EGU21-5547
https://doi.org/10.5194/egusphere-egu21-5547
EGU General Assembly 2021

Lightning Sferics for Lightning Location – Complex Analysis

Xue Bai and Martin Fullekrug
University of Bath, Bath, United Kingdom (x.bai@bath.ac.uk)

Lightning location networks commonly use the time stamps of the received radio waveforms from lightning flashes (sferics) at numerous stations to determine a single lightning flash location. In order to extract more information from the recorded lightning waveforms, a complex analysis of the received electromagnetic waves is investigated.

The long term aim of this study is to use the complex radio waveforms from lightning flashes (complex sferics) to develop an interferometry technique that uses complex parameters inferred from each individual sample (Liu et al., 2018). In this work, the coherency of complex lightning sferics is investigated, which is a measurement of the phase information. Complex lightning sferics are not well understood such that an analysis strategy needs to be developed. We adapt here the idea of using a waveform bank (Said et al., 2010), which is composed of lightning sferics at predefined distances. Before generating the waveform bank, a rigorous quality check process is carried out to ensure a high data reliability for the selected lightning events. Both, the amplitude waveform bank and the coherency waveform bank are generated. The novelty of this work is that the coherency measurement is shown to be as valid as the amplitude measurement towards the characterisation of the received lightning waveforms at various distances. In particular, the coherency has the capability to detect more skywaves than the amplitude alone.

The potential impact of this research for lightning detection and location networks is that this novel method is able to locate a single event in an area defined by the coherency distribution map when different combinations of the waveform time stamps are used (Füllekrug et al., 2016). In future work, the coherency distribution map of a single lightning event could be calculated, and a dynamic coherency map can be built on top of that. The dynamic coherency map is capable to reveal formation on propagation track of each storm, and may possibly be used for lightning forecasting.

References:

Füllekrug, M., Liu, Z., Koh, K., Mezentsev, A., Pedeboy, S., Soula, S., Enno, S.E., Sugier, J., and Rycroft, M.J. (2016), Mapping lightning in the sky with a mini array, Geophys. Res. Lett., 43, 10,448–10,454, doi:10.1002/2016GL070737.

Liu, Z., Koh, K.L., Mezentsev, A., Enno, S.E., Sugier, J., and Fullekrug, M. (2018),

Lightning sferics: Analysis of the instantaneous phase and frequency inferred from complex waveforms. Radio Science, 53, 448– 457, doi:10.1002/2017RS006451.

Said, R.K., Inan, U.S., and Cummins, K.L. (2010), Long□range lightning geolocation using a VLF radio atmospheric waveform bank, J. Geophys. Res., 115, D23108, doi:10.1029/2010JD013863.