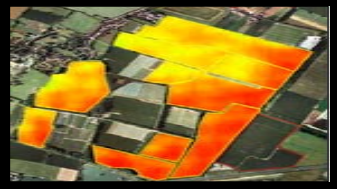
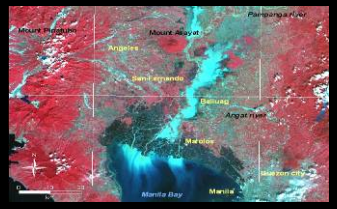




DMCii Report
WGCV-31
March 2010

Steve Mackin

dmc International Imaging

Presentation

- Calibration of the DMC Constellation
  - CEOS Intercomparison over Dome-C (UK-DMC-1 was compared with Landsat)
    - BRDF
    - Ozone
    - Other (Surface variability, aerosols, atmosphere)
  - “Gold” standard
    - Landsat / Sentinels
    - TRUTHS
- QA / QC
  - Automation of process
  - QA4EO

Intercomparison Study Site – Dome C

- 75°06’S, 123°18’E
- Flat plateau at 3200m a.s.l.
- Used in past (DMC since late 2003), AVHRR, SPOT
- Franco-Italian base. Sun photometer, ozone, radiosondes daily and BRDF measurements of surface from past campaigns.

DMC TOA Reflectance

- Radiance converted to TOA Reflectance using standard equation

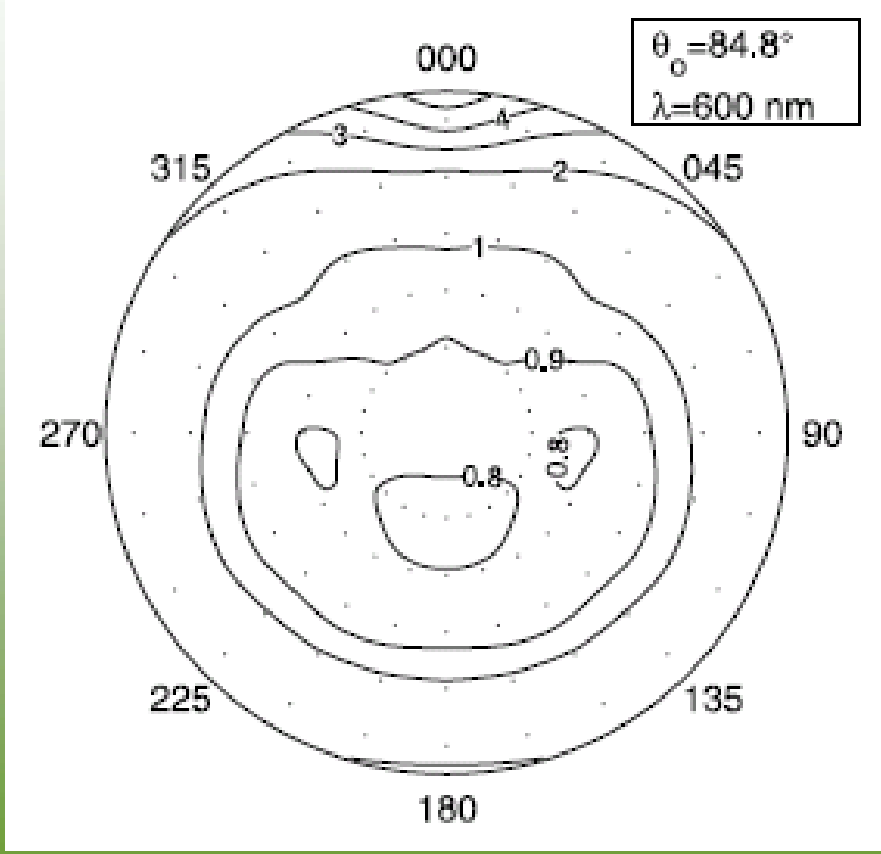
$$\rho_P = \frac{\Pi \cdot L_\lambda \cdot d^2}{\mathrm{ESUN}_\lambda \cdot \cos\theta_s}$$

where

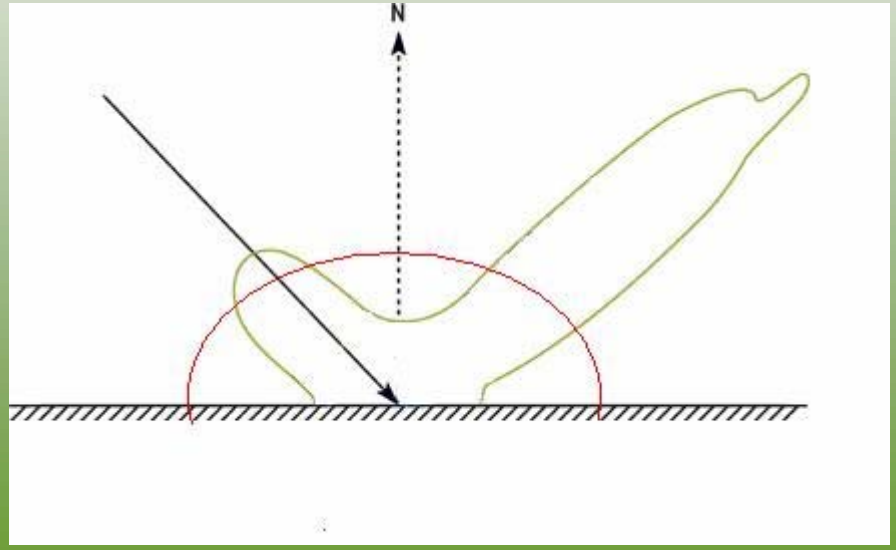
ρ_P	unitless planetary reflectance;
L_λ	spectral radiance at the sensor's aperture;
d	earth–sun distance in astronomical units;
ESUN_λ	mean solar exoatmospheric irradiances;
θ_s	solar zenith angle in degrees.

Problems in Comparison

- BRDF

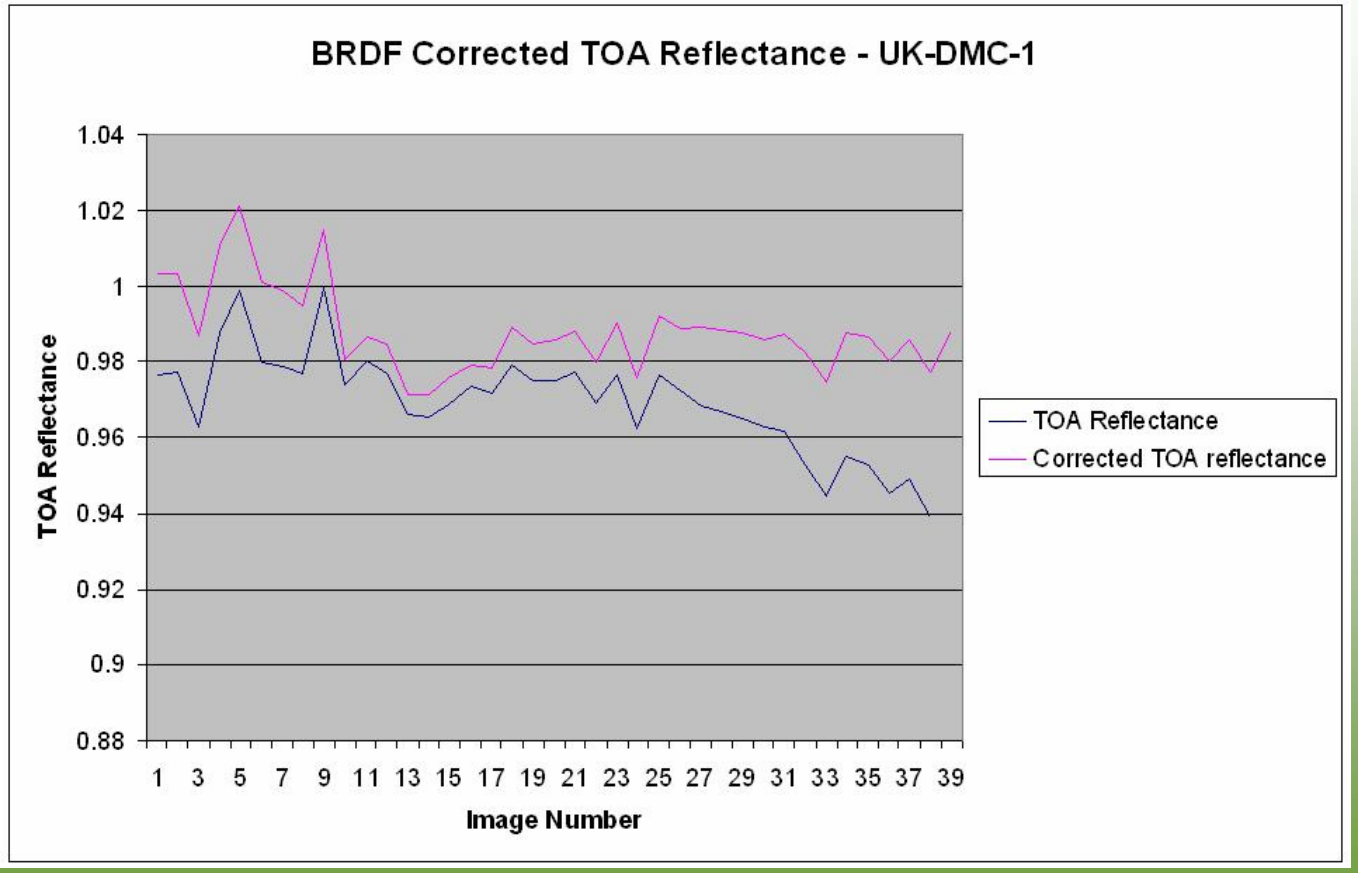


Anisotropic data values are scaled to those of the equivalent isotropic surface (red semi-circle in diagram below)



Correction for BRDF

- TOA Reflectance (BRDF corrected)

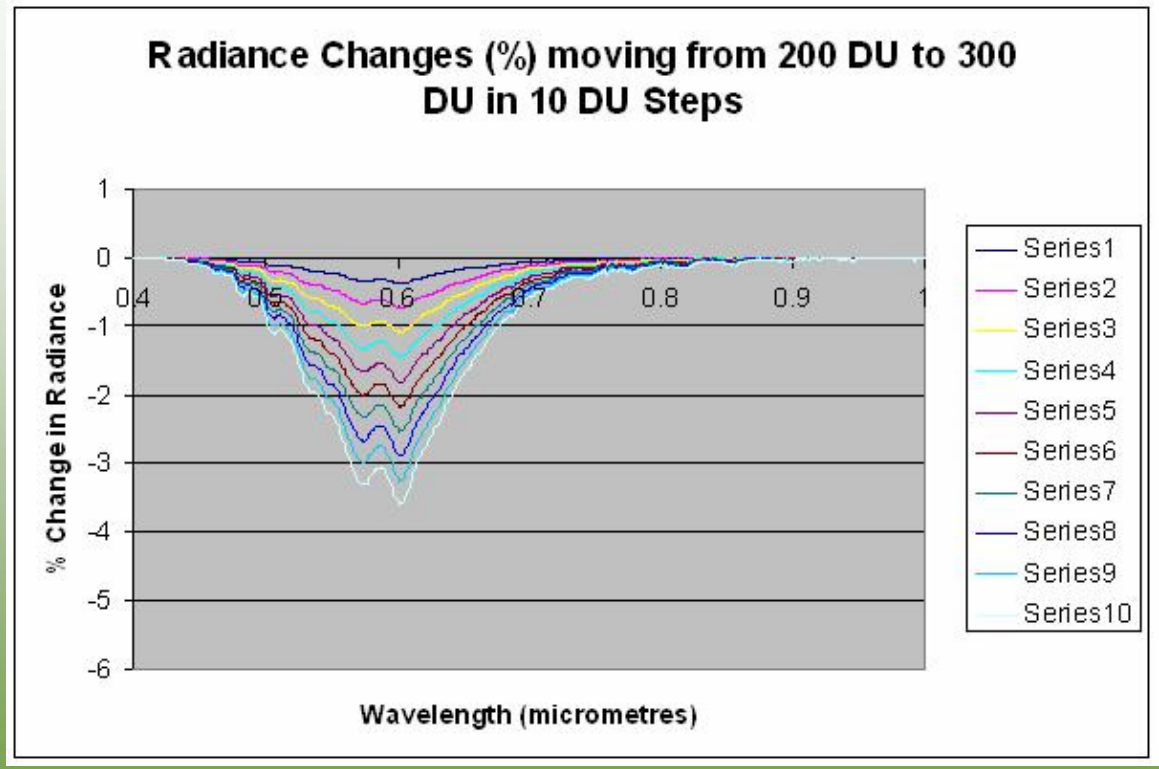


Note how the BRDF corrected values produce a much flatter response across all dates

The “bump” on the left of the image is partly due to ozone.

Problems in Comparison

- Ozone absorption in the VNIR

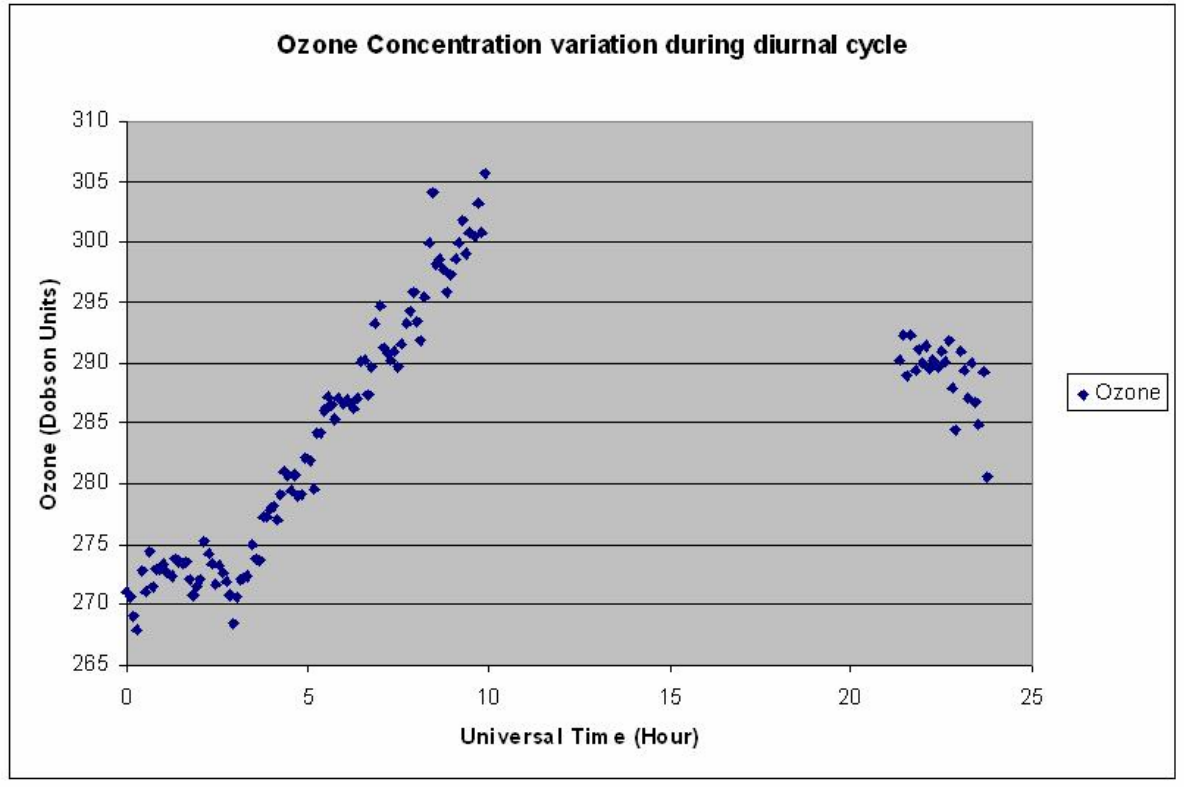


Known as the Chappius absorptions, the peak absorption is near the green / red boundary

Ozone values cover a range from about 210 DU to over 300 DU in the data collected during the CEOS intercomparison.

Ozone Variability

- Ozone variability during a day



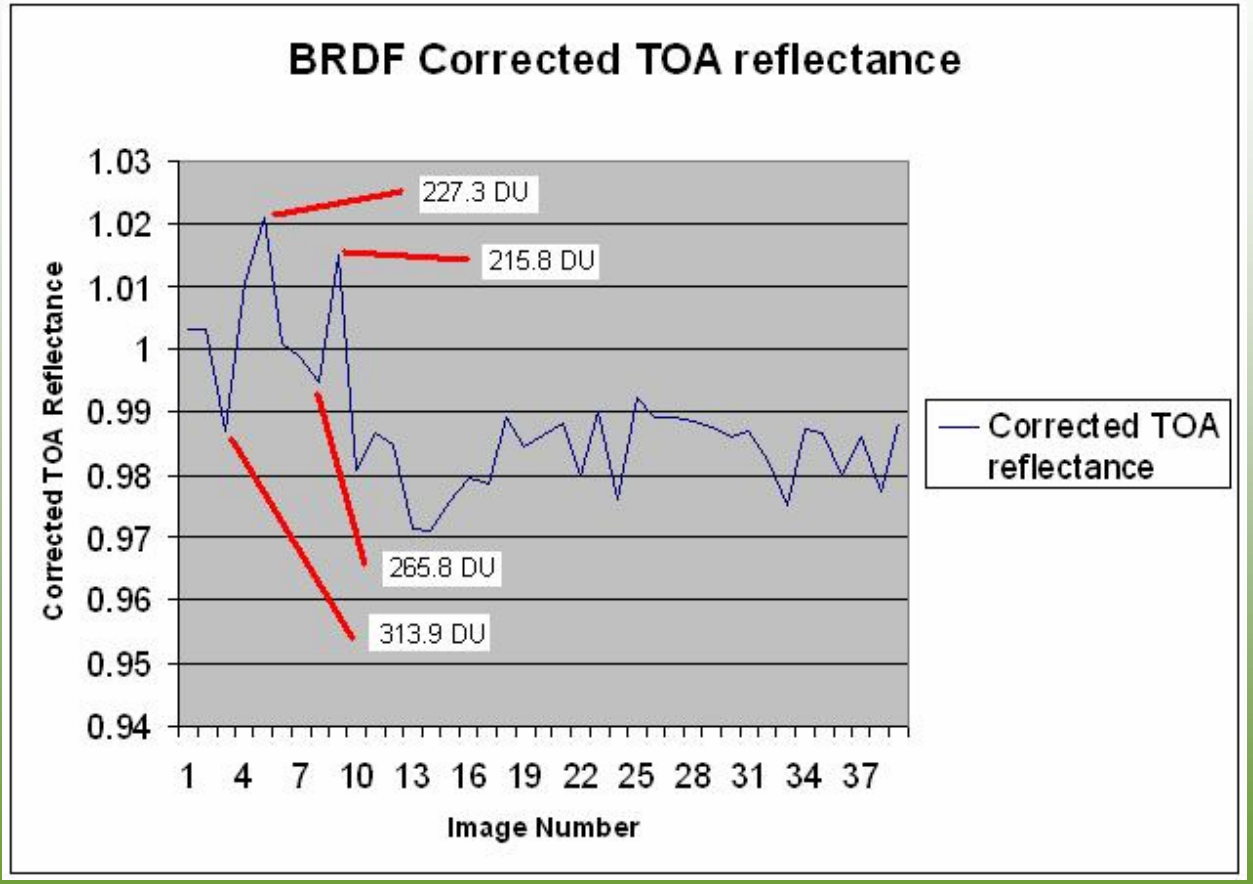
Variable from hour to hour and day to day. So important to get an ozone value that corresponds to the overpass time

Landsat and UK-DMC-2 are separated in time by between 4 and 4.5 hours, so ozone variation can be significant.

Normal ECT separation for the satellites is 45 minutes.

Ozone Correction

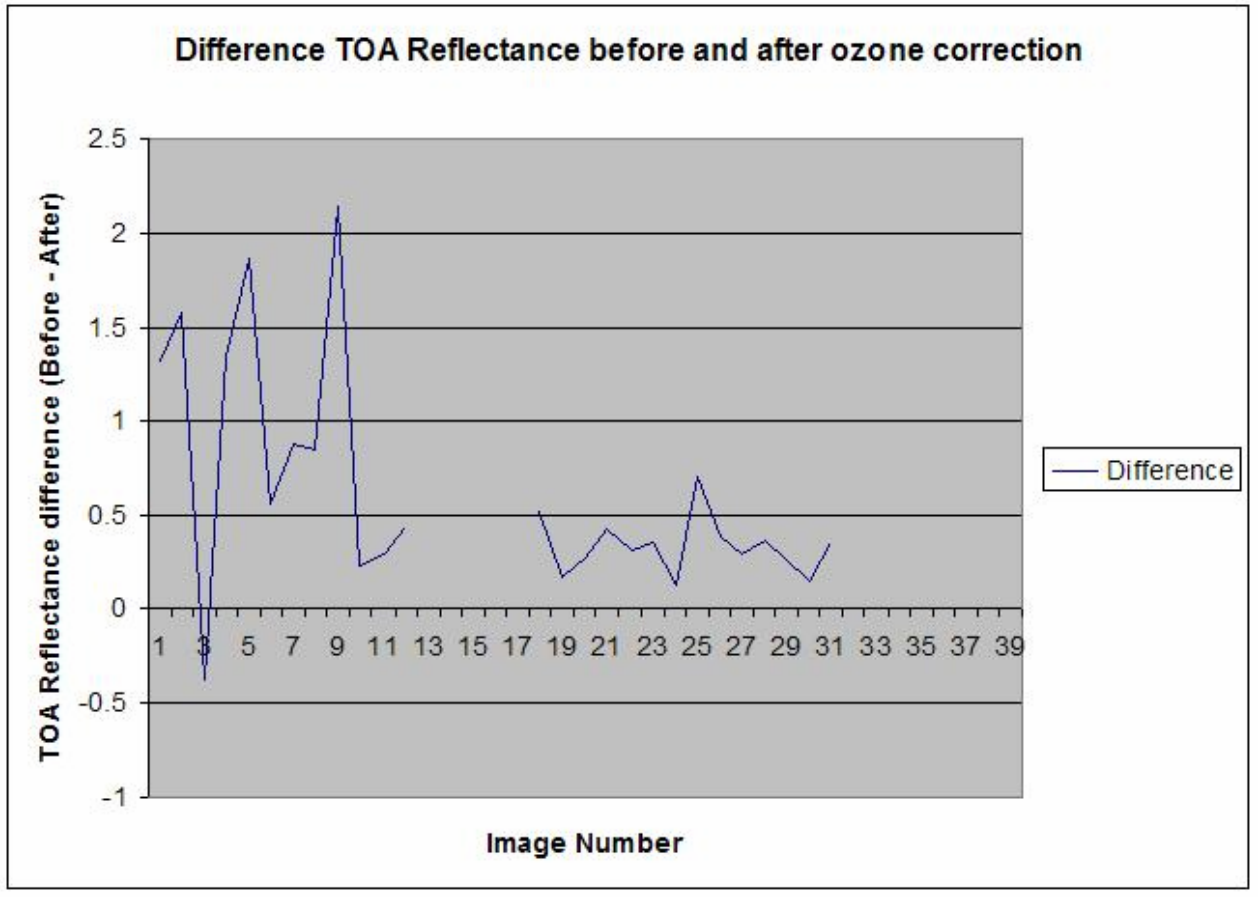
- Ozone effects



The blue line is the BRDF corrected TOA Reflectance, the large spikes on the left of the plot show acquisitions with extreme ozone variations (either very low or very high)

Ozone Correction

- Correction to UK-DMC-1 data



Used MODTRAN derived correction. Corrections of the order of 2% on major peaks.

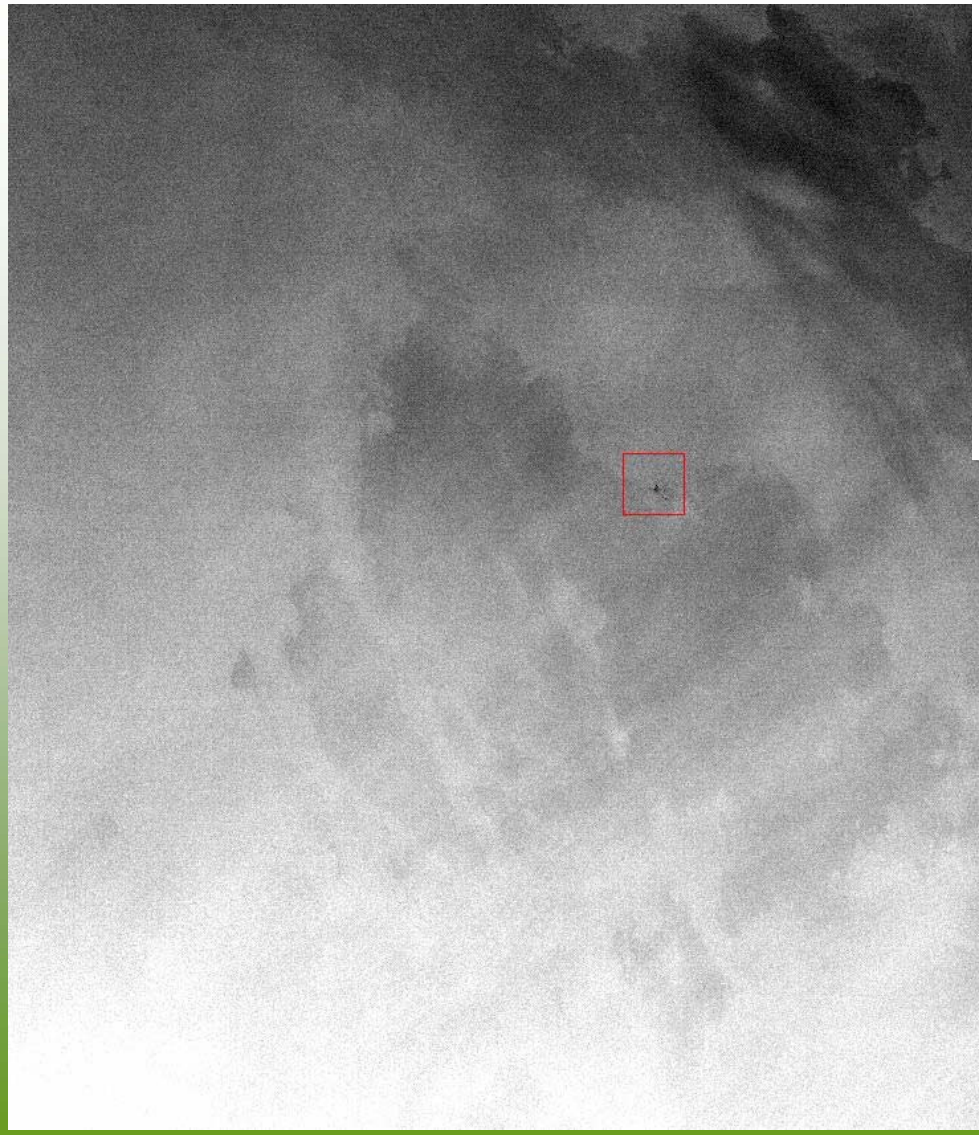
Normalised to 300 DU

Not perfect as residual features still present, in original data

Gaps are missing ozone data

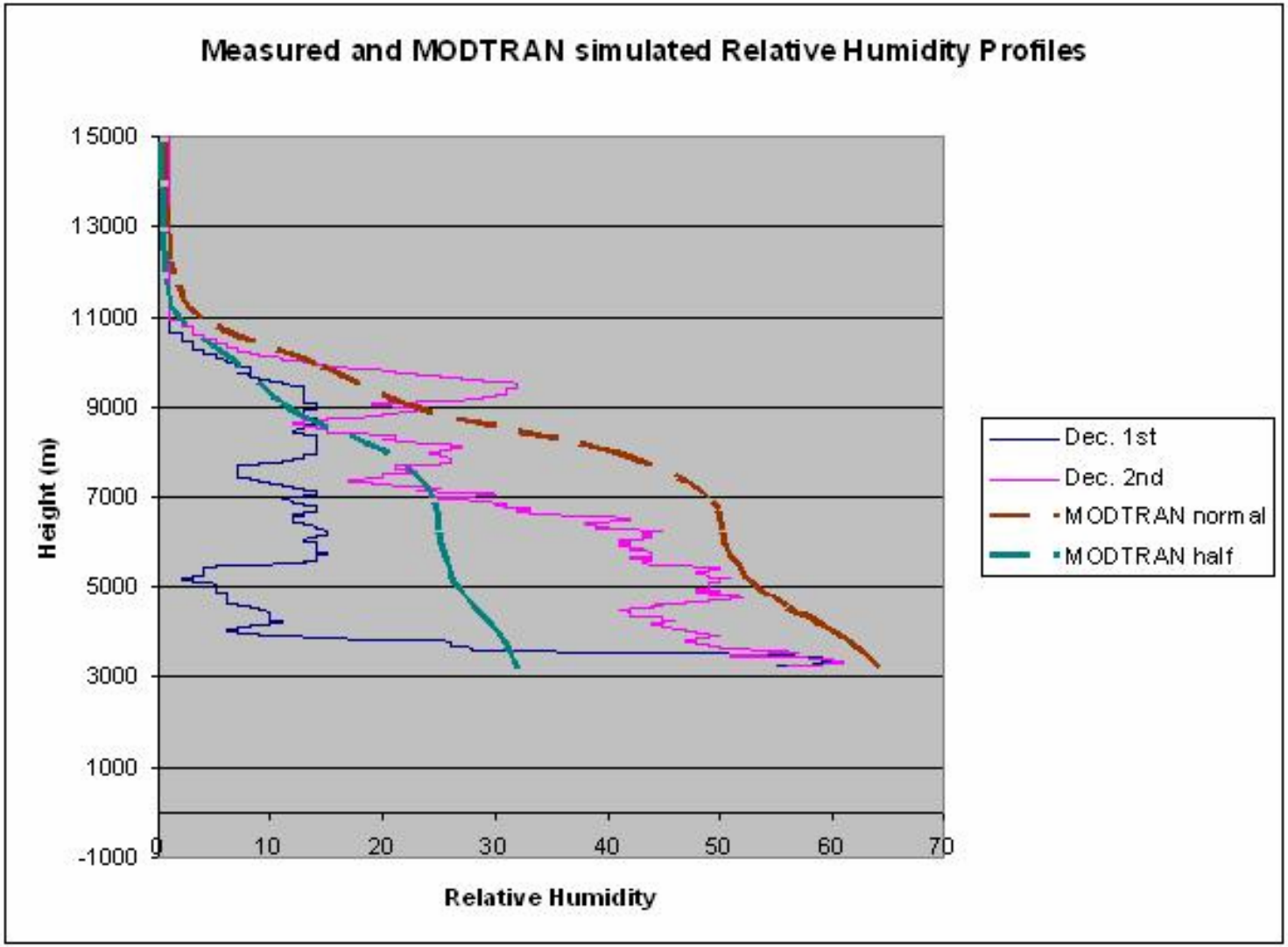
Other Factors – Surface Variability

Figure 3.12: View from an airplane near Siple Dome, West Antarctica (82°S, 150°W), November 1994. The surface elevation is about 500 m. The streaks which appear dark in this photograph were later identified (on an oversnow traverse by snowmobile) as surface frost; viewed from the opposite direction they instead appear brighter than the intervening regions of snow. (The frost therefore probably has little effect on the albedo.) Photo by Nadine Nereson.



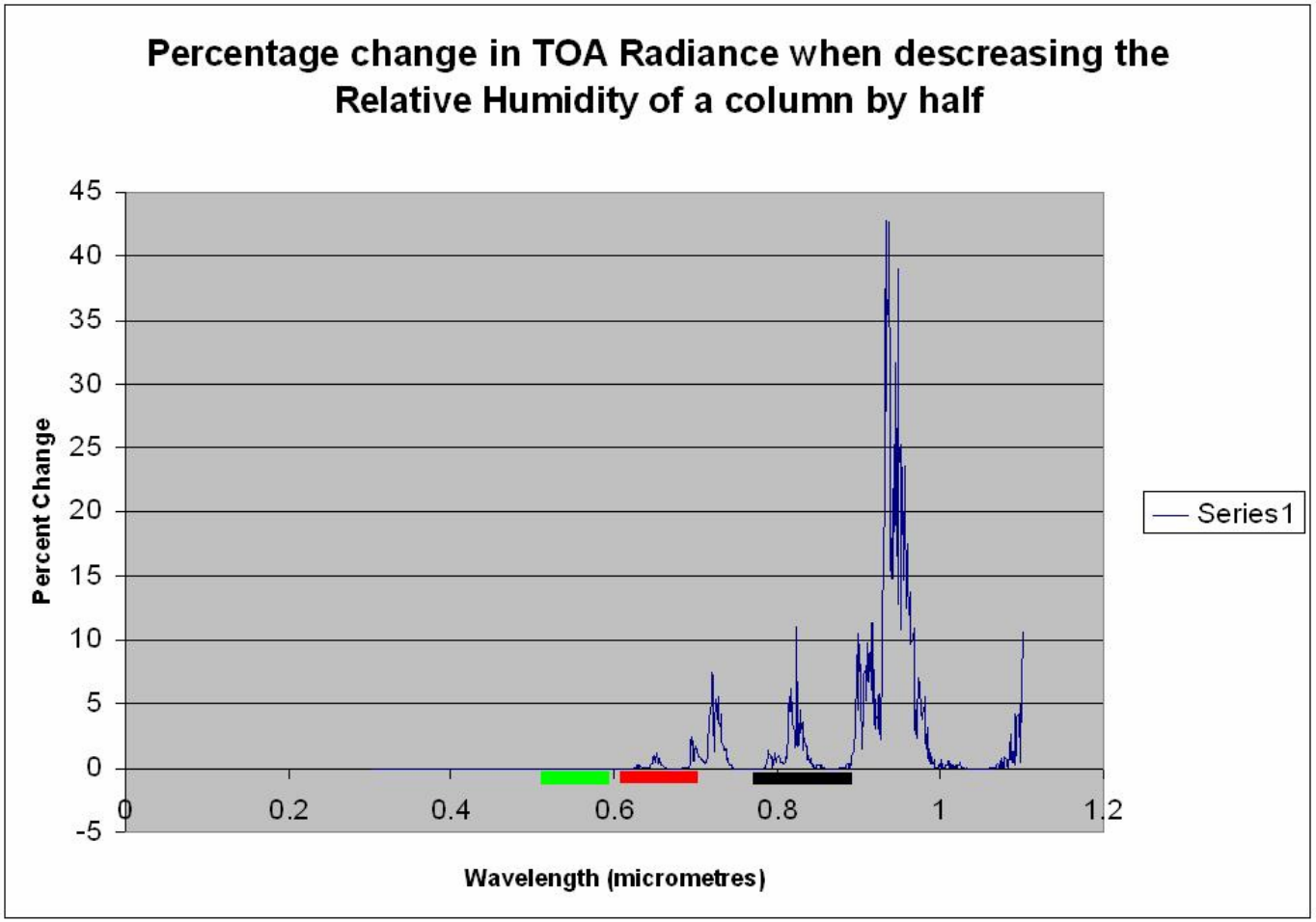
Other Factors

- Water Vapour



Other Factors

- Water Vapour

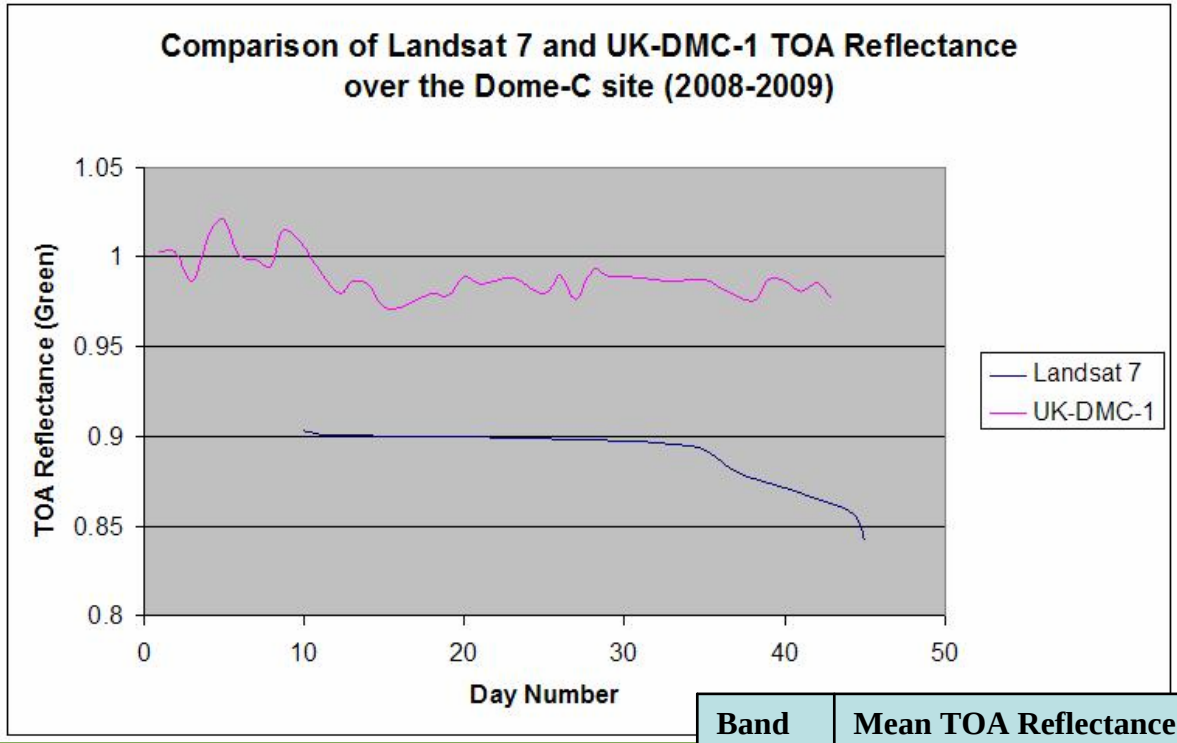


Water vapour effects have a larger impact in the NIR spectral band (black bar in diagram) with smaller effects in the red.

No real effects in the green spectral band.

Final Comparison UK-DMC-1 to Landsat

- 2008-2009 Comparison



Note that no correction has been made for ozone, water vapour or aerosols in this comparison.

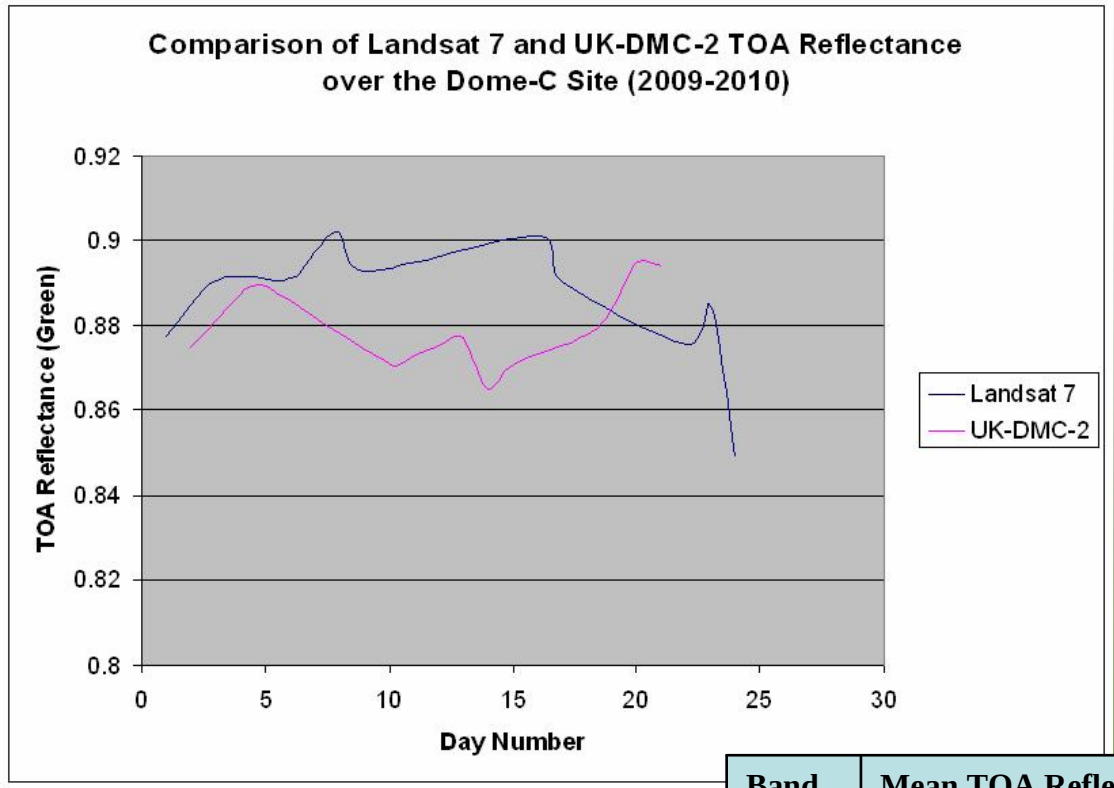
Data from November 2008 to February 2009

The uncertainty on calibration for UK-DMC-2 and Landsat 7 is 5%

Band	Mean TOA Reflectance Landsat 7	Mean TOA Reflectance UK-DMC-1	Difference
Green	88.27	98.33	+10.06 %
Red	89.24	97.58	+8.34 %
NIR	90.52	99.03	+8.51 %

Final Comparison UK-DMC-2 to Landsat 7

- 2009-2010 Comparison



Note that no correction has been made for ozone, water vapour or aerosols in this comparison.

Data from October 2009 to February 2010

The uncertainty on calibration for UK-DMC-2 and Landsat 7 is 5%

Band	Mean TOA Reflectance Landsat 7	Mean TOA Reflectance UK-DMC-2	Difference
Green	88.68	87.96	-0.72 %
Red	89.00	85.22	-3.78 %
NIR	91.47	89.63	-1.84 %

Plans

- Based on the successful use of the methodology developed, DMC will use Landsat as Gold standard in 2010
- Landsat will be tracked with overpasses over “invariant” sites. May require better BRDF (this is very important)
- Evaluating the use of Sentinel 2 in this role and perhaps tracking more than one satellite system.
- Prepare for TRUTHS

QA / QC

- In 2009 made basic design of QA4EO compliant system which were are now implementing slowly during 2010.
- Current QA/QC processes have been automated and log files and automated quality information is being generated.
- In 2010 modification of metadata to hold quality information produced.
- Provision of additional log files and quality products on request for 2010 with a server solution envisaged for 2011.
- First elements of brand new software system started as of February 2010.

Thank You!

- www.dmcii.com
- www.sstl.co.uk

Sustainable Earth Observation