

## CHAPTER 2

# DEFINITIONS AND CRITERIA

### 2.1. General

This chapter defines those common meteorological terms, subject to multiple interpretations, that are used by Federal agencies preparing severe local storms forecasts and warnings. Where possible, the definitions are based on or adapted from the American Meteorological Society (AMS) Glossary of Meteorology.

### 2.2 Severe Local Storm

A severe local storm is a tornado, waterspout, or thunderstorm with winds of 50 knots (25 m/s or 58 mph) or greater and/or hail one inch (25.4 mm) or greater in diameter at the ground. Significant wind damage (several downed trees) or sightings of large hail or a tornado can help supplement official observations (METAR and SPECI) to determine where severe local storms occur. The only exception over land is for “Airport Weather Warnings” where the hail criterion is  $\geq \frac{1}{2}$  inch in diameter. METAR is an aviation routine weather report issued at hourly or half-hourly intervals. It is a description of the meteorological elements observed at an airport at a specific time. SPECI is an aviation special weather report issued when there is significant deterioration or improvement in airport weather conditions.

### 2.3 Severe Local Storms Season(s)

Tornadoes and severe thunderstorms may occur anywhere and at any time of the year. The months and location of greatest frequency of severe thunderstorms and tornadoes shift from the southeast United States in the early spring, to the southern and central Plains and lower Midwest during the rest of the spring, and into the northern Plains and upper Midwest during the late spring and early summer. The lowest frequency of occurrence is west of the Rocky Mountains.

### 2.4 Squall Line

A squall line refers to a line of active thunderstorms, either continuous or with breaks, including contiguous precipitation areas resulting from the existence of the thunderstorms. Squall lines can extend hundreds of miles in length and can be especially disruptive to aviation activities.

### 2.5 Density/Risk of Severe Thunderstorms

The Storm Prediction Center (SPC) issues daily severe weather outlooks describing forecast coverage of severe thunderstorms across the conterminous United States. Three risk categories (Slight, Moderate, and High) are used to symbolize the coverage and intensity of the expected severe weather. Their definitions are:

- Slight risk—Well-organized severe thunderstorms are expected, but in small numbers and/or low coverage. Depending on the size of the area, approximately 5-29 reports of one inch diameter or larger hail, and/or 5-29 wind events, and/or 3-5 tornadoes would be possible.
- Moderate risk—A potential for a greater concentration of severe thunderstorms than the slight risk, and in most situations, greater magnitude of the severe weather. Within a moderate risk area, at least 30 reports of hail 1 inch diameter or larger, or 6-19 tornadoes, or numerous wind events (at least 30 reports that likely would be associated with a squall line, bow echo, or derecho).
- High risk—A major severe weather outbreak is expected, with a high concentration of severe weather reports and an enhanced likelihood of extreme severe (i.e., violent tornadoes or very damaging convective wind events occurring across a large area). In a high risk area, the potential exists for 20 or more tornadoes, some possibly F2 or stronger, or an extreme wind event potentially causing widespread wind damage and higher-end wind gusts (80+ mph) that may result in structural damage.

## 2.6 Thunderstorm Intensity Categories

Primary hazards in a thunderstorm are wind, hail, flash flooding, and lightning. Flash flooding and lightning may be mentioned in severe weather watches/warnings, if they will have a significant impact on the general public. The following thunderstorm intensity classes will be used in the forecasting and warning functions of concerned agencies:

- Thunderstorm—Wind gusts less than 50 knots and hail, if any, of less than one inch diameter at the surface.
- Severe Thunderstorm—Thunderstorm-related surface winds (sustained or gusts) of 50 knots or greater and/or surface hail one inch diameter or larger. Wind or hail damage may be used to infer the occurrence/existence of a severe thunderstorm. The word "hail" in a watch bulletin implies hail at the surface as well as aloft, unless a qualifying phrase such as "hail aloft" is used.

**NOTE:** The USAF uses an additional intensity definition for Moderate Thunderstorm—Wind gusts between 35 and 50 knots, and/or hail, if any, of 1/2 inch diameter up to 3/4 inch diameter at the surface.

## 2.7 Funnel Cloud

A funnel-shaped cloud of condensation, usually extending from a deep convective cloud, and associated with a violently rotating column of air that is not in contact with the ground.

## 2.8 Tornado

A violently rotating column of air that is in contact with the ground, either pendant from a cumuliform cloud or underneath a cumuliform cloud, and is often (but not always) visible as a funnel cloud.

## 2.9 Waterspout

In general, any tornado that occurs over a body of water, consists of an intense columnar vortex (usually containing a funnel cloud), and is connected to a cumuliform cloud.

## 2.10 Flash Flood

A rapid and extreme flow of high water into a normally dry area or a rapid water-level rise in a stream or creek above a predetermined flood level that begins within 6 hours of the causative event (e.g., intense rainfall over a relatively small area, dam failure, ice jam). However, the actual time threshold may vary in different parts of the country. Ongoing flooding can intensify to flash flooding in cases where intense rainfall results in a rapid surge of rising flood waters.

## 2.11 Other Warning Criteria

All phenomena, other than those classified as severe local storms, paragraph 2.2, described in the various warnings, bulletins, and advisories should be categorized as "other warning criteria" and are not called severe weather phenomena. Such other warning criteria will be listed separately in the appropriate NOAA/NWS publications.

**Table 2.1. Types of NWS Messages—General Categories**

<b>Product</b>	<b>Lead time</b>	<b>Certainty of event</b>	<b>Purpose/outcome</b>
Outlook	Hours to a few days	<i>Possible</i> occurrence of hazardous weather	Adequate notice to those who need hours or longer lead times
Watch	Less than 1 day for severe weather (e.g., thunderstorms, flash floods, tornadoes)  1-2 days for large-scale events (e.g., winter storms, hurricanes)	Risk of hazardous weather has increased but not necessarily occurred	Notify public to carefully monitor local weather conditions; prepare to protect life/property
Advisory	Hours for large-scale events  Minutes for severe weather	A hazardous weather event is occurring, is imminent, or has a very high probability of occurrence	Conditions <i>may</i> require immediate action to protect life and property; impacts are generally not as severe

			as with a warning
Warning	Hours for large-scale events  Minutes for severe weather	A hazardous weather event is occurring, is imminent, or has a very high probability of occurrence	Conditions <b><i>require immediate</i></b> action to protect life and property

### 2.12 Convective SIGMETs

Convective SIGMET bulletins for thunderstorms occurring or expected to occur in lines, for an area of thunderstorms covering at least 3,000 square miles, and/or for severe or embedded thunderstorms, are issued by the Aviation Weather Center (AWC) as scheduled products hourly at 55 minutes after the hour (H+55) and as nonscheduled specials. Special Convective SIGMET bulletins cover the conterminous United States and the adjacent coastal waters. For thunderstorm areas less than 3,000 square miles, a Center Weather Service Unit (CWSU) may issue Center Weather Advisories (CWA) for its area of responsibility.

### 2.13 Collaborative Convective Forecast Product (CCFP)

The CCFP—a graphical representation of expected convective weather at 2, 4, and 6 hours after issuance time—is produced through a collaborative process involving NWS meteorologists at the AWC, CWSU meteorologists, and airline meteorologists. The CCFP is issued every 2 hours, supports the strategic system-wide planning for the National Airspace System (NAS), and is intended to help reduce traffic-flow disruptions caused by convective weather.

### 2.14 Special Marine Warnings (SMW)

SMWs are for hazardous over-water events of short duration (up to 2 hours) that are not adequately covered by existing marine warnings and forecasts. These events include convective activity, squalls or wind-shift lines, waterspouts, cold-air funnels, and other localized short-lived phenomena. The nationwide criteria for the SMW issuance are forecast winds of 34 knots and/or hail 3/4 inch or more in diameter and/or a waterspout.

## CHAPTER 3

# GENERAL OPERATIONS AND PROCEDURES

### 3.1 General

Every effort has been made to standardize terminology, adopt common definitions, and adjust criteria to a common base; however, each agency has different operational watch and warning criteria that must be met. Although standardization will be used wherever possible in forecasts and warnings, each agency retains the right to specify the forecast, watch, and warning criteria needed to carry out its mission.

### 3.2 National Weather Service (NWS) Watch/Warning Procedures

#### 3.2.1 General

The NWS has statutory responsibility for providing severe local storms watch and warning service for all 50 States. This responsibility is fulfilled by the National Centers for Environmental Prediction (NCEP) Storm Prediction Center (SPC) and the NWS Weather Forecast Offices (WFOs). NCEP Central Operations (NCO), as the central data processing center for the NWS, issues prognostic charts, discussions, and other forecast data and information that are used by the WFOs, SPC, and NCEP's Aviation Weather Center (AWC) in fulfilling their severe local storm responsibilities.

#### Geographical Responsibilities

For the conterminous United States (CONUS), the SPC issues Severe Weather Outlooks and Watches. SPC does not issue severe local storm watches for Alaska or Hawaii. The WFOs at Anchorage and Honolulu have the responsibility for maintaining weather watches and issuing warnings as needed for their respective States. Each WFO in the 50 States and the U.S. territories, located in the NWS Pacific and Southern Regions, issues a Thunderstorm Outlook/Hazardous Weather Outlook for a forecast of, and Warnings for an imminent threat of, severe thunderstorms and/or tornadoes.

#### Watch/Warning Criteria

Any or all of the criteria listed in paragraph 2.2 Severe Local Storms, paragraph 2.5 Density/Risk of Severe Thunderstorms, and paragraph 2.6 Thunderstorm Intensity Categories/Severe Thunderstorms may be mentioned in severe weather watches/warnings to indicate more fully that severe weather is expected. Severe weather watches/warnings that mention tornadoes or waterspouts imply that thunderstorm activity, usually severe, is also expected/occurring.

#### Outlooks

The SPC issues separate Convective Outlooks for severe weather for Day One, Day Two, and Day Three. Each forecast covers 24 hours (see Appendix A, page A-1 for an example of a

Convective Outlook in both a text and graphical format). The outlook conveys forecasts of expected severe weather coverage as defined in Chapter 2. Additionally, the Day 1 and Day 2 Outlook cover the general thunderstorm outlook when greater than a 10 percent chance of a thunderstorm is forecast. A Day 4-8 Severe Weather Outlook is also issued to indicate areas where a severe potential exists several days in advance. A relatively high confidence for severe weather has to be expected before an area is indicated, given the greater uncertainty. Each WFO issues a Thunderstorm Outlook/Hazardous Weather Outlook to outline the severe convective threats of the day, public watches based on SPC watches, and public warnings for imminent severe thunderstorms and/or tornadoes.

## Mesoscale Discussions

The SPC issues Mesoscale Discussions (MDs) to convey to CONUS WFOs, the public, media, and emergency managers the current meteorological reasoning for different types of short-term hazardous weather concerns. MDs are nonscheduled, event-driven products. For severe potential and convective trends, SPC will issue a MD 1 to 2 hours prior to a watch issuance. SPC will also issue a MD for severe weather potential when an area is being monitored for a potential convective watch or when thunderstorm development is potentially severe but will not have enough areal coverage or duration to need a convective watch issuance. MDs are normally issued at least every 2 to 3 hours for each convective watch that is in effect and are focused on mesoscale and storm-scale features within the watch area. For an example of a MD, see Appendix A, page A-2.

The following descriptions are used in the MD “CONCERNING...” line to better identify the reasoning behind the particular SPC discussion of the severe potential:

Watch Unlikely  
Watch Possible  
Watch Likely  
Tornado Watch Likely  
Severe Thunderstorm Watch Likely  
Watch Needed Soon

## Public Watches

### SPC Public Watches

The SPC collaborates on watch issuances with the local WFOs and issues watches where severe thunderstorms and/or tornadoes are expected (see Appendix A, page A-3, for an example of a Severe Thunderstorm Watch). A Watch Outline Update (WOU) is also issued that lists all of the counties and, if applicable, the coastal zones that are in the watch issuance (see Appendix A, page A-4, for an example of a WOU). The watch type reflects the anticipated predominant threat. A tornado watch is issued when multiple weak tornadoes or at least one strong tornado is anticipated. A severe thunderstorm watch is issued when hail and/or thunderstorms producing damaging winds or large hail are expected to be the primary threat.

Following the issuance of a severe thunderstorm or tornado watch, SPC issues hourly watch status messages indicating which areas remain under the threat of severe weather (see Appendix A, pg. A-5, for an example of a Watch Status message).

Accompanying the public severe thunderstorm or tornado watch is the aviation version of the same watch, which outlines the watch area for plotting purposes (see Appendix A, page A-6 for an example of an Aviation Watch). This watch also includes the expected maximum hail size, strongest thunderstorm wind gusts, and storm motion vector of severe thunderstorms in the watch area.

### WFO Public Watch

Once a watch is issued by the SPC, the WFO issues a Watch County Notification (WCN) listing of the counties within the watch in its area of responsibility (see Appendix A, page A-6 for an example of a Watch County Notification). As the event unfolds, the WCN products are issued by the WFO to clear counties from each watch until the watch has expired. The WCN may also be used to add counties to the watch and to extend the valid time of the watch.

## Public Warnings

### Tornado Warning (TOR)

Each WFO issues tornado warnings (see Appendix A, page A-8, for an example of a tornado warning) where there is radar or satellite indication and/or reliable spotter reports of a tornado. Valid times are usually 15 to 45 minutes. Warnings are often updated with a severe weather statement while the warning is in effect. The warnings use a ‘bullet’ format to highlight the most important warning parameters such as type of warning, when a warning is in effect, basis for the warning, and an optional storm-path prediction forecasting the times and locations of the severe weather.

### Severe Thunderstorm Warning (SVR)

Each WFO issues severe thunderstorm warnings (see Appendix A, page A-8, for an example of a severe thunderstorm warning) when there is radar or satellite indication and/or reliable spotter reports of wind gusts equal to or in excess of 50 knots (58 mph) and/or hail size of one inch diameter (size of a U.S. quarter-dollar) or larger. Valid times are usually 30 to 60 minutes. Warnings are often updated with a severe weather statement while the warning is in effect. These warnings use a ‘bullet’ format to highlight the most important warning parameters such as type of warning, when a warning is in effect, basis for the warning, and an optional storm-path prediction forecasting the times and locations of the severe weather.

### Flash Flood Warning (FFW)

Each WFO issues a flash flood warning (see Appendix A, page A-9, for an example of a flash flood warning) in any of the following circumstances:

- Flash flooding is imminent or occurring. A dam or levee failure is imminent or occurring.

- A sudden failure of a naturally caused stream obstruction (including debris slide, avalanche, or ice jam) is imminent or occurring.
- Precipitation capable of causing flash flooding is indicated by radar, rain gages, and/or satellite.
- Local monitoring and prediction tools indicate flash flooding is likely.
- A hydrologic model indicates flash flooding for locations on small streams.
- A previously issued flash flood warning needs to be extended in time.

Warnings are often updated with a flash flood statement while the warning is in effect. The warnings use a ‘bullet’ format to highlight the most important warning parameters such as type of warning, when a warning is in effect, basis for the warning, and locations impacted.

### Special Marine Warnings (SMW)

The WFOs issue SMWs for hazardous over-water events of short duration (up to 2 hours) and for events inadequately covered by existing marine warnings and forecasts (see Appendix A, page A-10, for an example of an SMW). These events can include convective activity, squalls or wind shift lines, waterspouts, cold air funnels, and other localized short-lived phenomena.

### Convective SIGMETs

The AWC issues Convective SIGMET bulletins both hourly, at 55 minutes past the hour, and as required over CONUS and adjacent coastal waters for areas greater than 3000 square miles (see Appendix A, page A-11, for an example of a Convective SIGMET). Negative bulletins are issued if none of the criteria specified in Chapter 2 is met. Convective SIGMETs alert in-flight interests of the following hazards:

- Tornadoes
- Lines of thunderstorms
- Embedded thunderstorms of any intensity
- Active thunderstorms affecting at least 3000 square miles
- Severe thunderstorms with hail of 3/4 inch diameter or greater or winds 50 knots or greater

### National Convective Weather Forecast (NCWF) Product

The NCWF supplements the convective airmen’s meteorological information (AIRMET) and SIGMET products. The NCWF product provides forecasts of significant thunderstorm locations 1 hour in the future and is updated every 5 minutes. This product is available via Internet from AWC’s operational server: <http://aviationweather.gov/products/ncwf/>.

## Center Weather Service Unit (CWSU) Messages

The CWSU prepares the Center Weather Advisory message for the aviation community which can include severe weather convective SIGMETs for areas less than 3000 square miles.

### 3.3 DOD Watch/Warning Procedures

#### 3.3.1 USAF

The USAF's Air Force Weather (AFW) provides weather warning support for both the Air Force and Army, including the active and reserve components. All sites receive watches and warnings for thunderstorms, severe thunderstorms, tornadic thunderstorms, and lightning strikes. Warning lead times are standardized to the greatest extent possible; specific mission needs may drive nonstandard lead times and criteria. Standardized lead times are 90 minutes for moderate thunderstorms (those with 1/2 inch diameter hail and/or 35-49 knot winds), 2 hours for severe thunderstorms, 15 minutes for tornadoes, and 30 minutes (prior to a thunderstorm within 5 nm of the installation or airfield) for lightning watches. Lightning warnings are issued when lightning is observed within 5 nm of the installation.

#### Operational Weather Squadrons (OWS)

AFW's OWSs at Barksdale AFB, Louisiana; Scott AFB, Illinois; Davis-Monthan AFB, Arizona; and Hickam AFB, Hawaii, provide forecast services for designated regions of the United States. These squadrons provide weather warning support for active duty, guard, and reserve Air Force and Army installations within their areas of responsibility. Whenever possible, CONUS OWSs will be included on severe weather conference calls between SPC and the WFOs prior to issuance of a severe weather watch. Figure 3-1 graphically represents the relationship between principal CONUS forecast centers in case of severe weather. Routine collaboration between military and civilian forecast centers will ensure forecast consistency and provide full benefit of meteorological expertise.

# Severe Weather Product Generation

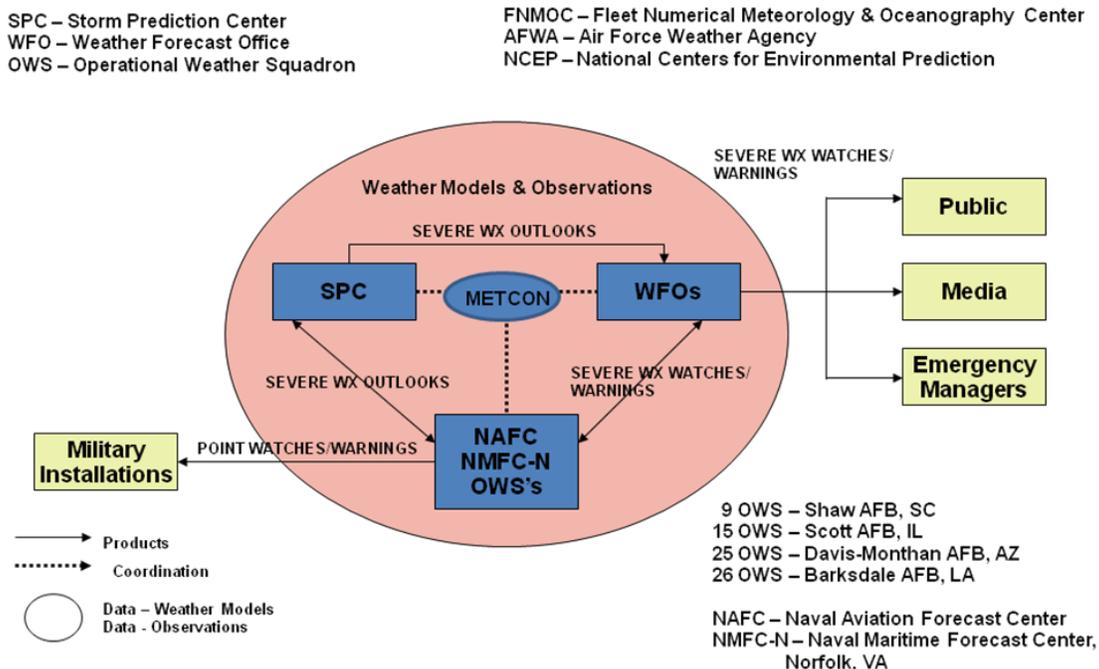


Figure 3-1. Severe Weather Product Generation

## Local Unit Warning

At those locations where an AFW forecaster is on duty, the forecaster may issue warnings and advisories, mainly for observed criteria. The criteria and any lead times for warnings are established locally, based on customer needs.

### 3.3.2 USN and USMC

Navy Meteorology and Oceanography (METOC) Command Centers and Marine Corps weather activities are responsible for the timely dissemination of warnings of hazardous or destructive weather via designated area commands and activities. The Naval Aviation Forecast Center (NAFC) is the centralized aviation weather forecasting hub for CONUS shore-based Naval Aviation activities, providing a combination of 24/7 and after-hours forecasting, severe weather warnings, and flight weather briefing services to 22 Naval Air Stations across the United States. NAFC also exercises operational and administrative control over two Naval Aviation Forecast Detachments and seven Components in Asia and Europe. The Naval Aviation Forecast Center Norfolk (NMFC-N) provides safety of navigation forecasting and route recommendations to a daily average of 70 U.S. Navy, Merchant Marine, and contract carrier vessels operating in the Caribbean Sea, Atlantic Ocean, and Mediterranean Sea. During the Atlantic hurricane season (1 June–30 November), NMFC-N provides advisory services to U.S. Navy shore installations from Brunswick, Maine, to Corpus Christi, Texas, which include National Hurricane Center track

forecasts, onset of gale and storm force winds, and storm surge model output for installations affected.

If USN and USMC weather activities are not available, full use should be made of storm warning information disseminated by other agencies (e.g. NWS, USAF, and local foreign meteorological services). In the United States, NWS Bulletins are often heard first over television or radio. Therefore, prior familiarity with their terminology will enhance their value and avoid confusion when Warning Conditions are set by local area commanders. For severe local storms, Conditions II and I are used to avoid or minimize loss and damage due to destructive weather phenomena and are based on all available weather information. Whenever possible, NAFC and NMFC-N will be included on severe weather conference calls between the SPC and the WFOs prior to issuance of a severe weather watch.

### 3.4 Backup Operations for SPC and AWC

The SPC, AWC, and AFWA have agreed that AFWA will provide limited backup capability for both the SPC and AWC. Appendix C contains the Memorandum of Agreement that covers these backup arrangements, specifying the severe weather forecast and aviation products that AFWA will produce when required to backup either the SPC or AWC. The coordination channel for backup plans and procedures and for exchange of data and products between the SPC, AWC, and AFWA shall be between the Commander, AFWA, and the Director, SPC or AWC, as appropriate. Unresolved differences will be worked out between the Director, NCEP, and the Commander, AFWA