

Role of ground base instrument for space weather monitoring

Nkosinathi Masango

SANSA



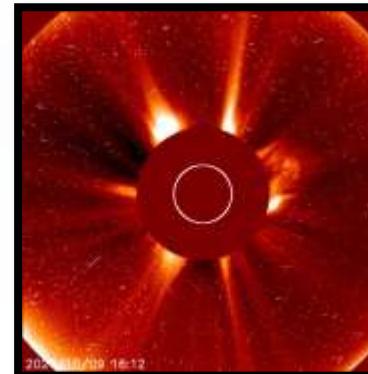
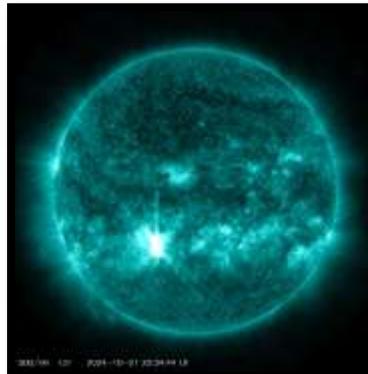
Process of space weather forecasting in simple terms

What:

Space weather is the conditions and processes occurring in space, including on the sun, in the magnetosphere, ionosphere and thermosphere, which have the potential to influence the functionality and reliability of space-borne and ground-based technological systems.

Why:

Process is important because clients use space weather forecasts product to make decisions.



Steps Required:

1. **Observational data**(Space based and **Ground based**).
2. Analysis and review of current conditions.
3. Numerical space weather prediction (NSWP) models (used to project conditions expected in the future).
4. Forecaster (Human intuition to add value to product).



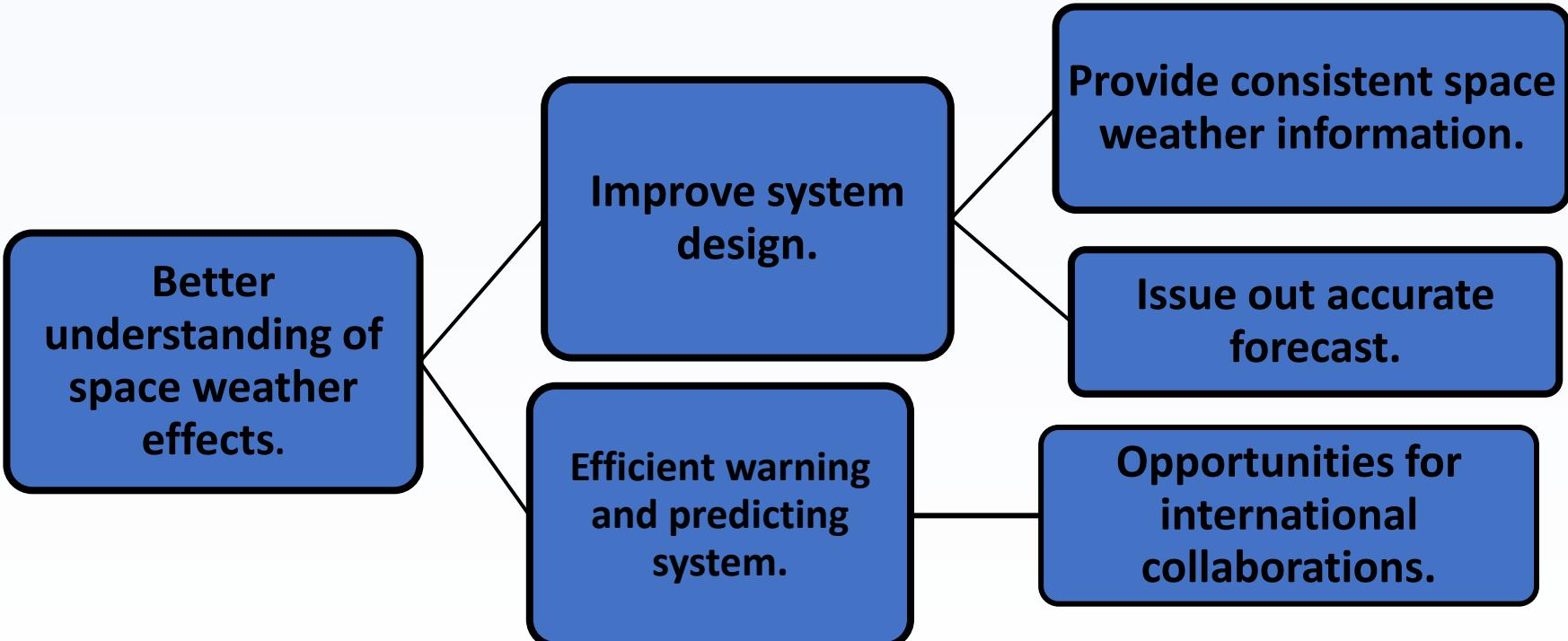
Benefits of space weather observations



www.spaceconference.co.za

**Space for
Societal
Resilience,
Transformation
and
Intelligence**

DATE: 20 – 22 August 2025

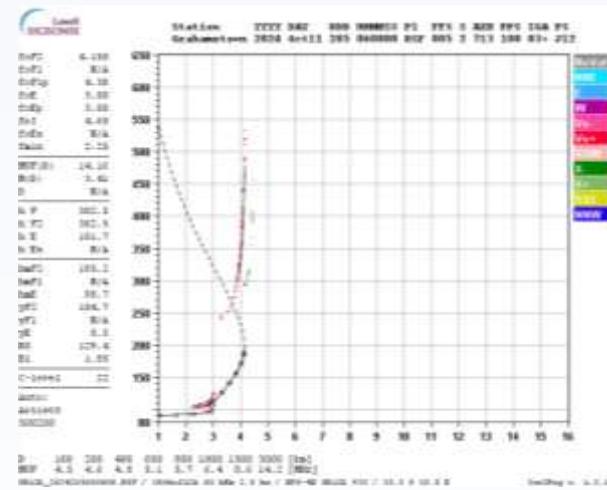
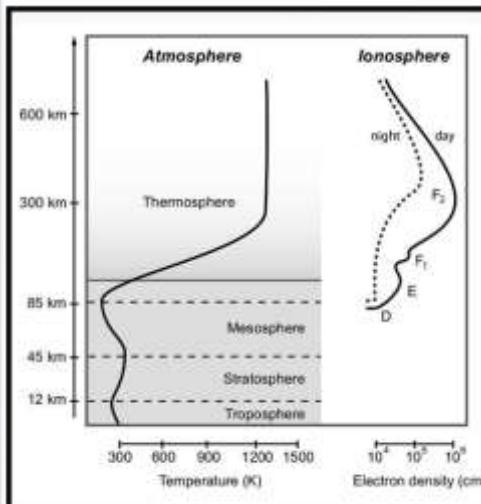
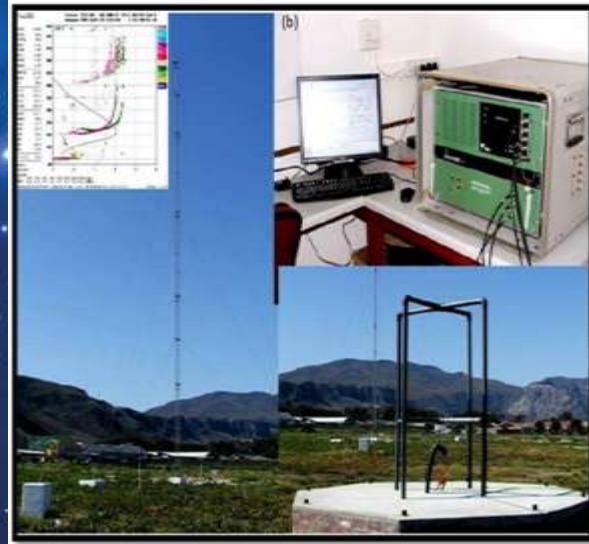


1/30/2026



Instruments used to monitor space weather: Ionosonde

- Ionosphere : region of Earth's upper atmosphere made of electrons and ions between approximately 50 to 1000 km.
- Main variations of the ionosphere : *Diurnal *Season *Location *Solar activity (McNamara, 1991).
- An Ionosonde is a high frequency radar which "sounds" the ionosphere by transmitting short pulses of HF radio energy at different frequencies vertically into the ionosphere.



- Limitations: -Measures up to the peak of F2.
- The time delay measures and draws out the map called **Ionogram**.

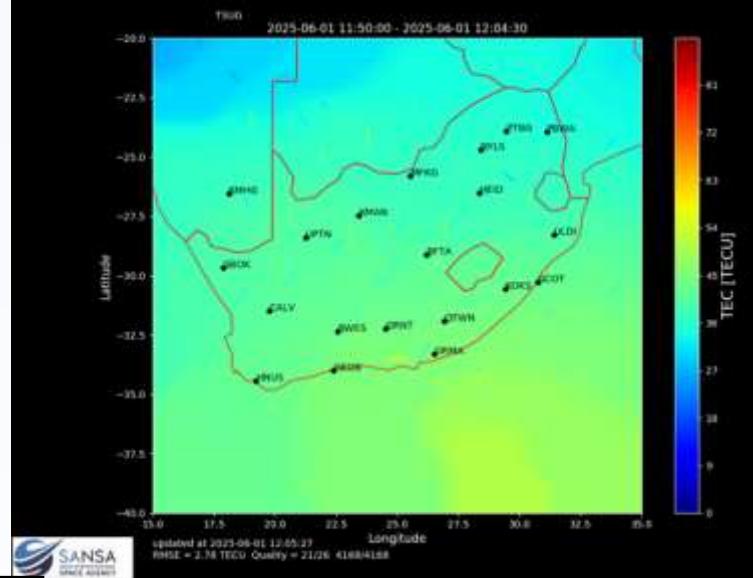
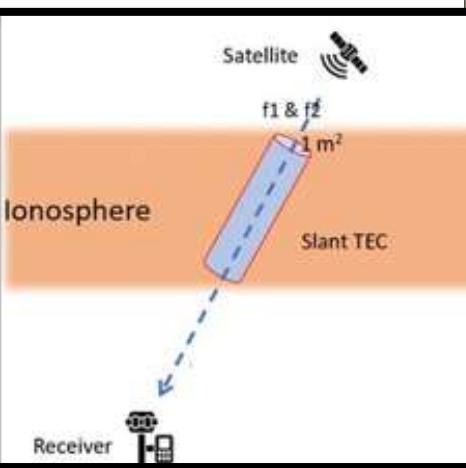


Space for
Societal
Resilience,
Transformation
and
Intelligence

DATE: 20 – 22 August 2025

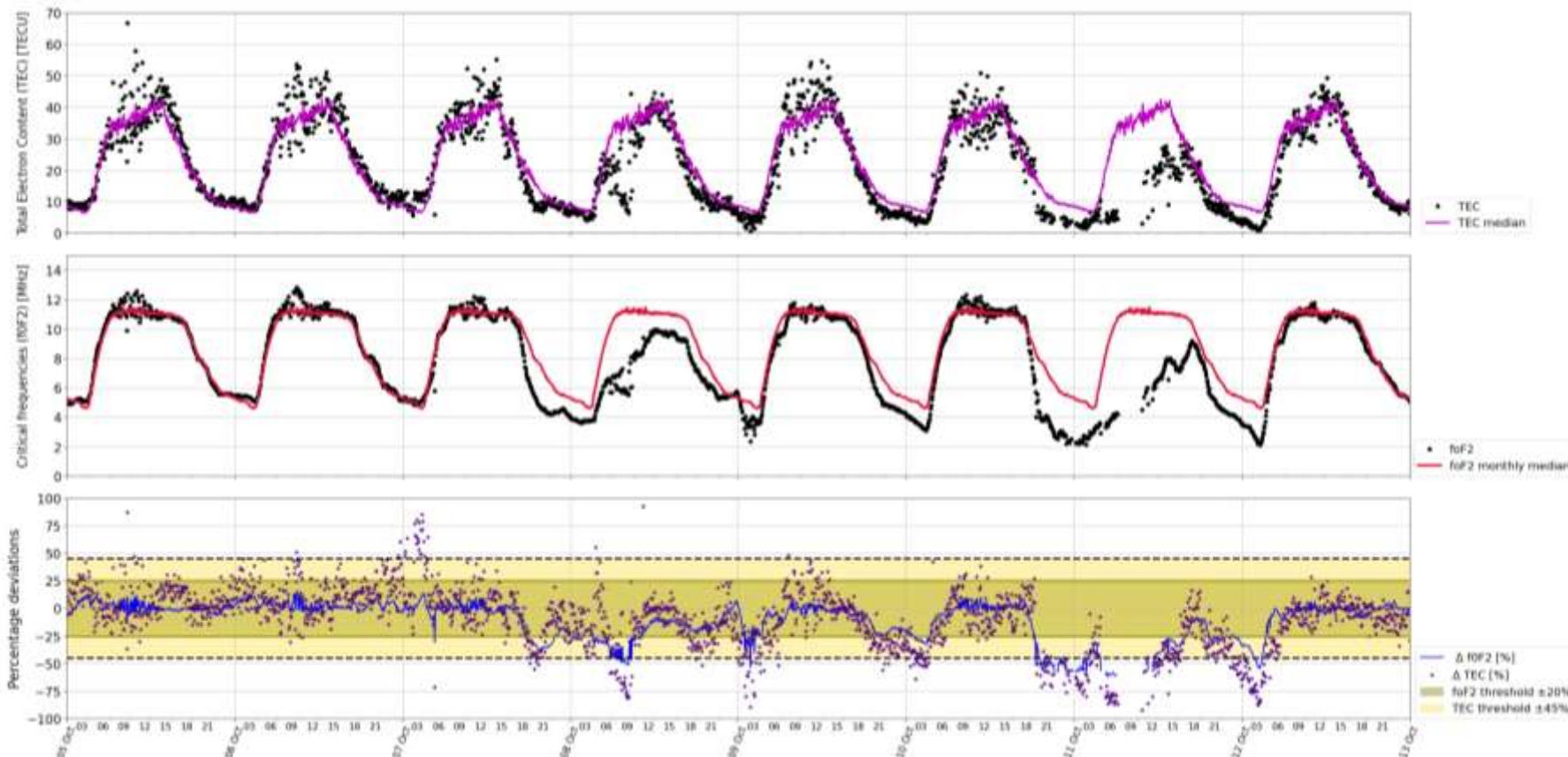
Instruments used to monitor space weather: GNSS receiver

- **Total Electron Content:** is a measure of the total number of electrons along the path between a GNSS satellite and a ground receiver.
- A parameter that measures the ionosphere and is directly proportional to **the time delay from transmitter to receiver**.



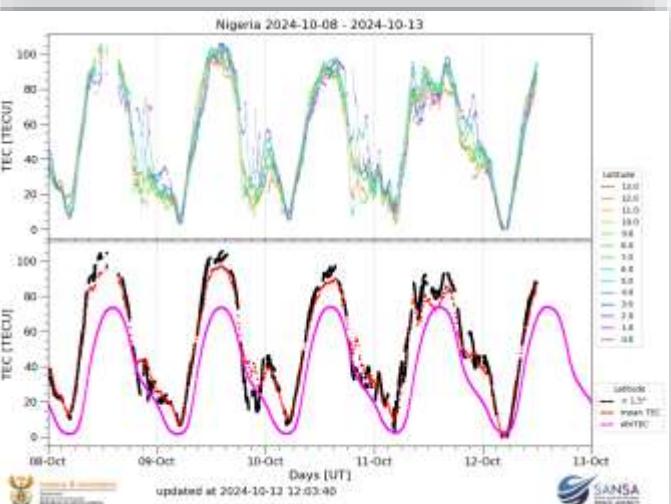
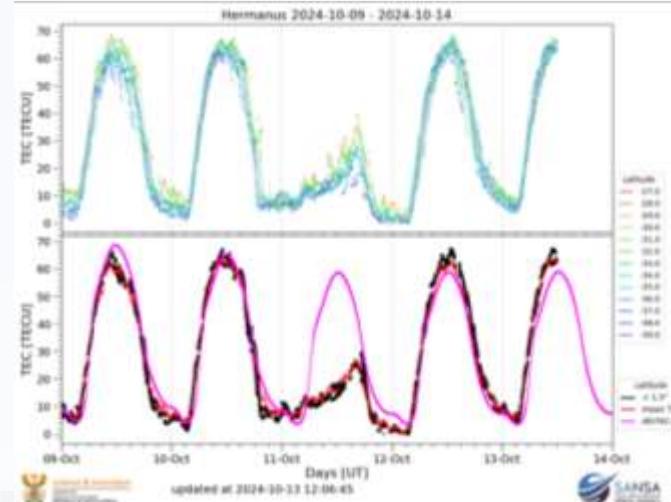
Ground based measurements for October storm from SANSA

Makhanda





SANSA instrumentation project



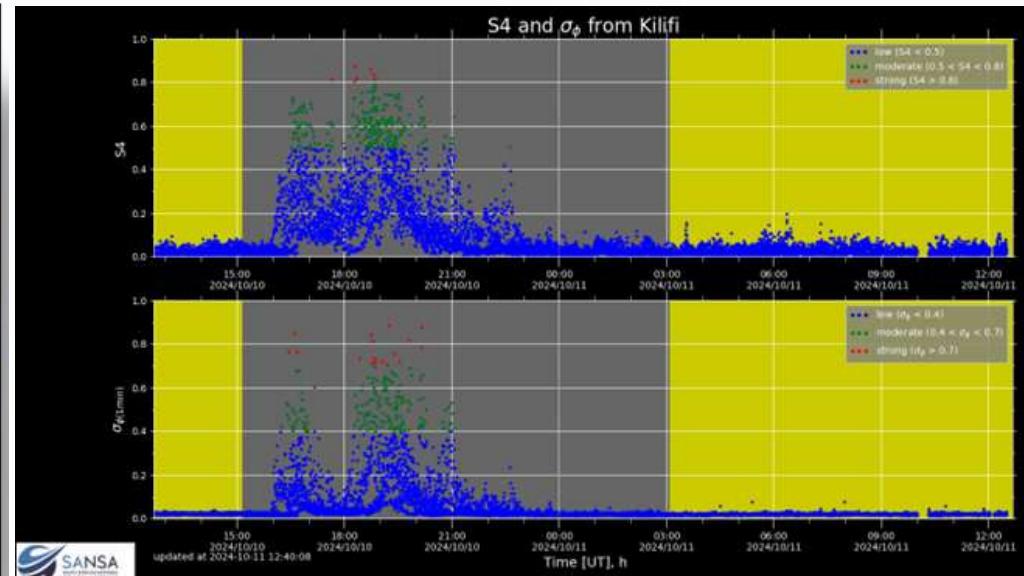
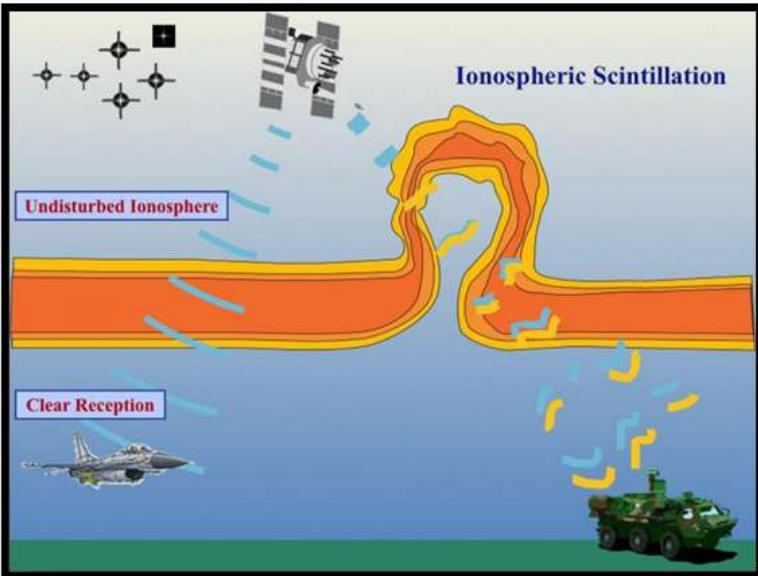
□ Latitudinal variation .



Ground based measurements for October storm from SANSA



- ❑ **What** : is a rapid fluctuation of radio-frequency signal phase or amplitude, generated as a signal passes through the ionosphere.
- ❑ **Where** :Usually in the **equatorial** and **polar** regions.
- ❑ **Why** :Caused by **turbulence** or **irregular electron density structures** in the ionosphere, often triggered by geomagnetic storms.
- ❑ **Strong scintillation** conditions can prevent a GPS receiver from locking on to the signal and can make it impossible to calculate a position.



1/30/2026

CONCLUSION



**Space for
Societal
Resilience,
Transformation
and
Intelligence**

DATE: 20 – 22 August 2025

- Ground-based instruments play a crucial role in complementing satellite observations for space weather monitoring.
- Satellites provide a global coverage but are limited to fully capture the localized impacts of space weather phenomena.
- Ground-based instruments offering high-resolution, continuous, and region-specific data that are essential for understanding and forecasting these localized impacts.
- 8-12 October 2024 geomagnetic storm was observed on various instruments that SANSA utilize for space weather monitoring.



Thank You

