Radiometric Calibration of the 22m GSD NigeriaSat-X satellite sensor using combined cross-calibration results over Dome-C and Libya 4

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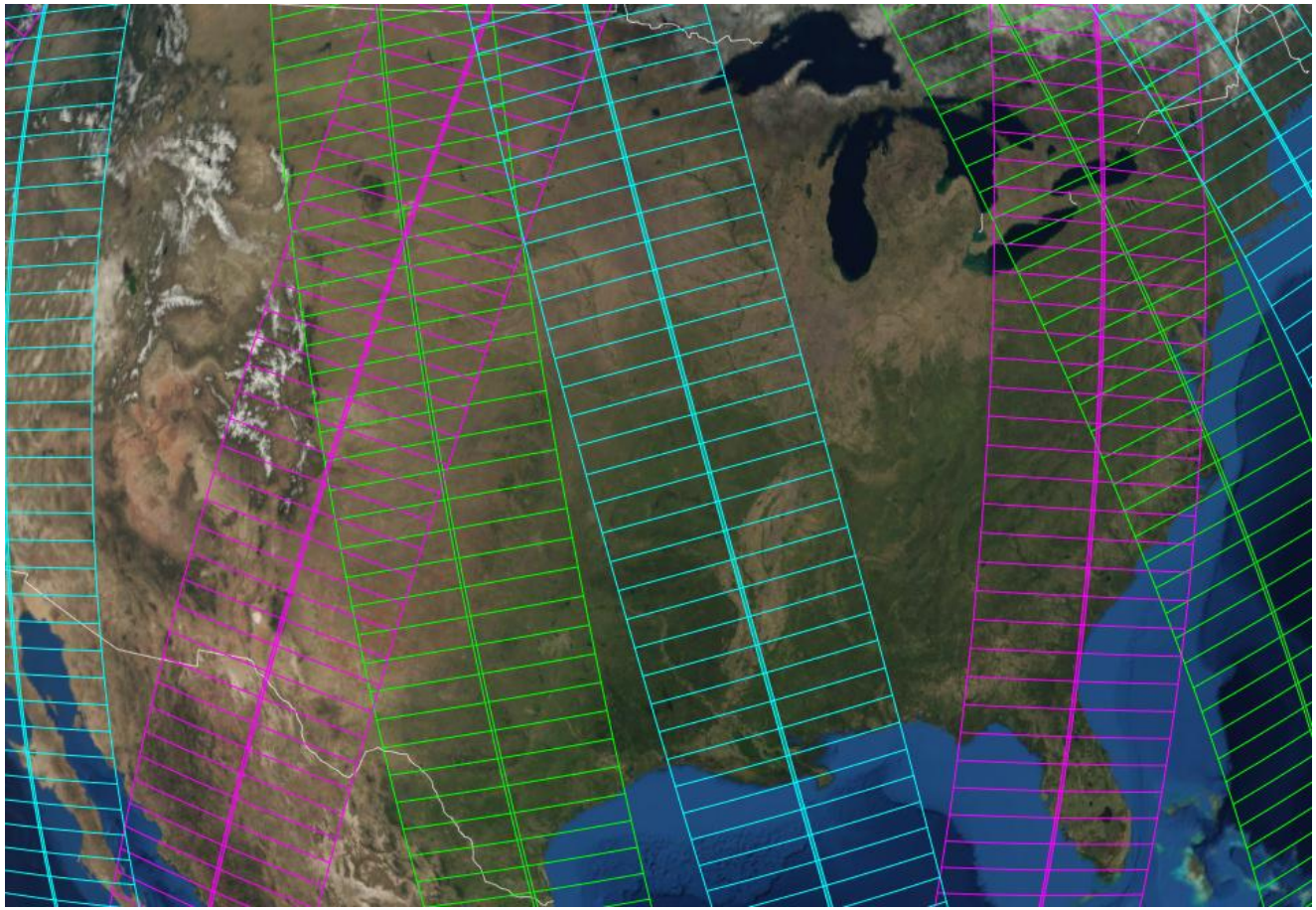
Introduction to Nigeriasat-X

- SSTL-100 platform
- 22m GSD
- Push-Broom
- 650km+ Swath
- Red, Green and Near Infrared bands
- Descending Node

Introduction to Nigeriasat-X

- First mission to provide continuation of 22m imagery following on from UK-DMC2 and Deimos-1



Calibration Method

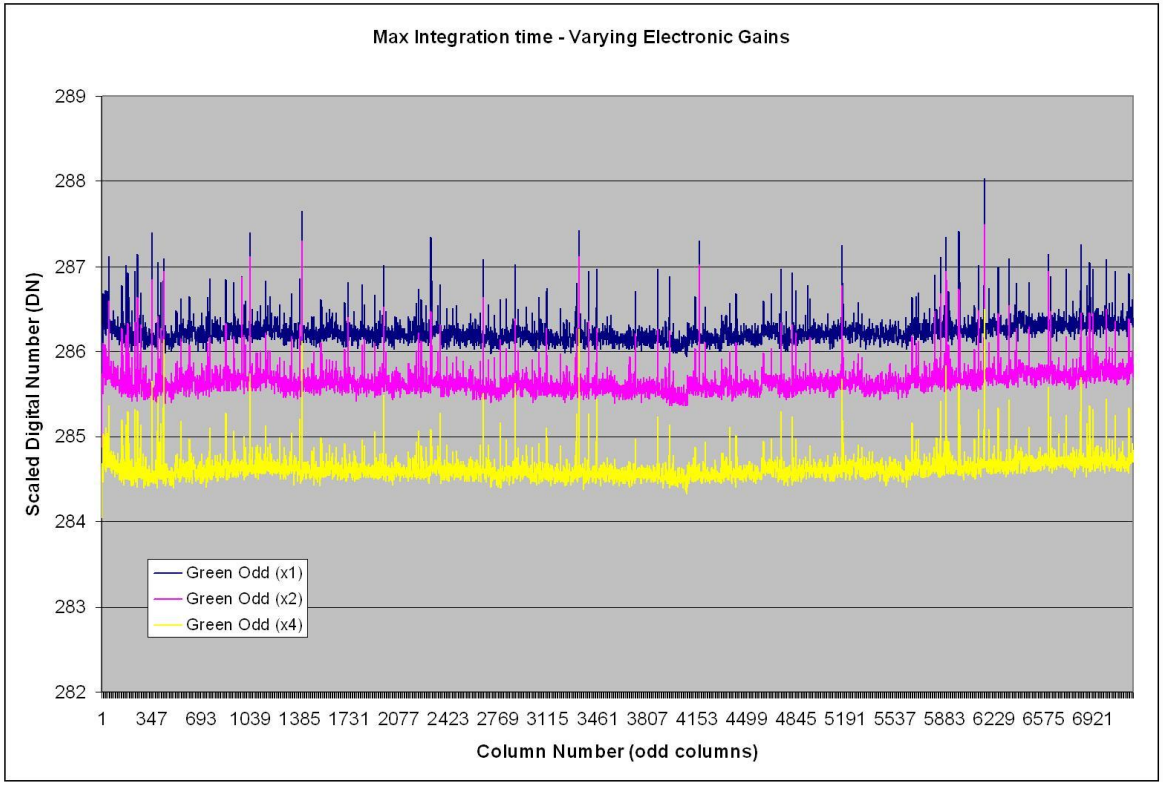
- Dark Images – Pacific at Night

- White Images
  - Equalisation
  - Cross-Calibration
  - MODTRAN Modelling

- Libya 4 Cross-Calibration
  - Vs Landsat 7 and UK-DMC2

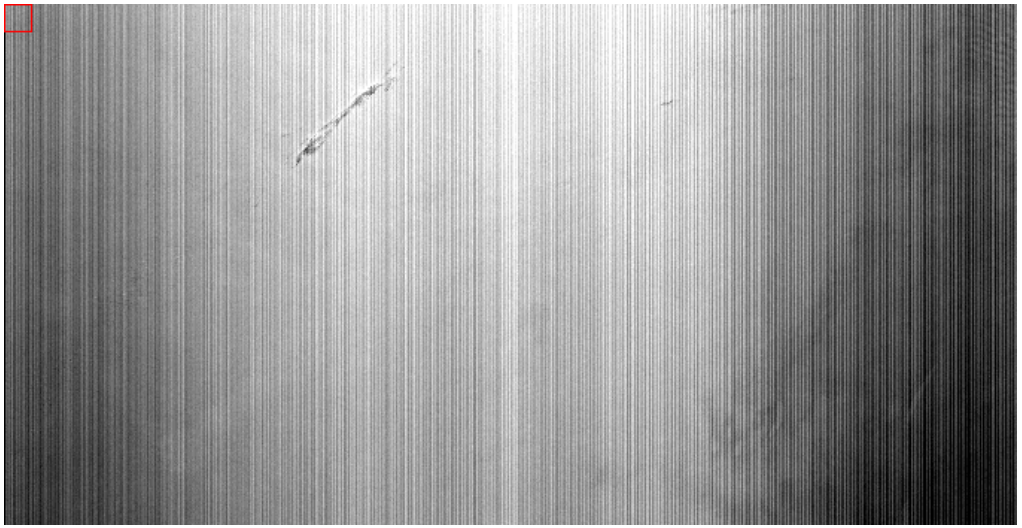
Dark Images

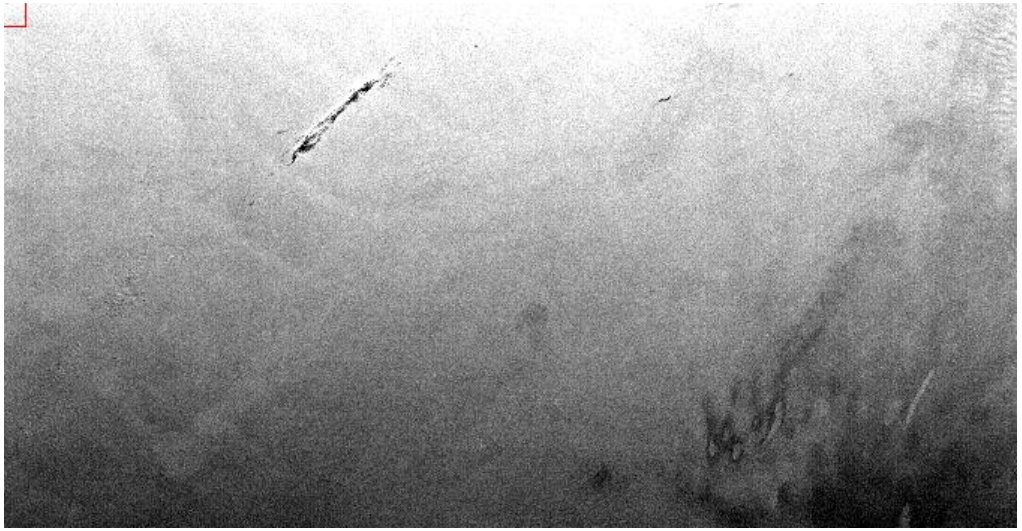
- Images collected over Pacific at night to determine the calibration bias terms



White Images - Equalisation

- Dome-C Images
- Images collected Nov 2011-Jan 2012
- Used to equalise the detectors and eliminate striping
- Will be carried out annually





White Images - Absolute

- Modelling with MODTRAN

  - Initial calibration based upon MODTRAN 4 radiative transfer code

  - Uses snow spectrum from Dome-C

  - Provides radiance estimate within 2-3%

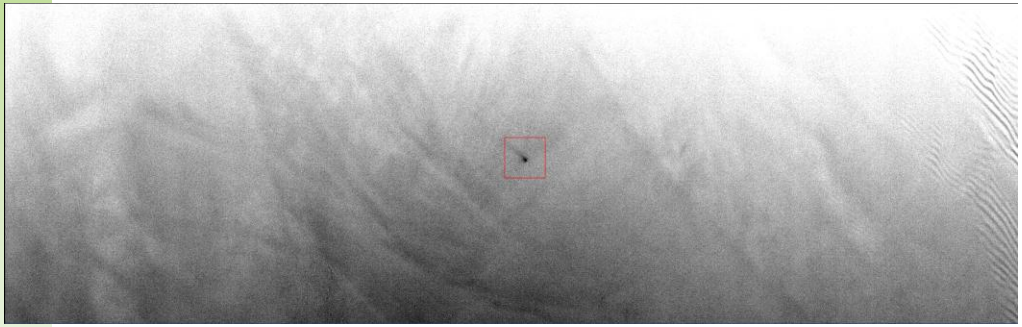
- Cross-Calibration

  - 2 Images acquired on the same dates as UK-DMC2

  - Showed good correlation

White Images – Absolute

- Surface Variability effects can cause up to 4% difference in response



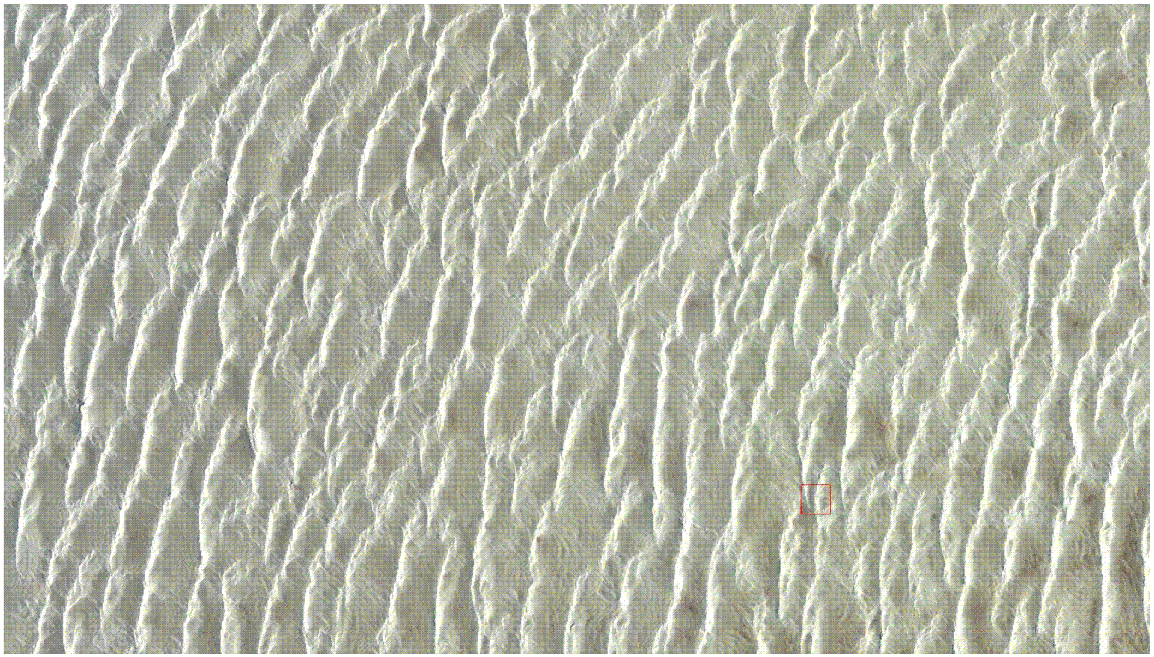
4th December 2011

Hoar frost effects are clearly visible in the lower image and can cause variability in response of up to 4% in some cases.

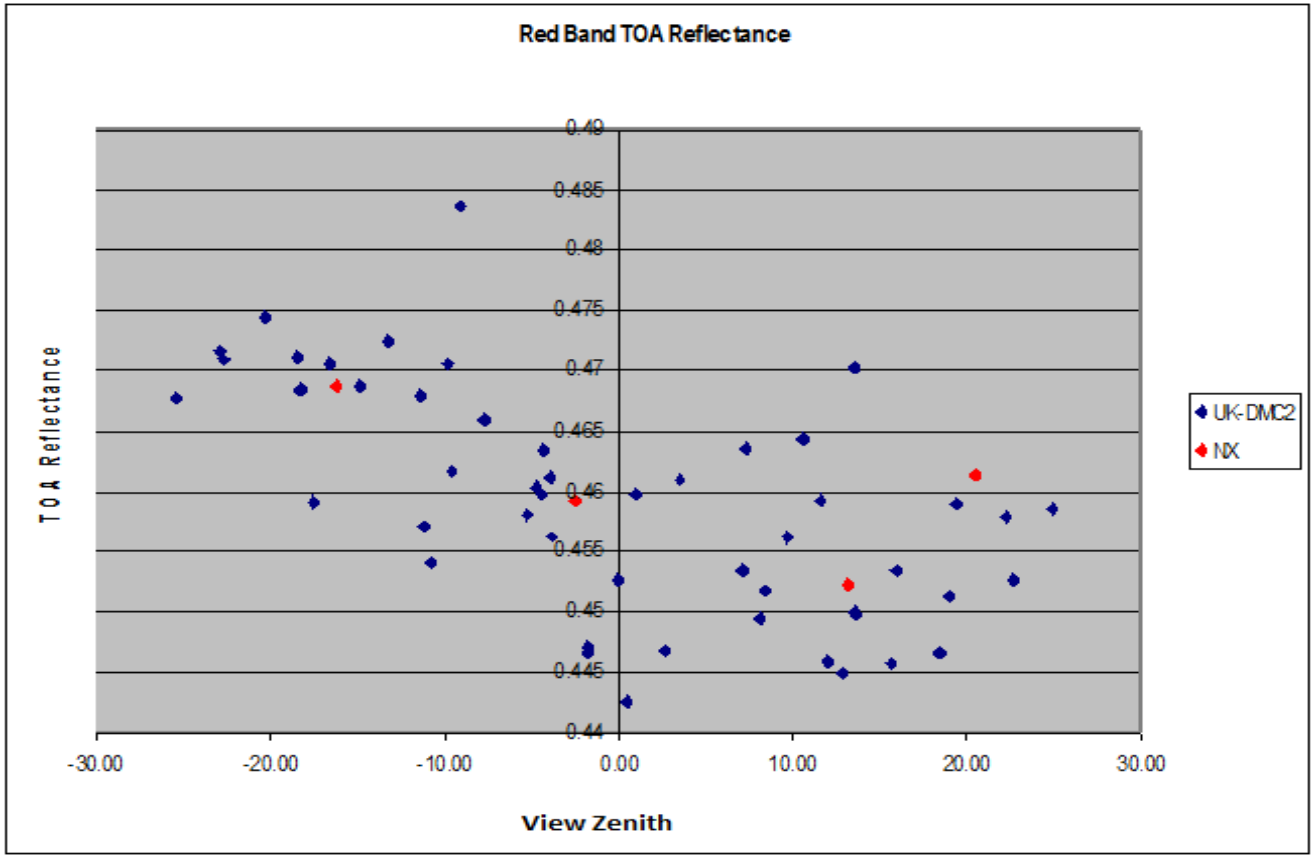
5th February 2012.

Libya 4 Cross Calibration

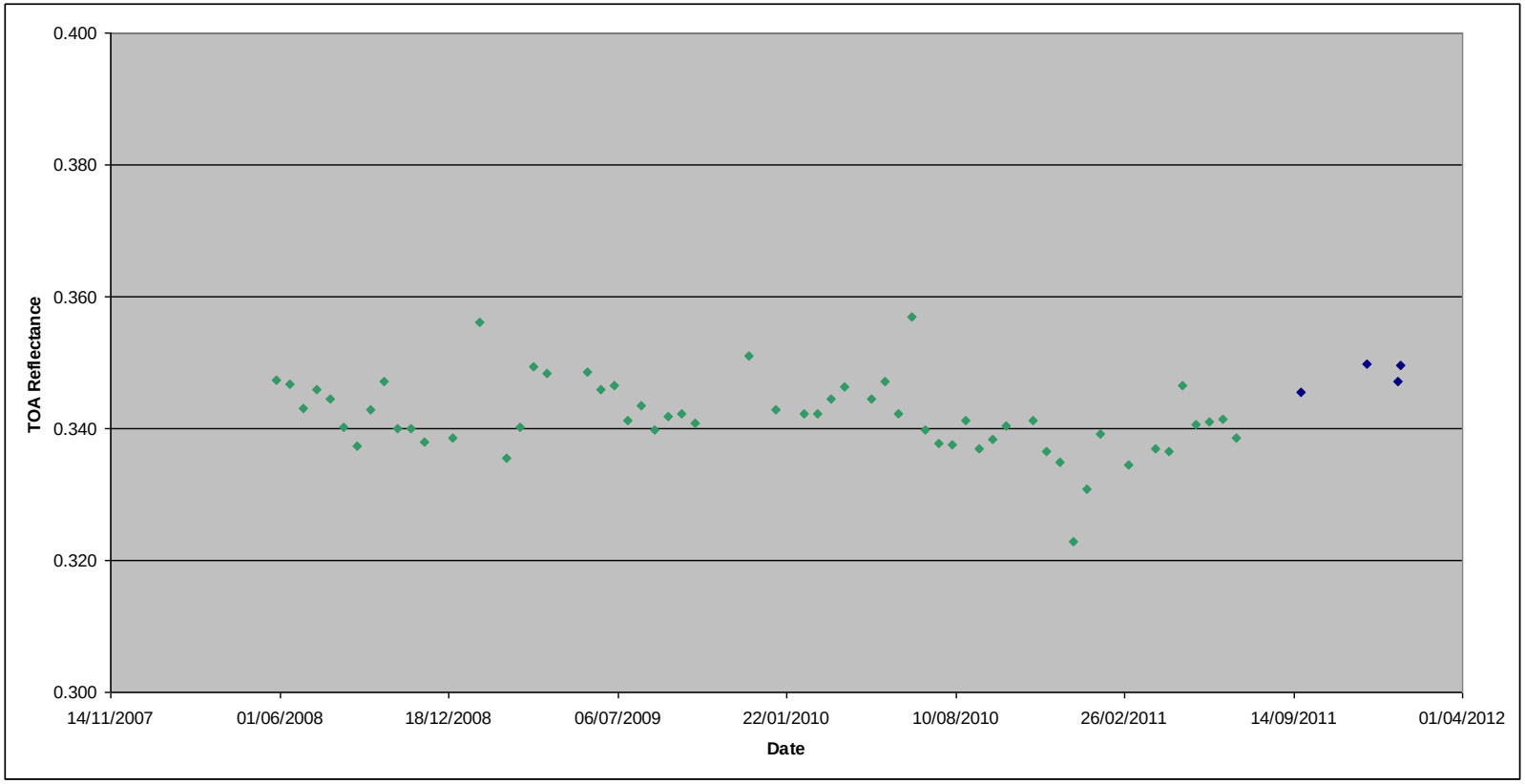
- Water Vapour affects NIR
- Solar Zenith Angle BRDF effects
- View Angle BRDF effects



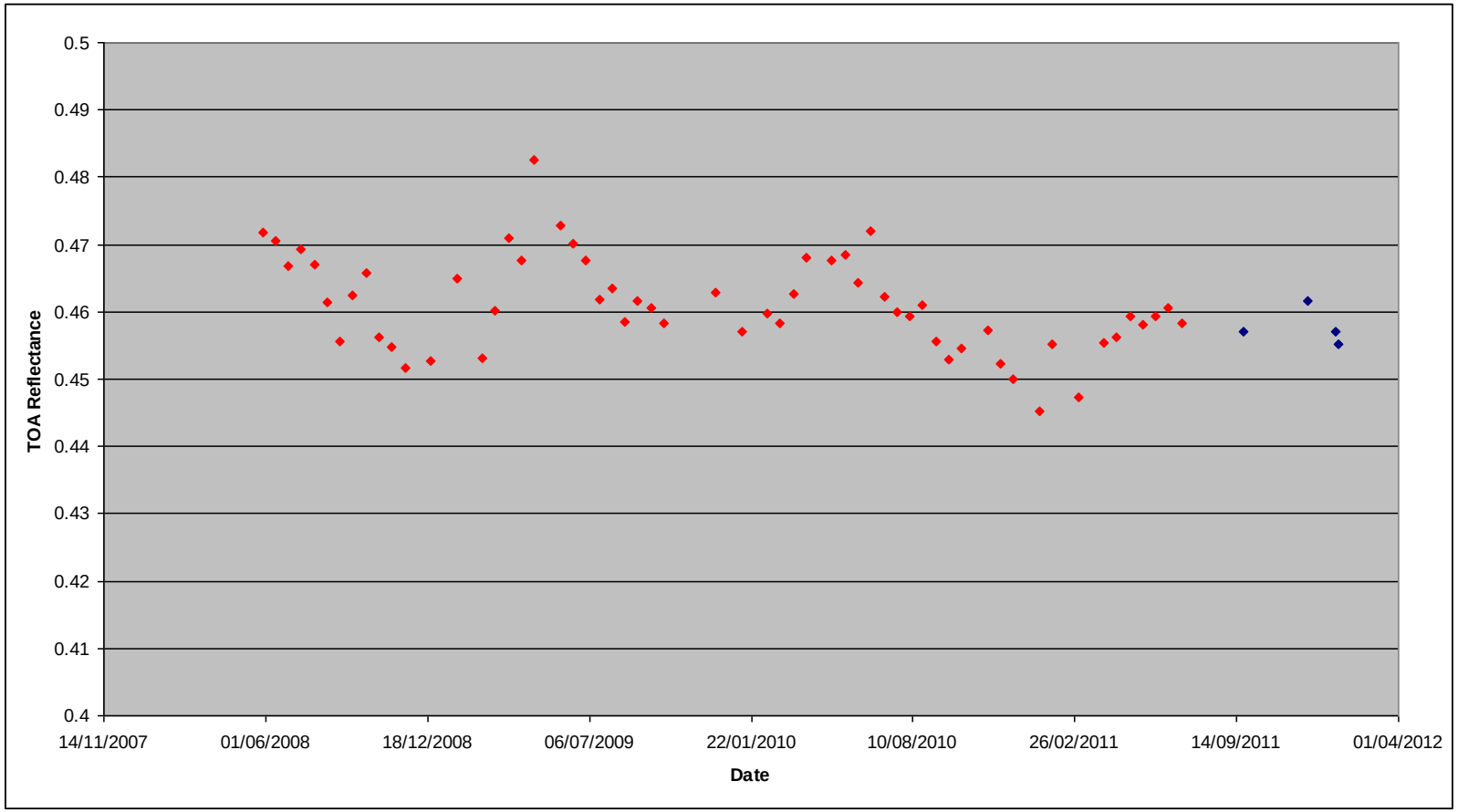
View Angle Profile



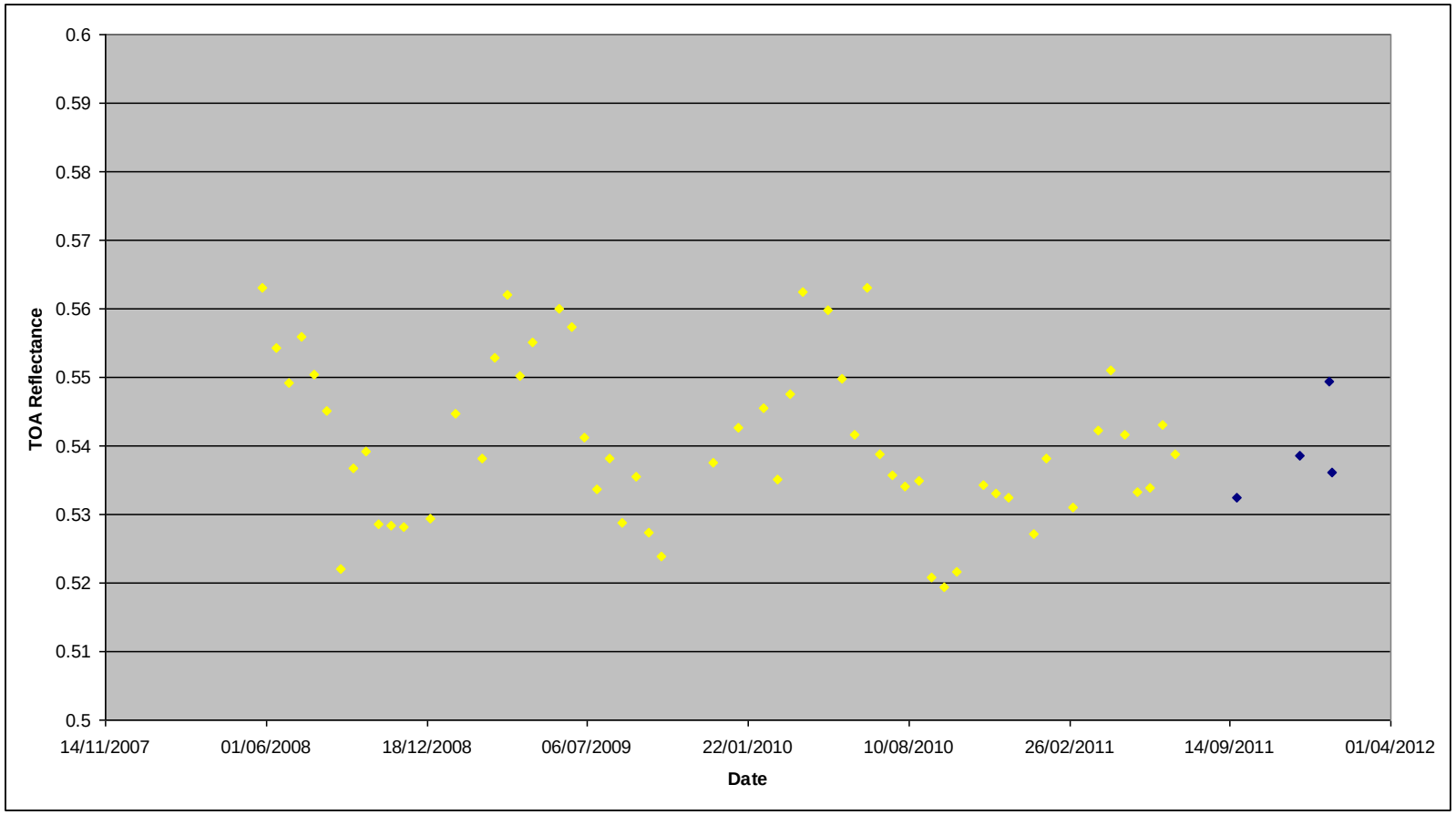
Final Calibration Results Green



Final Calibration Results Red



Final Calibration Results NIR



Final Calibration Results Summary

% Errors	Green	Red	NIR
Nigeriasat-X	6.09	3.57	4.59
UK-DMC2	3.77	3.95	3.74

- The overall results suggest that the sensor is as stable as the previous 22m imagers with an absolute calibration that is 6% or better in all spectral bands.
- Target is <5%
- The results will be improved as we analyse more images over time.

Future Developments

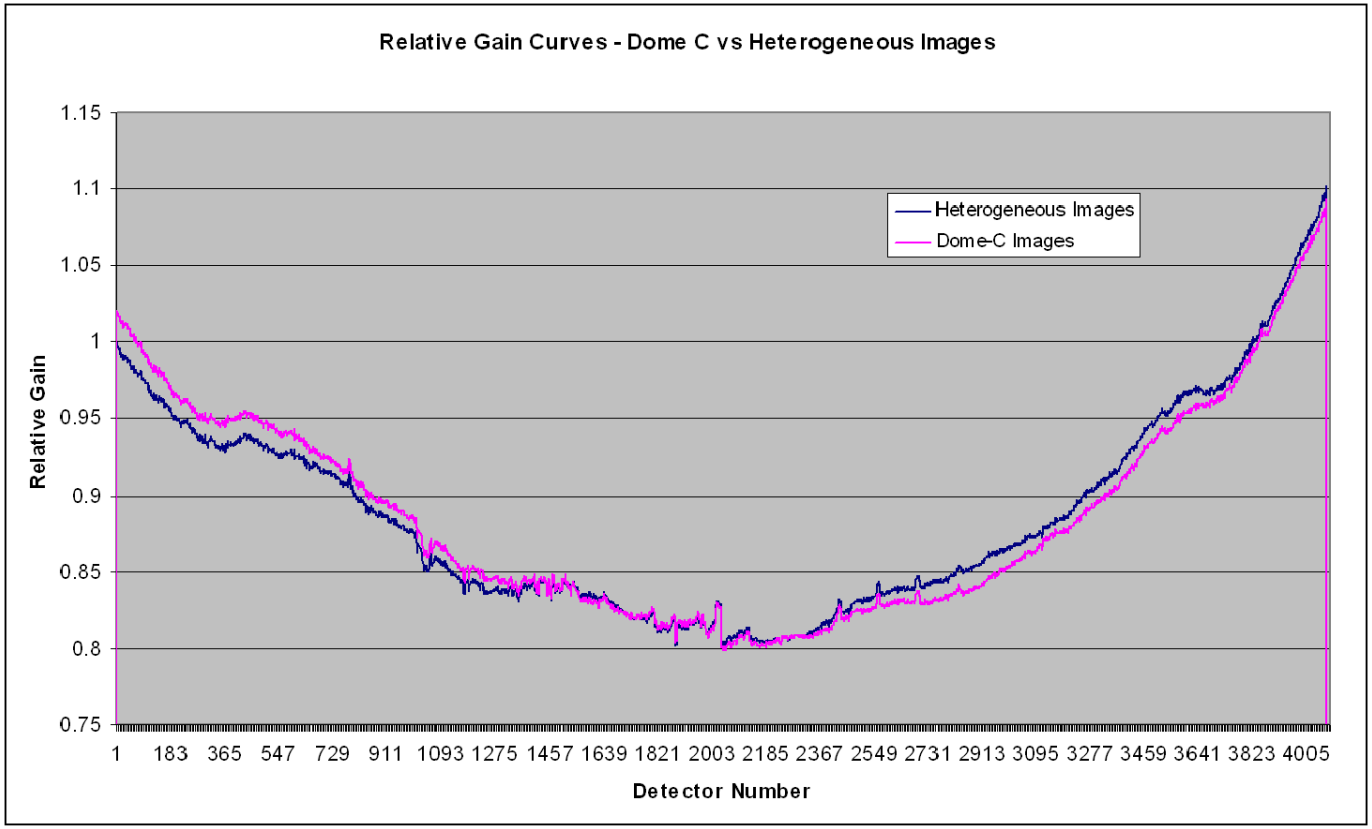
- Increased satellite numbers
- Increased data capacity
- Requirement for automated system
- Procedures established leading to “self-calibrating” systems

- 2 Initial Approaches to Relative calibration

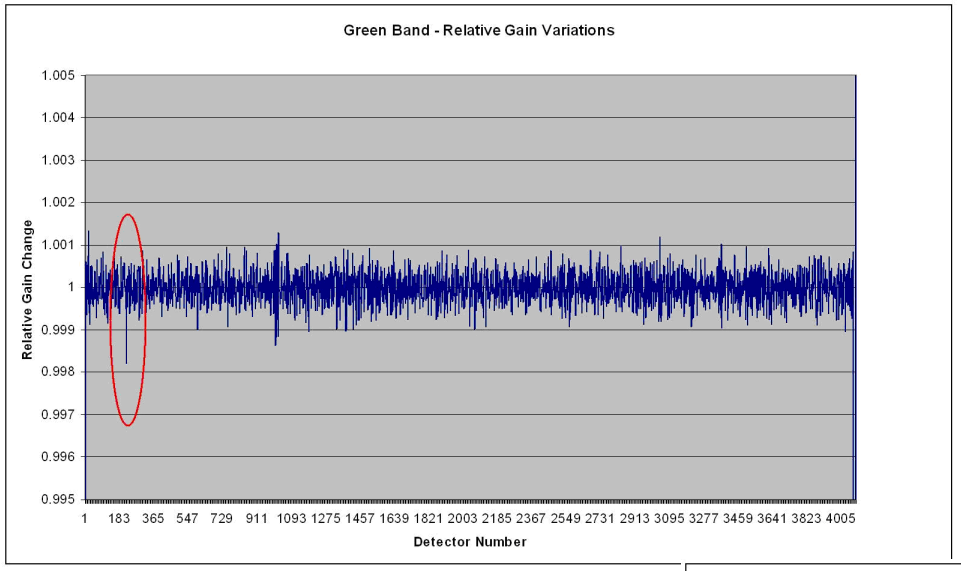
1. To identify anomalies in the calibration process pre-launch artefacts or post-launch calibration artefacts when using flat-field sites.
2. To identify individual/small groups of pixels that have changed since equalisation.

Automated Generation of Calibration Curves

- Effects of snow BRDF on flat fielding over the Dome-C site

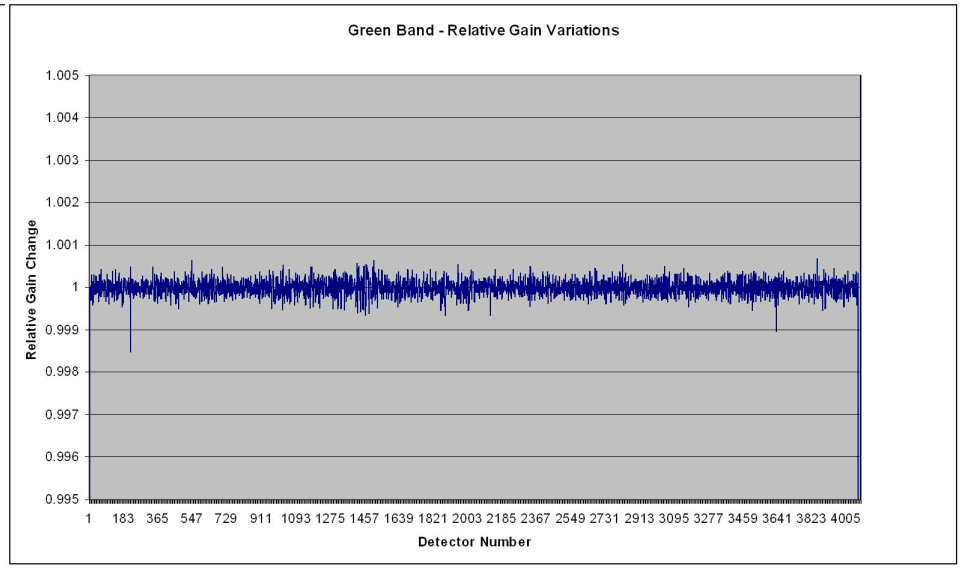


Automated Single Detector

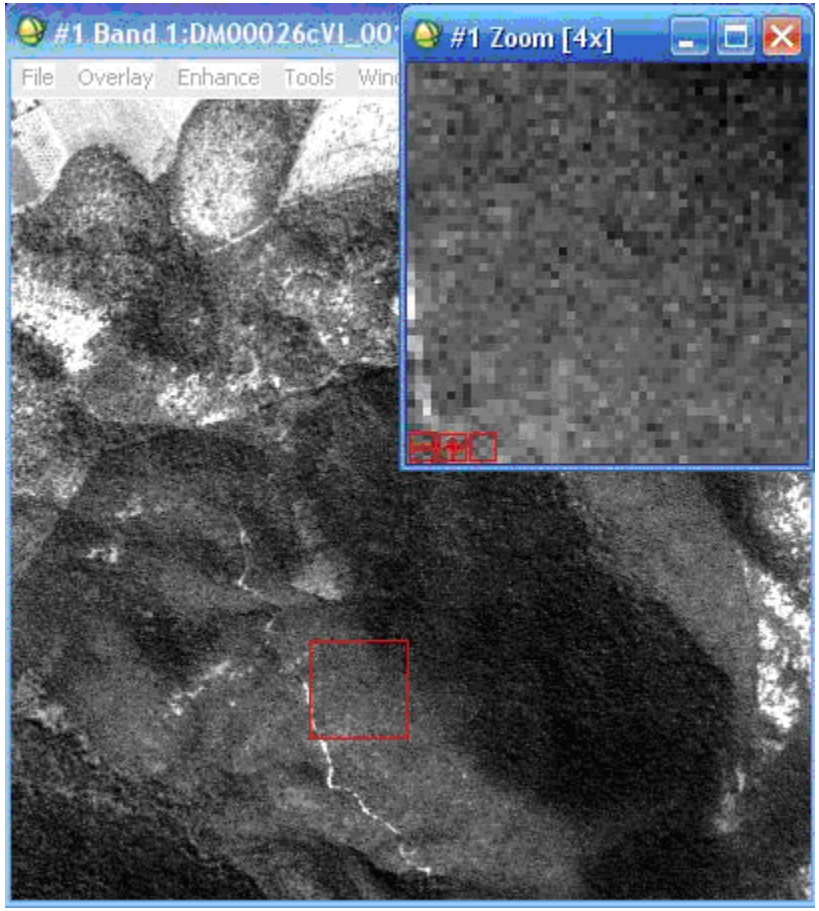


- Coefficient number 222 modified by 0.2% for 10 N2 scenes
- 40,000 lines of data, equivalent to 6.4 Landsat scenes

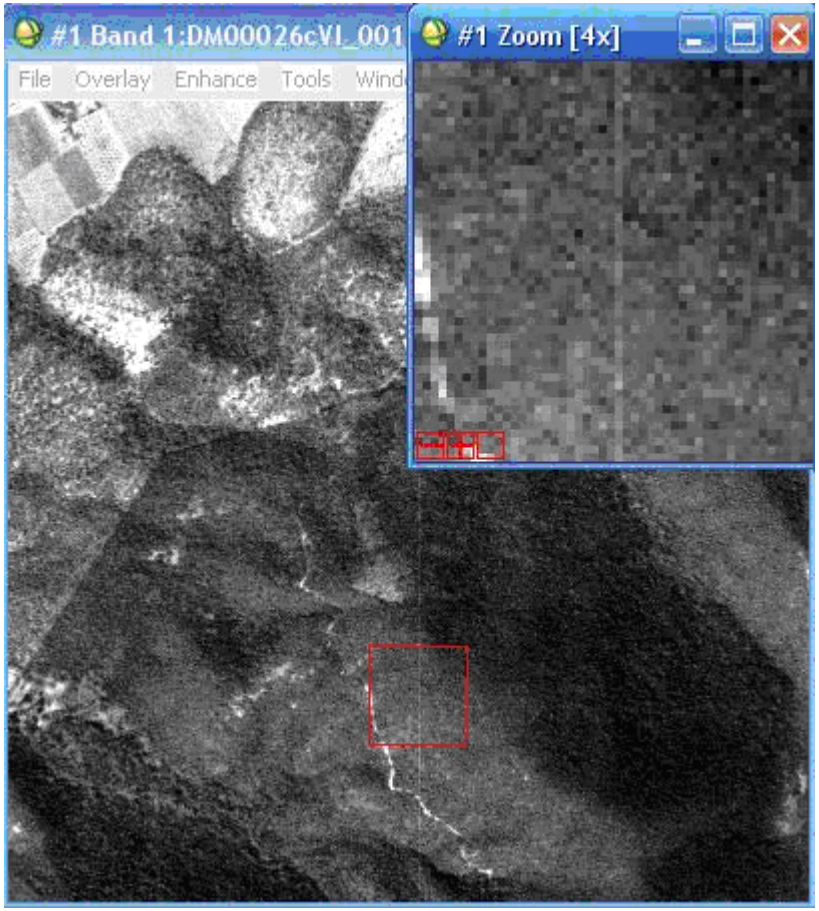
Increased scenes reduces the background clutter and reveals underlying features



Automated Single Detector



0.2% change



>1% change

Automated Absolute Calibration

- Final stage of the automated process is the absolute calibration
- Currently have prototype procedure that should guarantee a low level of uncertainty
- Expect the operational procedure to be completed by Autumn/Fall 2012

Questions?

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