

QA4EO Perspective from NCAVEO

Network for Calibration and Validation in EO

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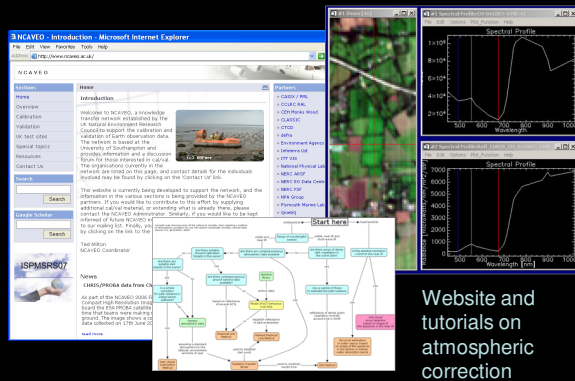
QA4EO March 2010

NCAVEO 2004 -2007

- Funded by NERC Knowledge Exchange scheme;
- Initial group of 12 partners, grew to 26 by 2007;
- Academia, industry and government;
- Emphasis on practical, hands-on learning.



NCAVEO Year 1 Outputs



NCAVEO Field Campaign 2006

- Involved 50 scientists from 22 organisations;
- Community-led campaign with clear science aims:
 - cal/val basic products (radiance, reflectance);
 - validation of leaf area index;
 - create a high quality database.
- Funded by partners;
- Logistic hub: STFC Chilbolton.



Scientific context

- Measurements and Models
 - Requirements for assimilation and for validation.
 - Land surface process models.
 - Specifically, carbon, water vapour & energy exchange.
- Ranging from statistical approaches (classification) to quantitative approaches (traceable to SI).
- 'Known unknowns'
 - Atmospheric correction uncertainty.
 - Upscaling data / information.

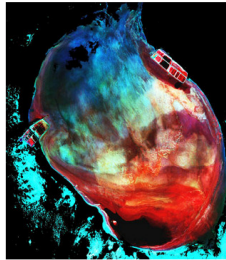
NCAVEO 2004 - 08

NFC remote sensing data sets

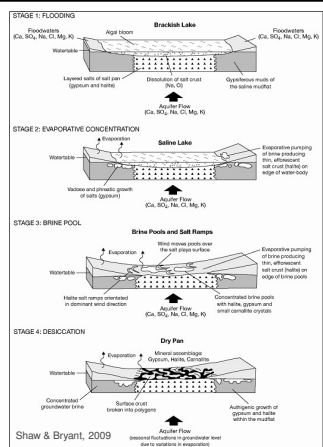
	Sensor	Date acquired	Operator	Spectral region No. of bands / Pixel size	Summary of data and pre-processing
1	CHRISProba	17/06/06	SSTL/ESA	VNIR 62 bands / 24 m	Multiple view angle super-spectral data. Registered to the British National Grid using ground control points.
2	UK-DMC	17/06/06	SSTL	VNIR 3 bands / 32 m	Wide swath multispectral data. UK-DMC has an estimated radiometric accuracy of 4.5%. AISat and Nigeria-Sat have been cross-calibrated with UK-DMC using an image-based method.
3	AISat	14/07/06	SSTL	VNIR 3 bands / 32 m	
4	Nigeria-Sat	13/06/06	SSTL	VNIR 3 bands / 32 m	
5	SPOT-5 HRG	10/06/06	CNES	VNIR/SWIR 4 bands / 10 m / 20 m	Registered to the British National Grid using ground control points.
6	CASI-2™	17/06/06	NERC	VNIR 15 bands / 2.5 m	Nine flightlines acquired using an Ikonos Instruments Compact Airborne Spectrographic Imager. Registered to the British National Grid using data from on-board sensors.
7	CASI-3™	17/06/06	EA	VNIR 32 bands / 1 m	Nine flightlines acquired using an Ikonos Instruments Compact Airborne Spectrographic Imager. Registered to the British National Grid using data from on-board sensors.
8	Specim AISA Eagle™	17/06/06	NERC	VNIR 244 bands / 1 m	Nine flightlines acquired. Registered to the British National Grid using data from on-board sensors.
9	Rollie-ABC Modular LS™ digital camera	17/06/06	EA	RGB 3 bands / 1 m	Nine flightlines acquired. Registered to the British National Grid using data from on-board sensors.
10	Integrating Z/I Imaging DMCC™	09/06/06	OS	VNIR 4 bands / 60 cm	Digital Mapping Camera. Orthorectified to the British National Grid using photogrammetric methods. 84 images acquired with 60% overlap along track.
11	Optech ALTM 2033™ LIDAR	17/06/06	EA	1064 nm 1 m	2km x 2km tiles of digital terrain model and digital surface model. First and last pulse returns were recorded, using an approximate pulse spacing of 1-2 metres.

††† Dates are expressed as DD/MM/YY
VNIR = Visible & Near IR-SWIR = Short-wave IR, RGB = Visible wavelengths only.

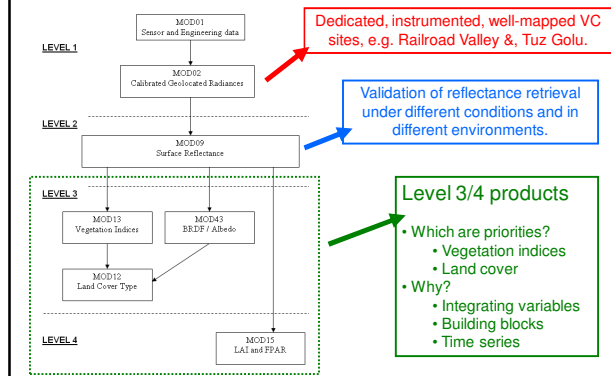
Salt pan processes and geochemistry



ASTER, 27th July 2005
Bands 3,4,7



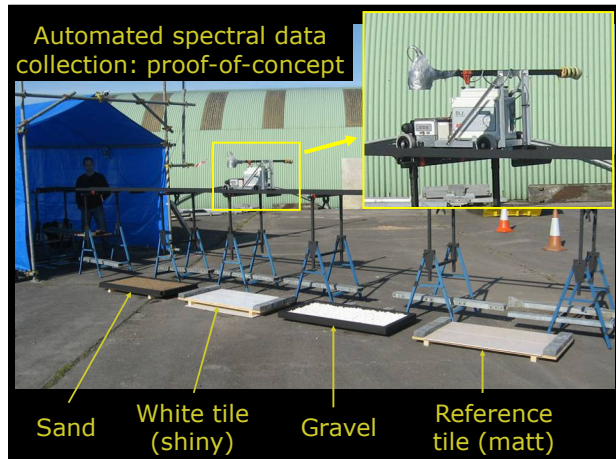
Perspective on Validation



A network of validation sites for the UK?

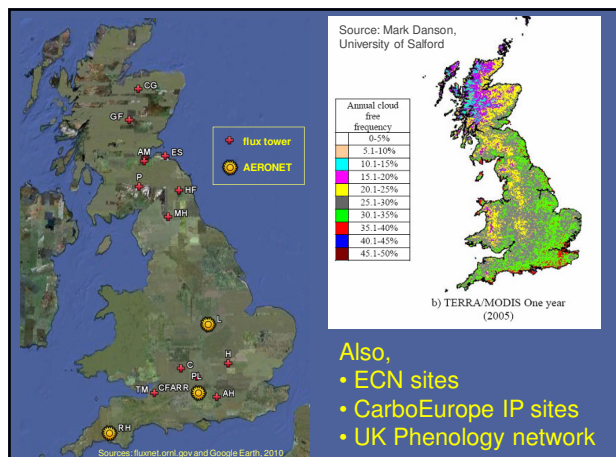
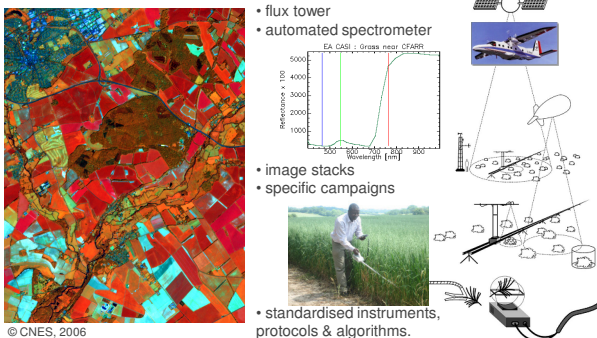
- Why the UK?**
 - QA starts at home;
 - Training / professional development role;
 - UK contribution to international activity.
- Criteria for site selection (say 3-5 sites)**
 - Continuous atmospheric measurements;
 - Flux tower on-site;
 - Local logistic support;
 - Uncontrolled air space (ARSF);
 - Ground measurements:
 - Automated (spectra) and campaign-specific (biophysical & spectra).

Automated spectral data collection: proof-of-concept



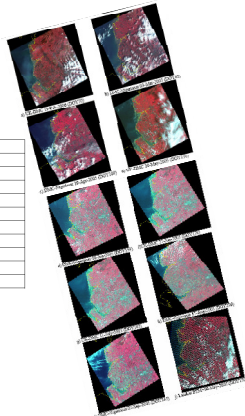
A network of validation sites for the UK?

each ~ 50 km², centred on secure site with:



DMC time series

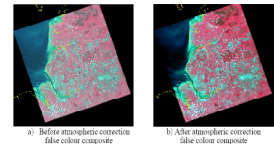
Satellite sensor	Date	DOY
UK-DMC	19-Feb-2006	50
DMC-Nigeriasat	03-Mar-2005	62
DMC-Nigeriasat	19-Apr-2005	109
UK-DMC 150	30-May-2005	150
LandSat ETM+	30-May-2005	150
DMC-Nigeriasat	08-Jun-2005	159
UK-DMC	27-Jun-2005	178
UK-DMC	11-July-2005	192
DMC-Nigeriasat	17-Aug-2005	226
DMC-Nigeriasat	02-Sep-2005	245



Source: Mark Danson, University of Salford

Data analysis

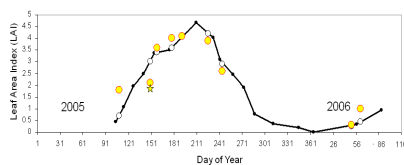
- Geometric correction to BNG
- Atmospheric correction for DMC DOY 150 using image COST method (Chavez, 1996)
- Identification of common spectrally invariant targets
- Cross-calibration of all images to DMC DOY 150 reflectance for around 10 targets
- Correction of all images to G, R, NIR reflectance
- Compute vegetation indices



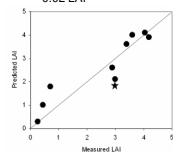
Source: Mark Danson, University of Salford

Results

Vegetation index	Equation	R ²
SAVI	$0.1014x + 0.2165$	0.85
DVI	$0.0697x + 0.99$	0.85
JPVI	$0.523x + 0.7442$	0.74
NDVI	$0.1044x + 0.488$	0.73



Root mean square error = 0.47 LAI
Range of errors 1.1 – 0.02 LAI



Source: Mark Danson, University of Salford

Conclusion

- NCAVEO as a model for community engagement and knowledge exchange about QA:
 - organisations
 - individuals
 } wide range of interests, expectations and remits.
- KE in NCAVEO was facilitated by joint activities – workshops & projects with a clearly defined outcome, for example the Field Campaign.
- Belief that multidisciplinary collaborative experiments are a highly effective use of the UK's EO assets. Involve all the community, not just a few groups.