CLPX-Airborne: Infrared Orthophotography and Lidar Topographic Mapping,Version 1

USER GUIDE

How to Cite These Data

As a condition of using these data, you must include a citation:

Miller, S. 2004. *CLPX-Airborne: Infrared Orthophotography and Lidar Topographic Mapping, Version 1.* [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/KRWSPR2J1N2N. [Date Accessed].

FOR QUESTIONS ABOUT THESE DATA, CONTACT NSIDC@NSIDC.ORG

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/NSIDC-0157

National Snow and Ice Data Center

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1 DETAILED DATA DESCRIPTION

This data set was collected to test the concept of measuring snow depth using aerial lidar. The data set consists of color infrared orthophotography (TerrainVision® - High resolution Topographic Mapping & Aerial Photography, with 6-inch pixel resolution), lidar elevation returns (raw/combined, filtered to bare ground/snow, and filtered to top of vegetation), elevation contours (0.5 meter) and snow depth contours (0.1 meter).

1.1 Format

Color infrared orthophotography are TIFF image files with an associated world file (TFW). World files provide the pixel size and the corner points for each image.

Lidar elevation returns (raw/combined, filtered to bare ground/snow, and filtered to top of vegetation) are in fixed-width ASCII. Elevations returns appear in three columns (without headers) as east, north, and elevation. Data are provided in the project coordinate system (UTM-WGS1984 datum, Zone 13, meters) with elevations provided in NAVD-1988, meters.

Elevation contours (0.5 meter) and snow depth contours (0.1 meter) are in AutoCAD data interchange format (DXF).

Note: Nearly all computer applications that create or display vector information support DXF format. Complete specifications for the current DXF standard are available at http://images.autodesk.com/adsk/files/autocad_2012_pdf_dxf-reference_enu.pdf. Some applications that support the DXF file format are ESRI ArcGIS, RSI, Global Mapper, and CorelDraw.

1.2 File and Directory Structure

Data are available via HTTPS in the `https://daacdata.apps.nsidc.org/pub/DATASETS/CLP/data/airborne/nsidc0157_lidar/` directory. Within this directory are 11 folders (see Figure 1), containing 14 files each except for the EXTRA_2003 folder, which contains 7 files.

Figure 1. Top level directory

1.3 File Naming Convention

Six data files are available for each Intensive Study Area (ISA) site and the Local Scale Observation Site (LSOS). The file naming structure is presented below. Five data files are available for the site adjacent to the NCAR flux tower (EXTRA), as snow depth contours are not available for this site.

1. Color infrared orthophotography
   Filename: `xx_YYYY-MM-DD.TIF`
   Format: TIFF with associated world file (TFW)

2. Lidar elevation returns (raw/combined)
   Filename: `xx_UF_YYYY-MM-DD.XYZ`
   Format: comma-delimited ASCII

3. Lidar elevation returns (filtered to bare ground/snow)
   Filename: `xx_BE_YYYY-MM-DD.XYZ`
   Format: comma-delimited ASCII

4. Lidar elevation returns (filtered to top of vegetation)
   Filename: `xx_VG_YYYY-MM-DD.XYZ`
   Format: comma-delimited ASCII

5. Elevation contours (0.5 meter)
   Filename: `xx_EL_YYYY-MM-DD.DXF`
   Format: AutoCAD data interchange format (DXF)

6. Snow depth contours (0.1 meter)
   Filename: `xx_SD_YYYY-MM-DD.DXF`
   Format: AutoCAD data interchange format (DXF)

where (xx) represents the site code (two characters for the ISA code, four characters for the LSOS, and five for the EXTRA site):

FA = Fraser, Alpine
FF = Fraser, Fool Creek
FS = Fraser, St.Louis Creek
NI = North Park, Illinois River
NM = North Park, Michigan River
NP = North Park, Potter Creek
RB = Rabbit Ears, Buffalo Pass
RS = Rabbit Ears, Spring Creek
RW = Rabbit Ears, Walton Creek
LSOS = Fraser, Local Scale Observation Site
EXTRA = North Park, site adjacent to NCAR flux tower

1.4 File Size

TIFF image files are 130 MB, ASCII elevation files are 20 to 60 MB, and DXF files are 10 MB.

1.5 Spatial Coverage

Data were collected in each ISA, in the LSOS, and at a site adjacent to the NCAR flux tower in the North Park MSA. All sites are within the Small Regional Study Area (105° -107.5°W, 39.5°-41°N).

1.5.1 Spatial Resolution

Elevation data were acquired at approximately 4200 ft via airborne lidar (normalized to ground controls and processed to remove noise and redundancies), with approximately 1.5 m horizontal spacing and approximately 0.05 m vertical tolerances. The pixel size of the orthophotographs is 0.15 m.

1.6 Temporal Coverage

Data were collected during April and September of 2003. Data collected in April show snow-covered land surface conditions, while data collected in September reflect snow-free conditions. Exact timings of data collection are described below:

Fraser MSA & LSOS: 8 April 2003 - 1:50 pm thru 3:40 pm local time
North Park MSA: 9 April 2003 - 9:45 am thru 11:15 am local time
Rabbit Ears MSA: 9 April 2003 - 11:30 am thru 1:00 pm local time
Fraser MSA & LSOS: 18 September 2003 - 1:45 pm thru 4:45 pm local time
North Park MSA & EXTRA: 19 September 2003 - 9:45 am thru 12:45 pm local time
Rabbit Ears MSA: 19 September 2003 - 1:45 pm thru 3:45 pm local time

1.7 Parameter or Variable

The parameters presented in this data set include color infrared orthophotographs, lidar elevation returns (raw/combined, filtered to bare ground/snow, and filtered to top of vegetation), elevation contours, and snow depth contours.

2 DATA ACQUISITION AND PROCESSING

2.1 Processing Steps

Bare earth filtering was used to generate contours. Classification techniques were determined to apply for each discrete area type, to best portray a bare earth surface. Factors that affect the classification are slope, vegetation, and cultural features. The classification techniques included analyzing the multi-return data in combination with a proprietary algorithm to identify the bare earth surface trends and those features that are not part of the bare earth. The filtering parameters were set based on this evaluation, and processed in an iterative fashion, with a quality control feedback on the results of the filter pass. The parameters were tuned to the study area's general morphology, (i.e., terrain “roughness”) and surface features (i.e., trees, buildings, etc.). The data were processed using SPECTRUMS proprietary photogrammetric software, LIDAMS, which allows for interactive realtime review of the filtering and 3D data viewing.

The bare earth filtered data sets were used to create Triangulated Irregular Network (TIN) surface models using AutoCAD - Land Development Desktop (LDD). This type of surface model is not based on interpolation, and therefore explicitly honors all data points supplied. A volume surface model was then generated within LDD from a stratum defined by the TIN surface representing the April 2003 data (snow-covered terrain), and the TIN surface representing the September 2003 data

(snow-free terrain). Contours, representing snow depth at the time of the April 2003 data collection, were then generated from this volume surface using LDD.

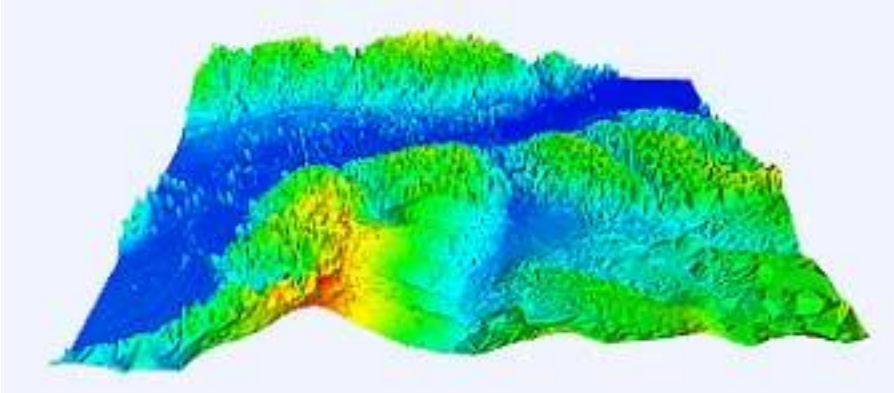

Figure 2. Before lidar point classification

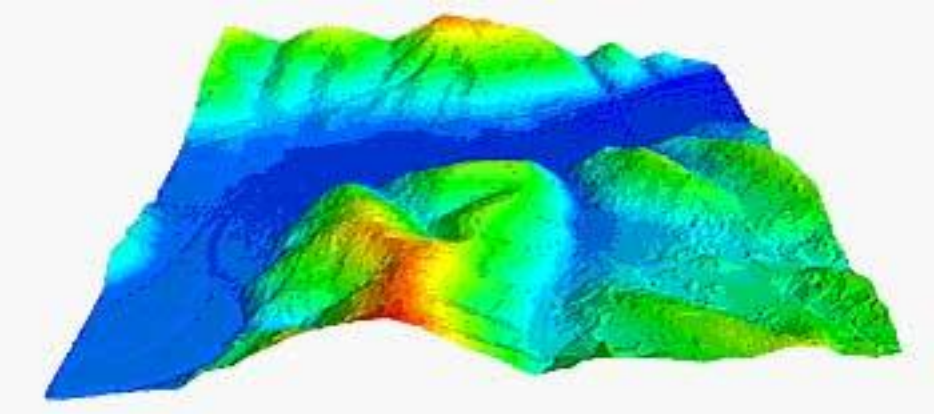

Figure 3. After lidar point classification

2.2 Sensor or Instrument Description

Lidar system and digital camera specifications are given in the following tables.

Lidar System Specifications	
Laser Altitude<	13,000 ft (4,000 m) AGL Max
Laser Swath Width	16,500 ft (5,000 m) Max
Laser Scan FOV	75 Degrees Max
Scan Rate	Up to 70 Hz (FOV dependent)
Laser Pulse Rate	24 - 45 kHz
Laser Returns	3 at 45 kHz or 5 at 38 kHz
Nominal X/Y Ground Sample Distance	3 - 15 ft (1 - 5 m)
X, Y, Z Positional Accuracy	Less than 1 ft (<30 cm) RMSE Absolute

Digital Camera Specifications

Camera Array	4k x 4k Pixel Panchromatic, Color, CIR
Recording Rate Per Frame	1.5 Seconds
Camera FOV 50mm Lens	40 Degrees Fixed
50 mm Lens Calibration	Less than 0.5 Pixel RMSE Full FOV
Camera FOV 90mm Lens	23 Degrees Fixed
90 mm Lens Calibration	Less than 0.5 Pixel RMSE Full FOV
Minimum Ground Projected Pixel Footprint	6 in (15 cm)
Image Geopositioning Accuracy	Better than 1 ft (20 cm) RMSE absolute

2.3 Quality Assessment

The lidar and image data were calibrated by overflying the Global Positioning System (GPS) base station to identify any possible systematic errors. The data post processing included a check of the root mean-square error (RMSE) post processing results from the internal measurement unit (IMU) and GPS data; a check of roll, pitch and yaw values; and the position dilution of precision (PDOP) during time of collection. The flight lines were checked for vertical offsets and any anomalies. The data sets were reviewed as part of the interactive filtering process to ensure correct depiction of the surface. The imagery was stereo checked to verify the exterior orientation parameters in conjunction with the post-processed IMU/ GPS solutions. The ortho imagery was used as a final background check on the lidar bare earth-to-surface for a visual verification of the filtering results.

3 REFERENCES AND RELATED PUBLICATIONS

Corbley, K.P. 2003. Project Case Study – Lidar for Elevation Mapping, CE News , 14:12, pp. 40-41.

3.1 Related Data Collections

All CLPX Data Sets

4 CONTACTS AND ACKNOWLEDGMENTS

Dr. Robert Davis
CRREL
72 Lyme Road
Hanover, NH, 03755

Stephen L. Miller, P.E.
Johnson, Kunkel & Associates, Inc.

P.O. Box 409
Chambers, Ave., Eagle, CO 81631

5 DOCUMENT INFORMATION

5.1 Publication Date

15 April 2004

5.2 Date Last Updated

6 April 2021