
# Big Data from Earth Observation Satellites: An overview opportunities and challenges

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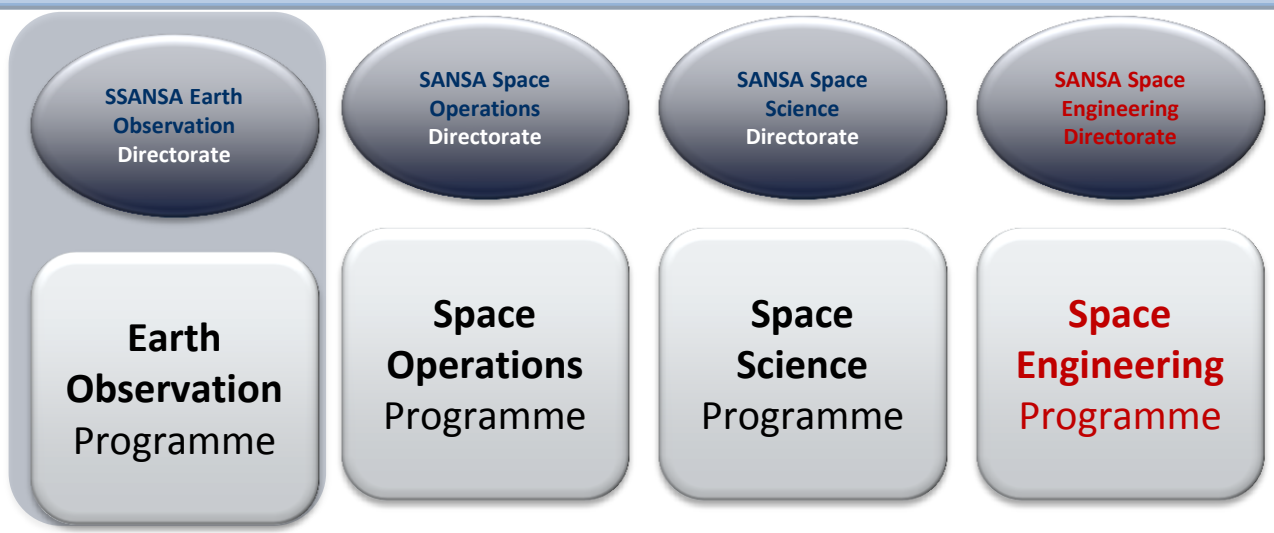
# Our Vision

To be the leader in ensuring that space science and technology benefits society, the environment, the economy and the global community through relevant services, research and development, and human capital development.




Goal 1: World-class & efficient services & societal benefits (Societal Capital)

Goal 2: Cutting-edge research, development, innovation, technology and applications (Intellectual Capital)

Goal 3: Human capital development, transformation & science advancement (Human Capital)

Goal 4: Globally competitive national space industry (Industrial Capital)

Goal 5: Make South Africa a recognised global space citizen (Global Capital)

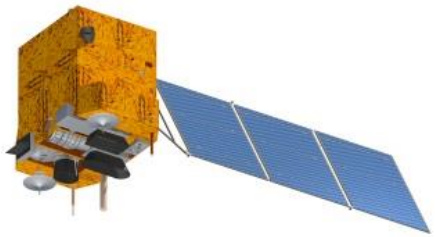
# Terabytes of Big Earth Observation Data


# Earth Observation Directorate

## Our core business

- Data reception
- Archive
- Data processing
- Data dissemination
- Applications

- Sensor Portfolio Management reception



- Data Archiving, Processing, Dissemination

- Development of applications and geo-spatial products

Contribute to
- greater utilisation of earth observation in addressing day-to-day societal problems & needs
- better planning & decision making; performance monitoring; environmental & resource management; disaster management; national security & health

# Big Data Challenges in Earth Observation

- **Reception, archiving, processing and dissemination of colossal volumes of ever increasing Earth Observation data.**
- **Long term time series analysis**
- **Integration of heterogeneous datasets with diverse formats and metadata.**
- **Issues with internet bandwidth**
- **Interoperability between different IT systems**

# Using Big Data in Earth Observation

**SANSA aims to:**

- **Promote data access for socio-economic benefit.**
- **Efficiently use big EO data for scientific analysis.**
- **Safeguard imagery for long term re-processing, time series analysis, verification or validation.**
- **Share big data on collaborative and inter-operable platforms.**

# Opportunities for Big Data in Earth Observation

- **Virtualisation and Cloud Computing**
  - Virtualised sharing of network, storage and computing resources
  - Virtualisation offers greater flexibility for management of systems
  - Greater independence for user
  - Performance overhead (and expense VMware)
  - External Cloud hosted on an independent internal network for greater security but also autonomy

- **Grid-based High Performance Computing (HPC)**
  - Advanced data processing infrastructure
  - Computational efficient algorithms
  - Intensive data processing using heterogeneous computing resources
  - Suitable to deal with the high dimensionality of satellite remote sensing data
- **Data Mining**

# Emerging Trends:  EO Big Data

- **Automatic Data Acquisition**
- **Spatial processing in cloud environments**
- **Semantic mining of information**
- **Intensive visualization**
- **Discovery and aggregation (cubes)**
- **Security of data access**
- **Interoperability standards**
- **Peak loads enabled web services**
- **New manipulation and transfer techniques**
- **New Data and algorithm descriptions**

# Data:

## Reception

Archive

Processing

Distribution

Application

# Direct reception sensors

Data received by SANSA Space Operations demodulators ….

Ingested, archived and catalogued by SANSA Earth Observation ground segments

- Landsat 7 (currently down for repair)
- SPOT 4 and SPOT 5 Preparing for SPOt 6 and 7
- MODIS (Aqua and Terra)
- NOAA AVHRR
- NOAA AVHRR
- CBERS (awaiting launch of CBERS 3)
- Landsat 8
- SumbandilaSat

# Big Data

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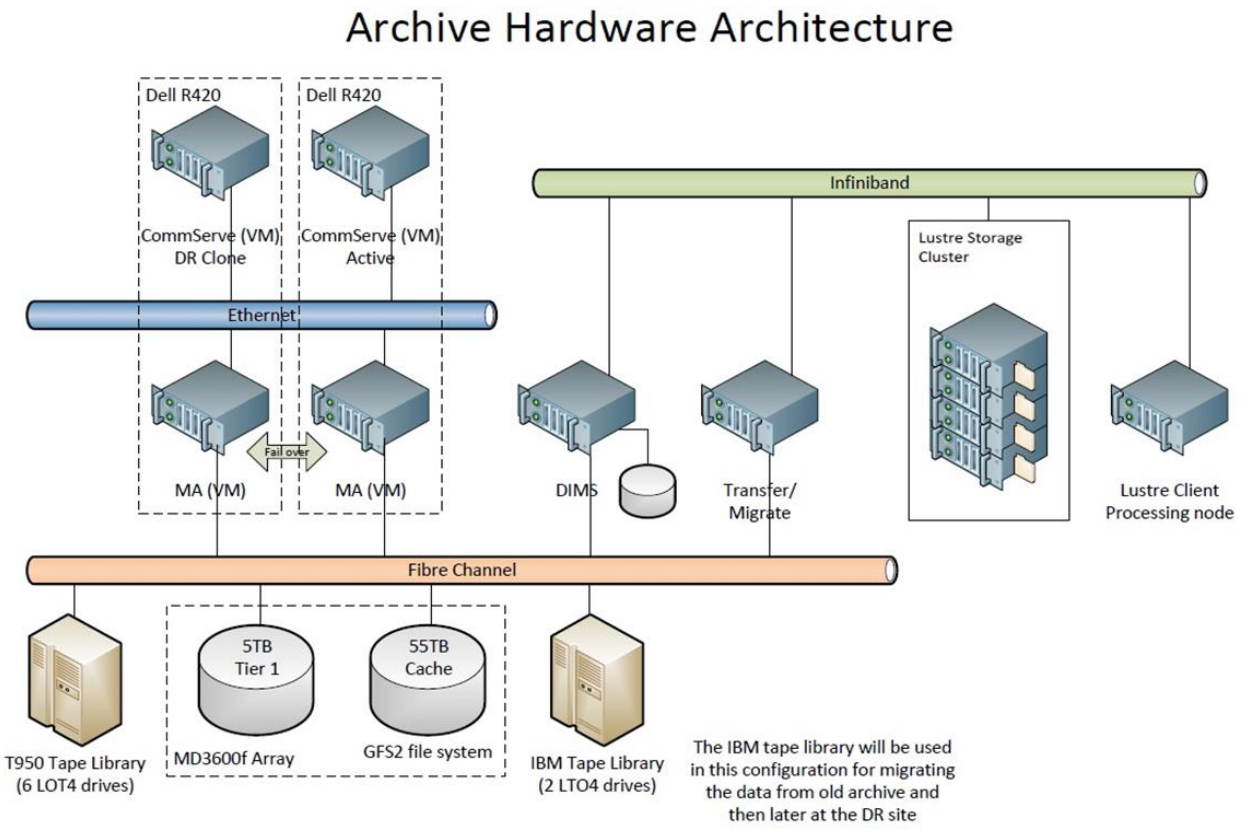
# ARCHIVE OVERVIEW



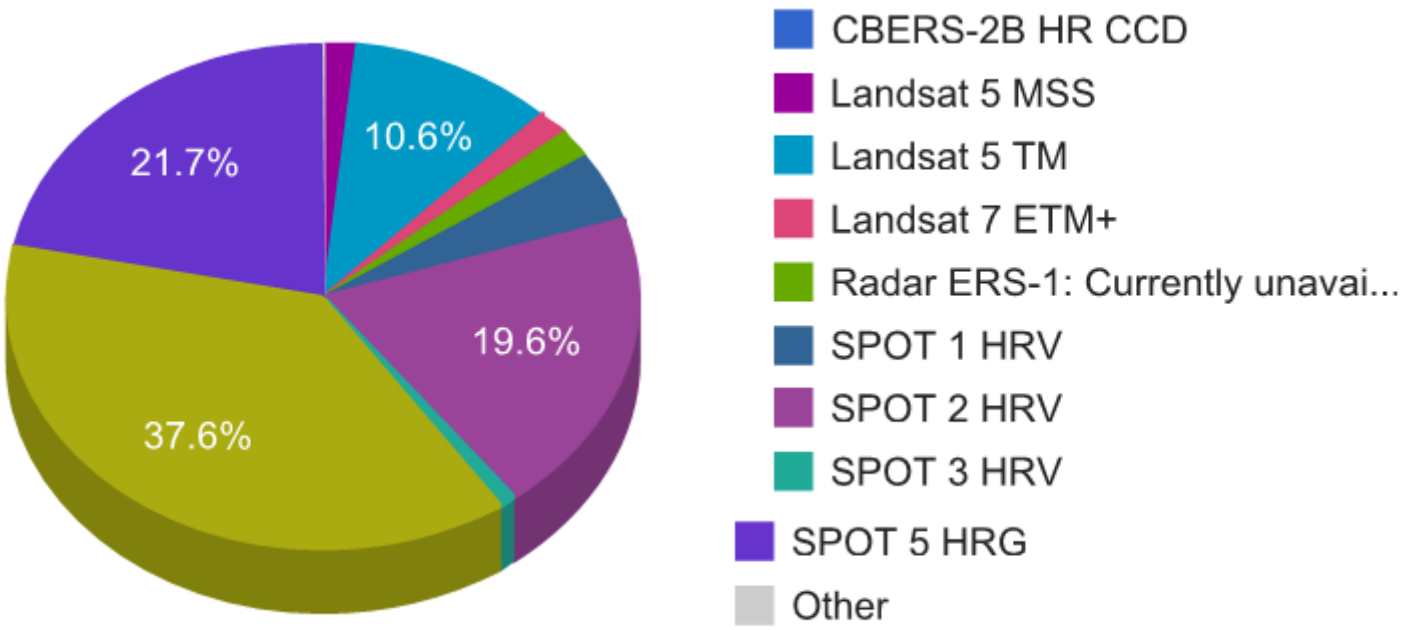
# SAEOS Hardware

14 dual/quad core processing servers

80 TB online storage

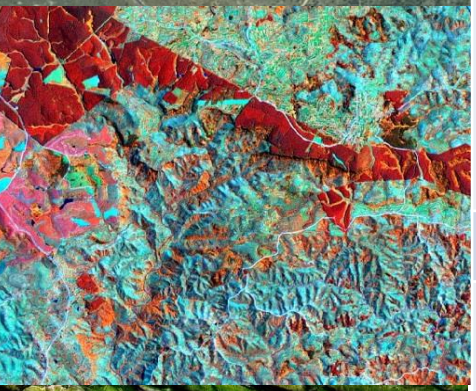
760 TB LTO4 Tape Library

# Current archived Data on Our Catalogue




- including Landsat 2,3 and 4
  SumbandilaSat
  SAC-C multi-spectral
  ERS-1 radar






# Details of EO Data Archive

| Sensor | Spatial resolution | Coverage | Date of Acquisition |
|---|---|---|---|
| Landsat: MSS,TM, ETM, LDCM (Landsat 8) | 15m-60m | Southern Africa | 1972 - 2011 |
| SPOT 2, 4,5, 6 | 1.5m-20m | Southern Africa | Since 1994 |
| CBERS 2B | 20m | SADC except, Mauritius, DRC, Madagascar and Seychelles | 2008-2009 |
| SAC-C | 175m | SADC except, Mauritius, DRC, Madagascar and Seychelles | 2008-2009 |
| MISR | 275m, 1.1km | Africa | 2003 - now |
| MODIS, AQUA & TERRA | 250m,500m, 1km | Africa | 2000 |
| NOAA AVHRR | 1.1km | Africa | 1984 |
| ERS-1 | 30m | Africa | 1994 to 2009 |
| MERIS | 300m | Africa | 2002 |

Data:

Reception

Archive

Processing

Distribution

Application

# Processing Levels

- Automated processing: Landsat and SPOT
  - Pre-processing by ground segment: Raw to Level 1
  - Ground control point collection: Level 1 to Level 2
  - Orthorectificaton: Level 2 to Level 3Aa
  - Radiance to top of atmosphere reflectance : Level 3 Ab
  - True colour processing for Blue Band of SPOT imagery
  - Pan-sharpening for imagery with panchromatic bands

- Manual/semi-automated processing or all Levels for remaining sensors
  - SumbandilaSat and CBERS orthorectification
  - MISR High Resolution processing to 275m for all bands and other value-added products (including albedo, LAI, FAPAR and atmospherically corrected reflectance)

# Data:

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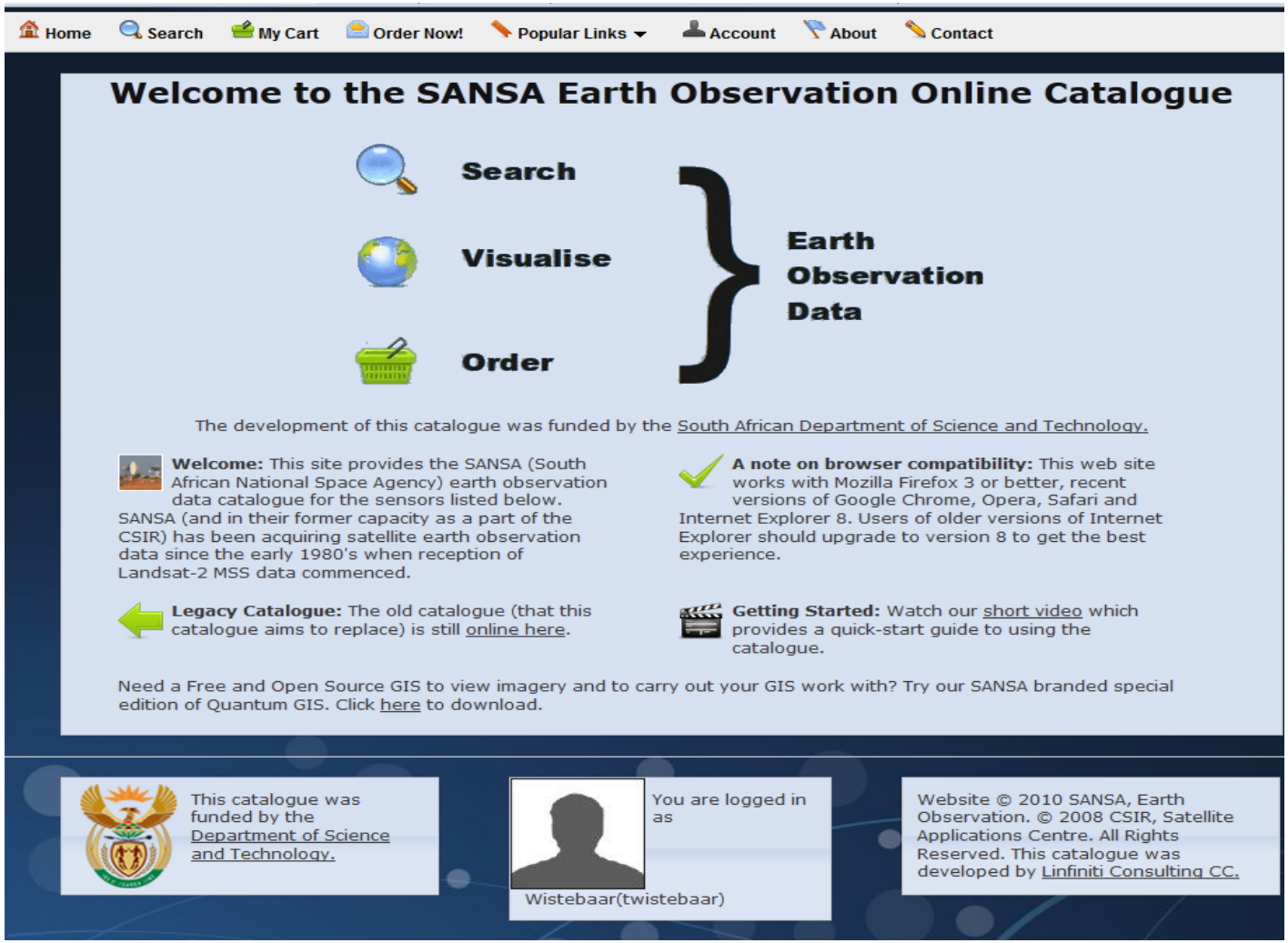
# SANSA Online catalogue Version 2:
# http://catalogue.sansa.org.za



# Thank you