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Variations of Schumann resonance frequencies at the extraordinary solar activity of October/November 2003

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The upper boundary of the Earth-ionosphere cavity is the ionospheric D-region. The upper part of this region is ionized by the solar UV, EUV, Lyman-α (121.6 nm) and Lyman-β (102.6 nm) as well as the soft (1-10 nm) and hard ($<$1 nm) X-ray in the sunlit site of the cavity. In the lower part of the D-region, the galactic cosmic rays are responsible for the ionization. A series of dramatic solar activity events occurred in October and November of 2003. The hard solar X-ray flux increased by more than two orders of magnitude already in October 18 and lasted until November 4 while the 10.7 cm radio flux indicating the 2-3 fold variations of EUV radiation maximized only in October 28. The time evolution of the disturbances of these two ionization sources was quite different. At the end of October and the beginning of November 2003 two active regions produced a series of extremely energetic solar eruptions. In connection with the flare on October 28, 2003, a coronal mass ejection was emitted at a high speed directly towards the Earth and caused a dramatic Forbush decrease. The effects of these events have been studied by Schumann resonance (SR) parameters measured at Nagycenk, Hungary and in Mitzpe Ramon, Israel. SR frequency increased simultaneously with the increase of the hard solar X-ray flux in October 18, 2003 and followed it in case of the 1^{st} and 2^{nd} Ez modes both at Nagycenk and in Mitzpe Ramon until November 4, 2003. Neither the increased EUV radiation with maximum at October 28, 2003 and nor the huge Forbush-decrease between October 28 and November 4, 2003 left any signature on SR frequencies. This result supports that the hard solar X-ray has an important role in conditioning the Earth-ionosphere cavity at the heights of $\sim$ 90km -100 km as shown on the 11-year solar cycle and during short solar X-ray bursts (Sátori et al., 2005).