

## MEMORANDUM FOR THE RECORD

1 August 2011

Subject: State Climate Extremes Committee Report for Oklahoma Hailstone of May 2011

### Summary:

On 20 July 2011, a State Climate Extremes Committee (SCEC) convened to verify / validate a report of a six-inch hailstone that fell near Gotebo, Oklahoma on the afternoon of 23 May 2011. If verified, this would become the SCEC's inaugural state record hailstone for Oklahoma, as no previous stone was vetted for such purposes.

The committee considered the following factors in their decision: *bona fide* nature of hailstone, meteorological plausibility, and methods of handling and measurement. After reviewing the observational evidence, *the SCEC unanimously agreed that the hailstone did indeed establish the state record for diameter*. In particular, the committee found that the following were true and valid:

- LOCATION: Approx. 2 miles North of Gotebo, Oklahoma
- TIME: approx. 535 pm CDT (2235Z) of 23 May 2011
- DIAMETER: 6.0 inches
- WEIGHT: not considered for this record

The stone established a new record for the state of Oklahoma. No prior record was compared, although previous potentially-competing reports were examined retroactively. Though some historical reports were larger, they lacked sufficient documentation and/or credibility and were therefore not considered contenders at the time of the SCEC meeting.

### Sequence of Events, Examination & Decision

#### Background

During the afternoon of 23 May 2011, several supercell thunderstorms occurred across parts of western Oklahoma. Several reports of severe weather, including large hail, accompanied these storms. One strong supercell thunderstorm moved east-southeastward across Washita, Kiowa and Caddo Counties, producing large hail, including the stone discussed in this report.

The hailstone discussed in this report was ultimately discovered approximately two miles north of Gotebo, Oklahoma by the HailSTONE research team led by off-duty NWS forecasters Scott Blair and Derek Deroche.

#### Storm Environment & Meteorological Plausibility

The storm that produced the stone developed in a very favorable environment for supercells, which frequently produce large hail. Very warm, moist air at the surface, combined with conditions higher in the atmosphere established very large values of instability (an indicator of the potential strength of storm updraft). In particular, the estimated Convective Available Potential Energy exceeded 4,000 J/kg in the region (this value is quite extreme: 1,000-1,500 J/kg is often cited as a "rule of thumb"

threshold for the potential to support severe weather). Moderate wind shear (the turning of winds in the lower atmosphere, related to the potential for storms to tilt and rotate) was also evident in the region.

### **Hailstone Collection, Measurement and Report**

The stone was collected at approximately 5:35 pm local time by members of the HailSTONE research team and subsequently reported to NWS Norman. The stone was on the ground for approximately 10 minutes (estimated) before retrieval. The initial measurement was made in the field near the site of impact using a ruler at 535 pm local time, 23 May 2011, 2 miles north of Gotebo, Oklahoma, and was 6.0 inches along the longest axis (see Appendix I). The perceived measurement discrepancy in the photo showing a diameter of approximately 5 ½ inches is due to a combination of the right edge of the stone extending past the ruler's zero line. The stone was kept in a sealed container until it could be properly verified. The stone was then transferred into a gas station walk-in freezer and measured again using a caliper at approximately 735 pm local time, 23 May 2011, in Apache, Oklahoma, verifying the previous measurement. The handling and measurement procedures were largely consistent with [those recommended by the SCEC](#).

The stone's weight was not measured and was not considered by the SCEC.

As with many very large hailstones, it is almost certain that this stone was larger upon impact than it was at the time of measurement and documentation. Outdoor exposure and handling, though minimal, will cause a reduction in size. However, as with any large stone, the official dimensions are taken as those recorded at the time of measurement.

### **Prior Observations**

A group of local hail experts (Gary McManus, Oklahoma Climatological Survey; Rick Smith, WFO Norman; Doug Speheger, WFO Norman) researched the NCDC Storm Data database to see if any archived hail events at or above 6" could be verified. See below image of the NCDC Storm Data web page for all hailstones of 5.5" or greater (see Figure).

Two entries in the NCDC *Storm Data* database had larger hail sizes, but could not be reasonably validated or verified. No photographic documentation or validation could be found for the 8.0" hailstone reported in *Storm Data* in Garfield County on 26 April 1971. No documentation could be found for the 7.0" hailstone entry in Canadian County on 30 April 1961 for which the Storm Data publication states "Hail up to 2 inches in diameters in diameter caused considerable damage from El Reno to north sections of Oklahoma City," indicating that this entry in the database may be the result of a transcription error. In addition to the lack of verification or photographic documentation for these reports, until June 2003 the accepted national record hailstone was considered to be the 5.7" diameter hailstone that fell in Coffeyville, Kansas on 3 September 1970.

One additional hailstone report was considered by the committee: a hailstone reported to be 4.5" by 6.5" (and listed as 4.5" on the NCDC Storm Data web page) fell in Kingfisher County on 17 August

1994 and is listed in the Storm Data publication. However, no photographic evidence is known to exist and this measurement could not be reasonably validated.

## **Finding of Committee**

All of the above evidence was presented to the SCEC by electronic mail leading to a one-hour face-to-face meeting (OUN participated remotely) on 20 July 2011. The SCEC solicited the input of WFO Norman and other highly-regarded hail experts to assist with its analysis.

The storm and storm environment supported the probability of very large hail. In addition to the Gotebo hail stone, many other stones with diameters exceeding 3 inches were collected on 23 May 2011.

Based upon the thoroughly-documented evidence (photographic and field notes), the SCEC and all additional experts agreed unanimously that all measurements associated with the stone were valid.

Consequently, the Gotebo, OK hailstone was unanimously acknowledged (by a vote of 5-0) by the SCEC to establish the Oklahoma state record for the dimension of hailstone diameter. Events recorded in Storm Data should be reviewed for validity.

The SCEC commends the HailSTONE project on their handling of the stone and the situation, and the additional historical research performed at the Oklahoma Climatological Survey and at WFO Norman.

## **Issues Raised:**

Several challenges from this event should be noted for future episodes.

The lack of a prior record for Oklahoma made the vetting process more challenging than that for an existing record. Hail was not one of the five original state record types established by the SCEC, due largely to the general condition of hail observations over time. It generally recognized that larger stones have surely fallen within the state borders since statehood. Thorough investigation of past events and future events will help solidify the record.

Finally, the SCEC's report on this matter was delayed administratively beyond an acceptable time. This will be remedied within NCDC's Climate Monitoring Branch, which will dedicate resources to ensure the timely delivery of completed decision reports.

## **Participation:**

Committee members:

- Renee McPherson, Oklahoma Climatological Survey
- Kevin Robbins, Southern Regional Climate Center
- Richard Smith, NWS WFO Norman
- Victor Murphy, NWS Southern Region
- Deke Arndt, National Climatic Data Center

Also participating in the verification:

- Doug Speheger, WFO Norman
- Gary McManus, Oklahoma Climatological Survey
- Scott Blair, WFO Topeka
- Derek Deroche, WFO Kansas City / Pleasant Hill

**Appendix I: A Photograph of the Stone Showing Diameter**



## Appendix II: Potentially Competing Records in the NCDC Storm Events Database



NOAA Satellite and Information Service  
National Environmental Satellite, Data, and Information Service (NESDIS)



National Climatic  
Data Center  
U.S. Department of Commerce



DOC > NOAA > NESDIS > NCDC Search Field:

Search NCDC

### Query Results

**4 HAIL** event(s) were reported in **Oklahoma** between **01/01/1950** and **04/30/2011** with hail size of at least **5.5 inch(es)**.

Mag: Magnitude

Dth: Deaths

Inj: Injuries

PrD: Property Damage

CrD: Crop Damage

*Click on **Location or County** to display Details.*

#### Oklahoma

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 <a href="#">CANADIAN</a>	04/30/1961	1815	Hail	7.00 in.	0	0	0	0
2 <a href="#">GARFIELD</a>	04/26/1971	1600	Hail	8.00 in.	0	0	0	0
3 <a href="#">MCCLAIN</a>	05/01/1980	2130	Hail	5.50 in.	0	0	0	0
4 <a href="#">Eufaula</a>	06/16/1997	05:15 PM	Hail	5.50 in.	0	0	0	0
TOTALS:					0	0	0	0