pointcloud export settings:



Step 2: Panorama export settings:



When you are done, the export folder should look as follows:

```
name-of-your-export-folder
    source-crs.txt    ⬅ if you chose a point cloud coordinate system
    pointclouds
        ScanPos001 - SINGLESCANS - 230428_170714.e57
        ScanPos002 - SINGLESCANS - 230428_170853.e57
        ...
    panos
        ScanPos001.jpg
        ScanPos002.jpg
        ...
```

Topcon MAGNET

Preparation:

1. During processing, ensure that your scans are colorized ("Colorize Scan from Images") and panoramas are created ("Stitch Panoramas").

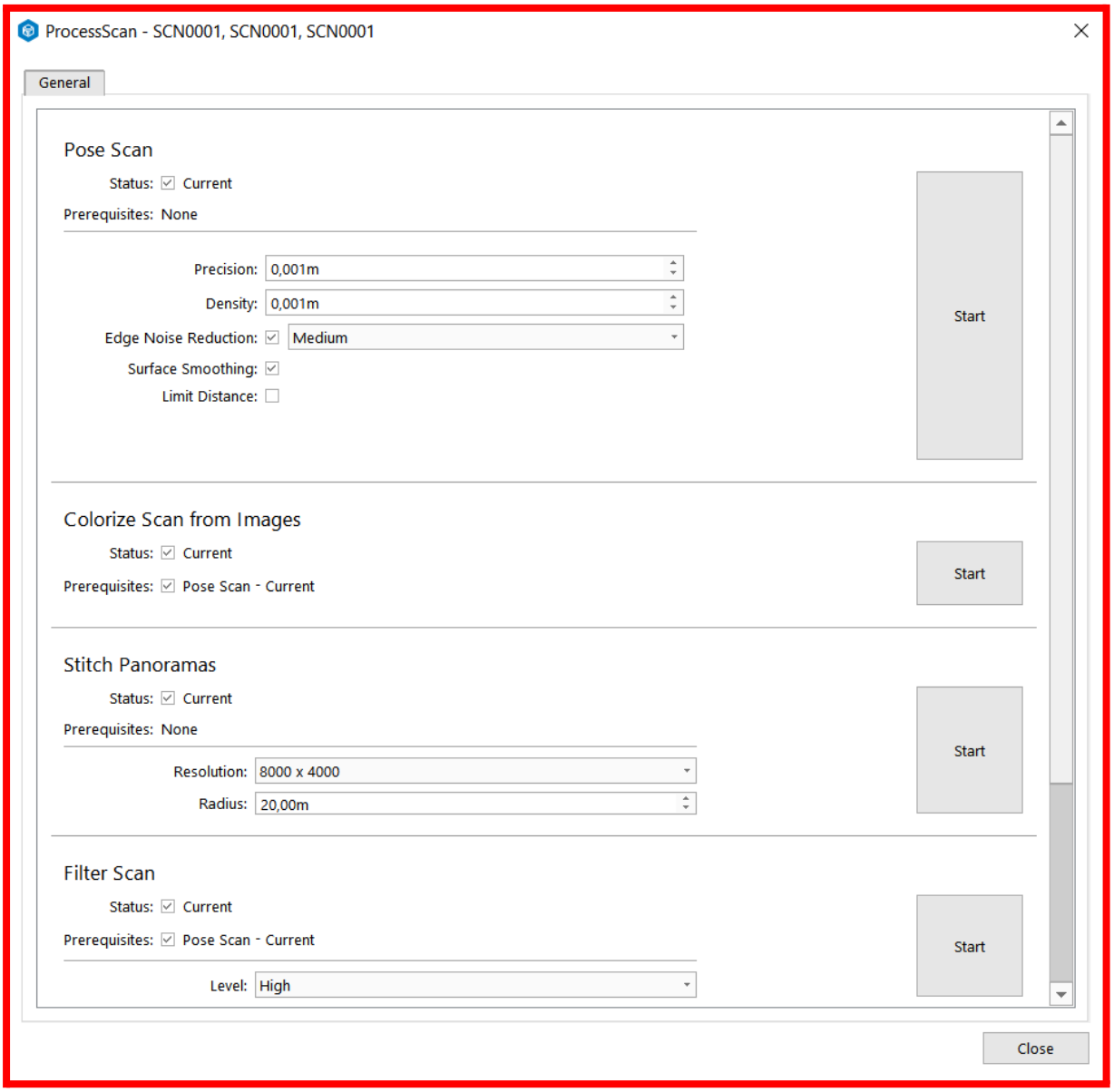
Provide Benaco with an export folder containing the following:

2. Right-click the project to export in the Workspace panel, choose **Export...**
3. Point clouds as E57, panos as JPEGs:
   In the **Exporters** list, **Add...** the following entries:
   a. Scans as **E57** file format.
   b. **Panorama** as JPEG file format.
   Choose "Transform coordinates" as **Registered**, "Distance Units" as **Meters**.

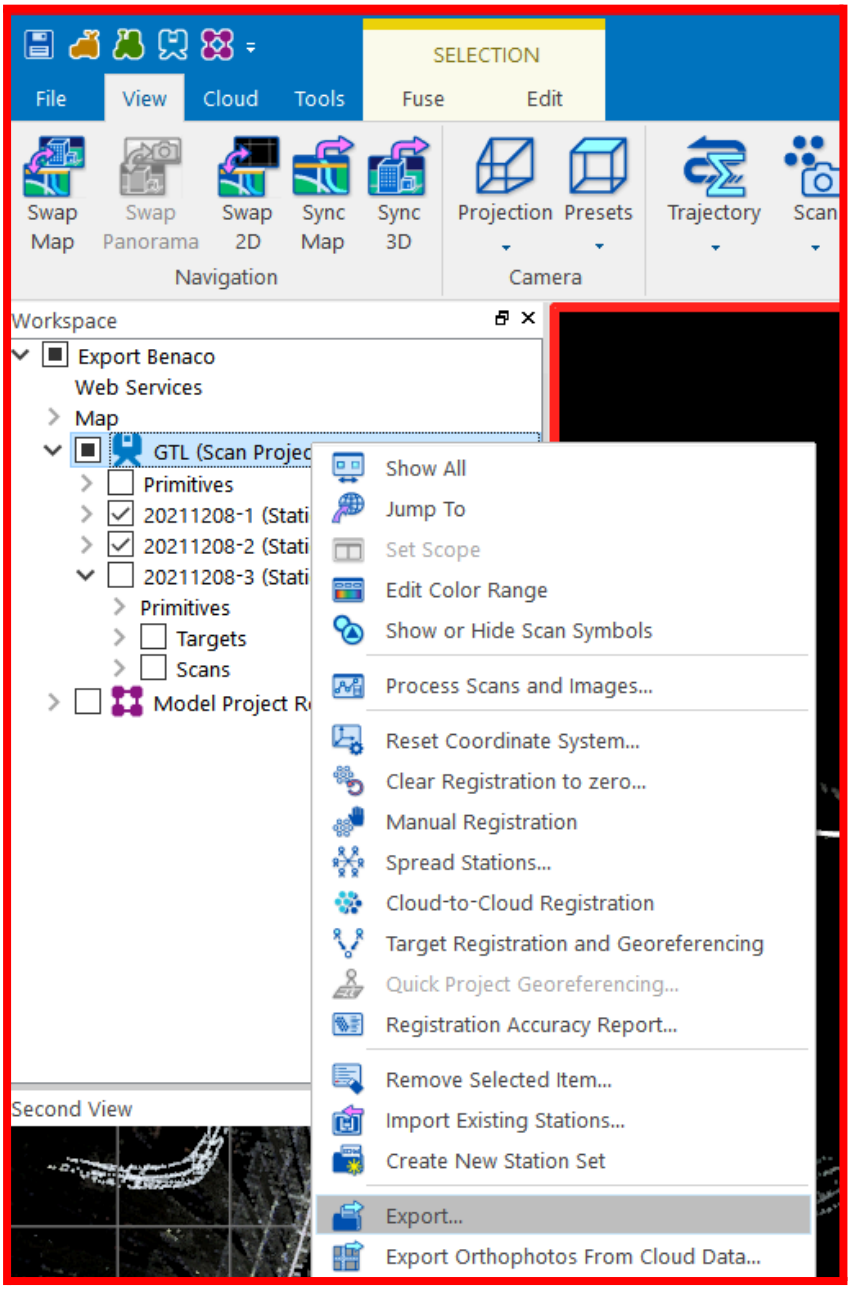
When you are done, the export folder should look as follows:

```
name-of-your-export-folder
      1_SCN0001.e57
      1_SCN0001.jpg
      2_SCN0001.e57
      2_SCN0001.jpg
      ...
```

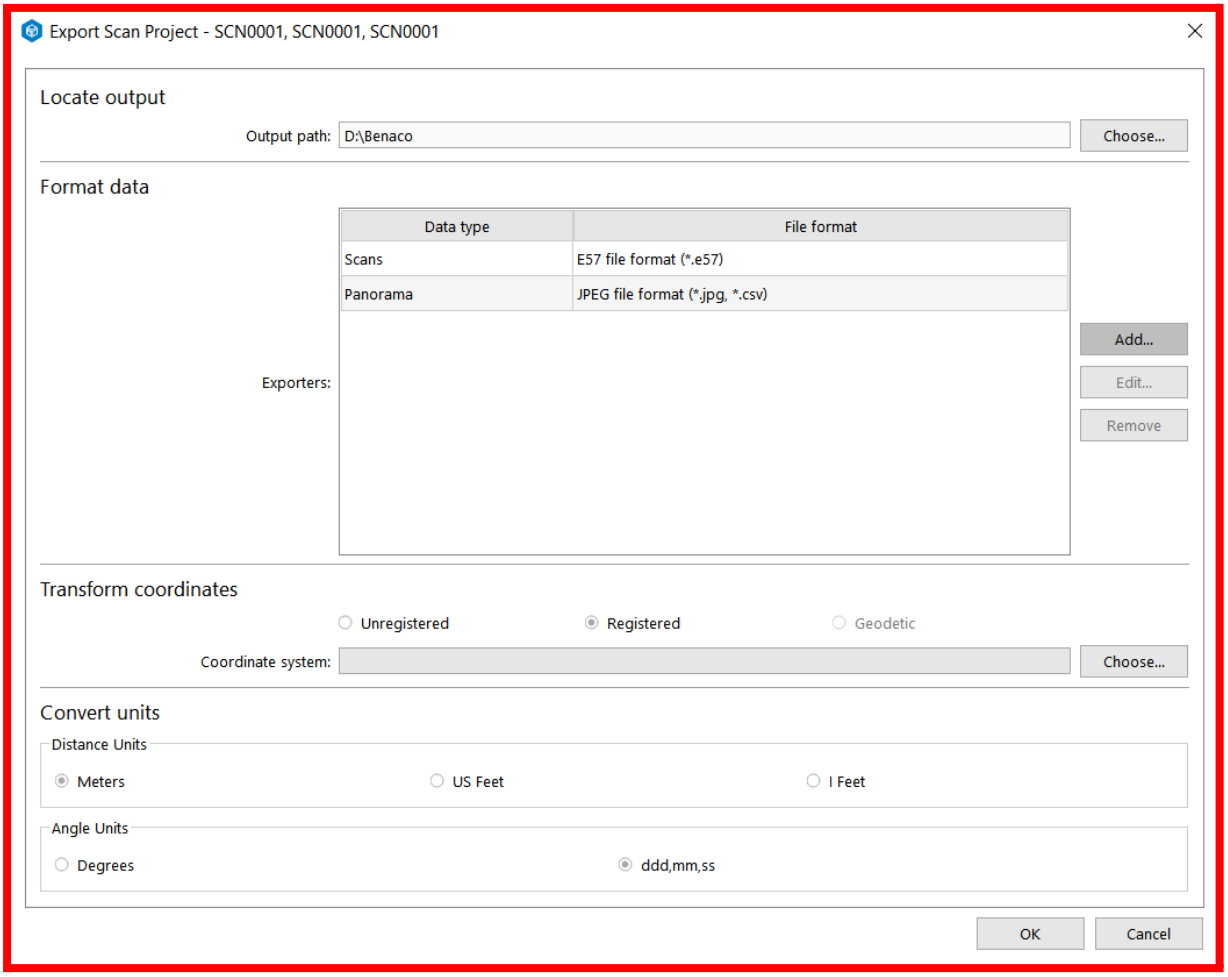
Step 1: Processing options to enable scan colorization and pano stitching:



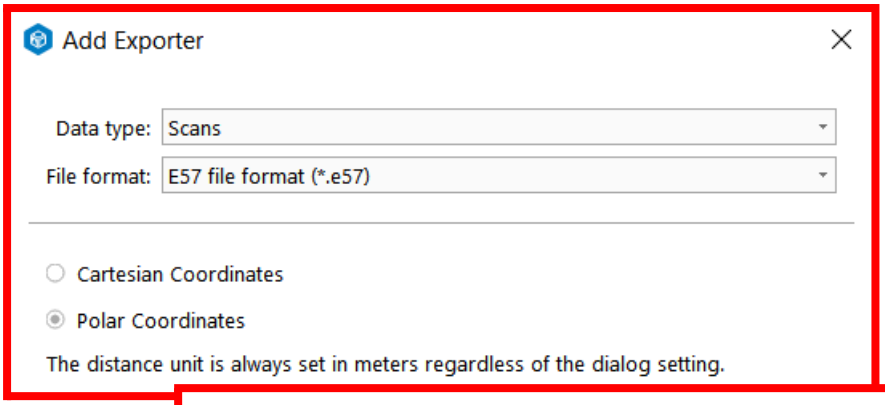
Step 2: Exporting Topcon results:

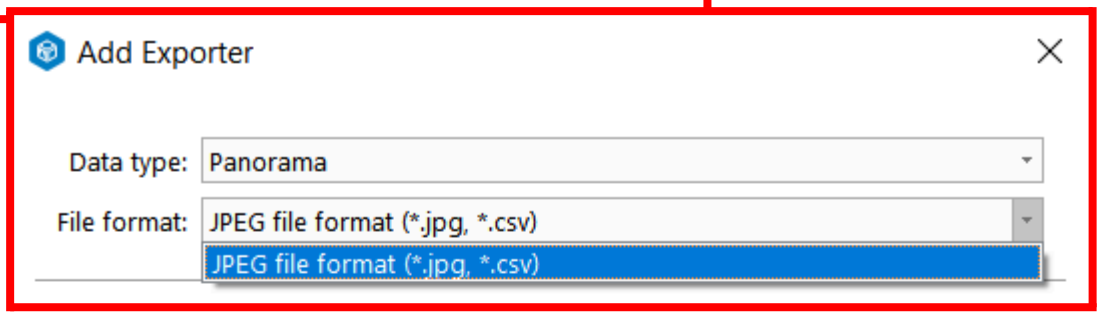


Step 3: Configuring data types to export:



Steps 3a and 3b: Adding the "Scans" and "Panorama" exports:





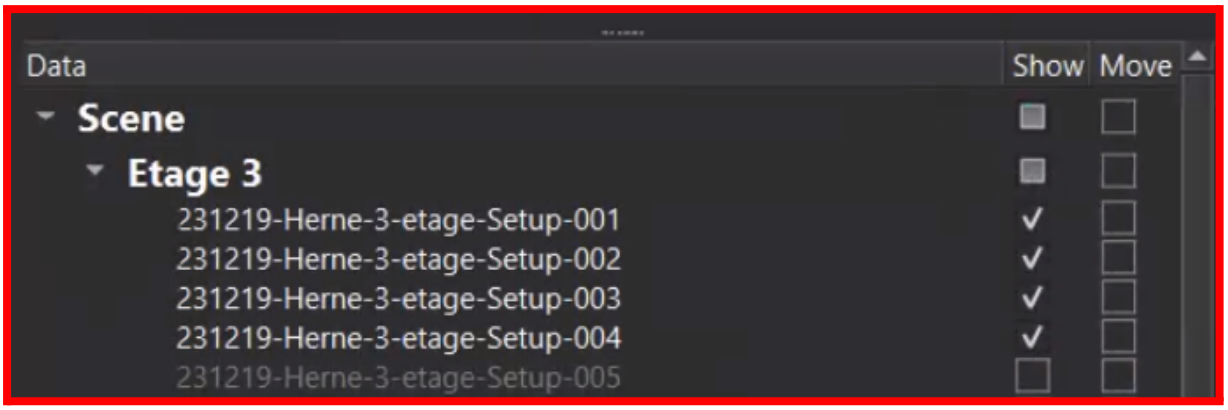
PinPoint

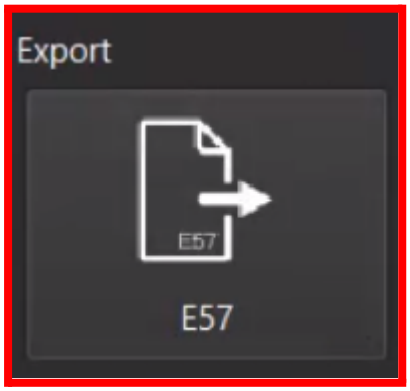
Provide Benaco with an export folder containing the following:

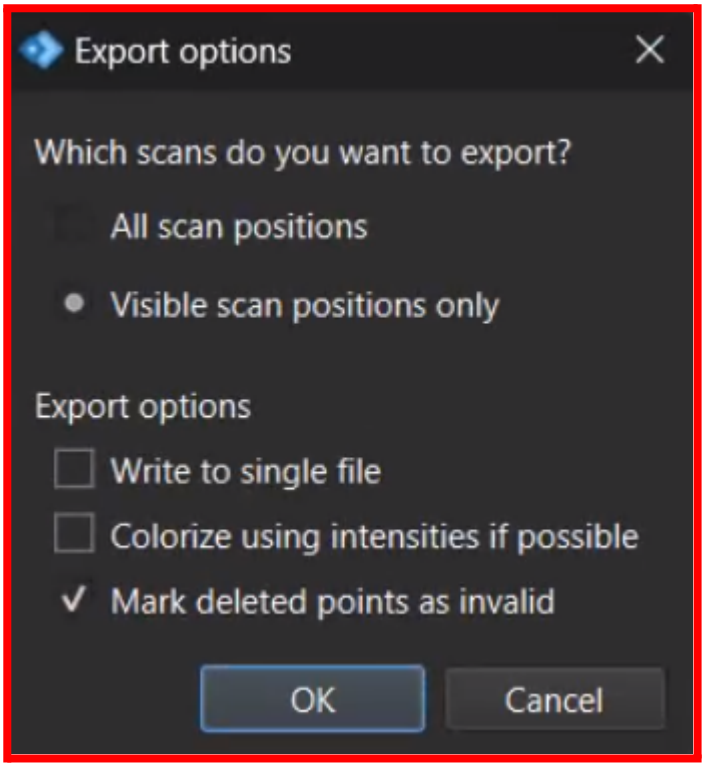
1. Mark all scans you want to export as **Show**.
2. Click the **E57** export button.
3. Ensure to check **[x] Mark deleted points as invalid**.

When you are done, the export folder should look as follows:

```
name-of-your-export-folder/
      Myproject-Setup-001.e57
      Myproject-Setup-001.e57
      ...
```







PointCab

Provide Benaco with an export folder containing the following:

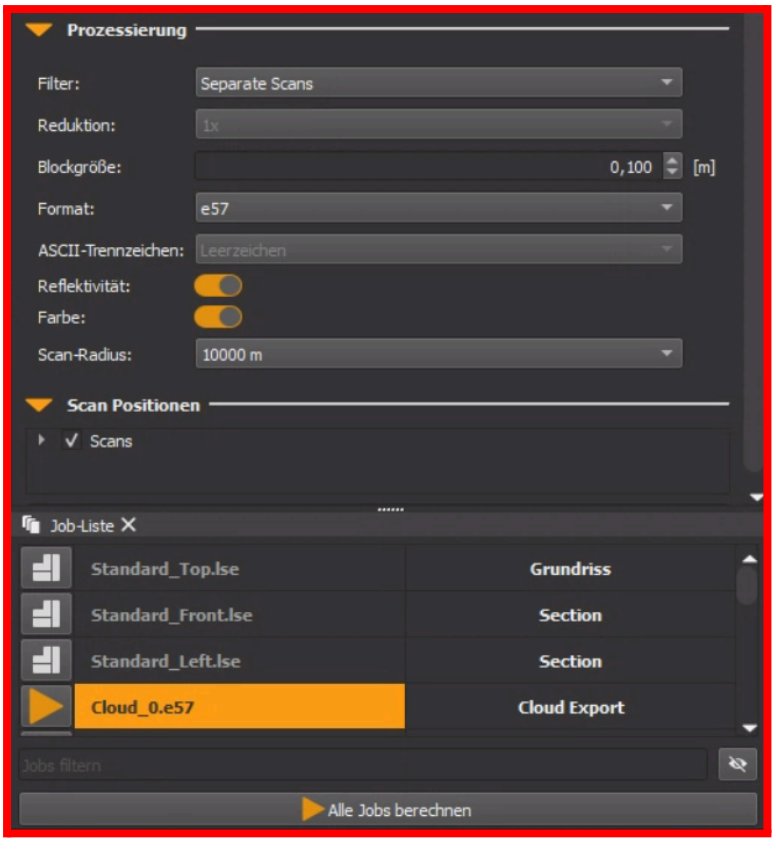
1. Add a **Cloud Export** action to the job list.
    a. Set **Filter** to **Separate scans**.
    b. Set **Format** to **e57**.
    c. Ensure **Color** is enabled.
2. Export all scan images as PNG or JPEG, with file names matching the E57 files.
    a. In the **Advanced Importer**, right-click a list entry and choose **All Scans > Save all Panoramas**

    Note that PointCab (as of September 2024) cannot yet export the *original* panoramas captured by the device for all laser scanners; it may export panorama images generated by *reprojecting* the color point cloud onto an image.

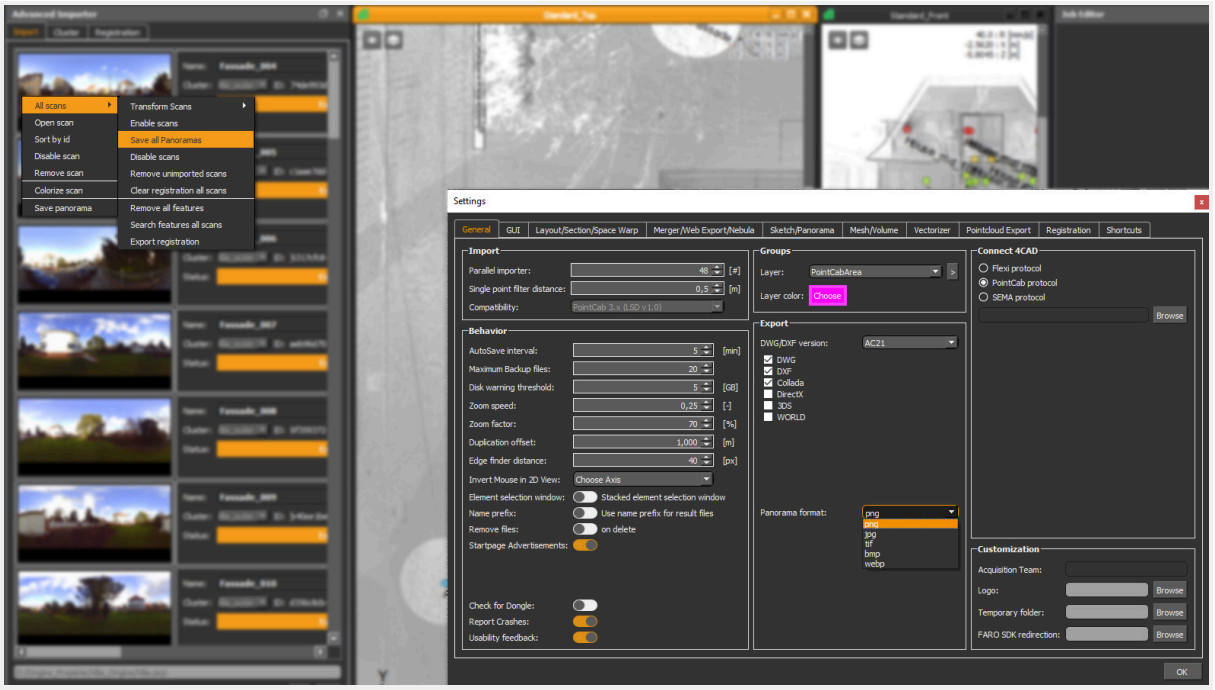
When you are done, the export folder should look as follows:

```
name-of-your-export-folder/
    pointclouds/
        myproject001.e57
        myproject002.e57
        ...
    panos/
        myproject001.png
        myproject002.png
        ...
```

Step 1: Exporting point clouds:



Step 2: Exporting panoramas:



(Image from https://pointcab-software.com/en/category/tips_and_tricks/*)*

LupoScan

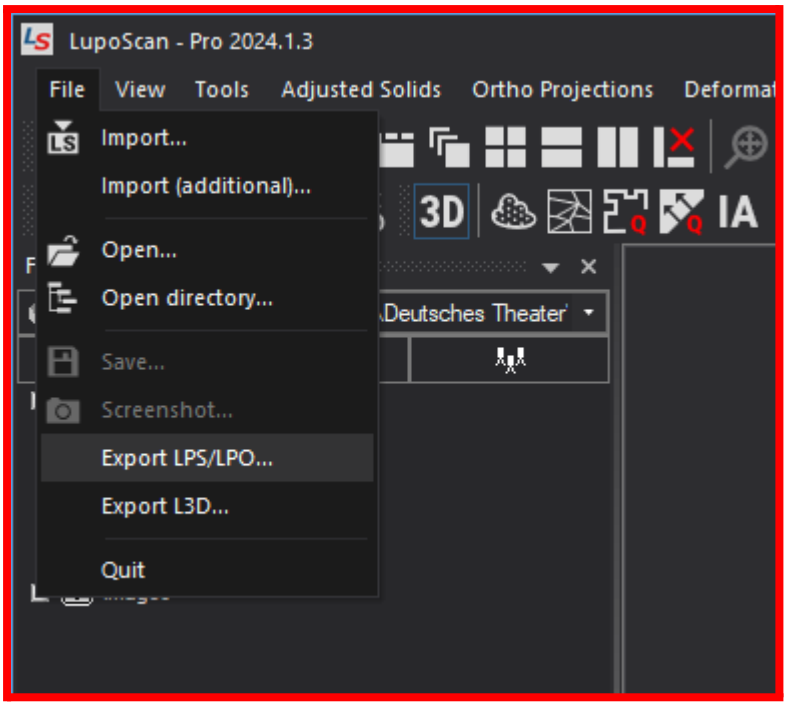
Provide Benaco with an export folder containing the following:

1. The point cloud in E57 format, into subfolder "`pointclouds`":
   Use the function **File > Export LPS/LPO**.
   In the tab **Format**, choose **E57.**
2. The RGB image data, into subfolder "`panos`".
   Use the function **File > Export LPS/LPO**.
   In the tab **Format**, choose **Colour.**
3. A file "`exporter.txt`" containing this text: `luposcan`

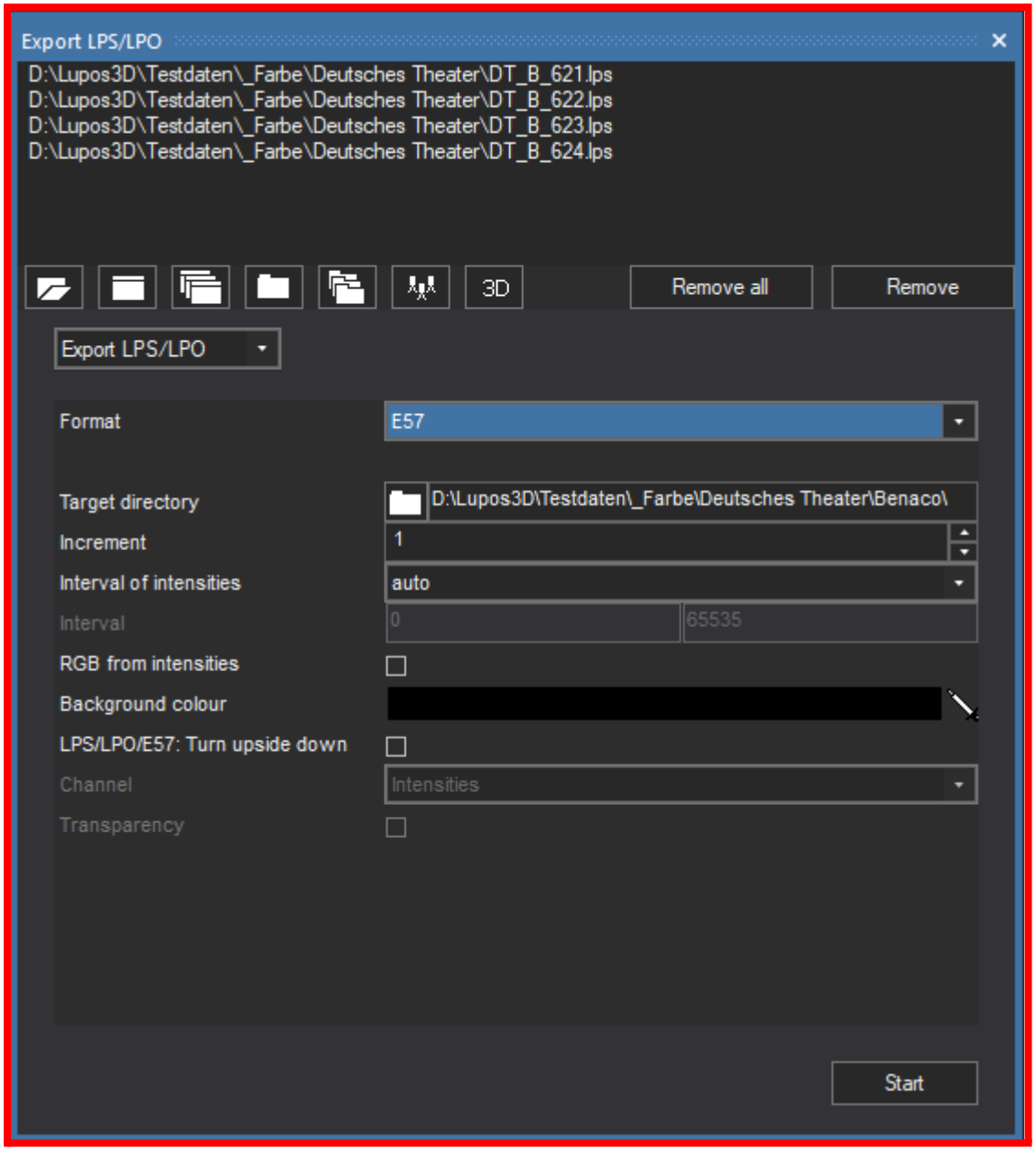
When you are done, the export folder should look as follows:

```
name-of-your-export-folder/
        exporter.txt        ⬅ containing text: luposcan
        pointclouds/
                myproject001.e57
                myproject002.e57
                ...
        panos/
                myproject001.png
                myproject002.png
                ...
```

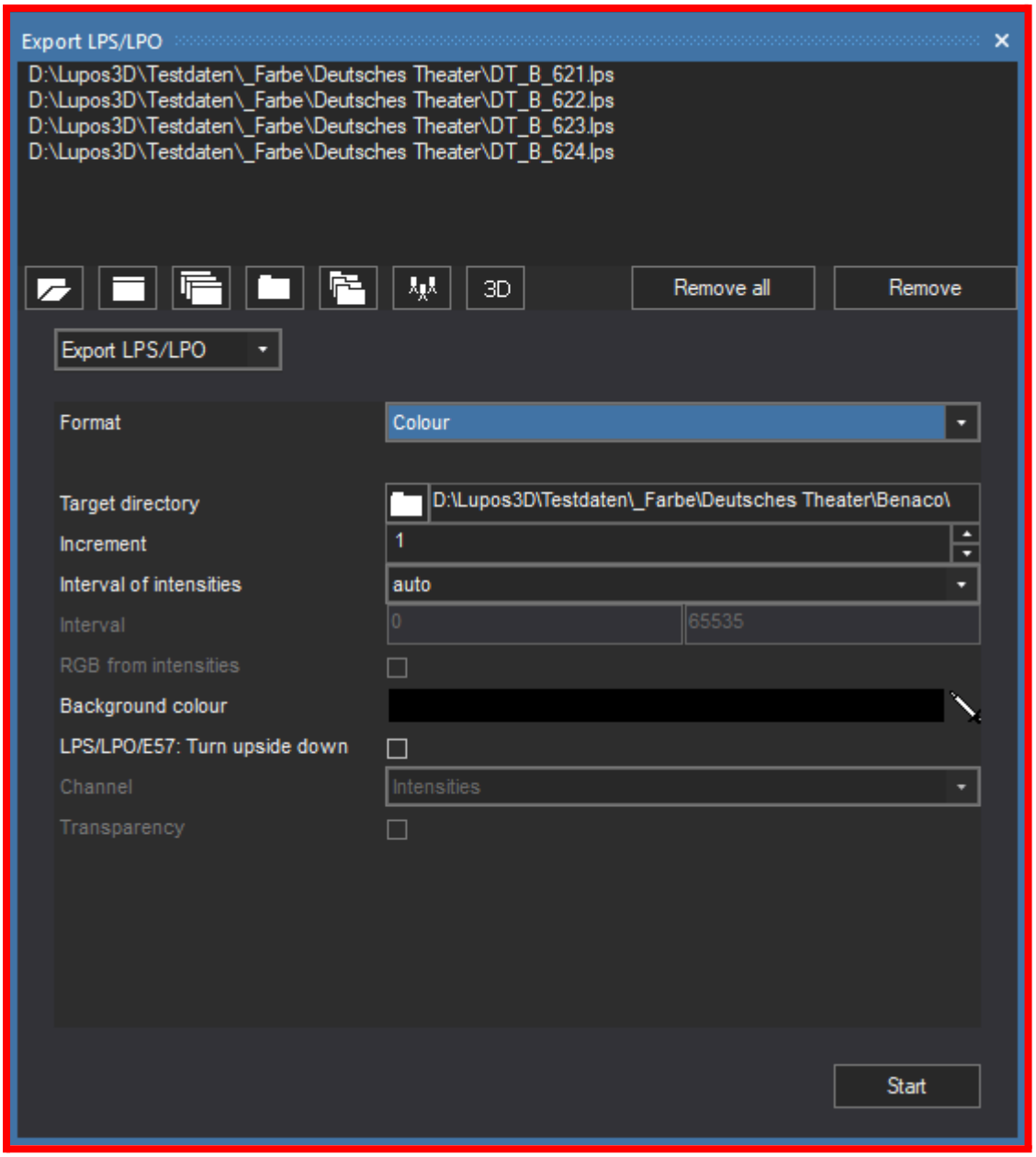
Step 1: Selecting the export menu:



Step 2: Exporting points as E57:



Step 3: Exporting panoramas:



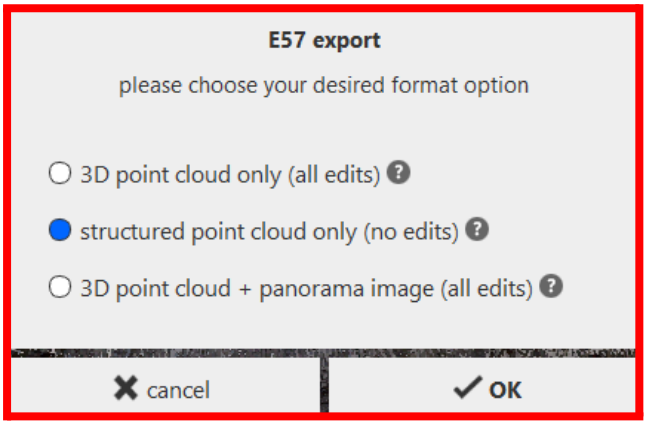
Autodesk ReCap

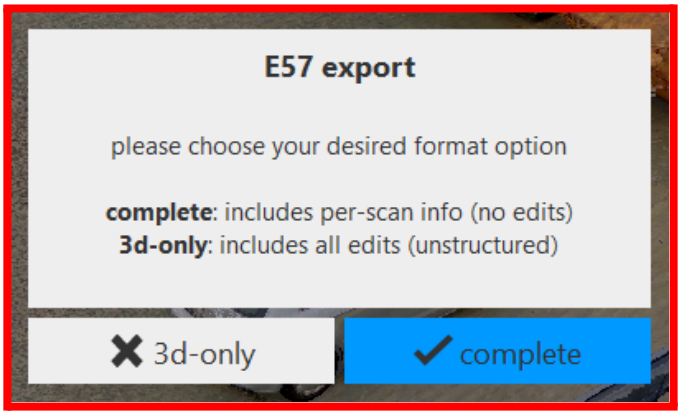
Provide Benaco with an export folder containing the following:

1. The point cloud in E57 format:
    a. From the ReCap main window, click the **House** button, expand the **Arrow-down** menu, and click the **Arrow-up (Export)** button. Alternatively, press **Ctrl+E**.
    b. Choose **E57** as file type.
    c. Choose **structured point cloud only (no edits)**.
    In older ReCap versions (< 2025), choose button ✓**complete** instead.
2. The RGB image data:
    a. From the location where your ReCap project is stored, copy the **.rcp** file and the **<Myprojectname> Support** folder into the export folder.
    From the Support folder, only the **.rcc** files are required; you may optionally delete the other files from the export folder to reduce the storage space.

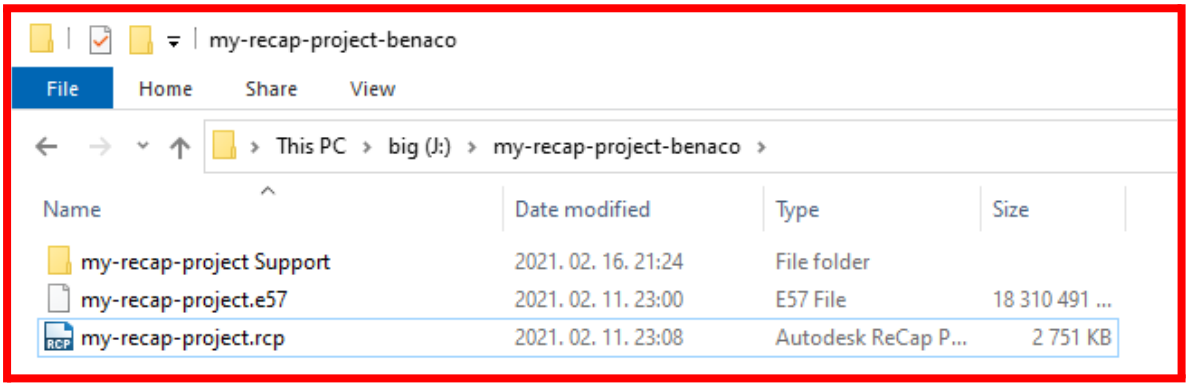
Step 1a: Exporting the point clouds:

Step 1c: Choosing structured export (screenshots show multiple ReCap versions):





When you are done, the export folder should look as follows:



Matterport

Buy the official E57 export from Matterport as described in:
https://support.matterport.com/s/article/Overview-of-Matterport-E57-File?language=en_US

Please **unpack ZIP** files downloaded from Matterport before uploading to Benaco.

When you are done, the export folder should look as follows:

- `name-of-your-export-folder/`
  - `cloud_0.e57`
  - `cloud_1.e57` (only present if there are many scan positions in your project)
  - `...`
  - `mesh` (optional, to upload an existing mesh, e.g. from a Matterpak)
    - `*.obj`
    - `*.mtl`
    - `*.jpg`

Z+F FlexScan

Requires LaserControl **>= 10.0.9**.

Provide Benaco with an export folder containing the following:

1. In the processing batch dialogue, **SLAM settings > Export**, choose settings:
    a. **[x] Panoramas**
        - **[x] Enhance image quality**
        - **[x] Use Stitching** (optional but recommended)
          (this enables stitching vs blending in camera overlap areas)
    b. **[x] Database**
        - **LOD: 0** (this means all data, **1** defaults to 5mm, **2** is 10mm)
        - Format: **e57**
    c. **[x] Track**

    This creates point clouds with embedded stitched equirectangular panoramas in **.e57** format, and a sensor trajectory in **.laser_0.txt** format.

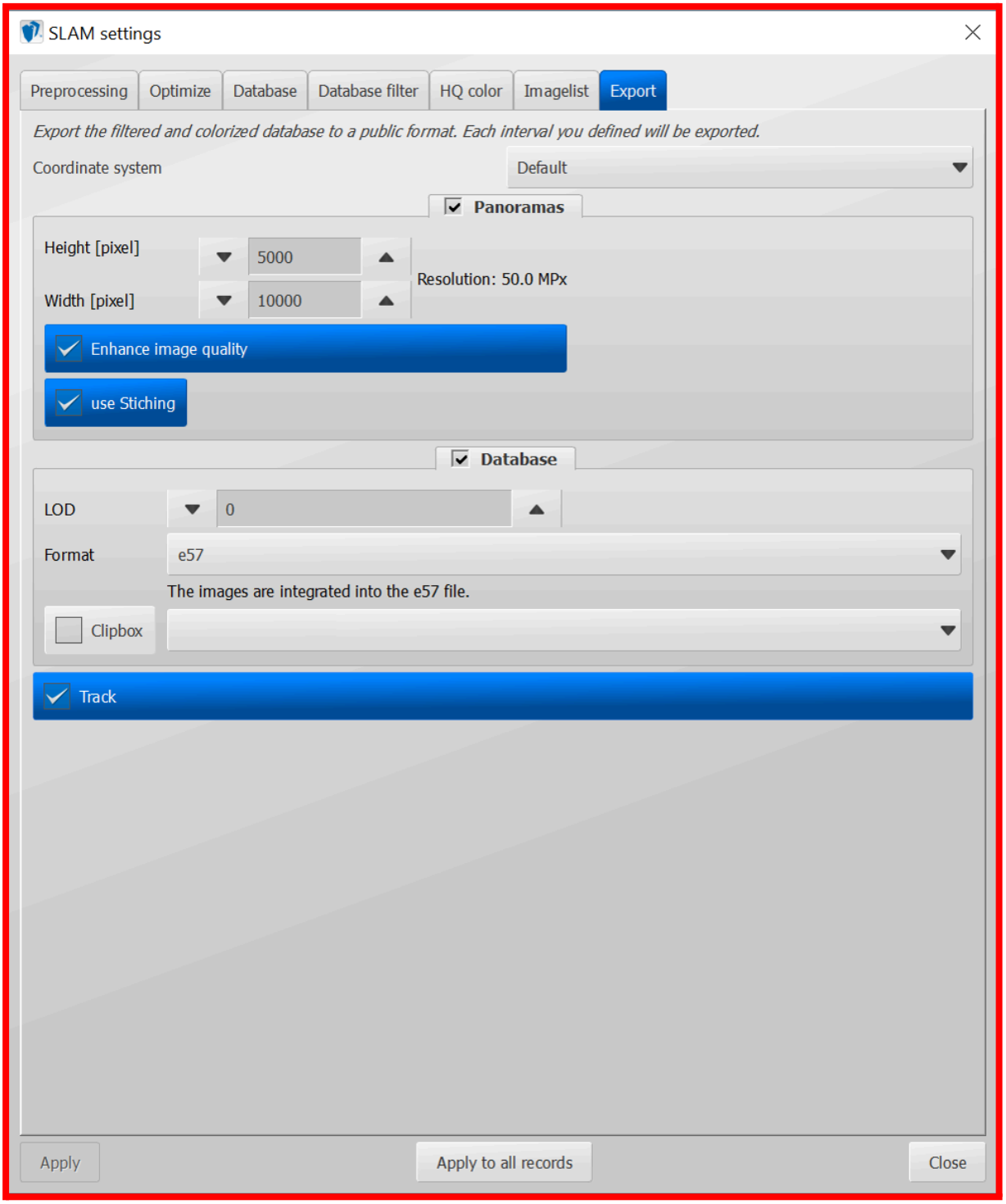
2. Only if you used geo-referencing:
    a. A file "`source-crs.txt`" containing as a single line the EPGS name of the coordinate system, for example: `EPSG:2056`

Multiple separately recorded data sets ("walks") can be combined into the same project if they are in the same coordinate system.
It is recommended to place them into separate folders.

When you are done, the export folder should look as follows for a project with 2 walks:

```
name-of-your-export-folder
    walk1
        2024-09-24_backpack_log_1_1_complete.e57
        2024-09-24_backpack_log_1_1_complete.laser_0.txt
                In the above, the naming is important:
                If the E57 file is called SOMETHING.e57,
                then the trajectory file must be called
                SOMETHING.laser_0.txt
    walk2
        2024-09-25_backpack_log_1_1_complete.e57
        2024-09-25_backpack_log_1_1_complete.laser_0.txt
    source-crs.txt    ⬅ if you used geo-referencing
```

Step 1: Exporting the point clouds with images and trajectory:



Viametris PPiMMS

Provide Benaco with an export folder containing the following:

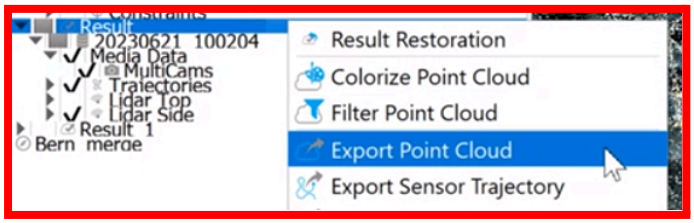
1. Point clouds in **.laz** or **.las** format.
    a. Right-click on your result data set, choose **Export Point Cloud**.
    b. Set **Output Format** to **LAZ**.
    c. Leave the **Output File Name** automatically determined; if you changed it, bring it back with **Reset**.
2. Sensor trajectories.
    a. Right-click on your result data set, choose **Export Sensor Trajectory**.
    b. Tick the checkbox [✘] **System**.
3. Stitched panorama images and their image trajectories.
    a. Right-click on your result data set, choose **Export Images**.
    b. Set **MultiCams mode** to **Dynamic Range Panoramic**.
    c. Leave the **MultiCams Image Name Prefix** automatically determined; if you changed it, bring it back with **Reset**.
4. Only if you used geo-referencing:
    a. A file "`source-crs.txt`" containing as a single line the EPGS name of the coordinate system, for example: `EPSG:2056`

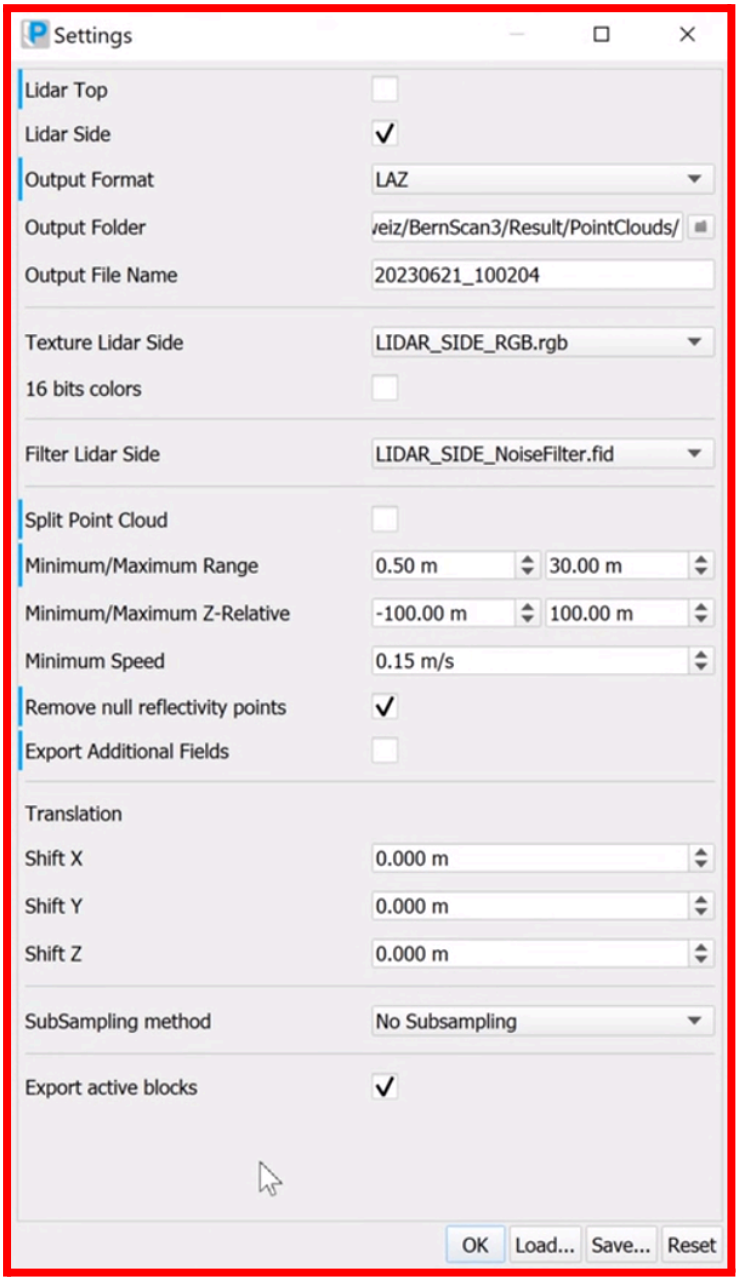
Multiple separately recorded data sets ("walks") can be combined into the same project if they are in the same coordinate system.

When you are done, the export folder should look as follows for a project with 2 walks; the underlined file name prefixes **must match**:

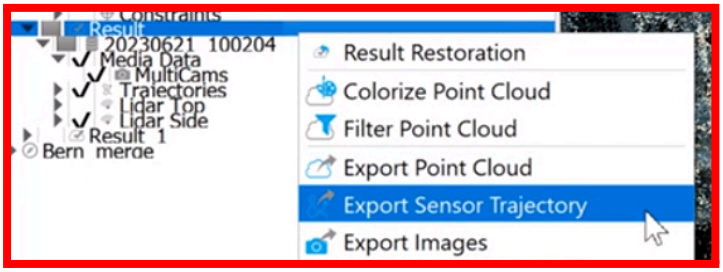
```
name-of-your-export-folder
    Images
        20230413_175004_Image_Trajectory.xyz
        20230413_175004_Image_000001.jpg
        ...
        20230413_175846_Image_Trajectory.xyz
        20230413_175846_Image_000001.jpg
        ...
    PointClouds
        20230413_175004_Lidar_Side.laz ← be sure to match prefix
        20230413_175846_Lidar_Side.laz ← with SensorTrajectories
    SensorTrajectories
        20230413_175004_System.xyz
        20230413_175846_System.xyz
    source-crs.txt    ← if you used geo-referencing
```

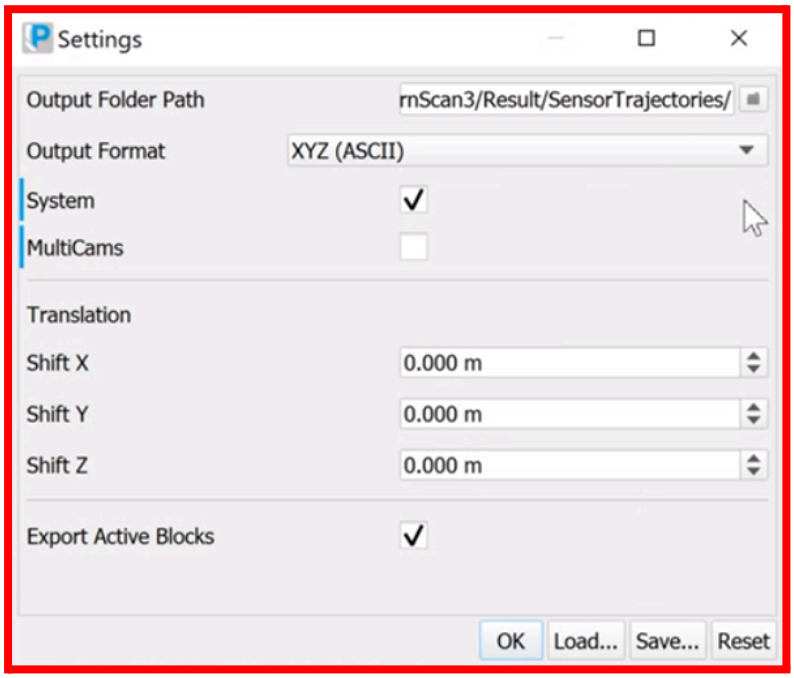
Step 1: Exporting the point clouds:



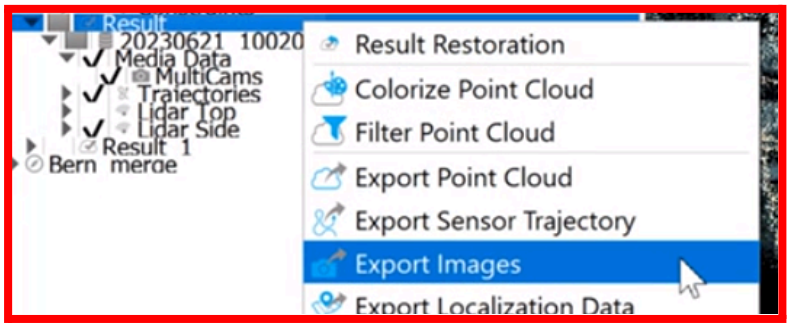


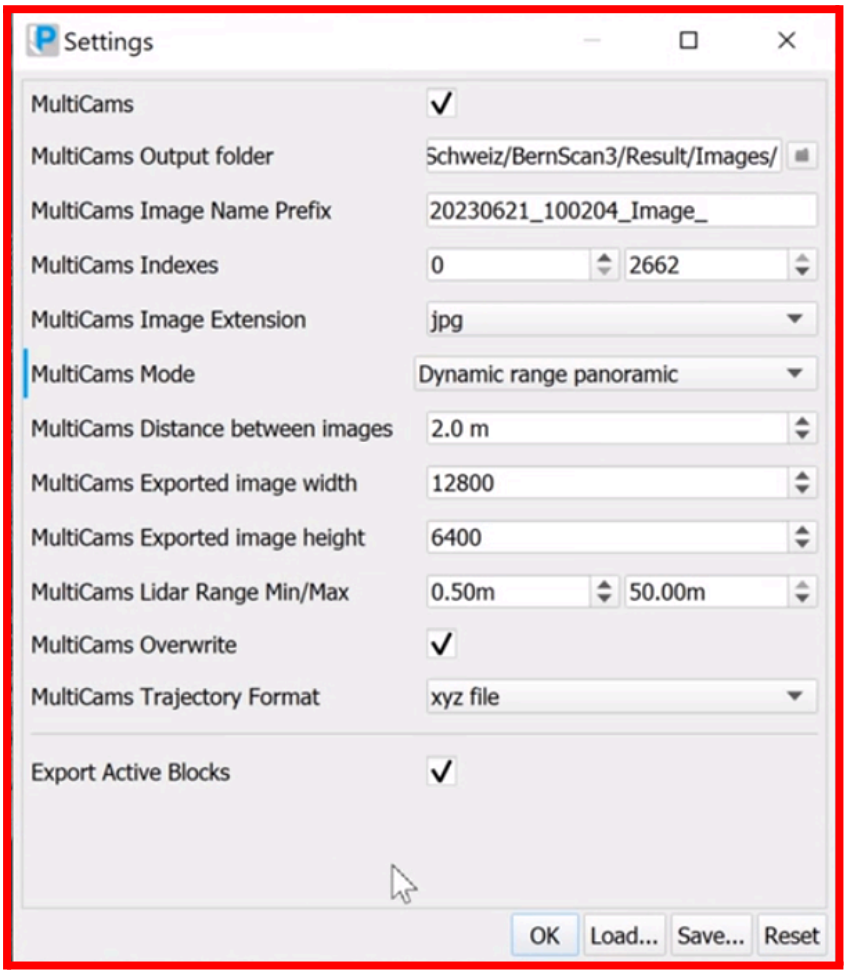
Step 2: Exporting the sensor trajectory:





Step 3: Exporting images:





Gexcel HERON mobile mappers

Provide Benaco with an export folder containing the following:

- The laser trajectory: **trajectory.csv**
- The colorized point cloud in **.e57** format.
    - It embeds the panoramas (preferably 8K resolution still photos).

When you are done, the export folder should look as follows:

```
name-of-your-export-folder
      trajectory.csv
      myproject.e57
```

Emesent Hovermap

Provide Benaco with an export folder containing the following:

- The laser trajectory: **myproject_traj.xyz**
- The colorized point cloud in **.laz** or **.las** format.
- The panorama photos (currently only projects with the Emesent GoPro panocam attached are supported).
- The **frames.json** file that carries pose information of the panorama photos.

When you are done, the export folder should look as follows:

```
name-of-your-export-folder
      myproject.laz
      myproject_traj.xyz
      frames/
            frames.json
            frame_000000.jpg
            frame_000025.jpg
            frame_000050.jpg
            frame_000075.jpg
            ...
```

Topcon mobile mappers

Provide Benaco with an export folder containing the following:

- The colorized point cloud in **.las** format.
- The panoramas in stitched **.jpg** format.
- The laser trajectory in **.csv**. format.

When you are done, the export folder should look as follows:

```
name-of-your-export-folder
      IP-S3-myproject.las
      IP-S3-myproject Panoramas/
            ladybug_panoramic_000000.jpg
            ladybug_panoramic_000001.jpg
            ...
            Trajectory/
                  ipsx_trajectory.csv
            ...
```

Trimble TIMMS

Provide Benaco with an export folder containing the following:

1. Point clouds in **.laz** or **.las** format. Ensure they have "Gps time" time stamps.
2. Sensor trajectory: **TIMMSpath.txt**
3. Camera trajectory: **area_eo.txt**
4. Stitched panorama images
5. Geo-referencing zone info file: **USR_frame.txt**

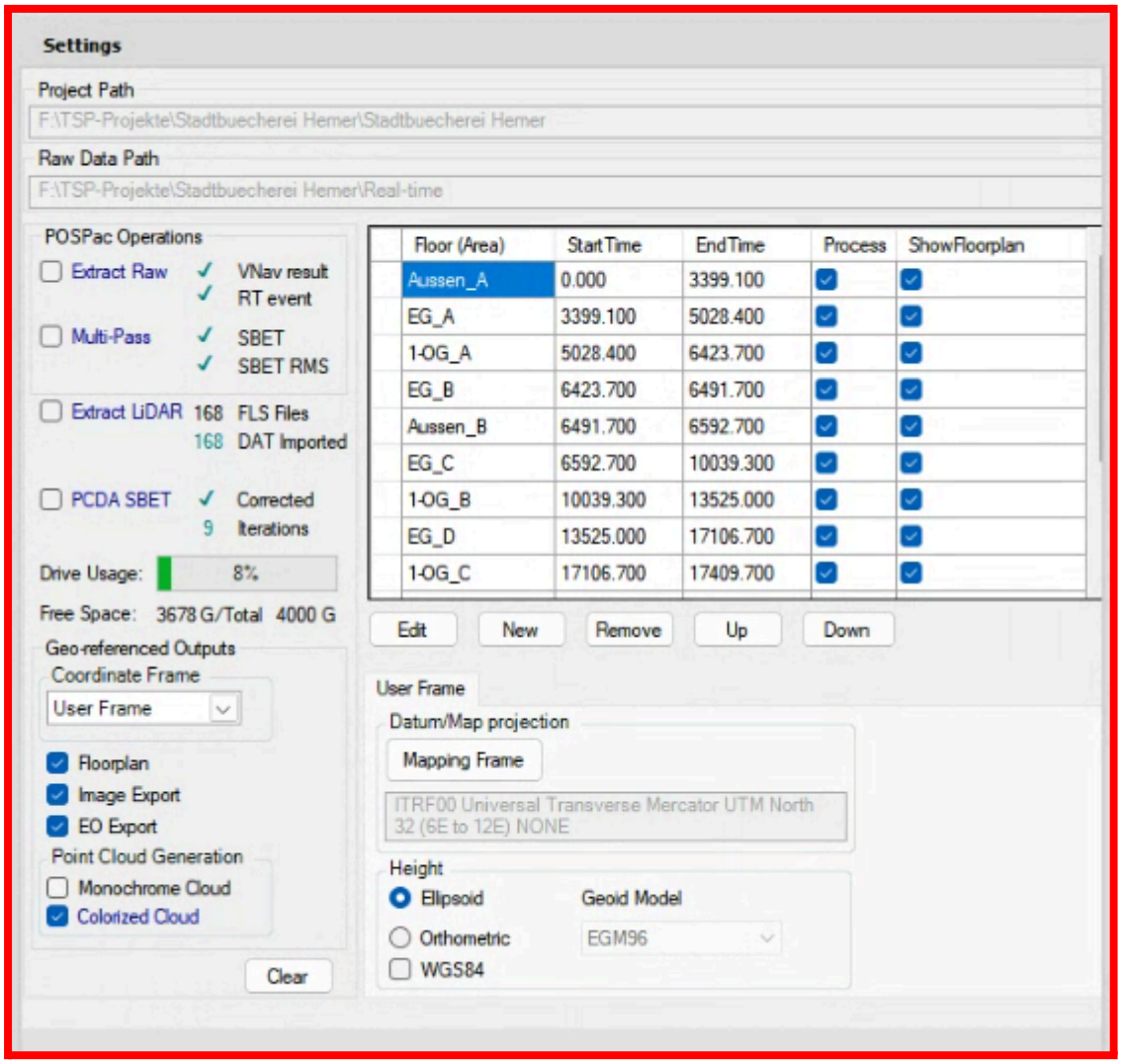
See the below screenshot for the settings.

These files will typically appear in the `Processed` sub-folder of your "Project Path" of your TIMMS Spatial Processor (TSP) software. You can upload the entire `Processed` folder.

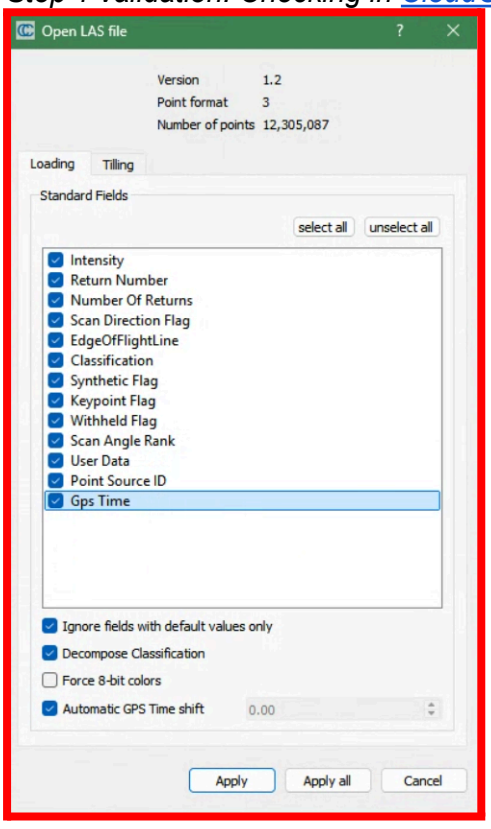
When you are done, the export folder should look as follows:

```
name-of-your-export-folder
    Processed/
        Myproj1/
            Color_LAS_USR/
                full/
                    L1_Myproj1_color_001.las
                    L1_Myproj1_color_002.las
                    ...
            TCC/
                TIMMSpath.txt
                area_eo.txt
                HD-Pics/
                    ladybug_panoramic_000000.jpg
                    ladybug_panoramic_000001.jpg
                    ...
        Myproj2/
            ...
        ...
```

Steps 1-5: Exporting data from TIMMS



Step 1 validation: Checking in CloudCompare that the .las/.laz has "Gps time":



Faro Orbis Connect / GeoSLAM Connect

Benaco requires projects that include the ZEB Vision camera (or any other, newer camera that allows colorizing the point cloud).
In Faro Connect or GeoSLAM Connect, process your project:
Ensure all **images are stitched** and the point **cloud is colorized**.
Applying the GeoSLAM provided filters helps reduce outliers for better results.

If you have **multiple datasets** that you registered together, do not forget to use the "Vision Calculate Image Poses" dialog to apply the found transformation onto the `.gs-traj` files, thus creating new, transformed `.gs-traj` files (see screenshot further down).

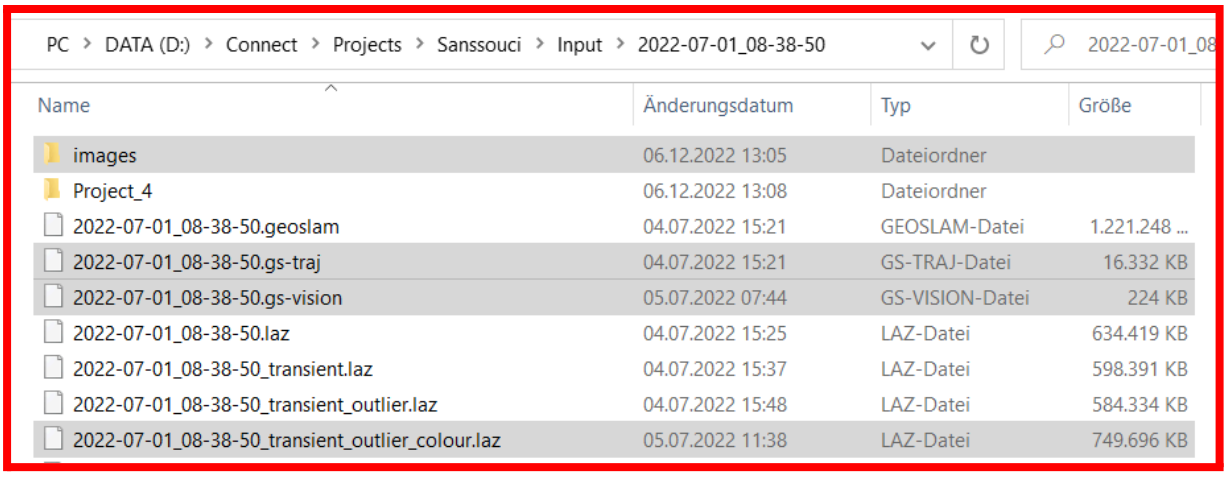
> As of writing (2025-06-23), you need to use Faro Connect, **not Faro SCENE**, because the orbis in Faro SCENE cannot do the above-mentioned step yet.
> Benaco can/will only add Orbis+SCENE support (for both single- and multi-datasets) once that works.

Provide Benaco with an export folder containing the following:

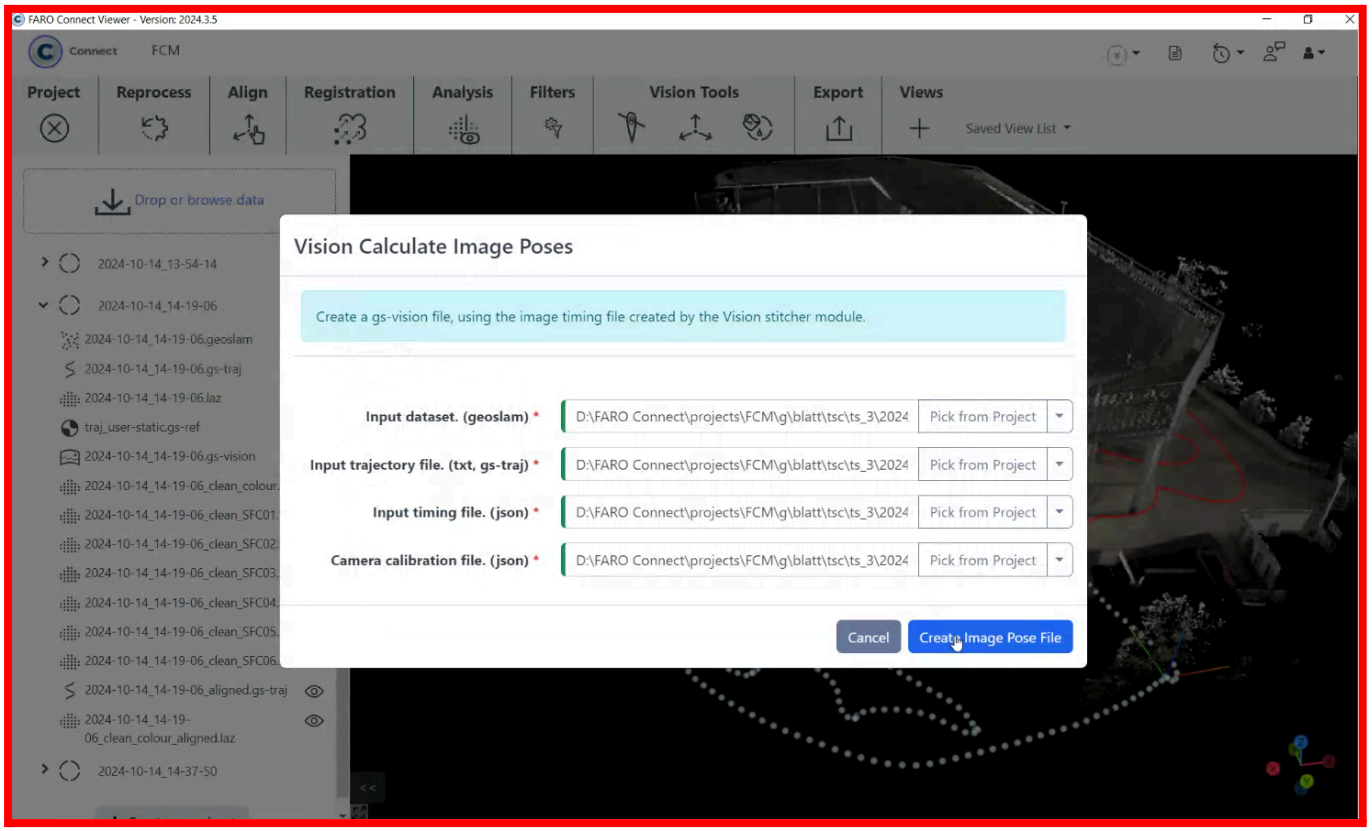
> From your GeoSLAM project folder's "**Input**" folder, these files and folders:

`images/`	*(folder of stitched images)*
`*.traj.txt`	*(if it exists)*
`*.gs-traj`	
`*.gs-vision`	
`*_colour.laz`	*(colored point cloud; the file name may be longer depending on the filters you applied)*

Highlighted in grey: The files to provide from GeoSLAM Connect
(you need to additionally provide traj.txt if it exists):



Creating transformed .gs-vision and .gs-traj/.txt trajectory files for merged multi-walk projects



XGrids Lixel Studio

Provide Benaco with an export folder containing the following:

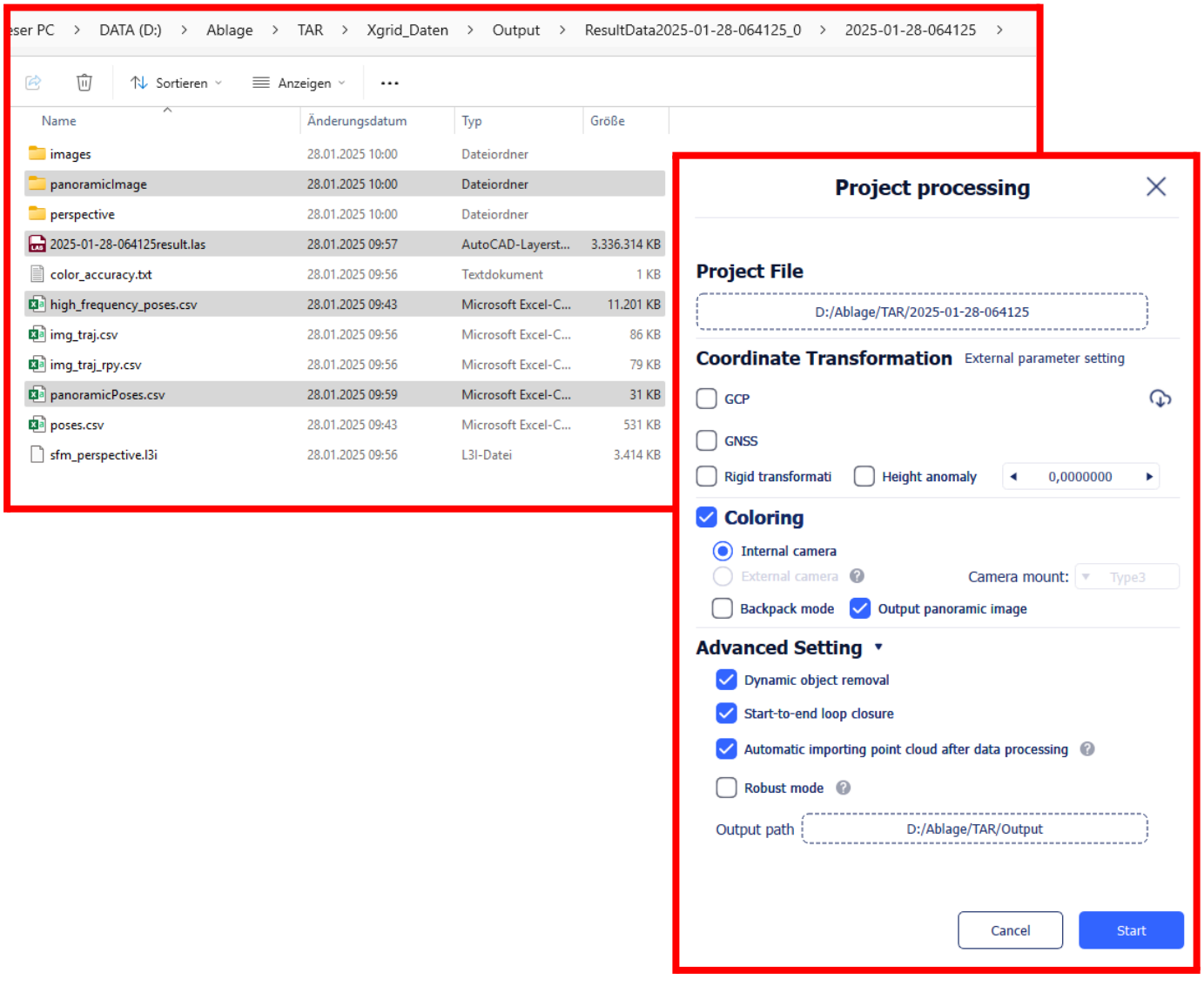
- The project subfolder of the **Output** folder created by Lixel Studio's processing.
  The subfolder is usually stored with a naming scheme similar to:
  `Output / ResultData2025-01-28-064125_0 / 2025-01-28-064125`
    - In the processing options, you need to enable:
        - **[x] Coloring**
        - **[x] Output panoramic image**

  You can upload the entire project output folder, or only the files mentioned below.

When you are done, the export folder should look as follows:

```
name-of-your-export-folder
    panoramicImage/   ← folder containing panorama images
    2025-01-28-064125result.las   ← cloud; name depends on project name
    high_frequency_poses.csv
    panoramicPoses.csv
```

Processing and exporting XGrids data:



NavVis Ivion

Provide Benaco with an export folder containing the following:

- The point cloud **.e57** format with embedded pano photos.
    - You need to enable processing of pano photos, otherwise they will be missing from the .e57.

When you are done, the export folder should look as follows:

```
name-of-your-export-folder
      myproject.e57
```

Placing additional panos against laser data

Benaco can automatically register separately-shot **stitched equirectangular** panorama photos (e.g. from Ricoh Theta or Insta360 cameras) against your laser data.

This creates additional panorama positions to which visitors of the 3D tour can navigate, "filling the gaps" in photo coverage between wider-spaced laser positions.

Because small panocams are extremely fast (1 second for a full pano shot) it allows to capture up to **20x more positions per time** compared to the slow cameras integrated in most stationary laser scanners.
These additional shots can be captured e.g. while the stationary laser scanner is still running, allowing greatly increased pano photo coverage at little to no extra time cost for the surveyor.

This can be especially useful for capturing device labels in the environment.
A professional extendable monopod is recommended. Camera features such as Ricoh's Time Shift Shooting plugin help to remove the photographer from the image by triggering panocam lenses separately. Additional panos may also be handheld but must not be blurry.

Additional panos only add more pano positions to the tour. They are not used for meshing or texturing (only the laser data is used for that).

The panos are placed against the laser color panos using **photogrammetry**.
This requires a significant amount of **visual overlap** between a to-be-placed additional pano and the nearby laser color panos: The additional pano must "see the same things" as a nearby laser pano so that the visual feature matching algorithm succeeds.
It is difficult to quantify exactly what "enough visual overlap" means; rough guideline:

- In **large, featureful** environments (e.g. football stadium) the view of what a camera sees changes insignificantly even when moving larger distances, so larger offsets between additional panos and laser positions can work, often up to multiple meters.
- In **large, featureless** environments with repeating visual patterns (e.g. flat outdoor areas, desert, large parking spaces), the visual features will not be distinct, making automatic placement more challenging. Place panos close to laser positions.
- In **narrow** environments (real estate, dense industrial) moving a small distance can significantly change what a camera sees. Place panos close to laser positions.

To add additional panos against your laser data, place them in the `external-panos` folder of your upload. It must have a **flat folder structure** (no subfolders inside, only image files).
Your export folder should look as follows:

```
name-of-your-export-folder
        ( ... your other laser data files here ... )

        external-panos    ⬅ additional panocam shots; must be equirectangular
              R0011533.JPG
              R0011534.JPG      ⬅ file names do not matter; but must be JPEGs
              ...
```

Agisoft Metashape

Provide Benaco with an export folder containing the following:

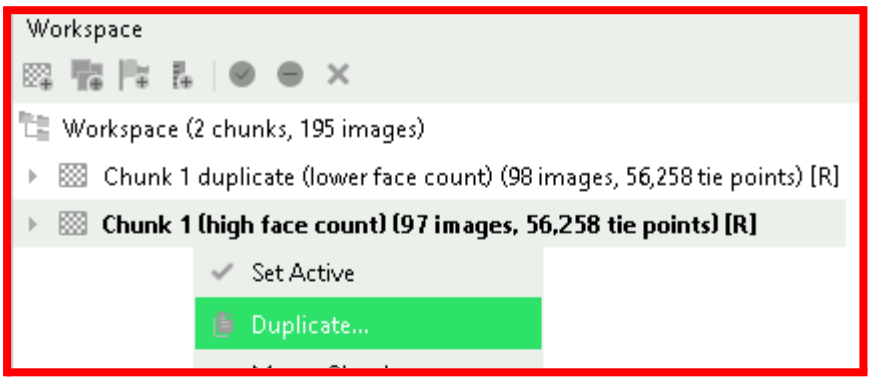
1. A textured OBJ mesh.
    a. **Ensure that your project does not have huge coordinates.**
    In the bottom left panel, click "Reference" and check that for your cameras and markers (if you have any), the X/Y/Z values are < 10000 instead of e.g. +/- multiple millions.
    If you see large coordinates, first click the "Reference Settings" button above the Cameras panel, and switch from "WGS 84" to "Local coordinates".
    If you still have large coordinates in markers (e.g. because you used them to define a scale bar to set the mesh scale), re-create those markers from the 3D mesh view instead from a camera 2D view, as otherwise Agisoft will create markers that associate 2D and 3D, when you only want to scale 3D.
    b. **Ensure that your mesh is not too large.**
    For Benaco use you should decimate meshes to 1M - 10M faces.

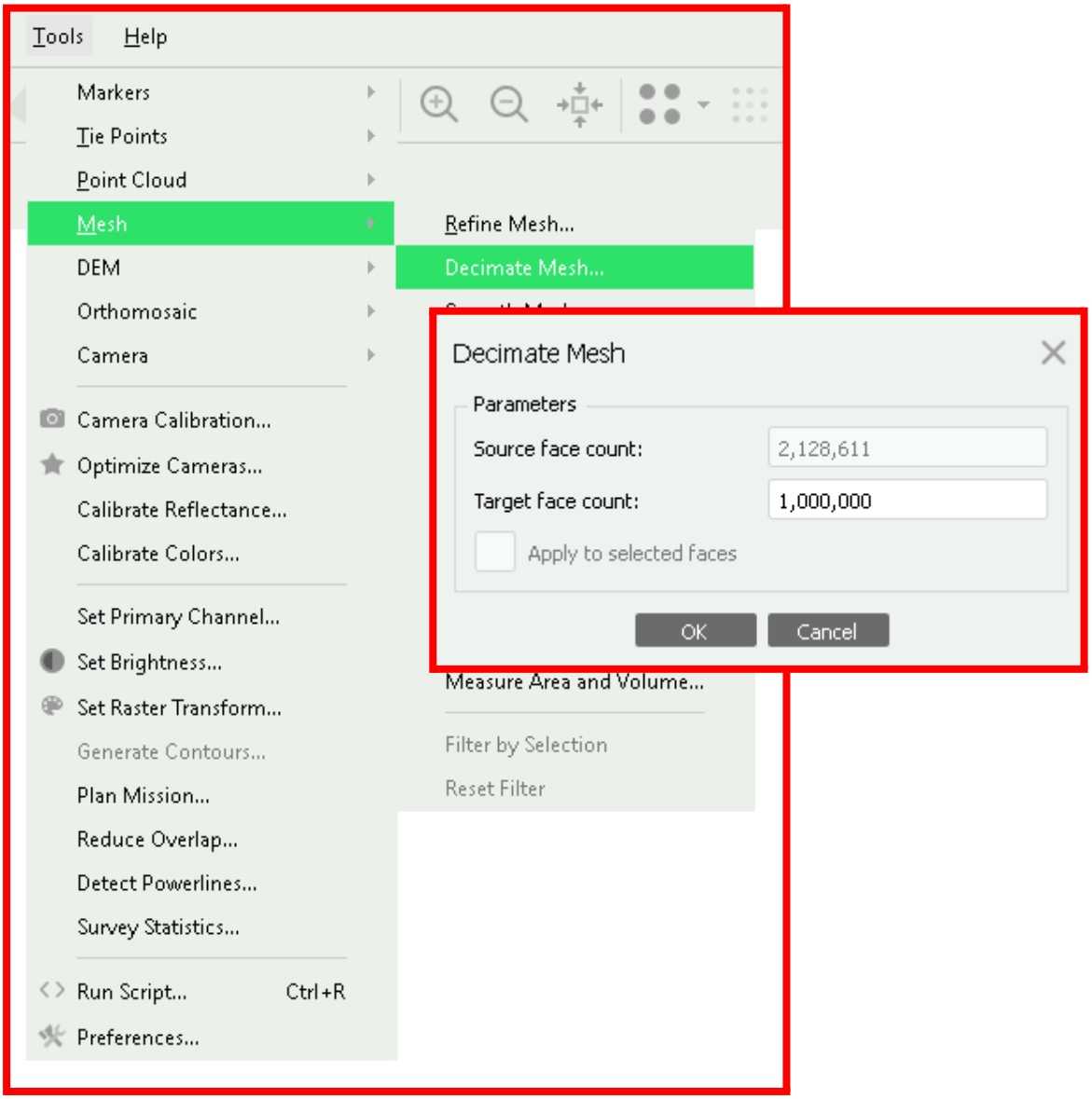
    Be aware that Agisoft generates higher-quality meshes if you first create a mesh with high face count and then decimate it.
    This preserves thin objects (such as poles, railings) better than when you ask Agisoft to directly create a low-face-count mesh.
    The reason is that the mesh creation and simplification algorithms work differently.

    To decimate large meshes:
        - **Duplicate** the current Agisoft Chunk that contains the original mesh so that you do not lose it after decimation.
        Double-click the duplicate Chunk to activate it.
        - Choose **Tools -> Model -> Decimate Model...** and set **Target face count** to e.g. **1,000,000**.
        - Re-texture the decimated mesh (see below).
    c. Ensure you have created textures using the **Workflow -> Build Texture** dialog, with these settings:
        - Texture size: **4096** pixels
        - Texture count: **10**
        (higher counts are acceptable but will result in longer loading times)
    d. Choose **File -> Export -> Export Model**.
    Save the file as `"model.obj"` with **Wavefront OBJ** format, into a `"mesh"` folder.
        - Tick the checkbox [✘] **Export Texture**.
        - Set "Coordinate system" to **Local Coordinates (m)**.
        - Tick the checkbox [✘] Write metadata.xml file.
        This is only necessary for geo-referencing in Benaco (optional but recommended).
        This option is only available in Metashape >= 2.1.
2. The camera positions and parameters:

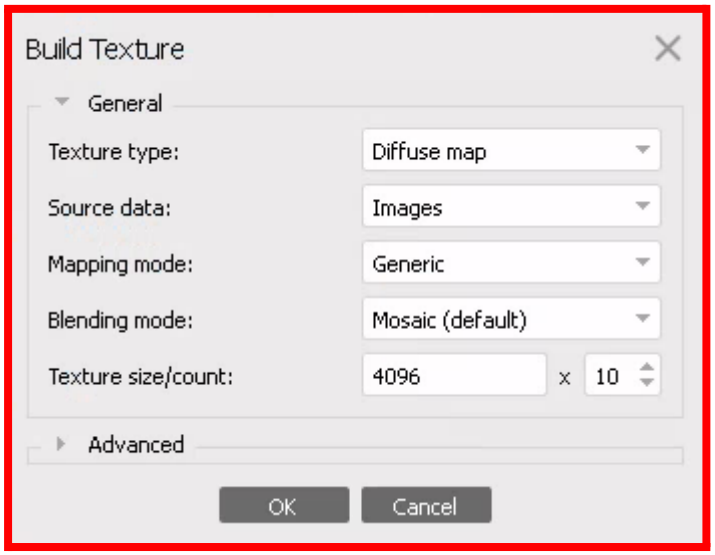
    a. Choose **File -> Export -> Export Cameras**.
       Save the file as `"cameras.opk.txt"` with **Omega Phi Kappa** format.
       If a "Select Projection" popup appears, choose **Local Coordinates (m)**, because Metashape's OBJ coordinates are also local.
    b. Again choose **File -> Export -> Export Cameras**.
       Save the file as `"agisoft-cameras.xml"` with **Agisoft XML** format.
3. The image files.
    a. Save them into an `"images"` folder.

Step 1a: Ensuring the mesh has a suitable face count

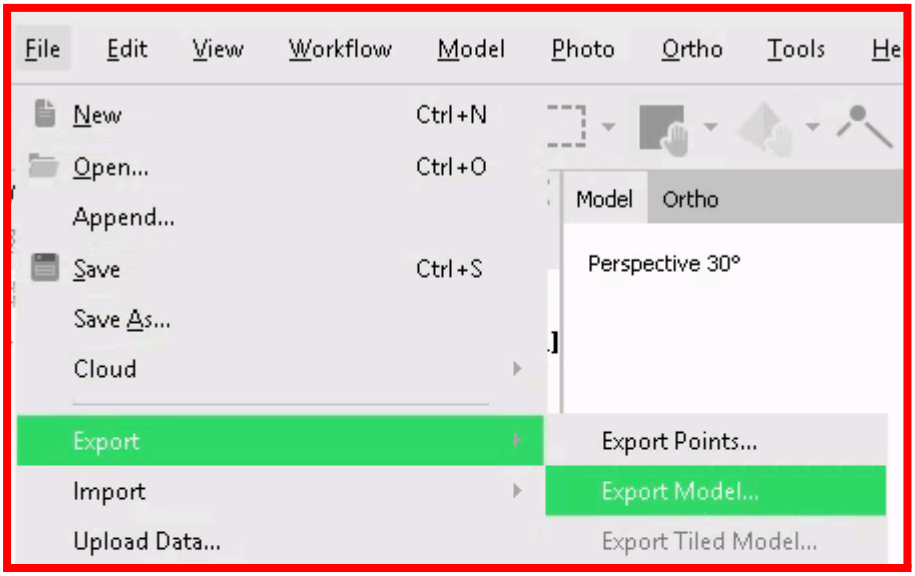


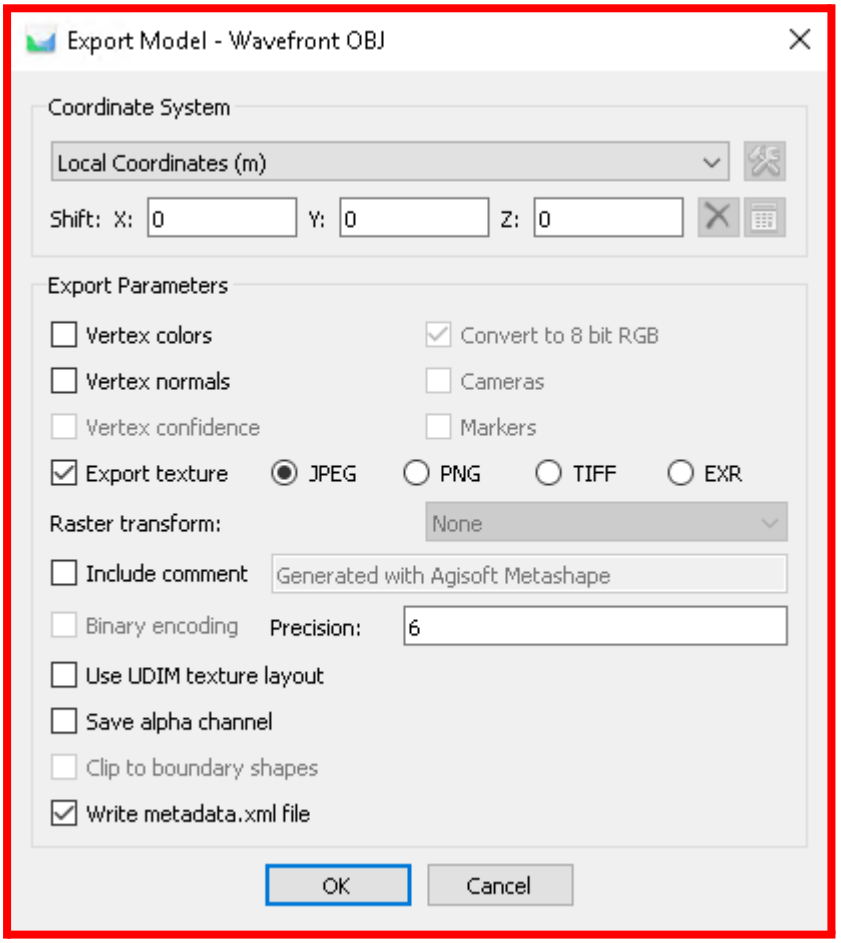


Step 1b: Creating a textured mesh

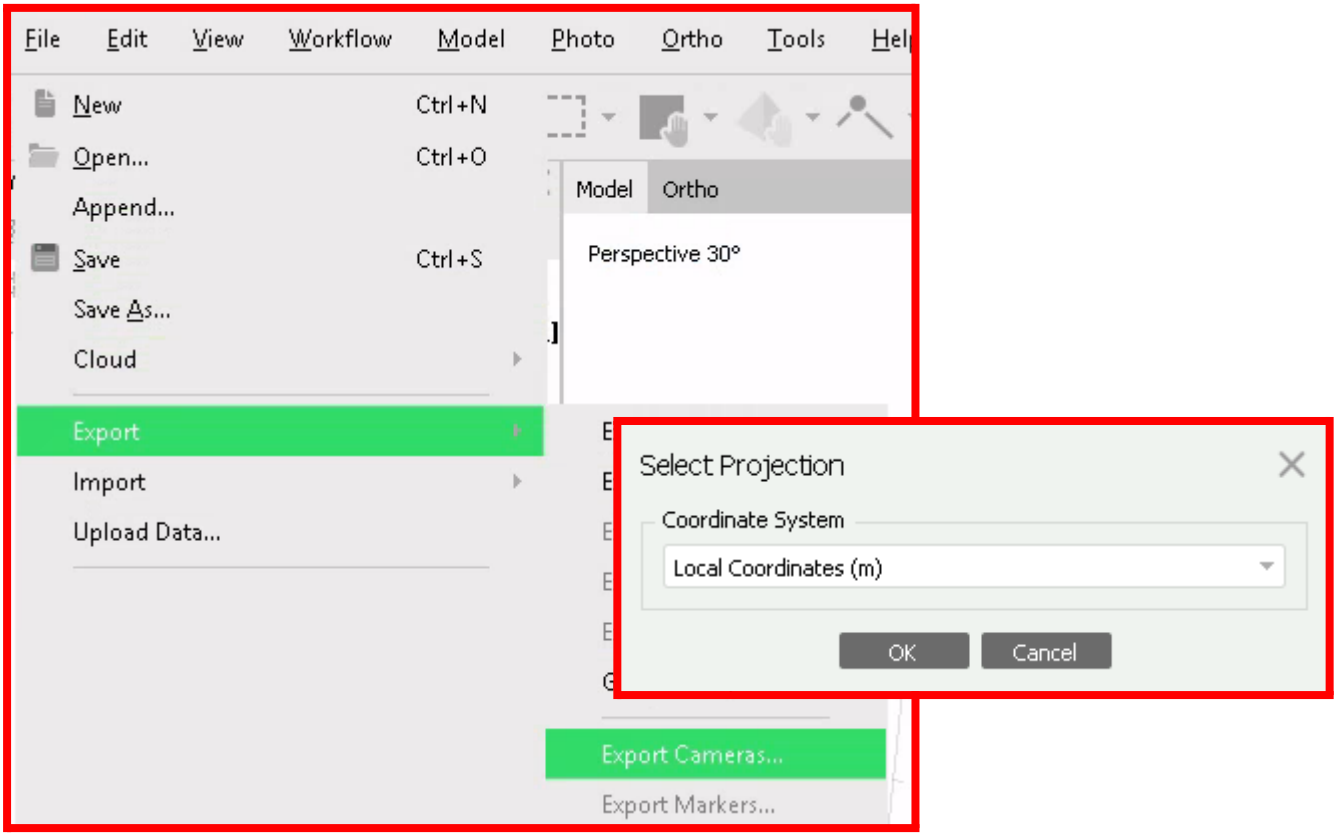


Step 1c: Exporting the textured mesh





Step 2: Exporting the camera positions



When you are done, the export folder should look as follows:

```
name-of-your-export-folder
    agisoft-cameras.xml
    cameras.opk.txt
    mesh
        model.obj
        model.mtl
        model.jpg   ⬅ the texture files
        model1.jpg
        ...
        model9.jpg
    images
        photo1.jpg
        photo2.jpg
        ...
```

RealityCapture

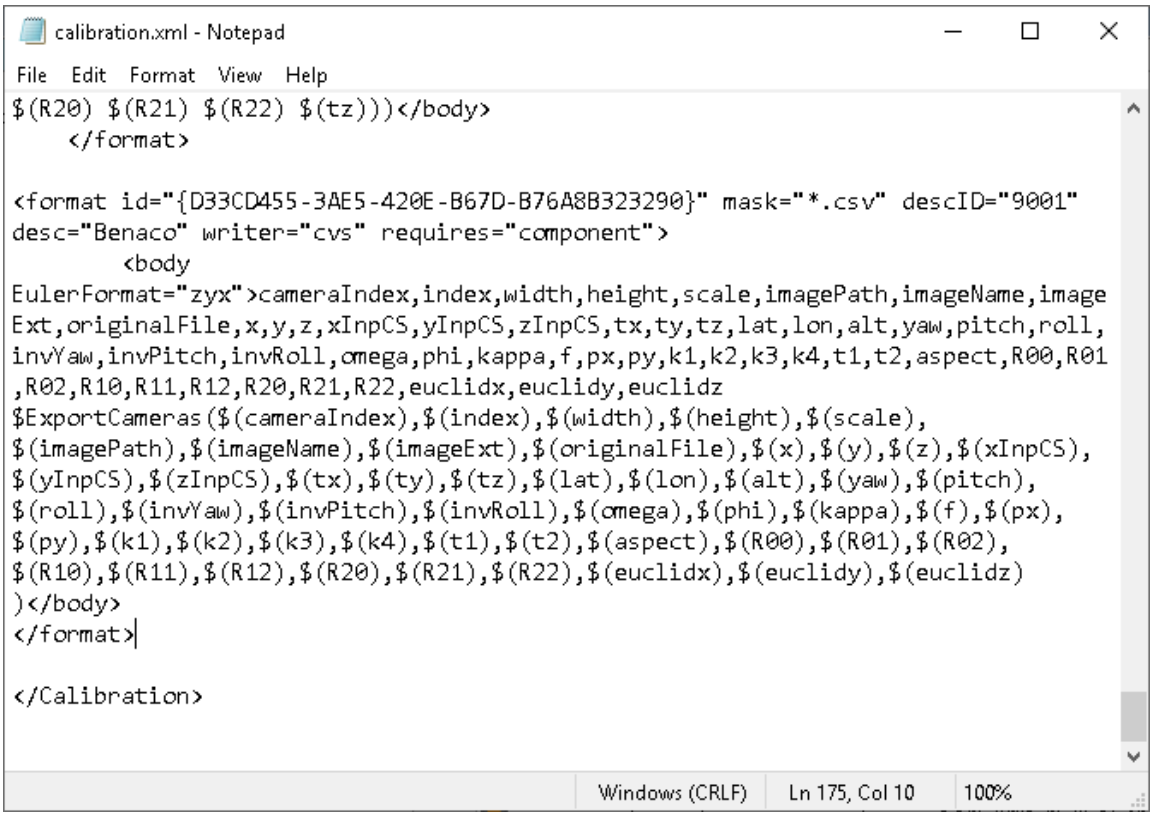
Preparation: Add a custom camera position exporter to RealityCapture.
Open the following file with a text editor, such as Notepad:

`C:\Program Files\Capturing Reality\RealityCapture\calibration.xml`

We recommend making a backup of the file before changing it.
Scroll down to the end of the file, and insert this snippet just before `</Calibration>`.

(Note that `writer="cvs"` in the snippet is not a typo for "csv", see RealityCapture documentation.
The syntax of RealityCapture's calibration.xml files is unfortunately not documented, and it does not seem to contain a proper CSV exporter. Thus your image file names must not contain double-quotes, as they will not be properly CSV-escaped.)

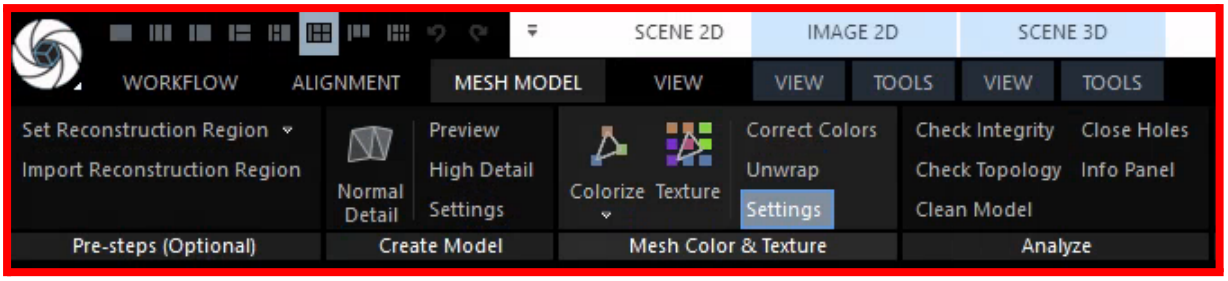
The result should look similar to this
(but use the link provided above for the text, do not type down the contents of the screenshot):

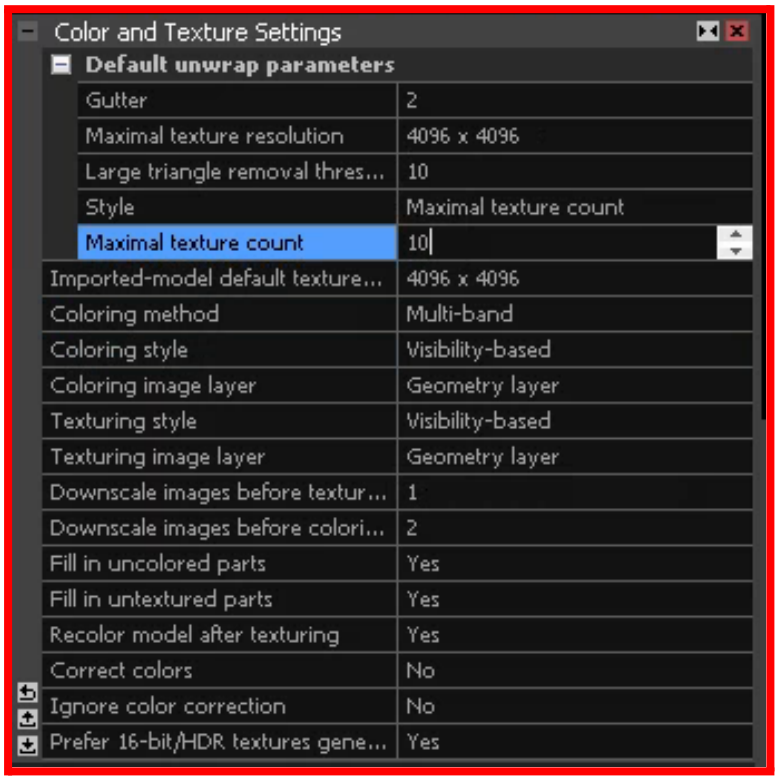


Provide Benaco with an export folder containing the following:

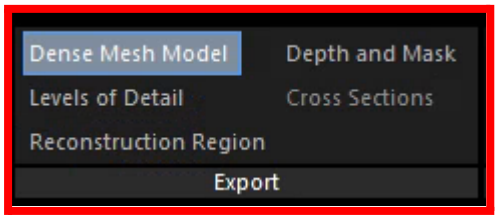
1. A textured OBJ mesh.
    a. Ensure your mesh has approximately **1M triangles**.
    More can be too much for smartphone browsers.
    b. Ensure you have created textures using the correct settings:
    In the **Mesh Model** tab, in section **Mesh Color & Texture**, choose **Settings** and set:
        - Maximal texture resolution**: 4096 x 4096**
        - Maximal texture count: **10**
        (higher counts are acceptable but will result in longer loading times)
    c. In the **Mesh Model** tab, in section **Export**, choose **Dense Mesh Model**
    Export the file as `"model.obj"` into a folder `"mesh"`.
2. The camera positions and parameters.
    In the **Alignment** tab, in section **Export**, choose **Registration**.
    Save the file as `"realitycapture-cameras.csv"` with **Benaco CSV** format (this format is only present after you followed the "Preparation" step above and restarted RealityCapture).
3. The image files.
    a. Save them into an "images" folder (flat, no subfolders).

Step 1a: Creating a textured mesh

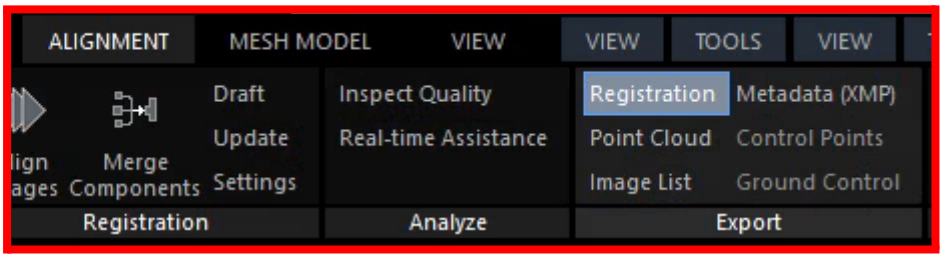


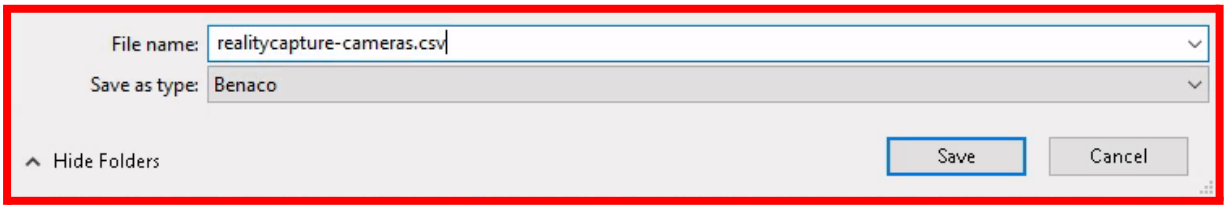


Step 1b: Exporting the mesh



Step 1b: Exporting the camera positions





When you are done, the export folder should look as follows:

```
name-of-your-export-folder
    realitycapture-cameras.csv
    mesh
        model.obj
        model.mtl
        model_u1_v1_diffuse.jpeg      ← the texture files
        model_u1_v2_diffuse.jpeg
        ...
        model_u3_v3_diffuse.jpeg
    images
        photo1.jpg
        photo2.jpg
        ...
```

Pix4D PIX4Dmapper

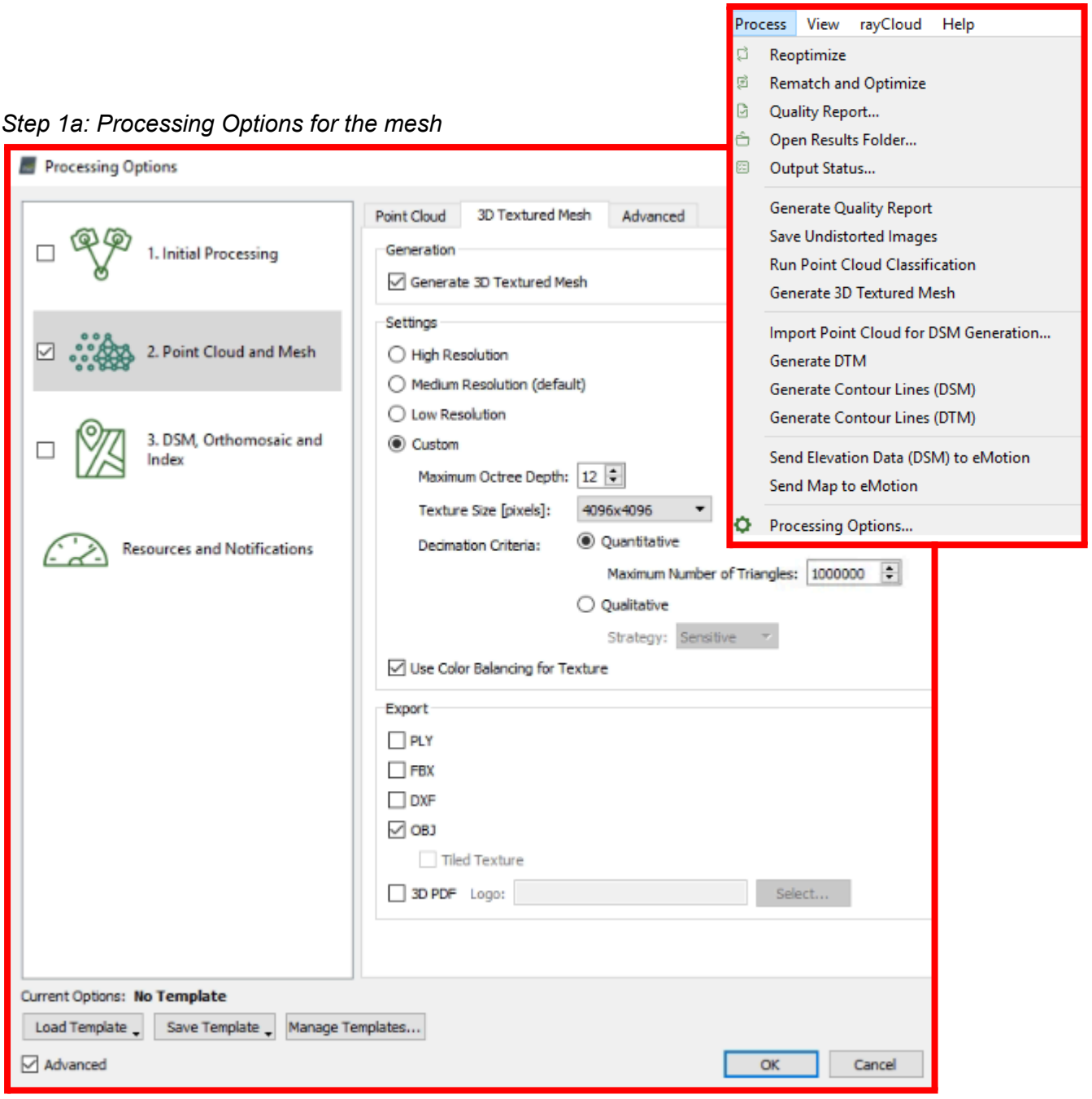
Provide Benaco with an export folder containing the following:

1. A textured OBJ mesh.
    a. From the menu, choose **Process -> Processing options**.
    Under **Point Cloud and mesh**, configure:
        i. ☑ Generate 3D textured mesh
        ii. Settings: **Custom**
        iii. Texture size: **4096x4096**
        iv. Maximum number of triangles: **1M - 10M**
        Smaller loads faster. Use 1M if it looks good.
        v. Export: ☑ **OBJ**
    You may wish to **Save Template** and call it "Benaco".
    b. Right-click your mesh and choose **Export Mesh...**
    Save the mesh as `"model.obj"`, into a `"mesh"` folder.
    Do not enable: ☐ Tiled texture.
    Do not enable: ☐ Generate LOD Mesh and Export
2. The camera positions and parameters:
    In Windows Explorer, navigate to your Pix4D project folder, into **1_initial\params**.
    Copy the following files into your export directory into subfolder `"pix4d-params"`:
    `myproject_calibrated_camera_paramters.txt`
    `myproject_calibrated_external_camera.parameters.txt`
    `myproject_calibrated_external_camera.parameters_error.txt`
    `myproject_calibrated_external_camera.parameters_wgs84.txt`
3. The image files, distortion-corrected:
    a. Choose **Process -> Save Undistorted Images**.
    b. Save them into an `"undistorted-images"` folder.

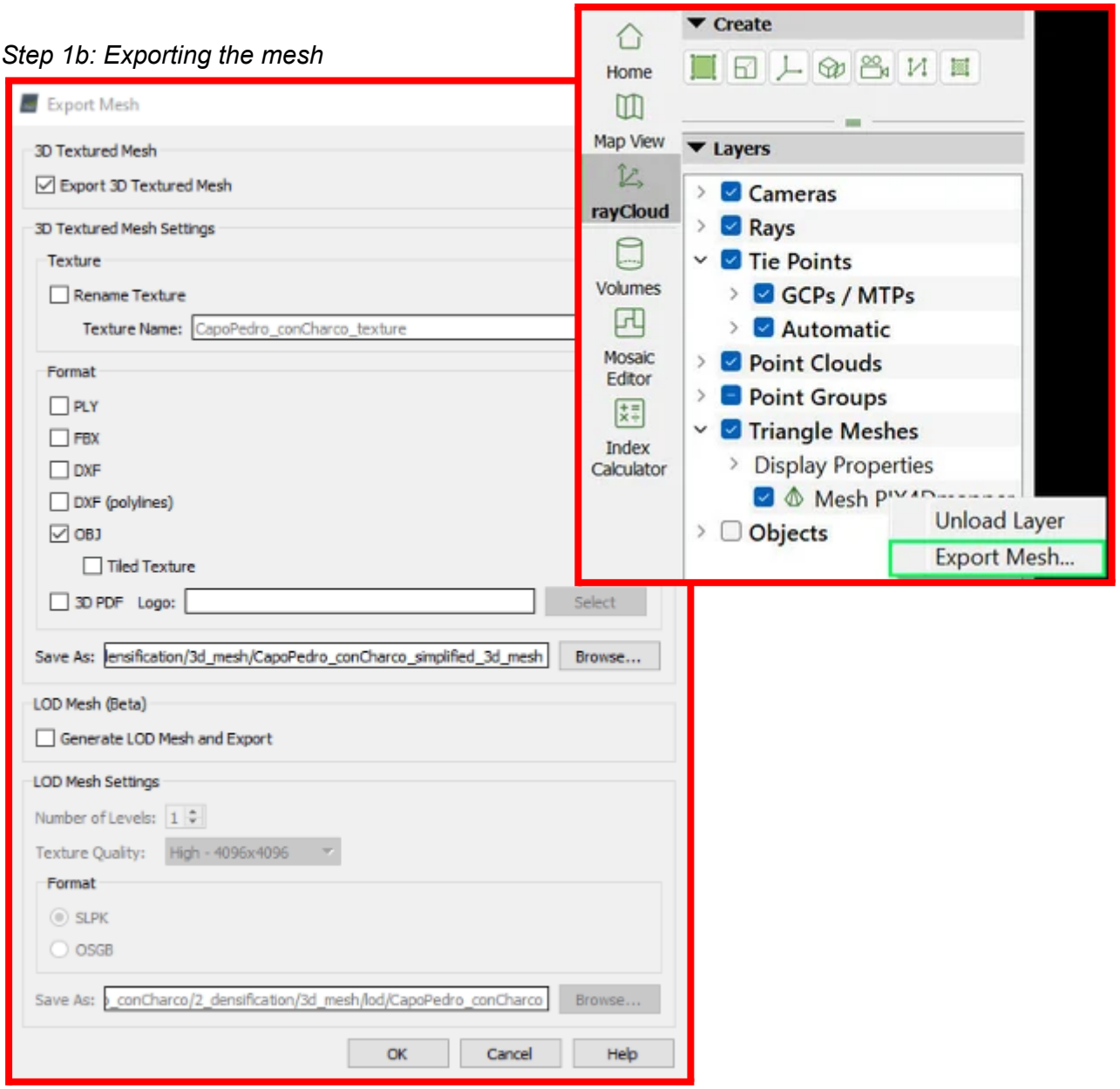
When you are done, the export folder should look as follows:

```
name-of-your-export-folder
    pix4d-params/
        myproject_calibrated_camera_parameters.txt
        myproject_calibrated_external_camera.parameters.txt
        myproject_calibrated_external_camera.parameters_error.txt
        myproject_calibrated_external_camera.parameters_wgs84.txt
    undistorted-images/
        100_0074_0001.JPG
        100_0074_0002.JPG
        ...
    mesh/
        CP_Charco_ExpMalla_simplified_3d_mesh.obj
        CP_Charco_ExpMalla_simplified_3d_mesh.mtl
        CP_Charco_ExpMalla_texture.jpg
        ...
```

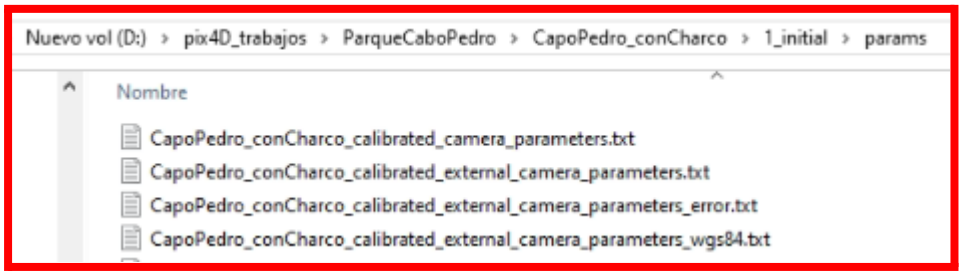
Step 1a: Processing Options for the mesh



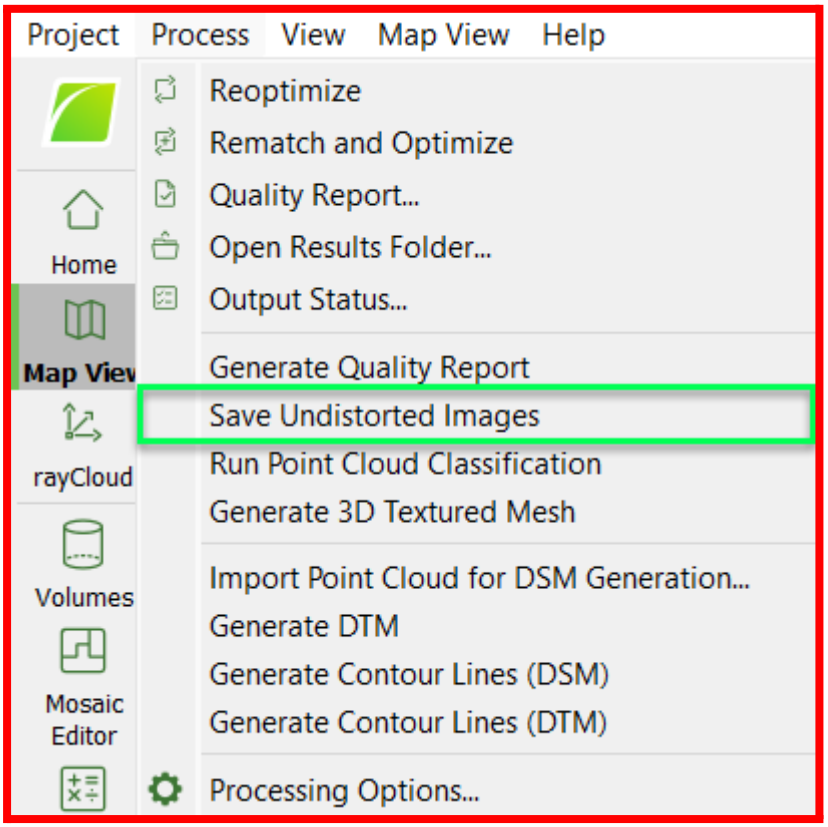
Step 1b: Exporting the mesh



Step 2: Taking camera parameters from the project folder.



Step 3: Saving undistorted images



3DSurvey

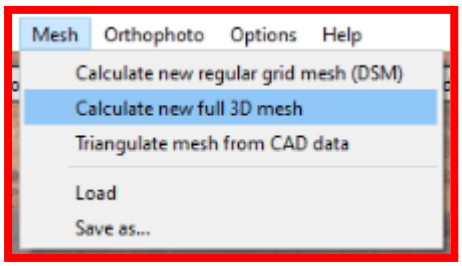
Provide Benaco with an export folder containing the following:

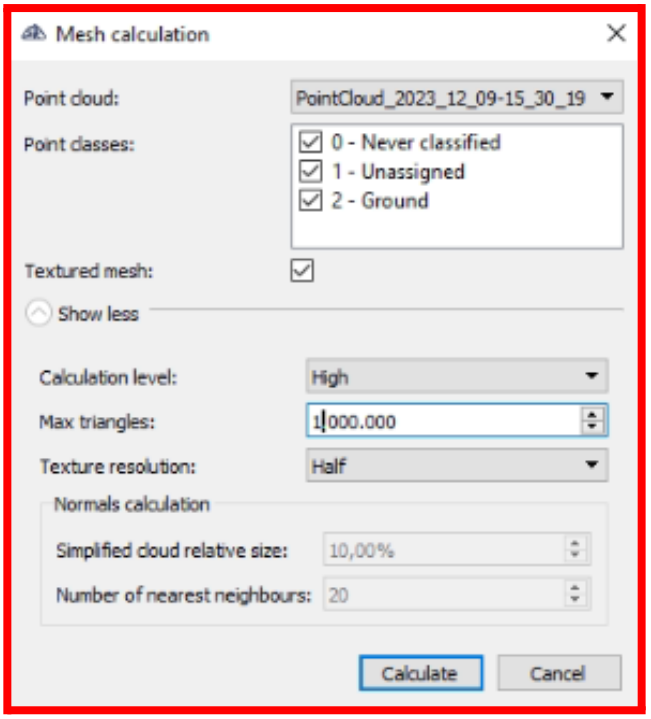
1. A textured OBJ mesh.
    a. From the menu, choose **Mesh -> Calculate new full 3D Mesh** with options:
        i. **Textured mesh:** ☑
        ii. Max triangles: **1M - 10M**
        Smaller loads faster. Use 1M if it looks good.
        iii. Texture resolution: **Half**
        This generates 4096² pixel textures. Larger does not work reliably in web browsers.
    b. Choose **Mesh -> Save as...**
    Save the file as `"model.obj"` with **Wavefront OBJ** format, into a `"mesh"` folder.
2. The camera positions and parameters:
    Choose **Data -> Export camera parameters**
    Save the file as `"3dsurvey-cameras.csv"`.
3. The image files, distortion-corrected:
    a. Choose **Data -> Export undistorted images**.
    b. Output directory: Save them into an `"undistorted-images"` folder.
    c. File prefix: **undistorted_**
    d. Enable ☑ Normalize principal point
    e. Enable ☑ Remove camera motion

When you are done, the export folder should look as follows:

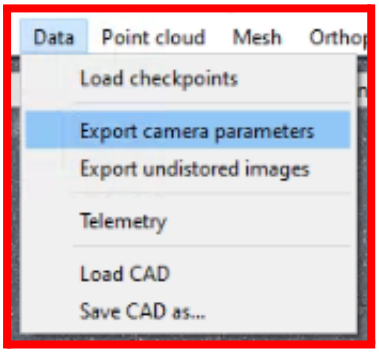
```
name-of-your-export-folder
    3dsurvey-cameras.csv
    undistorted-images/
        undistorted_100_0060_0001.JPG
        undistorted_100_0060_0002.JPG
        ...
    mesh/
        PointCloud_2023_12_09-15_30_19.obj
        PointCloud_2023_12_09-15_30_19.mtl
        PointCloud_2023_12_09-15_30_19_1001.jpg
        ...
        PointCloud_2023_12_09-15_30_19_1007.jpg
```

Step 1: Exporting the mesh

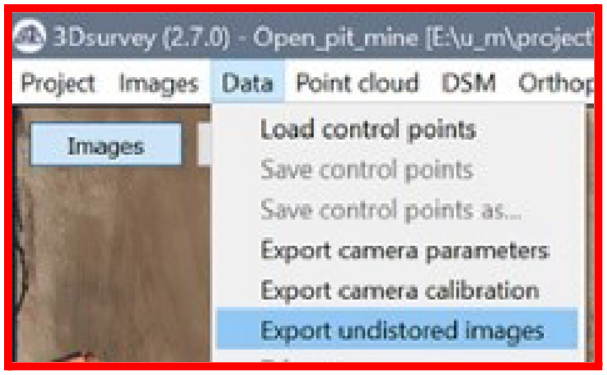


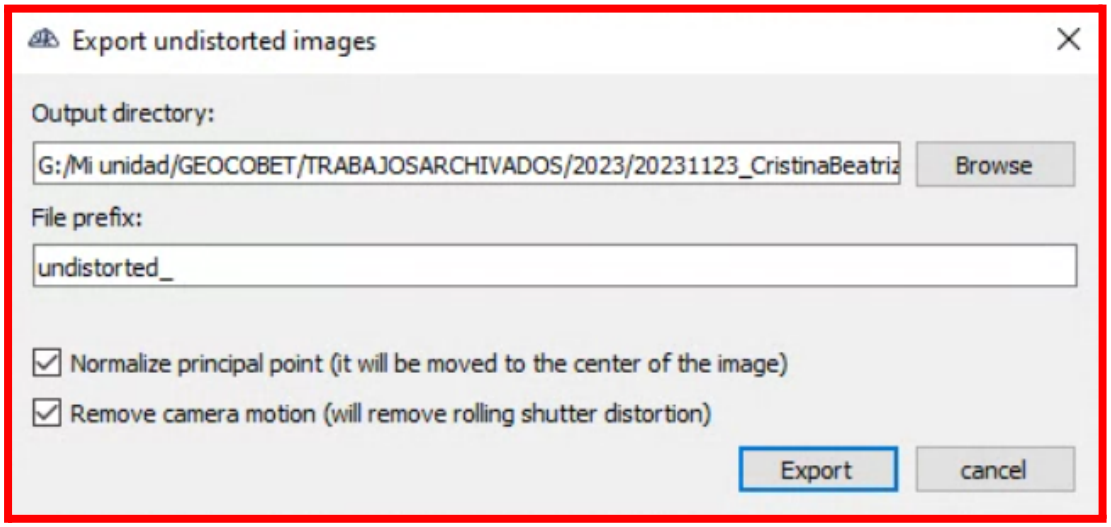


Step 2: Exporting camera parameters



Step 3: Exporting undistorted images





Plain meshes

Provide Benaco with an export folder containing the following:

- Into the `"mesh"` folder, a textured OBJ mesh:
    - Recommended is **1M** triangles.
      Up to **10M** triangles are accepted, but will take longer to load and may be slow to interact with (low frames per second) on end devices without powerful graphics cards.
    - Recommended are up to 10 JPEG texture files.
      Individual texture files must be <= 4096² pixels. Larger does not work reliably in web browsers.

Note the Benaco viewer currently requires at least 1 photo.
If a plain mesh is given, a black 1x1 pixel placeholder photo is generated 100m above XYZ=(0,0,0).
This placeholder will be used for the 3D tour loading screen, which makes such tours slightly less visually appealing than those that have real original photos exported from e.g. photogrammetry software (as described in other sections of this document).

When you are done, the export folder should look as follows:

```
name-of-your-export-folder
    mesh/
        mymesh.obj
        mymesh.mtl
        texture1.jpg
        ...
        texture10.jpg
```

After the tour is processed, you need to set the correct up-axis in the 3D tour by going to the **Editor**, tab **Straighten**, and click the corresponding button (in most cases that is **+Z**).

Combining photogrammetry with lasers

It is possible to combine drone photogrammetry data from the sections above with laser data.

Do *not* upload laser and drone data together into a single tour -- only one of them will be processed into the tour in that case.
Instead:

1. Process the laser data into a standalone tour.
2. Process the photogrammetry data into a standalone tour.
3. Combine the two tours as shown in our drone combination guide.
   See especially its section *"Adding original drone photos"*.