Characteristics of TEC perturbations observed over the mid-to-low latitude regions during geomagnetic storms

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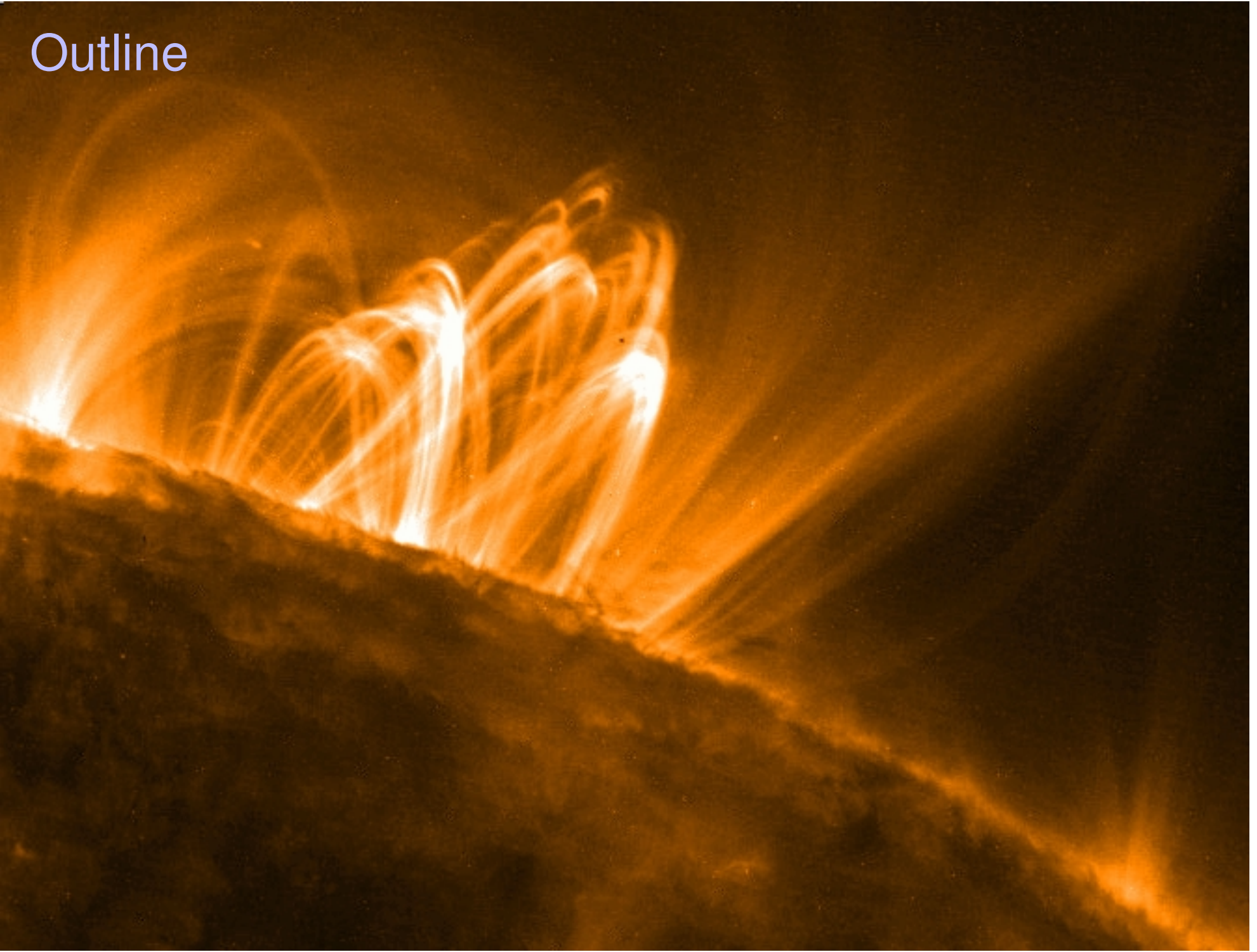
United Nations/Japan Workshop on Space Weather,
Fukuoka - Japan,
2-6 March 2015

Outline



Outline

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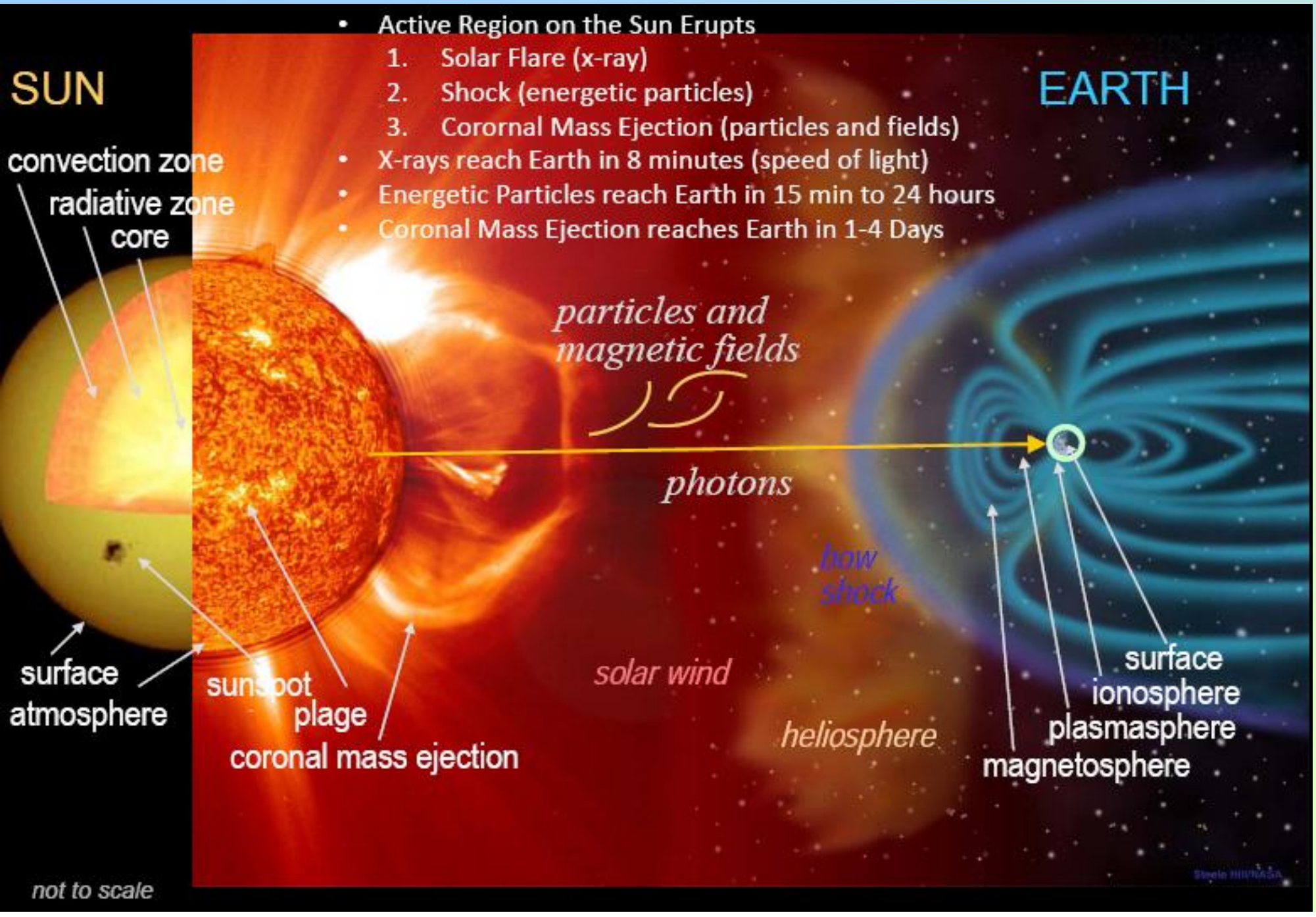
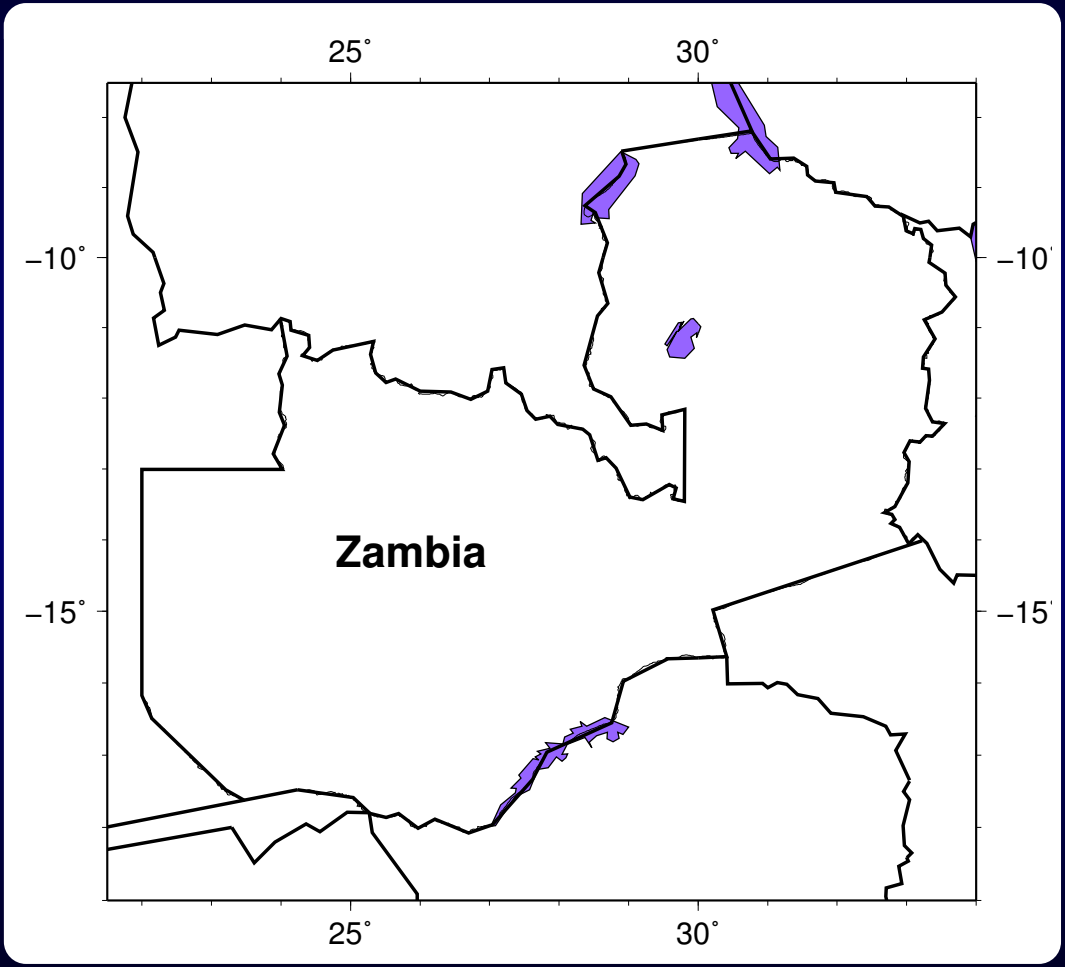
- Brief intro on space weather?
- Recent developments in Zambia
- Some Science results
- Summary and comments- - -

... Space Weather

Space Weather happens when the Sun sends out light, particles, and magnetic fields that hit objects in the solar system


SUN
EARTH
Active Region on the Sun Erupts
1. Solar Flare (x-ray)
2. Shock (energetic particles)
3. Corornal Mass Ejection (particles and fields)
X-rays reach Earth in 8 minutes (speed of light)
Energetic Particles reach Earth in 15 min to 24 hours
Coronal Mass Ejection reaches Earth in 1-4 Days
convection zone
radiative zone
core
particles and magnetic fields
photons
bow shock
solar wind
heliosphere
surface
atmosphere
sunspot
plage
coronal mass ejection
surface
ionosphere
plasmasphere
magnetosphere
not to scale

STATUS
Space weather and ionospheric monitoring in Zambia



- before IHY workshops

STATUS
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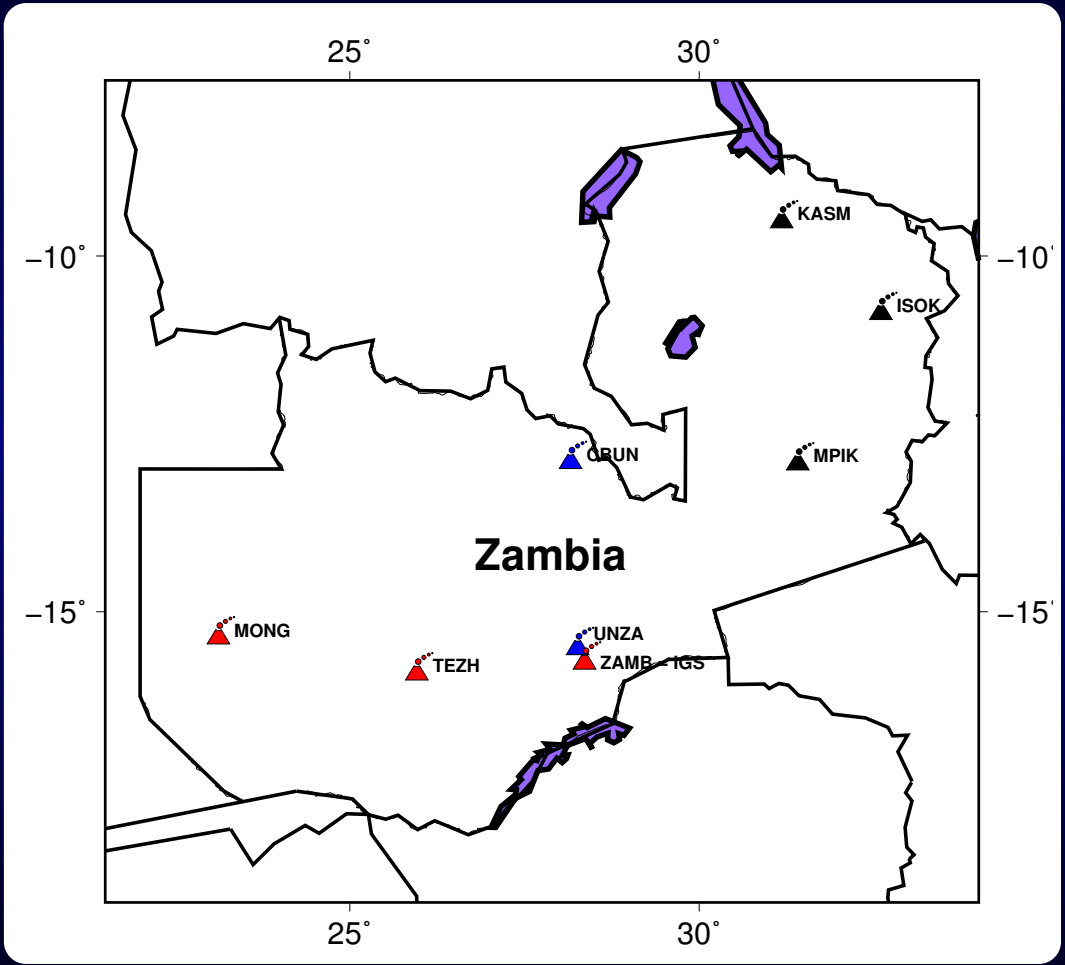

- ...current status..

We have....

- 7 active GNSS receivers
- 1 scintillation monitor
- 2 need physical access
- A MAGDAS Magnetometer

Zambian GNSS data base to date

Station	Available date	Comments
ZAMB	Jun-2002 - May-2008	reactivated Jan 2012
MONG	Aug-2010 - present	active
TEZH	Aug-2010 - present	active
UNZA	Aug-2011 - present	active
CBUZ	Dec-2012 - present	active
MPIK	Jun-2014 - present	Physical access
KASM	Jun-2014 - present	Physical access
ISOK	Jun-2014 - present	Physical access

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MAGDAS host - -

- MAGDAS - - operational at the University of Zambia since Sept 2008

Capacity building and skills development

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Human capacity development

- new space science program at the UNZA.
- building a research team - a huge challenge

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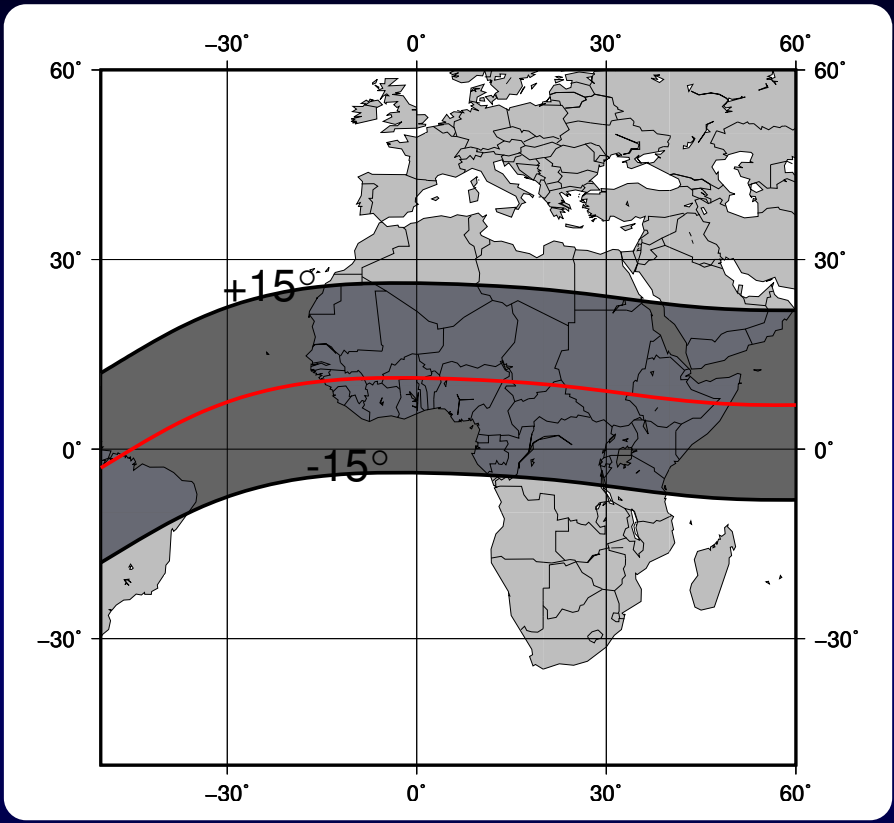
IMPORTANT ...government support

Jointly funded project by South Africa & Zambia

- First call:- 2012 - 2013 - among the 8 projects, installation of more GPS receivers
- Second call:- 2015 - 2015 - among the 11 other projects - science investigations

Zambia - location - - mid-low latitude region



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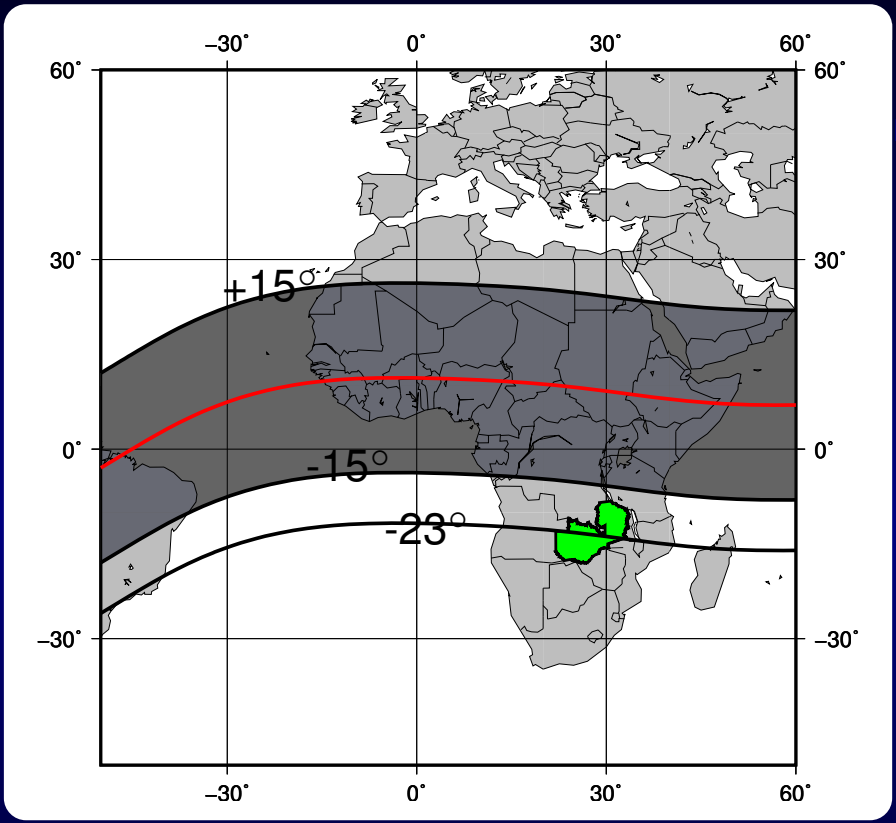
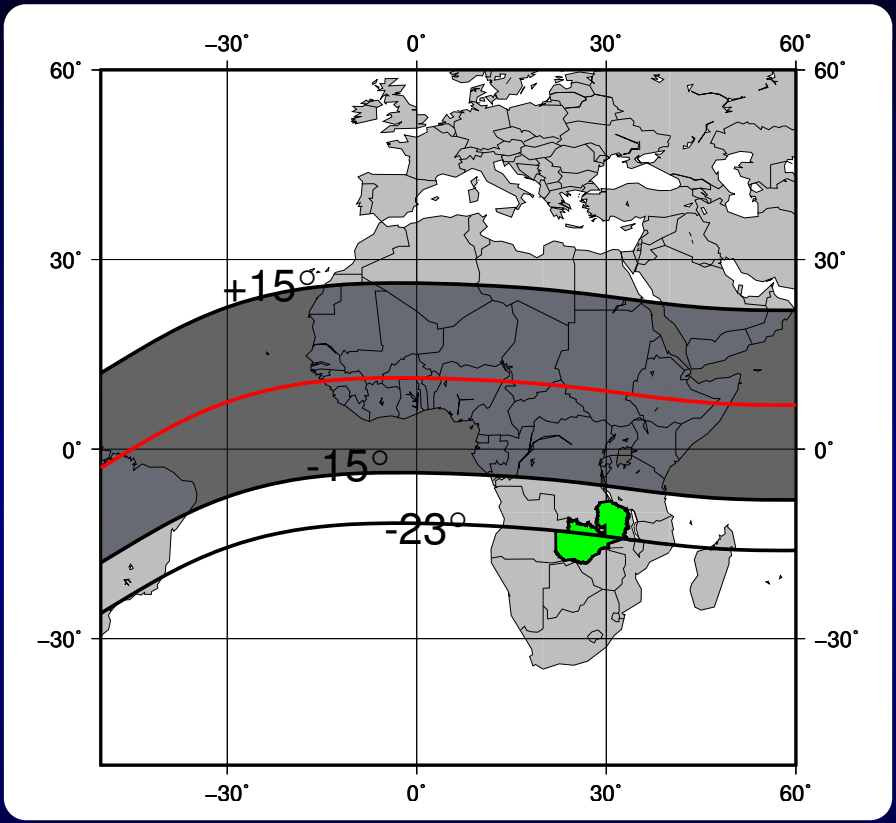


mid-lat science questions

direct influence?? - a manifestation of moving disturbances

Zambia - location - - mid-low latitude region



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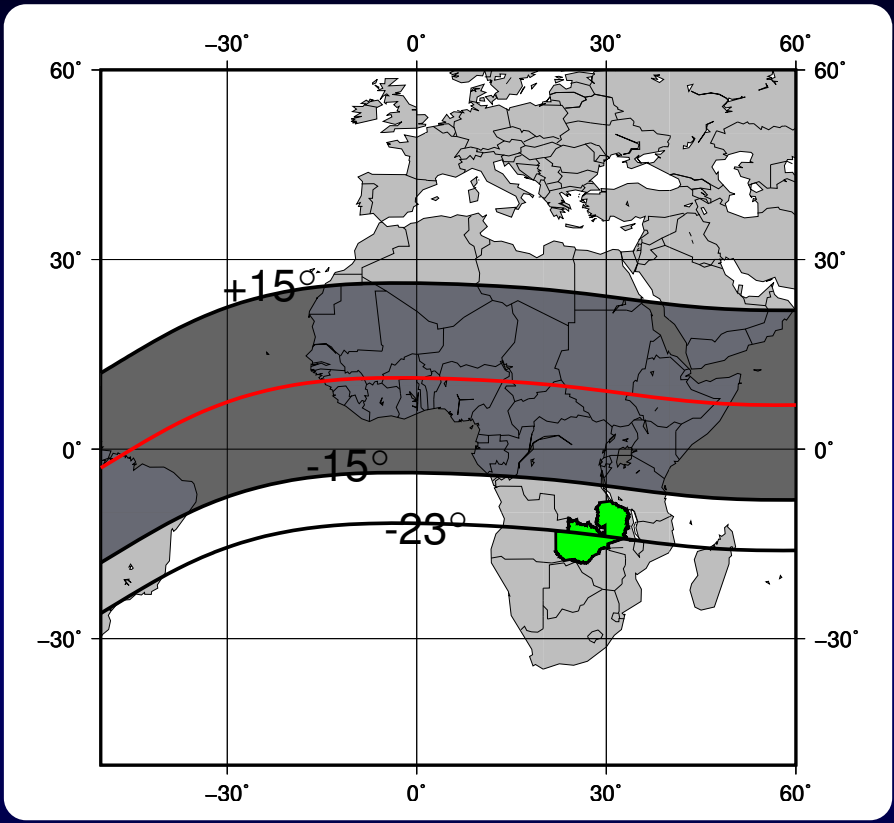

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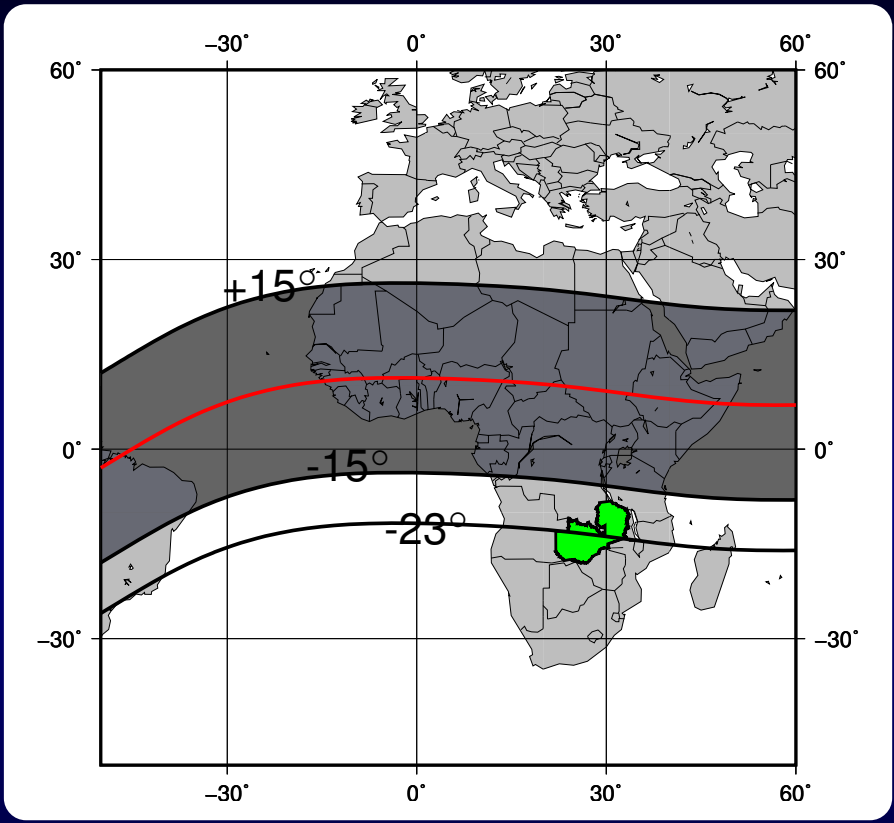

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- large-scale perturbation processes characterized by moving ionization fronts
- wave-like traveling ionospheric disturbances

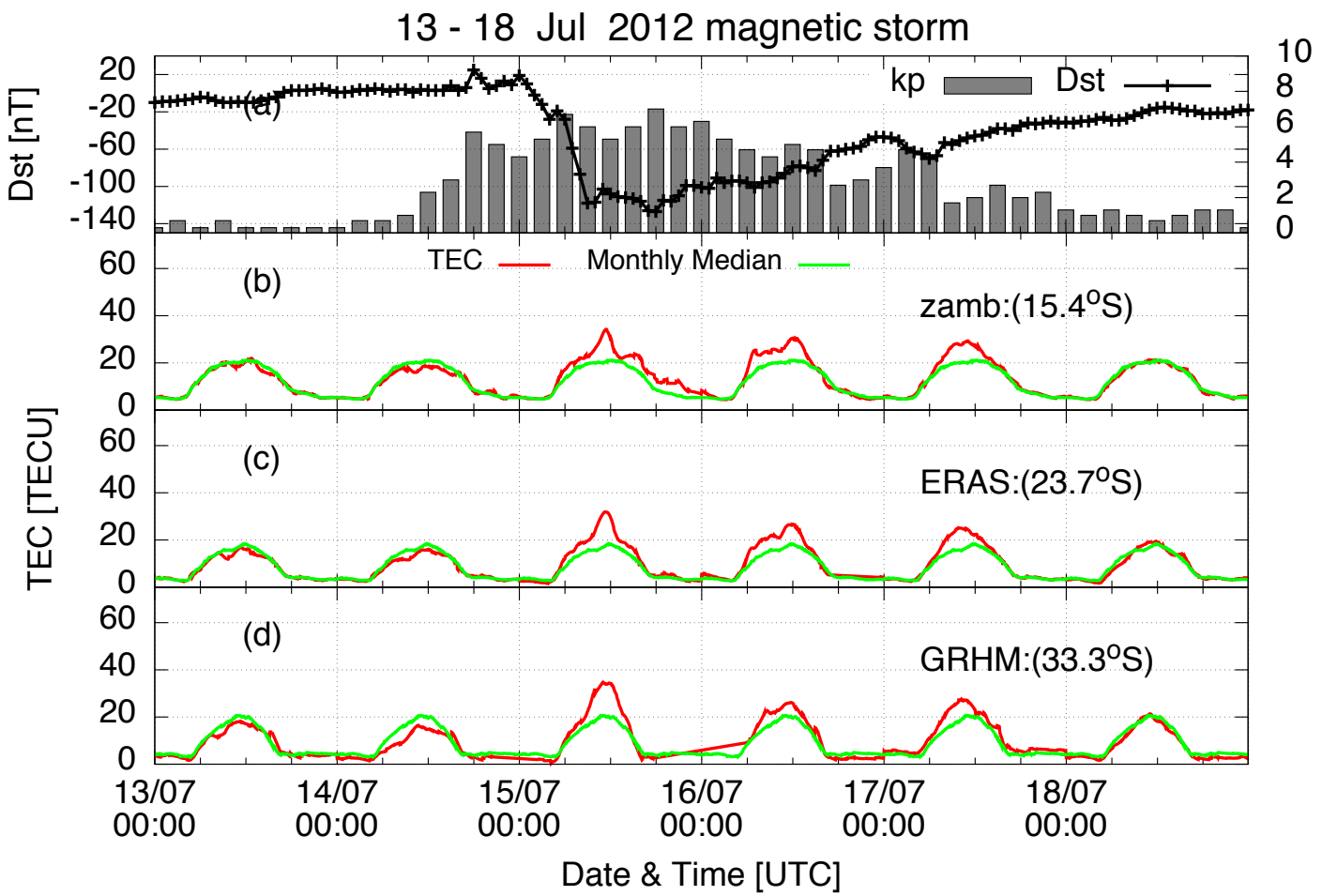
- should also be able to participate in studies of small-scale irregularities causing radio scintillation

2012 geomagnetic storms.....

Storm date & min Dst	
Date & Time	Dst
2012-03-09 08:00	-133
2012-04-24 04:00	-102
2012-07-15 18:00	-127
2012-10-01 03:00	-133
2012-10-09 08:00	-111
2012-11-14 07:00	-109

- 6 major storms in 2012

The quiet time TEC trend.....



- monthly median a fair representation of the quite time TEC
- can copter %ge deviations from this for disturbed periods

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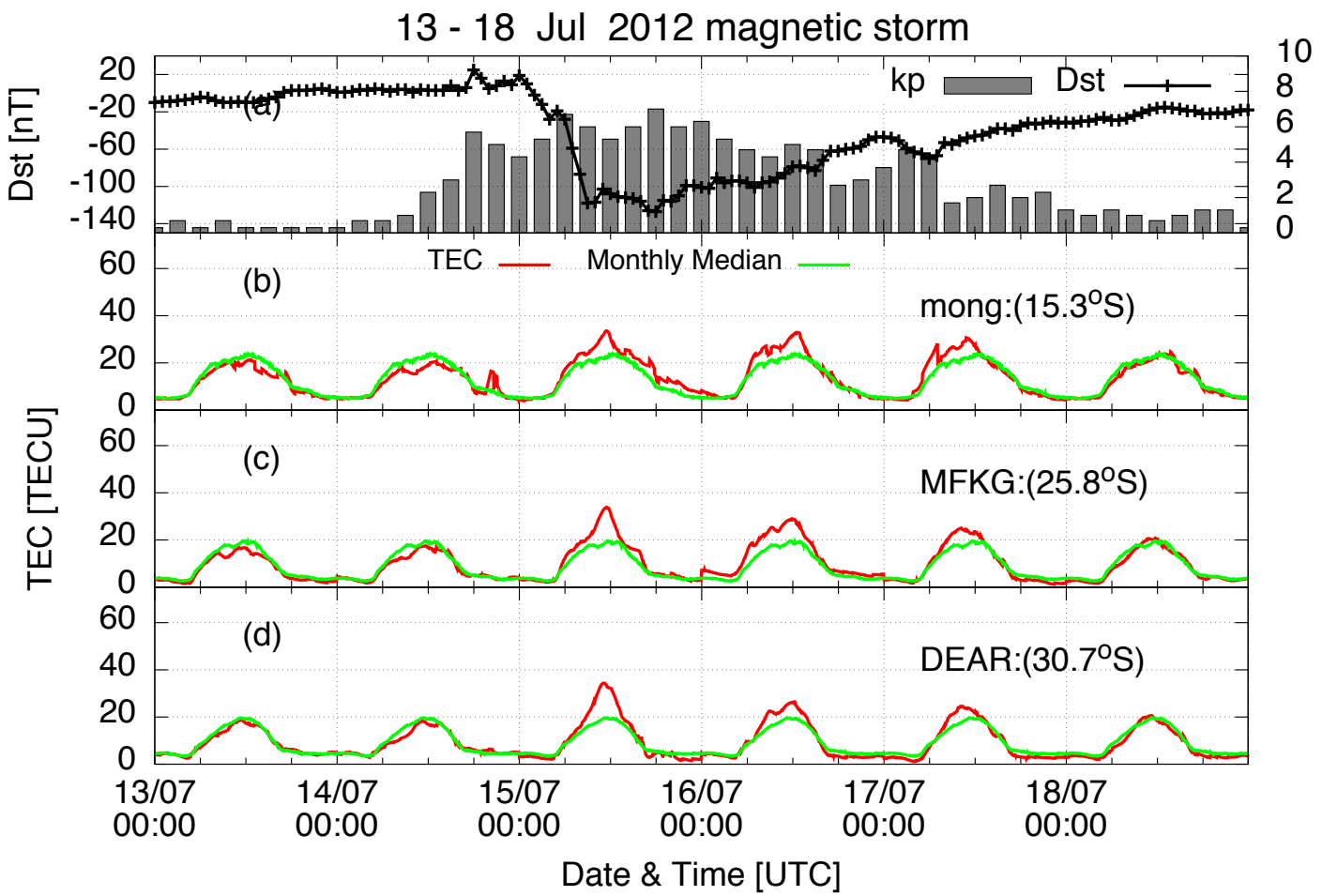

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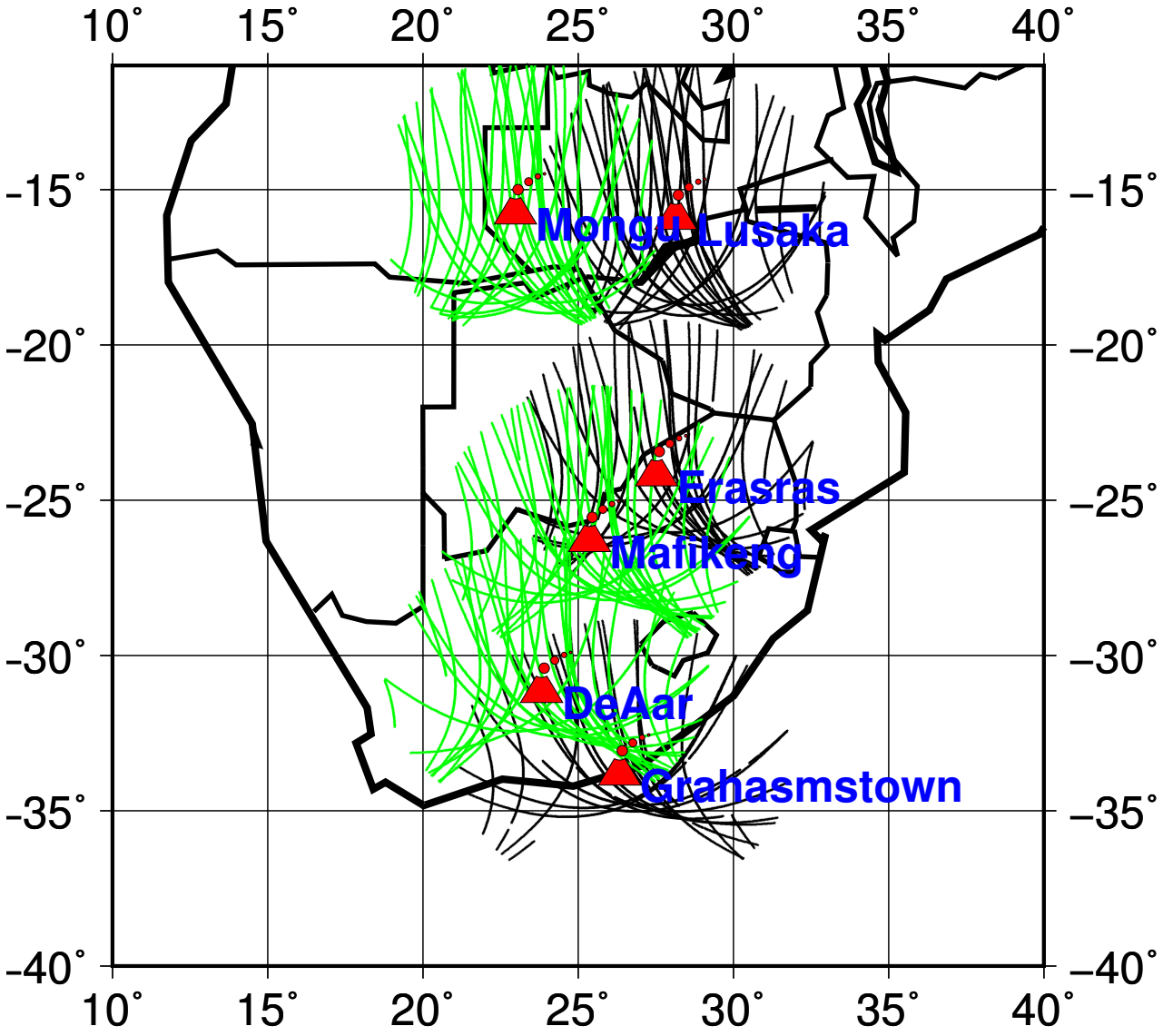
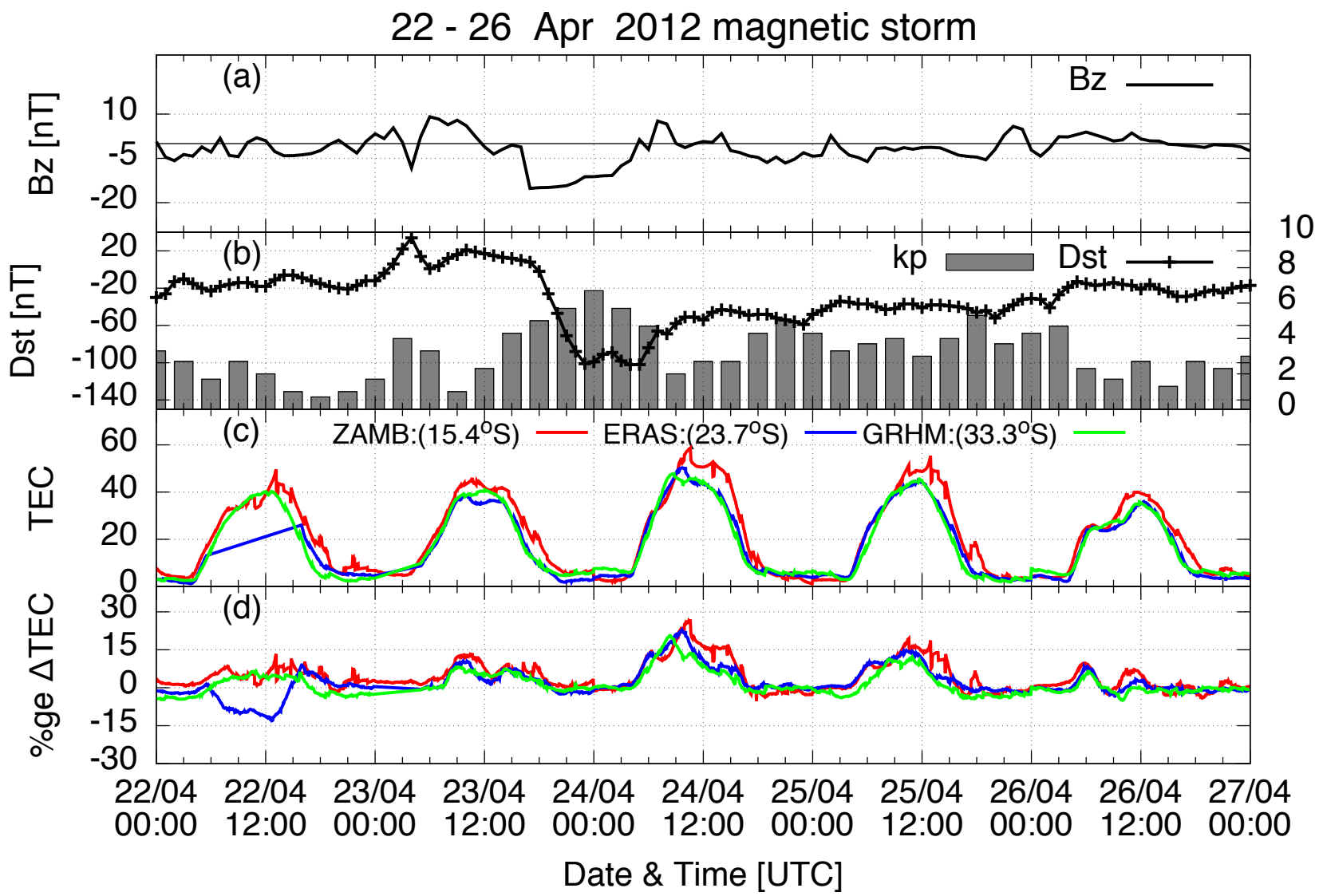
GPS arrays..


10°
15°
20°
25°
30°
35°
40°
-15°
-20°
-25°
-30°
-35°
-40°
Mongu
Lusaka
Erasras
Mafikeng
DeAar
Grahasmstown

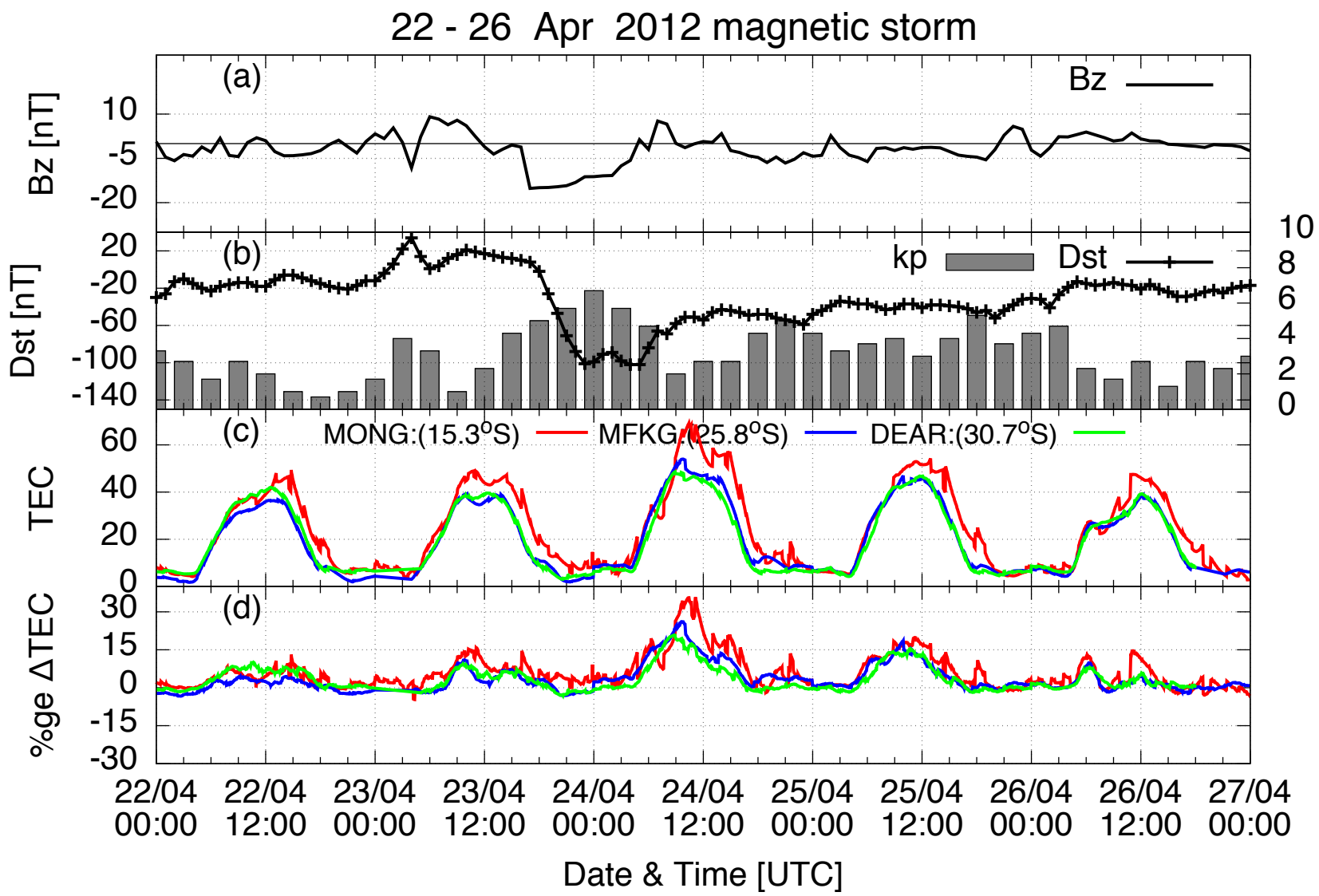
some features of the TEC perturbations .....

array along $\sim 28^{\circ}$ meridian



some features of the TEC perturbations .....

and along the $\sim 28^{\circ}$ meridian



ongoing work:- observations and comments ...

22 - 26 storm PRN 22 observations from the 3 stations

- The TIDs were detected as the wave-like structures with a period of 20-40 min at 1330-1800 UT on March 24, and 1400-1500 UT on March 25.

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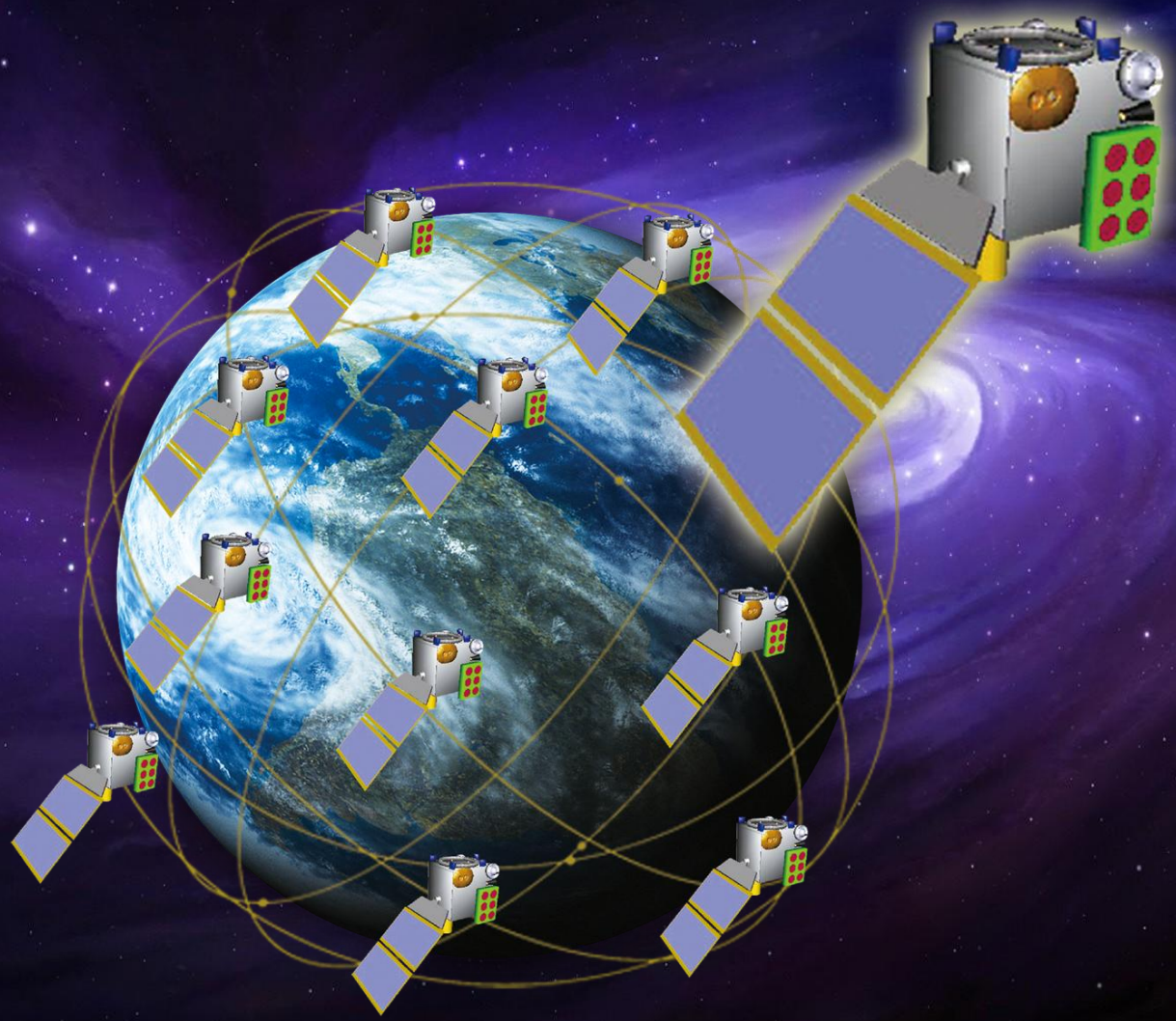
General observation and ongoing study...

each geomagnetic storm has its unique characteristics, the governing mechanisms are yet to be fully understood

Thank you



Thank you

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- LOC and for the support to attend this meeting
- National Science and Technology Council (NSTC), for the support of our work
- The University of Zambia (UNZA) - where this work is carried out