Data Quality Report - 2021

Hyperspectral

NEODAAS

Updated on: November 24, 2021

Contents

1 Introduction

The NERC Earth Observation Data Acquisition and Analysis Service (NEODAAS) have processed hyperspectral data collected with NERC's Specim AISA Fenix1K instrument starting in 2021. The Specim AISA Fenix1K replaces the older Aisa Fenix model previously flown.

The NERC Fenix1K instrument comprises two detectors covering the Visible to Near Infra-Red (VNIR) and Short Wave Infra-Red (SWIR) regions, giving a total spectral range of 380–2500 nm. This data quality report describes issues for hyperspectral data acquired with the Fenix1K instrument that should be considered when further processing any NEODAAS datasets acquired in 2021.

This document may be updated over the course of the year, the latest version is available at:

https://nerc-arf-dan.pml.ac.uk/trac/wiki/Reports

2 Geo-referencing accuracy

NEODAAS currently delivers level 1b (calibrated at-sensor radiance) and level 3 data (mapped level 1b data). This offers users quick access to georeferenced data whilst maintaining the capability to operate on the original pre-gridded data and use a coordinate projection or datum of choice.

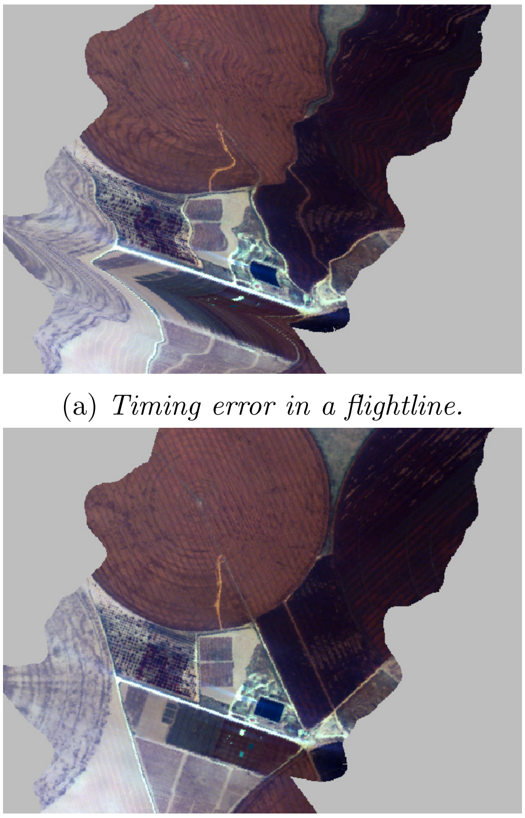
The quality of the geocorrection for each project is described in the documentation supplied with the delivery. Typically the geocorrection is of the order of a couple of metres, equating to approximately 1 pixel depending on flight altitude. High accuracy relies on an accurate Digital Surface Model (DSM). The freely available global ASTER digital elevation data are used during quality checks and an elevation model is supplied with the delivered mapped files. Accuracy may be improved by using a DSM derived from higher resolution data such as LiDAR. An indication of the average error between vector overlays is included in the delivery documentation where vector overlays or other ground truth information is available.

It may be possible to tune specific flight lines for higher accuracy and instructions can be provided on how to make your own alignments. If a higher accuracy is required, please contact us at: helpdesk@neodaas.ac.uk

3 Timing Errors

If the navigation data and scanline imagery are misaligned then it will manifest itself as a distortion in the geocorrected image. This misalignment is most often caused by an error in the timing, which means that the scanlines get syncronised to incorrect navigation (position and attitude). A timing error can range from a fraction of a second to tens or hundreds of seconds if the system crashes. An example is shown in Figure 1.

This issue was extensively investigated and fixed in 2016 for the NERC-ARF Fenix instrument. This fix also appears to apply to the loan instrument used in 2017. If any distortions are found in your data then please contact us at helpdesk@neodaas.ac.uk and we will investigate and correct (where possible).



(a) *Timing error in a flightline.*

(b) *Corrected version of the above image (0.5 s timing difference).*

Figure 1: *Illustration of timing offset present in geo-referenced Fenix data.*

4 Sensor calibration

The Fenix1K sensor calibration was undertaken by Specim, the manufacturer, in December 2020 before being delivered to NERC for the 2021 field campaign. The Specim calibration reports can be found in the 2021 data quality report section here: https://nerc-arf-dan.pml.ac.uk/trac/wiki/Reports

NERC aims to undertake new sensor calibrations before each of the following yearly campaigns in collaboration with NEODAAS and the NERC Field Spectroscopy Facility to ensure spectral (wavelength) and radiometric accuracy.

5 Bad CCD Pixels

The Fenix1K instrument has a varying number of pixels that provide inaccurate values, these are identified and flagged as 'bad pixels' during calibration. In this case, the latest calibration was performed who provided a list of bad pixels with the calibration data. The processed data delivered by NEODAAS include level1b mask files which account for those bad pixels. The delivered mapped files are already masked.

For the 2021 flight campaign, the aircraft slit that the Fenix1k observes through was not large enough to include the full swath. Therefore the mask files provided also include pixels located at the edge of the Fenix1K swath to mask these regions. This is expected to be resolved before future campaigns take place. This effect is clearly visible in the example image in Figure 2. From the full Fenix1K swath of 1024 pixels, 91 pixels have been masked from the left side and 100 from the right.

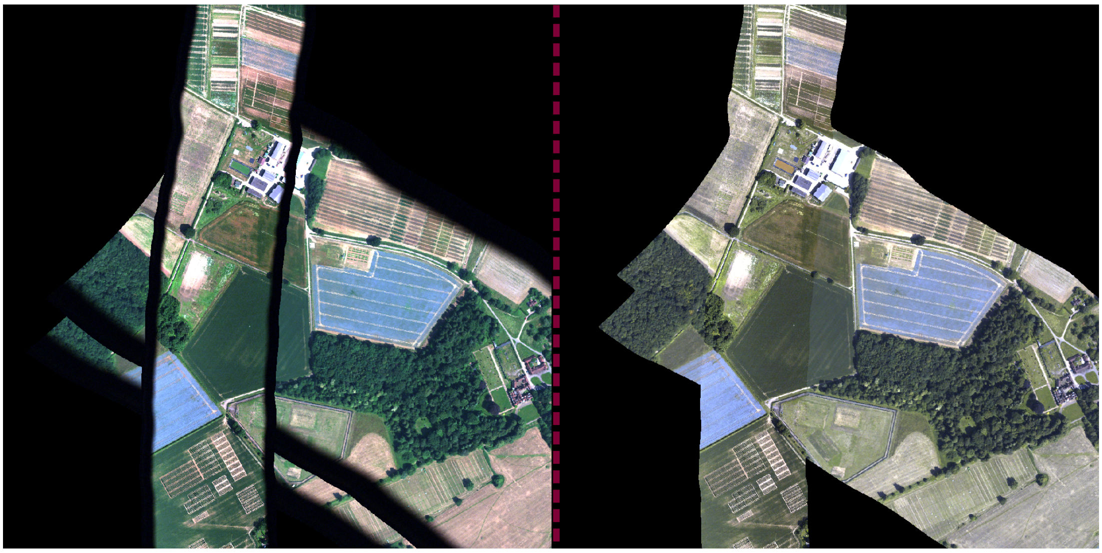


Figure 2: *The image on the left shows level-3b geocorrected Fenix1k data unmasked, whilst on the right the data are masked. Note the swath edges have been removed.*

6 Detector sensitivity

The detector response is non-uniform across each of the bands with varying Signal to Noise Ratio (SNR) and sensitivity. The lowest sensitivity is found in bands at the upper and lower limits of each detector as shown in Figure 3. These bands have high calibration gains and therefore noise may result in spikes in the radiometrically calibrated data. The normalised sensitivity (sensitivity for each band divided by maximum sensitivity for detector) is calculated and shown in Figure 3. The SNR as measured by Specim can be downloaded from: https://nerc-arf-dan.pml.ac.uk/trac/wiki/Reports.

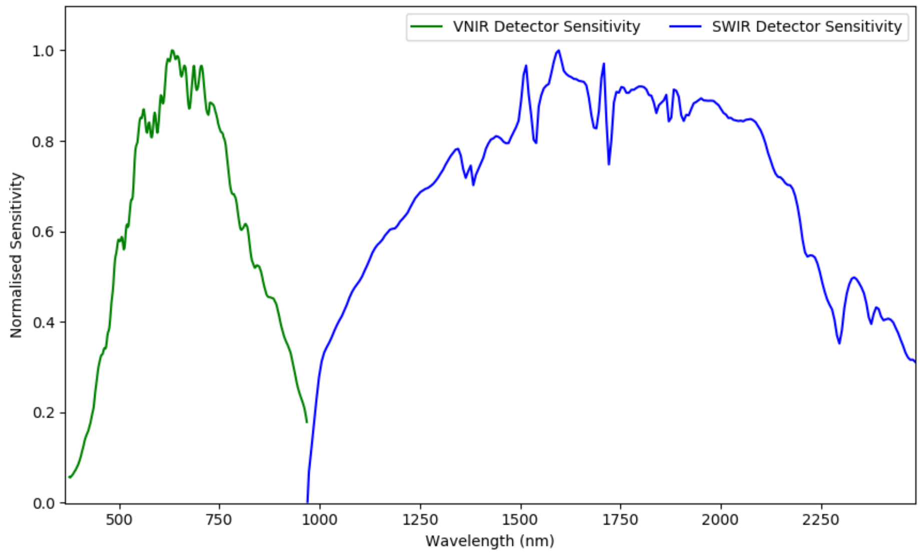


Figure 3: *Normalised sensitivity averaged over all pixels in the field of view of the VNIR and SWIR bands for Fenix1K detector.*