



# SURREY

SATELLITE TECHNOLOGY LTD

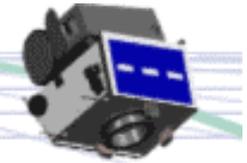


## **Surrey Space Know-how Transfer & Training Programme for Sustainable Development**

Presentation for 15<sup>th</sup> UN/IAF Workshop on “Space Education and  
Capacity Building for Sustainable Development”

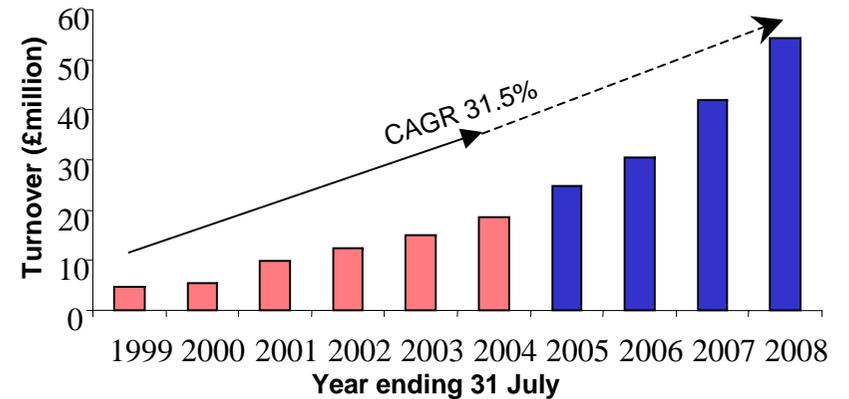
14 October 2005





**Surrey Satellite Technology Ltd is a private British satellite manufacturing company owned by the University of Surrey (80%), employees (10%) and USA Space-X (10%)**

- Formed in 1985, the Company now employs 203 staff and occupies dedicated facilities at the Surrey Space Centre.



- New purpose-built building on University Research Park ready early 2006





SSTL's nanosat



SSTL's microsat



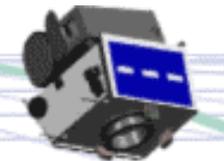
SSTL's minisat

- **Reducing the cost of entry into space**
- **Achieving more missions within fixed budgets**
- **Making constellations & formation flying financially viable**
- **Responding rapidly from initial concept to orbital operation**
- **Bringing the latest industrial COTS component advances to space**

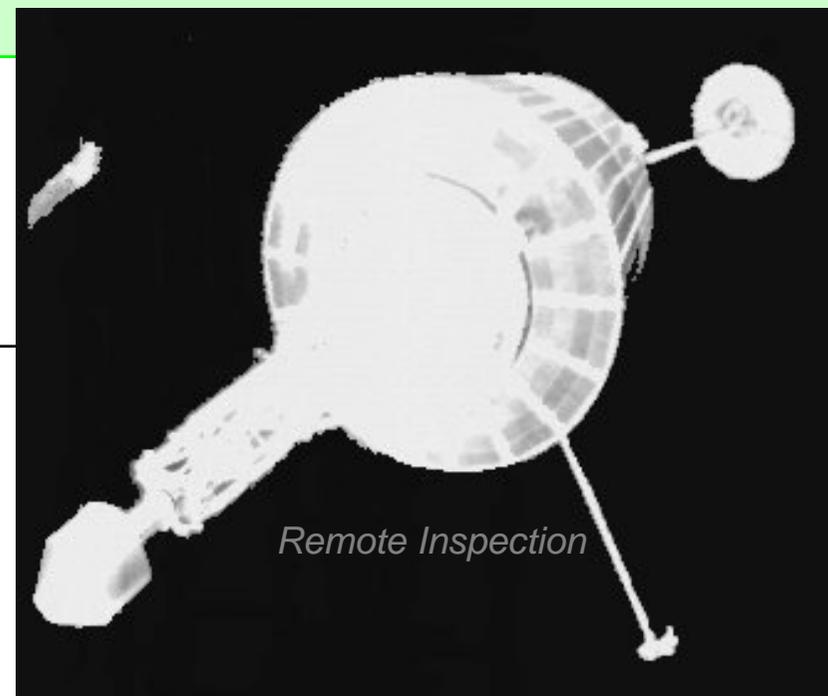
**Low cost and rapid response small satellite using advanced terrestrial technologies**



# Revolution in Space



	<i>Mass</i>	<i>Cost</i>	<i>Time</i>	<i>Tech</i>
<b>ESA Envisat</b>	8000kg	\$3000m	15yrs	4MIPS
<b>SSTL SNAP-1</b>	6.5kg	\$1m	6 mths	10MIPS



*Remote Inspection*

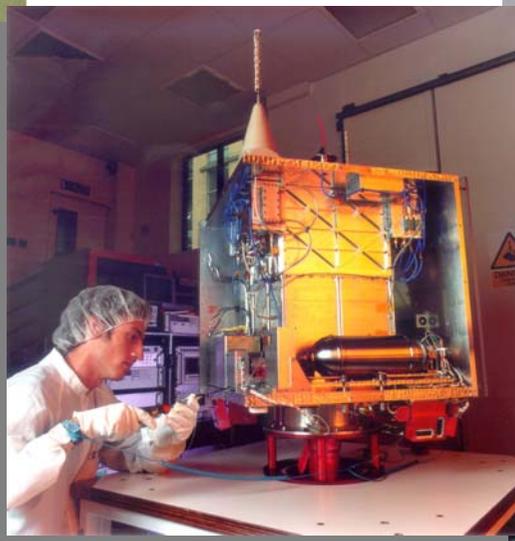
*SNAP-1 under construction*

## 'PC in Space'

- similar impact as PC in computer industry and user community



**Nigerian President opening NigeriaSat-1 User Seminar**



**NigeriaSat-1**



**Primary School Children visiting Surrey Space Centre**

**As a national focus to promote space awareness to decision maker & public to make the funding available and gain public support**

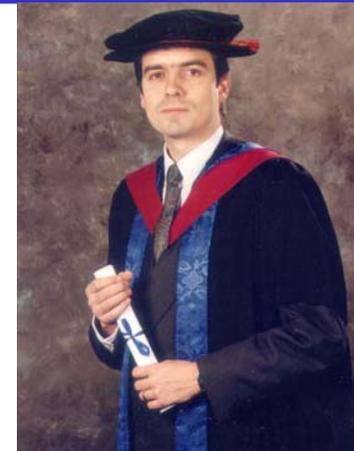




**SSTL Managing Director**  
- First S&F communications



**SSTL Marketing Director**  
- First DSP Communications



**SSTL GPS Team Leader**  
- First GPS Receiver



**Ball Aerospace engineer**  
- First optical payload



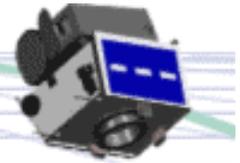
**SSTL Marketing Director**  
- Flying her payload on PoSAT-1



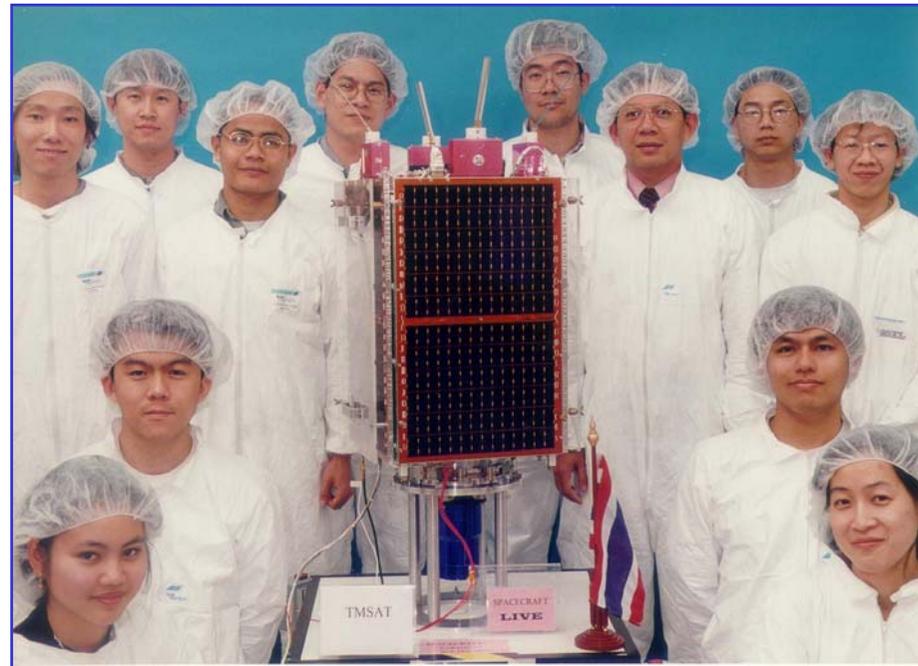
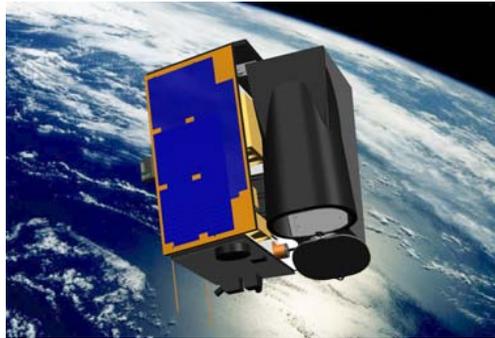
**USAF Academy**  
- First low cost propulsion

**PhD from Surrey Small Satellites**





- Takes advantage of the *'faster, cheaper & better'* small satellites pioneered by Surrey to...
  - Launch first national microsatellite & demonstrate its applications
  - Train engineers as nucleus of a space agency & industry
  - Establish national space facilities & capabilities



**to provide an Affordable, Independent, Sustainable Space Capability**



Algerian Team



Nigerian Team



Algerian KHTT Team



*Left to Right: Andy Bradford, Unsal Orlu, Ali Telli, Gokhan Yuksel, Ugur Leloglu, Mehmet Durna, Cem Ozkaptan, Levent Erturk, Dogu Cetin*  
Turkish Team



NigeriaSat-1, UK-DMC and Bilsat in Launch Site

## Capacity Building for Algeria, Nigeria and Turkey Long Term Space Programme



## DMC promotes

- ★ International cooperation with
- ★ Individual satellite ownership

## Three launches into the same orbit:

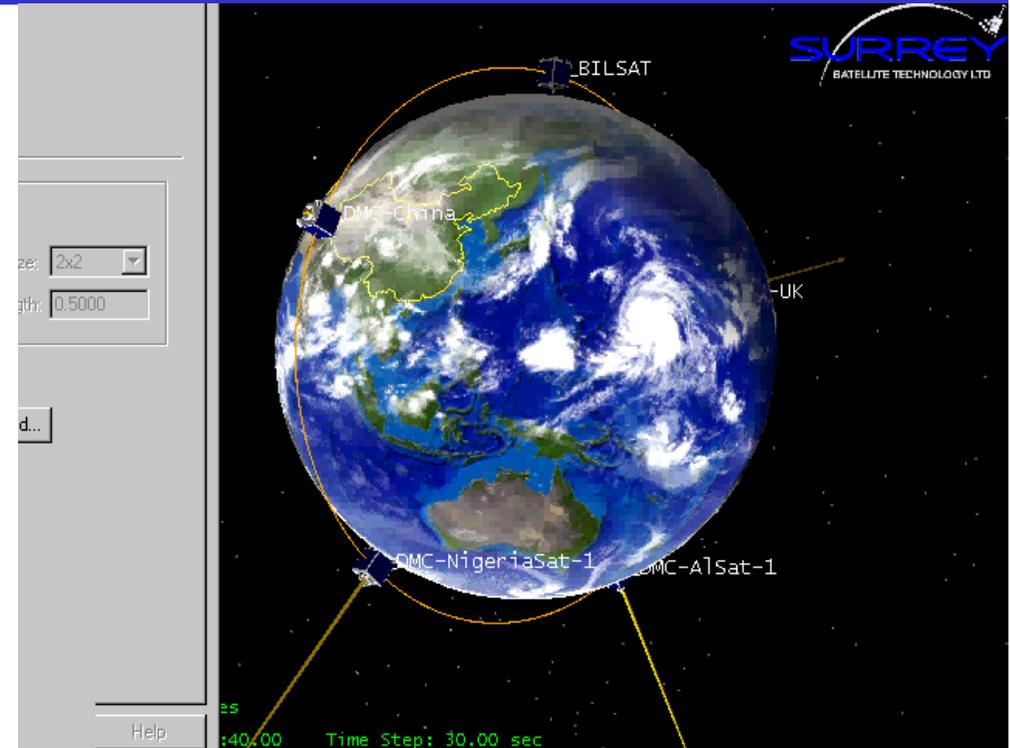
November '02:	Algeria
September '03:	Nigeria, Turkey, UK
September '05:	China, (TOPSat)

**Global daily imaging capability – stimulate new EO applications and services**



First DMC Consortium Meeting at Surrey

## Participation in High Profile International Cooperation For National Supports



## Five national satellites in a coordinated constellation

## DMCII imaging service company providing operational services:

- ★ Coordinate the constellation
- ★ Commercial sales of images
- ★ Contribute to international disaster monitoring

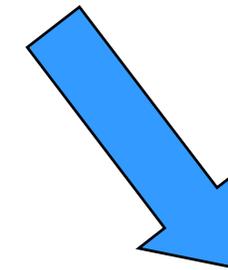


Space Agencies Sharing Space Assets for Global Disaster Management

ASAL/CNTS



Emergency  
Management  
Agency



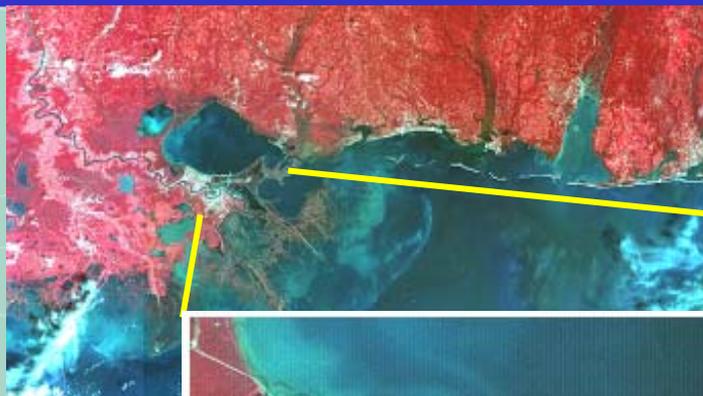
Supplies Data for  
International Crisis'

Receives data for  
National Crisis'

**Contribute to Global Disaster Monitoring Gains Decision Maker and Public Supports**



# New Orleans Flooding August 2005

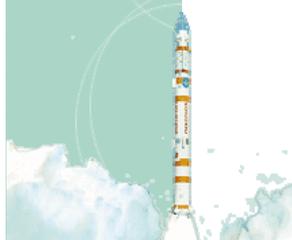


Gulf of Mexico  
02-Sep-2005 15:56:21 UTC



**International Charter Call 103**

Source: AISAT-1

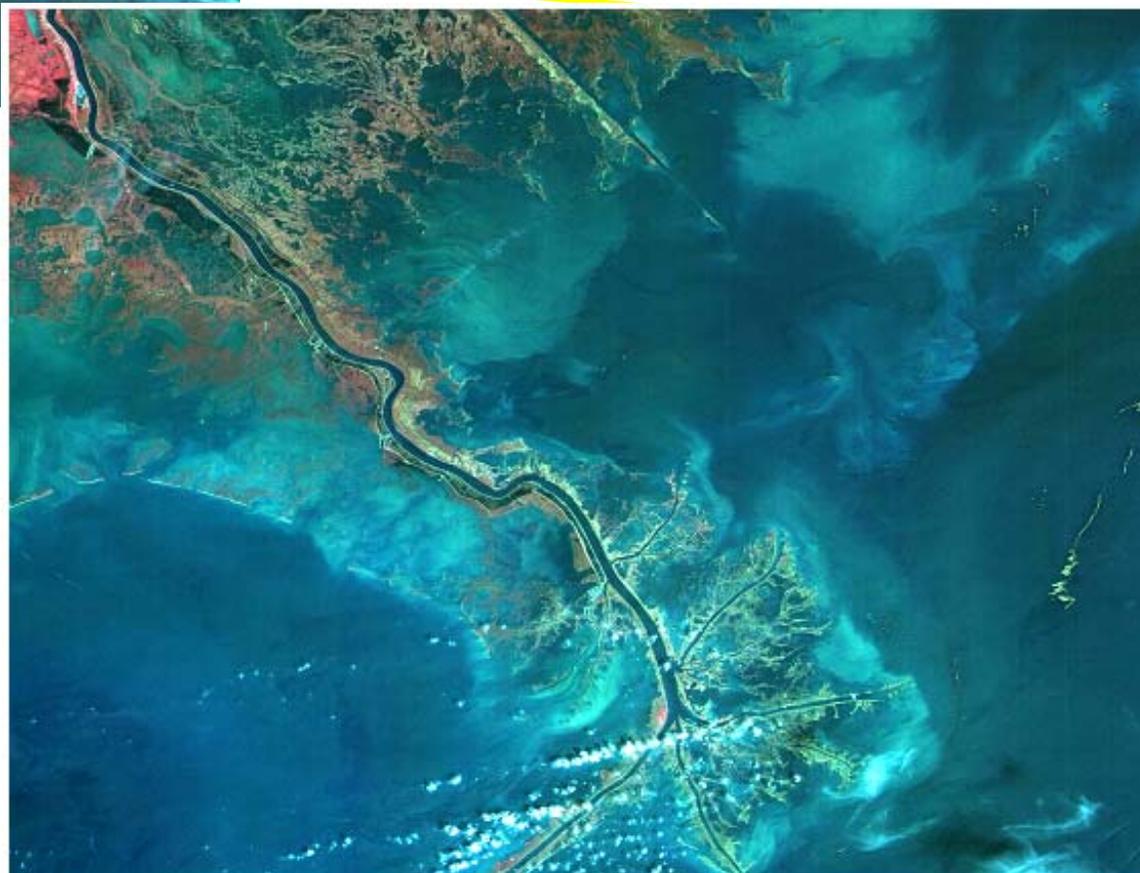


# New Orleans Flooding August 2005



Gulf of Mexico  
02-Sep-2005 15:56:21 UTC

Source: AISAT-1



Mississippi Delta

**International Charter Call 103**





**Legend**

**Quickbird Scenes (JRC)**

Quickbird Scenes (JRC)

**Quickbird scenes (04/01/2005)**

Quickbird scenes (04/01/2005)

**IRS PAN scenes (26/12/2004)**

IRS PAN scenes (26/12/2004)

**SPOT scenes (04/01/2005)**

SPOT scenes (04/01/2005)

**Affected Area (<20m and <5km inland)**

Affected Area (<20m and <5km inland)

**Ikonos scenes (10/01/2005)**

Ikonos scenes (10/01/2005)

**DMC scenes (11/01/2005)**

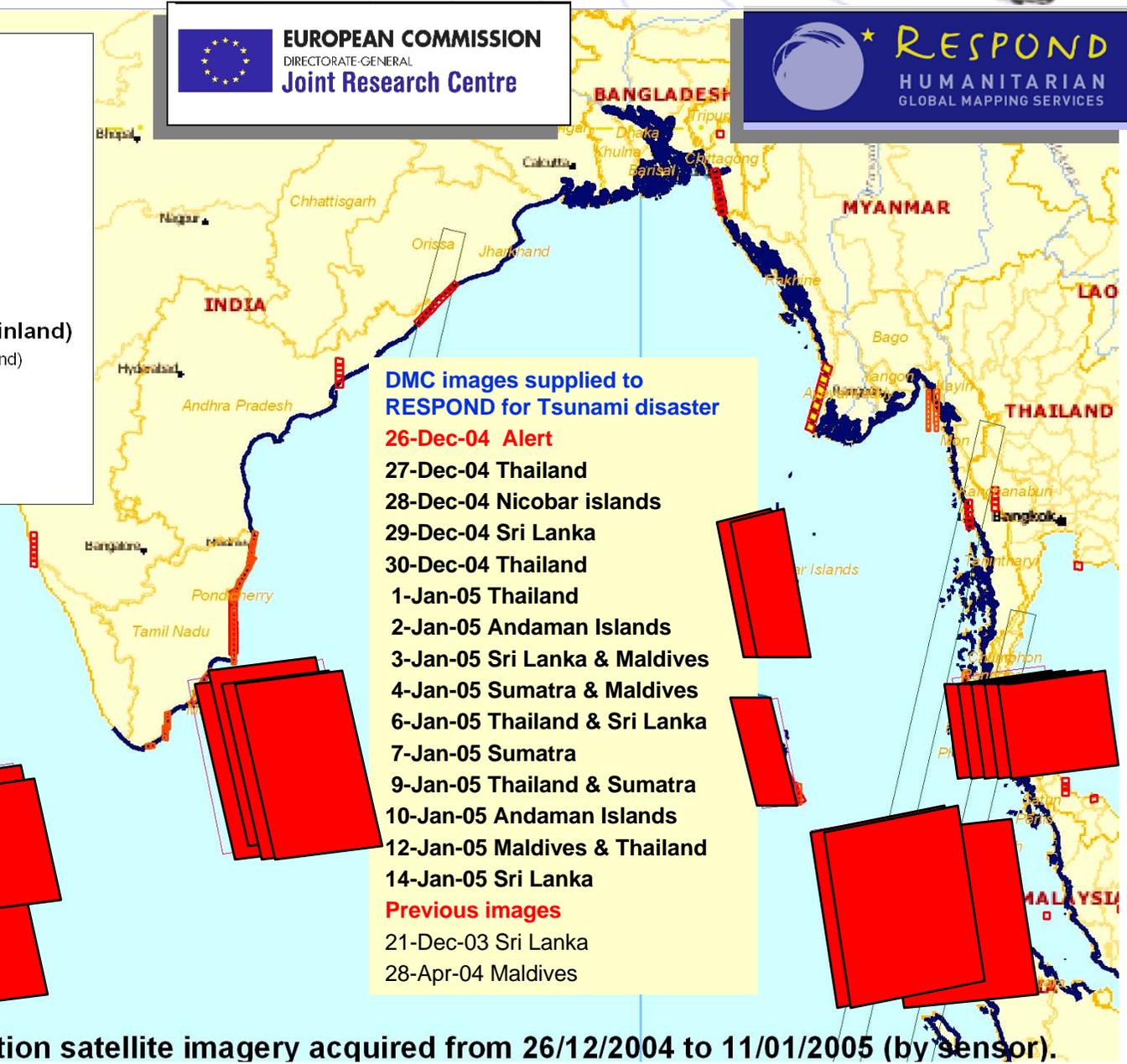
DMC scenes (11/01/2005)



**EUROPEAN COMMISSION**  
DIRECTORATE-GENERAL  
**Joint Research Centre**



**RESPOND**  
HUMANITARIAN  
GLOBAL MAPPING SERVICES



**DMC images supplied to RESPOND for Tsunami disaster**

**26-Dec-04 Alert**

27-Dec-04 Thailand

28-Dec-04 Nicobar islands

29-Dec-04 Sri Lanka

30-Dec-04 Thailand

1-Jan-05 Thailand

2-Jan-05 Andaman Islands

3-Jan-05 Sri Lanka & Maldives

4-Jan-05 Sumatra & Maldives

6-Jan-05 Thailand & Sri Lanka

7-Jan-05 Sumatra

9-Jan-05 Thailand & Sumatra

10-Jan-05 Andaman Islands

12-Jan-05 Maldives & Thailand

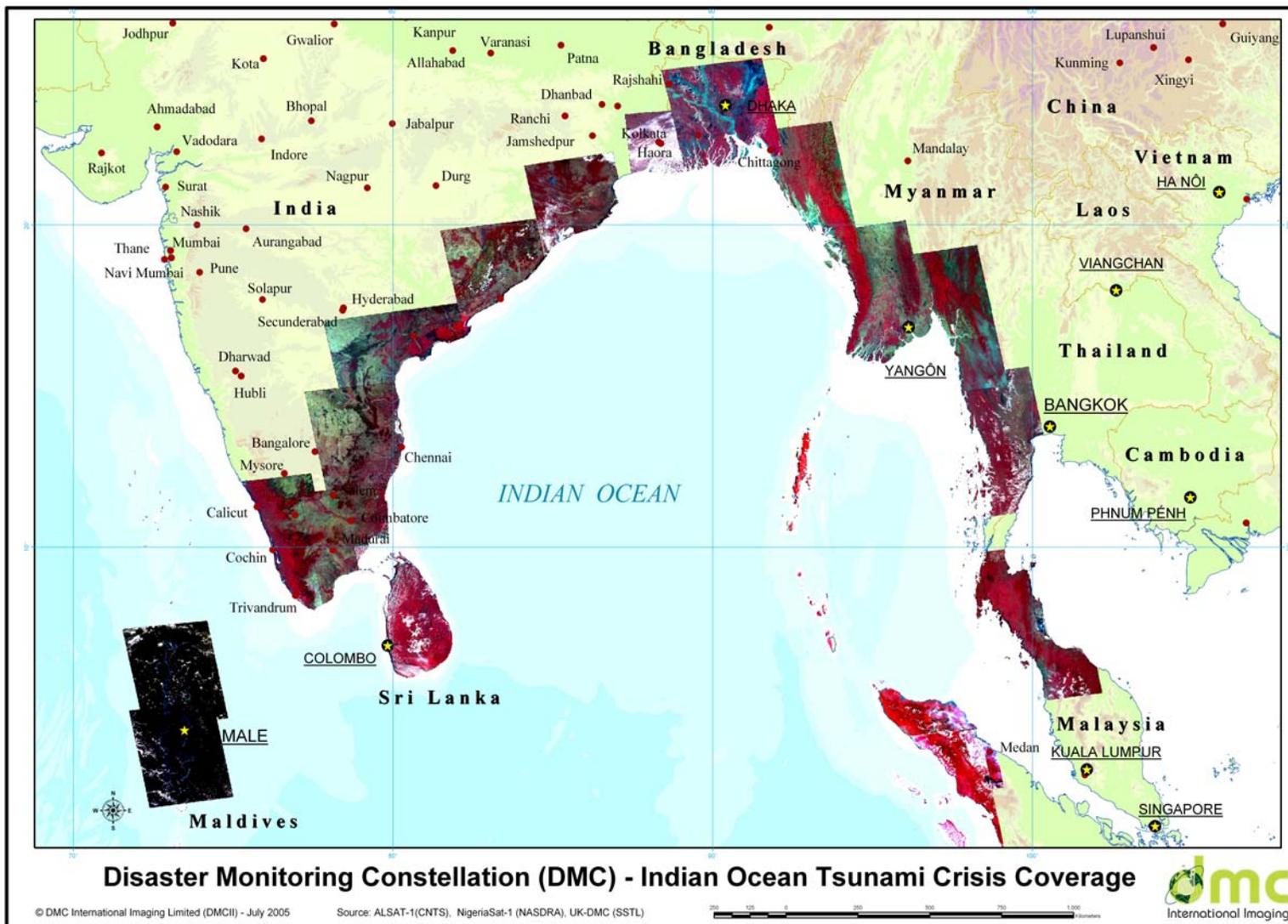
14-Jan-05 Sri Lanka

**Previous images**

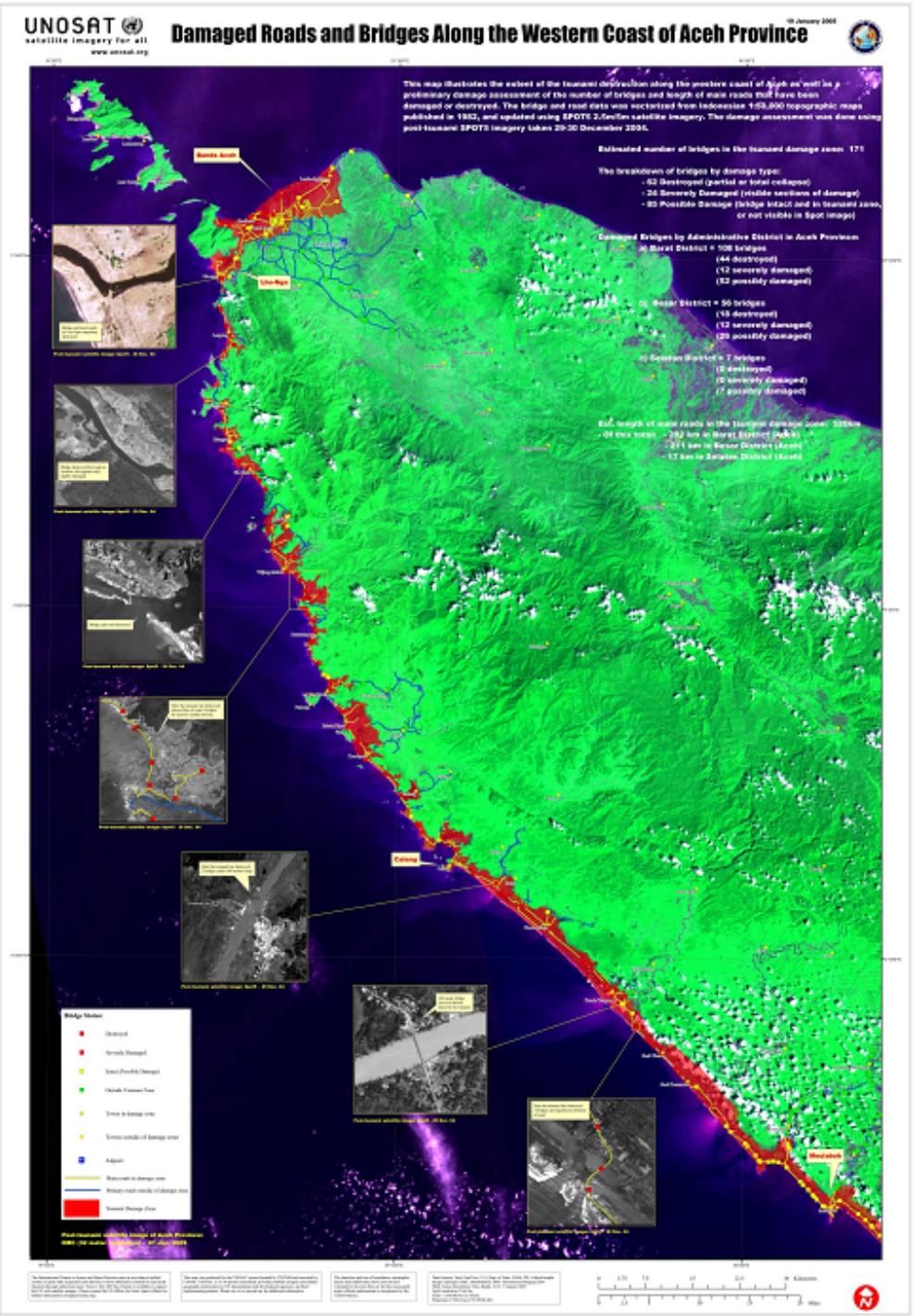
21-Dec-03 Sri Lanka

28-Apr-04 Maldives

High and very high resolution satellite imagery acquired from 26/12/2004 to 11/01/2005 (by sensor).



**With Imagery Before, During and After the Crisis**





## Environment & Forestry

- *Costal Erosion Monitoring*
- *Burn Scar Mapping*
- *Forest Powerline Risk Mapping*
- *Landcover & Habitat Mapping*
- *Hydrological Mapping*
- *Logging & Deforestation Management*



## Agriculture

- *International Precision Farming*
- *Illicit Crop Monitoring*
- *EC AGRIFISH*
- *Food Security*

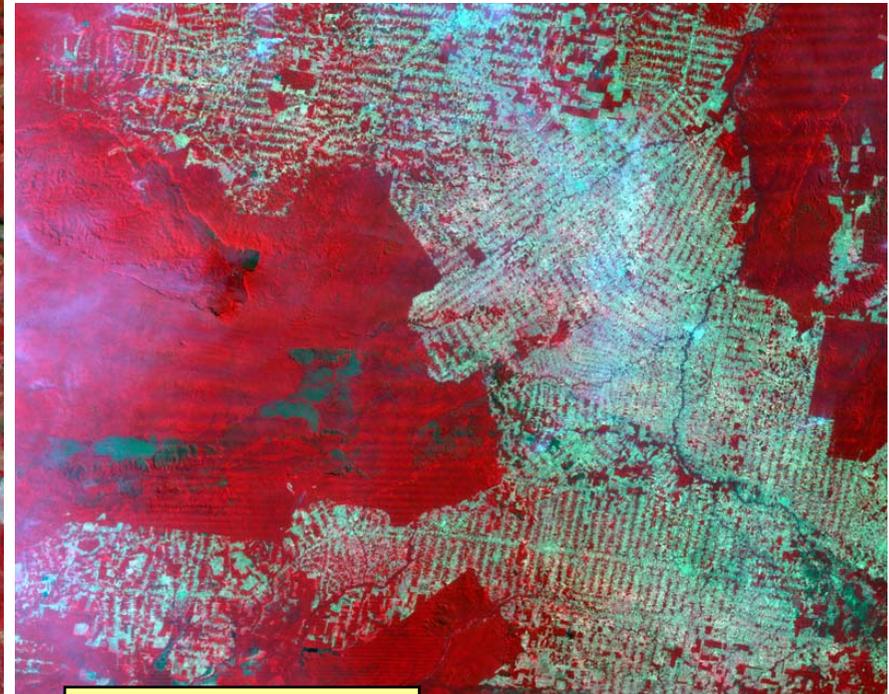




**Customer:** The Brazilian National Institute for Space Research (INPE)



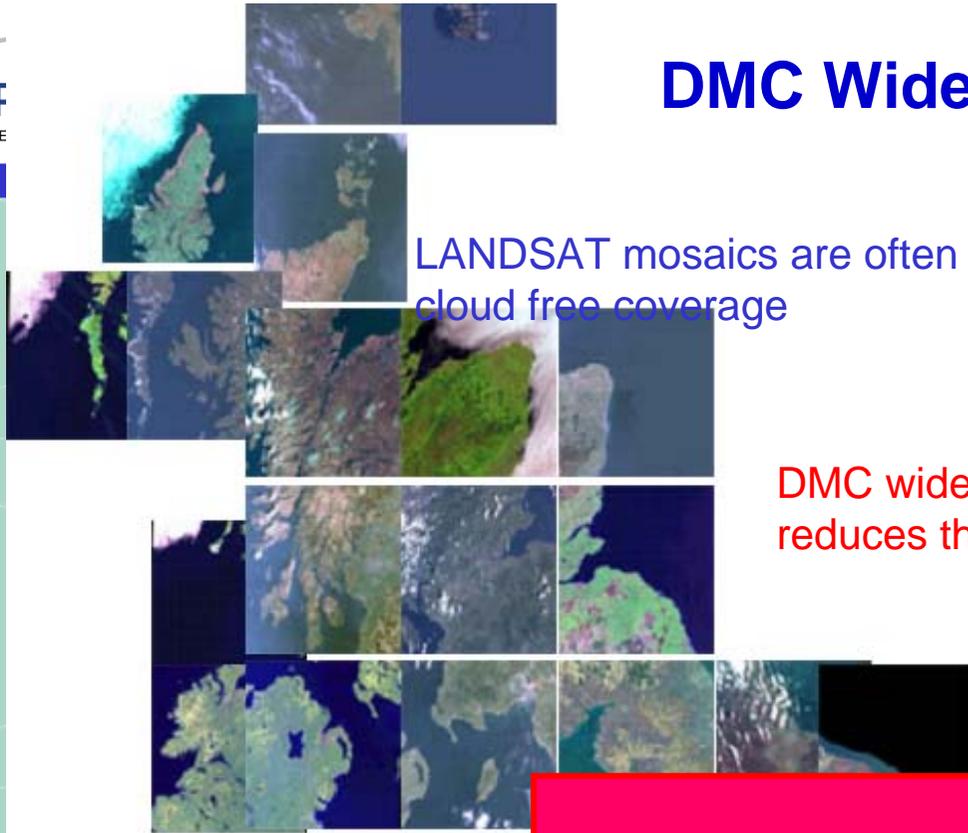
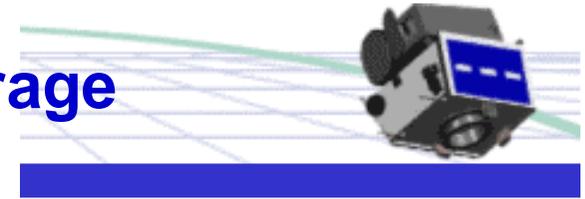
Source: NigeriaSat-1



Source: UK-DMC

The Amazon basin is a critical Brazilian national and global environmental resource. Illegal logging and forest clearance over this vast region depletes natural resources, increases pollution from clearance fires and reduces taxation revenues. INPE selected DMC sensors including NigeriaSat-1 for the \$200,000 contract to provide repeat coverage of the Amazon Basin in 2005. Only DMC can provide the wide coverage with multiple satellite revisits to image this cloudy region and meet INPE's data requirements.

# DMC Wide Coverage



LANDSAT mosaics are often taken over many seasons to provide cloud free coverage

DMC wide area coverage & frequent revisit reduces these problems

DMC 600 x 600 km image

Coverage Exceed LandSAT

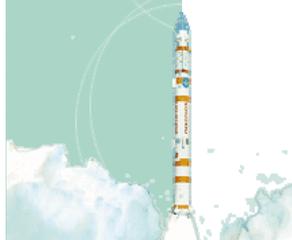
LANDSAT 185 x 185 km image

Wide coverage and daily revisit imaging capability stimulate new services



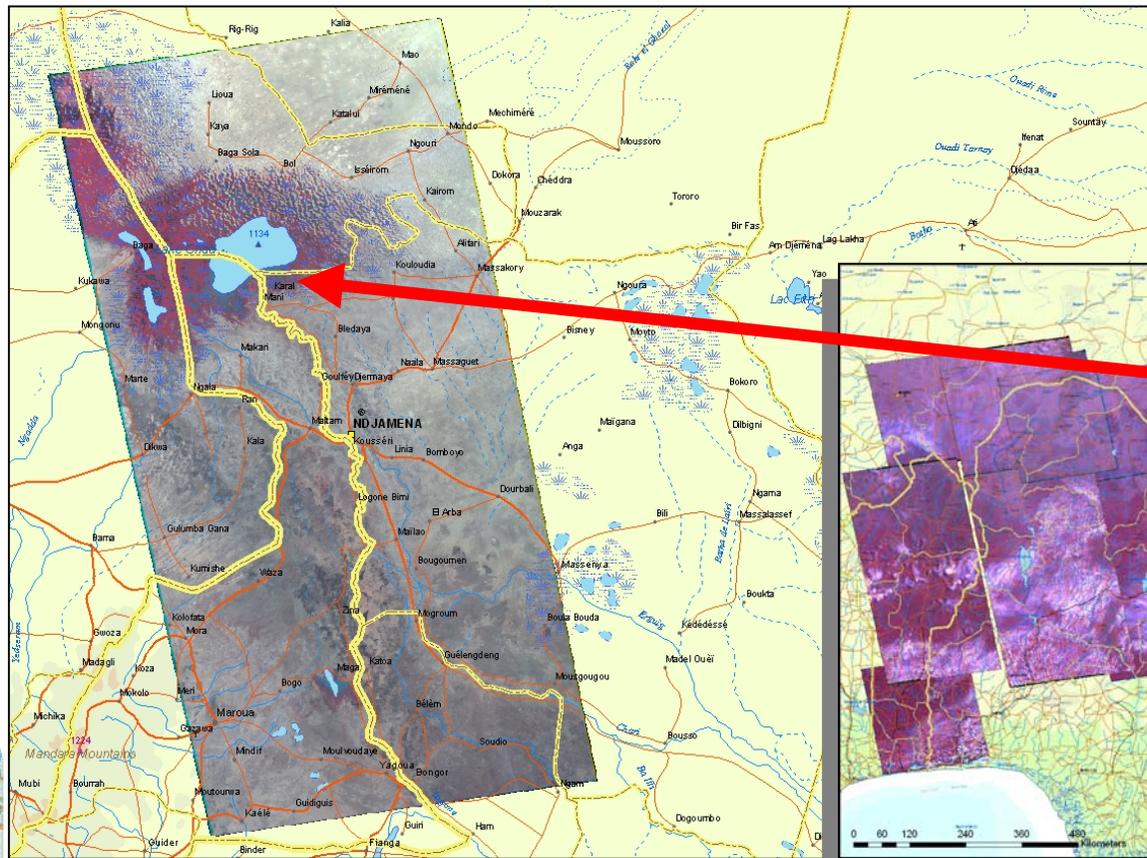
## UK-DMC

- **Imaging the whole of England in one pass**
- **Monitoring crop growth during critical growing season**

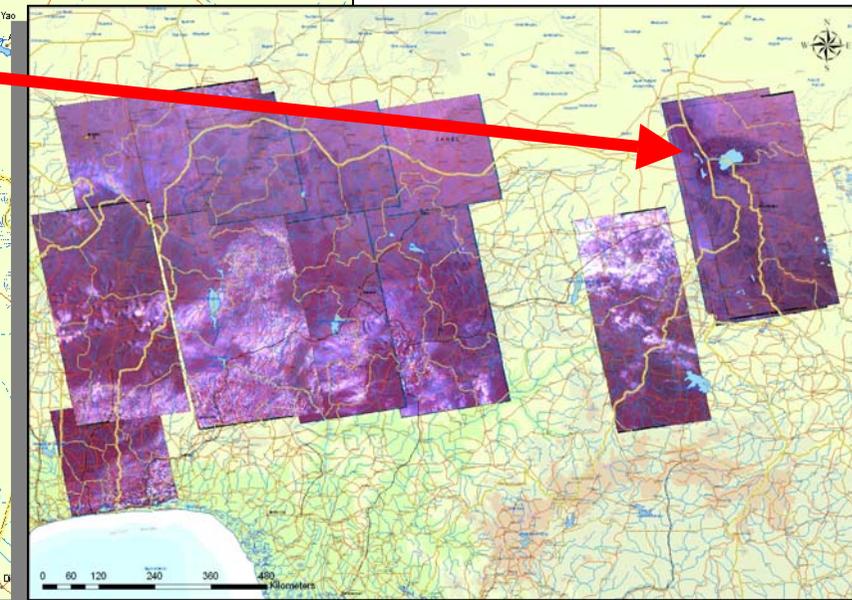




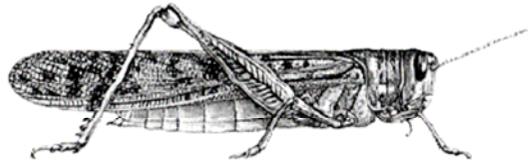
Regulation of water resources development in Nigeria is defined in Water resources decree 101 of 1993 (Fed. Govt. Gazette Extraordinary No. 27 Vol.80 of 1<sup>st</sup> Sept. 1993). Transboundary water sources are stated to include all “water courses rising, directly or indirectly influent to Lake Chad”. Regular Monitoring of lake Chad with NigeriaSat-1 allows rapid & regular water exploration of the region.



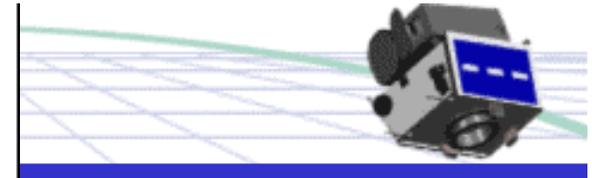
Source: NigeriaSat-1



**NigeriaSat-1 Stimulate Nigerian National Space Applications**



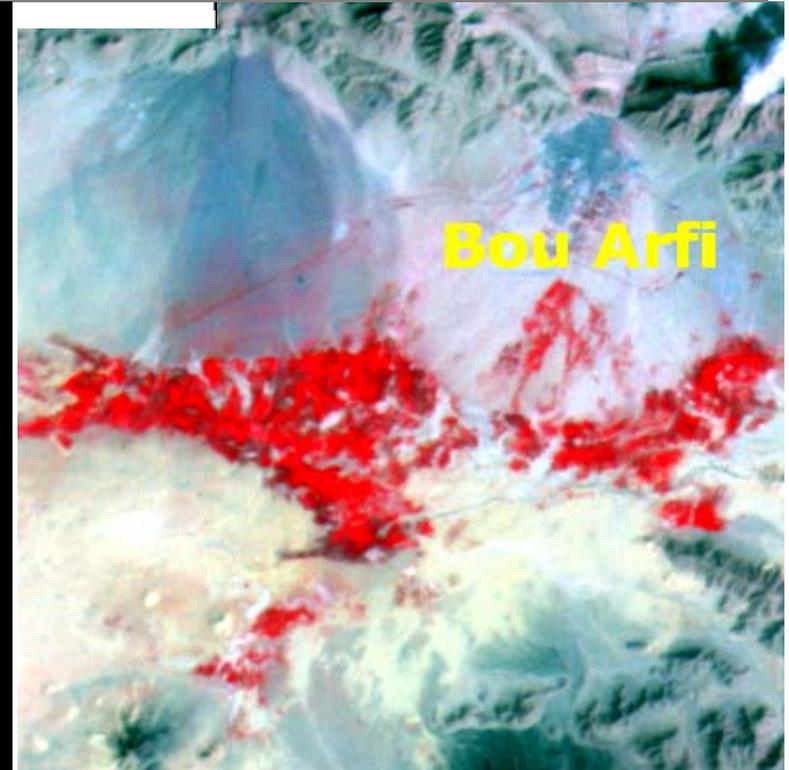
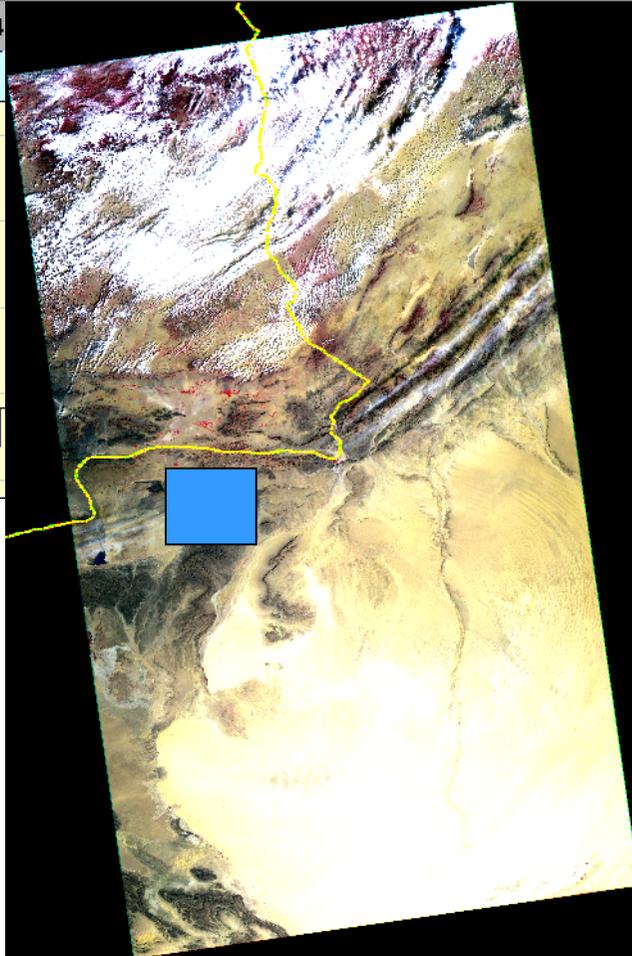
ORGANISATION DES NATIONS UNIES  
 POUR L'ALIMENTATION ET L'AGRICULTURE  
*aider à construire un monde libéré de la faim*



**Contribution of the Algerian satellite AISat-1 in the battle against the Desert Locust.**

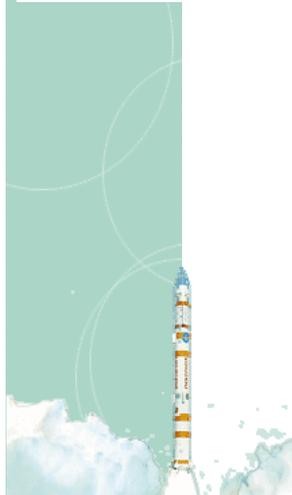
Images from Alsat-1 were of great support to the preventive phase of the fight against the Desert Locust, since they enabled a periodic monitoring of the swarming areas, said M. Belhamouda, manager at the Algerian Space Agency ( ASAL) and member of the Interministerial Committee for supervising the combat against the Desert Locust (CISLA) (20-06-04)

Situation early March 2004



Increased chlorophyll activity – indicates risk of locusts

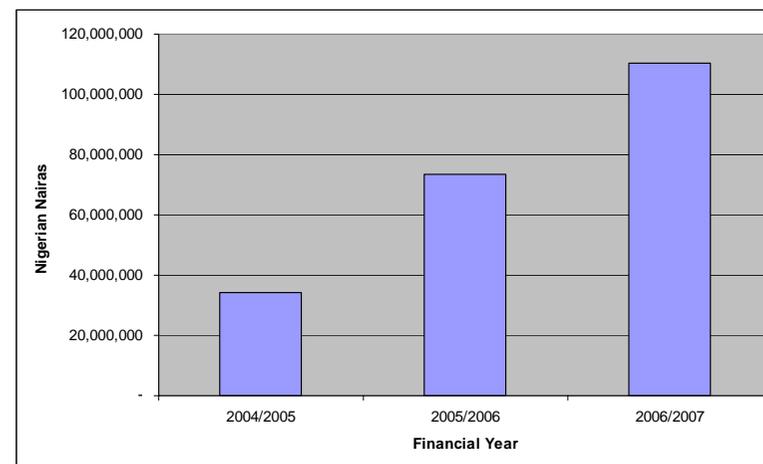
**AISAT-1 Data Used In the Battle Against Desert Locust**





*DMC data has been purchased in volume by the following International Customers:*

- **USA - US Geological Survey**
- **Brazil - The Brazilian National Institute for Space Research (INPE)**
- **Canada - Canadian Forestry Commission**
- **France - Geosys, Farmsat (Europe), US**
- **EC Joint Research Centre (JRC)**
- **UK - The Countryside Council of Wales**



***NigeriaSat-1 earned 3.87 Million Nairas (16,400 GBP) Royalties in first 6 months of commercial operations.***

***(Feb 2005 – Jul 2005)***

**Commercial Return For Public Investment for Sustainable Development**





- **Deliver State-of-Art small satellite technology**

SSTL is the acknowledged world leader in small satellite development.

- **Comprehensive Space Technology Transfer**

Only company with complete space capability from mission definition to application exploitation.

- **In depth Satellite Technology Transfers**

Probably the only company that manufactures nearly all of the spacecraft platform in house.

- **Access to Advanced Academic Research**

Co-located with the Surrey Space Centre at the University of Surrey.

- **Deliver the most suitable space technology**

SSTL created the low cost satellite approach in satellite design and ground facilities management.

- **Deliver standard / compatible small satellite bus technologies**

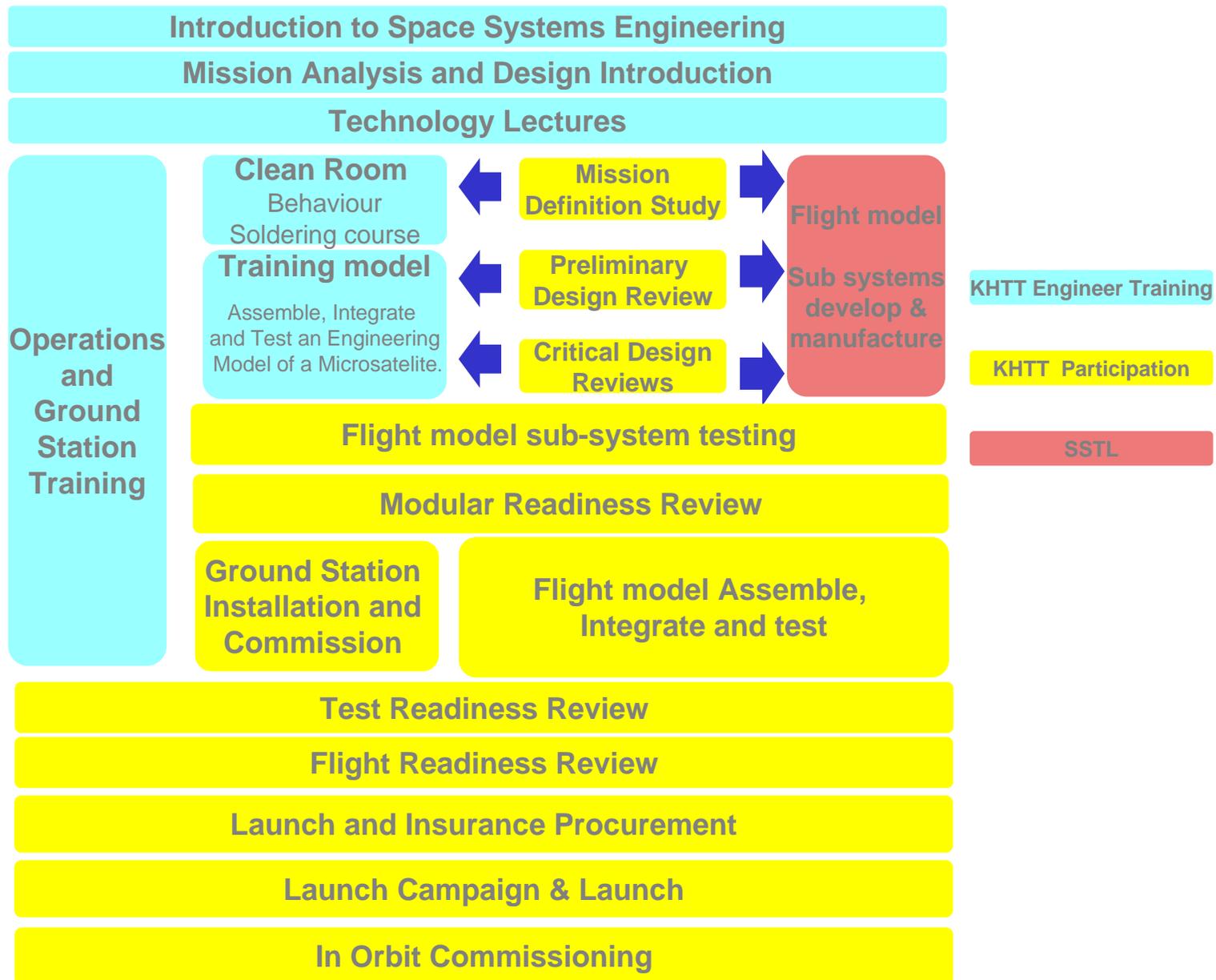
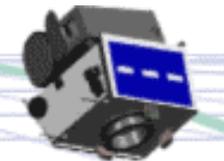
SSTL's platforms are well proven and widely accepted by customers worldwide.

- **Long-term commitment**

Continued co-operation utilising SSTL's wide product range offerings and satellite bus experience

**The KHTT Programme Constructed Around Satellite Manufacture**







- Unique and comprehensive in-house 'beginning-to-end' capability from mission definition through to launch, commission and operation.



Mission Definition and Design



Sub Systems Design and Manufacturing



AIT



Testing



EVT



Launch

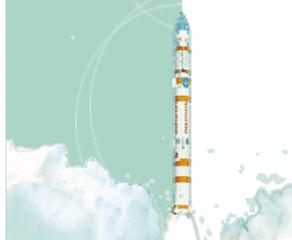


Mission Commission & Operations

Image Processing & Application



**Complete Beginning-to-End Capability and experience**

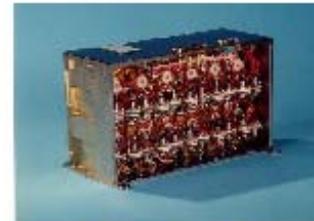




**Power conditioning electronics**



**GPS receiver**



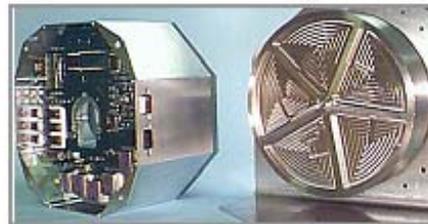
**Batteries**



**S-Band transmitter**



**Gravity gradient boom**



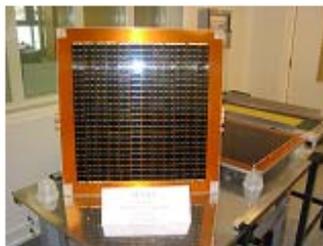
**Momentum wheel**



**Magnetorquer rod**



**Propulsion Systems**



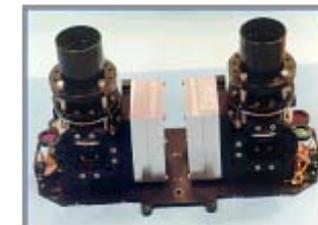
**Solar Panels**



**On-Board Data Handling/  
Solid State Data Recorders**



**10-metre panchromatic imager**



**32-metre multispectral imager**

**Complete In-house Subsystem Capability**

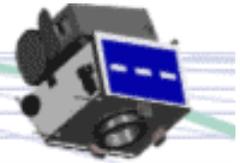




- UAE Engineers will have the opportunity to observe and participate in advanced Research Projects underway within the Surrey Space Centre and SSTL – the current PhD research topics include:
  - Advanced LEO communications protocols
  - On-board Earth image High efficiency Ku-band power amplifiers
  - processing and compression
  - Autonomous on-board uplink spectrum analysis
  - CDMA communications techniques in LEO
  - Lunar micro-satellite technologies
  - Uplink interference counter-measures and SIGINT from LEO micro-satellites
  - Adaptive hybrid coding schemes for micro-satellite downlinks in LEO
  - GPS for autonomous on-board orbit and attitude determination
  - Optimal multi-sensor, multi-actuator attitude control algorithms
  - Ionosphere HF topside sounding radar payload for a LEO micro-satellite
  - Various propulsion technologies for small satellites
  - Optimal orbit control techniques for micro/mini-satellite constellations

**Access to advanced academic research at the Surrey Space Centre**



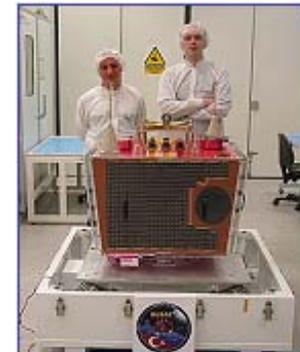


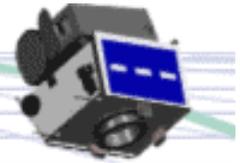
The only company in the world to have extensive experience with ***know how transfer programmes***, including:

- Programme construction
- Quality control
- Know how transfer management
- Appreciation of foreign cultures



	♦	<b>Nigeria</b>	<b>(2001-2001)</b>	<b>NigeriaSat-1</b>
	♦	<b>Turkey</b>	<b>(2001-2002)</b>	<b>BiSat</b>
	♦	<b>Algeria</b>	<b>(2000-2001)</b>	<b>AlSat-1</b>
	♦	<b>China</b>	<b>(1998-99)</b>	<b>Tsinghua-1</b>
	♦	<b>Malaysia</b>	<b>(1996-98)</b>	<b>TiungSat-1</b>
	♦	<b>Singapore</b>	<b>(1995-97)</b>	<b>UoSAT-12 (payload)</b>
	♦	<b>Thailand</b>	<b>(1995-97)</b>	<b>Thai-Phutt</b>
	♦	<b>Chile</b>	<b>(1994-95)</b>	<b>FASat-A&amp;B</b>
	♦	<b>Portugal</b>	<b>(1992-94)</b>	<b>PoSAT-1</b>
	♦	<b>S.Korea</b>	<b>(1989-93)</b>	<b>KITSAT-1 (2,3)</b>
	♦	<b>S. Africa</b>	<b>(1989-92)</b>	<b>UoSAT-3/4/5 (SUNSAT)</b>
	♦	<b>Pakistan</b>	<b>(1984-88)</b>	<b>BADR-1 (BADR-B)</b>





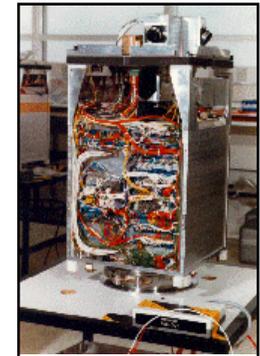
- **SSTL has an unrivalled track record in delivering 12 KHTT programmes and training over 150 engineers.**

As a result of this training, SSTL has helped to create:

- 5 space agencies formed + 1 in progress
- 2 space centres
- 4 satellite manufacturing companies

- **Korea: The Korea Advanced Institute of Science & Technology (KAIST) worked alongside SSTL engineers from 1990:**

- Trained on SSTL's UoSAT-5 micro-satellite and on Korea's first micro-satellite KITSat-1
- KAIST then built the KITSat-2 micro-satellite in Korea using a 'kit-of-parts' provided by SSTL
- KAIST was then able to develop KITSat-3 as its own 100kg enhanced micro-satellite



**Proves SSTL's willingness to share its technology with customers**





- **Turkey: The Information Technologies and Electronics Research Institute (BILTEN) worked with SSTL on BILSAT-1 in 2002**

- SSTL provided hands-on training at Surrey for a team of BILTEN engineers. SSTL also acted as prime contractor for the design and construction of a satellite manufacturing facility, laboratories and clean rooms.
- BILTEN are now planning to manufacture their own 5m GSD micro-satellite



- **Existing customers want to continue working with SSTL**

- Nigeria currently considering continuing technology transfer programmes with SSTL for their follow-on programmes  
*“NASRDA was **allowed full access to the SSTL small satellite engineering methodology** documentation and worked alongside the individual SSTL engineers responsible for each subsystem”.*  
*“SSTL **fully matched or exceeded our expectations** in all areas of the transfer.”*



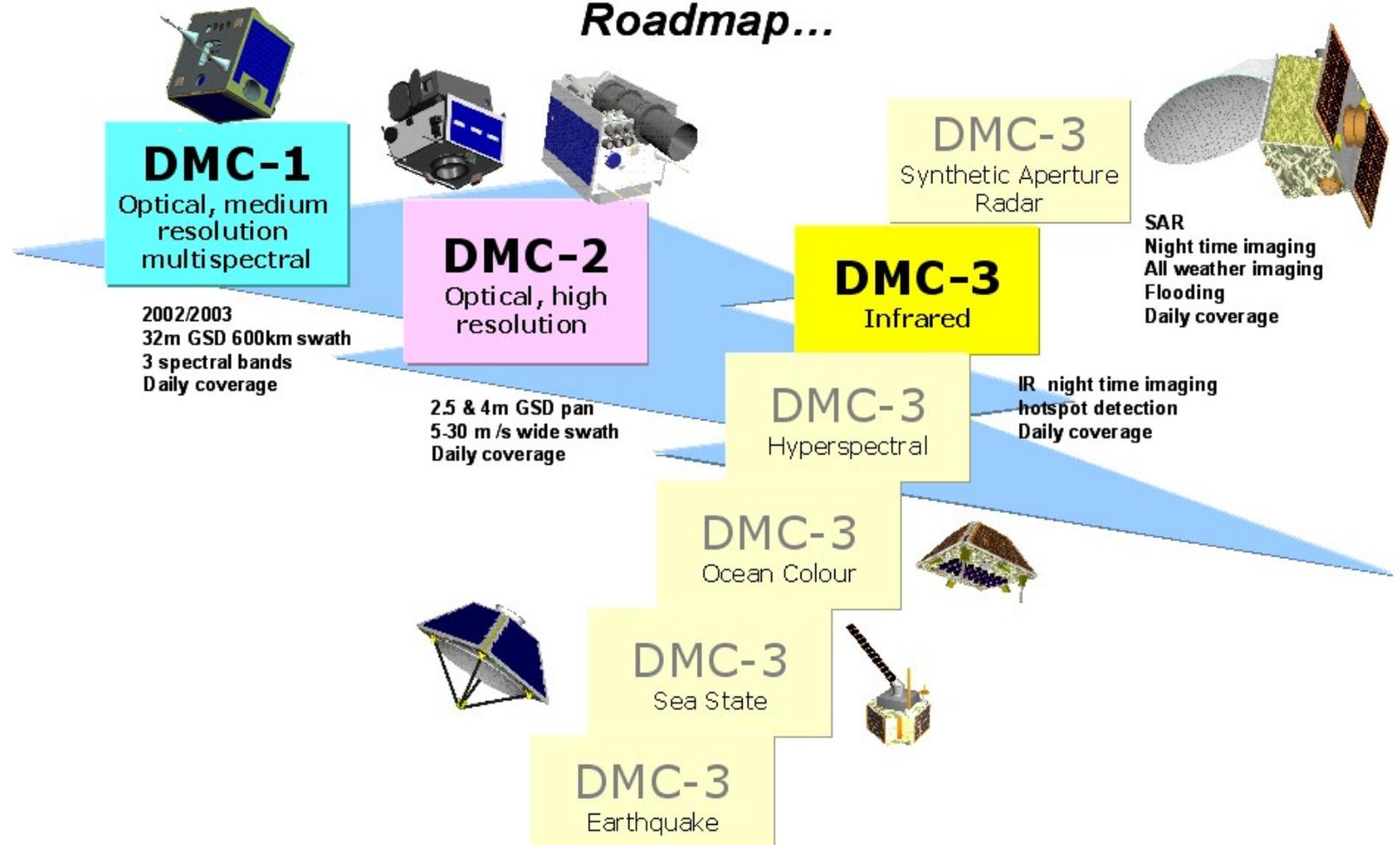
**Proves SSTL's willingness to share its technology with customers**



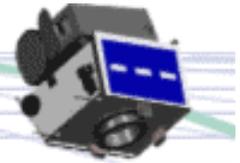


- DMC follow-on constellation
- DMC continuity

## Roadmap...

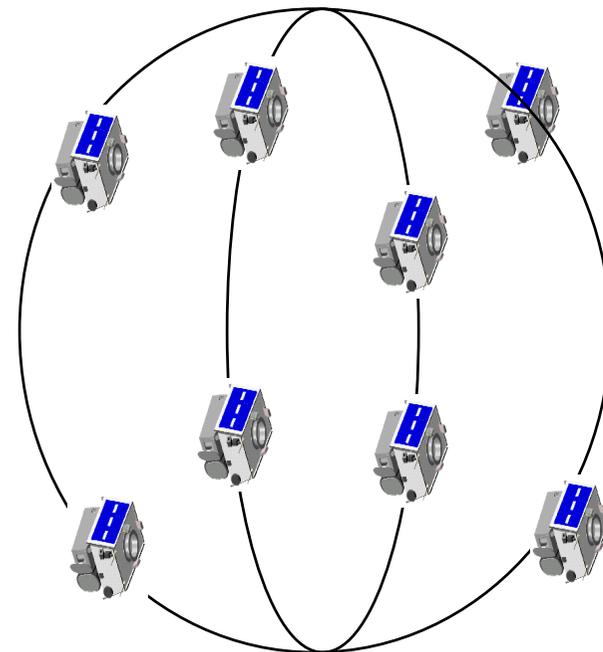
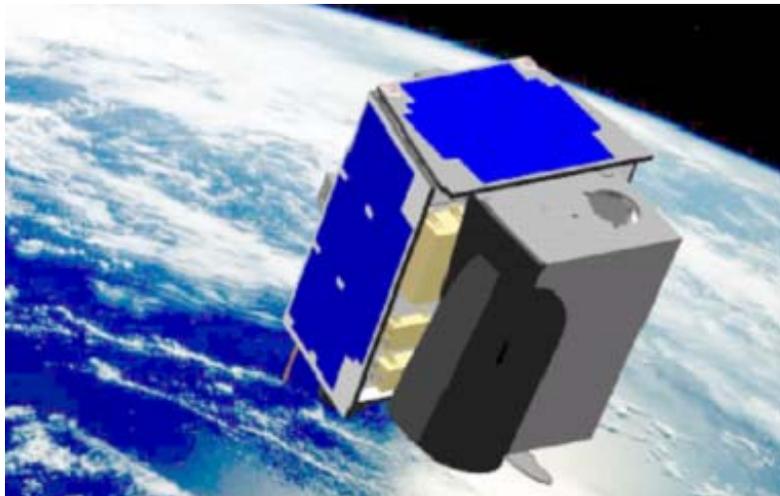


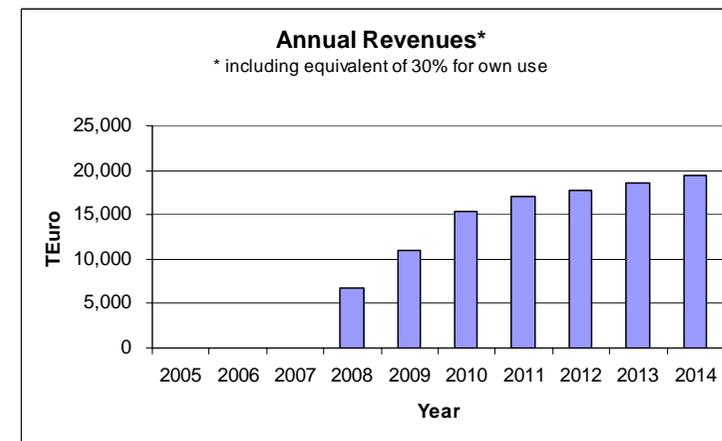
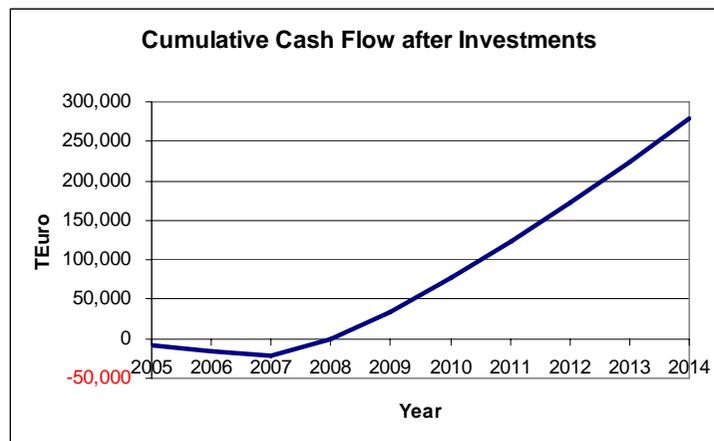
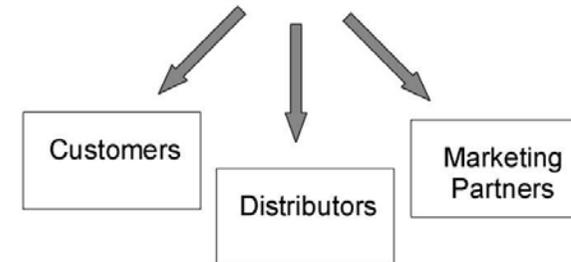
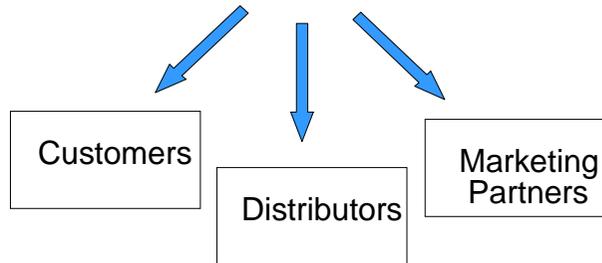
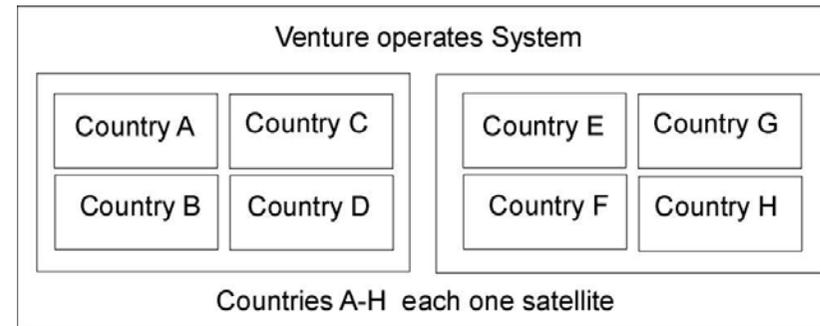
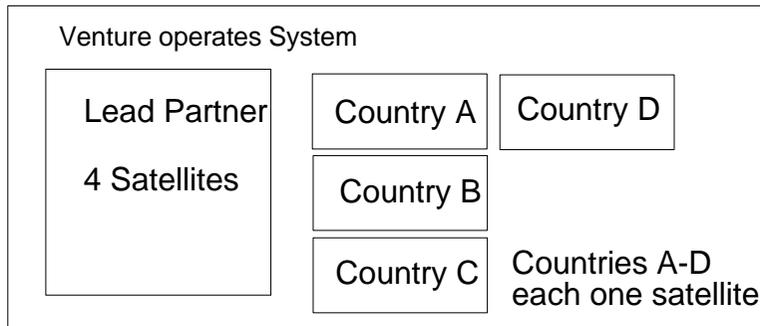
**Small nations play important roles in global environment monitoring**



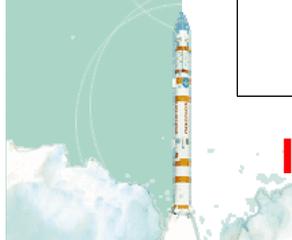
## Constellation of eight 2.5 Satellites - “Real Time Mosaic”

- 2-4 times revisit per day with <math><2.5\text{m}</math> GSD
- 2 x 4 satellites in two orbital planes
- Satellite design based on enhanced SSTL’s TopSat Satellite for UK Ministry of Defence
- Compatible to DMC control





**Imaging Company Business Case Analysis Shows Good Return**



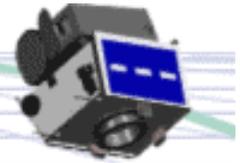


## **Surrey Small Satellite KHTT Programme Developed to Address the Need for Sustainable Development in Developing Countries**

- Launch the first national satellite to promote space awareness to decision maker and stimulate public interests
- Comprehensive and in-depth training to build up national space capacity
- Affordable & independent satellite data to stimulate national remote sensing applications
- Unique image sales to generate commercial return for the public investment
- Contribute to many important international Earth science research projects
- Makes significant contribution to global disaster management
- Emergency agencies benefit from satellite images from other members of International Charter
- Participate in high profile international cooperation
  - Work with multi-nations in internationally coordinated constellations
  - Work alongside big space agencies the International Charter
- Higher revisit capability to stimulate new applications and services

**SSTL has been helping developing countries to play important role in Global Environment and Security Monitoring to make the Earth a better place to live for generations**





**Thank you**

**Latest Surrey's Capability**