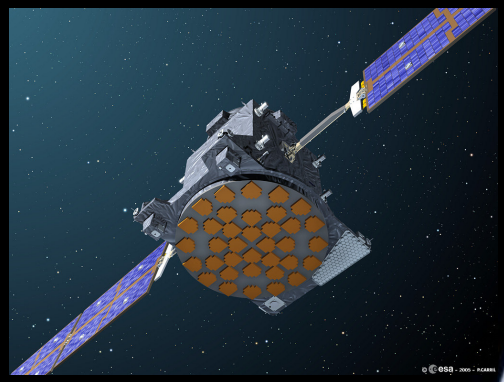
SURREY SATELLITE TECHNOLOGY LTD

JACIE
27 March 2008

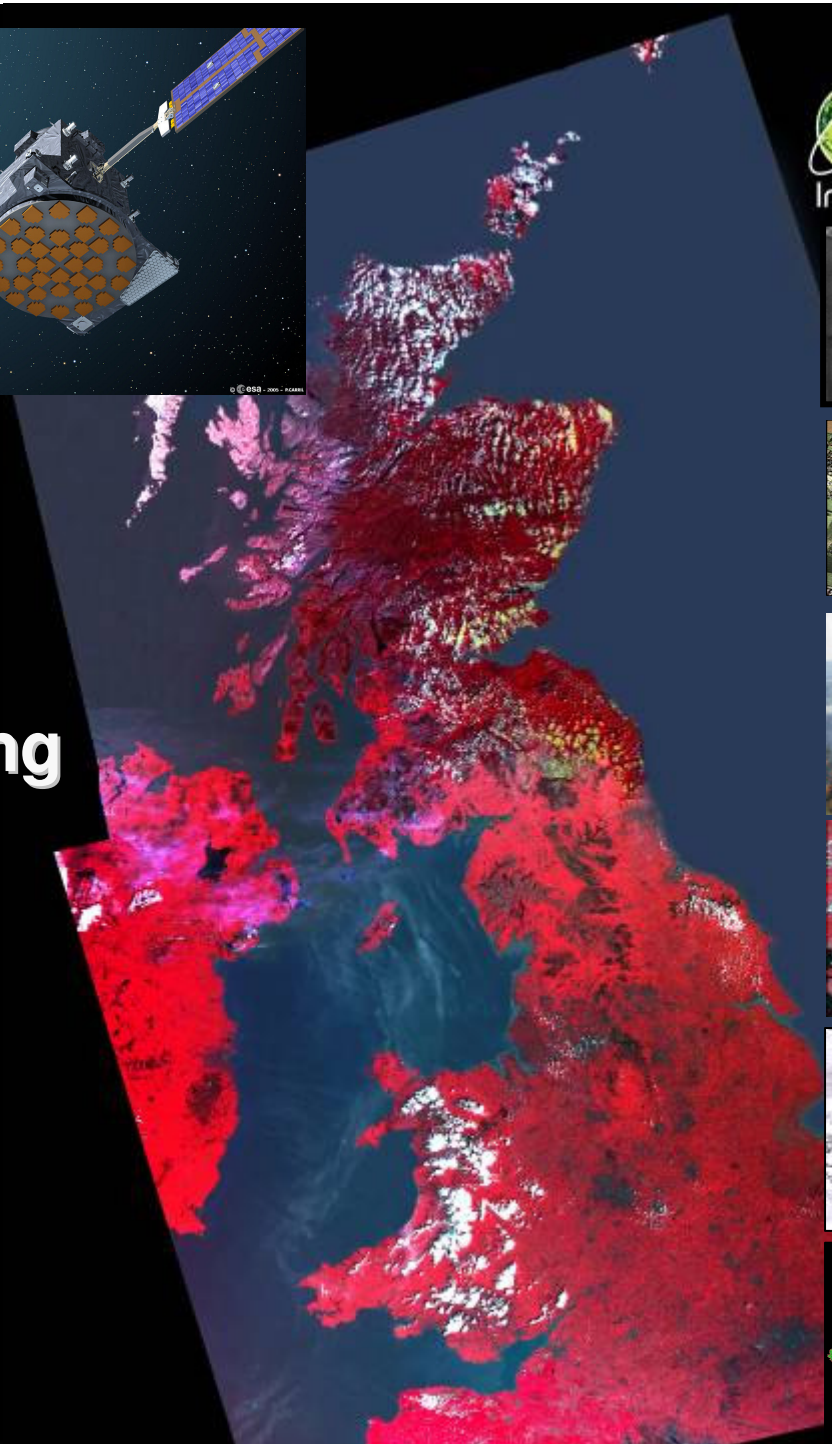


Developments in The Disaster Monitoring Constellation

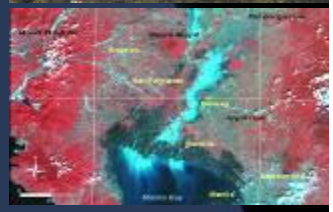
Paul Stephens
Director; Sales & Marketing
DMC International Imaging Ltd

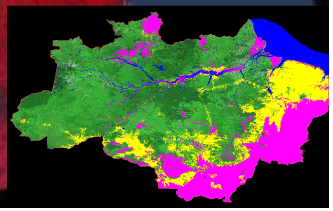
SURREY SATELLITE TECHNOLOGY LTD

JACIE
27 March 2008



dmc International Imaging





Developments in The Disaster Monitoring Constellation

Paul Stephens
Director; Sales & Marketing
DMC International Imaging Ltd

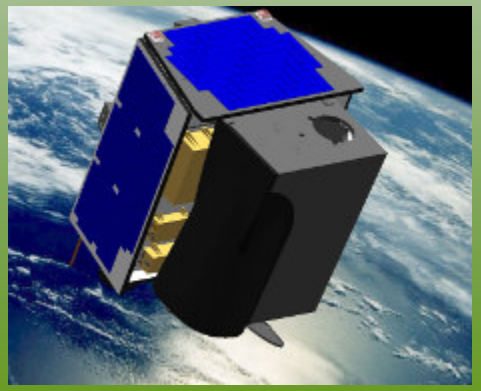
Pioneering a different approach to space

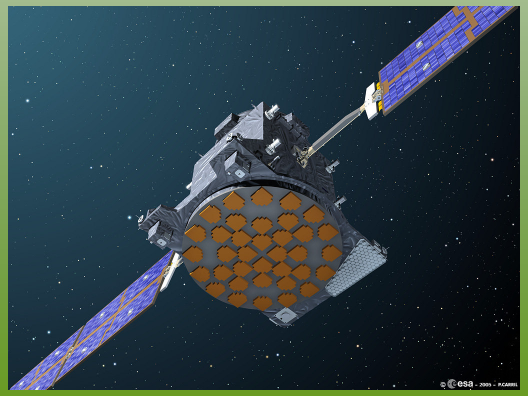
"Changing the Economics of Space"

Achieved through:

Rapid-response small-satellites

built from advanced terrestrial technology





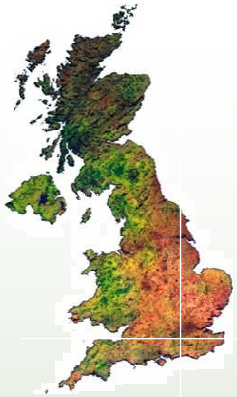
Small satellite and EO expertise

SURREY SATELLITE TECHNOLOGY LTD

SURREY SPACE CENTRE
- Research
- Postgraduate Education

- Space Missions
- Payloads
- Hands-on Training

dmc International Imaging
- Space Operations
- Data Services



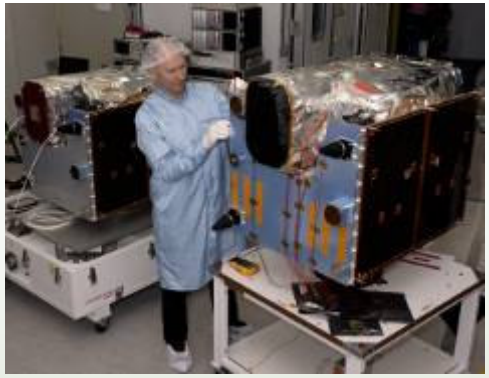
Based in UK

- **300 Experts in small satellites & applications**
- **27 satellites launched to date**
- **13 spacecraft in production**

Surrey today…

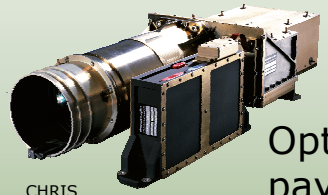
SSTL HQ

Across three UK sites



RapidEye constellation

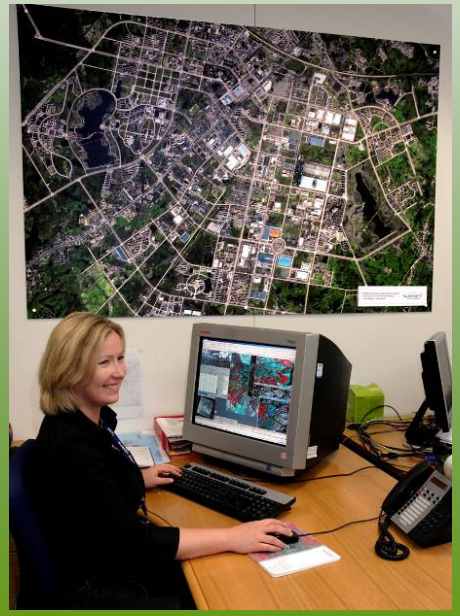
Commercial Applications



CHRIS Hyperspectral imager

Optical payloads group

First Galileo Spacecraft for **ESA**



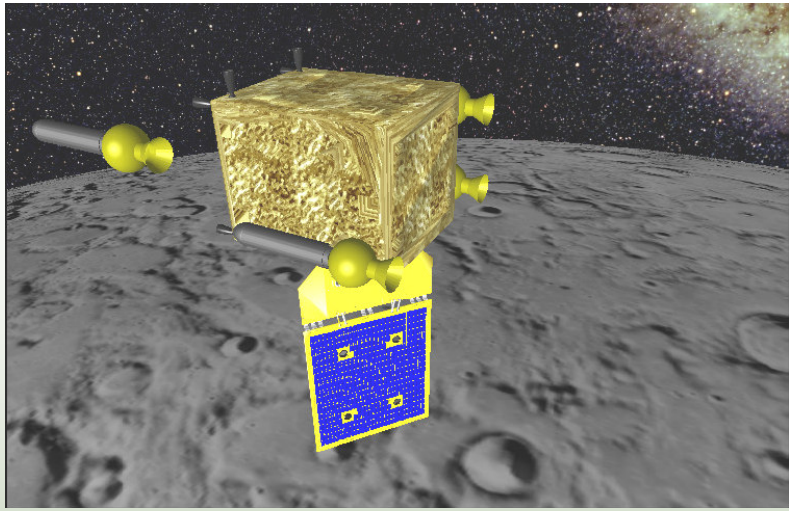
Data sales and value-added data products subsidiary

CFESAT

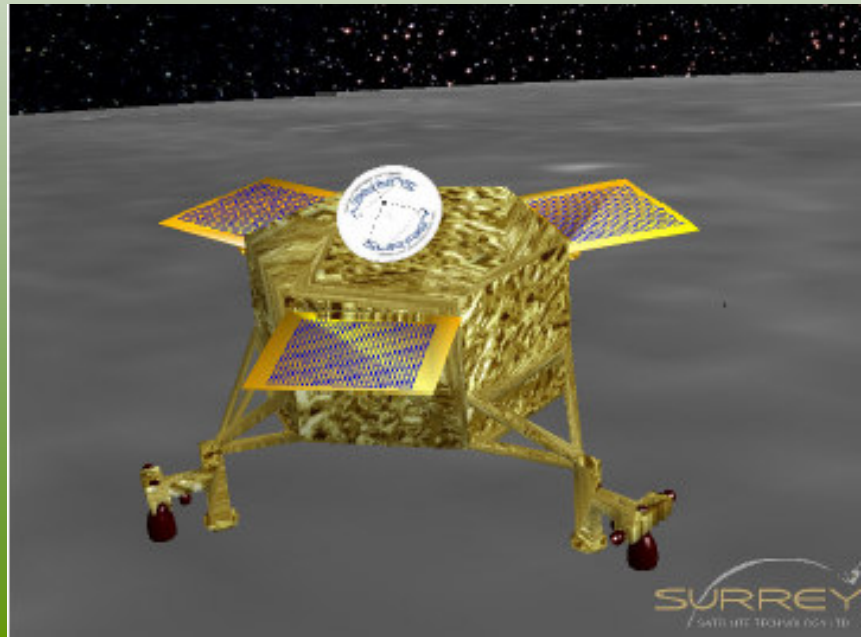
Space missions for **USA**, **China** and **Russia**

Beyond LEO - The Moon

- MoonLITE:
  - A polar orbiter for communication, navigation plus orbital remote sensing
  - Multiple micro-penetrators far-side and near-side deployment and in-situ geophysics & geochemistry
  - Launch in 2010 & 2012



- Moonraker:
  - Small lander (semi-hard or soft) for northern near-side geophysics & geochemistry
  - Micro-rover for surface mobility (<1 km range) and multiple sites sampling
  - Launch in 2013

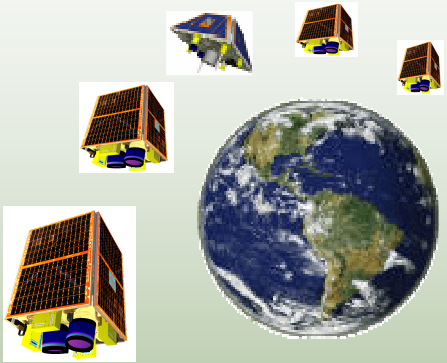


The DMC Concept

A Unique International Partnership Combining National Objectives, Humanitarian Aid and Commerce…

The Consortium

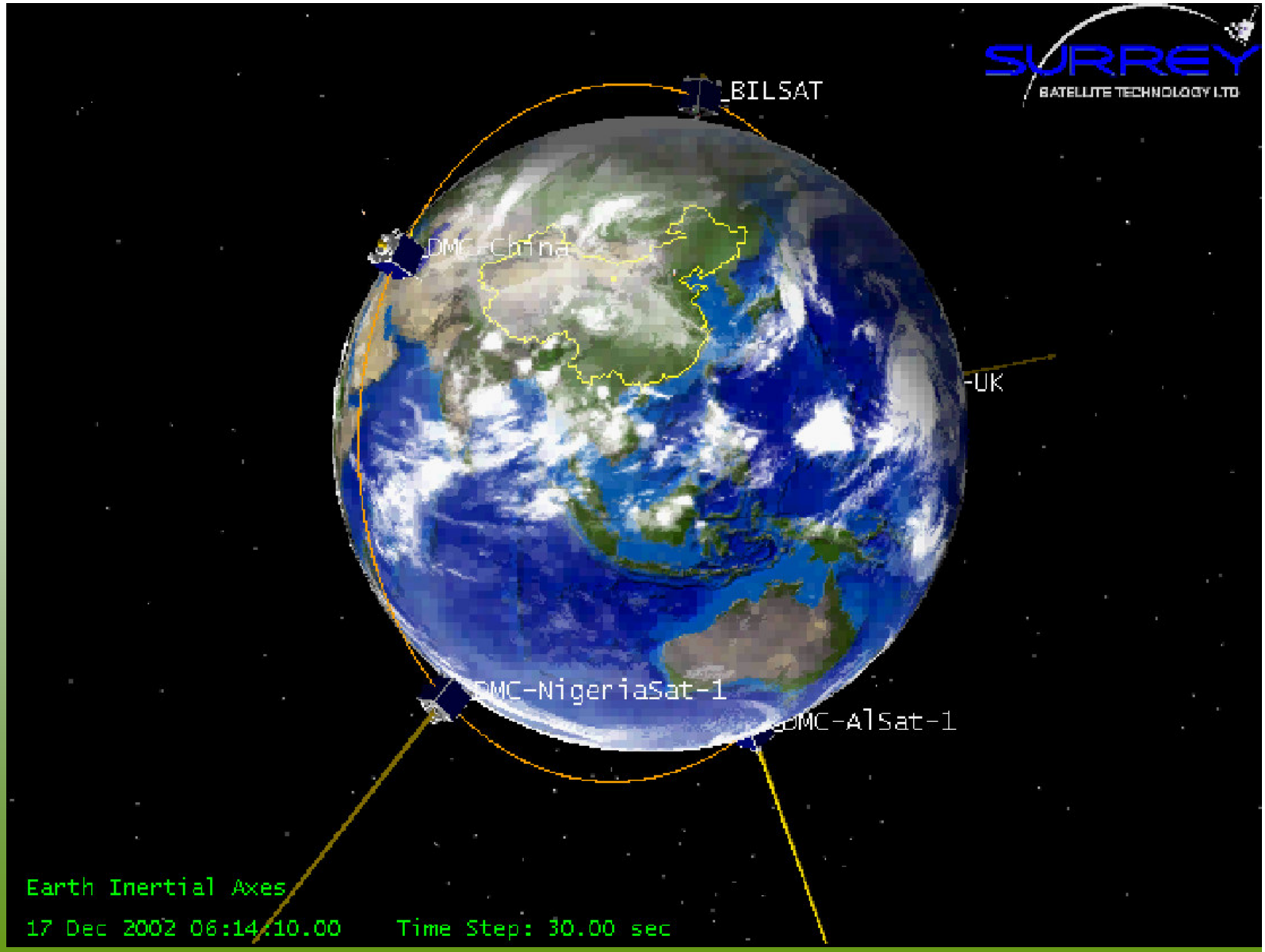
The Coordinator



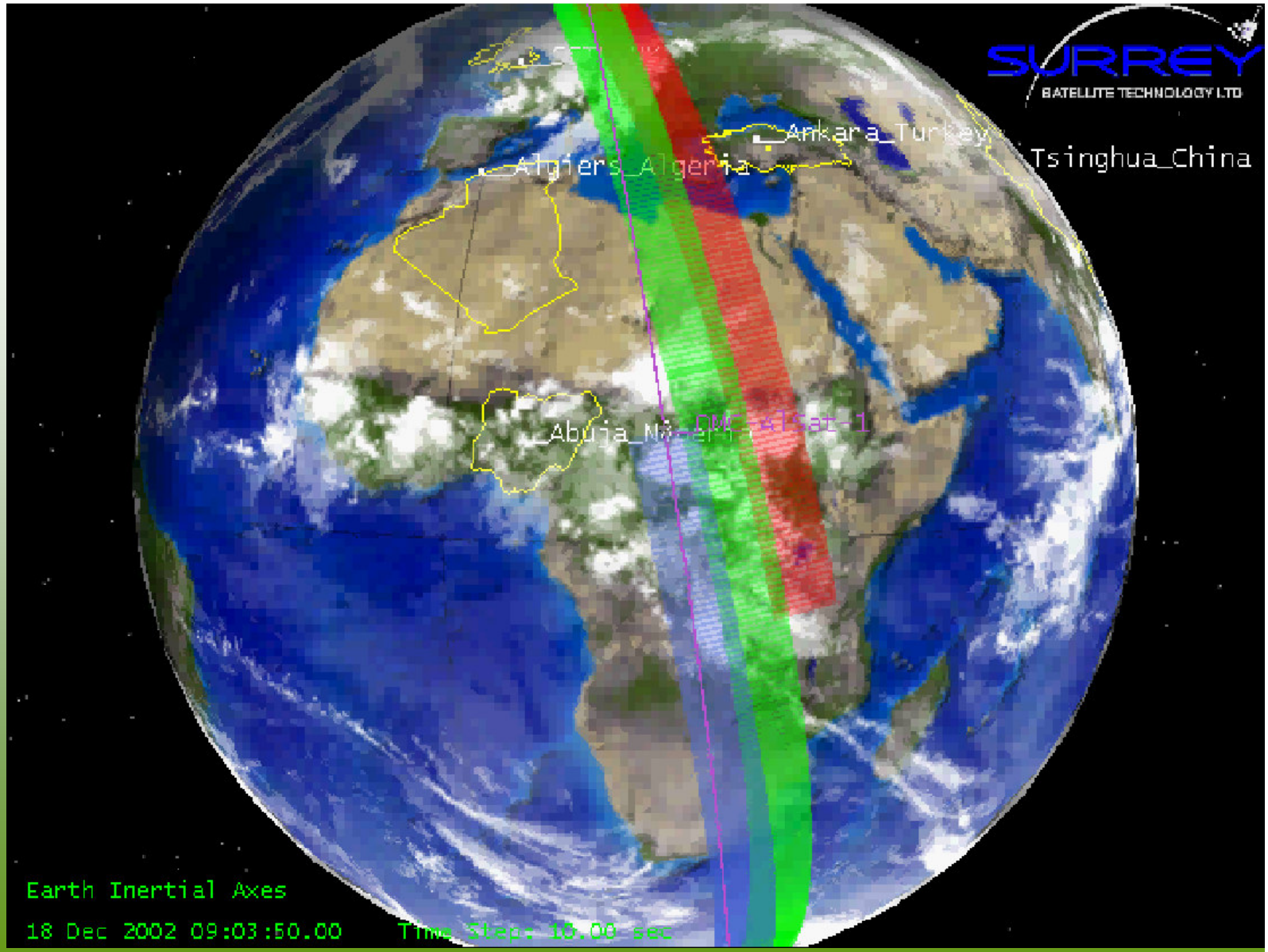
The Constellation

Applications;
Commercial, Government and Humanitarian

Disaster Monitoring Constellation



Disaster Monitoring Constellation



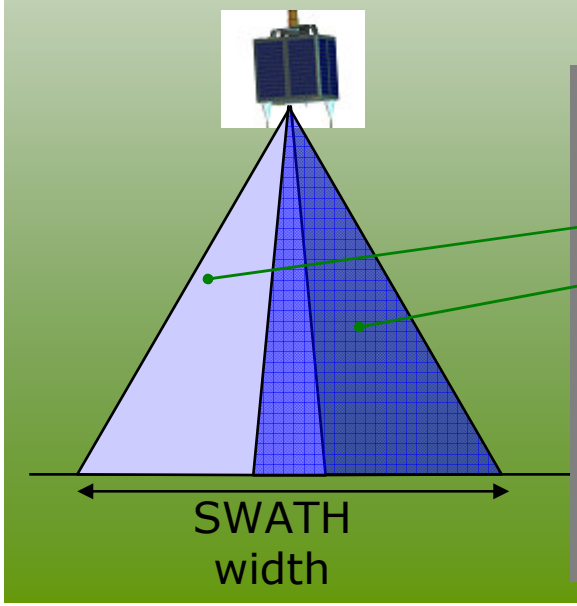
DMC Standard SLIM6 Sensor

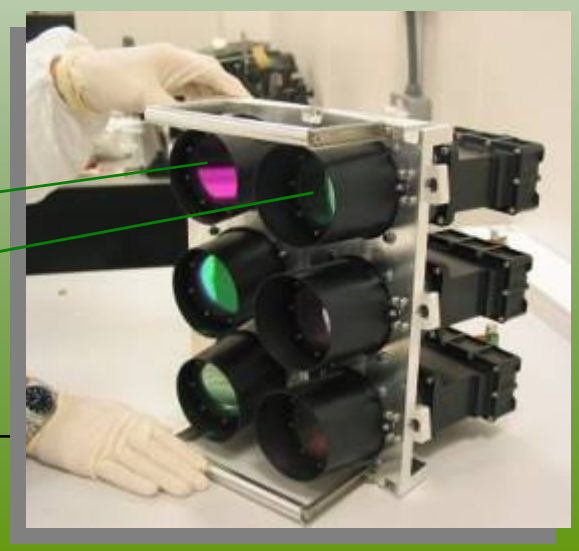
Sensor: Eastman Kodak KL10203 Linear CCD
10224 7.0 x 7.0um pixel array

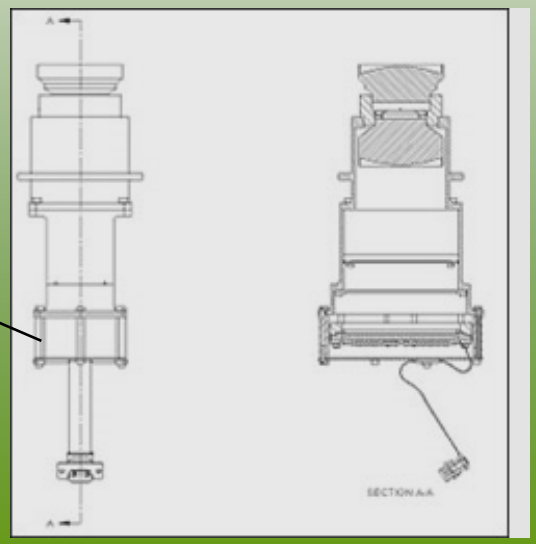
Lens: Schneider Apo-Componon HM
150mm, f/6.3

Per channel
FoV= 26.62 degrees
Swath = 324.58km

Filters: Barr Associates Inc., USA
Landsat equivalent
- NIR 0.77 - 0.90um ETM+4
- Red 0.63 - 0.69um ETM+3
- Green 0.52 - 0.60um ETM+2





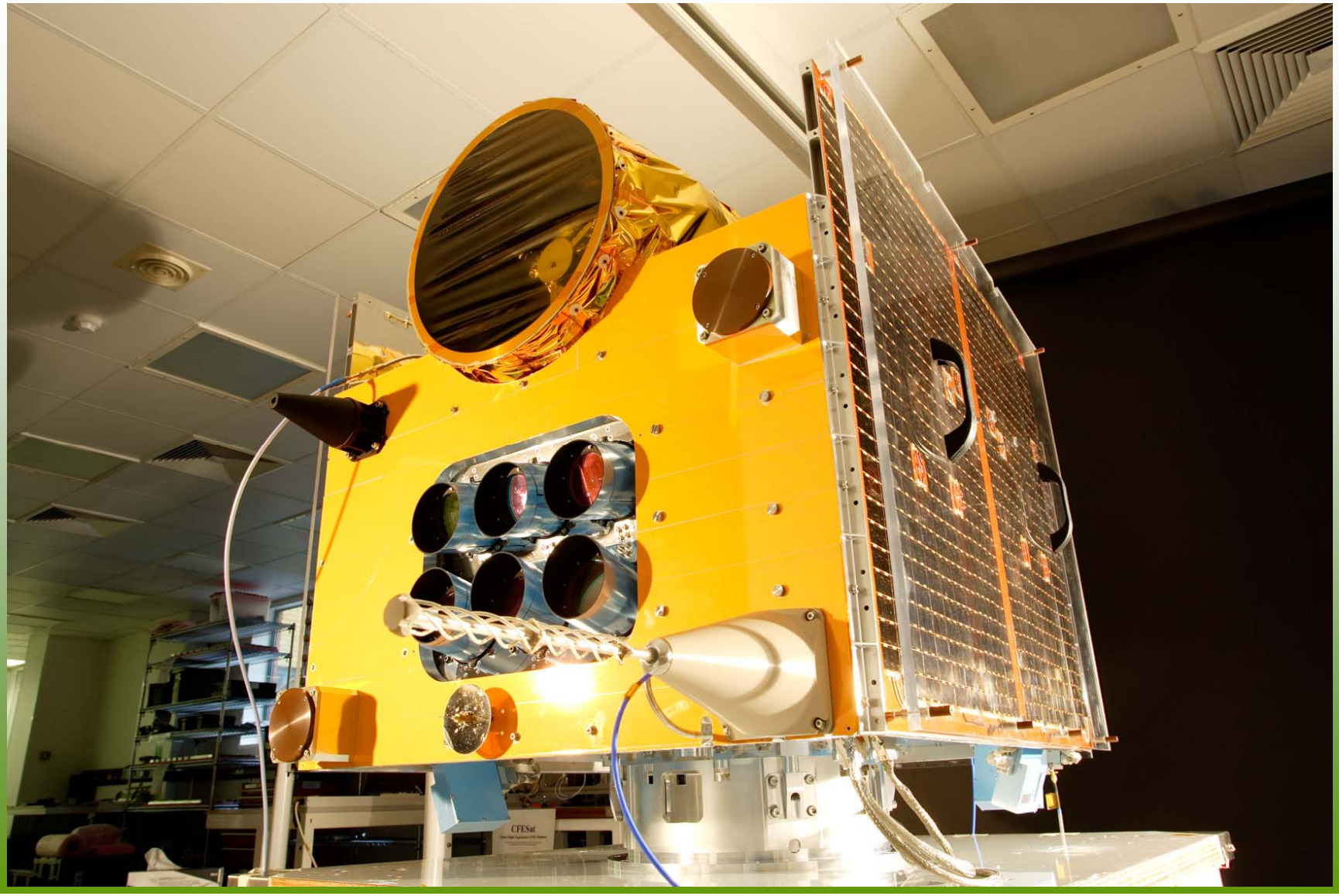


DMC Launches: ALSAT-1 – 28 November 2002
BILSAT, NigeriaSat-1, UK-DMC - 27 September 2003

Kosmos 11K65M, Plesetsk Cosmodrome

Higher Resolutions & Capacity

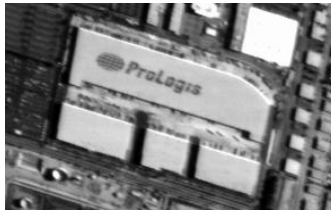
- Beijing-1 Launched on 27 October 2005

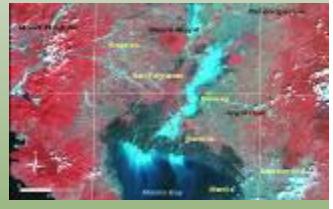
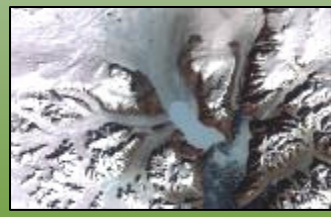
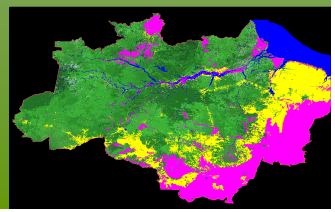


DMC Global Imaging Service

DMCii coordinates Constellation

- Fast responsive imaging service
  - 2.8 and 4 metre panchromatic
  - 5.6 metre multispectral (R, G, B)
  - 32 metre multispectral (R, G, NIR)
  - 22 metre multispectral (2009) (R, G, NIR)
- Daily revisit capability
- Applications
  - Agriculture
  - Land Cover Monitoring
  - Forestry
  - Urban mapping
  - Disaster response

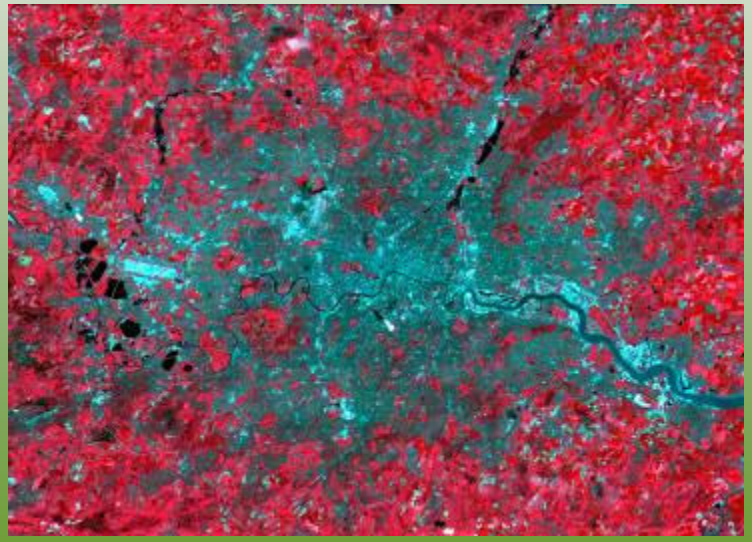


DMC Image Products

Multispectral

- 32 metre gsd
- Swath 660km
- Along track 160 - 4100km
- Revisit – daily capability
- Radiometric accuracy <10%
- Orthorectify <25m RMSE

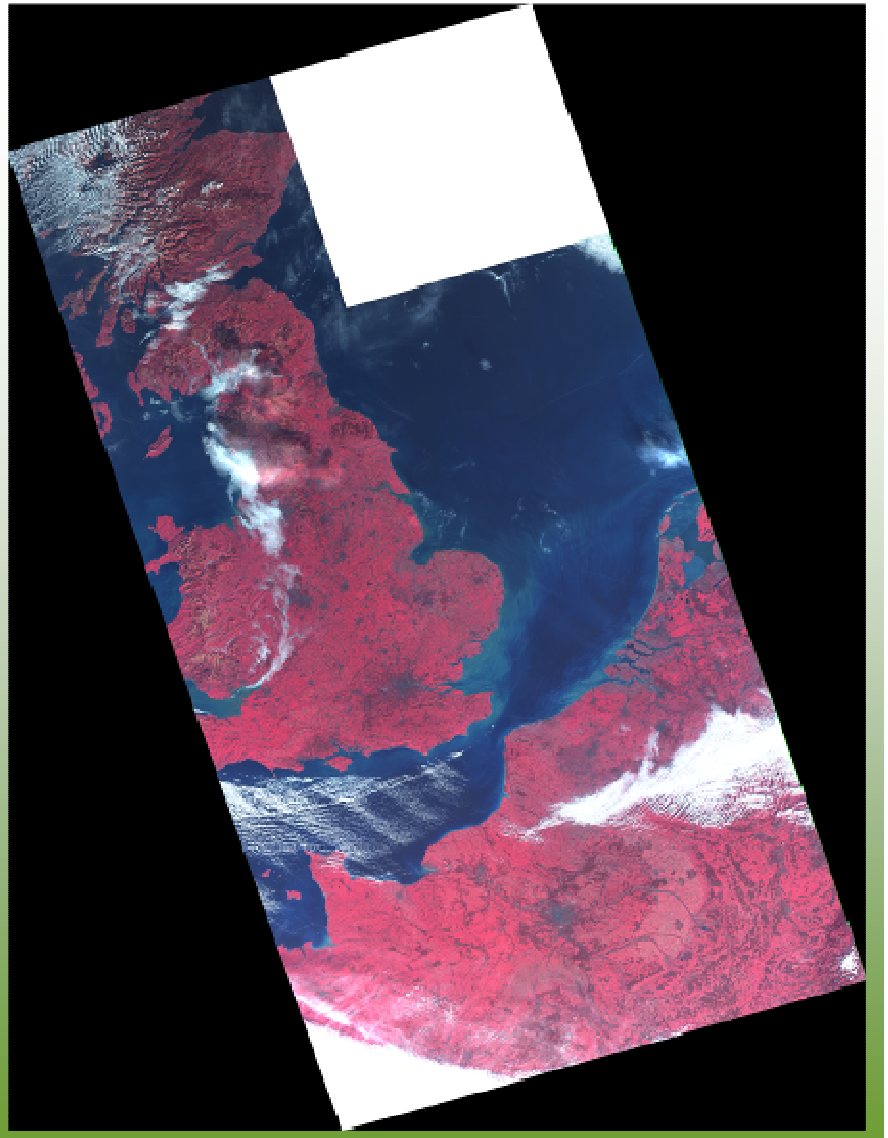


Panchromatic

- 2.8 & 4 metres gsd
- Swath 16 & 24km
- Along track 16-4100km
- Revisit - 5 days (offpoint)

Clouds – Constellations for daily imaging

Multiple MODIS images May 2006



Single DMC image April 2007

4 metre panchromatic

4 metre panchromatic

Beijing –1 image; Beijing Landview Mapping Information Technology Co Ltd

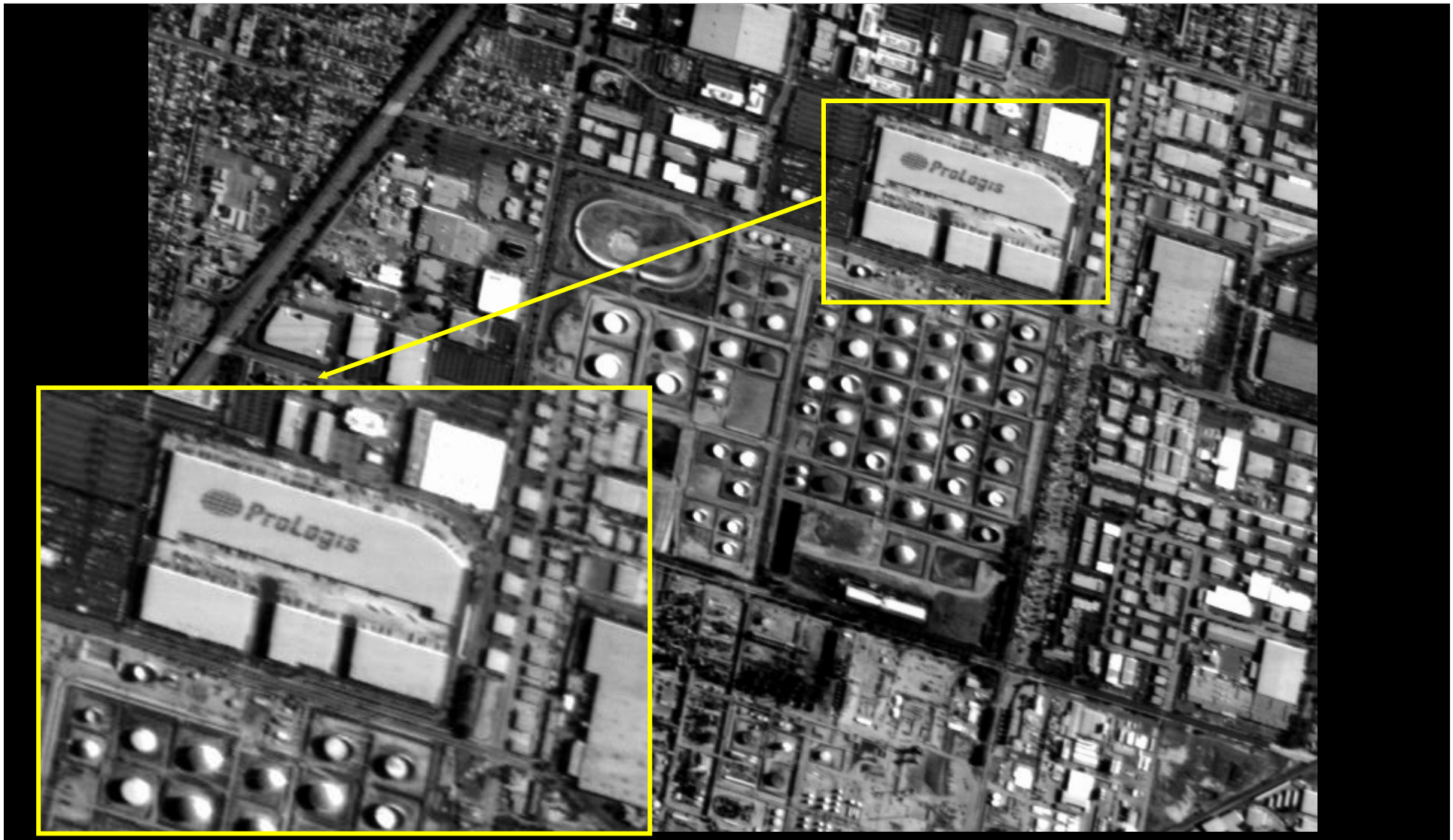
Hei Fei City,
China
Pan sharpened Beijing -1 image: Beijing Landview Mapping Information Technology Co Ltd

Hei Fei City,
China
Pan sharpened Beijing -1 image: Beijing Landview Mapping Information Technology Co Ltd

TOPSAT 2.8 meter panchromatic

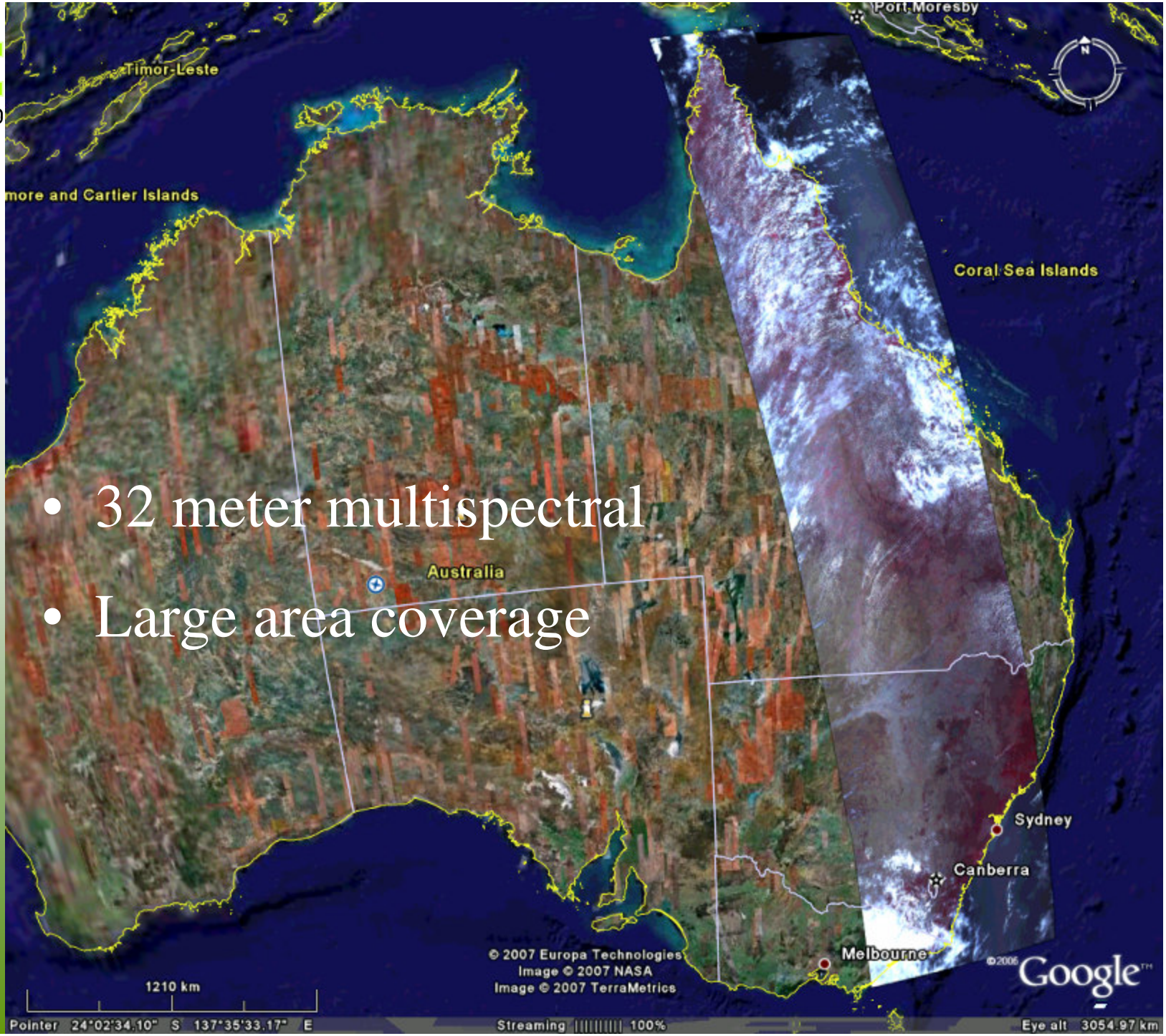
TopSat 2.8 meter image of Los Angeles, USA

TOPSAT 2.8 meter panchromatic



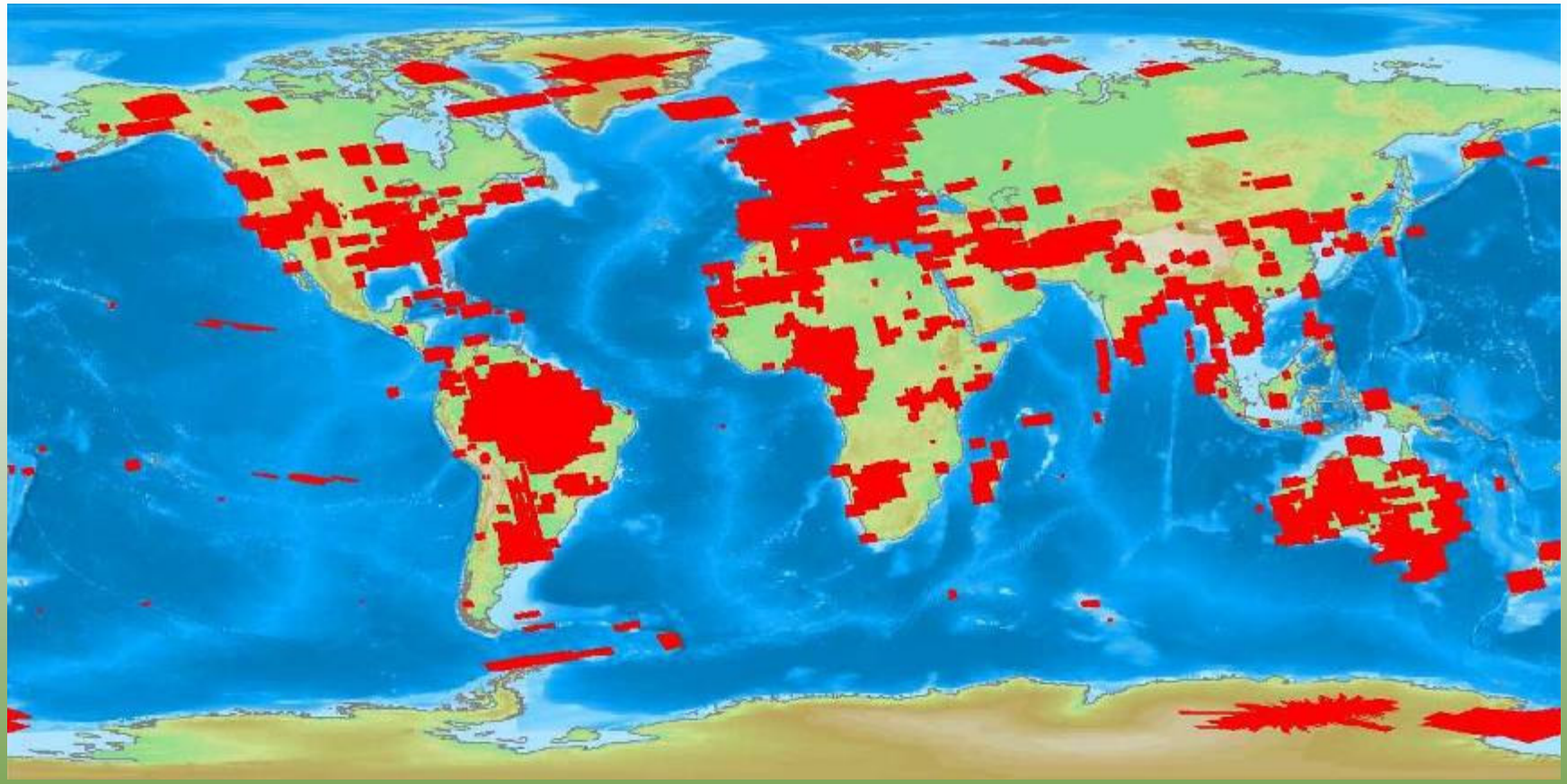
TopSat 2.8 meter image of Los Angeles, USA

dmc International Imaging



- 32 meter multispectral
- Large area coverage

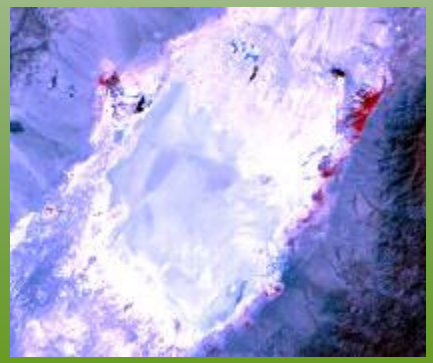
DMCii Archive Data



DMC Data Products: Regular Radiometric Calibration

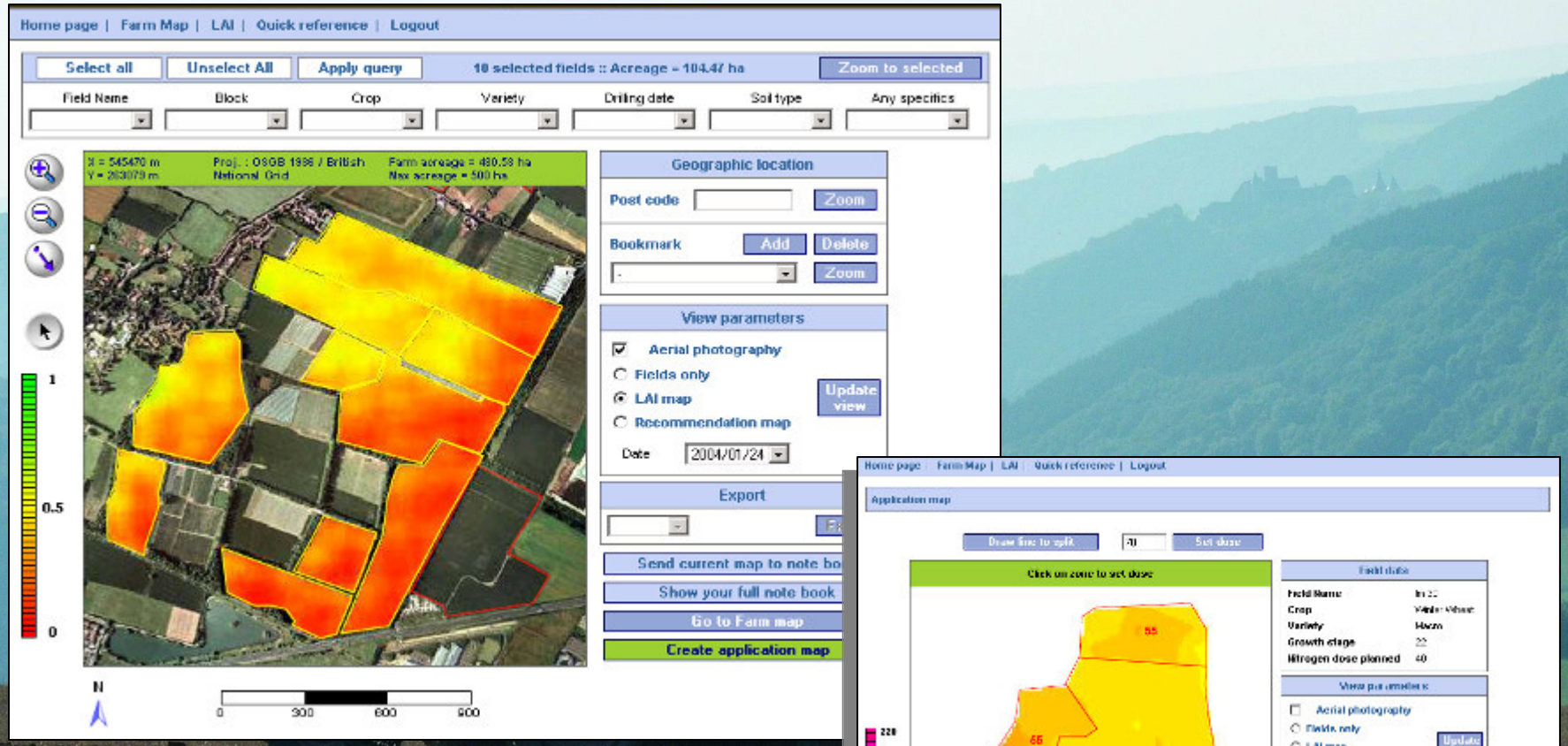
Principal Scientist Dr Stephen Mackin (Surrey Space Centre, UK)

- Annual Absolute Calibration since July 2004
  - Railroad Valley, Nevada instrumented test site
  - Facilities & TOA radiance supplied by Arizona Uni., USA
- Ongoing Monthly Relative Calibration
  - ‘Pacific at Night’ & ‘Antarctic & Greenland’ images
- No significant performance change noted
- Full documentation available
  - Calibration report



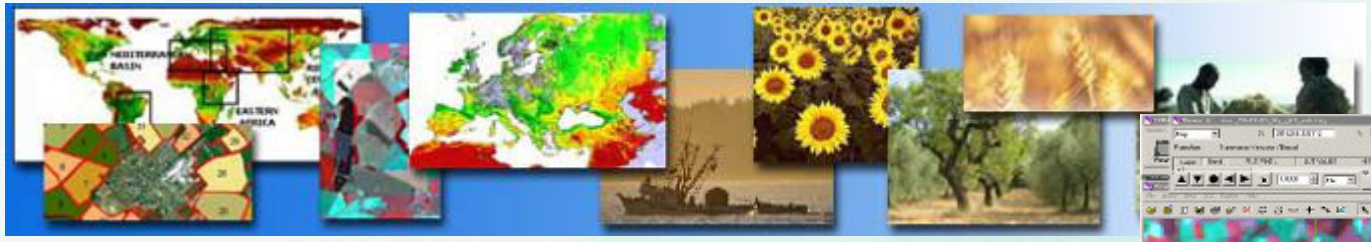
Precision Agriculture – Value Added Services

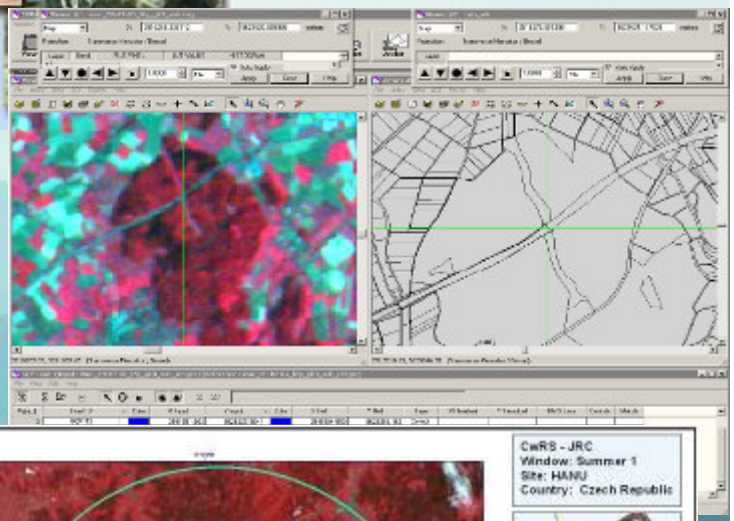
Online Agricultural services Including Field level monitoring of crop health…

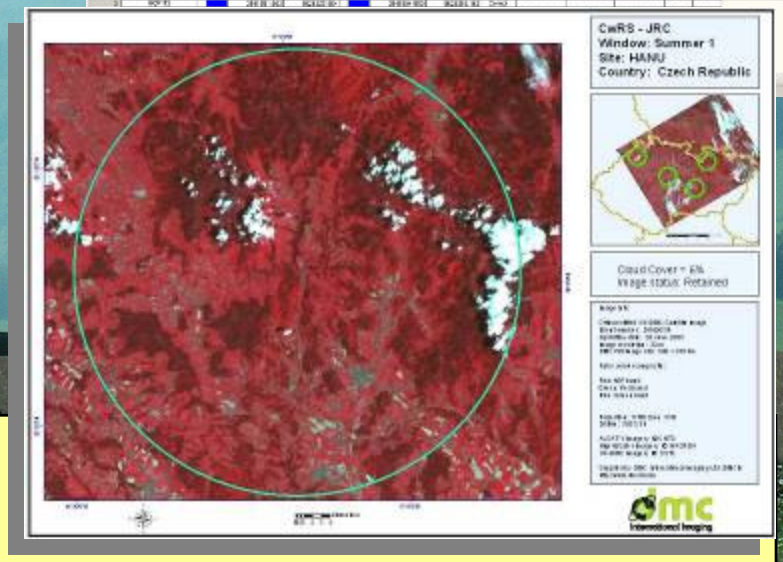


DMC 32m data located over 5m aerial photo in UK

Agriculture – Control with Remote Sensing (CwRS)







- CwRS 'Europe's biggest remote sensing project'
- DMC active in 2006 Campaign
- Multiple test sites captured (42% accepted to date)
- €1.6M (4 yr) EC Joint research Centre contract

Environment - Illicit Crop Monitoring

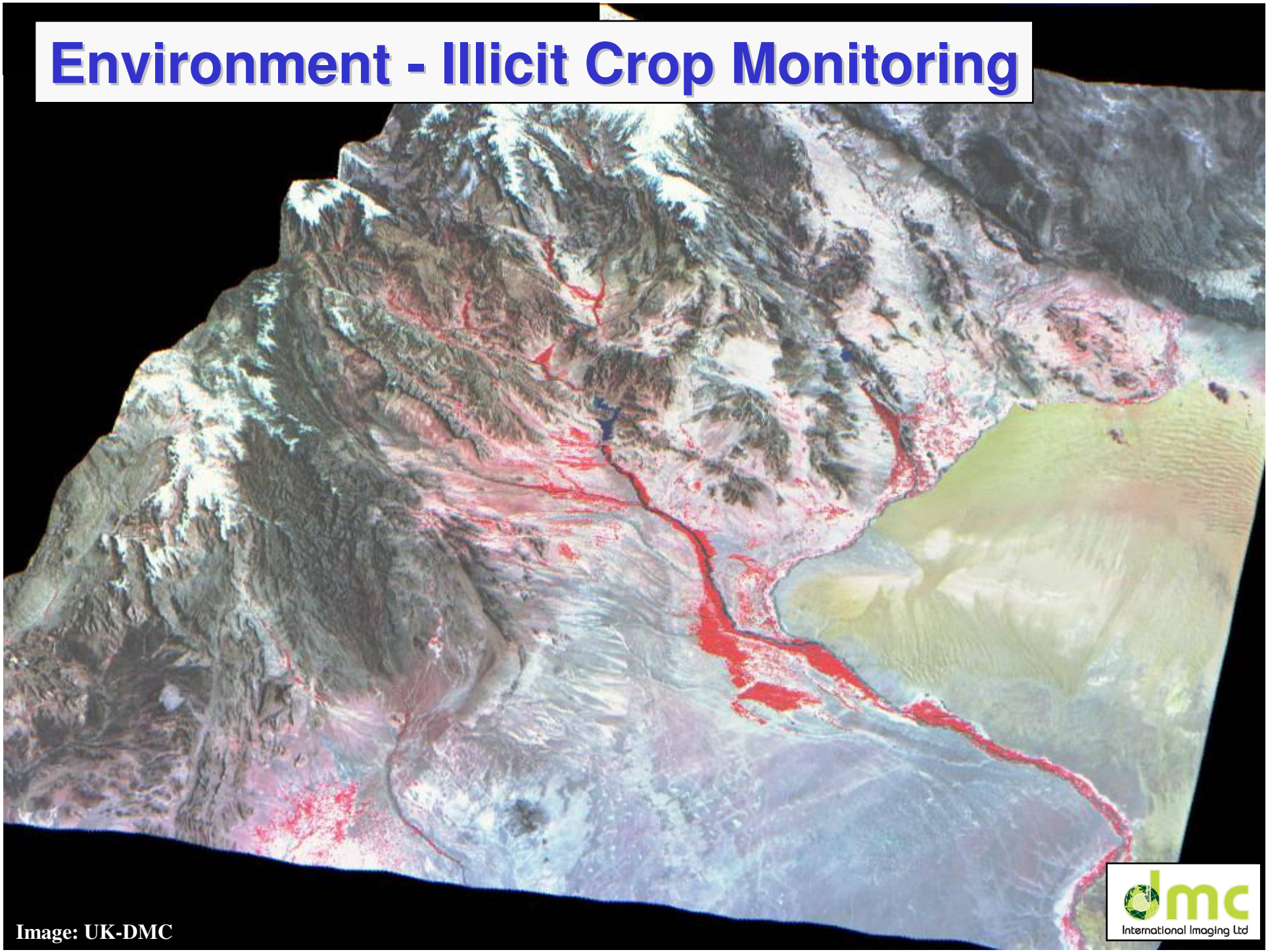
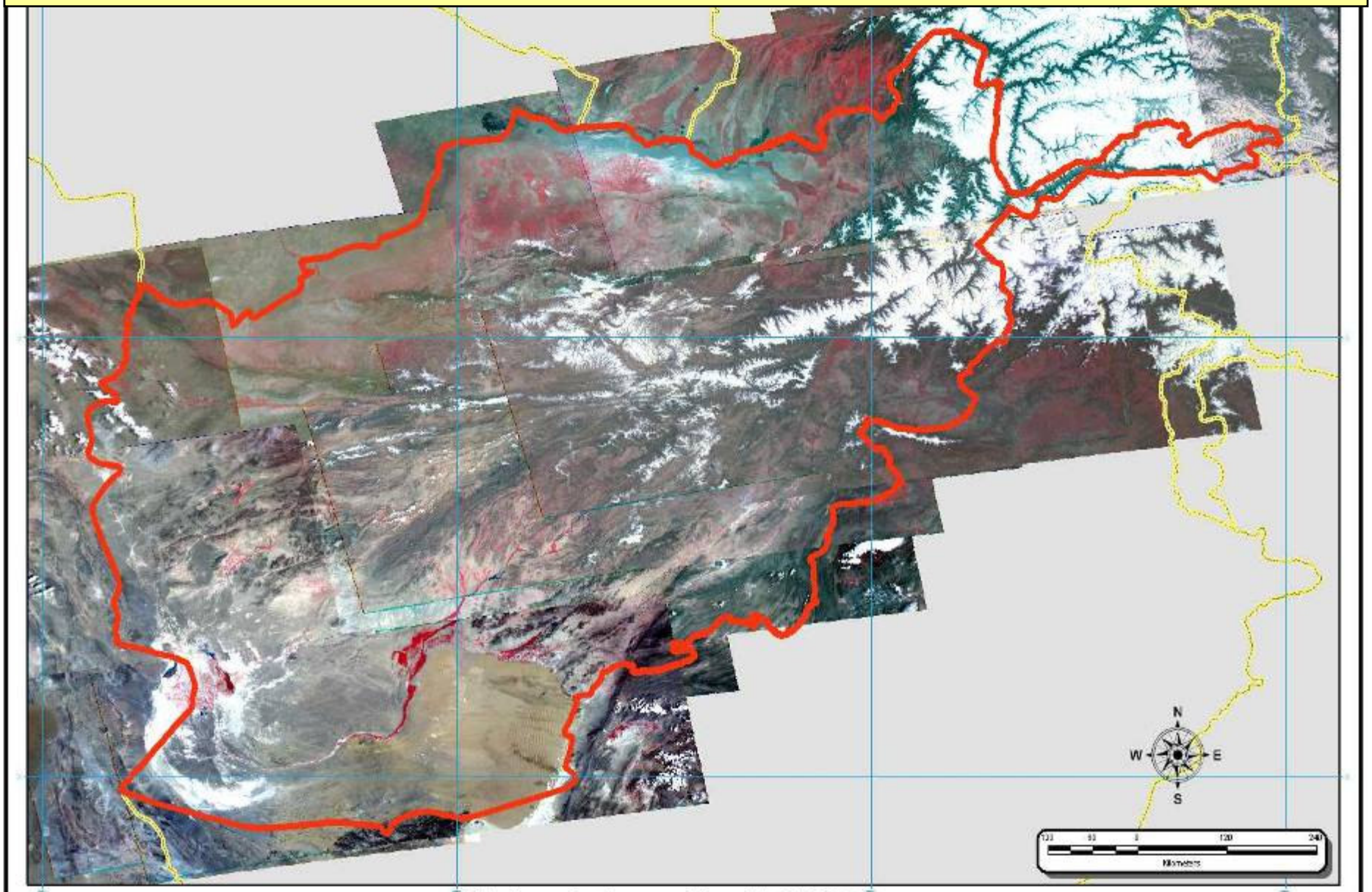


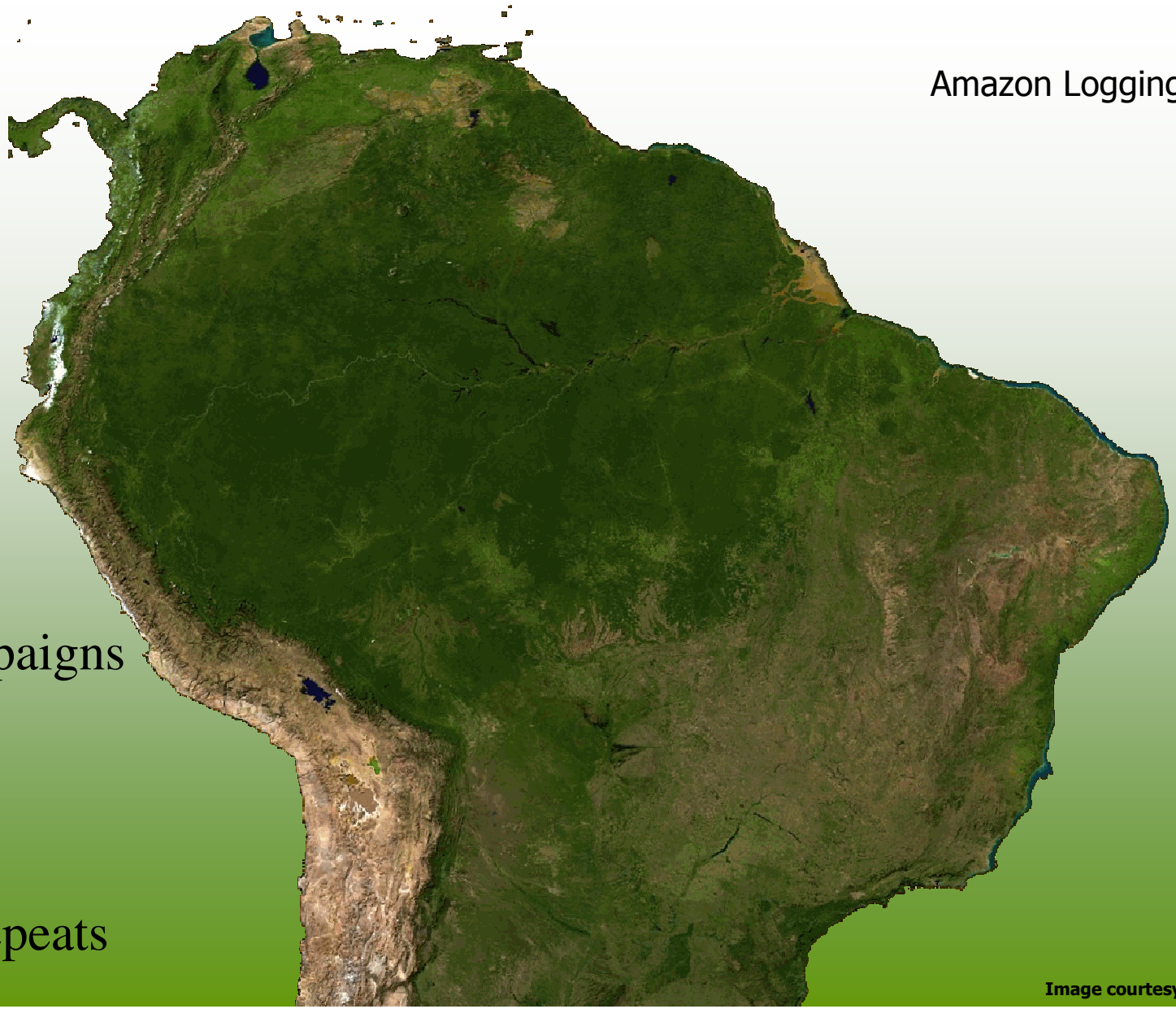
Image: UK-DMC

2005/2006/2007 Opium Poppy Crop Estimates…



Afghanistan - April 2006

Monitoring Deforestation



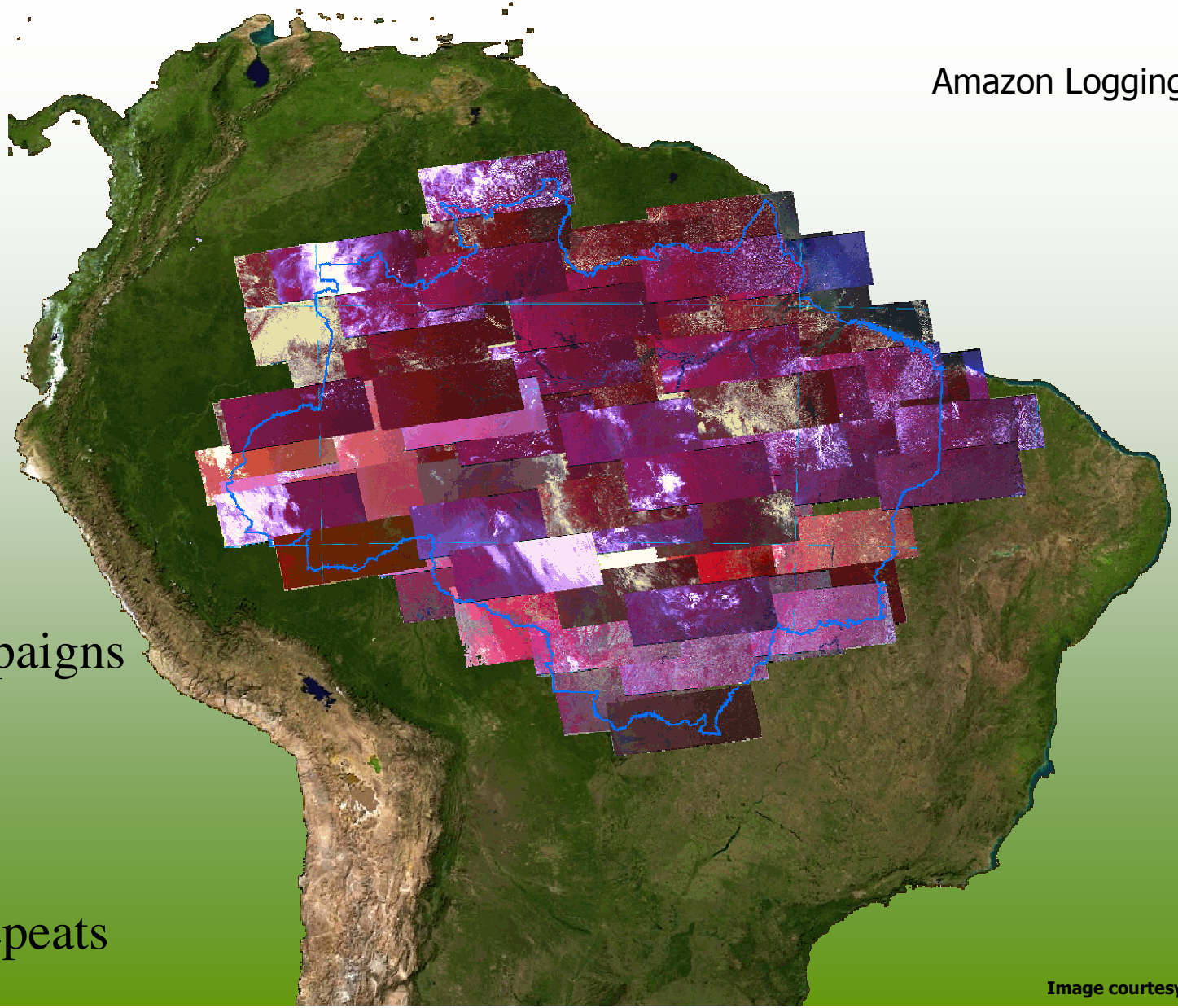
Amazon Logging

Annual campaigns

- 2005
- 2006
- 2007 – 3 repeats

Image courtesy of DMCii

Monitoring Deforestation

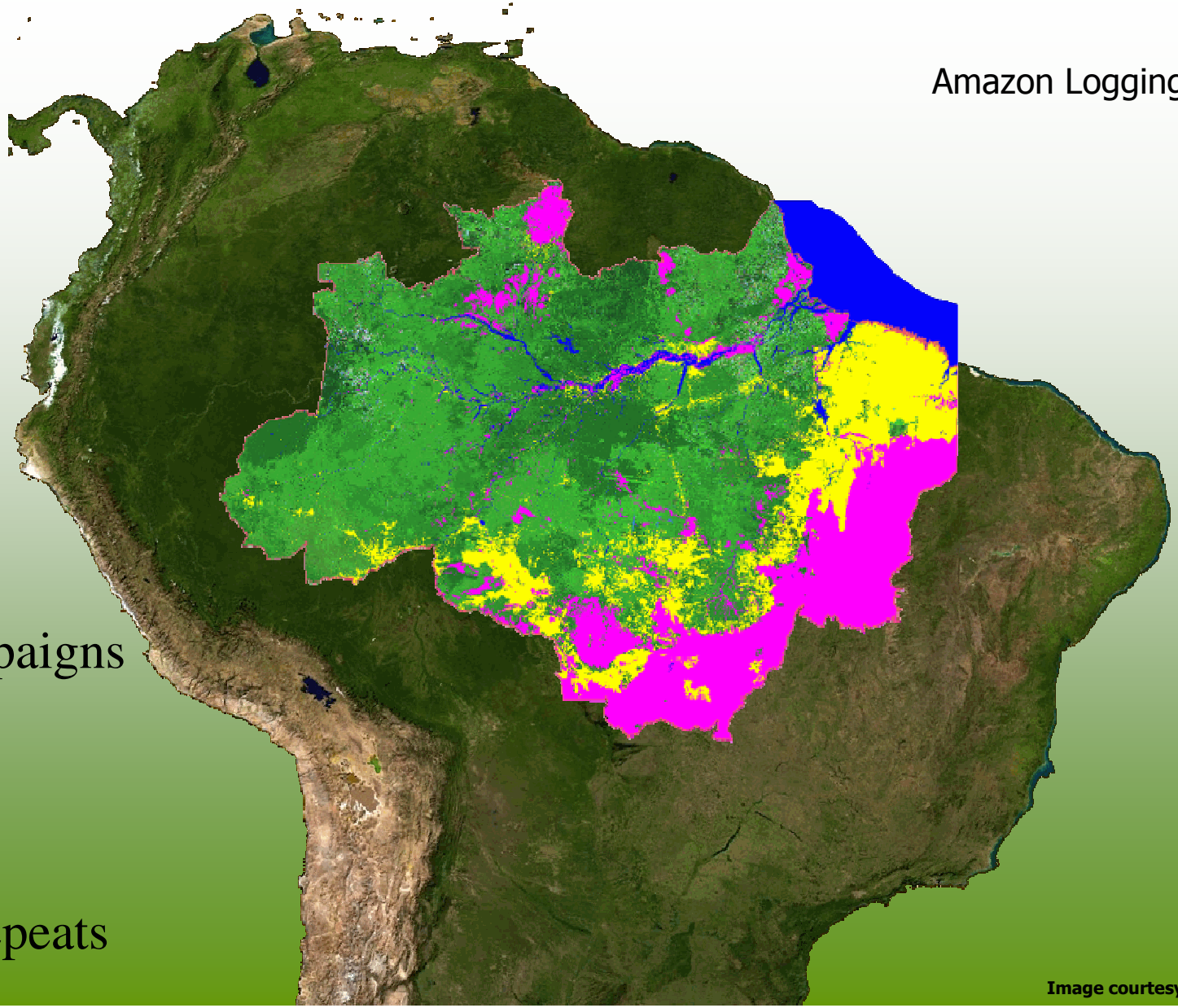


Annual campaigns

- 2005
- 2006
- 2007 – 3 repeats

Image courtesy of DMCii

Monitoring Deforestation



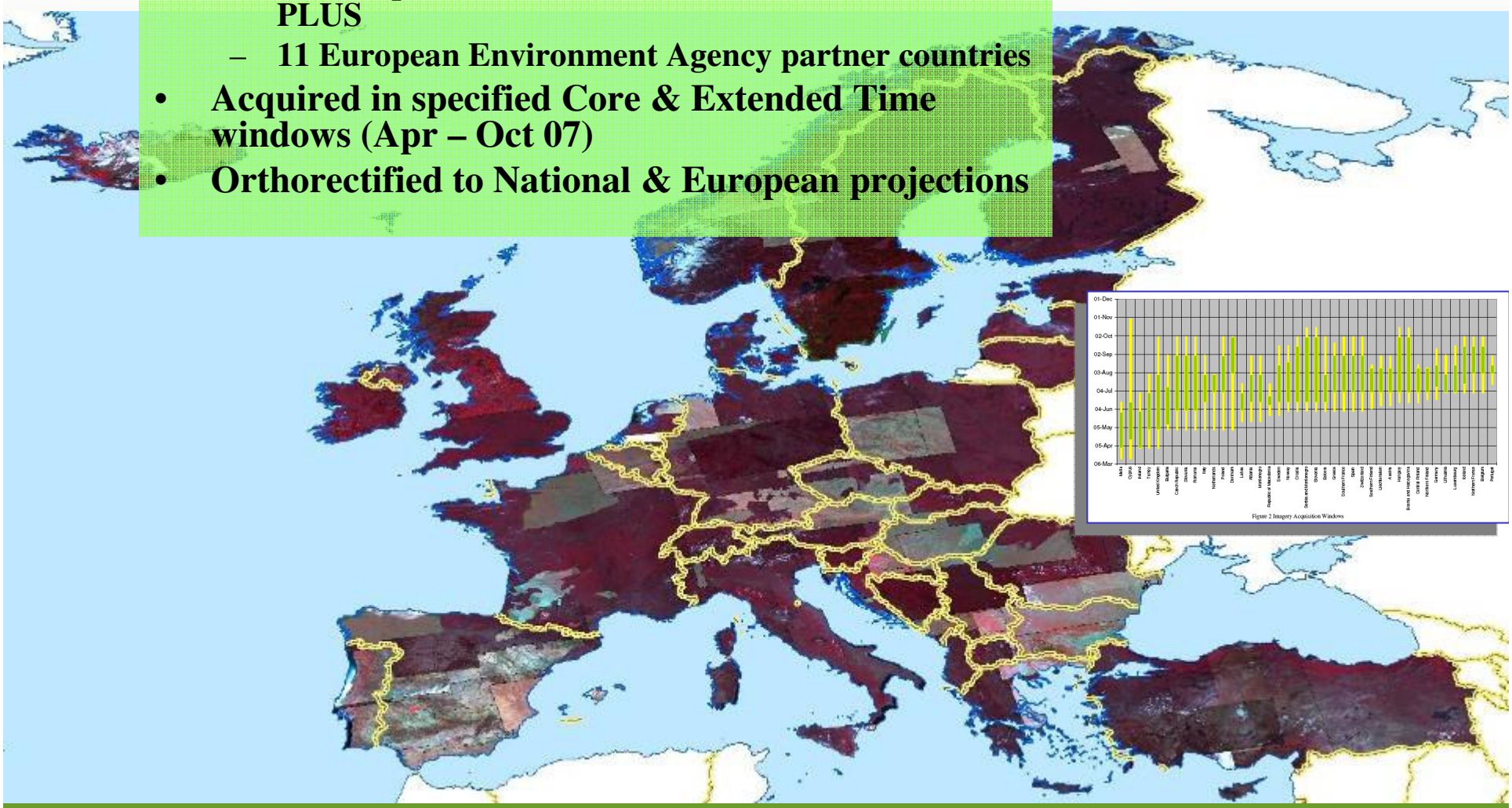
Annual campaigns

- 2005
- 2006
- 2007 – 3 repeats

Image courtesy of DMCii

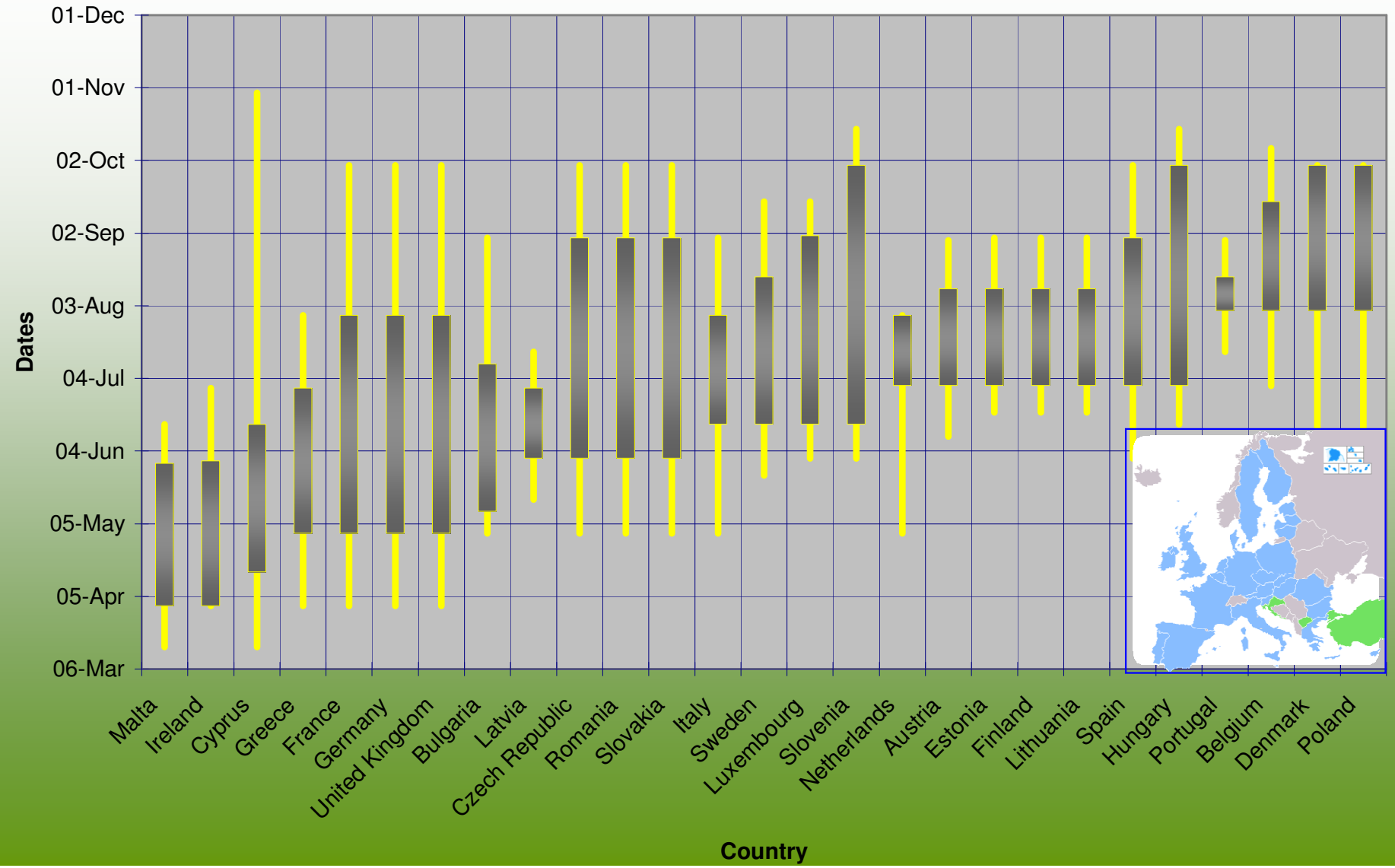
European Imaging Contract - 2007

- **Cloud free (<5%) imagery of**
  - **27 European Union countries PLUS**
  - **11 European Environment Agency partner countries**
- **Acquired in specified Core & Extended Time windows (Apr – Oct 07)**
- **Orthorectified to National & European projections**

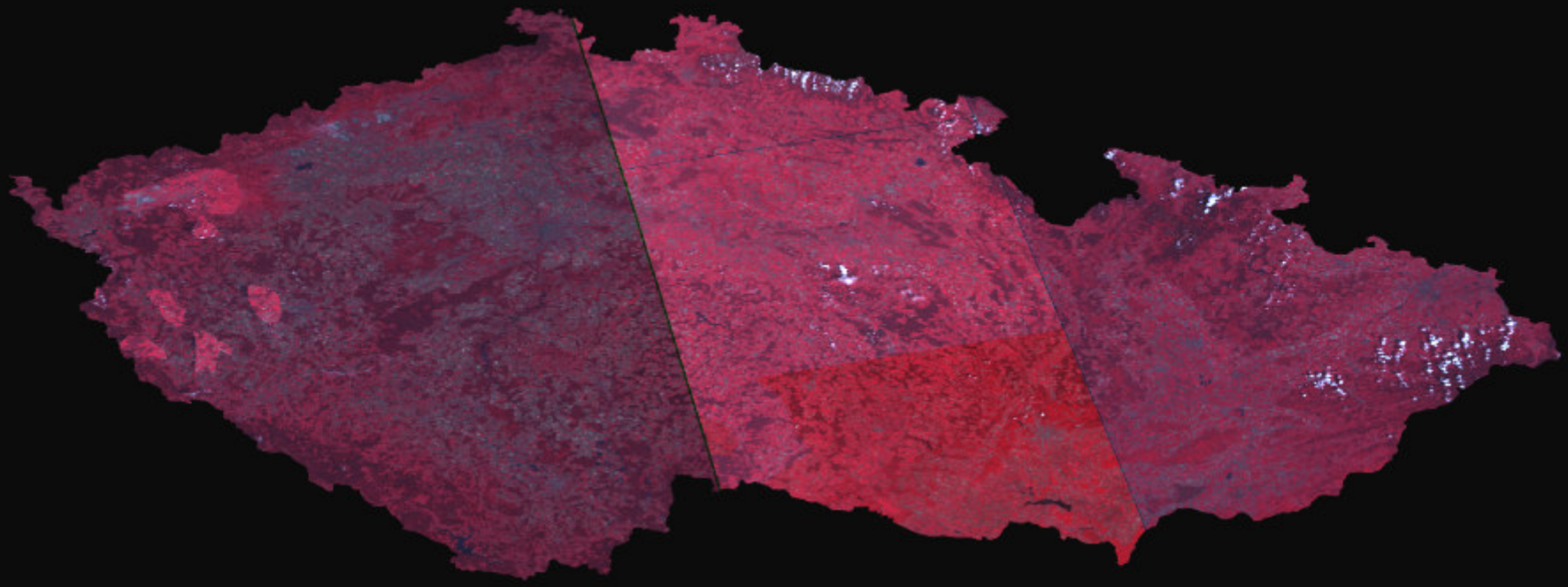


European Country Imaging windows

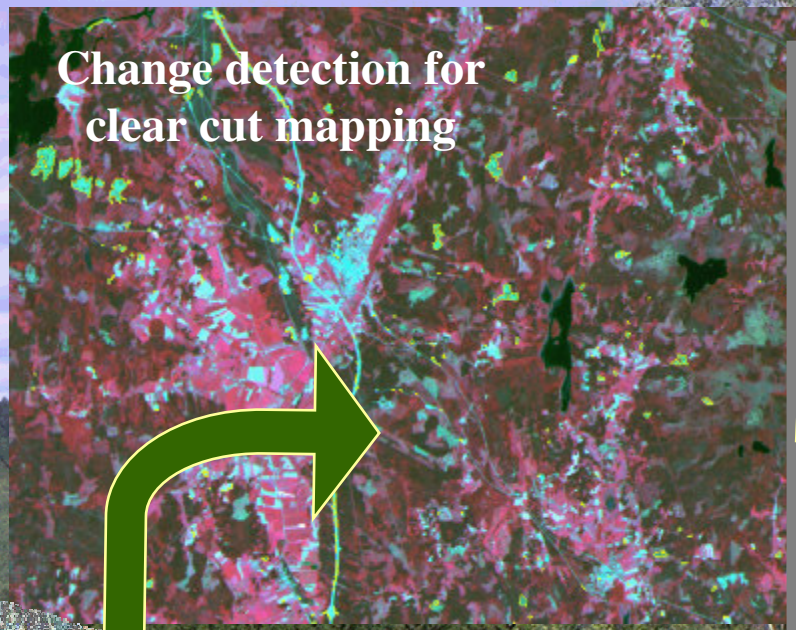
Country Imaging windows (Narrow & Extended) - Full DMC EU27 coverage 2007

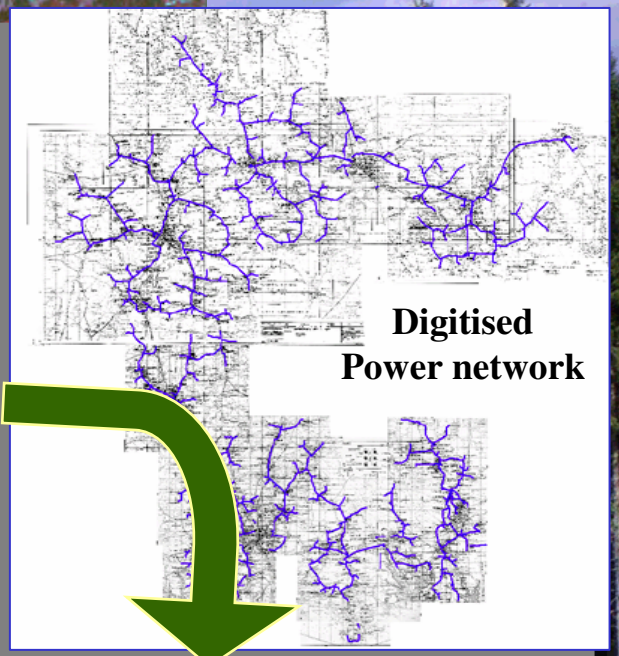


Czech Republic DMC 2007 data

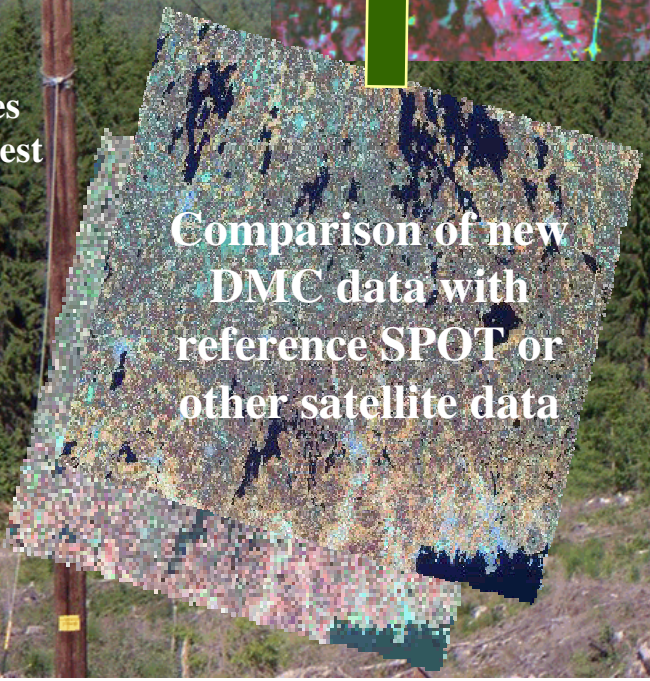


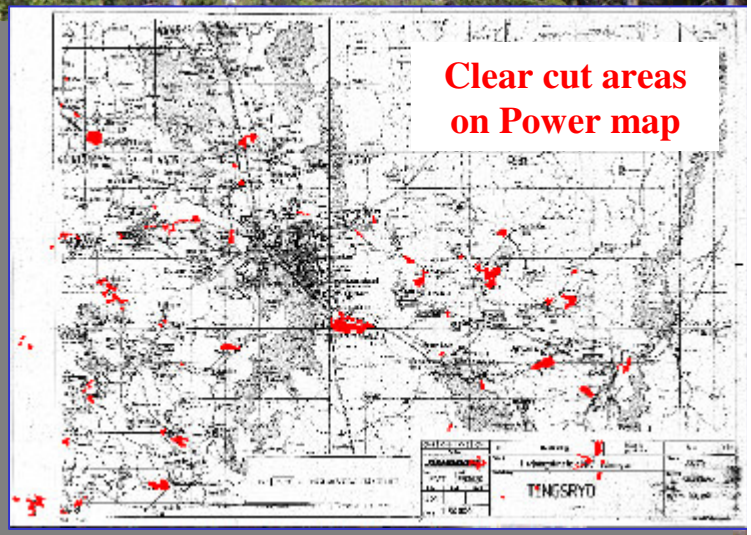
Forestry - ESA EOMD: MONITOR





Power lines
through forest





Glacial Calving, Greenland Ice Sheet

- **Monitoring Rates of glacial ice release (Calving flux)**
- The Greenland Ice Sheet is melting at rates far quicker than previously realised.
- Predicted global impact: Rising sea levels, Ocean Current instability.

Image: UK-DMC

Investigators: Adrian Luckman and Tavi Murray, Swansea University

Boreal Forest Fire Mapping, Central Siberia

- Are the Siberian Forests a Carbon Source or Sink?
- Approx. 16,000 forest fires (0.9M hectares) in Russia annually
- Future climate change may alter fire frequency and area
- There is little easily accessible information on Siberian Boreal forest fire dynamics

Image: UK-DMC

Photo: James T. Randerson

Investigators: Dr F. Gerard, Dr. H. Balzter, C. George, Dr. M. Wooster, (CEH & Kings, UK) Dr. Alexander Onuchin, (Russian Academy of Sciences)

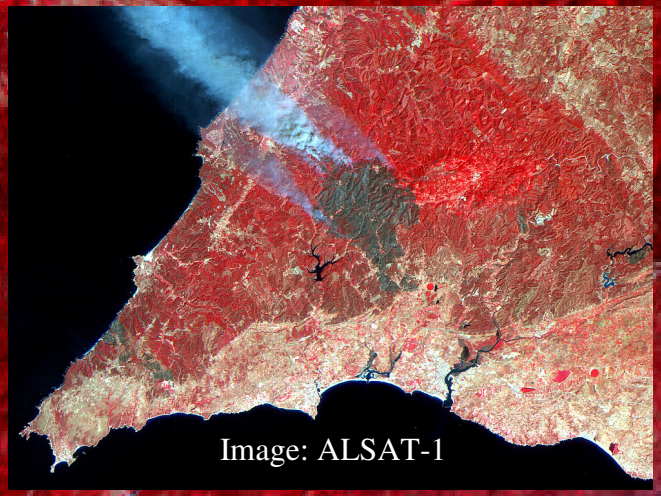
Peat Fire Mapping - Central Kalimantan, Indonesia

- **Mapping vegetation burning & peat soil fires in Central Kalimantan**
- Approx. 11 % of Indonesia's total land is peatland (50M Acres 20M Hectares)
- Burning, Logging and Draining has increased fire & flood risk
- In 1997 fires released an estimated 0.87 &2.57 billion tons of carbon into the atmosphere (13-40% of total annual anthropogenic emissions)

Image: UK-DMC

Investigators: Dr. K. Tansey, Dr. S. Page, University of Leicester (UK) Ir. S. Limin, University of Palangka Raya (Indonesia)

Fire Monitoring in Portugal



Accurate, validated burnt area products for Portugal

- To derive algorithms for mapping burnt areas.
- Determine Severity of burn, pre- and post-burn vegetation characteristics (e.g. biomass)
- Data on the type of fire that has occurred.
- Use data in computing the resultant gas emissions.
- Field validation

Image: UK-DMC

Investigators: Dr. K.Tansey, University of Leicester
Dr. JM Pereira, JM das Neves Silva & T Santos, Instituto Superior de Agronomia, Lisbon, Portugal.

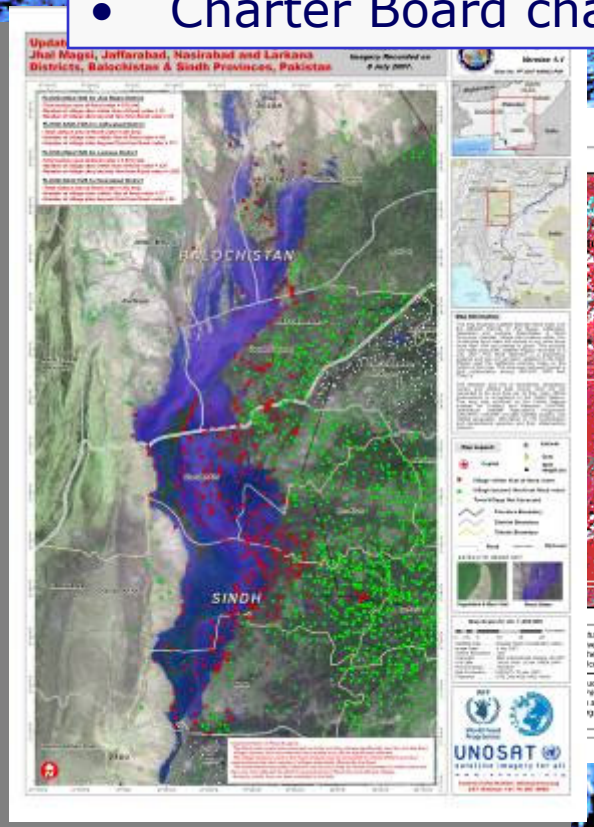
dmc International Imaging Ltd

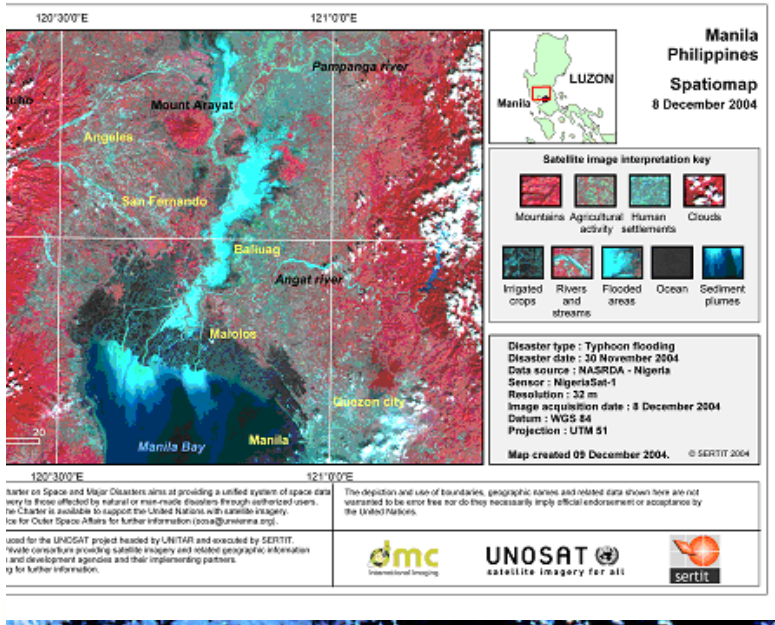
IRAQ: Basra Oil Fires

DMC Disaster Response

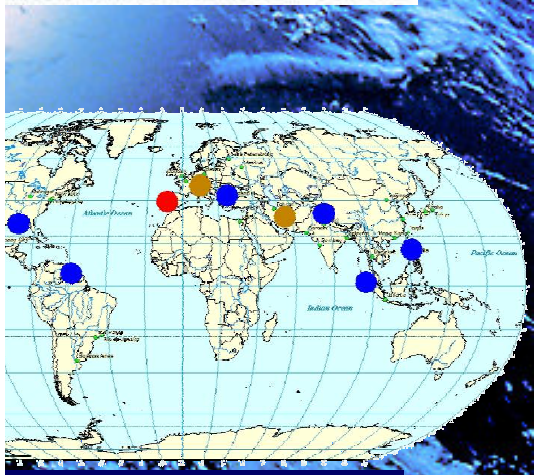
DMC's role in International Charter; Space & Major Disasters.

- Rapid response Imagery
- Emergency On Call Officers
- Executive Secretariat chair – Oct 07
- Charter Board chair– Oct 07



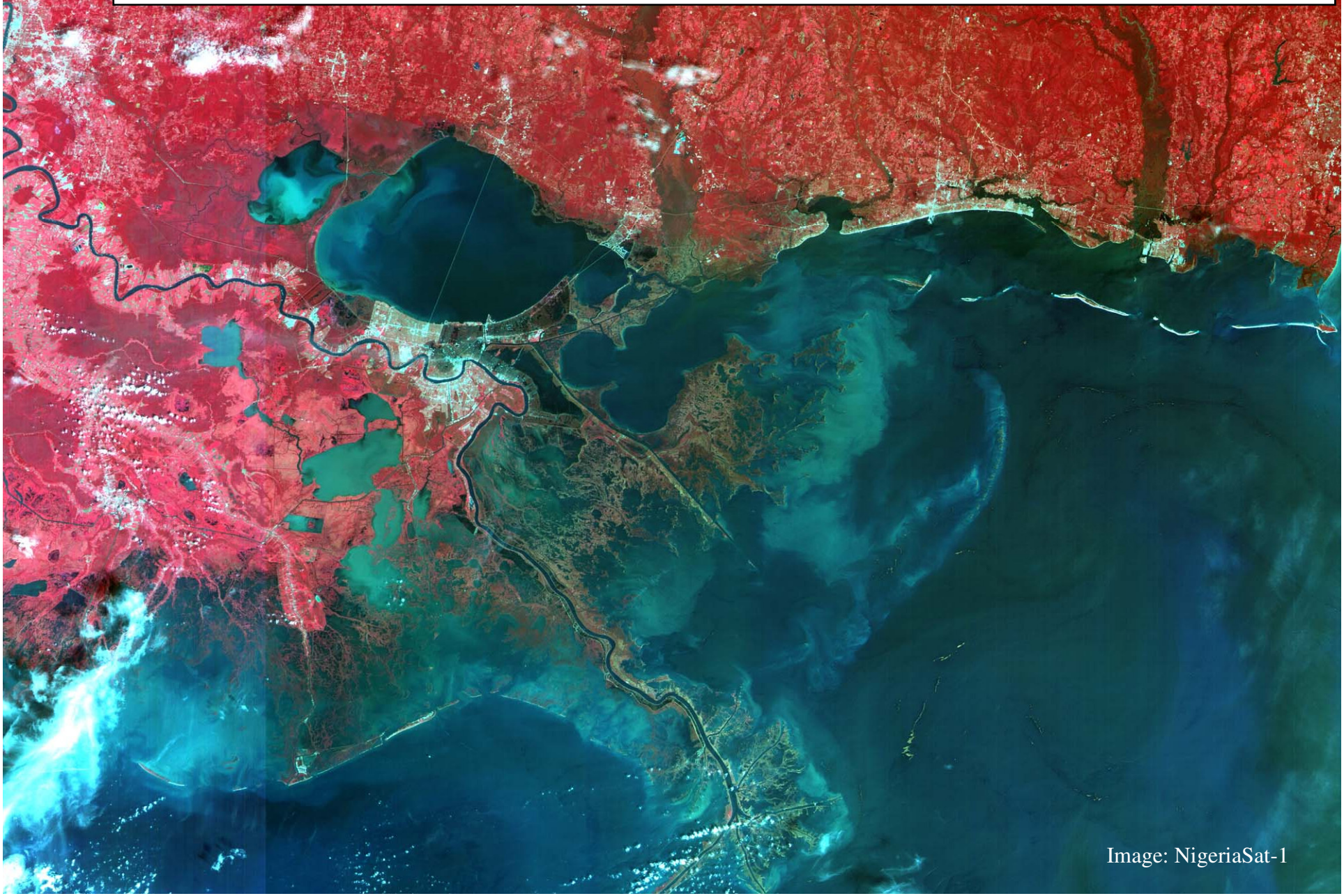


UK Charter Board Member

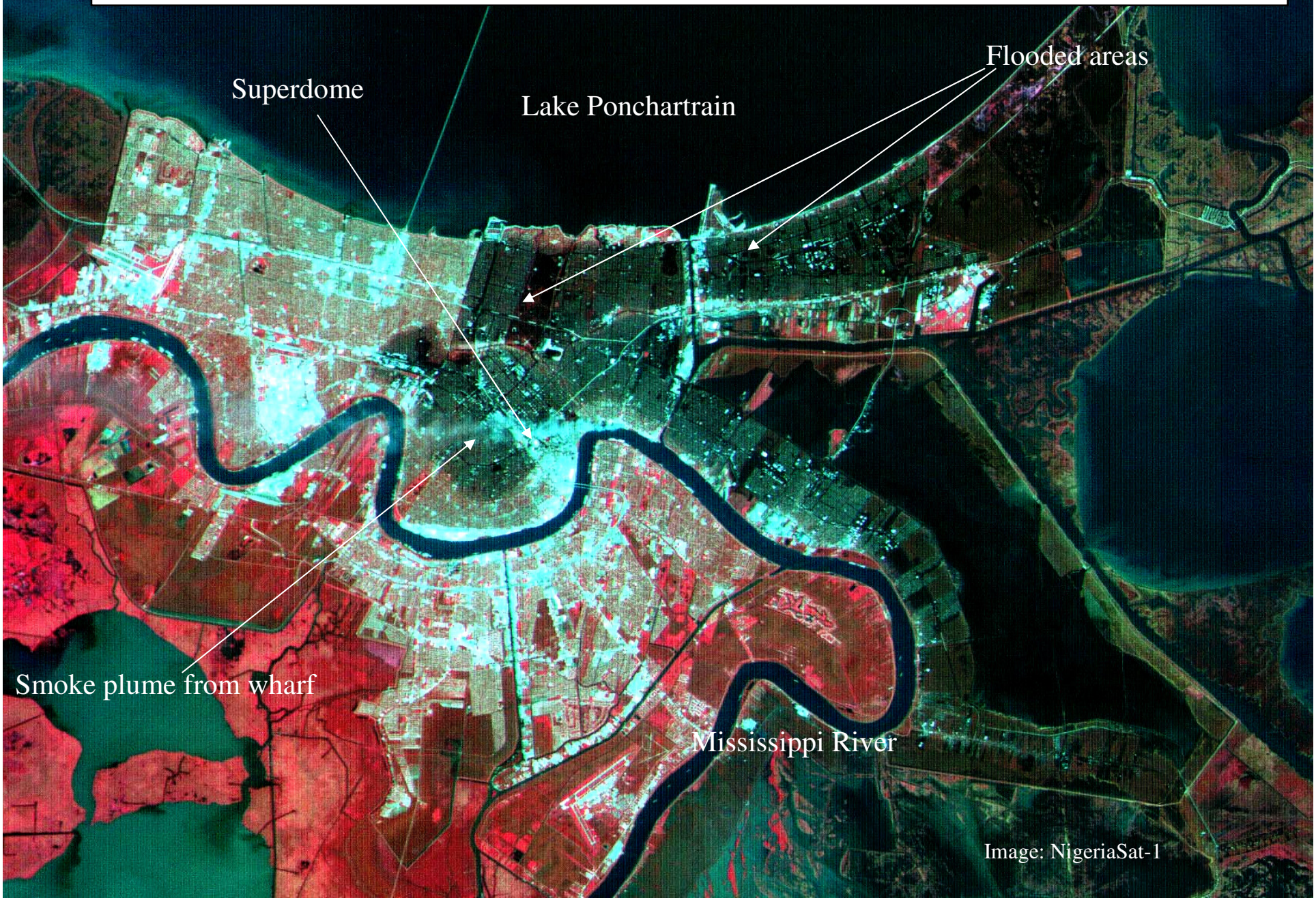


DMC Disaster Response

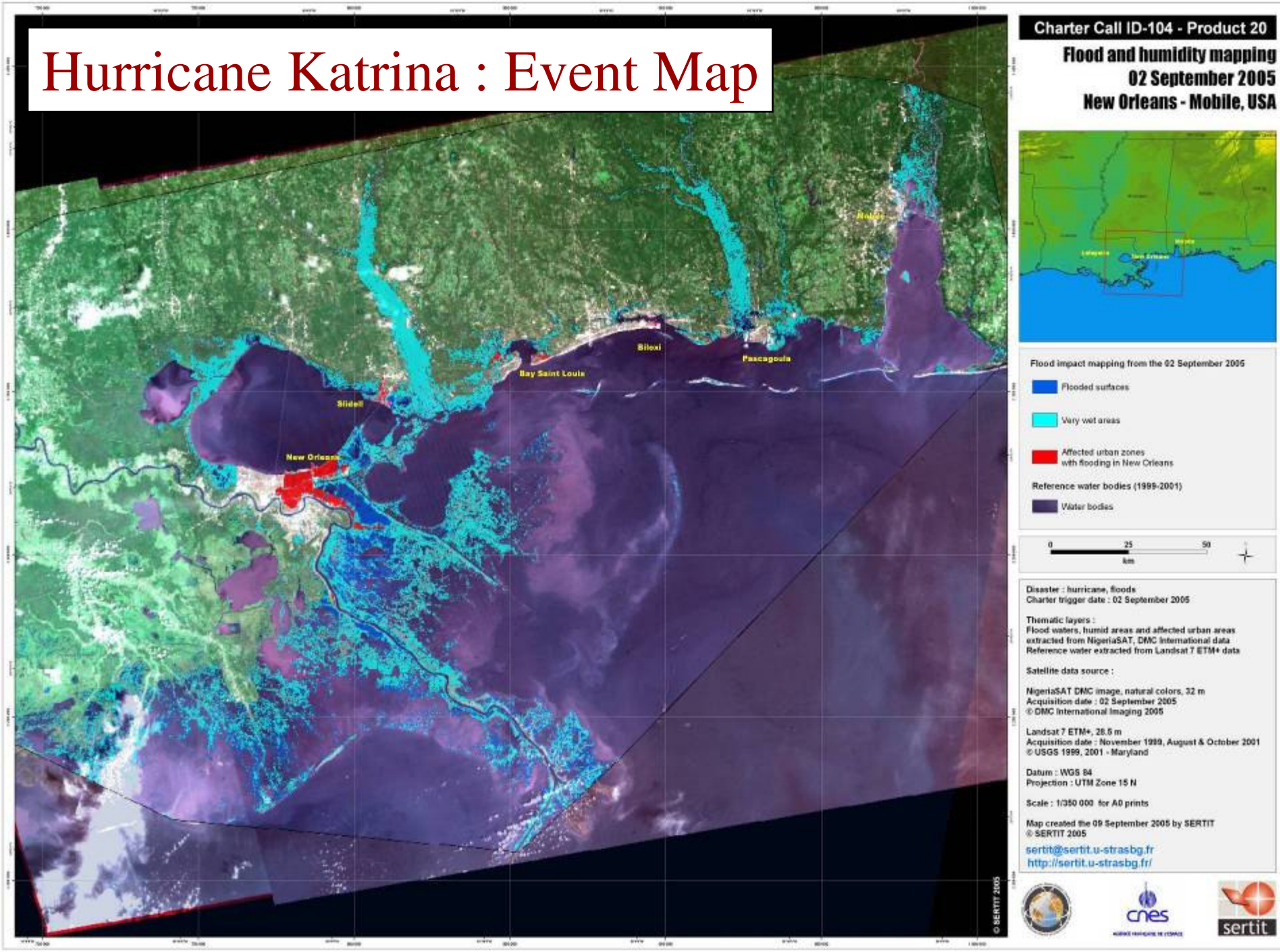
Hurricane Katrina : International Charter Call 104



Hurricane Katrina : International Charter Call 104



Hurricane Katrina : Event Map



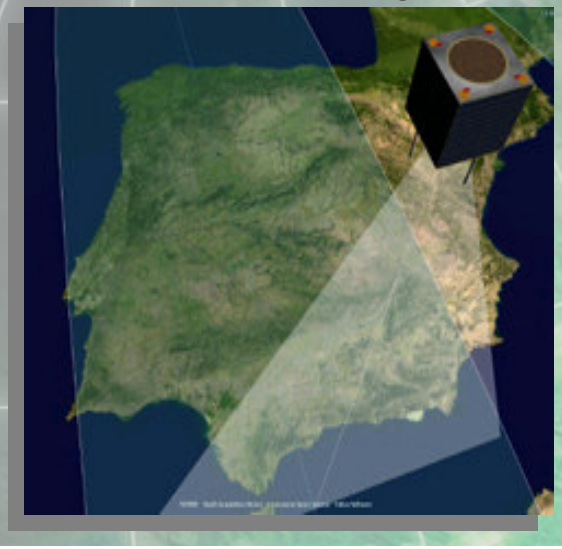
Next Generation DMC Optical Systems

UK DMC2 & Deimos-1
launch Oct 2008

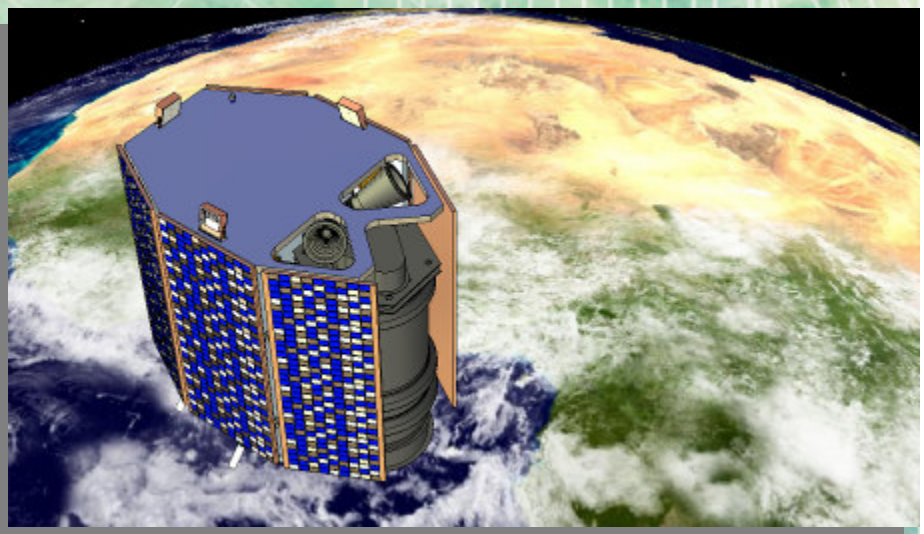
Nx satellite launch 2009

High Resolution Imager
- **22m 3-band multispectral**
- **650km swath**
- **10 bit data**

X-band downlink
- Enhanced along track imaging



Nigeriasat-2
launch 2009
- **VHR Imagers**
  - **2.5m PAN (1.25m Stereo Mode)**
  - **5.0m 4-band multispectral**
- **HR Imager**
  - **32m 4-band multispectral**
- Advanced modes
- Dual X-band downlink



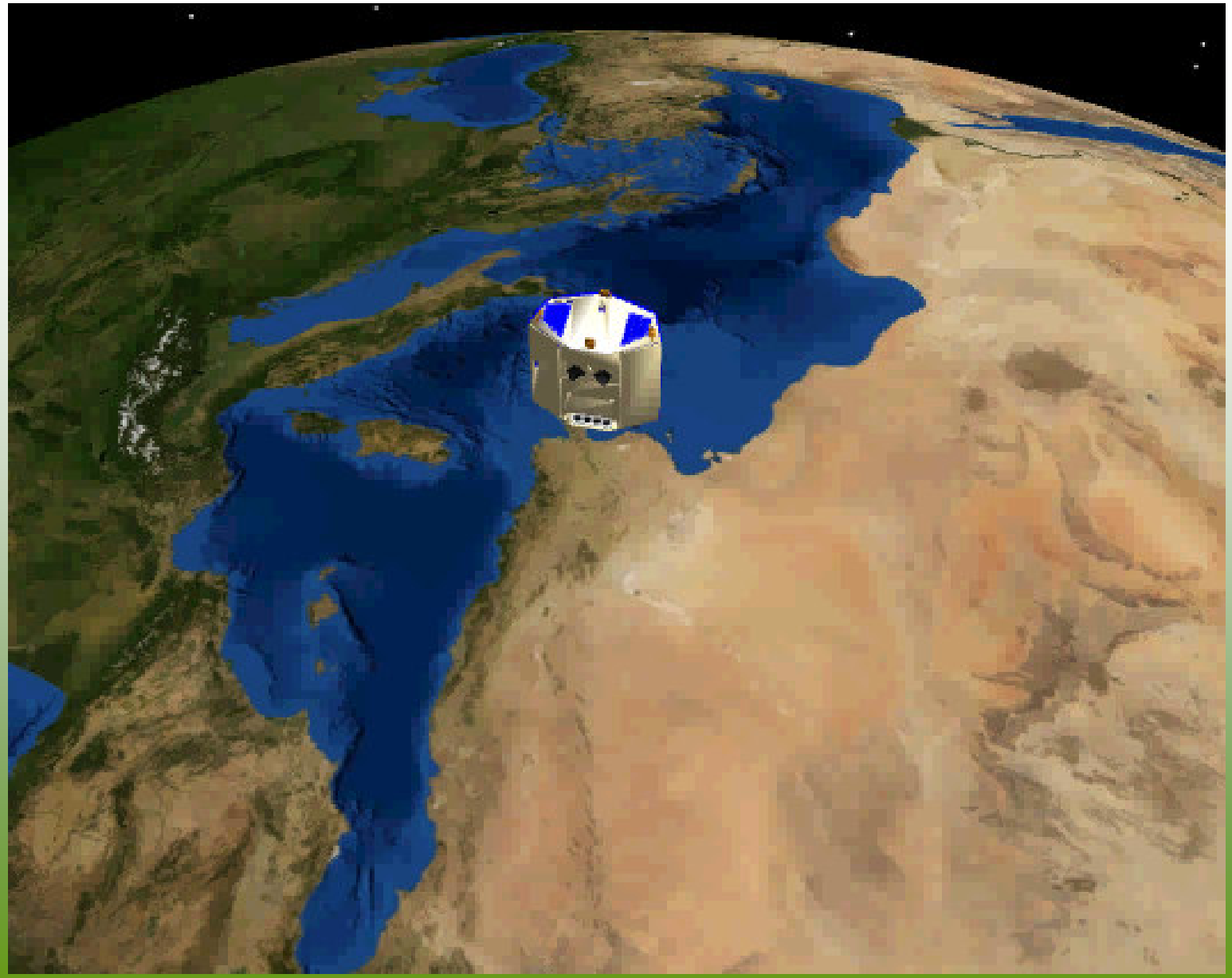
22 metre multispectral service

UK DMC-2 provides near real-time direct broadcast service to X-band groundstations

Direct broadcast to licensed ground stations from 2009

Rapid wide area coverage with coordinated constellation

NigeriaSat-2 – advanced imaging modes

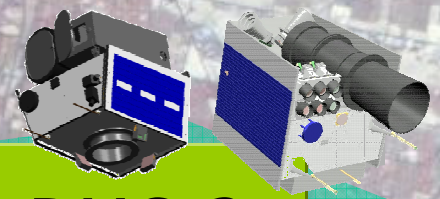


Next generation DMC

Where next? The DMC Roadmap

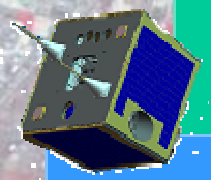
DMC-1
Optical, medium resolution multispectral

2002/2003
32m GSD
3 spectral bands
Daily coverage



2.5 & 4m GSD
Daily coverage

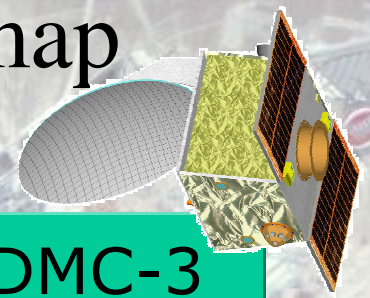
DMC-2
Optical, high resolution



DMC-3
Infrared

IR night time imaging
- hotspot detection

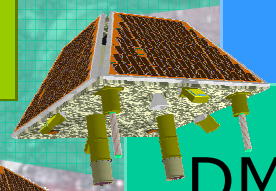
12 hourly coverage



DMC-3
Synthetic Aperture Radar

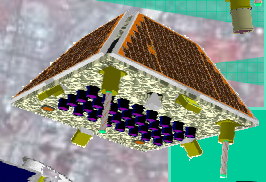
SAR "imaging"
- Night time
- All weather
- Flooding

Daily coverage



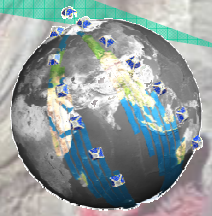
DMC-3
Hyperspectral

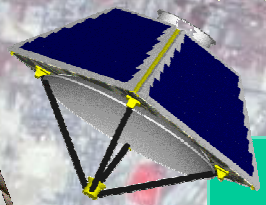
Hyperspectral imaging
Identification and detection
Daily coverage



DMC-3
Ocean Colour

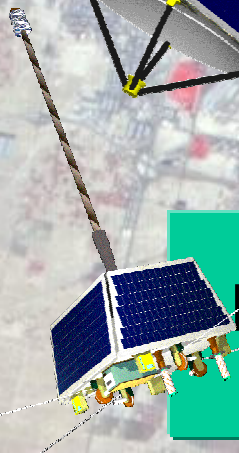
Ocean colour imaging
Pollution and fisheries
Daily coverage





DMC-3
Sea State

Sea State monitoring
Disaster mitigation
3-6 hourly coverage



DMC-3
Earthquake

Earthquake science
Disaster science

VISTA
Near Real-Time imaging constellation

Daily Earth imaging service

DMC leads the way in International coordination in space

- **5 DMC satellites in orbit**
- **4 more launch in 2008/9**
- **More planned for data continuity**

- **Coordinated Constellation**
  - Responsive Imaging service
  - High Frequency revisit
  - Wide area coverage
  - Well calibrated data
  - Moderate and High Resolution Imaging
- **Affordable Earth observation** for natural resource management

Thanks
Paul Stephens
www.dmcii.com
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International Imaging