Researchers optimize errors caused by traditional interferometer system in lightning study

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Lightning is one of the most spectacular natural phenomena. With technological advancements, researchers are using more advanced tools

and methods to study lightning to better understand its complex physical processes.

Among these tools, the Very High Frequency Lightning Interferometer stands out as a significant method in lightning research, capable of tracking lightning discharges with nanosecond precision and providing key data on lightning paths and mechanisms. However, the accuracy of interferometers is affected by systematic errors arising from fundamental observational models.

A research team led by Fan Xiangpeng from the Northwest Institute of Eco-Environment and Resources of the Chinese Academy of Sciences found that the traditional model (plane wave assumption) of interferometers introduces significant errors when dealing with close-range radiation sources or longer baseline lengths. Their study was published in *IEEE Transactions on Geoscience and Remote Sensing* on Nov. 7.

The researchers found that these errors affect the accurate measurement of discharge source directions, limiting the interferometer's ability in high-precision lightning detection.

Fan proposed a conceptual model for systematic errors caused by the plane wave assumption and verified by simulation that an equilateral triangle baseline layout is superior to the commonly used orthogonal baseline layout.

The researchers showed that systematic errors can be optimized by utilizing the geometric relationships of the equilateral triangle layout.

Additionally, they introduced a baseline layout scheme with the coordinate origin at the center of the equilateral triangle, thereby improving positioning accuracy.

The results are significant in improving the reliability and precision of lightning observations. This work not only provides new theoretical insights but also proposes a highly symmetrical (axially and centrally symmetrical) pentagonal (comprising five antennas) interferometer observation scheme for practical observations.

With this scheme, systematic errors are effectively eliminated, providing theoretical guidance for high-precision lightning observations.

More information: Xiangpeng Fan et al, Effect of Spherical Wavefronts on Very-High-Frequency (VHF) Lightning Interferometer Observations, *IEEE Transactions on Geoscience and Remote Sensing* (2023). DOI: 10.1109/TGRS.2023.3330899

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