SANSA GNSS Instrumentation Network

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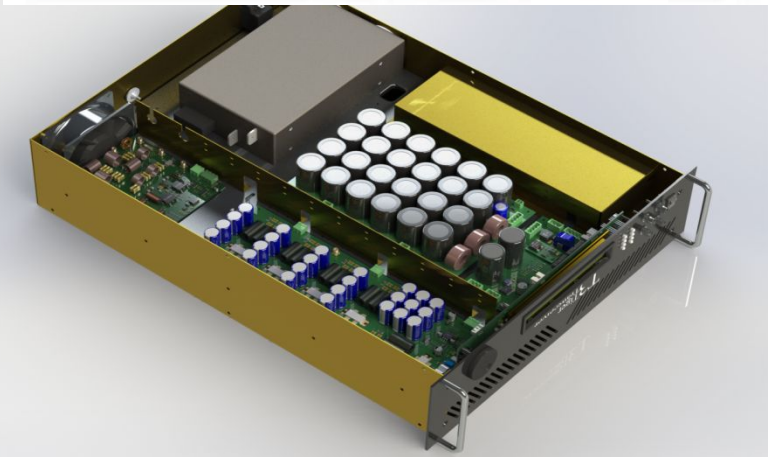


Background

- SANSA has an 85 year history of operating and maintaining instrumentation for Space Science and Space Physics Research
- Previous focus on South Africa and Namibia
- NEW FOCUS: The African Instrumentation Network
- NEW FOCUS: Real-time data to drive operational products and service provision to various sectors.
- A project that will help to expand the instrumentation network into the rest of Africa through partnerships and give greater access to real-time data for collaborating institutions and their researchers.
- Share in knowledge towards achieving national capabilities in operational space weather
- A test bed towards an operational SBAS Africa for economic benefit.

Instrumentation in Africa

Current Partners:

Zimbabwe
Zimbabwe National Geospatial and Space Agency (ZINGSA)

Nigeria
University of Lagos (UNILAG)

Ethiopia
SSGI & EORC

South Africa
- South African National Space Agency (SANSA)
- National Geospatial Information (NGI) TRIGNET

Zambia
Kwame Nkrumah University (KNU)

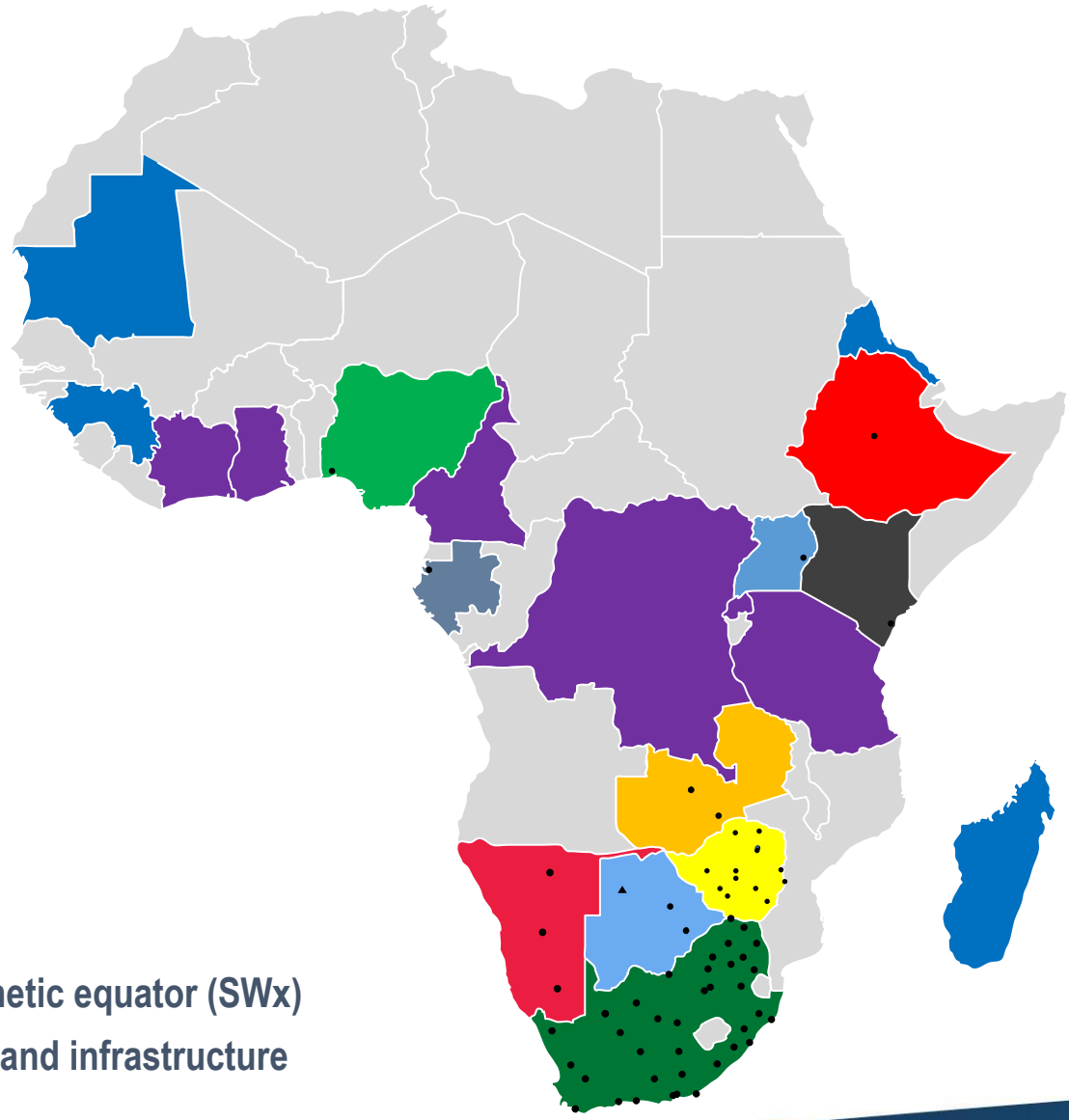
Namibia
Ministry of Mines and Energy (MME)

Uganda
Busitema University (BU)

Kenya
Pwani University (PU)
Kenyan Space Agency (KSA)

Gabon
L'Agence Gabonaise d'Etudes et d'Observations Spatiales (AGEOS).

Botswana
Botswana International University of Science and Technology (BIUST)



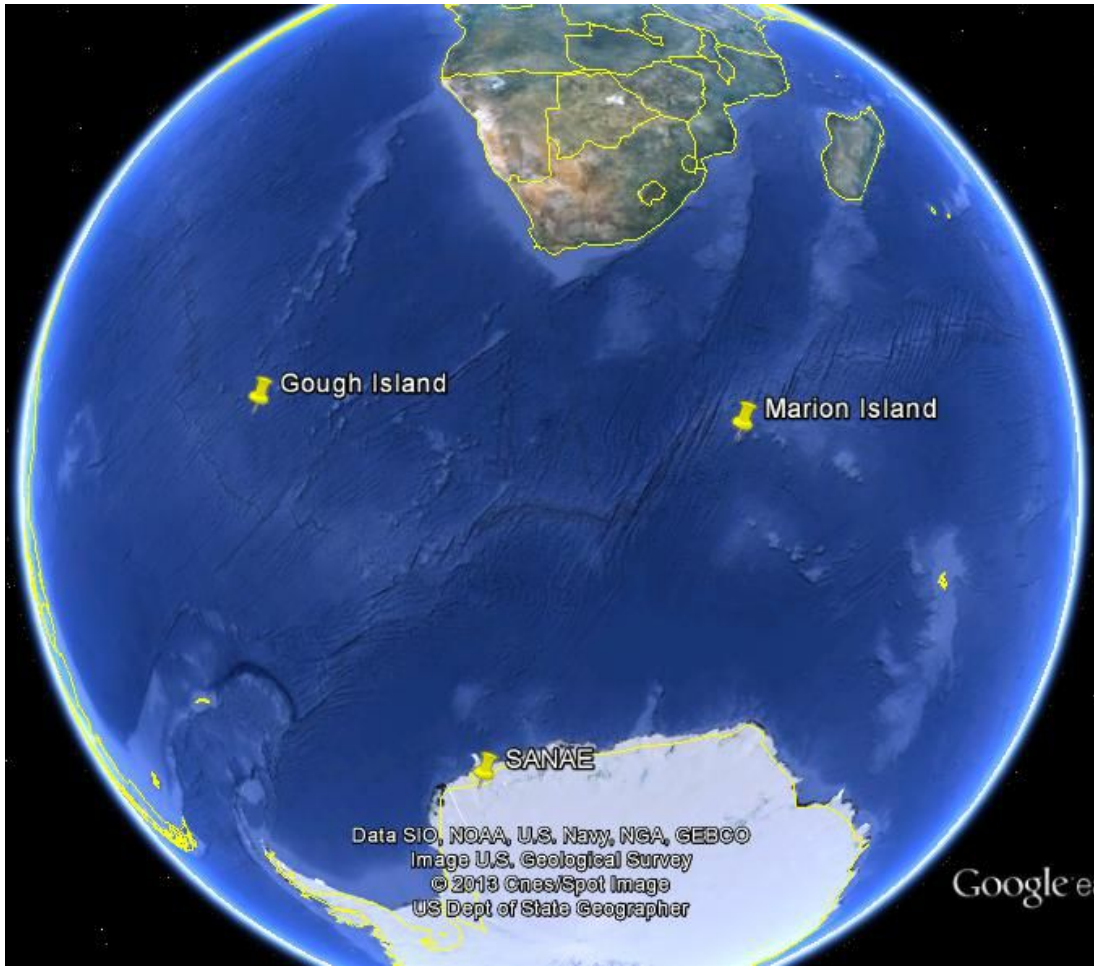
More to come!

IGS (TEC only)

Focus is currently on the SADC region (SBAS + SWx) and the magnetic equator (SWx)

Focus is currently on the deployment of GNSS stations as the cost and infrastructure requirements offer the best value in terms of the outputs gained.

Space Science in Remote Areas



Applications for GNSS Data

There is a great appetite for real-time GNSS data across multiple economic sectors:

1. Surveying – acting as a reference station for differential GPS surveying of landmarks
2. Geodesy – providing a means to track continental drift
3. Total Electron Content (TEC) – Ionospheric measurements and generation of TEC maps
4. Electron Density Profiles – Derived from TEC measurements combined with ionospheric tomography
5. Ionospheric Scintillation – Derivation of the Rate of Change of TEC index from TEC measurements
6. Precipitable Water Vapour (PWV) – used in Terrestrial Weather prediction and climate studies
7. Avionics – support for Air Traffic Navigation through estimation of navigation errors near airports
8. Operational SBAS

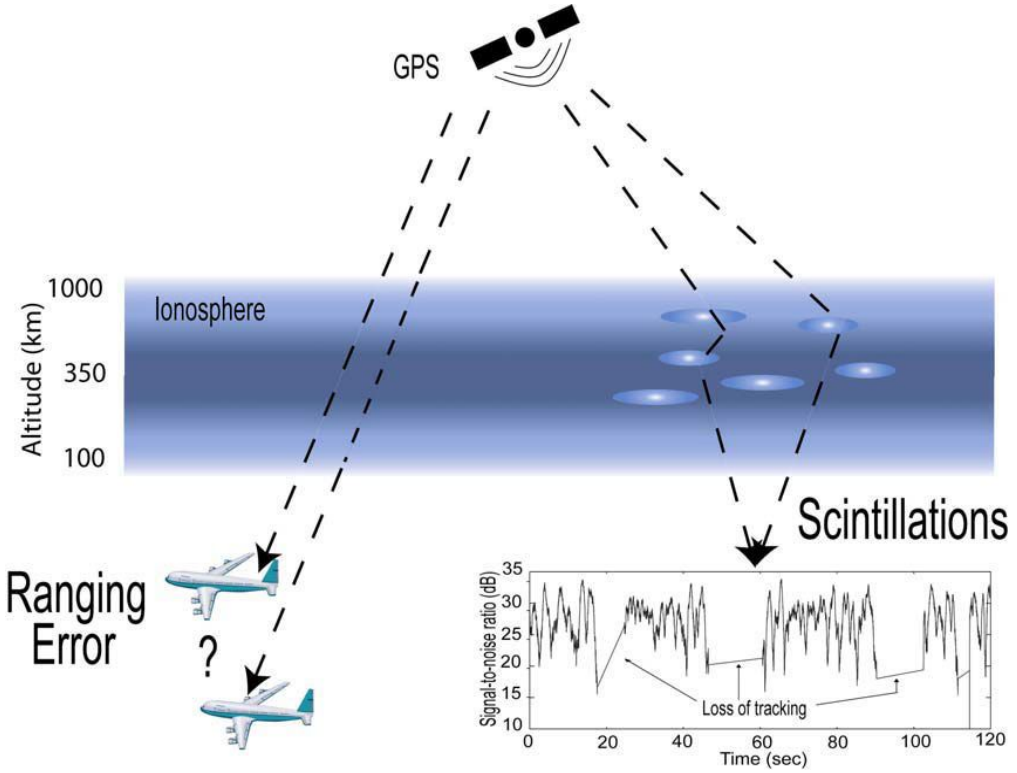
GNSS Navigation and Surveillance

Ionosphere: SW can induce perturbations in the ionosphere – inducing strong spatial gradients in TEC.

Scintillation: Attenuation of the GNSS-signal, lower C/N0 level

Solar Radio Noise: Results in background noise over GNSS frequencies and degrades signal

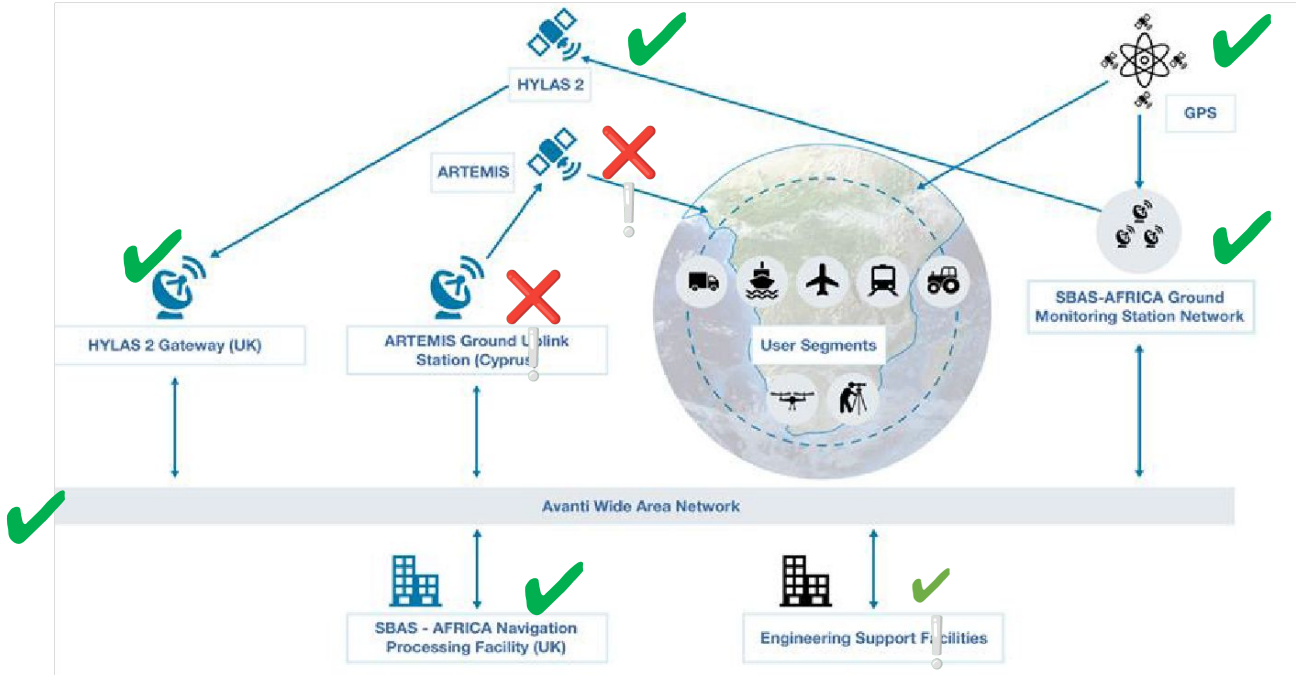
Solar flares, CMEs and the resulting magnetic storms can result in damaging effects on GNSS Signals.



A Beginner's Guide to Space Weather and GPS
Professor Paul M. Kintner, Jr.

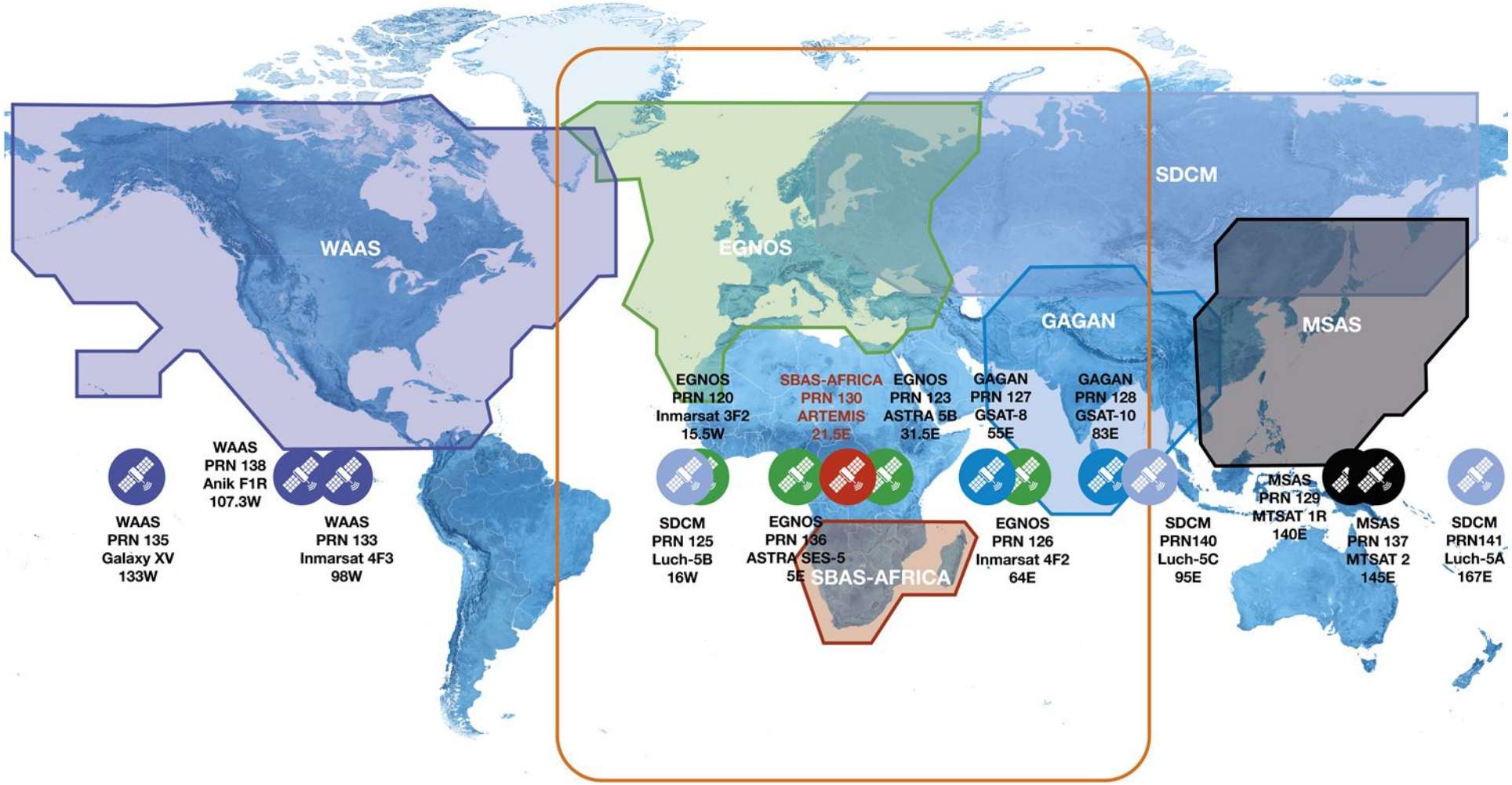
All result in poor positioning performance.

What is an SBAS?



- Satellite-based augmentation services (SBAS) improve the performance of GPS
  - They provide corrections to improve accuracy to around 1m horizontal and 1.5m vertical
  - They provide integrity information within 6s to confirm service status
- SBAS systems broadcast these data from a geostationary satellite using a GPS-like signal
- SBAS data can be used by many existing low-cost GPS receivers without the expense of an additional data-link

The global SBAS context



An African perspective

- Four SBAS services are needed to cover Africa due to
  - Geographical size.
  - Ionospheric activity ± 10° - 15° from the equator.
- SBAS has not yet been fully deployed in all regions, likely due to cost constraints.
- SBAS-Africa, based in RSA, was the proof of concept of a fully-operational SBAS in Module 4.

Source: Lapie, J. and Diouf, S. (2015)

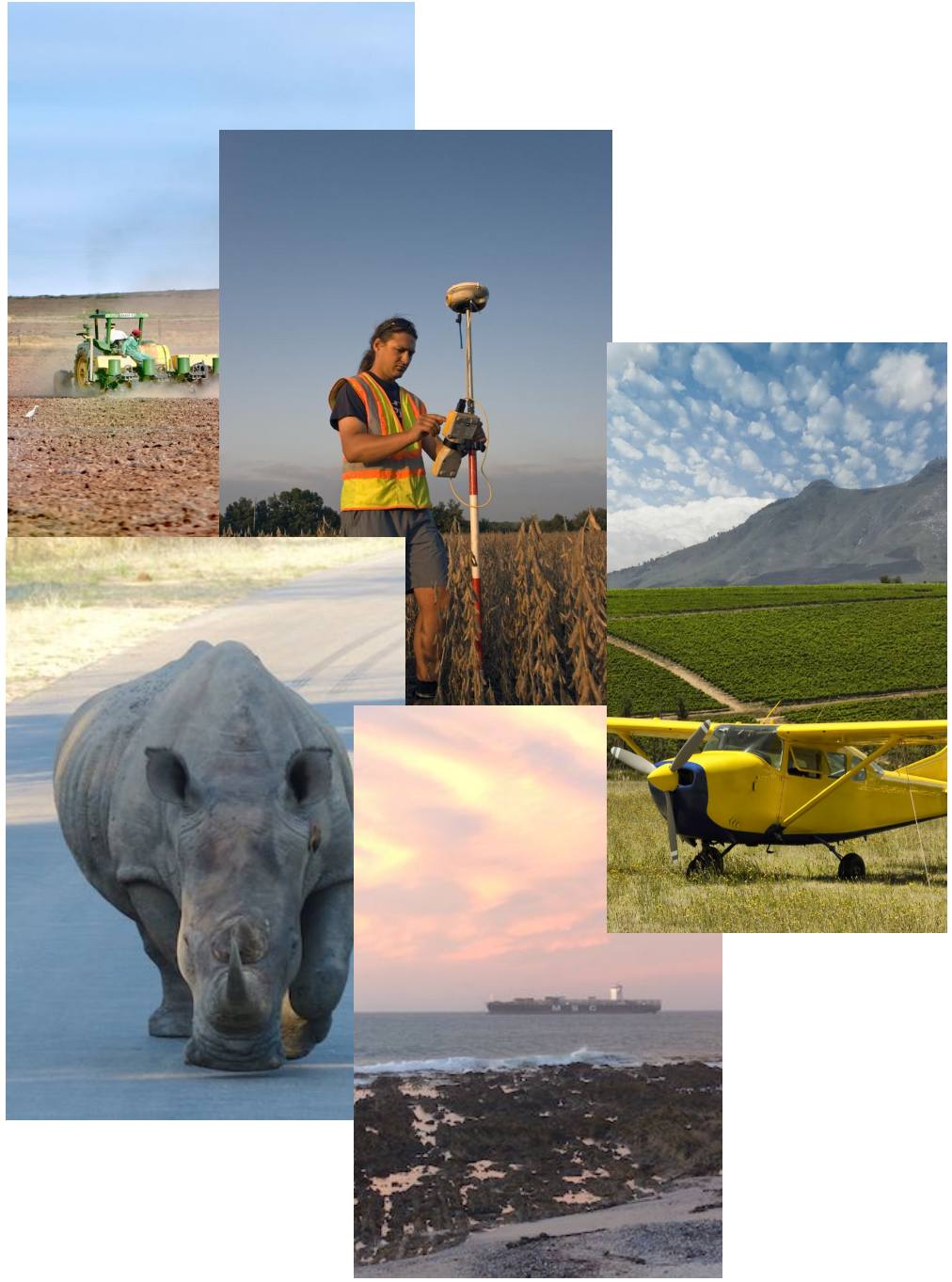
SBAS Precision Farming
Revitalising agriculture and raising rural incomes by improving the productivity of smaller farms and cooperatives

SBAS Asset Management
Supporting land reform, cadastre modernization and public and private sector asset management

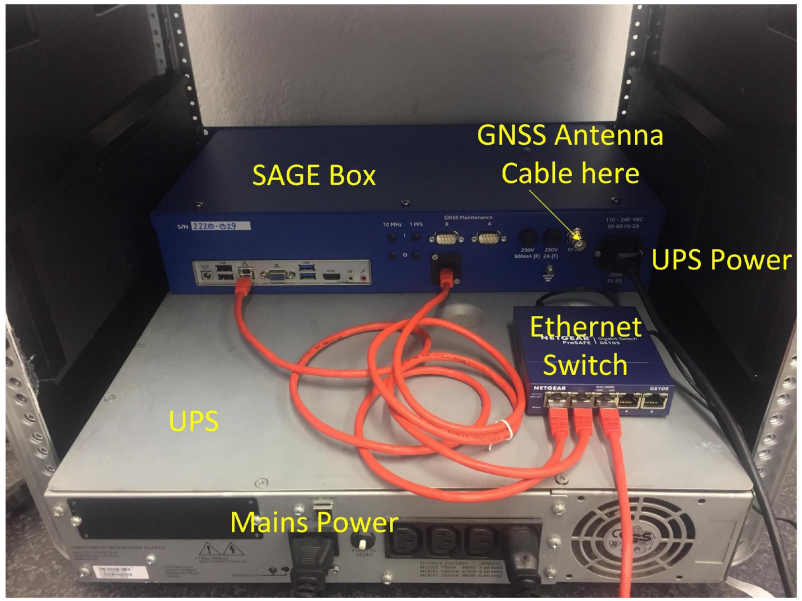
SBAS Animal Tracking
Combatting crime and conserving the environment for future generations

SBAS Offshore Positioning
unlock economic potential by protecting, conserving and managing the ocean and coastal environment

SBAS General and Business Aviation
Improving fixed-wing and helicopter operations to enhance safety and better serve remote rural areas



SBAS GNSS RECEIVERS



- Up to 8 Stations to be deployed in SADC countries.
- GPS constellation with the option to extend to other constellations
- Multi-frequency
  - Multi-constellation
  - High precision geodetic choke ring antennas
- Real-time data streamed directly to NTRIP Caster
- No in-situ storage
- Remote control
- Rinex data can be derived through NTRIP Client software for TEC as well as other products

SCINTILLATION GNSS RECEIVERS

Source: www.septentrio.com

- Up 8 New Septentrio PolaRx5S receivers for deployment in equatorial regions
- State-of-the-art Ionospheric Monitoring GNSS Receivers
  - Multi-frequency
  - Multi-constellation
  - High precision geodetic choke ring antennas
  - Real-time output
  - Remote control
- TEC and Scintillation data products

Opportunities

- Fostering collaboration with other African institutions
- Promoting and possibly developing a Space Science curriculum with university partners
- Student and staff exchanges
- Access to new / additional state of the art instrumentation with support and training from SANSA
- Science Awareness and Engagement
- HCD

The Way Forward

- A user forum for participants in the AIN to engage and collaborate
- Testing and improving the capabilities of the new stations
- Finding what local GNSS infrastructure is operational and accessible to host institutions
- An NTRIP Caster for AIN?
- Possible data sharing agreements with other partners that have existing infrastructure

Thank you