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TLE producing ionospheric disturbanaces: Observation and numerical modeling

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This paper reports on the direct comparison between experimental and numerical results of the ionospheric disturbances associated with red sprites in the mesosphere. The ionospheric disturbances due to the sprite ionization column is observed by a continuous monitoring of the amplitude and phase of distant VLF transmitter signals at several locations in Japan, whilst the numerical computation to calculate the spatio -temporal dependence of the observed VLF waves is performed by using a two-dimensional finite-difference time-domain (FDTD) method. As a result, the observed maximum scattered amplitude and phase changes are in close agreement with the numerical results both for carrot and column sprites. The distance variation of the scattered amplitude from the numerical simulation is found to strongly depend on the spatial dimension of the sprite ionization column due to the different scattering mechanisms. The forward scattering amplitude is significantly larger than that for back scattering for the carrot sprite indicating the nature of Mie scattering, while both backward and forward scatterings are comparable for a column sprite showing the nature of Rayleigh scattering.