Ionospheric scitillation activity measured in the African sector

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Abstract

A sample of ionospheric scintillation activity measured in the African sector (Douala, magnetic latitude 5.36° N) is analysed, using measurements provided by a dual frequency GPS Ionospheric Scintillation and TEC monitor (GSV4004). The measurements consist of classical ionospheric scintillation indices evaluated at L1 and Total Electron Content (TEC) computed over 1 minute intervals on both L1 and L2. Measurements referring to quiet and disturbed conditions occurring between 4 November 2004 and 15 November 2004 were considered in this analysis. An overview of the scintillation activity in that event is presented (also in comparison with simultaneous measurements collected in the Brazilian sector). The importance of this type of analyses relies on the need to understand the potential threats to GNSS based applications.

1 Introduction

Ionospheric irregularites in the low latitude region are associated with the formation of the F layer irregularites ocurring after sunset due to plasma instabilities and equatorial evening vertical plasma drift [1]. Plasma irregularities can have a significant effect on GPS signals in form of scintillations of their amplitude and phase, which can cause degradation in the accuracy of satellite based navigation and precise positioning. Ionospheric scintillations pose limitations in the tracking pf GNSS signals [2] as well as on the performance of Earth observation systems. Ionospheric irregularites show a dependence on the season, latitude, and magnetic disturbances [2]. Ionospheric scintillations in the African region usually occurr after the sunset bewtween 2100UT and 0300UT and are more significant during the equinoxes [3].

2 Discussion

For this analysis data values of all visible GPS satellites in view with elevation larger that 40° have been used. In Fig. 1 the S_4, σ_ϕ indices, Total Electron Content (TEC) and magnetic index Kp for the period between 4 November 2004 and 15 November 2004 is shown. During this period a magnetic storm ocurred with two main phases. The first main phase occurred on 8 November (Dst -373 nT), while the second on 10 November (Dst -295 nT). Unfortunately, data gaps limited the plain description of those events. Nevertheless it was possible to compare the available data with simultaneous measurements carried out in the Brazilian region [1]. In the America sector indeed they observed moderate scintillation between 7 and 8 November and weak scintillation during the next day, due to the first main storm phase.

In the African sector a medium scintillation activity ocurring between 6/7 November and 12/13 November whith $S_4 > 0.3$ and $\sigma_\phi > 0.4$ was observed, (Fig. 1) in presence of TEC fluctuations. The increase in scintillation activity showed to occur at some ealier times than in the Brazilian sector. On the other hand, there was no scintillation observed when the second main storm phase ocurred (10 November), with no TEC fluctuations. This feature corresponded to the observations in Brazil [1].

3 Conclusion

Experimental data collected in the African sector showed very similar features with respect to those simultaneously measured in the American sector. Scintillation events were found to occur at earlier times in the African sector than

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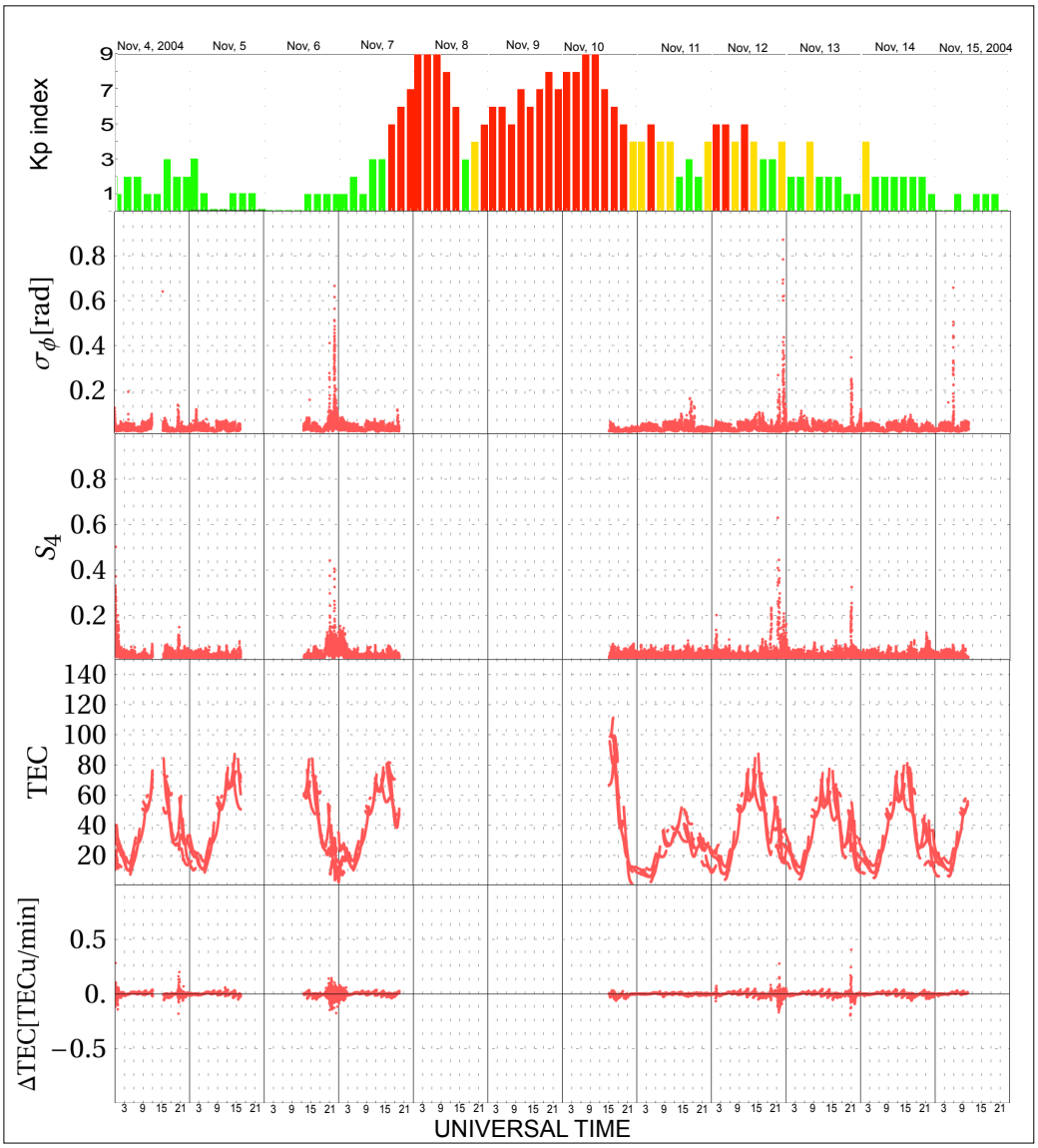

Figure 1: Scintillation indices (S_4 and σ_ϕ), Total Electron Content (TEC) and magnetic index Kp for the period 4 November 2004 - 15 November 2004.

in the American one. Futher analysis will be carried out in order to better understand the ionospheric irregularites causing scintillations in the African sector their effects on GPS signals.

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