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STORM DATA PREPARATION

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SUMMARY OF REVISIONS: Supersedes Weather Service Operations Manual (WSOM) Chapter F-42, "*Storm Data* and Related Reports," Issuance 94-5, dated July 1, 1994; and Operations Manual Letters 5-95, 3-96, and 09-01 (also filed with C-75). This directive supercedes 10-1605, Storm Data Preparation, dated January 6, 2003.

Signed by Gregory Mandt February 9, 2004
Gregory A. Mandt Date
Director, Office of Climate,
Water, and Weather Services

Storm Data Preparation

Table of Contents: Page

1. *Storm Data* Disclaimer. *Storm Data* is an official publication of the National Oceanic and Atmospheric Administration (NOAA) which documents the occurrence of storms and other significant weather phenomena having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce. In addition, it is a partial record of other significant meteorological events, such as record maximum or minimum temperatures or precipitation that occurs in connection with another event.

Some information appearing in *Storm Data* may be provided by or gathered from sources outside the National Weather Service (NWS), such as the media, law enforcement and/or other government agencies, private companies, individuals, etc. An effort is made to use the best available information but because of time and resource constraints, information from these sources may be unverified by the NWS. Therefore, when using information from *Storm Data*, customers should be cautious as the NWS does not guarantee the accuracy or validity of the information. Further, when it is apparent information appearing in *Storm Data* originated from a source outside the NWS (frequently credit is provided), *Storm Data* customers requiring additional information should contact that source directly. In most cases, NWS employees will not have the knowledge to respond to such requests. In cases of legal proceedings, Federal regulations generally prohibit NWS employees from appearing as witnesses in litigation not involving the United States.

2. *Storm Data* Preparation. The *Storm Data* preparer should allocate a sufficient amount of preparation time to ensure that documentation and verification of significant weather phenomena is as accurate and complete as possible. The preparer should carefully coordinate the time and

location of events that cross county warning and forecast areas (CWFA) to prevent inconsistencies in the *Storm Data* database. These quality control procedures are particularly important for events used in the NWS national verification program.

Preparation will be done using the currently authorized electronic method. Software methodology and hardware requirements are provided on the Office of Services internal StormDat/Verification Web site. Transmittal of the monthly report and upgrades to the software will be accomplished electronically. Inclusion of pictures in the monthly reports should be limited to unusual or highly significant events in order to keep *Storm Data* at a reasonable size.

The *only* events permitted in *Storm Data* are listed below. The chosen event name should be the one that predominately describes the meteorological event that led to fatalities, injuries, damage, etc. However, significant events having no impact (all tornadoes or flash floods causing no damage, etc.) also should be included in *Storm Data*. See Appendix A for detailed examples. Additional details about record values of temperature, precipitation, etc., may be included in the narrative of an appropriate *Storm Data* event. However, only the more significant values should be summarized, such as monthly, seasonal, or yearly records. For example, a new monthly single-storm, snowfall record can be included in the narrative of a heavy snow event, or a new all-time, 4-hour rainfall record value can appear in the narrative of a flash flood event.

Event Name	**Designator**	**Event Name**	**Designator**
Astronomical High Tide	Z	Landslide	Z
Avalanche	Z	Lightning	C
Blizzard	Z	Marine Hail	M
Dense Fog	Z	Marine Thunderstorm Wind	M
Drought	Z	Rip Current	M
Dust Devil	C	Seiche	Z
Dust Storm	Z	Sleet Storm	Z
Excessive Heat	Z	Storm Surge	Z
Extreme Cold/Wind Chill	Z	Strong Wind	Z
Flash Flood	C	Thunderstorm Wind	C
Flood	Z	Tornado	C
Frost/Freeze	Z	Tropical Depression	Z
Funnel Cloud	C	Tropical Storm	Z
Hail	C	Tsunami	Z
Heavy Rain	C	Volcanic Ash	Z
Heavy Snow	Z	Waterspout	M
Heavy Surf/High Surf	Z	Wildfire	Z
High Wind	Z	Winter Storm	Z
Hurricane (Typhoon)	Z	Winter Weather/Mix	Z
Ice Storm	Z		

<u>Legend</u>: There are three designators: C - County/Parish; Z - Zone; and M - Marine.

All documentation used for production of Storm Data will be retained for two years.

2.1 Aircraft/Marine Incidents. It is the responsibility of the National Transportation Safety Board (NTSB) to investigate and file reports on the probable causes of aviation and discussed. See examples in Appendix A under funnel cloud, marine thunderstorm wind, and seiche.

2.2 Time. The beginning and ending time for each event will be entered as accurate as possible. Use local standard time in 24-hour clock throughout the year, such as 0600 Eastern Standard Time (EST), 0925 Central Standard Time (CST), 1800 Mountain Standard Time (MST), etc. Forecast offices having a CWFA responsibility in multiple time zones should enter data in the appropriate time zone for the event's location.

Establishing the time of an event to the nearest minute will be difficult in certain situations. To minimize this problem, the *Storm Data* preparer should carefully compare all storm reports to available radar data, using unique radar signatures to make adjustments in the event time.

2.2.1 Events that Span More than One Month. Events that span more than one month will be entered for each month they occur. Directly-related fatalities, injuries, and damages will be given in the appropriate column for the month currently being prepared. Additional summary information on cumulative fatalities, injuries, or damages from previous months can be explained in the narrative portion of the *Storm Data* entry for the final month of the event.

2.3 Location. A hydrometeorological event will be referenced to the particular village/city, airport, or inland lake, providing that the reference point is documented in the StormDat location database. Additional detailed information on the exact location of an event can be included in the narrative paragraph. This detailed information would be useful when the event occurs within the boundaries of a large city. For example, if a tornado occurred just inside the northern border of Chicago, the location would be listed as Chicago. The narrative paragraph might include a statement “the tornado moved along the northern border of the city,” or “touched down 8 miles north of city center.” In some cases, if the event is relatively widespread, it may be referenced to geographical portions of a county/parish (e.g., northern portion or countywide/parishwide).

For marine zones, a hydrometeorological event will be referenced (azimuth and range) to the reference points documented in the StormDat location database.

2.4 Event Source. The source of each *Storm Data* event will be entered in the software program. Possible sources of reports include “trained spotter,” “law enforcement,” and “emergency management.” In those cases where the source of the event report is not obvious, the preparer should use professional judgment as to what source is appropriate. Even though the event source does not appear in the final *Storm Data* publication, this information is used in related NWS statistical studies.

2.5 Fatalities/Injuries. The determination of direct versus indirect causes of weather-related fatalities or injuries is one of the most difficult aspects of *Storm Data* preparation. Determining whether a fatality or injury was direct or indirect has to be examined on a case-by-case basis. It is impossible to include all possible cases in this directive. The preparer should include the word “indirect” in all references to indirect fatalities or injuries in the narrative. This will minimize any potential confusion as to what fatalities and injuries referenced in the narrative were direct or indirect. A narrative example follows.

> "Powerful thunderstorm winds leveled trees and power lines in and around Morristown, TN. One of the toppled trees struck and killed two men running for shelter. During the clean-up operations after the storm, a person on an ATV was injured (indirect) when their vehicle struck a tree that blocked a road."

Special care must be exercised when dealing with situations in which vehicles leave a road surface (due to a non-weather reason) *not* covered with flood waters and go into river/canals *not* above flood stage. Any fatalities, injuries, or damage in these cases will *not* be entered into *Storm Data*, since they are not weather related.

2.5.1 Direct Fatalities/Injuries. A direct fatality or injury is defined as a fatality or injury directly attributable to the hydrometeorological event itself, or impact by airborne/falling/moving debris, i.e., missiles generated by wind, water, ice, lightning, tornado, etc. In these cases, the weather event was an "active" agent or generated debris became an active agent. A fatality or injury resulting from an unavoidable encounter with a weather hazard may be classified as direct. Generalized examples of direct fatalities/injuries would include:

a. Thunderstorm wind gust causes a moving vehicle to roll over;

b. Vehicle goes over crest of hill and unknowingly into a blinding, local, snow squall. Loss of vehicle control results in a fatality/injury;

c. Blizzard winds topple a tree onto a person; and

d. Vehicle is parked on a road, adjacent to a dry arroyo. A flash flood comes down the arroyo and flips over the car. The driver drowns.

An injury shall be reported on the header line if a person suffers a weather-related injury requiring treatment by a first responder or subsequent treatment at a medical facility. Injured persons who deny medical treatment also may be included. Persons who are not considered injured but who are affected by the phenomenon may be discussed in the narrative.

Fatalities and injuries directly caused by the weather event will be entered in the StormDat software "fatality" and "injury" entry tables, respectively. For direct fatalities, enter the specific data as queried by the software, i.e., number of individuals, age, sex, location, etc. Obtain information from sources usually regarded as reliable. The alphanumeric fatality code trailing the narrative is automatically inserted by the software. See Appendix A for detailed examples.

When specifying the location of the direct fatality, only the following choices are to be used:

BF	Ball Field	BO	Boating

BU	Business	MH	Mobile Home
CA	Camping	OT	Other
EQ	Heavy Equipment/Construction	OU	Outside/Open Areas
GF	Golfing	PH	Permanent Home
IW	In Water	SC	School
LS	Long Span Roof	TE	Telephone
		UT	Under Tree
		VE	Vehicle

2.5.2 Indirect Fatalities/Injuries. Fatalities and injuries, occurring in the vicinity of a hydrometeorological event, or after it has ended, but are not directly caused by impact or debris from the event (weather event is a passive entity), are classified as indirect. Any available indirect fatalities and injuries should be discussed in the narrative paragraph, but will not be entered in the software "fatality" or "injury" entry tables. Indirect fatalities/injuries will not be tallied in official *Storm Data* statistics.

Fatalities and injuries due to motor vehicle accidents on slippery, rain, or ice covered roads are indirect. Ice, snow, and water on road surfaces are "passive" agents that do not directly impact a person or property, even though they induce conditions that trigger another event causing a fatality and injury.

If the hydrometeorological event induced conditions that triggered another event resulting in the fatality/injury, then it is indirect. Heart attacks, resulting from overexertion during or following winter storms, or electrocution caused by contact with a downed power line after a storm has ended, are indirect.

Fatalities and injuries resulting from driving into dense fog or a blinding blizzard or dust/ sandstorm that was in plain view down the road, or already widespread, are indirect. Generalized examples of indirect fatalities/injuries follow (see Appendix A for detailed examples).

a. Widespread dense fog reduces visibilities from zero to 1/8 mile. A 20-vehicle pile-up occurs;

b. Thunderstorm winds topple trees onto a road. A motorist runs into a tree 30 minutes after the storm occurred;

c. Heavy snow is in progress and roads become icy/snow-covered. A vehicle slides across road into another vehicle; and

d. Lightning starts a fire which destroys a home, killing its occupants.

2.5.3 Delayed Fatalities. On occasion, a fatality will occur a few days after the end of a meteorological event, due to weather-related injuries or the effects of the event. This is most common with long-duration, excessive heat episodes in which individuals never recover from the initial effects of the heat wave. The *Storm Data* preparer has two methods to include these fatalities.

a. Enter the post-event fatality information as part of the meteorological event that just ended, but enter the actual date of delayed fatality in the fatality entry table. This is the preferred method. An explanation can be given in the narrative; or

b. Enter the post-event fatality information as part of a new meteorological event, if appropriate. An explanation can be given in the narrative.

2.6 Damage. Property damage estimates should be entered as actual dollar amounts, if a reasonably accurate estimate from an insurance company or other qualified individual is available. The *Storm Data* preparer should not estimate the damage but should make a good faith attempt to obtain the information. Estimates also can be obtained from emergency managers, U.S. Geological Survey, U.S. Army Corps of Engineers, power utility companies, and newspaper articles. If the estimates provided are rough guesses, then this should be stated as such in the narrative. Estimates should be rounded to three significant digits, followed by an alphabetical character signifying the magnitude of the number, i.e., 1.55B for $1,550,000,000. Alphabetical characters used to signify magnitude include “K” for thousands, “M” for millions, “B” for billions, and “T” for trillions. If additional precision is available, it may be provided in the narrative part of the entry. When damage is due to more than one element of the storm, indicate, when possible, the amount of damage caused by each element. If the dollar amount of damage is unknown, or not available, leave the entry blank.

In order to determine if the damage is directly related or indirectly related to the hydrometeorological event, the *Storm Data* preparer will use the same guidelines for fatalities and injuries provided in Sections 2.5.1 and 2.5.2.

2.6.1 Flood-Related Damage. Damage resulting from flash floods or floods should be reported by each office in whose CWFA responsibility the damage was reported. The Service Hydrologist should assist in the collection and assessment of flood/flash flood information that pertains to *Storm Data*.

2.6.2 Crop Damage Data. Crop damage information may be obtained from reliable sources, such as the U.S. Department of Agriculture, the county/parish agricultural extension agent, the state department of agriculture, crop insurance agencies, or any other reliable authority.

2.6.3 Other Related Costs. The cost of such items as snow removal, debris clearing/moving, fire fighting, personnel overtime charges, public housing assistance, etc., will not be tallied as part of the storm/crop damage. If “other related” cost estimates are available, they may be included in the narrative as a separate item.

2.6.4 Delayed Damage. On occasion, vegetative or structural damage will occur within a few days, or even a couple weeks, after a meteorological event. This is most common after a very heavy snowfall, or very heavy rain due to weight loading on roofs or buildings, tree branches, or power lines. Windy conditions after a heavy snow or heavy rain event may amplify the damage. In these cases, the *Storm Data* has two methods to include this damage.

a. Enter the post-event damage information as part of the meteorological event that just ended and explain the situation in the narrative; or

b. Enter the post-event damage information as part of a new meteorological event, if appropriate, and explain the situation in the narrative.

2.7 Character of Storm. Enter the type of storm or phenomena in accordance with the look-up table provided in the software. If known, maximum gusts will be encoded as "measured," otherwise they will be an estimate (gusts are given in knots). Hail size will be given in hundredths of an inch (0.50, 0.75, 0.88, 1.00, 1.50, etc., are the most common). Data regarding multiple severe phenomena within a single event will be provided separately, except for tornadoes. A single narrative may be used to describe the multiple severe phenomena within single severe weather episodes. A separate narrative will be composed for every tornado event.

2.8 Textual Description of Storm (Narrative). Only the more complex events require narratives. For example, lightning strikes or hail occurrences, as a single phenomena, should not necessitate narratives unless they are part of a more complex weather event or cause fatality/injury or significant damage. The narrative should expand on the information in the quantitative data, especially casualties. For lightning fatalities or injuries, include weather conditions at the time of occurrence, if known or determinable. Include times, locations, and destruction of trees, crops, power lines, roads, bridges, etc. Storm characteristics, such as the intermittence of tornado paths, may be included.

Additional remarks (or an electronically inserted picture) may serve to locate storms more precisely and may give the areal extent and the directional movement or speed. Such additional detail should be prepared as support documentation to Outstanding Storms of the Month (see Section 4, Outstanding Storms of the Month [OSM]).

The narrative should be concise and not repeat information provided in the quantitative data. When used properly, the narrative integrates the numerical data into a cohesive meteorological event.

When writing the narrative, always indicate when and where tornadoes and thunderstorm wind events cross county, parish, and state lines, and boundaries of WFO CWFA responsibility. *Storm Data* preparers will coordinate with other affected offices to determine time and location of border-crossing tornadoes or other events.

2.9 Speed-Distance Conversion. On occasion, the *Storm Data* preparer may need to calculate beginning and ending times, time of arrival, or validity of storm report times, based on a known thunderstorm speed from radar. To assist in this task, see Table 1.

2.10 Pictures. Inclusion of electronic images (.gif, .tif, .jpg, etc.) into the monthly reports should be limited to unusual or highly significant events in order to minimize the size of the *Storm Data* publication.

Table 1. Speed to Distance Conversion.

KTS/MPH	1 Mile in X Minutes	KTS/MPH	1 Mile in X Minutes
52/60	1 mile in 1.0 min	**26/30**	1 mile in 2.0 min
48/55	1 mile in 1.1 min	**22/25**	1 mile in 2.4 min
43/50	1 mile in 1.2 min	**17/20**	1 mile in 3.0 min
39/45	1 mile in 1.3 min	**13/15**	1 mile in 4.0 min
35/40	1 mile in 1.5 min	**9/10**	1 mile in 6.0 min
30/35	1 mile in 1.7 min	**4/5**	1 mile in 12.0 min

3. Event Types. This section provides guidelines for entering event type in StormDat (*Storm Data*). This is not a complete list. Only those events that may result in confusion are discussed here.

3.1 Wind Gusts. A maximum wind gust value, whether estimated or measured, will always be entered for "thunderstorm wind," "marine thunderstorm wind," and "high wind" events. If the high wind event is based on maximum sustained wind equal to, or greater than, 35 knots (40 mph) for 1 hour or more, then enter that value instead. Maximum wind gust values will be entered for severe and non-severe convective *Storm Data* events ("thunderstorm wind" and "marine thunderstorm wind").

The *Storm Data* preparer must use professional judgment to determine the estimated maximum wind value based on observed structural or tree damage. For example, a rotted tree that is toppled by "thunderstorm winds" would not support an estimated wind gust of 50 knots (58 mph). On the other hand, numerous large trees, power lines, and road signs toppled by "high winds" would support an estimated gust value over 50 knots (58 mph).

The StormDat software program requires the preparer to indicate whether the wind gust value is measured or estimated. The fact that a particular maximum wind gust value is estimated should be indicated in the event narrative. A similar distinction is not needed for measured maximum wind gust values since the StormDat software automatically "marks" the gust values, in the *Storm Data* publication, with the "M" superscript in the event header strip.

To assist in estimating wind gusts, guidelines relating maximum wind gusts to damage follows in Table 2.

Table 2. Estimating Wind Speed from Damage.

Wind Speed	Observations
26-38 kts (30-44 mph)	Trees in motion. Light-weight loose objects (e.g., lawn furniture) tossed or toppled.

39-49 kts (45-57 mph)	Large trees bend; twigs, small limbs break, and a few larger dead or weak branches may break. Old/weak structures (e.g., sheds, barns) may sustain minor damage (roof, doors). Building partially under construction may be damaged. A few loose shingles removed from houses. Carports may be uplifted; minor cosmetic damage to mobile homes and pool lanai cages.
50-64 kts (58-74 mph)	Large limbs break; shallow rooted trees pushed over. Semi-trucks overturned. More significant damage to old/weak structures. Shingles, awnings removed from houses; damage to chimneys and antennas; mobile homes, carports incur minor structural damage; large billboard signs may be toppled.
65-77 kts (75-89 mph)	Widespread damage to trees with trees broken/uprooted. Mobile homes may incur more significant structural damage; be pushed off foundations or overturned. Roof may be partially peeled off industrial/commercial/ warehouse buildings. Some minor roof damage to homes. Weak structures (e.g., farm buildings, airplane hangars) may be severely damaged.
78+ kts (90+ mph)	Many large trees broken and uprooted. Mobile homes severely damaged; moderate roof damage to homes. Roofs partially peeled off homes and buildings. Moving automobiles pushed off dry roads. Barns, sheds demolished.

Note: All references to trees are for trees with foliage. Significantly higher winds may be required to cause similar damage to trees without foliage. In addition, very wet soil conditions may allow weaker winds of 26 to 49 knots (30 to 57 mph) to uproot trees.

Tables 3 and 4 will assist in conversion of wind speed values between knots and miles per hour.

Table 3. Knots to miles per hour. (Example...45 knots equals 52 mph)

KTS	0	1	2	3	4	5	6	7	8	9
0	0	1	2	3	5	6	7	8	9	10
10	12	13	14	15	16	17	18	20	21	22
20	23	24	25	26	28	29	30	31	32	33
30	35	36	37	38	39	40	41	43	44	45
40	46	47	48	49	51	52	53	54	55	56
50	58	59	60	61	62	63	64	66	67	68
60	69	70	71	72	74	75	76	77	78	79
70	81	82	83	84	85	86	87	89	90	91
80	92	93	94	96	97	98	99	100	101	102
90	104	105	106	107	108	109	110	112	113	114

Table 4. Miles per hour to knots. (Example...45 mph equals 39 knots)

MPH	0	1	2	3	4	5	6	7	8	9
0	0	1	2	3	3	4	5	6	7	8
10	9	10	10	11	12	13	14	15	16	17
20	17	18	19	20	21	22	23	23	24	25
30	26	27	28	29	30	30	31	32	33	34
40	35	36	36	37	38	39	40	41	42	43
50	43	44	45	46	47	48	49	49	50	51
60	52	53	54	55	56	56	57	58	59	60
70	61	62	63	63	64	65	66	67	68	69
80	70	70	71	72	73	74	75	76	76	77
90	78	79	80	81	82	83	83	84	85	86

3.1.1 Thunderstorm Wind Events. StormDat software permits only one event name for encoding severe and non-severe "thunderstorm winds." Maximum wind gusts (measured or estimated) equal to or greater than 50 knots (58 mph) always will be entered. Events with maximum wind gust values less than 50 knots (58 mph) should be entered as a *Storm Data* event only if it results in fatalities, injuries, or significant property damage.

Note that damage alone does not automatically imply wind speeds of 50 knots (58 mph) or greater. When estimating a wind speed value, the preparer should take into account the amount and degree of severity, and condition of the damaged property. The resultant damage must support such a value. Refer to Section 3.1 for guidelines on estimating wind speeds. Estimated or measured wind gusts below 50 knots (58 mph), regardless of extent and/or severity of fatalities, injuries, and property damage, will not initiate the verification process. However, when significant damage is reported, the *Storm Data* preparer should consider entering estimated winds of 50 knots or greater for consistency. Encoded wind values of 50 knots (58 mph) or more will initiate the verification process for "thunderstorm wind" events.

Downbursts, including dry or wet microbursts or macrobursts, will be classified as "thunderstorm wind" events. In some cases, the downburst may travel several miles away from the parent thunderstorm, or the parent thunderstorm/convective shower may dissipate. However, since the initiation of the downburst event was related to a convective shower/thunderstorm, "thunderstorm wind" is the appropriate event to use.

Gustnadoes will be classified as "thunderstorm wind" events. The scientific community generally recognizes gustnadoes as short-lived vortices, not attached to a convective cloud base, that develop in response to eddies along a gust front or gust front intersection.

3.1.2 Marine Thunderstorm Wind Events. StormDat software permits only one event name for encoding severe and non-severe "marine thunderstorm winds." Maximum wind gusts (measured or estimated) equal to or greater than 34 knots (39 mph) always will be entered. Values less than 34 knots (39 mph) should be entered only if it results in fatalities, injuries, or significant property damage.

Note that damage alone does not automatically imply wind speeds of 34 knots (39 mph) or greater. When estimating a wind speed value, the preparer should take into account the amount and degree of severity, and condition of the damaged property. The resultant damage must support such a value. Refer to Section 3.1 for guidelines on estimating wind speeds. Estimated or measured wind gusts below 34 knots (39 mph), regardless of extent and/or severity of fatalities, injuries, and property damage, will not initiate the verification process. Wind values of 34 knots (39 mph) or more will initiate the verification process for "marine thunderstorm wind" events.

3.1.3 High Wind Events. Use of the "high wind" event name will be reserved for non-convective, widespread, gradient strong winds (sustained winds equal to or greater than 35 knots[1] (40 mph) for 1 hour or more, or sustained winds/maximum gusts of any duration equal to or greater than 50 knots (58 mph)[1]. When these wind conditions are satisfied, a *Storm Data* event entry is required, and the preparer will indicate in the entry table whether the wind value represents a maximum wind gust or a maximum sustained wind. Depending on the choice, the software will place an S or G in front of the wind value that appears in the *Storm Data* publication.

Events with winds less than the threshold numbers, resulting in fatalities, injuries, or significant property damage, will be encoded as a "strong wind" event. Similar to the high wind event, the preparer will indicate whether the strong wind event is based on a maximum wind gust or maximum sustained wind value.

The StormDat software program requires the preparer to indicate whether the wind gust value, or sustained wind value, is measured or estimated.

The "high wind" event name will also be used for wind damage reports from inland counties/ parishes that experienced a tropical cyclone. Refer to Section 3.6 for details.

3.2 Hail Events. StormDat software permits only one event name for encoding severe and non-severe hail events. If hail diameters are equal to, or greater than, 3/4 inch, a hail event always will be encoded. If hail stones with diameters less than 3/4 inch result in fatalities, injuries, or significant damage, encoding a hail event is recommended. Encoded values of estimated or measured hail diameters below 3/4 inch (non-severe), regardless of extent and/or severity of fatalities, injuries, and damage, will not initiate the verification process.

3.2.1 Marine Hail Events. StormDat software permits only one event name for encoding severe and non-severe marine hail events. If hail diameters over water surfaces with an assigned marine zone number are equal to, or greater than, 3/4 inch, a marine hail event always will be encoded. It is recognized that a number of marine hail events will never be documented.

If hail stones with diameters less than 3/4 inch result in fatalities, injuries, or significant damage, encoding a marine hail event is recommended. Encoded values of estimated or measured marine hail diameters below 3/4 inch (non-severe), regardless of extent and/or severity of fatalities, injuries, and property damage, will not initiate the verification process.

To assist in the task of converting spotter hail reports to actual hail diameter, a guideline follows in Table 5.

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[1] Note: Threshold values for some western mountain states are 43 knots (50 mph) instead of 35 knots (40 mph), and 65 knots (75 mph) instead of 50 knots (58 mph).

Table 5. Hail Conversion Chart.

Pea	0.25 - .375 inch	Golf ball	1.75 inch
-	0.50 inch	Hen Egg	2.00 inch
Penny	0.75 inch	Tennis Ball	2.50 inch
Nickel/Mothball	0.88 inch	Baseball	2.75 inch
Quarter	1.00 inch (15/16")	Tea Cup	3.00 inch
Half dollar	1.25 inch	Grapefruit	4.00 inch
Walnut/Ping Pong	1.50 inch	Softball	4.50 inch

Note: For many years, dime-size hail was the coin type associated with 0.75-inch diameter hail stones. However, the diameter of a dime is 11/16 inch, slightly smaller than a penny, which is 12/16 inch (0.75 inch). Also, for many years, marble-size hail was associated with hail stones ½ inch in diameter. However, marbles come in different sizes. Therefore, use of the term "marble-size" or "dime-size" hail is not recommended.

3.3 Lightning Events. Fatalities and injuries related to lightning strikes will be included in *Storm Data*. If reliable, significant lightning-related damage reports (such as structural fires or loss of electrical power and/or communications) are available, they may be entered. Often, the preparer is unaware of a lightning incident unless it is reported by the broadcast or print media, or by a governmental or law enforcement agency. Therefore, a number of lightning incidents will never be documented.

Over the western states, lightning may start hundreds of wildfires in a single CWFA. In these cases, the preparer will have to limit the number of incidents appearing in *Storm Data* by arbitrarily setting a threshold value based on minimum burned acreage, or some other parameter. In other situations, lightning may cause a fire that ultimately leads to fatalities and/or injuries. In these cases, the fatalities and/or injuries will be classified as indirectly related. Refer to Section 2.5.2 for additional information.

3.4 Winter Weather Events. Heavy snow, ice storm, and sleet storm will be the event name for those weather systems producing respective accumulations that meet or exceed nationally or regionally established threshold values. This is regardless of wind speed value/duration, or reduced visibilities, and one of the three above mentioned event types was the primary precipitation type.

In order to be classified as a "winter storm" event, the winter weather event must satisfy criteria in one of these two groups:

a. Heavy snow and blowing snow event - accumulations meet or exceed locally defined 12 and/or 24-hour, nationally or regionally established warning threshold values, and sustained wind or frequent gusts of 22 to 30 knots (25 to 34 mph) accompanied by falling and blowing snow, occasionally reducing visibilities to 1/4 mile or less for three hours or more, or

b. Mixed event - the weather system must have consisted of at least two of the following precipitation types: snow, freezing rain, or sleet, and the accumulation of the precipitation types must meet or exceed nationally or regionally-established warning threshold values.

As with classification of other events, the preparer must use care in classifying an event as a "winter storm." For example, if the winter event initially consists of a brief mixture of snow and freezing rain, but changes to sleet for most of its duration, and ends with a brief period of freezing rain, it should be classified as a "sleet" event.

3.5 Coastal Flooding Events. “Storm surge,” “seiche,” or “astronomical high tide” will be the event names for flooding of those portions of coastal land zones (coastal county/parish) adjacent to the waters and bays of the oceans, Great Lakes, Lake Okeechobee, or Lake Pontchartrain. Further inland, in a coastal or inland county/parish adjacent or near the oceanic waters and bays, the *Storm Data* preparer must determine when and where to encode a flood event as “Flash Flood” or “Flood.” Terrain (elevation) features will determine how far inland the coastal flooding extends.

3.6 Tropical Cyclone Events. After a tropical cyclone event, offices will: (a) have an entry for “tropical cyclone,” summarizing the total impact, and (b) list the impacts attributed to individual hazards events (storm surge, freshwater flooding, tornadoes, inland high winds, rip currents, etc.) These separate events (i.e., their associated fatalities, injuries, and damage amounts) are not included/encoded as part of the header strip of the tropical cyclone event. Additionally, the name of the tropical cyclone will be included in the narrative of all associated individual hazards/events.

The only individual hazard that will be encoded as one of the three tropical cyclone events is wind damage in coastal counties/parishes. This restriction prevents a “double-count” from occurring in the national report entitled “*A Summary of Natural Hazard Fatalities for [Year] in the United States*,” which is based upon the header strips of *Storm Data* events. In other words, the fatalities, injuries, and damage amounts appearing in the above header strip of a tropical cyclone are attributed only to wind damage experienced in the coastal counties/parishes listed in the header strip. The effects from the other individual hazards associated with a tropical cyclone can be found in other cyclone-related events.

In order to provide complete documentation of the tropical cyclone effects, the *Storm Data* preparer will do two additional things:

a. Insert into the tropical cyclone narrative the *total* fatalities, injuries, and damage amounts attributed to *all* tropical cyclone hazards, for affected coastal and inland counties/ parishes within a CWFA (e.g., “The collective effects of Hurricane Alpha during the period of August 1-3, resulted in 10 fatalities, 50 injuries, $800M in property damage, and $200M in crop damage in the counties of S, T, U, V, W, X, Y, and Z”). This will ensure that all tropical cyclone effects are summarized in one phrase; and

b. Provide in the tropical cyclone narrative, a general breakdown of fatalities, injuries, and damage amounts attributed to individual hazards/events, for both coastal and inland counties/parishes (e.g., “During the passage of Hurricane Alpha in the counties of S, T, U, V, W, X, Y, and Z, five tornadoes killed 3 people and resulted in $1.0M in property damage, flash floods injured 20 people and resulted in $175M in crop damage, rip currents resulted in 5 fatalities,” etc.).

In addition, the following information will be included in the narrative for tropical cyclones at coastal locations:

- Tropical cyclone name;
- For coastal locations, the point of landfall;
- Storm surge/storm tide;
- Minimum surface pressure; and
- Saffir/Simpson Hurricane Scale category, when appropriate.

The following information will be included for both coastal and inland locations:

- Maximum sustained wind speed/peak gusts;
- rainfall totals; and
- record-breaking data.

Effects that occur well outside the circulation of the tropical cyclone, such as swell that may occur hundreds of miles away, will be listed under another specific event, such as “Rip Current” or “Heavy Surf,” with its narrative mentioning the tropical cyclone as a secondary effect.

In some situations, there may be tropical cyclone-related hazards, as mentioned above, occurring prior to or after the beginning/ending time of the tropical cyclone event. Professional judgment must be exercised in determining if these related hazards are part of the cyclone. Refer to Sections 2.5.2 and 2.6.4 for the decision process.

Damage listed in the header strip of the individual hazards, or the tropical cyclone, should not include such things as business losses from reduced tourism, etc.

Table 6 depicts the Saffir-Simpson Hurricane Scale.

3.7 Tornado, Funnel Cloud, and Waterspout Events. The terms "tornado," "funnel cloud," and "waterspout” are defined below.

a. Tornado. A violent rotating column of air, usually pendant to a cumulus/ cumulonimbus, with circulation reaching the ground. On a local scale, it is the most destructive of all atmospheric phenomena.

b. Waterspout. A violently rotating column of air usually pendant to a cumulus/ cumulonimbus, over a body of water, with its circulation reaching the water.

c. Funnel Cloud. A rotating visible extension of cloud pendant to a cumulus/ cumulonimbus with circulation not reaching the ground or water.

Table 6. Saffir-Simpson Hurricane Scale.

CATEGORY (SCALE NUMBER)	WIND SPEED	STORM SURGE (FT)	DAMAGE
1	64-83 kts (74-95 mph)	4-5	Minor
2	84-96 kts (96-110 mph)	6-8	Moderate
3	97-113 kts (111-130 mph)	9-12	Major
4	114-135 kts (131-155 mph)	13-18	Severe
5	Greater than 135 kts (Greater than 155 mph)	Greater than 18	Catastrophic

Note: A scale ranging from 1 to 5 based on a hurricane's intensity. This can be used to give an estimate of the potential property damage and flooding expected. In practice, wind speed is the parameter that determines the category since storm surge is highly dependent on the slope of the continental shelf.

WFOs are responsible for identifying, investigating, and confirming storms occurring in their warning areas. To accomplish this, the *Storm Data* preparer should use all available severe weather reports, including information from newspapers, letters and photographs, airborne surveys and pilot reports, state/local emergency management, and personal inspections.

When available information includes a reliable report that a tornado vortex was distinctly visible (condensation funnel pendant from a cloud—usually a cumulonimbus), and in contact with the ground, or a rotating dust/dirt/debris column at the ground is overlaid with a condensation funnel cloud pendant above, identification of a tornado is a simple matter. This is particularly true when reports have been investigated by the responsible NWS official and found to be reliable. However, tornadoes, funnel clouds, and waterspouts can be hidden by precipitation, low clouds, or dust. Darkness or lack of observers also may result in a tornado or waterspout not being observed. The WFO must exercise professional judgment to identify a tornado or waterspout from its effects.

If a tornado develops on, or moves over, an inland lake that does not have an assigned marine zone number, it is classified as a tornado during its time over those waters. If a tornado moves over a body of water with a marine zone assigned to it, the event will be classified as a waterspout for that portion of its trajectory over water. One can describe the characteristics of the tornado, over land or water surfaces, in the narrative.

Tornadoes crossing state lines or boundaries of WFO CWFA responsibility will be coordinated between WFOs. The preparer will ensure that the exact location, where a tornado crosses a county, parish, or state line, is incorporated into the narrative. Sharp-turning tornadoes may need to be segmented into individual pieces in order to adequately describe the path of that event. However, segmenting a tornado within the same county/parish is <u>not</u> encouraged since this practice may lead to confusion and over-counting of tornadoes by *Storm Data* customers. It is recommended that the preparer encode only one beginning and ending point for the tornado path within each county/parish affected, and provide detailed information in the narrative about the intermediate locations where the tornado turned sharply. Additional instructional information regarding these "border-crossing" tornadoes can be found in the "tornado" event examples in Appendix A.

In some situations, many public and spotter reports of funnel clouds are passed on to a WFO. In these cases, the preparer should document only the most significant funnel clouds, especially those that generate public or media attention.

"Landspouts" will be classified as tornadoes, assuming the preparer has reliable reports meeting the criteria outlined in Section 3.7.2. Similarly, "cold-air funnels," meeting the criteria outlined in Section 3.7.2, will be classified as a tornado event.

On the other hand, dust devils shall not be classified as tornadoes since they are a ground-based whirlwind that doesn't meet the tornado criteria outlined in Section 3.7.2. A dust devil is an allowable *Storm Data* event name as indicated in Section 2.

3.7.1 <u>On-site Inspections (Surveys)</u>. WFO tornado/waterspout and significant downburst damage surveys are desirable in those cases when the Meteorologist in Charge (MIC) believes additional information is needed for *Storm Data* preparation. A survey should be done as soon as possible before clean-up operations remove too much evidence.

3.7.2 <u>Objective Criteria for Tornadoes</u>. An event will be characterized as a tornado if the type or intensity of the structural and vegetative damage and/or scarring of the ground only could have been tornadic, or if any two of the following guidelines are satisfied:

a. Fairly well-defined lateral boundaries of the damage path;

b. Evidence of cross-path wind component, e.g., trees lying 30 degrees or more to the left/right of the path axis (suggesting the presence of a circulation);

c. Evidence of suction vortices, ground striations, and extreme missiles; or

d. Evidence of surface wind convergence as suggested by debris-fall pattern and distribution. In fast-moving storms, the convergence pattern may not be present and debris pattern may appear to fall in the same direction.

Additionally, an event will be characterized as a tornado if:

a. Eyewitness reports from credible sources, even with little or no structural or vegetative damage, and/or little or no scarring of the ground, indicate that a violent circulation extended from the convective cloud base to the ground; or

b. Videotapes or photographs from credible sources, even with little or no structural or vegetative damage, and/or little or no scarring of the ground, indicate that a violent circulation extended from the convective cloud base to the ground.

There may be situations, especially in the central or western parts of the United States, where verification of tornadoes will be difficult. However, if available evidence establishes that it was highly likely a tornado event occurred, then the preparer will enter the event in *Storm Data*.

3.7.3 Criteria for a Waterspout. A vortex in contact with the water surface that develops on, or moves over, the waters and bays of the oceans, Great Lakes, Lake Okeechobee, or Lake Pontchartrain will be characterized as a waterspout for that portion of its path over those water surfaces.

3.7.4 Determining Path Length and Width. Path length (in miles and tenths) and maximum path width (in yards) will be indicated for all tornadoes, including each member of families of tornadoes, or for all segments of multi-segmented tornadoes. The length in the header strip is the length of that particular segment in that particular county/parish. A *Storm Data* customer can determine the entire length of a multi-segmented tornado by adding the lengths from each segment.

Path length excludes sections without surface damage or burn marks, unless other evidence of a ground-based circulation exists, e.g., a trained spotter report, or a videotape of the tornado over plowed field. The excluded section will not exceed 2 continuous miles or 4 consecutive minutes of travel time. Otherwise, the path will be categorized as consisting of separate tornado events.

The width in the header strip is the maximum observed through the entire length of a tornado, or of each segment in a multi-segment tornado. To determine the tornado's maximum width, a *Storm Data* customer must check each segment which is entered as a separate event.

The preparer is encouraged to include in the narrative the average path width (in yards) of all tornadoes. Availability of average path width information in *Storm Data* benefits the scientific research community and other customers.

3.7.5 Determining F-Scale Values. The F-scale values will be assigned to every documented tornado. The *Storm Data* preparer must exercise professional judgment to determine the F-scale rating. Eyewitness verbal accounts, newspaper or personal photographs, and videotapes of the tornado(s) may be relied upon when an inspection/survey is not possible. In cases where there is damage to numerous structures, damage to a single structure should not be used as the deciding factor for the appropriate F-scale rating. Experience has shown that the F-scale of a tornado cannot be determined, consistently and reliably, solely on appearance. Due to the difficulty in judging the F-scale, the assigned value may be off by one (+/-) F value.

To assist the WFO, a set of uniform objective guidelines are listed in Table 7 followed by pictures of related damage. Table 8 correlates observed structural damage with types of construction and the resultant F-scale value.

3.7.6 Simultaneously Occurring Tornadoes. On occasions, especially over the Plains states, a single cumulonimbus may have several, separate, tornadoes occurring simultaneously. They may be separated by a distance as little as ½ to 1 mile; and each may have a distinct, separate trajectory. In these cases, the Storm Data preparer should classify the tornadoes as separate events, each with a unique start/end location/time combination. The preparer will have to rely on credible evidence such as eyewitness reports, video tapes, and damage along the path in order to determine how many tornadoes actually existed. Existing *Storm Data* indicates that "landspout" tornadic situations have resulted in several simultaneously occurring tornadoes.

If evidence suggests that a multiple-vortex tornado occurred, the *Storm Data* preparer shall document this situation as a single tornado event, even though each vortex created a distinct damage path. The multiple vortices rotate around a common center—the tornado center. Conversely, separate tornadoes, even if they are closely spaced, will not rotate around a common center.

A brief detailed explanation of simultaneously occurring tornadoes can be included in the narrative associated with each tornado event.

Table 7. Fujita Tornado Intensity Scale.

F-Scale	Tornado Intensity	Damage Intensity	Wind Speed	Typical Damage
F0	Weak	Gale Tornado	35-63 kts (40-72 mph)	Tree branches broken, chimneys damaged, shallow-rooted trees pushed over; sign boards damaged or destroyed, outbuildings and sheds destroyed.
F1	Weak	Moderate	64-97 kts (73-112 mph)	Roof surfaces peeled off, mobile homes pushed off foundations or overturned, moving autos pushed off the roads, garages may be destroyed.
F2	Strong	Significant	98-136 kts (113-157 mph)	Roofs blown off frame houses; mobile homes demolished and/or destroyed, train boxcars pushed over; large trees snapped or uprooted; airborne debris can cause damage.
F3	Strong	Severe	137-179 kts (158-206 mph)	Roofs and walls torn off well constructed houses; train cars are overturned; large trees are uprooted, can knock down entire forest of trees; heavy cars lifted off the ground and thrown.
F4	Violent	Devastating	180-226 kts (207-260 mph)	Well-constructed frame houses leveled, but debris remains close by; structures with weak foundations blown off some distance; automobiles thrown and disintegrated, large airborne objects can cause significant damage.
F5	Violent	Incredible	227-276 kts (261-318 mph)	Brick, stone, and cinder-block buildings destroyed, most debris is carried away by tornadic winds, large and heavy objects can be hurled in excess of 300 feet, trees debarked, asphalt peeled off of roads, steel reinforced concrete structures badly damaged.

(Aerial photographs courtesy of Brian Smith, Meteorologist, National Weather Service, Valley, Nebraska. Ground photographs courtesy of Tim Marshall, Structural Engineer, Haag Engineering, Dallas, Texas.)

Typical F0 Tornado Damage
Note the trees have been stripped of leaves, but the trees remain standing. Only light roof damage with a few missing shingles.

Typical F0 Tornado Damage
A poorly anchored home is pushed off its foundation.

Typical F1 Tornado Damage
Shallow-rooted trees are uprooted and shingles are ripped from the roof with significant roof damage.

Typical F1 Tornado Damage
Structural damage can occur to well built structures as shown in this photograph. The garage wall supports have been pushed in.

Typical F2 Tornado Damage
This home has had the entire roof blown off, yet the exterior walls remain intact. Some of the stronger hardwood trees remain standing.

Typical F2 Tornado Damage
More significant structural damage occurs. Note the severe damage to this home's roof and exterior walls.

Typical F3 Tornado Damage
This home is missing the entire roof as well as some of the exterior walls. Trees are blown over or snapped near the base and outbuildings are destroyed.

Typical F3 Tornado Damage
Most walls of a home can be knocked down. Only an interior wall of this home remains standing.

Typical F4 Tornado Damage
This home is completely obliterated, with no walls left standing. The debris from the home remain at the location where the house once stood.

Typical F4 Tornado Damage
All walls of well-built structures are blown down, including most of those made of brick or stone.

Typical F5 Tornado Damage
These homes have been completely removed from their original locations. The debris field has been scattered some distance from their foundation.

Typical F5 Tornado Damage
Debris created by the destroyed house has been scattered from the homesite. Only the foundation remains to indicate the structures' original location.

Typical F5 Tornado Damage
Most homes in a wide area are destroyed, leaving only foundations. The debris seen in the foreground is most likely debris from other homes in the area.

Table 8. Estimate of F-Scale Wind from Structure Type and Damage Category By Fujita (1989).

Structure Type	Damage Categories						
	No Damage	Minor Damage	Roofing Blown Off	Whole Roof Blown Off	Some Walls Standing	Flattened to Ground	Blown Off Foundation
Outbuilding Mobile Home	F0	F0	F0	F1	F1	F1	F2+
Weak Frame House	F0	F0	F1	F1	F2	F2	F3+
Strong Frame House	F0	F0	F1	F2	F3	F4	F5+
Brick Building	F0	F1	F2	F3	F4	F5+	F5++
Concrete Building	F1	F2	F3	F4	F5+	F5++	F5+++

Minimum wind speeds: F0 (35 kts/40 mph); F1 (64 kts/73 mph); F2 (98 kts/113 mph); F3 (137 kts/158 mph); F4 (180 kts/207 mph); F5 (227 kts/261 mph).

4. Disposition of *Storm Data*. *Storm Data* files will be transferred electronically to the Performance Branch (W/OS52), using the currently authorized software, no later than 60 days after the end of the month for which the data is valid. Negative reports are required, and simply require one to transmit a "blank" month in compressed format (no entries or text needed, just type in beginning and ending dates). Additional related reports may be needed prior to, or after, 60 days after the end of the month for which the data is valid, depending on local, regional, or national requirements. The *Storm Data* preparer will refer to appropriate directives, and their MIC, for preparation instructions and distribution requirements.

5. Outstanding Storms of the Month (OSM). An important feature of the publication *Storm Data* is the OSM section. The OSM may be any type of event (tornadoes, hurricanes, snow, ice, hail, etc.). Events may be selected for this section for their meteorological significance even if damage or casualties are minimal. Tornadoes of F4 intensity or greater should be submitted for the OSM. Otherwise, providing information for the OSM is optional but highly desirable.

Although the Warning Coordination Meteorologist or *Storm Data* focal point prepares the OSM, the MIC is ultimately responsible for OSM contributions from the field office. This includes all forensic discovery (data gathering, fact finding, development of statistics, etc.), drafting graphics and tables, supplying photographs, and preparing the narrative.

5.1 Requirements for Outstanding Storms of the Month. The OSM material is used to enhance the cover appearance of the *Storm Data* publication, as well as provide additional detail not found in a documented event.

5.1.1 Text Format. The OSM should be prepared using any American Standard Code for Information Interchange (ASCII)-based software.

5.1.2 Disposition Dates. NCDC should be contacted within 60 days following the end of the month in which the event occurred, if a WFO wishes to have material considered for the OSM. The OSM material will be submitted to NCDC within 90 days following the end of the month in which the event occurred. The OSM material submitted beyond 90 days will not be considered.

5.1.3 Copyrights. Permission or credit for the use of each item must be obtained from the original source before mailing or E-mailing to NCDC. Make sure that the submitted materials are accompanied by a description and name of photographer.

5.1.4 Final Editing. NCDC will be responsible for final editing of the narrative and any necessary assembly of multiple OSM products. In addition, NCDC may produce additional OSM features.

5.1.5 Write-up/Discussion. The OSM will include a one or two-page write-up which incorporates the following: synoptic discussion of events leading up to the "Storm," warnings and watches in effect, notable information about the storm, storm statistics: (F-scale, hail size, wind gusts, snow amounts, etc.), aftermath (fatalities, injuries, damage).

5.1.6 Pictures. Photographs, charts, or maps of the storm or the damage/aftermath should conform to the following guidelines:

a. Hand drawn or computer generated maps may be sent to depict damage amounts and/or location;

b. 35 mm photographs (or slides), images, maps, or charts may be sent via mail to NCDC, scanned and returned to sender;

c. 35 mm photographs (or slides), images, maps, or charts may be scanned by sender, and sent via E-mail or FTP to NCDC;

d. Scan at original size;

e. Scan at 150 - 300 dpi (dots per inch);

f. Save as .jpg or .tif formats; and

g. Digital camera images may be used if they have a 1024x768 or greater resolution, or 144 or greater dpi.

6. Tornado and Severe Thunderstorm Confirmation Reports. Four Advanced Weather Interactive Processing System (AWIPS) alphanumeric text products are produced by the Storm Prediction Center (SPC). These products summarize unofficial (preliminary) tornado and severe thunderstorm reports that were processed at SPC and originated from each WFO's CWFA

responsibility. Each field office should compare the appropriate message with its local records. Any change in event information should be noted, but corrections will be made via *Storm Data*. Additional severe weather statistics and graphics can be found on the SPC Web page.

STADTS WWUS60 - Listing of tornado and severe thunderstorm reports for previous calendar day;

STAHRY WWUS60 - Listing of tornado and severe thunderstorm reports for current day, and updated on an hourly accumulative basis;

STAMTS WWUS61 - Statistics for tornado totals, tornado-related fatalities, and number of killer tornadoes on a monthly and yearly basis (current year and previous 3 years); and

STATIJ WWUS63 - Listing of killer tornadoes for current year.

7. Weekly Warning Reports. A weekly listing of all short-fuse severe weather warnings, categorized by WFO, are posted on the StormDat/Verification Web site. A *Storm Data* preparer should note any discrepancies in this report, and E-mail copies of warning/text changes to W/OS52 as soon as possible. Photocopies will suffice.