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ASOS LIGHTNING SENSOR ASSESSMENT

Glen Sampson - WRH - Salt Lake City, UT

Background on the Lightning Sensors

NWS Level D ASOS sites (i.e., Ely, Winnemucca, Astoria, Kalispell, Havre and Sheridan) were recently retrofitted with a lightning sensor. These sensors place a "TS" in the observation, and are currently operating when a human is present augmenting the ASOS. After these sensors are formally approved in early October, they will be operating 24 hours per day.

The output from these lightning sensors differs from the National Lightning Detection Network (NLDN) data, and the techniques used by human observers. These differences result in an increase in thunderstorms being reported. Hence, these sensors will have a direct impact on the terminal forecasts issued for these sites. This document presents the differences between these observation methods, so that you have a better understanding of the data.

How the ASOS Lightning Sensor Works

The ASOS lightning sensor requires a simultaneous radio and optical pulse. Both cloud-to-cloud (CC) and cloud-to-ground (CG) strikes are detected. Range estimates are generated with the CG strikes by analyzing the radio signal strength. No directional capability is present, and no range estimates are available for CC strikes. The range estimates for CG strikes are separated into categories of 0-5, 5-10 and 10-30 miles. Strikes for both CC and CG between 30 and 50 miles can be detected if they are extremely intense; beyond 50 miles no strikes will be detected.

Two strikes within a 15 minute period are required for a thunderstorm to be reported by ASOS. These strikes can either be CG within 10 miles or CC. Thus, two CC strikes within 30 miles of the sensor would cause a thunderstorm to be reported. These sensor and algorithm characteristics give a false alarm rate of 0.0039; hence, the sensor is unlikely to give a false report of a thunderstorm, although the thunderstorm may be beyond 10 miles.

How the Lightning Sensor Compares to NLDN Data

The NLDN detects only 80-90% of the total CG strikes, and no CC strikes. Therefore, the NLDN data will always report less than an ASOS or an observer. The loss of CC strikes can be significant, since researchers at NSSL estimate the normal ratio of CC/CG in a supercell to be about 4 to 1. In supercells with elevated freezing levels, almost 100% of the lightning activity can be within the cloud (MacGorman, 1997).

How the Lightning Sensor Compares to Observers

From March 29, 1997 through July 12, 1997, ten lightning sensors were installed across the country for evaluation. Two sites were in the West: Ely, Nevada and Alamos, Colorado. During this test, the ASOS lightning sensors agreed with the observer 88% of the time. Overall, ASOS reported 28% more events, and 17% more minutes of thunderstorm activity than the observers (Ramsay, 1997). Possible reasons for ASOS reporting more events than an observer are: (1) the observer did not hear all thunder within a 10-mile radius, (2) ASOS detects CC strikes outside the 10 mile radius, and (3) ASOS starts and stops a thunderstorm more frequently than an observer.

When thunderstorms were moving through an area, observers tended to group thunderstorm cells together in an observation, and leave a larger time gap between the ending of one thunderstorm and the beginning of a new one. ASOS, on the other hand, would track each "cell" with multiple beginning and ending times within the same time period.

Lightning Sensor Effects on TAFs

The ASOS lightning sensor will increase the thunderstorm activity at a site in comparison to climatology. Hence, expectations are that terminal forecasts for a site with an ASOS lightning sensor will carry more thunderstorms. Much of this increase is due to better sensing techniques, although the detection of cloud-to-cloud lightning outside 10 miles is also a factor.

Modifications to the algorithm are being examined to place a Lightning Cloud-to-Cloud (LTGCC) remark on observations carrying thunderstorms due to CC strikes. This remark would alert the forecaster to the possibility of thunder outside the terminal area. However, a target implementation date for such a change is unknown at this time.

References

MacGorman, D. and D. Rust. "The Electrical Nature of Storms", in press, 1997.

Ramsay, A. and B. Whisel. 1997 Lightning Sensor Performance Assessment, Hughes STX Corporation briefing, August 1997.