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Lightning Observations of the Taal Eruption

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Volcanic eruptions can severely affect our environment by directly impacting local and downwind communities, reducing air quality, and disrupting airline flights and marine traffic. Understanding how volcanic lightning is produced, as well as trends in its characteristics, can help mitigate these hazards by giving early warning of the eruption onset and improving the forecasts of ash dispersal.

In this study, we use data from the Earth Networks Total Lightning Network (ENTLN) to investigate the lightning activity during the Taal Eruption, and compare that activity to normal, non-volcanic thunderstorms. ENTLN is a global network of wideband electric field sensors used to detect and locate lightning since 2009. Recently, ENTLN was expanded with a dense deployment of sensors in the Philippines, where Taal is located, offering very detailed observations of the lightning activity during the eruption. The Taal eruption started around 7 UTC on January 12, 2020, with lightning activity immediately following the eruption and continuing unabated for 14 hours. 1-2 hours following the eruption, there was a surge of lightning activity where flash rates reached a peak value of 87 flashes per minute, after which the lightning flash rate subsided. Around 4-5 hours after the eruption began, there was a second surge of lightning activity with flash rates reaching 103 flashes per minute. After this second surge of activity, the flash rates gradually decreased for the rest of the eruption. In comparison to normal thunderstorms, the Taal eruption was very electrically active, with flash rates comparable to strong thunderstorms [2,4]. Initial results show a reasonable correlation between flash rate and IC:CG ratio, with the ratio being lower just prior to times of rapid increase in flash rates. The peaks in IC:CG ratio were ~90% during peaks in flash rate, comparable to conventional thunderstorms [1,3], and dropped to ~80% during rapid increases in flash rates. Furthermore, the average peak current increased from ~5 kA/flash at the beginning of the eruption and peaked at 15 kA/flash coincident with the 2nd peak in flash rate. These results will help with understanding how volcanic plumes evolve over time as well as the underlying mechanisms for plume electrification.

References

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