Improvement of estimation method for propagation distance of tweek atmospherics

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Tweeks are very low frequency (VLF) / extremely low frequency (ELF) waves radiated from a lightning discharge and propagate in the Earth-Ionosphere waveguide for a long distance. As the most important characteristics, tweeks have frequency dispersion that the frequency rapidly falls down from 10 kHz to 2 kHz during several tens of milliseconds. So far, the cutoff frequency and the horizontal propagation distance of tweeks were estimated by curve fitting on dynamic spectra drawn by the maximum entropy method (MEM). However, the rapid variations in the frequency at the arrival time and overlapping tweeks caused the low estimation accuracy. The accuracy of the lightning location estimated from tweek atmospherics is low to be 60 km [Santolik and Kolmasova, 2017], while the accuracy of lightning location for the lightning discharges of world-wide lightning location (WWLLN) data is high to be less than 10 km [Rodger et al., 2005]. In this study, we propose a new method to estimate tweek propagation distances and compare the results from the new and previous methods. The new method uses conversion of non-linear dispersion equation to a linear equation. The linear equation would be more useful for estimating the propagation distance, even if attenuation around the cut-off frequency is large. As a result of evaluation by pseudo-tweeks using this method, the error of the propagation distance was estimated to be 6.8%. In this presentation, we show the new method for tweek propagation distance in detail and discuss its accuracy.