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A Review Of NOAA's Lightning Safety Awareness Campaign and It's Impact Across The United States

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1. ABSTRACT

In 2001, the National Oceanic and Atmospheric Administration (NOAA) began a nationwide campaign to reduce the number of lightning deaths and injuries across the United States. For this effort, NOAA teamed up with non-governmental organizations and individuals to find ways to draw attention to the dangers associated with lightning. Many of NOAA's partners on the team included people that had worked on the lightning safety effort since the early 1990s (Cooper, 2012) or earlier. Since 2001, NOAA's "Lightning Safety Awareness Team" has worked together to provide lightning safety information to local National Weather Service (NWS) offices, the media, and the public. The centerpiece of this effort is NOAA's Lightning Safety web site, which serves as a clearinghouse for information on lightning safety. Also during this time, NOAA and the National Weather Service (NWS) have declared the last full week in June as Lightning Safety Awareness Week and have worked with organizations and agencies involved with outdoor activities and the media to help deliver these safety messages. As a result of these efforts, lightning fatalities in the United States have declined. In fact, as of the start of 2011, lightning had dropped to the third greatest storm-related killer in the U.S., falling below tornadoes. In 2012, lightning deaths in the U.S. fell to the lowest level ever recorded.

In this paper, we review NOAA's and the NWS's efforts to reduce lightning casualties in this country and show some of the specific resources NOAA, the NWS, and NOAA's Lightning Safety Awareness Team have made available to the public and media. We will also highlight some of the recent coordinated efforts to promote lightning safety between NOAA and non-governmental organizations and individuals.

2. NOAA'S LIGHTNING SAFETY CAMPAIGN

While the NWS has promoted weather safety and preparedness for many years, the current effort to highlight the dangers of lightning began in 2001 when NOAA organized a team to spearhead a national lightning safety effort (Jensenius and Franklin, 2006). Since then, NOAA's Lightning Safety Awareness Team has developed information and safety materials, and made this information available to the public and media. Most of this information is available on NOAA's Lightning Safety web site. In addition, the National Weather Service holds a national Lightning Safety Awareness Week during the last full week of June to highlight the dangers associated with lightning.

3. NOAA's Lightning Safety Web Site

NOAA's Lightning Safety web site (<http://www.lightningsafety.noaa.gov>) provides information and awareness materials on a variety of topics related to lightning and lightning safety. In the following sub-sections, we highlight a few. The main goal of the web site is to provide materials that lead to an increased awareness to the dangers of lightning so that the public takes the appropriate precautions when thunderstorms threaten.

3.1 Safety Information

A primary objective of the web site is to provide accurate safety information on lightning. The web site has information on indoor and outdoor safety issues and emphasizes that there is no safe place outside when thunderstorms are in the area. The web site contains many resources related to lightning safety. We discuss some of these resources later in this paper.

3.2 Science

The science section of the web site contains information on the science of thunderstorms and lightning. Also included is a history of the beliefs related to lightning throughout the ages and the misconceptions that people had throughout history. Finally, the section debunks many of the myths about lightning and lightning safety that people still believe.

During 2011, a new overview section was added to the web site to provide basic information on thunderstorm development and electrification, lightning, and lightning safety. Animations are included in this section to help people understand thunderstorms and lightning. Figure 1 shows a still image from one of the animations. NOAA will add a more thorough section on the science of thunderstorms during 2012.

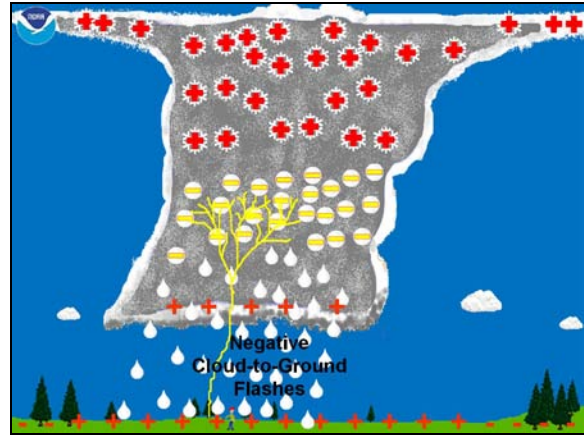


Figure 1. Screen capture from NOAA web animation showing types of lightning flashes.

3.3 Statistical Information

Statistical information on lightning and lightning incidents is very important in understanding safety issues related to lightning. In addition to safety, the vast majority of media inquiries include requests for statistical information on lightning and lightning incidents.

3.3.1 Real-Time Documentation of Lightning Fatalities

Since 2006, the NWS has kept an up-to-date detailed list of U.S. lightning fatalities on the NOAA lightning safety web site (Figure 2). The list includes the date, day of the week and location of the incident, the age and sex of the victim, and the activity the victim was involved in at the time of the lightning strike. In addition, the web site includes a map showing the number of lightning fatalities by state (Figure 3). Finally, a summary of the demographics of the lightning victims is included (Figure 4). In addition to the media, the detailed information on lightning fatalities is becoming an increasingly important source of information for research on lightning fatalities in the U.S. (Roeder and Jensenius, 2012).

To date, there has been 26 fatalities in 2011 in 18 States and Guam Missouri and Utah tragically have 3 deaths

No.	Date	Day	ST	City	Age	Sex	Location	Activity	Victim
1	5/23	Mon	MO	Joplin	31	M	Outside open	Tornado rescue	Officer Jeff Taylor
2	6/7	Tue	LA	Shreveport	49	M	Golf course	Golfing	Jay Greenleaf
3	6/9	Thu	PA	Sadsbury	13	M	Open field	Baling hay	Levi Lantz
4	6/10	Fri	NC	Durham Cnt	45	M	Field	Feeding livestock	Steven Taylor
5	6/11	Sat	MT	Bridger	54	M	In open, on horse	Herding cattle	Gary Devries
6	6/21	Tue	SC	Ruby	26	M	Open field	Playing baseball	Michael Gulleddge
7	7/1	Fri	WI	Burnett Cnty	11	F	Under Tree	Camping	McKenzie Klar
8	7/3	Sun	NJ	Hammonton	54	M	Near Tree	Family picnic	Stephen M. Rooney
9	7/11	Mon	UT	Emery Cnty	56	M	Open Desert	Camping	Joseph L. Geiser
10	7/12	Tue	AZ	Big Lake	46	M	Camping	Camping	Rob Christopher
11	7/13	Wed	UT	Carbon Cnty	12	M	Open area	Camping, Scouts	David Rayborn
12	7/23	Sat	MI	Oscoda Cnty	54	F	River bank	Tubing	Lisa Mann
13	7/23	Sat	MI	Oscoda Cnty	54	F	River bank	Tubing	Cheryl Nickert-Keyser
14	7/30	Sat	MO	Polaski Cnty	20	F	River bank	Canoeing	Lindsey Smith
15	7/31	Sun	MS	Pacagula	41	M	Pier	Fishing	Bobby Broadus
16	8/3	Wed	SD	Wasta	57	M	On Interstate	Riding motorcycle	Kurt Stolba
17	8/4	Thu	AZ	Fredonia	64	F	Grand Canyon	Tourism	German tourist
18	8/5	Fri	MO	Warsaw	78	F	Boat Ramp	Pulling out boat	Peggy Louise White
19	8/8	Mon	AR	Rector	71	M	Open Field	Chopping cotton	William 'Neil' Arnel
20	8/18	Thu	UT	Bryce Canyon	51	M	Under tree	Tourism	Volker Kunz
21	8/31	Wed	CO	Westcliffe	59	M	Open area near mountain	Camping	Kirk Snyder
22	9/4	Sun	OH	Westchester	40	M	On Lake	Camping	Donnell Russell
23	9/11	Sat	FL	Tampa	21	M	Water Park	In water evacuating pool	Justin Savers Inverso
24	9/10	Sat	KS	New strawn	48	F	Reservoir dam	Bicycling	Patty Gilliam
25	9/15	Thu	NJ	Atlantic City	40	M	Building under construction	Finishing concrete	Bryan Bradley
26	10/14	Fri	GU	Hagåtña	59	M	In water on reef	Fishing	Edward Cruz San Nicolas

Figure 2. Detailed list of lightning fatalities for 2011

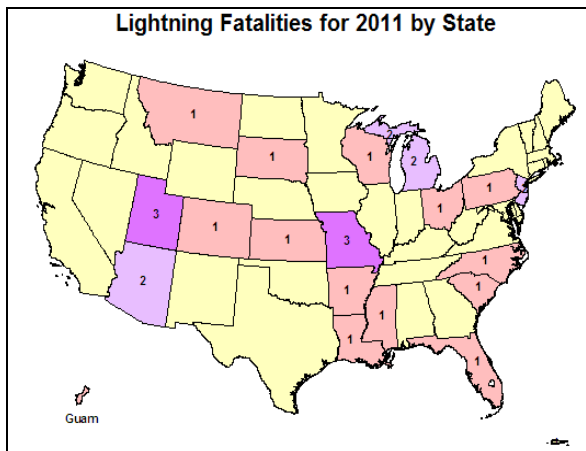


Figure 3. Map showing lightning fatalities by state.

2011 Lightning Fatality Demographics

State	Gender	Age	Day Of Week	By Month										
AZ	2	19 (73%)	0-9	0 (0%)	Sun	3 (12%)	Jan	0	0	0	1	0	1	0
AR	1	Fem	7 (27%)	10-19	3 (12%)	Mon	3 (12%)	Jan	0	0	0	1	0	1
CO	1		20-29	3 (12%)	Tue	3 (12%)	Feb	0	0	0	1	0	0	0
FL	1		30-39	1 (4%)	Wed	3 (12%)	Mar	0	0	1	0	1	0	1
GU	1		40-49	7 (27%)	Thu	4 (15%)	Apr	0	0	1	0	1	3	2
KS	1		50-59	9 (35%)	Fri	4 (15%)	May	1	4	2	2	5	5	6
LA	1		60-69	1 (4%)	Sat	6 (23%)	Jun	5	7	12	9	12	10	12
MI	2		70-79	2 (8%)			Jul	9	11	10	14	10	16	16
MO	3		80-89	0 (0%)			Aug	6	4	3	0	9	7	12
MS	1		Unknown	0 (0%)			Sep	4	2	4	1	5	4	5
MT	1						Oct	1	1	1	0	2	2	1
NC	1						Nov	0	0	0	0	0	0	0
NJ	2						Dec	0	0	0	0	0	0	0
OH	1						Year	26	29	34	28	45	48	55
PA	1													
SC	1													
SD	1													
UT	3													
WI	1													

Percentages may not add up to 100% due to rounding. * - Known Fatalities to date

Fatality data for past years is also available.

Figure 4. Demographics of lightning victims for 2011

3.3.2 Historical Lightning Flash Data

NOAA's web site contains historical information on lightning and lightning fatalities. Specifically, the web site includes maps of lightning flash density across the U.S. in terms of flashes per square mile (Figure 5) and flashes per square km, and includes tables showing state statistics and state rankings for lightning flashes (Figure 6) and flash density.

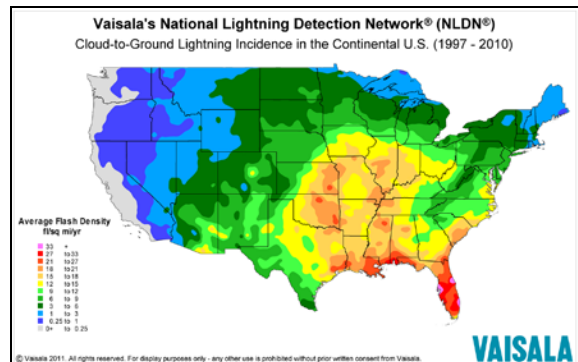


Figure 5. Average yearly flash density across the United States as observed by Vaisala's National Lightning Detection Network.

VAISALA					
Number of Cloud-To-Ground Flashes by State from 1997 to 2010					
State	Flashes In 2010	Average Flashes 1997 to 2010	State	Flashes In 2010	Average Flashes 1997 to 2010
Alabama	779,399	819,634	Nebraska	736,208	549,112
Arizona	523,570	653,324	Nevada	74,345	159,129
Arkansas	768,690	776,071	New Hampshire	9,992	23,194
California	75,557	85,202	New Jersey	37,831	45,611
Colorado	436,430	520,833	New Mexico	808,537	898,167
Connecticut	16,926	20,216	New York	113,761	219,792
Delaware	13,562	15,969	North Carolina	483,408	532,851
D.C.	789	791	North Dakota	354,408	295,782
Florida	1,098,979	1,438,322	Ohio	425,639	442,822
Georgia	816,772	815,701	Oklahoma	905,798	1,054,602
Idaho	67,234	84,145	Oregon	41,040	54,938
Illinois	1,030,558	804,484	Pennsylvania	239,808	307,045
Indiana	539,765	504,053	Rhode Island	3,548	2,617
Iowa	1,002,734	644,774	South Carolina	535,510	450,634
Kansas	1,052,961	944,191	South Dakota	452,905	398,133
Kentucky	524,256	537,537	Tennessee	691,886	583,369
Louisiana	693,515	921,775	Texas	2,554,117	2,987,181
Maine	26,234	47,260	Utah	208,597	247,766
Maryland	75,808	88,188	Vermont	13,966	26,733
Massachusetts	21,566	25,346	Virginia	301,008	344,702
Michigan	265,177	296,156	Washington	20,618	21,309
Minnesota	454,471	386,280	West Virginia	181,882	206,421
Mississippi	945,355	867,964	Wisconsin	382,025	302,683
Missouri	1,218,638	1,032,593	Wyoming	233,864	304,973
Montana	399,084	358,471			
TOTALS			TOTALS	22,669,742	23,148,843

These cloud-to-ground lightning flashes were measured by the National Lightning Detection Network* (NLDN) over the land area inside state borders. The NLDN does not cover Alaska or Hawaii. The NLDN is owned and operated by Vaisala.

VAISALA
 Vaisala Inc.
 2705 E. Medina Road
 Tucson, Arizona 85726
 520 806 7300
 www.vaisala.com

Figure 6. Table showing 2010 and yearly average number of lightning flashes by state.

3.3.2 Historical Lightning Fatality Data

Detailed lightning fatality data (similar to Figures 2 through 4) are available from 2006 through the present. Maps and summaries of fatality data are available from 1959 through the present (Figures 7 and 8). A list giving the number of U.S. lightning fatality from 1940 to the present is accessible from the web site. These data help to determine patterns in lightning fatalities so that the NOAA's can focus its efforts on the most vulnerable populations. Figure 9, which is based on the detailed data available from 2006 to the present, is an example of how the historic lightning fatality data can be used to identify patterns in the lightning victims. This example shows that the majority of the victims struck and killed by lightning were involved in some sort of leisure activity.

3.4 Medical Effects on Victims

The health section of the web site contains information for, about, and from lightning strike victims.

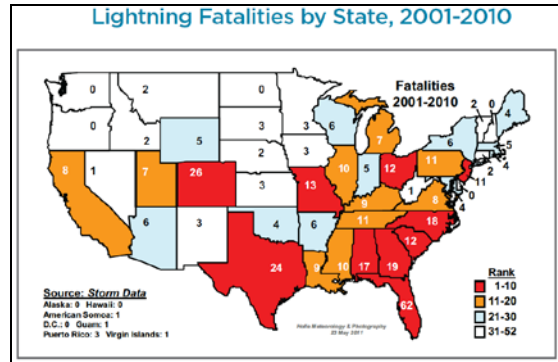


Figure 7. Number of lightning fatalities by state for the 10-yr period from 2001 through 2010.

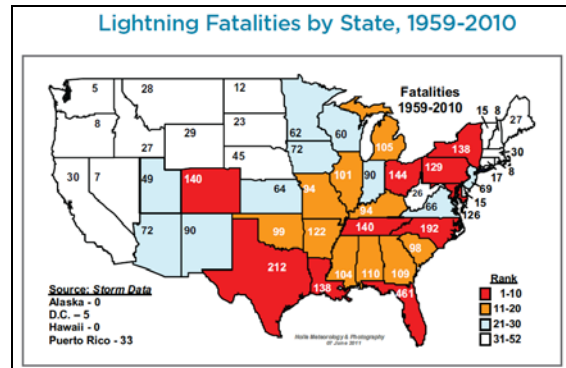


Figure 8. Number of lightning fatalities by state from 1959 through 2010.

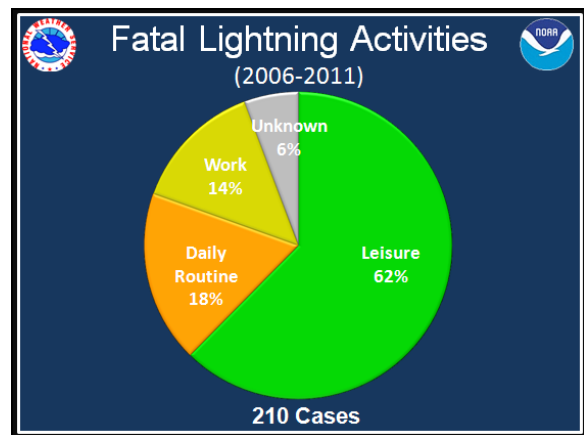


Figure 9. A summary of the activities that lightning victims were involved in prior to deadly lightning strikes from 2006 to 2011.

NOAA developed animated graphics to show the five ways people are struck by lightning (see Figure 10 for example). A medical section provides information on the odds of being struck by lightning, describes the short- and long-term effects of lightning injuries on lightning strike survivors, and provides a link to a web site where survivors can find additional information and support. Finally, the health section includes stories from lightning strike survivors.



Figure 10. Screen capture of animated graphic showing one of the ways (side flash/side splash) that victims are struck by lightning.

3.5 Awareness Materials and Activities

As part of its efforts to promote lightning safety awareness, NOAA has developed, printed, and distributed a variety of lightning safety materials. These include articles, papers, posters, pamphlets (Figure 11), stickers (Figure 12), refrigerator magnets, etc. Some materials were designed to target certain "at risk" activities (such as water activities) or groups (such as golfers and sports organizations). NWS field offices distribute these materials, and most of them are available in electronic versions from the NOAA web site.

The web site also contains materials targeted especially for children, including an interactive lightning safety game, coloring pages, and experiments. These materials teach children important safety guidelines in an effective and enjoyable manner.



Figure 11. NOAA's Lightning Safety Brochure



Figure 12. National Weather Service's lightning safety sticker.

4.0 LIGHTNING SAFETY AWARENESS WEEK

Each year, NOAA designates the last full week in June as Lightning Safety Awareness Week. The week serves as an impetus for the media to run lightning safety awareness stories in both the broadcast and print media, and for the 122 local NWS offices to promote lightning safety

with a consistent message and focus. NOAA selected the last full week in June as Lightning Safety Awareness Week for two reasons. First, the week immediately precedes July which is the most active month for lightning in the United States and also the most deadly month for lightning fatalities. Second, during June, there is sufficient lightning activity across the United States (and unfortunately, lightning casualties) to prompt the media to carry stories related to lightning safety. Because the media plays a critical role in getting information to the public, their participation is vital to the success of the campaign.

During Lightning Safety Awareness Week, NOAA focuses on various aspects of lightning or lightning safety. Also, during the week, many NWS offices issue public information statements on lightning safety and work with local media to provide interviews and/or other information such as state/local statistics (Hodanish, 2012).

5. LIGHTNING SAFETY ACTIVITIES

During the year, National Weather Service Offices across the country work with local organizations and groups to promote lightning safety. These include emergency management agencies, interscholastic and sports organizations and numerous other groups. In addition, NWS staff pass out safety information and materials at a variety of events highlighting the dangers of lightning.

During the 2011 Lightning Safety Awareness Week, many NWS offices passed out “*When Thunder Roars, Go Indoors*” visors to draw children’s attention to the lightning threat and to provide safety advice. Figure 13 shows an example of the visors which were given to children at many events.

“*When Thunder Roars, Go Indoors*” signs were developed and can be posted at public places such as beaches, boat landings, and parks to warn people of the dangers of lightning (Figure 14). The design is available from the web site for any community to use.



Figure 13. Young baseball fans show off their “When Thunder Roars, Go Indoors!” lightning safety visors given out at a professional baseball game during Lightning Safety Awareness Week.



Figure 14. NOAA design for lightning safety signs.

6. WORKING WITH OUR PARTNERS IN THE MEDIA

The broadcast and print media play an important role in educating the public on the dangers of lightning. NWS Offices across the country rely on the local broadcast and print media to help get safety information out on lightning safety. Figure 15 shows the news team on a local NBC affiliate (wearing the lightning visors) promoting a lightning safety event during the 2011 Lightning Safety Awareness Week.



Figure 15. Portland Maine NBC affiliate news team wearing lightning safety visors during Lightning Safety Awareness Week in Portland, Maine.

To aid in our efforts to promote lightning safety awareness, we have worked with our partners to develop several Public Service Announcements (PSAs). For children, a PSA was developed featuring Leon, the lightning safety lion. For adults, a PSA featuring 2011 Miss Ohio, Ellen Bryan, the sister of a lightning strike survivor, was developed.

In 2011, NOAA added a blog to the web site to comment on recent lightning incidents and to dispel any of the false information about lightning and lightning safety that occasionally appears in media stories.

The media also rely on the web site after an incident to obtain up-to-date information on recent fatalities, both nationally and locally.

7. IMPACTS OF THE LIGHTNING SAFETY EFFORT AND CONCLUSIONS

Figure 16 shows the average number of yearly lightning fatalities in the U.S. since 1970, averaged over 5 year periods. Despite a rising population, the number of lightning fatalities continues to decrease. Although not included in Figure 16, there were only 26 fatalities across the U.S. in 2011, the lowest number ever recorded.

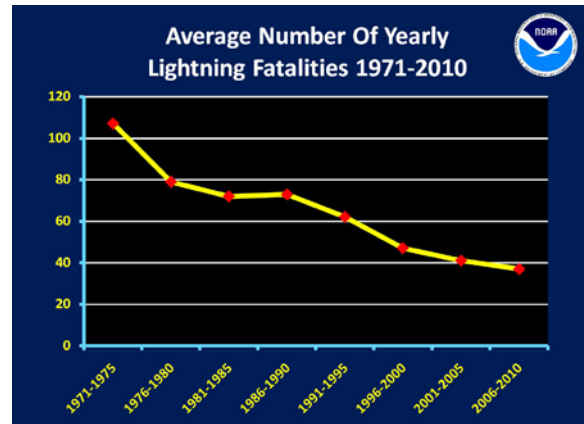


Figure 16. Number of yearly lightning fatalities in the U.S. averaged for 5-year periods.

NOAA's efforts over the years to draw attention to the dangers of lightning appear to be working. In addition to the lower fatality rate, the effort to get accurate information out through the media is also working well. Most of the media rely on the information provided on the NOAA and National Weather Service web sites. In addition, we've noted a significant change in the safety policies related to organized outdoor recreational activities. Many schools and organizations now require an event to be stopped immediately when lightning is seen and thunder is heard. This provides for the safety of those at the event and also teaches a valuable lesson; that is, that it is simply not safe to be outdoors when thunderstorms are in the area.

The downward trend in lightning fatalities is very promising, but there is still work to be done. Based on the analysis of lightning fatalities shown in Figure 9, most of the victims are involved in unorganized leisure activities. In general, when it comes to thunderstorms and safety, people balance the risk of being struck by lightning against the inconvenience necessitated by decisions to be safe. However, because many people have only a vague knowledge of the risks associated with lightning, they tend to underestimate the threat posed by lightning. This may be especially true since people often make decisions based on past personal experiences that may include many instances where they engaged in unsafe activities without being struck.

The ultimate goal of NOAA's efforts is to reduce the number of lightning casualties in this country; an intermediate goal is to educate the public on the dangers of lightning so that they can make informed decisions when thunderstorms are forecast or are nearby. During the past eleven years, the authors have noticed an increase in the number of media stories related to lightning safety, especially during NOAA's Lightning Safety Awareness Week. Also, during the last eleven years, the number of lightning fatalities in the United States has been relatively low compared to prior years. While it is difficult to estimate the exact impact of the NOAA's awareness campaign on the number lightning fatalities, it is very likely that NOAA's nationwide campaign, along with the efforts of other individuals and organizations, have contributed to the declining number of lightning fatalities in the United States.

With regard to organized outdoor activities, NOAA and the NWS continue to work with both local and national organizations and officials to emphasize the need for written lightning safety policies and plans. A recent example of these efforts is the NOAA toolkits for counties and communities, and more recently for large outdoor venues (Woodrum and Franklin, 2012). It is important that these policies are well known and publicized before an outdoor event begins so that everyone involved in the activity is aware of and ready to follow the policies and act upon the plans.

Continued efforts to inform and educate the public are needed to keep the number of lightning casualties low. Personal experience and a lack of knowledge often give people a false sense of safety. This false sense of safety, combined with the desire to not be inconvenienced, can lead people to engage in unsafe activities when thunderstorms are nearby. Education is the most powerful tool we have for decreasing lightning casualties. People who understand the dangers of lightning and know what actions to take when lightning threatens will make better decisions for themselves and those around them. Without continued lightning awareness efforts, lightning casualties would likely increase.

8. ACKNOWLEDGEMENTS

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