NERC SCIENCE OF THE ENVIRONMENT Airborne Research Facility

PML | Plymouth Marine Laboratory

An overview of the NERC Airborne Research Facility (NERC-ARF) data processing system

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Data Acquisition

The NERC Airborne Research Facility (NERC-ARF) acquires data from a full-waveform LiDAR, visible/thermal hyperspectral sensors (Specim Fenix and Owl) and a digital camera in support of research by scientists based in the UK (through NERC) and Europe (through EUFAR).

Following data acquisition, the raw files are sent to the NERC-ARF Data Analysis Node (NERC-ARF-DAN) at Plymouth Marine Laboratory (PML) where the following processing steps are applied to each dataset to calibrate and geometrically correct prior to delivery to the project PI. The processing uses a mixture of commercial and in-house software.

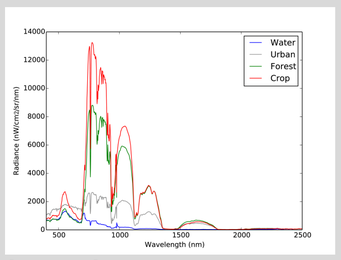
Navigation Data Processing

1) Verify base station position
- Within the UK the Ordnance Survey RINEX network of base stations is used.
- Outside the UK NERC-ARF or project PIs deploy a base station.

2) Post process GPS data acquired from the plane using base station data
- Take into account lever arm values for instruments. Whenever the instruments are removed from the plane it is surveyed to obtain the precise instrument positions.

Hyperspectral + Thermal

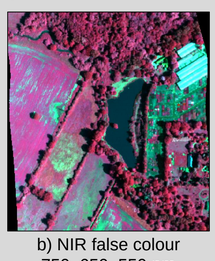
1) Calibrate raw data to at-sensor radiance (Level 1b)
- Radiometric calibration performed annually for hyperspectral.
- Black bodies used for thermal



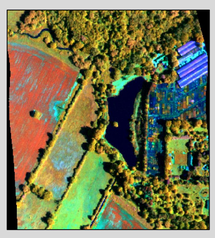
2) Synchronise navigation data to account for timing offsets
- Geometrically correct a subset of bands using a range of timing offsets using APL software running on PML's HPC.
- Manually pick best values.
- No longer needed for Fenix

3) Geometrically correct all bands

a) True colour (650, 550, 450 nm)



b) NIR false colour 750, 650, 550 nm



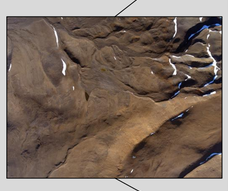
c) NIR/SWIR false colour 750, 1700, 650 nm

4) Create Delivery
- Level 1b (unmapped at-sensor radiance).
- Level 3b (mapped at-sensor radiance).
- A DEM and configuration files required for the PI to geometrically correct Level 1b or atmospherically corrected Level 2 data in the open source APL software (download link and tutorial supplied).
- A 'Read Me' file with specific information about the data.

Digital Camera

1) Convert raw data to TIFF

2) Tag TIFF images with plane location using EXIF standards



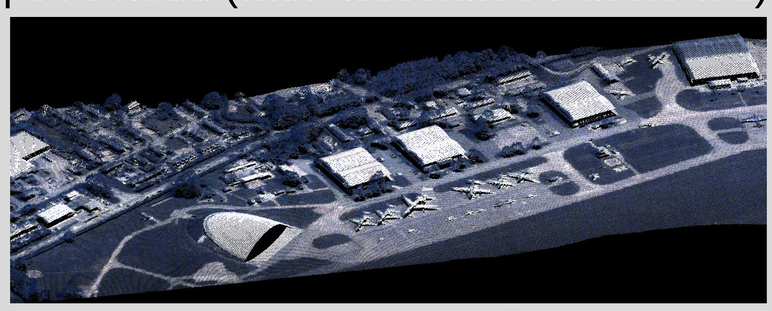
```
ExifTool Version Number         : 9.76
File Name                       : RCD105-BGS11_01-2012236a-00001.tif
GPS Altitude                    : 2561.786982 m
GPS Time Stamp                  : 09:34:58.563013
GPS Map Datum                   : WGS84
GPS Dest Bearing Ref            : True North
GPS Dest Bearing                : 119.040319
GPS Date Stamp                  : 2012:08:23
Unique Camera Model             : Leica RCD105 CH39 digital camera
Camera Serial Number            : 21
GPS Date/Time                   : 2012:08:23 09:34:58.56301268Z
GPS Latitude                    : 72 deg 24' 16.66" N
GPS Longitude                   : 22 deg 53' 20.36" W
Image Size                      : 7212x5408
```

3) Generate KML File
- Can be viewed in Google Earth.
- Location of flight lines and information about each photo.

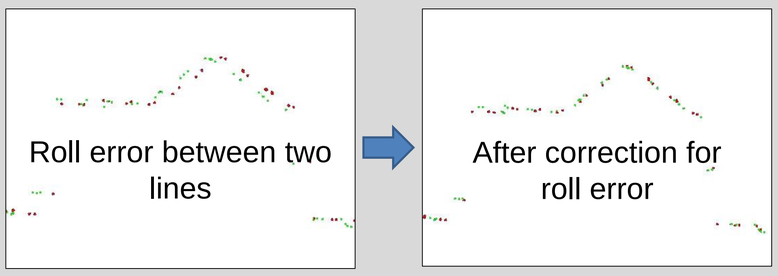
4) Create Delivery
- Tagged TIFF images.
- Thumbnail JPEG images.
- A KML with the location of each image.
- A 'Read Me' file with specific information about the data.

LiDAR

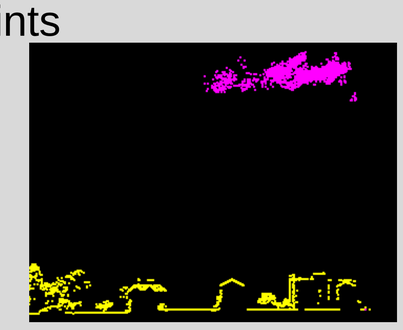
1) Convert raw data to a georeferenced point cloud (with associated waveforms)



2) Determine pitch and roll errors between overlapping strips and correct for these
- Iterative procedure of processing and manually comparing using the in-house LiDAR Analysis GUI (LAG) viewer.



3) Classify noisy points
- Isolated points automatically identified.
- Classification checked and refined manually to flag clouds etc.
- Points flagged but not removed.



4) Create Delivery
- Discrete return data in LAS 1.2 format.
- Full waveform data (if available) in LAS 1.3 format.
- A DEM patched with ASTER data for processing hyperspectral data using APL.
- Intensity screenshots for each line.
- A 'Read Me' file with specific information about the data including residual height offsets between overlapping lines.

Delivery, Archiving and Support

Following quality checking, data are dispatched to the PI on a hard drive or via FTP. We then archive data at the NERC Earth Observation Data Centre (NEODC; http://neodc.nerc.ac.uk), which allows users to download previously acquired NERC-ARF datasets.

In addition to data processing, NERC-ARF-DAN offers support for users of current NERC-ARF and NEODC archive data through a help desk, wiki (https://nerc-arf-dan.pml.ac.uk/trac/) and training sessions held annually. We also make some of our processing tools such as APL (hyperspectral processing), LAG (LiDAR visualisation) and ARSF DEM Scripts (DEM generation from LiDAR) publically available via https://github.com/arsf/ and contribute to other open source tools such as TuiView and points2grid.