

CURRENT TRENDS IN NIGERIA'S SPACE DEVELOPMENT PROGRAMME TO FACILITATE GEOSPATIAL INFORMATION (GI) SHARING AND IMPLEMENTATION OF THE NGDI



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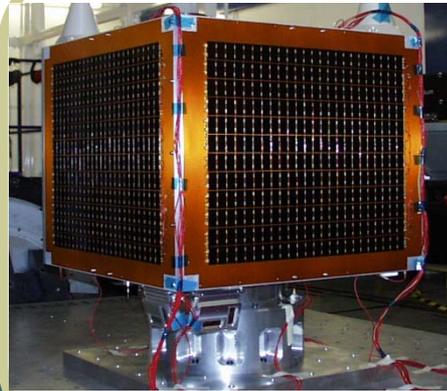
(DIRECTOR, MISSION CONTROL & DATA MANAGEMENT)

NATIONAL SPACE RESEARCH & DEV. AGENCY

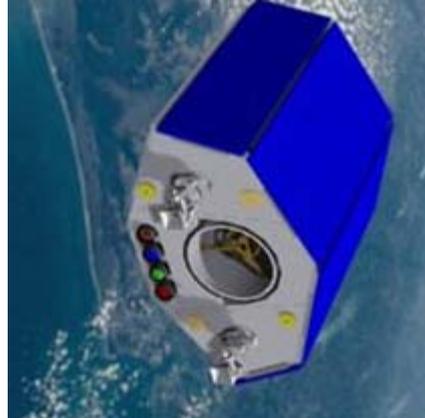
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“Geospatial Sciences for Sustainable Development in Africa”



NIGERIASAT-1



NIGERIASAT-2



ABUJA – NIGERIASAT-1

**Global Dialogue on Emerging Science and Technology (GDEST) 2008
Cape Town, South Africa—17-19 March, 2008**

**U. S. Department of State
Office of the Science and Technology Adviser**



PRESENTATION OUTLINE

- INTRODUCTION
 - SUSTAINABLE DEVELOPMENT & THE MDGs TARGET
- CURRENT NATURAL & MANMADE CHALLENGES FACING US
- NIGERIAN SATELLITE PROGRAMMES – AS A CATALYST
 - NIGERIASAT-1
 - NIGERIASAT-2
 - NIGERIASAT-X
 - NIGCOMSAT-1
 - ARMS
- NGDI – THE NIGERIAN MODEL
- CONCLUSION



SOME KEY NATURAL & MANMADE DISASTERS

- Deforestation
- Land Degradation
- Coastal and River Flooding and Erosion
- Gully Erosion
- Forest fire
- Sand Storms
- Droughts and Desertification
- Africa Flood

We should therefore embark on initiatives and develop agenda to address these problems



SUSTAINABLE DEVELOPMENT

- Sustainable Development of any nation depends on access to reliable and adequate geospatial information (GI).
- **Root Causes of Underdevelopment -**
 - Poor Quality of Data Collection and Management Practices
 - Lack of adequate data infrastructure and;
 - Lack of skilled human capacity in natural resources and environmental management
- **Consequences:**
 - Food Insecurity
 - Air & Water Pollution
 - Environmental Degradation etc.
- **Solution:**

Design, implementation, and maintenance of mechanisms to facilitate the sharing, access to, and responsible use of geospatial data at an affordable cost for various applications.



NIGERIAN SPACE TECHNOLOGY STRATEGIES TO ADDRESS/REDRESS HER SUSTAINABLE DEVELOPMENT PROBLEMS

- Establishment of the Space Agency – NASRDA in 1999
- Approval Space Policy & Space Programme- 2001
- Implementation of Space Programme
- Launch of Earth Observation and Communication Satellites
- Mainstream Geospatial Information in the National Development Strategies through the establishment of NGDI.



NIGERIAN SPACE PROGRAMME IMPLEMENTATION STRATEGY

Setting up of: [1999]

- ▶ “National Space Council” CHAIRED BY MR. PRESIDENT
- ▶ Technical Committee
- ▶ International Cooperation Committee



Multi-Institutional

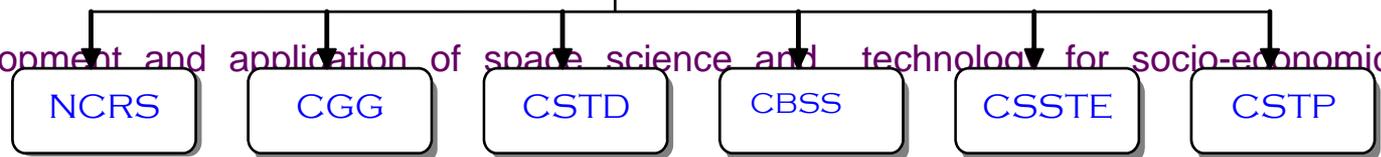


- ▶ Centre for Basic Space Science and Astronomy, Nsukka
- ▶ Centre for Remote Sensing, Ibadan
- ▶ Centre for Geodesy and Geodynamics, Toro
- ▶ Centre for Space Transport, Lagos
- ▶ Centre for Space Science and Technology Education, Ile-ife



Focus:

- Pursue the development and application of space science and technology for socio-economic development
- Integrate the programmes of the Agency into the overall national strategies for sustainable development
- Promote Nigeria's participation in the global industry



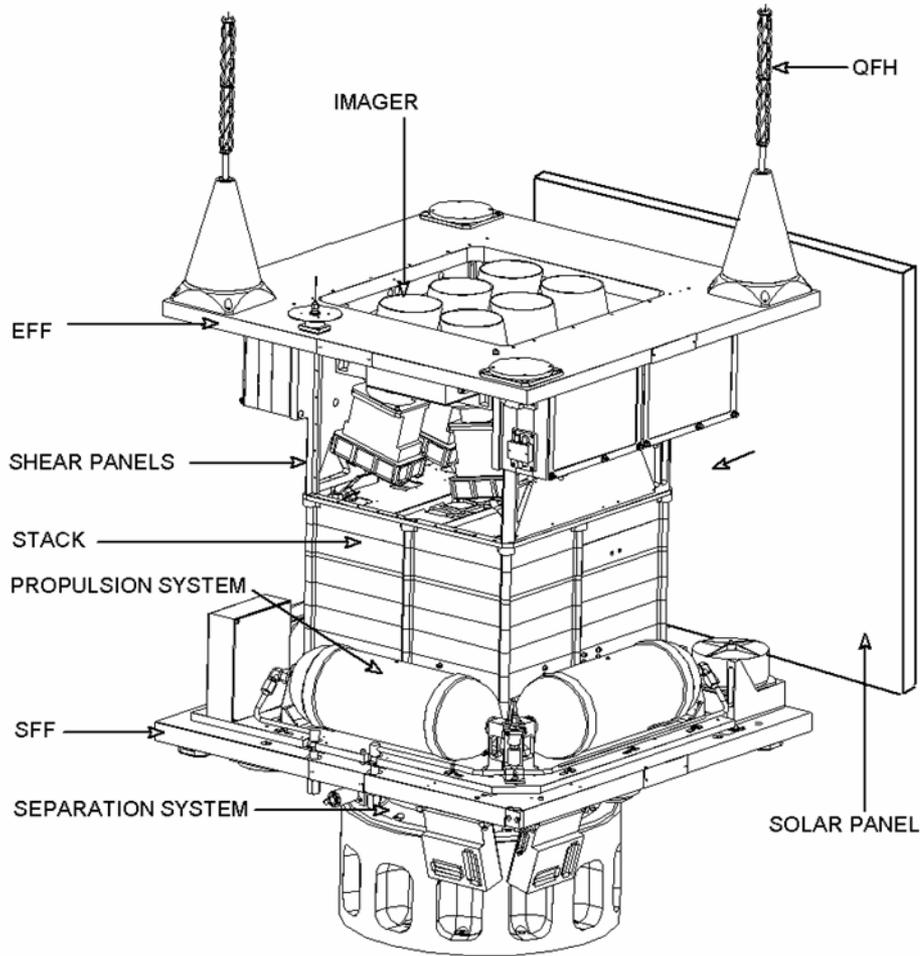
HISTORY MADE, NIGERIA LAUNCHED HER FIRST SATELLITE



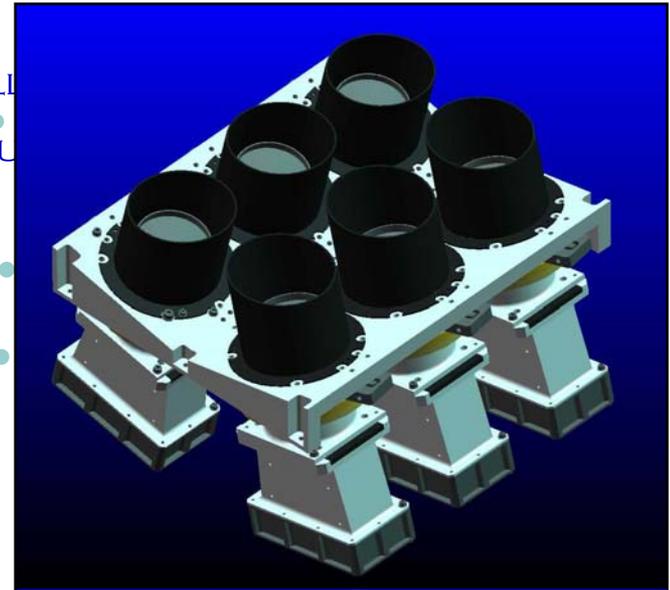
NIGERIASAT-1



NIGERIAN SPACE PROGRAMMES: NIGERIASAT-1: TECHNICAL FEATURES

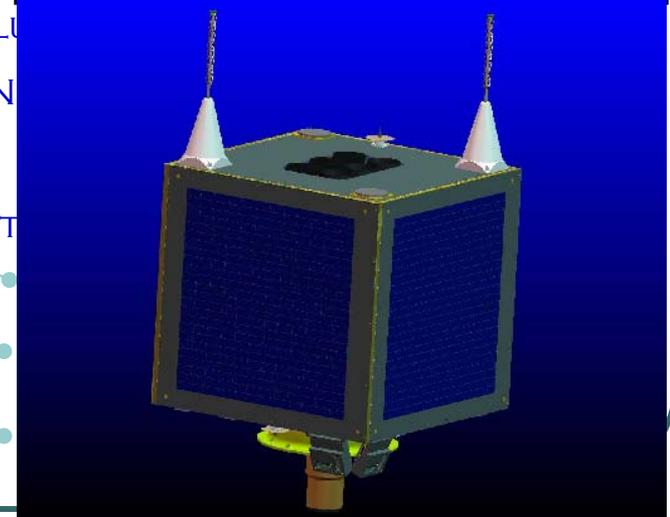


SATELLITE
RESOLUTION



RESOLUTION
0.9 (N)

ACTIVITY



**NIGERIAN SPACE PROGRAMMES:
NIGERIASAT-1: INFRASTRUCTURE**

IMPACT OF THE LAUNCH

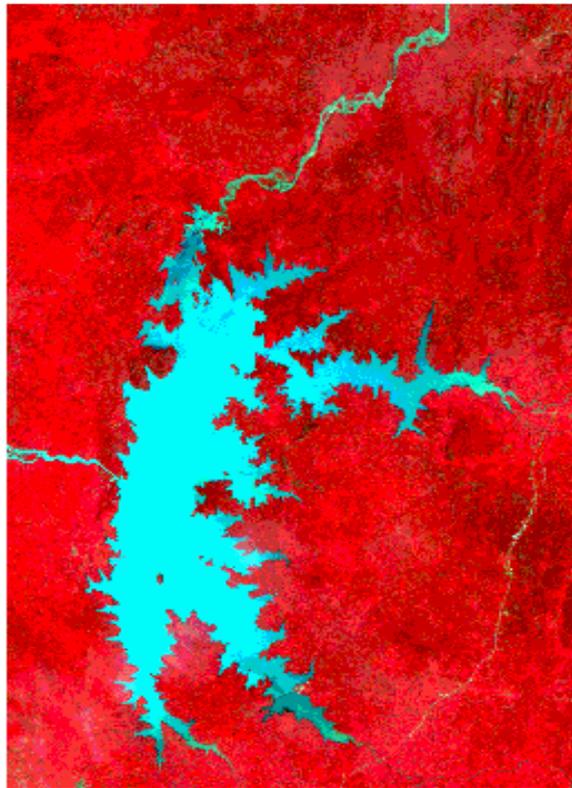
- **GENERATED WIDESPREAD NATIONAL ATTENTION**
- **STIMULATED RESEARCH & DEVELOPMENT BY MANY INSTITUTIONS**
- **PROVIDES OPPORTUNITY FOR AN ARRAY OF APPLICATIONS IN MANY AREAS OF SOCIO-ECONOMIC DEVELOPMENT & ENVIRONMENTAL MANAGEMENT**
- **NIGERIA - NOW A RECOGNISED SPACE FARING NATION**



NIGERIASAT-1 DATA UTILISATION

Flood Study: Shiroro Dam

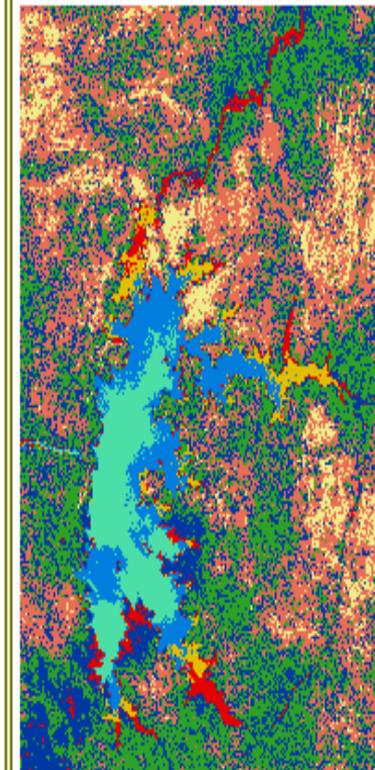
Halilu et al. (Fed. University of Tech. Minna)



Shiroro Dam Composite Image (October 2007)



Shiroro Dam Composite Image (December 2007)



- Water Depth 1
- Water Depth 2
- Water Depth 3
- Water Depth 4
- Bare surface
- Shrubs
- Bare Rocks
- Montane Vegetation

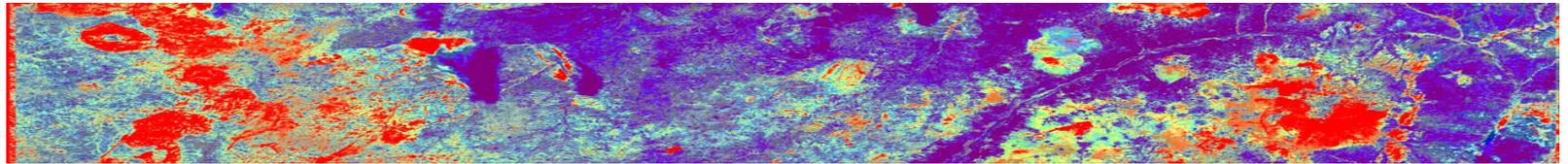
Fig. 5 Landcover and Various Water depths

NIGERIASAT-1 DATA UTILISATION

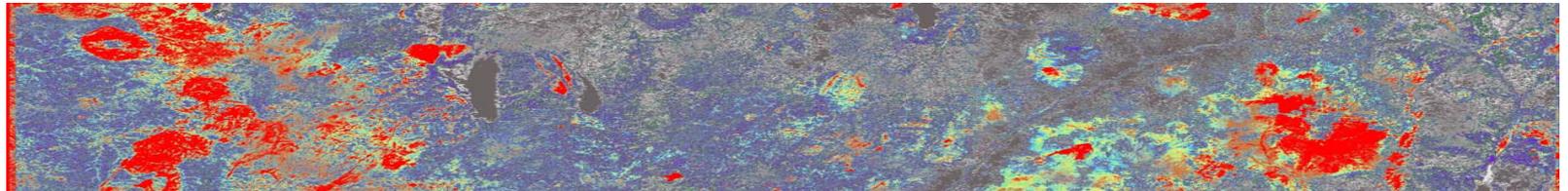
Fire scare Mapping and Monitoring – Mbaye et al. (RECTAS)



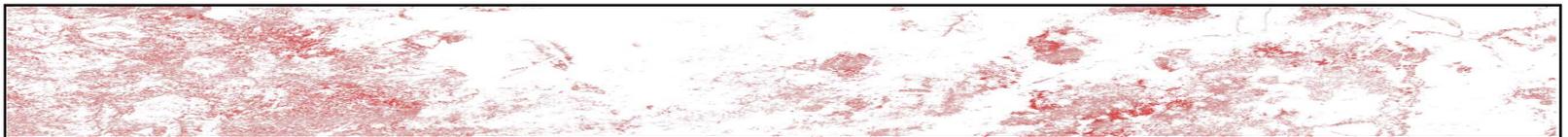
Enhanced false colour composite image of Bauchi,



Unsupervised classification



Semi-supervised classification



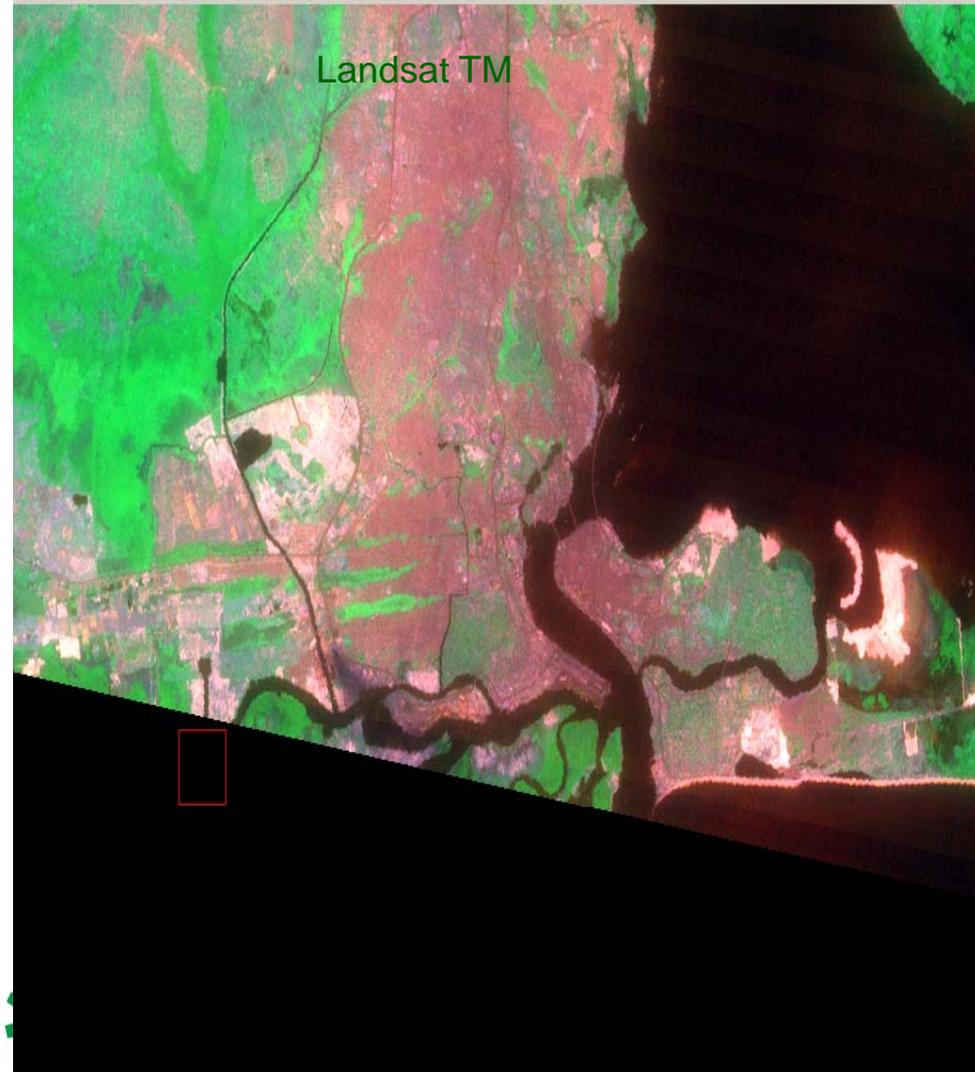
Supervised classification

NIGERIASAT-1 DATA UTILISATION

NIGERIASAT-1 & LANDSAT ETM+ IMAGES COMPARED

Landsat TM

NigeriaSat-1



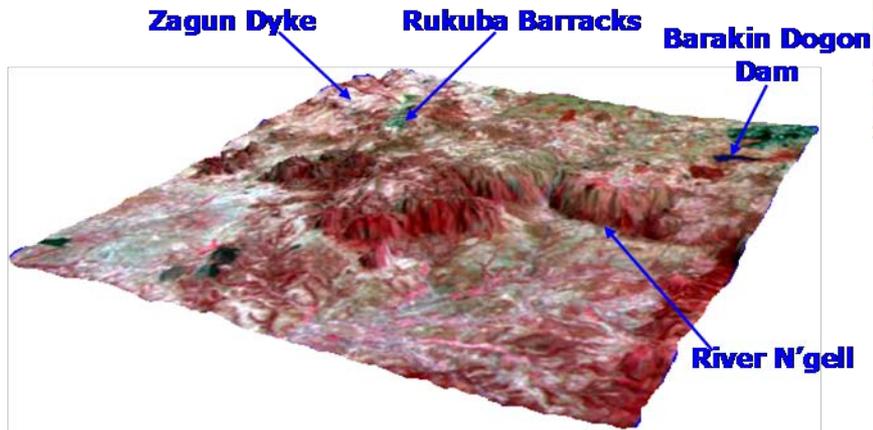
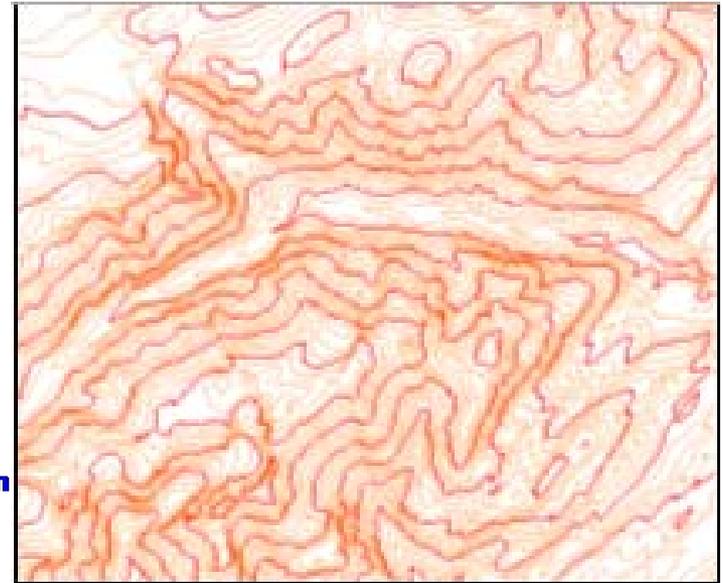
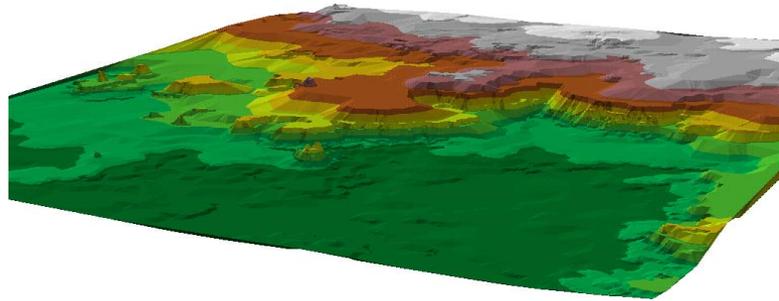
SETTLEMENTS IDENTIFICATION

Prof Ayeni, O. O. *et al.* University of Lagos



DIGITAL TERRAIN MODELLING

Jos Plateau West

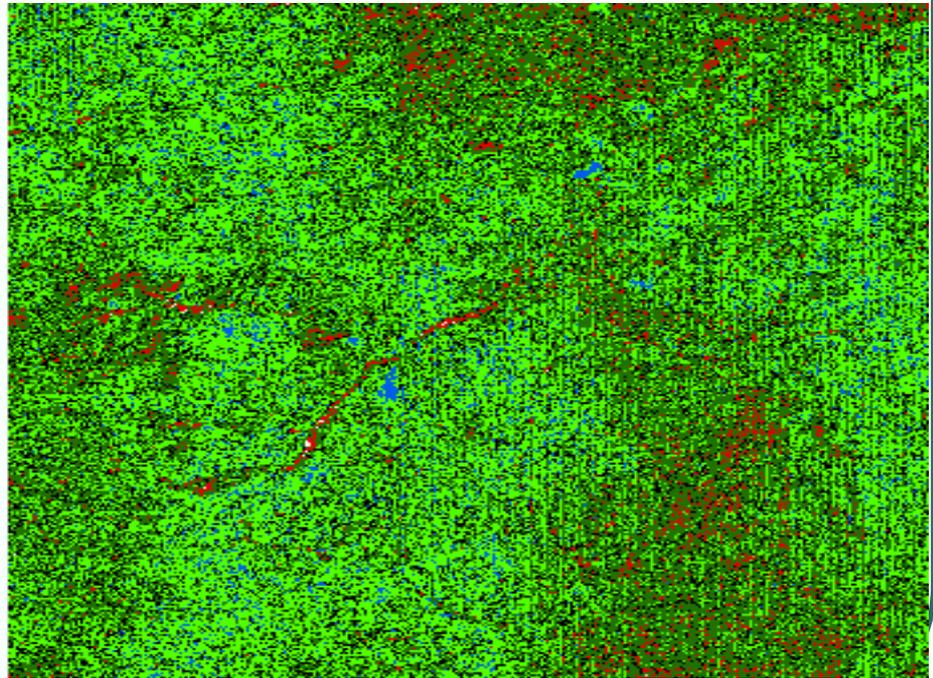
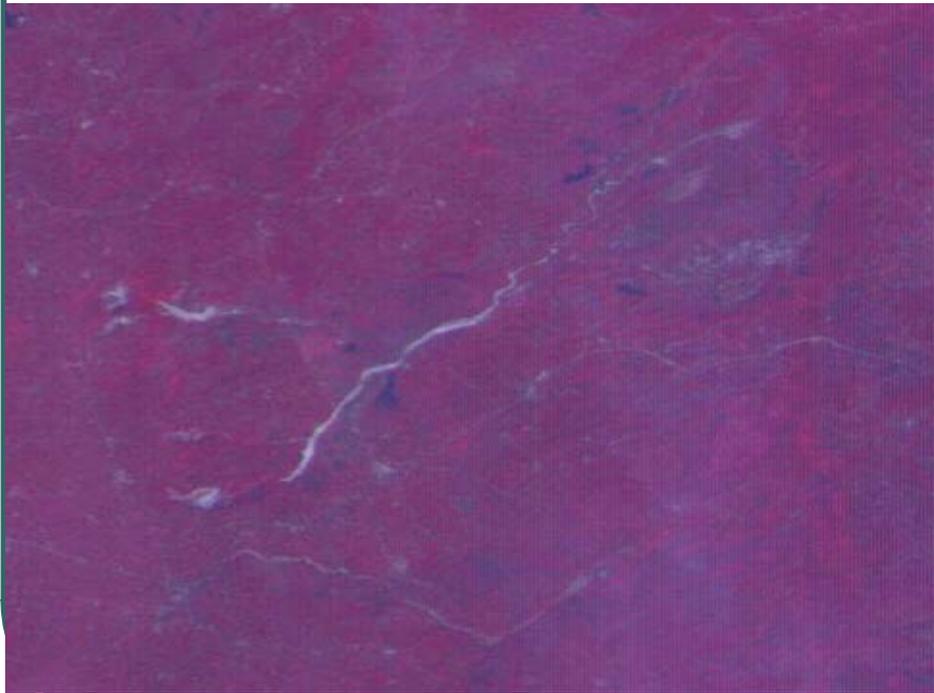


3D Perspective View – NigeriaSat-1
(West of Jos)

Gully Erosion Mapping/Monitoring

– SE of Nigeria

Igbokwe, J. I. *et al.*, Nnamdi Azikwe
University

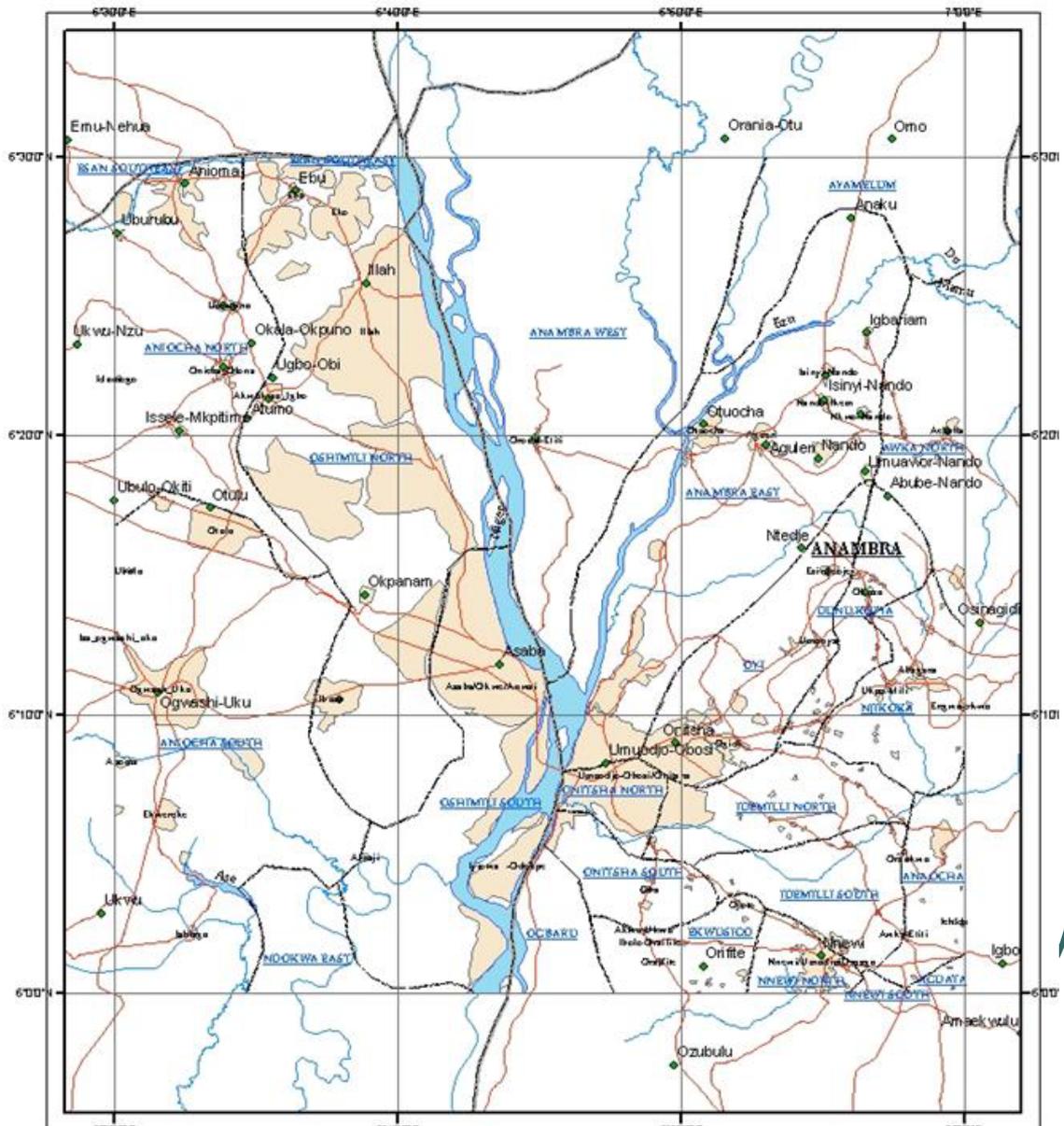


Identification & Mapping of Settlements, Major Roads & Water Bodies

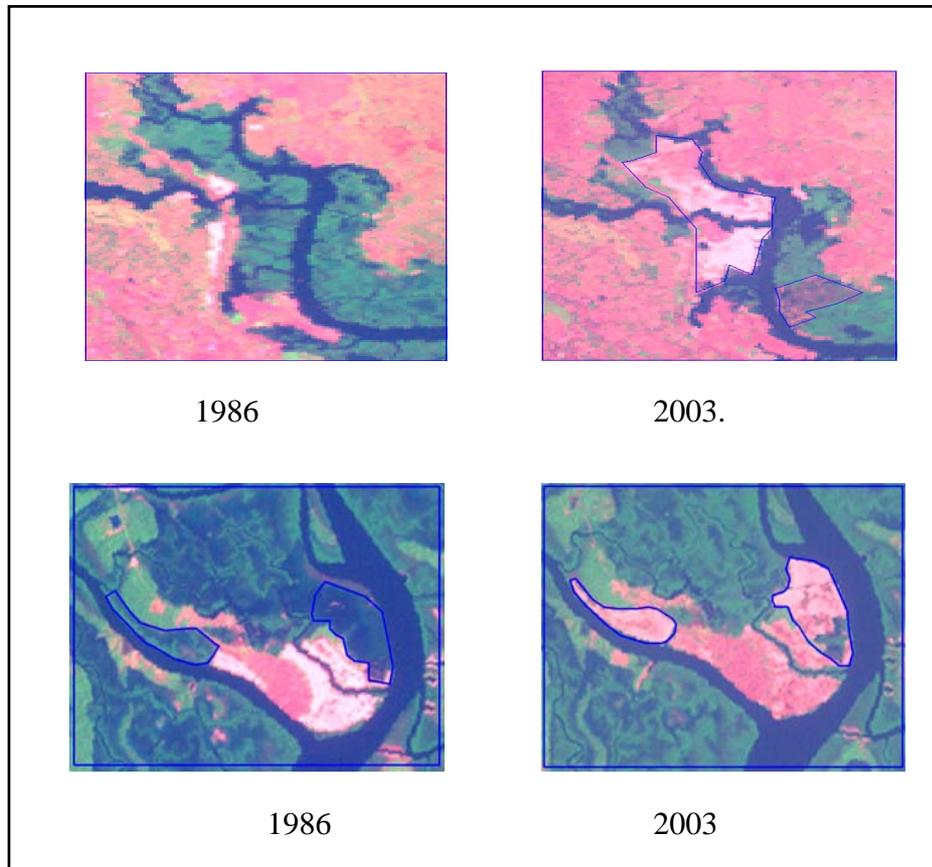
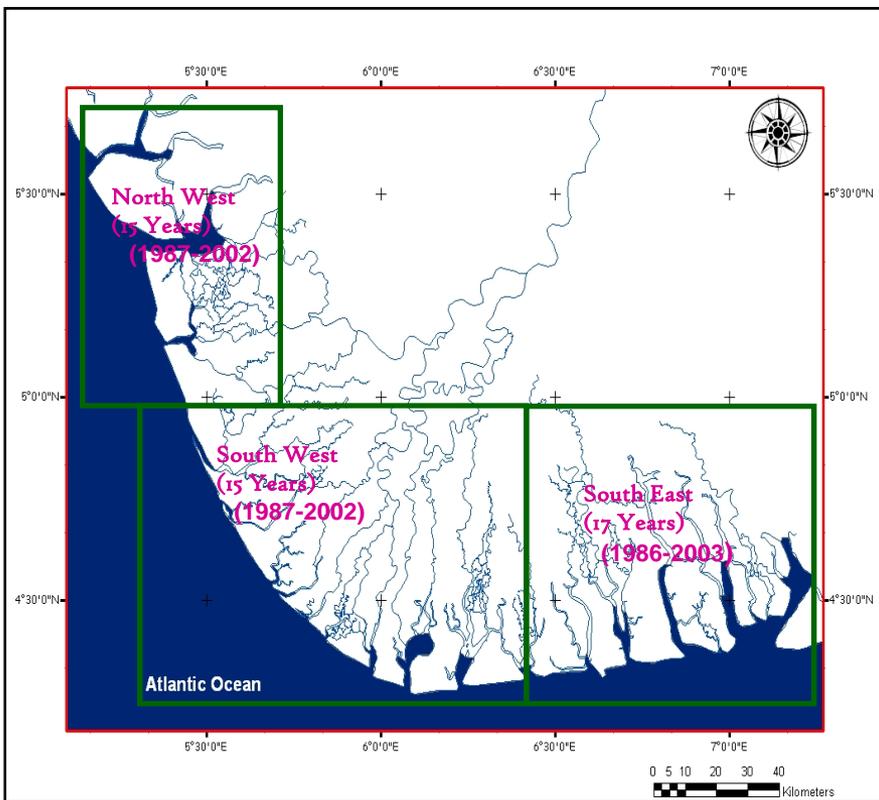
Final composite map of part of Anambra State, Nigeria showing the extracted features from the satellite images

Legend

-  State Boundary
-  LGA Boundary
-  Towns
-  Water Bodies
-  Rivers
-  Settlement



NIGER-DELTA MANGROVE LOST

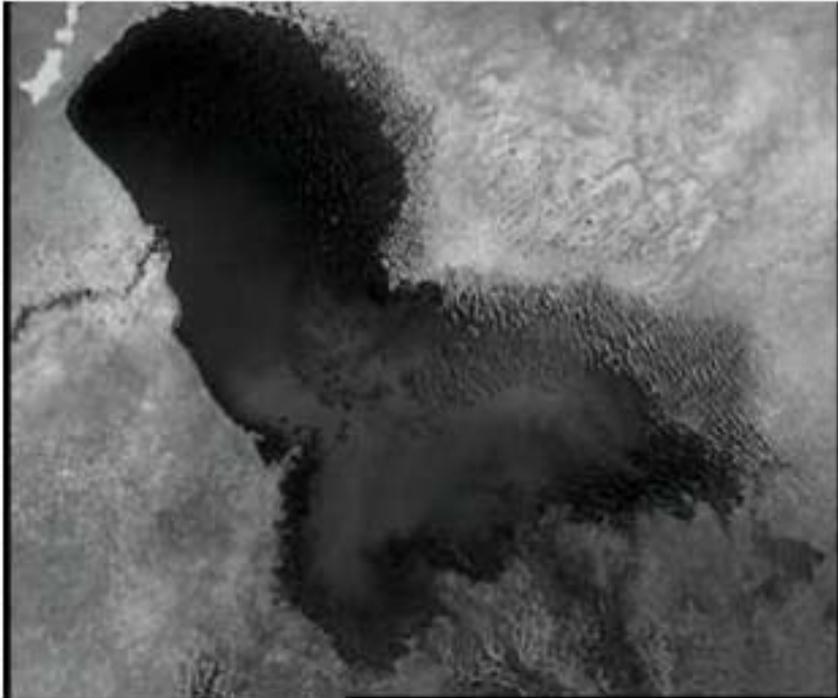


Study area showing the northwest, southwest, & southeast segments

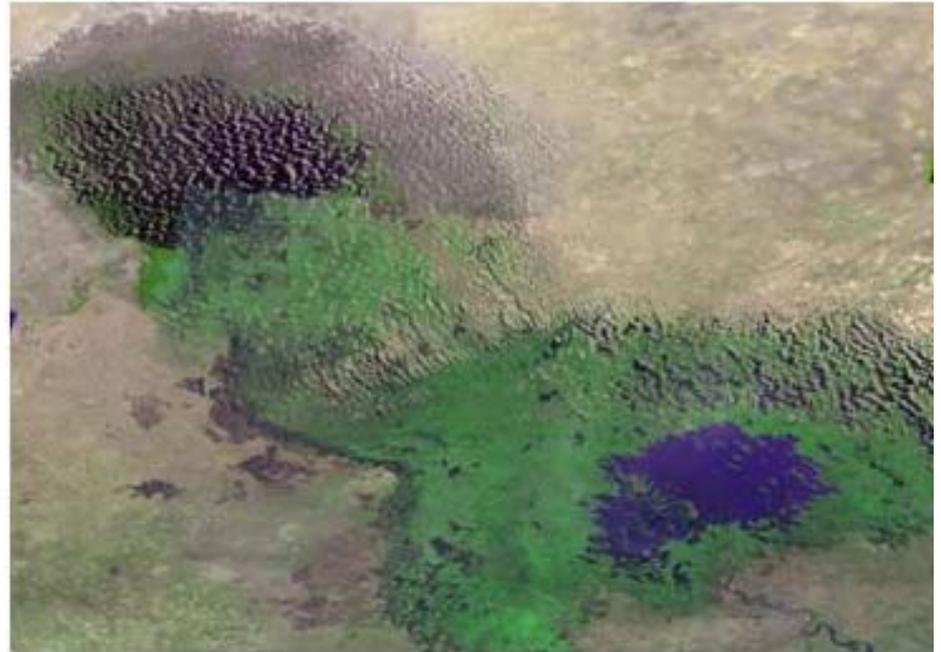
Mangrove loss between 1986 and 2003 estimated at 153 ha and 165 ha respectively



LAKE CHAD



October 1963 - Corona



October 2005 – NigeriaSat-1



The Three-Arms

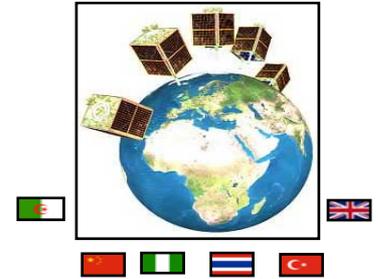
ABUJA,
NIGERIA

Stadium



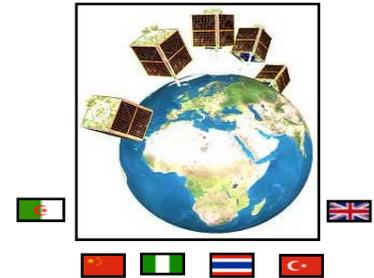
NIGERIASAT-1– PART OF DISASTER MONITORING CONSTELLATION

- Disaster Monitoring Constellation is an International collaboration between 5 countries
 - Nigeria, Algeria, Turkey, United Kingdom, and China
- To Address the need for daily revisit and global coverage using Earth Observation (EO) satellites to monitor natural disasters
- The five satellite owners agreed to form a “DMC Consortium” to derive maximum mutual benefits through exchange of their DMC satellites resources daily for monitoring of disasters and other dynamic phenomena.
- NigeriaSat-1 has the advantages of frequent revisits and being locally available and free of foreign transaction problems
- Will provide a service that will greatly improve the response time to aid - environmental monitoring and the management and mitigation of disasters wherever and whenever they occur.



NIGERIASAT-1 – PART OF DISASTER MONITORING CONSTELLATION**THE DMC IMAGES REQUEST :**

- Monitoring of farm land within France
- Australia – Mapping of the entire country
- Vietnam – Mapping of its coastal areas
- South America – Mapping part of (Amazon Campaign)
- Mapping of the EU States (38 Countries)

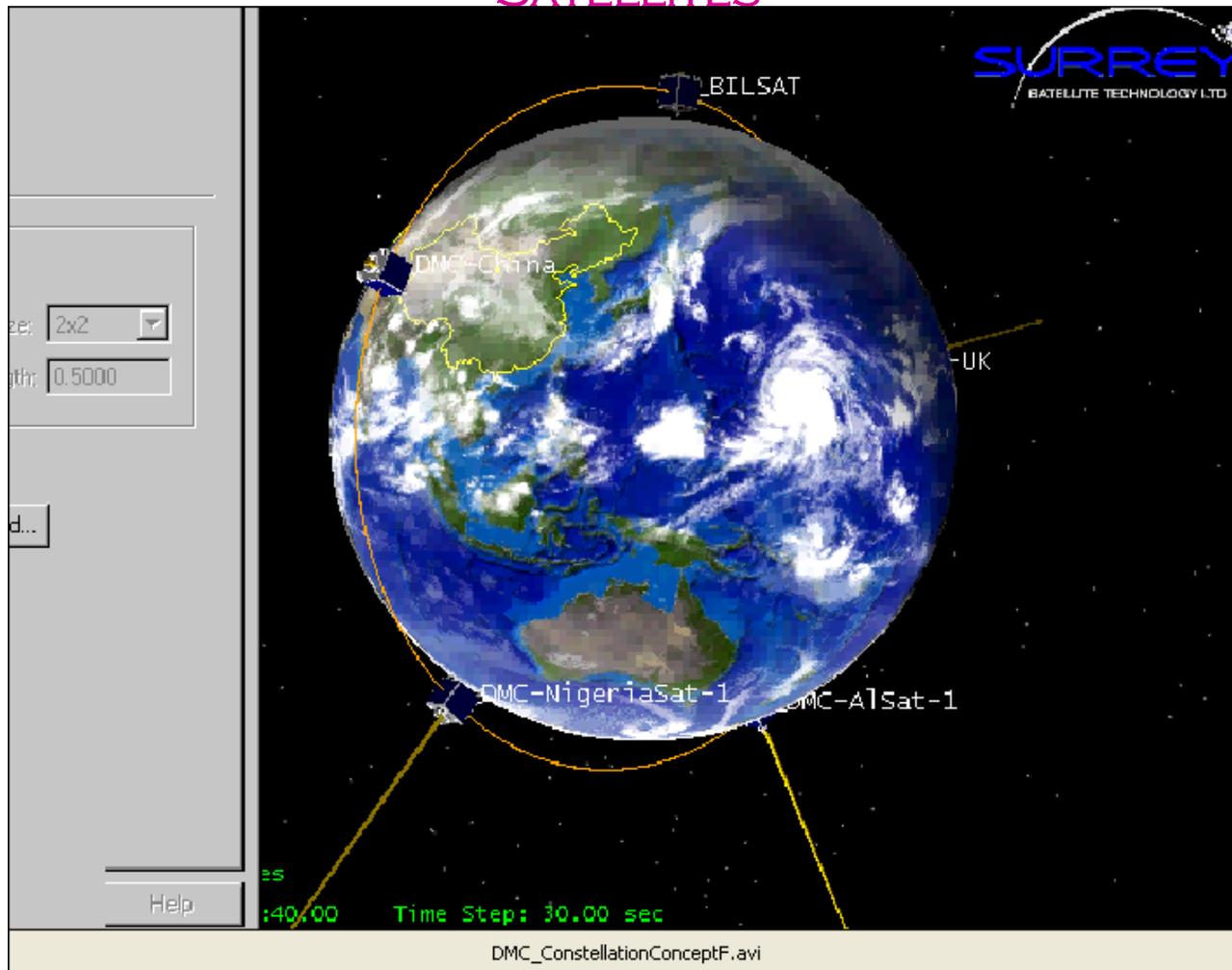
**Other DMC Data Requests:**

- UNOSAT, Geneva – for creation of damaged map of Nicobar Island
- MapAction, UK & SERTIT, France– Sri-Lanka field mapping/damage detection
- OXFAM – for earthquake region
- KeyOBs, Belgium – for Sumatra and Benda Aceh region
- **Tsunami Disaster and NigeriaSat-1 Contribution**
 - Acquired over 20 images each of 300km X 150km of the Asian Tsunami disaster – delivered to RESPOND



DISASTER MONITORING CONSTELLATION (DMC)

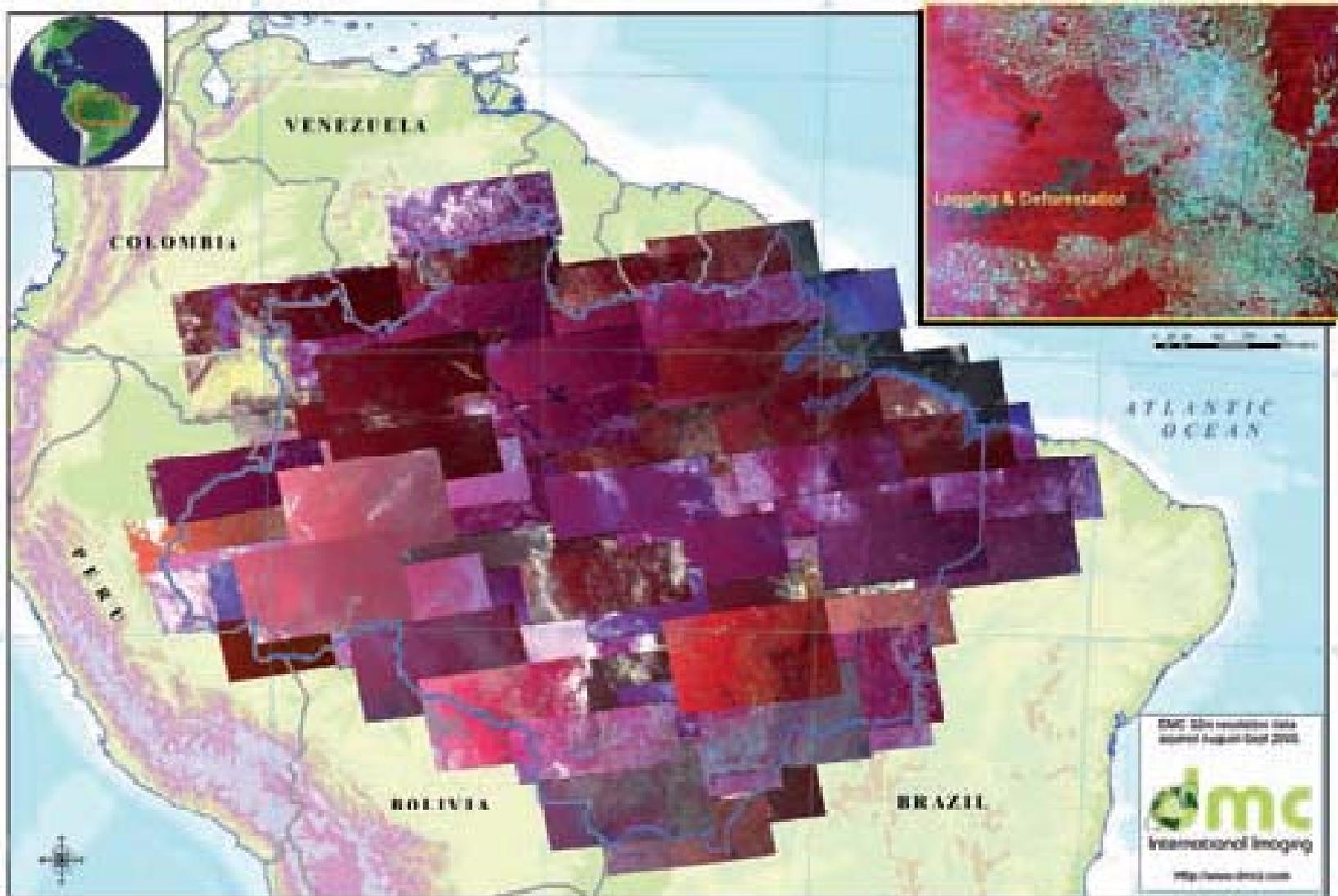
SATELLITES



New Orleans from NigeriaSat-1 showing the effect of Hurricane Katrina



NigeriaSat-1, 2nd Sept 2005



Amazon Basin - Brazil



DMCII CAMPAIGN OVER EUROPE (38 COUNTRIES): APRIL– OCTOBER 2007



NIGERIAN SPACE PROGRAMMES: NIGERIAN OBSERVATION SATELLITE – NIGERIASAT-2

PHYSICAL CONFIGURATION

- NIGERIASAT-2 IS AN EARTH-OBSERVATION SATELLITE
- 2.5M PANCHROMATIC (VERY HIGH RESOLUTION)
- 5M MULTI SPECTRAL (HIGH RESOLUTION)
 - NIR,RED,GREEN &BLUE.
- 32M MULTI SPECTRAL (MEDIUM RESOLUTION)
 - NIR,RED,GREEN&BLUE
- 7.2M DISH
- DESIGN LIFE SPAN 7YEARS
- TO BE LAUNCHED IN 2009



NIGERIAN SPACE PROGRAMMES:

NIGERIASAT-X [ENHANCED MICRO SATELLITE 100]

- NIGERIASAT-2 TRAINING MODEL – BUILT TO FLIGHT SPECIFICATION
- TO BE LAUNCHED WITH NIGERIASAT-2
- BEING BUILT BY NIGERIAN ENGINEERS
- 22M MULTI-SPECTRAL (RGB, NIR) IMAGERY
- MAX SWATH 600KM @ 8BITS
- HIGH RATE X-BAND DOWNLINK SET TO 20MBPS
- LOW RATE S-BAND 8MBPS
- 2 X 2GBYTE DATA RECORDERS



AFRICAN RESOURCE (& ENVIRONMENTAL) MANAGEMENT SATELLITE [ARMS] CONSTELLATION

- COMBINE RESOURCES
- CONTINENT WIDE IMPACT
 - NEPAD – DEVELOPMENT
 - POVERTY ERADICATION
- AFRICAN INDIGENOUS INTELLECTUAL CAPITAL DEVELOPMENT
 - HUMAN RESOURCES



Mostert, 2005



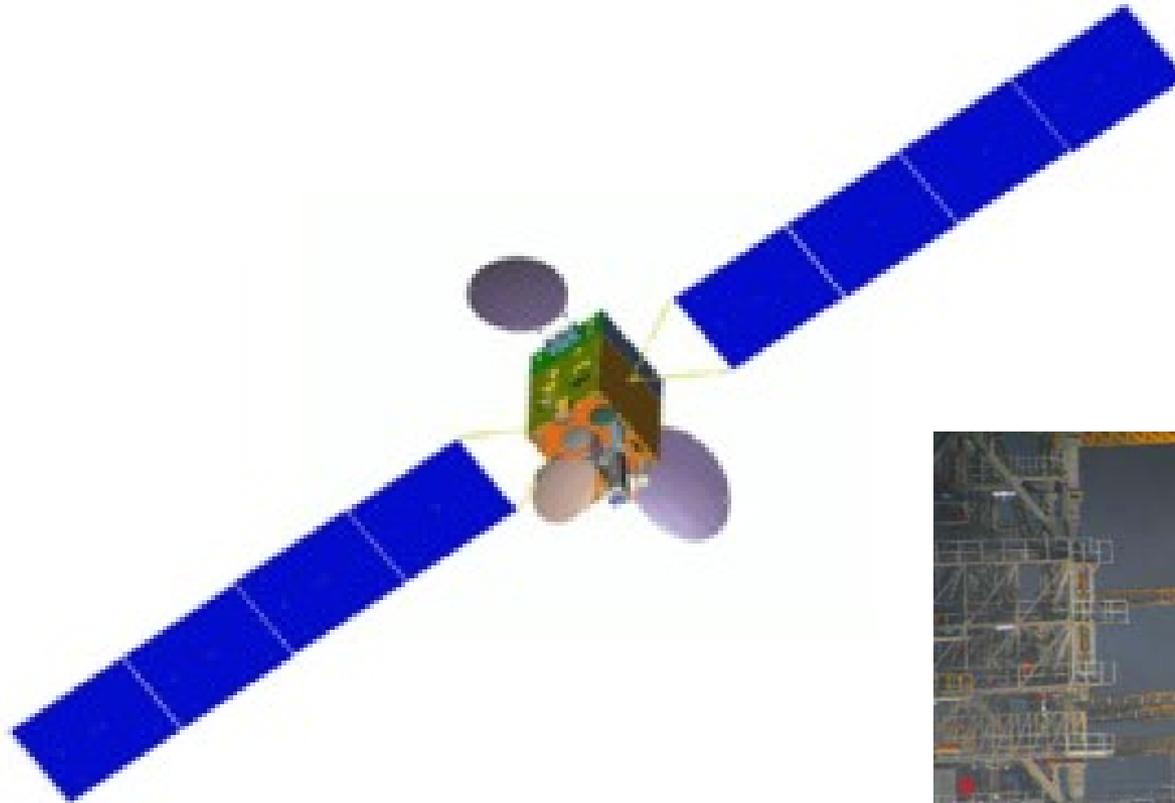
ARMS: OPPORTUNITIES

- CRITICAL MASS OF MICRO-SATELLITE ENGINEERING ESTABLISHED AND GROWING
SOUTH AFRICA, NIGERIA, ALGERIA, EGYPT, KENYA*
- AN OPPORTUNITY FOR AFRICAN COUNTRIES TO WORK TOGETHER TO:
 - ESTABLISH A CONTINENT WIDE REAL-TIME GEO-SPATIAL INFRASTRUCTURE WITH AN AFRICAN PRIORITY
 - BRAIN ATTRACTION VS BRAIN-DRAIN
 - INDUSTRY DEVELOPMENT
 - CONTRIBUTE TO THE WORLD BODY OF KNOWLEDGE

(Mostert, 2005)



NIGERIAN SPACE PROGRAMMES: NIGERIAN COMMUNICATION SATELLITE – NIGCOMSAT-1



TECHNICAL FEATURES:

- A GEOSTATIONARY SATELLITE
- OVER 5 TONS WET MASS
- CARRYING 40 HYBRID TRANSPONDERS (28 ACTIVE) IN KU, KA, C AND L-BANDS
- COVERAGE: AFRICA, MIDDLE EAST, AND EUROPE (PARTS OF)
- LIFE SPAN – 15 YEARS - LAUNCHED ON THE 14TH MAY 2007

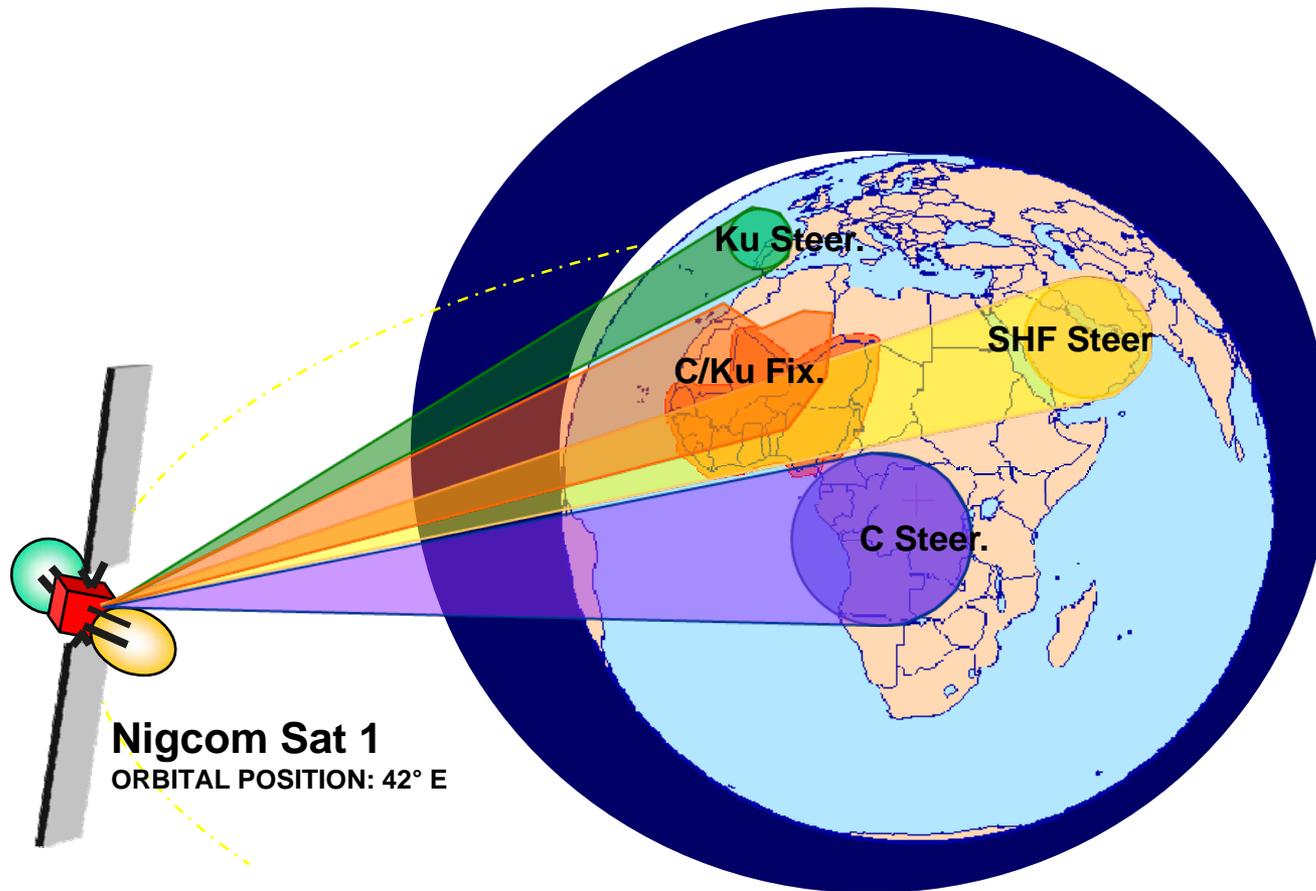


APPLICATIONS OF FREQUENCY BANDS

- **Ku-Band:** Telephony; Video; Data; Telemedicine, Teleconferencing
Teleeducation
- **Ka-Band:** Telephony; Video; Data;
- **C-Band:**
 - Predominantly used for television signal and Internet data transmissions.
- **L-Band:**
 - will augment GPS signal to about 3-5m ; - reduce delay
 - real time application; - Uses L1 & L5 and thus reduces errors
 - extended regional coverage
- **L-Band Applications:**
 - Defence and Surveillance; -Emergency & Recovery Services
 - Transportation -Surveying & Mapping
 - Precision Agriculture - Utility Management



NIGERIA COMMUNICATION SATELLITE SERVICE COVERAGE AREA



TELEMEDICINE PROJECT

- Telemedicine and Tele-education is one of the target applications of the Nigerian Communication Satellite (NIGCOMSAT-1)
- Hughes VSAT equipment, Polycom video equipment and AMD telemedicine equipment, are installed in the telemedicine mobile unit shown below:



NATIONAL GEOSPATIAL DATA INFRASTRUCTURE [NGDI]

- ◆ NGDI Coordination by NASRDA - 2002
- ◆ NGDI Policy
 - ◆ National Drafting Committee - 2002
 - ◆ National Stakeholders' Workshop – 2003
 - ◆ National GI Policy – 2003 (www.nasrda.net)
- ◆ NGDI Concept
 - ◆ Discovery, Harmonisation and Standardisation of geospatial data production and management, and the provision of a platform for data sharing thereby eliminating data duplication and conserving cost and time spent in producing already existing data.
 - ◆ To promote greater awareness and public access to standard and coordinated geo-spatial production, management and dissemination by all sectoral institutions with linkages to private sector,



NGDI- NIGERIAN MODEL

- **Vision**

“To enhance optimal use of Geospatial Information as a critical resource in all phases of sustainable national development for the alleviation of poverty and improvement of quality of life of the people of Nigeria “ (NASRDA, 2003, p. 1)

- **NGDI System**

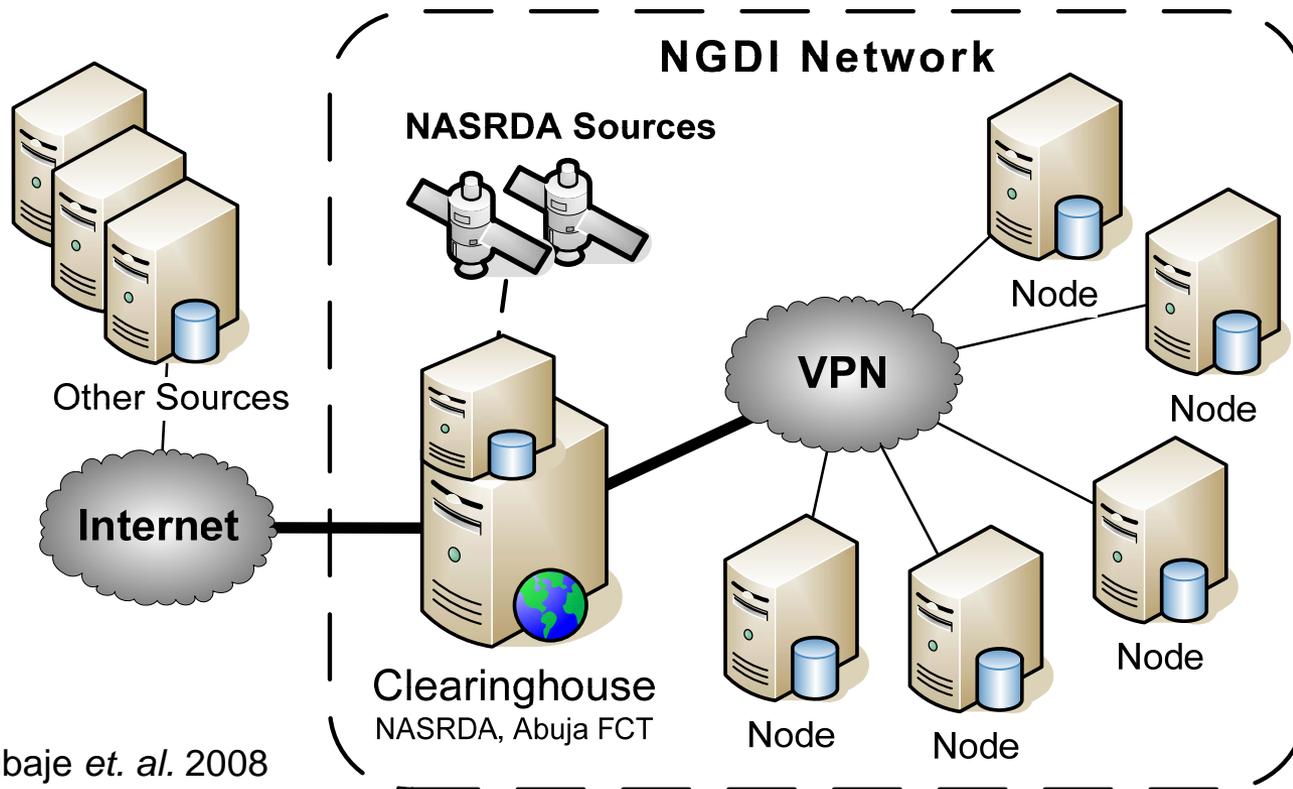
- A metadata catalog describing the holdings within NGDI;
- Storage capabilities to house significant quantities of geoinformation;
- Mechanisms to enable timely access and sharing of the holdings; and
- Tools to enable analysts and other end users to use the NGDI holdings



NGDI- NIGERIAN MODEL

NGDI System

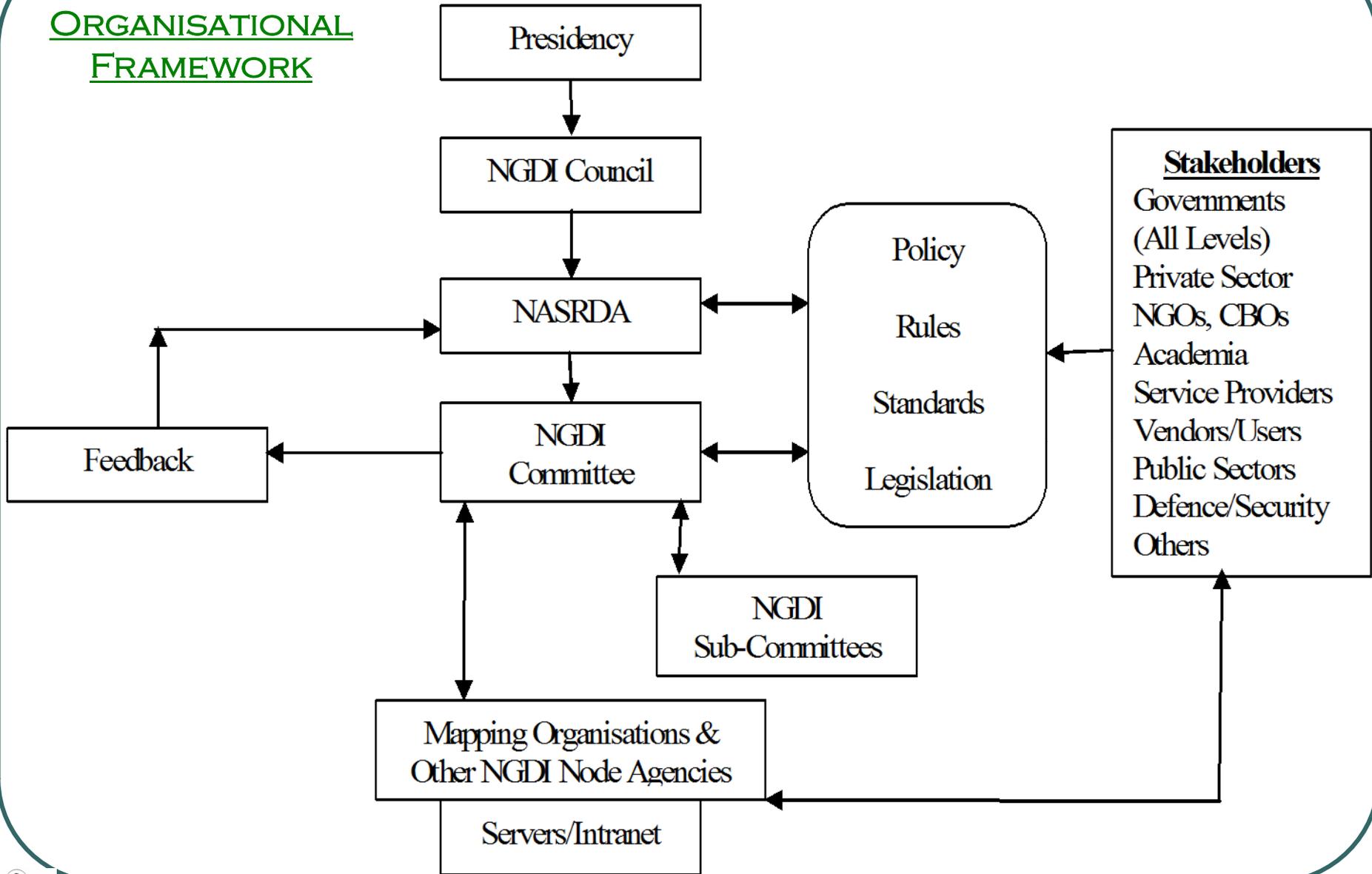
- Nodes will be linked to the Clearinghouse



Source: Agbaje et. al. 2008



NGDI
ORGANISATIONAL
FRAMEWORK



NGDI Committee

| No | Representation | Remarks |
|----|--|--|
| 2 | NASRDA | |
| 2 | Universities | Universities selected in rotation |
| 2 | Poly/Monotechnics | Poly/Monotechnics selected in rotation |
| 6 | Six Geopolitical zones – States nodal agencies | States selected in rotation |
| 4 | Private Sector, Inter- governmental & Non- governmental organisations | |
| 11 | Federal Ministries/Agencies | |



NGDI Sub-Committees

- **Sub-Committees**

- Geospatial Dataset
- Clearing House & Metadata
- Sustainability & Funding
- Capacity Building
- Legal
- Standards

- **Working Groups**

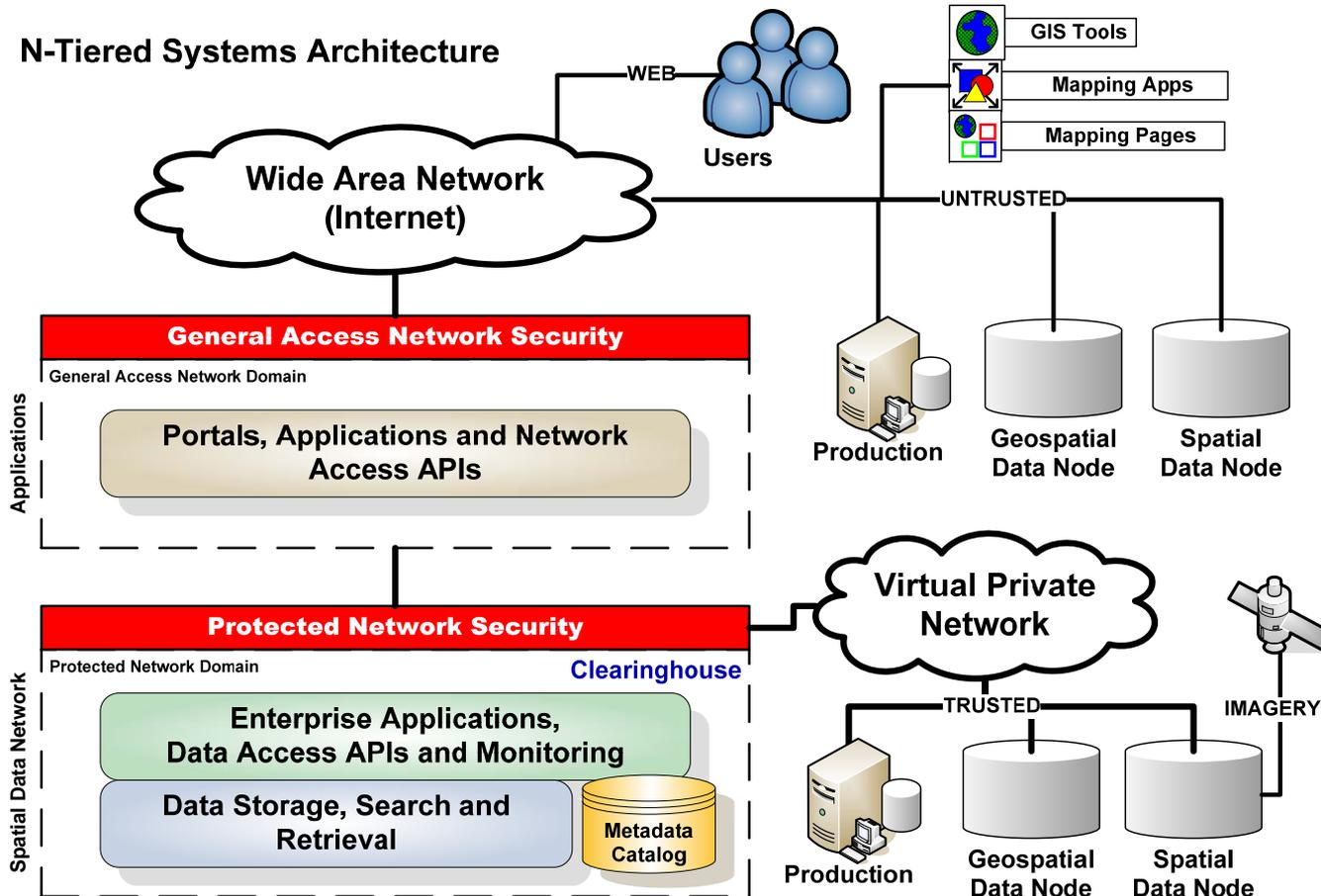
- Each Sub-Committee is allowed to create a number of Working Groups for the effective implementation of their mandate.



NGDI- NIGERIAN MODEL

- Access & Retrieval

Service interfaces for accessing metadata and retrieval of the core data.



Source: Agbaje et. al. 2008



NGDI- NIGERIAN MODEL

● **Implementation**

Project Phases

- Phase 0: Programme Definition Phase
- Phase 1: Creation of the NGDI Clearinghouse, to be hosted within NASRDA's Digital Databank and Library Building;
- Phase 2: Deployment of NGDI nodes to stakeholder organizations in the Federal Capital Territory; training and production of geospatial datasets and metadata;
- Phase 3: Continue the expansion of the NGDI communications network, deployment of remote nodes, training and the increasing utilization of NGDI holdings

| | NGDI Implementation Phases | 2008 | | | | 2009 | | | | 2010 | | | |
|---|------------------------------------|--------------|----|----|----|-------------|----|----|----|-------------|----|----|----|
| | | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| 1 | Phase 0 – Program Definition Study | [Yellow bar] | | | | | | | | | | | |
| 2 | Phase 1 – NGDI Clearinghouse | [Green bar] | | | | | | | | | | | |
| 3 | Phase 2 – NGDI Nodes, NigeriaSat2 | | | | | [Green bar] | | | | | | | |
| 4 | Phase 3 – Network Expansion | | | | | | | | | [Green bar] | | | |



CONCLUSION

- A SOCIETY THAT FAILS TO INVEST IN THE FUTURE MAY HAVE NO FUTURE AT ALL. THE NEED FOR RESOURCE INFORMATION AND MAPPING IN THE DEVELOPING WORLD, PARTICULARLY IN A AFRICA IS ENORMOUS.
- FOR OUR FUTURE DEVELOPMENT IT IS PERTINENT TO COMMIT OURSELVES TO THE DEVELOPMENT AND GROWTH OF INFORMATION ECONOMY, WHICH IS PRESENTLY BEEN DRIVEN BY SPACE TECHNOLOGY. GREATER PRIORITY TO THE DEVELOPMENT AND TRANSFER OF KNOWLEDGE AND SKILLS THROUGH CAPACITY BUILDING, JOINT PARTICIPATION, KNOWLEDGE SHARING, AND BILATERAL AND INTERNATIONAL COOPERATION.



CONCLUSION

- THE NIGERIAN SPACE PROGRAMME:

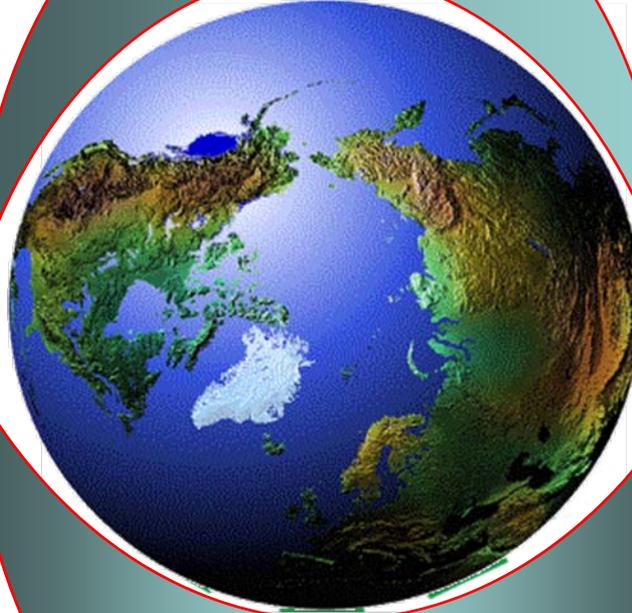
- NIGERIASAT-1 IN SEPTEMBER 2003
- NIGCOMSAT-1 IN MAY 2007
- NIGERIASAT-2 AND NIGERIASAT-X EXPECTED FOR LAUNCH IN 2009,

SERVES AS CATALYST TO THE DEVELOPMENT OF THE COUNTRY'S NATIONAL GEOSPATIAL DATA INFRASTRUCTURE (NGDI).

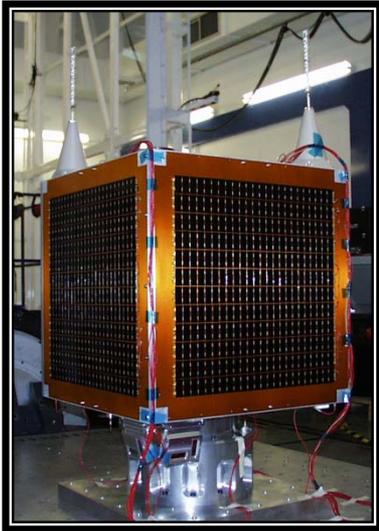
- ▶ NGDI WITH THE SUSTAINING POLICY IF PROPERLY IMPLEMENTED IN THE COUNTRY, WILL FACILITATE A RAPID IMPROVEMENT OF THE NATION'S ECONOMY INCLUDING AN EFFICIENT MANAGEMENT OF THE NATION'S NATURAL RESOURCES AND ENVIRONMENT.



THANK U



FOR YOUR ATTENTION



NIGERIASAT-1

