# Study of the Direct Penetration of Magnetospheric Convection Electric Field at low Latitudes with $B_z$-component and $B_y$-component of Interplanetary Magnetic Field (IMF) Variations during the magnetic storm on August 6th 1998

*__N. M. MENE__* [1], *A. T. KOBEA* [2], *O. K. OBROU* [3] *and K. Z. ZAKA* [4]

[1] Laboratoire de Physique de l'Atmosphère, Université de Cocody, 22 BP 582 Abidjan 22, COTE D'IVOIRE, medardmene@yahoo.fr

[2, 3,4] Laboratoire de Physique de l'Atmosphère, Université de Cocody, 22 BP 582 Abidjan 22, COTE D'IVOIRE,

## Abstract

variations of the ground-based magnetic field measurements show a correlation between the magnetic disturbances observed at the auroral zone and equatorial zone. This correlation is an evidence of the direct effects of high latitudes fields, and currents at equatorial latitudes. A study is made to understand how the magnetospheric convection electric field penetrates at low latitudes during the magnetic storm on August 6th 1998.

The results show a decreasing of the auroral activity and Super Dual Auroal Radar Network (SuperDARN) observation exhibits a falling of the magnetospheric convection during the penetration. This study reveals that IMF component Bz and By are dependently related to this disturbance event.

## 1.Introduction

A sudden deviation, usually appears on the magnetic field variation during storm events. It Often observed a simultaneous variations at high and low latitudes [1, 2].

This correlation is an evidence of a direct effect of high latitude electric fields and currents at low latitude, according to several authors [3-5].

Magnetospheric convection electric field creates a secondary electric field polarization that stops the penetration of magnetospheric convection electric field at low latitudes [6]. This phenomenon is the shielding effect. When the secondary electric field settles with lateness or falls, the convection electric field influences the low latitudes and the ionospheric parameters [7, 8]. The process describe above is the penetration or overshielding.

In order to more understand the overshielding process, we study the IMF components Bz and By variations during the penetration of magnetospheric convection electric field of magnetic storm on August 6th 1998

## 2.Data used and method of analysis

The geomagnetic data used in this study are those of ground-based magnetometers from high to low latitudes. The locations and coordinates of this magnetometers are listed in this table 1.

Table 1: locations and coordinates of ground-based magnetometers

| **Stations** | Codes | Geo. lon | Geo. lat. | Mag. lat. |
|---|---|---|---|---|
| **Hornsund** | HRN | 15.55 E | 77.00 N | 73.88 N |
| **Abisko** | ABK | 18.82 E | 68.36 N | 66.06 N |
| **M'bour** | MBO | 16.97 W | 14.18 N | 20.11 N |
| **Bangui** | BNG | 18.57 E | 4.33 N | 4.20 N |

The penetration of magnetospheric convection electric field is characterized by the H-component of magnetic field. The low latitude disturbances originated in polar region (DP) are estimated by the following equation:

$$DP = H - Dst \times \cos(L) - Sr \qquad (1)$$

Where H is the horizontal component of geomagnetic field from which the ring current effect (Dst x Cos(L) with L representing the dipole latitude of the station) and H-component of the reference quiet day(Sr) are removed.
The interplanetary magnetic field data used are from the Space Physics Center (SPC) and magnetospheric convection data are obtain by Super Dual Auroal Radar Network (SuperDARN).

## 3.Study of magnetic storm on August 6$^{th}$, 1998

This storm begins on August 06$^{th}$ 1998 at 0700 UT with a main phase that follows immediately the initial phase (figure 1a). At 1100UT the Dst stops to decrease but the H-component at Bangui decrease until 1230UT (figure 1c, Dotted line represents H-component of the reference quiet day: August 23$^{th}$, 1998).
The H disturbance (DP) variations (figure 2) show in the time-interval 0900UT-1230 UT, a decreasing at high latitudes (Hornsund : HRN) and low latitudes (M'Bour: MBO and Bangui: BNG). This correlation is an evidence of penetration of westward magnetospheric electric field at low latitudes. The intensity of the penetration increases at around 1145 UT. The variation of AE index is presented in (figure 1b), the AE index shows a downward deviation that confirms a decreasing of auroral activity during the penetration.
The Super Dual Auroal Radar Network (SuperDARN) magnetospheric convection maps present a falling of the convection during this event that proves a decreasing of polar cap potential observed in the maps (figure 3).
Figure 4 presents the IMF components (Bz and By) variations during the penetration. Due to the lack of IMF data we present the variations from 1040 UT to 1550 UT. We observe that the magnetospheric convection electric field penetrates at low latitudes when the IMF Bz-component turns southward (Bz < 0) and the IMF By-component takes negatives values. From 1100 UT to 1200 UT Bz and By have negatives values and we observed the penetration in this period. Around 1130 UT the penetration is falling, we observe that the increasing of By; and Bz is practically constant. Around 1145UT the penetration increases, we observe a decreasing of By and Bz is negative but increases. At 1230 UT the penetration stops, Bz and By return to positive values.

## 4.Discussion and Conclusion

The penetration of magnetospheric electric field depends on Bz and By variations. When Bz is negative and By positive the establishment of the secondary electric field is fast and we have a falling or stopping of the penetration. The intensity of the penetration is high when Bz and By are negatives and decrease together.
Magnetospheric convection begins when IMF component Bz is southward [9] and the shielding or overshielding conditions should depend of IMF By variation.
The phenomenon of penetration depends on the variation of IMF components Bz and By. One can study their variations to understand when and how the penetration takes place during a magnetic storm.

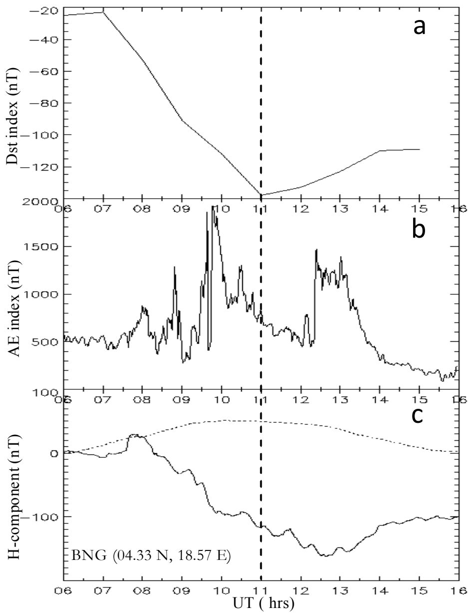


**Figure 1**: Time variations of equatorial *Dst* (a), auroral activity index AE (b) and H-component at Bangui (c) on August 6th,1998 .Dotted line presents H-component of the reference quiet day

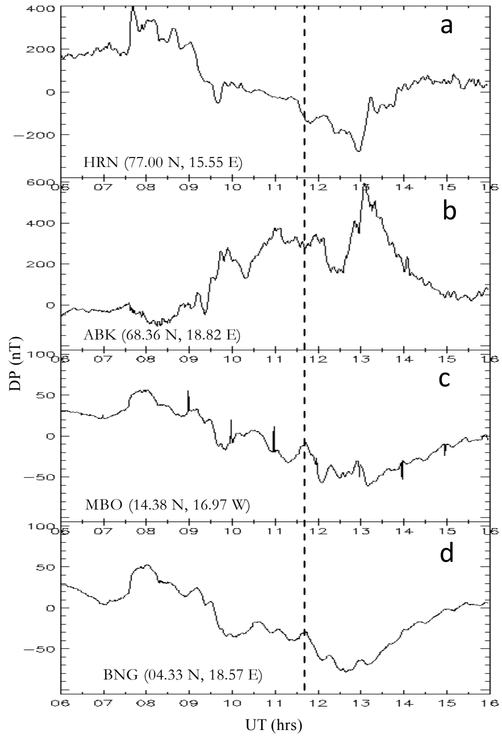


**Figure 2 :** H disturbance (DP ) variations at Hornsund (a), Abioko (b), M'bour (c) and Bangui (d). on August 6th,1998

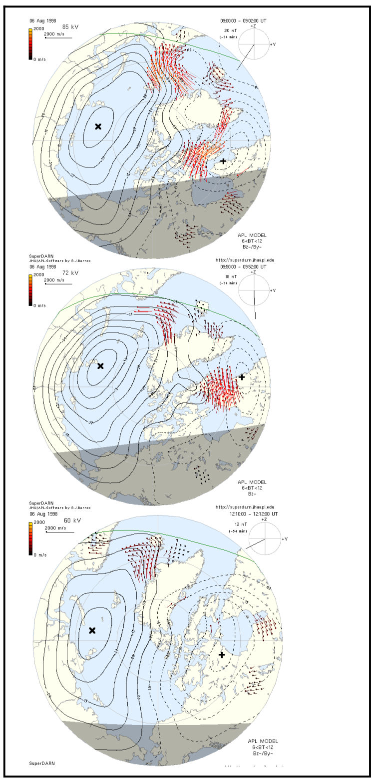

**Figure 3** : Magnetospheric convection maps observed by SuperDARN during the penetration at 0900 UT, 0950 UT and 1200UT ( from top to bottom).

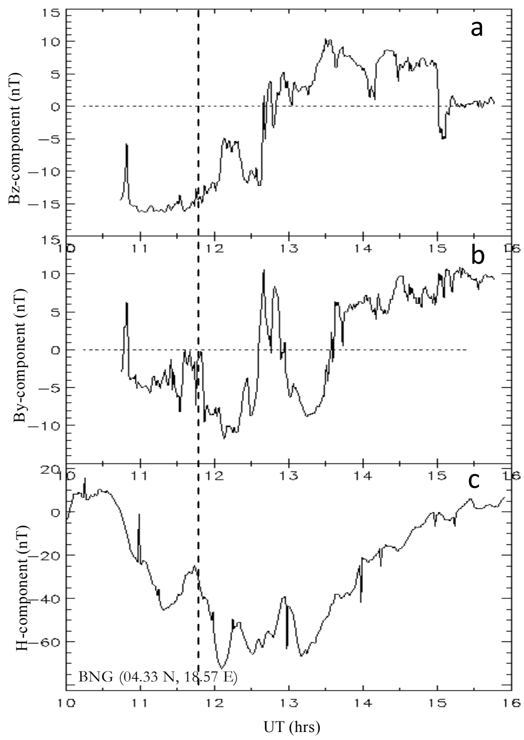


**Figure 4**: Time variations of interplanetary magnetic field components Bz (a), By (b) and terrestrial magnetic field component H at Bangui (c).

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