

Question:

Title: Analysis on Electric Field Based on Three-Dimensional Atmospheric Electric Field Apparatus

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_Summarize the main findings of the paper in a minimum of 400 words. The summary should be written in a way that the reader can understand the following:

- a) What issue or problem is being addressed by the authors? In other words, what is the problem statement of the paper.
- b) What is the solution presented by the authors? You may ignore the Experimental results section if you like.

ANSWER

The main problem statement of this paper is how can we measure the electric field of the atmosphere to get an idea of the chances of lightning striking any location, and therefore develop an accurate lightning warning system. Old methods only worked for measuring the vertical component of the electric field, and are thus not effective in giving accurate measure of electric field especially within a thunderstorm. The researchers will use a 3D electric field system to measure the electric field of the atmosphere. The innovation is that this system can measure electric field in all three unit directions of Cartesian system i.e. along X, Y, and Z axis. This will be done by studying the electric field and the permittivity of the ground and the relation between these two quantities. This will allow us to calculate a model to measure the electric field in 3 dimensions. They will also create a sensor to detect the permittivity and another sensor to detect the electric field. These will be used to find the total electric field.

This effort is made because a necessary part of predicting and warning against lightning strikes relies upon measuring the electric field of the atmosphere. As we are now using more electrical equipment than ever before, it is even more important so that we can prevent disasters. As lightning strikes can completely destroy electronic equipment. It has been previously observed that the electric field inside and outside a thundercloud during a storm rapidly fluctuates. Detecting these rapid changes can help in predicting strikes of lightning. Previously researches have tried to measure the electric field located at the center of charges of a thunderstorm, but have only been able to find its vertical component. Yet, the components of electric field in horizontal direction will also play a role. Different researchers have worked on measuring the horizontal parts as well, yet their methods have involved expensive and complicated equipment. This paper has progressed by using previous work done to measure components of electric field in 2 dimensions. One thing previous research work ignored was the effect of dielectric constant. Usually the ground is modeled as a conductor, but the Earth has layers of different materials such as rock and water, etc. and thus can be modelled better with a dielectric constant. This assumption of Earth as a perfect conductor will thus lead to inaccurate findings. The researchers have tried to build an accurate system to predict lightning strikes by taking into account all components of

electric field of atmosphere as well as the permittivity of the Earth. They have used a sensor for the measurements. Moreover, the elevation and azimuth of the place we want to predict chance of lightning strike is also taken into account. The assumptions made include treating the earth and thunderstorm cloud as a point charge. They also use the method of images to find the electric field at a surface, by assuming there is a charge of opposite sign and equal magnitude from surface. They find the azimuth angle and angle of elevation using mathematical manipulation of equations for electric field with these assumptions and methods. The equipment for measuring 3d electric field is integrated with the tool to measure permittivity. Through signal processing we get readings from both. The equipment to measure 3d electric field uses electrostatic induction principle. It has different parts such as electrode and a motor in x, y and z directions. While the permittivity measuring equipment is developed. It uses different electrodes and measures capacitance to find permittivity.

The results of implementing such a system showed that it provided a good response and can give accurate results of elevation and azimuth of thunder clouds. It also had more reliable measurement of electric field and can provide a base for future work.

Word count: 633