JP1.6 METEOROLOGICAL CASE STUDIES OF LIGHTNING STRIKE VICTIMS IN COLORADO – AN UPDATE

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1. Introduction

This paper continues the work of examining the meteorology prior to people being struck by lightning in the state of Colorado. In previous work, individual case studies were examined in detail showing the: (1) Temporal and spatial aspects of the Cloud to Ground (CG) lightning activity and: (2) Precipitation characteristics prior to the strike that caused the casualty (Hodanish 2006). This paper will focus on summarizing the temporal/spatial aspects of the CG lightning activity, with a focus on the activity occurring within 6 miles and 5 minutes of the flash which caused the casualty.

2. Discussion

A total of 17 cases have been examined to date. The first case occurred in 2000 (Hodanish 2004), while the latest case occurred late in the warm season in 2008. It should be mentioned that not every lightning flash which caused a casualty in Colorado during the last 8 years was examined. The author of this paper is an operational meteorologist, and examines lightning casualty cases as time permits.

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In order to observe which CG flash from the NLDN data set caused the casualty, two pieces of information need to be known. The first piece of information is acquiring the exact time of when the lightning flash hit the victim, while the second piece of information is accurately documenting the location of where the victim was struck. Typically, the victim(s) location is well documented. Emergency responders will typically use GPS to mark the location of where the victim was found after being struck (this assumes the victim was not moved until the emergency medical authorities arrived). On the other hand, knowing the exact time of when a lightning flash incident occurred can be difficult at times, especially if it is only one victim and no other people were in the vicinity when the flash occurred. This is typically the case of lone hikers in the Colorado high country. Victim(s) who were affected by a flash in more densely populated areas, or if a group of people were affected, then the time of the incident is likely to be well documented.

A complicating factor in this study was found to occur when multiple CG flashes occurred within close proximity of the victims' location. In this situation, it was difficult to ascertain which flash actually caused the casualty. In this paper, cases where the exact flash could not be determined, then the flash which occurred closest to the victim and closest to the time

of the 9-11 call was determined to be the flash which caused the casualty.

In Hodanish (2006), the following definitions were used to define the frequency of CG lightning activity prior to the flash which caused a lightning casualty:

Frequent CG activity: CG activity during the 5 minute time period up to the time of the casualty was occurring on average at the rate of >=1 flash per minute within a 6 mile (9.7 km) radius of the casualty location.

Infrequent CG activity: CG activity during the 5 minute time period up to the time of the casualty was occurring on average at a rate of <1 flash per minute within a 6 mile (9.7 km) radius of the casualty location.

A subset of infrequent CG activity are events which the first flash from the cell produced a casualty. This event type is defined as:

First flash of the convective cell: No CG lighting within a 6 miles (9.7 km) radius in a 30 minute time period up to the time of the casualty.

In this paper, these same definitions will be used. In the definitions above, the distance of 6 miles (9.7 km) was chosen as this is the distance in which people should be in safe shelter when lighting is occurring (30-30 lightning rule, AMS 2002). The flash rate values of <1 flash per minute and >= 1 flash per minute were arbitrarily chosen.

Table 1 shows the date, general location and the flash rates (# flashes/5 minutes) prior to the flash which caused the casualty. Of the 17 cases, six had frequent CG activity (>=1 flash/min averaged over a 5 minute time period prior to the fatal flash) while 11 other cases had infrequent CG activity. Of the 11 cases which had infrequent CG activity, 2 were "first flash of the convective cell" events. In one of the cases in Table 1, it could not be determined which flash caused the casualty.

Figure 1 shows plots of CG activity for the first 16 cases shown in Table 1. Each plot shows the CG activity within 6 miles and a 10 minute time period prior to the casualty. Of the 17 cases, the exact GPS location of the victim was known for 11 of them. The other 6 the victims location was fairly well defined (e.g.,"on a ballfield at Pueblo East High School"), but an exact GPS location was not available. The cases where a specific GPS location was not available were: Pikes Peak, Red Cone Pass, Littleton, Arvada, Pueblo, and Colorado Springs (COS).

For the last case in Table 1, (Mineral), it could not be determined which flash actually caused the casualty. In this case, the victim was not found until several days after the fatality occurred (the location of the body was marked by GPS). A review of the NLDN data between the time he was last seen and the time he was found indicated only one short lived thunderstorm occurred at the victims' location, and this storm occurred on the 28th of July 2008. The storm lasted for about 35 minutes and produced 19 CG flashes. A review of the CG activity in

this case (Fig 2) indicated 4 flashes occurred within 0.5 miles of the victims' location. Either one of these flashes could have caused the fatality.

As the data shows, most of the people struck by lightning in Colorado are struck by storms that produce infrequent CG activity, that is, storms that produce less than 1 flash per minute. Based on this information, *people are reminded that ANY cloud to ground lightning is dangerous, no matter how infrequent it is.*

More information about these individual case studies can be found on the NOAA/NWS Pueblo Colorado Lightning Resource Page:

http://weather.gov/pub/ltg.php

Table 1. Date, general location and flash rates of storms which produced casualties in the State of Colorado

Date yymmdd	Location	#flashes/5min, (f/min)
000725	Pikes Peak	0/5 min, (0.0 f/min)
030727	Crestone	10/5 min, (2.0 f/min)
030824	Lake George	5/5 min, (1.0 f/min)
030824	Redcone Pass	1/5 min, (0.2 f/min)
040529	Littleton	0/5 min, (0.0 f/min)
040619	Kremmling	5/5 min, (1.0 f/min)
040707	Arvada	1/5 min, (0.2 f/min)
040801	Breckenridge	7/5 min, (1.4 f/min)
050723	Pueblo	2/5 min, (0.4 f/min)
050906	Rocky Ford	0/5 min, (0.0 f/min)
060621	Jeffco	0/5 min, (0.0 f/min)
060719	Colo Sprgs (COS)	1/5 min, (0.2 f/min)
060719	Woodland	4/5 min, (0.8f/min)
070902	Oldstage	9/5 min, (1.8 f/min)
080703	Bear Basin	4/5 min, (0.8 f/min)
080724	CSU, Ft Collins	40/5 min, (8.0 f/min)
080728	Mineral (contdvd)	Could not be determined

then click on the "Lightning Casualty Case Studies in the State of Colorado" link.

3. Acknowledgments

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4. References

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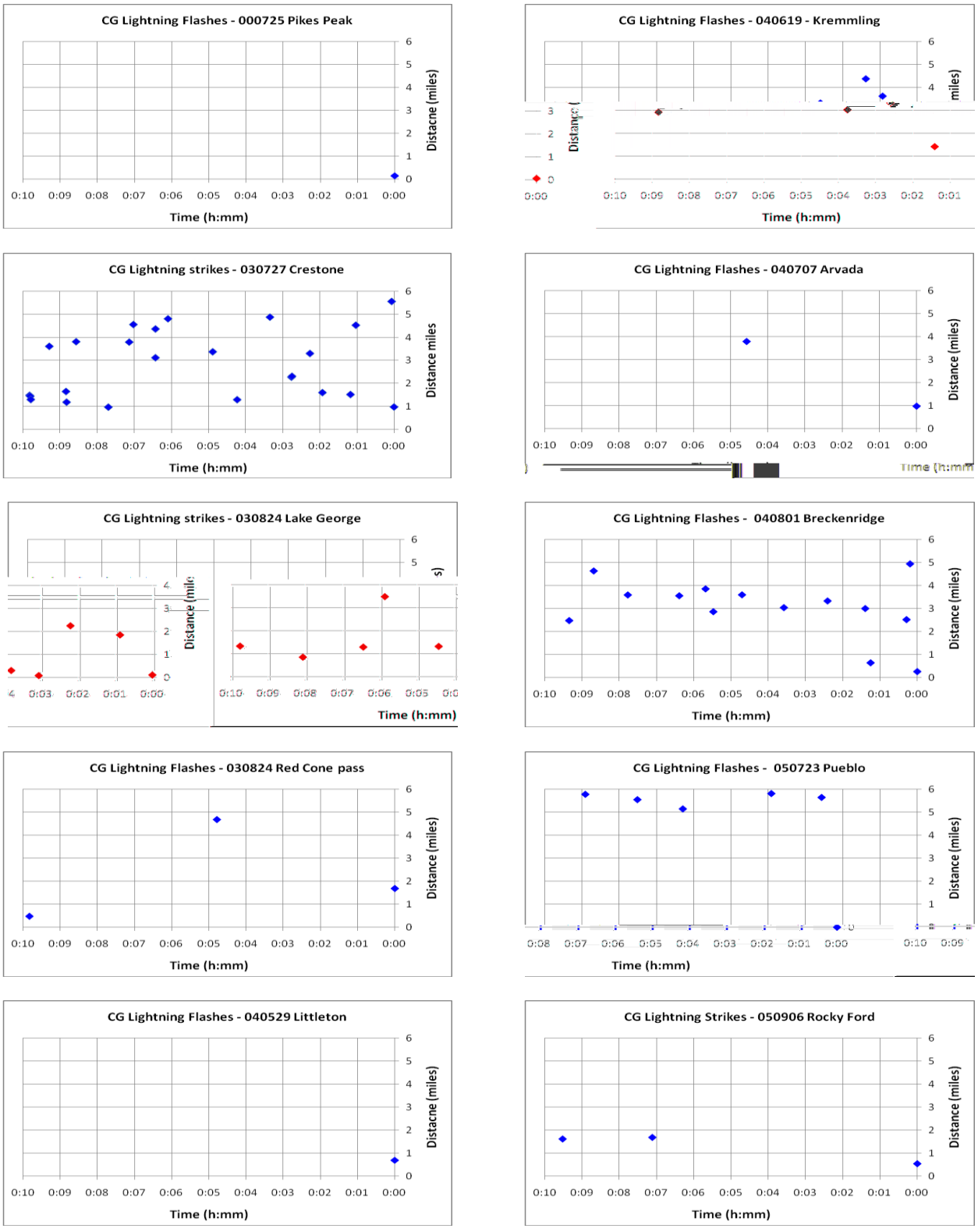

Figure 1. Time vs distance plots of CG activity for the first 10 cases shown in Table 1. Each plot shows the CG activity within 6 miles and 10 minutes leading up to the casualty. “0:00” represents the time of the actual casualty.

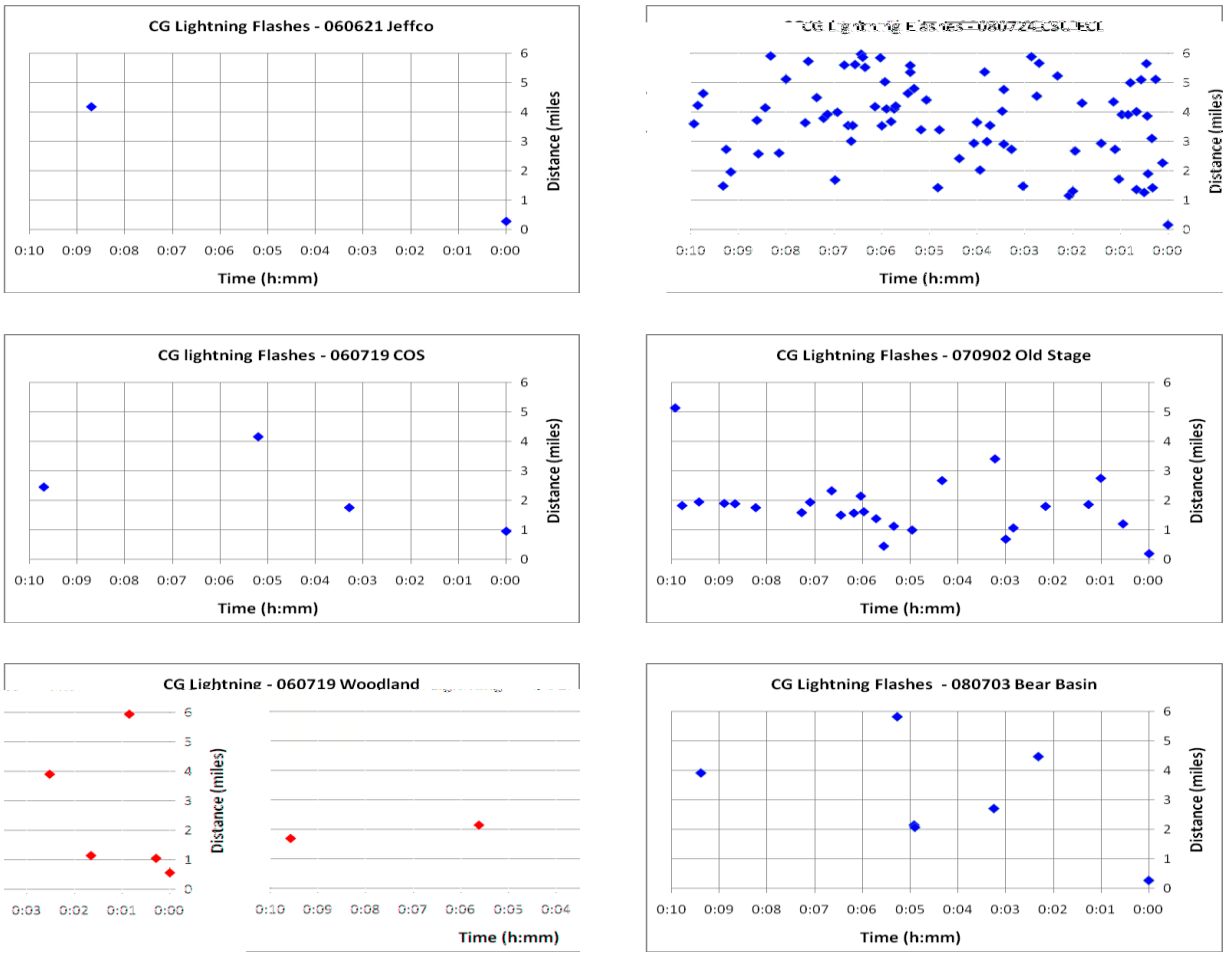

Figure 1 (cont). Time vs distance plots of CG activity for 6 additional cases shown in Table 1. Each plot shows the CG activity within 6 miles and 10 minutes leading up to the casualty. “0:00” represents the time of the actual casualty.

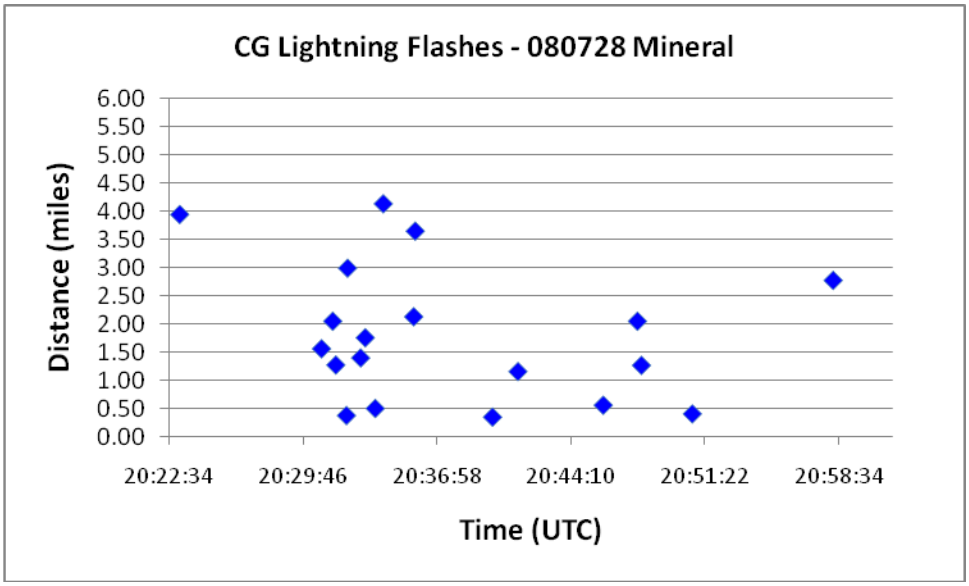

Figure 2. Same as the plots in figure 1, except in this case the flash which caused the casualty could not be determined. In this case, the time on the abscissa is the actual time of when each flash occurred.