



**2333-30**

**Workshop on Science Applications of GNSS in Developing Countries (11-27 April), followed by the: Seminar on Development and Use of the Ionospheric NeQuick Model (30 April-1 May)**

*11 April - 1 May, 2012*

**The South African National Space Agency (SANSA)**

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*Dr Lee-Anne McKinnell*

*Managing Director: SANSa Space Science*

# **SANSa Space Science**

## ***Space Science in the new Space Agency***

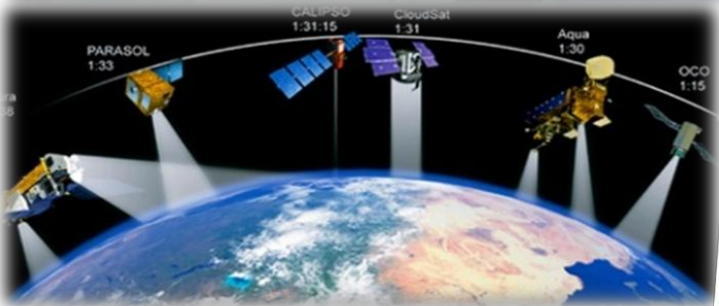


## Legislative Mandate (SANSa Act)

*“...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...”*

# SANSA's Strategic Mandate

- Ten Year Innovation Plan (Grand Challenges)
- National Space Strategy
- South African Earth Observations Strategy





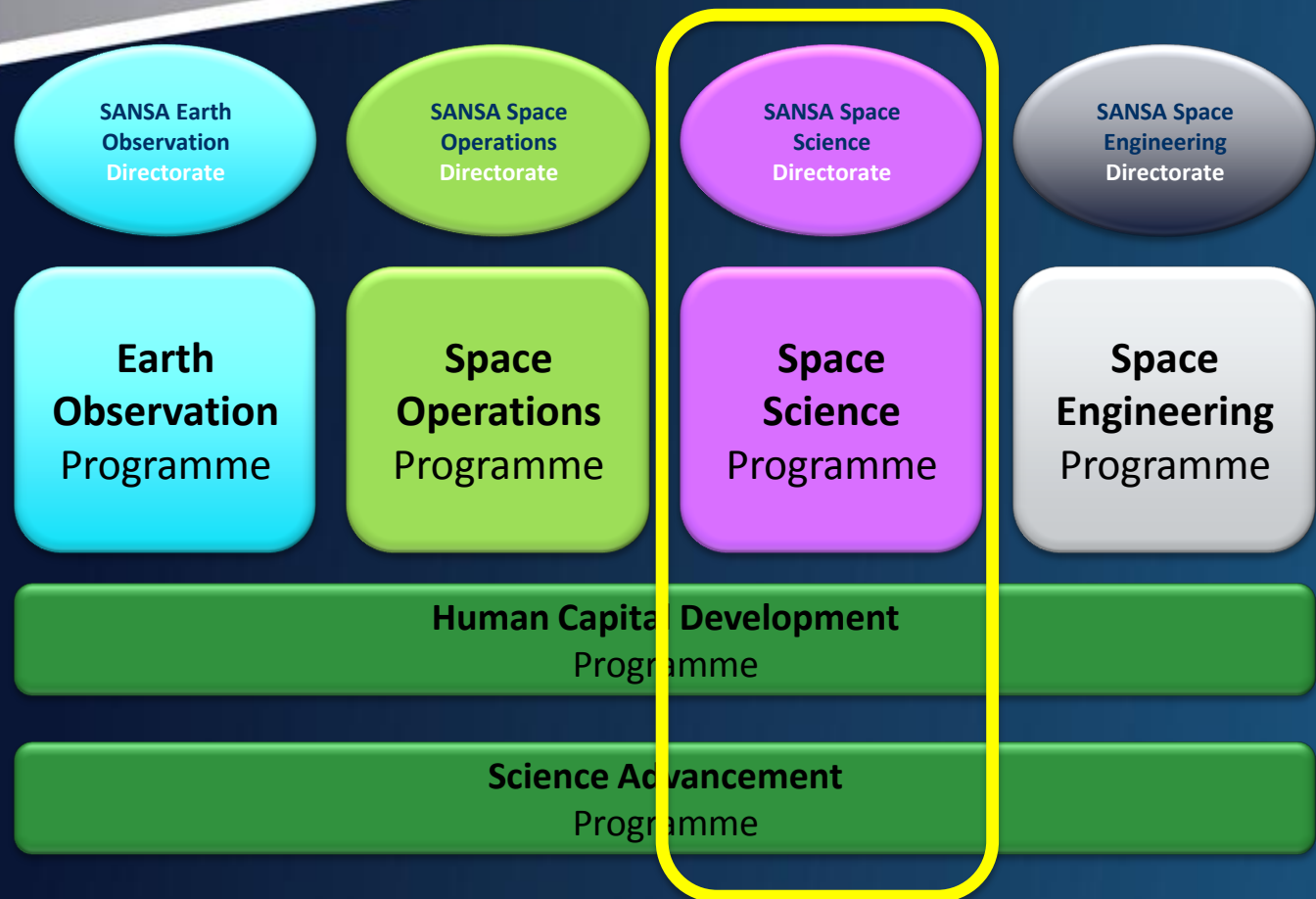
# SANSA's Strategic Goals

- *Goal 1: World-class & efficient services and societal benefits (**Societal Capital**)*
- *Goal 2: Cutting-edge research, development, innovation, technology & applications (**Intellectual Capital**)*
- *Goal 3: Effective development of human capital, transformation and engagement of citizenry (**Human Capital**)*
- *Goal 4: Globally competitive national space industry (**Economic Capital**)*
- *Goal 5: Make South Africa a recognised global space citizen (**Global Capital**)*

***in service of humanity***



# Strategic Programmes





# SANSA Space Science Programme

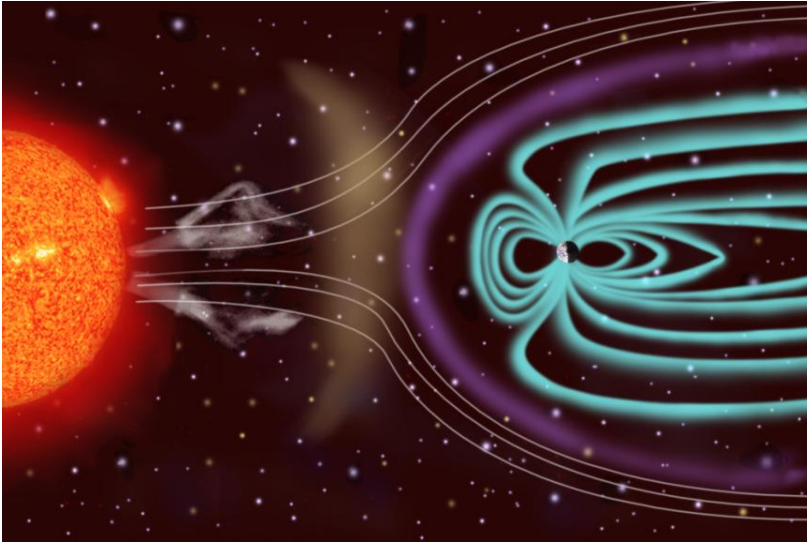
- Knowledge platform
  - Knowledge creation
  - Knowledge utilisation – applied science services e.g. space weather services
  - Knowledge distribution – publications & other research outputs
  - Knowledge impartation - student & personnel training (transferable skills)

# Hermanus Magnetic Observatory TO SANSA Space Science

Year	Event
300	Chinese used loadstone for compass navigation
1600	William Gilbert stated that the Earth itself is a giant magnet
1932	Prof Ogg at UCT established a magnetic observatory (in response to International Commission for the Polar Year)
1937	Magnetic Observatory placed under Trigonometrical Survey Office, Department of Lands
1941	Magnetic Observatory relocated to Hermanus (to escape the disturbing effects of the electric railway system)
1969	Magnetic Observatory incorporated into the CSIR
1987	Some of HMO's services commercialised as a result of CSIR commercialisation
2001	HMO declared a National Facility and transferred to the NRF
2011	HMO migrates to the South African National Space Agency (SANSA)



# SANSA SPACE SCIENCE



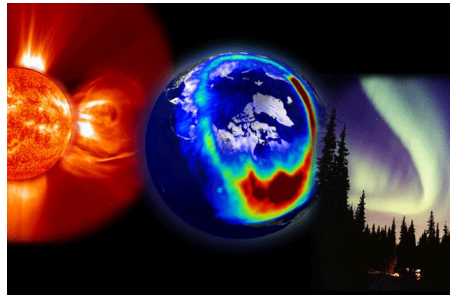
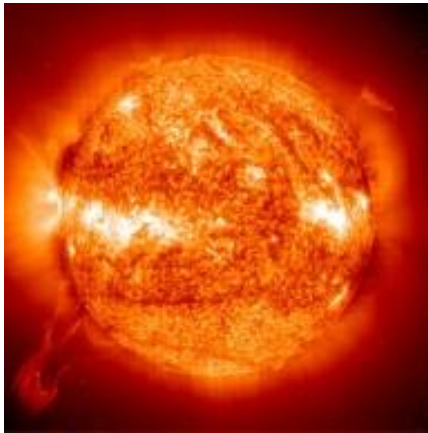
The Space Science Directorate of SANSA is part of the worldwide network of magnetic observatories and is responsible for research infrastructure and data used to monitor the near Earth space environment. The scope of activities include fundamental and applied space physics research, post-graduate student training, science advancement, Space Weather and the provision of geomagnetic field related services on a commercial basis.

# **SANSA SPACE SCIENCE VISION**

**By 2015 we want to be the hub for earth-space science and technological services in Africa and a key player in the South African earth-space programme.**

# Space Science Core Function: Sun-Earth Interactions & Related Technologies

## Research



- Monitoring the Earth-Space system
- Distributing data on the system
- Creating new knowledge on the system
- Developing human capital

## Technology

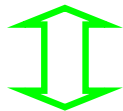


- Advanced & customised system solutions
- Innovative product integration
- In-service training

## Science Advancement



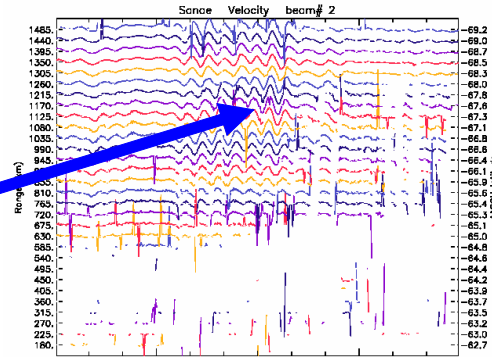
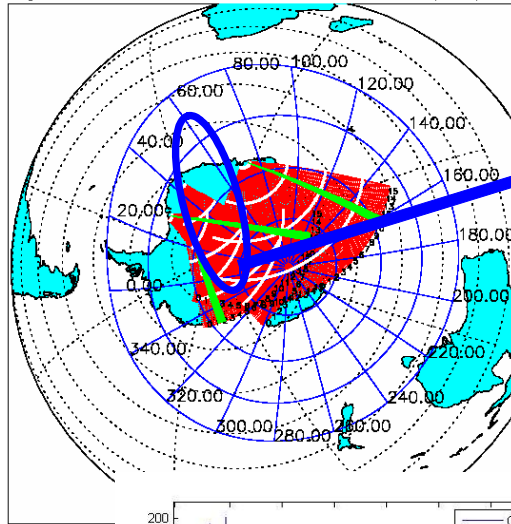
- Getting the youth into science
- Enhancing science learning
- Increasing science awareness & interest among the public
- Changing lives
- Transforming society



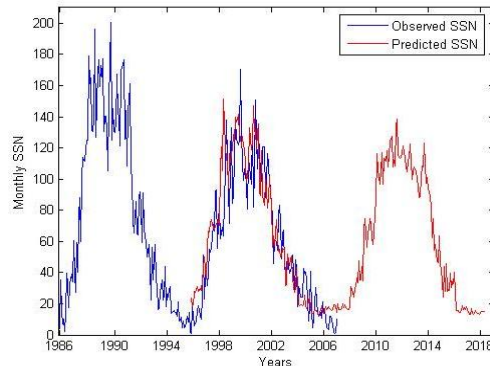
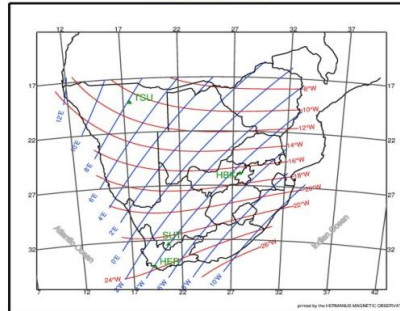


# RESEARCH TOPICS

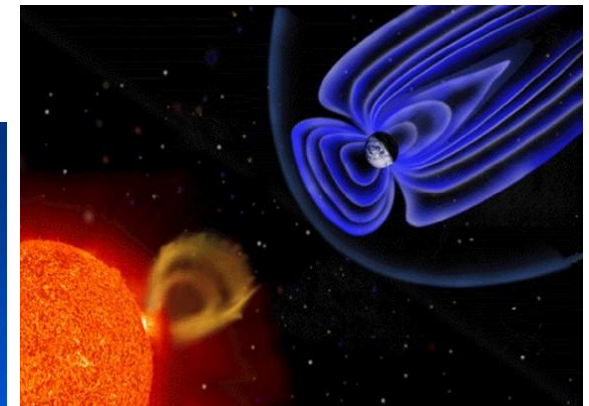
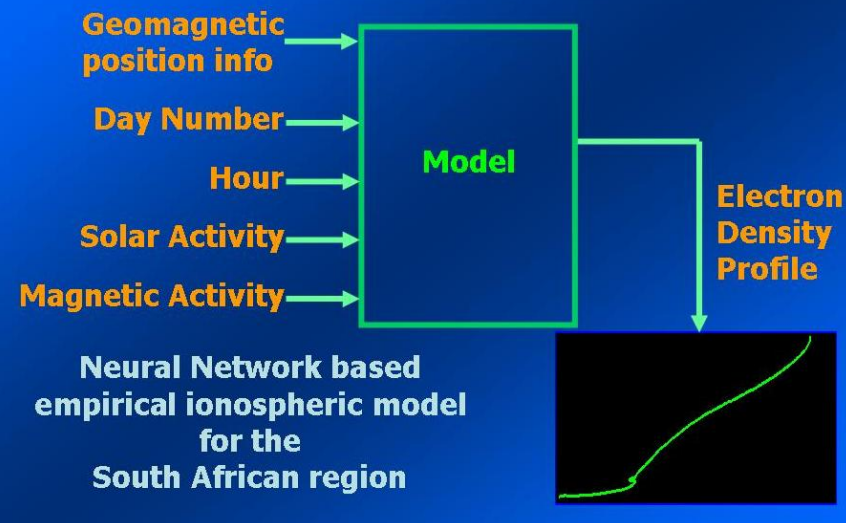
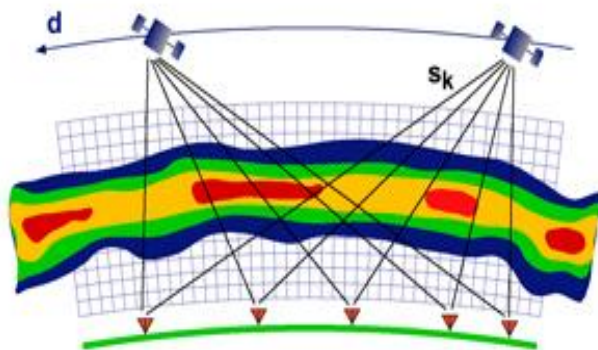
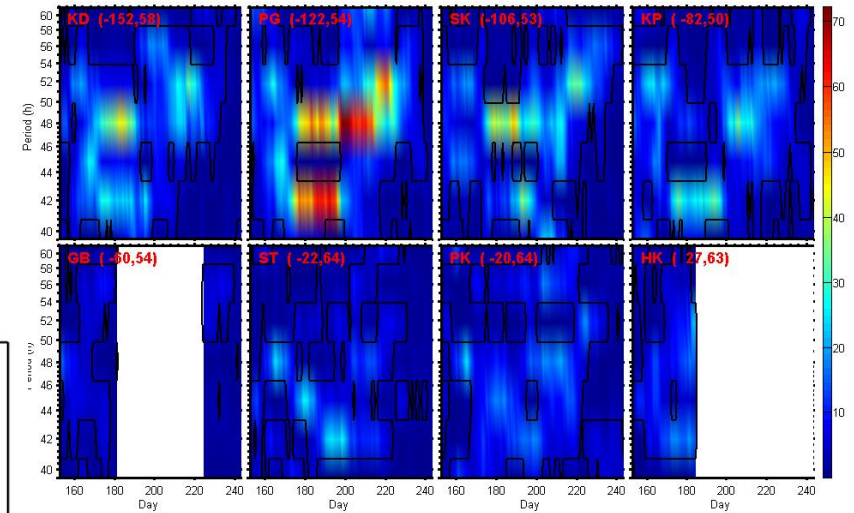
High resolution sampled beams for 2002/08/05



MAGNETIC DECLINATION 2000.0  
and mean annual change 1995-2000



MERIDIONAL FLOW: Normalised power spectrum (28d window)





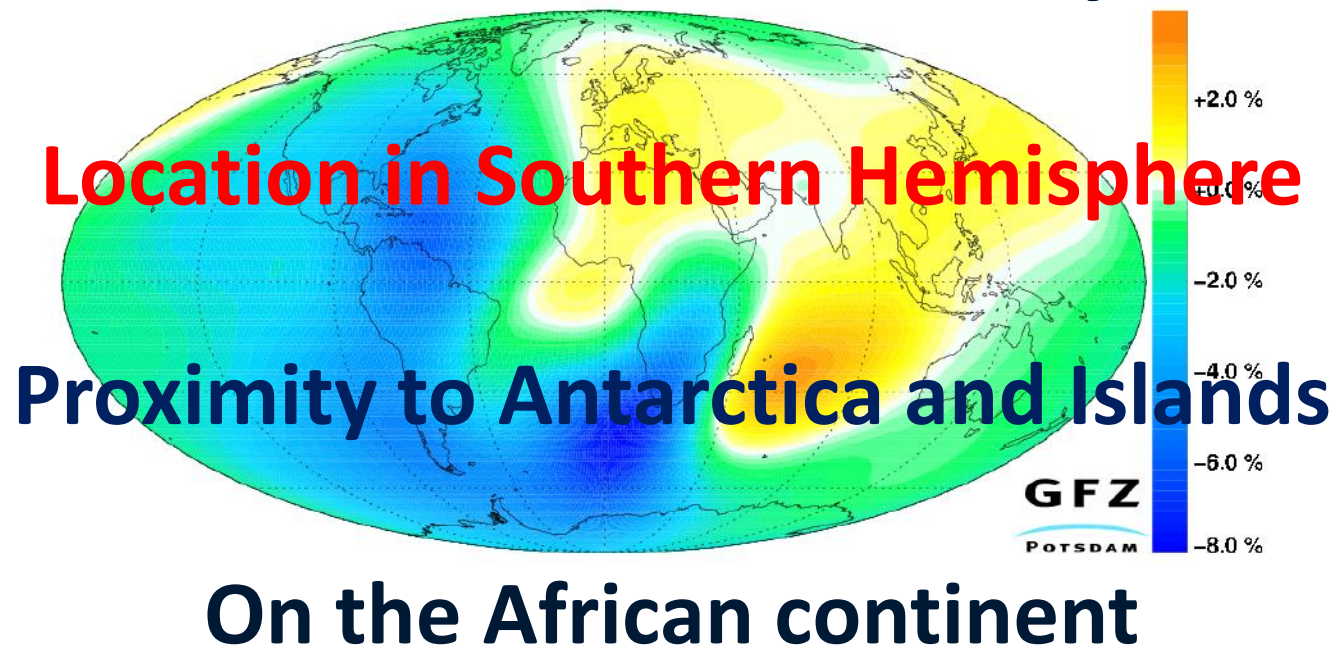
# RESEARCH TOPICS

- Geomagnetic Research
- Ionospheric Research incl Characterisation
- Waves and Space Plasmas
- Space Weather (Solar, Prediction etc)

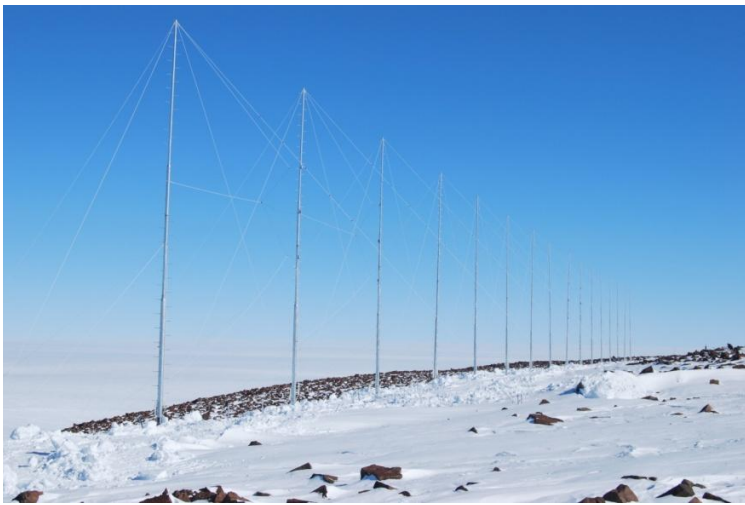


# EARTH-SPACE SCIENCE IN A GEOGRAPHICALLY ADVANTAGEOUS REGION

## South Atlantic Anomaly



# RESEARCH SUPPORT UNIT

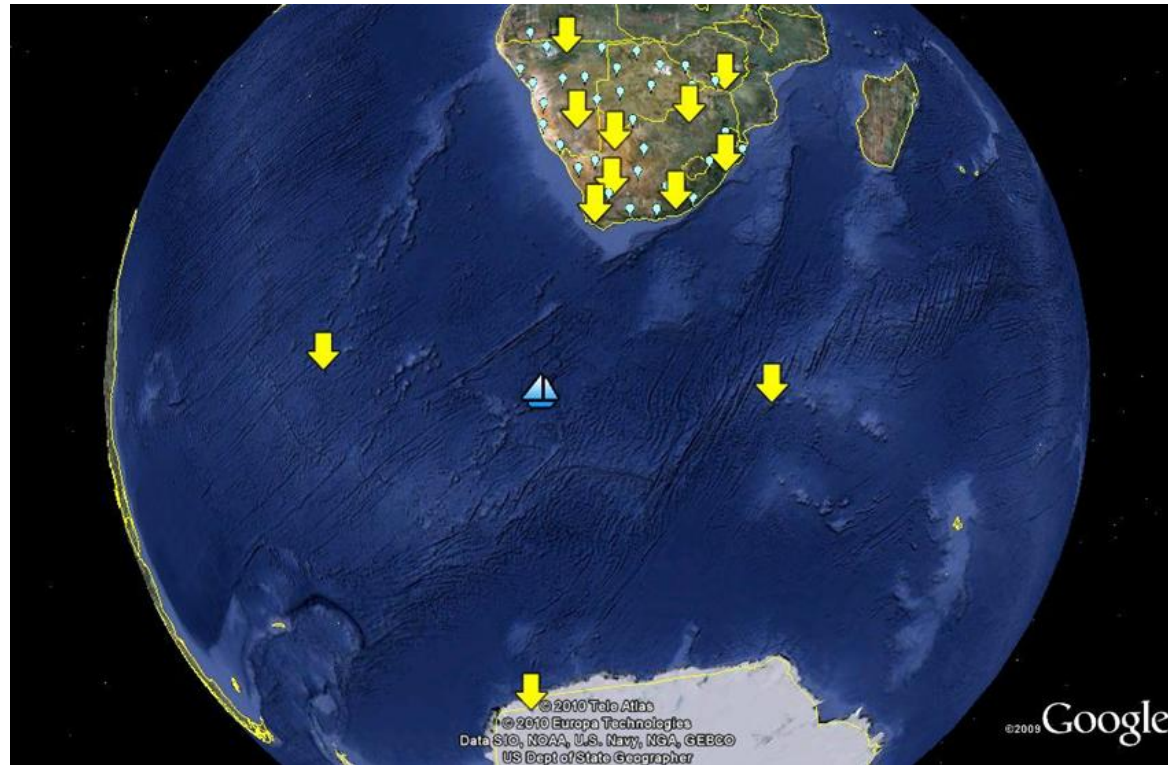


# RESEARCH SUPPORT UNIT

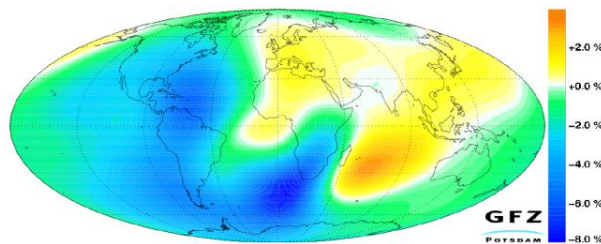
- Ionosondes
- GPS receivers (dual frequency & scintillation)
- VLF receivers
- Doppler Radar
- Magnetometers (variation & pulsation)
- Riometer
- MT Stations
- Radar (Aurora and Mid Latitude)
- Lidar
- Lightning detectors
- Neutron Monitor



# Research Platform – Geo-space Laboratory



## Geographic Advantage



## Wide Observational Network



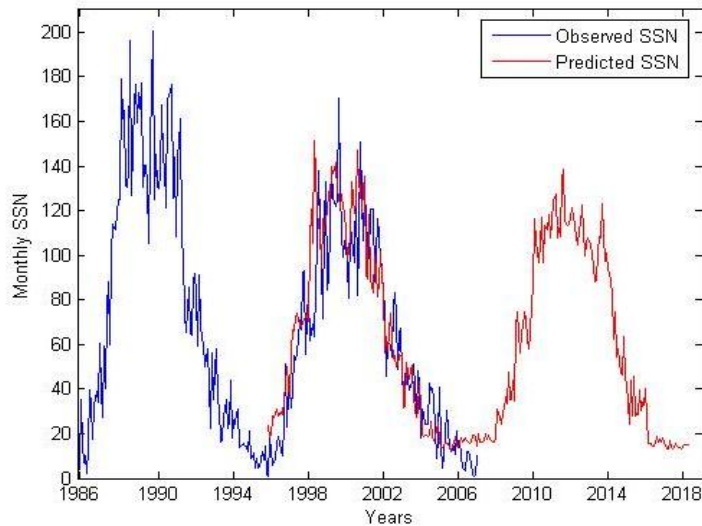
## Global Data Distribution & Access

- ISES
- INTERMAGNET
- SuperDARN

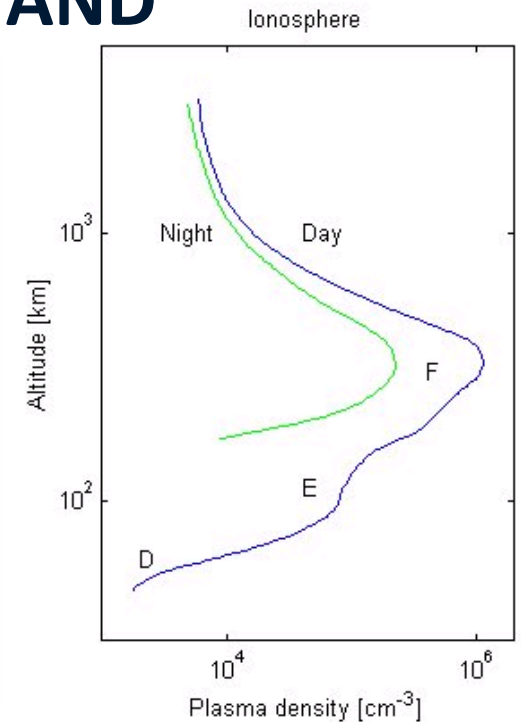
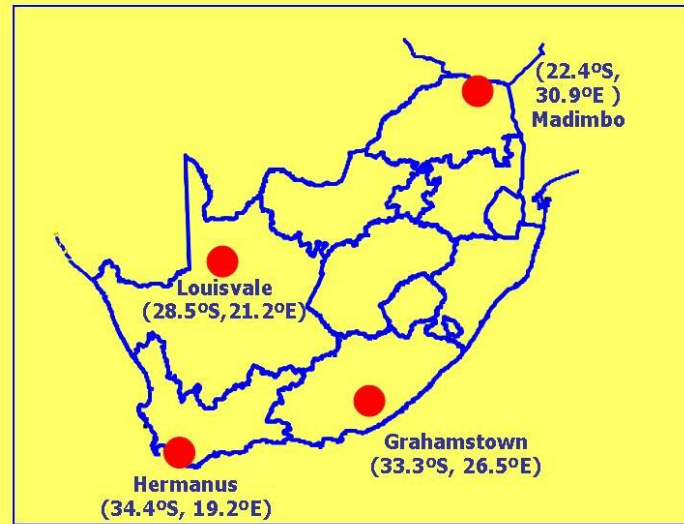
*And now, if I may for a moment, I will digress .....*



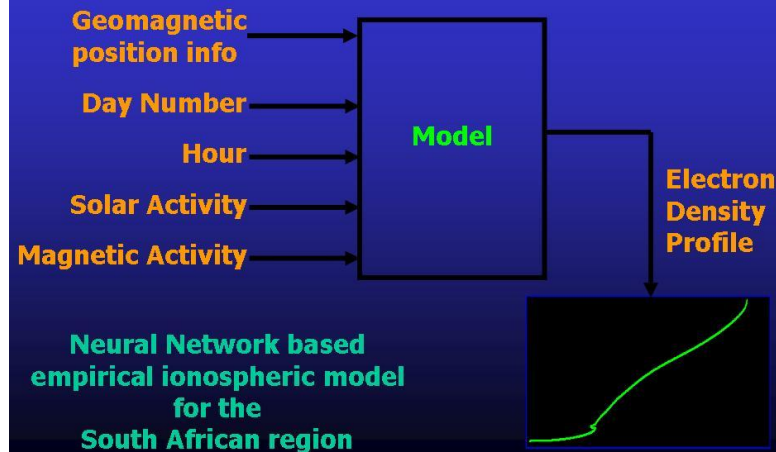
# IONOSPHERIC OBSERVATIONS, MODELLING AND APPLICATIONS



## South African Ionospheric Stations



## NATIONAL SA MODEL A South African Ionospheric Model





# HERMANUS



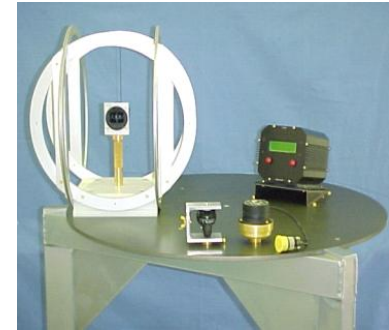


***And back to the full story.....***



# TECHNOLOGY

The **Technology Division** utilises our knowledge of geomagnetism and our unique facilities, located in a magnetically clean environment, to provide quality controlled services to clients in the defense and aerospace industries.



HMO designed and built test bench for the evaluation of aircraft compasses

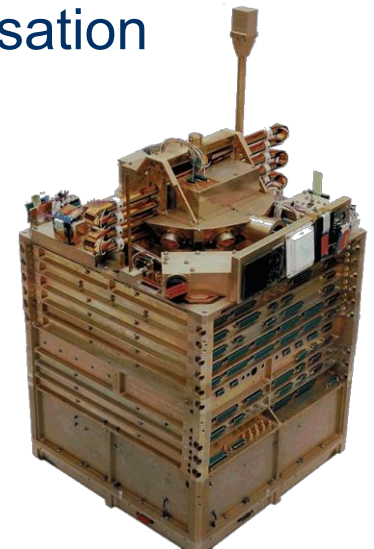
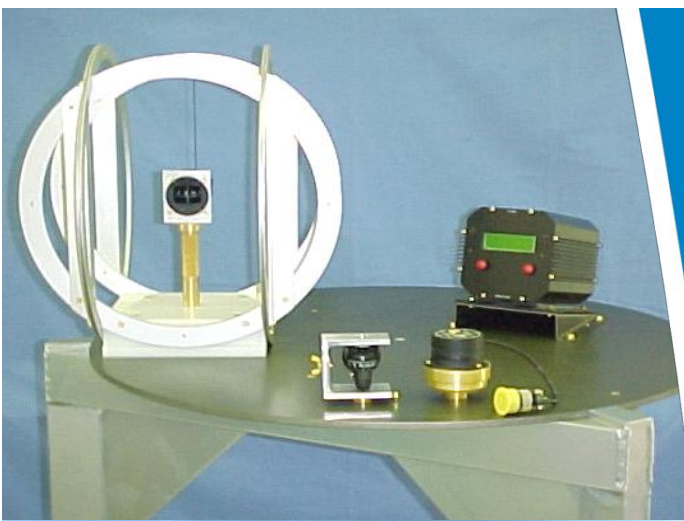
- Magnetic navigation support to SAAF and civilian aviation
- Magnetometer technology support services
- Application of signal processing techniques
- Low cost sensor integration



Magnetic evaluation of 220 kg rocket-propelled bomb

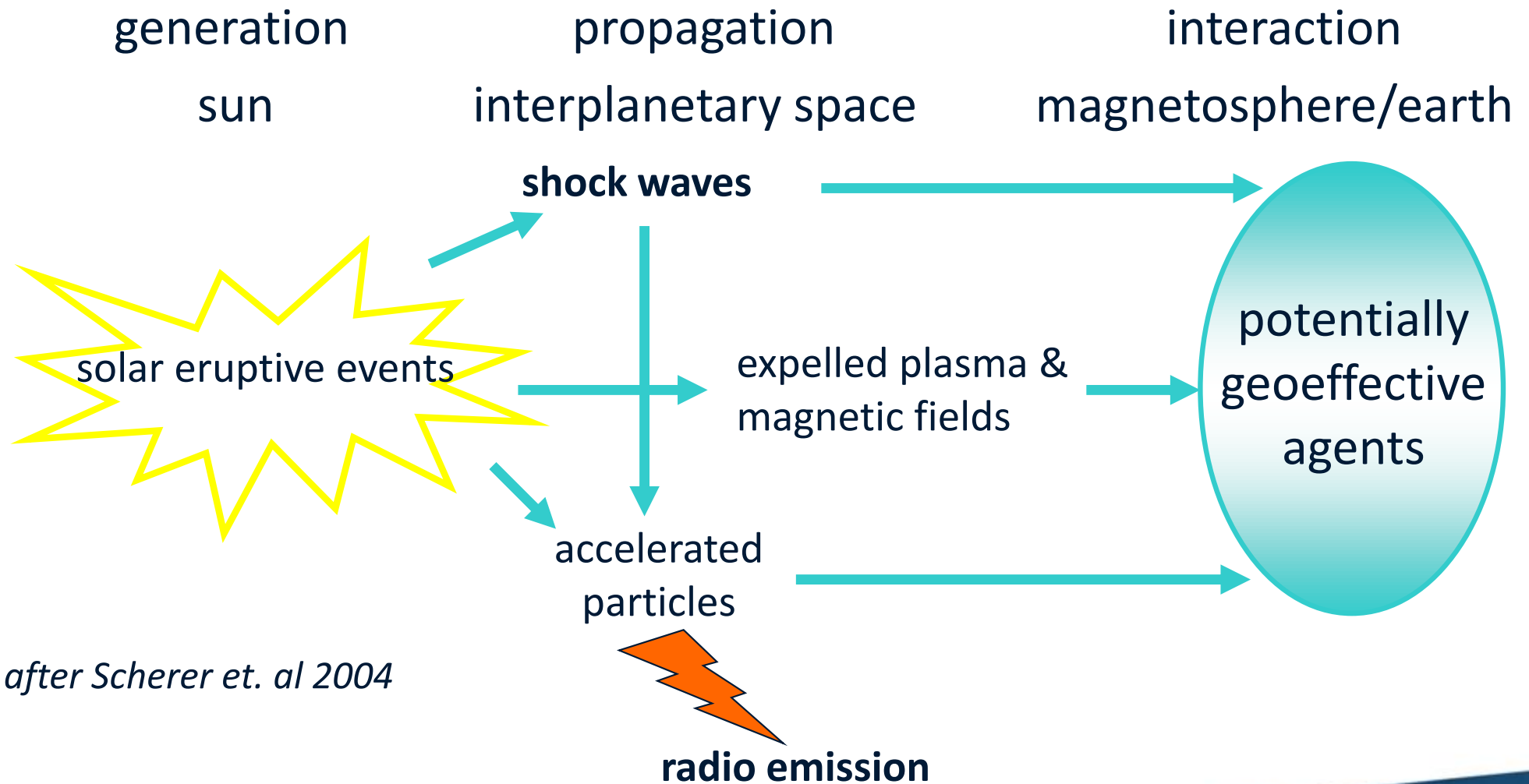
# Technology Services

- Maintenance & calibration of landing compasses
- Magnetic surveying of compass swing areas
- Maritime electric and magnetic signature management
- Magnetometer-based system integration
- Satellite orientation-magnetometers
- Satellite magnetic characterisation



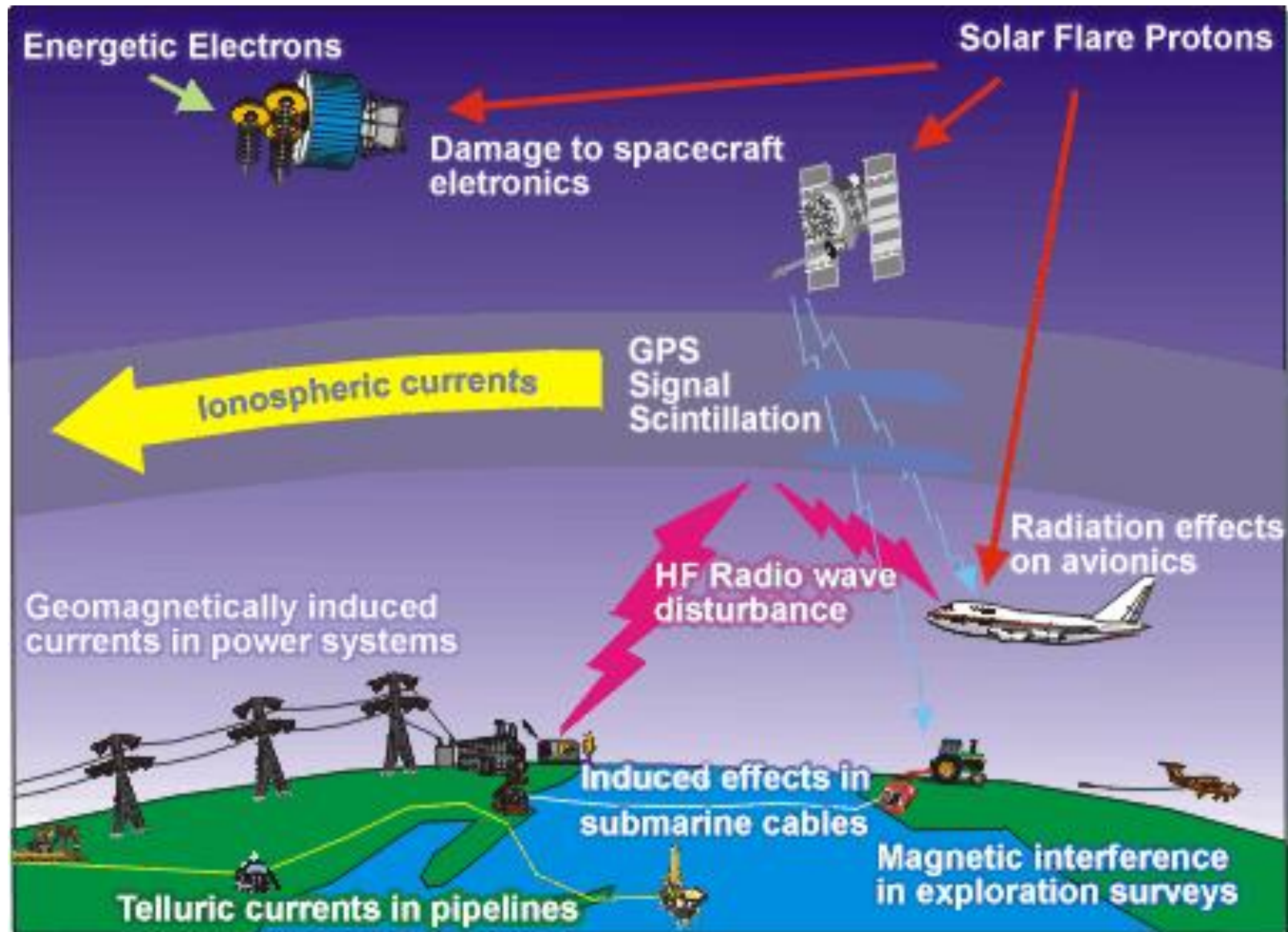
# Space Weather – Operations and Research

Solar eruptive events (solar flares, coronal Mass ejections (CMEs)) are the main drivers of space weather





# Space Weather Effects



# Opening of Space Weather Center

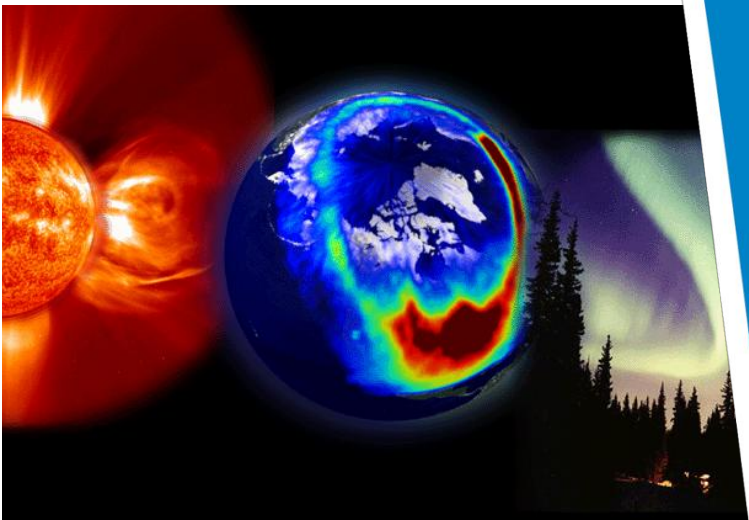
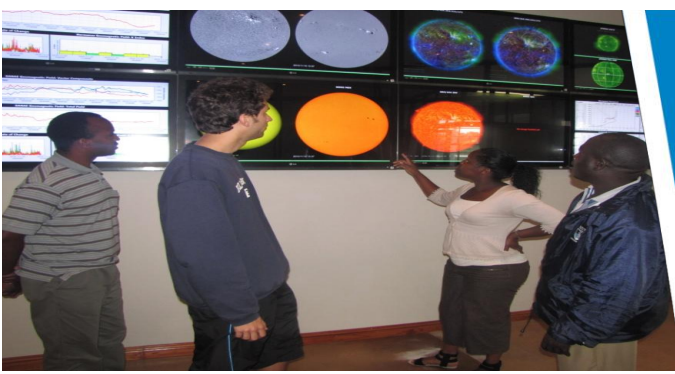
**Space Weather Center in Hermanus was opened officially by Mrs Naledi Pandor, South African Minister of Science and Technology on 10 December 2010.**

A first public Space Weather open day was held in the center on 4 April 2011.

**Real time data and information is displayed from both satellite and ground based stations.**

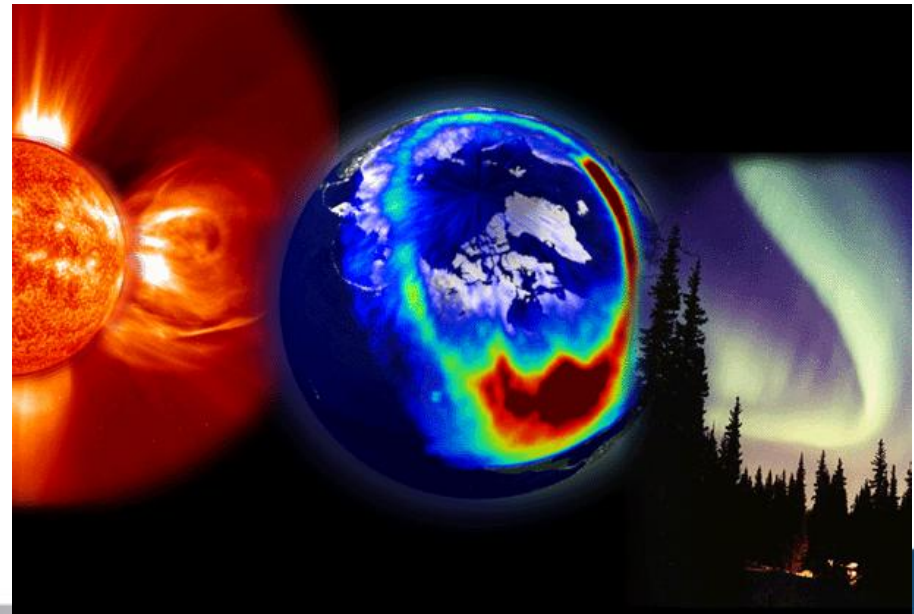
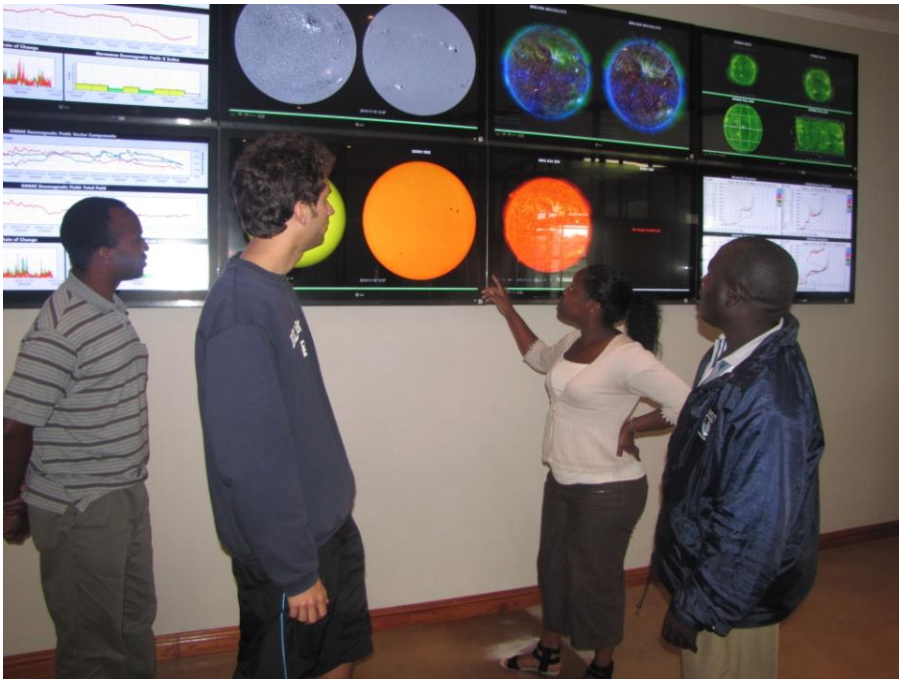
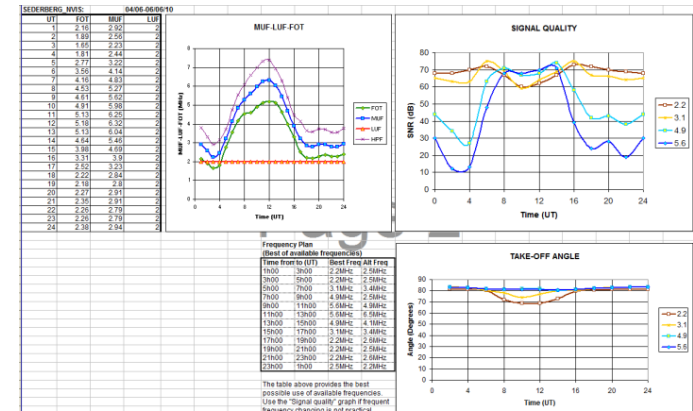
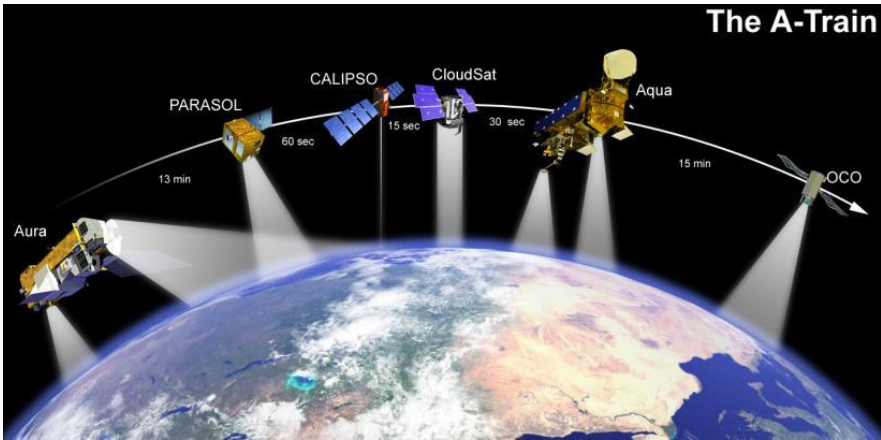
Forecasts and predictions are served from the center.

**An attractive working area that is providing useful information and educating the public on space weather.**



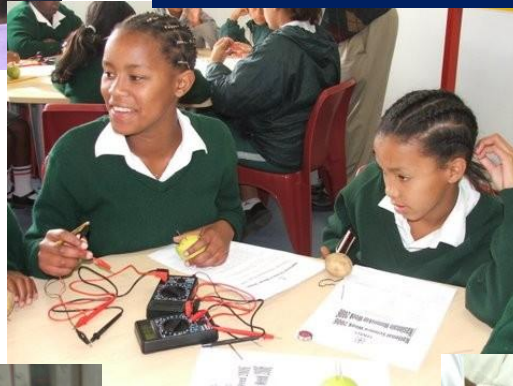


# SPACE WEATHER OPERATIONS CENTER



# SCIENCE ADVANCEMENT

- Science Center
- School Visits
- Educator Training
- Public Awareness





# What SANSA Space Science currently offers

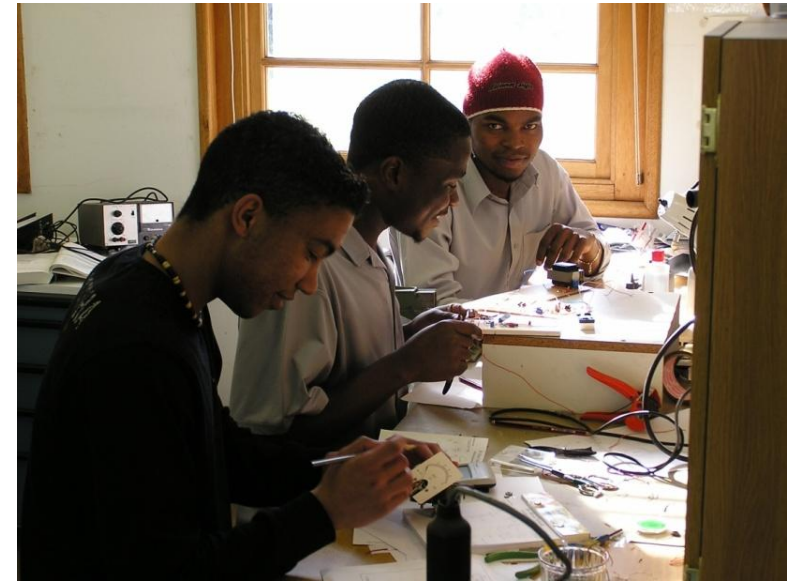
- Access to Science Center
- Public lectures (limited numbers)
- Educator workshops by arrangement
- Open days and Public Tours
- Curriculum Activities
- Science Awareness
- Participation in Exhibitions (eg: SciFest)





# STUDENT TRAINING (HCD)

Postgraduate student supervision  
Summer & Winter Schools  
Honours projects & Supervision  
University courses in Space Physics  
Internship & Volunteer programs



# Student Groups who use SANSA facilities

- PhD students doing research projects with SANSA supervisors
- MSc students doing research projects with SANSA supervisors
- Coursework MSc students completing practical component
- Interns/volunteers who spend 1 or 2 years at SANSA
- Honours students doing Hons projects
- Honours summer school students
- Post-graduate engineering students
- Under-graduate winter school students
- Under-graduate summer school students





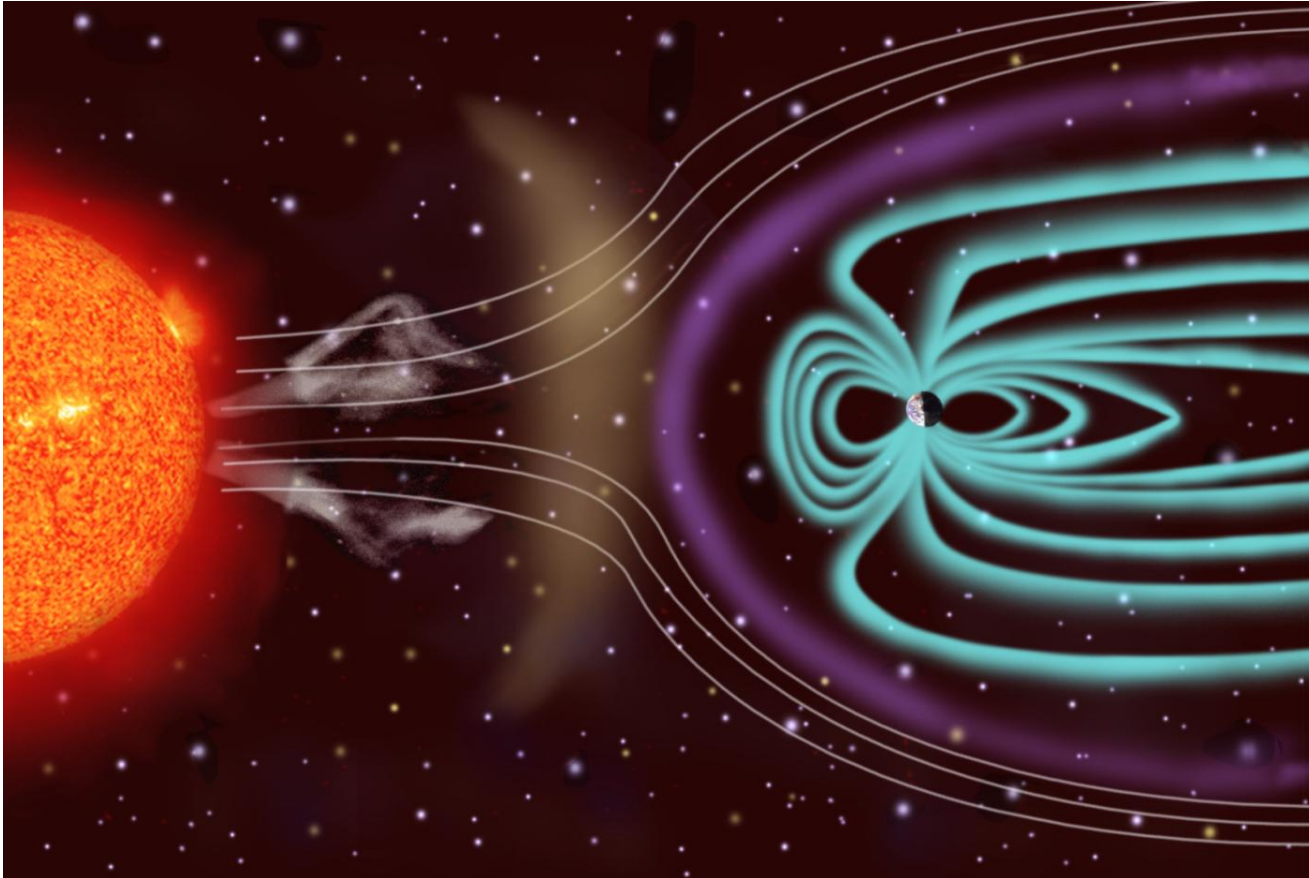
# African Partnerships

- Kenya, Zambia – formal Bilateral Agreements
- Nigeria – currently in process of signing a MoU btn Space Agencies
- Uganda & Rwanda – trained students
- Ethiopia – currently setting up agreement



# **SANSA SPACE SCIENCE**

## ***KEEPING AN EYE ON***



## ***OUR SPACE ENVIRONMENT***

# Strategic Programmes

SANSA Earth  
Observation  
Directorate

SANSA Space  
Operations  
Directorate

SANSA Space  
Science  
Directorate

SANSA Space  
Engineering  
Directorate

**Earth  
Observation  
Programme**

**Space  
Operations  
Programme**

**Space  
Science  
Programme**

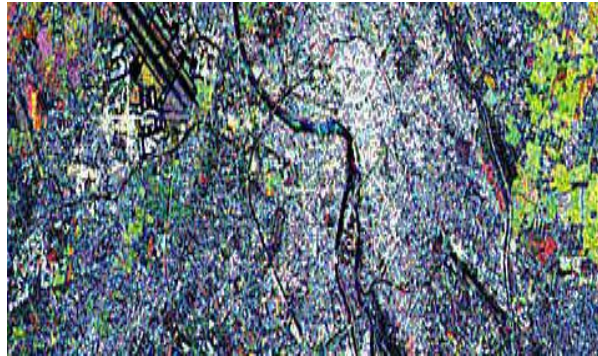
**Space  
Engineering  
Programme**

**Human Capital Development  
Programme**

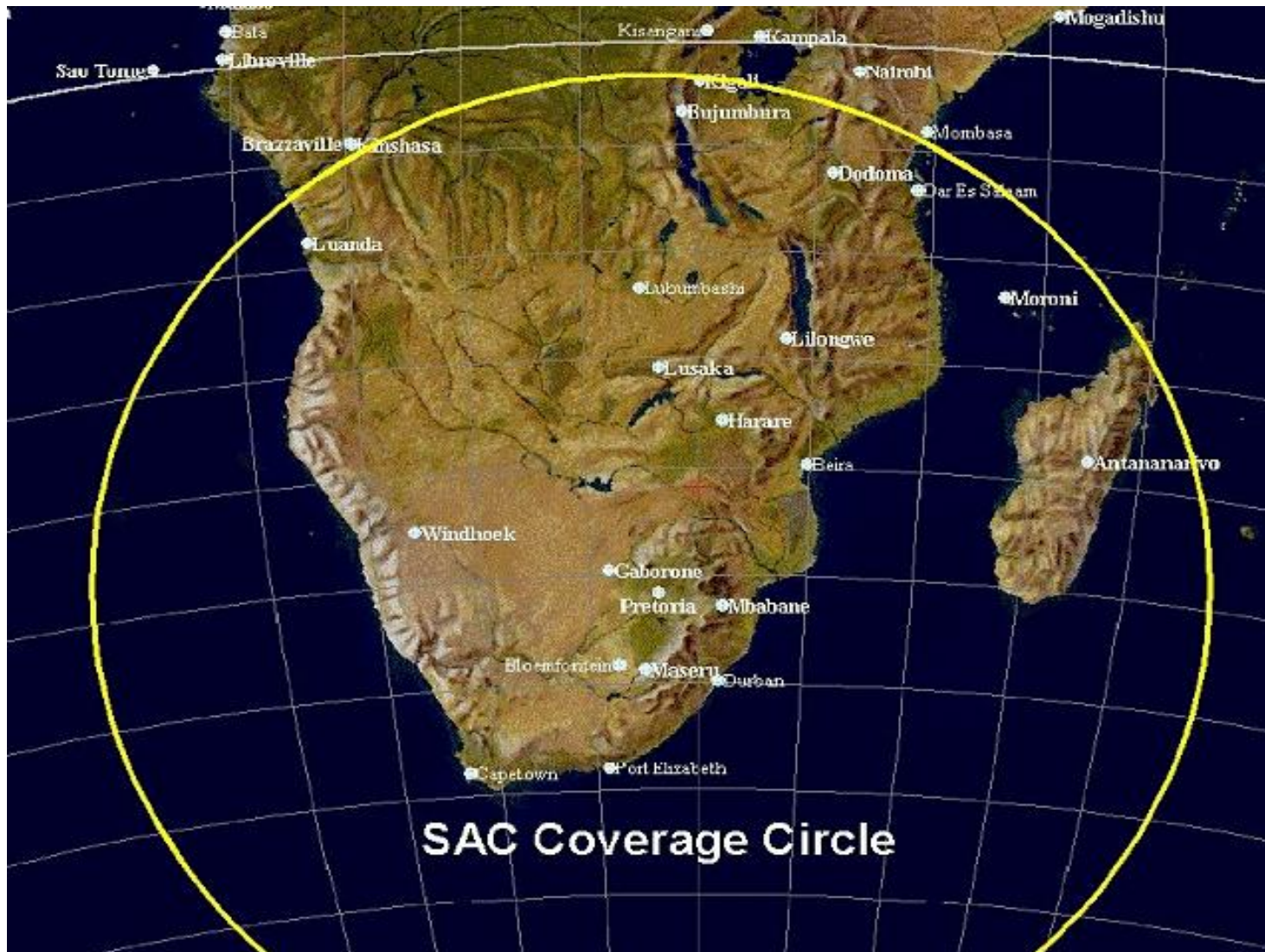
**Science Advancement  
Programme**



# SANSA EARTH OBSERVATION



# SANSA Earth Observation





# Satellite Sensor Portfolio Management



**MODIS - 2003**

**NOAA - 1986**

**Landsat - 1972**

**SPOT 1,2 & 4 - 1990**

**SPOT 5 - 2006**

**Ikonos - 2001**

**GeoEye - 1 - 2009**

**QuickBird - 2002**

**WV - 1 - 2008**

**Radarsat - 2001**

**EnviSAT - ASAR, MERIS,**

**ASTER**

**KompSat-2**

**CBERS**

**SAC - C**

**FORMOSAT**





# SANSA SPACE OPERATIONS



# SANSA Space Operations



# 1. Telemetry, Tracking & Command

- Launch support
- Transfer orbit support
- In Orbit Testing
- Lifecycle support
- Emergency support
- Carrier Monitoring
- Remote Sensing
- Hosted Infrastructure
- Mission control

# 2. Position, Navigation & Timing





# SANSA

*in service of humanity*