Drone Lidar Data Processing Protocol

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Scope

This document describes the processing workflow to generate a point cloud from raw data collected using DJI Zenmuse L1 sensor with Matrice 300 (M300) RTK.

DJI Terra setup

DJI Terra software is used to reconstruct the 3D point cloud model (refer to DJI 2022 for hardware requirements). Open DJI Terra and click on the Settings icon. Click on the last icon '…'.

1. Check that 'Reconstruction Parameter Checklist' is enabled.
2. The default Cache directory used to store the LiDAR point cloud results is: C:\Users\<UserName>\Documents\DJI\DJITerra\<DJI account name>\
3. To use a different location, select 'Change' next to 'Cache Directory'. Ensure sufficient storage in the new location. (Any missions stored in the previous cache directory will be transferred and could take a while). Navigate to select a new location.

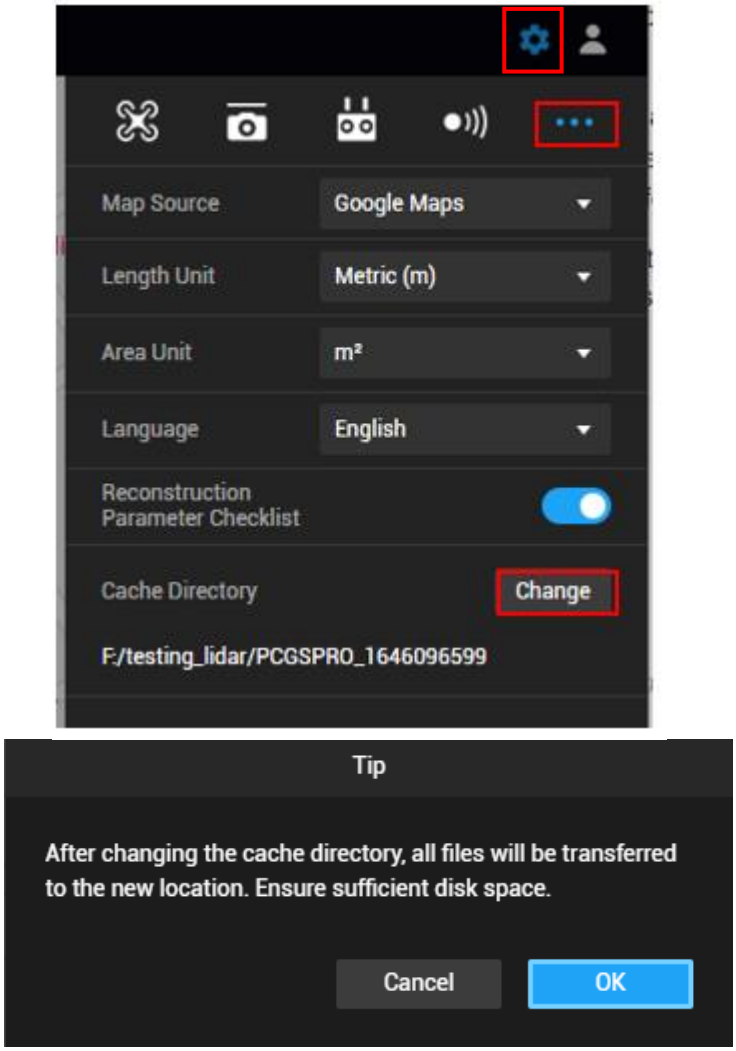

Figure 1: DJI Terra setup

Lidar point cloud reconstruction

1. Open DJI Terra. Click on New Mission. Under Mission Type select ‘LiDAR Point Cloud’. Enter Mission Name in the format ‘YYYYMMDD_SiteName’ and select OK.

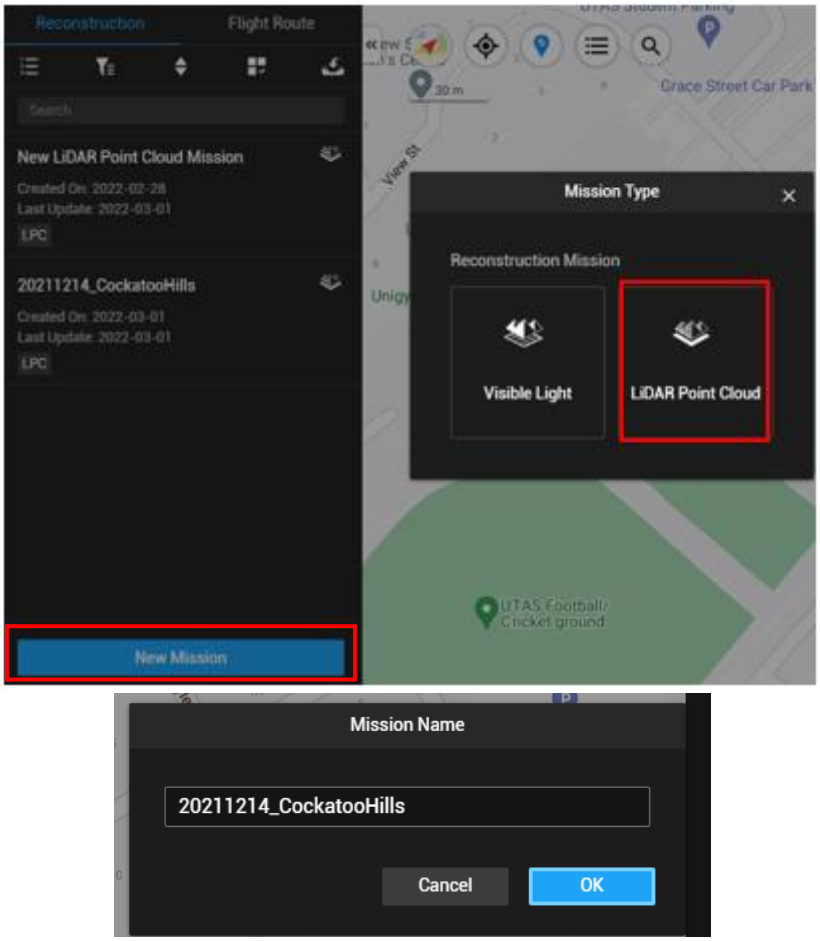

Figure 2: Create a new mission to reconstruct the lidar point cloud.

2. Add input folder(s) containing the raw data from the L1 sensor.
    - The raw data folder is by default named ‘DJI_<datetime>…Zenmuse-L1-mission’ and contains the raw lidar data, RTK/IMU files and images in jpeg format from the lidar mission. (As per the Data Collection protocol, raw lidar data is saved in <plot>/<YYYYMMDD/lidar/level0_raw/ folder).
    - Note that a new folder is created on every flight. If there were errors during the flight, or if more than one lidar mission was flown for other reasons, ensure that the correct raw data folder is selected as the input.

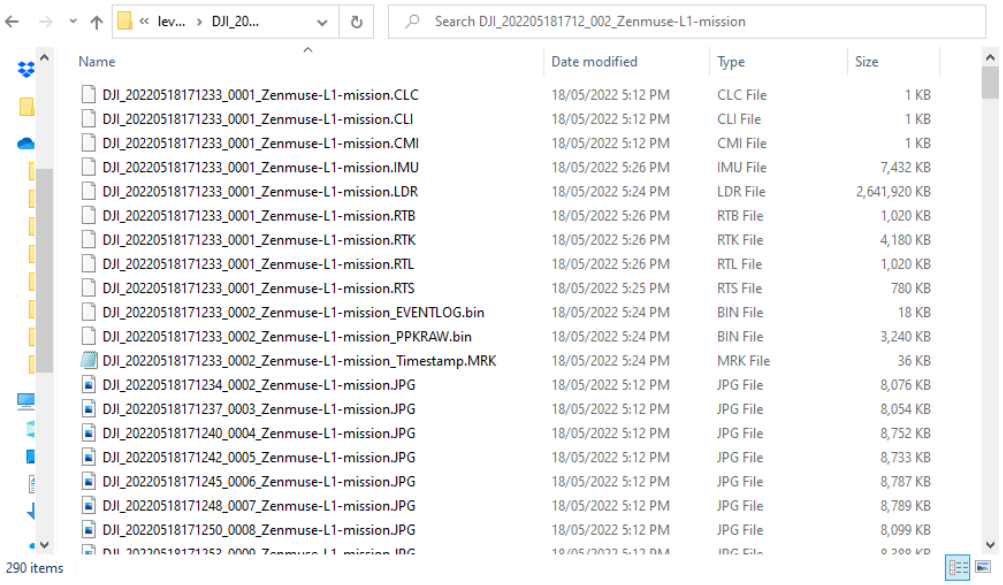

Figure 3: Example of a folder containing raw data from a lidar mapping mission.

- Click on the Folder icon in the top right of the screen and select the folder(s) containing the raw data.
- When this is complete, the display will be updated to show how many folders (sets of data) were added.

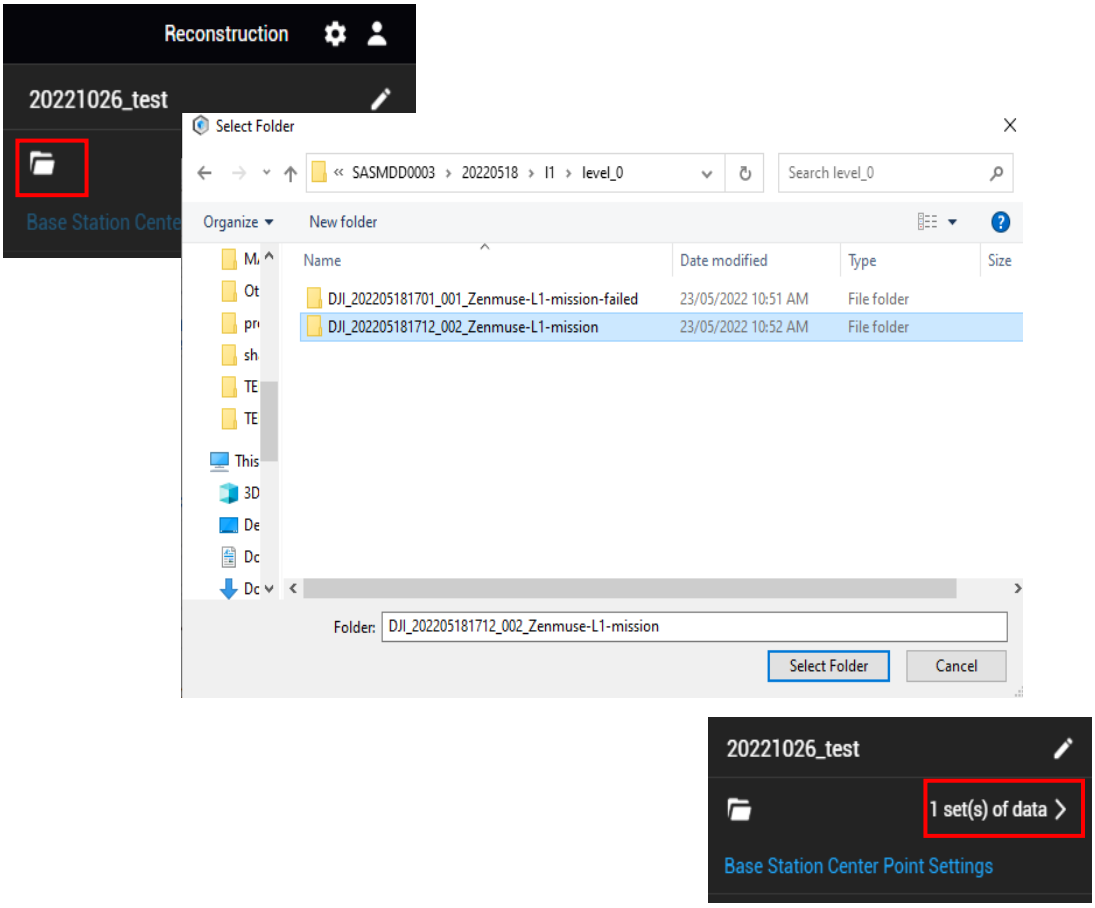

Figure 4: Click on the folder icon and select the folder containing the raw data for the mission. If more than one mission was required to map the plot, ensure that all relevant folders are selected in this step. Note that the display is updated to show how many folders (sets of data) were added.

3. If **Base Station** coordinates are to be post-processed, follow the steps in 'Appendix: Update Base Station Settings in DJI Terra'.
4. **LiDAR Point Cloud**
   Point cloud reconstruction settings are summarised in Figure 6. Update the settings as follows:
   - Point Cloud Density: **High**
   - Scenarios: **Point Cloud processing**

   Advanced:

   - Point Cloud Effective Distance: **250 m** (see To do list)
   - **Optimise Point Cloud Accuracy:** This setting is only available in DJI Terra Pro (licensed) version. It has been found that optimising point cloud accuracy can lead to mixed results. For example, in some datasets, raw data from adjacent flight lines have been processed without issues on the free version of DJI Terra. Whereas on other datasets without Optimize point cloud accuracy, there is an obvious height offset between flight lines and they appear layered along the edges. This has been observed even in sites with no large elevation difference. This setting hence needs further testing (see To do list).
   - Output Coordinate System: Follow the steps below (also shown in Figure 5) to select the output coordinate system for the point cloud.
     a) Select the appropriate projected coordinate system using 'Horizontal Coordinate System Database' from the drop-down list under Horizontal Datum Settings.
     b) Enter the EPSG code. It is recommended to use the relevant **GDA2020 MGA Zone projected coordinate system**. Find the EPSG code of the coordinate system. For example, for Calperum, South Australia, this is GDA2020 MGA Zone 7854 (EPSG: 7854).
     c) Select the coordinate system from the results. Click OK.
   - Altitude Settings: Default
   - Height Offset: 0 m
   - Output format: LAS
   - Merged Output: enable the checkbox to generate a single merged output point cloud from multiple flights.

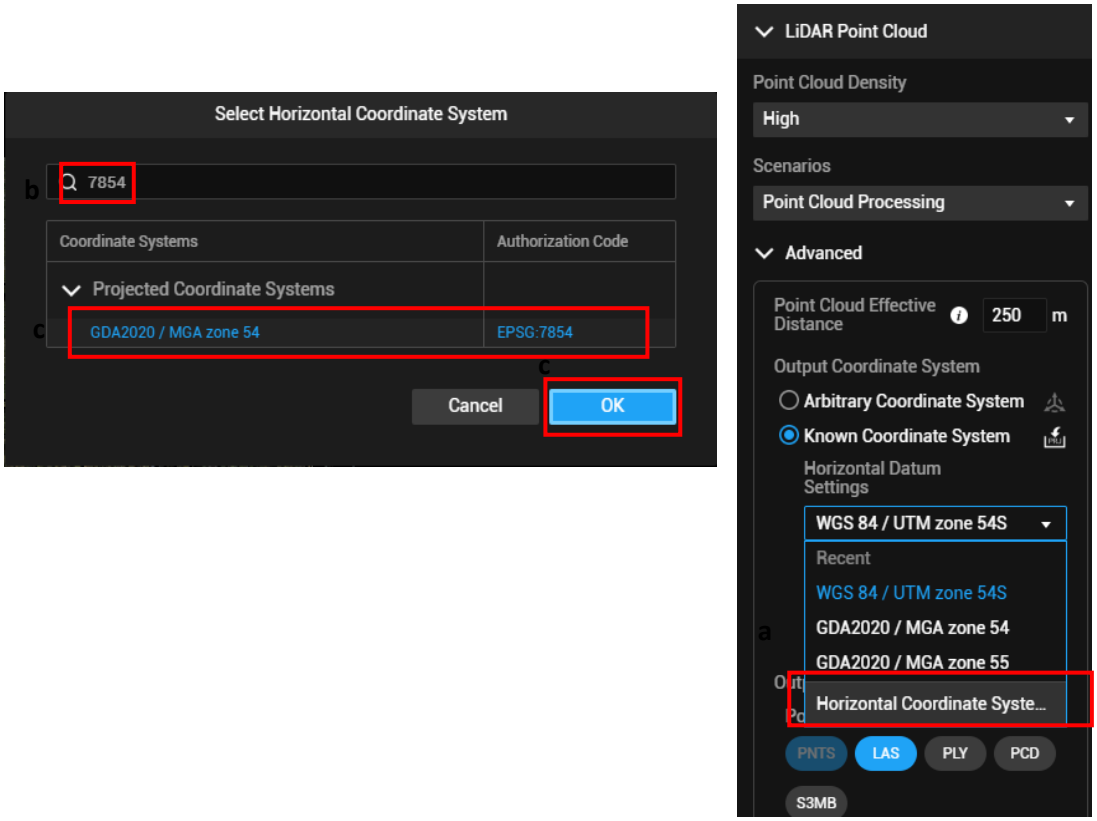

Figure 5: Select the appropriate projected coordinate system by entering the EPSG code in the search box.

5. Select 'Start Processing' (A in Figure 6).
6. In the **Reconstruction Parameter Checklist** dialog, check the settings and select OK (B in Figure 6).
7. Note that reconstruction can take several minutes or more depending on the size of the dataset. When Reconstruction is complete, click OK (C in Figure 6).

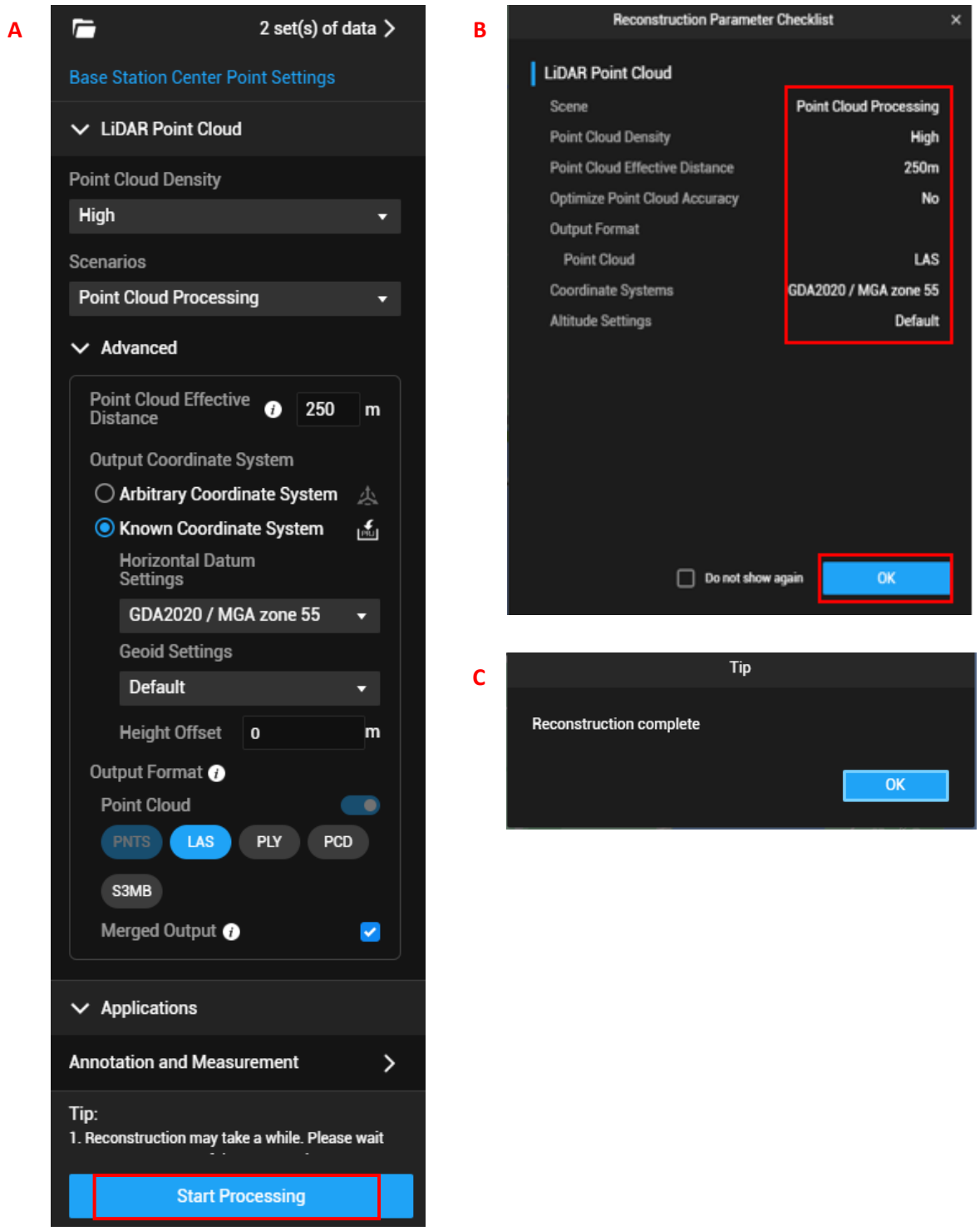

Figure 6: A: Summary of settings used for lidar point cloud reconstruction. B: Reconstruction Parameter Checklist. C: Reconstruction can take several minutes depending on the volume of data.

Point cloud visualisation and export

1. On the main screen the point cloud can be visualised by RGB, Reflectivity, Height or Return (Figure 7).
2. Click on 'Quality Report' to save a report (includes overview of data, processing settings and reconstruction times).

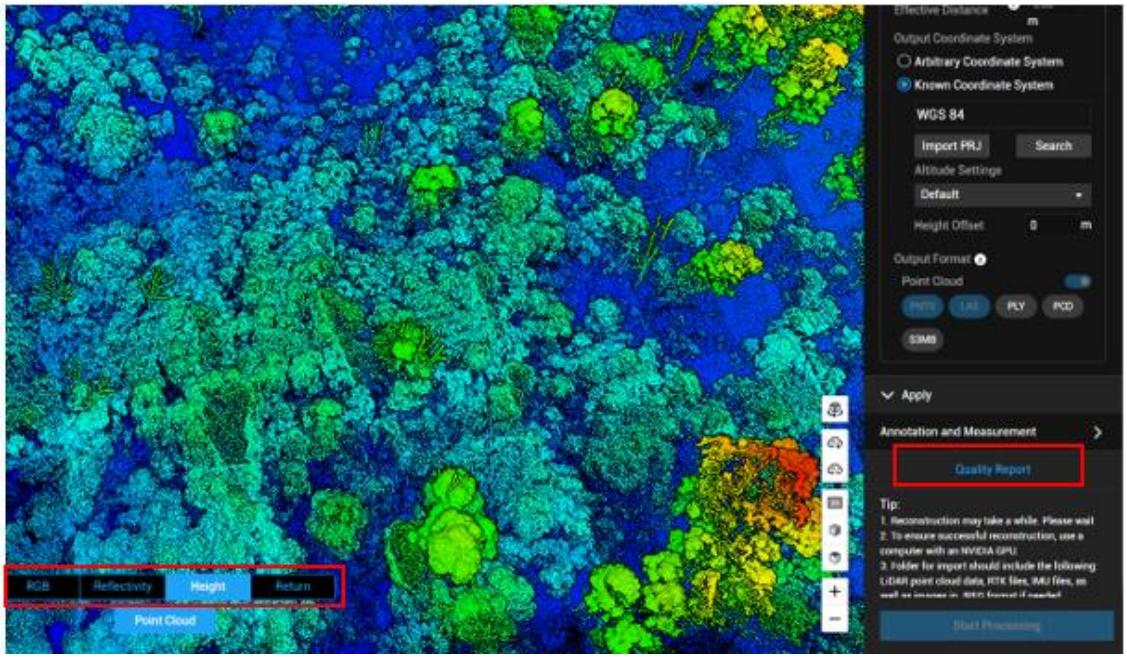

Figure 7: The point cloud can be visualised using RGB, Reflectivity, Height or Return number.

3. Click on the Home button to see the list of missions (Figure 8).
4. Select the folder icon ('Open Folder') to explore the results.
5. The results are organised in 2 subfolders: AT (aerotriangulation), and lidars.
   - The folder **lidars/terra_las/** contains the output point cloud in las format.
6. To export the contents in a zip folder, click on the last icon (Figure 10). Save the zip file in level1_proc/ folder within the lidar/ collection.

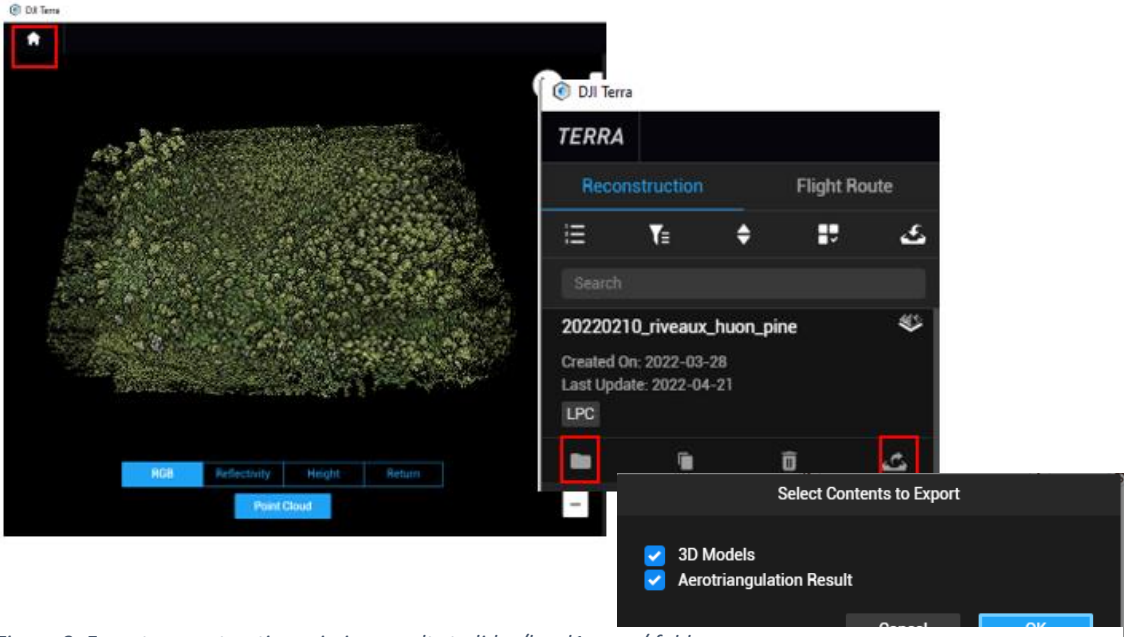

Figure 8: Export reconstruction mission results to lidar/level1_proc/ folder.

To do list

1. Height offset: 0m – does this account for D-RTK2 height?
2. Test Optimise Point Cloud Accuracy (pro version) – mixed results with enabling/disabling this setting. Requires further testing.
3. Point Cloud Effective Distance: impact of this setting? Set to 100 m?

References

DJI 2022, *DJI Terra – User Manual 3.5,* DJI, Australia, viewed 01 August 2022, <https://www.dji.com/au/downloads/products/dji-terra>

Appendix: Update Base Station Settings in DJI Terra

If base station coordinates were post processed through AUSPOS, select Base Station Center Point Settings to enter the updated coordinates from the AUSPOS report. For the workflow to submit data to AUSPOS, see 'Process D-RTK 2 data' in M300 Data Processing Protocol.

1. Click on 'Base Station Center Point Settings' (top right on screen).

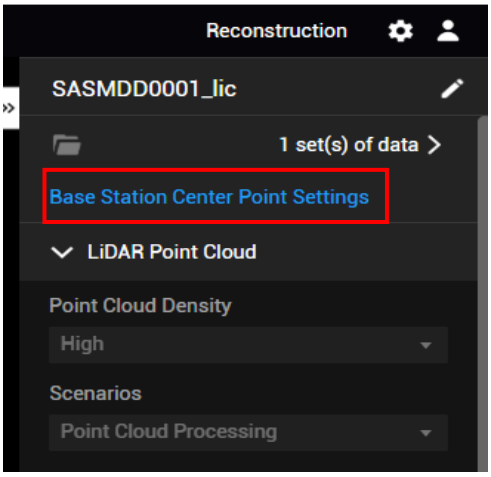

Figure 9: Update Base Station settings.

2. Under Coordinate System, click 'Search'. Enter the EPSG code 7844 in the search bar to change the Coordinate System (default WGS84) to GDA2020 geodetic coordinate system. Click OK.

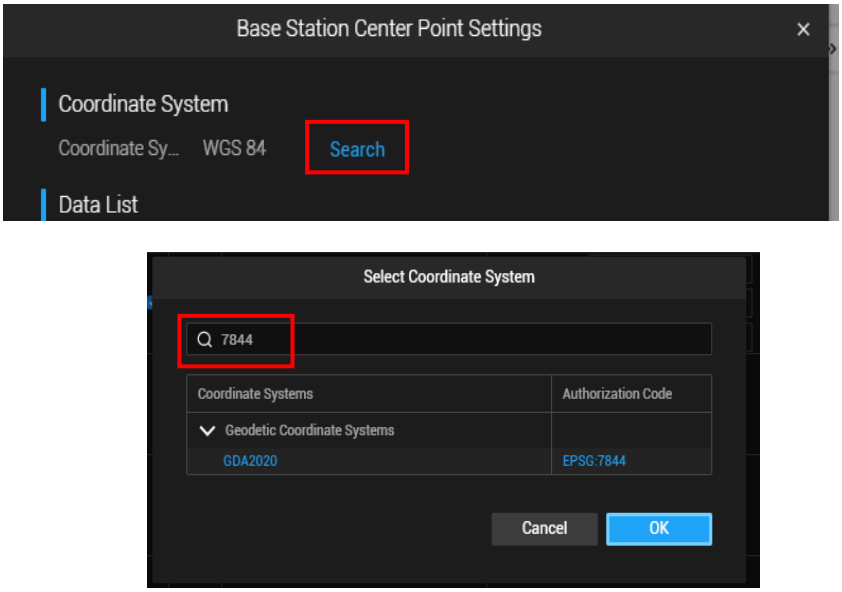

Figure 10: Update the Coordinate System to GDA2020 geodetic coordinate system

3. Raw data folders that were added earlier are displayed under Data List with the base station center point settings recorded in the field. These coordinates must be replaced with those from the AUSPOS report (section Geodetic, GRS80 Ellipsoid, GDA2020). The base station coordinates in the AUSPOS report are in degrees, minutes, seconds, and must be converted

to decimal degrees for entry in DJI Terra. Use an [online calculator] to convert Lat/Lon in degrees minutes seconds to decimal degrees.

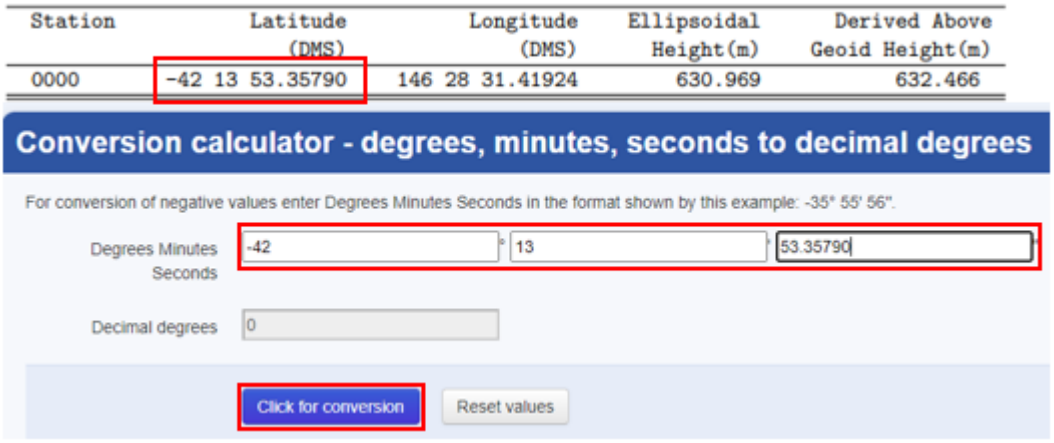

Figure 11: Get the base station coordinates from the AUSPOS report and convert Latitude and Longitude to decimal degrees.

4. Copy coordinates in decimal degrees and paste under 'Latit..' at the top of the table.

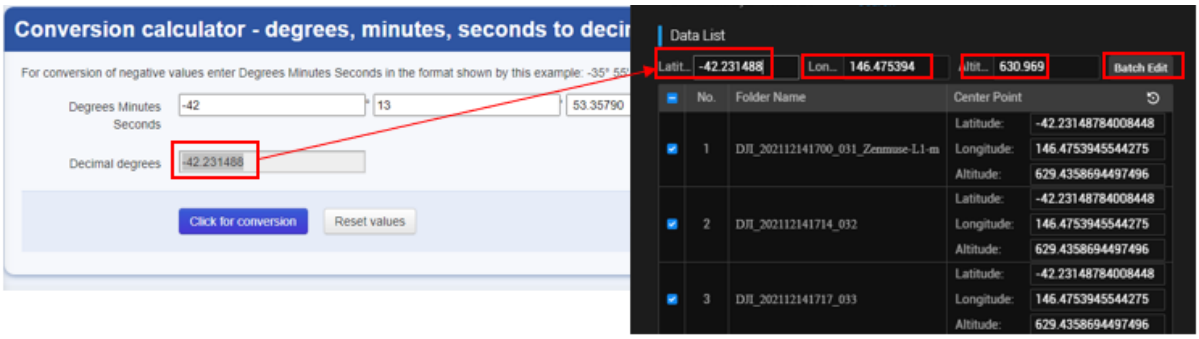

Figure 12: Under Data List, update the values for Latitude, Longitude and Altitude either through Batch Edit or directly for each input folder.

5. Repeat steps 3 and 4 for Longitude and enter the updated value next to 'Lon..'. .
6. Enter updated ellipsoidal height from the AUSPOS report in 'Altit..'.
7. Click on 'Batch Edit'.
   Note: in the above steps the assumption is that the base station coordinates for all datasets are the same. However, when base station coordinates are different for datasets (e.g., if the D-RTK2 battery was changed, or the base station was moved to a different location), the coordinates must be updated separately for each folder.
8. Check that Latitude, Longitude and Altitude values have been updated for all input folders. Click Save.
9. Resume processing as per the main document ('Lidar point cloud reconstruction') to process the data.

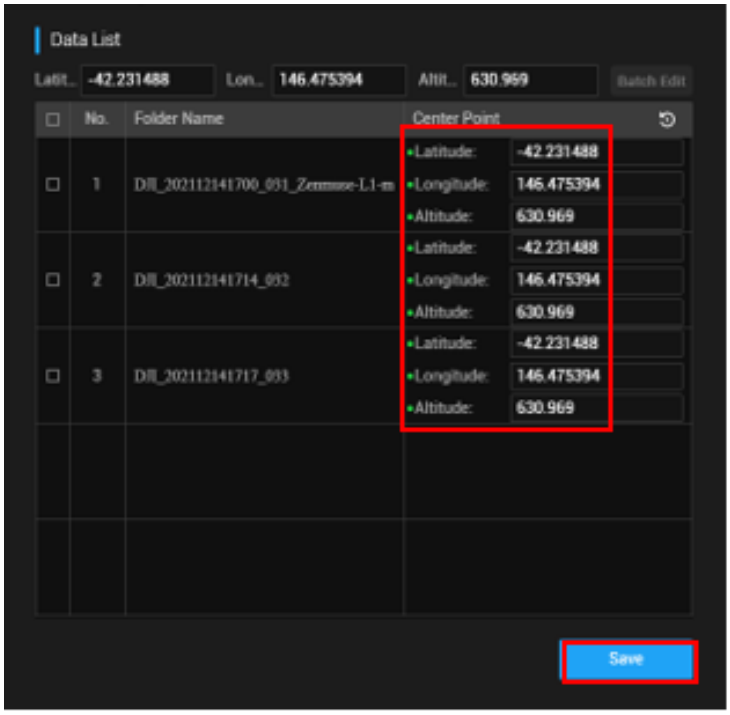

Figure 13: Check that the coordinates have been updated on a Batch Edit.

Revision History

Date	Revision	Changes
28/02/2022	1.0	Initial version
21/04/2022	1.1	Screenshots for point cloud export
11/05/2022	1.2	Updated on review by Arko Lucieer
02/08/2022	2.0	Updated following Calperum campaign in May 2022.
26/10/2022	2.1	Updated following DJI Terra update (coordinate system selection)
03/11/2022	3.0	Fix formatting and cross-references