Review of “Analysis of Lightning-Induced Currents in Supply Cable Shields and Their Impact on LLS Sensor Site Errors “ by Kohlmann et al., initial draft

Reviewer: Martin Murphy

The paper presents a very interesting “deep dive” into modeling the sources of angle and amplitude site errors at sensor sites in lightning locating systems. The modeling work here provides useful guidance in planning the layout of sensor sites with the goal of minimizing the errors in the first place. The paper is in good shape overall, although I do have some suggestions about clarifications, as follows:

equation 3 looks like it may have an error – it should have a “d” somewhere in it; otherwise, the exponential term is just a constant

line 214 vs lines 226-227: $Y_g$ is referred to as “impedance” in the first place, and “admittance” farther below.

lines 267-268: “considering a channel-base current typical of subsequent return strokes, as depicted in Fig. 4” - should we assume that all calculations, even as far down as figures 11, 12, etc, are all done using a stroke peak current of 12 kA, given the words here about “as depicted in fig. 4”? Or does the stroke peak current ever vary in the calculations presented farther down?

line 298: “ground conductivity values ranging from $\sigma_p = 10^{-1}$ S/m to $\sigma_p = 10^{-4}$ mS/m” That second unit of measurement should be S/m, I think, rather than mS/m. More generally, it might just make more sense to stick with one unit of measurement, whether mS/m or S/m, throughout the paper.

lines 299-300: “(1) fields with shorter rise times (fast transients) tend to create larger $E_x$-field peaks, and (2) fast transients are better preserved over propagation path with high conductivity σp” – I think that I may have lost touch a bit: in figure 10a, I assume that the frequency content of the lightning signal is an issue ***indirectly***, via the fact that higher values of $\sigma_p$ attenuate the high-frequency content of the original signal less, as shown in figure 7 rather than figure 10a. Is my understanding correct, or have I missed something?

lines 365-368: it is worth pointing out that the sampling instant in question here applies only to the measurement of angle of arrival and peak amplitude, but the sampling of the arrival time is hardly affected because times of arrival are measured as close as possible to the start of the rising edge of the waveform, precisely to avoid the significant delay of the peak due to propagation effects.

lines 404-414: discussion surrounding figure 15 appears to be on solid ground, but slightly confusing. In lines 407-408, “For a burial depth of 1.5 m, the angle site errors $\alpha_{err}$ decrease by only -8.5%, while the total reduction reaches -46%” you may want to clarify that the decrease of 8.5% addresses only the cable depth component, whereas the term “total reduction” is the combination of cable depth plus increased distance to the sensing antenna when the antenna is kept at 2 m above ground. It is also not exactly clear what is meant by “Thus, the contribution of the cable distance to the sensor remained practically the same, as expected” at the end of that section: In figure 15a, the combined total reduction actually appears to be about 3 degrees zero to peak, as opposed to the 1.3-degree reduction (3.07 vs 1.78) stated in the high-conductivity case.

lines 470-489 make reference to “wave propagation effects” several times. This may be another place where I've lost touch with earlier sections of the paper. I see “wave propagation” in line 163, where it clearly appears to refer to the effects on the overall signal as it propagates long distances over lossy ground. Then again “wave propagation” appears in line 373, which is a reference to the vertical penetration of the $E_x$ component and thus the induction of current on the cable. In lines 470-483, I think that the “wave propagation effects” refer to the vertical penetration part, but it's not entirely clear, at least not to me.