



ICAO

UNITING AVIATION

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Readiness of the regional Space weather center to assist the state in implementing the ICAO Annex 3 Requirements

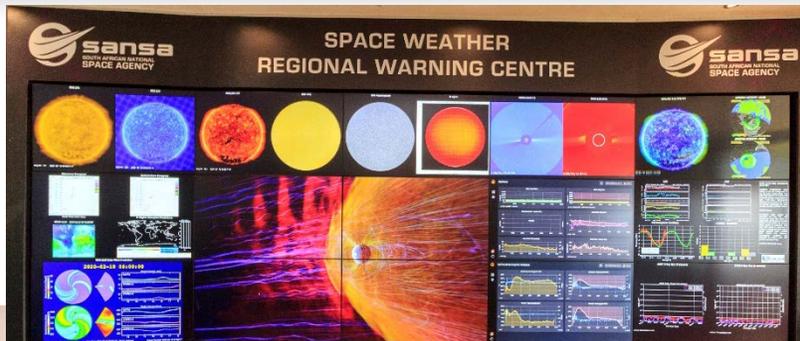
DR Rendani Nndanganeni

Specialist: Space weather Researcher at South African National Space Agency

PPT 07

Virtual Meeting/ 29 July 2021





Towards 24/7
Operational Space
Weather Centre

Space Weather Regional
Warning Centre Upgrade

Space Weather Regional
Warning Centre for Africa



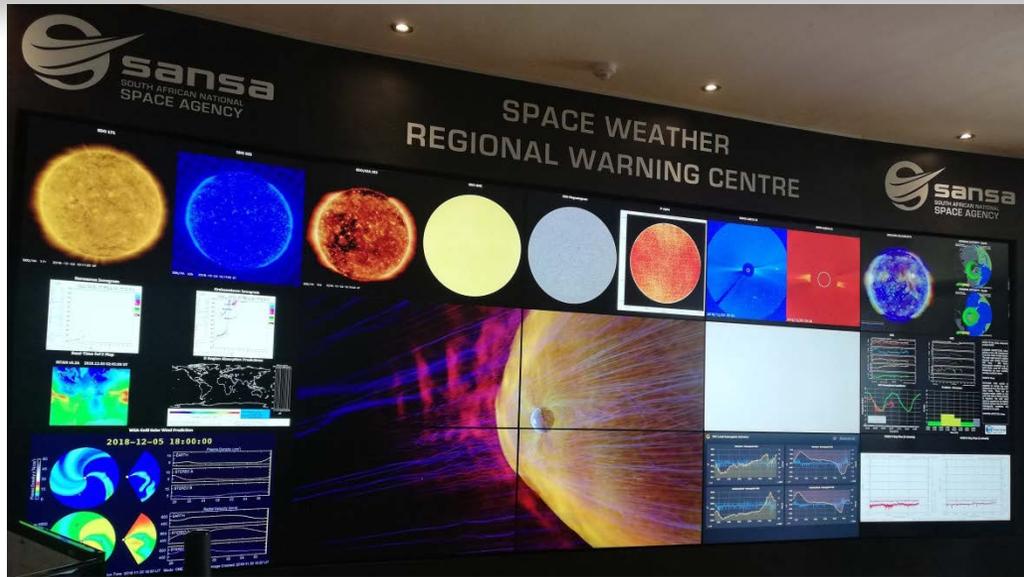
Member of ISES
(Space Weather
Community)



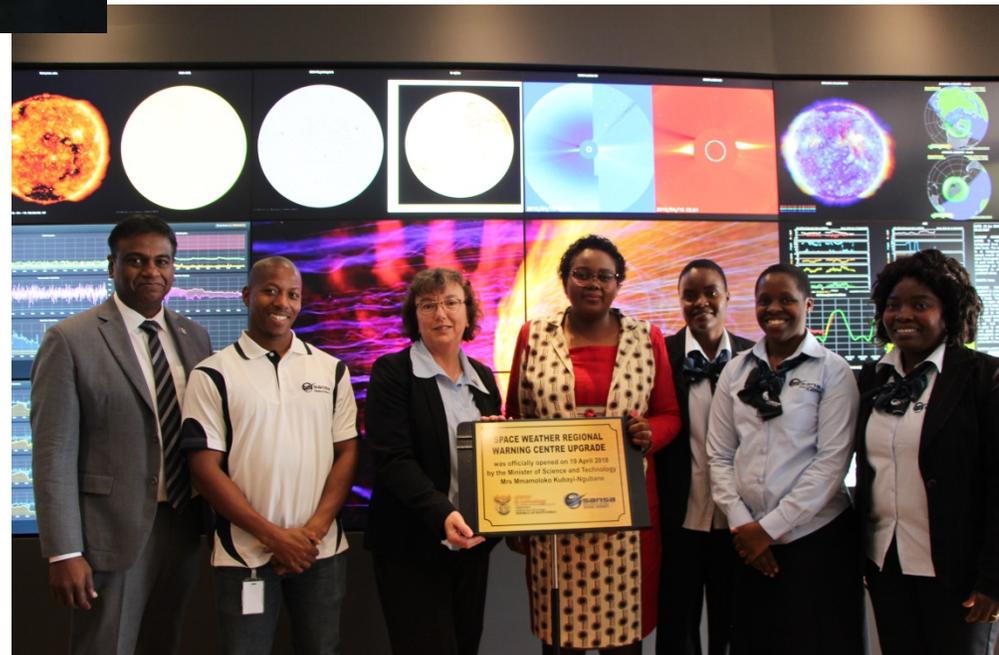


SANSA SPACE WEATHER CENTRE

Space Weather Centre
launched in December 2010
Re-launched after upgrade in
April 2018
New Centre opening in 2022



Provide the *right* information...
in the *right* format...
at the *right* time... to the *right*
people...
to enable and facilitate the
right decisions!





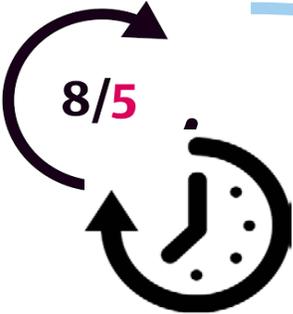
Readiness Implementation

- One of the 22 member of ISES (International Space Environment Service) as a Regional Warning Centres for Space Weather.
- Representation on WMO, UNCOPUOS and ICAO expert groups on Space Weather.
- African Instrumentation Network partners (e.g., Kenya, Zambia)
- High quality regional data is benchmarked with international databases to deliver accurate well researched information.
- Regional designation by ICAO as Space Weather Information Provider for international air navigation.
- SANSa is leading the ICAO Met Project 3 entitled “Implementation of Annex 3 provisions relating to Space Weather requirements within the AFI Region”.

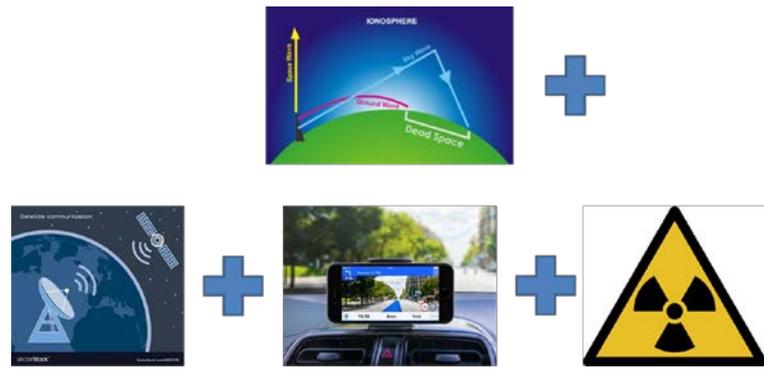


Readiness Implementation

- A national working group (MET Space WX) reporting to ATM/cns implementation committee is in place to identify readiness activities for all affected parties .
- Collaboration between ATNS and SANSA on Impact of Space Weather on the Aviation
- Collaboration between SAWS and SANSA with SANSA recognised as national space weather experts South Africa has applied to ICAO for accreditation as a Regional Space Weather Information provider, and has undergone 2 phases of the accreditation process.
- SANSA is currently responding to the requirements set out by ICAO for Regional Space Weather information providers.

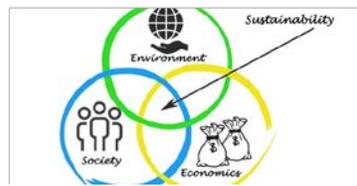
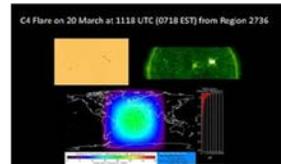


Upgrade to 24/7 operational centre



Increase products & services

- Development of credible Research and Development component
- Create an extensive quality data base representing the region
- Understand International and regional priorities and linking them to the value proposition of Space Weather
- User awareness, and engagement is key to success
- Regional and Global partnerships are important success factors
- Provide the **right** information... in the **right** format... at the **right** time... to the **right** people... to enable and facilitate the **right** decisions!



Meet user requirements



Ensure required foundation for services



ICAO DECISION

GLOBAL CENTRES

(provide information from 2019)

1. ACFJ consortium (formed by Australia, Canada, France and Japan)
2. PECASUS consortium (formed by Austria, Belgium, Cyprus, Finland, Germany, Italy, Poland, Netherlands and United Kingdom)
3. United States

REGIONAL CENTRES

(provide information no later than November 2022)

1. China/Russian Federation consortium
2. South Africa



Identified Requirements

- **Align with international standards** for the provision and access to space weather information in order to meet the ICAO recommendations.
- **Create awareness** of the space weather information requirements within the national aviation sector (Two policy briefs were developed and Two AIC).
- **Continuous engagement** with the user community to ensure that the needs, concerns and requirements of the sector are taken into account, and that the various role players are kept informed.
- **Data, statistics and information** on aviation events, concerns, and legislative requirements are needed in order to ensure that the right information can be prepared at the right time to enable safe decision-making.



IDENTIFIED TYPICAL PRODUCTS and SERVICES for AVIATION

- Regular space weather bulletins (in ICAO approved format and according to required latency)
- Warnings and alerts on adverse space weather and its potential impact (space weather advisory)
- Radiation dose calculations for given routes
- Predictions of Communication Conditions
- Real time TEC maps that indicate impacts on Navigation and Communication applications

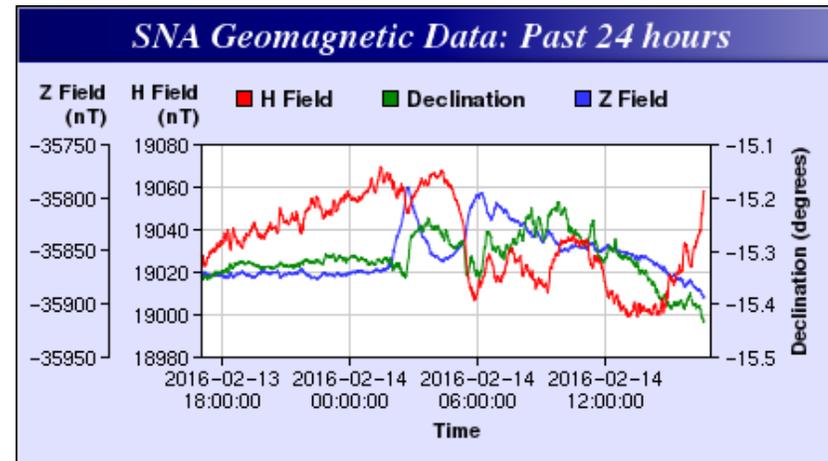
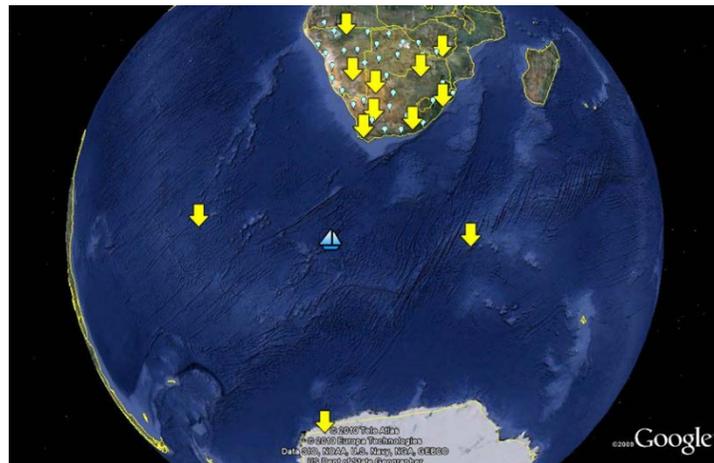


SPACE WEATHER DATA

Measuring space from the ground in support of space weather research and applications

SANSA operates an extensive geophysical instrumentation network across Southern Africa, Antarctica and the Atlantic Islands (with immediate future plans for expansion within Africa)

This is complemented with available satellite data





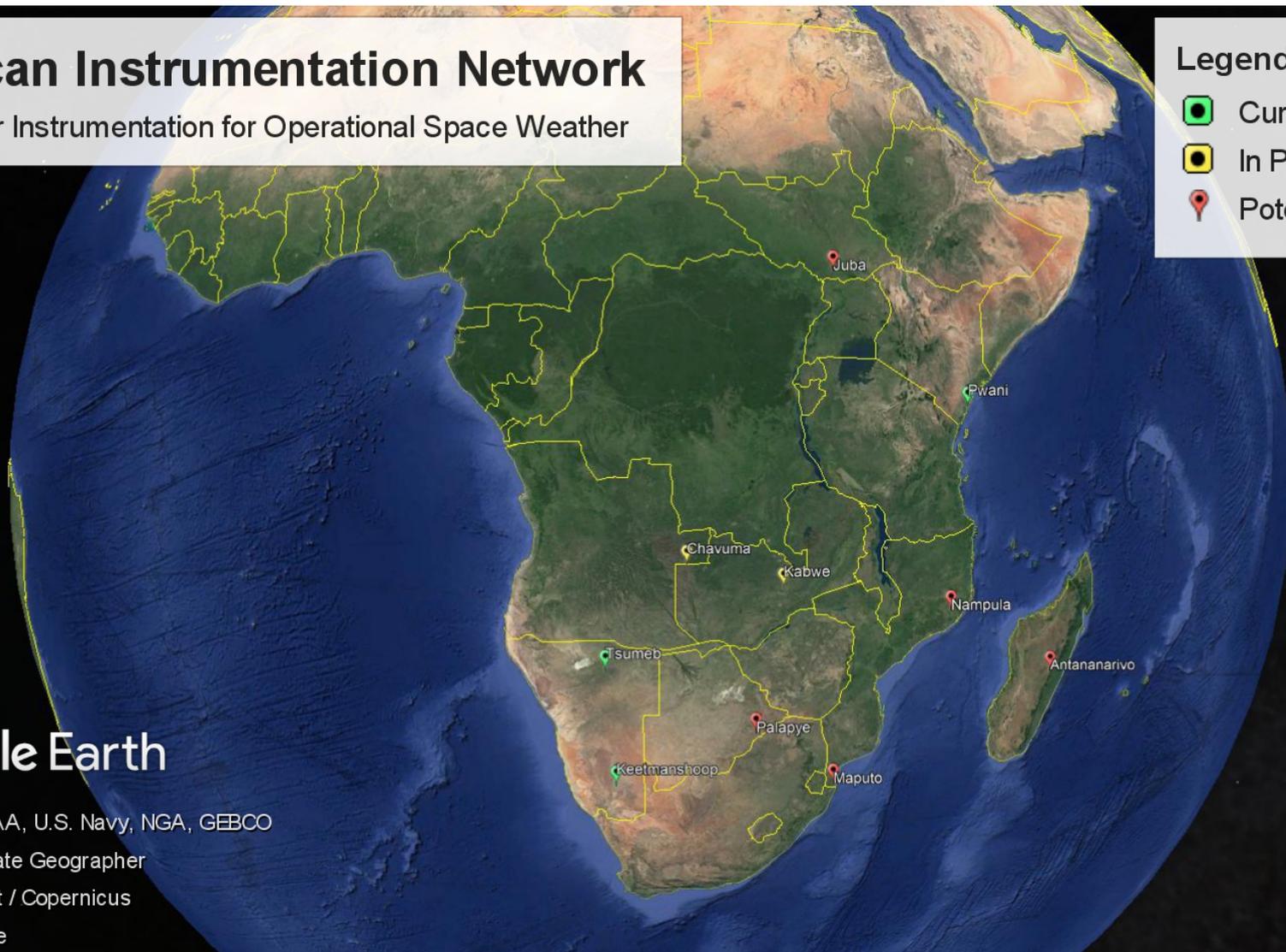
FUTURE EXPANSION PLANS

African Instrumentation Network

Sites for Instrumentation for Operational Space Weather

Legend

-  Current
-  In Progress
-  Potential



Google Earth

Data SIO, NOAA, U.S. Navy, NGA, GEBCO

US Dept of State Geographer

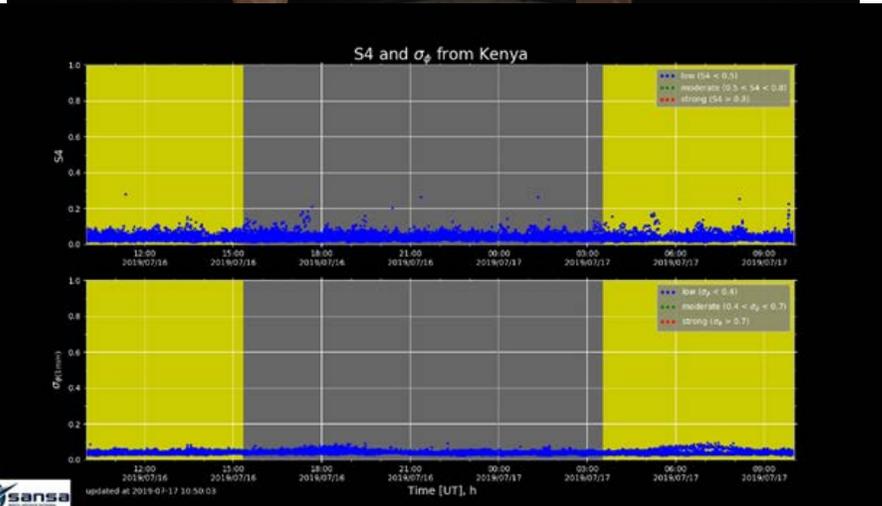
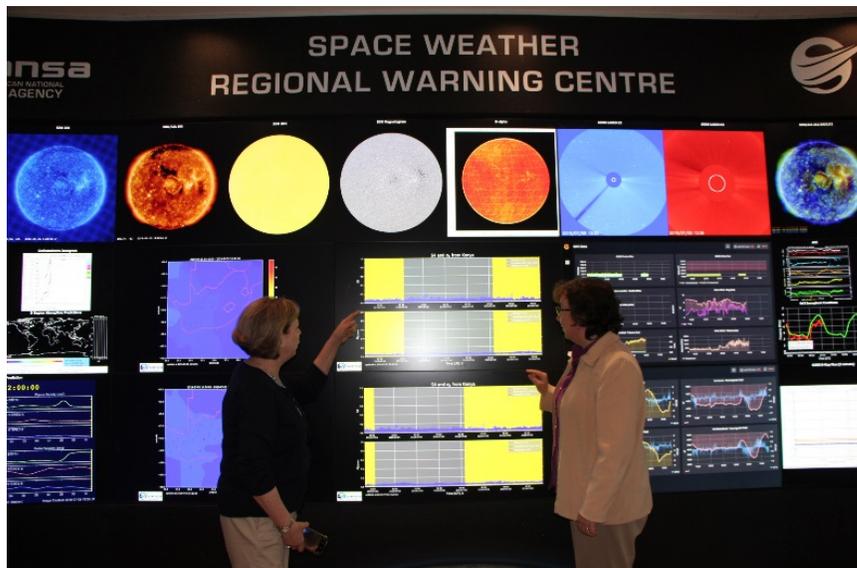
Image Landsat / Copernicus

© 2020 Google

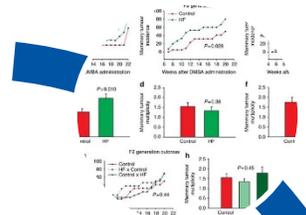




PRODUCTS AND SERVICES



Information for aviation



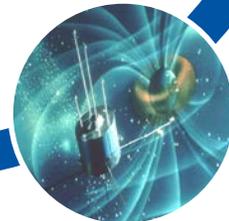
High Frequency Communications



GNSS Navigation and Surveillance



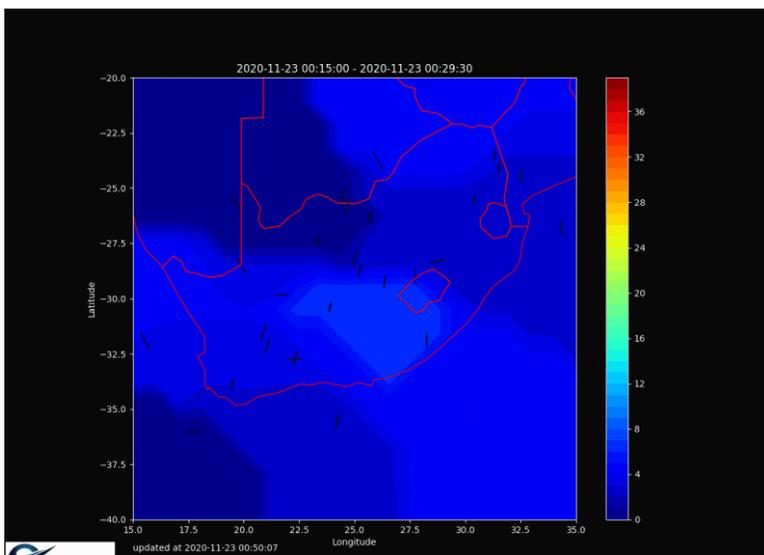
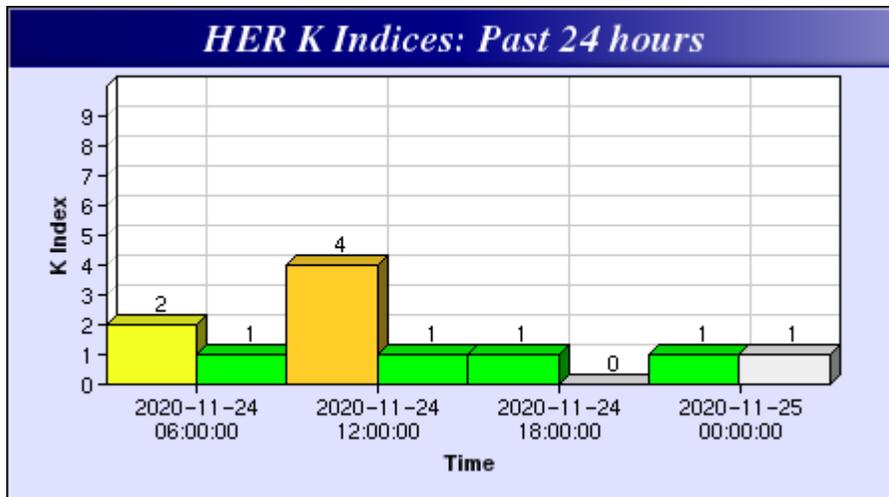
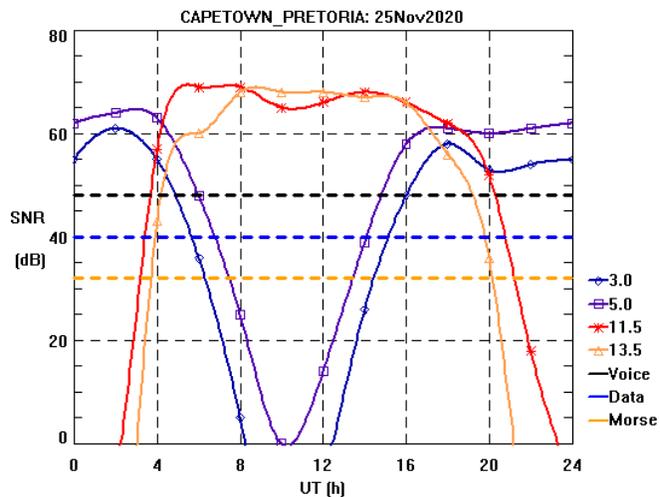
Radiation Exposure



Satellite Communication



PRODUCT EXAMPLES – AFRICAN CONDITIONS

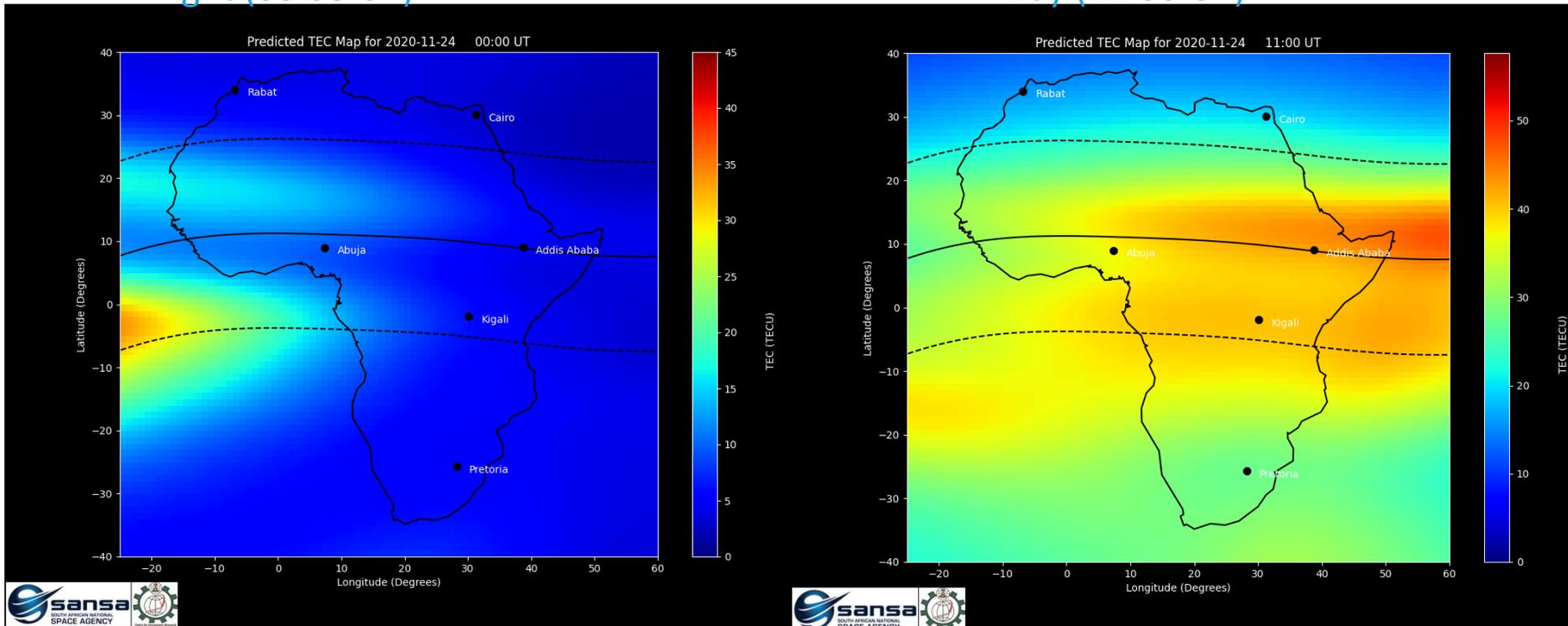




PRODUCT EXAMPLES – AFRICAN CONDITIONS

Night (00:00 UT)

Day (11:00 UT)



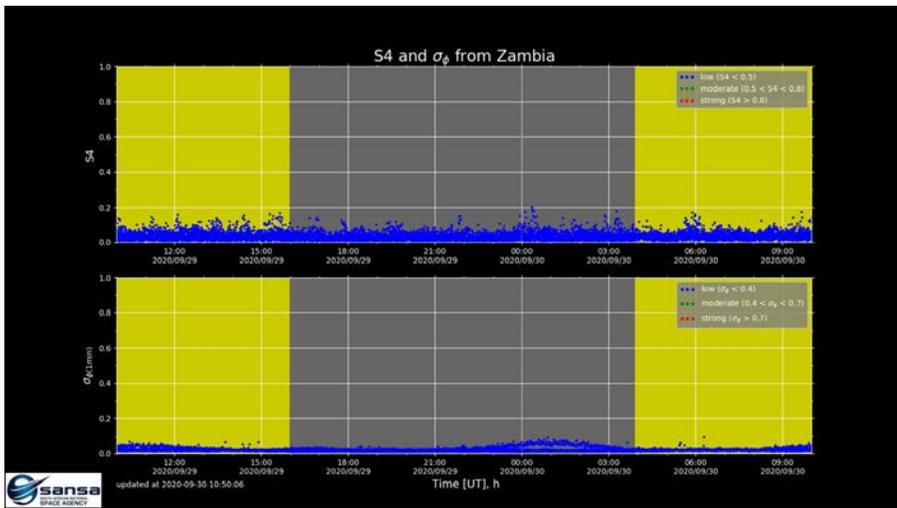
- Solid line: geomagnetic equator
- Dashed lines: geomagnetic latitudes 15 N and 15 S

Collaboration between SANSA and the Nigerian National Space Research and Development Agency (NASRDA)

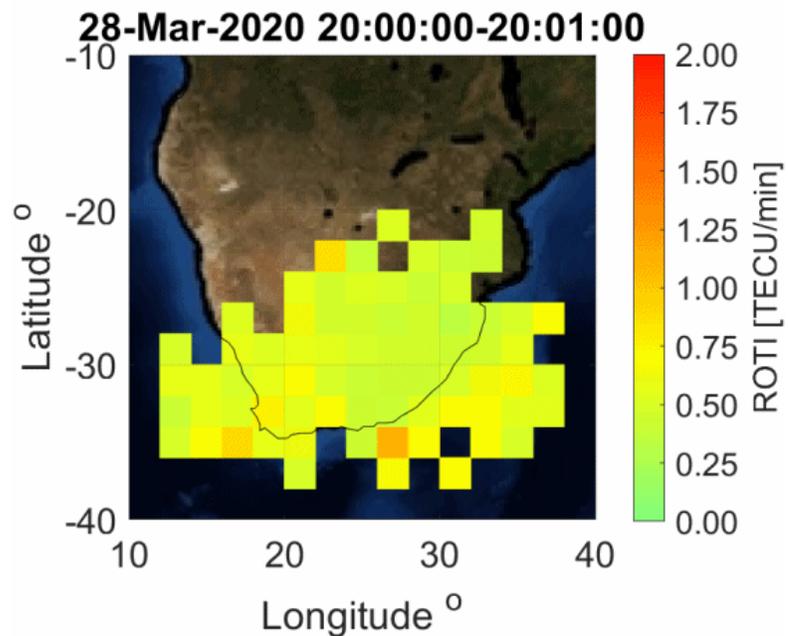
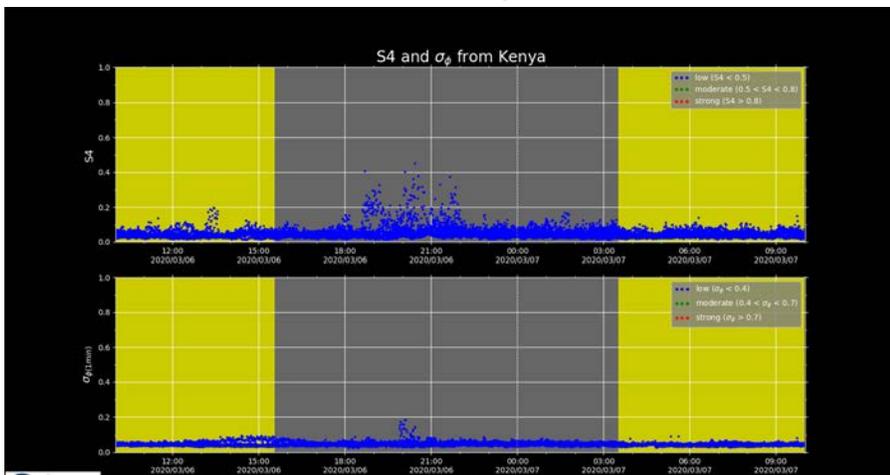
Reference: Okoh, D., Habarulema, J. B., Rabiou, B., Seemala, G., Wisdom, J. B., Olwendo, J., et al. (2020), O. Obrou, T.M. Matamba, Storm-time modeling of the African regional ionospheric total electron content using artificial neural networks. *Space Weather*, 18, e2020SW002525. <https://doi.org/10.1029/2020SW002525>



PRODUCT EXAMPLES – AFRICAN CONDITIONS



Zambia : 29 – 30 September 2020



Rate of Change of TEC Index (ROTI)

The ROTI maps have a 1 x 1 degree resolution and are updated every minute using 1-s data from the Trignet



OTHER OPERATIONAL DEVELOPMENTS

Radiation Exposure

- Investigating the impact of radiation exposure from space weather events over Africa
- Pilot project with domestic South African airline to obtain in situ data during flight paths
- Utilisation of South Africa's legacy neutron monitor data

High Frequency Communications

- Characterisation of MUF
- Development of an ionospheric index
- Utilisation of South Africa's legacy ionosonde network



APRIG conclusion 23/29: Establishment of a Regional Space weather project in order to ensure the provision of the space weather service information in the AFI Region

- a) an APIRG IIM MET Project 3-Space Weather Project is established within the IIM SG to guide the implementation of the Annex 3 provision relating to Space Weather requirements within the AFI Region.
- b) South Africa, hosting the AFI Regional Space Weather Center through the South African National Space Agency (SANSA), coordinate the APIRG IIM MET Project 3; and
- c) ICAO regional Offices, after reception of the Project initial document by 31 January 2021, call for nominations of the project team members from interested AFI States/Organizations.



Conclusion 23/30: Development of action plans for the implementation of Space Weather requirements

That; in order to improve the implementation of requirements for the provision of space weather services in air navigation plans:

- a) States/Organizations consider the implications of Annex 3 space weather requirements for AFI States' regulatory authorities, ANSPs and operators' operational policies.
- b) the designated Regional Space Weather Center (SANSA) liaise with other relevant national institutions in the AFI region to ensure effective coordination.
- c) the Secretariat, with the support of the designated Regional Space Weather Centre (SANSA), take appropriate actions to assist States to meet the space weather implementation requirements.



MET Project 3 Activities

- a) Nomination of Project team coordinator which is South Africa
- b) State member nomination for experts to form part of MET 3
- c) Project documentation development
- d) Bi-Monthly meeting to address the project objective and work structure for MET 3
- e) Survey to the state to assess their readiness and the knowledge with regard to the space weather impact
- f) Training , education and awareness



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UNITING AVIATION

NO COUNTRY LEFT BEHIND



ICAO

North American
Central American
and Caribbean
(NACC) Office
Mexico City

South American
(SAM) Office
Lima

ICAO
Headquarters
Montréal

Western and
Central African
(WACAF) Office
Dakar

European and
North Atlantic
(EUR/NAT) Office
Paris

Middle East
(MID) Office
Cairo

Eastern and
Southern African
(ESAF) Office
Nairobi

Asia and Pacific
(APAC) Sub-office
Beijing

Asia and Pacific
(APAC) Office
Bangkok



THANK YOU