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Investigating the variation of the ionospheric absorption during large solar flares based on modern Digisonde data

Attila Buzás[1,2], Dalia Burešová[3], Daniel Kouba[3], Zbyšek Mošna[3], and Veronika Barta[1]
[1]Institute of Earth Physics and Space Science, Sopron, Hungary
[2]Doctoral School of Earth Sciences, Eötvös Loránd University, Budapest, Hungary
[3]Institute of Atmospheric Physics of the Czech Academy of Sciences

As a result of the enhanced X-ray and EUV fluxes following large solar flares, the electron density of the ionospheric layers increases. Furthermore, it causes higher absorption or even partial or total fade-out of the emitted radio waves which can be measured with ionosondes and Digisondes by studying the amplitude of the reflected electromagnetic waves [1,2].

In the present study, the ionospheric response to large solar flares has been investigated using the ionosonde data measured at the Průhonice (Czech Republic, 49.98° N, 14.55° E) and San Vito (Italy, 40.6° N, 17.8° E) stations in September 2017, the most active solar period of Solar Cycle 24. A novel method [3] to calculate and investigate the absorption of radio waves propagating in the ionosphere is used to determine the absorption during large solar flare events (M and X class). Subsequently, the absorption data are compared with the indicators derived from the fmin method (fmin, the minimum frequency is considered as a qualitative proxy for the “nondeviative” radio wave absorption occurring in the D-layer). Total and partial radio fade-out and increased values (with 2–5 MHz) of the fmin parameter were experienced during and after the intense solar flares (> M3). Furthermore, the signal-to-noise ratio (SNR) measured by the Digisondes was used as well to quantify and characterize the fade-out events and the ionospheric absorption. The combination of these three methods may prove to be an efficient approach to monitor the ionospheric response to solar flares.

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