COMPARING LIGHTNING POLARITY AND CLOUD MICROPHYSICAL PROPERTIES OVER REGIONS OF HIGH GROUND FLASH DENSITY IN SOUTH AFRICA

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INTRODUCTION

Lightning carries either a positive or a negative charge. Positive lightning strokes are where positive cloud charges are discharged from the cloud to the earth, and negative lightning strokes are where negative cloud charges are discharged from the cloud to the earth (Berger, 1977). Positive lightning flashes are known to be more intense and cause more damage than negative flashes, although positive flashes only occur about 10% of the time (Rakov et al, 2003). This study aims to find a correlation between lightning polarity and microphysical properties of a storm cloud, for events where large amounts of lightning damage have occurred and/or there has been a reported lighting-related fatality. Between January 2007 and May 2011 there have been approximately 28778 paid insurance claims by an insurance company, with an average of 6261 claims per year, only for lightning related damage over the Highveld region of South Africa. Most of this damage has been reported over the Gauteng region.

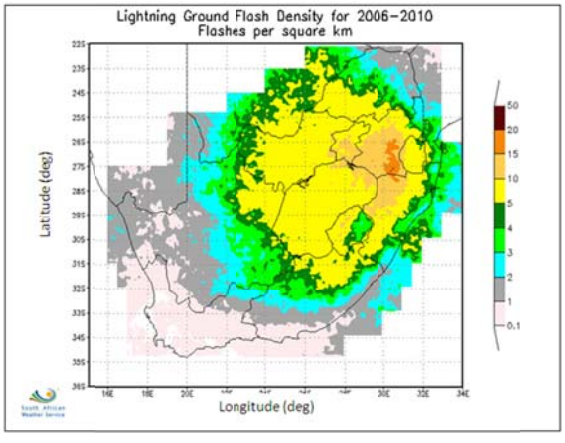

Figure 1: Lightning Ground Flash Density 2006-2010.

The Highveld region of South Africa receives the highest ground flash density compared to any other region in the country, as seen in Figure 1 (Gill 2008). This region will be focused on in the study, with an emphasis towards the Gauteng Province.

DATA AND METHOD

The data used in this study is narrowed down into specific cases, gathered from the information received from insurance claims data. Dates on which lightning related fatalities were reported are compared with the insurance claim data, in order to investigate these events. Data from the SAWS Lightning Detection Network (LDN) is manipulated in order to identify the total amount of lightning strokes and the stroke polarities for each case study date. The lightning polarity data will be displayed separately for the amount of positive and negative strokes for the relevant time period. Meteosat Second Generation (MSG) satellite data is used to determine the cloud microphysical properties of the storms identified in each of the case studies. Data from single satellite channels, as well as channels differences and Brightness Temperature Difference (BTD) are further used in order to ascertain particle phase information. Once the two data sets have been compared, a correlation between lightning polarity and cloud microphysical properties can be established for the areas of interest.

RESULTS

The first case study to be investigated is for the 2nd December 2009, a day for which over 150 insurance claims were honoured and where there was a reported fatality in Vanderbijlpark during the afternoon. Figure 2 shows the monthly lightning claims data for December 2009, over the Highveld region of South Africa and includes the average amount of claims for the month. This image shows that on the 2nd

December 2009, the amount of lightning damage was well above average for this data set.

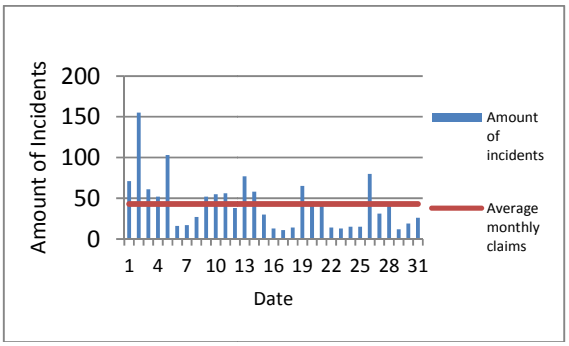

Figure 2: Histogram of number of insurance claims due to lightning for December 2009

Figure 3 shows that Vanderbijlpark falls within one of the regions with the highest total stroke count, and has received 600-800 lightning strokes between 13Z-14Z.

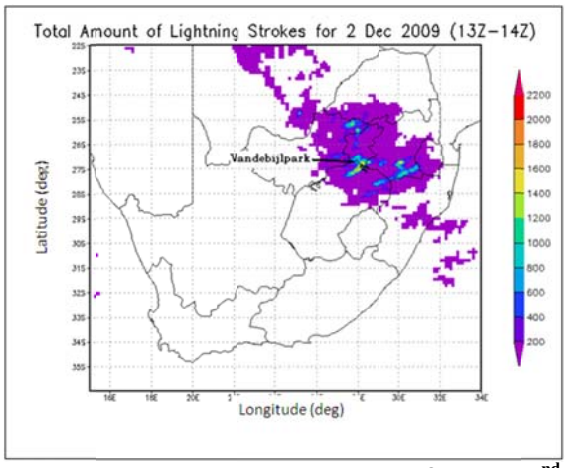

Figure 3: Total lightning strokes for the 2nd December 2009 13Z-14Z. (copyright SAWS)

Further manipulation of the data shows that the amount of positive lightning strokes during this period, as can be seen in Figure 4, is between 40-60 positive strokes detected over the Vanderbijlpark region, which relates to a percentage of approximately 6-7.5% of all strokes being positive during the same time period. This falls slightly below the generally accepted rate of 10% of lightning strokes being of positive polarity.

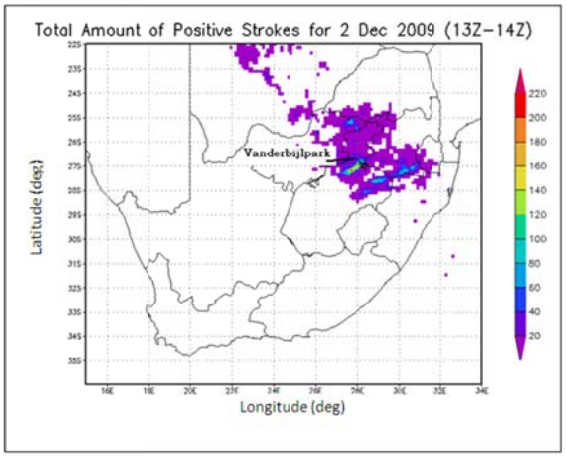

Figure 4: Positive lightning strokes 2nd December between 13Z-14Z (copyright SAWS)

Similar data sets will be created for each of the identified case studies, with the addition of satellite data.

SUMMARY

Comparing total lightning strokes and the percentage of positive strokes between 13Z-14Z on the 2nd December 2009, it is seen that of the 600-800 lightning strokes detected, 6-7.5% percent of those were of a positive polarity over Vanderbijlpark.

REFERENCES

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