A method for locating lightning discharges using tweek atmospherics

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Locating accuracy for lightning discharges of world-wide lightning location (WWLLN) is high to be less than 10 km [Rodger et al., 2005], although the accuracy of horizontal propagation distance for tweek atmospherics is low to be ~60 km [Santolik and Kolmasova, 2017]. Tweek atmospherics are very low frequency (VLF)/extremely low frequency (ELF) waves radiated from lightning discharges, and propagate between the Earth surface and the bottom of the ionosphere for a long distance (several thousand kilometers). In this study, we improve the estimation method for the tweek propagation distance, and compare between the lightning location estimated from tweek propagation distance by intersection method with those from the WWLLN data and cloud images derived by the MTSAT-2 satellite. We used two wideband VLF data observed at Kagoshima (31.48˚N, 130.72˚E) and Moshiri (44.37˚N, 142.27˚E), Japan, at 12:20-12:22 UT, on 23 August, 2013. The main point of the improvement was modification for the width of window on dynamic spectra drawn by maximum entropy method. The accuracy of the estimation became higher and the error for the propagation distance became the half of the original estimation, by using narrow window for the beginning, and wide window for the end of the tweek signals. We estimated the lightning location by both automatic and manual methods. In the manual method, the estimated location of lightning for the two-minute data was in good agreement with thick clouds observed by the MTSAT-2 satellite. However, in the automatic method, the location of the lightning was in disagreement with cloud images, because the accuracy of triggered times were not sufficient due to overlapping tweeks or noises such like short pulses just before the tweeks. In the presentation, we discuss the estimation method for the lightning location in detail.

