

2nd UN/NASA WORKSHOP, Bangalore



A South Hemisphere magnetic variations improved coverage and South Atlantic Magnetic Anomaly (SAMA) monitoring by the installation of a small magnetometer network on the Brazilian territory

Fernandez, J. H., Raulin, J.-P., Correia, E., Brum, C. G. M., Trivedi, N. B., Dutra, S. L. G., da Costa, J. M., and Russell, C. T.

Brazilian Magnetometer Network



Groups:

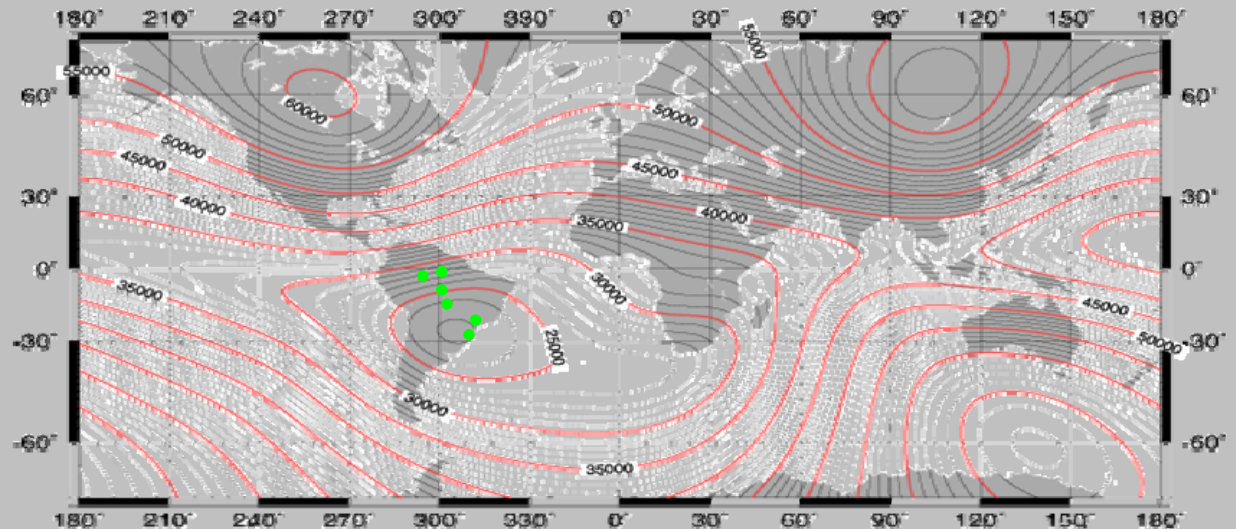
- GEOMA/INPE
- Geophysics/USP
- Geomagnetism/ON
- MagTerr/UNITAU
- CRAAM/Mackenzie
- UCLA – USA

Objectives:

- Monitoring SAGA region.
- Increase the South hemisphere coverage.
- Planetary geomagnetic indices.
- Equilibrium mechanism of Van Allen radiation belts.
- Magnetosphere/Atmosphere interaction.

Costs: US\$ 10k/mag.

Support of UNBSSI (2005/11/20-23 United Arab Emirates)



● MAGNETOMETERS

VLF receivers network



Groups:

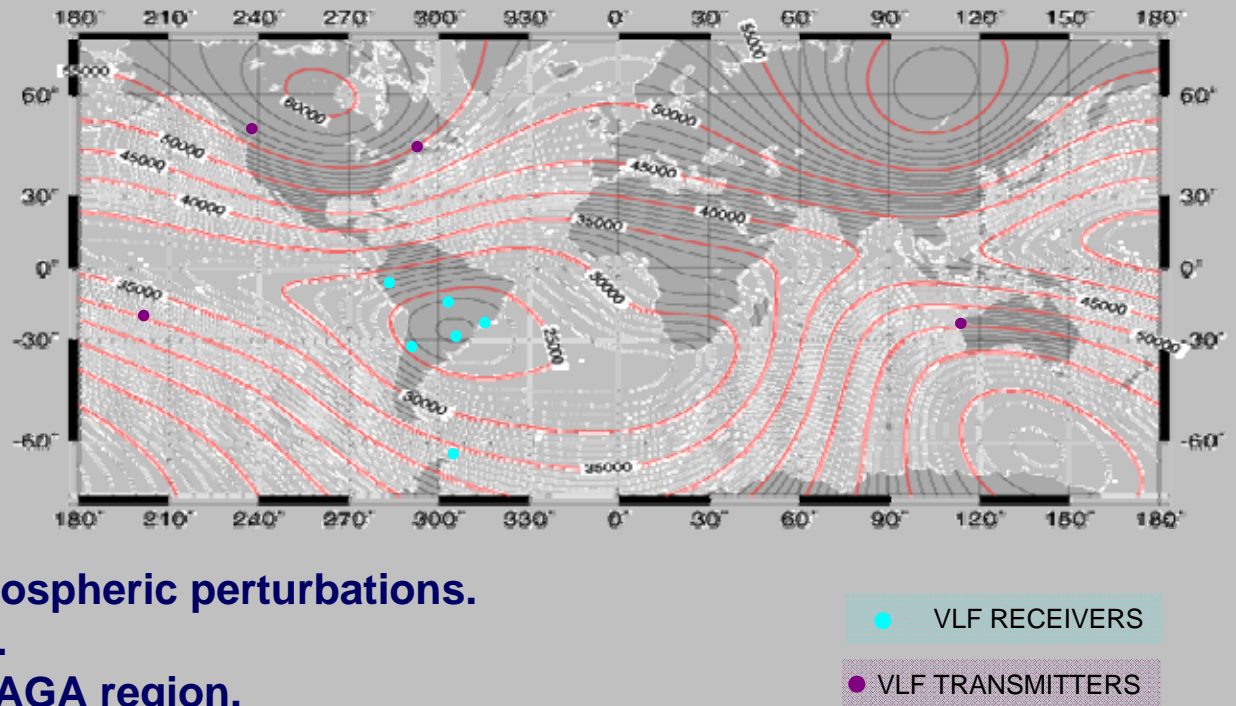
- CRAAM/Mackenzie
- UNITAU

Objectives:

- Monitoring SIDs.
- Solar and extra-solar ionospheric perturbations.
- Long trend solar activity.
- Low ionosphere in the SAGA region.
- Atmospheric studies.
- Radio propagation.

Costs: US\$ 5k/unit.

Support of UNBSSI (2005/11/20-23 United Arab Emirates)



Brazilian Magnetometer Network



Main Scientific Goals:

- *Improving in the South Hemisphere Magnetic Variations Monitoring*

One of the main bonus of the “International Years” has been to provide infrastructure to the continuity of the researches even after the thematic year

There is a lack in the South Hemisphere magnetic variations coverage

At the present moment, the Brazilian region, a very important region in terms of the magnetic variations measurement, is not well covered.

Brazil has a special position: the magnetic equator crosses our country and the South Atlantic Magnetic Anomaly is actually the South Brazil Magnetic Anomaly since it is centered today over the South Brazil region

Brazilian Magnetometer Network



- *Local and Continuous Monitoring of South Atlantic Magnetic Anomaly (SAMA)*

The Magnetic Anomaly is the region where there is a natural loss of particles from the geospace to the Earth atmosphere

There are a lot of different magnetic indices. Some of them indirectly related to the particle precipitation at the SAMA

But with the implementation of a permanent magnetic observatories network in the SAMA region we can establish a continuous monitoring (that could generate a kind of a SAMA precipitation activity index very important to measure the equilibrium (particle population) of the radiation belts (geospace conditions)).

Brazilian Magnetometer Network



- *Magnetosphere/Atmosphere Interaction*

Particle precipitation (from the magnetosphere) affects the Earth atmosphere. It could create a bulge (in plasma density) in the lower ionosphere that affects the VLF subionospheric propagating waves

The typical signature of that disturbance in the phase or amplitude of the propagating wave is known as Trimp event.

Measuring the Trimp event occurrence we can try to establish the patterns of the magnetosphere/atmosphere interaction

Brazilian Magnetometer Network



- *Equilibrium Mechanisms of the Van Allen Radiation Belts
(Trimpi events versus Geomagnetic Activity)*

And also measuring the Trimpi events occurrence rate and associating it with the geomagnetic activity we can establish the role of the Trimpi event in the electron loss rate in the radiation belts
(not computed in the present models such as the AE-8)

Brazilian Magnetometer Network



The establishment of the Brazilian Magnetometer Network also will help the ionospheric researches in that particular region.

A lot of different phenomena occurs in the Brazilian ionosphere (Equatorial Electrojet, plasma bubbles, GPS and satellites anomalies due to the SAMA, etc) all of that linked to the geomagnetic field.

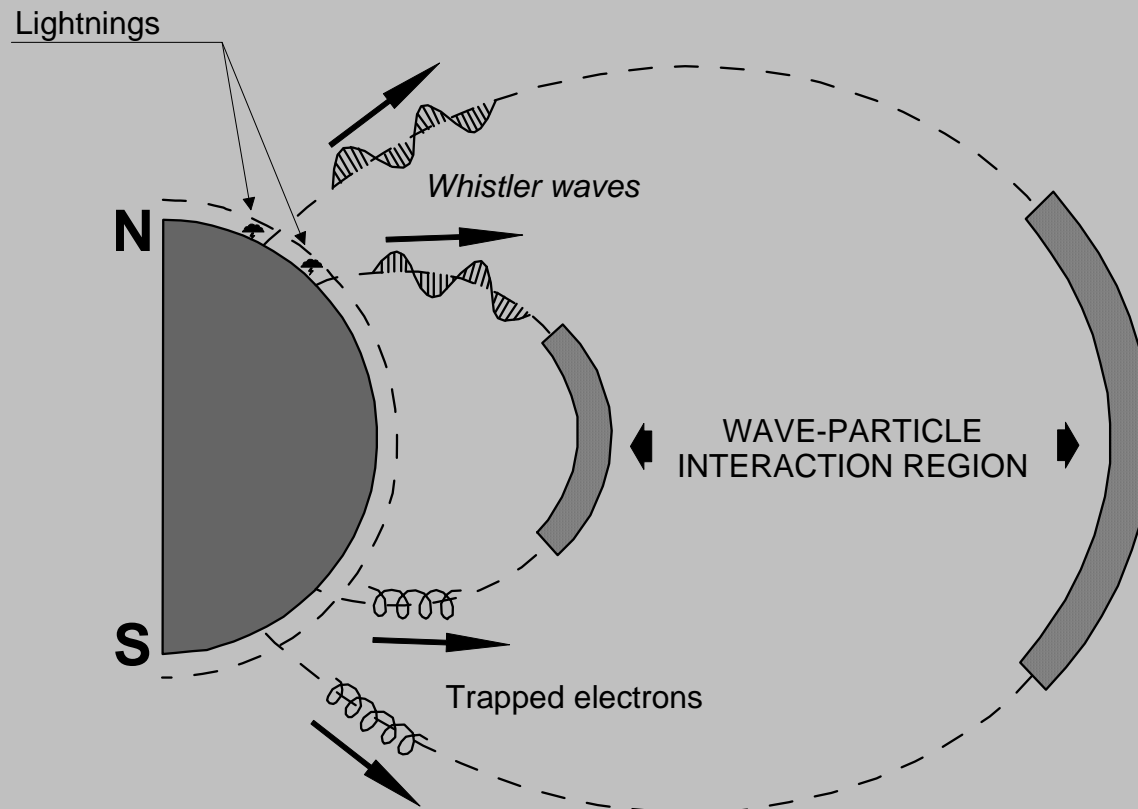
And a better understanding of the geomagnetic variations will be very useful

What is the TRIMPI EVENT ?

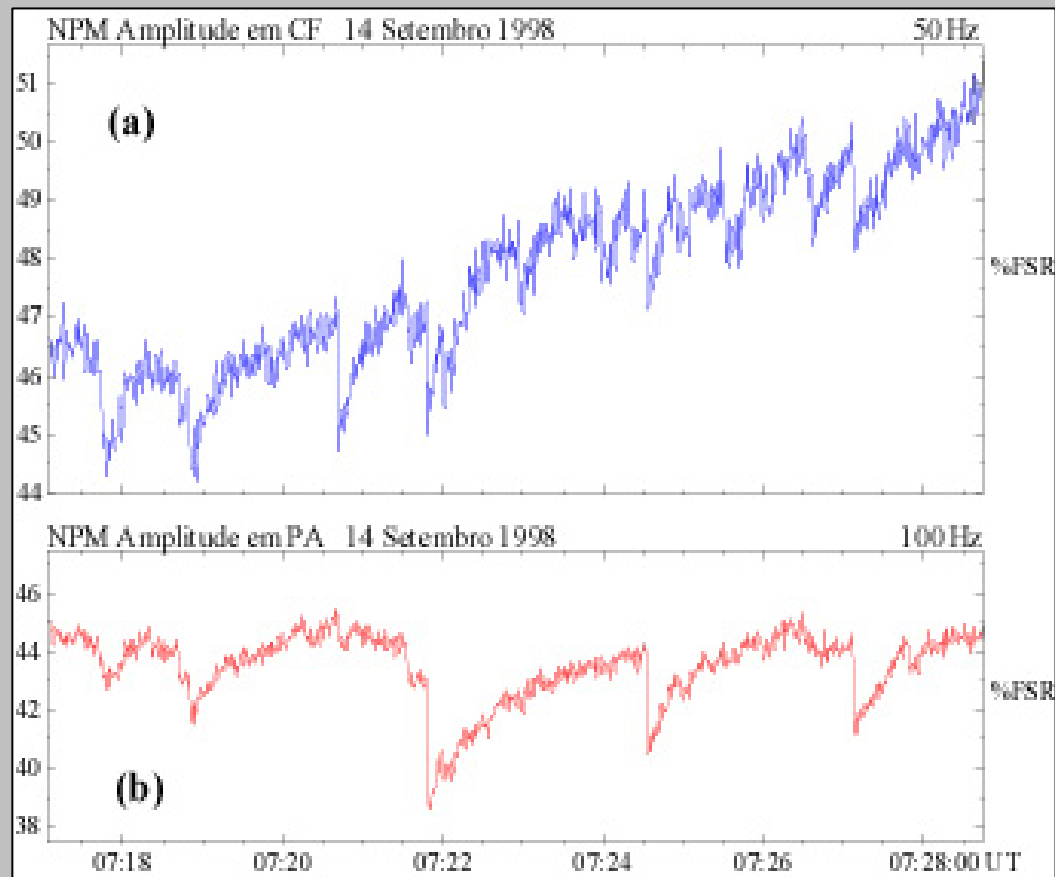


- Trimpi event is defined like an amplitude and/or phase disturbance on VLF propagating (Earth-ionosphere wave guide) signals due to Lightning-induced Electron Precipitation (LEP) from the Van Allen's radiation belts (CLASSICAL EVENTS)
- Also there are other classes of Trimpi events like the so-called Early-Fast events (associated white sprites, elfos and jets).

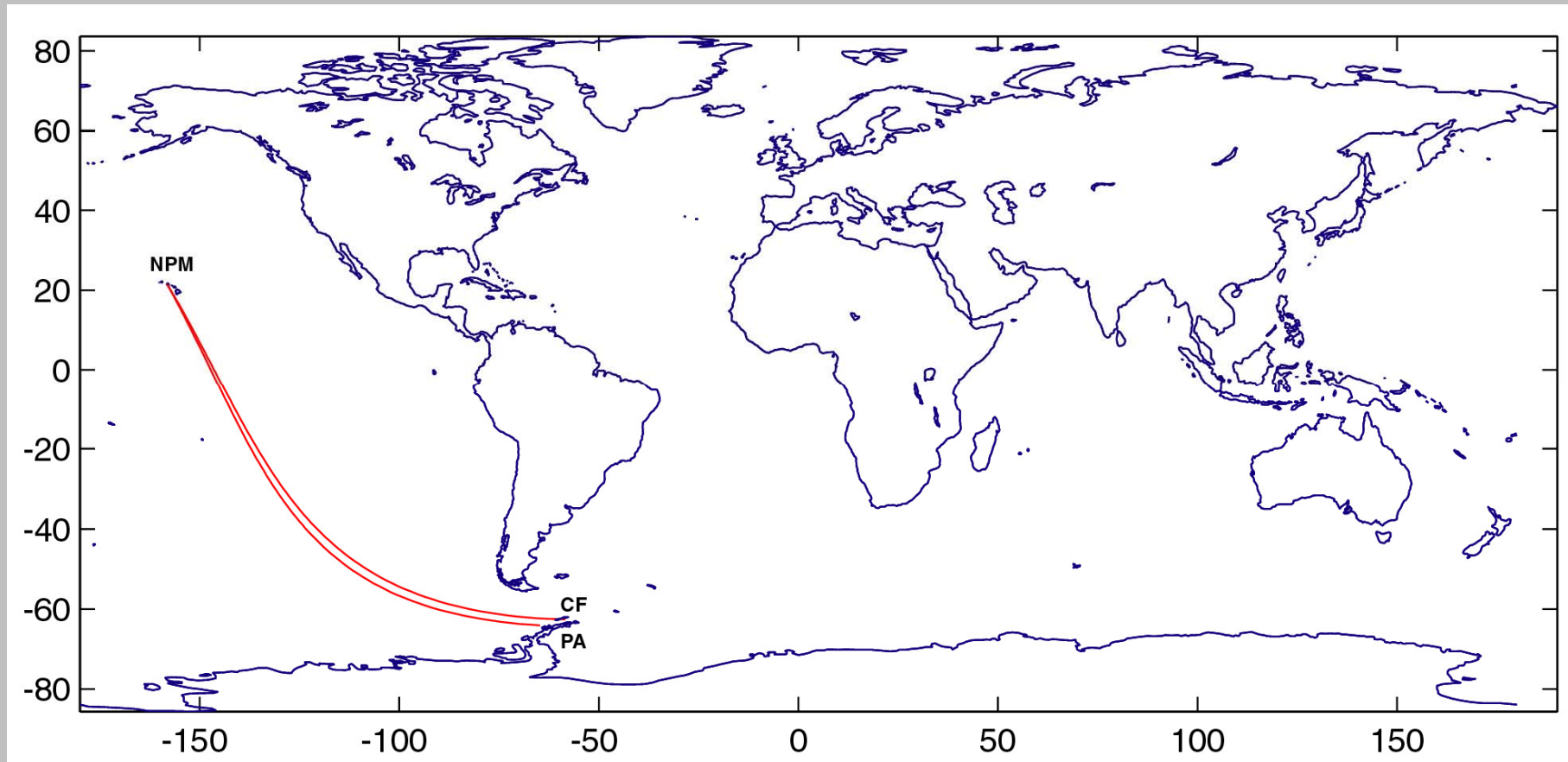
Event Stage



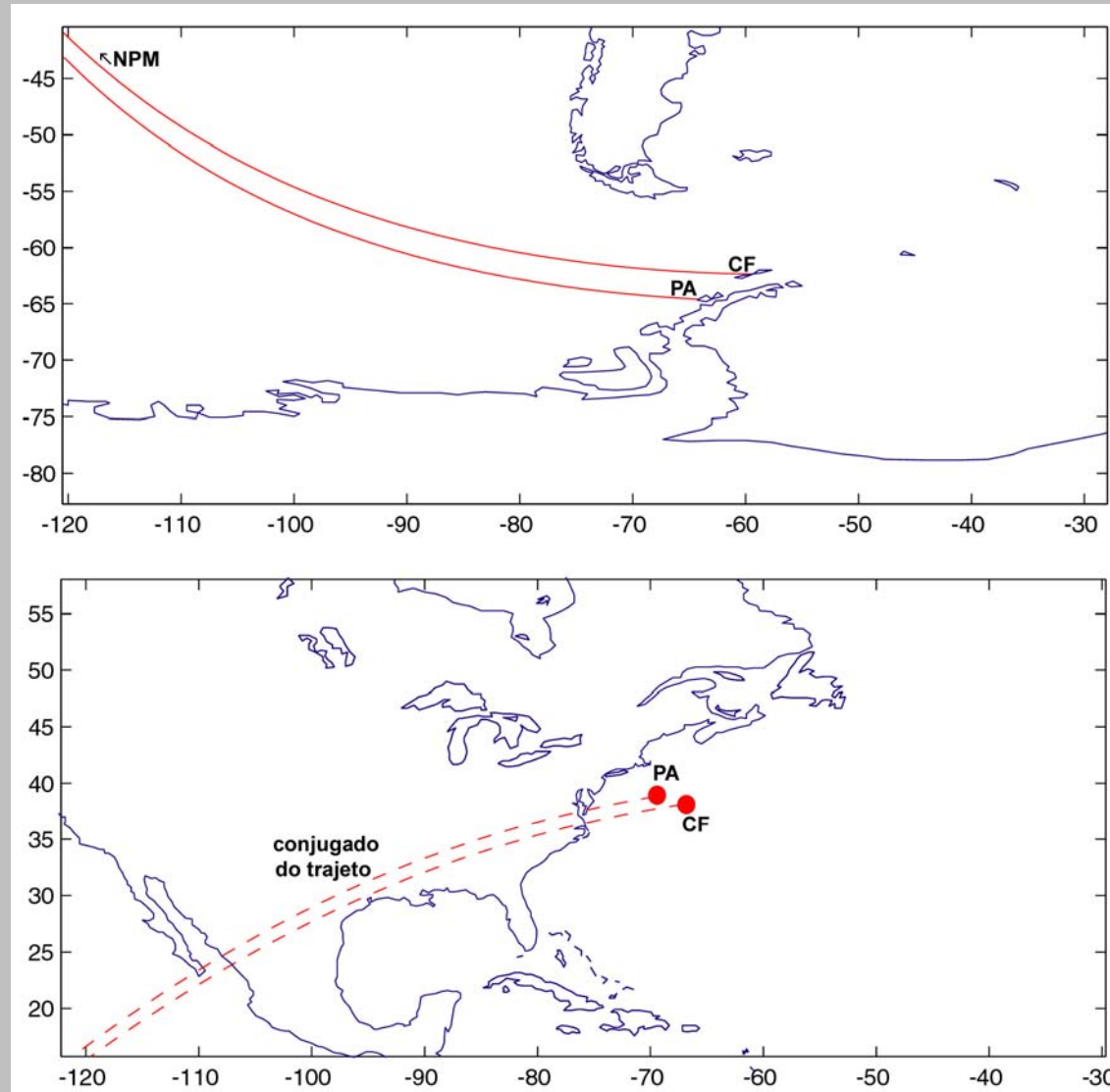
Event Signature



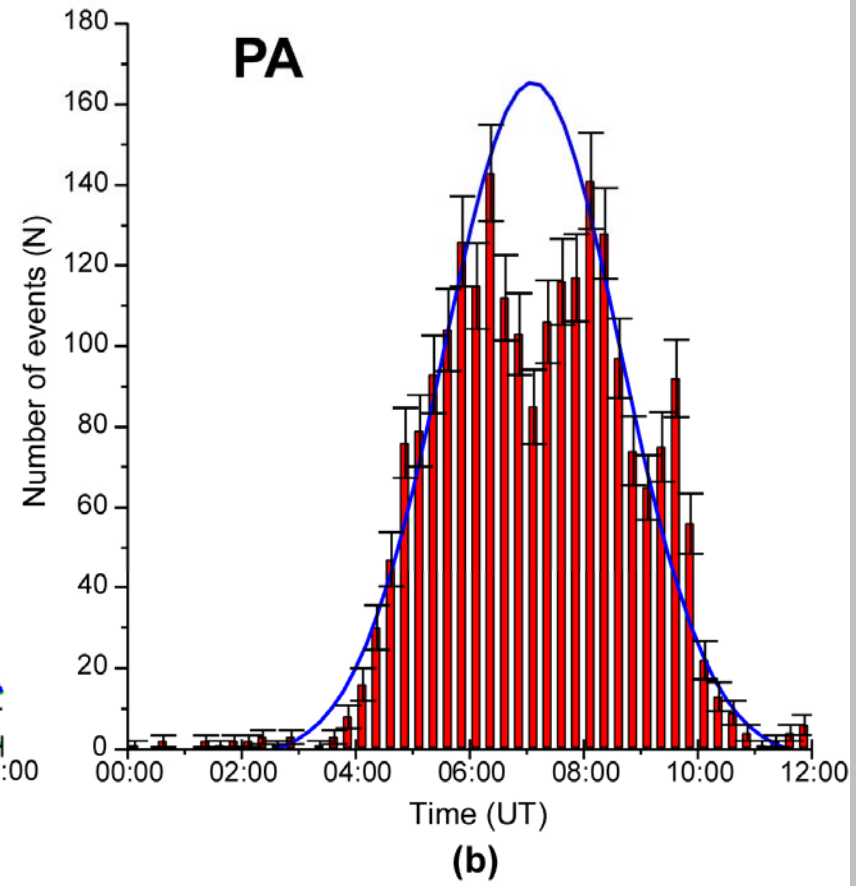
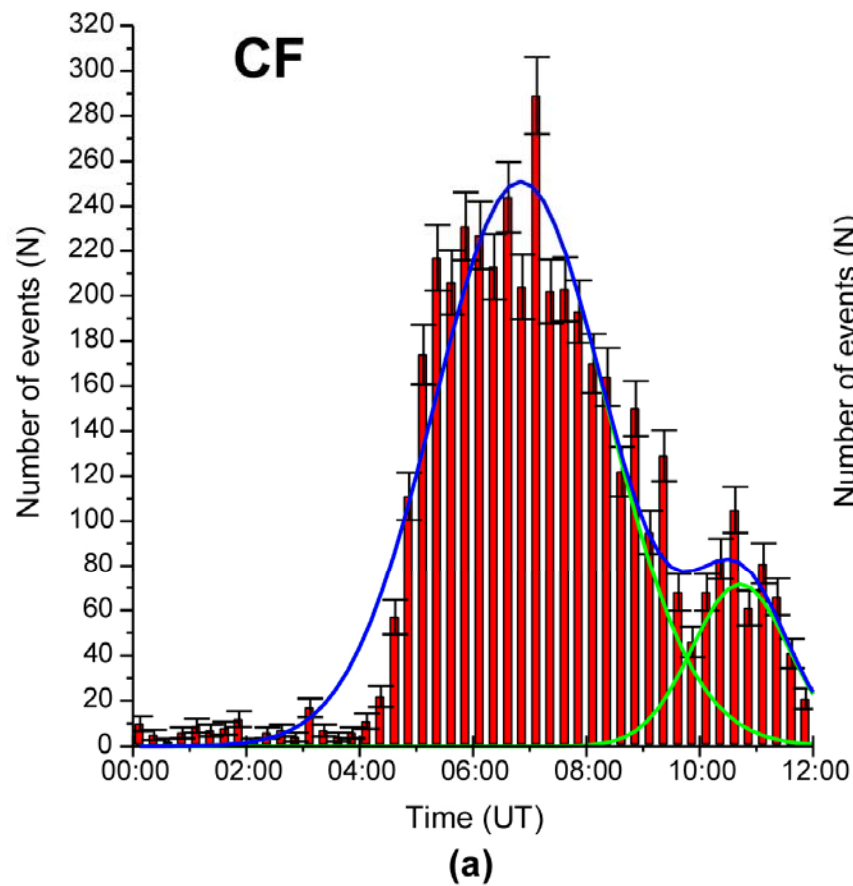
Palmer and Ferraz Stations



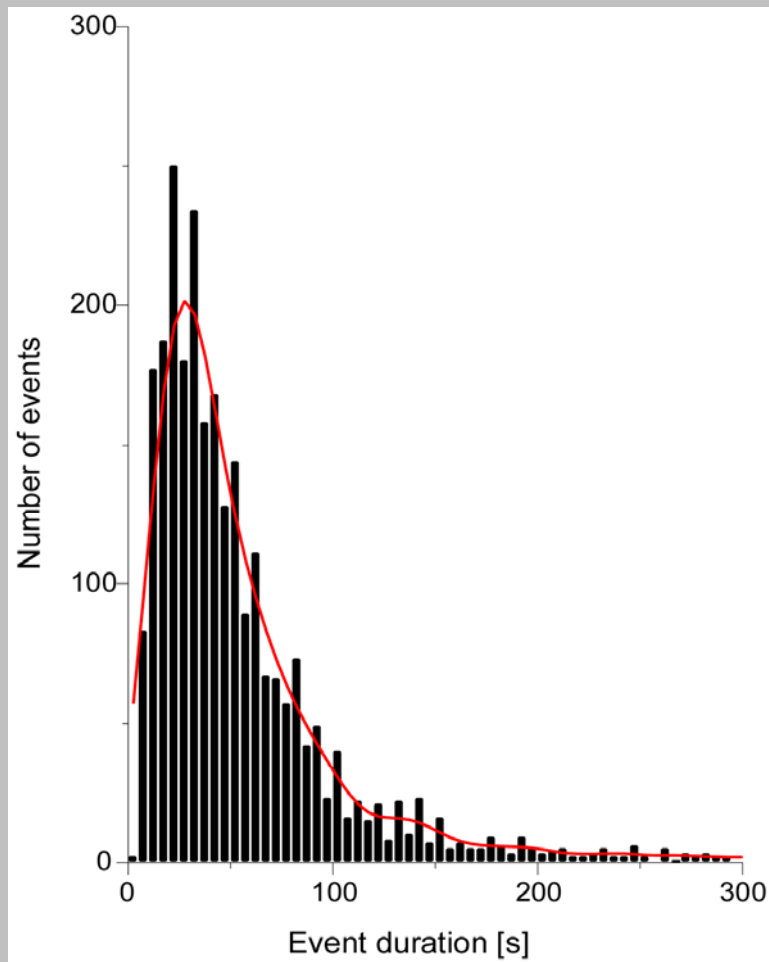
Palmer and Ferraz Stations



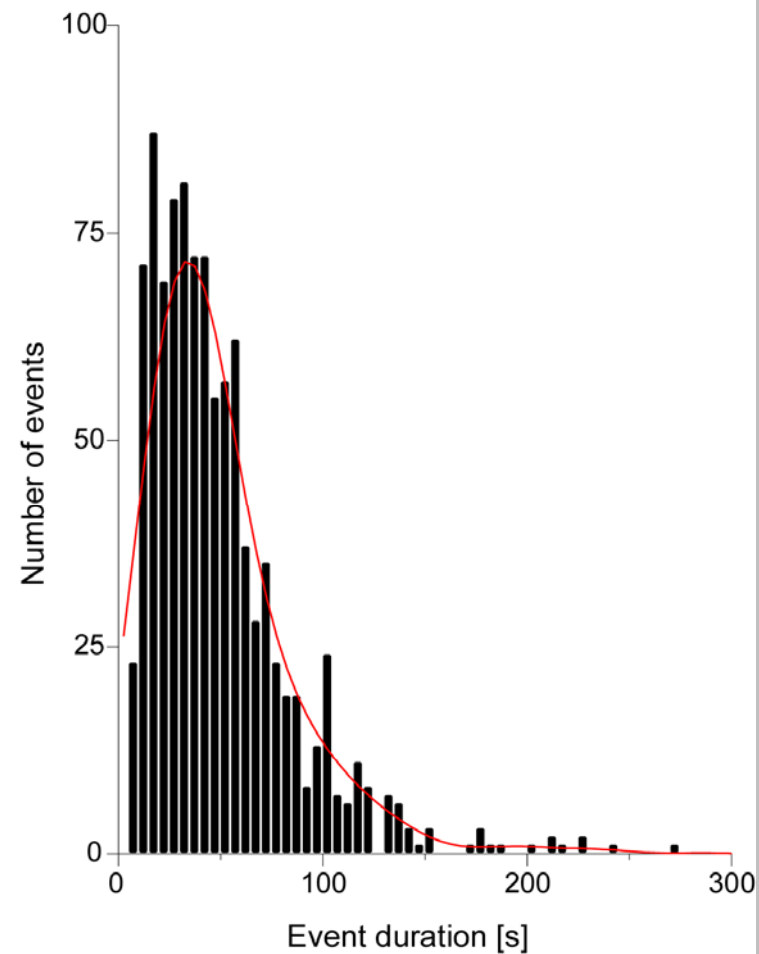
Event Characteristics



Event Characteristics

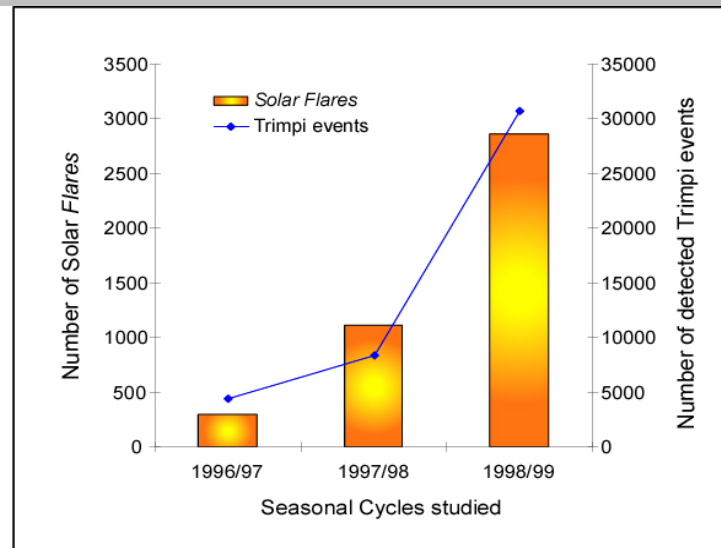
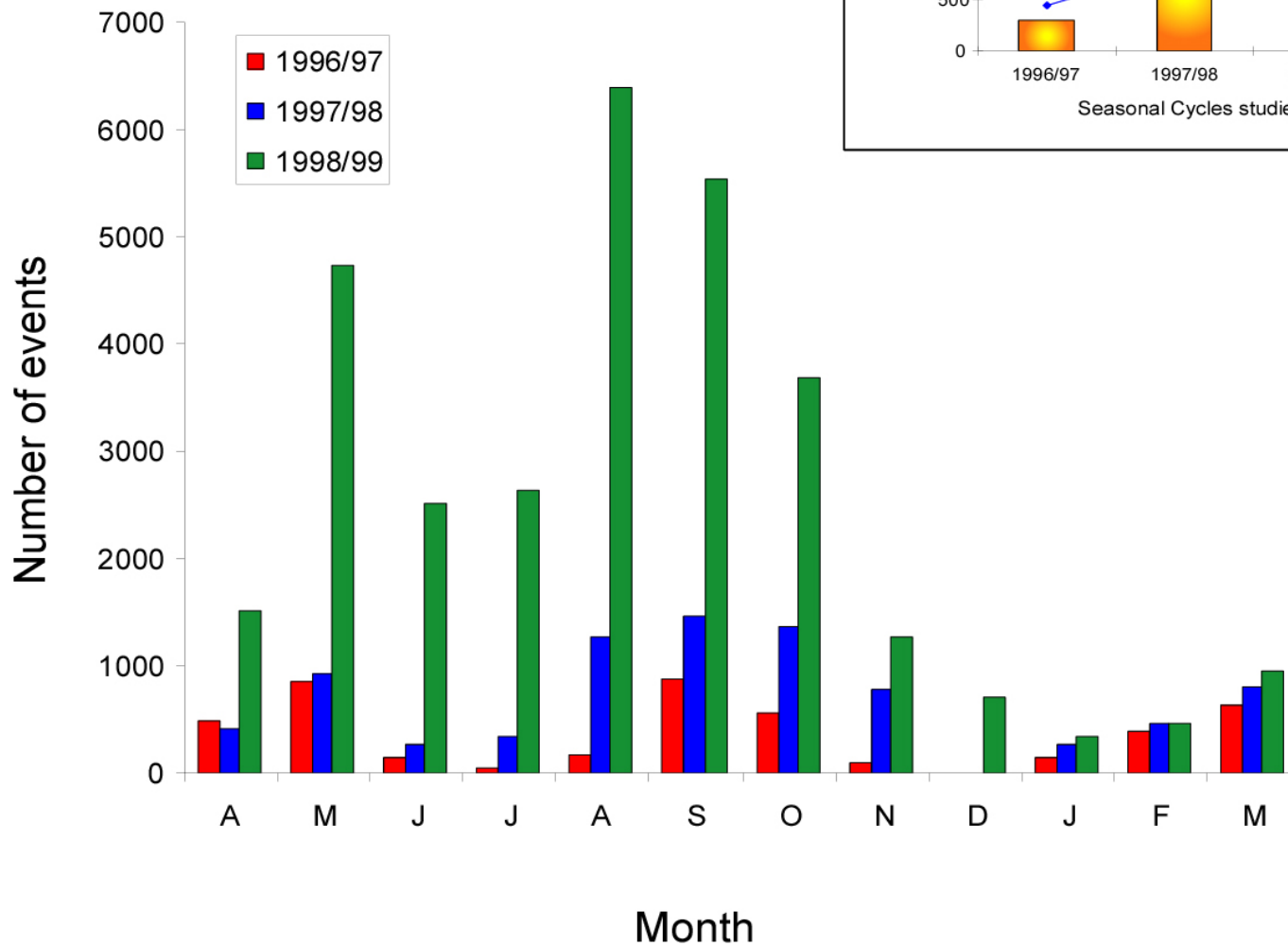


(a)

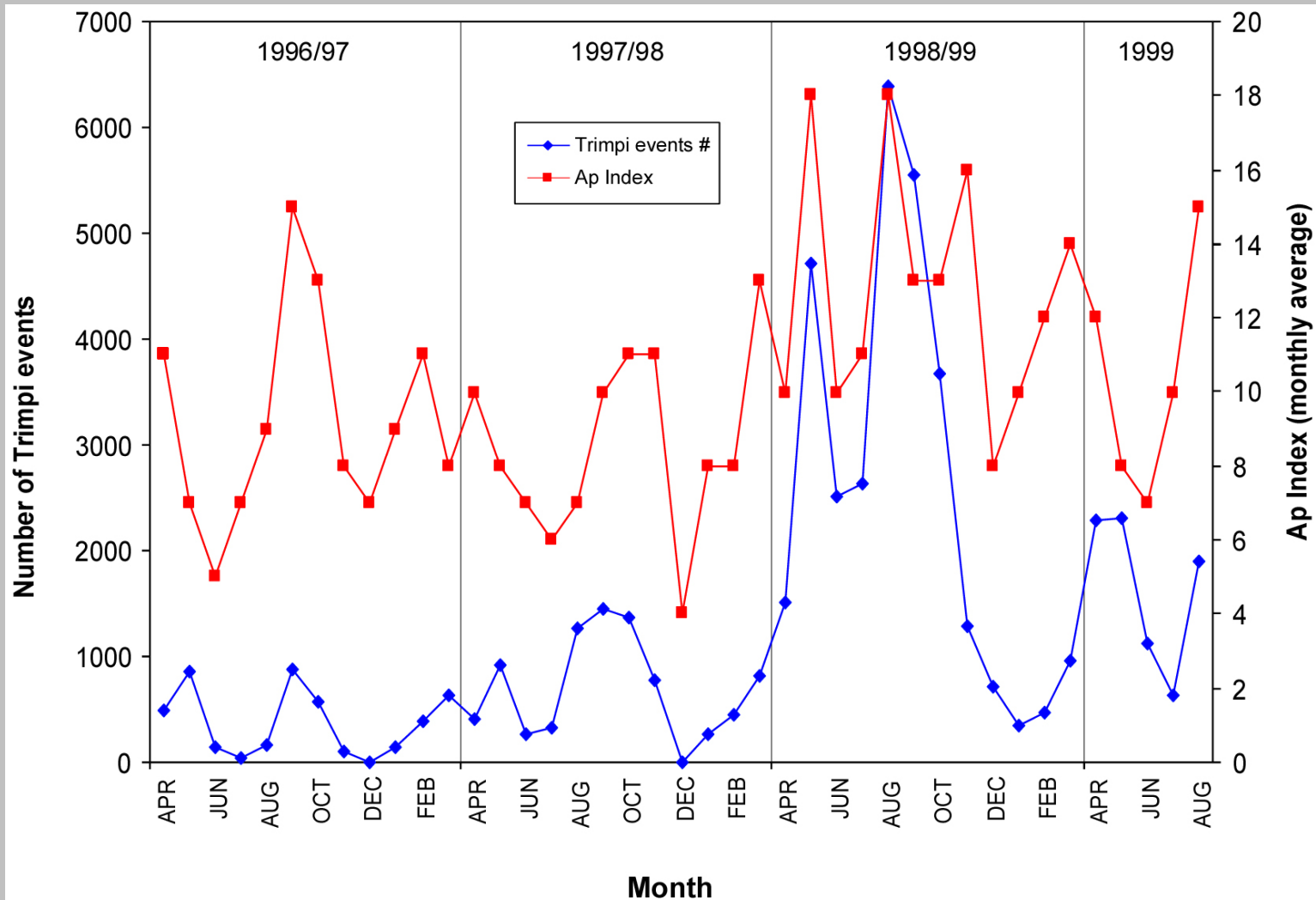


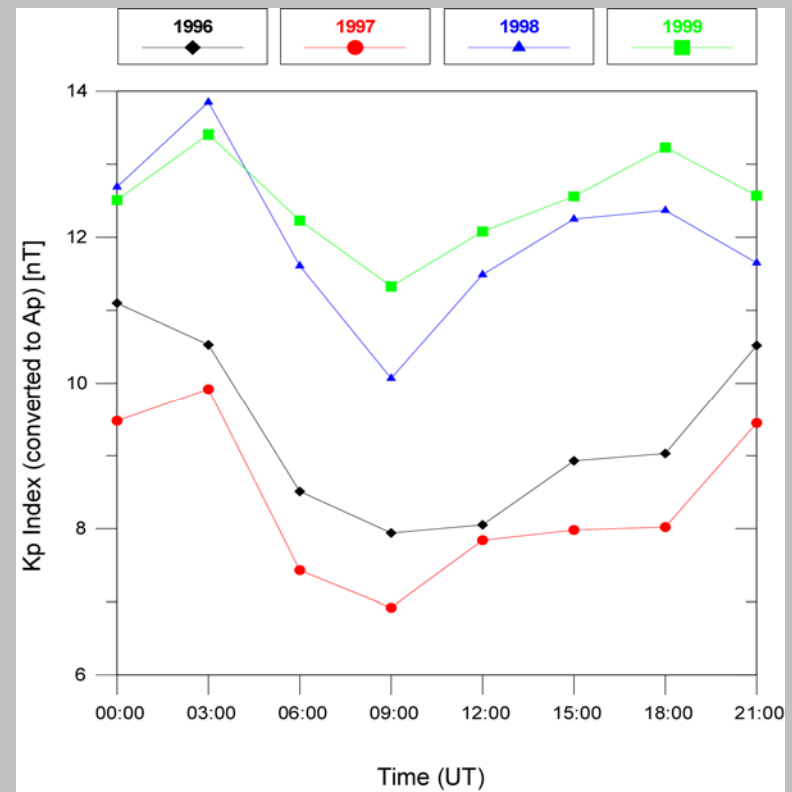
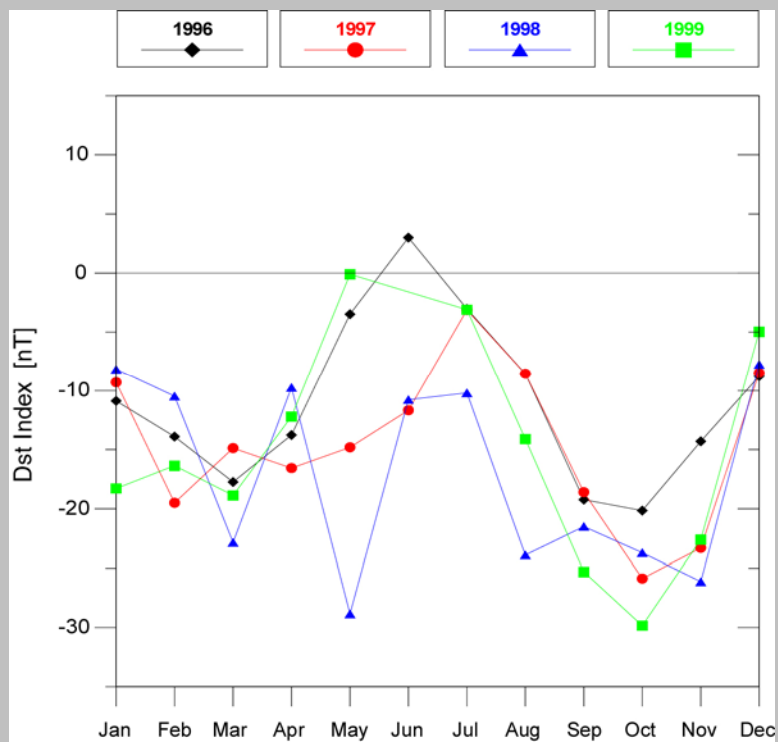
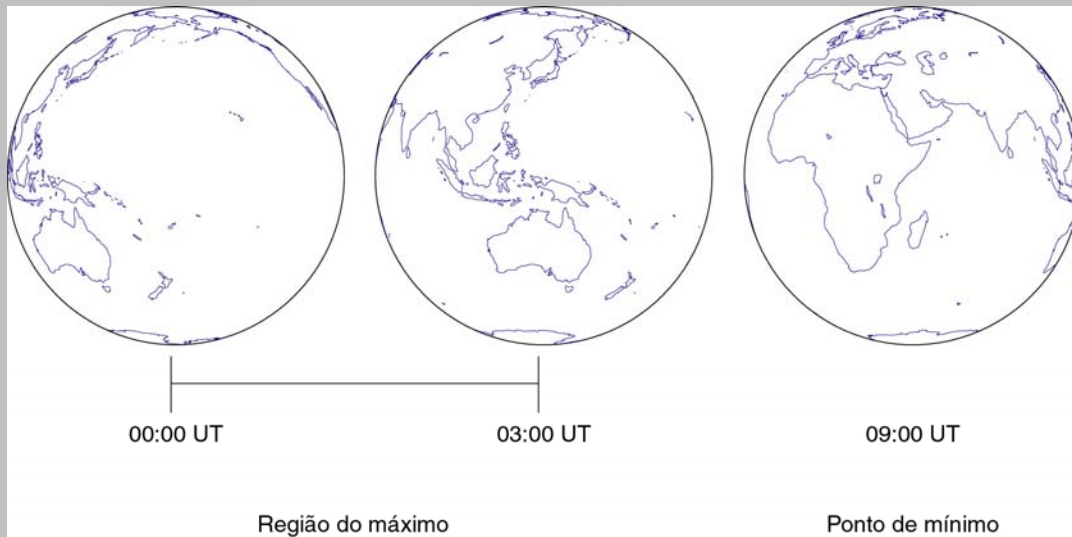
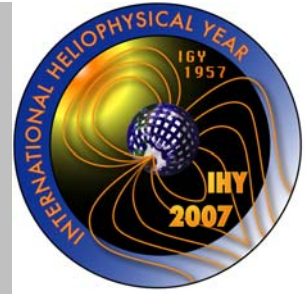
(b)

Solar Cycle Dependence

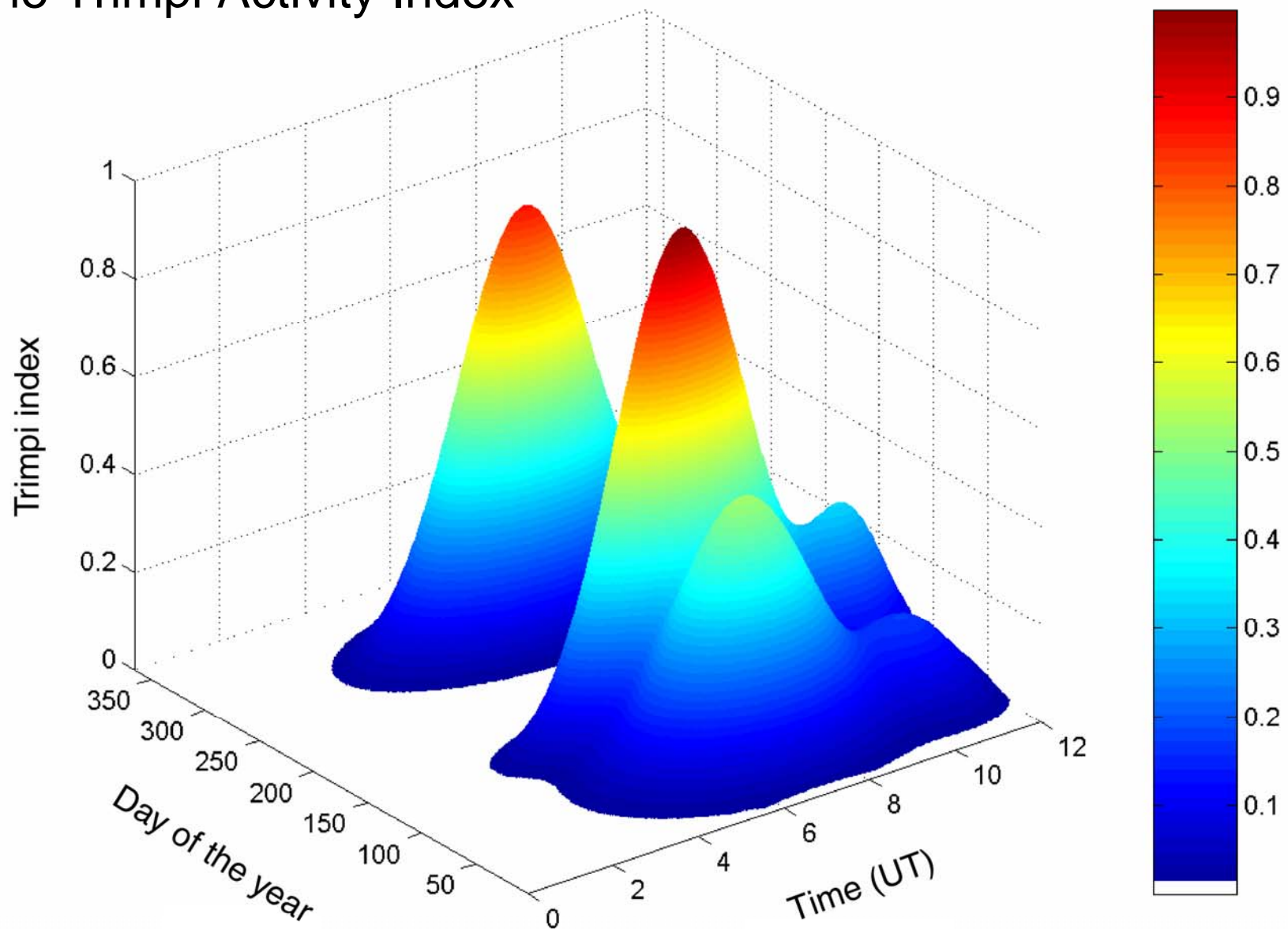


Dependence with Geomagnetic Activity





The Trimpi Activity Index



CONCLUSIONS 1



We hope to estimate the overall role due to the Trimpi occurrence in the loss rate of the Van Allen radiation belts and add this information in the modern models (like the AE-8 electron model [Vette, 1991]. The Trimpi electrons precipitation was not computed in the present models and it can drastically affect our current understanding about the equilibrium mechanisms of the Van Allen radiation belts (specially after the new class of the phenomenon – the *oblique Trimpi* – recently discovered [Lauben et al., 1999 and 2001] producing ionospheric disturbed areas one magnitude order bigger than the classical events) meaning that the particle capture mechanisms (from the solar wind, specially during Coronal Mass Ejections events) also need to be revised.

CONCLUSIONS 2



About the magnetometer network, Brasil has a special position in terms of being the site for the installation of such equipment.

The SAMA is over the South Brazilian region at this moment and there are several groups from research institutes and universities, in Brazil, that can operate and maintain the equipments, carry out the data analysis and put the available data on the Internet.

Also the establishment of the permanent magnetic observatories, in Brasil, as proposed, could contribute to the generation of the planetary average indices, giving a more realistic character to them.

With the implementation of the Brazilian Magnetometer Network important benefits will be reached to the space physics research and new and modern infrastructure will be added to this area for supply a new breath in the researches during long term.



The End

Thank you!