Forbush decrease on September 6-13, 2017 observed by the Tanca water-Cherenkov detector

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Introduction

September of 2017 was a non-typical period where numerous solar events were registered, such as 27M-class flares and four X-class flares [1]. Three flares with intensity M5.5, X9.3 and X8.2 originated three halo CME (*Coronal Mass Ejection*) with the shock arrival time at 2017-09-06T23:08Z (CME1), 2017-09-07T22:30Z (CME2) and 7-09-12T19:26Z (CME3), respectively [2, 3]. These events produced Forbush decreases that were registered by a water Cherenkov detector located at the University of Campinas, Brazil, named Tanca ("*Tanque de Campinas*") which also registered a signal dropout due a stream interaction region (SIR) [4].

Experimental Methodology

Tanca is a replica of the detectors used in Pierre Auger Observatory. It is a cylinder tank with 10m2 of base area filled with 11400 liters of ultra-pure and deionized water. The water is wrapped with a *liner* coated with *Tyvek* to reflect the light diffusely. At the top of the tank, there are three equidistant photomultipliers tubes (PMT) Photonics XP1805 to convert Cherenkov radiation originated from the passage of the ultrarelativistic muons in water into a measurable signal.
Tanca data had barometric effects corrected and compared with data from two neutron monitors available in the neutron monitor database (NMDB) [5]: the Tsumeb (Tsmb) and Terre Adelie (Tera) neutron monitors.

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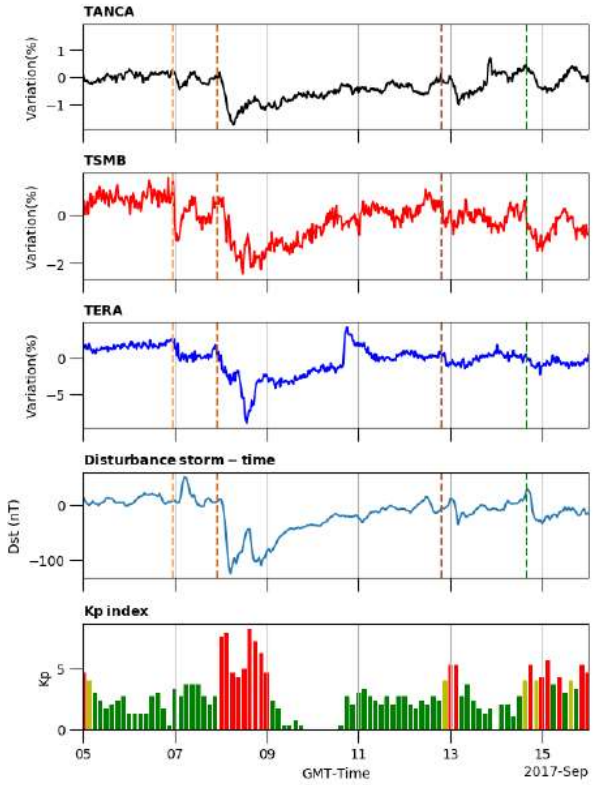

Figure 1: Cosmic ray signal from Tanca (Rc = 9.36 GV) in black, Tsmb (Rc = 9.15 GV) in red and Tera (Rc = 0.01 GV) in blue, hourly averaged Dst in cyan and the Kp index (green: Kp < 4, yellow: Kp = 4 and red: Kp > 4) registered during the strong solar activity in September 2017. The four dashed vertical lines are associated with the shock time arrival of the CME1, CME2 and CME3, and with the SIR.

Results and Conclusion

According to the geomagnetic disturbances indexes, the three CMEs recorded in the analyzed period were associated with a weak, strong and moderate magnetic storm, respectively, which produced three Fds, as illustrated in Figure 1. The Tanca's signal is in accordance with the behavior of the signal variation of the Tsmb and Tera detectors and show the effects of solar events on the Earth's magnetic field for a region of energy above the energies observed by space missions, adding information about the effects of the more energetic particles of these events.

References

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