



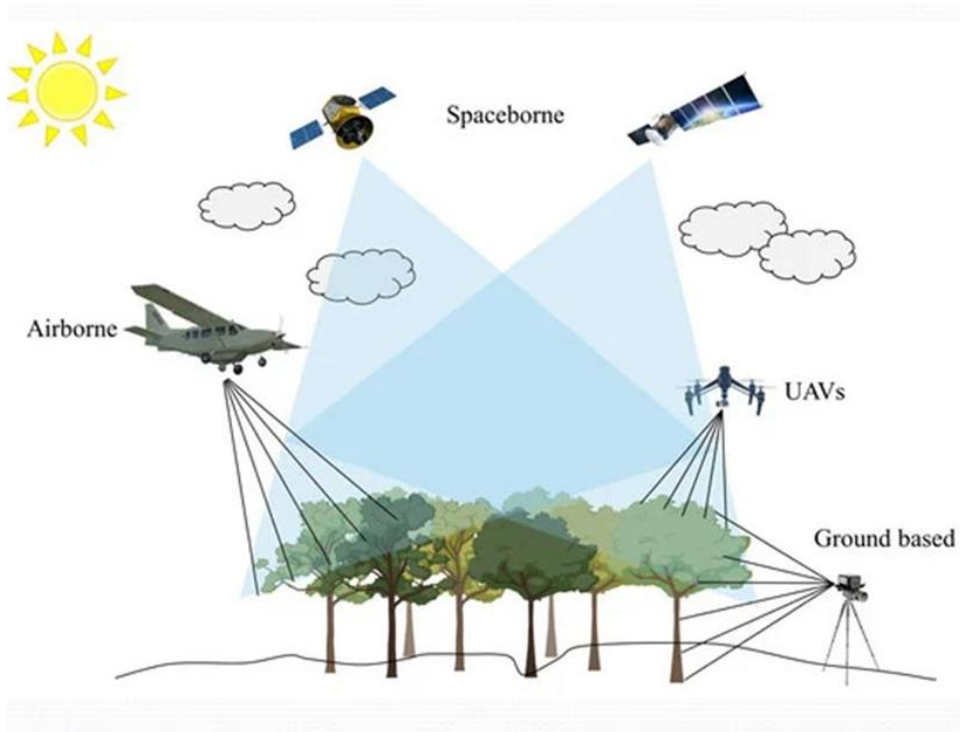
Earth Observation Applications



Lesiba Tsoeleng, South African National Space Agency
SAGWG Workshop, DLRRD, Pretoria | 02 October 2026



Earth Observation



- “Earth observation (EO) is the gathering of information about the physical, chemical and biological systems of planet Earth”.
- It can be performed using remote sensing technologies (EO satellites) or through direct-contact sensors in ground-based or airborne platforms (such as weather stations or weather balloons)
- It encompasses both “space based or remotely-sensed data, as well as ground based or in situ data
- EO is used to monitor and assess the status of changes in natural and built environment

01

Satellite Data Access Overview



● **SANSA's Mandate, South African National Space Agency(Act No. 36, 2008)**

- To provide for the promotion and use of space and co-operation in space-related activities, foster research in space science, advance scientific engineering through human capital
- Support the creation of an environment conducive to industrial development in space technologies within the framework of national government policy.

● **Key point**

Functions of Agency 5. (1) The Agency we—

(d) acquire, assimilate and disseminate space satellite imagery for any organ of state
Support research, industrial development, and human capital in space science.

Sources of Satellite Data for South Africa

**Data received at SANSA Ground Receiving Station
(Space Operations)**

**Ingested, archived and catalogued by SANSA Earth
Observation ground segments**



Currently directly receiving
Landsat 8,9 CBERS 4A, 4B, MODIS (Aqua and Terra
and NOAA AVHRR

Archive Data Collection

Satellite	Sensor	Abbreviation	Start Date	End Date
CBERS-04	P10	CB04	2015	2017
CBERS-04-MUX	MUX	CBMUX	2015	2016
CBERS-04-P5M	P5M	CBP5M	2015	2016
CBERS-04-WFI	WFI	CBWFI	2015	2016
CBERS-2B	CCD	C2B	2008	2010
Landsat 2	MSS	L2	1981	1982
Landsat 3	MSS	L3	1982	1982
Landsat 4	MSS	L4	1984	1987
Landsat 5	TM	L5	1989	2011
Landsat 5	MSS	L5	1985	1993
Landsat 7	ETM+	L7	2001	2014
Landsat 8	OLI/TIRS	L8	2013	2020
RADARSAT-2	SAR	RSAT2	2008	2021
SAC-C	MMRS	SCC	2008	2009
SPOT 1	HRV	S1	1986	1997
SPOT 2	HRV	S2	1991	2009
SPOT 3	HRV	S3	1996	1996
SPOT 4	HRVIR	S4	1998	2013
SPOT 5	HRG	S5	2002	2014
SPOT 6	NAOMI	S6	2013	2018
SPOT 7	NAOMI	S7	2014	2018
SumbandilaSat	MSI	ZA2	2009	2011

Accessing the Archive

Visit the Online Catalogue:

<http://catalogue.sansa.org.za/>

Search for Imagery:

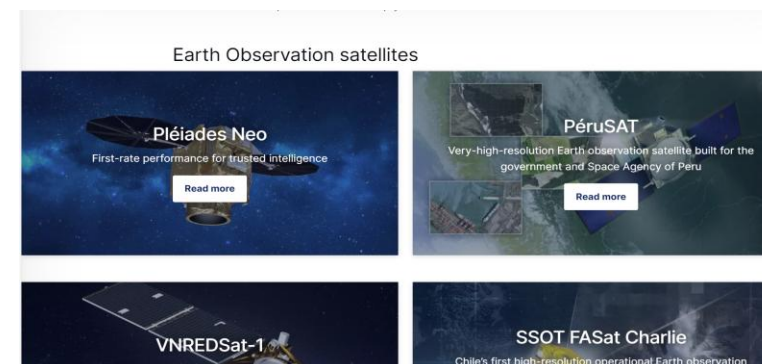
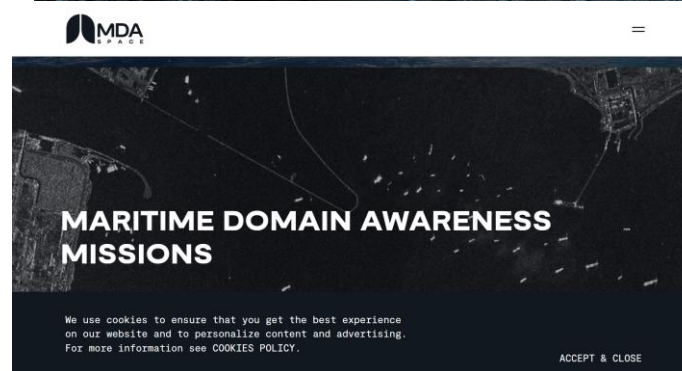
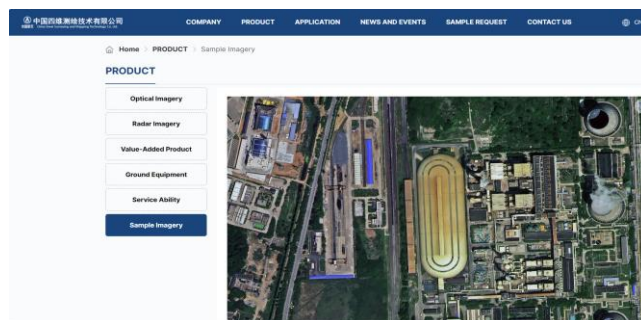
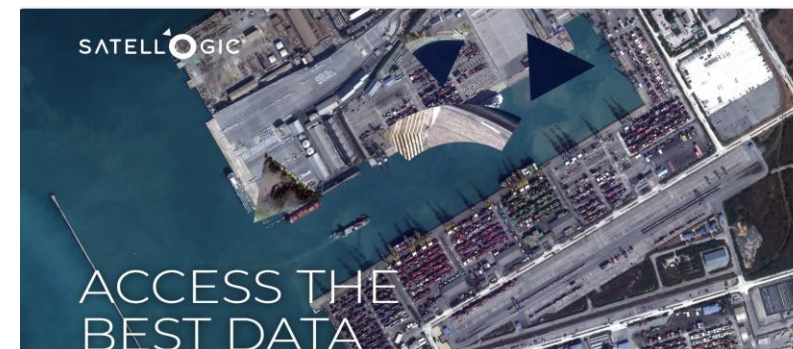
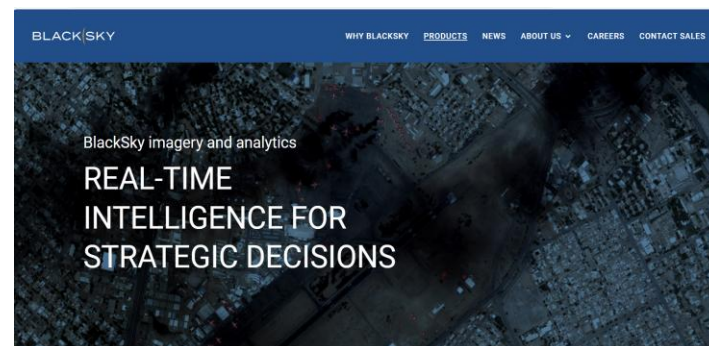
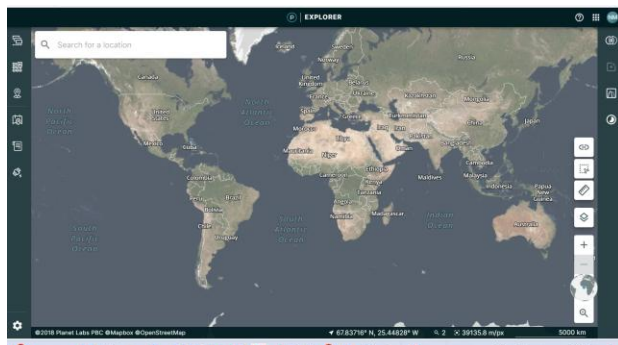
- Use filters such as **satellite, sensor, date range, and location.**
- Preview available imagery and metadata before placing the order.

Order now or Request Data:

Commercial Data Access

- SANSA is a **certified reseller** of commercial satellite datasets.
- Commercial data includes **very high-resolution imagery (1 m – 30 cm).**
- Commercial Online cloud-based platforms
- Data is acquired **on request** and may include **new tasking** over your area of interest.

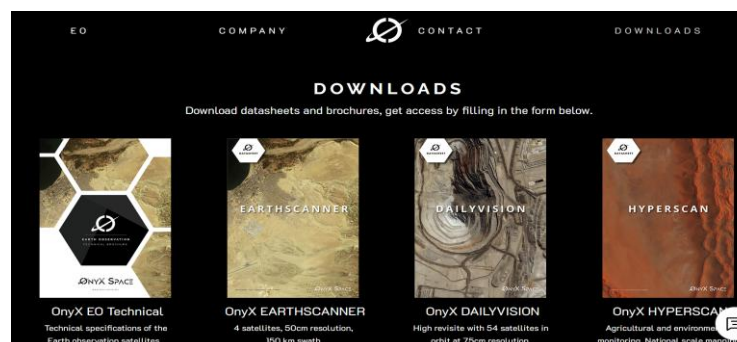
Access to high temporal and spatial resolution data



Versatility and value

Satellite imagery provides foundational context and visualization of ground conditions, empowering organizations to make critical, time-sensitive decisions. Emerging remote sensing technologies continue to broaden the capabilities of imaging satellites, providing more types of data at global scale.

Hover over image to see the highest resolution satellite imagery available



02

Earth Observation Applications



Spatial Data Integration

❑ What?

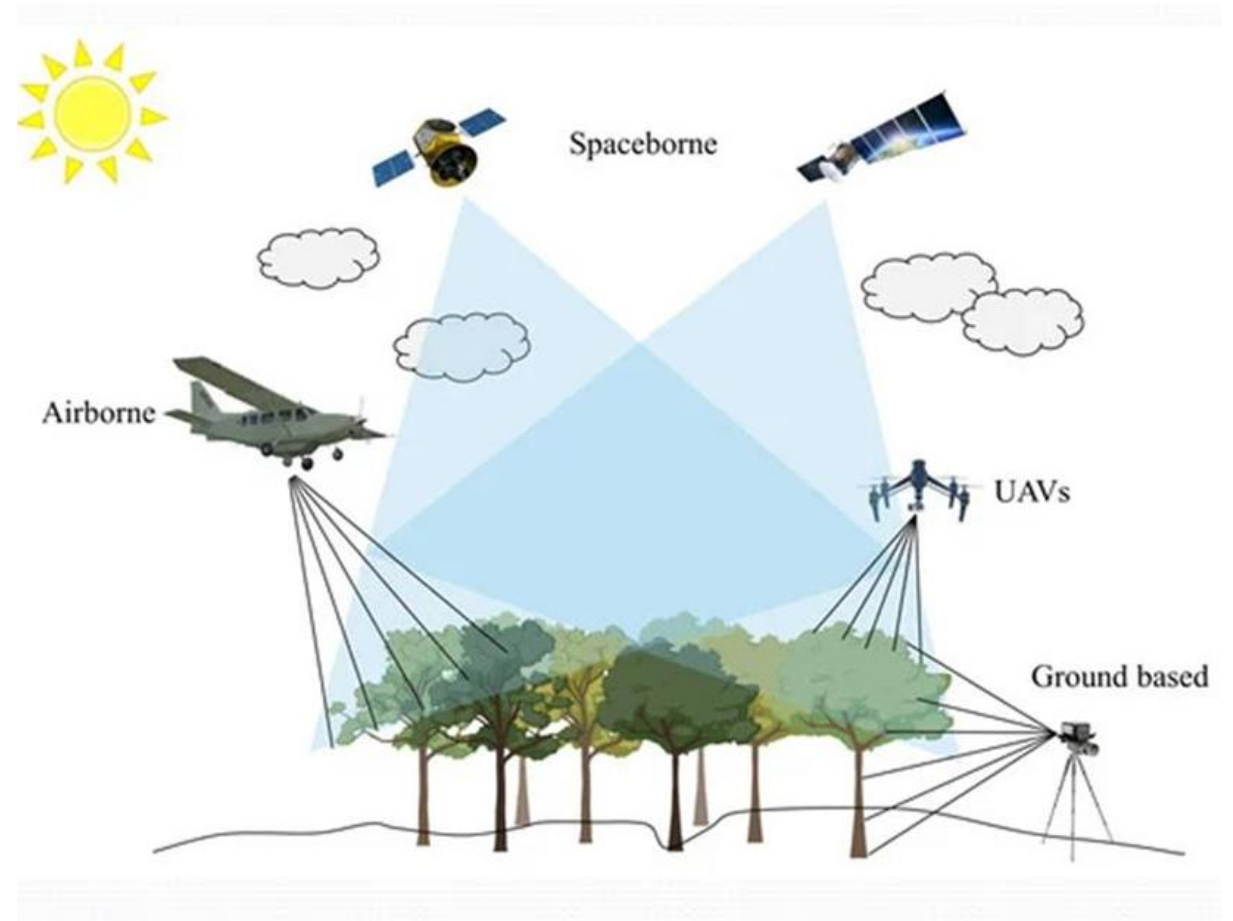
Multi-sensor data integration is to synergistically combine sensory data from disparate sources—with different characteristics, resolution, and quality.

❑ Why?

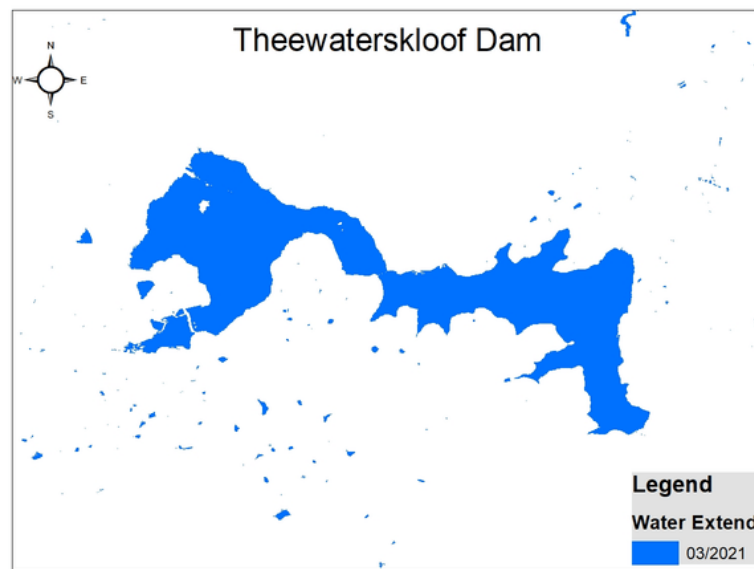
In order to provide more reliable, accurate, and useful information required for diverse mapping, modelling and monitoring applications.

Contributes to the robust interpretation of the observed objects/scenes and provides the basis of effective planning and decision-making.

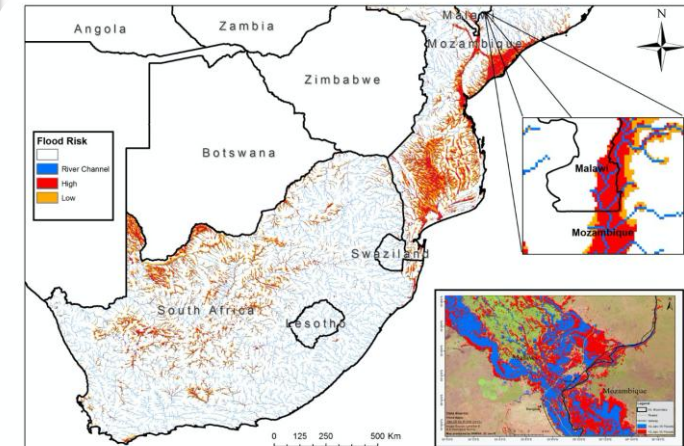
GNSS play a central role ensure that observations from different sensors refer to the **same geographic location and coordinate reference system**



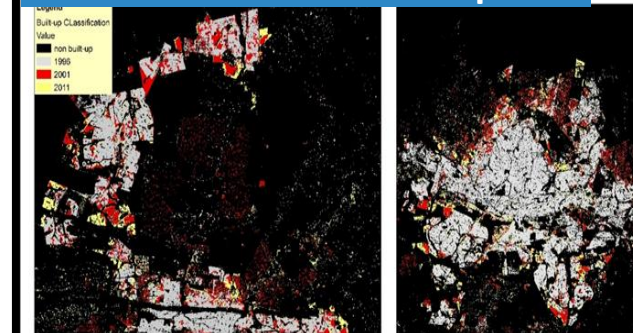
EO Thematic Areas



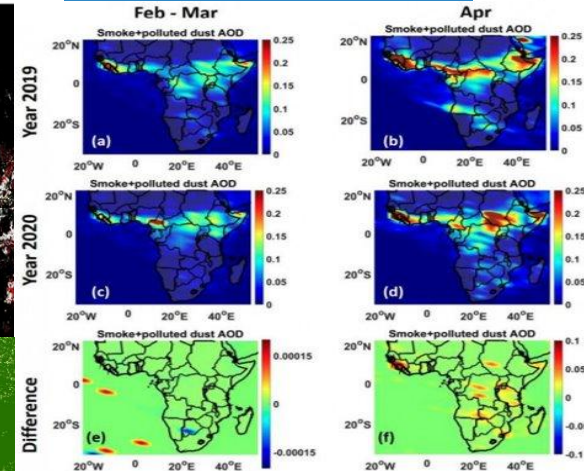
Flood Risk Mapping



Human settlement mapping and Infrastructure Development



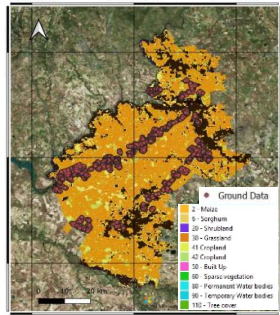
Air Quality Assessment



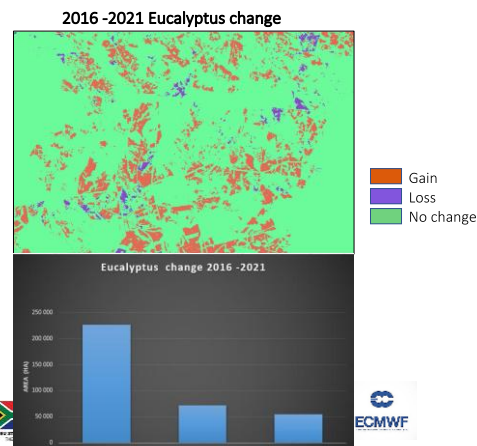
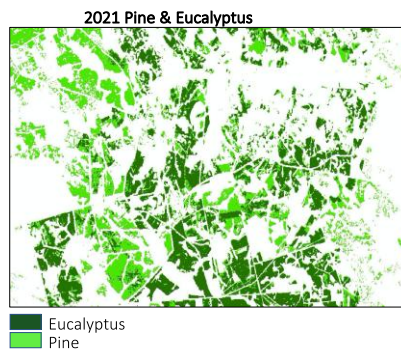
Informal settlement mapping



Crop type mapping



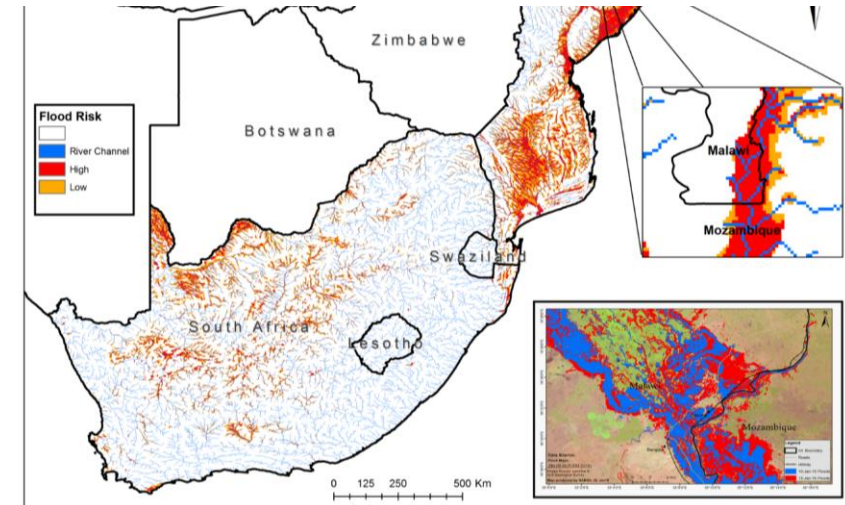
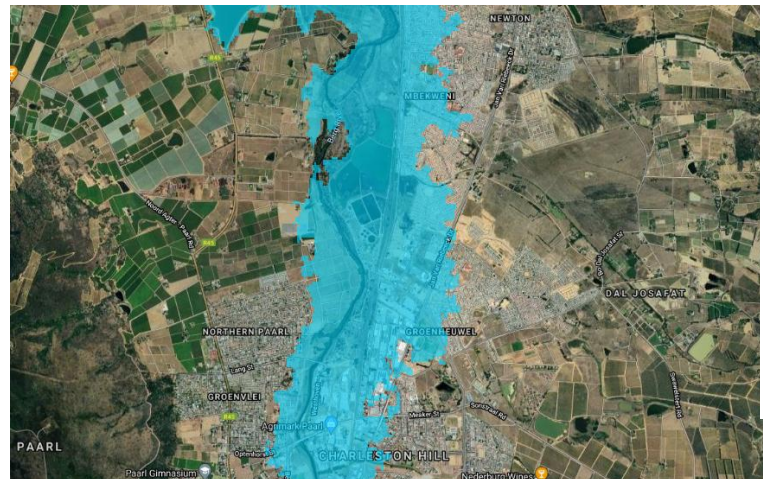
Forest type and forest change mapping



Applications Disaster Management

Disaster Preparedness and Response

- Enables early warning systems for floods, droughts, fires, or earthquakes.
- Supports emergency response by mapping affected areas in near real-time.
- Damage assessment post-disaster using satellite data.
- Evacuation route planning using GIS.
- Wildfire detection and tracking in near-real time.
- GNSS-R can be used as complementary observation,
- GNSS-R can potentially detect changes in Surface conditions associated with Inundation



Applications Human Settlement

Urban Planning and Infrastructure

- Monitoring urban sprawl and land use changes.
- Infrastructure health checks (e.g., roads, bridges) using Very high resolution imagery.
- Utility management (e.g., power lines, water pipelines).
- Informal settlement monitoring
- The integration of GNSS data with UAVs (drones) for rapid urban mapping or 3D mapping.

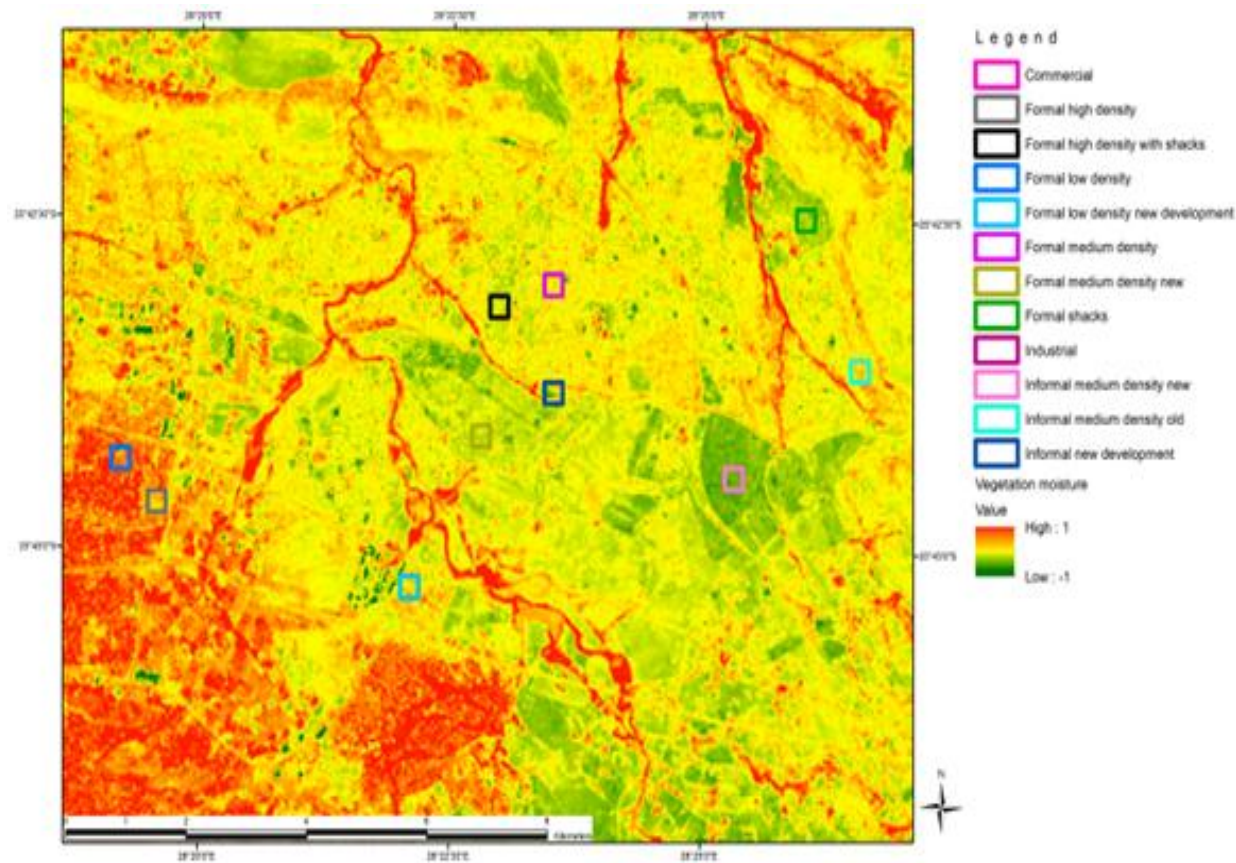
Tshwane



Johannesburg



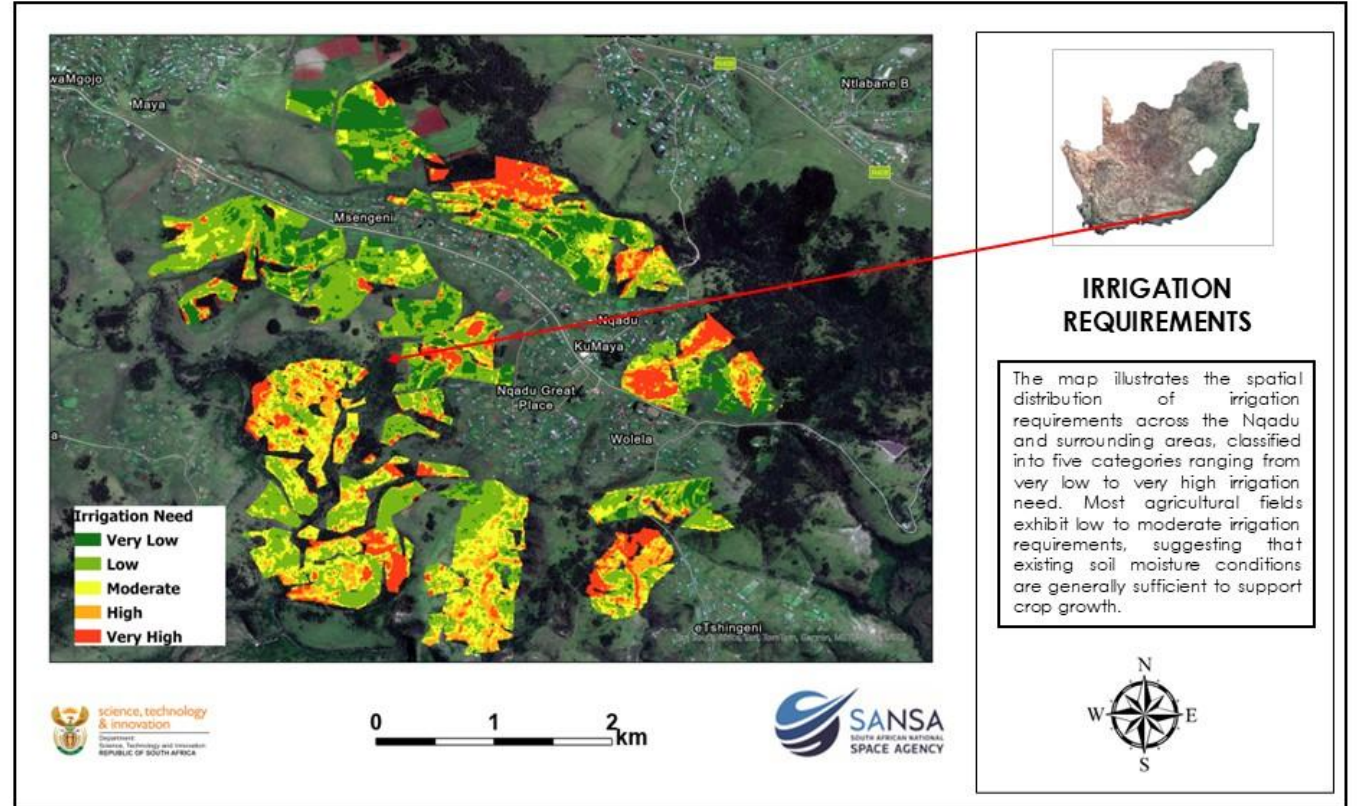
Remote sensing data and community-based data collection: Increase awareness; preparedness; improved health



Applications of Agriculture

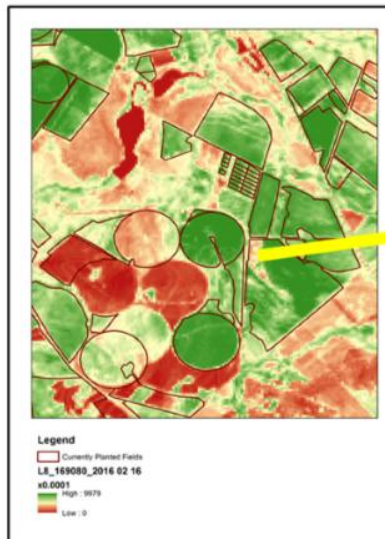
Agriculture

- Crop health monitoring with NDVI (Normalized Difference Vegetation Index) from satellite/drone data.
- Soil moisture and yield predictions using remote sensing data.
- Precision farming and irrigation planning.
- GNSS forms the foundational framework for precision agriculture.
- Precision Drones (UAV) for targeted crop spraying.

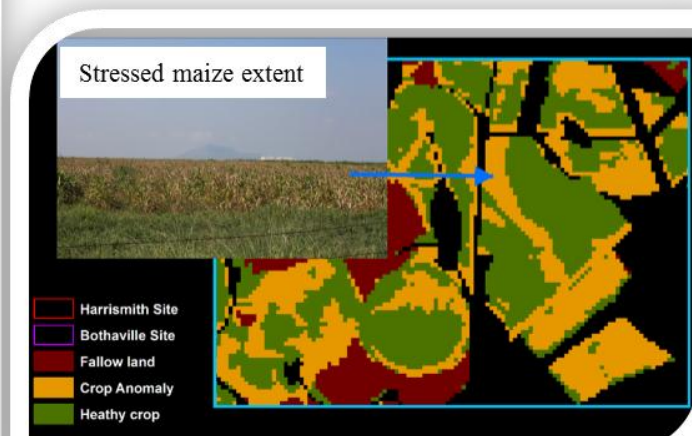
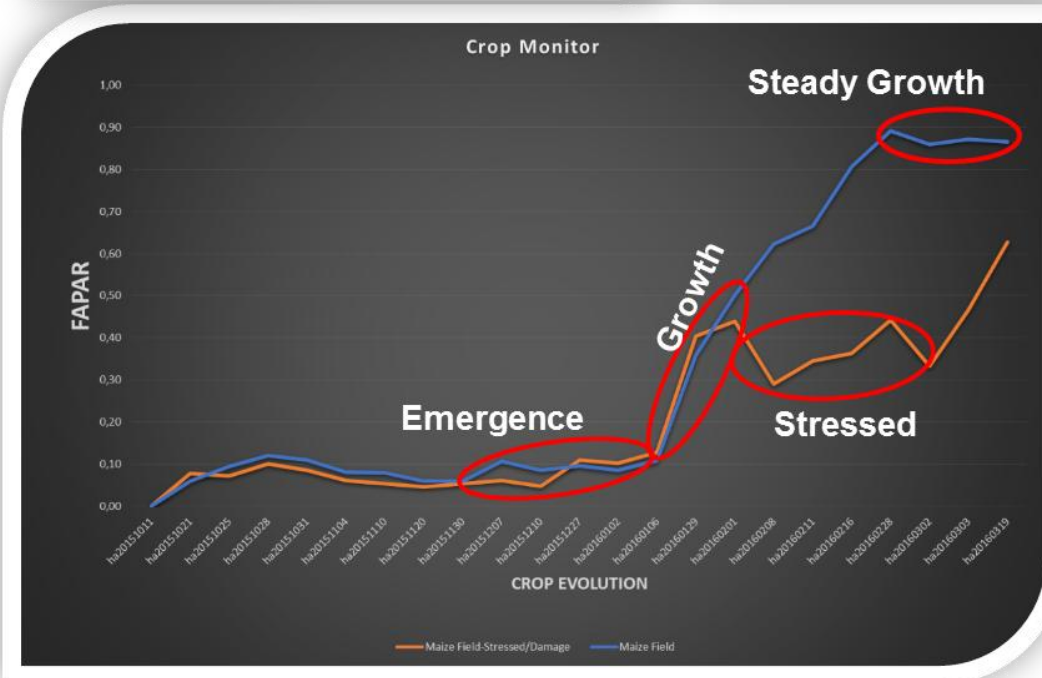


Crop Condition & Growth Monitoring

GNSS for EO
ground validation

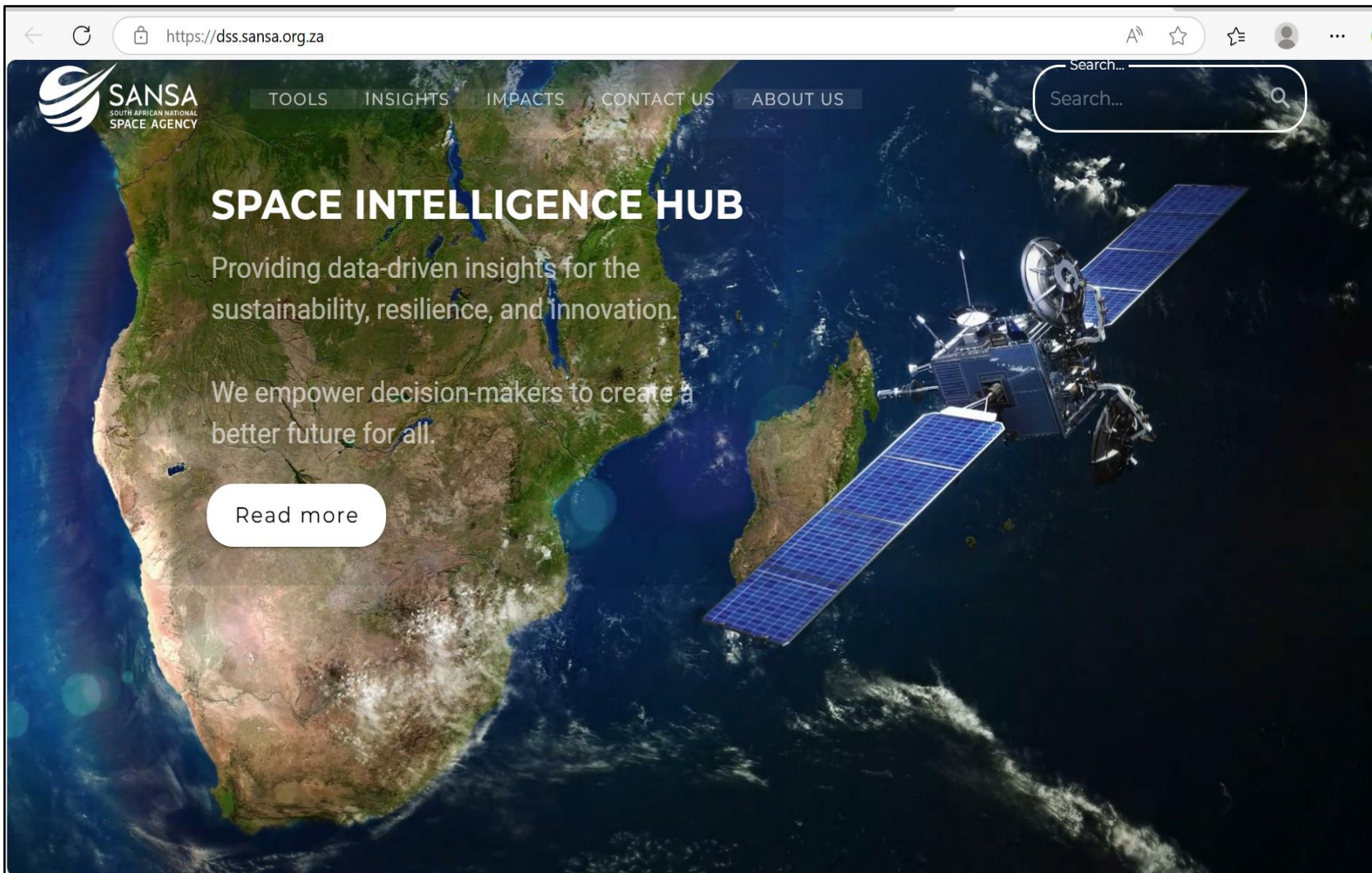


CROP STRESS DUE TO :
hail, pests, diseases,
water & nutrient
deficiency, etc



Biophysical parameters such as Leaf Area Index, canopy chlorophyll, fAPAR, canopy water, etc are used.

The Future or now “Decision Support Dashboards”



- **Water Resource Management**
- marine and maritime,
- **Disaster Management**
- Human Settlement
- Agriculture,
- **Atmosphere Air Quality**
- Ecosystems & biodiversity
- Energy & minerals, built environment,
- Defence & security

Water Quality Analysis

MONITORING TYPE:

Total Suspended Solids (TSS) ▾

ANALYSIS MONTH

February 2026



AREA OF INTEREST:

National Boundary ▾

National Boundary

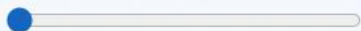


Use the national boundary for the current analysis.

Results Applied

Layer Transparency

0%



None 25% 50% 75% 100%

Opaque Transparent



Total Suspen...

WMS Layer

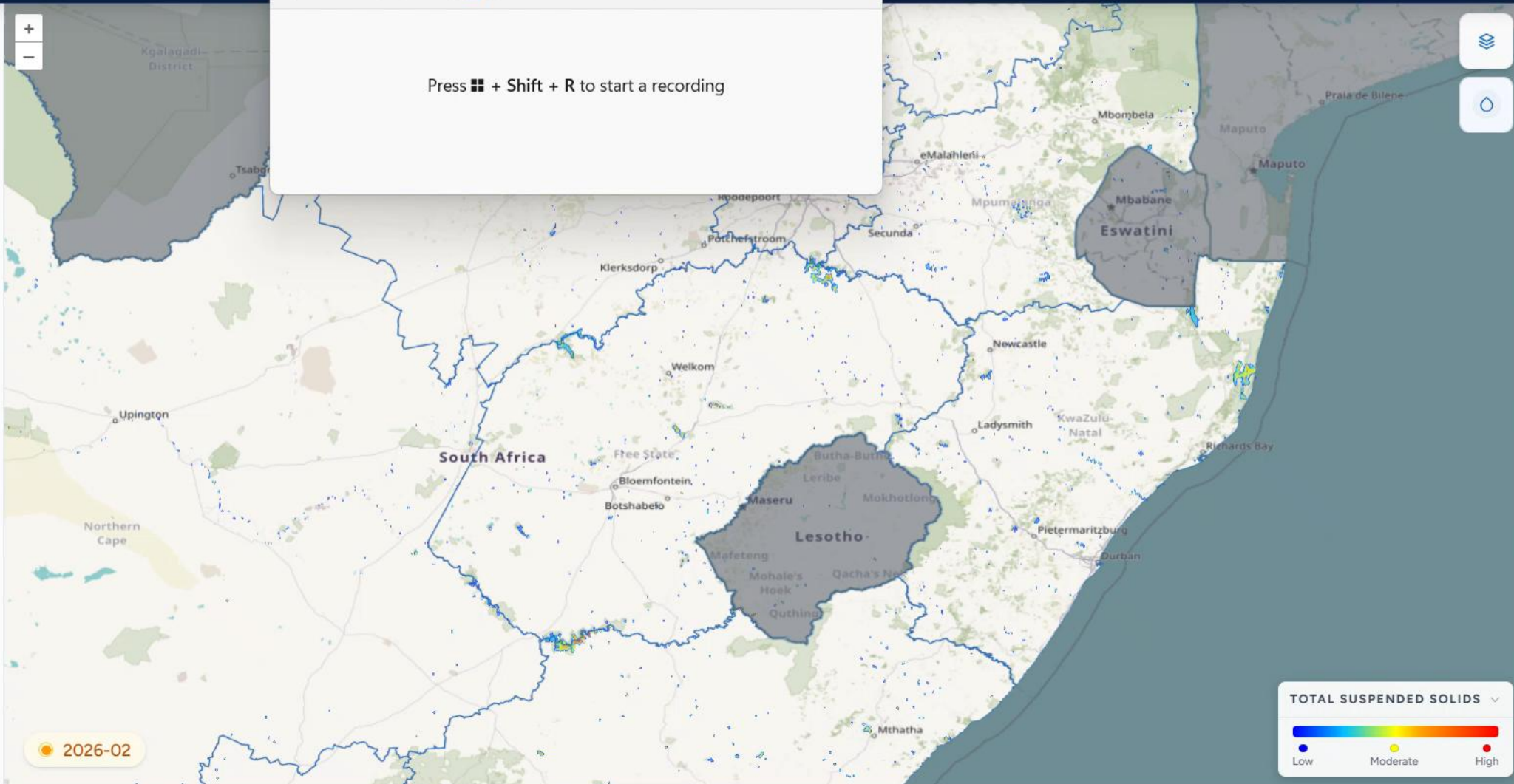


> Show Logos

+ New

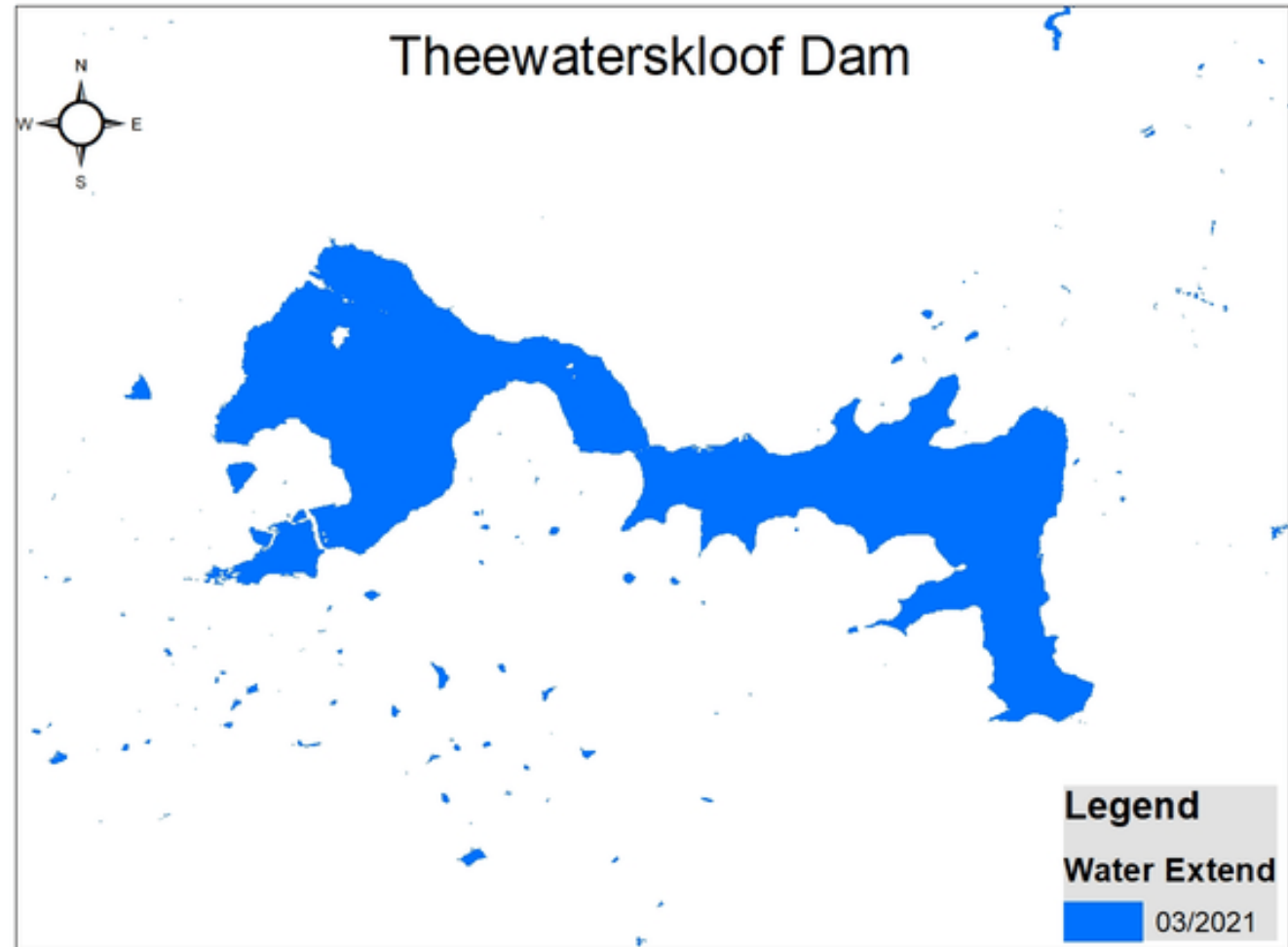


Press  + Shift + R to start a recording



GNSS in water-resource monitoring

- GNSS-based techniques can also contribute to monitoring water-surface elevation.
- GNSS receiver positioned near a water body can receive: the direct satellite signal; and a signal reflected from the water surface.
- The geometry between the satellite, receiver and reflecting surface is known, changes in the reflected signal can provide information about the water surface.
- BeiDou/GNSS + GNSS-R + EO + field observations + AI = integrated water intelligence.
- ESA's HydroGNSS mission, for example, uses GNSS reflectometry to investigate variables including **soil moisture and inundation/wetlands**, demonstrating how GNSS signals can complement conventional EO



GNSS enabled EO validation

How can BeiDou and multi-GNSS observations, including GNSS Reflectometry, be integrated with multi-source Earth Observation and in-situ measurements to improve the spatial, temporal and predictive capability of water-resource monitoring and decision support in South Africa?



GNSS can play a central integration role in remote sensing, not only as a positioning system but also as an independent source of environmental observations. the strongest approach is to treat GNSS as the geospatial reference and field-observation layer, with GNSS Reflectometry (GNSS-R) providing an additional Earth-observation data source.

Thank you



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& innovation
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