Data quality overview

This report documents issues that should be considered when further processing any of the 2007 ARSF datasets. Overall, the data appears to be of generally good quality.

Issues affecting all sensors

Geo-referencing accuracy

ARSF currently deliver data at level 1 (calibrated sensor data) rather than level 3 (geo-referenced). This allows users to generate level 2 products (e.g. atmospherically corrected radiances) if they wish, and/or map to any projection or datum that suits.

Since ARSF does not currently process data to level 3 except for quality control purposes, instructions for applying precise geometric adjustments to align imagery to other data sets (such as vector overlays) are given to users with delivered datasets. Where a vector overlay or other ground truth information is available, ARSF provide an indication of the average error prior to any such adjustments.

Timing errors

Correction of the timing offsets between navigation and imagery has been necessary to correct errors in some flight lines. These are primarily present in the Eagle/Hawk system but occasionally occur in ATM and CASI data. Timing errors manifest as "wobbles" in the imagery correlated to but out of sync with movements of the aircraft. An example is shown in Figure 1 below.

In Eagle and Hawk, the issue is presently attributed to some part of the system losing scan lines of data without recording the loss. Consequently the image scans become out of sync with the GPS data. This is under investigation at various levels and has been raised with Specim.

We endeavour to correct all timing errors prior to delivery. As this is a manual process and relies on finding suitable visible features in the imagery, some errors may still remain. If any are found, please contact us at arsf-processing@pml.ac.uk.

Figure 1a: timing error in an Eagle line

Figure 1b: corrected version of above (0.13 seconds difference)

Specific sensor issues

CASI

No known issues.

ATM

Radiometric calibration

The ATM radiometric calibration undertaken at the beginning of 2007 has been found to differ markedly from the 2007 post-season and the subsequent 2008 pre-season calibrations. Furthermore, ATM suffered a serious failure at the beginning of the 2008 Ethiopia campaign, and this may partly explain the poor quality of the two calibrations prior to this.

Through comparison against CASI and/or Eagle data collected simultaneously, the 2007 pre-season calibration has been judged as the more accurate representation for the whole of 2007 and has been used on the data delivered herewith. See Figure 2 for a single sample over land.

While the results appear good, it is considered that you should be aware of this issue and its possible effect on data quality in any further processing. For more information, see: http://www.npm.ac.uk/rsg/projects/arsf/trac/ticket/39
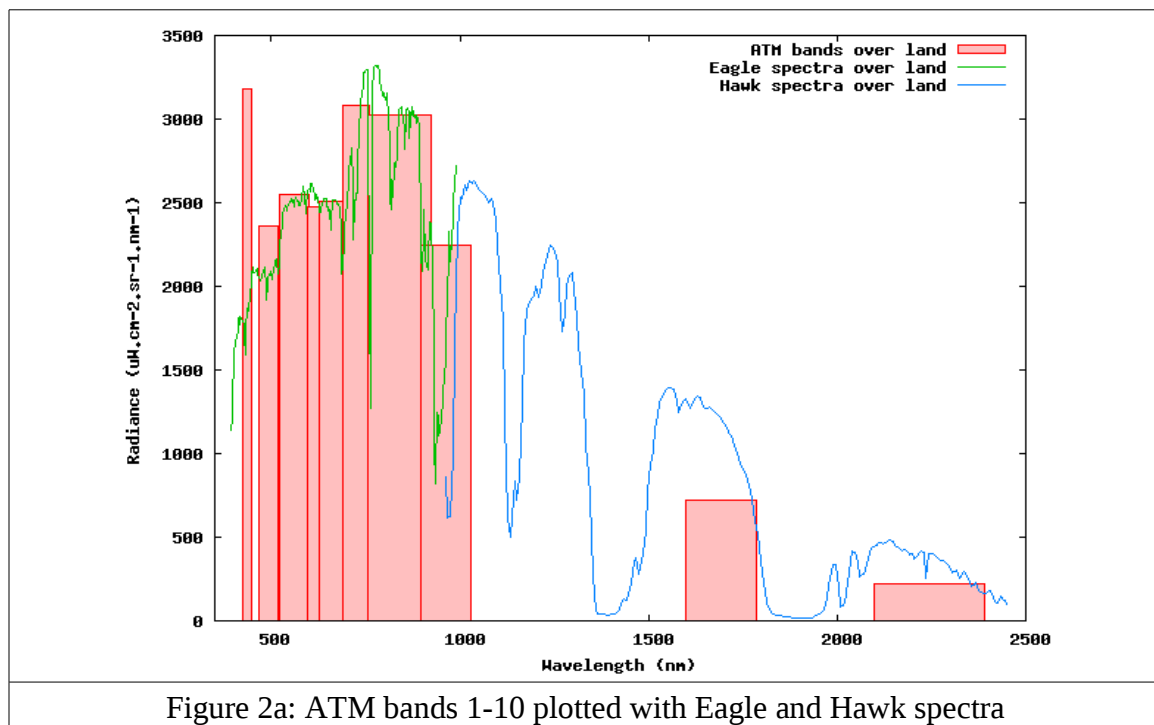

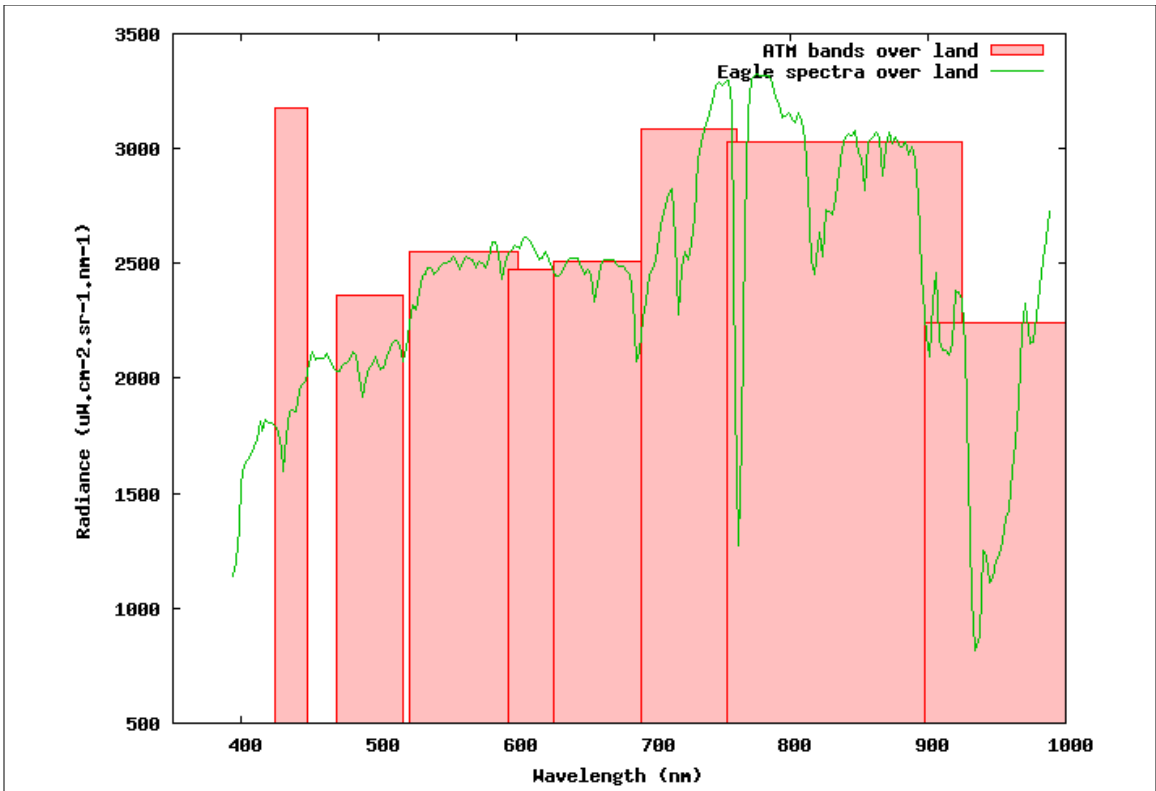Figure 2a: ATM bands 1-10 plotted with Eagle and Hawk spectra

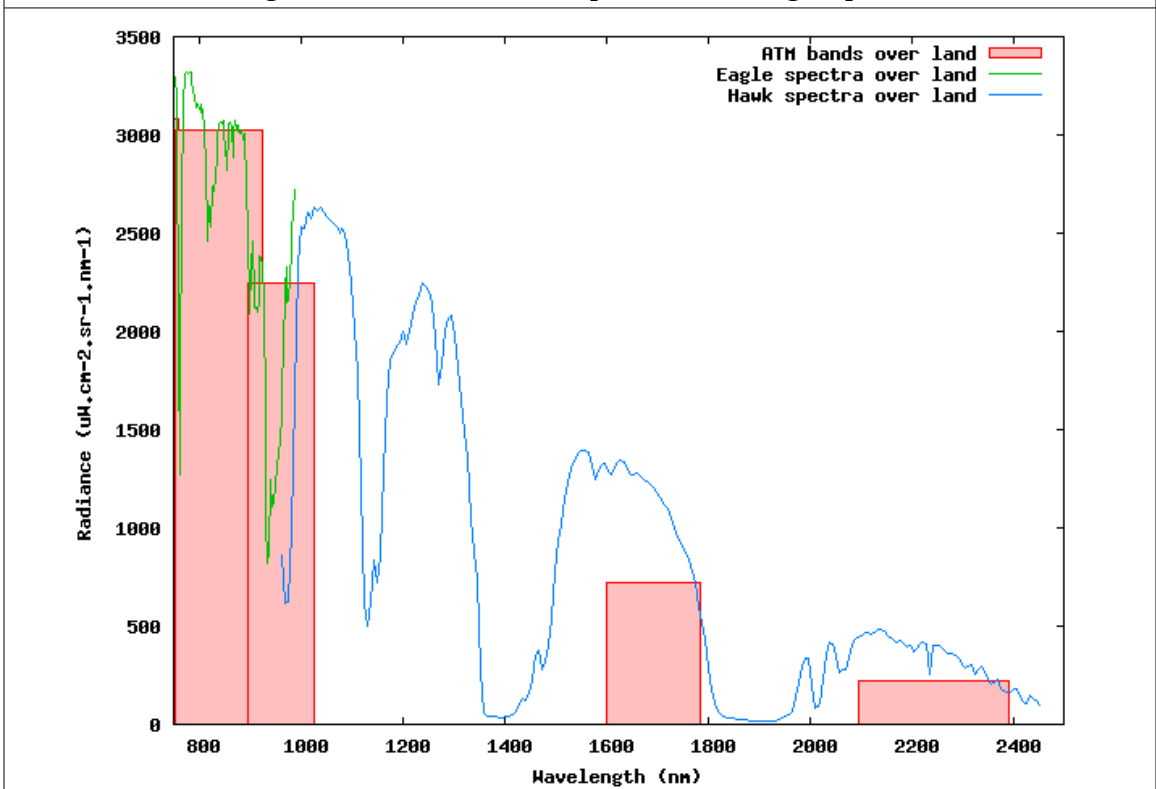Figure 2b: ATM bands 1-8 plotted with Eagle spectra

Figure 2c: ATM bands 7-10 plotted with partial Eagle and complete Hawk spectra

Noise

Some ATM data exhibit small black and white speckles, particularly in band 11 (thermal infra-red), which is believed to be due to electrical interference (see Figure 3).

Figure 3a: band 2 of ATM showing suspected electrical interference (dark speckles)
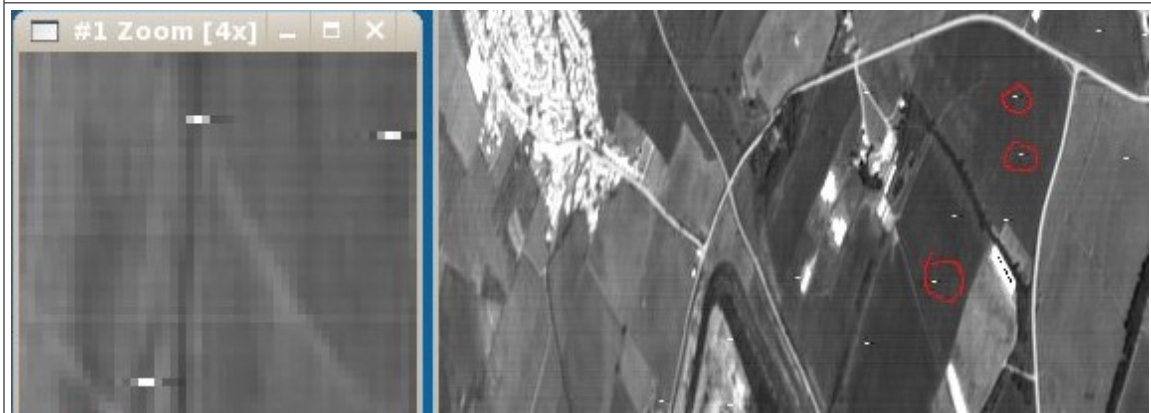

Figure 3b: band 11 of ATM showing suspected electrical interference (white speckles)
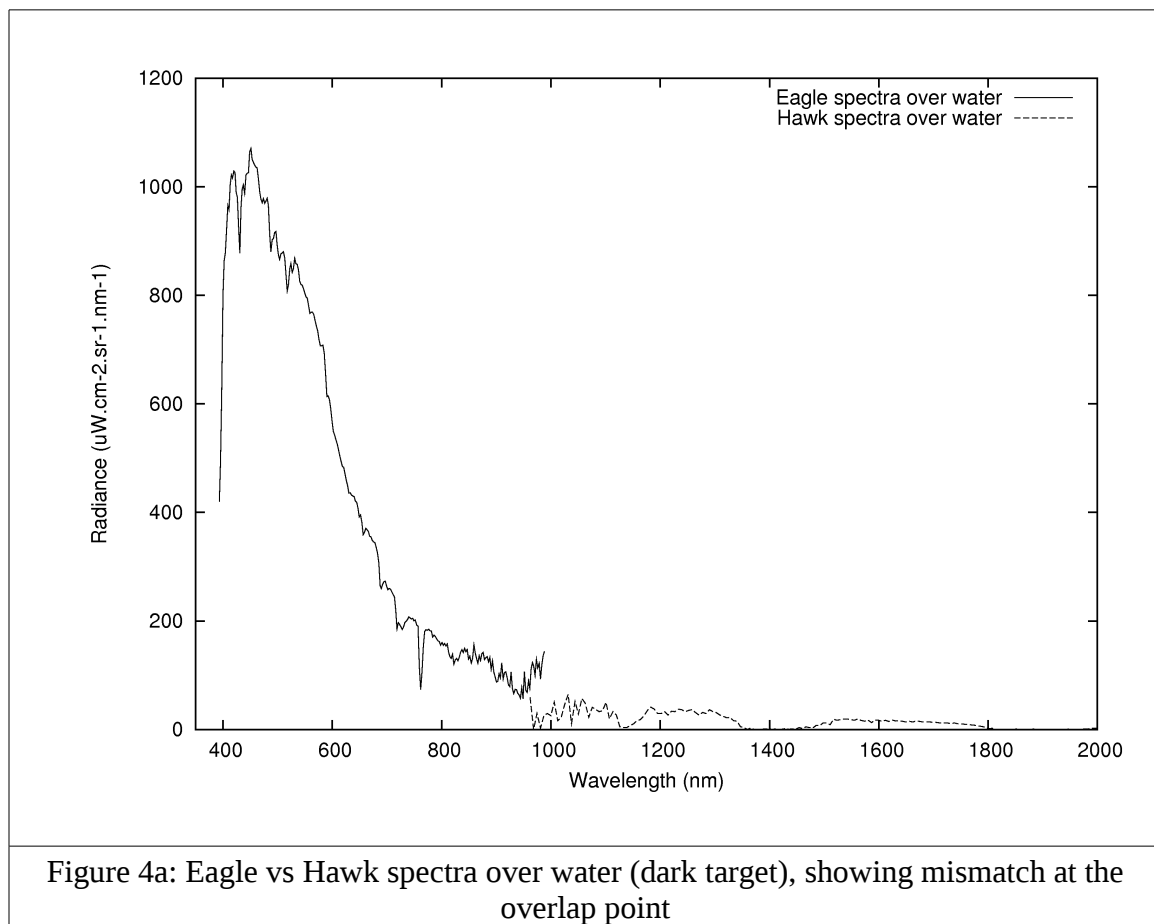
Specim Eagle and Hawk

Radiometric calibration

Due to the failure of the lamp in their NPL calibrated uniform sphere source during the 2007 radiometric calibration procedure, the NERC Field Spectroscopy Facility (FSF) were unable to do a complete calibration for 2007. However, by examining spectral response to various other known light sources, FSF were able to partially validate the February 2007 factory calibration as spectrally correct and suitable for 2007 data. Comparisons of concurrent Eagle and CASI spectra, and of Eagle/Hawk data versus modelled data support this.

The quality of the output appears to degrade at the low and high wavelength limits of both Eagle and Hawk. For example, a comparison of pixels near the Eagle/Hawk spectral overlap over dark targets such as water reveals a mismatch (see Figure 4).   Caution is advised when examining spectral responses at the edges of the usable range.

Issue tracked at: http://www.npm.ac.uk/rsg/projects/arsf/trac/ticket/113

Figure 4a: Eagle vs Hawk spectra over water (dark target), showing mismatch at the overlap point
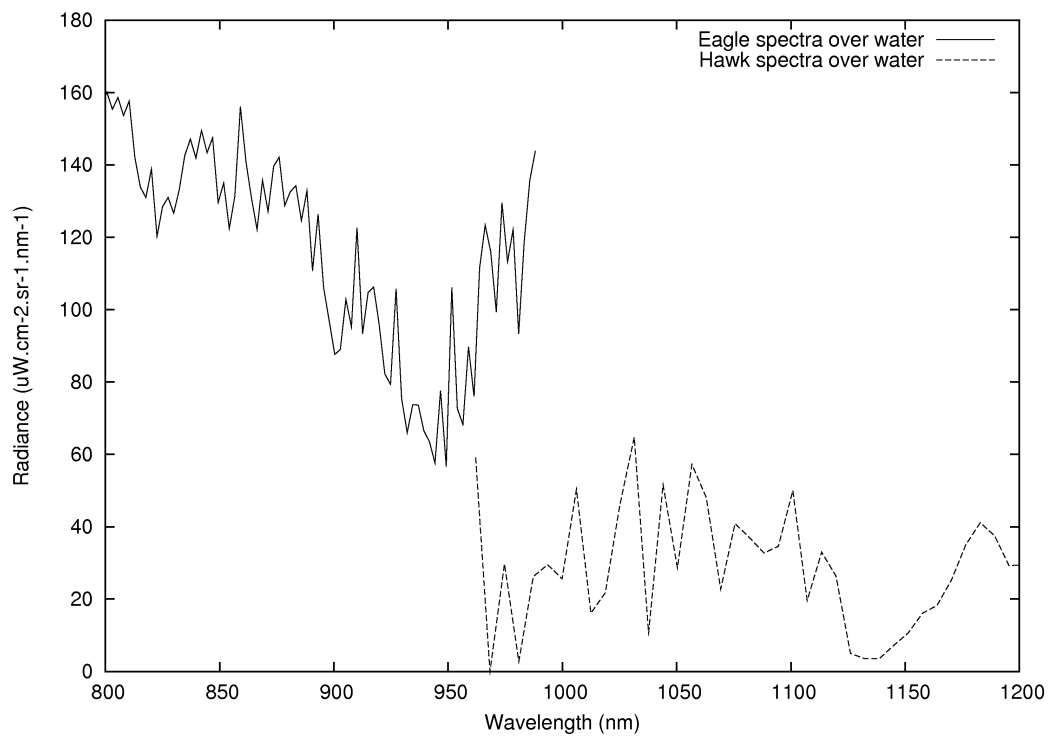
Figure 4b: zoomed up version of Figure 4a

Bad pixels

The Hawk instrument has a number of bad pixels, which are pixels that give inaccurate values. There are a number of different types of error (e.g. constant pixel values, uncorrected offset, duplicating neighbouring pixels, etc), and a number of bad pixels (~1%) are common on the type of CCD used in the Hawk instrument. Specim has provided a list of known bad pixels and these are filled with zero values in delivered data.

While the majority of bad pixels are corrected or blanked out, some have not been detected and may appear in delivered data. These appear in level 1 datasets as straight lines along the direction of flight and as undulating lines in level 3 (following the motion of the aircraft). See Figure 5 for an example. Typically, they will only affect a single band and are difficult to detect. A complete solution for detecting and removing these will be pursued in 2008.

Issue tracked at: http://www.npm.ac.uk/rsg/projects/arsf/trac/ticket/111
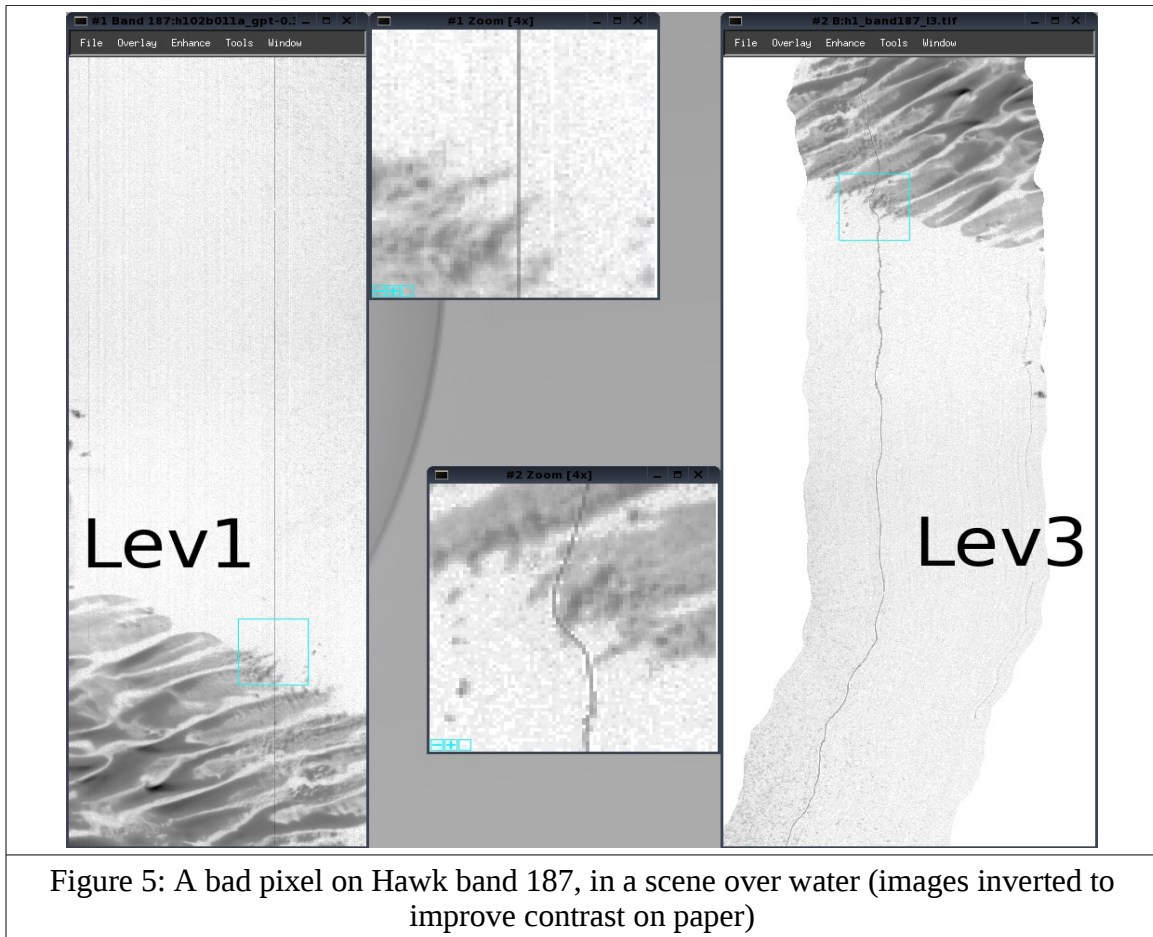

Figure 5: A bad pixel on Hawk band 187, in a scene over water (images inverted to improve contrast on paper)