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A modified K-Means method to evaluate location accuracy of lightning networks based on video data

Authors

Dr. Antonio Saraiva - UNESP - State University of Sao Paulo

Dr. Gisele Saraiva - National Center for Natural Disasters Monitoring and Warning (CEMADEN)

Ms. Gabriela Cardozo - UNESP - State University of Sao Paulo

Dr. Osmar Pinto - Earth System Science Center - CCST / INPE

Abstract

The evaluation of a lightning location network should contain two basic information, the detection efficiency, which shows the percentage of total lightning actually observed, and the location accuracy, which is related to the uncertainty about the point of contact of the ground discharge. According to Nag et al. (2015), direct and indirect methods are used for the assessment of location accuracy. Direct methods are based on accurate knowledge of the discharge location (e.g., tower or artificially triggered lightning), while indirect methods are based on other methods where location is not precisely known (camera analysis, network self-evaluation, comparison between networks, etc.).

In this work, we proposed a new method to evaluate the lightning location accuracy of BrasilDAT network using on a modified K-means method, using high-speed videos as base data from RAMMER network. We refined a camera-based indirect method, previously used in the literature (e.g. Biagi et al., 2007). The great advantage of this method is that it can be used to benchmark anywhere without the need for special conditions. The lightning data were observed during three summer seasons (2012, 2013 and 2014), with high-speed cameras that filmed the phenomena at up to 2500 frames per second, synchronized by GPS and compared to data provided by BrasilDAT.

We developed a program that calculated the centroid of locations provided by BrasilDAT for those discharges that hit the same ground contact point. Confirmation that a group of discharges on the same ground contact point was given by the video data. The program still iteratively eliminated from the centroid calculation the locations whose error exceeded a certain threshold (2km in this work). An optimized centroid was calculated after a few iterations. Because this centroid represents the optimal location of the discharge, the error is measured between the location given by the network and the centroid.

The data obtained were compared with the method used by Biagi et al. [2007] using the first return discharge, which occurs on the same channel, as the reference. A variation of the method, which uses the most intense discharge as a reference, was also used in the comparison.

In Table 1 we compare all the methods used in this work. A decrease in localization error is noticeable when we use the method proposed in this work, reaching half of what is proposed by the method of Biagi et al. for 2012 data.

More details on the method are presented on the paper, as well as other evaluations of BrasilDAT network, like the detection efficiency and IC/CG discrimination.

References

Biagi, C. J., Cummins, K. L., Kehoe, K. E., & Krider, E. P. (2007). National lightning detection network (NLDN) performance in southern Arizona, Texas, and Oklahoma in 2003–2004. *Journal of Geophysical Research: Atmospheres*, 112(D5).

Nag, A., Murphy, M. J., Schulz, W., & Cummins, K. L. (2015). Lightning locating systems: Insights on characteristics and validation techniques. *Earth and Space Science*, 2(4), 65-93.

Attachments

[table1.png](#)

ANO	Método do Centroide	Biagi et al. [2007]	Modificada de Biagi et al. [20017]
2012	0,82	1,59	1,32
2013	0,53	0,73	0,72
2014	0,60	0,94	0,90

Topic Areas

Lightning Detection Systems Technology and Performance

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