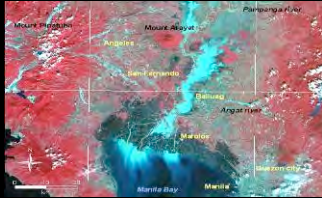
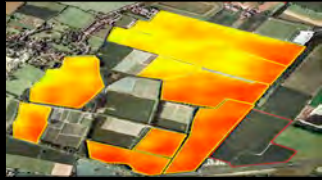


Disaster Monitoring Constellation (DMC) – The constellation experience



Stephen Mackin

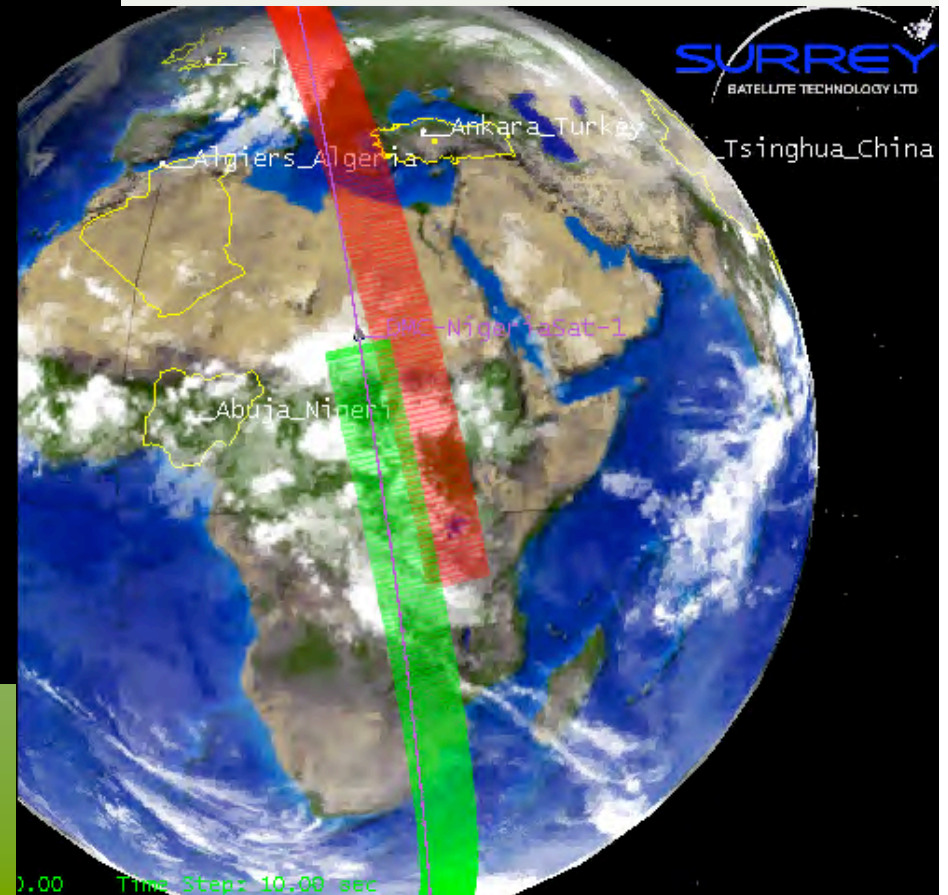
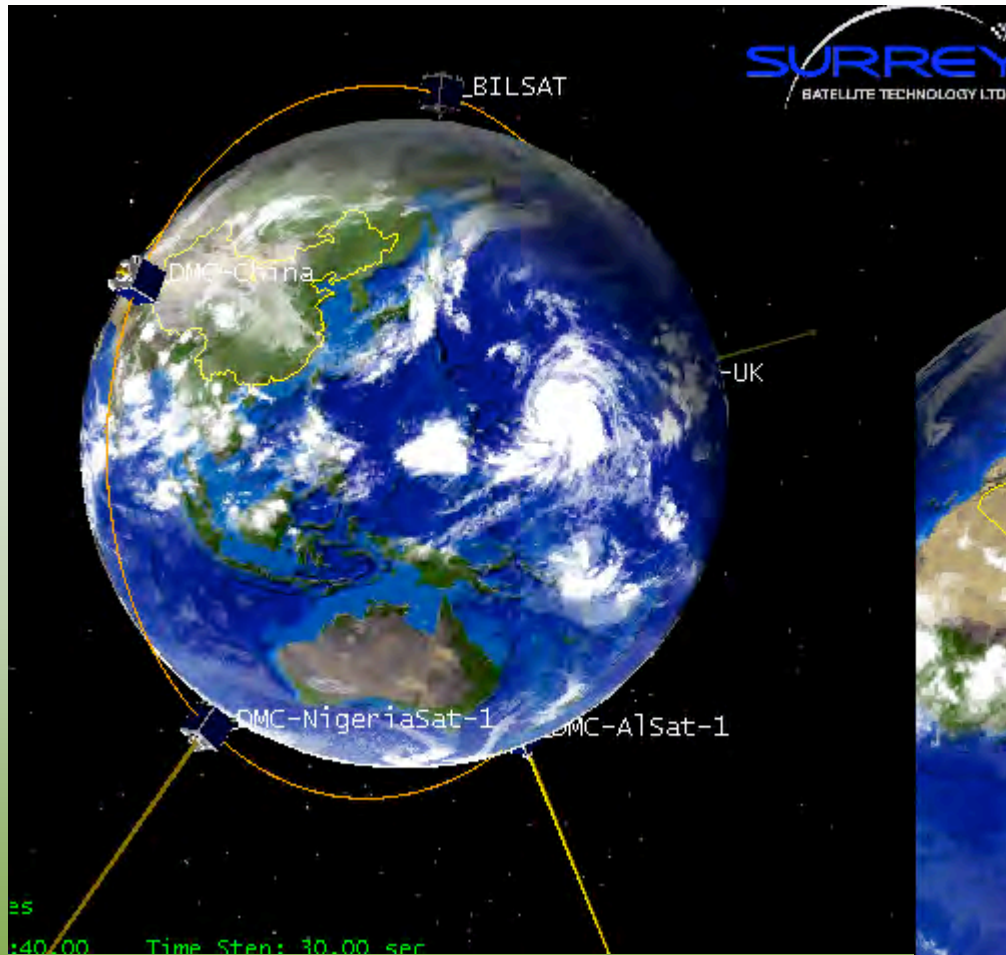
Chief Scientist
DMC International Imaging Ltd



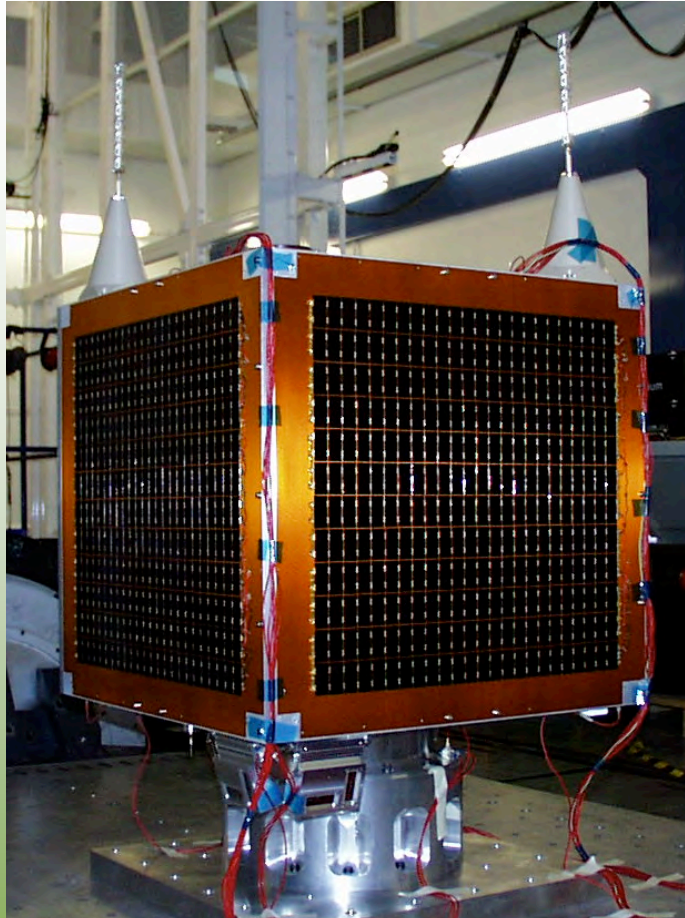
Disaster Monitoring Constellation (DMC)

- Idea developed in 1990's.
- Low cost micro-satellites owned as individual assets (by countries and commercial organisations)
- Use in constellation to maximise use of resource
- Massively increased temporal resolution
- Redundancy in multiple platforms and ground-stations
- Priority – Disaster, National, Partner, Commercial

DMC – Orbital Phasing

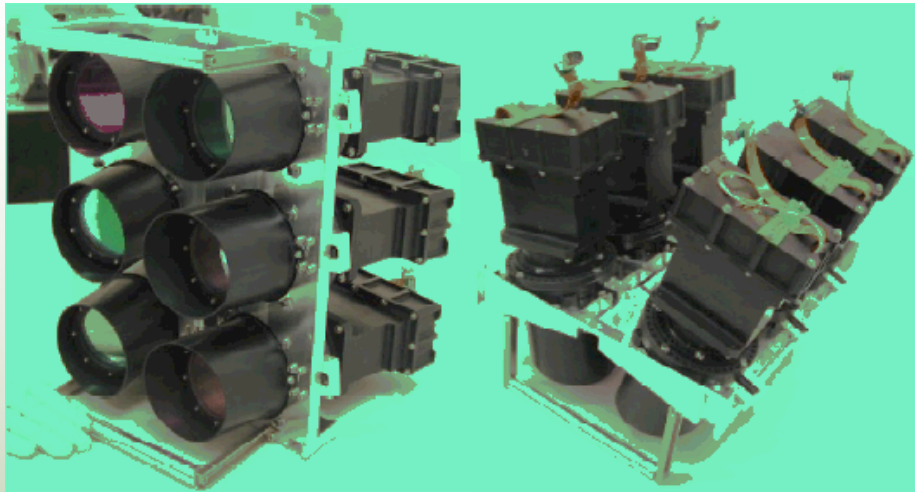


DMC Satellite



- Sub 100 kg usually
- Three spectral bands (equivalent to bands 2,3 and 4 of Landsat but 32m GSD)
- Currently four in orbit (three in one plane and fourth is second plane)
- Three more DMC satellites under construction (22m GSD)
- Older satellites gravity gradient boom stabilised

DMC Satellite



Three bands per bank

Two banks (starboard and port)

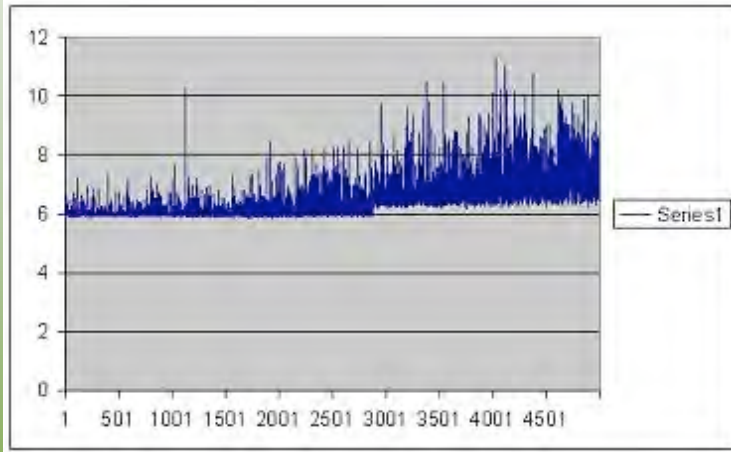
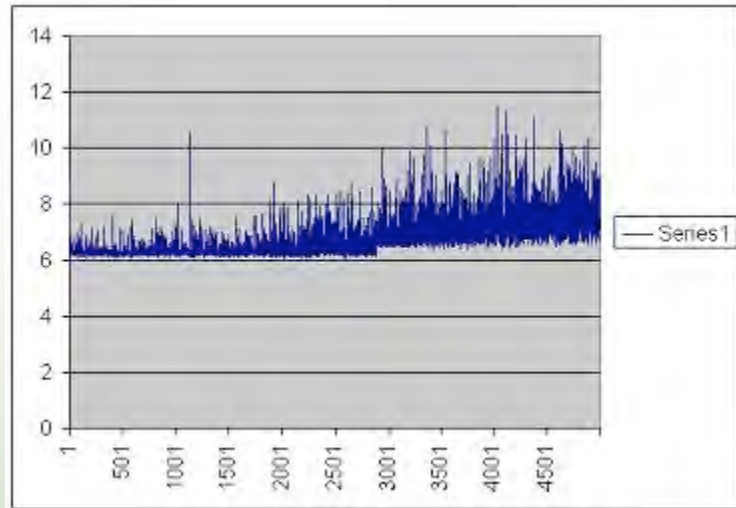
10, 000 active detectors per band

Band	Channel	Bank	Common	Bandwidth (nm)	IFOV (m)	Sub Satellite GSD (m)	Closest Landsat
0	1	1 (Starboard Ground)	NIR	0.77 to 0.90 um	46.388	31.822	ETM+4
	4	0 (Port Ground)	NIR	0.77 to 0.90 um	46.388	31.822	ETM+4
1	2	1 (Starboard Ground)	Red	0.63 to 0.69 um	46.388	31.822	ETM+3
	5	0 (Port Ground)	Red	0.63 to 0.69 um	46.388	31.822	ETM+3
2	3	1 (Starboard Ground)	Green	0.52 to 0.60 um	46.388	31.822	ETM+2
	6	0 (Port Ground)	Green	0.52 to 0.60 um	46.388	31.822	ETM+2

Calibration Data (Vicarious)

- Dark Images
 - Deep Space
 - Pacific Ocean at Night
- White Images (full FOV)
 - Greenland
 - Antarctica (DOME-C)
- Absolute Calibration site
 - RRV

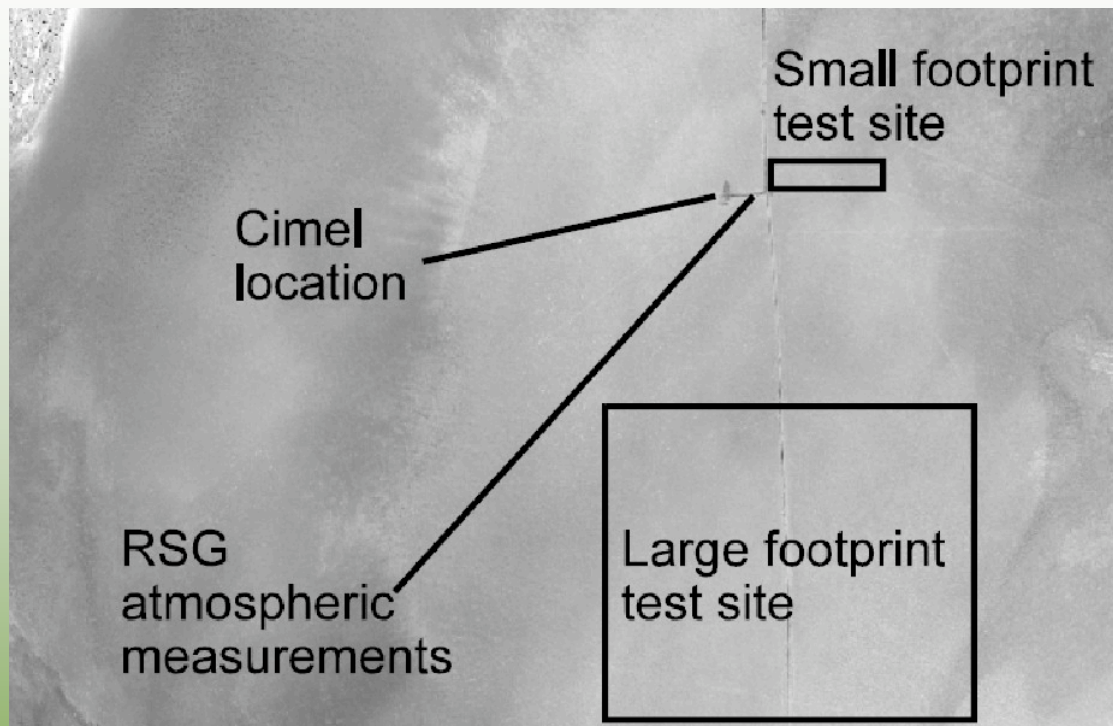
Dark Images



Deep space (top) and Pacific at night data (column average values)

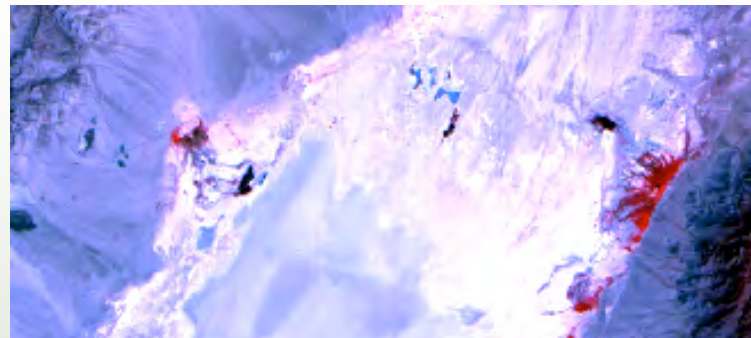
- Dark current calculated on-board per line and subtracted
- Uses shielded pixels
- Leaves a residual pattern
- Consistent from image to image
- Does not vary with integration time
- Deep space and Pacific at night are equivalent

Absolute Calibration Images

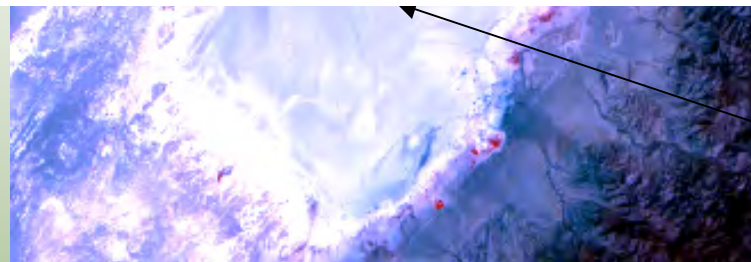


- Railroad Valley, Nevada
- Carried out by RSG from Arizona
- Aim to collect 6-10 images per calibration season
- All processing carried out by Arizona team up to derivation of TOA radiances
- Uses reflectance method

Absolute Calibration Images



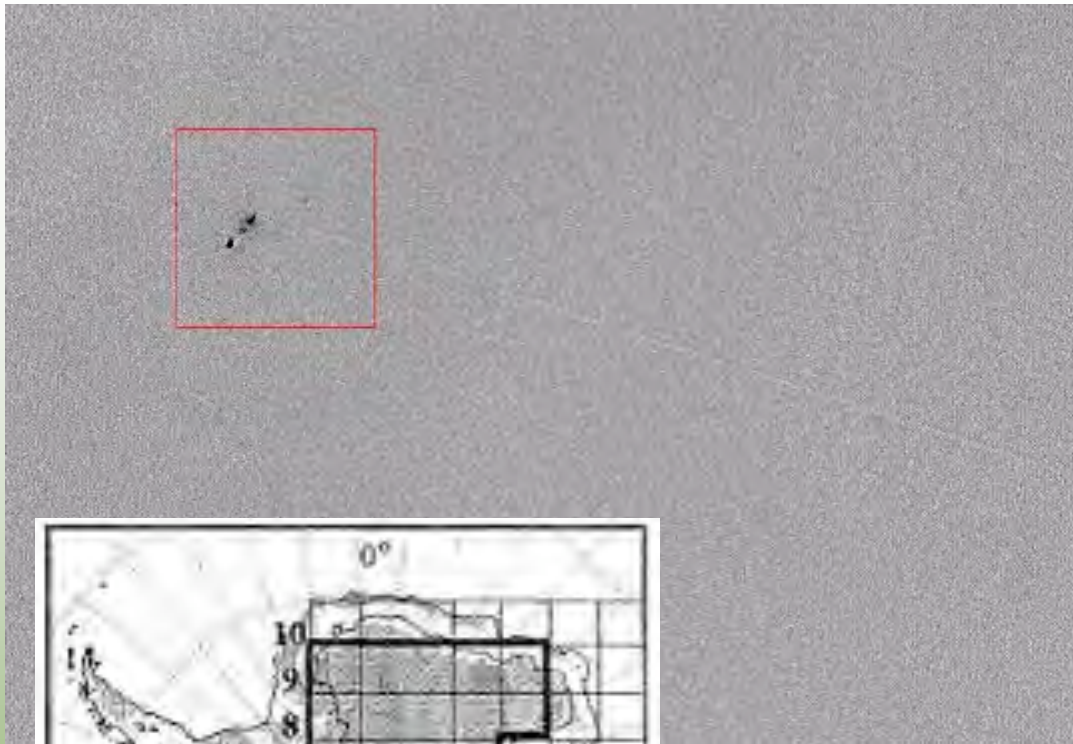
Absolute Calibration
Railroad Valley Nevada



Calibrated
Pixels (9)

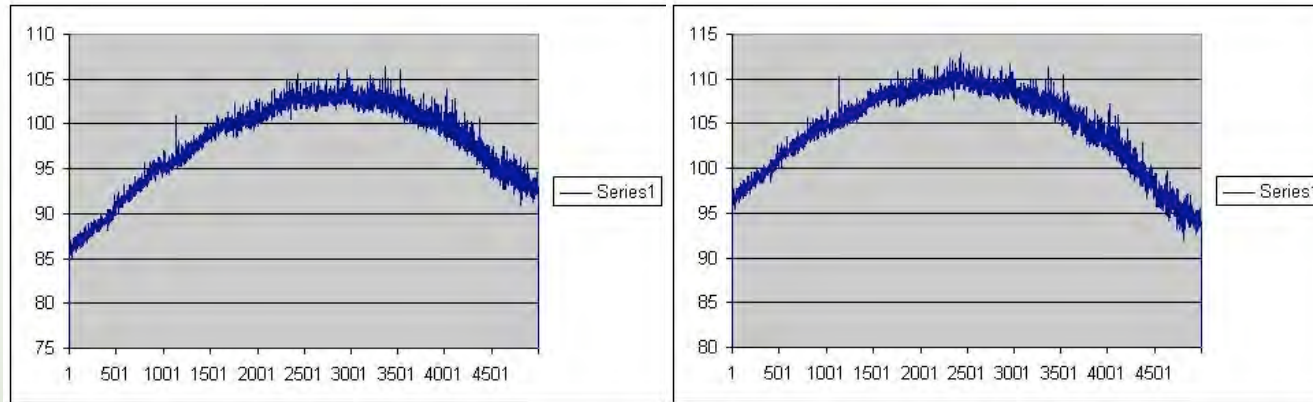
- 10,000 detectors per band in each bank
- 20,000 detectors in total for each image band
- Only 9 detectors cover the target area
- Only two rows of data cover the target area
- Side-slither technique not applicable due to pointing constraints

White Images

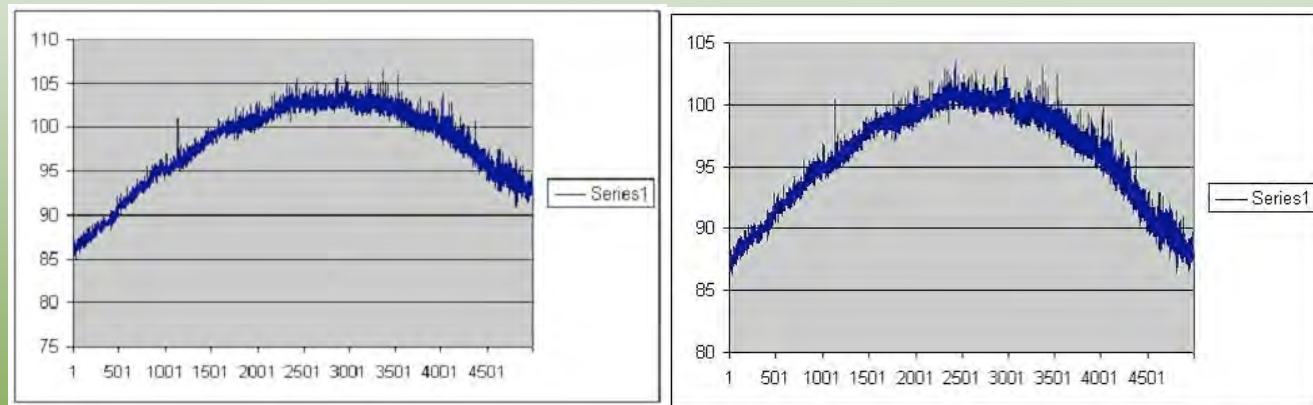


- Only nine pixels calibrated absolutely
- Need homogeneous scene over 600 km + wide with good temporal stability
- DOME-C site in Antarctica is the primary
- Very high flat plateau, stable snow conditions
- Instrumented year round, some BRDF studies
- Used by AVHRR, SPOT-VEG

White Images



Asymmetry normal (left), Yaw 180 degrees (right)

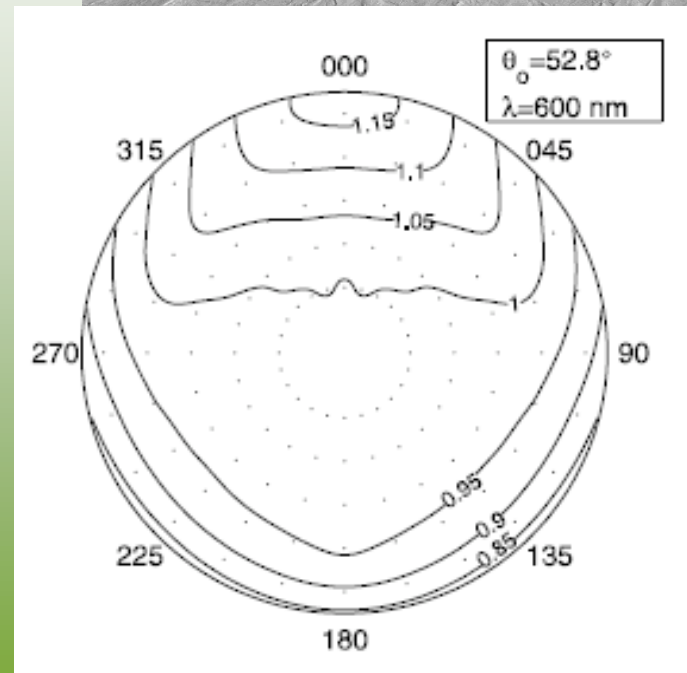
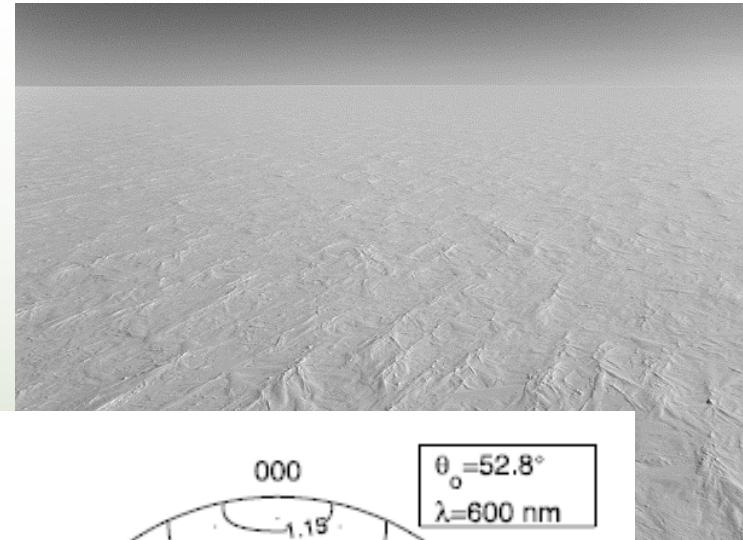


Asymmetry normal (left), Aligned across principal plane

- Original images showed asymmetry due to variable illumination across swath.
- Reversing flight direction confirmed this
- Yawing spacecraft across principal plane eliminated the effect
- Residual geometry error (< 0.2%)
- BRDF effects

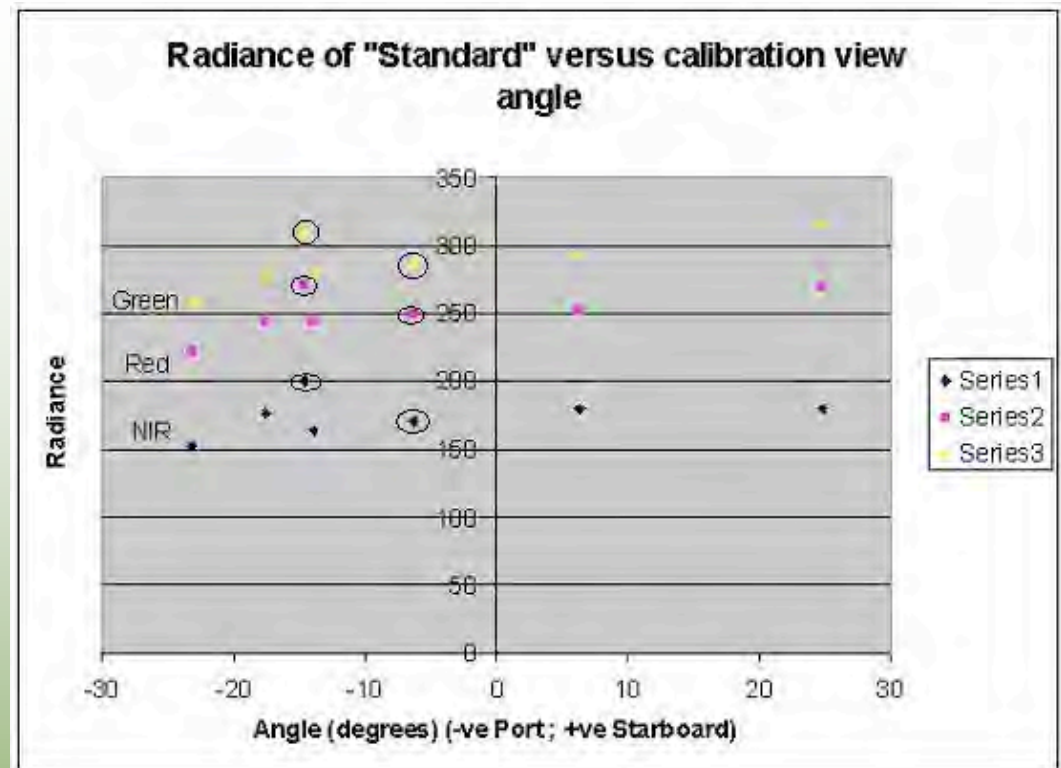
White Images – Other Issues

- Wide swath produces uneven illumination (even after Yaw) but small effect ($< 0.11\%$ variation across array)
- BRDF is a problem, but minimised (across array) by Yaw manoeuvre

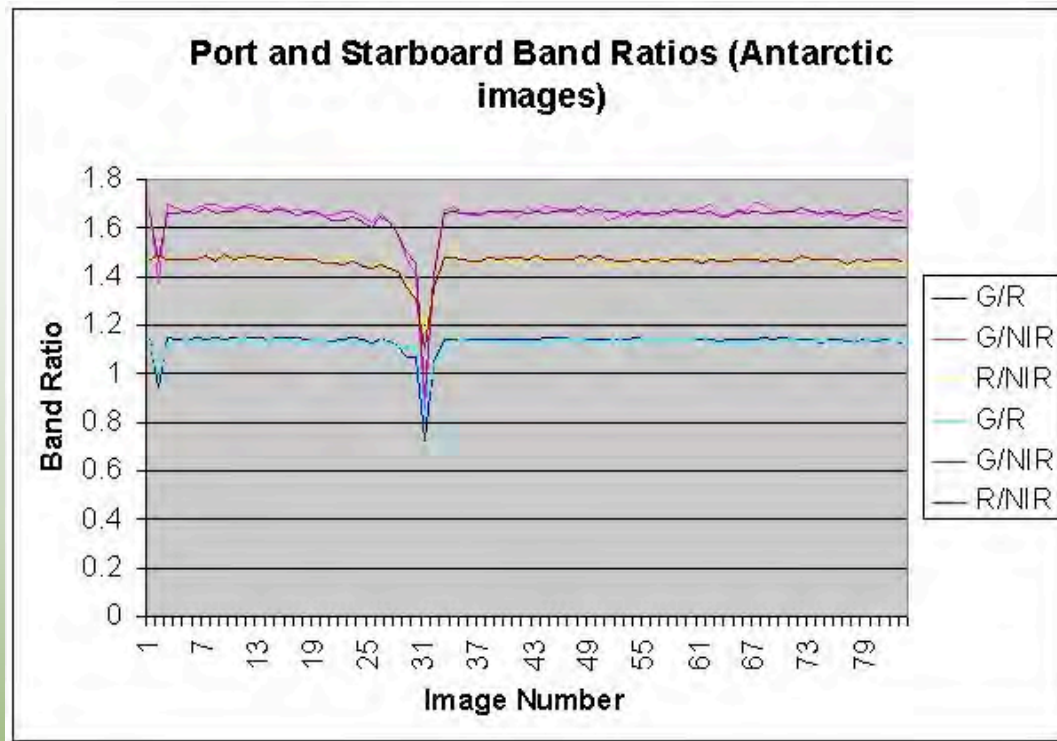


Calibration Stability

- Absolute over several seasons at RRV
 - Absolute gave a variation in absolute coefficients of 1.5% in the red and 4% in the NIR over two years
 - BRDF(?) effects observed over RRV
- Relative by monitoring the band to band ratios over the primary site in Antarctica



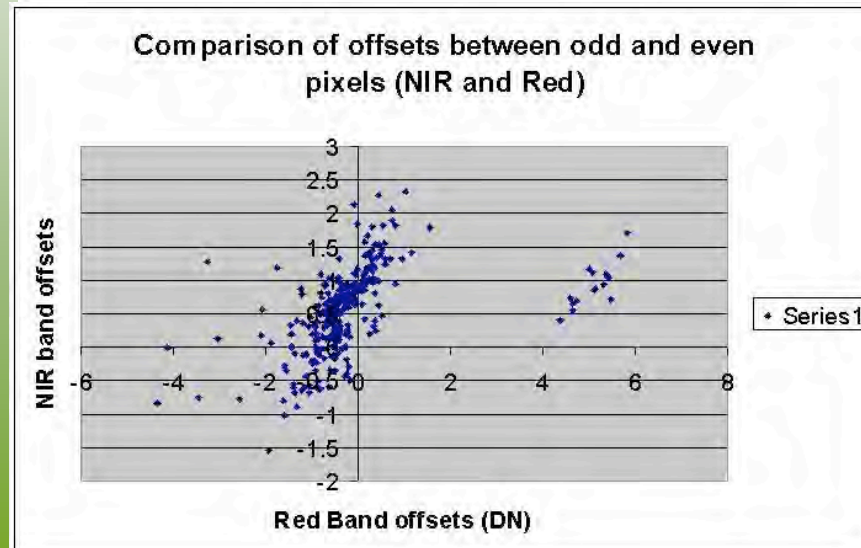
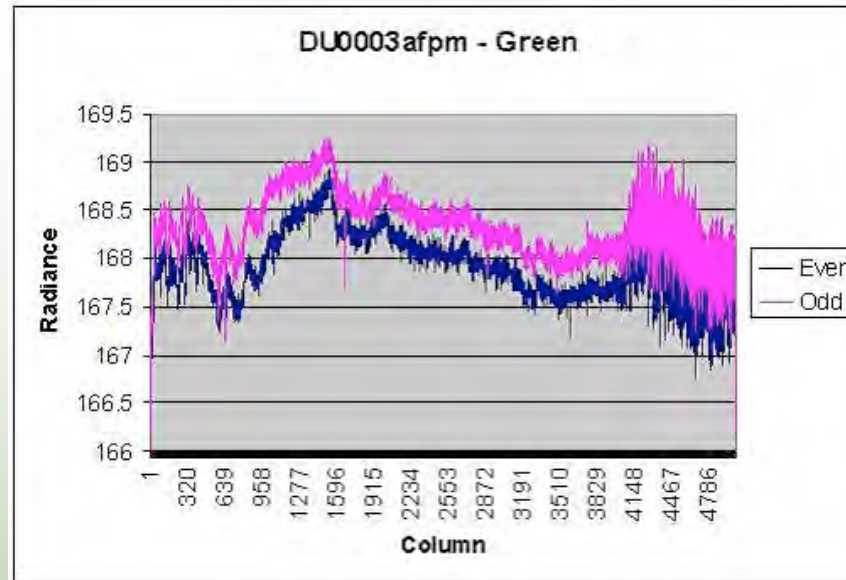
Calibration Stability



- Over 100 scenes analysed (cloud free selected)
- Monitored band ratios. Consistent for three years across both image banks
- Variation of less than 0.34% r.m.s. across three years
- Odd feature around Scene 31. Coincided with very high snowfall conditions and low sun angle

Problems

- Odd / Even pixel drift (residual striping) related to electronics design
- Effects of SAA on NigeriaSat-1 spectral bands on one bank



The Future

- Four new satellites being launched in 2008/2009
- Use of well-calibrated “Gold” standard based on 6-10 vicarious calibrations over RRV per year of a stable satellite (UK-DMC)
- Cross-calibration over Antarctica (especially of satellites launched in October 2008)
- NEED a Southern Hemisphere site used in the same manner as RRV (short term)
- NEED automation with more sites would make life much easier (medium term)
- TRUTHS like approach would really reduce the uncertainty in the vicarious calibration process (longer term ?)

- www.dmccii.com
- www.sstl.co.uk

Thank You!

