Integration of Magnetospheric, Ionospheric, an
Ground Station Data for Geomagnetic Storm
Case Study Event: 01 January 2025 over
Southern Europe

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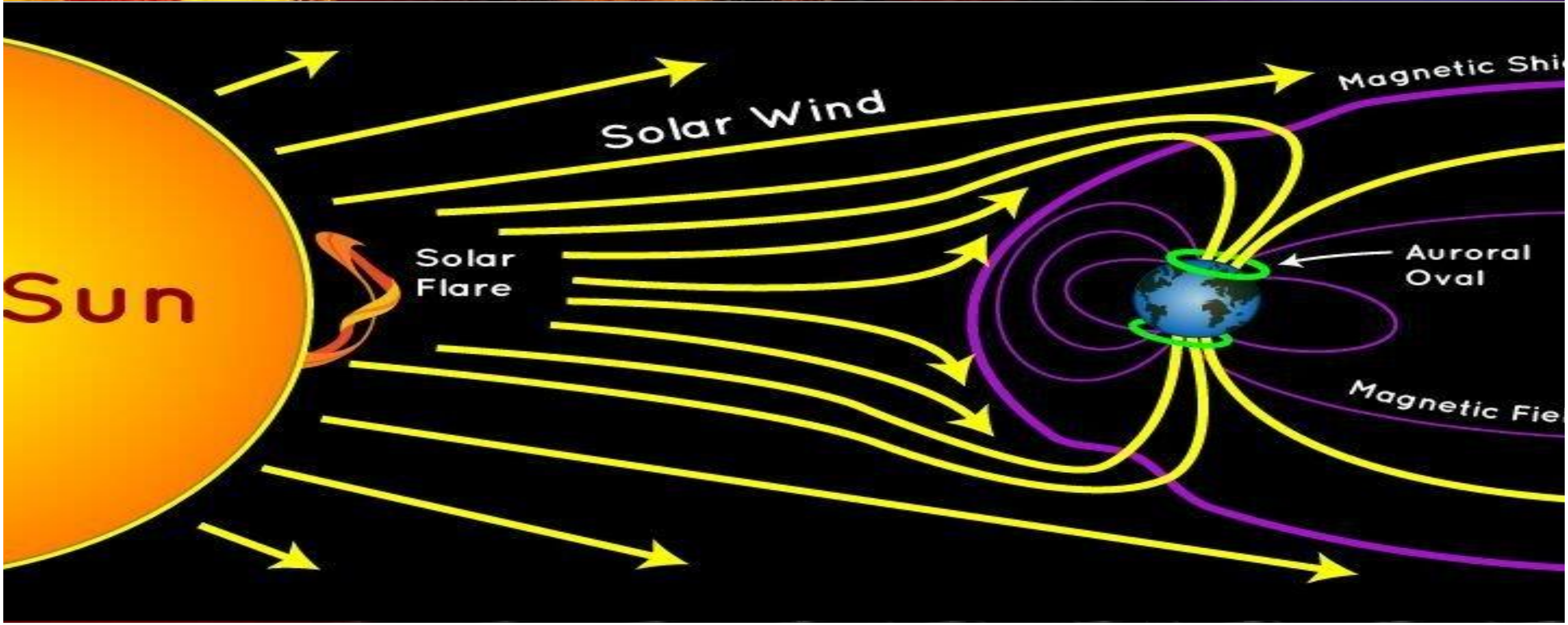
OUTLINE

- Introduction
- Objective
- Data and Method
- Results
- Conclusions

1. Introduction (1)

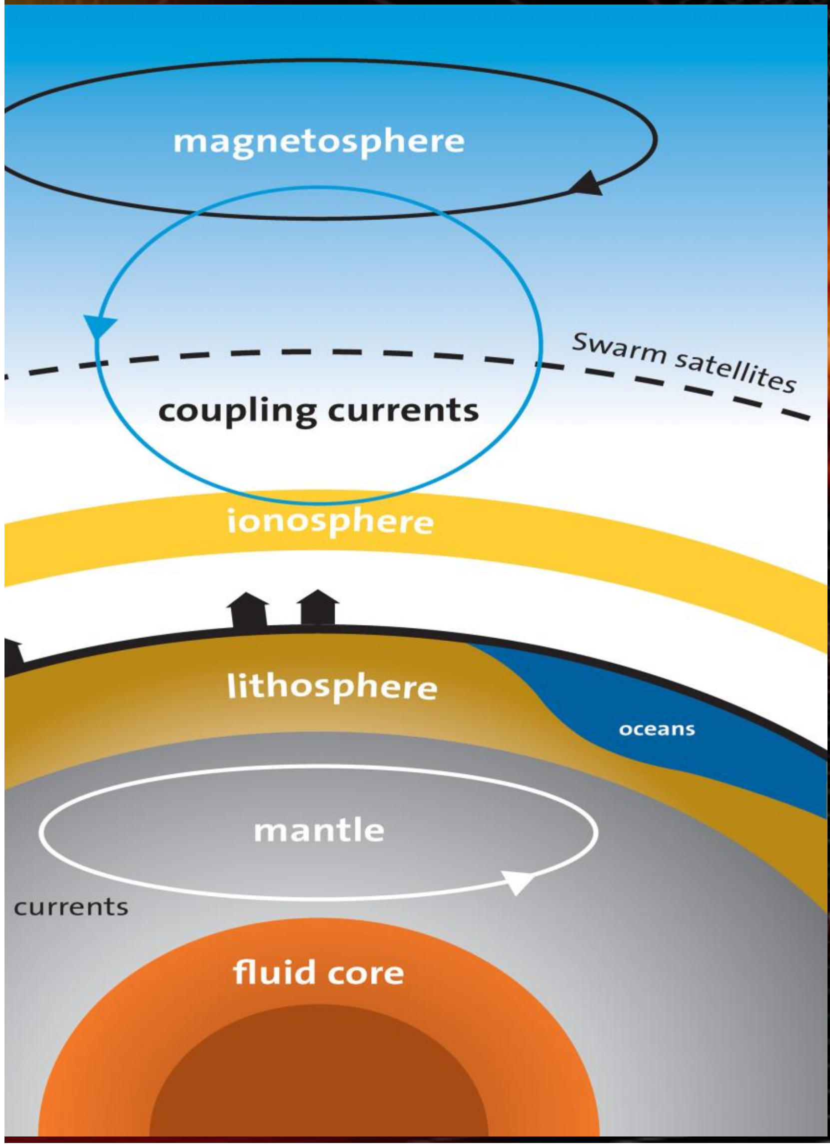
The Earth’s magnetic field is:

The magnetic field that extends from the Earth's interior to where it meets the solar wind from the Sun.



1. Introduction (2)

Sources of the Earth’s Geomagnetic Field



External Field — Electric currents in the ionosphere, particles ionized by solar radiation

Local Field — Variations caused by local magnetic anomalies in the Earth's crust

Main Field — 90% of the field is generated internally from the outer core

1. Introduction (3)

Cause Geomagnetic Storms

- Solar flares
- Coronal Mass Ejections (CMEs)
- High-speed solar wind streams
- Solar magnetic field changes
- Sunspots activity

1. Introduction (4)

A disturbance in the Earth's magnetic field is caused by enhanced solar wind interacting with the magnetosphere.

1. Introduction (5)

Geomagnetic Indices

Dst

sturbance Storm Time

red the intensity of the
symmetrical equatorial
et, the ring current from
ork of near-equatorial
agnetic observatories

(1 h)

azaki et al, (2015)

Kp and Ap

Planetary index

Measured the general level of geomagnetic activity over the globe for a given (UT) day.

(3 h)

Rangara jan et al, (1997)

SYM-H

Symmetric H-compone

Measured short-te
disturbances in Ear
magnetic field cause
solar activity

(1 min)

Wanliss and Showalter, (

1. Introduction (6)

y This Storm 01 January 2025?

one of the strongest and most well-documented events of So
le 25.

sed by a fast Earth-directed CME from 31 December 2024.

eached G3–G4 levels, with a strongly southward IMF Bz and s
d speeds over 600 km/s, producing significant disturbances in
magnetosphere, ionosphere, and ground magnetic field.

event's clear multi-domain signatures and availability of high
olution data make it ideal for studying solar wind–geospace
pling through integrated analysis.


2. Objective

2. Objective

To integrate datasets from

Magnetospheric (Solar wind parameter, SYM-H)

Ionospheric (TEC, hmF2, foF2)

Ground-based (magnetometers) observations.

o assess the impact of the storm on space-weather-
nsitive systems such as GNSS and communications.

3. Data and Method

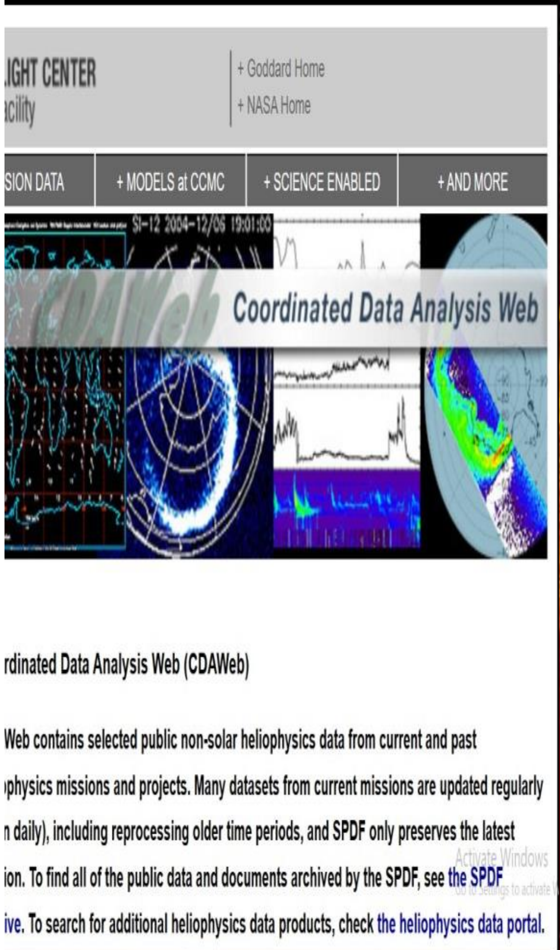
3. Data and Method (1)

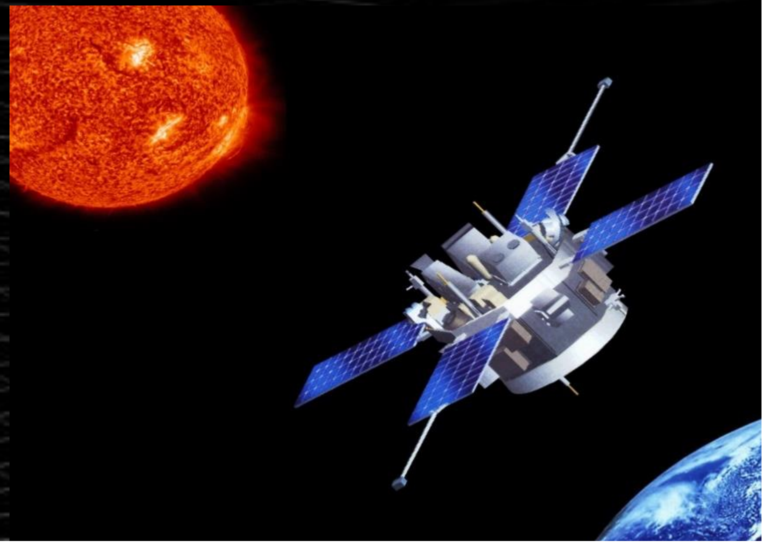
Sources of solar wind parameters measured

Advanced Composition Explorer (A

It is a NASA Explorer program satellite and space exploration mission to study matter comprising energetic particles from the solar wind, the interplanetary medium, and other sources.

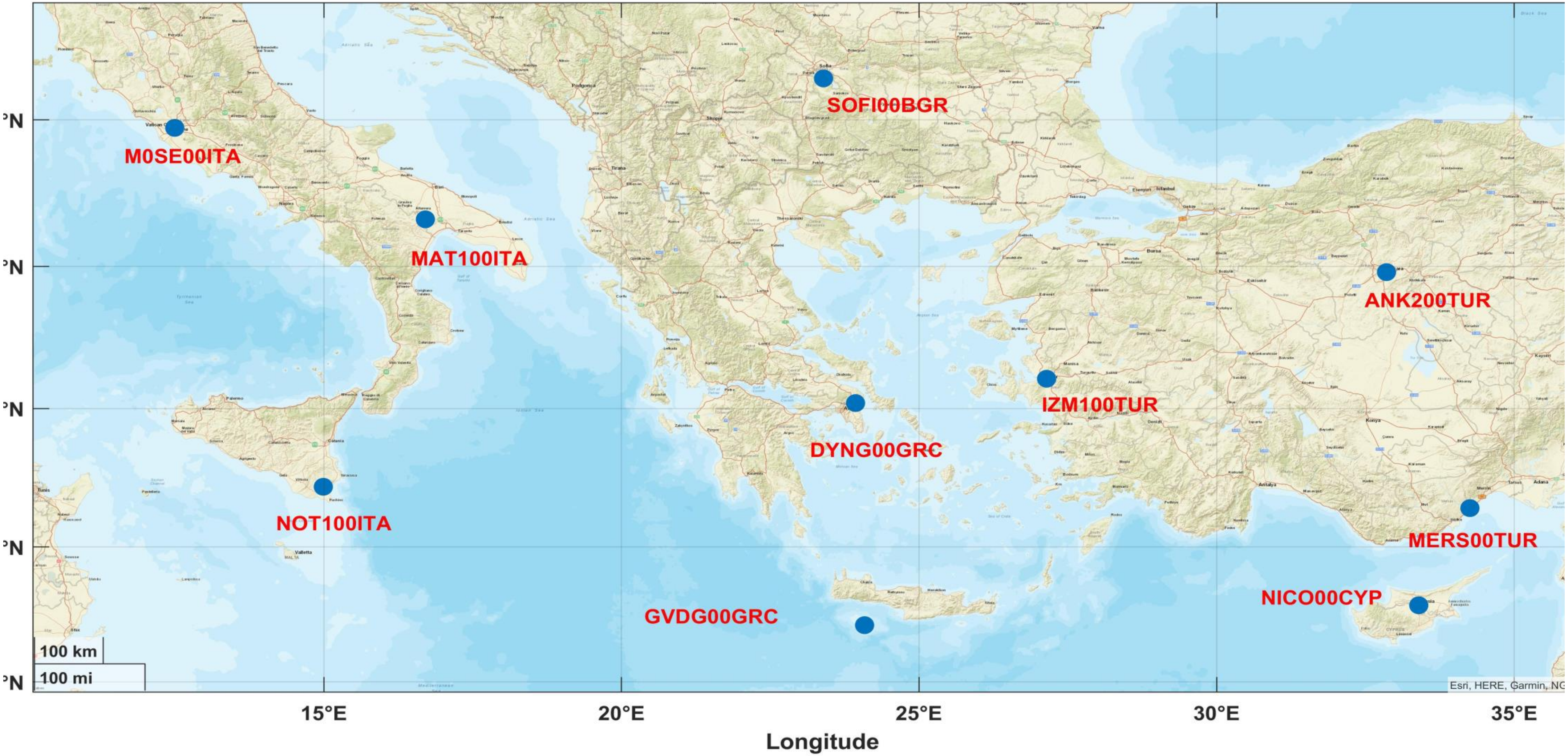
https://cdaweb.gsfc.nasa.gov/





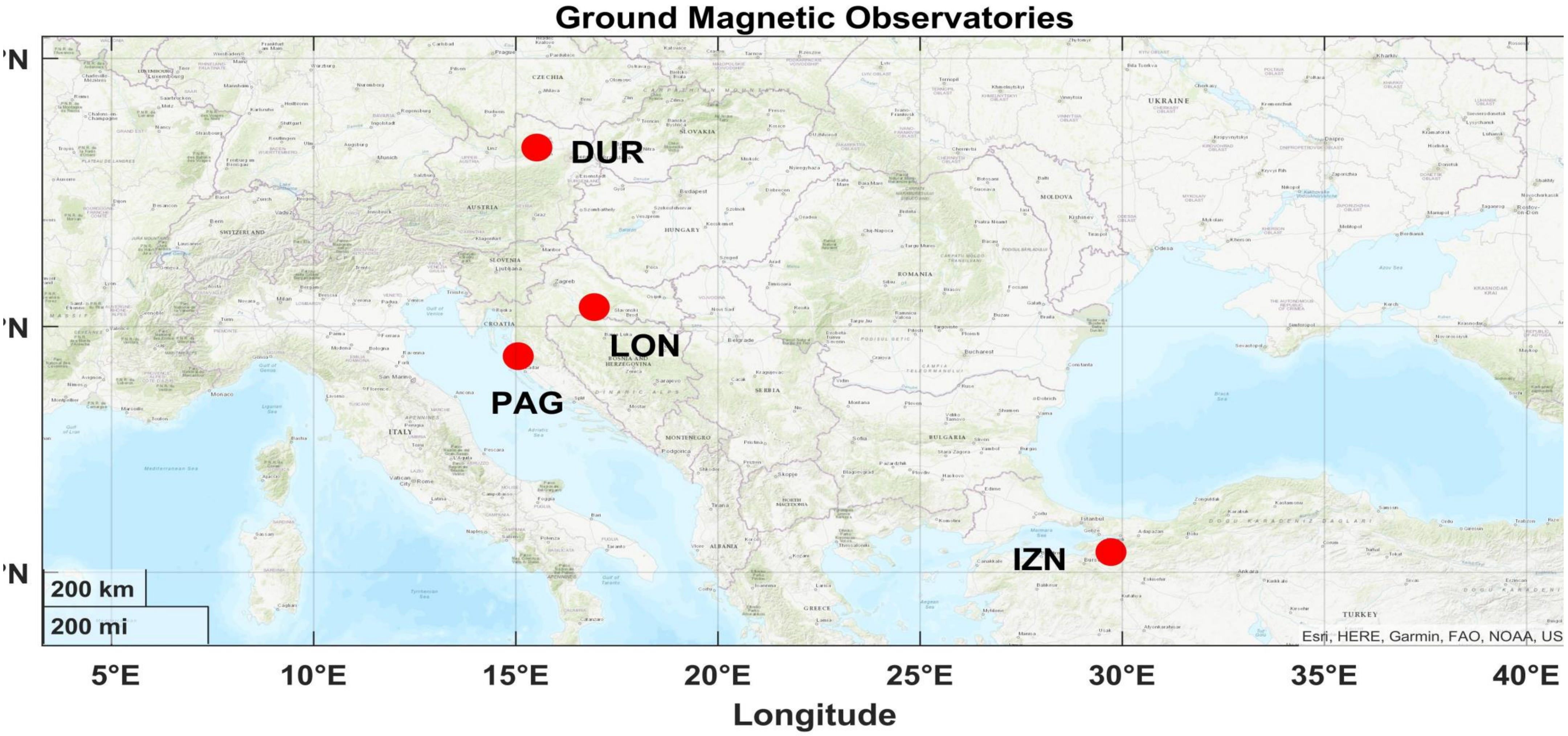
3. Data and Method (2)

Ionosphere



4. Results

Ground Magnetometer Networks



3. Data and Method (3)

IRI Model

NeQuick Model

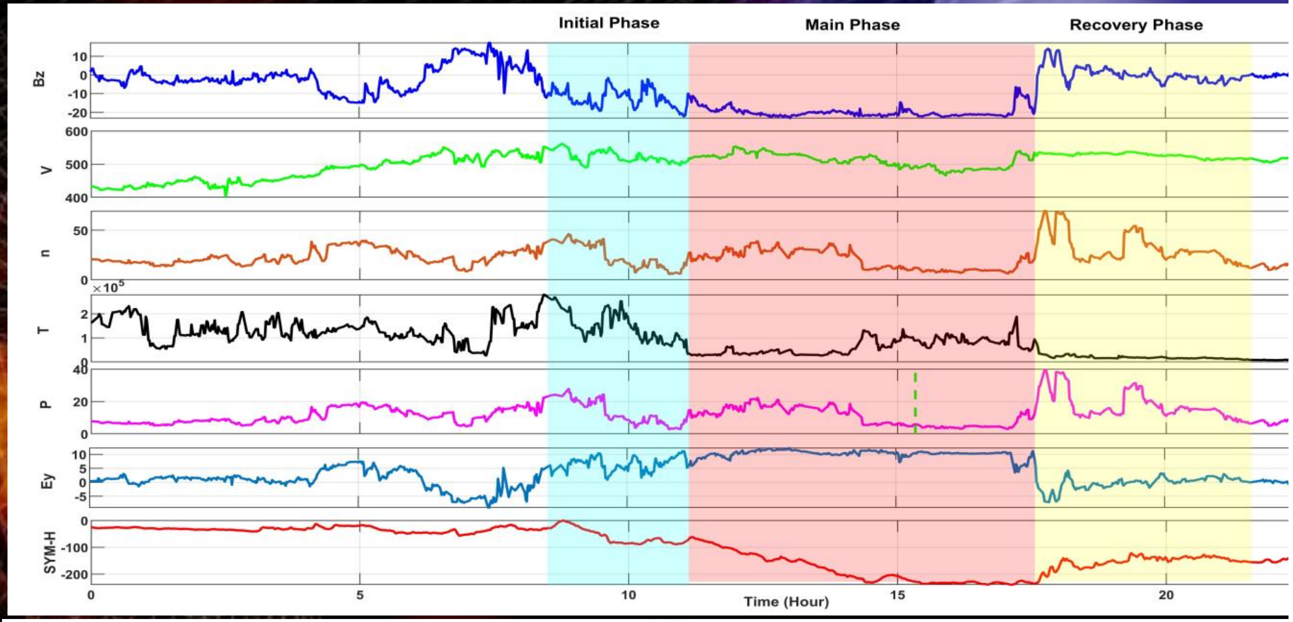
IONOLAB **(IRI PLAS) Mode**

GOPY Model

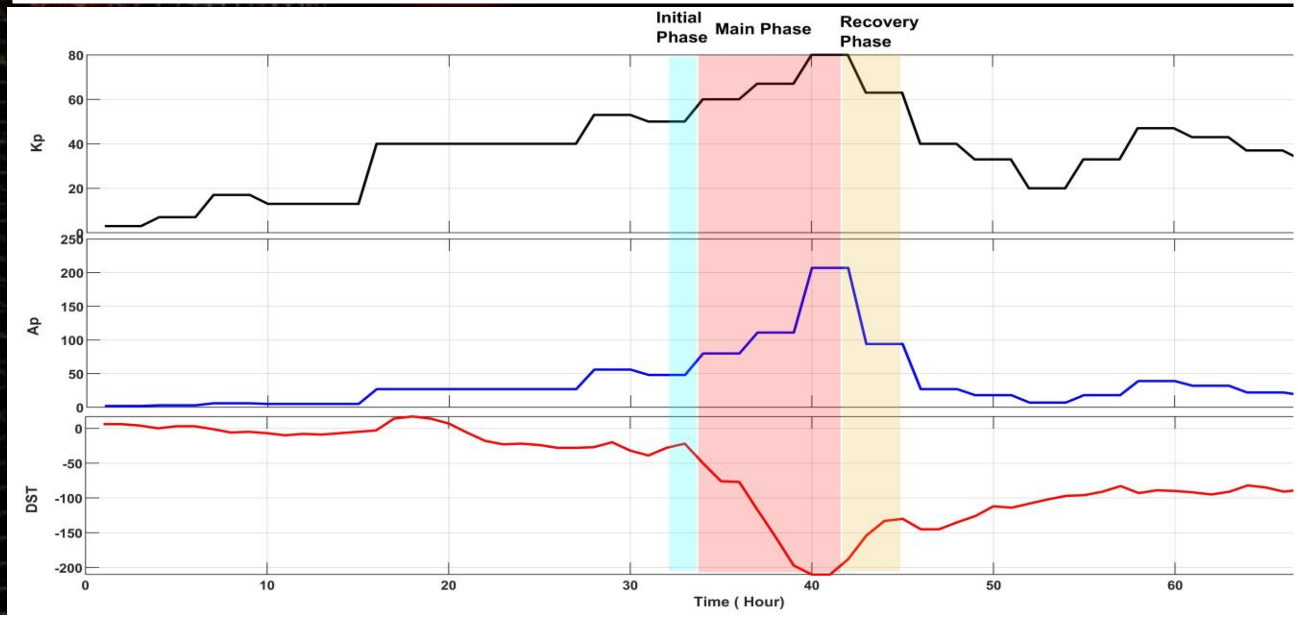
4. Results

Magnetospheric

ACE Satellite

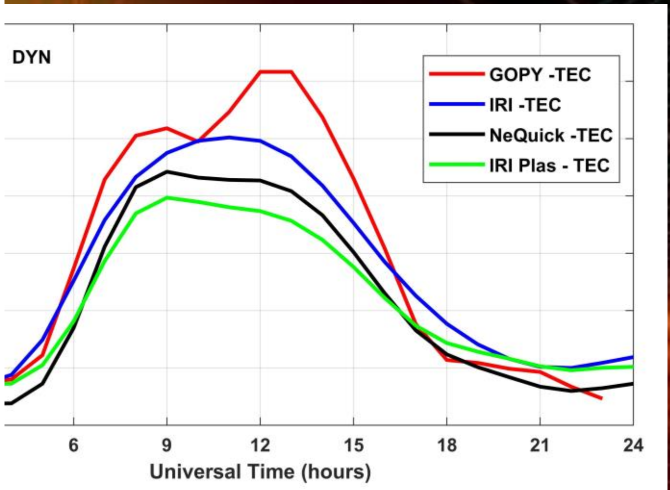


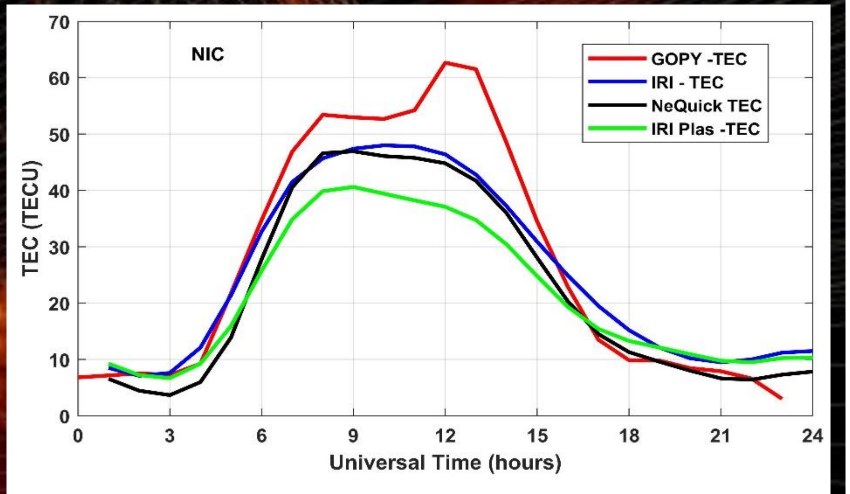
omagnetic Indices

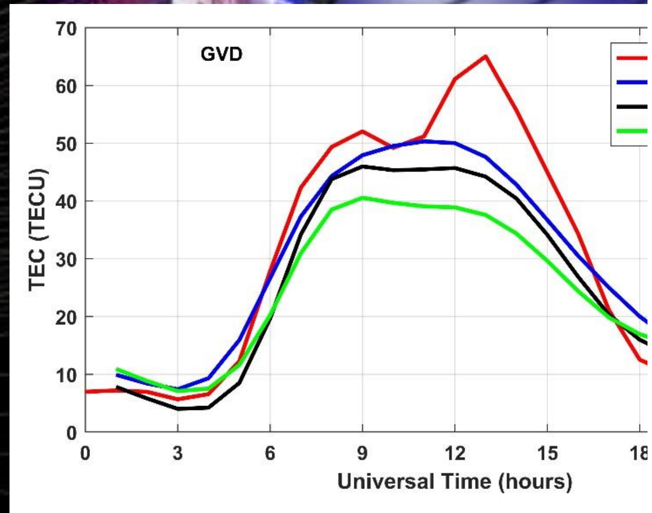


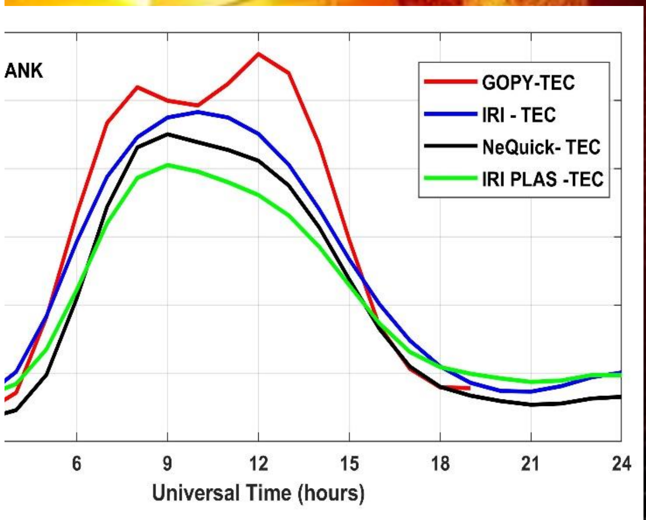
4. Results

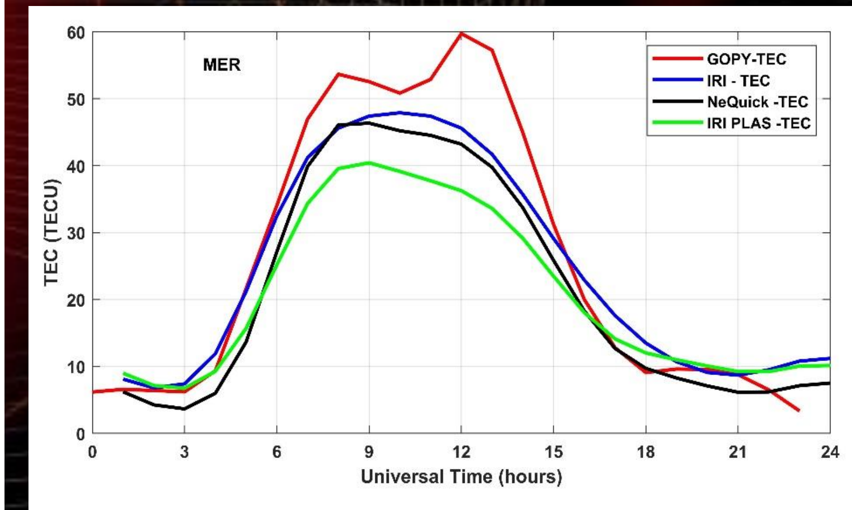
Ionosphere

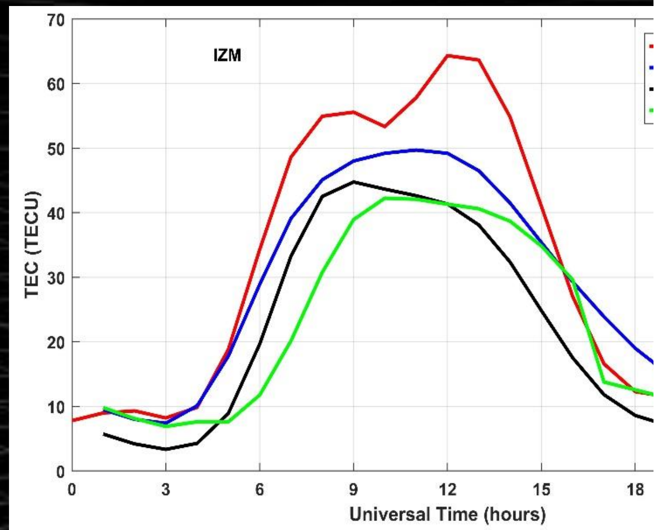




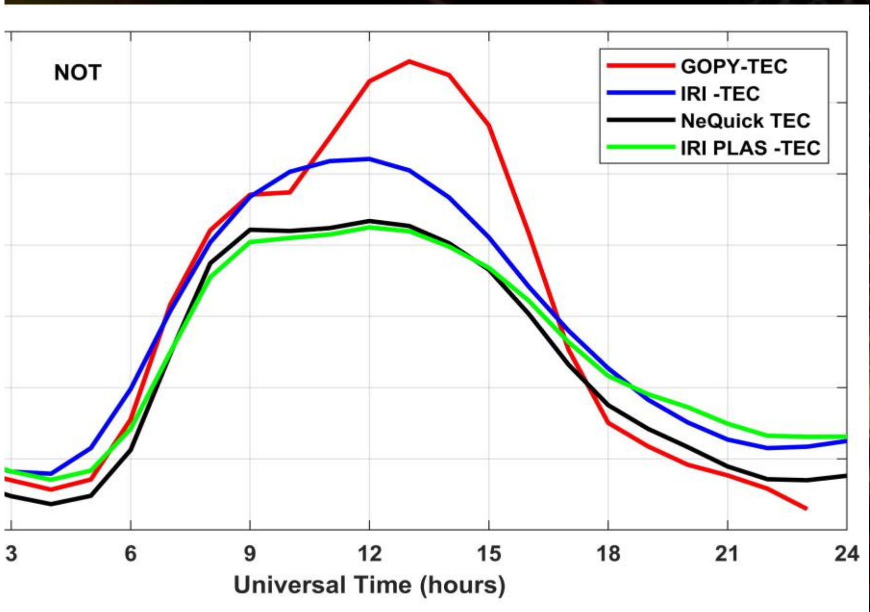


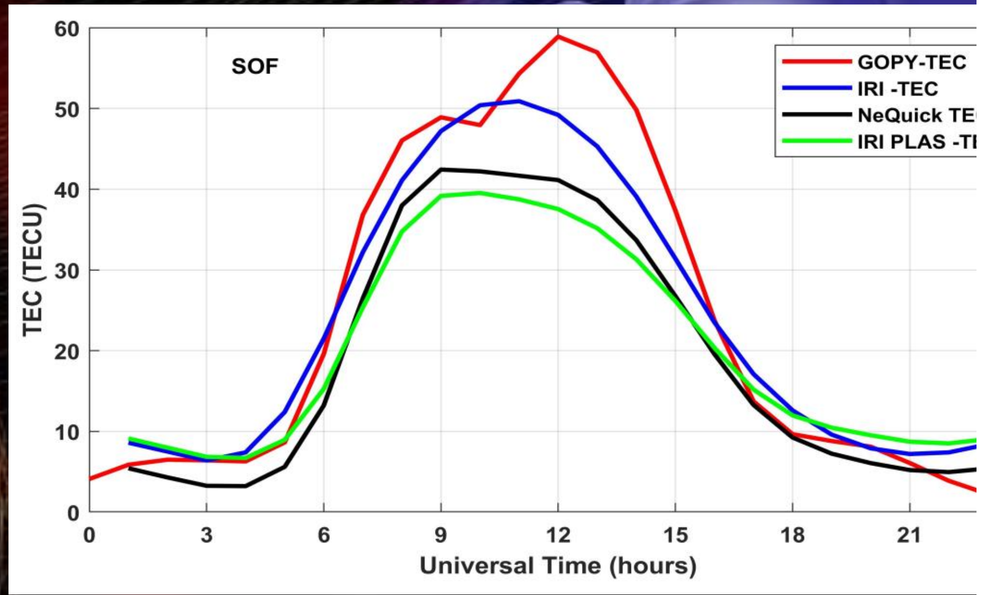






4. Results


NOT
GOPY-TEC
IRI -TEC
NeQuick TEC
IRI PLAS -TEC
3
6
9
12
15
18
21
24
Universal Time (hours)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GOPY-TEC
IRI -TEC
TEC (TECU)
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18
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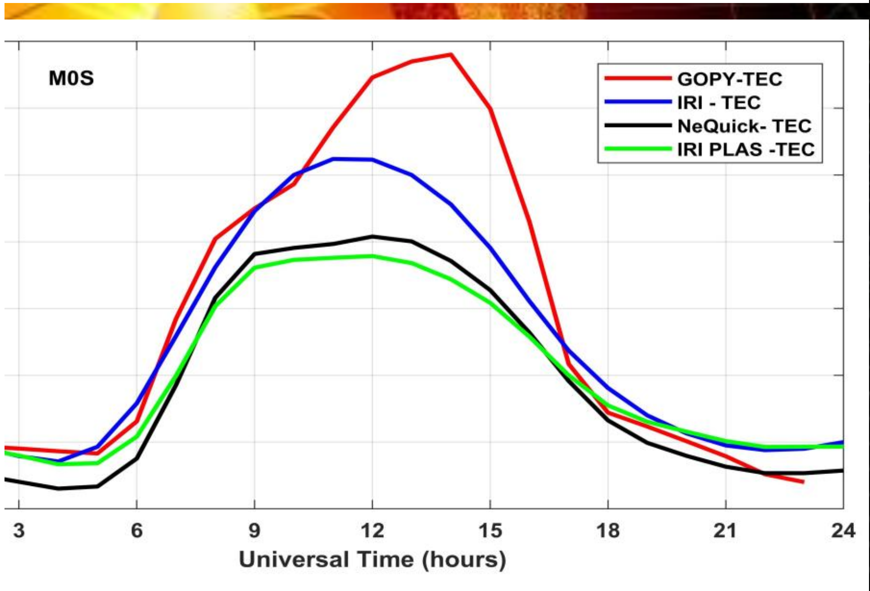
Universal Time (hours)


M0S
GOPY-TEC
IRI - TEC
NeQuick- TEC
IRI PLAS -TEC
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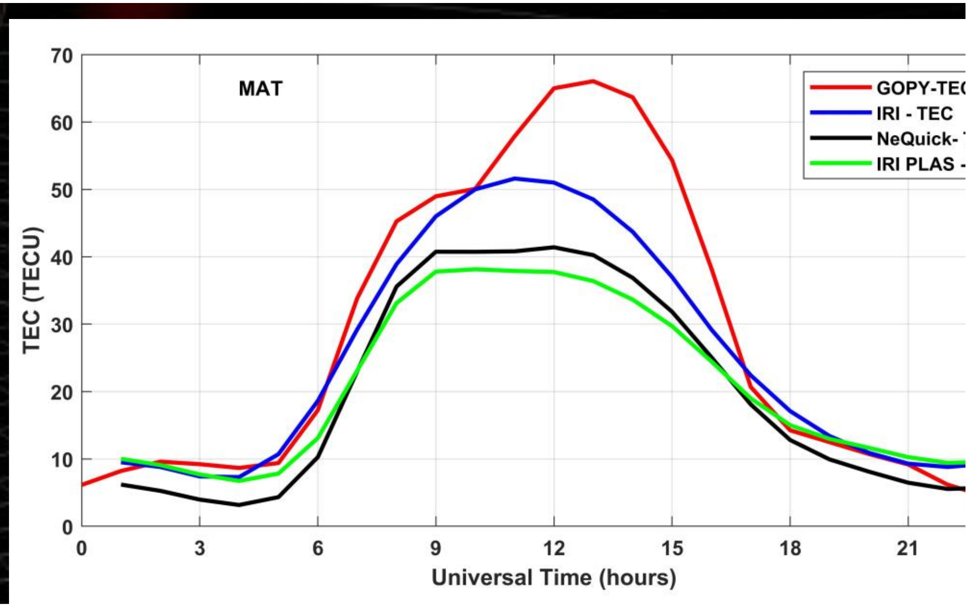
24
Universal Time (hours)


MAT
IRI - TEC
TEC (TECU)
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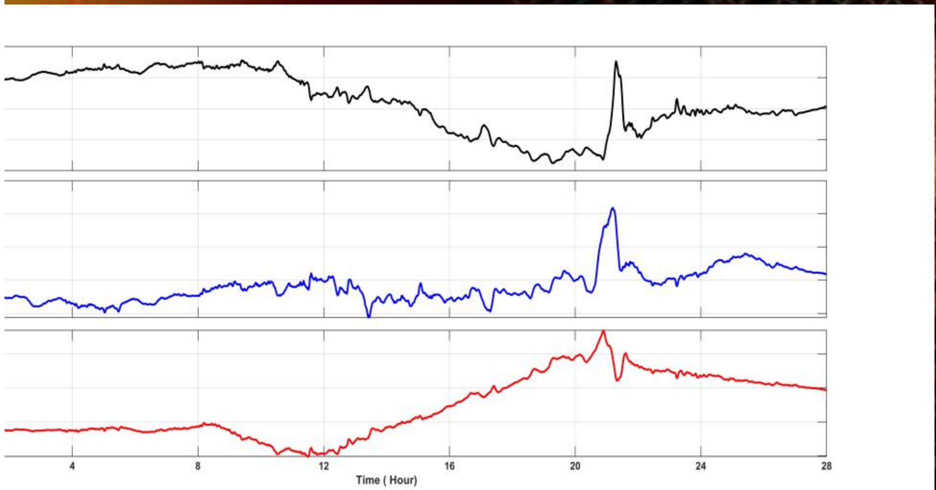
Universal Time (hours)

4. Results

Ground Magnetometer Networks

IZN



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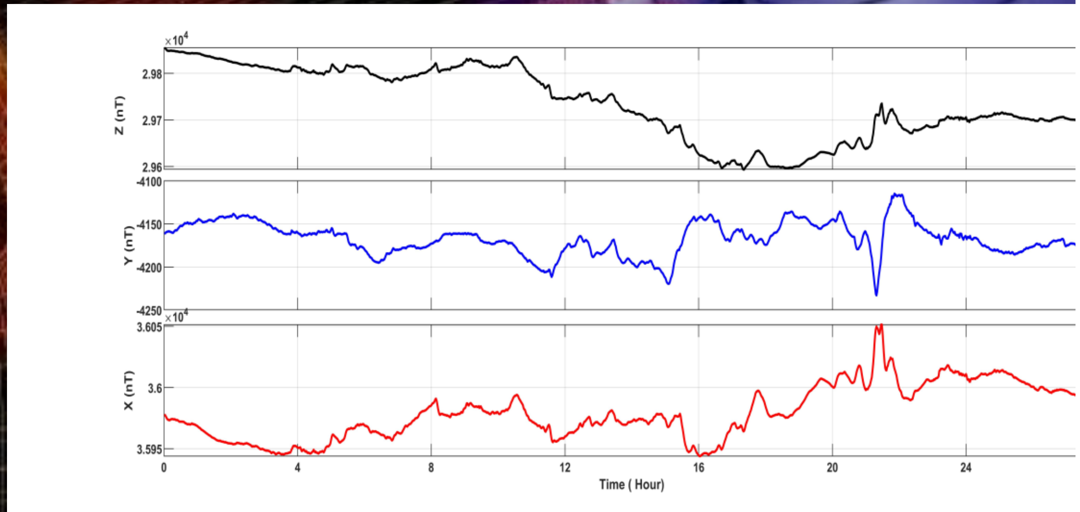
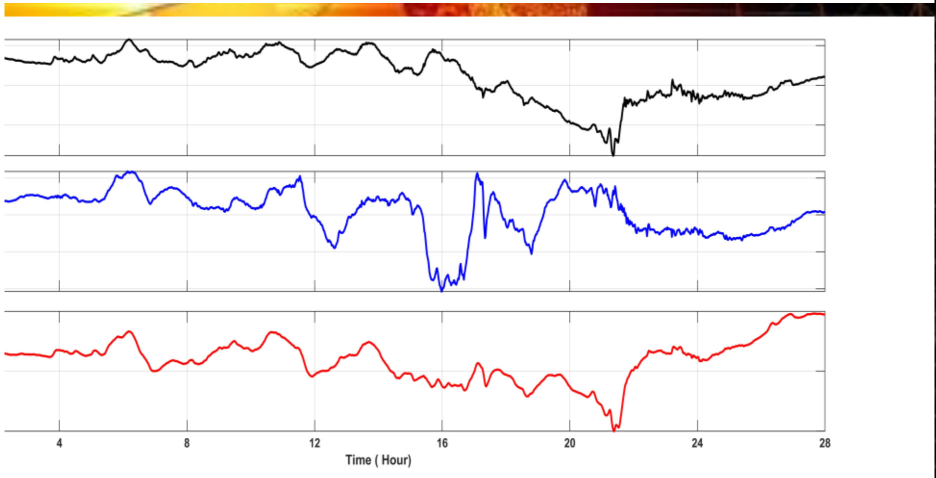
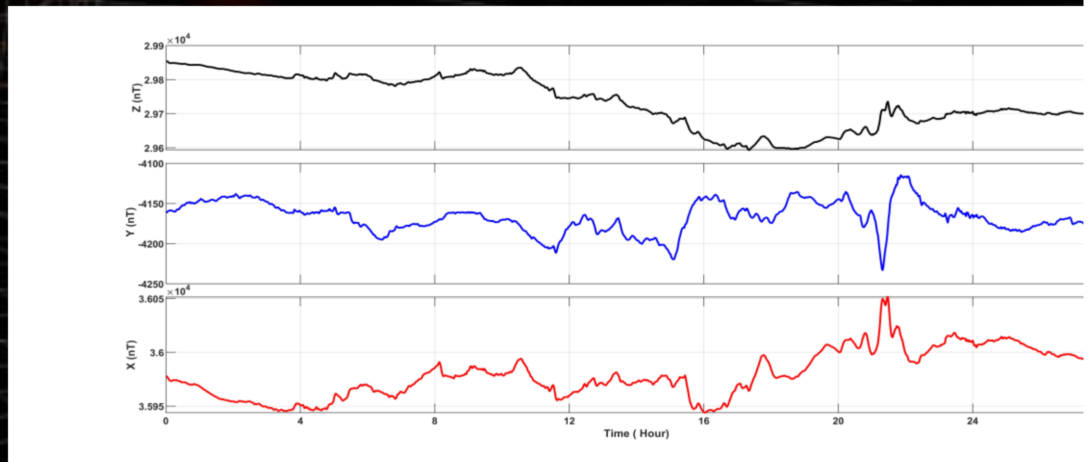




LON



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6. Conclusions

The integration of magnetospheric, ionospheric, ground-based observational datasets provides comprehensive framework to analyze space weat phenomena.

Future work: combining solar wind and IMF parame with ionospheric measurements like TEC, hmF2, and fo alongside ground magnetometer data, it becomes poss **to capture the multi-layered response of the geosp environment.**

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Thank You