Characteristic of Solar Wind Parameters and Geomagnetic Indices during Solar Flares

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Abstract. Active sun is characterized by compelling short-lived flash of solar eruption like solar flare, coronal mass ejections (CMEs), high-speed solar winds and solar energetic particles along with colossal release of energy and mass. This paper proposes a new method to evaluate solar wind parameters and geomagnetic indices based on wavelet analysis during the solar flares. The crucial role of IMF-Bz (interplanetary magnetic field) is examined for the two solar flares events. The key result obtained from our study is substantial dependence of solar flare intensity on IMF-Bz together with solar wind velocity. We also observed the duration of solar flares and their effect on ionospheric and ground based parameters.

Keywords. Solar Flares, Continuous Wavelet Analysis, Space Weather, Periodicity

1. Introduction

Solar wind possesses tremendous amount of kinetic and electrical energy, some part of it directly enters the earths magnetosphere causing a turmoil to the geomagnetic activities and eventually resulting to geomagnetic storms, sub-storms and aurora (Chapman & Bartels 1962 ; Gonzalez *et al.* 1994). Geomagnetic indices characterizes the variability of the earths magnetic field in all its complexity in a single number.

2. WAVELET ANALYSIS

Continuous Wavelet Transform (CWT) is used to provide the reliable description of the signal in term of time and frequency domain, which expresses a continuous signal into wavelets. The CWT coefficient is defined as

$$W(a,b) = \int f(t)\phi^*((t-b)/a)dt$$

where $\phi^\star$ represents the complex conjugate of ϕ and the parameters a and b are scaling and shifting factors respectively and W (a, b) gives the values of the coefficients (Adhikari *et al.* 2017; Adhikari *et al.* 2018).
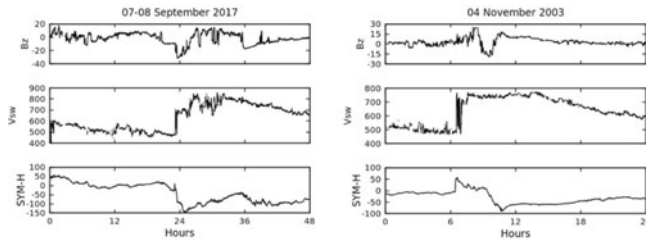
Figure 1. Plot of the hourly variation of Bz, Vsw, and SYM-H component on 07-08 September 2017 (left) and 04 November 2003 (right)
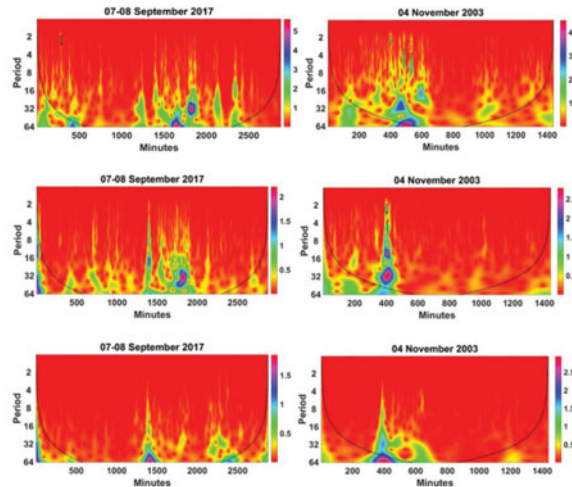
Figure 2. Scalograms for IMF-Bz (top), Vsw (middle) and SYM-H (Bottom)

3. Result and Discussion

Our analysis verifies that the power intensities of IMF-Bz, Vsw and SYM-H show a high spectral variability. Results present that both higher and small periodicities are observed on each parameter. The periodicities around 64 to 2 minutes are seen at the time of flare.

4. CONCLUSION

The CWT analysis on IMF-Bz, Vsw and SYM-H shows higher and small periodicities during the peak phase of solar flare. The periodicities variation of 64 to 2 minutes have been observed on each parameter, however the periodicity of 64 -32 portrait larger power regions.

References

Adhikari B., Mishra R. K., Pandit D., Bhattarai B. & Chapagain N. P. 2017, *JIST*, 22 (1), 45

Adhikari B., Sapkota N., Bhattarai B., Mishra R. K., Bohora S., Chapagain N. P. & Regmi B. 2018, *Russ. J. Ea.*, 18, 1

Chapman, S. & Bartels, J. 1962, *Geomagnetism, Clarendon Press, Oxford*, 1

Gonzalez, W. D., Josely, J. A., Kamide, Y., Korehi, H. W., Rostoker, G., Tsuruntani, B. T., & Vasylianas V. M. 1994, *Journal of Geophysical Research: Space Physics*, 99, 5771