

LIGHTNING ACTIVITY DURING 2011 PUYEHUE VOLCANIC ERUPTIONS

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In this paper we conducted a study of electrical activity generated by the eruption of Puyehue-Cordon Caulle in June 2011 using lightning data detected by the World Wide Lightning Location Network. The electrical activity observed corresponds to electrical discharges generated in the plume with a good correlation between the amount of discharge and the volcanic plume height. Although the electrical activity detected was low, the results agree with those obtained in previous studies and show that electrical activity can be used as an indicator of volcanic activity.

1. General

Several studies (Thomas et al., 2007[1], 2010[2], Bennett et al., 2010[3], Harrison et al., 2010[4], Behnke et al., 2012[5], among others) have shown that volcanic eruptions can generate lightning. For instance, McNutt and Williams (2010) presented a global dataset of volcanic lightning and showed that 212 eruptions, produced by 80 volcanoes, had been documented as lightning producer.

The aim of this work is to study the volcanic lightning due to the Puyehue- Cordon Caulle (1507-15) volcano eruption using the lightning data from the World Wide Lightning Location Network (WWLLN).

The Puyehue – Cordon Caulle Volcano is located at 40.5900° South latitude and 72.1170° West longitude and summit elevation 2236 meters and had erupted at 15 hour (local time) on June 4th of 2011. The eruption was classified as level 6, which represents a VEI (Volcanic Explosivity Index) of Class 3, and presented a plume with a height between 7 and 12 km for the major event

2. Discussion

A spatial windows between [-42°; -40°] of latitude and [-73°; -71°] of longitude with a 0.1° x 0.1° spatial resolution was used. In this spatial window, 115 events were detected by WWLLN between 4 and 7 of June, while for the previous days only an event was detected. Figure 1 shows the electrical activity detected between 4 and 7 of June, which presents a spatial distribution with a southeast preferential direction. The reports for these days indicate that there was a gas column height of 10 km and 5 km wide, with south winds at 5 km altitude

and south-east direction at 10 km altitude. Therefore, the location of the detected discharges is consistent with these reports and plume observed in different satellite images.

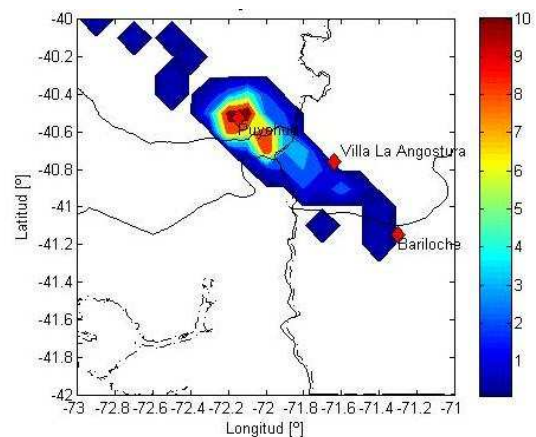


Figure 1. Electrical activity detected by WWLLN between 4 and 7 of June.

Most of the discharges (> 60%) occurred between 5 and 20 km from the volcano (See Figure 2). Reports indicate that the eruption began at 15:00 (local time) on June 4 and the first event detected by WWLLN occurred at 18:41 (local time) the same day. All this would indicate that the detected electrical discharges occurred in the volcanic plume as they have a spatial and temporal distribution consistent with it.

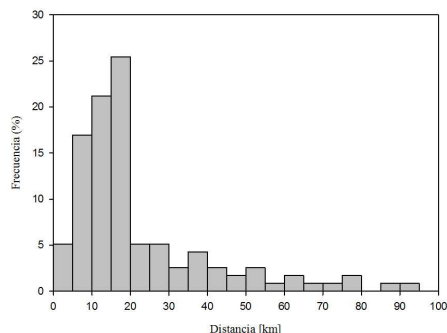


Figure 2. Histogram of the distance between the location of the lightning and the position of Puyehue crater.

There is good correlation (Pearson coefficient > 0.8) between the height of the plume and the number of detected lightning discharges. It is further observed that the WWLLN detects electrical activity when the height of the volcanic plume is higher than 7 km as is shown by Figure 3.

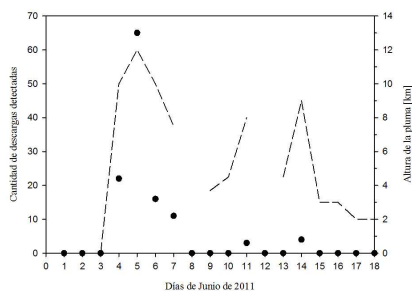


Figure 3.: Number of detected lightning discharges (black circles) and plume height (broken line) per day between 1 and 18 of June.

3 Conclusions

The electrical activity observed is consistent with the plume generated by the eruption of Puyehue Volcano. The location of most of the discharges identified had a southeasterly direction from the volcano which is in accordance with the prevailing wind direction and the plume observed.

For the first time, the electrical activity generated by a volcanic eruption in South America was detected. Although the detected electrical activity is low and corresponds only to the electrification of the plume, the results are in agreement with results obtained in previous studies and show that electrical activity can be used as an indicator of volcanic activity, particularly for those volcanoes which are not monitored and are located at high latitudes as those located in southern Argentina and Chile.

4. References

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4 Acknowledgments

The authors wish to thank the World Wide Lightning Location Network (<http://wwlln.net>) collaboration among over 50 universities and institutions, for providing the lightning location data used in this paper.