LIDAR dataset overview

This report describes issues that may affect the quality of your LIDAR dataset and what should be considered for further processing of your dataset. It is anticipated that the document will be updated throughout the year, the latest version of which will be available at:

http://arsf-dan.nerc.ac.uk/trac/wiki/Reports

Measurement of geo-referencing accuracy

Currently, the ARSF delivers LIDAR datasets in ASCII point cloud format with separate files per flight line. Prior to delivery, each flight line is compared to its neighbouring lines to compare respective elevation in overlapping regions and also horizontal planar shifts. For UK flights where vectors are available, we compare the horizontal planar accuracy to these vectors. If ground control points are available for the region then we will use these as control to correct for possible elevation errors in the LIDAR data. If no GCPs or accurate ground truth are available then no height correction will be applied, but an average per-line elevation difference for the overlapping region may be included within the readme file of your delivery.

Data accuracy (flights Sept 2008)

The calibration flight was flown when the system was initially installed in to the aircraft. The accuracy of elevations from the calibration flight data, checked against ground control points, range from:

- Mean error magnitude of 2cm with standard deviation of 2cm for flights of 1350m altitude
- Mean error magnitude of 7.1cm with standard deviation 6.2cm for flights of 2350m altitude
- Elevations from 2350m altitude flight data are consistently lower than 1350m data by an average difference of approximately 8cm

Data accuracy (flights Jan 2009 – June 2009)

The first LIDAR calibration flight for 2009 was flown at the end of February. The following is a description of the final outcome and remaining issues.

The accuracy of the LIDAR elevation has been compared to ground control points using the TerraScan software. This creates a surface from LIDAR points near to the GCP and then compares against the GCP and surface elevation. The summary of this is:

- Mean error magnitude of 4.3cm with a standard deviation of 4.8cm for the 1350m altitude data.
- Mean error magnitude of 4.7cm with a standard deviation of 5.1cm for the 2300m altitude data.

Unfortunately there appears to be an issue with the roll boresight angle such that it varies between flight lines. No definite trend in the variations is apparent at the moment but the roll boresight value does differ between flight lines collected on the same day. Figure 1 shows the elevation difference between two point clouds from opposing flight lines flown at 1350m altitude. The difference should be flat and close to zero but a slope across track is clearly visible with a magnitude of approximately 25cm change across the swath.

The current protocol for dealing with this issue in the data is to manually boresight using the overlapping areas between different point clouds as a guide, iteratively processing until there are no relative trends between the neighbouring point clouds.

If there are no areas of overlap between neighbouring flight lines then this issue can not currently be corrected for and an unknown roll error of the order of 25cm will remain in the dataset.

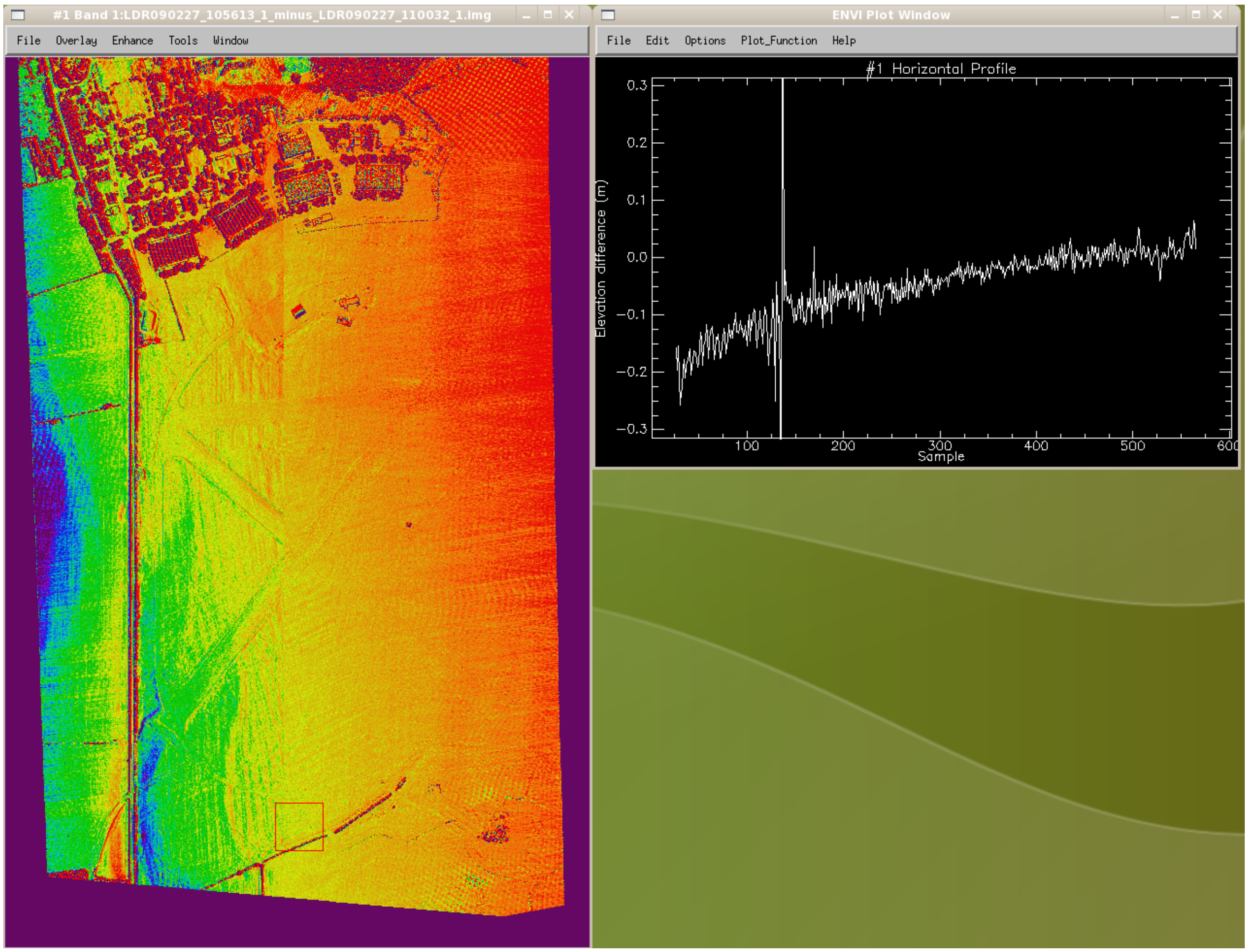

Figure 1. Elevation difference between two point clouds from opposing flight lines flown at 1350m altitude, showing an across track slope. Note large spikes are due to hedge rows.

Data accuracy (flights June 2009 – August 2009)

The second LIDAR calibration flight for 2009 was flown at the end of June, following repairs made to the Leica system in mid June. The final outcome of this calibration and remaining issues are as follows:

The comparison between LIDAR and GCPs gives:

- Mean error magnitude of 3.9cm with a standard deviation of 4.5cm for the 1350m altitude data
- Mean error magnitude of 7.4cm with a standard deviation of 9.2cm for the 2300m altitude data.

The high altitude (2300m) data has areas of patchy cloud which caused drop outs in the data from some flight lines and affected the intensity (and therefore probably the range – due to the intensity based range correction) in some regions of the data. Also, the processed navigation data was not as accurate as desired, which in turn affected the geolocation accuracy.

This calibration has shown that the roll boresight error is still apparent in the data. The same correction protocol as above will have been applied to processed data.

Data accuracy (flights mid-September 2009)

The third LIDAR calibration flight for 2009 was flown at the beginning of September (09/09/2009) following the instruments removal from the aircraft due to a fault developing with the RCD camera. The results from this calibration are summarised below:

The comparison between LIDAR and GCPs gives:

- Mean error magnitude of 3.05cm with a standard deviation of 1.6cm for the 1550m altitude data
- Mean error magnitude of 3.6cm with a standard deviation of 4.2cm for the 2500m altitude data.

This calibration shows similar results to the previous calibrations where there is an inherent roll boresight error in the data. The magnitude of this is in the region of 15-20cm.

Data accuracy (flights end September 2009 – January 2010)

The final calibration flight for 2009 was flown at the end of September (25/09/2009). This was necessitated by the removal and repair of the Leica instruments in the middle of that month. The resulting calibration is summarised below:

The comparison between LIDAR and GCPs gives:

- Mean error magnitude of 3.1cm with a standard deviation of 2.2cm for the 1350m altitude data
- Mean error magnitude of 4.1cm with a standard deviation of 5.4cm for the 2300m altitude data.

This calibration shows that the previous roll boresight error has disappeared or has at least been reduced in magnitude to a near-negligible size of approximately 2cm – 5cm.