Detection Efficiencies and Range Accuracies of Three Portable Lightning Detectors Compared with the National Lightning Detection Network

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Objective

To compare three commercially available, portable, hand-held lightning detectors with the National Lightning Detection Network (NLDN).

Motivation

- **Portable, hand-held lightning detectors are marketed to sportsmen, athletic trainers, construction workers, landscapers, and for personal use.**
- **These detectors use 'single-station' techniques, rather than measurements from multiple locations.**
- **The use of single-station techniques for short-range location of lightning strikes is not robust (TSB, 2008; Uman 2008)**
- **The methods used by these detectors are proprietary, with publicly available, independent verification of their detection efficiency and range accuracy scarce or nonexistent.**

The Detectors

- **SkyScan™ and StrikeAlert™: These two detectors use a series of LED readouts to indicate ranges to lightning strikes.**
- **Thunderbolt: This detector uses an LCD readout to give textual messages regarding general lightning activity.**

Method

- **Detectors were videotaped during periods of lightning activity.**
- **Data from detectors was manually transcribed from videotape into a spreadsheet, recording:**
  - **Time (one second interval)**
  - **Status of detector (which LEDs are lit, or what textual message is displayed)**
- **Times and distances from all NLDN lightning strikes occurring within 40 miles (64 km) were cataloged in a separate spreadsheet.**
- **Detector data was compared with NLDN data to determine:**
  - **Was NLDN strike detected by the detector?**
  - **If so, did detector range match NLDN range?**

Reportable Statistics

- **For SkyScan™ and StrikeAlert™ we calculated:**
  - ***Detection Efficiency*: % of NLDN strikes detected by portable detector**
  - ***Range Efficiency*: % of detector ranges agreeing with NLDN range**
- **For Thunderbolt we calculated:**
  - ***Consistency Factor*: % of NLDN strikes for which detector displayed a message consistent with the NLDN data**

Considerations

- **Detectors do not have data-logging output ports. Data was manually transcribed from videotape to spreadsheet.**
  - **Two people independently transcribed data to ensure consistency.**
- **Time must be accurate in order for comparison with NLDN.**
  - **Video camera clock was set with NIST Atomic Clock prior to taping.**
- **Allowed ±1 second time window for comparison with NLDN**
  - **e.g., if the NLDN reported a strike at time *t*, and the detector indicated a strike at time *t*–1, *t*, or *t*+1, it was counted as a detection.**
- **Allowed ± 1 mile range window for comparison with NLDN**
  - **e.g., if NLDN reported a strike at 19 miles, and the detector LED for 20-40 miles was lit, it was counted as an accurate detection.**
- **StrikeAlert™ was tilted on its front to allow simultaneous videotaping of all three detector indicators.**
  - **The manufacturer recommends placing the StrikeAlert™ upright. The effects of having the unit on its front are unknown.**
- **Thunderbolt reports status using textual messages rather than LCD readout.**
  - **This makes quantitative comparison with NLDN more difficult, since Thunderbolt does not always report a simple range to the lightning strike.**

References

TSB (Transportation Safety Board), 2008: Lightning-Warning Systems for Use by Airports, Aircraft Cooperative Research Program (ACRP) Report 8, 71 pp.

Uman, M.A., 2008: *The Art and Science of Lightning Protection*, Cambridge University Press, 240 pp.

Results

SkyScan™			
Date	*NLDN Strikes*	*Detection Efficiency*	*Range Efficiency*
5/16/2007	126	96%	65%
7/11/2007	55	100%	76%

StrikeAlert™			
Date	*NLDN Strikes*	*Detection Efficiency*	*Range Efficiency**
5/16/2007	96	100%	42%
7/11/2007	55	98%	36%

Thunderbolt			
Date	*NLDN Strikes*	*Consistent Messages*	*Consistency Factor*
5/16/2007	45	31	69%
7/11/2007	123	79	64%

***StrikeAlert™ was not in an upright position, contrary to manufacturer's recommendation.**

Excerpt of Thunderbolt data for 5/16. Shading shows messages inconsistent with NLDN.

NLDN time (sec. GMT)	*NLDN distance (miles)*	*Thunderbolt Message at t−1 second*	*Thunderbolt Message at t*	*Thunderbolt Message at t+1 second*
63280	18	local activity possible	local activity possible	local activity possible
63288	17	local activity possible	***closest strike 1 mile***	***closest strike 1 mile***
63294	20	***closest strike 1 mile***	***closest strike 1 mile***	***closest strike 1 mile***
63321	17	***closest strike 1 mile***	***closest strike 1 mile***	***closest strike 1 mile***
63333	27	***closest strike 1 mile***	***closest strike 1 mile***	***closest strike 1 mile***
63335	20	***closest strike 1 mile***	***closest strike 1 mile***	***closest strike 1 mile***
63340	18	***closest strike 1 mile***	***closest strike 1 mile***	***closest strike 1 mile***
63357	20	local activity possible	local activity possible	local activity possible
63377	18	warning strikes detected	warning strikes detected	warning strikes detected
63488	18	warning strikes detected	warning strikes detected	warning strikes detected
63498	16	warning strikes detected	warning strikes detected	warning strikes detected
63516	18	warning strikes detected	warning strikes detected	warning strikes detected
63537	16	***storm activity 7 miles***	***storm activity 7 miles***	***storm activity 7 miles***
63550	15	***ground strikes 4 miles or less***	***ground strikes 4 miles or less***	***ground strikes 4 miles or less***
63577	17	***ground strikes 4 miles or less***	***ground strikes 4 miles or less***	time to < 15 minutes
63577	13	***ground strikes 4 miles or less***	***ground strikes 4 miles or less***	time to < 15 minutes
63583	17	time to < 15 minutes	***ground strikes 4 miles or less***	***ground strikes 4 miles or less***
63598	19	***warning storm is local***	***warning storm is local***	***warning storm is local***
63599	13	***warning storm is local***	***warning storm is local***	***warning storm is local***
63612	15	time to < 15 minutes	time to < 15 minutes	time to < 15 minutes
63614	16	time to < 15 minutes	time to < 15 minutes	time to < 15 minutes
63624	17	time to < 15 minutes	time to < 15 minutes	time to < 15 minutes
63656	15	time to < 15 minutes	time to < 15 minutes	time to < 15 minutes
63660	16	time to < 15 minutes	time to < 15 minutes	local strikes extend time
63664	15	***local strikes extend time***	***local strikes extend time***	***local strikes extend time***
63673	12	***warning storm is local***	***warning storm is local***	***warning storm is local***
63686	17	***warning storm is local***	***warning storm is local***	***warning storm is local***
63689	14	***warning storm is local***	***warning storm is local***	***warning storm is local***
63706	11	time to < 15 minutes	local strikes extend time	local strikes extend time
63729	12	time to < 15 minutes	local strikes extend time	local strikes extend time
63739	14	***local strikes extend time***	***local strikes extend time***	***local strikes extend time***
63742	14	***local strikes extend time***	***local strikes extend time***	***local strikes extend time***
63751	12	***local strikes extend time***	***local strikes extend time***	***local strikes extend time***
63764	10	***warning storm is local***	***warning storm is local***	time to < 15 minutes
63784	13	***warning storm is local***	***warning storm is local***	***warning storm is local***

For Thunderbolt the term 'local' is defined by the manufacturer as eight miles or less.

Summary

- **Both SkyScan™ and StrikeAlert™ had near perfect detection efficiencies compared to the NLDN.**
- **SkyScan™ and StrikeAlert™ had less than 77% percent agreement with the NLDN regarding distances to lightning strikes.**
- **Thunderbolt displayed messages consistent with NLDN for less than 70% of the NLDN strikes.**
- **False alarm rates were not evaluated.**