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Poster Draft

SOUTH ATLANTIC MAGNETIC ANOMALY IONOSPHERE RESPONSE TO THE COROTATING STREAM PERIODS

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Abstract. This work presents the lower ionosphere response to the corotating stream periods on the South Atlantic Magnetic Anomaly region. Analyses of the galactic cosmic noise absorption registered by riometers operating at 30 MHz over Cachoeira Paulista (connected to an antenna pointed to the zenith direction -22.50°S; 45.00°W) during almost one complete solar cycle (1989-1996) were performed. Previous results for the same geomagnetic conditions (expressed by kp index) show that the cosmic noise absorption during corotating stream periods is lower than for transient streams and quiet periods. The same response was identified during periods of the magnetic storms (categorized in terms of their intensity by the Dst index). In both cases, it was identified a possible evolution of the equatorial anomaly during corotating stream periods, although less intensive when compared with transient and quiet periods. These preliminary studies show that those corotating stream periods are less geoefective than in transient and quiet periods in the South Atlantic Magnetic Anomaly region.

1. Instrumentation and Data Analysis

A riometer measures the absorption of cosmic radio noise (ABS) as it passes through the atmosphere. Riometers are convenient instruments for investigation of the processes leading to absorption in the lower ionosphere (D and E regions) and also for higher altitudes in the lower latitudes. Riometers are based on the principle that, if no absorption of the cosmic radio noise occurs in the ionosphere, the pattern of noise power variation repeats every sidereal day (*Figure 1.a*). The galactic radio noise power received on a fixed receiving system at the earth surface will be a function of sidereal time only, since each day the aerial beam explores the same strip of sky as the earth rotates (*Figure 1.b*), with the maximum amplitude when the antenna is pointed to the center of the galaxy (these registers are proportional to the stellar density to which the antenna is pointed - *Figure 1.c*). The absorption of the radio noise in the atmosphere at a particular instant of time is, therefore, given by the ratio of the signal strength received under conditions of little ionospheric absorption to that present signal received on a particular day at the same sidereal time. The amount of absorption of the galactic radio waves passing through the ionosphere is measured related to the amplitude signal received under quiet ionospheric conditions, which makes it important to obtain a consistent 'Quiet Day Curve' (normally called QDC). Since the ionosphere is always present, we cannot get to an ideal situation of zero absorption for the QDC. Also the cosmic radio noise level continuously fluctuates. Therefore, statistical techniques are employed to determine the QDC. The estimation of the QDC involves the examination of the diurnal variation over an extended period of time. In this work, the QDC used was obtained from almost one year of the data from days considered geomagnetically quiet ($kp<1^+$) and inserted between 00:0 ad 04:00 local time (*Figure 1.d*) during the minimum solar activity period (1996). The cosmic noise absorption computed from all-available data was performed from this quiet day curve (*Figure 1.e*).

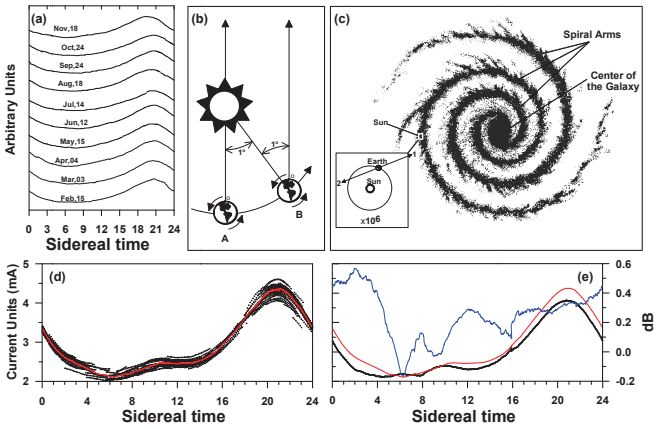

Figure 1. Instrumentation and data analysis.

2. Behavior of the cosmic noise absorption with the geomagnetic activity

In this work the behavior of the cosmic noise absorption for the periods associated to different types of stream (corotating and transient) and no stream periods is presented. At the solar

maximum activity (1989-1992) it was verified an increase of the ABS mean with the increase of the geomagnetic activity during daytime for transient stream periods and periods with no stream (*Figure 2.a.1*) (the classification of geomagnetic activity according to kp index as well the classification of magnetic storm condition based on Dst index values are presented in Tables 1 and 2, respectively). In periods with corotating stream, the ABS mean decreases with the increase of the geomagnetic activity during daytime and practically it remains stable during nighttime (*Figure 2.a.1* and *2.a.2*). It was noticed that in all of the analyzed cases at the solar maximum a development of the equatorial anomaly (for all stream types and periods with no stream) occurred. This phenomenon was observed by the increase of the cosmic noise absorption by the ionospheric F region, soon after the sunset, manly during periods with no streams and transient stream periods (*Figure 2*, panels *b.1*, *b.2* and *b.3*). The ABS intensity of the equatorial anomaly expansion in the corotating stream periods was lower in amplitude than in the periods with no streams and transient stream periods.

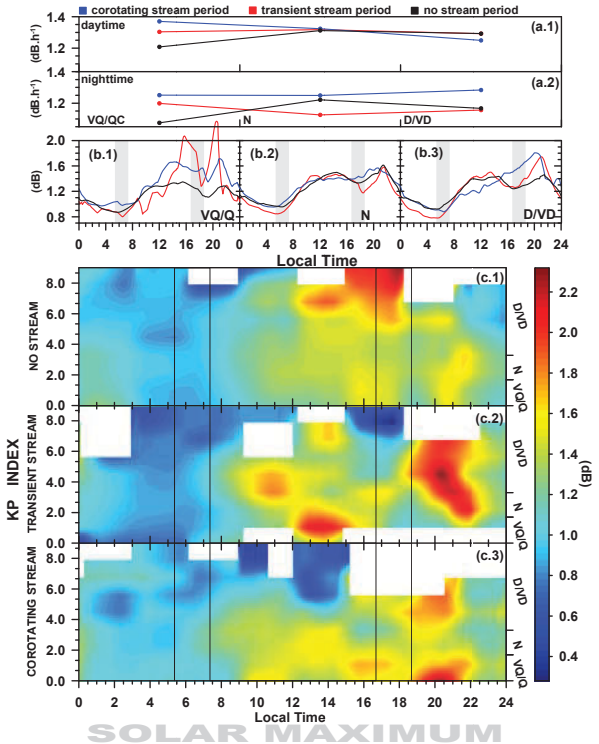

Figure 2. Cosmic noise absorption variation by the geomagnetic activity during solar maximum (1989-1992).

At the solar minimum it was registered an increase of the ABS mean with the geomagnetic activity for all periods analyzed (corotating and transient stream periods and period with no streams) during nighttime and daytime (*Figures 3.a.1* and *3.a.2*). The equatorial anomaly evolution during corotating stream periods was not verified, independent of its geomagnetic activity. During no stream and transient stream periods its evolution was less intensive than that registered during the solar maximum activity. Basically, the ionospheric absorption mean was higher during no stream periods than in periods with transient and corotating streams, manly during daytime ABS registers.

3. Behavior of the cosmic noise absorption with the magnetic storms

At the maximum solar activity the ionospheric cosmic noise absorption mean increases with the increase of the magnetic storm intensity condition, as much during daytime as during nighttime (*Figures 4.a.1* and *4.a.2*). An increase of the ABS mean was also registered during corotating and transient streams with the increase of the magnetic storm conditions; however this increase does not spread to periods of intensive and very intensive magnetic storm condition. In almost of these related and presented cases it was noticed the equatorial anomaly evolution, which presents as an increase in intensity with the increase of the magnetic storm condition. The highest values of the ABS mean registered in these cases appeared after sunset (*Figures 4.c.1*, *4.c.2* and *4.c.3*).

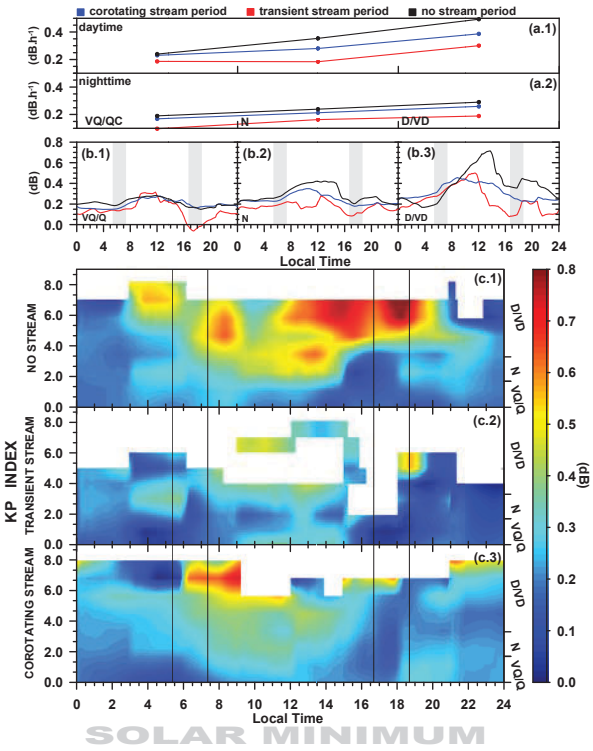

Figure 3. Cosmic noise absorption variation by the geomagnetic activity during solar minimum (1993-1996).

Table1 - Geomagnetic activity ranges

Classification	Range
VQ: Very Quiet period	$0^{o} \leq kp \leq 1^{o}$
Q: Quiet period	$1^{o} < kp \leq 2^{-}$
N: Normal period	$2^{-} < kp \leq 3^{+}$
D: Disturbed period	$3^{+} < kp \leq 4^{+}$
VD: Very Disturbed period	$kp > 4^{+}$

Table 2 – Magnetic storm condition ranges

Classification	Range
SW/SC - Shock Wave/Sudden Commencement period	**dst** > 0 nT
QC - Quiet Condition period	0 nT ≥ **dst** ≥ -30 nT
WS - Weak Storm period	-30 nT > **dst** ≥ -50 nT
MS - Moderate Storm period	-50 nT > **dst** ≥ -100 nT
IS - Intense Storm period	-100 nT > **dst** ≥ -250 nT
VIS - Very Intense Storm period	**dst**<-250 nT

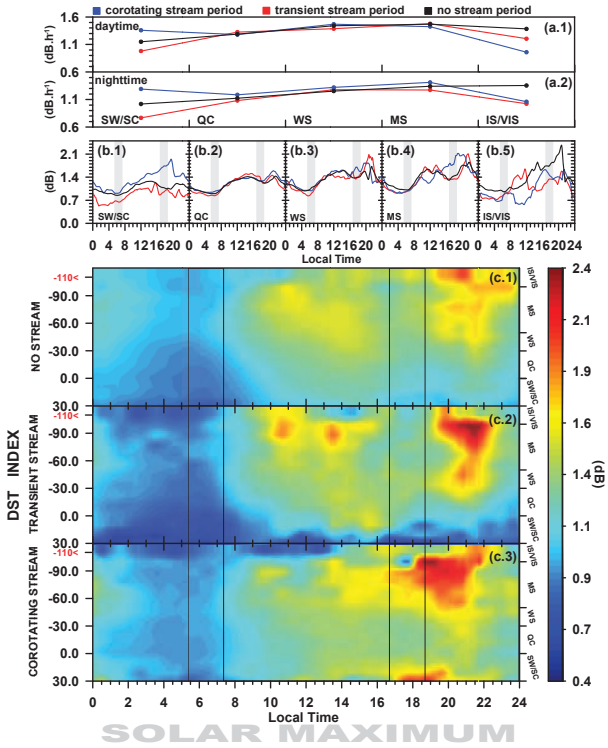

Figure 4. Cosmic noise absorption variation by the magnetic storm condition during solar maximum (1989-1992).

At the solar minimum there was basically an ABS mean increase with the magnetic storm condition, independently of the type of stream. It was noticed the possible equatorial anomaly occurrence in the same conditions, however the ABS was lower than the ABS registered during daytime, in contrast to that observed under the same magnetic storm conditions during solar maximum (*Figures 5.a.1* and *5.a.2*).

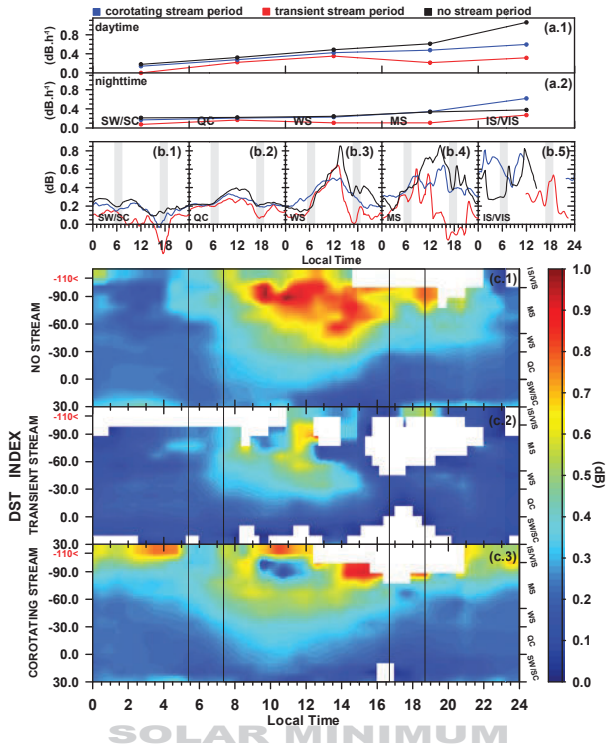

Figure 5. Cosmic noise absorption variation by the magnetic storm condition during solar minimum (1993-1996).

4. Conclusions

At the solar maximum and corotating stream periods was detected a highest cosmic noise absorption mean, manly during the nighttime where it was detected a possible evolution of the equatorial anomaly, characterized by the increase of the ABS soon after the sunset. Compared to transient stream periods, the corotating stream periods showed more geoeffective during the maximum solar, while in that compared with data from no stream periods, under lowest disturbed conditions, the ionospheric absorptions were lower.

At the minimum solar the ionospheric cosmic noise absorption increases with the increase of the geomagnetic activity and with the magnetic storm condition. The ABS mean registered during corotating stream periods in general was lower than the transient stream periods, manly during daytime. The possible equatorial anomaly evolution during this solar phase was less intensive than when compared to the same geomagnetic and magnetic storm condition at the solar maximum.

Basically, the ionospheric response associated to the corotating stream is more intensive (when analyzed by ionospheric cosmic noise absorption) at the solar maximum when compared with transient stream periods and periods with no stream. At the solar minimum no stream periods presented more geoeffective, while the ABS of the corotating stream periods show more susceptible to the variations of the geomagnetic activity and magnetic storm conditions.

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