Benefits and Challenges of Multi-GNSS for Africa

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Outline

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2- Multi GNSS in Africa

3- GNSS needs in AFRICA

4- Emergent applications of GNSS

5- Conclusion

Introduction

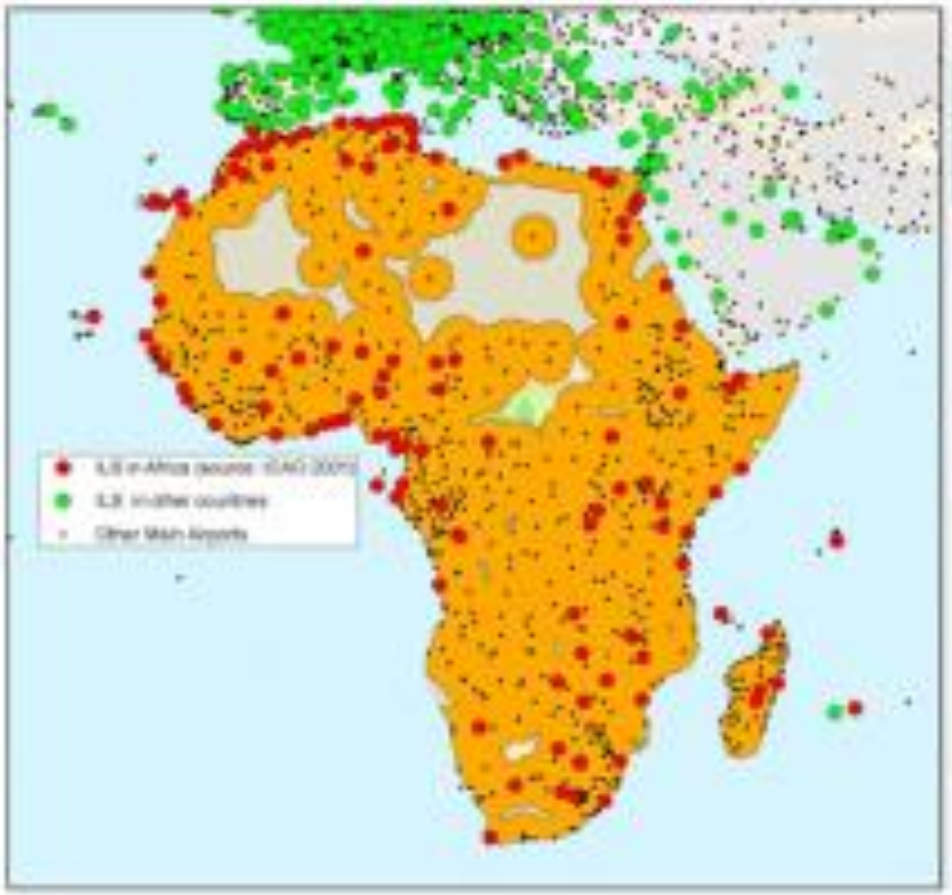
- GNSS is an umbrella term that includes any satellite navigation system,
- Multi GNSS include using of several systems :
  - GPS : US, Operational since 1994
  - GLONASS: Russian ‘Re-operational since 2010
  - Galileo: European Union, anticipated operation 2019
  - Beidou (3): China, operational in Asia/Pacific since 2012

GNSS Landscape in Africa

- 54 individual nations
- Multi-cultural structure
- Africa is a continent with a very high linguistic diversity, there are an estimated 1500-2000 African languages …
- English, French, Portuguese, Arabic, Spanish,
- Religions, Political organizations, …
- ~ 30 billion km^2
- ~ 1400 million people (2022)

https://www.nationsonline.org/oneworld/africa.htm

MULTI GNSS SITUATION FOR AFRICA



GNSS COVERAGE WORLD/AFRICA

Low SBAS GNSS Systems

- **Europe:** European Geostationary Navigation Overlay Service (EGNOS)
- **US**
- **Jap**
- **Ind**
- **Ch**
- **So**
- **Ru**
- **AS**
- **Au**

dev

Less than 20% of Runways are equipped with Instrument Landing Systems (ILS) in Africa.

2011-2015 [IATA annual review 2016] Controlled Flights into Terrain (CFITs) = 20% of fatalities, most of them occurring in the approach/landing phase and being often associated with imprecise approach.

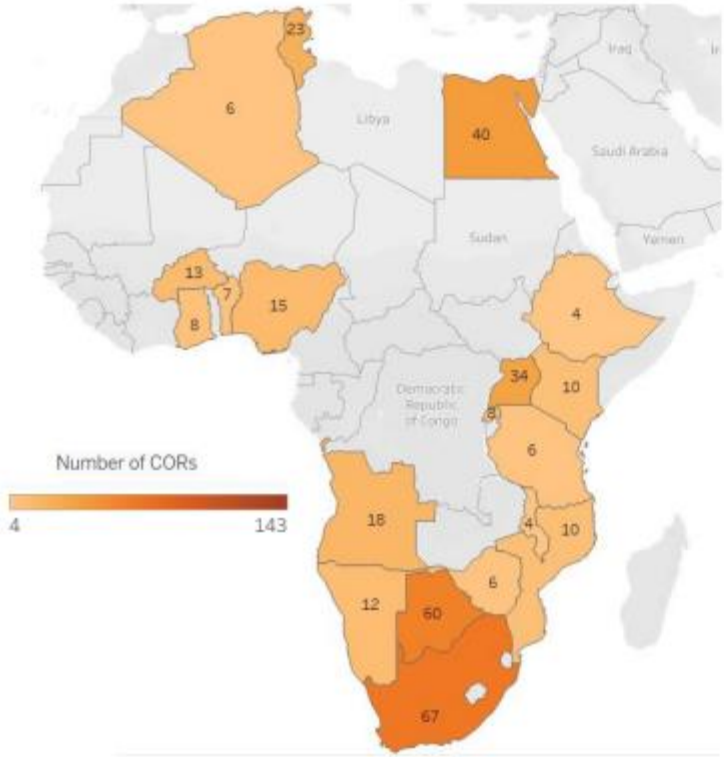
SBAS helps overcome known safety and operational limitations of the technical constraints of lateral navigation (LNAV) and Vertical Navigation (VNAV) operations.

Reduced maintenance Costs of Legacy Systems and calibration requirements

SBAS is a Cost-effective solution in complement to ILS.

An Environmental Scan of PNT infrastructure on the Continent

GNSS CORS and Precise Point Position (PPP) Ground Reference Stations



Distribution of GNSS CORS on the African Continent

Precise Point Position (PPP) Ground Reference Stations (Coshared between Hexagon AB & OmniStar)

- African Space Industry Annula Report 2022

PROGRESS ON THE IMPLEMENTATION OF THE GNSS IN AFRICA

The implementation of SBAS is on-going on the continent, with more than half of AU members involved in deployment programs:

- Agency for Air Navigation Safety in Africa and Madagascar (ASECNA)
- Arab Civil Aviation Organization (ACAO)

In Africa, the 'EGNOS in Africa Support Program', a partnership between Africa and the European Union, is championing a roadmap for the development of GNSS applications and implementation of EGNOS services across the continent.

- Space in Africa - September 23, 2019
- International Civil Aviation Organization

NIGCOMSAT-1R AS A HYBRID SATELLITE

- NIGCOMSAT-1R is a hybrid satellite with a Navigation (L-Band) payload for a Space Based Augmentation System meant to provide a Navigation Overlay Service (NOS) similar to the European Geostationary Navigation Overlay Service (EGNOS).

Related R&D projects covering Africa in the framework of the 7FP and H2020

- Among the projects which have been awarded in the frame of the “7th Framework Programme (FP7), the following projects were of direct interest to SBAS and Africa:

- **SIRAJ: SBAS Implementation in the Regions of ACAC and ASECNA,**

- **ESESA: EGNOS Service extension to South Africa,**

- **Awareness in Africa,**

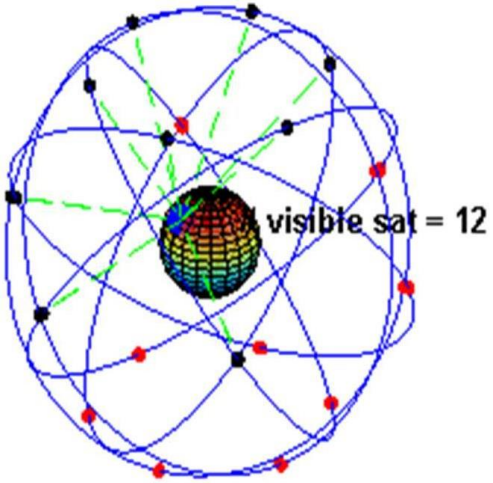
- **SATSA (www.satsa-project.eu): SBAS Awareness and Training in South Africa.**

AFRICA NEED ACCURATE AND MULTIUSING GNSS

GNSS - Vital for Science

- GNSS enable amazing information technology
  - Navigation, Surveying, Geodesy,…
- Geodesy, the science of
  - measuring and monitoring the size and shape of the Earth
- Understanding changes and complex dynamic processes of our home planet - to better protect our world
- Future of IoT infrastructure
- **Increasing Importance of GNSS Technology**

Needs of GNSS Technology in Africa

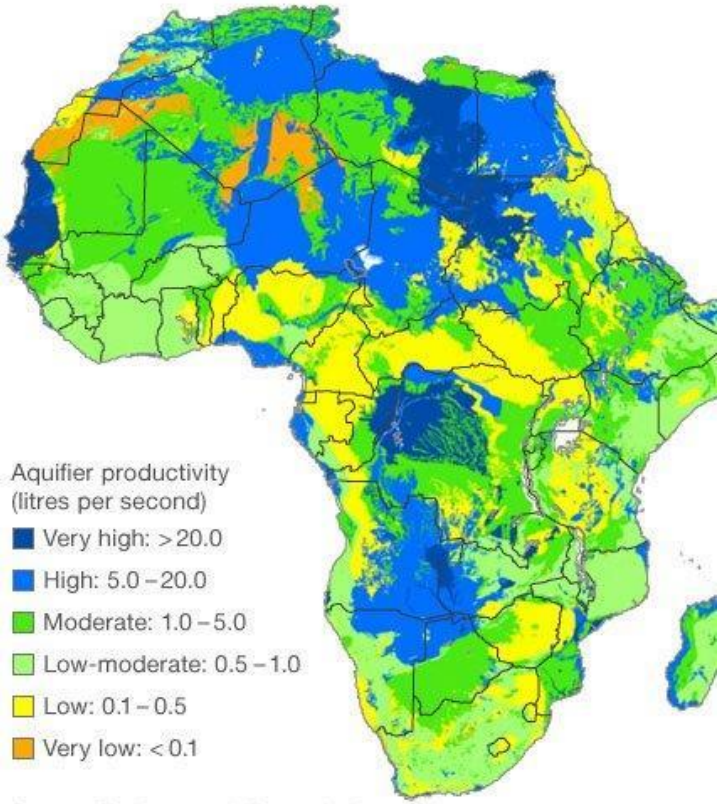


Wild life conservation

GNSS Contributes to Monitoring the Earth

Global Geodetic Observing System - GGOS

GNSS combines with other space geodetic techniques, VLBI, SLR, DORIS, InSAR, UAVSAR



Source: Environmental Research Letters

mapping of wells and wat
resourc

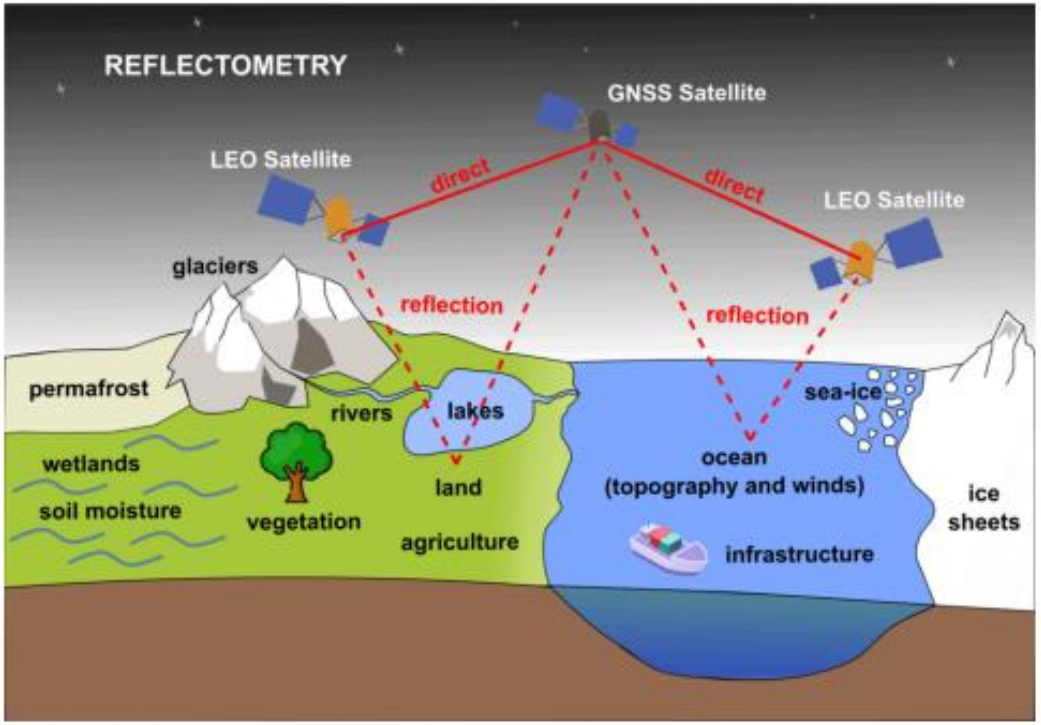
Animal and wildlife protection

NEW CHALLENGES OF GNSS

Remote sensing by Multi "reflected" GNSS-R

GNSS reflected at the Earth's surface,

- Allows monitoring of water levels as well as that the determination of different properties of ocean surfaces andterrestrial
- Reception by nanosatellites or Tower
- Measurement of snow depth, vegetation growth, ocean tides or SNR



Science with GNSS

Atmospheric & Geophysical research

- Characterization of ionosphere using TEC
- Space weather studies
- Scintillation studies
- Atmospheric delay
- TIDs
- Validation/improvement of existing atmospheric models
- Water vapour estimation
- Climate change studies
- Seismic studies

Social-Economic Applications on increasing level

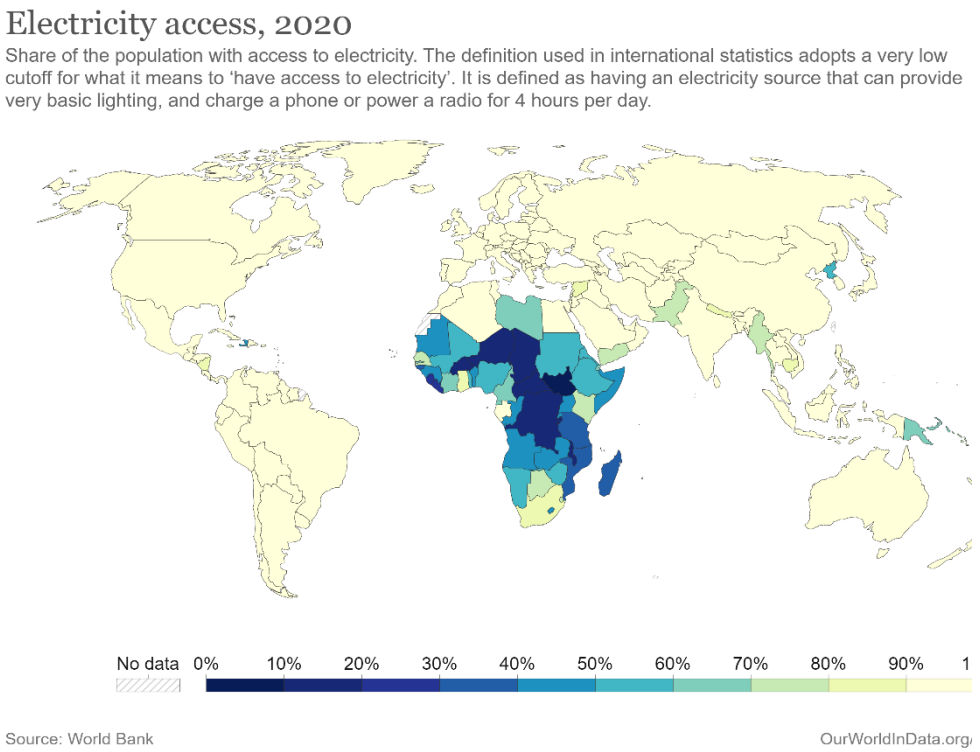
- positioning services,
- surveying & mapping,
- Boundary mapping
- Food security,
- Disaster management,
- air, land & sea secure navigation,
- Land administration
- emergency response
- Wild life management

Multi GNSS regulation

- Freedom of Use and Exploration for the Benefit of All Mankind
- Sovereignty with Multi GNSS using
- Cybersecurity and GNSS Apps
- More Accuracy GNSS Research and development
- Responsibility of States for National Activities

Recommendations in Africa

- Intensify complimentary efforts at densifying the GNSS ground infrastructures
- Development of Pre-requisite physical infrastructures for GNSS facilities
- Internet connectivity
- **Access to Energy**



Conclusion

- Multi-GNSS provides a unique and valuable tool for observing and understanding our planet
  - Climate change, sea-level change, ice and glacier melting, earthquakes, tsunamis, volcanoes, subsidence, severe weather, severe space weather,…
- ***Scientific observations and understanding can lead to actions in order to better protect our world today and for future generations***
- SBAS adoption in Aviation sector in Africa aligns with the Single African Air Transport Market (SAATM) agenda of African Union (AU);
- a flagship project of the AU agenda 2063 to advance the liberalization of civil aviation in Africa through a unified sky and acting as an impetus to the continent's economic integration agenda.

Thank you for your attention