RS and GIS Data Integration

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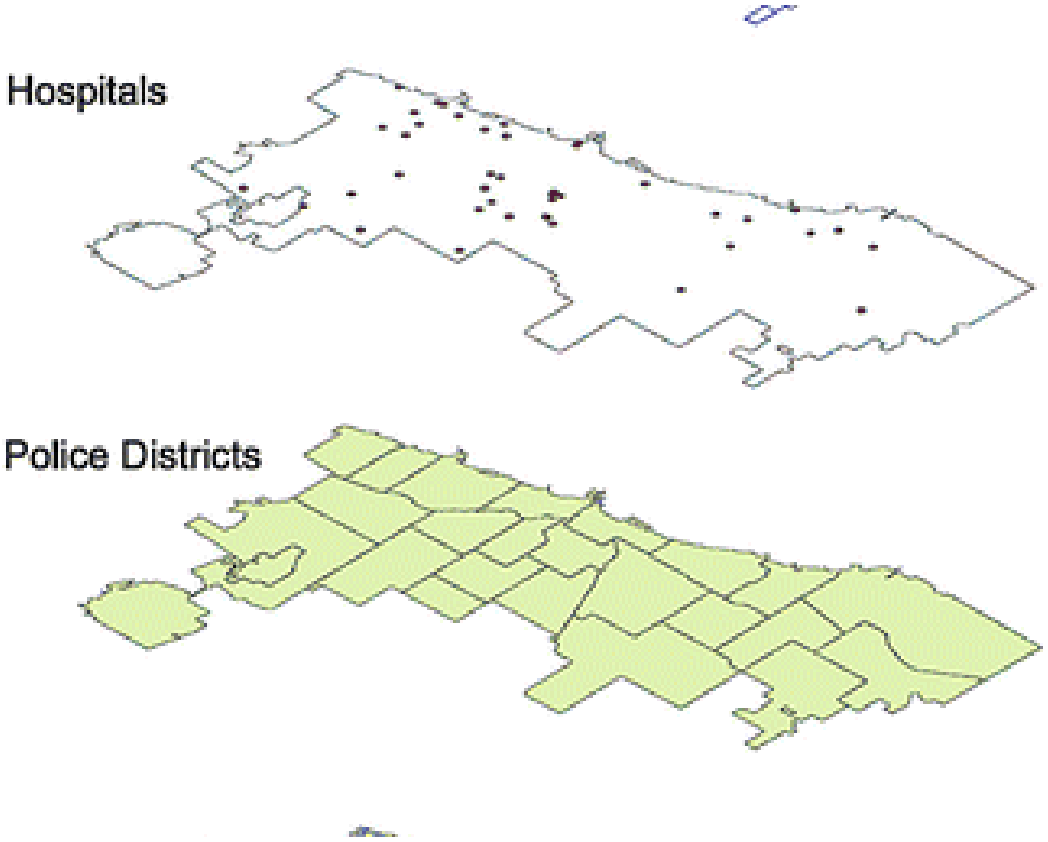
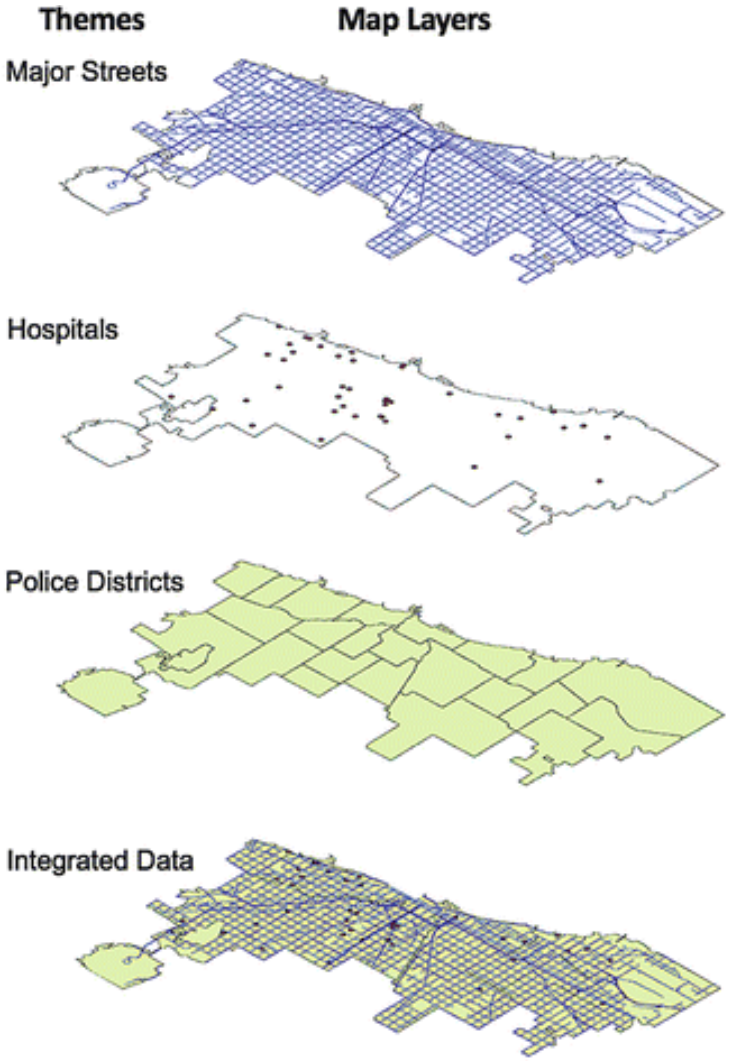
Spatial Data Integration

- Data integration involves combining data residing from different sources.
- Is the process of combining spatial data from multiple sources and formats to create a comprehensive, integrated dataset for analysis and decision-making.
- It involves harmonizing different data sources and formats dealing with inconsistencies in data quality and accuracy, and creating a unified spatial database that can be easily queried and analyzed



Why data integration?

- Varying data formats
- Analyses and decision-making
- Poor data quality
- Technological revolution improved sensor characteristics e.g. resolution
- Creation of new possibilities for researching planet Earth
- Enhance the analysis, reasoning, querying or visualization of the integrated data



Consideration for data integration

What is the goal of the user, or for what purpose the results will be applied?

What kind of data type are the best for user needs?

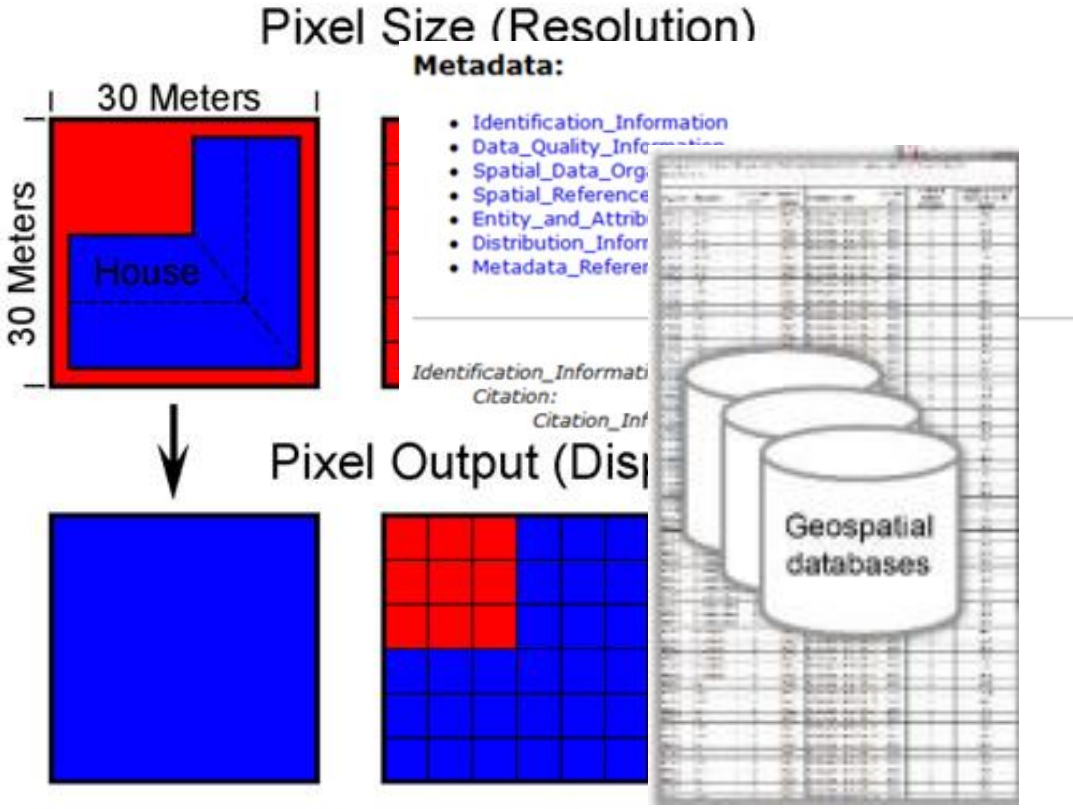
Which is the most appropriate integration technique for selected data?

What are the necessary pre-processing steps?

What is the best combination of data?

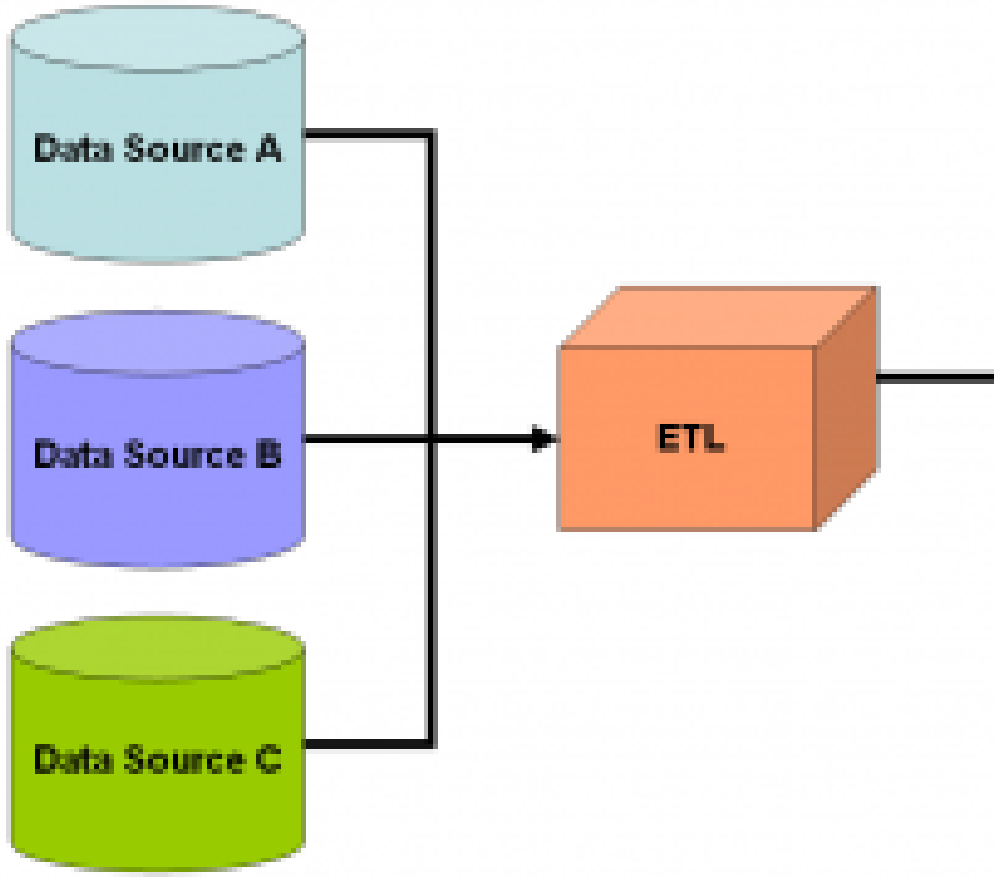
Data integration features

- **Data compatibility**: All datasets being integrated should be compatible in terms of format, projection, coordinate system and data structure. “This often involves reformatting or reprojecting datasets to ensure that they align with each other and can be integrated properly”
- **Data quality**: Ensuring data quality is essential for GIS data integration. It is important to evaluate the quality of data sources, Identify data inconsistencies or errors, and take appropriate measures to improve data quality.
- **Data harmonization**: Data harmonization is the process of aligning data across different sources to create a unified and consistent data set. This may involve mapping data from different sources to a common reference system or transforming data to a consistent format.
- **Metadata**: Metadata is important for GIS data integration, as it provides information about the data source, data quality, and data structure. Metadata helps ensure that the data is used appropriately and is properly integrated with other datasets.
- **Data management**: Effective data management is important for GIS data integration. This involves organizing and managing data sources, tracking changes to data over time, and ensuring that the integrated dataset is updated and maintained.



Data integration features

- Choice of appropriate data structure
- Metadata is especially important for assessing data quality, data history, and error propagation
- Content
- Scale or
- Spatial extent
- Projections
- Acquisition methods
- Formats
- Schema, or levels of uncertainty

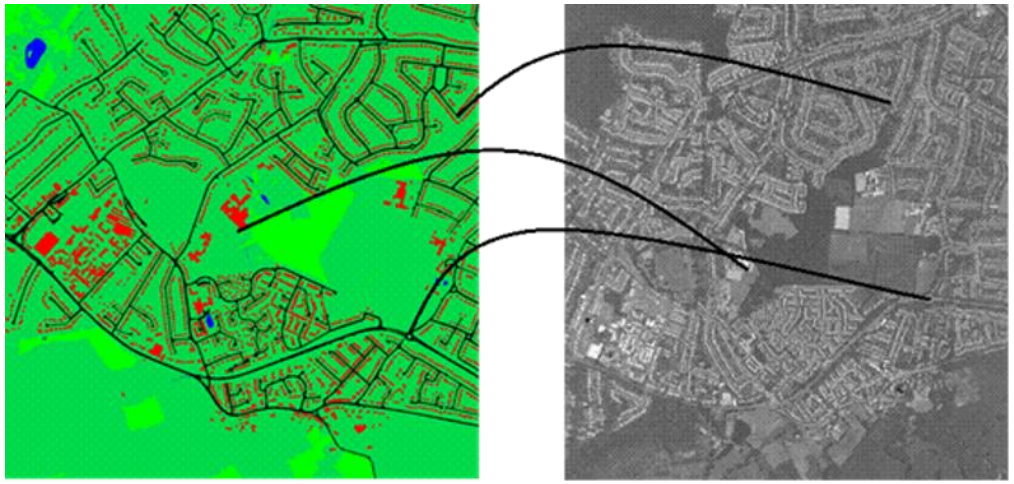


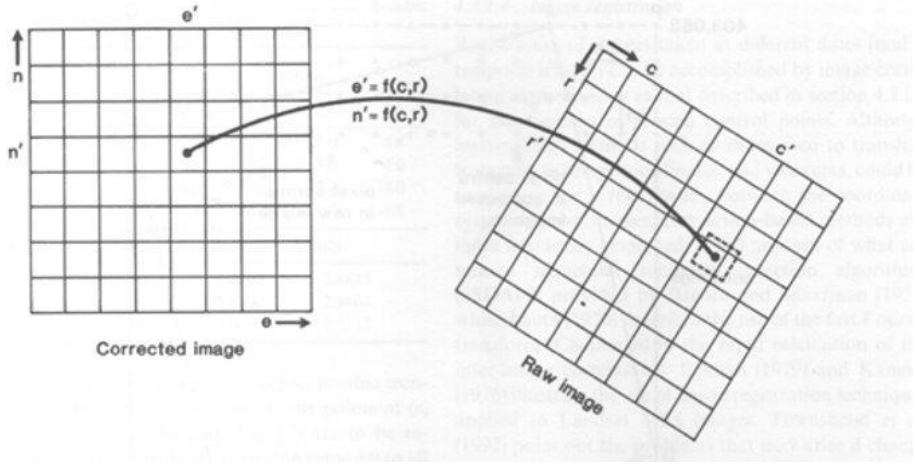
Challenges in data integration

- Poor data quality
- Management of very large spatial databases
- Uncertainty with large spatial databases
- Error propagation
- Choice of appropriate data structures
- No proper data integration
- Data collection delay
- Data availability
- Security Risk
-

Data integration techniques

- Geocoding: assigning geographic coordinates to points
  - Most basic form of spatial data entry
- Data media conversion
  - Scanning
  - Digitizing
- Data reduction
- Topology, error detection and topology editing
- Rectification and registration
- Edge matching and image adjustment
- Interpolation
- Conflation





Benefits of data integration

Data integrity and data quality.

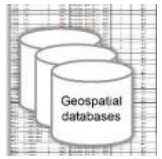
Easy, available and fast connections between data stores

Seamless data analysis and knowledge transfer between users

Better collaboration

Complete real-time business insight, intelligence and analytics

Better and more precise information can be collected (Using and analyzing different data



Integration of GIS & RS lead to synergistic approach to spatial data handling

RS and GIS data integration

- Essential for many application, including land-use planning, emergency management, environmental analysis and infrastructure planning.

- Integrating spatial data from different sources and formats, GIS can provide a comprehensive and accurate picture of the area being analyzed, enabling better decision-making

Further reading list

- https://www.linkedin.com/pulse/gis-data-integration-bhupinder-singh-asprs-lidar
- Definitions of Sensor Data Fusion in the Literature. (2018, July 24). Retrieved from University of Bonn, Institute of Computer Science 4: https://net.cs.uni-bonn.de/de/wg/sensor-data-andinformation-fusion/wha
- Ohl, C., & van Genderen, J. L. (1998). Multisensor image fusion in remote sensing: Concepts, methods and applications. International Journal of Remote Sensing, 823-854.
- Bonham-Carter, G.F. (1991). Integration of geoscientific data using GIS. In D.J. Maguire, M. F. Goodchild, & D. W. Rhind (Eds.) Geographical Information Systems: Principles and Applications (pp. 171–184). New York: John Wiley and Sons.
- Jensen, J., Saalfeld, A., Broome, F., Cowen, D., Price, K., Ramsey, D., Lapine, L., & Usery, E. L. (2004). Spatial data acquisition and integration. In R. E. McMaster and E. L. Usery (Eds.), A Research Agenda for Geographic Information Science (pp. 17–60). Boca Raton, FL: Taylor & Francis-CRC Press.
- Wilkinson, G.G. (1996). A review of current issues in the integration of GIS and remote sensing data, International Journal Geographical Information Science, 10, 85– 101.

Data Access Platforms

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Introduction

- ***South African National Space Agency Act no 36 of 2008***

"Acquire, assimilate and disseminate satellite imagery for all organs of state"

- ***Spatial Data Infrastructure Act No. 54, 2003***

SANSA appointed by the Committee for Spatial Information as the Base Dataset coordinator for Satellite imagery theme.

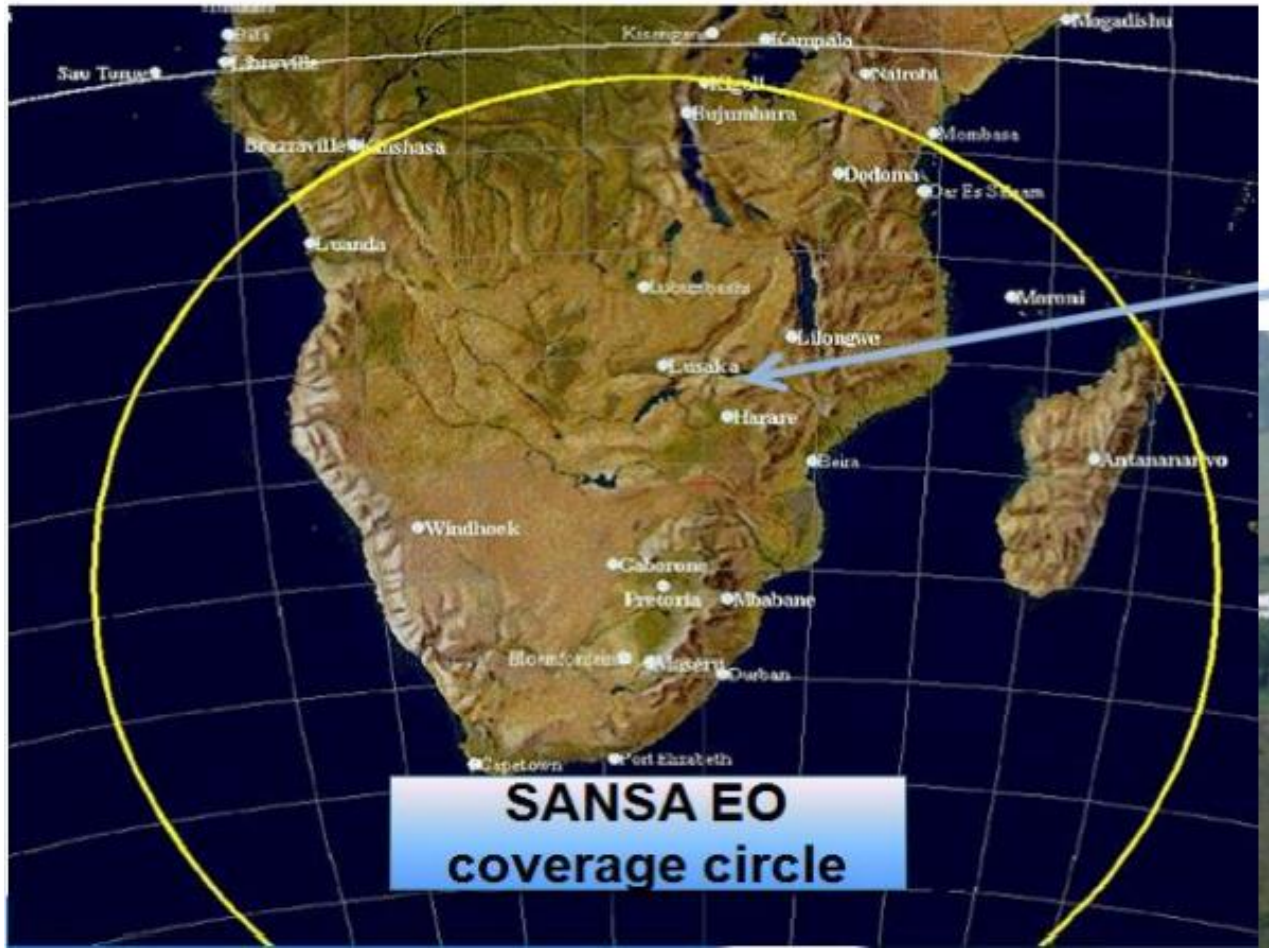
SANSA data platforms

- *Data catalogue*
- *Decision support tool*
- *Mzansi Amanzi portal*
- *Digital Earth South Africa(DESA)*
- *Remote Sensing Atlas*
- *Fundisa learning portal*

SANSA satellite portfolio

SENSOR	SPATIAL RESOLUTION	COVERAGE	DATE OF ACQUISITION
Landsat: MSS,TM, ETM, 7,8, 9	15m-100m	Southern Africa	1972 - current day
CBERS-04A	2m Pan, 8m MS	SADC	August 2023-current
CBERS 2B, 4	10m Pan, 5m Pan, 10m MS, 64m WIF	SADC(except, Mauritius, DRC, Madagascar and Seychelles)	2008 -current
SPOT1, 2, 4,5,6,7	1.5m-20m	Southern Africa	1994 - current day
MODIS, AQUA & TERRA	250m,500m, 1km	Africa	2000 - current day
Worldview1/2/3/4 (SecureWatch platforms)	Multiple from 30cm – 1.85m	Global	Current – Reseller Agreement
GeoEye2 (EarthWatch platforms)	41cm Pan, 1.65m MS	Global	Current – Reseller Agreement
Quickbird (EarthWatch platforms)	0.61m Pan, 2.44m MS	Global	Current – Reseller Agreement
RADARSAT 2	Multiple	Global	April2018 – early 2021
Sumbandila	6.25m	Global	2009 to 2011

Acquisition Footprint



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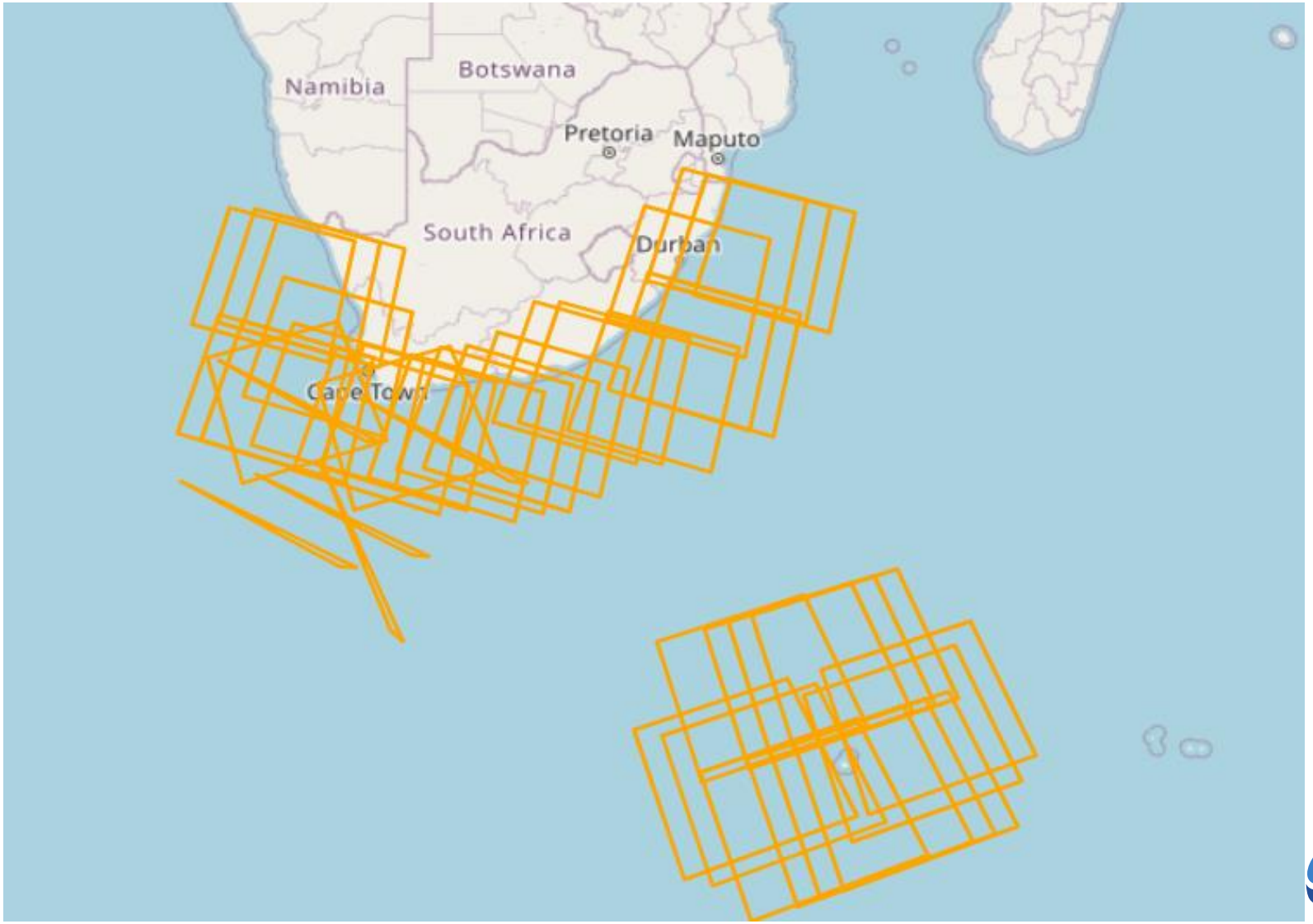
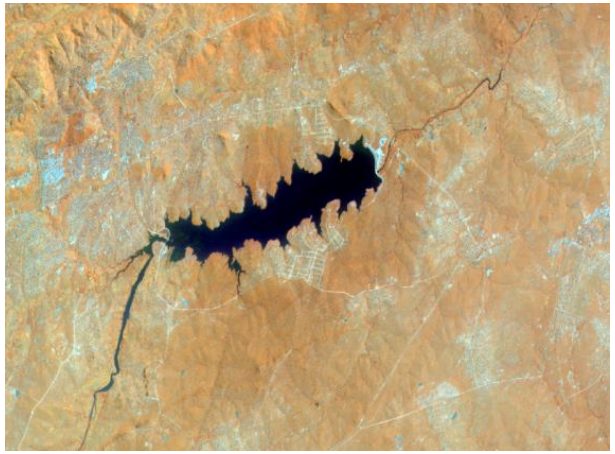
Radarsat-2 acquisition area



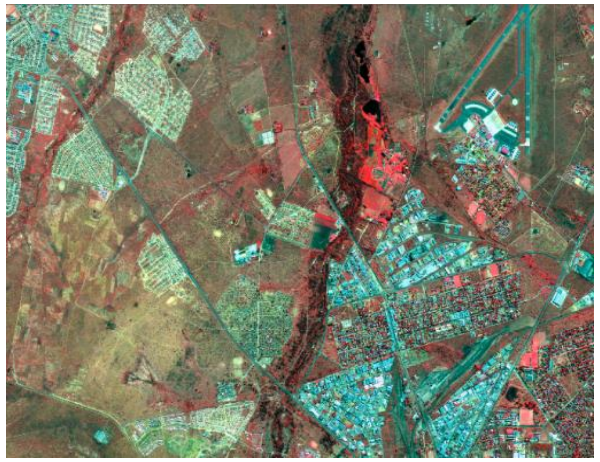
Examples of satellite imagery at SANSA

Landsat 30m

SumbandilaSat 6.25m



SPOT 5 - 2.5m



SPOT 6 – 1.5m

Pleiades 50cm

Worldview3 30cm

SANSA satellite imagery data catalogue

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http://catalogue.sansa.org.za

Email: Customers-eo@sansa.org.za

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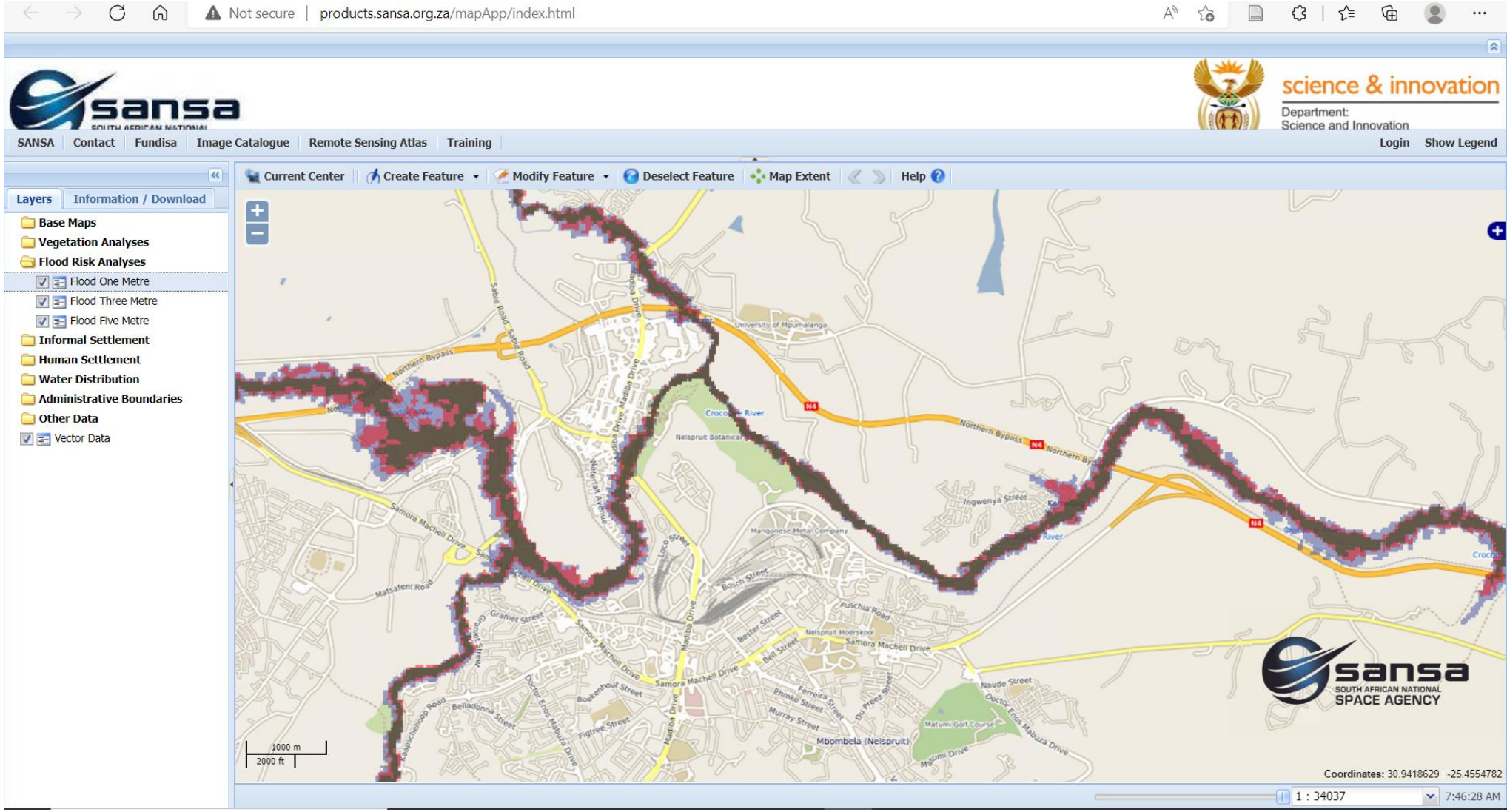
Decision support tool

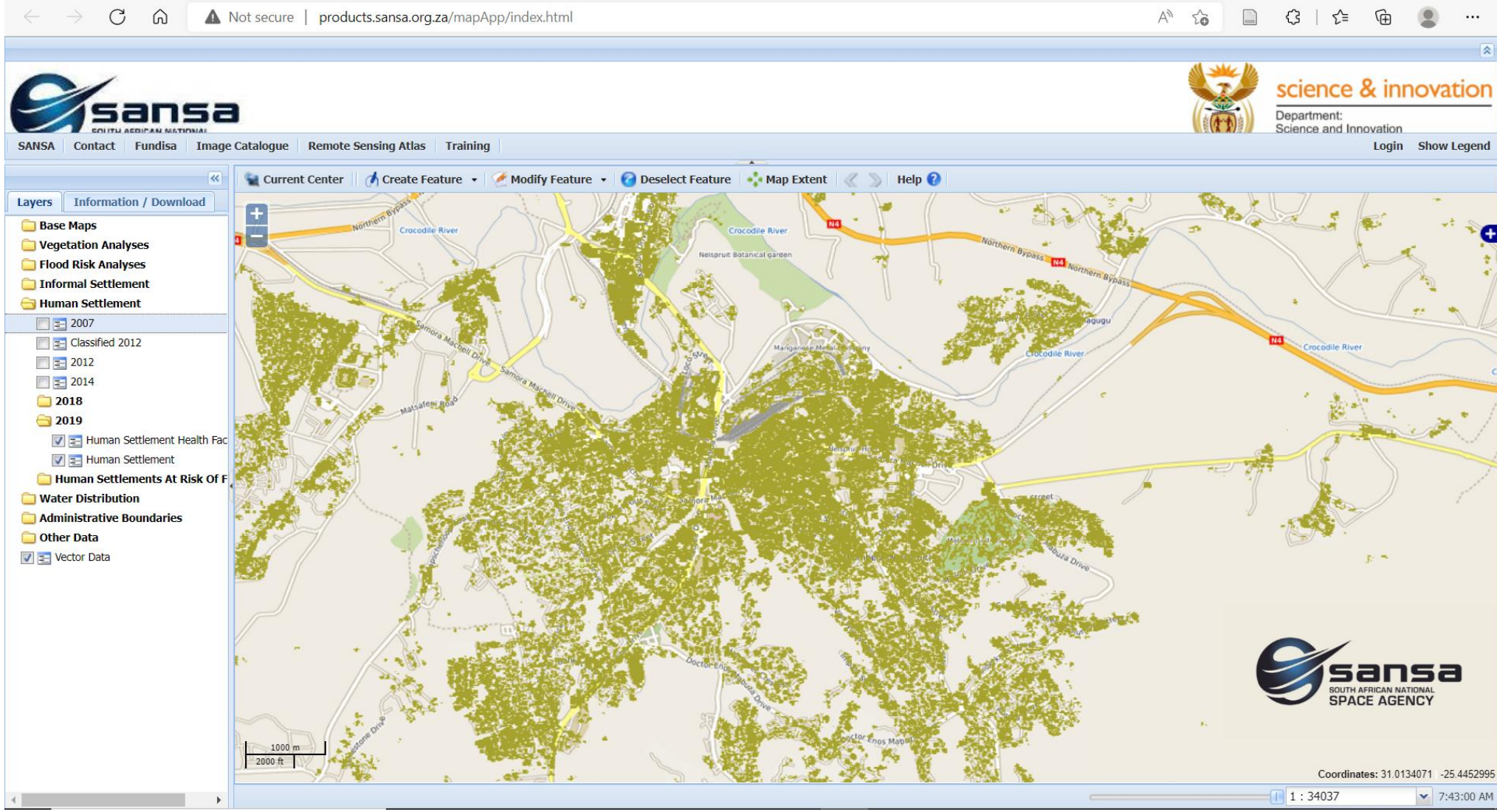
access to value added products-Flood inundation



- http://products.sansa.org.za/mapApp/index.html

Decision support tool

access to value added products-Urban mapping and infrastructure monitoring



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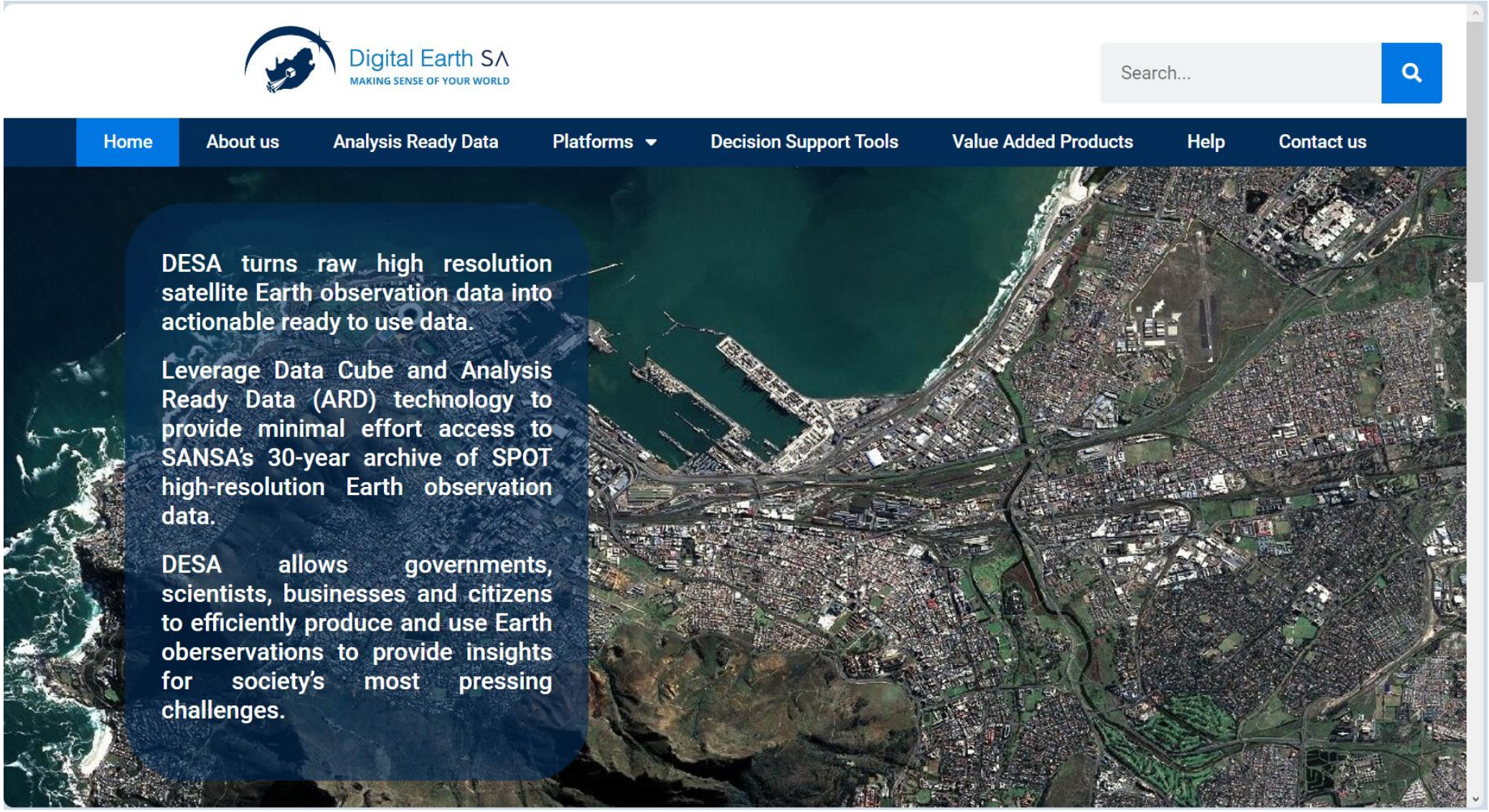
Digital Earth South Africa



- https://desa.sansa.org.za

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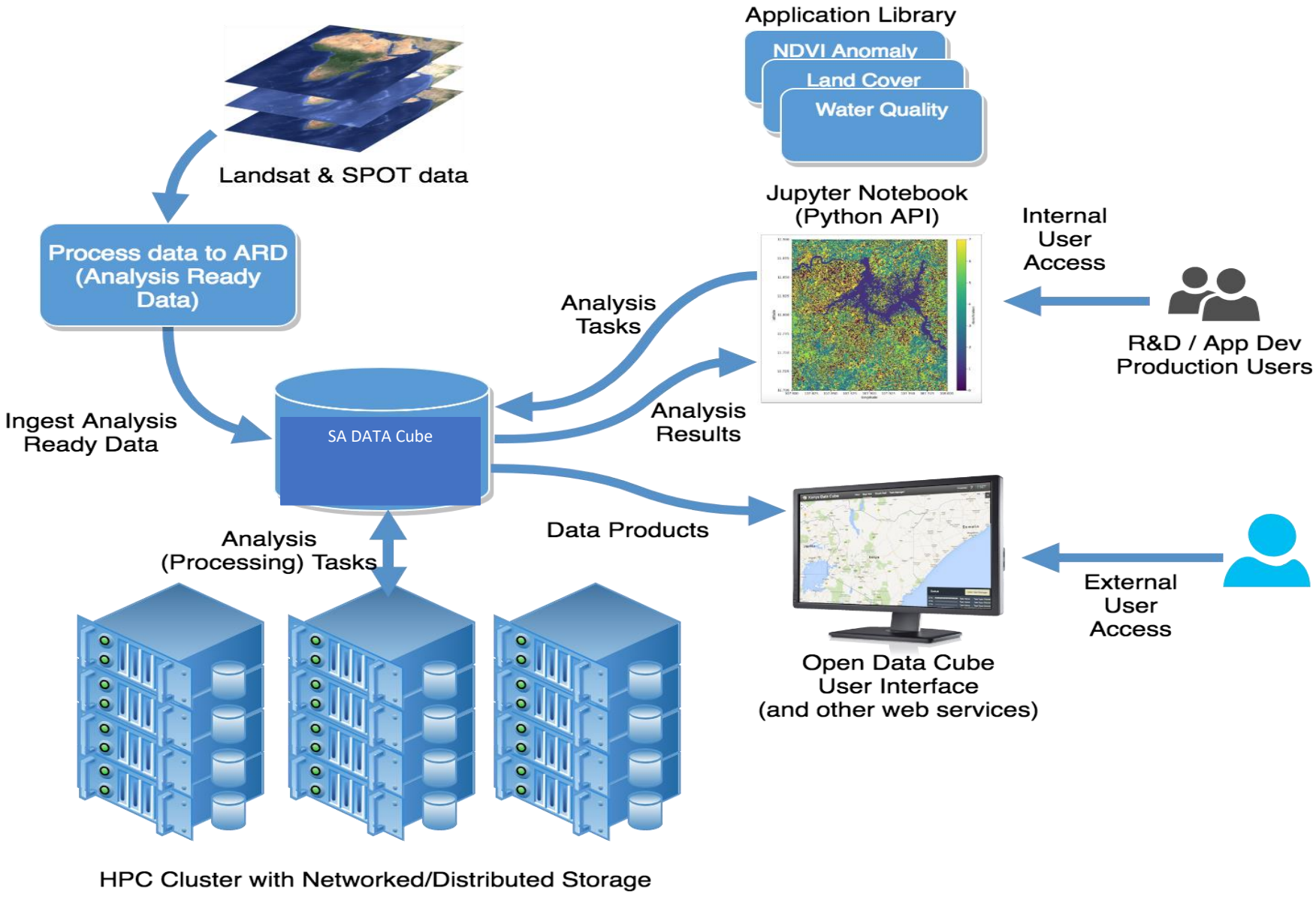

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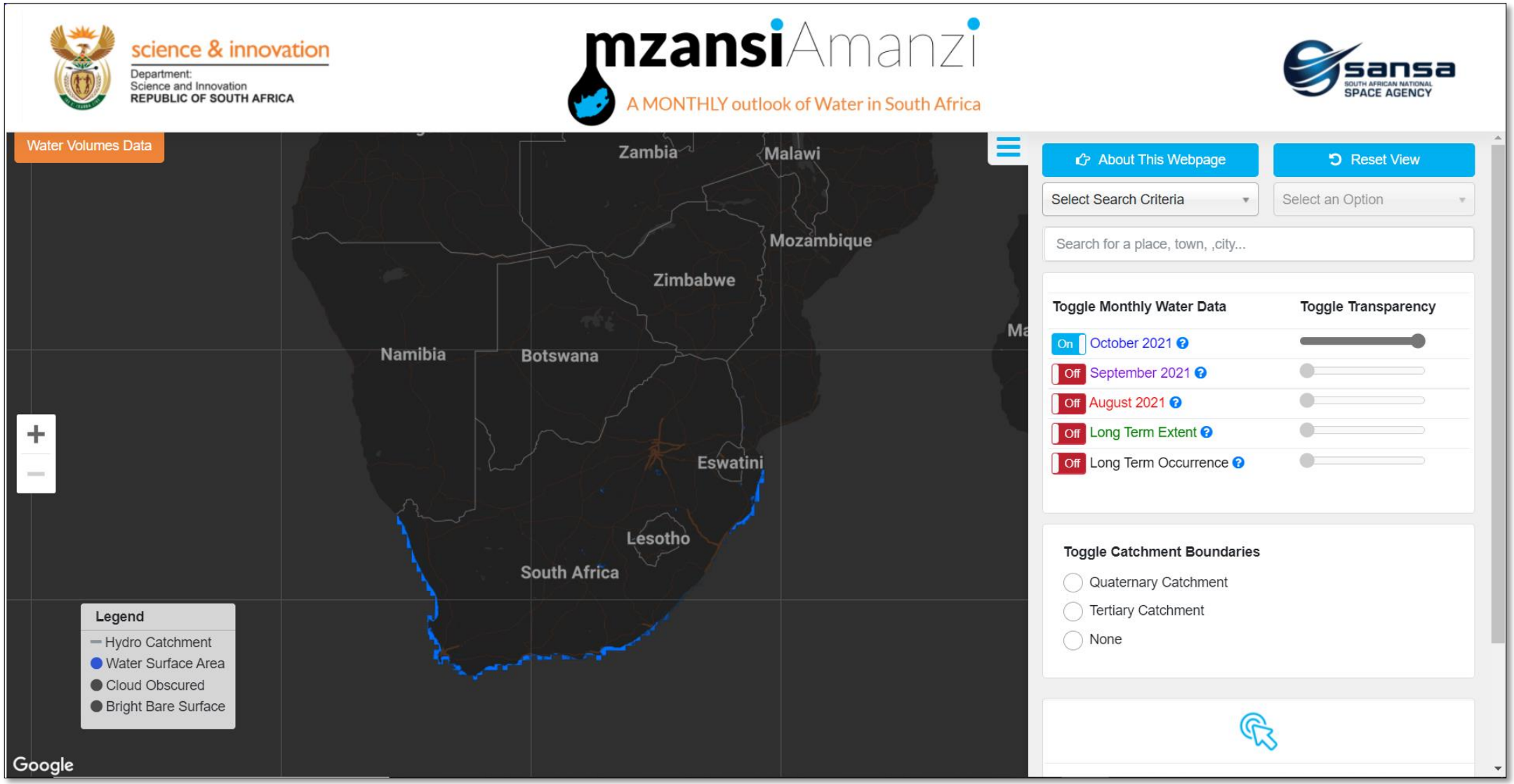
Mzansi Amanzi



- https://www.water-southafrica.co.za/

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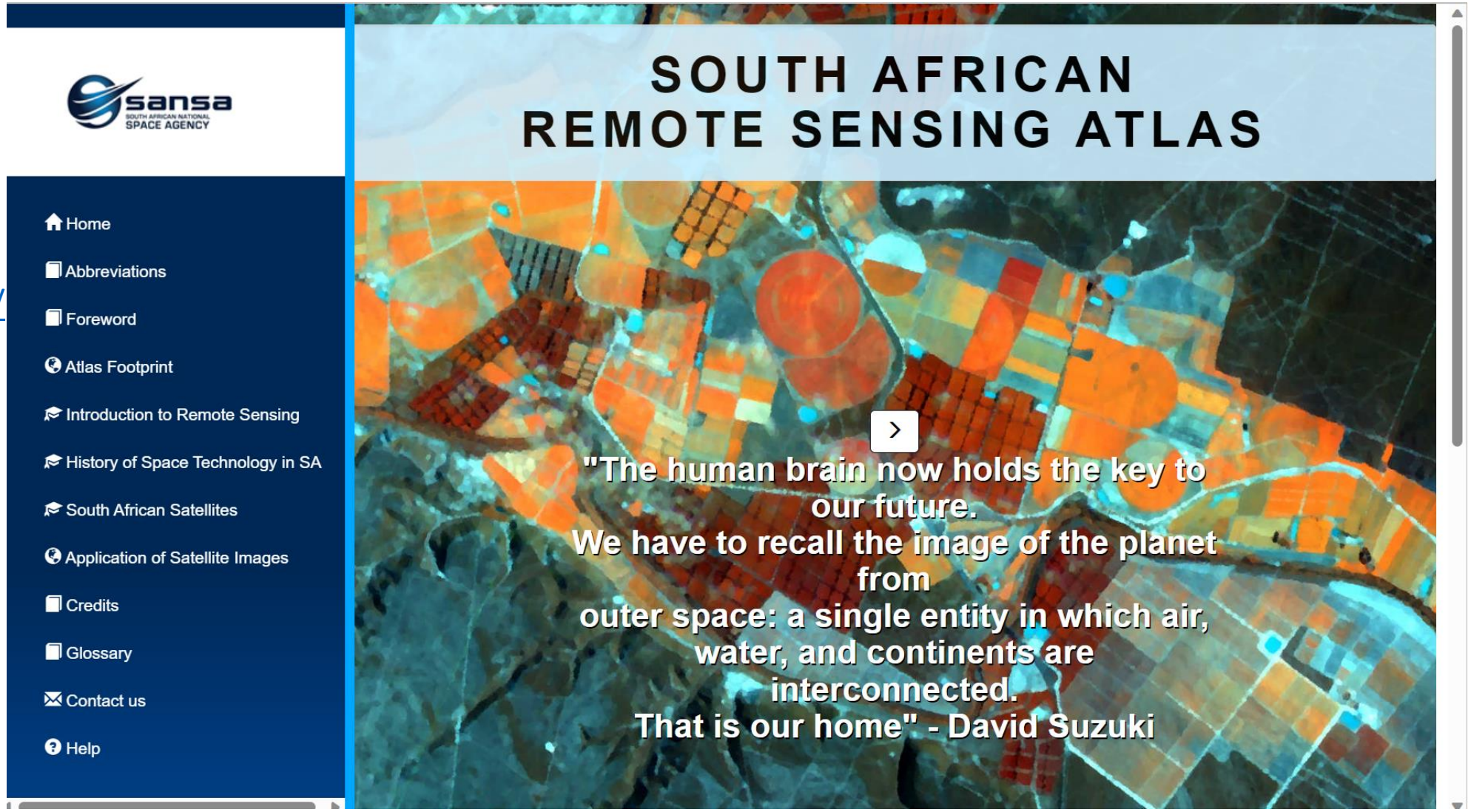
SANSA learning resources

- ***South African RS Atlas***
  - http://atlas.sansa.org.za/



SANSA Remote Sensing Atlas

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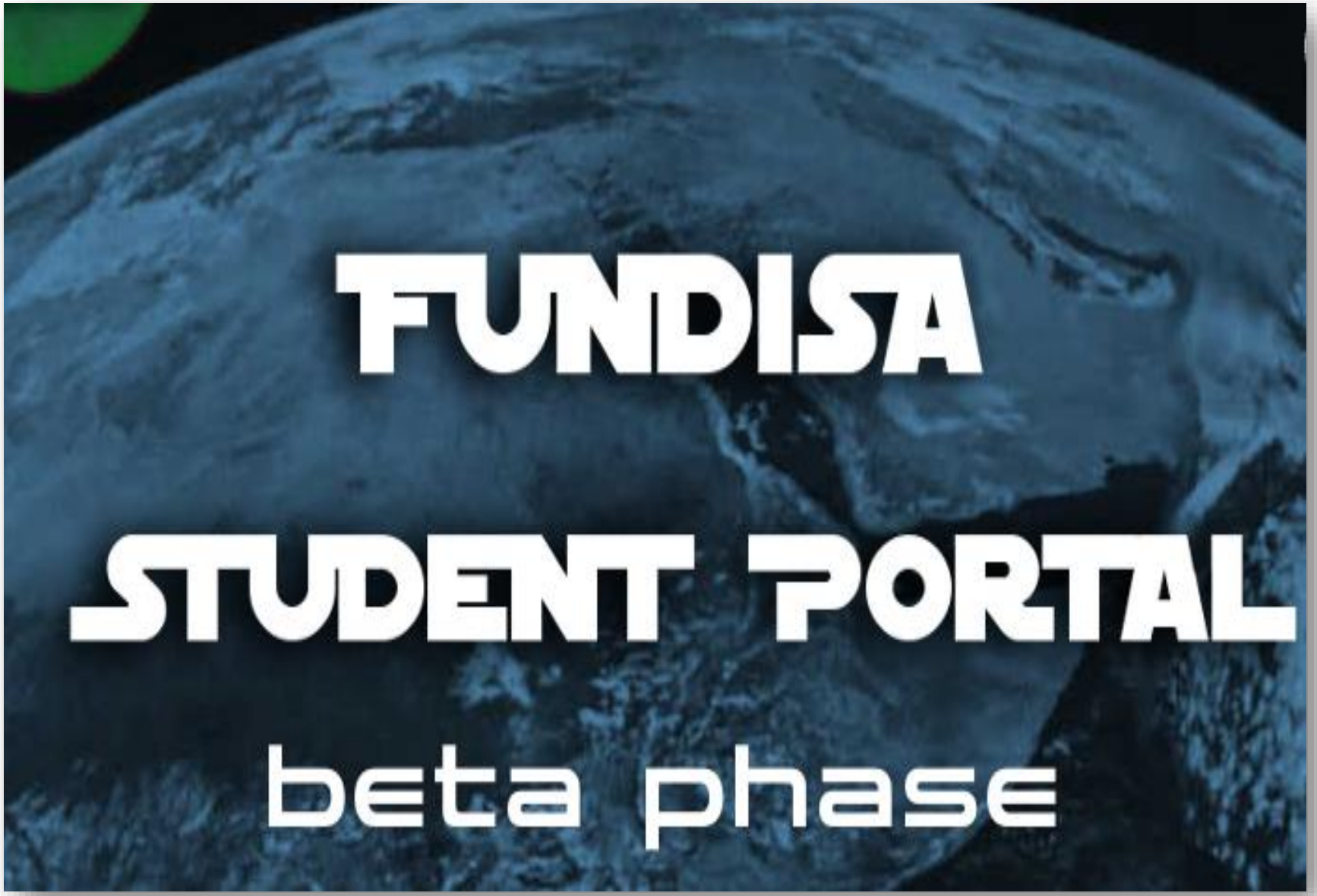
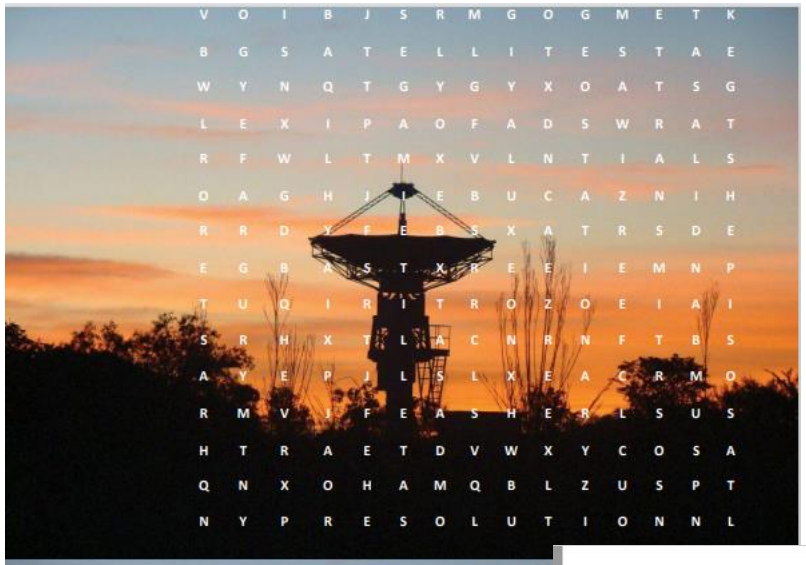
SANSA learning resources

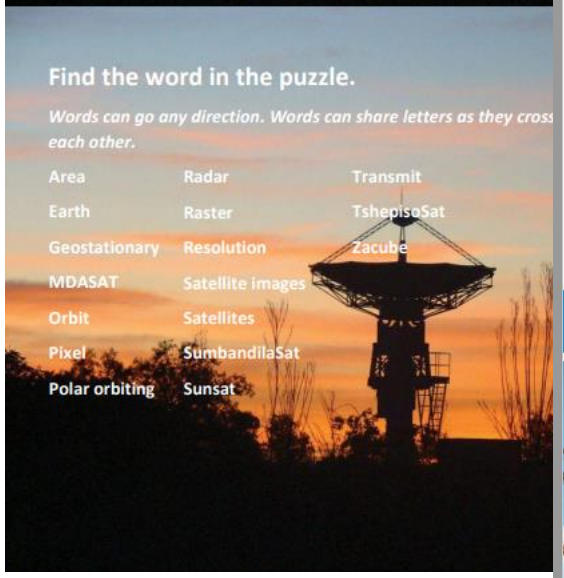
- ***Fundisa portal:***
  - http://fundisa.sansa.org.za/

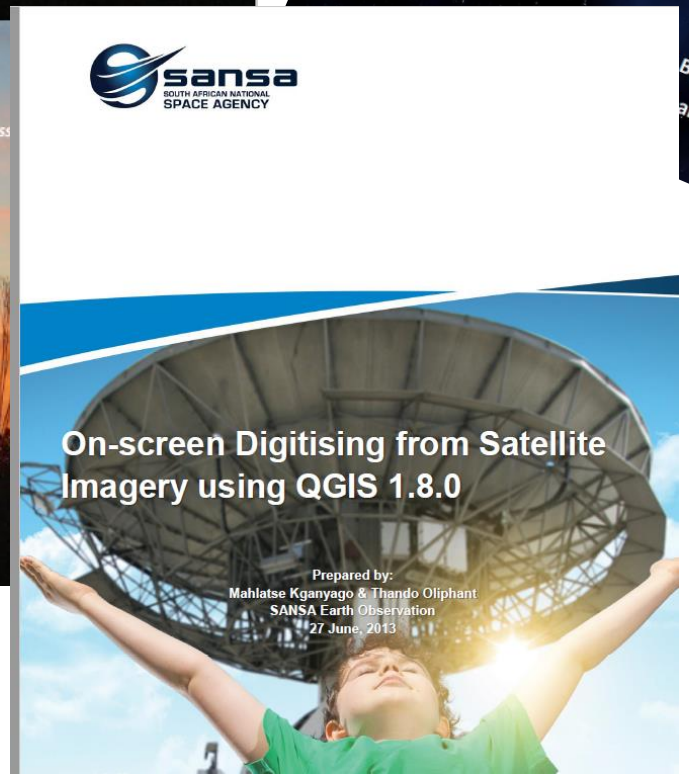


SANSA learning resources

- ***Fundisa school's edition***
  - *GIS Tutorial*
  - *Remote sensing tutorial*
  - *Educational EO games*







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Other sources of spatial information in South Africa:

- *Aerial imagery:*
  - *CD-NGI: http://www.cdngiportal.co.za/cdngiportal/*
- *Land cover :*
  - *DEA portal: https://egis.environment.gov.za/data_egis/home#*
- *Cadastral:*
  - *CSG: http://csg.dla.gov.za/*
- *Wetlands:*
  - *SANBI: https://bgis.sanbi.org/*
- *Water datasets:*
  - *DWS: https://gia.dws.gov.za/DWSPortalApplication/*

- *Administrative boundaries(Municipality/wards) : MDB : http://www.demarcation.org.za/ or http://dataportal-mdb-sa.opendata.arcgis.com/*
- *Geodesy:*
  - *CD-NGI: http://www.cdngiportal.co.za/cdngiportal/*
  - *TrigNet- www.trignet.coza*

Other sources of data platforms

- ***World bank geospatial catalogue***: World bank open data- https://data.worldbank.org
- ***USGS Catalogue***: *https://earthexplorer.usgs.gov/*
- ***ESA catalogue***: *https://dataspace.copernicus.eu/*
- ***Africa Geoportal***: *https://www.africageoportal.com/*

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