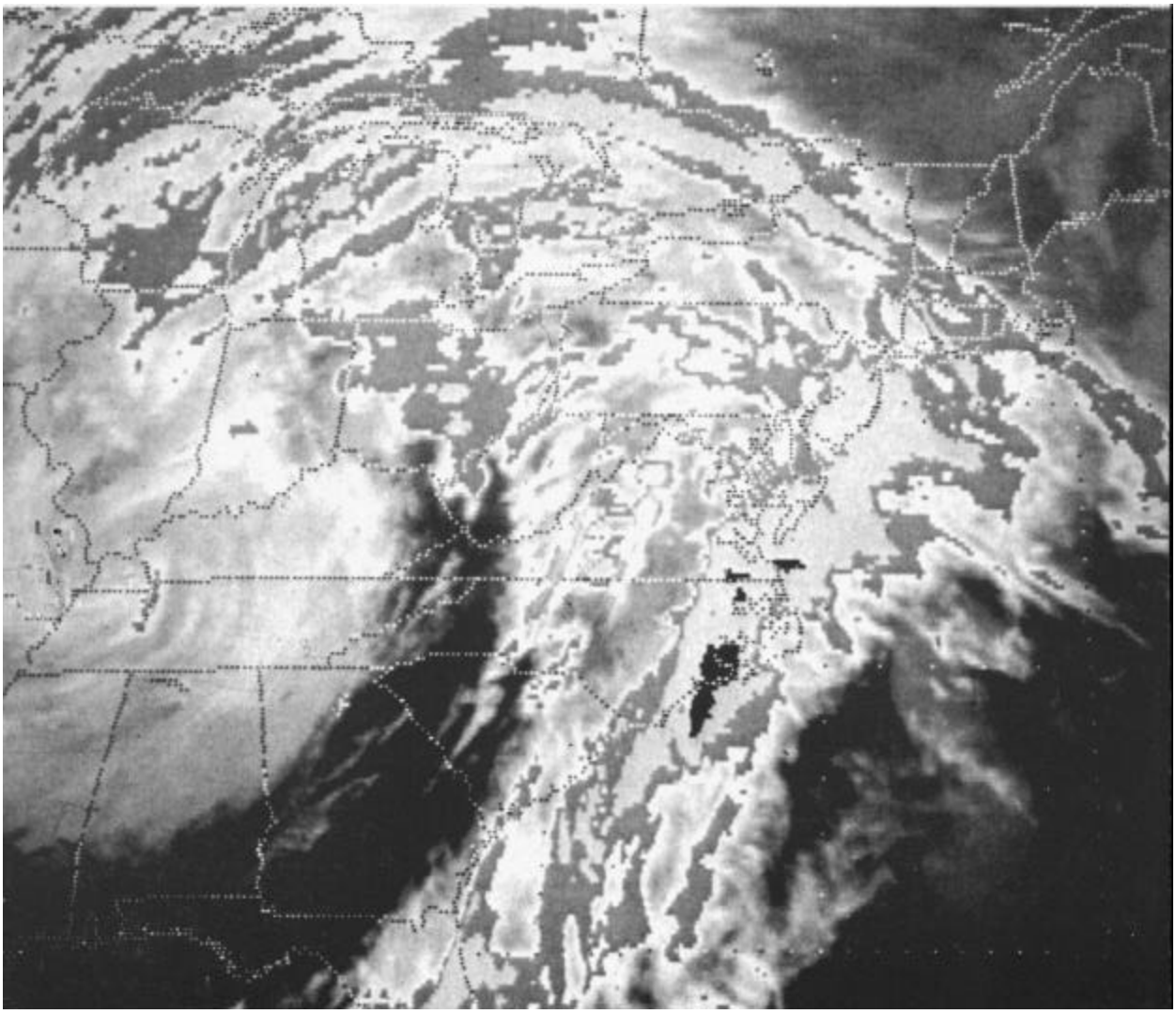
RESOURCE GUIDE



Federal Emergency Management Agency
Emergency Management Institute

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Weather Service

HAZARDOUS WEATHER RESOURCE GUIDE

A Source Book For:
Planning For Hazardous Weather And Flooding

Developed By:

Federal Emergency Management Agency
Emergency Management Institute

And:

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Weather Service

August 1996

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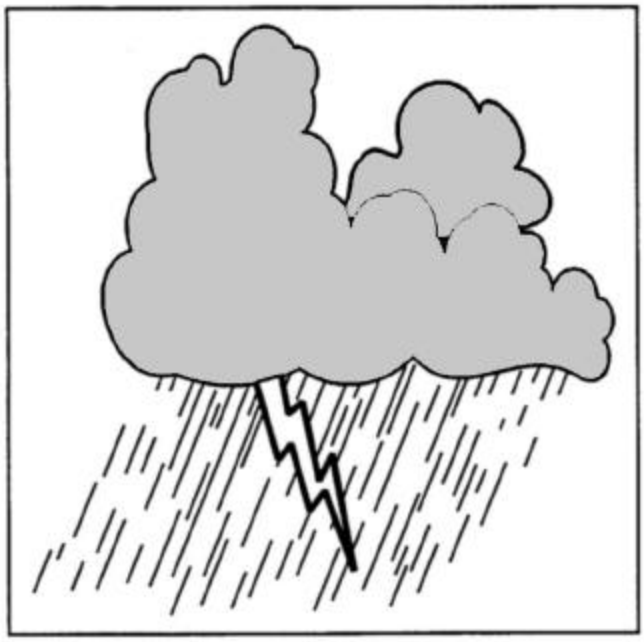


INTRODUCTION

PURPOSE

This Resource Guide has been designed as a desk reference for you to use when you return to your job.

HOW TO USE THIS GUIDE

This guide is organized in three sections. Each section is indicated with a weather icon.

- **Section I: Introduction** describes this guide, including its purpose and intended use.
- **Section II: Weather Review** summarizes important climate and weather concepts from this course.
- **Section III: Hazardous Weather Fact Sheets** presents characteristics (including hazards), historical examples, a table listing information products, and sample National Weather Service (NWS) products related to major U.S. weather events. These products are listed in an index at the end of Section III.

Several appendixes follow this guide:

- **Appendix A** includes sources of additional information about hazardous weather, including private vendors and universities. Where possible, Internet addresses are included.
- **Appendix B** provides an explanation of NWS Product Identifier List (PIL) Codes that are included on all products. It also contains a list of abbreviations of cities, as used in the PIL codes.
- **Appendix C** provides a conversion chart for temperature, relative humidity, and dew point.
- **Appendix D** includes a bibliography of hazardous weather resources.
- **Appendix E** includes a glossary of weather-related terms.

Use this guide:

- During your planning process as a guide to the types of damage you can expect for the hazards facing your community.

HOW TO USE THIS GUIDE (Continued)

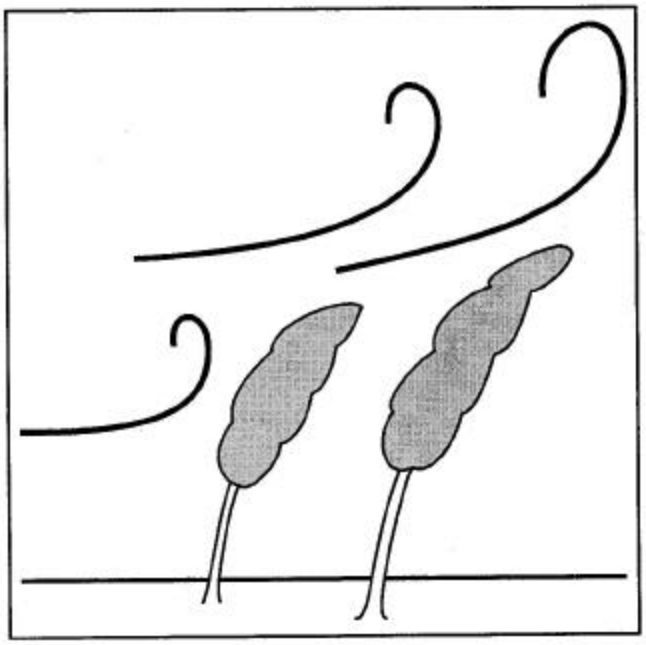
- ❒ When you have a question about the physical elements that cause weather or the factors that influence weather in your area.

- ❒ When you have a question about a specific hazard facing your community. Refer to specific fact sheets for information about the type of damage that the hazard can cause or products that the NWS issues for the hazard—or to review a sample product.

II. WEATHER AND CLIMATE REVIEW

Weather Review

Physical Elements Of Weather
General Circulation Of The Atmosphere
Global Effects on U.S. Weather



WEATHER AND CLIMATE REVIEW

WEATHER REVIEW

To understand and plan for hazardous weather events, you must have a basic understanding of the physical elements and hydrometeorological factors that work together to cause weather—and how, under certain conditions, these elements and factors can contribute to hazardous weather. This weather review provides a general review of those factors.

Various physical elements, or building blocks, contribute to the differences in the atmosphere that create weather. These elements are the basic components of weather and are described in Table 1.

Scientists have observed how the physical elements interact to form some general, systematic weather phenomena. Understanding how the physical elements interact helps us to understand how the atmosphere circulates and how weather events, such as storms, are formed. Major systematic factors are summarized in Table 2 and include water currents, air movement, temperature and air pressure differences, and geographic features.

Table 3 describes several global effects of the interaction of the physical elements.

As you review each of these tables, consider how:

- ❒ The information relates to weather that affects your community.
- ❒ You can use the information in your planning process.

PHYSICAL ELEMENT	*DESCRIPTION*
Solar Energy	The sun heats the earth's surface during the day. Incoming solar radiation to the earth's surface is called *insolation.* Heat is radiated from the earth by outgoing radiation, called *terrestrial radiation.* Cooling results at night as terrestrial radiation continues and insolation ceases.
Earth's Motions	The earth has two basic motions within the solar system. The first is the daily rotation of the earth about its axis. A complete rotation of the Earth takes about 24 hours. This rotation causes periods of daylight and darkness and, in turn, produces numerous weather effects and causes a predictable effect on the flow of wind over the surface of the Earth. This second motion of the Earth is the rotation around the sun, which takes 1 year. This causes the seasonal variation in temperature.
Atmosphere	The atmosphere is the gaseous envelope covering the Earth and is held in place by *gravity.* The atmosphere consists of a mixture of various gases. The atmosphere is divided into layers, or spheres, each having certain properties and characteristics. ❒ The *troposphere* is the layer adjacent to the Earth. It varies in depth from an average of 60,000 feet over the equator to 28,000 feet over the poles, with greater depth in the summer than in the winter. The troposphere is characterized by a decrease in temperature with height. ❒ At the top of the troposphere is the *tropopause,* which serves as the boundary between the troposphere and the next layer, the *stratosphere.* The location of the tropopause is characterized by a pronounced warming of temperature with altitude. The tropopause acts like a lid in that it resists exchange of air between the tropopause and the atmosphere above. This helps explain why almost all water vapor is found in the troposphere. ❒ The atmospheric layer just above the tropopause is the *stratosphere.* The average altitude at the top of this layer is 22 miles. Characteristic of the stratosphere are a slight increase in temperature with height and the near absence of water vapor and clouds. Occasionally a strong thunderstorm will break through the tropopause. Except for a substantial increase in the amount of ozone, the composition of the stratosphere is the same as that of the troposphere. Ozone is important because it absorbs most of the deadly ultra-violet rays from the sun.

Table 1. Physical Elements Of Weather

PHYSICAL ELEMENT	DESCRIPTION
Atmosphere (Continued)	The remaining atmospheric layers include the mesosphere and thermosphere. Atmospheric Composition ❒ Pure, dry air is composed of about 78 percent nitrogen, 21 percent oxygen, and a one-percent mixture of other gases, mostly argon. ❒ Suspended in the air is water vapor, which varies in amounts from 0 to 5 percent by volume. The maximum amount of water vapor the air can hold depends primarily on the temperature of the air; the higher the temperature, the move vapor it can hold. The water vapor will remain suspended in the air until, through condensation, it grows to sufficient droplet or ice crystal size to fall to the earth as precipitation.
Jet Stream	A jet stream is a narrow, shallow band of winds 58 mph (50 knots) or more meandering vertically and horizontally around the hemisphere in wave-like patterns. Jet streams are characteristic of both hemispheres. Jet stream winds can be found at breaks in the troposphere. Wind speeds in the jet stream sometimes may reach 200 mph (185 knots). Since the jet stream is stronger at some places than at others, it rarely encircles the entire hemisphere as a continuous river of wind. More frequently it is found in segments from 1,000 to 3,000 miles in length, 100 to 400 miles in width, and 3,000 to 7,000 feet in depth.

Table 1. Physical Elements Of Weather
(Continued)

PHYSICAL ELEMENT	*DESCRIPTION*
Temperature	Temperature is a measurement of heat energy and expresses the degree of molecular activity. Since different substances have different molecular structures, equal amounts of heat applied to different substances will cause one to get hotter than the other. Fahrenheit and Celsius are the names given to the two temperature scales most commonly used to measure heat energy. *Diurnal variation* is the change in temperature from day to night caused by the daily rotation of the earth. During the day solar radiation exceeds outgoing terrestrial radiation and the surface becomes warmer. At night, solar insolation ceases, but terrestrial radiation continues and cools the surface. Temperature distribution over the surface of the earth depends first on the seasons and secondly on the composition and distribution of land and sea surfaces over the earth. Key points: ❒ Ocean areas between latitudes 40ºN and 40ºS show very little temperature change from summer to winter. ❒ Land areas are warmer than the adjacent water areas at the same latitude during the summer. ❒ Water areas are warmer than adjacent land areas at the same latitude during winter. ❒ Both the warmest and coldest temperatures are found over land areas. Temperature normally decreases with increasing height throughout the troposphere. This decrease in temperature with altitude is called the *lapse rate* and is usually expressed in degrees per thousand feet. The average or standard lapse rate is 3ºC (5.4ºF) per 1,000 feet. Many times there are layers within the troposphere that are characterized by an increase of temperature with altitude rather than a decrease. Such increases are usually confined to a relatively shallow layer — called an *inversion* because the usual decrease in temperature with height is inverted.

Table 1. Physical Elements Of Weather
(Continued)

PHYSICAL ELEMENT	*DESCRIPTION*
Temperature (Continued)	The most frequent type of inversion over land is that produced immediately above the ground on a clear, relatively still night. The ground loses heat rapidly through terrestrial radiation, cooling the layer of air in contact with it. The amount of cooling decreases rapidly with height, and the temperature of the air a few hundred feet above the surface is affected very little or not at all. Inversions are also found when colder air moves under warm air or when warm air moves over cold air. These inversions are call *frontal inversions.* Inversions sometimes form as a result of widespread sinking air within a relatively thick layer aloft, while the air below remains essentially unchanged. This sinking air is heated by compression and may become warmer than the air below. This type of inversion is called a *subsidence inversion.* Restrictions to vision, such as fog, haze, smoke, and low clouds, are often in or below inversions and in layers through which there is only a small change in temperature.
Moisture	Water in the atmosphere is found in three states: vapor, liquid, and solid. Water vapor is water in its gaseous state and is not visible. As a liquid, water is found as rain, as drizzle, and as the small visible water droplets that form clouds and fog. As a solid, water takes the form of snow, hail, ice pellets, ice-crystal clouds, and ice-crystal fog. More than two-thirds of the Earth's surface is covered with water. This water is continually evaporating into the atmosphere, cooling by various processes, condensing, and falling to Earth again as precipitation. This never-ending process is referred to as the *hydrologic cycle.* This cycle keeps the atmosphere supplied with moisture and aids in producing temperature and pressure changes. The remaining one-third of the Earth's surface is composed of land of various and vastly different terrains. Each type of terrain significantly influences local wind flow, moisture availability, and in turn, the resulting weather.

Table 1. Physical Elements Of Weather
(Continued)

PHYSICAL ELEMENT	*DESCRIPTION*
Hydrologic Cycle	Evaporation, condensation, sublimation, freezing, and melting are *changes of state.* Any change of state involves heat exchange–that is, heat energy used or released. *Evaporation* is the changing of water from a liquid to a gas. Molecules escape from the surface of the liquid and enter the air as water vapor. The rate of escape increases as the temperature near the liquid's surface increase. *Condensation* is the reverse of the evaporation process. *Sublimation* is the changing of ice directly to water vapor, or water vapor to ice, by passing the liquid state in each process. A good example of the sublimation process is the icing of bridge decks well before road surfaces freeze.
Moisture Content	There is a limit to the amount of water vapor that the air at a given temperature can hold. When the limit is reached, the air is said to be *saturated.* The warmer the air, the more water vapor it can hold. For approximately every 20ºF increase in temperature, the capacity of a volume of air to hold water vapor is about doubled. *Unsaturated* air containing a given amount of water vapor will become saturated if its temperature decreases sufficiently. Further cooling forces some of the water vapor to condense as fog, clouds, or precipitation.
Relative Humidity	*Relative humidity* is the ratio of the amount of water vapor actually in the air to the maximum amount that the air can hold at that temperature. When the air contains all of the water vapor possible for a given temperature, the relative humidity is 100 percent. A relative humidity of 50 percent indicates that the air contains one-half of the water vapor that is capable of holding at its temperate.
Dew Point	The *dew point* is the temperature at a given atmospheric pressure to which air must be cooled to become saturated. When the dew point is below freezing, it sometimes is referred to as the *frost point.* The difference between the actual air temperature and the dew point is an indication of how close the air is to saturation. This temperature difference is commonly called the *temperature spread* or *dew point depression.*

Table 1. Physical Elements Of Weather
(Continued)

PHYSICAL ELEMENT	*DESCRIPTION*
Condensation and Sublimation Products	The most common forms of condensation and sublimation products are *clouds* and *fog*. The most frequent cause of condensation is cooling of the air and often results when: ❒ Warm air moves over a colder surface. ❒ Lifting air cools by expansion. ❒ Air near the ground is cooled as a result of nighttime radiational cooling. Except at temperatures well below freezing, clouds and fog are composed of very small droplets of water that collect on microscopic water-absorbent particles of solid matter in the air called *condensation nuclei.* These particles include salt from evaporating sea spray, dust, and combustion by-products. Precipitation is liquid or solid moisture that falls from the atmosphere in the form of rain, drizzle, ice pellets, hail, snow, or a combination. Although there can be no precipitation with out clouds, most clouds do not precipitate. Initial cloud particles are usually very small and remain suspended in the atmosphere. Precipitation occurs when these water droplets grow sufficiently in size and weight to fall because of the gravitational pull of earth. This growth can occur through a number of processes. Once a water droplet or ice crystal forms, it continues to grow by added condensation or sublimation directly onto the droplet. In clouds with above freezing temperatures, collision of droplets of varying size is the most common process that produces precipitation. Vertical air currents cause the droplets to collide and assist in the growth of clouds by carrying water droplets to higher altitudes. Sometimes strong, vertical currents sustain large, supercooled water droplets until some freeze; subsequently, other droplets freeze to them forming hailstones.

Table 1. Physical Elements Of Weather
(Continued)

PHYSICAL ELEMENT	*DESCRIPTION*
Condensation & Sublimation Products (Continued)	Not all precipitation reaches the earth. On many occasions, it evaporates completely in the dry air beneath the cloud base. This is known as virga and is a relatively common occurrence in hot, dry regions such as the southwestern United States. Dew and frost develop on clear, still nights as surfaces cool by terrestrial radiation to a temperature equal to the dew point of the adjacent air. Moisture collects on surfaces just as it does on a pitcher of ice water in a warm room. The moisture comes from the air in direct contact with the cool surface. Often heavy dew is observed on grass or plants when there is none on the pavements or on large solid objects. Since large objects absorb so much heat during the day, their temperature falls slowly, and their temperature may not cool to the dew point of the surrounding air. Frost forms in a similar way. The difference is that the dew point of the surrounding air must be colder than freezing.
Clouds	Clouds are weather signposts in the sky. They are visible evidence of the atmosphere's motions, water content, and the degree of stability. When clouds form, the degree of stability of the air helps determine what type they will be. ❒ Stratus clouds are low, uniform, sheet-like clouds associated with fog or precipitation, the combination resulting in restricted visibilities. ❒ Cumulus clouds are characterized by vertical development resulting from heating of the earth's surface.

Table 1. Physical Elements Of Weather
(Continued)

PHYSICAL ELEMENT	*DESCRIPTION*
Pressure Patterns	Atmospheric pressure patterns are used extensively by weather forecasters. Pressure patterns, when analyzed, provide insight to observed weather and expected changes. For example, there is a direct relationship between pressure systems and the flow of air (wind), and in general high pressures are typically regions of favorable weather conditions, while lows are often associated with bad weather. On meteorological charts depicting the surface, pressure patterns are shown by a series of lines referred to as isobars, which connect points of equal pressure. ❒ **Low** – An area of low pressure surrounded on all sides by higher pressure; also known as a cyclone. ❒ **High** – An area of high pressures surrounded on all sides by lower pressure; also known as an anticyclone. ❒ **Trough** – An elongated area of low pressure with the lowest pressure along a line called a "trough line" which marks the place of maximum curvature in the isobars or contours. ❒ **Ridge** – An elongated area of high pressure with the highest pressure along a line called a "ridge line" which marks the place of maximum curvature in the isobars or contours.
Standard Atmosphere	Since the vertical distribution of both temperature and pressure changes with time and place, some convenient vertical structure of the atmosphere, representing average conditions, had to be assumed to obtain fixed reference points. This requirement led to the defining of the standard atmosphere as follows: ❒ A surface temperature of 15ºC (59ºF) at sea level. ❒ A surface pressure of 29.92 inches of mercury (1013.2 millibar, 14.7 pounds per square inch) at sea level. ❒ A lapse rate (see page II-4, Temperature) within the troposphere of approximately 3ºC (5.4ºF) per 1,000 feet. ❒ A tropopause of approximately 36,000 feet. ❒ A lapse rate of 0ºC in the stratosphere to approximately 82,000 feet.

Table 1. Physical Elements Of Weather
(Continued)

PHYSICAL ELEMENT	*DESCRIPTION*
General Circulation	The term general circulation may be considered as simply the long-term, average movement of air relative to the earth's surface. Since the atmosphere is fixed to the earth by gravity and rotates with the earth, there would be no circulation were it not for forces which upset the atmosphere's equilibrium. The sun heats the earth's surface unevenly. The most direct rays of the sun strike the earth in the vicinity of the equator, thus heating equatorial regions much more than polar regions. In addition, equatorial regions re-radiate less heat to space than is received from the sun while the reverse is true at the poles. Yet the equatorial regions do not continue to get hotter and the polar regions do not get colder and colder. The only plausible explanation is that heat is transported from one latitude to another by some circulation. Factors that influence circulation: ❒ The irregular distribution of oceans and continents; ❒ The relative effectiveness of differing surfaces in transferring heat to the atmosphere; ❒ The irregular terrain; ❒ The daily variation in temperature; ❒ The seasonal changes, and many other factors. Semipermanent highs and lows are important to our basic understanding of the atmosphere's circulation. However, of far greater significance are migrating cyclones and anticyclones which are associated with rapid changes in weather so characteristic to the middle latitudes.

Table 1. Physical Elements Of Weather
(Continued)

PHYSICAL ELEMENT	*DESCRIPTION*
Atmospheric Pressure	Atmospheric pressure is the force-per-unit area exerted by the weight of a column of air lying directly above a point. As a result of the constant and complex air movements and the changes in temperature and moisture content of the air, the weight of this column over a fixed point is continually fluctuating. These changes in weight, and therefore pressure, are measured with pressure-sensitive instruments called barometers. Pressure is expressed in many ways throughout the world. The two most common units are inches or millibars of mercury.
Pressure Distribution	The average worldwide distribution of pressure affects the types of weather and weather hazards that control regional conditions. Some of the more prominent features are: ❒ The semipermanent belt of high pressure located in the subtropical ocean regions both hemispheres (between 20º and 30º latitude). ❒ The subtropical belt of high pressure normally extents northward to Siberia and continental North America during the winter and disappears during the summer. ❒ Deep low pressure areas are normally resent in the Northern Pacific Ocean (Aleutian Low) and the North Atlantic (Icelandic Low) in the winter. ❒ Low pressure usually dominates land areas of the Southern Hemisphere during both winter and summer.
Pressure Variations	Pressure variations are continually occurring at any given location with occasional abrupt changes due to thunderstorms and fronts and more gradual variations on a weekly, monthly, and seasonal basis. Changes in altitude account for the greatest change in pressure. Since all reporting points are not at the same elevation and conditions vary, the observed station pressure is adjusted to sea level pressure for reporting purposes. If this were not done, Denver, for instance, would always report lower pressure than New Orleans. Temperature is another factor that affects pressure. Air expands as it gets warmer and contracts as it cools. The rate of decrease of pressure with altitude in warm air is less than in cold air.

Table 1. Physical Elements Of Weather
(Continued)

PHYSICAL ELEMENT	DESCRIPTION
Wind	Atmospheric pressure and temperature variations cause the air to move in two ways: ascending and descending currents and the horizontal flow of air known as wind. Both of these air motions are of primary interest because they transport water vapor and therefore play an important role in the formation of fog and clouds and on the production of precipitation. Migrating air masses are the sources of our surface winds – but not necessarily their direction. In some cases where the flow of high pressure systems displaces warmer, less dense air, and the distance is comparatively short, that air flow can be direct. However, as the distance lengthens, other forces can affect the direction of the wind. ❒ The earth rotates from west to east at a given speed in much the same way that a phonograph record turns on a turntable. Although the revolutions-per-minute are the same, the outward rim of the phonograph record (which in the case of the earth is the equator) has more distance to cover over one complete revolution than any of the inner points of the record and is therefore moving at a faster rate of speed. Our atmosphere is brought along by its gravitational attachment to the earth at the same relative speeds at each latitude. However, in the Northern Hemisphere when a migrating parcel of air moves toward another latitude – either northward or southward – a phenomenon takes place known as the **coriolis force.** If the parcel of air moves northward from a lower latitude, it will move ahead (to the right) of the point directly north of its initial starting point because of its greater speed. Similarly, a parcel of air moving from north to south, from an area with a smaller circumference to an area with a larger one, would encounter a lag because it is entering a plane with a greater rim speed than the plane it left. Therefore, because of the lag, it too would encounter the effect of a deflection to the right. ❒ The coriolis force is strongest at the poles and decreases to zero at the equator. The stronger the wind, the stronger the deflective force.

Table 1. Physical Elements Of Weather
(Continued)

PHYSICAL ELEMENT	*DESCRIPTION*
Pressure Gradient	The rate of change with horizontal distance between higher and lower pressure areas is called pressure gradient. The greater the difference in pressure between two horizontal points, the greater is the pressure gradient between those two points. The greater the pressure gradient, the higher the wind speeds.
Large Wind Systems	Migrating cyclones and anticyclones furnish the most important means through which heat is exchanged between high and low latitudes. ❒ Cyclones (lows) are usually a few hundred miles in diameter. Anticyclones (highs) are generally larger and often more elongated, the longer axis extending for 2,000 miles or more in some cases. ❒ Hurricanes originate over the Atlantic Ocean, the Caribbean Sea, the Gulf of Mexico, and the eastern Pacific.
Local Winds	Superimposed on the general wind circulations are local wind systems create by mountains, valleys, and water masses. These local systems usually cause significant changes in the weather of the area. The term local, in the case of wind systems, applies to areas whose sizes range from about one-half of an average size state to roughly the size of two states. ❒ **Valley winds.** In the daytime, the air next to a mountain slope is heated by contact with the ground as it receives radiation from the sun. This air usually becomes warmer than the air at the same altitude but farther from the slope. At the same time, colder, denser air settles downward and forces the warmer air near the ground to move up the mountain slope. This wind is called a valley wind because the air is flowing up from the valley. ❒ **Mountain winds.** At night, the air that is in contact with the mountain slope is cooled by terrestrial radiation and becomes heavier than the surrounding air. It sinks along the slope, producing the mountain wind, which flows down the slope. Mountain winds are usually stronger than valley winds, especially in winter. ❒ A **katabatic wind** is any wind blowing down an incline when the incline influences the cause of the wind. A katabatic wind originates because cold, heavy air spills down sloping terrain, displacing warmer, less dense air ahead of it. Air is heated and dried as it flows down the slope.

Table 1. Physical Elements Of Weather
(Continued)

PHYSICAL ELEMENT	*DESCRIPTION*
Local Winds (Continued)	❒ **Sea breezes.** Because land is warmer than the sea during the day, wind blows from the cool water to warm the land. This flow of air is called a **sea breeze.** At night, the wind reverses, blowing from the cooler land to warmer water and creating a **land breeze.** Land and sea breezes develop only when the overall pressure gradient is weak. Wind with a stronger pressure gradient mixes the air so rapidly that local temperature and pressure gradients do not develop along the shore line.
Stability	Stability is the atmosphere's resistance to vertical motion. It depends on the vertical distribution of the air's temperature and moisture. Warmer air is lighter than colder air and moist air is lighter than dry air. Therefore, if air is warmer or more moist than its surroundings, it is considered unstable and it will rise. On the other hand, if the air is colder or drier than its surroundings, it is considered stable and it will sink until it reaches equilibrium. ❒ Air which is heated near the earth's surface on a hot summer day will rise. The speed and vertical extent of its travel depend upon the temperature distribution of the atmosphere. Since the temperature of air is an indication of its density, a comparison of temperatures from one level to another can approximate the degree of atmospheric stability. ❒ Saturated air rises, condensation occurs, and the latent heat, used during the evaporation process, is released and absorbed by the air. This causes the air to cool at a slower rate than the unsaturated air. The following may be concluded from the standard lapse rate: ❒ Unsaturated air, on the average, is stable. ❒ Saturated air is normally unstable. ❒ Saturated air at low temperatures, on the average, is stable. ❒ The general conclusion is that at moderate and high temperatures, air is normally either stable or unstable, depending upon the amount of moisture it contains.
Air Masses	An air mass is a body of air extending over a large area. Properties of temperature and moisture are fairly constant throughout the airmass. The terrain surface beneath the air mass is the primary factor in determining air mass characteristics.

Table 1. Physical Elements Of Weather
(Continued)

PHYSICAL ELEMENT	*DESCRIPTION*
Source Region	The region where an air mass acquires its identifying properties of temperature and moisture is called the *source region.* The ideal source region has a uniform surface, a uniform temperature, and is an area where stagnant air forms high pressure systems. In general, the best source regions for airmasses are large snow- or ice-covered polar regions, tropical oceans, and large desert areas.
Air Mass Classification	A detailed world-wide air mass analysis is beyond the scope of this course. The following proved a general description of the air masses affecting the weather in the continental United States: ❒ Air stagnating over the northern continental regions forms continental polar (cP) or continental arctic air masses. They are cold and dry, and their source region is very stable. ❒ Maritime polar (Mp) air masses form over northern oceanic areas. They are generally not as cold as continental polar air masses. They have a higher moisture content and can be either stable or unstable. ❒ Maritime tropical (Mt) air masses form over warmer oceanic areas nearer the equator. They are very humid and generally are the most unstable of all. ❒ Arid continental regions give rise to continental tropical (Ct) air masses, which are hot, dry, and unstable. Due to the absence of water vapor, they produce few showers and the showers that do develop yield small rainfall amounts.
Air Mass Modification	Just as an air mass tends to take on temperature and moisture properties of its source region, it also tends to have these same properties changed when it moves out of its source region. The degree of modifications of an air mass is dependent on: ❒ The speed with which it travels; ❒ The nature of the region it moves over; ❒ The temperature difference between the new surface and the air mass; ❒ The depth of the air mass.

Table 1. Physical Elements Of Weather
(Continued)

PHYSICAL ELEMENT	*DESCRIPTION*
Fronts	Fronts are transition zones between air masses that have different densities. The density of air is primarily controlled by the temperature and humidity of the air. Therefore, fronts in the mid-latitudes usually form between tropical and polar air masses. Frontal zones are indicated on surface weather charts by lines. Designs of the line indicate the type of front and the direction of movement. Fronts may also be indicated by colored lines.
Difference Across Fronts	Differences in the properties of adjacent air masses, such as temperature, moisture, and wind, are used to locate fronts. ❒ Temperature is one of the most easily recognized discontinuities across a front. At the surface the passage of a front usually causes noticeable temperature change. The amount and rate of change are a partial indication of the front's intensity. Strong fronts are accompanied by abrupt and sizeable temperature changes. Weak and diffuse fronts are characterized by gradual and minor changes in temperature. ❒ The dew-point temperature, together with the air temperature, gives a rough indication of the relative humidity in the air. Dew point and temperature dewpoint-spread usually differ across a front. This difference can assist in identifying the front and may provide a clue to differences in cloudiness and fog. ❒ Near the earth's surface the discontinuity of wind across a front is primarily a matter of change in direction. Wind speed is very much the same on both sides of the front. ❒ Since a front lies in a pressure trough, the pressure is higher on both sides of the front. Thus, when a front is approaching, the pressure is usually decreasing. Pressure normally rises abruptly or becomes a steady following a frontal passage.
Cold Front	The leading edge of an advancing cold air mass is called a cold front. Cold air is overtaking and replacing warmer air. Cold fronts are accompanied by very marked weather changes. Cold fronts may be divided into two general types: fast-moving and slow-moving. In extreme cases, cold fronts can move with speeds of 60 or more miles-per-hour, but they normally move at less than half this speed. They move faster in the winter than in summer.

Table 1. Physical Elements Of Weather
(Continued)

PHYSICAL ELEMENT	*DESCRIPTION*
Cold Front Hazards	The chief hazards are caused by the cumuliform clouds along and ahead of the cold front. Active cold fronts are typically preceded by a squall-line. The hazards associated with cold fronts include wind shear, thunderstorms, lightning, heavy rains, hail, and possibly tornadoes.
Warm Front	The leading edge of a warm air mass is called a warm front; that is , warmer air is overtaking and replacing colder air. Since the cold air is more dense than warm air, the cold air is slow to retreat in advance of the overriding warm air. If the warm air is moist and stable, stratiform clouds develop. Precipitation increases gradually with the approach of this type of warm front and usually continues until it passes. If the warm front is warm and unstable, thunderstorms will be embedded in the cloud masses which normally accompany the warm front.
Warm Front Hazards	The widespread precipitation ahead of a warm front causes low clouds and reduced visibilities due to precipitation and fog. Slow-moving thunderstorms during the summer may produce copious amounts of rain, providing the risk of flooding.
Stationary Fronts	Sometimes opposing forces exerted by adjacent air masses of different densities are such that the frontal surface between them shows little or no movement. In such cases, it is usually found that the steering winds tend to blow parallel to the front rather than against and or away from it. The weather condition and hazards occurring with a stationary front are similar to those associated with a warm front.
Frontal Waves and Occlusions	Frontal waves are primarily the result of the interaction of two air masses; and they usually form on slow-moving cold fronts or stationary fronts and are the result of one frontal system overtaking a previously formed frontal system. Occlusions combine the weather of both warm and cold front into one extensive system. Precipitation and low visibilities are widespread over a large area on either side of the surface position of the occlusion. In addition, strong winds will occur around an intense low at the northern end of the occlusion.

Table 1. Physical Elements Of Weather
(Continued)

FACTOR	*EXAMPLE*	*DESCRIPTION*	*EFFECT ON U.S. WEATHER*
Water current	**Gulf stream**	The Gulf Stream is a warm current in the Atlantic that flows from the Caribbean, along the coast of the southern U.S. and across the Atlantic to Great Britain.	The Gulf Stream temperatures contribute tot he temperate weather of the east coast much of the year. During the winter, the contrast between the warm Gulf Stream waters flowing near the coast and the cold air flowing over the ocean help create and add energy to coastal storms.
	Pacific currents	A cold current along the west coast of North America cools the air that moves from the Pacific over land.	This cool air creates low clouds and fog along the coast.
Air movement	**Prevailing winds**	❒ **Trade winds** blow toward the Equator. Trade winds meet at the Equator to form the **Intertropical Convergence Zone (ITCZ).**	
		❒ The **prevailing westerlies** blow away from the Equator, north of the trade winds. In the Northern Hemisphere, they blow from west to east due to the Coriolis Force. The area where the prevailing westerlies meet the trade winds is called the **horse latitudes.**	The prevailing westerlies blow across most of the U.S. and Canada.
	Jet Streams	Jet streams are narrow bands of high-speed winds about six to nine miles above the Earth. The jet streams are formed by pressure differences at high altitudes, generally following the boundaries between warm and cold air. Jet stream wind speed increase with greater temperature and pressure differences; winds may exceed 200 miles per hour.	❒ Above the polar front is a cold jet stream, flowing west to east, that is the major jet stream affecting our weather. The **polar jet stream** lies across Canada in the summer and over the midsection of the U.S. in winter. It can bring Pacific coastal storms or polar air across the U.S.

Table 2. General Circulation Of The Atmosphere

FACTOR	*EXAMPLE*	*DESCRIPTION*	*EFFECT ON U.S. WEATHER*
Air movement (Continued)	Jet streams (Continued)		❒ **Subtropical jet streams** often flow over the southern U.S. in winter, creating warm temperatures.
Pressure differences	Pressure systems	Pressure systems are high- or low-pressure areas that cover a large area. Most develop along the polar front and create turbulence and eddies.	The Great Plains often are subjected to thunderstorms and tornadoes. The prevailing westerlies carry the turbulent weather eastward across the U.S. and Canada, bringing cloudy skies and often rain or snow.
		❒ **Low-pressure systems** are cyclones swirling inward and counterclockwise.	Polar air rises and warms as it flows south, forming low-pressure systems over the Pacific and Iceland. In winter, these spawn winter storms. It the summer, the contrast between land and ocean temperatures lessens, and the low-pressure systems weaken.
		❒ **High-pressure systems** are anticyclones, swirling outward and clockwise. Anticyclones follow cyclones, bringing clearer weather.	Air from the ITCZ flows northward in the upper atmosphere and sinks when it reaches the latitudes of Florida. There, it forms high-pressure systems with light winds at the surface. On land, these systems help create the deserts of the Southwest, with calm or light, variable winds and mostly clear skies.

Table 2. General Circulation Of The Atmosphere
(Continued)

FACTOR	EXAMPLE	DESCRIPTION	EFFECT ON U.S. WEATHER
Pressure differences (Continued)	Air masses	Huge bodies of air that form over areas of fairly constant temperature are air masses. As they move, air masses affect the weather of the new location before gradually taking on the new area's temperature.	
		❒ **Continental polar** air masses are cool, dry air that affects Greenland, northern Canada, and the far north of Asia and Europe.	Continental polar air masses bring cold, dry air into southern Canada and the U.S. year-round.
		❒ **Continental tropical** air masses contain hot, dry air that affects North Africa and northern Australia.	Continental tropical air masses bring warm air from Mexico into the Southwest U.S., producing a warm, dry climate. These air masses affect the U.S. only in summer and usually do not move beyond the Southwest.
		❒ **Maritime polar** air masses contain cool, moist air that affects the North and South Atlantic and Pacific Oceans.	Maritime polar air masses bring cool, humid air into southern Canada and the U.S. year-round. Cool, humid maritime polar air masses form over the Pacific Northwest, brining precipitation.
		❒ **Maritime tropical** air masses contain warm, moist air that affects the Middle Atlantic and Pacific Oceans and the Indian Ocean.	Maritime tropical air masses off the northeast and northwest coasts bring cool weather to the U.S. When located off the southeast and southwest coasts, these air masses bring warm, muggy weather.

Table 2. General Circulation Of The Atmosphere
(Continued)

FACTOR	*EXAMPLE*	*DESCRIPTION*	*EFFECT ON U.S. WEATHER*
Pressure differences (Continued)	Fronts	A front is a line where cold and warm air masses meet. Most changes in weather occur along fronts.	
		❒ A **cold front** is an advancing mass of cold air that moves under a mass of warm air. The cold air forces the warm air to rise.	A cold front causes sudden changes in weather. The resulting weather depends on the amount of moisture in the warm air being replaced. It may bring strong winds, a drop in temperature and humidity, followed by clearing skies.
		❒ A **warm front** is an advancing mass of warm air that moves over a mass of cold air. It contains a cold air mass at ground level that retreats and is replaced by warm air.	A warm front causes a gradual change in the weather. It may bring precipitation, a rise in temperature and humidity, followed by clearing skies.
		❒ **Occluded fronts** occur when cold, warm, and cool air come into conflict and form boundaries above the ground and at the surface.	
		❒ In a **cold occlusion**, cold air shoves under cool air at the surface, forming a cold-warm air boundary aloft.	The weather associated with a cold occlusion resembles that of a cold front.
		❒ In a **warm occlusion**, cool air rises over cold air at the surface, forming a warm-cold air boundary aloft.	The weather associated with a warm occlusion resembles that of a warm front.
		❒ **Stationary fronts** occur when cold and warm air masses meet but then move very little.	Stationary fronts can bring prolonged precipitation.

Table 2. General Circulation Of The Atmosphere
(Continued)

FACTOR	*EXAMPLE*	*DESCRIPTION*	*EFFECT ON U.S. WEATHER*
Pressure differences (Continued)	Storms	The interaction of the jet streams with eddies that are formed by pressure systems can cause storms.	Pacific storms can hit anywhere along the west coast. These storms weaken in the Rockies, then regain strength as they move across the Great Plains. Many storms re-form over Colorado to bring heavy snow to the central U.S. To the north, Alberta Clippers form over Canada's Alberta Province and move eastward across the northern U.S., usually bringing light snow. Storms from the Gulf of Mexico may stay west of the Appalachians, carrying snowstorm activity northward toward the Ohio Valley and rain along the east coast. Alternately, these storms may take a path east of the mountains and form storms off the North Carolina coast. In the Northeast, winter storms that form over the Atlantic may turn inland, bringing snowstorms to New England.

Table 2. General Circulation Of The Atmosphere
(Continued)

FACTOR	*EXAMPLE*	*DESCRIPTION*	*EFFECT ON U.S. WEATHER*
Geographic features	Oceans	Water absorbs more heat and holds it longer than land, but land absorbs heat faster. During the day, coastal land becomes warmer than the ocean, the air above the land rises, and cool breezes blow off the water to replace it.	
	Mountains	When winds blow against mountains, air rises and cools, water vapor condenses, and clouds form. Air flowing over a mountain and down the other side becomes warmer and dries up.	When humid air from the Pacific Ocean moves over the west coast and hits the Rockies, moisture condenses out of the air. The air is warmed as it runs down the eastern slope, creating warm winds called **chinooks,** resulting in dry hot weather in the Great Plains. In the East, the smaller Appalachians create a similar effect.
	Cities	Buildings and pavement absorb more heat than vegetated areas. This, together with added heat from cars, factories, and heating and cooling equipment, makes the air above cities warmer than surrounding rural areas. Water vapor condenses on airborne pollutants produced in cities, making cities rainier.	

Table 2. General Circulation Of The Atmosphere
(Continued)

GLOBAL EFFECT	*DESCRIPTION*	*EFFECT ON U.S. WEATHER*
El Niño-Southern Oscillation (ENSO)	**El Niño** is the phenomenon of a warm current replacing normally cool waters off the coast of Peru. Coastal winds usually push away surface water and the water is replaced by cold, nutrient-rich water from deep in the ocean, which supports abundant sea life. The **Southern Oscillation** is the phenomenon of weather on the east side of the Pacific being linked to the weather on the west side. When air pressure is low on one side, it is high on the other. These two effects combine to impact weather worldwide.	El Niño-Southern Oscillation shifts the normal storm tracks of the U.S. farther north, producing a warmer than average winter in the Northwest and a wetter than average winter in the Southeast.
Global warming	The atmosphere is warmed by solar energy reflected off the Earth's surface and absorbed by water vapor and trace gases, creating the **greenhouse effect.** Increased levels of trace gases in the lower atmosphere would increase the greenhouse effect and cause a general worldwide warming.	The effects of global warming are under debate.
Other effects	Polar caps increase temperature contrasts and help create stronger storms, which in turn mix warm and cold air to weaken temperature contrast. Ocean currents affect the flow and temperature of winds, which help create continental weather. Changes in air temperatures, in turn, affect ocean temperatures. Clouds cool the Earth by reflecting solar energy upward. They warm the Earth by radiating energy downward.	

Table 3. Global Effects On U.S. Weather

GLOBAL EFFECT	*DESCRIPTION*	*EFFECT ON U.S. WEATHER*
Other effects (Continued)	Changes in the Sun's energy, as well as volcanic eruptions, can affect the amount of sunlight reaching the Earth, which affects temperatures. Oceans absorb and release carbon dioxide. The variation in the amounts of carbon dioxide changes the amount of water vapor in the air. Fires add carbon dioxide to the air and reduce the amount of water vapor.	

Table 3. Global Effects On U.S. Weather
(Continued)

III. HAZARDOUS WEATHER FACT SHEETS

Definition
Characteristics
Historical Examples
Sources Of Information
Sample Products

INTRODUCTION

This section contains fact sheets on the most common hazardous weather events that occur in the United States. Each fact sheet includes:

- ❒ A definition of the event.
- ❒ Characteristics common to the event, including hazards and dangers.
- ❒ Historical examples of the types and amounts of damage that each event may cause.
- ❒ NWS products, their Product Identifier List (PIL) codes, the office that issues them, and descriptions.
- ❒ Sample products (e.g., watches, warnings, etc.) produced by the National Weather Service (NWS) related to the event.

An index listing all NWS products contained in the fact sheets is at the end of this section.

Refer to this section during your planning process or when you want to know about a specific event and the danger that it potentially poses to your community.

THUNDERSTORMS

DEFINITION

A thunderstorm is a local storm produced by a cumulonimbus cloud and is always accompanied by lightning and thunder. Thunderstorms also often are accompanied by gusty winds, heavy rain, and occasionally by hail. Thunderstorms sometimes may be violent at the surface. Thunderstorms may be classified as ordinary, approaching severe (or non-severe), or severe. Thunderstorm categories, as classified by wind speed and precipitation, are shown in the table below.

CATEGORY	*WIND SPEED*	*PRECIPITATION*
Ordinary	< 35 knots (40 mph)	Variable
Approaching Severe	≥ 35 knots (40 mph)	Hail > ½ inch
Severe	≥ 50 knots (58 mph)	Hail ≥ ¾ inch

CHARACTERISTICS

The characteristics of thunderstorms depend on the type of storm that develops. To understand the differences in the types of storms, a brief discussion on the ingredients and stages is necessary.

Three basic factors contribute to thunderstorm development: moisture, instability, and lift.

- **Moisture** comes from large bodies of water (e.g., oceans, bays, the Great Lakes) or possibly from large vegetation areas.

- **Instability** is related to the rate at which temperature decreases with height and moisture content of the air. The NWS uses Lifted Index (LI) and Convective Available Potential Energy (CAPE) to measure instability. The more unstable the air mass, the more severe the thunderstorm.

- **Lift** can be caused by fronts, sea breezes, heat rising from the earth's surface, outflow boundaries from prior thunderstorms, or dry line boundaries. Lift brings warm air up through the air mass.

CHARACTERISTICS (Continued)

These factors combine to develop into thunderstorms in three stages.

- **Developing Stage:** A towering cumulus cloud forms as air rises. The cloud extends to about 20,000 feet above the level of freezing temperatures. Usually there is little if any rain, but occasional lightning occurs during this stage, which lasts about 10 minutes.

- **Mature Stage:** During this stage, the storm builds to heights of 40,000 feet or more. This is the most likely time for hail, heavy rain, frequent lightning, strong winds, and tornadoes. The storm occasionally has a black or dark green appearance. The mature stage lasts an average of between 10 and 20 minutes, but may last much longer.

- **Dissipating Stage:** Downdrafts begin to choke off the supply of air that feeds the storm, the storm stops building, loses height, and dissipates. Rainfall decreases in intensity, but some thunderstorms produce a burst of strong winds in this stage, and lightning remains a danger.

Thunderstorms are categorized into four types.

- **Single Cell:** Single cell thunderstorms are short lived (i.e., generally lasting 20-30 minutes or less) and are stifled by intensifying downdrafts. These storms are relatively uncommon and cover a limited area (i.e., only a few square miles).

- **Multicell:** Multicell storms are most common. Multicell storms are an organized cluster of two or more single cell storms. Air flowing out of one storm fuels other storms, causing new cells to develop on the right or right rear storm flank every 5 to 15 minutes.

- **Squall lines:** A line or narrow band of active thunderstorms, a squall line may extend over 250 to 500 miles, may be from 10 to 20 miles wide, and consist of many laterally aligned cells that do not interfere with one another. The cells may be ordinary, non-severe, or severe, and they may be multicell, supercell, or a combination of theses. Squall-line storms may form along cold fronts, but often form as much as 100 miles ahead of an advancing cold front in the warm sector of an extratropical storm. They often trail a large flat cloud layer that brings significant rain after the storms pass.

- **Supercell:** Supercells are relatively uncommon but produce the most severe weather and longest lasting (1 to 6 hours) weather. Supercells can travel 200 miles or more. These storms can cause strong winds of more than 78 mph, giant hail (e.g., 2 inches), and significant tornado activity. Supercells produce updrafts of between 56 and 112 miles per hour that coexist with sustained downdrafts. Together, the updrafts and downdrafts act to extend the storm's duration.

CHARACTERISTICS (Continued)

The NWS uses the Lift Index (LI) and Convective Available Potential Energy (CAPE) to indicate atmospheric instability, which is a measure of the potential severity of a thunderstorm.

- ❒ The greater the instability the more severe the thunderstorm.
- ❒ LIs with greater negative numbers indicate a greater degree of instability.
- ❒ CAPE is a positive number; the higher the number, the greater the instability.

Thunderstorms most often occur in the spring and summer, during the afternoon and evenings, but can occur at any time.

Hazards associated with thunderstorms include:

- ❒ Lightning.
- ❒ Hail.
- ❒ Damaging winds.
- ❒ Heavy rain causing flash flooding.
- ❒ Tornadoes.
- ❒ Lightning produced by dry thunderstorms can cause fires.

The damaging winds of thunderstorms include straight-line winds, downbursts, and micro bursts.

- ❒ Straight-line winds are high winds across a wide area.
- ❒ Downbursts are localized currents of air blasting down from a thunderstorm, which induce an outward burst of damaging wind on or near the ground.
- ❒ Micro bursts are minimized downbursts covering an area of less than 2.5 miles across. They induce a strong wind shear (a rapid change in the direction of wind over a short distance) near the surface. Micro bursts may or may not include precipitation and can produce winds over 150 miles per hour.

HISTORICAL EXAMPLES

- In May 1995, a hail storm in Dallas, Texas dropped softball-sized hail, damaging more than 100 planes at the Dallas-Fort Worth Airport and causing $750,000,000 in damages, 510 injuries, and 21 deaths.

- In April 1974, treacherous thunderstorms developed in the Midwest. Cold, dry air pushed east by a low-pressure center east of the Rockies, an extratropical storm bringing warm, humid air north from the Gulf, the jet stream winds bringing dry air from Texas, and cool, humid air in the Northeast set up the storms. The storms caused 127 tornadoes, the largest, most damaging tornado outbreak in U.S. history. More than 300 people were killed, 6,142 were injured, and damages were estimated at $600 million.

PRODUCTS

The table on the next page lists NWS products that can provide planning and preparedness information on thunderstorms. Appendix A describes the dissemination systems of these products, as well as other sources (such as the Internet or private online services). Refer to the fact sheets on coastal floods, extratropical coastal cyclones, tornadoes, and riverine floods for other products.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	SOURCE	*DESCRIPTION*
Outlooks			
Convective Outlook Day 2	MKCSWODY2	Storm Prediction Center (SPC)	Forecast for severe thunderstorms for the conterminous 48 states for the next day (DY2) and that day (DY1). Includes areas, degree of risk or probability, hazards and severity.
	MKCSWODY1	SPC	
Convective Outlook Day 1			
Public Weather Outlook	MKCPWOMKC	SPC	Discussion of an especially significant and/or widespread outbreak of severe thunderstorms.
Severe Weather Outlook	__SPS__	Local NWS Office	These are local outlooks for the potential of severe weather. They include hazards, locations, severity, and time frames.
Watches			
Severe Thunderstorm Watch	MKCSEL (1-9)*	SPC	A Watch contains: ❒ Type of severe weather. ❒ Watch area. ❒ Valid period. ❒ Type of severe weather possible. ❒ Intensity of severe weather. ❒ Watch axis. ❒ Meaning of watch. ❒ Call to action statements. ❒ Discussion of meteorological reasoning. ❒ Other watch information.
Watch Cancellation	MCKSEL (1-9)		This product cancels a severe thunderstorm watch.

* 1-9 indicates the consecutive number of the issuance for the day.

PRODUCTS (Continued)

PRODUCT	***IDENTIFIER***	SOURCE	***DESCRIPTION***
Statements			
Severe Thunderstorm Watch Redefining Statement	__SLS__	Local NWS Office	Provides geographical or areal redefinition of a specific watch area including states, counties and cities at risk.
Special Weather Statement	__SPS__	Local NWS Office	Provides for clearance of counties from local severe thunderstorm watches.
Severe Weather Statement	__SVS__	Local NWS Office	Provides: ❒ A brief report of imminent danger. ❒ A cancellation of all or part of a warning. ❒ An extended watch for 1 – 2 hours.
Advisories/ Warnings			
Severe Thunderstorm Warning	__SVR__	Local NWS Office	Warning for severe thunderstorm(s) including the: ❒ Hazards. ❒ Affected area. ❒ Expiration time. ❒ Basis of warning. ❒ Threat to confirmation. ❒ Location and movement. ❒ Call to action statements. NOTE: Warnings for severe thunder-storms, flash floods, and tornadoes may be combined and issued under one header based on the most severe threat.
Special Marine Warnings	__SMW__	Local NWS Office	Issued for severe thunderstorms over large bodies of water and include the same types of information as do severe thunderstorm warnings.

PRODUCTS (Continued)

PRODUCT	***IDENTIFIER***	SOURCE	***DESCRIPTION***
Discussions			
SPS Mesoscale Discussion	MKCSWOMCD	SPC	This is a daily unscheduled product used to communicate the current judgement of SPC forecasters to the user community.
Short Term Forecasts	__NOW__	Local NWS Office	The NOW is intended as the primary way to provide a short term forecast of hydrometeorological conditions over an area. It gives a concise forecast of the most significant weather during the next few hours. It highlights watches, warnings and advisories in effect at the time.

SAMPLE PRODUCTS

The sample products listed below are shown on the following pages:

- ❒ Convective Outlook Narrative. (Revised 3/2000)
- ❒ Public Severe Weather Outlook.
- ❒ Severe Weather Watch. (Revised 3/2000)
- ❒ Mesoscale Discussion. (Revised 3/2000)
- ❒ Severe Weather Outlook. (Revised 3/2000)
- ❒ Redefining Statement for Severe Weather Watch.
- ❒ Tornado Warning. (Revised 3/2000)
- ❒ Severe Thunderstorm Warning. (Revised 3/2000)
- ❒ Short Term Forecast. (Revised 3/2000)
- ❒ Severe Weather Statement (Tornado).
- ❒ Severe Weather Statement (Severe Thunderstorm).

CONVECTIVE OUTLOOK NARRATIVE

ZCZC MKCSWODY1 000
ACUS1 KMKC 061606
MKC AC 061606

CONVECTIVE OUTLOOK...REF AFOS NMCGPH940.

VALID 06163OZ -071200Z

REF WW NUMBER 0532...VALID TIL 021OZ

THERE IS A SLGT RISK OF SVR TSTMS TO THE RIGHT OF A LINE FROM 60 ESE YUM 55 E BLH 35 SW PRC 60 NE PHX 30 W E74 20 ESE DUG.

THERE IS A SLGT RISK OF SVR TSTMS TO THE RIGHT OF A LINE FROM 15 S SSI 30 SW MGR 25 W DHN 15 NW MGM 10 NE GAD 30 NNW AND 35 ENE CAE 40 ENE CHS.

THERE IS A SLGT RISK OF SVR TSTMS TO THE RIGHT OF A LINE FROM 65 W CAR 55 N 3B1 45 SW 3BI 15 WSW AUG PWM...CONT...15 SSE JFK 15 WSW ABE 20 NE AOO 30 W AOO 10 SSW HLG 25 S CMH 20 SSW DAY 35 SE FWA 40 WSW TOL 10 WNW TOL 25 ENE TOL.

GEN TSTMS ARE FCST TO THE RIGHT OF A LINE FROM 15 S ACY 15 SSE ILG 15 WNW BWI 35 NNE SHD 35 ENE SSU 35 SSW ROA 10 NE GSO 20 NNE RDU 35 NNE RWI 25 W ECG 20 ENE ECG...CONT...35 NE CTB 50 E LWT 45 ESE MLS 30 SE REJ 20 ENE RAP 65 W VTN 25 WSW MHN 30 WSW LBF 15 NNW MCK 30 SSE MCK 25 W RSL 15 WSW SLN 10 W TOP 40 SE P35 25 NW UIN 15 SE MMO 30 NE BEH 25 ENE GRR 10 SW MBS 35 SSE OSC...CONT...20 SW IPL TRM 35 NE DAG 30 ESE DRA 15 NNW P38 25 W PUC BPI 50 NE JAC DLN 55 SSE S80 10 WSW PDT YKM 50 WNW YKM SEA 10 SE CLM 50 NNW UIL.

...SEVERE THUNDERERSTORM FORECAST DISCUSSION...

UPPER LOW APPROACHING SRN HUDSON BAY WILL MOVE EWD INTO QUEBEC THROUGH TONIGHT...WITH STRONG UPPER LEVEL JET MOVING ACROSS THE GREAT LAKES AND NEW ENGLAND. A SERIES OF WEAK UPPER LEVEL IMPULSES WILL MOVE WWD ACROSS THE SRN U.S. UNDERNEATH UPPER RIDGE LOCATED OVER THE CENTRAL STATES.

...NERN STATES...
MOIST UNSTABLE AIR MASS REMAINS IN PLACE ACROSS MUCH OF THE REGION BETWEEN COLD FRONT OVER LOWER MI AND BACKDOOR FRONT OVER NEW HAMPSHIRE. AS TEMPERATURES WARM WELL INTO THE 90S...SURFACE-BASED CAPE VALUES ARE EXPECTED TO EXCEED 3000 J/KG ACROSS MUCH OF NEW YORK AND SRN NEW ENGLAND. THUNDERSTORMS ARE ALREADY DEVELOPING OVER THE ST. LAWRENCE RIVER VALLEY AND ADDITIONAL ACTIVITY IS EXPECTED TO BUILD SWWD DURING THE DAY ALONG LAKE BREEZE BOUNDARIES S AND E OF LAKES ERIE AND ONTARIO. STRONG UNIDIRECTIONAL WLY FLOW ABOVE THE SURFACE AND DRY

AIR AT MID LEVELS WILL PROVIDE A FAVORABLE ENVIRONMENT FOR FAST MOVING STORMS PRODUCING WIND DAMAGE AND SOME MARGINALLY SEVERE HAIL. BY LATE AFTERNOON...ACTIVITY IS EXPECTED TO SPREAD INTO SRN NEW ENGLAND.

...SC/GA...
WELL DEFINED VORTICITY MAXIMUM CURRENTLY OVER SERN NC WILL MOVE WSWWD ACROSS SC AND GEORGIA TODAY AND TONIGHT. LAPSE RATES ARE RATHER STEEP FOR THIS TIME OF YEAR /6.5-7.0 C/KM IN THE 850-500 MB LAYER/ AND MID-HIGH LEVEL ELY FLOW OF 30 KT MAY ALLOW FOR WWD PROPAGATING MULTICELL STORMS THROUGH THIS EVENING. GIVEN STRONG INSTABILITY IN PLACE...THREAT FOR A FEW SEVERE STORMS PRODUCING DAMAGING WINDS AND SOME HAIL WILL PERSIST UNTIL AROUND SUNSET.

...SRN AZ...
ELY FLOW REGIME UNDERNEATH UPPER RIDGE WILL CONTINUE THROUGH TONIGHT. SKIES HAVE CLEARED IN THE WAKE OF MONDAY AFTERNOONS STORMS AND WILL ALLOW SUBSTANTIAL DAYTIME HEATING/AIRMASS DESTABILIZATION. STORMS WILL ONCE AGAIN FORM OVER THE HIGHER TERRAIN OF AZ THIS AFTERNOON WITH THE POTENTIAL FOR ACTIVITY TO BECOME LOCALLY SEVERE OVER THE DESERTS GIVEN GULF OF CA MOISTURE SURGE AND MODERATE INSTABILITY.

...VESCIO...07/06/99

...GENERAL THUNDERSTORM FORECAST DISCUSSION...

...VESCIO...07/06/99

NNNN

PUBLIC SEVERE WEATHER OUTLOOK

MKCPWOMKC
WOUS36 KMKC 260900
PUBLIC SEVERE WEATHER OUTLOOK
NATIONAL WEATHER SERVICE KANSAS CITY MO
400 AM CDT FRIDAY APRIL 26 1991

...OUTBREAK OF TORNADOES AND SEVERE THUNDERSTORMS EXPECTED TODAY INTO TONIGHT OVER MUCH OF THE CENTRAL UNITED STATES...

THE NATIONAL SEVERE STORMS FORECAST CENTER IN KANSAS CITY MISSOURI IS
FORECASTING AN OUTBREAK OF SEVERE THUNDERSTORMS AND TORNADOES TODAY INTO TONIGHT OVER MUCH OF THE CENTRAL AND SOUTHERN PLAINS AND THE LOWER MISSOURI VALLEY.

THE STATES WHICH ARE MOST LIKELY TO EXPERIENCE THE BRUNT OF THE SEVERE THUNDERSTORM AND TORNADO ACTIVITY INCLUDE MOST OF OKLAHOMA AND KANSAS...PARTS OF NORTH CENTRAL TEXAS...AND PARTS OF SOUTHERN NEBRASKA.

A LOW PRESSURE AREA OVER NORTHEAST COLORADO IS FORECAST TO DEEPEN RAPIDLY AND MOVE NORTHEAST INTO THE DAKOTAS BY TONIGHT. A STRONG COLD FRONT WILL MOVE EAST ACROSS MUCH OF THE GREAT PLAINS TODAY INTERACTING WITH A WARM AND MOIST AIRMASS.

A STRONG UPPER LEVEL JET STREAM IS FORECAST TO EXTEND FROM NEW MEXICO ACROSS THE TEXAS PANHANDLE INTO KANSAS AND IOWA...WHILE STRONG SOUTHERLY WINDS AT THE SURFACE BRING WARM AND MOIST AIR NORTHWARD ACROSS MUCH OF THE CENTRAL UNITED STATES. THIS SITUATION LIKELY WILL RESULT IN AN OUTBREAK OF SEVERE THUNDERSTORMS AND DAMAGING TORNADOES FROM NEBRASKA ACROSS KANSAS AND OKLAHOMA INTO NORTHERN TEXAS.

THERE IS ALSO A LIKELIHOOD OF A FEW SEVERE THUNDERSTORMS THIS AFTERNOON INTO TONIGHT OVER PORTIONS OF NORTHERN NEBRASKA...SOUTHERN SOUTH DAKOTA...SOUTHERN MINNESOTA...IOWA...MISSOURI...AND ARKANSAS.

IT IS EMPHASIZED THAT THIS IS A POTENTIALLY DANGEROUS WEATHER SITUATION FORPARTS OF OKLAHOMA...KANSAS...NORTHERN TEXAS...AND SOUTHERN NEBRASKA. DESTRUCTIVE TORNADOES ARE POSSIBLE WITH THIS WEATHER SYSTEM AS THUNDERSTORMS DEVELOP OVER THE PLAINS DURING THE AFTERNOON AND EVENING HOURS.

ALL PERSONS IN THE THREATENED AREA ARE URGED TO REVIEW SAFETY RULES...AND LISTEN TO RADIO...TV...OR NOAA WEATHER RADIO FOR LATER STATEMENTS AND POSSIBLE WATCHES OR WARNINGS. THIS IS A POTENTIALLY DANGEROUS WEATHER SITUATION FOR THE AFFECTED AREAS AND SHOULD BE MONITORED CLOSELY.

...LARRY WILSON...

SEVERE LOCAL STORM WATCH

ZCZC MKCSEL2 ALL 062100;445,0763 451,0705 434,0705 432,0763;
WWUS9 KMKC 061505
MKC WW 061505
NYZ000-VTZ000-NHZ000-LOZ000-062100-

URGENT - IMMEDIATE BROADCAST REQUESTED
SEVERE THUNDERSTORM WATCH NUMBER 532
STORM PREDICTION CENTER NORMAN OK
1105 AM EDT TUE JUL 6 1999

THE STORM PREDICTION CENTER HAS ISSUED A
SEVERE THUNDERSTORM WATCH FOR PORTIONS OF

NORTHERN NEW YORK
VERMONT
NEW HAMPSHIRE
EASTERN LAKE ONTARIO

EFFECTIVE THIS TUESDAY MORNING AND AFTERNOON FROM 1145 AM UNTIL 500 PM EDT.

HAIL TO 1 INCHES IN DIAMETER...THUNDERSTORM WIND GUSTS TO 80 MPH...AND DANGEROUS LIGHTNING ARE POSSIBLE IN THESE AREAS.

THE SEVERE THUNDERSTORM WATCH AREA IS ALONG AND 55 STATUTE MILES NORTH AND SOUTH OF A LINE FROM 30 MILES WEST NORTHWEST OF WATERTOWN NEW YORK TO 15 MILES SOUTHEAST OF BERLIN NEW HAMPSHIRE.

REMEMBER...A SEVERE THUNDERSTORM WATCH MEANS CONDITIONS ARE FAVORABLE FOR SEVERE THUNDERSTORMS IN AND CLOSE TO THE WATCH AREA. PERSONS IN THESE AREAS SHOULD BE ON THE LOOKOUT FOR THREATENING WEATHER CONDITIONS AND LISTEN FOR LATER STATEMENTS AND POSSIBLE WARNINGS.

DISCUSSION...THUNDERSTORMS WILL RAPIDLY INCREASE THIS AFTERNOON IN ASSOCIATION WITH UPPER TROUGH. STRONG UNIDIRECTIONAL WLY FLOW COUPLED WITH STEEP LAPSE RATES FAVOR THE DEVELOPMENT OF DAMAGING WIND GUSTS...WITH POSSIBLE BOW ECHO DEVELOPMENT.

AVIATION...A FEW SEVERE THUNDERSTORMS WITH HAIL SURFACE AND ALOFT TO 1 INCHES. EXTREME TURBULENCE AND SURFACE WIND GUSTS TO 70 KNOTS. A, FEW CUMULONIMBI WITH MAXIMUM TOPS TO 500. MEAN STORM MOTION VECTOR 27040.

...VESCIO
;445,0763 451,0705 434,0705 432,0763;

NNNN

MESOSCALE DISCUSSION

ZCZC MXCSWOMCD ALL;346, 0844 352,0779 332,0779 326,0844;
ACUS3 KMKC 061514
MKC MCD 061514 COR
NCZ000-SCZ000-061800-

SPC MESOSCALE DISCUSSION #0743 FOR NC SC CONCERNING...HEAVY RAINFALL...

AN MVC...OR MESOSCALE VORTICITY CENTER...WHICH APPEARS TO BE A REMNANT OF NORTHERN PLAINS/SERN CANADA/MAINE DERECHO PRODUCING CONVECTIVE SYSTEM...HAS MOVED AROUND THE RIDGE AND IS NOW MOVING WWD IN DEEP EASTERLIES. THIS FEATURE APPEARS TO BE ASSOCIATED WITH STRONG THUNDERSTORMS NOW OCCURRING FROM EXTREME SOUTHERN NC INTO NERN SC. PRECIPITABLE WATER VALUES IN SOUNDINGS AT MHX AND CHS AT 12Z ARE VERY HIGH...AROUND 2.00 INCHES. TWO SURFACE BOUNDARIES ARE LIKELY TO FOCUS EVOLUTION OF HEAVY RAIN POTENTIAL AS MVC MOVES INLAND TO THE WSW. ONE BOUNDARY EXTENDS FROM JUST N OF HAT TO S OF FAY TO AHN AND A SECOND BOUNDARY EXTENDS FROM JUST S OF FAY SSWWD TO JUST E OF CAE AND INTO SERN GA. SURFACE FLOW FROM THE SW APPEARS TO BE PROVIDING CONVERGENCE INTO STORMS THAT ARE MOVING WLY. PRIND THAT THUNDERSTORMS WITH LOCAL RAINFALL RATES OF GREATER THAN 2.50 PER HOUR WILL DEVELOP SWWD INT0 LOW LEVEL FLOW ALONG AND TO THE EAST OF THE SECOND BOUNDARY MENTIONED ABOVE. POTENTIAL FOR VERY HEAVY RAINFALL SHOULD DEVELOP SWWD INTO WILLIAMS..GEORGETOWN.. BERKELEY...AND CLARENDON COUNTIES DURING THE NEXT HOUR OR TWO AND POSSIBLY INTO ADDITIONAL COUNTIES FARTHER SW IN SC THEREAFTER. RAINFALL RATES SHOULD BEGIN DECREASING OVER SRN NC COUNTIES DURING THE NEXT ONE TO TWO HOURS AS CONVERGENCE ASSOCIATED WITH MVC MOVES PAST AREA.

..JOHNS/HART.. 07/06/99

SEVERE WEATHER OUTLOOK

WWUS35 KGSP 061456
SPSGSP
GAZ010-017-018-026-028-029-NCZ033>037-048>059-062>072-082-SCZ001>014-019-062100-

SEVERE WEATHER OUTLOOK
NATIONAL WEATHER SERVICE GREENVILLE-SPARTANBURG SC
1052 AM EDT TUE JUL 6 1999

...STRONG TO SEVERE THUNDERSTORMS MAY OCCUR OVER THE WESTERN CAROLINAS AND NORTHEAST GEORGIA THIS AFTERNOON AND THIS EVENING...

A WEAK UPPER LEVEL LOW WILL ROUND THE BERMUDA HIGH...CROSSING SOUTH CAROLINA FROM THE EAST THIS AFTERNOON. AS THE UPPER LOW CROSSES THE AREA...IT WILL COOL MID LEVEL TEMPERATURES ENOUGH TO ALLOW STRONG AND A FEW SEVERE THUNDERSTORMS TO DEVELOP. THE SOUTH CAROLINA UPSTATE AND NORTHEAST GEORGIA WILL BE THE AREA OF GREATEST CONCERN AS THEY WILL BE DIRECTLY BENEATH THE UPPER LOW. DUE TO THE WARM TEMPERATURES AND HIGH HUMIDITIES THE NORTH CAROLINA PIEDMONT...FOOTHILLS AND MOUNTAINS CAN STILL EXPECT ISOLATED SEVERE THUNDERSTORMS LATER THIS AFTERNOON.

SEVERE THUNDERSTORMS CAUSE DAMAGING WIND AND/OR LARGE HAIL. THE STORMS THIS AFTERNOON COULD CAUSE HAIL UP TO ABOUT AN INCH IN DIAMETER AND THERE IS POTENTIAL FOR WIND GUSTS WELL IN EXCESS OF 60 MPH...OVER SMALL AREAS. THE TYPE OF SEVERE THUNDERSTORM WHICH MAY OCCUR TODAY DEVEL0PS RAPIDLY AND CAUSES HAIL OR DAMAGE SHORTLY AFTER DEVELOPMENT.

ANY OF THE STRONG STORMS TODAY MAY HAVE VERY GUSTY WINDS...EXTREMELY HEAVY RAINFALL WHICH CAN CAUSE LOCAL FLOODING...AND EXCESSIVE CLOUD TO GROUND LIGHTNING STRIKES.

SKYWARN SPOTTER GROUPS SHOULD MONITOR CONDITIONS DURING THE DAY AND RELAY REPORTS OF SEVERE WEATHER THROUGH DESIGNATED REPORTING SYSTEMS.

$$
MCAVOY

REDEFINING STATEMENT FOR SEVERE WEATHER WATCH

FTWSLSTX
WWUS32 KFTW 062145

AREAL OUTLINE FOR SEVERE THUNDERSTORM WATCH NUMBER 303
NATIONAL WEATHER SERVICE FORT WORTH TX
445 PM CDT WED JUL 6 1994

TEXAS
THIS WATCH INCLUDES 32 COUNTIES

TXC011-045-065-075-087-101-107-125-129-153-179-189-191-211-219-269-279
-303-345-375-381-393-437-483-070300-

IN NORTHWEST TEXAS 25 COUNTIES...

ARMSTRONG	BRISCOE	CARSON	CASTRO
CHILDRESS	COLLINGSWORTH	COTTLE	CROSBY
DICKENS	DONLEY	FLOYD	GRAY
HALE	HALL	HEMPHILL	HOCKLEY
KING	LAMB	LUBBOCK	MOTLEY
POTTER	RANDALL	ROBERTS	SWISHER
WHEELER			

$$

023-077-155-197-275-485-487-070300-

IN NORTH-CENTRAL TEXAS 7 COUNTIES...

BAYLOR	CLAY	FOARD	HARDEMAN
KNOX	WICHITA	WILBARGER	

$$

TORNADO WARNING

WFUSI KICT 010346
TORICT
KSC169-010430

BULLETIN-EAS ACTIVATION REQUESTED
TORNADO WARNING
NATIONAL WEATHER SERVICE WICHITA KS
1045 PM CDT MON MAY 31 1999

THE NATIONAL WEATHER SERVICE IN WICHITA HAS ISSUED A

★ TORNADO WARNING FOR...
SALINE COUNTY IN CENTRAL KANSAS

★ UNTIL l130 PM CDT

★ AT 1042 PM CDT NATIONAL WEATHER SERVICE DOPPLER RADAR INDICATED A SEVERE THUNDERSTORM WITH STRONG ROTATION OVER SMOLAN...OR ABOUT 6 MILES SOUTHWEST OF SALINA...MOVING EAST AT 25 MPH. THIS STORM COULD PRODUCE A TORNADO AT ANY TIME.

★ THE SEVERE THUNDERSTORM WILL BE...
NEAR ASSARIA AROUND 1055 PM CDT
NEAR GYPSUM AROUND 1115 PM CDT

THIS WARNING REPLACES THE SEVERE THUNDERSTORM WARNING PREVIOUSLY ISSUED FOR THE WARNED AREA AT 1005 PM CDT.

VERY LARGE HAIL AND DAMAGING THUNDERSTORM WINDS ARE ALSO EXPECTED WITH THIS STORM.

IF YOU ARE CAUGHT OUTSIDE...SEEK SHELTER IN A NEARBY REINFORCED BUILDING. AS A LAST RESORT...SEEK SHELTER IN A CULVERT...DITCH OR LOW SPOT AND COVER YOUR HEAD WITH YOUR HANDS.

LAT...LON 3884 9777 3867 9784 3860 9751 3876 9744
ES

SEVERE THUNDERSTORM WARNING

WUUS1 KGSP 061652 COR
SVRGSP
SCCO45—61730-

BULLETIN – IMMEDIATE BROADCAST REQUESTED
SEVERE THUNDERSTORM WARNING...CORRECTED EXPIRATION TIME
NATIONAL WEATHER SERVICE GREENVILLE-SPARTANBURG SC
1244 PM EDT TUE JUL 6 1999

THE NATIONAL WEATHER SERVICE IN GREENVILLE-SPARTANBURG HAS ISSUED A

★ SEVERE THUNDERSTORM WARNING FOR...SOUTHERN GREENVILLE COUNTY IN SOUTH CAROLINA

★ UNTIL 130 PM EDT

★ AT 1242 PM EDT...NATIONAL WEATHER SERVICE RADAR INDICATED A SEVERE THUNDERSTORM IN THE VICINITY OF SIMPSONVILLE...MOVING SOUTH AT 10 MPH.

★ THE SEVERE THUNDERSTORM WILL BE NEAR...
DONALDSON CENTER AT 1245 PM EDT
MOONVILLE AT 100 PM EDT
FOUNTAIN INN AT 100 PM EDT
PIEDMONT AT 110 PM EDT

PEOPLE IN THE PATH OF THIS STORM SHOULD BE ALERT FOR LARGE HAIL AND DAMAGING WINDS. FREQUENT LIGHTNING AND LOCALLY HEAVY RAIN CAN OCCUR WITH ANY THUNDERSTORM.

MCAVOY

SHORT TERM FORECAST

FPUS74 KAMA 061732
NOWAMA

SHORT TERM FORECAST
NATIONAL WEATHER SERVICE AMARILLO TX
1231 PM CDT TUE JUL 6 1999

OKZ003-TXZ003-004-008-009-013-014-018-019-062100-
BEAVER-BORGER-CLARENDON-CLAUDE-MIAMI-PAMPA-PANHANDLE-PERRYTON-
SPEARMAN-
1231 PM CDT TUE JUL 6 1999

.NOW...
THROUGH 4 PM...SHOWERS AND THUNDERSTORMS WILL DEVELOP BETWEEN BEAVER OKLAHOMA TO PANHANDLE TEXAS AND FROM SPEARMAN TO SHAMROCK. THE SHOWERS AND STORMS WILL BE SLOW MOVING SO LOCALLY HEAVY RAINFALL AMOUNTS MAY RESULT LATER THIS AFTERNOON FROM THE MORE ORGANIZED STORMS. TEMPERATURES WILL GENERALLY WARM TO AROUND 90 DEGREES.

$$

TXZ005-010-062100-
BOOKER-CANADIAN-
1231 PM CDT TUE JUL 6 1999

SEVERE WEATHER STATEMENT
(TORNADO)

BHMSVSBHM
WWUS34 KBHM 262143
ALZ024>027-033>036-262230-

SEVERE WEATHER STATEMENT
NATIONAL WEATHER SERVICE BIRMINGHAM AL
443 PM CDT TUE APR 26 1994

...TORNADO WARNING UNTIL 515 PM CDT FOR EASTERN BIBB COUNTY...
A TORNADO IS EXPECTED TO BE NEAR THE SIX MILE COMMUNITY BY 500 PM CDT. AT 441 PM...SPOTTERS REPORTED A TORNADO 3 MILES EAST OF CENTREVILLE. PEOPLE IN THE PATH OF THIS STORM SHOULD TAKE COVER NOW!

&

SPECIAL WEATHER STATEMENT
(SEVERE THUNDERSTORM)

```
SPSCAE
        WNU535 KCAE 192225
        SCZ001>014-018>021-200100-

        SPECIAL WEATHER STATEMENT
        NATIONAL WEATHER SERVICE COLUMBIA SC
        625 PM EDT MON SEP 19 1994

...SEVERE THUNDERSTORM WATCH HAS BEEN CANCELED FOR PARTS OF NORTHWEST
SOUTH CAROLINA...

THE SEVERE THUNDERSTORM WATCH ISSUED AT 300 PM EDT HAS BEEN CANCELED
FOR OCONEE...PICKENS...GREENVILLE...ANDERSON...ABBEVILLE...MCCORMICK
...AND GREENWOOD COUNTIES. SEVERE THUNDERSTORMS HAVE MOVED THROUGH
THESE COUNTIES AND ARE NOT EXPECTED TO THREATEN AGAIN THIS EVENING.

THE SEVERE THUNDERSTORM WATCH REMAINS IN EFFECT FOR
SPARTANBURG...CHEROKEE...YORK...LAURENS...UNION...CHEETER...NEWBERRY..
.AND FAIRFIELD COUNTIES. PEOPLE IN THESE COUNTIES SHOULD PAY CLOSE
ATTENTION TO WEATHER DEVELOPMENTS AS THE THUNDERSTORMS APPROACH. BE
READY TO QUICKLY MOVE TO SHELTER IF SEVERE WEATHER IS OBSERVED OR A
WARNING IS ISSUED FOR YOUR AREA.
```

TORNADOES

DEFINITION

Tornadoes are the most violent storms on Earth, with estimated wind speeds of 250 miles per hour or more. A tornado is a violently rotating column of air that extends from the base of a thunderstorm and comes in contact with the ground. The spinning motion of a tornado is almost always counterclockwise.

Thunderstorms develop in warm, moist air in advance of eastward-moving cold fronts. These thunderstorms often produce large hail, strong winds, and tornadoes. Tornadoes in the winter and early spring are often associated with strong, frontal systems that form in the Central States and move east. Occasionally, large outbreaks of tornadoes occur with this type of weather pattern. Several states may be affected by numerous severe thunderstorms and tornadoes.

During the spring in the Central Plains, thunderstorms frequently develop along a "dryline," which separates very warm, moist air to the east from hot, dry air to the west. Tornado-producing thunderstorms may form as the dryline moves east during the afternoon hours.

Along the front range of the Rocky Mountains, in the Texas panhandle, and in the southern High Plains, thunderstorms frequently form as air near the ground flows "upslope" toward higher terrain. If other favorable conditions exist, these thunderstorms can produce tornadoes.

Tornadoes occasionally accompany tropical storms and hurricanes that move over land. Tornadoes are most common to the right and ahead of the path of the storm center as it comes onshore.

A **funnel cloud** is a similar column of air that is not in contact with the ground. A **water spout** is a tornado that is over water. When either a funnel cloud or a water spout come in contact with the ground, they become, by definition, a tornado.

The visible column is composed of water droplets formed by condensation in the funnel. The fast-moving winds (either flowing into the tornado or in the main tornadic circulation) cause most of the damage. The vortex (or multiple vortexes) sucks in air from near the ground, along with dirt and debris. The dirt and debris block light, giving the tornado a dark color.

Tornadoes are defined in terms of the Fujita Scale, which ranks tornadoes on the basis of wind speed and damage potential. The Fujita Scale is shown in the following table.

DEFINITION (Continued)

CATEGORY	*WIND SPEED*	EFFECTS
F0	40-72 mph	**Light damage:** Some damage to chimneys; branches break from trees; shallow rooted trees pushed over; sign boards damaged.
F1	73-112 mph	**Moderate damage:** Roof surfaces peeled off; mobile homes pushed from foundations or overturned; cars pushed off roads.
F2	113-157 mph	**Considerable damage:** Roofs torn off frame houses; mobile homes demolished; large trees snapped or uprooted.
F3	158-206 mph	**Severe damage:** Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.
F4	207-260 mph	**Devastating damage:** Well-constructed houses leveled; structures with weak foundations blown off some distance.
F5	261-318 mph	**Incredible damage:** Strong frame houses lifted off foundations and carried considerable distance to disintegrate.

- ❒ F0 and Fl tornadoes comprise 70 percent of all tornadoes that occur in the U.S. They usually touch down briefly and cause minor damage. However, forecasting these tornadoes is less reliable than for stronger tornadoes, so less than 50 percent occur during tornado watches.

- ❒ F2 and F3 tornadoes comprise about 28 percent of the tornadoes in the U.S. They can cause significant damage and cause injuries and deaths.

- ❒ F4 and F5 tornadoes comprise about 2 percent of the tornadoes in the U.S. and cause 70 percent of the death and destruction. Fortunately, the NWS has identified precursor conditions for the more damaging tornadoes. Over 95 percent of these tornadoes, therefore, occur during tornado watches.

CHARACTERISTICS

- ❒ **Wind.** Tornadoes consist of strong, often destructive winds. The winds in the strongest tornadoes are the fastest winds experienced anywhere on earth with rotation velocities up to 300 mph.

- ❒ **Rain/hail.** Tornadoes are associated with thunderstorms, so they may be preceded or followed by heavy rainfall or hail. Depending on the hydrological conditions, flash flooding may occur.

- ❒ Total destruction of homes, especially mobile homes, businesses, and cars, causing many deaths.

- ❒ Extensive tree damage along roadways, which may inhibit or block access.

CHARACTERISTICS (Continued)

- ❒ Extensive damage to electric and telephone lines.
- ❒ Utility line breaks.
- ❒ Damaged or destroyed radio and television towers.

Tornadoes develop as an outgrowth of thunderstorms. Large, strong, and long-lasting tornadoes are spawned by supercells. Once a thunderstorm has formed, given the right ingredients, a tornado can develop.

- ❒ A thunderstorm needs rising air for a tornado to form.
- ❒ The rising air begins to rotate due to strongly changing (veering) winds in the lower part of the atmosphere.

Each year, approximately 800 tornadoes touch down in the U.S., the highest frequency in the world. Tornadoes occur most often when the lower layer of air is warm, which varies according to the time of year:

- ❒ Midwestern U.S.: April, May, and June.
- ❒ Southwest and North Central U.S.: May, June, July, August, and September.
- ❒ Southeastern U.S.: March, April, May, and June.
- ❒ Western U.S.: April, May, June, July, and August.

HISTORICAL EXAMPLES

- ❒ An outbreak of tornadoes hit the Midwest on April 26-27, 1991. Fifty-four tornadoes caused 21 deaths, 308 injuries, and over $277 million in damages. Fifteen deaths occurred in or near mobile homes and two occurred in vehicles.
- ❒ An outbreak of 41 tornadoes hit the area of Lake Erie and Lake Ontario on May 31, 1985, causing 75 deaths in the U.S. There were 1,025 injuries and these tornadoes caused $450 million in damages.
- ❒ On March 28, 1984, 22 tornadoes hit North and South Carolina in the afternoon and evening. They caused 57 deaths, over 1,000 injuries, and $200 million in damages; 37 percent of the fatalities were in mobile homes.
- ❒ In April 1974, treacherous thunderstorms developed in the Midwest, causing 127 tornadoes, the largest, most damaging tornado outbreak in U.S. history. Over 300 people were killed, 6,142 were injured, and damages were estimated at $600 million.

PRODUCTS

The table below and on the next pages lists products that can provide planning and preparedness information on tornadoes. Appendix A describes the dissemination systems of these products, as well as other sources (such as the Internet or private online services). Refer to the fact sheet on thunderstorms for more products.

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Outlooks			
Convective Outlook Day 2	MKCSWODY2	Storm Prediction	Forecast for severe thunderstorms, including tornadoes, for the conterminous 48 states for the next day (DY2) and that day (DY1). Includes areas, degree of risk or probability, hazards and severity.
Convective Outlook Day 1	MKCSWODY1	SPC	
Public Weather Outlook	MKCPWOMKC	SPC	Discussion of an especially significant and/or widespread outbreak of severe thunderstorms.
Severe Weather Outlook	__SPS__	Local NWS Office	These are local outlooks for the potential of severe weather. They include hazards, locations, severity, and time frames.
Watches			
Tornado Watch	MKCSEL (1-9)	SPC	A watch contains: ❒ Type of severe weather watch. ❒ Watch area. ❒ Valid period. ❒ Type of severe weather possible. ❒ Intensity of severe weather. ❒ Watch axis. ❒ Meaning of watch. ❒ Call to action statement. ❒ Discussion of meteorological reasoning. ❒ Other watch information.
Watch Cancellation	MKCSEL (1-9)	SPC	This product cancels a tornado watch.

* 1-9 indicates the consecutive number of issuance for the day.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Statements			
Tornado Watch Redefining Statement	__SLS__	Local NWS Office	Provides geographical or areal redefinition of a specific severe thunderstorm watch area including states, counties and cities at risk.
Special Weather Statement	__SPS__	Local NWS Office	Provides for clearance of counties from local severe thunderstorm watches.
Severe Weather Statement	__SVS__	Local NWS Office	Provides: ❒ A brief report of imminent danger. ❒ A cancellation of all or part of a warning. ❒ An extended watch for 1 – 2 hours.
Warnings/ Advisories			
Tornado Warning	__TOR__	Local NWS Office	Warning for tornado(s) including: ❒ Hazards. ❒ An affected area. ❒ Expiration time. ❒ A basis of warning. ❒ A threat confirmation. ❒ The location and movement. ❒ A call to action statements. NOTE: Warnings for tornadoes, severe thunderstorms, and flash floods, may be combined and issued under one header based on the most severe threat.
Special Marine Warnings	__SMW__	Local NWS Office	Issued for water spouts and include the same types of information as do tornado warnings.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Discussions SPS Mesoscale Discussion	MKCSWOMCD	SPC	This is a daily unscheduled product used to communicate the current judgement of SPC forecasters about the potential of severe weather to the user community.
Short Term Forecasts	__NOW__	Local NWS Offices	This is intended as the primary way to provide a short term forecast of hydrometeorological conditions over an area. It gives a concise forecast of the most significant weather during the next few hours. It highlights watches, warnings and advisories in effect at the time.

SAMPLE PRODUCTS

The fact sheet on thunderstorms contains the NWS products used for monitoring tornadoes. Refer to these products on pages III-10 through III-20 as necessary.

FLASH FLOODS

DEFINITION

A flash flood occurs suddenly, within a short time (from minutes to less than 6 hours) after a causative event. Flash floods are the number one weather-related killer in the U.S. Nearly half of all flash-flood fatalities are auto related.

Causative events include heavy rains from slow moving thunderstorms, dam or levee failure, or the sudden release of water from the breakup of an ice jam. Intense short-duration rainfall on impervious areas, such as urban areas or certain soils, also causes flash floods.

Flash floods are most prevalent on small streams, generally draining areas ranging in size from a few square miles to several hundred square miles. The most dangerous flash floods are usually associated with steep mountain streams, canyons, and desert washes where they can manifest themselves as a wall of water traveling downstream.

ACTERISTICS

Rainfall intensity and duration affect the potential for flash floods. Other non-meteorological factors that could affect an area's ability to absorb water include the topography, soil conditions, and ground cover.

Topography is important, especially when there are steep slopes. Gravity rapidly moves the water to the lowest point(s), reducing the time the runoff is susceptible to being absorbed by the ground as well as funneling water from larger areas into the lowest region.

Some soils can absorb runoff more effectively (i.e., sand is better than clay) and reduce runoff. Soils covered with vegetation tend to retard runoff, and mitigate rapid accumulation of water at low points. Wet soils have limited capability to absorb runoff, so rainfall is more effective in causing flooding when soils are moist. Frozen soils also do not allow for absorption of runoff. Finally, some soils, such as clay, that have been "baked" by long periods of hot, dry conditions, often have little capability to absorb runoff.

The most severe flash floods can roll boulders, tear out trees, destroy buildings and bridges, and scour out new channels. However, less serious flash flooding is still capable of taking lives. As little as a foot of moving water is enough to sweep a car into deeper flood waters. Also, children playing in flood waters, especially near culverts and drainage pipes, can be swept away. Other hazards associated with flash floods include:

- **Sudden release of huge walls of water.** Floating debris or ice can collect at an obstruction and restrict the flow of water. Pressure builds up behind the jam, and when the pressure bursts through, a huge wall of water of up to 30 feet is released, causing tremendous destruction.

ACTERISTICS (Continued)

- **Debris flows.** Debris caught in the water flow acts as battering rams, causing additional destruction.
- **Mud slides.** Flash floods can also trigger mud slides in areas with clay soils, saturated soils, or little ground cover.

RICAL EXAMPLES

- In May 1889, a dam break in Johnstown, Pennsylvania, caused the worst flood in U.S. history. A 36- to 40-foot wall of water left over 2,200 dead.
- In June 1990, 4 inches of rain fell in less than 2 hours at Shadyside, Ohio, producing a 30-foot high wall of water. It caused 26 deaths and $6 to $8 million in damages.
- In Cheyenne, Wyoming, 6 inches of rain fell in 3 hours in August 1985. The flood left 12 dead and caused $61 million in damages.
- In July 1976, the headwaters of Big Thompson Canyon in Colorado received 10 to 12 inches of rain, most of it in 2 hours. The rain produced a 19-foot wall of water and debris, which caused about $35.5 million in damages. Victims had little warning and 139 people were killed.
- In July 1972, Rapid City, South Dakota had 15 inches of rain in a 5-hour time period. The resulting flood caused 238 deaths and $164 million in damages.

JCTS

The table on the following pages lists NWS products that can provide planning and preparedness information on flash floods. Appendix A describes the dissemination systems of these products, as well as other sources (such as the Internet or private online services). Refer to the fact sheet on riverine floods for other products.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Outlooks			
Flood Potential Outlook	__ESF__	Local NWS Office	This product is issued when conditions indicate that significantly heavy precip-itation will cause or aggravate flash flooding. It is issued with a 36 hour or greater lead time. It includes the : ❒ Area affected. ❒ Time frames. ❒ Discussion of hydrologic and meteorological factors and conditions. ❒ Information on projected watches and warnings.
Watches			
Flash Flood Watch	__FFA__	Local NWS Office	Flash Flood Watches are used to inform cooperating agencies and the public about the threat of flash flooding. It covers precipitation, snow/ice melt, and dam break conditions. They Include the: ❒ Area affected. ❒ Time frames. ❒ Conditions. ❒ Extent of hazardous conditions possible. ❒ Potential severity. ❒ Call to action statements.
Statements			
Flash Flood Statement	__FFA__	Local NWS Office	This product is issued to provide updates to flash flood watches and warnings. It can provide the: ❒ Latest information on flooding. ❒ Reduction in the area covered by a watch or warning. ❒ Termination of a watch or warning.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Advisories/ Warnings			
Urban and Small Stream Flood Advisory	__FFS__	Local NWS Office	This product is designed to provide advance notice for flash flooding on small streams and in urban areas such as roads, underpasses and low-lying areas. This product is used for situations that are primarily a major inconvenience, not a life threatening flood. In includes the: ❒ Area affected. ❒ Time frames. ❒ Location and movement of flood producing storms. ❒ Call to action statement.
Flash Flood Warning	__FFW__	Local NWS Office	This warning indicates flash flooding is imminent or in progress. The warning should include the: ❒ Time frames. ❒ Area impacted. ❒ Severity of the flood. ❒ Movement of the flood. ❒ Call to action statement. ❒ Time of next issuance.
Discussions Hydrometeorological Discussion	__HMD__	River Forecast Centers (RFCs)	This product summarizes the current hydrometeorological situation, general trends of the RFC's hydrologic forecasts, and flood potential for the entire RFC area. The types of conditions monitored include: ❒ Areas where data indicate significant potential for runoff-causing rainfall. ❒ Rivers that are already above flood stage. ❒ Areas where soil moisture is above normal due to recent excessive rainfall. ❒ Areas covered by a significant, ripe snowpack that could readily melt in changing meteorological conditions such as a rain-on-snow event or a heat wave.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Discussions (Continued) Hydrometeorological Discussion	__HMD__	River Forecast Centers (RFCs)	❒ Areas where frozen ground could generate dangerous runoff with moderate rainfall. ❒ Areas where ice jam breakups could potentially produce backwater flooding or dam-break-like flood conditions.
Short Term Forecasts N/A			

LE PRODUCTS

The sample products listed below are shown on the pages that follow:

- ❒ Flood Potential Outlook. (Revised 3/2000)
- ❒ Flash-Flood Watch. (Revised 3/2000)
- ❒ Urban and Small Stream Flood Advisory.
- ❒ Flash-Flood Warning. (Revised 3/2000)

FLOOD POTENTIAL OUTLOOK

FGUS73 KMSR 261426
ESFMSP
MNZ041>045-047>070-073>078-082>085-091>093-WIZ014>016-023>028-271800-

FLOOD POTENTIAL OUTLOOK
NATIONAL WEATHER SERVICE TWIN CITIES/CHANHASSEN MN
800 AM CST FRI FEB 26 1999

SPRING SNOWMELT FLOOD OUTLOOK
NATI0NAL WEATHER SERVICE FORECAST OFFICE
TWIN CITIES/CHANHASSEN, MINNESOTA
FEBRUARY 26 1999

THE FLOOD 0UTLOOK FOR RIVERS IN SOUTHERN MINNESOTA AND WEST CENTRAL WISCONSIN IS FOR MINOR OR NO SNOWMELT FLOODING. CURRENT SNOW DEPTHS IN SOUTHERN MINNESOTA AND WESTERN CENTRAL WISCONSIN ARE WELL BELOW NORMAL FOR THIS TIME OF YEAR. THEREFORE...WITH EXISTING CONDITIONS...COMBINED WITH NORMAL PRECIPITATION AND TEMPERATURES THROUGH THE SNOWMELT PERIOD...ONLY MINOR OR NO SNOWMELT FLOODING IS EXPECTED.

ABOVE NORMAL PRECIPITATION DURING THE SNOWMELT PERIOD OR ICE JAMS COULD INCREASE THE THREAT OF FLOODING.

SUMMARY OF TEMPERATURES AND PRECIPITATION

PRECIPITATION AMOUNTS SINCE OCTOBER HAVE GENERALLY BEEN ABOVE NORMAL EXCEPT FOR DECEMBER AND FEBRUARY. TEMPERATURES THROUGHOUT THE WINTER HAVE BEEN VERY MILD AND ABOVE NORMAL.

FORECASTS FOR THIS WEEKEND AND INTO EARLY NEXT WEEK INDICATE ABOVE NORMAL TEMPERATURES AND PRECIPITATION OF GENERALLY LESS THAN ONE QUARTER OF AN INCH.

THE 6 TO 10 OUTLOOK INDICATES NEAR NORMAL TEMPERATURES AND PRECIPITATION.

THE 30 DAY OUTLOOK FOR MARCH AND THE 90 DAY OUTLOOK FOR THE PERIOD MARCH THROUGH MAY BOTH INDICATE NEAR NORMAL TEMPERATURES AND PRECIPITATION.

SNOW COVER

MOST OF THE SOUTHERN HALF OF MINNESOTA HAS LESS THAN ONE INCH OF SNOW COVER. SOME AREAS IN WESTERN AND EASTERN MINNESOTA WERE REPORTING 1 TO 3 INCHES OF SNOW COVER. IN WEST CENTRAL WISCONSIN THE UPPER PORTIONS OF THE CHIPPEWA RIVER BASIN HAS 8 TO 16 INCHES OF SNOW REMAINING WHILE

THE SOUTHERN PORTION OF THE RIVER BASIN IS MOSTLY BARE. WATER CONTENT OF THE SNOW PACK IN THE UPPER PORTIONS OF THE CHIPPEWA BASIN IS 2 TO 3 INCHES.

SOIL CONDITIONS

FROST DEPTH FOR MINNESOTA ARE GENERALLY 1 TO 2 FEET, AND A FOOT OR LESS IN WISCONSIN...WELL BELOW NORMAL. SOIL MOISTURE AS SHOWN BY THE PALMER DROUGHT INDEX INDICATES NORMAL SOIL MOISTURE CONDITIONS FOR MOST OF THE AREA AND SLIGHTLY ABOVE NORMAL CONDITIONS IN SOUTHEAST MINNESOTA.

PRESENT RIVER CONDITIONS

THE MILD WINTER TEMPERATURES KEPT THE RIVERS OPEN AND RUNNING THROUGH DECEMBER AND MOST OF JANUARY RESULTING IN ABOVE NORMAL RIVER LEVELS. ALTHOUGH RIVER LEVELS HAVE BEEN ABOVE NORMAL THROUGHOUT THE WINTER THEY HAVE REMAINED WELL BELOW FLOOD STAGE.

FLOOD OUTLOOK FOR SOUTHERN MINNESOTA AND WEST CENTRAL WISCONSIN

THE SNOWMELT FLOOD OUTLOOK BASED ON ASSUMED NORMAL PRECIPITATION UNTIL THE MELT IS COMPLETE IS FOR MINOR OR NO SNOWMELT FLOODING FOR THE MISSISSIPPI RIVER AND TRIBUTARIES IN SOUTHERN MINNESOTA AND WEST CENTRAL WISCONSIN.

TERMINOLOGY

MINOR FLOODING: A GENERAL TERM INDICATING MINIMAL OR NO PROPERTY DAMAGE...BUT POSSIBLY SOME PUBLIC INCONVENIENCE.

MODERATE FLOODING: THE INUNDATION OF SECONDARY ROADS...TRANSFER TO HIGHER ELEVATION NECESSARY TO SAVE PROPERTY...SOME EVACUATION MAY BE REQUIRED.

MAJOR FLOOD: A GENERAL TERM INCLUDING EXTENSIVE INUNDATION AND PROPERTY DAMAGE...USUALLY CHARACTERIZED BY THE EVACUATION OF PEOPLE AND LIVESTOCK AND THE CLOSURE OF BOTH PRIMARY AND SECONDARY ROADS.

SEVERE FLOODING: WIDESPREAD INUNDATION...REQUIRING SUBSTANTIAL RESOURCES FROM OUTSIDE THE LOCAL COMMUNITIES...RECORD OR NEAR RECORD FLOODING.

GENERAL COMMENTS

THESE PROJECTIONS OF RIVER STAGES ARE BASED ON CURRENT OBSERVED STATES OF STREAMFLOW...SOIL MOISTURE...AND SNOW PACK...COUPLED WITH FUTURE PRECIPITATION AND TEMPERATURE PATTERNS AND ANTICIPATED OPERATIONAL HYDROLOGIC CHANGES SUCH AS RESERVOIR RELEASES AND CANAL DIVERSIONS.

OUTLOOKS ARE PROVIDED FOR LONG-RANGE...WEEKS TO MONTHS...PROJECTIONS BASED ON CLIMATOLOGICAL PATTERNS OF PRECIPITATION AND TEMPERATURE. FORECASTS ARE PROVIDED FOR SHORT-TERM...DAYS...PROJECTIONS BASED ON FUTURE FORECASTED PATTERNS OF PRECIPITATION AND TEMPERATURE. THE UNCERTAINTY OF THESE PRODUCTS VARIES FROM SEASON TO SEASON AND SITE TO SITE. IN RECENT YEARS OUTLOOK CRESTS HAVE BEEN ABOVE THE OBSERVED CREST ABOUT AS OFTEN AS THEY HAVE BEEN BELOW THE OBSERVED CREST. THE UNCERTAINTY OF FORECASTS TENDS TO BE LESS THAN THE UNCERTAINTY OF OUTLOOKS DUE TO THEIR SHORTER LEAD TIME. USERS OF THESE PRODUCTS ARE ENCOURAGED TO CONTACT THEIR NEAREST NATIONAL WEATHER SERVICE FORECAST OFFICE FOR CONTINUED UPDATES OF METEOROLOGICAL CONDITIONS WHICH CAN HAVE SIGNIFICANT IMPACTS ON FLOOD PLANNING AND FLOOD FIGHTING ACTIVITIES.

THIS FLOOD OUTLOOK DOES NOT INCLUDE NUMERICAL CREST OUTLOOK VALUES. A NUMERICAL CREST OUTLOOK WILL BE INCLUDED IN THE 3/12/99 OUTLOOK FOR RIVER BASINS WHERE A SIGNIFICANT SNOW COVER REMAINS.

CRAIG EDWARDS
METEOROLOGIST IN CHARGE

GARY MCDEVITT
SERVICE HYDROLOGIST

FLASH FLOOD WATCH

RWUS31 KSTL 010907
FFASTL
KSZ073-097-101-M0Z055-066>068-077>079-088>089-093>094-101>102-011700-

BULLETIN - IMMEDIATE BROADCAST REQUESTED
FLASH FLOOD WATCH
NATIONAL WEATHER SERVICE SPRINGFIELD MO
400 AM CDT THU JUL 1 1999

A FLASH FLOOD WATCH IS IN EFFECT THIS MORNING FOR THE FOLLOWING COUNTIES...

...IN KANSAS...

BOURBON... CHEROKEE... CRAWFORD...

...IN MISSOURI...

BARRY... BARTON... BENTON... CEDAR...
DADE... HICKORY... JASPER... LAWRENCE...
MCDONALD... NEWTON... POLK... ST. CLAIR...
VERNON...

THE NATIONAL WEATHER SERVICE IN SPRINGFIELD HAS ISSUED A FLASH FLOOD WATCH FOR PORTIONS OF SOUTHEAST KANSAS AND SOUTHWEST MISSOURI THIS MORNING. THE WATCH AREA IN GENERALLY WEST OF A LINE FROM WARSAW...TO BOLIVAR...TO PINEVILLE.

RECENT RAINS OVER THE PAST WEEK HAS MADE THE GROUND SATURATED ACROSS MUCH OF SOUTHWEST MISSOURI AND SOUTHEAST KANSAS. ANOTHER AREA OF SHOWERS AND THUNDERSTORMS WILL MOVE EASTWARD FROM CENTRAL KANSAS AND MOVE INTO SOUTHEAST KANSAS AND SOUTHWEST MISSOURI LATER THIS MORNING. HEAVY RAIN WILL ACCOMPANY SOME OF THE STORMS...WHICH WILL INCREASE THE THREAT OF FLASH FLOODING. RAINFALL AMOUNTS OF ONE TO TWO INCHES WILL BE POSSIBLE IN THE WATCH AREA THIS MORNING.

PERSONS ACROSS THE WATCH AREA SHOULD REMAIN ALERT FOR THE THREAT OF FLASH FLOODING THIS MORNING. AVOID TRAVEL THROUGH AREAS PRONE TO FLOODING...SUCH AS LOW WATER CROSSINGS. IF FLOODING IS OBSERVED...MOVE TO HIGHER GROUND QUICKLY.

STAY TUNED FOR LATER STATEMENTS AND POSSIBLE WARNINGS FROM THE. NATIONAL WEATHER SERVICE.

RICKARD

URBAN AND SMALL STREAM FLOOD ADVISORY

OMAFFSOMA
TTAAOO KOMA 072053
NEZ010-015-019-020-

URBAN AND SMALL STREAM FLOOD ADVISORY
NATIONAL WEATHER SERVICE OMAHA NE
453 PM CDT THU JUL 7 1988

THE NATIONAL WEATHER SERVICE HAS ISSUED AN URBAN AND SMALL STREAM FLOOD ADVISORY EFFECTIVE UNTIL 800 PM CDT FOR A PORTION OF SOUTHEAST NEBRASKA. THE AREA IS GENERALLY SOUTH AND EAST OF AN OMAHA TO LINCOLN TO BEATRICE LINE.

AT 445 PM CDT THUNDERSTORMS PRODUCING VERY HEAVY RAINS WERE CAUSING SMALL STREAM FLOODING OVER A PORTION OF SOUTHEASTERN NEBRASKA. THE THUNDERSTORMS PRODUCING HEAVY RAIN WERE IN A 30-MILE WIDE BAND FROM 20 MILES WEST OF LINCOLN TO 10 MILES NORTHEAST OF OMAHA. AT THE AIRPORT IN OMAHA...NEARLY 2 INCHES OF RAIN FELL IN A 40-MINUTE TIME PERIOD. FLOODING OF SMALL STREAMS...STREETS...AND UNDERPASSES CAN BE EXPECTED IN THE OMAHA AREA. MOTORISTS SHOULD BE ESPECIALLY CAUTIOUS.

FLASH FLOOD WARNING

WRUS1 KSGF 011446
FFWSGF
KSC021-MOC011-097-119-145-011850-

BULLETIN - EAS ACTIVATION REQUESTED
FLASH FLOOD WARNING
NATIONAL WEATHER SERVICE SPRINGFIELD MO
945 AM CDT THU JUL 1 1999

THE NATIONAL SERVICE IN SPRINGFIELD HAS ISSUED A

* FLASH FLOOD WARNING FOR...
  CHEROKEE COUNTY IN SOUTHEASTERN KANSAS
  BARTON COUNTY IN SOUTHWESTERN MISSOURI
  JASPER COUNTY IN SOUTHWESTERN MISSOURI
  MACDONALD COUNTY IN SOUTHWESTERN MISSOURI
  NEWTON COUNTY IN SOUTHWESTERN MISSOURI

* UNTIL 150 PM CDT

* AT 942 AM...WEATHER SERVICE DOPPLER RADAR WAS INDICATING THUNDERSTORMS PRODUCING HEAVY RAINFALL. THESE STORMS WERE LOCATED IN A LINE FROM GIRARD TO COLUMBUS AND WERE MOVING EAST AT 40 TO 50 MPH. DOPPLER RADAR WAS ESTIMATING ONE TO TWO INCHES WITHIN THE PAST HOUR WITH THESE STORMS.

* DESPITE THE FAST MOVEMENT OF THESE STORMS...ONE TO THREE INCHES OF RAIN WILL OCCUR ON ALREADY SATURATED GROUND FROM THE HEAVY RAIN DURING THE PREVIOUS WEEK. THIS WILL LIKELY PRODUCE RUNOFF FLASH FLOODING INTO THE EARLY AFTERNOON HOURS.

EXCESSIVE RUNOFF FROM THIS STORM WILL CAUSE FLOODING OF SMALL CREEKS AND STREAMS...HIGHWAYS AND UNDERPASSES. ADDITIONALLY...COUNTRY ROADS AND FARMLANDS ALONG THE BANKS OF CREEKS AND STREAMS AND OTHER LOW LYING AREAS ARE SUBJECT TO FLOODING.

DO NOT UNDERESTIMATE THE POWER OF FLOOD WATERS. ONLY A FEW INCHES OF RAPIDLY FLOWING WATER CAN QUICKLY CARRY AWAY YOUR VEHICLE.

LINDENBERG

RIVERINE FLOODS

ITION

Whereas flash floods occur quickly after an upstream event, riverine flooding is a longer term event that may last a week or more.

Flooding along rivers and streams is natural and inevitable. Some floods occur seasonally when winter or spring rains, coupled with melting snows, fill river basins with too much water, too quickly. Torrential rains from hurricanes or tropical systems also can produce river and stream flooding.

Flooding on a nonleveed stream occurs when overbank flows are of sufficient magnitude to cause considerable inundation of land and roads. Flooding on a leveed stream occurs when the stream level rises above the levee. Flooding also can occur if the levee fails. The ability of the levee to withstand flooding depends on the design standards used when constructing the levee. Many private (mostly agricultural) levees are not intended to withstand major floods.

ACTERISTICS

Riverine flooding is normally the result of a combination of meteorological and hydrological factors. Although excessive rainfall alone can cause flooding, the most severe riverine floods usually have multiple causative factors. These factors may include:

- ❒ Heavy prolonged rainfall from large-scale storms or a series of large-scale storms.
- ❒ Heavy rainfall from a near-stationary or slow-moving thunderstorm complex.
- ❒ Saturated soil conditions from previous rainfall events.
- ❒ High existing river flows from previous rainfall events.
- ❒ Extreme cold temperatures followed by thawing, leading to river ice jams.
- ❒ Rapid snowmelt. Snowmelt floods can develop over periods ranging from several hours to several days, depending upon the part of the country, the water content of the snow, and temperatures during the melting period. The combination of large-scale storm rainfall and rapidly melting snow can cause severe flooding.
- ❒ Silt buildup in river channels during previous storm events that reduces the capacity of the river to carry water.

CHARACTERISTICS (Continued)

The dangers of riverine floods are similar to coastal and flash floods. Dangers include:

- ❒ Damaged or destroyed buildings and vehicles.
- ❒ Uprooted trees causing power and utility outages.
- ❒ Drowning, especially people trapped in cars.
- ❒ Contamination of drinking water.
- ❒ Dispersion of hazardous materials.
- ❒ Interruption of communications and/or transportation systems.

HISTORICAL EXAMPLES

- ❒ The Great Flood of 1993 in the Mississippi Valley affected 9 States, resulted in 31 deaths, and caused $15 to 20 billion in damage. Months of above-average rainfall, heavy spring rains, saturated soils, continued summer rains, failed levees, and riverbed erosion contributed to the major flooding on the Missouri and Mississippi Rivers and numerous tributaries. Numerous drinking water systems were contaminated; river shipping was closed for 2 months; and crops, homes, businesses, roads, and bridges were destroyed.
- ❒ The South-Central Texas River Flood in December 1991 and January 1992, caused widespread flooding in the Guadalupe, Brazos, Trinity, and Colorado River basins. Seventeen inches of rain fell, causing 15 deaths and $100 million in damage.
- ❒ In 1979, Tropical Storm Claudette brought 45 inches of rain to an area near Alvin, Texas, contributing to more than $600 million in damage.
- ❒ In 1972, Hurricane Agnes fused with another storm system, producing floods in the Northeast that contributed to 122 deaths and $6.4 billion in damage.
- ❒ In 1955, long after the winds of Hurricane Diane subsided, the storm brought floods to Pennsylvania, New York, and New England that contributed to nearly 200 deaths and $4.2 billion in damage.

PRODUCTS

The following table lists NWS products that can provide planning and preparedness information on riverine floods. Appendix A describes the dissemination systems of these products, as well as other sources (such as the Internet or private online services).

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Outlooks			
Flood Potential Outlook	__ESF__	Local NWS Office	This product is issued when conditions indicate that significantly heavy precipitation will cause or aggravate flooding. It is issued with a 36 hour or greater lead time. It includes the: ❒ Area affected. ❒ Time frames. ❒ Discussion of hydrologic and meteorological factors and conditions. ❒ Information on projected watches and warnings.
Excessive Rain Outlook	NMCGPH94E	NCEP	
Watches			
Flood Watch	__FFA__	Local NWS Office	This is used to inform cooperating agencies and the public about the threat of flooding. It covers precipitation, snow/ice melt, and dam break conditions. It Includes the: ❒ Area affected. ❒ Time frames. ❒ Conditions. ❒ Extent of hazardous conditions possible. ❒ Potential severity. ❒ Call to action statement.
Statements			
Flood Statement	__FFS__	Local NWS Office	This product is issued to provide updates to flood watches and warnings. It can proved the: ❒ Latest information on flooding. ❒ Reduction in the area covered by a watch or warning. ❒ Termination of a watch or warning.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Statements (Continued)			
Flood Statement	__FLS__	Local NWS Office	This product is issued to update and expand the information in a Flood Warning (FLW, see below). The Flood Statement may be used in lieu of a warning if flooding is forecast, imminent, or existing and presents no threat to life or property. The statement is used also to terminate a Flood Warning.
River Statement	__RVS__	Local NWS Office	This product provides daily river stage forecasts, information about ice jams and ice movement that does not warrant a Flood Warning or a Flood Statement. It is used also to communicate conditions such as low flows, chemical spills, etc.
River Ice Statement	__RVI__	Local NWS Office	This product can contain numeric and/or narrative information on river ice conditions.
Advisories/ Warnings			
Flood Warning	__FLW__	Local NWS Office	This product normally specifies crest information and is issued for specific communities or areas along rivers where flooding has been forecast, is imminent, or is in progress.

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Discussions Hydrometeorological Discussion	__HMD__	River Forecast Centers (RFCs)	This product summarizes the current hydrometeorological situation, general trends of the RFC's hydrologic forecasts, and flood potential for the entire RFC area. The types of conditions monitored include: ❒ Areas where QPFs indicate significant potential for runoff-causing rainfall. ❒ Rivers that are already above flood stage. ❒ Areas where soil moisture is above normal due to recent excessive rainfall. ❒ Areas covered by a significant, ripe snowpack that could readily melt in changing meteorological conditions such as a rain-on-snow event or a heat wave. ❒ Areas where frozen ground could generate dangerous runoff with moderate rainfall. ❒ Areas where ice jam breakups could potentially produce backwater flooding or dam-break-like flood conditions.
Short Term Forecasts N/A			

SAMPLE PRODUCTS

The sample products are shown on the next pages under Hydrometeorological Discussion (Revised 3/2000)

FLOOD POTENTIAL OUTLOOK

AGUS74 KTUA 061640
HMDTUR
HYDROMETEOROLOGICAL DISCUSSION
NATIONAL WEATHER SERVICE RIVER FORECAST CENTER, TULSA, OK
1140 AM CDT TUE JUL 06 1999

...PAST TWENTY-FOUR HOUR PRECIPITATION DISCUSSION...

SCATTERED SHOWERS AND THUNDERSTORMS PRODUCED AREAS OF HEAVY PRECIPITATION IN THE NORTHWEST THIRD OF THE ABRFC BASIN LATE MONDAY AND EARLY TUESDAY. THE RAINFALL WAS PRIMARILY NORTH AND WEST OF AN ALBUQUERQUE TO DODGE CITY LINE. REPORTS OF HAIL UP TO 1.5 INCHES WERE RECEIVED CAUSING WSR-88D RAINFALL ESTIMATES IN EXCESS 0F GROUND REPORTS. RADAR ESTIMATES WERE MORE THAN TWICE AS HIGH IN SOME AREAS. DUE TO THE ISOLATED NATURE OF THE RAINFALL...BASIN AVERAGE AMOUNTS WERE GENERALLY LESS THAN ONE-HALF INCH EXCEPT FOR THE UPPER HEADWATER BASINS OF THE PURGATOIRIE...CANADIAN AND CIMARRON RIVERS WHERE SOME SMALLER BASINS RECEIVED BETWEEN 1 AND 2 INCH AVERAGES.

SOME OF THE HIGHER POINT RAINFALL TOTALS WERE:

WOTC2	:WOOTON RANCH	CO: 3.06
ZKGK1	:SUBLETTE 3SSW	KS: 2.40
TRIC2	:TRINIDAD	CO: 2.20
CMPC2	:CAMPO 7S	CO: 1.30
WLSC2	:WALSH 1W	CO: 1.25
EGNN5	:EAGLE NEST	NM: 0.89
SUBK1	:SUBLETTE 1SE	KS: 0.75

...HYDROLOGIC CONDITIONS...

MINOR RISES ARE EXPECTED TO OCCUR ALONG THE UPPER END OF THE PURGATOIRIE...CANADIAN AND CIMARRON RIVERS...WITH THE MOST SIGNIFICANT INCREASE AT TAYLOR SPRINGS FROM HEAVY RAINFALL AT THE HEADWATERS OF THE CANADIAN RIVER BASIN.

THE DEEP FORK RIVER NEAR BEGGS OK REMAINS NEAR BANKFULL BUT IS BEGINNING TO FALL. STAGES ALONG THE ARKANSAS RIVER ARE CONTINUING TO FLOW AT ELEVATED LEVELS BUT ALL AREAS EXCEPT THE REACH DOWNSTREAM OF LITTLE ROCK HAVE RECEDED FROM THE RISE OF LAST WEEK. OTHERWISE RIVERS AND STREAMS ACROSS THE BASIN ARE EITHER AT SEASONAL NORMS OR WILL CONTINUE RECEDING TOWARDS SEASONAL NORMS.

...FUTURE HYDROMETEOROLOGICAL CONDITIONS...

RAINFALL IS AGAIN FORECAST FOR THE NORTHWEST PORTION OF THE ABRFC IN

COLORADO AND NEW MEXICO. MAXIMUM BASIN MOUNTS ARE EXPECTED TO BE LESS THAN 0.25 INCHES. OTHER AREAS WITH PRECIPITION FORECAST INCLUDE...A NARROW BAND ALONG THE OKLAHOMA...KANSAS BORDER BETWEEN ENID AND GUYMON AND ANOTHER NARROW STRIP IN THE FAR NORTHEAST PORTION OF THE BASIN. MAXIMUM BASIN AMOUNTS ARE APPROXIMATELY 0.1 INCHES

...FLOOD POTENTIAL OUTLOOK...

FLOOD POTENTIAL WILL BE LOW THE NEXT 24 HOURS ENDING AT 12Z WEDNESDAY.

...FLASH FLOOD POTENTIAL...

OVERALL FLASH FLOOD POTENTIAL WILL ALSO BE LOW THE NEXT 24 HOURS BUT ISOLATED HEAVY RAINFALL MAY CREATE LOCALIZED FLASH FLOODING.

...AREAS WITH A MODERATE OR HIGH RISK OF FLASH FLOODING BASED ON THREE HOUR BASIN FLASH FLOOD GUIDANCE VALUES...

SOUTHEAST KANSAS: NONE
SOUTH CENTRAL KANSAS: NONE
SOUTHWEST KANSAS: NONE
SOUTHWEST MISSOURI: NONE
NORTHWEST ARKANSAS: NONE
WEST ARKANSAS: NONE
CENTRAL ARKANSAS: NONE
NORTHCENTRAL OKLAHOMA: NONE
NORTHEAST OKLAHOMA: NONE
SOUTHEAST OKLAHOMA: NONE
SOUTHWEST OKLAHOMA: NONE
NORTHWEST OKLAHOMA: NONE
OKLAHOMA PANHANDLE: NONE
PANHANDLE OF TEXAS: NONE
NORTH TEXAS: NONE
NORTHEAST NEW MEXICO: NONE
SOUTHEAST COLORADO: NONE.

jzm

COASTAL FLOODS

ITION

Coastal flooding is the inundation of land areas along the oceanic coast that is caused by sea waters over and above normal tidal action. Such flooding can originate from the ocean front, back bays, sound, etc. Coastal flooding affects the general public and maritime interests along much of the U.S. coastline extending from the shoreline beaches to inland tidal waterways and the tidal portions of river mouths.

Coastal flooding basically results from one or a combination of the following:

- ❒ A storm surge and/or seiche reaching land.
- ❒ Heavy surf.
- ❒ Tidal piling.

Other factors affecting the local severity, extent and duration of coastal flooding include:

- ❒ Tidal cycles.
- ❒ Persistence and behavior of the storm that is generating the flooding.
- ❒ Topography, shoreline orientation, and bathymetry of the area.
- ❒ River stage or stream run-off.
- ❒ Presence or absence of offshore reefs or other barriers.

Lakeshore flooding affects the general public as well as marine interests in some areas of the Great Lakes. These areas extend from beaches to portions of rivers flowing into the lakes to larger lake plains. The causes of flooding are variable and the extent of the flooding will be highly dependent on surrounding shore terrain. The underlying causes of lakeshore flooding are:

- ❒ **Seiches** in the Great Lakes can be generated either by strong winds blowing along the axis of a lake or by a pressure jump and down draft winds associated with fast moving squall lines over a lake. In either case, water is piled up at one end of the lake. When the forcing mechanism ends, the water sloshes from one end of the lake to the other, causing water fluctuations of perhaps several feet before damping out.

ITION (Continued)

- **Storm surges** on the Great Lakes are characterized by a rise above normal water level along a shore because of the action of wind stress and atmospheric pressure reduction over the open water. Locally generated waves accentuate the storm surge as they are superimposed on the water level as it rises. Surge height is the difference between the observed water level and the level that would have occurred in the absence of the storm (often called the **still water level.)**

A **storm surge** is a dome or bulge of water that is caused by wind and pressure forces. It is a rise above the normal water level along a shore that is caused by strong onshore winds and/or reduced atmospheric pressure. The surge height is the difference of the observed water level minus the predicted tide.

A **seiche** is caused by winds that push lake water to one end of the lake. When the storm ends or moves on, the water sloshes to the other end of the lake, causing water level changes of up to several feet.

The **surf** is the waves in the area between the shoreline and the outermost limit of breakers.

The **Tidal Cycle** is the periodic change in the intensity of tides that is caused primarily by the varying relations among the earth, moon, and sun.

Mean Sea Level (MSL) is the average height of the surface of the sea at a particular location for all stages of the tide over a 19-year period.

The **Datum Plane (tidal datum)** is the horizontal plane, unique to each individual tidal station, to which soundings, ground elevations, or water surface elevations for that station are referred. The plane is called a **tidal datum** when it is defined by a certain phase of the tide.

ACTERISTICS

A storm surge is caused by powerful coastal storms that move toward or adjacent to the coastline. It may be worsened by higher than normal astronomical tide levels. Two factors are key in the development of a storm surge.

- **Low barometric pressure** reduces the weight of the air on the ocean surface causing a slight rising (1 to 2 feet) of the surface of the water. This rising creates a dome and a new balance of forces.

ACTERISTICS (Continued)

- **Wind** sweeps around the dome of water and induces currents that spiral toward the center of the storm. The force of the winds induces high waves that travel away from the storm. Wind is the dominant force at landfall, often bringing violent wave action far inland. The battering of these waves causes damage beyond mere flooding.

The weight of the water piling up creates pressure on water at lower depths. In deep water, the water under pressure can escape rather easily, reducing the height of the dome. Closer to the coasts, however, there is less opportunity for water at lower depths to escape, and the water is forced to rise, elevating the height of the dome. As a result, islands and coastal areas with a short continental shelf that drops off quickly (e.g., Ft. Lauderdale, Florida) have fewer problems with storm surges than areas along the coast that have a wide continental shelf, bays, and "angle" topography (e.g., Florida's Panhandle or the Texas coast).

As storm surge comes ashore, it may combine with the tide. Thus, a 10-foot storm surge, combined with a 2-foot high tide produces a water level or storm tide that is 12 feet tidal datam. The surge does not usually arrive as a wall of water but rather as a rapid rise in the tide to abnormally high levels.

Storm surge, together with heavy rains from the storm that produced the surge, will cause extensive coastal and inland flooding. Other hazards associated with coastal floods include:

- High winds.
- Quickly rising water levels.
- Fierce wave action.
- Shore erosion, seawall destruction.
- Debris from destroyed property carried by the water.

RICAL EXAMPLES

- A Nor'easter backed up water and caused coastal flooding on the north side of St.Augustine, FL, when more than five and one-half inches of rain fell during 24 hours on June 5, 1995. This storm caused more than $300,000 worth of damage, and with numerous roads and streets closed, school was canceled at 15 of 23 schools.

- In March 1963, a storm surge developed south of a deepening low, causing damage totaling $3 million in Barrow, AK. Buildings and vehicles were damaged, the fresh water supply was contaminated with sea water, and the electrical generating plant received major damage.

- On December 10, 1993, a strong storm hit the Pacific Northwest, causing the spit of beach south of the Grays Harbor Entrance to be breached by the waves. The channel that developed between the ocean and Half Moon Bay kept getting wider and deeper and subjected the city of Westport to frequent wave action, thus eroding the sand dunes protecting the city's wastewater treatment plant. Millions of cubic yards of sand had to be pumped in to fill the breach.

JCTS

The table list below and on the next pages lists NWS products that provide planning and preparedness information on Coastal Flooding and Lakeshore Flooding. Appendix A describes the dissemination systems of these products, as well as other sources (such as the Internet or private online services). Refer to thunderstorms, tropical cyclones, and tsunamis fact sheets for other products.

COASTAL FLOODING

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Outlooks N/A			
Watches			
Coastal Flood Watch	__CFA__	Local Weather Service Office	This watch is used to inform the public that coastal flooding is possible approximately 12 to 36 hours after issuance time. Watches include the: ❒ Time of next update. ❒ Geographical area covered. ❒ Valid time of watch. ❒ Brief description of event including – severity of flooding, inland extent, associated weather and the effects of tides.

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Watches (Continued) Coastal Flood Watch			Watches may include: ❒ A Heavy Surf Advisory. ❒ A definition of watch (time permitting). ❒ An appropriate call to action (time permitting). A Coastal Flood Watch is either replaced by another Coastal Flood Watch, upgraded to a Coastal Flood Warning, updated by a Coastal Flood Statement (every six hours) or canceled by a Coastal Flood Statement.
Statements Coastal Flood Statement	__CFS__	Local Weather Service Office	This product is issued to keep the public informed of the status of existing coastal flood watchers and/or warnings. (It is issued at least every six hours after the issuance of a watch or warning until the watch or warning is canceled.) The coastal flood statement is used to cancel a watch or warning or to clear part of a watch or warning that is no longer threatened by coastal flooding. It also provides the latest information on local conditions, an overview of the threat for the entire coastline and current tidal information.

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Statements (Continued) Coastal Flood Statement (Continued)			Coastal Flood Statements include the same information as the watch or warning that the statement updates **and** the status of the watch/warning. ❒ If clearing an area from the watch or warning, the statement will describe the area being removed and the reasons for the removal. ❒ If canceling the entire watch/warning, will state cancellation and reason for cancellation. ❒ If the watch/warning is being absorbed into another product, statement shall explain the changes and refer user to the new information source.
Marine Weather Statement	__MWS__	Local Weather Service Offices	This statement is issued for less severe episodes or when conditions are uncertain. The MWS also may be used to issue Heavy Surf Advisory. The MWS is updated at least every six hours until canceled.

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Advisories/ Warnings			
Coastal Flood Warning	__CFW__	Local Weather Service Office	This product is used to inform the public that coastal flooding, posing a serious threat to life and property, is occurring, is imminent, or is expected within approximately the next 12 hours. A warning includes the: ❒ Time of next update. ❒ Geographical area covered. ❒ Valid time of warning. ❒ Brief description of event including – severity of flooding, inland extent, associated weather, effects of tides. A warning may include: ❒ A Heavy Surf Advisory. ❒ A definition of the warning (time permitting). ❒ An appropriate call to action (time permitting). A Coastal Flood Warning is either replaced by another Coastal Flood Warning, updated by a Coastal Flood Statement (every six hours) or canceled by a Coastal Flood Statement.
Heavy Surf Advisory		Coastal Local Weather Service Office	This is a forecast of heavy (high) surf that may pose a threat to life or property. These advisories may be issued alone within a Marine Weather Statement or in conjunction with Coastal Flood Watches or warnings.
Discussions N/A			

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Short Term Forecasts	__NOW__	Coastal Local Weather Forecast Office	This is designed to proved the public with a plain language description of current and short-term weather and flooding conditions for the issuing office's county warning area. The coastal flood information contained in the forecast will supplement, not replace, the Coastal Flood Statement.

LAKESHORE FLOODING

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Outlooks N/A			
Watches N/A			
Statements Lakeshore Statement	__LSH__	Open Lake Responsible Local Weather Service Office	This product is issued as a followup to warnings and to alert the public of potentially hazardous conditions. They also are issued to provide advance notice of a developing situation that may require later issuance of a Lakeshore warning and to cancel a warning when conditions improve. Statements include: ❒ The latest information available on local conditions. ❒ An overview on the threat to the shoreline community. Statements are issued at least every 6 hours after warnings are issued (more frequently if conditions are changing rapidly).

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Advisories/ Warnings Lakeshore Warning	__LSH__	Open Lake Responsible Local Weather Service Office	This is issued for Lakeshore flooding that is occurring or imminent within approximately the next 12 hours and which poses a serious threat to life or property. In unusual circumstances that require longer advance notice for public response, the warning lead time may be extended to 24 hours. The Lakeshore Warning provides the following information on the extent, location and duration of the event: ❒ Geographical area. ❒ Effective time of the warning in hours or in general terms (e.g. this afternoon, this evening). ❒ Definition of warning. ❒ Severity of the flooding (including water levels, if available). ❒ Call to action. If there are changes in the warning area, a new Lakeshore Warning will be issued.
Discussions N/A			
Short Term Forecasts N/A			

SAMPLE PRODUCTS

The NWS products listed below are shown on the pages that follow:

- ❒ Coastal Flood Watch.
- ❒ Coastal Flood Statements.
- ❒ Marine Weather Statement/Heavy Surf Advisory.
- ❒ Coastal Flood Warning. (Revised 3/2000)
- ❒ Short Term Forecast.
- ❒ Lakeshore Warning. (Revised 3/2000)
- ❒ Lakeshore Statement.

COASTAL FLOOD WATCH

RDUCFWRDU
TTAAPP KRDU 300352
NCZ001-501-301000-

COASTAL FLOOD WATCH
NATIONAL WEATHER SERVICE RALEIGH/DURHAM NC
1045 PM EST TUE OCT 29 1991

...A COASTAL FLOOD WATCH IS IN EFFECT FROM SOUTH OF VIRGINIA BEACH TO CAPE LOOKOUT THROUGH WEDNESDAY...

...A HEAVY SURF ADVISORY REMAINS IN EFFECT FROM VIRGINIA BEACH TO CAPE LOOKOUT...

AN INTENSE LOW 200 MILES SOUTHEAST OF LONG ISLAND AND A STRONG HIGH CENTERED OVER NEW ENGLAND ARE COMBINING TO PRODUCE WINDS TO 60 MILES AN HOUR AND SEAS UP TO 40 FEET HIGH IN THE NORTH ATLANTIC. NORTHEAST SWELLS GENERATED BY THIS STORM WILL THREATEN THE OUTER BANKS BY WEDNESDAY EVENING. SOME BREAKERS FROM THESE SWELLS ARE ALREADY BEING SEEN OFF KITTY HAWK.

THE GREATEST DANGER WILL COINCIDE WITH THE 11 PM WEDNESDAY HIGH TIDE WHENWATER LEVELS MAY BE 3 OR 4 FEET ABOVE TIDE TABLE VALUES. ALTHOUGH THE AREA FROM DUCK TO OREGON INLET IS IN THE GREATEST THREAT...THE ENTIRE NORTH CAROLINA COAST AS FAR SOUTH AS CAPE LOOKOUT COULD BE INUNDATED BY THE STORM.

GALE WARNINGS ARE IN EFFECT FOR THE WATERS INSIDE THE OUTER BANKS AS WELL AS OVER THE OPEN OCEAN DUE TO THE INCREASING WINDS.

REMEMBER...A COASTAL FLOOD WATCH MEANS COASTAL FLOODING WILL OCCUR IF WEATHER DEVELOPS AS EXPECTED. PEOPLE IN THE WATCH AREA SHOULD BE READY TO MOVE TO SAFE GROUND IF FLOODING OCCURS OR IF WARNINGS ARE ISSUED. LISTEN TO LOCAL RADIO...TELEVISION...OR NOAA WEATHER RADIO FOR FURTHER INFORMATION.

WARNINGS WILL BE ISSUED IMMEDIATELY AS CONDITIONS WARRANT. THE NEXT SCHEDULED STATEMENT ON THIS STORM WILL BE ISSUED AROUND 5 AM WEDNESDAY.

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COASTAL FLOOD STATEMENT

BOSCFWBOS
TTAAPP KBOS 311505
MAZ002–003–007–PP8–PO9–501–RIZ501–312100-

COASTAL FLOOD STATEMENT
NATIONAL WEATHER SERVICE BOSTON MA
1000 AM EST THU OCT 31 1991

...A COASTAL FLOOD WARNING CONTINUES IN EFFECT FOR MASSACHUSETTS THROUGH THIS AFTERNOON...

NORTHEAST WINDS TO 40 MILES AN HOUR CONTINUE ACROSS THE WATERS EAST OF MASSACHUSETTS WITH WAVES REPORTED TO 20 FEET. NORTHEAST WINDS ALONG THE SOUTH COAST OF MASSACHUSETTS ARE AS HIGH AS 30 MILES AN HOUR WITH WAVES TO 15 FEET. THE STORM HAS REMAINED STATIONARY FOR THE LAST FEW HOURS AND CONTINUES TO WEAKEN.

THE SWELLS WILL CONTINUE AND SOME COASTAL FLOODING MAY STILL OCCUR AROUND HIGH TIDE THIS AFTERNOON. HOWEVER...WINDS AND TIDES WILL BE LOWER THIS AFTERNOON THAN THEY WERE YESTERDAY AND WILL CONTINUE TO DIMINISH TONIGHT. MANY STRUCTURES WERE WEAKENED BY THE STORM SURGE AND EROSION YESTERDAY AND LAST NIGHT AND WILL BE ESPECIALLY VULNERABLE TO MORE DAMAGE.

HIGH TIDE ALONG THE EAST MASSACHUSETTS COAST WILL OCCUR BETWEEN 5 AND 6 PM WITH WATER LEVELS APPROACHING 16 FEET ABOVE MLLW...4 FEET ABOVE PREDICTED TIDES. ALONG THE SOUTH COAST THE HIGH TIDE WILL OCCUR BETWEEN 2 AND 3 PM WITH WATER LEVELS AROUND 10 FEET ABOVE MLLW...3 FEET ABOVE PREDICTED TIDES.

STAY TUNED TO RADIO...TELEVISION...OR NOAA WEATHER RADIO TO KEEP INFORMED OF THE LATEST SITUATION. THE NEXT SCHEDULED STATEMENT ON THIS STORM WILL BE ISSUED NO LATER THAN 4 PM.

A Coastal Flood Statement canceling an existing watch or warning:

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 PWMCFWPWM
 TTAAOO KPWM 311530
MEZ004-008-011-014-501-NHZOO7-311600-

 COASTAL FLOOD STATEMENT
 NATIONAL WEATHER SERVICE PORTLAND ME
 1030 AM EST THU OCT 31 1991

...THE COASTAL FLOOD WARNING FOR THE COAST OF MAINE AND NEW HAMPSHIRE
HAS BEEN CANCELED...

 ...A HEAVY SURF ADVISORY CONTINUES FOR THE COAST OF MAINE AND NEW
 HAMPSHIRE...

 WINDS HAVE DECREASED AND TIDES ARE RECEDING ALONG THE MAINE AND NEW
 HAMPSHIRE COASTS. AT 10 AM WINDS HAD DROPPED TO 30 MILES AN HOUR AND
 SEAS TO 15 FEET AT THE LARGE NAVIGATIONAL BUOY OFF PORTLAND HARBOR.
 THE WINDS AND SEAS WILL DIMINISH DURING THE DAY ALTHOUGH SWELLS WILL
 CONTINUE BETWEEN 10 AND 20 FEET. SOME MINOR FLOODING AND BEACH
 EROSION IS STILL EXPECTED AT HIGH TIDE THIS EVENING BUT SERIOUS
 FLOODING IS NOT LIKELY.

PEOPLE TRAVELING TO THE COAST ARE REMINDED NOT TO VENTURE TOO CLOSE TO
THE WAVES.

NO FURTHER SCHEDULED STATEMENTS ON THIS FLOODING SITUATION WILL BE
ISSUED UNLESS CONDITIONS WARRANT. INFORMATION ON THE HEAVY SURF
ADVISORY WILL BE INCLUDED IN FUTURE MARINE WEATHER STATEMENTS. THE
NEXT STATEMENT WILL BE ISSUED AROUND 4 PM.
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A Coastal Flood Statement that clears part of a watch or warning area:

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 SEACFWSEA
 TTAAOO KSEA 052300
 WAZ004-005-501-060500-

 NATIONAL WEATHER SERVICE SEATTLE WA 300 PM PST MON FEB 5 1991

...THE COASTAL FLOOD WATCH FOR THE WASHINGTON COAST FROM GRAYS HARBOR
TO CAPE FLATTERY CONTINUES IN EFFECT FOR TONIGHT...

...THE COASTAL FLOOD WATCH FOR THE WASHINGTON COAST SOUTH OF GRAYS
HARBOR IS CANCELED...

AT 2 PM...SATELLITE PICTURES SHOW A STRONG LOW IN THE NORTHEAST
PACIFIC TURNING TOWARD BRITISH COLUMBIA. THIS SHOULD DEFLECT THE
STRONGEST WINDS AND WAVES FARTHER NORTH ALONG THE WASHINGTON COAST
REDUCING THE THREAT SOUTH OF GRAYS HARBOR.
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A Coastal Flood Statement that clears part of a watch or warning area: *(Continued)*

THE LOW REMAINS INTENSE...GENERATING WINDS TO 50 MILES AN HOUR AND SEAS TO 25 FEET EXTENDING OUT 300 MILES OVER THE NORTHEAST PACIFIC. AS THE LOW CONTINUES NORTHEAST THE COASTAL AREAS NORTH OF GRAYS HARBOR SHOULD BEGIN FEELING THE IMPACT LATE TONIGHT WITH THE BRUNT OF THE STORM ARRIVING AROUND DAWN TUESDAY.

PEOPLE IN COASTAL AREAS NORTH OF GRAYS HARBOR SHOULD TAKE ALL NECESSARY PRECAUTIONS TO PROTECT LIFE AND PROPERTY AND SHOULD BE READY TO MOVE TO HIGHER GROUND. REMAIN ALERT AND KEEP LISTENING TO YOUR RADIO...TELEVISION...OR NOAA WEATHER RADIO FOR UPDATES.

THE NEXT SCHEDULED STATEMENT WILL BE ISSUED AROUND 9 PM.

A Coastal Flood Statement issued when a Coastal Flood Watch or Warning is absorbed into another product:

MIACFWPBI
TTAAPP KPBI 231514
FLZP85-099-111-502-231545-

COASTAL FLOOD STATEMENT
NATIONAL WEATHER SERVICE WEST PALM BEACH FL
1115 AM EDT SUN AUG 23 1992

...THE COASTAL FLOOD WARNING FOR THE FLORIDA COUNTIES OF ST. LUCIE...MARTIN.. AND PALM BEACH HAS BEEN UPGRADED TO A HURRICANE WARNING...

STRONG HURRICANE ANDREW IS EXPECTED TO REACH THE COAST OF FLORIDA EARLY MONDAY MORNING. THE SURGE OF THE OCEAN ASSOCIATED WITH THE HURRICANE MAY DRIVE WATER LEVELS 6 TO 8 FEET ABOVE THE PREDICTED TIDES BEGINNING AFTER MIDNIGHT TONIGHT.

FURTHER COASTAL FLOOD INFORMATION WILL BE INCLUDED IN HURRICANE ANDREW ADVISORIES AND STATEMENTS.

MARINE WEATHER STATEMENT/HEAVY SURF ADVISORY

HNLMWSHLN
WCHW2 PHNL 081800
HIZALL-090200-

ATHER STATEMENT
NATIONAL WEATHER SERVICE HONOLULU HI
600 AM HST WED JAN 8 1992

...A HEAVY SURF ADVISORY REMAINS IN EFFECT FOR THE NORTH AND WEST SHORES.. SURF ALONG THE NORTH AND WEST SHORES OF THE ISLANDS CONTINUES TO DECLINE SLOWLY. OBSERVATIONS FROM OAHU THIS MORNING SHOWED WAVE HEIGHTS UP TO 13 FEET AT SUNSET BEACH AND 8 FEET AT MAKAHA. SURF HEIGHTS WILL RANGE BETWEEN 8 AND 12 FEET TODAY AND FALL BELOW THE 10 FOOT LEVEL BY FRIDAY. HOWEVER...SWELLS FROM A NEW STORM IN THE NORTHWEST PACIFIC WILL ARRIVE ABOUT SATURDAY.

RESIDENTS AND BEACH GOERS ALONG THE AFFECTED SHORES SHOULD EXERCISE CAUTION UNTIL THE SURF SUBSIDES.

CONTINUING INFORMATION ON THE SURF CONDITIONS WILL BE CONTAINED IN THE AREA WEATHER UPDATE. THE NEXT SCHEDULED ADVISORY ON THIS SYSTEM WILL BE ISSUED AT OR BEFORE 2 PM.

COASTAL FLOOD WARNING

FZUS68 KSEA 032016
CFWSEA

URGENT - WEATHER MESSAGE
COASTAL FLOOD WARNING
NATIONAL WEATHER SERVICE SEATTLE WA
1215 PM PST WED MAR 3 1999

PZZ150-153-156-WAZ015-016-032315
-WASHINGTON COAST-

...THE NATIONAL WEATHER SERVICE IS CONTINUING A COASTAL FLOOD WARNING FOR THE WASHINGTON COAST THIS AFTERNOON FROM CAPE FLATTERY TO CAPE SHOALWATER...

HEAVY SEAS OF 25 FEET WILL CONTINUE TO AFFECT THE WASHINGTON COAST THIS AFTERNOON. THE COMBINATION OF HIGH SEAS...STRONG SOUTHWEST WINDS...AND LOW ATMOSPHERIC PRESSURE WILL PRODUCE AN INCREASE IN THE HIGH TIDE THIS AFTERNOON OF 3 TO 3.5 FEET.

HIGH TIDE AT ABERDEEN IS AT 2 PM THIS AFTERNOON. ADDING THE ADDITIONAL SURGE TO THE TIDE TABLE VALUE OF 10.9 FEET BRINGS THE FORECAST HIGH TIDE TO 14 TO 14.5 FEET. THIS IS THE LEVEL OF TIDE WHICH CAN BE EXPECTED TO BRING SOME FLOODING TO LOW LYING COASTAL AREAS.

AS THE LOW PRESSURE SYSTEM WEAKENS TONIGHT WINDS AND SEAS WILL SUBSIDE. THE THREAT OF COASTAL FLOODING WILL END LATER THIS AFTERNOON.

STAY TUNED TO THE NATIONAL WEATHER SERVICE RADIO OR OTHER NEWS SOURCES FOR MORE INFORMATION.

MCFARLAND
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SHORT TERM FORECAST

CZC BOSNOWBOS
TAAOO KBOS DDHHMM

SHORT TERM FORECAST
ATIONAL WEATHER SERVICE TAUNTON MA
00 PM EDT MON AUG 19 1991

IZALL-501-MA020>024-5053-504-192300-
HODE ISLAND/SOUTHEAST MASSACHUSETTS AND ADJACENT WATERS

OW...

..A DEEPENING LOW PRESSURE SYSTEM WILL BRING STRONG WINDS AND HIGH SEAS NEAR THE RHODE ISLAND AND MASSACHUSETTS BORDER BY 2 PM...
IND GUSTS EXCEEDING 60 MPH ARE EXPECTED OVER EASTERN RI BETWEEN 2 AND 4 PM AND EAST OF NARRAGANSETT BAY BETWEEN 4 AND 6 PM. WAVES UP TO 10 FEET POSE A THREAT OF COASTAL FLOODING AT THE UPPER END OF BUZZARDS BAY TO SUCH TOWNS AS ONSET...MATTAPOISETT AND POCASET BETWEEN 3 AND 5 PM...WHILE 4 TO 7 FOOT WAVES ARE LIKELY TO CAUSE MINOR COASTAL FLOODING FROM CHATHAM WEST TO NEWPORT RI

IRODO
NNNN

LAKESHORE WARNING

WHUS63 KLOT 021056
LSHCHI
LMZ740>743-030000-

LAKESHORE STATEMENT
NATIONAL WEATHER SERVICE CHICAGO IL
450 AM CST SAT JAN 2 1999

...EAST TO NORTHEAST GALES WILL PRODUCE HIGH WAVES ALONG THE WESTERN SHORES OF SOUTHERN LAKE MICHIGAN TODAY...

A STRONG LOW PRESSURE SYSTEM ASSOCIATED WITH A MAJOR WINTER STORM IS PRODUCING EAST TO NORTHEAST GALES TO 35 KNOTS THIS MORNING OVER SOUTHERN LAKE MICHIGAN. THESE GALES SHOULD LAST THROUGH MUCH OF THE DAY...PRODUCING WAVES OF 7 TO 10 FEET ALONG THE ILLINOIS SHORES.

BROWNING

LAKESHORE STATEMENT

LELSHCLE
TAA00 KCLE 120000

AKESHORE STATEMENT
ATIONAL WEATHER SERVICE CLEVELAND OH
00 PM EDT THU MAY 11 1989

LAKESHORE WARNING CONTINUES IN EFFECT FOR THE WESTERN AREAS OF LAKE ERIE FROM MARBLEHEAD TO MAUMEE BAY TONIGHT.

ALE FORCE NORTHEAST WINDS HAVE CONTINUED TO KEEP WATER LEVELS HIGH THIS EVENING. HIGH WAVES WERE ADDING TO THE PROBLEM. AT 745 PM THE WATER LEVEL AT TOLEDO COAST GUARD WAS 6.2 FEET ABOVE LOW WATER DATUM WHICH IS ALMOST 3 FEET ABOVE THE RECENT AVERAGE.

ITTLE CHANGE IN CONDITIONS IS LIKELY UNTIL AFTER MIDNIGHT. SOME SHORELINE ROADS IN ERIE COUNTY WERE REPORTED UNDER WATER BY THE ROAD DEPARTMENT. LEVELS SHOULD PEAK AROUND MIDNIGHT BETWEEN 6 AND 7 FEET ABOVE LOW WATER DATUM WHICH IS BETWEEN 3 AND 4 FEET ABOVE THE RECENT AVERAGE.

RESIDENTS ALONG THE LAKE SHOULD CONTINUE TO TAKE PRECAUTIONS TO AVOID FURTHER DAMAGE AND MOTORISTS DRIVING ALONG THE LAKE TONIGHT SHOULD BE ESPECIALLY CAUTIOUS.

EXTRATROPICAL CYCLONES

DEFINITION

Most of the storms that affect U.S. weather are extratropical. These are deep, low-pressure storms that form outside the tropics off the Pacific coast, in the Gulf of Mexico, over the Atlantic Ocean, or in the Great Lakes. Extratropical storms may cover a larger area than tropical cyclones. Their storm centers are colder than the surrounding air and their strongest winds are in the upper atmosphere.

Extratropical cyclones.

- ❒ Form outside the tropics.
- ❒ Cover a large area (700-1000 miles across).
- ❒ Have a storm center that is colder than the surrounding air.
- ❒ Have their strongest winds in the upper atmosphere.

CHARACTERISTICS

Under ideal wind and temperature conditions, a coastal low-pressure system deepens rapidly. Because these storms form over water, which has a smoother surface than land, wind speeds pick up rapidly. Fewer weather data tend to be available from the ocean areas, so detection may lag behind storm development. Extratropical cyclones tend to *deepen quickly near the shore*, which shortens the time available for communities to respond.

Hazards from extratropical cyclones include:

- ❒ Swells, storm surges, and huge waves that pound the coastline.
- ❒ Very high winds generated by strong gradients of pressure.
- ❒ Coastal flooding.
- ❒ Heavy rains, flooding, and flash flooding.
- ❒ Heavy snow.
- ❒ Mud slides.
- ❒ Downbursts.
- ❒ Tornadoes.

CHARACTERISTICS (Continued)

Refer to the fact sheets on coastal floods, winter storms, and tornadoes for more information on these hazards.

HISTORICAL EXAMPLES

- The extratropical coastal cyclone, named the 1993 Superstorm, formed in the Gulf of Mexico and affected 22 States. It produced deadly 12-foot storm surges that flooded the gulf coast of Florida; generated thunderstorms, gale-force winds gusting to over 80 mph and tornadoes; spread blizzard conditions over a massive area from the Southeast through New England; and then plummeted the eastern half of the U.S. into deep-freeze temperatures. Over 400 people died and damage estimates exceeded $2 billion.

- The October 1991 storm that formed in the Atlantic had devastating effects on the coastlines of New England. It damaged sea walls, closed roads, and produced flooding that caused massive damage and injuries over a large area from New Jersey northward.

- In February 1986, a series of coastal storms formed in the Pacific and struck California, producing gale-force winds and heavy flooding. Thirty-nine counties were declared disaster areas, and at least 15 people died because of drowning, mud slides, and collapsing buildings. Flooding washed out roads, bridges, dams, and railroad beds; destroyed homes and businesses; and caused massive power outages. Preliminary property loss estimates exceeded $350 million.

PRODUCTS

The National Weather Service does not issue any products unique to extratropical cyclones. Refer to fact sheets on winter storms, thunderstorms, coastal floods, or riverine floods, as necessary, for products related to extratropical cyclones.

TROPICAL CYCLONES

DEFINITION

Tropical cyclones are coastal storms that form over the ocean, within the tropics. These storms cover a smaller area than extratropical coastal cyclones; the storm center is warmer than the surrounding air, and the strongest winds are about 10,000 feet above the ground.

- ❒ Form over a tropical ocean.
- ❒ Cover a smaller area (200-500 miles across).
- ❒ Have a storm center warmer than the surrounding air.
- ❒ Have the strongest winds at about 10,000 feet.

Tropical cyclones are categorized by wind speed as shown in the next table.

CATEGORY	*WIND SPEED*
Tropical Depression	Maximum sustained winds near the surface less than 39 mph.
Tropical Storm	Winds of 39–73 mph.
Hurricane	Winds of 74 mph or more.

(NOTE: A hurricane is called a **typhoon** if formed in the western Pacific and a **cyclone** if formed in the Indian Ocean.)

In the northern Hemisphere intense tropical cyclones are called hurricanes, a term that echoes colonial Spanish and Caribbean Indian Words for evil spirits and big winds. The storms are products of the tropical ocean and atmosphere, powered by the easterly trades and temperate westerlies, and their fierce energy. Around the core, winds blow with lethal velocity, the ocean develops inundating surge, and as they move ashore, tornadoes may descend from the advancing thunderclouds.

This fact sheet provides planning and preparedness information on hurricanes, as the other tropical cyclones present similar hazards, yet typically are not as severe.

CHARACTERISTICS

Hurricanes are generated by the rising and cooling of humid air over the ocean. They need the following ingredients to develop:

- ❒ Ocean water over 80ºF and about 200 feet deep.
- ❒ Winds converging near the water surface.
- ❒ Unstable air, so the warm air will continue rising.
- ❒ Humidity up to about 18,000 feet, to supply heat energy.
- ❒ Winds moving in one direction, to move the storm along without breaking it up.
- ❒ Upper atmosphere high pressure, to help move out the rising air of the storm.

Hurricane winds blow counterclockwise around the center, or eye, of the storm and air currents carry the storm along. Most Northern Hemisphere hurricanes move from east to west in the trade winds. They may turn north or northwest out in the Atlantic, then curve toward the northeast. Storms that move up the east coast usually pick up speed around North Carolina and may travel at speeds up to 70 mph.

Hurricanes are classified using the following Saffir-Simpson Hurricane Damage Potential Scale, based on central barometric pressure and wind speed. The Saffir-Simpson Scale is shown in the table below.

CATEGORY	*CENTRAL PRESSURE (MILLIBARS)*	*CENTRAL PRESSURE (INCHES)*	*WINDS (MPH)*	*WINDS (KTS)*	*DAMAGE*
1	≥ 980	28.94	74 - 95	64 - 83	Minimal
2	965 - 979	28.50 – 28.93	96 - 110	84 - 96	Moderate
3	645 - 964	27.91 - 28.49	111 - 130	97 - 113	Extensive
4	920 - 944	27.17 - 27.90	131 - 155	114 - 135	Extreme
5	< 920	< 27.17	> 155	> 135	Catastrophic

Hydrometeorological hazards associated with hurricanes include the following:

- ❒ **Coastal Flooding** caused by a storm surge.
- ❒ **Windstorms** due to extremely strong winds.

CHARACTERISTICS (Continued)

- ❒ **Riverine flooding** caused by heavy rains.
- ❒ **Tornadoes.**

These hazards are described below. Refer to the fact sheet for each hazard for more information.

Historically, the worst damage from hurricanes comes from coastal flooding caused by storm surge. A storm surge is an abnormal rise in water level caused by wind and low-pressure forces; the lower the pressure of the storm, the greater the height of the storm surge. High winds and low pressure can build a wall of water out in the ocean about 10 feet high. The highest surges in the U.S. have reached 20 feet. When the surge reaches land, the wall of water can cause extensive coastal flooding.

Hurricane-force winds also can cause extensive damage and death. The strongest winds in a hurricane occur from 10 to 30 miles from the center of the eye, in a region called the **eyewall**. Winds that extend outward from the eyewall in the front right quadrant are the most devastating. Precursor winds will affect land well before the most damaging winds of the eye.

When a hurricane reaches land, it begins to weaken as it loses its warm-water energy source and encounters greater surface friction over land. This weakening process is gradual, so even though wind speeds may be reduced by 50 percent within 12 hours, hurricane-force winds can penetrate far inland in that timeframe. Additionally, tropical storm-force winds can extend far beyond the storm center and, although weaker, can cause significant damage.

Coastal and inland jurisdictions affected by hurricane winds should anticipate:

- ❒ Widespread damage to homes, especially mobile homes, and businesses.
- ❒ Extensive tree damage along roadways, which may inhibit or block access.
- ❒ Extensive damage to electric and telephone lines.
- ❒ Damaged and/or destroyed signs and traffic-control devices.
- ❒ The potential for utility line breaks, if large trees are uprooted.
- ❒ Damaged radio and television towers.

Widespread torrential rains of 6 to 12 inches are not uncommon in hurricanes and can produce deadly and destructive floods. Riverine flooding is a major threat to areas well inland.

CHARACTERISTICS (Continued)

Hurricanes may also spawn tornadoes, which add to the hurricane's destructive power. These tornadoes most often occur in the thunderstorms embedded in rain bands out from the right front quadrant of the hurricane, although they can also occur near the eyewall.

HISTORICAL EXAMPLES

- Hurricane Andrew, in 1992, caused an estimated $25 billion in damage, making it the most expensive hurricane in U.S. history. Wind gusts were estimated to be at least 175 mph in south Florida.
- Hurricane Agnes, in 1972, fused with another storm system, producing floods in the Northeastern U.S. that contributed to 122 deaths and $6.4 billion in damage.
- Long after the winds of Hurricane Diane in 1955 subsided, the storm brought floods to Pennsylvania, New York, and New England that contributed to nearly 200 deaths and $4.2 billion in damage.

PRODUCTS

A valuable source of information is your community's Hurricane Evacuation Study, if one has been completed. Contact the local WSFO to check if a study has been completed for your area and to obtain a copy.

The table below lists NWS products that can provide planning and preparedness information on tropical cyclones. Appendix A describes the dissemination systems of these products, as well as other sources (such as the Internet or private online services).

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Tropical Weather Outlooks	__TWO__ MIATWOAT (1-5)* MIATWOEP (1-5)* HNLTWOCP (1-5)*	National Hurricane Center Central Pacific Hurricane Center	The Tropical Weather Outlook is prepared by the National Hurricane Center (NHC) and Central Pacific Hurricane Center (CPHC). (Note: The last two letters in the identifiers indicate location; e.g., AT is Atlantic, EP is Eastern Pacific).
	SJUTWOSJU	San Juan, PR NWS Office	It is issued by San Juan in a Spanish translation. It should include the system's location (in either general terms or map coordinates), status, and change in status.

* (1-5) indicates the consecutive number of issuances for the day.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Tropical Weather Outlooks	__TWO__ MIATWOAT (1-5)* MIATWOEP (1-5)* HNLTWOCP (1.5)* SJUTWOSJU	National Hurricane Center Central Pacific Hurricane Center San Juan, PR NWS Office	The Tropical Weather Outlook is prepared by the National Hurricane Center (NHC) and Central Pacific Hurricane Center (CPHC). (Note: the last two letters in the identifiers indicate location; e.g., AT is Atlantic, EP is Eastern.) It is issued by San Juan in Spanish translation. It should include the system's location (in either general terms or map coordinates), status and change in status.
Watches N/A			Hurricane Watches are contained in the Public Advisories.
Statements Hurricane Local Statements	__HLS__	Local NWS Office	These products are issued at regular and frequent intervals. When a tropical storm or hurricane is close to the coast, the products are issued at 2 or 3 hourly intervals and more frequently if information and circumstances warrant. These statements contain the following: ❒ A concise lead sentence or headline. ❒ A sentence detailing which counties, parishes, or cities are included. ❒ Watches and warnings in effect and counties or parishes to which they apply.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Public Advisories			Scheduled and issued every six hours.
Tropical Depression Advisory	MIATCPAT (1-5)*	National Hurricane Center	The type of advisory depends upon the strength of the tropical cyclone. A tropical depression advisory will be issued for winds up to 33 knots (38 mph). A tropical storm advisory will be issued for winds 34 knots to 63 knots (39 to 73 mph). A hurricane/typhoon advisory is issued for wind 64 knots (74 mph) or greater. All advisories shall include the: ❒ Location of the center of the tropical cyclone. ❒ Present movement. ❒ 24-hour forecast movement. ❒ Uncertainties in either location or movement. ❒ Wind, central pressure, and storm surge to describe the storm. ❒ Expected time of onset of tropical storm or hurricane/typhoon force winds. ❒ Intensity forecasts. ❒ Inland effects of tropical cyclones to include threat of strong winds, and anticipated rainfall amounts, including the potential for flooding.
Tropical Storm Advisory	MIATCPEP (1-5)		
Hurricane/ Typhoon Advisory	HNLTCPCP (1-5)		

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Public Advisories (Continued) Tropical Cyclone Forecast/ Advisory	 MIATCPAT (1-5) MIATCPEP (1-5) HNLTCPCP (1-5)	 National Hurricane Center Central Pacific Hurricane Center	Because intermediate advisories are designed to update earlier scheduled advisories, their format and content may be less formal and less complete. The content of special advisories is generally similar to that of the scheduled advisory. This product is scheduled and issued every six hours. It provides invaluable wind field information to emergency managers, local decisionmakers, and other users who must make preparations and take response actions for the inland wind effects of tropical cyclones. Accordingly, inland interests should be appraised of the availability of this product and should be encouraged to use it in concert with the public advisories for decisionmaking purposes. Advisories contain 12-, 24-, 36-, 48-, and 72-hour forecast positions.
Warnings N/A			Hurricane Warnings are contained in the Public Advisories.
Strike Probability Forecast	__SPF__	National Hurricane Center	This product describes the probability of tropical cyclone conditions and is issued in tabular form at the regularly scheduled public advisory times and when special public advisories are listed. The probabilities, which are based on the official forecast track and are carried in advisories, are issued when the 72-hour position approaches the coast.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Strike Probability Forecast (Continued)			Probabilities are computed shortly after synoptic times for the periods 0-24, 24-36, 36-48, and 48-72 hours. A total probability for the 72 hours is shown in the last column representing a total of all forecast products. Probabilities are not issued for the west coast of the continental United States or Hawaii. If the probability for a location is less than 1 percent, and "X" will be indicated in the table. If probabilities are not issued, a statement indicating this exclusion will be contained in both the public advisory and tropical cyclone forecast/advisory.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Discussions			
Tropical Weather Discussion	__TCD__	National Hurricane Center and Central Pacific Hurricane Center	This product explains the forecaster's reasoning behind the analysis and forecast of tropical cyclone characteristics. These discussions normally include prognostic reasoning, objective techniques employed, and guidance used.
Preliminary Post-Storm Report	__PSH_	Local NWS Office	These reports provide details of the storm's impact to include accounts of unusual storm damage. Reports will include the: ❒ Highest recorded 1-minute sustained surface wind, peak gust, and date/time of occurrence. ❒ Lowest sea level pressure recorded, including date/time of occurrence. ❒ Storm total rainfall amount and duration, to include 1-, 6-, 12-, 24-hour amounts identifying date/time occurrence. ❒ Maximum storm tide heights and storm surge heights in feet above normal. ❒ Extent of beach erosion if appropriate. ❒ Flooding/flash flooding within the area of responsibility. ❒ Tornadoes within the area of responsibility. ❒ Preliminary storm effects, such as deaths, injuries, dollar damage amounts, number of residents evacuated, etc.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Short Term Forecast	__NOW__	Local NWS Office	The NOW is intended as the primary way to provide a short term forecast of hydrometeorological conditions over an area. It gives a concise forecast of the most significant weather during the next few hours. It highlights watches, warnings and advisories in effect at the time.

SAMPLE PRODUCTS

The sample products listed below are shown on the following pages:

- ❒ Public Advisory.
- ❒ Intermediate Public Advisory.
- ❒ Tropical Cyclone Forecast/Advisory.
- ❒ Strike Probability Forecast.
- ❒ Hurricane Local Statement.
- ❒ Short Term Forecast.
- ❒ Preliminary Storm Report.
- ❒ Tropical Cyclone Discussion.

PUBLIC ADVISORY

IATCPAT3
TAAOO KNHC 231700

URRICANE ANDREW ADVISORY NUMBER 28
100 AM EDT SUN AUG 23 1992

..DANGEROUS CATEGORY FOUR HURRICANE TAKING AIM ON SOUTH FLORIDA...

URRICANE WARNINGS REMAIN POSTED FOR THE EAST COAST OF FLORIDA FROM VERO BEACH SOUTHWARD THROUGH THE FLORIDA KEYS TO THE DRY TORTUGAS. A TROPICAL STORM WARNING AND HURRICANE WATCH ARE ALSO IN EFFECT NORTH OF VERO BEACH TO TITUSVILLE FLORIDA. IN ADDITION A HURRICANE WATCH IS IN EFFECT FOR THE WEST COAST OF FLORIDA FROM BAYPORT.. TO INCLUDE THE GREATER TAMPA BAY AREA...TO NORTH OF FLAMINGO.

LL PRECAUTIONS FOR THE PROTECTION OF LIFE AND PROPERTY...INCLUDING ORDERED EVACUATIONS...SHOULD BE RUSHED TO COMPLETION.

T 11 AM EDT...1500Z...THE CENTER OF HURRICANE ANDREW WAS LOCATED NEAR LATITUDE 25.4 NORTH AND LONGITUDE 75.0 WEST OR APPROXIMATELY 330 MILES...430 KM EAST OF MIAMI FLORIDA.

URRICANE ANDREW IS MOVING TOWARD THE WEST AT 16 MPH...20 KM/HR. THIS MOTION IS EXPECTED TO CONTINUE FOR THE NEXT 24 HOURS. HURRICANE CONDITIONS WILL OVERSPREAD THE NORTHWEST AND CENTRAL BARAMAS TODAY. ON THIS PRESENT COURSE HURRICANE CONDITIONS SHOULD REACH THE SOUTHEAST COAST OF FLORIDA DURING THE PREDAWN HOURS ON MONDAY.

HIS IS A DANGEROUS CATEGORY FOUR HURRICANE WITH MAXIMUM SUSTAINED WINDS NEAR 135 MPH...155 KM/HR...WITH HIGHER GUSTS. LATEST AIRCRAFT RECONNAISSANCE INDICATE HURRICANE FORCE WINDS EXTENDING OUTWARD UP TO 30 MILES...50 KM FROM THE CENTER AND TROPICAL STORM FORCE WINDS EXTENDING OUTWARD UP TO 85 MILES...135 KM. LATEST AIRCRAFT REPORTED MINIMUM CENTRAL PRESSURE WAS 930 MB OR 27.46 INCHES.

TORM SURGE FLOODING OF 10 TO 14 FEET ABOVE NORMAL TIDES IS POSSIBLE FOR SOME LOCATIONS IN THE NORTHWEST BAHAMAS AND UP TO 18 FEET OF STORM SURGE IS POSSIBLE ON THE NORTHWEST SIDE OF ELEUTHERA ISLAND. STORM SURGES OF 7 TO 10 FEET ABOVE NORMAL TIDES ARE POSSIBLE FOR THE FLORIDA COAST AND KEYS NEAR TO WHERE THE CENTER MAKES LANDFALL IN SOUTHEAST FLORIDA. SURGE HEIGHTS OF 9 TO 13 FEET ARE POSSIBLE IN BISCAYNE BAY.

REPEATING THE 11 AM EDT POSITION...25.4 NORTH LATITUDE AND 75.0 WEST LONGITUDE MOVING TOWARD THE WEST AT 16 MPH...20 KM/HR. LATEST AIRCRAFT REPORTS INDICATED MAXIMUM SUSTAINED WINDS...135 MPH...155 KM/HR. MINIMUM CENTRAL PRESSURE...930 MB OR 27.46 INCHES.

PUBLIC ADVISORY (Continued)

AN INTERMEDIATE ADVISORY WILL BE ISSUED BY THE NATIONAL HURRICANE CENTER AT 2 PM EDT FOLLOWED BY THE NEXT COMPLETE ADVISORY ISSUANCE AT 5 PM EDT.

MAYFIELD

INTERMEDIATE PUBLIC ADVISORY

ΙATCPAT3
ΓAAOO KNHC 240658

JRRICANE ANDREW INTERMEDIATE ADVISORY NUMBER 31B
ΑTIONAL WEATHER SERVICE MIAMI FLORIDA
ϽO AM EDT MON AUG 24 1992

..EXTREMELY DANGEROUS HURRICANE ANDREW CLOSING IN ON SOUTHEAST FLORIDA...

JRRICANE WARNINGS REMAIN IN EFFECT FOR THE NORTHWEST BAHAMAS..THE FLORIDA EAST COAST FROM VERO BEACH SOUTHWARD THROUGH THE FLORIDA KEYS TO THE DRY TORTUGAS INCLUDING FLORIDA BAY...THE FLORIDA WEST COAST SOUTH OF VENICE...AND FOR LAKE OKEECHOBEE. A HURRICANE WATCH AND A TROPICAL STORM WARNING ARE IN EFFECT FOR THE FLORIDA EAST COAST FROM VERO BEACH NORTHWARD TO TITUSVILLE...AND THE FLORIDA WEST COAST NORTH OF VENICE TO BAYPORT. THE HURRICANE WARNING FOR THE CENTRAL BAHAMAS HAS BEEN DISCONTINUED.

ΑDAR DATA...SATELLITE PICTURES...AND REPORTS FROM AN AIR FORCE RESERVE UNIT RECONNAISSANCE AIRCRAFT INDICATE THAT ANDREW CONTINUES ON ITS WESTWARD TRACK WITHOUT SIGNIFICANT CHANGE IN STRENGTH. THE CENTER OF ANDREW IS EXPECTED TO MOVE INLAND NEAR OR JUST SOUTH OF THE CITY OF MIAMI AROUND 5 AM THIS MORNING.

ΕATHER CONDITIONS ARE RAPIDLY DETERIORATING OVER SOUTHEAST FLORIDA. FOWEY ROCKS...LOCATED ABOUT 10 MILES SOUTHEAST OF DOWNTOWN MIAMI...REPORTED SUSTAINED WINDS OF 59 MPH WITH A GUST TO 69 MPH DURING THE PAST HOUR.

Γ 3 AM EDT...0700Z...THE CENTER OF ANDREW WAS LOCATED NEAR LATITUDE 25.4 NORTH...LONGITUDE 79.6 WEST OR ABOUT 40 MILES EAST OF MIAMI.

ΕPORTS FROM RECONNAISSANCE AIRCRAFT INDICATE THAT THE CENTRAL PRESSURE IS NOW 936 MB...27.64 INCHES.

ΝDREW IS MOVING TOWARD THE WEST NEAR 18 MPH AND THIS MOTION IS EXPECTED TO CONTINUE TODAY.

ΑXIMUM SUSTAINED WINDS ARE NEAR 140 MPH.. .225 KM/HR...WITH HIGHER GUSTS.
ΙTTLE CHANGE IN STRENGTH IS LIKELY PRIOR TO LANDFALL. HURRICANE FORCE WINDS EXTEND OUTWARD UP TO 45 MILES FROM THE CENTER AND TROPICAL STORM FORCE WINDS EXTEND OUTWARD UP TO 140 MILES FROM THE CENTER.

ANDREW IS EXPECTED TO LOSE LITTLE STRENGTH UPON MAKING LANDFALL AND CROSSING THE PENINSULA. HURRICANE FORCE WINDS WILL BE SPREADING INLAND ACROSS PORTIONS OF SOUTH FLORIDA. FOR ADDITIONAL INFORMATION RELATED TO INLAND HIGH WIND WARNINGS REFER TO ISSUANCES BY LOCAL NATIONAL WEATHER SERVICE FORECAST OFFICES.

INTERMEDIATE PUBLIC ADVISORY (Continued)

STORM SURGE FLOODING OF 10 TO 14 FEET ABOVE NORMAL TIDES IS POSSIBLE FOR SOME LOCATIONS IN THE NORTHWEST BAHAMAS. STORM SURGES OF 7 TO 10 FEET ABOVE NORMAL TIDES ARE LIKELY FOR THE FLORIDA EAST COAST AND KEYS NEAR TO WHERE THE CENTER MAKES LANDFALL IN SOUTHEAST FLORIDA...WITH POSSIBLE HEIGHTS OF 9 TO 13 FEET IN BISCAYNE BAY. STORM SURGES OF 7 TO 11 FEET ARE POSSIBLE ON THE FLORIDA WEST COAST NEAR AND TO THE SOUTH OF THE CENTER AFTER PASSAGE OF THE HURRICANE.

ORRENTIAL RAINS OF 5 TO 8 INCHES CAN BE EXPECTED ALONG THE PATH OF THE STORM AND ACROSS MOST OF EXTREME SOUTH FLORIDA INCLUDING THE CITY OF MIAMI. THOUGH THE SPEED OF THE STORM SHOULD PRECLUDE ANY MASSIVE INLAND FLOODING...RESIDENTS NEAR LAKES...DRAINAGE CANALS...AND OTHER FLOOD PRONE AREAS SHOULD BE ALERT FOR POTENTIAL FLOODING. THERE IS THE POSSIBILITY OF AN ISOLATED TORNADO OVER SOUTH FLORIDA.

T THIS POINT...ALL EVACUATIONS FOR STORM SURGE SHOULD HAVE BEEN COMPLETED. THOSE NOT EXPECTED TO EVACUATE SHOULD HAVE TAKEN APPROPRIATE SHELTER FOR HIGH WINDS...INLAND FLOODING...AND POSSIBLE TORNADOES. RESIDENTS SHOULD MONITOR ADVICE FROM THEIR LOCAL WEATHER OFFICES AND LOCAL OFFICIALS FOR CRITICAL INFORMATION ON THE SPECIFIC THREATS FROM HURRICANE ANDREW.

EPEATING THE 3 AM EDT POSITION...25.4N...79.7W. MOVEMENT TOWARD THE WEST NEAR 18 MPH. MAXIMUM SUSTAINED WINDS...140 MPH.

THE NEXT ADVISORY WILL BE ISSUED BY THE NATIONAL HURRICANE CENTER AT 5 AM EDT.

TROPICAL CYCLONE FORECAST/ADVISORY

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IATCMAT3
TAA00 KNHC 182100

URRICANE BOB FORECAST/ADVISORY NUMBER 12
ATIONAL WEATHER SERVICE MIAMI FL
100Z SUN AUG 18 1991

T 5 PM EDT...HURRICANE WARNINGS WERE EXTENDED NORTH AND EASTWARD FROM
       CAPE HENLOPEN DELAWARE THROUGH PLYMOUTH MASSACHUSETTS. THE
       WARNING AREA INCLUDES LONG ISLAND...LONG ISLAND
       SOUND...CONNECTICUT EAST OF NEW HAVEN...AND CAPE COD. HURRICANE
       WARNINGS NOW EXTEND FROM LITTLE RIVER INLET NORTH CAROLINA TO
       PLYMOUTH MASSACHUSETTS.

 TROPICAL STORM WARNINGS WERE EXTENDED TO INCLUDE DELAWARE BAY...AND
 CONTINUE FOR THE LOWER CHESAPEAKE BAY SOUTH OF THE MOUTH OF PATUXENT
 RIVER INCLUDING THE GREATER NORFOLK AREA. A HURRICANE WATCH HAS ALSO
 BEEN POSTED FOR A PORTION OF THE NORTHEAST COAST FROM PLYMOUTH
 MASSACHUSETTS NORTHWARD THROUGH EASTPORT MAINE.

ENTER LOCATED NEAR 33.9N 76.0W AT 18/2100Z
STIMATED MINIMUM CENTRAL PRESSURE...960 MB.

URRENT MOTION TOWARD THE NORTH OR 10 DEGREES AT 16 KT

T 18/1800Z...CENTER WAS LOCATED NEAR 33.6N 75.9W.

EPEAT...CENTER LOCATED AT 33.9N  76.0W AT 18/2100Z.
STIMATED MINIMUM CENTRAL PRESSURE...960MB.

IAMETER OF EYE 20 NM

 MAX WINDS 100 KT...GUSTS 120 KT
 64 KT. . . 100NE   100SE        25SW      25NW        WIND RADII IN NM
 50 KT. . . 125NE   125SE        50SW      50MW
 34 KT. . . 150NE   150SE        75SW      75NW
 12 FT SEAS 150NE   150SE        75SW      75NW

 FORECAST VALID      19/0600Z   35.4N     74.5W

 MAX WIND  100KT...GUSTS  120 KT
 64 KT. . . 100NE   100SE        25SW      25NW
 50 KT . . .125NE   125SE        50SW      50NW
 34 KT. . . 150NE   150SE        75SW      75NW
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TROPICAL CYCLONE FORECAST/ADVISORY

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 FORECAST VALID 19/1800Z 41.0N  71.0W
 MAX WIND  100KT. . . GUSTS 120 KT
 64 KT. . .100NE                100SE     25SW     25NW
 50 KT. . .125NE                125SE     50SW     50NW
 34 KT. . .150NE                150SE     75SW     75NW

 FORECAST VALID 20/0600Z 46.0N  66.0W
 MAX WIND  90KT. . . GUSTS 105 KT
 64 KT. . .100NE                100SE     25SW     25NW
 50 KT. . .125NE                125SE     50SW     50NW
 34 KT. . .150NE                150SE     75SW     75NW

TORM SURGE OF 4 TO 7 FEET ABOVE NORMAL TIDE IS POSSIBLE IN THE WARNED
      AREA OF NORTH CAROLINA AND 3 TO 5 FEET IN THE REMAINDER OF THE
      WARNED AREA. IN ADDITION...LARGE WAVES WITH BEACH EROSION WILL BE
      EXPERIENCED IN THE WARNED AREAS.

EQUEST FOR 3 HOURLY SHIP REPORTS WITHIN 300 MILES OF 33.9N  76.0W.

 EXTENDED OUTLOOK...USE FOR GUIDANCE ONLY...ERRORS MAY BE LARGE
 OUTLOOK VALID 20/1800Z 50.5N  60.0W
 MAX WNDS  70 KT...GUSTS     85 KT
 50 KT...125NE       125SE      50SW       50NW

 OUTLOOK VALID 21/1800Z 56.ON 47.OW
 MAX WNDS  60 KT...GUSTS     75 KT
 50 KT...125NE       125SE      50SW       50NW

 NEXT ADVISORY AT 19/0300Z

 GERRISH
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STRIKE PROBABILITY FORECAST

MIASPFNHC
TTAA00 KNHC 230900

STRIKE PROBABILITY FORECAST
NATIONAL WEATHER SERVICE MIAMI FL
5 AM EDT SUN AUG 23 1992

HURRICANE ANDREW ADVISORY 28. PROBABILITIES FOR GUIDANCE IN HURRICANE PROTECTION PLANNING BY GOVERNMENT AND DISASTER OFFICIALS.

CHANCES IN PERCENT OF CENTER OF THE HURRICANE PASSING WITHIN 65 MILES OF LISTED LOCATIONS THROUGH 11 AM EDT SUN AUG 23 1992.

COASTAL LOCATIONS	A	B	C	D	E	COASTAL LOCATIONS	A	B	C	D	E
25.5N 80.3W	40	X	X	X	40	VENICE FL	5	16	1	X	22
26.1N 83.3W	4	20	X	1	25	TAMPA FL	1	13	2	1	17
26.9N 86.2W	X	8	9	2	19	CEDAR KEYS FL	X	5	5	2	12
MUCF 221N 805W	1	2	1	1	5	ST MARKS FL	X	1	4	5	10
MUSN 216N 826W	X	3	1	1	5	APALACHICOLA FL	X	1	6	5	12
MUHA 230N 824W	3	10	1	1	15	PANAMA CITY FL	X	X	6	5	12
MUAN 219N 850W	X	3	4	2	9	PENSACOLA FL	X	X	3	8	11
MMCZ 205N 869W	X	X	2	2	4	MOBILE AL	X	X	2	9	11
MYSM 241N 745W	13	X	X	X	13	GULFPORT MS	X	X	2	9	11
MYEG 235N 758W	2	X	X	X	2	BURAS LA	X	X	3	10	13
MYAK 241N 776W	33	X	X	1	34	NEW ORLEANS LA	X	X	2	10	12
MYNN 251N 775W	68	X	X	X	68	NEW IBERIA LA	X	X	1	10	11
MYGF 266N 787	43	X	X	X	43	PORT ARTHUR TX	X	X	X	10	10
MMSO 238N 982W	X	X	X	3	3	GALVESTON TX	X	X	X	10	10
MMTM 222N 979W	X	X	X	2	2	FREEPORT TX	X	X	X	9	9
MMMD 210N 897W	X	X	1	4	5	PROT OCONNOR TX	X	X	X	8	8
MARATHON FL	29	3	X	X	32	CORPUS CHRISTI TX	X	X	X	7	7

STRIKE PROBABILITY FORECAST (Continued)

MIAMI FL	40	X	X	X	40	BROWNSVILLE TX	X	X	X	6	6
W PALM BEACH FL	32	1	X	X	33	GULF 29N 85W	X	2	8	4	14
FT PIERCE FL	17	5	X	1	23	GULF 29N 87W	X	1	7	6	14
COASTAL LOCATIONS	A	B	C	D	E	COASTAL LOCATIONS	A	B	C	D	E
COCOA BEACH FL	6	8	1	1	16	GULF 28N 89W	X	X	8	8	16
DAYTONA BEACH FL	1	5	2	2	10	GULF 28N 91W	X	X	4	10	14
JACKSONVILLE FL	X	1	2	3	6	GULF 28N 93W	X	X	1	11	12
SAVANNAH GA	X	X	X	2	2	GULF 28N 95W	X	X	X	10	10
KEY WEST FL	20	7	1	X	28	GULF 27N 96W	X	X	X	9	9
MARCO ISLAND FL	23	7	1	X	31	GULF 25N 96W	X	X	X	7	7
FORT MYERS FL	15	11	1	X	27						

COLUMN DEFINITION...PROBABILITIES IN PERCENT
A...IS PROBABILITY OF STRIKE FROM NOW THROUGH 5 AM MON
B...IS PROBABILITY OF STRIKE FROM 5 AM MON THROUGH 5 PM MON
C...IS PROBABILITY OF STRIKE FROM 5 PM MON THROUGH 5 AM TUE
D...IS PROBABILITY OF STRIKE FROM 5 AM TUE THROUGH 5 AM WED
E...IS THE TOTOAL PROBABILITY FROM NOW THROUGH 5 AM WED
X...REPRESENTS PROBABILITIES LESS THAN ONE PERCENT

HURRICANE LOCAL STATEMENT

DUHLSILM
TAA00 KILM 242100
ROPICAL STORM DANIELLE...LOCAL STATEMENT
ATIONAL WEATHER SERVICE WILMINGTON NORTH CAROLINA
10 PM EDT THU SEP 24 1992

HIS STATEMENT RECOMMENDS SPECIFIC ACTIONS BE TAKEN IN THE FOLLOWING COUNTIES OF SOUTHEAST NORTH CAROLINA...CARTERET...CRAVEN...PAMLICO.. .AND BEAUFORT.

..A TROPICAL STORM WARNING HAS BEEN POSTED FOR THE NORTH CAROLINA COAST FROM CAPE LOOKOUT NORTH INCLUDING PAMLICO AND ALBEMARLE SOUNDS...

...PREPAREDNESS ACTIONS...
PERSONS LOCATED IN AND NEAR THE POSTED WARNING AREA SHOULD PREPARE FOR HIGH WINDS AND SIGNIFICANT COASTAL FLOODING THAT SHOULD BEGIN TONIGHT.

ROPICAL STORM DANIELLE WAS CENTERED NEAR 34.1 NORTH LATITUDE AND 74.0 WEST LONGITUDE...MOVING WEST AT 5 MPH. DANIELLE IS SHOWING SIGNS OF MOVING WEST NORTHWEST. ESTIMATED MINIMUM CENTRAL PRESSURE AT 1006 MB WITH MAXIMUM SUSTAINED WINDS OF 45 MPH. AN AREA OF STRONG HIGH PRESSURE WILL SHIFT EAST TONIGHT FORCING DANIELLE WEST NORTHWEST AND INCREASING ITS FORWARD SPEED TO NEAR 10 MPH.

...WIND INFORMATION...
IND ALONG SOUTHEAST NORTH CAROLINA WAS FROM THE NORTHEAST AT 15 TO 25 MPH. GUSTS IN THE PAMLICO SOUND WERE NEARING 40 MPH. THESE WINDS ARE NOT DIRECTLY RELATED TO TROPICAL STORM DANIELLE. THEY ARE THE RESULT OF THE TIGHT FLOW OF AIR BETWEEN STRONG HIGH PRESSURE TO OUR NORTH AND THE APPROACH OF DANIELLE.

..TIDE AND WATER LEVEL INFORMATION...
IDE LEVELS ALONG OCEAN FRONT BEACHES OF NORTH CAROLINA ARE CURRENTLY 2 FEET ABOVE NORMAL WITH HEAVY SURF ACTION. SOME MINOR COASTAL FLOODING AND BEACH EROSION IS LIKELY. AS DANIELLE MAKES LANDFALL MORE SERIOUS FLOODING AND EROSION IS EXPECTED ALONG THE COAST FROM CARTERET COUNTY NORTH. TIDAL STORM SURGES ALONG THIS PORTION OF THE COAST ARE FORECAST TO REACH LEVELS S TO 7 FEET ABOVE NORMAL.

IMES OF HIGH TIDE...630 PM THURSDAY 700 AM FRIDAY 715 PM FRIDAY

HE NATIONAL WEATHER SERVICE ADVISES RESIDENTS IN THE AFFECTED AREA TO CONTINUE MONITORING RADIO/NOAA WEATHER RADIO AND TELEVISION ON THE PROGRESS OF TROPICAL STORM DANIELLE THROUGH THE WEEKEND.

HE NEXT SCHEDULED LOCAL STATEMENT WILL BE ISSUED AT 1030 EDT UNLESS CONDITIONS WARRANT EARLIER RELEASES.

HINN

SHORT TERM FORECAST

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)SHLSBOS
TAA00 KEGS 191653

HORT TERM FORECAST
ATIONAL WEATHER SERVICE BOSTON/TAUNTON MA
)0 PM EDT MON AUG 19 19--

[ALL-501-502-MAZ020>024-503-504-192000-
HODE ISLAND/SOUTHEAST MASSACHUSETTS AND ADJACENT WATERS

NOW...
  ...HURRICANE WARNING FOR MASSACHUSETTS AND RHODE ISLAND COASTS...
TORM SURGES OF 4 TO 7 FEET ARE EXPECTED ALONG THE SOUTH FACING COASTS OF
HODE ISLAND AND MASSACHUSETTS BY 2 PM. SURGES AS HIGH AS 15 TO 17 FEET ARE
)SSIBLE IN BUZZARDS BAY. HURRICANE FORCE WINDS SHOULD REACH THE COAST BY 2
M. BY 1 PM...WINDS WERE ALREADY 61 MPH AT FALL RIVER. AN ADDITIONAL 2 TO 4
NCHES OF RAIN PER HOUR ARE EXPECTED BY 3 PM...CAUSING FLASH FLOODING. FALL
IVER AND CRANSTON ALREADY HAVE RECEIVED 3 INCHES OF RAIN AT 1 PM.

  &&
HE EYE OF HURRICANE BOB WILL BE MOVING ONSHORE BY 2 PM BETWEEN NEWPORT RI AND
        NEW BEDFORD MA. OTHER WATCHES AND WARNINGS IN EFFECT INCLUDE A FLASH
        FLOOD WARNING...INLAND HIGH WIND WARNING FOR HURRICANE FORCE
        WINDS...AND TORNADO WATCH.

  $$

AZ005>007-013>019-501-5O2-l92000-
ASTERN MASSACHUSETTS AND ADJACENT WATERS

NOW...
  ...HURRICANE WARNING FOR MASSACHUSETTS COAST...
  HURRICANE FORCE WINDS ARE EXPECTED BY 3 PM. AT 1 PM WINDS WERE ALREADY 30 TO
) MPH IN MOST AREAS. BOSTON HAD A WIND GUST TO 45 MPH AT 1 PM. AN
)DITIONAL 2 TO 4 INCHES OF RAIN IS EXPECTED BY 3 PM...CAUSING FLASH FLOODING IN
        MANY AREAS. 1 TO 2 INCHES OF RAIN HAD FALLEN IN MOST AREAS BY 1 PM.
        TIDES ARE EXPECTED TO BE 3 TO 5 FEET ABOVE NORMAL CAUSING SOME COASTAL
        FLOODING.

  &&
THER WATCHES/WARNINGS IN EFFECT INCLUDE A FLASH FLOOD WARNING...INLAND HIGH
        WIND WARNING FOR HURRICANE FORCE WINDS...AND A TORNADO WATCH.

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PRELIMINARY STORM REPORT

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ΕWPSHNEW
ΓAA00 KNEW 032226

ЯELIMINARY STORM REPORT...HURRICANE ANDREW
ΑTIONAL WEATHER SERVICE NEW ORLEANS LA
ϽO PM CDT MON SEP 3 1992

. HIGHEST WINDS...

    NEW ORLEANS INTERNATIONAL AIRPORT...
    1 - MINUTE 39 KNOTS FROM 150 DEGREES  0950 UTC AUG 26 1992
    PEAK GUST 72 KNOTS FROM 020 DEGREES AT 0728 UTC AUG 26 1992
    P92 AMOS LOCATED AT SALT POINT, ST. MARY PARISH 19.5N 91.3W
   ...ETC

. LOWEST PRESSURE...

    LOWEST PRESSURE NEW ORLEANS INTERNATIONAL AIRPORT - 960.1 MB AT 0805 UTC
    AUG 26 1992
   ...ETC

. RAINFALL...

    NEW ORLEANS INTERNATIONAL AIRPORT
    STORM TOTAL                    5.70        AUG 25-26 1992
    1 HOUR TOTAL                   0.89        0800-0900 UTC 26 AUG 1992
   ...ETC

. STORM TIDES...

    MARINA                    4.28       2100 UTC AUG 26 1992
    N END OF CAUSEWAY         4.94       1100 UTC AUG 26 1992
   ...ETC

. BEACH EROSION...

    LEVEL OF EROSION PRESENTLY UNKNOWN
   ...ETC

. FLOODING...

    STORM TIDE FLOODING TO THE ENTIRE LOUISIANA COAST FROM LAKE BORGNE WEST
    TO VERMILION BAY...ETC

 G. TORNADOES...

    F3 TORNADO FROM LA PLACE TO RESERVE IN ST JOHN THE BAPTIST PARISH...ETC
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PRELIMINARY STORM REPORT (Continued)

H. STORM EFFECTS...

TORNADO	2 DEAD	32 INJURED	
HURRICANE	4 DEAD	UNKNOWN	2 MISSING

\ ESTIMATED ONE AND ONE QUARTER MILLION PEOPLE EVACUATED ACROSS SOUTHEAST AND SOUTH CENTRAL LOUISIANA...ETC

KOZIARA

TROPICAL CYCLONE DISCUSSION

ZCZC MIATCDAT3
TTAAOO KNHC 070217
...FOR INTERGOVERNMENTAL USE ONLY...
HURRICANE LUIS DISCUSSION NUMBER 39
NATIONAL WEATHER SERVICE MIAMI FL
11 PM EDT WED SEP 06 1995

HE INITIAL MOTION ESTIMATE IS 320/08. ALL OF THE TRACK MODELS ARE IN GOOD AGREEMENT ABOUT A TURN TOWARD THE NORTH WITH SLIGHT ACCELERATION AND THE OFFICIAL TRACK FORECAST GOES ALONG WITH THIS.

HE LATEST AIR FORCE RECON PRESSURE IS 939 MB AND THE EYE DIAMETER HAS DECREASED FROM 32 TO 20 N MI. THIS SUGGESTS INTENSIFICATION. SO FAR THE MAX FLIGHT LEVEL WIND IS 122 KNOTS...80 110 KNOTS SHOULD STILL COVER THE MAX SURFACE WIND...BUT IT COULD GET STRONGER SHORTLY.

JRFACE WINDS AT SAN JUAN ARE ONLY 15 KNOTS. TROPICAL STORM WARNINGS ARE DISCONTINUED FOR PUERTO RICO AND THE VIRGIN ISLANDS.

AWRENCE

FORECAST POSITIONS AND MAX WINDS

INITIAL	07/0300Z	21.0N	65.7W	110 KTS
12HR VT	07/1200Z	21.8N	66.5W	120 KTS
24HR VT	08/0000Z	23.0N	67.5W	115 KTS
36HR VT	08/1200Z	24.2N	68.8W	115 KTS
48HR VT	09/0000Z	26.0N	69.0W	115 KTS
72HR VT	10/0000Z	30.5N	69.0W	115 KTS

TSUNAMIS

DEFINITION

A tsunami is a series of ocean waves of extremely long length, generated by disturbances from earthquakes, underwater volcanic eruptions, or landslides occurring below or near the ocean floor.

CHARACTERISTICS

From wave crest to wave crest, the length of a tsunami may be 100 miles or more in the deep ocean, with a wave height of only a few feet or less. The waves may reach speeds of up to 500 mph. As tsunamis approach land and the water depth decreases, wave heights may increase to between 30 and 100 feet. Tsunamis from nearby earthquakes may take only a few minutes to reach coastal areas, but may take up to 24 hours from distant earthquakes.

The deep ocean trenches off the coasts of the Aleutian Islands, Japan and South America are known for their underwater earthquakes and are the source for many tsunamis.

Hazards from tsunamis include coastal flooding and damage from debris. The flood inundation area from a tsunami may be extensive, as tsunamis can travel up rivers and streams that lead to the ocean. Defining the extent of worst-case flooding is an important aspect of preparing for tsunamis.

HISTORICAL EXAMPLES

- A tsunami in Nicaragua in 1992 was generated from slow movement occurring beneath the ocean floor. This "slow" earthquake generated a devastating tsunami with localized damage to coastal communities in Nicaragua.

- In March 1964, a tsunami hit Alaska following an earthquake in the sea floor beneath Prince William Sound. The tsunami hit the coast between 20 and 30 minutes after the quake, devastating villages. Damages were estimated to be over $100 million. Approximately 120 people drowned.

- A 1960 Chilean earthquake generated a Pacific-wide tsunami that caused widespread death and destruction in Chile, Hawaii, Japan, and other areas in the Pacific.

PRODUCTS

The International Tsunami Information Center (ITIC), run jointly by the NWS and the Intergovernmental Oceanographic Commission, is the primary source for non-operational tsunami information.

NWS operates two tsunami warning centers: the **Alaska Tsunami Warning Center** (ATWC) and the **Pacific Tsunami Warning Center** (PTWC) in Hawaii.

The International Tsunami Information Center (ITIC), run jointly by the NWS and the Inter-governmental Oceanographic Commission, is the primary source for non-operational tsunami information. Its purpose is to:

- ❒ Locate and size major earthquakes in the Pacific Basin.
- ❒ Determine their potential for generating tsunamis.
- ❒ Predict tsunami wave arrival times and, when possible, run-up on the coast.
- ❒ Provide timely and effective tsunami information and warnings to the population of the Pacific to reduce the hazards of tsunamis, especially to human life.

The PTWC carries the responsibility for regional, national and international warning services while the ATWC has only regional responsibility.

Area of Responsibility (AOR)–the geographical area within which a center has the responsibility for the dissemination of tsunami watches, warnings, and information bulletins and the provision of interpretive information to emergency managers and other officials.

- ❒ **ATWC** – located in Palmer, Alaska, is the regional center for:
  - ❒ Alaska.
  - ❒ British Columbia.
  - ❒ Washington.
  - ❒ Oregon.
  - ❒ California.
- ❒ **PTWC** – located at Ewa Beach, Oahu, Hawaii, is:
  - ❒ The Regional center for Hawaii.
  - ❒ The National center for the United States.
  - ❒ The International center for the Pacific.

Regional Tsunami Warning Center–a center that is responsible for the detection of tsunamis in the ocean basin that pose a threat within its regional AOR.

PRODUCTS (Continued)

National Tsunami Warning Center–a center that is responsible for the detection of tsunamis in the ocean basin that pose a threat to U.S. National interests outside of a regional AOR.

The International Warning System provides watch/warning services to all of the nations of the Pacific who are members of the International Coordination Group for the TWS in the Pacific (ICG/ITSU) or those who provide the Tsunami Warning Service with supporting data.

The table below lists NWS Products that can provide planning and preparedness information on tsunamis.

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Outlooks N/A			
Watches Regional Tsunami Watches	ANCTSUPAQ (Alaska) HNLSUCP (Pacific)	Alaska and Pacific Tsunami Warning Centers	This product is a bulletin issued initially using only seismic information to alert all within one to three hours travel time beyond the tsunami warning area. The watch is expanded hourly until it is canceled or upgraded by issuing a Pacific-wide Warning. A watch may be included in the text of the message that disseminates a Regional Tsunami Warning.
Statements N/A			

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Advisories/ Warnings			
Regional Tsunami Warning	ANCTSUPAQ (Alaska) HNLTSUCP (Pacific)	Alaska (ATWC)	This bulletin usually is based only on seismic information without tsunami confirmation and is issued as a means of providing the earliest possible alert to the population near the epicentral area of an earthquake. It places the restricted area (two or three hour tsunami travel time) in a condition that requires all coastal areas in the region to be prepared for imminent flooding from a tsunami. Subsequent warning bulletins that incrementally expand the warning area will be issued at least hourly or when conditions warrant until the warning is either upgraded to a Pacific-wide Warning or canceled.
Pacific-wide Tsunami Warning	HNLTSUCP	PTWC	This warning is issued by the PRWC after confirmation has been received that a tsunami has been generated that has caused damage at distances greater than 1000km from the epicenter and thus poses a threat to any populated area within the Pacific Basin that is located within the PTWC's area of responsibility.
Tsunami Advisory	ANCTSUPAQ	ATWC	This bulletin is issued to advise interested persons within its area of responsibility that the Pacific Tsunami Warning Center has issued a tsunami warning for an earthquake whose epicenter is located outside of the Alaska Tsunami Warning Center Area of Responsibility (AOR) and more than six hours tsunami travel time from any part of the ATWC AOR, and that ATWC will continue to monitor the event, issuing hourly updates. The advisory will be continued, upgraded to a watch or warning or canceled.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Advisories/ Warnings (Continued) Tsunami Information Bulletin	ANCTSUPAQ HNLSUCP	ATWC PTWC	This product is issued by both the ATWC and the PTWC to advise participants of the occurrence of an earthquake in the Pacific or near-Pacific area with the evaluation that a potentially destructive tsunami was not generated. If the evaluation indicated the possible generation of a non-destructive tsunami, an investigation will be initiated and additional tsunami information bulletins will be issued until the investigation is concluded.
Discussions N/A			
Short Term Forecast N/A			

SAMPLE PRODUCTS

ıple products listed below are shown on the following pages:

- ❒ Pacific-wide Tsunami Warning.
- ❒ Tsunami Warning and Watch.
- ❒ Tsunami Advisory Bulletin.
- ❒ Tsunami Information Bulletin.

PACIFIC-WIDE TSUNAMI WARNING

TSUNAMI BULLETIN NUMBER 002
PACIFIC TSUNAMI WARNING CENTER/NOAA/NWS
ISSUED 22 FEB, 2319 UTC

THIS BULLETIN IS FOR ALL AREAS OF THE PACIFIC BASIN EXCEPT CALIFORNIA, OREGON, WASHINGTON, BRITISH COLUMBIA, AND ALASKA.

...A TSUNAMI WARNING IS IN EFFECT...

THIS WARNING IS FOR ALL COASTAL AREAS AND ISLANDS IN THE PACIFIC.

AN EARTHQUAKE, PRELIMINARY MAGNITUDE 8.9, OCCURRED 22 FEB, 2159 UTC, LOCATED LATITUDE 45.1 NORTH, LONGITUDE 148.5 EAST
VICINITY: OF THE KURIL ISLANDS.

EVALUATION: A TSUNAMI HAS BEEN GENERATED WHICH COULD CAUSE DAMAGE TO COASTS AND ISLANDS IN THE PACIFIC. TSUNAMI WAVE HEIGHTS CANNOT BE PREDICTED AND MAY BE A SERIES OF WAVES WHICH COULD BE DANGEROUS FOR SEVERAL HOURS AFTER THE INITIAL WAVE ARRIVAL.

WAVE HEIGHTS HAVE BEEN REPORTED AT THE FOLLOWING TIDE GAUGES:

SENDAI, JAPAN	10.	OM	1950Z
AOMORI, JAPAN	5.	OM	2000Z
HACHINOHE, JAPAN	S.	SM	2005Z

ESTIMATED TIME OF INITIAL WAVE ARRIVAL IS AS FOLLOWS:

HACHINOHE, JAPAN	2335Z	22	FEB
MARCUS	0053Z	23	FEB
WAKE, USA	0205Z	23	FEB
OKINAWA, JAPAN	0215Z	23	FEB
MIDWAY, USA	0225Z	23	FEB
GUAM, USA	0232Z	23	FEB
ENIWETOK, MARSHALL ISLS	0251Z	23	FEB
HUALIEN, TAIWAN	0305Z	23	FEB
TRUK, FSM	0310Z	23	FEB
YAP	0320Z	23	FEB
KWAJALEIN, MARSHALL ISLS	0335Z	23	FEB
MALAKAL, PALAU	0342Z	23	FEB
LEGASPI, PHILIPPINES	0353Z	23	FEB
SHIMIZU, JAPAN	0520Z	23	FEB
CHRISTMAS, KIRIBATI	0654Z	23	FEB
HONG KONG	0713Z	23	FEB
APIA, WESTERN SAMOA	0723Z	23	FEB
PAGO PAGO, AM SAMOA	0731Z	23	FEB
SUVA, FIJI	0819Z	23	FEB
NOUMEA, NEW CALEDONIA	0826Z	23	FEB

PACIFIC-WIDE TSUNAMI WARNING (Continued)

RAROTONGA, COOK ISLS	0905Z	23	FEB
PAPEETE, FR POLYNESIA	0933Z	23	FEB
SOCORRO, MEXICO	0952Z	23	FEB
MANZANILLO, MEXICO	1043Z	23	FEB
ACAPULCO, MEXICO	1138Z	23	FEB
RIKITEA, FR POLYNESIA	1146Z	23	FEB
LYTTLETON, NEW ZEALAND	1303Z	23	FEB
ACAJUTLA, EL SALVADOR	1322Z	23	FEB
WELLINGTON, NEW ZEALAND	1352Z	23	FEB
BALTRA IS, ECUADOR	1446Z	23	FEB
EASTER IS, CHILE	1454Z	23	FEB
BALBOA HTS, PANAMA	1644Z	23	FEB
LA PUNTA, PERU	1656Z	23	FEB
ARICA, CHILE	1815Z	23	FEB
IQUIQUE, CHILE	1817Z	23	FEB
ANTOFAGASTA, CHILE	1834Z	23	FEB
CALDERA, CHILE	1852Z	23	FEB
COQUIMBO, CHILE	1857Z	23	FEB
VALPARAISO, CHILE	1914Z	23	FEB
TALCAHUANO, CHILE	1934Z	23	FEB
PUERTO WILLIAMS, CHILE	2019Z	23	FEB
PUERTO MONTT, CHILE	2049Z	23	FEB
PUNTA ARENAS, CHILE	2313Z	23	FEB

WHEN NO MAJOR WAVES ARE RECORDED FOR TWO HOURS AFTER THE ESTIMATED TIME OF ARRIVAL OR DAMAGING WAVES HAVE NOT OCCURRED FOR AT LEAST TWO HOURS, LOCAL AUTHORITIES SHOULD ASSUME THAT THE TSUNAMI THREAT IS PASSED. DANGER TO BOATS AND COASTAL STRUCTURES MAY CONTINUE FOR SEVERAL HOURS DUE TO RAPID CURRENTS. AS LOCAL CONDITIONS CAN CAUSE A WIDE VARIATION IN TSUNAMI WAVE ACTION, THE ALL CLEAR DETERMINATION MUST BE MADE BY LOCAL AUTHORITIES.

BULLETINS WILL BE ISSUED HOURLY OR SOONER IF CONDITIONS WARRANT. THE TSUNAMI WARNING WILL REMAIN IN EFFECT UNTIL FURTHER NOTICE.

RECIPIENTS OF THIS MESSAGE LOCATED IN CALIFORNIA, OREGON, WASHINGTON, BRITISH COLUMBIA, AND ALASKA SHOULD REFER ONLY TO ALASKA TSUNAMI WARNING CENTER MESSAGES FOR INFORMATION ABOUT THE TSUNAMI THREAT IN THOSE AREAS.

BT
40010
NMNN

TSUNAMI WARNING AND WATCH

SS PHNLYMYT KWBCYMYX KRSEYAYX PDINTSUA RJTDYMYX
302114 PAAQYQYX

WEPA42 PAAQ 302114
TO KWBC COMM CENTER WASH DC/RELAY TO ALL AUTODIN ADDRESSEES
UNCLAS
TSUNAMI BULLETIN NUMBER 001
ALASKA TSUNAMI WARNING CENTER/NOAA/NWS
ISSUED MAR 30 AT 211 UTC

...A TSUNAMI WARNING AND WATCH ARE IN EFFECT...
THIS IS A TSUNAMI WARNING FOR THE COASTAL AREAS FROM ATTU, AK. TO KODIAK, AK.,INCLUSIVE.
A TSUNAMI WATCH IS IN EFFECT FROM KODIAK, AK. TO POINT SUR, CA. NO ACTION REQUIRED AT THIS TIME FOR OTHER COASTAL AREAS. A SEVERE EARTHQUAKE,PRELIMINARY MAGNITUDE 7.6 OCCURRED AT 0000 AST ON JAN 1 OR 0900 UTC ON JAN 1.THE EARTHQUAKE WAS LOCATED 40 MILES SE OF ADAK, AK.
EVALUATION: IT IS NOT KNOWN /REPEAT NOT KNOWN/ IF A TSUNAMI EXISTS, BUT A TSUNAMI MAY HAVE BEEN GENERATED. THEREFORE, PERSONS IN LOW LYING COASTAL AREAS SHOULD BE ALERT TO INSTRUCTIONS FROM THEIR LOCAL EMERGENCY OFFICIALS. PERSONS ON THE BEACH SHOULD MOVE TO HIGHER GROUND. TSUNAMI WAVE HEIGHTS CANNOT BE PREDICTED AND MAY BE A SERIES OF WAVES WHICH COULD BE DANGEROUS FOR SEVERAL HOURS AFTER THE INITIAL WAVE ARRIVAL.

ESTIMATED TIMES OF ARRIVAL FOR WATCH/WARNING AREAS:

SHEMYA	0115 AST JAN 1		JUNEAU	0505	AST JAN 1
ADAK	0030 AST JAN 1		SITKA	0350	AST JAN 1
DUTCH HARBOR	0130 AST JAN 1		KETCHIKAN	0445	AST JAN 1
COLD BAY	0245 AST JAN 1		LANGARA	0500	PST JAN 1
SAND POINT	0225 AST JAN 1		TOFINO	0625	PST JAN 1
KODIAK	0315 AST JAN 1		NEAH BAY	0640	PST JAN 1
HOMER	0435 AST JAN 1		ASTORIA	0705	PST JAN 1
SEWARD	0335 AST JAN 1		SEASIDE	0650	PST JAN 1
VALDEZ	0355 AST JAN 1		CHARLESTON	0640	PST JAN 1
CORDOVA	0355 AST JAN 1		CRESCENT CITY	0645	PST JAN 1
YAKUTAT	0350 AST JAN 1		SAN FRANCISCO	0735	PST JAN 1

FOR INFORMATION ONLY:

SAN PEDRO	0750 PST JAN 1		LA JOLLA	0805	PST JAN 1

BULLETINS WILL BE ISSUED HOURLY OR SOONER IF CONDITIONS WARRANT.
THE TSUNAMI WARNING WILL REMAIN IN EFFECT UNTIL FURTHER NOTICE.

TSUNAMI ADVISORY BULLETIN

TO ALL TSUNAMI WARNING SYSTEM PARTICIPANTS
INFOR KWBC/NWS COM CENTER ONLY, NO RELAY REQUIRED

:N NUMBER 1
WARNING CENTER/NOAA/NWS
ISSUED FEB 9 AT 1918 UTC

...THIS IS A TSUNAMI ADVISORY BULLETIN FOR ALASKA, BRITISH COLUMBIA,
WASHINGTON, OREGON, AND CALIFORNIA ONLY...
NO, REPEAT NO, WATCH OR WARNING IS IN EFFECT FOR ALASKA, BRITISH COLUMBIA, WASHINGTON, OREGON, OR CALIFORNIA.
AN EARTHQUAKE, PRELIMINARY MAGNITUDE 7.6, OCCURRED AT 1008 AST ON FEB 9, OR 1108 PST ON FEB 9, OR 1908 UTC ON FEB 9. THE EARTHQUAKE WAS LOCATED IN THE GENERAL AREA OF:
PAPUA, NEW GUINEA NEAR 6.05, 145.OE.
THE PACIFIC TSUNAMI WARNING CENTER AT EWA BEACH, HAWAII HAS ISSUED A TSUNAMI WARNING AND WATCH FOR THE EPICENTRAL AREA.
EVALUATION: BASED ON THE LOCATION, MAGNITUDE AND HISTORICAL RECORDS, THE EARTHQUAKE WAS NOT SUFFICIENT TO GENERATE A TSUNAMI DAMAGING TO CALIFORNIA, OREGON, WASHINGTON, BRITISH COLUMBIA OR ALASKA. SOME AREAS MAY EXPERIENCE SMALL SEA LEVEL CHANGES. A FEW SELECTED ETA'S FOLLOW FOR INFORMATION AND REFERENCE:

LA JOLLA	0401	PST FEB 10	TOFINO	0418	PST FEB 10
SAN FRANCISCO	0403	PST FEB 10	SITKA	0222	AST FEB 10
CRESCENT CITY	0343	PST FEB 10	KODIAK	0141	AST FEB 10
NEAH BAY	0425	PST FEB 10	SHEMYA	2243	AST FEB 9

BULLETINS WILL BE ISSUED AT LEAST HOURLY TO KEEP YOU INFORMED OF THE PROGRESS OF THIS EVENT UNTIL THE PACIFIC TSUNAMI WARNING CENTER ISSUES A CANCELLATION OR FINAL BULLETIN.

TSUNAMI INFORMATION BULLETIN

TO ALL TSUNAMI WARNING SYSTEM PARTICIPANTS
INFO KWBC/NWS COM CENTER ONLY, NO RELAY REQUIRED
UNCLAS
:N NUMBER 1
WARNING CENTER/NOAA/NWS
1809 UTC

...THIS IS A TSUNAMI INFORMATION BULLETIN FOR ALASKA, BRITISH COLUMBIA, WASHINGTON, OREGON, AND CALIFORNIA ONLY...
NO, REPEAT NO, WATCH OR WARNING IS IN EFFECT FOR ALASKA, BRITISH COLUMBIA, WASHINGTON, OREGON, OR CALIFORNIA.
AN EARTHQUAKE, PRELIMINARY MAGNITUDE 6.8, OCCURRED AT 1008 AST ON FEB 9, OR 1108 PST ON FEB 9, OR 1908 UTC ON FEB 9.
THE EARTHQUAKE WAS LOCATED IN THE GENERAL AREA OF:
KURIL IS. NEAR 45.ON, 149.OE.
THE PACIFIC TSUNAMI WARNING CENTER HAS ISSUED A TSUNAMI INFORMATION BULLETIN FOR HAWAII AND OTHER AREAS OF THE PACIFIC.
EVALUATION: BASED ON LOCATION AND MAGNITUDE THE EARTHQUAKE WAS NOT SUFFICIENT TO GENERATE A TSUNAMI DAMAGING TO CALIFORNIA, OREGON, WASHINGTON, BRITISH COLUMBIA OR ALASKA. SOME AREAS MAY EXPERIENCE SMALL SEA LEVEL FLUCTUATIONS. THIS WILL BE THE ONLY BULLETIN ISSUED FOR THIS EVENT BY THE ALASKA TSUNAMI WARNING CENTER UNLESS CONDITIONS WARRANT.

WINTER STORMS

DEFINITIONS

Winter storms are extratropical storms that bring cold temperatures, precipitation, and possibly, high winds.

The following conditions can occur during winter storms:

Snow is defined as a steady fall of snow for several hours or more.

Heavy Snow generally means:

- ❒ Snowfall accumulating to 4 inches or more in depth in 1 2 hours or less.
- ❒ Snowfall accumulating to 6 inches or more in depth in 24 hours or less.

Snow Squalls are periods of moderate to heavy snowfall, intense, but of limited duration, accompanied by strong, gusty surface winds and possibly lightning.

A **Snow Shower** is a short duration of moderate snowfall.

Snow Flurries are an intermittent light snowfall of short duration with no measurable accumulation.

Blowing Snow is wind-driven snow that reduces surface visibility. Blowing snow can be falling snow or snow that already has accumulated but is picked up and blown by strong winds.

Drifting Snow is an uneven distribution of snowfall/snow depth caused by strong surface winds. Drifting snow may occur during or after a snowfall.

A **Blizzard** means that the following conditions are expected to prevail for a period of 3 hours or longer:

- ❒ Sustained wind or frequent gusts to 35 miles/hour or greater.
- ❒ Considerable falling and/or blowing snow reducing visibility to less than 1/4 mile.

Freezing Rain or Drizzle occurs when rain or drizzle freezes on surfaces, such as the ground, trees, power lines, motor vehicles, streets, highways, etc.

DEFINITIONS (Continued)

The term **Ice Storm** is used to describe occasions when damaging accumulations of ice are expect during freezing rain situations.

Sleet is pellets of ice composed of frozen or mostly frozen raindrops or refrozen partially melted snowflakes.

A **Freeze** occurs when the surface air temperature is expected to be 32ºF or below over a widespread area for a climatologically significant period of time. Use of the term usually is restricted to advective situations or to occasions when wind or other conditions prevent frost.

Frost describes the formation of thin ice crystals on the ground or other surfaces in the form of scales, needles, feathers, or fans. Frost develops under conditions similar to dew, except the temperatures of the Earth's surface and earthbound objects fall below 32ºF. Because frost is primarily an event that occurs as the result of radiational cooling, it frequently occurs with a thermometer-level temperature in the mid-30s.

Wind Chill describes that part of the cooling of a body by air motion. Increased wind speeds accelerate heat loss from exposed skin. As a general rule, the threshold for potentially dangerous wind chill conditions is about -20ºF.

CHARACTERISTICS

elopment of a winter storm requires cold air, moisture, and lift.

- ❒ **Cold air.** Subfreezing temperatures (below 32ºF, 0ºC) in the clouds and near the ground are needed to make snow and/or ice.

- ❒ **Moisture.** The air must contain moisture in order to form clouds and precipitation. Air blowing across a body of water, such as a large lake or an ocean, is an excellent source of moisture.

- ❒ **Lift.** A mechanism to raise the moist air to form the clouds and cause precipitation must be present. Lift may be provided by any or all of the following:

    - ❒ The flow of air up a mountainside.
    - ❒ Fronts, where warm air collides with cold air and rises over the cold dome.
    - ❒ Upper level low pressure troughs.

CHARACTERISTICS (Continued)

The hazards involved with winter storms include strong winds, extreme cold, precipitation, and blizzard/heavy snow conditions.

- **Strong winds.** Sometimes winter storms are accompanied by strong winds, creating wind-driven snow, severe drifting, and dangerous wind chill. Strong winds can knock down trees, utility poles, and power lines. Storms near the coast can cause coastal flooding and beach erosion. In the West and Alaska, winds descending off the mountains can gust to 100 miles per hour or more, causing extensive damage.

- **Extreme cold.** Extreme cold may accompany or follow a winter storm. Freezing temperatures can cause bursting pipes, crop damage, river ice jams and subsequent flooding, and frostbite or hypothermia due to exposure. Refer to the fact sheet on extreme cold for more information.

- **Precipitation.** The type of precipitation accompanying a winter storm depends on surface and atmospheric conditions. Ice and snow accumulation can knock down trees and power lines, disrupting power and communication for days. Accumulated winter precipitation also causes hazardous traffic conditions and disrupts transportation routes, especially in warmer climates where accumulation is uncommon. This can leave travelers and rural residents stranded and stop the flow of supplies for a region.

- **Heavy snow and blizzard conditions.** During a blizzard, snow and strong winds combine to produce a blinding snow (near zero visibility), deep drifts, and life-threatening wind chill. Along with other hazards of accumulated ice and snow and extreme cold, the reduced visibility can lead to extreme transportation problems and increase fatalities due to exposure. Areas around the Great Lakes are affected by **lake effect storms.** Lake effect storms form as arctic air is drawn from the north and moves across the lakes, drawing moisture from the unfrozen water. These storms typically form snow squalls and deliver heavy snow to a localized area.

HISTORICAL EXAMPLES

- The 1993 Superstorm dumped massive amounts of snow from the Gulf Coast States northeastward through New England. Many cities experienced record low barometric pressure readings, indicative of a hurricane-force storm. In the South, many areas received record-breaking snowfalls (e.g., Birmingham, Alabama received 13 inches of snow). The volume of water that fell as snow may be unprecedented—estimated at 44 million acre-feet. At least 243 deaths were attributed to the storm, and 48 persons were lost at sea. For the first time, every major airport on the east coast was closed at one time or another by the storm. Over 3 million customers were without electricity. Wind gusts were recorded at 110 mph in Florida. Damages were estimated at $2 billion.

- An unexpected spring blizzard in May 1986 trapped 13 people on Mt. Hood, Oregon. Nine died, two walked to safety, and two were rescued after being buried under 4 feet of snow. One of the rescued survivors later had his lower legs amputated due to frostbite.

PRODUCTS

The table on the following pages lists NWS products that can provide planning and preparedness information on winter storms. Appendix A describes the dissemination systems of these products, as well as other sources (such as the Internet or private online services). Refer to the fact sheets on extratropical coastal cyclones and extreme cold for information on other products.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Outlooks			
Winter Storm Outlook	__SPS__	Local NWS Office	This product may be issued when there is a good chance of a major winter storm beyond the point normally covered by a watch (3-5 days). The prime objective of the outlook is to inform users of the potential of the upcoming event. The need for an outlook depends on: ❒ NCEP Guidance. ❒ High confidence that a large-scale storm will occur. ❒ Need for advance public notice (e.g., national holiday or regionally significant event associated with wide-spread travel).
Watches			
Winter Storm Watch	__WSW__	Local NWS Office	This product is issued when conditions are favorable for hazardous winter weather conditions to develop over part or all of the forecast area, but the occurrence is still uncertain. It is intended to provide enough lead time so those who need to take action can do so. Winter Storm Watches include the: ❒ Affected area. ❒ Reason the watch was issued. ❒ Potential snowfall amounts, and ice accumulations. ❒ Explanation of a watch and the uncertainty involved. ❒ Precautions, call to action state-ments, and potential impact. Winter Storm Watches either evolve into Winter Storm Warnings or advisories or they are canceled. (See Special Weather Statement.)

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Statements			
Special Weather Statements	__SPS__	Local NWS Office	These statements are issued at frequent intervals: ❒ Before active weather develops, to outline expected conditions, affected areas, timing and appropriate response actions. ❒ When the event begins, to keep users informed about the currents aspects of the storm to heighten awareness and ensure a proper response. ❒ To cancel winter storms watches, warnings and advisories including the reason for ending the advisory, warning or watch, and details about the history or the event (snow accumulations, height of snow drifts, amount of freezing rain, general road conditions, etc.).
Severe Weather Statements	__SVS__	Local NWS Office	These statements are used during blizzard situations for greater emphasis on the life-threatening nature of these dangerous storms. (They contain the same information as the special weather statements.)
Advisories/ Warnings			
Winter Storm Warning Heavy Snow Warning Ice Storm Warning	__WSW__	Local NWS Office	Warnings are issued when hazardous winter weather is occurring, imminent, or highly likely over part or all of the forecast area. They are reissued whenever there is a change to the timing, areal extent, or expected condition. (If the event is expected to be limited to a specific condition, the forecaster can issue a specific warning, e.g. Heavy Snow Warning, or Ice Storm Warning.)

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Advisories/ Warnings (Continued)			Warnings include the: ❒ Affected area. ❒ Potential snowfall amounts, ice accumulations, wind chill, etc. ❒ Timing of the event (beginning, ending, time of heaviest precipitation or worst conditions, duration, etc.). ❒ Reason the warning was issued. ❒ Definition of a warning (especially if the event has not yet begun). ❒ Safety rule, call to actions statement.
Winter Weather Advisories	__WSW__	Local NWS Office	Advisories are issued for winter weather situations that cause significant inconveniences but do not meet warning criteria and, if caution is not exercised, could lead to life-threatening situations. Advisories are issued for significant events that are occurring, are imminent, or have a very high probability of occurrence. Advisories should be reissued when there is a change in timing, areal extent, expected condition. If the forecaster is confident that only one type of event will occur, then an event-specific advisory can be issued (e.g., Freezing Drizzle Advisory, Blowing Snow Advisory.) Advisories include the: ❒ Affected area. ❒ Potential snow amount, ice accumulations, wind chill, etc. ❒ Timing of the event (beginning, ending, time of heaviest precipitation or worst conditions, duration, statement about skill of timing, etc.). ❒ Reason for issuing the advisory. ❒ Precautions, call to action statement, potential impact.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Advisories/ Warnings (Continued)			Complex weather systems may require that watches, warnings, and advisories be in effect for a variety of times and places within the Local Weather Service Office area of responsibility. In this case, all watches, warnings, and advisories are combined in the same product. Warnings are listed first, advisories are listed second, and watches last. Warning and advisories are canceled when the weather event fails to materialize or tapers off so that the criteria no longer are met. (See Special Weather Statement for details.)
Discussions N/A			
Short Term Forecast	__NOW__	Local NWS Office	The primary purpose of the Short Term Forecast is to provide users with a concise, non-technical short term forecast of ongoing hydrometeorological conditions for the office's County Warning Areas (CWA). Issuance should be tied to events of significant interest as well as local media requirements. Frequency of issue should increase as a result of rapidly changing conditions. (As a general guideline, issuance should occur every hour or so when there is precipitation and more frequently during changeable or severe conditions forecasts.)

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Short Term Forecast (Continued)			The forecast includes: ❒ Hazardous conditions (e.g., winter weather including snow, freezing rain, wind and wind chill). ❒ Non-hazardous conditions (e.g., precipitation anywhere in the offices CWA, wind and temperature variations, effects of frontal passage, and state of the sky). ❒ A brief call to action statement, as appropriate to further highlight significant or hazardous conditions.

SAMPLE PRODUCTS

The sample products listed below are shown on the following pages:

- ❒ Winter Storm Outlooks.
- ❒ Winter Storm Message. (Revised 3/2000)
- ❒ Special Weather Statements.
- ❒ Short Term Forecasts.

WINTER STORM OUTLOOKS

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SPSRNO
 TTAA00 KRNO 142004
)3-150200-

/EATHER STATEMENT
 WEATHER SERVICE RENO NV
I PST WED FEB 14 1990

 ...A STORM WITH HEAVY SNOW APPEARS HEADED TOWARD NORTHERN NEVADA AND
 THE LAKE TAHOE AREA THIS HOLIDAY WEEKEND...
 ANOTHER PACIFIC STORM IN THE GULF OF ALASKA WILL DIVE SOUTH ALONG THE
 PACIFIC NORTHWEST COAST THURSDAY. THIS STORM SYSTEM WILL BRING A
 CHANCE OF SNOW TO NORTHERN NEVADA AND THE LAKE TAHOE AREA BY LATE
 THURSDAY. SNOW WILL CONTINUE FRIDAY AND INTO THE HOLIDAY WEEKEND.
 DEPENDING ON THE TRACK OF THE SLOW MOVING STORM...THERE IS THE
 POTENTIAL FOR VERY HEAVY SNOWFALL DURING THE HOLIDAY
 WEEKEND...PARTICULARLY ALONG THE WEST SLOPES OF THE SIERRA AROUND LAKE
 TAHOE.
 ANYONE PLANNING TRAVEL OR OUTDOOR ACTIVITIES SHOULD KEEP INFORMED ON
 THE PROGRESS OF THIS STORM. BE READY FOR WINTER DRIVING AND DANGEROUS
 HIGHWAY CONDITIONS.

;
/BC 112100
)4-006>009-120300-

/EATHER STATEMENT
 WEATHER SERVICE WASHINGTON DC
ST THU JAN 11 1990

TIAL WINTER WEATHER PROBLEMS FOR SOUTHERN VIRGINIA SUNDAY...
 A WEATHER SYSTEM WILL DEVELOP OVER LOUISIANA AND MISSISSIPPI SATURDAY
 AND INTENSIFY AS IT MOVES OFF THE NORTH CAROLINA COAST EARLY MONDAY.
 IF THE STORM FOLLOWS THIS TRACK...THERE IS THE POTENTIAL FOR A WINTER
 STORM WITH HEAVY SNOW AND/OR FREEZING RAIN OVER SOUTHERN VIRGINIA ON
 SUNDAY.

 ANYONE PLANNING TO TRAVEL IN SOUTHERN VIRGINIA ON SUNDAY SHOULD KEEP
 INFORMED ON THE POTENTIAL DEVELOPMENT OF THIS STORM.
```

WINTER STORM OUTLOOKS (Continued)

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BOSSPSBOS
TTAA00 KBOS 150900
MAZALL-152200-

SPECIAL WEATHER STATEMENT
NATIONAL WEATHER SERVICE BOSTON MA
400 AM EST FRI FEB 15 1991

...THERE IS A CHANCE OF HEAVY SNOW FOR NEW ENGLAND ON MONDAY...
A STORM SYSTEM IS EXPECTED TO DEVELOP IN THE GULF OF MEXICO AND MOVE
NORTHEAST TO THE VIRGINIA COAST BY SUNDAY AFTERNOON. THIS STORM WILL
INTENSIFY RAPIDLY LATE SUNDAY AND SUNDAY NIGHT AND MAY DEVELOP INTO A
MAJOR WINTER STORM. THE EXACT TRACK OF THE STORM IS STILL
UNCERTAIN...BUT CURRENT INDICATIONS ARE THAT THE STORM WILL MOVE NORTH
ALONG THE EAST COAST. IF THE STORM FOLLOWS THIS TRACK...THERE IS THE
POTENTIAL FOR HEAVY SNOW FOR NEW ENGLAND BEGINNING MONDAY.
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WINTER STORM MESSAGE

WWUS43 KDLH 110408
WSWDLH

URGENT - WINTER WEATHER MESSAGE
NATIONAL WEATHER SERVICE DULUTH MN
1107 PM CDT SAT APR 10 1999

...SNOW WILL CONTINUE OVERNIGHT...
A STORM SYSTEM WILL TRACK EAST ALONG THE MINNESOTA IOWA BORDER OVERNIGHT. SNOW IS FORECAST NORTH OF THE STORM SYSTEM...AND WILL AFFECT MAINLY THE NORTHWEST QUARTER OF WISCONSIN AND EAST CENTRAL MINNESOTA.

MNZ035>038-WIZ001>004-006>009-111010-
DOUGLAS-BAYFIELD-ASHLAND-IRON-BURNETT-WASHBURN-SAWYER-PRICE-NORTHERN AITKIN-SOUTHERN AITKIN-DULUTH/CARLTON AREA-PINE-INCLUDING SUPERIOR...BAYFIELD...ASHLAND...HURLEY...GRANTSBURG...SHELL LAKE...HAYWARD...PARK FALLS...HILL CITY...AITKIN...DULUTH...PINE CITY

...SNOW ADVISORY TONIGHT...
THREE TO FIVE INCHES OF SNOW ARE LIKELY TO ACCUMULATE OVERNIGHT IN PORTIONS OF CENTRAL MINNESOTA AND NORTHWEST WISCONSIN. COUNTY SHERIFFS REPORT SLUSHY ROADS AND AREAS OF POOR VISIBILITY. A NUMBER OF VEHICLES HAVE RUN OFF THE ROAD DUE TO THE SLIPPERY CONDITIONS. SNOW WILL CONTINUE THROUGH SUNDAY MORNING...BUT MOST OF THE SNOW IS EXPECTED TO FALL BEFORE 6 AM.

THE SNOW HAS BEEN WET AND SLUSHY...BUT AS TEMPERATURES DIP BELOW THE FREEZING MARK OVERNIGHT...MORE ICY STRETCHES OF ROADS...STREETS...AND SIDEWALKS WILL LIKELY DEVELOP. DRIVING TONIGHT WILL REQUIRE UTMOST CARE AND CAUTION. REDUCED SPEED IS THE SINGLE BEST DEFENSE AGAINST THESE TRAVEL HAZARDS.

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CS

SPECIAL WEATHER STATEMENTS

L5

STATEMENT
NATIONAL WEATHER SERVICE CHICAGO IL
WED JAN 30 1991

ITER STORM WARNING FOR ILLINOIS IS NO LONGER IN EFFECT...
THE STORM THAT BROUGHT HEAVY SNOW TO ILLINOIS HAS MOVED OUT OF THE AREA AND THE SNOW HAS ENDED. HOWEVER...STRONG WINDS WILL CONTINUE BLOWING AND DRIFTING SNOW AS COLD ARCTIC AIR SWEEPS INTO THE STATE TONIGHT.

TOTAL SNOWFALL AMOUNTS FROM THIS STORM RANGE FROM 6 INCHES AT MARION AND SPRINGFIELD TO 10 INCHES AT ROCKFORD AND CHICAGO. TWO FOOT DRIFTS ARE COMMON ACROSS NORTHERN ILLINOIS AND ARE HAMPERING ROAD CLEARING EFFORTS. THE STATE HIGHWAY DEPARTMENT INDICATES THAT ROAD CONDITIONS WILL IMPROVE SLOWLY DURING THE AFTERNOON AS CREWS CONTINUE THEIR PLOWING. MOTORISTS SHOULD DRIVE CAREFULLY AS MOST ROADS ARE STILL SNOW COVERED.

:N 281700
)-

:ATHER STATEMENT
SERVICE DENVER CO
:T THU FEB 28 1991

...A WINTER STORM WATCH REMAINS IN EFFECT FOR SOUTHEAST AND SOUTH CENTRAL COLORADO TONIGHT AND FRIDAY...
A WINTER STORM WAS BECOMING WELL ORGANIZED OVER WESTERN ARIZONA LATE THURSDAY MORNING. IT IS FORECAST TO MOVE ACROSS SOUTHERN COLORADO TONIGHT AND FRIDAY. HEAVY SNOW AND STRONG WINDS ARE LIKELY FOR THE FOUR CORNERS...GUNNISON AND SAN LUIS VALLEYS...ALONG WITH THE SANGRE DE CRISTO MOUNTAINS WHERE A WINTER STORM WATCH CONTINUES. SOME LARGER CITIES AND TOWNS IN THE WATCH AREA INCLUDE OURAY...MONTROSE...GUNNISON...SALIDA...DURANGO...AND ALAMOSA.

SNOWFALL AMOUNTS COULD RANGE FROM 8 INCHES IN THE LOWER VALLEYS TO NEARLY 2 FEET IN THE MOUNTAINS. BLIZZARD CONDITIONS ARE POSSIBLE BECAUSE OF THE STRONG WINDS.

IF YOU ARE HEADING INTO THE WATCH AREA TONIGHT OR FRIDAY...BE PREPARED FOR SNOW PACKED ROADS AND NEAR ZERO VISIBILITY. THE COLORADO STATE POLICE HAS ADVISED THAT THEY MAY REQUIRE CHAINS ON CERTAIN ROUTES...SO BE SURE AND CHECK BEFORE LEAVING. THIS COULD BE A VERY DANGEROUS STORM. STAY INFORMED IF YOU PLAN ANY TRAVEL ESPECIALLY ACROSS THE SOUTHERN HALF OF THE STATE.

SPECIAL WEATHER STATEMENTS (Continued)

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 CYSSPSCYS
:YS 131718
.5-016-017-131830-

: STATEMENT
:R SERVICE CHEYENNE WY
IST WED MAR 13 1991

 ...A WINTER STORM WARNING CONTINUES FOR SOUTHEAST WYOMING TODAY INTO

 AT 1015 AM BANDS OF SNOW WERE INTENSIFYING AND EXPANDING OVER
 SOUTHEAST WYOMING. ONE OF THESE BANDS JUST MOVED TO THE EAST OF
 CHEYENNE WHICH RECEIVED 3 INCHES OF NEW SNOW SINCE 7 AM. ANOTHER BAND
 WHICH DUMPED 4 TO 5 INCHES OF SNOW IN THE CITIES OF CASPER AND LARAMIE
 SINCE 7 AM IS EXPECTED TO REACH CHEYENNE BY NOON. CHEYENNE AND
 SURROUNDING AREAS SHOULD EXPECT UP TO AN ADDITIONAL 5 INCHES OF SNOW
 BY MID AFTERNOON. TOTAL STORM SNOWFALL COULD REACH 8 TO 12 INCHES
 ACROSS SOUTHEAST WYOMING THIS EVENING.

 VISIBILITIES TO 1/8TH MILE IN THE HEAVIER SNOW BANDS AND NORTHERLY
 WINDS OF 15 TO 25 MILES AN HOUR WILL CONTINUE TO PRODUCE BLOWING AND
 DRIFTING SNOW ACROSS SOUTHEAST WYOMING THROUGH THIS AFTERNOON. TRAVEL
 WILL BE HAZARDOUS ESPECIALLY ALONG INTERSTATES 80 AND 25.
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SHORT TERM FORECASTS

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 WBCNOWWBC
 TTAA00 KWBC 080955

 SHORT TERM FORECAST
:R SERVICE WASHINGTON DC
 500 AM EST THU FEB 08 1996

;7-MDZ013>014-016>018-081600-
'RINCE GEORGES INCLUDING THE DISTRICT OF COLUMBIA-ANNE
 ARUNDEL-CALVERT-ST. MARYS-PRINCE WILLIAM INCLUDING MANASSAS AND
 MANASSAS PARK-FAIRFAX INCLUDING THE CITY OF FAIRFAX-ARLINGTON/
 ALEXANDRIA/FALLS CHURCH-STAFFORD-SPOTSYLVANIA INCLUDING
 FREDERICKSBURG-KING GEORGE-

 .NOW...

 TEMPERATURES OVER THE AREA ARE ABOVE FREEZING SO ANY PRECIPITATION
 THAT FALLS WILL BE RAIN. OCCASIONAL LIGHT RAIN IS EXPECTED THROUGHOUT
 THE MORNING. BY NOON TEMPERATURES WILL BE APPROACHING 40 DEGREES.
 LIGHT SOUTH WINDS WILL SLOWLY INCREASE TO 10 TO 15 MPH BY NOON.

 $$
 VAZ021-025>031-036>042-050>051-MDZ002>007-009>011-WVZ048>055-081600-
 ALLEGANY-WASHINGTON COUNTY-FREDERICK MD-CARROLL-NORTHERN BALTIMORE
 COUNTY - HARFORD - SOUTHERN BALTIMORE COUNTY INCLUDING BALTIMORE-
 JEFFERSON-HIGHLAND-AUGUSTA INCLUDING STAUNTON AND WAYNESBORO-
 ROCKINGHAM INCLUDING HARRISONBURG-SHENANDOAH-PAGE-WARREN-FREDERICK VA
 INCLUDING WINCHESTER-CLARKE-ALBEMARLE INCLUDING CHARLOTTESVILLE-
 NELSON-GREENE-MADISON-RAPPAHNNOCK-FAUQUIER-LOUDOUN-CULPEPER-ORANGE


 .NOW...
 TEMPERATURES OVER THE AREA ARE NEAR OR ABOVE FREEZING AND ANY
 PRECIPITATION WHICH FALLS WILL BE IN THE FORM OF RAIN. HOWEVER THERE
 WILL CONTINUE TO BE PATCHES OF ICE ON ROADS UNTIL ABOUT 9 AM THIS
 MORNING AS REMNANTS OF THE SLEET AND FREEZING RAIN WHICH OCCURRED
 DURING THE NIGHT. ICY CONDITIONS ON ROADS WILL MOST LIKELY BE FOUND ON
 BRIDGES AND OVERPASSES AND IN LOW LYING AREAS SO MOTORISTS NEED TO
 EXERCISE CAUTION THROUGH THE MORNING RUSH HOURS. OCCASIONAL LIGHT RAIN
 IS EXPECTED THROUGHOUT THE MORNING. TEMPERATURES WILL APPROACH 40
 DEGREES BY EARLY AFTERNOON. SOUTH WINDS WILL INCREASE TO 10 TO 15 MPH
 BY NOON.

 $$
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SHORT TERM FORECASTS (Continued)

MDZS02-081600-
PORTION OF CHESAPEAKE BAY & TIDAL POTOMAC-

OCCASIONAL LIGHT RAIN WILL BE SEEN THROUGHOUT THE MORNING. SOUTH WINDS OF 15 TO 20 KNOTS CAN BE EXPECTED. WAVES WILL BE 2 TO 3 FEET ON THE BAY AND NEAR ONE FOOT ON THE TIDAL POTOMAC.
$$

RER

EXCESSIVE COLD

DEFINITION

What is considered an excessively cold temperature varies according to the normal climate of a region (e.g., in a relatively warm climate, temperatures just below or at freezing can be hazardous). Excessive cold may accompany or follow winter storms—or can occur without storm activity.

CHARACTERISTICS

Freezing temperatures can cause problems with burst pipes and automobiles that will not start, but the greatest danger is to people. Prolonged exposure to extreme cold can lead to frostbite, hypothermia, and death.

- **Frostbite** is damage to body tissue caused by that tissue being frozen. Frostbite causes a loss of feeling and a white or pale appearance in the extremities.

- **Hypothermia** is low body temperature. Normal body temperature is 98.6ºF. When body temperature drops to 95ºF, however, immediate medical help is needed. Hypothermia also can occur with prolonged exposure to temperatures above freezing.

er deaths attributed to exposure to cold:

- 50 percent are people over 60 years old.

- Over 75 percent are male.

- About 20 percent occur in the home.

Cold air temperatures combined with wind create the wind-chill effect. Wind chill is based on the rate of heat loss from exposed skin caused by combined effects of wind and cold. As the wind increases, heat is carried away from the body at an accelerated rate, driving down the body temperature. Forecasters use a **wind-chill index** as a guide to heat loss resulting from wind and cold. Wind chills for given temperatures and wind speeds are shown in the table on the next page.

CHARACTERISTICS (Continued)

WIND-CHILL INDEX

TEMPERATURES							
WIND	30º	25º	20º	15º	10º	5º	0º
15 mph	9º	2º	-5º	-11º	-18º	-25º	-31º
20 mph	4º	-3º	-10º	-17º	-24º	-31º	-39º
25 mph	1º	-7º	-15º	-22º	-29º	-36º	-44º
30 mph	-2º	-10º	-18º	-25º	-33º	-41º	-49º

HISTORICAL EXAMPLES

- Four soldiers participating in Army Ranger training died from hypothermia in February 1995 after spending hours in chest-deep waters in a Florida swamp. Air temperatures were well above freezing, but prolonged exposure to the chilly water severely lowered their body temperatures.

- The 1993 Superstorm dumped massive amounts of snow from the Gulf Coast States northeastward through New England. Many cities experienced record low barometric pressure readings, indicative of a hurricane-force storm. In the South, many areas received record-breaking snowfalls; e.g., Birmingham, Alabama received 13 inches of snow. Fifty inches of snow fell at Mt. Mitchell in North Carolina. More than 100 hikers were rescued from the North Carolina and Tennessee mountains, many suffering from exposure, as wind chill in the southern Appalachians dropped as low as –20ºF. In Alabama alone, six people died of exposure after abandoning vehicles. Damages were estimated at $2 billion.

- In December 1992, a couple and their 4-month old baby got caught in their pick-up truck during a blizzard in Nevada. They waited 2 days for help, then set out on foot. After 2 days of walking, the woman and baby stayed in a cave and the man continued walking for 3 more days before reaching help. The baby survived unscathed; the parents lost toes to frostbite and spent 2 months in wheelchairs and casts regaining their strength and the use of their legs.

PRODUCTS

The table below and on the next page lists NWS products that can provide planning and preparedness information on excessively cold conditions. Appendix A describes the dissemination systems of these products, as well as other sources (such as the Internet or private online services). Refer to the fact sheet on winter storms for other products.

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Outlooks N/A			
Watches			
Winter Storm Watch	__NPW__	Local NWS Office	These watches are issued 12 - 24 hours in advance of onset and include the: ❒ Area affected. ❒ Reasons for watch. ❒ Potential impacts. ❒ Explanation of a watch and uncertainty. ❒ The precautions and call to action statement.
Statements			
Special Weather Statement	__SPS__	Local NWS Office	These statements highlight the impending cold temperatures.
Cancellation of Watch	__NPW__	Local NWS Office	These cancel existing watches.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Advisories/ Warnings			
Wind Chill Advisory	__NPW__	Local NWS Office	A Wind Chill Advisory is issued when conditions produce a non-dangerous situation that is a major inconvenience. It contains information on the: ❒ Area affected. ❒ Potential temperature, wind chills, general impacts, and general conditions. ❒ Timing of events – beginning, peak, and ending. ❒ Reasons for warning. ❒ Advisory definition. ❒ Precautions and call to action statement.
Wind Chill Warning	__NPW__	Local NWS Office	A Wind Chill Warning is issued when conditions are dangerous. It contains information on the: ❒ Area affected. ❒ Potential temperatures, wind chills, general impacts, and general conditions. ❒ Timing of events – beginning, peak, and ending. ❒ Reasons for warning. ❒ Advisory definition. ❒ Precautions and call to action statement.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Discussions N/A			
Short Term Forecasts Short Term Forecasts	__NOW__	Local NWS Office	This is intended as the primary way to provide a short term forecast of hydrometeorological conditions over an area. It gives a concise forecast of the most significant weather during the next few hours. It highlights watches, warnings and advisories in effect at the time.

SAMPLE PRODUCTS

The sample products listed below are shown on the pages that follow:

- ❒ Wind Chill Advisory.

WIND CHILL ADVISORY

PITWSWPIT
WINTER STORM WATCH
NATIONAL WEATHER SERVICE PITTSBURGH, PA
5 AM EST MON JAN 21 1991

...ADVISORY FOR DANGEROUS WIND CHILL FOR ALL OF WESTERN PENNSYLVANIA TODAY...

EXTREMELY COLD TEMPERATURES AND STRONG WINDS WILL PRODUCE DANGEROUS WIND CHILLS TODAY ACROSS WESTERN PENNSYLVANIA. ARCTIC AIR STORMED INTO THE REGION LAST NIGHT AND TEMPERATURES ARE EXPECTED TO CONTINUE FALLING THROUGHOUT THE DAY. TEMPERATURES IN THE SINGLE DIGITS THIS AFTERNOON.

FOG

DEFINITION

Fog is defined as water droplets suspended in the air at the Earth's surface. Fog is often hazardous when the visibility is reduced to 1/4 mile or less.

CHARACTERISTICS

Thick fog reduces visibility, creating a hazard to motorists as well as to air traffic. Airports may close because of heavy fog.

The intensity and duration of fog varies with the location and type of fog—from early morning ground fog that burns off easily to prolonged valley fog that lasts for days. Generally, strong winds tend to prevent fog formation. The table on the next page summarizes several scenarios for the formation, intensity, and duration of fog.

CHARACTERISTICES (Continued)

TYPE OF FOG	*FACTORS*	*DESCRIPTION*	*EFFECTS*
Ground Fog	❒ Clear nights. ❒ Stable air (winds less than 5 mph). ❒ Small temperature dew point spread.	Heat radiates away from the ground, cooling the ground and surface air. When the air cools to its dew point, fog forms—usually a layer of less than 100–200 feet.	Common in many areas, ground fog burns off by morning sun.
Valley Fog	❒ Cold surface air and weak winter sun. ❒ May follow a winter storm of prolonged nighttime cooling.	Fog can build to a height of more than 1,500 feet. Weak sun may evaporate lower levels of the fog but leave upper levels in place.	Found in valleys (especially in the West) in winter, valley fog can last for days, until winds are strong enough to push out the cold air.
Advection Fog	❒ Horizontal wind. ❒ Warm, humid air. ❒ Winter temperatures.	Wind pushes warm humid air over the old ground or water, where it cools to the dew point and forms fog.	Advection fog can cover wide areas of the central U.S. in winter. It may be sufficient to close airports.
Upslope Fog	❒ Winds blowing up hill or mountains. ❒ Humid air.	As humid air pushed up hills and mountains, it cools to its dew point and forms fog, which drifts up the mountain.	Upslope fog is common and widespread in the Great Plains, where land slopes gently upward toward the Rockies.
Sea Smoke, Steam Fog	❒ Body of water. ❒ Air much colder than water. ❒ Wind.	As cold air blows over warmer water, water evaporates into the cold air, increasing the humidity to the dew point. Vapor condenses, forming a layer of fog 1 to 2 feet thick over the water.	Forms on fall days over ponds and streams.

CHARACTERISTICS (Continued)

TYPE OF FOG	*FACTORS*	*DESCRIPTION*	*EFFECTS*
Precipitation Fog	❒ Warmer air. ❒ Cool rain.	Some rain evaporates, and the added vapor increases the air to its dew point. The vapor then condenses into fog.	Precipitation fog forms on cool, rainy days.

HISTORICAL EXAMPLES

❒ In March 1995, fog caused a 100-car wreck on a 7-mile bridge over Mobile Bay in Alabama, leaving 87 injured and 1 dead.

PRODUCTS

The table on the following pages lists products that can provide planning and preparedness information on fog. Appendix A describes the dissemination systems of these products, as well as other sources (such as the Internet or private online services).

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Outlooks			
Fog Outlook	__SPS__	Local NWS Office	This product is issued when there is a good chance of fog occurring. These are issued at least 12 hours in advance. The prime goal of outlooks is to give advance notice. They include the: ❒ Area of impact. ❒ Hazards. ❒ Timeframes.
Watches			
Fog Watch	__NPW__	Local NWS Office	Watches are issued when conditions are favorable for fog to develop. They cover 12-24 hours in advance. Watches include the: ❒ Area affected. ❒ Reason for the watch. ❒ Potential impact. ❒ Explanation of the watch and uncertainty. ❒ Precautions and call to action.
Statements			
Special Weather Statement	__SPS__	Local NWS Office	Special Weather Statements are issued to cancel Non-Precipitation Watches.
Advisories			
Fog Advisory	__NPW__	Local NWS Office	Fog advisories should be issued when existing or imminent fog covers part or all of the forecast area and poses a mere inconvenience. Advisories include the: ❒ Area and time affected. ❒ Potential impact. ❒ Timing of events – beginning, ending, peaking, weakening. ❒ Reason for the advisory. ❒ Advisory definition. ❒ Precautions and call to action.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Warnings Fog Warning	__NPW__	Local NWS Office	Fog warnings should be issued when existing or imminent fog covers part or all of the forecast areas and poses a threat to life and property. Warnings include the: ❒ Area and time affected. ❒ Potential impact. ❒ Timing of events – beginning, ending, peaking, weakening. ❒ Reasons for the advisory. ❒ Advisory definition. ❒ Precautions and call to action.
Discussions N/A			
Short Term Forecast	__NOW__	Local NWS Office	The NOW forecast is intended as the primary way to provide a short term forecast of hydrometeorological conditions over an area. The NOW gives a concise forecast of the most significant weather during the next few hours. It highlights watches, warnings and advisories in effect at the time.

SAMPLE PRODUCT

The sample product listed below is shown on the next page:

❒ Dense Fog Advisory. (Revised 3/2000)

DENSE FOG ADVISORY

NPWJKL

URGENT - WEATHER MESSAGE
NATIONAL WEATHER SERVICE JACKSON KY
631 AM EDT SUN JUL 25 1999

...DENSE FOG WILL REDUCE VISIBILITIES TO UNDER A QUARTER OF A MILE ACROSS EAST KENTUCKY THIS MORNING...

KYZ044-050>052-058>060-068-069-079-080-083>088-104-106>120-251400-
BATH-BELL-BREATHITT-CLAY-ELLIOTT-ESTILL-FLEMING-FLOYD-HARLAN-JACKSON-
JOHNSON-KNOTT-KNOX-LAUREL-LEE-LESLIE-LETCHER-MAGOFFIN-MARTIN-MCCREARY-
MENIFEE-MONTGOMERY-MORGAN-OWSLEY-PERRY-PIKE-POWELL-PULASKI-ROCKCASTLE-
ROWAN-WAYNE-WHITLEY-WOLFE- INCLUDING
OWINGSVILLE...PINEVILLE...MIDDLESBORO...JACKSON...MANCHESTER...ONEIDA.
..BIG CREEK...SANDY
HOOK...IRVINE...FLEMINGSBURG...PRESTONSBURG...HARLAN...EVARTS...CUMBER
LAND...MCKEE...PAINTSVILLE...HINDMAN...BARBOURVILLE...LONDON...BEATTYV
ILLE...HYDEN...RED BIRD...WHITESBURG...SALYERSVILLE...INEZ...WHITLEY
CITY...FRENCHBURG...MT STERLING...JEFFERSONVILLE...WEST
LIBERTY...EZEL...BOONEVILLE...HAZARD...VICCO...PIKEVILLE...ELKHORN
CITY...META...STANTON...CLAY CITY...SOMERSET...BURNSIDE...MT
VERNON...MOREHEAD...MONTICELLO...WILLIAMSBURG...CORBIN...CAMPTON

...DENSE FOG ADVISORY THROUGH 10 AM EDT...
MOISTURE FROM YESTERDAY/S RAIN AND CLEAR SKIES HAVE LEAD TO WIDESPREAD FOG ACROSS EAST KENTUCKY THIS MORNING. WITH LIGHT WINDS AND LITTLE MIXING THIS FOG WILL BE SLOW TO BURN OFF. EXPECT VISIBILITIES BELOW A QUARTER OF A MILE AT MANY LOCATIONS AND LESS THAN 100 FEET IN A FEW SPOTS DUE TO DENSE FOG. THIS FOG WILL PERSIST THROUGH 10 AM EDT BEFORE BRIGHT SUNSHINE IS ABLE TO BURN IT OFF.

IF YOU ARE DRIVING THIS MORNING...SLOW DOWN...USE LOW BEAM HEADLIGHTS...AND ALLOW PLENTY OF TIME TO REACH YOUR DESTINATION.

$$
GREIF

EXCESSIVE HEAT

DEFINITION

What is considered excessive heat varies according to the normal climate of a region. Tropical air masses can raise summer temperatures high above the average for an area. Sudden rises in temperature–when people don't have a chance to acclimatize–or prolonged heat waves increase death rates. People die from excessive heat.

Excessive heat occurs from a combination of high temperatures (significantly above normal) and high humidities. At certain levels, the human body cannot maintain proper internal temperatures and may experience heat stroke. The "Heat Index" (HI) is a measure of the effect of the combined elements on the body.

A daytime HI reaching 105ºF or above with nighttime lows at or above 80ºF for two consecutive days may significantly impact public safety and, therefore, generally requires the issuance of an advisory or warning by local NWS offices.

CHARACTERISTICS

There are some practical problems that can result from high temperatures, such as overheated car engines, "brown-outs" from overuse of electricity for air conditioning, and changes in airplanes' performance. As with extreme cold, however, the major danger of extreme heat is to humans and animals. Heat-related ailments can range from annoying conditions to life-threatening situations, such as:

- **Heat Cramps.** Muscle cramps, especially in the legs after exercising, are caused by imbalances in body salt.
- **Fainting.** Exercising in the heat can cause a rapid drop in blood pressure, resulting in fainting.
- **Heat Exhaustion.** Loss of fluid and salt through excessive sweating can lead to dizziness, overall weakness, and a rise in body temperature. This can result from normal activity during several days of a heat wave or strenuous activity in extreme temperatures.
- **Heatstroke.** If heat exhaustion is not treated, the body temperature may rise to 105ºF or more and heatstroke may occur. A heatstroke victim may exhibit lethargy, confusion, or unconsciousness and is at risk of dying.

CHARACTERISTICS (Continued)

When the air is humid, the "apparent temperature" is even higher. Forecasters use the **Humidity Index** to show apparent temperature, The chart below shows the Humidity Index.

HUMIDITY INDEX

	TEMPERATURES							
HUMIDITY	75º	80º	85º	90º	95º	100º	105º	110º
40 %	74º	79º	86º	93º	101º	110º	122º	135º
50 %	75º	81º	88º	96º	107º	120º	135º	150º
60 %	76º	82º	90º	100º	114º	132º	149º	163º
70 %	77º	85º	93º	106º	124º	144º	161º	--
80 %	78º	86º	97º	113º	136º	157º	166º	--
90 %	79º	88º	102º	122º	150º	170º	--	--

HISTORICAL EXAMPLES

- ❒ In July 1995, a heat wave hit the Eastern and Midwestern U.S. Over 475 heat-related deaths occurred in Chicago alone.
- ❒ In July 1993, a heat wave hit the Eastern U.S., causing power shortages and many illnesses and deaths. For example, between July 6 and 14, there were 118 heat-related deaths in Philadelphia.
- ❒ In July 1980, a heat wave hit the mid-western U.S. In Kansas City and St. Louis, 1,448 people were killed by the heat.
- ❒ The U.S. Centers for Disease Control estimates that 5,379 people have died from excessive heat between 1979 and 1992. This is an average of 384 deaths per year.

PRODUCTS

The table below and on the next page lists NWS products that can provide planning and preparedness information on extreme heat conditions. Appendix A describes the dissemination systems of these products, as well as other sources (such as the Internet or private online services).

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Outlooks			
Outlook for Excessive Heat	__SPS__	Local NWS Office	In extreme circumstances and outlook can be issued to include the: ❒ Advanced notice of excessive heat. ❒ Expected conditions. ❒ Locations. ❒ Time frames.
Watches			
Excessive Heat Watch	__NPW__	Local NWS Office	These watches are issued 12 – 24 hours in advance of onset and include the: ❒ Area affected. ❒ Reasons for the watch. ❒ Potential impacts. ❒ Explanation of a watch and uncertainty. ❒ Precautions and call to action statement.
Statements			
Cancellation Of Watch	__SPS__	Local NWS Office	These products cancel existing watches.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	*DESCRIPTION*
Advisories/ Warnings			
Excessive Heat Advisory	__NPW__	Local NWS Office	An Excessive Heat Advisory is issued when the conditions produce a non-dangerous situation that is a major inconvenience. They include the: ❒ Area affected. ❒ Potential temperatures, heat index, general impacts, and general conditions. ❒ Timing of events, including the beginning, peak, and ending. ❒ Reasons for the advisory. ❒ Advisory definition. ❒ Precautions and call to action statements.
Excessive Heat Warning	__NPW__	Local NWS Office	An Excessive Heat Warning is issued when conditions are considered dangerous. The warning includes the: ❒ Area affected. ❒ Potential temperatures, heat index, general impacts and general conditions. ❒ Timing of events, including the beginning, peak, and ending. ❒ Reasons for the advisory. ❒ Advisory definition. ❒ Precautions and call to action statements.
Discussion N/A			
Short Term Forecasts	__NOW__	Local NWS Office	This is intended as the primary way to provide a short term forecast of hydrometeorological conditions over and area. It gives a concise forecast of the most significant weather during the next few hours. It highlights watches, warnings and advisories in effect at the time.

SAMPLE PRODUCTS

The sample products listed below are shown on the pages that follow:

- ❒ Excessive Heat Outlook. (Revised 3/2000)
- ❒ Excessive Heat Warning. (Revised 3/2000)

EXESSIVE HEAT OUTLOOK

SPSBHM
ALZ001>050-GAZ089-090-102-120-270220-

HAZARDOUS WEATHER OUTLOOK
FOR NORTH/CENTRAL AL AND WEST CENTRAL GA
NATIONAL WEATHER SERVICE BIRMINGHAM AL
923 AM CDT MON JUL 26 1999

ANOTHER HOT...HUMID...AND HAZY DAY EXPECTED ACROSS ALABAMA THIS MONDAY. AS THE MERCURY RISES WELL INTO THE 90S...THE COMBINATION OF THE HEAT AND MOISTURE WILL MAKE HEAT INDICES JUMP INTO THE 105 TO 110 DEGREE RANGE. ISOLATED AFTERNOON AND EVENING THUNDERSTORMS WILL DEVELOP AND WILL BE CAPABLE OF PRODUCING BRIEF HEAVY RAINFALL AND GUSTY WINDS. BUT OVERALL...THE THUNDERSTORMS ARE NOT EXPECTED TO REACH SEVERE LIMITS AND WILL NOT BE ORGANIZED.

ACTIVATION OF STORM SPOTTERS AND EMERGENCY MANAGEMENT PERSONNEL WILL NOT BE NECESSARY.

THE HAZARDOUS WEATHER OUTLOOK FOR SOUTHWEST ALABAMA...SEE PRODUCT BHMSPSMOB. FOR SOUTHEAST ALABAMA...LOOK AT MIASPSTLH. FOR MORE WEATHER INFORMATION VISIT OUR INTERNET SITE ON THE WORLD WIDE WEB AT HTTP://WWW.ACES.EDU/NWS/

SPSMOB
ALZ051>064-FLZ001>006-MSZ067-075-076-078-079-281200-

HAZARDOUS WEATHER OUTLOOK
NATIONAL WEATHER SERVICE MOBILE AL
532 AM CDT TUE JUL 27 1999

...CODE RED OZONE ALERT FOR MOBILE COUNTY...
...HIGH HEAT INDEX VALUES TODAY...

THE ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT IS FORECASTING A CODE RED OZONE ALERT FOR MOBILE COUNTY ALABAMA TODAY AND WEDNESDAY...JULY 27TH AND 28TH RESPECTIVELY.

THIS MEANS AIR QUALITY WILL BE UNHEALTHFUL. HERE ARE SOME RECOMMENDED ACTIONS:

CHILDREN...ELDERLY INDIVIDUALS AND THOSE INDIVIDUALS WHO SUFFER FROM HEART AND RESPIRATORY PROBLEMS SHOULD REDUCE OUTDOOR ACTIVITIES. IF BREATHING BECOMES DIFFICULT...MOVE INDOORS.

RESIDENTS ARE STRONGLY URGED TO LIMIT DRIVING. AVOID MOWING LAWNS WITH GASOLINE POWERED MOVERS. REFUEL CARS AFTER DUSK. AVOID THE USE OF DRIVE-THROUGHS. IT IS SUGGESTED TO PARK AND WALK IN.

ANOTHER HOT AND MUGGY DAY IS EXPECTED WITH LIMITED RELIEF EXPECTED FROM STORMS. DEWPOINTS IN THE 70S AREAWIDE AND TEMPERATURES LIFTING INTO THE MID 90S IN MOST AREAS MAKES FOR HEAT INDICES IN THE 105 TO 110 DEGREE RANGE THIS AFTERNOON. WEAR LIGHT COLORED...LIGHT WEIGHT CLOTHING AND DRINK PLENTY OF WATER IF YOU ARE REQUIRED TO BE OUTSIDE. AVOID THE USE OF ALCOHOLIC BEVERAGES.

ACTIVATION OF STORM SPOTTERS AND EMA PERSONNEL WILL NOT BE REQUIRED THROUGH TONIGHT.

ADDITIONAL WEATHER INFORMATION CAN BE FOUND ON THE WORLD WIDE WEB AT WWW.NWSMOBILE.NOAA.GOV

EXCESSIVE HEAT WARNING

NPWILM
  URGENT - WEATHER MESSAGE
NATIONAL WEATHER SERVICE WILMINGTON NC
415AM EDT TUE JUL 27 1999

...HEAT ADVISORY IN EFFECT FOR TODAY...
HOT AND HUMID CONDITIONS ARE AGAIN EXPECTED TODAY. THE COMBINATION OF THE TWO WILL CONTINUE TO PROVIDE AFTERNOON HEAT INDEX VALUES RANGING FROM 105 TO NEAR 110 DEGREES. THESE INDICES REMAIN IN THE DANGER CATEGORY AND AS A RESULT A HEAT ADVISORY WILL BE IN EFFECT FOR TODAY.

NCZ087-096-097-099>101-SCZ017-023-024-032>034-039-046-280000- BLADEN-BRUNSWICK-COLUMBUS-DARLINGTON-DILLON-FLORENCE-GEORGETOWN-HORRY-MARION-MARLBORO-NEW HANOVER-PENDER-ROBESON-WILLIAMSBURG- INCLUDING THE CITIES OF
BENNETTSVILLE...BURGAW...DARLINGTON...DILLON...ELIZABETHTOWN...FLORENCE...GEORGETOWN...KINGSTREE...LUMBERTON...MARION...MYRTLE BEACH...SOUTHPORT...WHITEVILLE...WILMINGTON...WRIGHTSVILLE BEACH
415 AM EDT TUE JUL 27 1999

...HEAT ADVISORY IN EFFECT FOR TODAY ACROSS NORTHEAST SOUTH CAROLINA AND SOUTHEAST NORTH CAROLINA...
AFTERNOON TEMPERATURES WILL RISE TO 95 TO NEAR 100 EXCEPT ALONG THE BEACHES WHERE IT WILL ONLY RISE TO AROUND 90. IN COMBINATION WITH RELATIVELY HIGH HUMIDITIES...AFTERNOON HEAT INDEX VALUES WILL RISE TO BETWEEN 105 AND 110 ACROSS THE AREA.

IN THIS TYPE OF HEAT...PEOPLE AND ANIMALS MAY BE UNABLE TO MAINTAIN PROPER INTERNAL TEMPERATURES...RESULTING IN HEAT EXHAUSTION OR STROKE. THIS IS ESPECIALLY DANGEROUS TO THOSE WHO MUST WORK OUTSIDE...THE ELDERLY...YOUNG CHILDREN...AND TO LIVESTOCK AND OUTDOOR PETS.

IF YOU MUST BE OUTSIDE...FREQUENTLY SEEK SHADE AND DRESS IN LIGHTWEIGHT...LIGHT COLORED CLOTHING. BE SURE TO DRINK PLENTY OF NON-ALCOHOLIC FLUIDS...AND IF YOU FEEL NAUSEOUS...SEEK COOL SHELTER IMMEDIATELY. ANIMALS SHOULD BE PROVIDED WITH WELL VENTILATED SHADY LOCATIONS WITH PLENTY OF DRINKING WATER.

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RWA

DUSTSTORMS

DEFINITION

Strong winds over dry ground that has little or no vegetation can lift particles of dust or sand into the air. These airborne particles can reduce visibility, cause respiratory problems, and have an abrasive affect on machinery. A concentration reducing the visibility to 1/4 mile or less often poses hazards for travelers.

CHARACTERISTICS

Duststorms cause a significant reduction in visibility (to ¼ mile or less) cause damage and injury, and affect commerce.

There are two situations that lead to the development of blowing dust or sand:

- ❒ Sustained high wind at the surface, which tends to pick up dust and sand in dry environments. This condition may last for several hours or even days and may occur simultaneously with a windstorm. (Refer to the fact sheet on windstorms for more information.) This is referred to as a nonconvective event.

- ❒ Local events because of thunderstorm outflow or micro bursts. In this situation, the event is usually sudden and short, over in a matter of minutes. These events are referred to as convective events.

Factors affecting both nonconvective and convective events are shown in the table on the next page.

CHARACTERISTICS (Continued)

FACTOR	*LARGE SCALE, NONCONVECTIVE EVENTS*	*CONVECTIVE EVENTS*
Speed of onset	❒ Recognizable weather patterns are easily identified 24 to 36 hours in advance.	❒ Predicable over an area of jurisdiction within 0 to 3 hours. ❒ Specific locations identifiable only minutes in advance.
Duration	❒ Ranges from 3 to 4 hours up to 2 to 3 days, usually with nocturnal lulls.	❒ Micro bursts – a few seconds. ❒ Macro bursts – a few minutes. ❒ Wake depression – up to two hours.
Timing	❒ Occur mainly during the late winter and early spring when pressure gradients are extreme. ❒ Conditions worsen during late morning and are most intense during late afternoon.	❒ Occur in association with late afternoon or evening thunderstorms, usually during the spring and summer.

Duststorms involve horizontal high winds or wind gusts and blowing dust, sand, or both. The hazards and damage caused by these storms include:

- ❒ Impaired visibility and breathing difficulties, especially for outdoor workers, people in recreational activities, and motorists.
- ❒ Crop damage.
- ❒ Destruction to buildings, vehicles, and trailers.
- ❒ Power outages and other infrastructure damage.
- ❒ Broken trees.
- ❒ Scouring damage to buildings and automobiles.
- ❒ Damage to computers and communications equipment from accumulated dust.

High winds may accompany major winter or early spring blizzards. A mixture of snow and dust may bring travel to a standstill. For convective duststorms, all elements associated with severe thunderstorms may occur. Refer to the fact sheet on thunderstorms for more information.

HISTORICAL EXAMPLES

- In April 1995, a duststorm caused a 24-car wreck in Arizona that killed 10 people. Swirling dust reduced visibility to less than a car length.
- A wind and duststorm along a California highway in November 1991 caused a traffic wreck that left 17 dead and 150 injured. The storm came during the sixth year of a drought.
- In March 1975, a mixture of blowing dust and sand accompanied high winds (at times exceeding 100 mph) in the Texas South Plains. Visibility remained near zero during daylight hours for 3 days. Dust extended aloft to 30,000 feet, and visibility was reduced as far east as Atlanta. A total of 1.38 inches of dust collected in an official rain gauge at the Lubbock, Texas Weather Service Forecast Office. Commerce came to a standstill, with most highways closed due to overturned tractor trailers, blowing tumbleweeds, and the sandblasting effect on automobiles.

PRODUCTS

The following table lists NWS products that provide planning and preparedness information on dust storms. Appendix A describes the dissemination systems of these products, as well as other sources (such as the Internet or Private online services). Refer to the fact sheet on wind storms for other products.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	DESCRIPTION
Outlooks Blowing Dust or Sand	__SPS___	Local NWS Office	This product is issued when there is a good chance of blowing dust or sand occuring. The prime goal of the outlook is to give advance notice. Outlooks include the: ❒ Area of impact. ❒ Hazards. ❒ Time frames.
Watches Blowing Dust/Sand Watch	__NPW__	Local NWS Office	Watches are issued when conditions are favorable for blowing dust or sand to develop. They are issued 12 – 24 hours in advance. Watches include the: ❒ Area affected. ❒ Reason for the watch. ❒ Potential impact. ❒ Explanation of the watch and uncertainty. ❒ Precautions and call to action statement.
Statements	__SPS__	Local NWS Office	Special Weather Statements are issued to cancel Non-Precipitation Watches.
Advisories Blowing Dust/Sand	__NPW__	Local NWS Office	A blowing dust/sand advisory should be issued when existing or imminent significant events cover part or all of the area and pose a mere inconvenience. Advisories include the: ❒ Area and time affected. ❒ Potential impact. ❒ Timing of the events' beginning, ending, peaking and weakening. ❒ Advisory definition. ❒ Precaution and calls to action.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	DESCRIPTION
Warnings Blowing Dust/Sand Warning	__NPW___	Local NWS Office	Blowing Dust/Sand warnings should be issued when existing or imminent significant blowing dust/sand cover part or all of the forecast area and are a threat to safety and property. Warnings include the: ❒ Area and time affected. ❒ Potential impact. ❒ Timing of events beginning, ending, peaking and weakening. ❒ Advisory definition. ❒ Precautions and call to action.
Discussions N/A			
Short Term Forecast	__NOW__	Local NWS Office	This forecast is intended as the primary way to provide a short term forecast of hydrometeorological conditions over an area. It gives a concise forecast of the most significant weather during the next few hours. It highlights watches, warnings and advisories in effect at the time.

SAMPLE PRODUCTS

A NWS product is on the following page. (Revised 3/2000)

BLOWING DUST ADVISORY

NPWPHX
URGENT - WEATHER MESSAGE
NATIONAL WEATHER SERVICE PHOENIX AZ
351 PM MST TUE JUL 6 1999

AZZ023-027-028-070150-
GREATER PHOENIX AREA-SOUTHWEST MARICOPA COUNTY-CENTRAL DESERTS-

...DUST STORM WARNING FOR THE GREATER PHOENIX AREA UNTIL 530 PM...

STRONG WINDS AND DENSE BLOWING DUST...GENERATED FROM THUNDERSTORMS NEAR APACHE JUNCTION...ARE MOVING INTO THE EASTERN PORTIONS OF THE GREATER PHOENIX AREA.

A STRONG DUST STORM IS FORECAST TO SWEEP THROUGH THE GREATER PHOENIX AREA FROM EAST TO WEST THIS AFTERNOON. WIND GUSTS TO NEAR 50 MPH...ALONG WITH VISIBILITIES NEAR ZERO IN SPOTS STILL ACCOMPANY THE DUST STORM.

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WINDSTORMS

DEFINITION

High winds not associated with convective events (severe local storms, hurricanes, and winter storms) that require a warning when one of the following occurs:

- ❒ Sustained wind speeds of 40 mph or greater lasting for 1 hour or longer;
- ❒ Winds of 58 mph or greater for any duration.

The above thresholds generally are increased for locations at higher elevations because of the lower air density and subsequent reduction in damage from less force.

The types of wind that do not involve the mechanism of convection include:

- ❒ **Gradient High Winds.** High winds that usually cover a large area and are due to large-scale pressure systems.
- ❒ **Mesoscale High Winds.** These high winds usually follow the passage of organized convective systems and are associated with wake depressions or strong meso-scale (small-scale) high pressure.
- ❒ **Channeled High Winds.** In mountainous areas or in cities with tall buildings, air can be channeled through constricted passages producing high winds. Channeled high winds are local in nature but can be extremely strong.
- ❒ **Tropical Cyclone Associated High Winds.** High winds can occur a few hundred miles from the coast of a landfalling tropical cyclone. These inland winds are forecasted independent of the tropical cyclone.
- ❒ **Chinook or Foehn Wind.** These are warm, dry winds that occur in the lee of high mountains ranges. They are fairly common in the mountainous west and sections of Alaska during the winter months. These winds develop in well defined areas and can be quite strong.

CHARACTERISTICS

Windstorms are caused by an extreme pressure gradient (difference in pressure over a small distance). The pressure gradient itself may be caused by one—or a combination of:

- ❒ Terrain effect.
- ❒ Temperature differences, as with downslope winds.
- ❒ Mesoscale systems or convective complexes.

CHARACTERISTICS (Continued)

Windstorms involve sustained, potentially damaging, high winds. These high winds can cause the following hazards and damage:

- ❒ Impaired visibility.
- ❒ Crop damage.
- ❒ Destruction to buildings and vehicles.
- ❒ Power outages and other infrastructure damage.
- ❒ Broken trees.

High winds may accompany major winter or early spring blizzards. Major high-wind events frequently affect multiple jurisdictions, extending horizontally for hundreds of miles.

Windstorms are nonconnective events and the speed of onset is less than with convective events, such as duststorms. Recognizable weather patterns are easily identified 24 to 36 hours in advance of a large scale, nonconnective storm. The NWS may issue a High Wind Watch during this period.

The duration of the event ranges from about 4 hours up to 2 to 3 days, usually with nocturnal lulls. The storms occur mainly during the late winter and early spring, when pressure gradients are extreme and soils are bare. They worsen during the late morning and become most intense during the late afternoon, when atmospheric mixing is most pronounced.

HISTORICAL EXAMPLES

- ❒ A wind and duststorm along a California highway in November 1991 caused a wreck leaving 17 dead and 150 injured. This storm came during the sixth year of a drought.
- ❒ In March 1975, a mixture of blowing dust and sand accompanied high winds (at times exceeding 100 mph) in the Texas South Plains. Visibility remained near zero during daylight hours for 3 days. Dust extended aloft to 30,000 feet and visibility was reduced as far east as Atlanta. A total of 1.38 inches of dust collected in an official rain gauge at the Lubbock, Texas Weather Service Forecast Office. Commerce came to a standstill, with most highways closed due to overturned tractor trailers, blowing tumbleweeds, and the sandblasting effect on automobiles.

PRODUCTS

The following table lists NWS products that can provide planning and preparedness information on wind storms. Appendix A describes the dissemination systems of these products, as well as other sources (such as the Internet or private online services). Refer to the fact sheet on duststorms.

PRODUCT	*IDENTIFIER*	*SOURCE*	DESCRIPTION
Outlooks			
Potential for High Winds	__SPS___	Local NWS Office	This product is issued when there is a good chance of high winds occurring. The time frame is 12 + hours. The prime goal of the outlook is to give advance notice. Outlooks include the: ❒ Inherent uncertainty of the event. ❒ Area of impact. ❒ Hazards. ❒ Time frames.
Watches			
High Wind Watches	__NPW__	Local NWS Office	Watches are issued when conditions are favorable for high winds to develop. They come 12-24 hours in advance. Watches include the: ❒ Area affected. ❒ Reasons for the watch. ❒ Potential impact. ❒ Explanation of the watch and uncertainty. ❒ Precautions and calls to action.
Statements	__SPS__	Local NWS Office	Special Weather Statements are issued to cancel Non-Precipitation Watches.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	DESCRIPTION
Advisories High Wind Advisories	__NPW___	Local NWS Office	High wind advisories should be issued when existing or imminent high winds cover part or all of the area and pose a mere inconvenience. Advisories include the: ❒ Area and time affected. ❒ Potential impact. ❒ Timing of events, including the beginning, ending, peaking, and weakening. ❒ Reasons for the advisory ❒ Advisory definition. ❒ Precautions and call to action.
Warnings High Wind Warnings	__NPW__	Local NWS Office	High wind warnings should be issued when existing or imminent high winds cover part or all of the forecast area and pose a threat to life and property. Warnings include the: ❒ Area and time affected. ❒ Potential impact. ❒ Timing of events, including the beginning, ending, peaking, and weakening. ❒ Reasons for the advisory. ❒ Warning definition. ❒ Precautions and calls to action.
Discussions N/A			
Short Term Forecast	__NOW__	Local NWS Office	This forecast is intended as the primary way to provide a short term forecast of hydrometeorological conditions over an area. It gives concise forecast of the most significant weather during the next few hours. It highlights watches, warnings, and advisories in effect at the time.

SAMPLE PRODUCTS

The sample product listed below are shown on the following pages:

- ❒ High Wind Advisory. (Revised 3/2000)
- ❒ High Wind Warning. (Revised 3/2000)

HIGH WIND ADVISORY

NPWFTW

URGENT - WEATHER MESSAGE
NATIONAL WEATHER SERVICE FORT WORTH TX
440 AM CDT THU JUL 15 1999

TXZ098>101-113>116-127>130-139>143-154>156-160100-
BROWN-CALLARAN-COLEMAN-COMANCHE-EASTLAND-ERATH-HAMILTON-HASKELL-JACK-
JONES-LAMPASAS-MCCULLOCH-MILLS-PALO PINTO-SAN SABA-SHACKELFORD-
STEPHENS-TAYLOR-THROCKMORTON-YOUNG-

...WIND ADVISORY IN EFFECT FOR THE WESTERN THIRD OF NORTH TEXAS...

THE NATIONAL WEATHER SERVICE HAS ISSUED A WIND ADVISORY FOR THE WESTERN THIRD OF NORTH TEXAS FOR TODAY THROUGH SUNSET. THE ADVISORY AREA IS WEST OF A JACKSBORO TO LAMPASAS LINE...AND INCLUDES THE CITIES OF ABILENE...GRAHAM...MINERAL WELLS...STEPHENVILLE...AND LAMPASAS.

A TIGHT PRESSURE ACROSS WEST TEXAS AND STRONG LOW LEVEL WINDS UP TO 7000 FEET WILL RESULT IN SOUTHERLY WINDS OF 20 TO 30 MPH WITH HIGHER GUSTS ACROSS THE WESTERN THIRD OF NORTH TEXAS TODAY AND EARLY THIS EVENING. TO THE EAST OF THE ADVISORY AREA...CAUTION IS ADVISED ON AREA LAKES ACROSS THE CENTRAL THIRD OF NORTH TEXAS WHERE SOUTHERLY WINDS OF 15 TO 25 MPH WITH HIGHER GUSTS ARE EXPECTED TODAY. SURFACE WINDS SHOULD DIMINISH INTO THE 10 TO 20 MPH RANGE ACROSS THE WEST AND CENTRAL AREAS OF NORTH TEXAS AFTER SUNSET.

MOTORISTS...ESPECIALLY DRIVERS OF HIGH PROFILE VEHICLES...SHOULD EXERCISE CAUTION WHILE DRIVING IN THE WIND ADVISORY AREA. BE ALERT TO SUDDEN GUSTS OF WIND WHICH MAY CAUSE YOU TO LOSE CONTROL OF YOUR VEHICLE. BOATERS ALSO SHOULD USE EXTREME CAUTION IF VENTURING ONTO AREA LAKES...AS THESE WINDS WILL MAKE OPEN WATERS OF LAKES VERY ROUGH AND HAZARDOUS.

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HIGH WIND WARNING

WAZ004-006>008-010-011-040530-
CENTRAL CASCADE FOOTHILLS-EVERETT AND VICINITY-
SEATTLE METROPOLITAN AREA-TACOMA AREA-HOOD CANAL/KITSAP PENINSULA-
SOUTHWEST INTERIOR-
INCLUDING
EVERETT...SEATTLE...BELLEVUE...RENTON...KENT...AUBURN...TACOMA...PUYAL
LUP ...GRAHAM...ORTING...
BREMERTON...SHELTON...TAHUYA...OLYMPIA...CENTRALIA...MONTESANO

...THE NATIONAL WEATHER SERVICE HAS ENDED THE HIGH WIND WARNING FOR THE PUGET SOUND AREA AND THE SOUTHERN WASHINGTON INTERIOR...

WINDS HAVE DIMINISHED. SOUTHWEST WINDS 15 TO 25 MPH WITH GUSTS TO 35 MPH NEAR SHOWERS WILL CONTINUE TONIGHT. HOWEVER THE DAMAGING WINDS ARE OVER.

$$

THE DEEP LOW PRESSURE SYSTEM THAT BROUGHT HIGH WIND TO WESTERN WASHINGTON OVERNIGHT HAS MOVED INTO SOUTHERN BRITISH COLUMBIA AND HAS FILLED TO 993 MB. THE SYSTEM IS MUCH WEAKER AND IS NO LONGER CAUSING HIGH WINDS IN WASHINGTON.

RESIDUAL WIND WILL CONTINUE OVERNIGHT WITH MOST WINDS IN THE 20 TO 30 MPH RANGE AND SLIGHTLY STRONGER WINDS...25 TO 35 MPH...IN THE NORTH INTERIOR OF WASHINGTON. SHOWERS WILL CONTINUE TONIGHT AND GUSTS NEAR SHOWERS WILL BE STRONGER. HOWEVER NO DAMAGING WINDS ARE EXPECTED. CONDITIONS WILL BE BREEZY THURSDAY WITH SOUTH WINDS 15 TO 25 MPH LIKELY.

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BURKE

FIRE WEATHER

DEFINITIONS

Fire weather is a term used for the meteorological conditions that promote the spread of wildfire. Hydrological and topographical and vegetation conditions also impact the spread of fire.

Fire Weather Offices are those Weather Service Forecast Offices (WSFO) and Weather Service Offices (WSO) assigned responsibility to provide fire weather services for specified areas.

Fire Danger is the result of both constant factors (fuels) and variable factors (primarily weather), that affect the ignition, spread, and difficulty of control of fires and the damage they cause.

Prescribed Burn is fire applied to wildland fuels, in a definite place for a specific purpose under exacting weather and fuel conditions (the prescription), to achieve land management objectives.

Wildfire is any free-burning and uncontainable wildland fire not prescribed for the area that consumes the natural fuels and spreads in response to its environment.

Wildlands are any non-urbanized land not under extensive agricultural cultivation (e.g., forests, grasslands, rangelands).

CHARACTERISTICS

owing weather conditions promote ignition and rapid spread of fires:

- ❒ Low humidity.
- ❒ High winds (over 10-20 mph).
- ❒ Dry thunderstorm (i.e., lightning without rain).
- ❒ Unstable air.

ctors that impact the spread and severity of fires include:

- ❒ **Dry, antecedent conditions.** Prolonged hot, dry conditions greatly increase fire danger. In drought conditions, forests can ignite with a weak source that would normally not be a threat.

CHARACTERISTICS (Continued)

- **Urban-wildland interface.** The spread and severity of residential areas into wildlands means the population faces a greater risk of forest fires. Coordination is necessary between urban emergency responders and land management agencies, such as the USDA Forest Service, the National Park Service, Bureau of Indian Affairs, and the Bureau of Land Management.

- **Available fuel**. The spread of fire depends on the amount of burnable material. Trees that contain oily sap, such as eucalyptus, provide tremendous fuel when dry.

- **Hilly terrain.** When other factors are even, fire spreads faster uphill than downhill.

Forecasters use the **Haines Index** to indicate the potential for large fire growth. The Haines Index is shown below.

HAINES INDEX	*RISK*
2 or 3	Very low
4	Low
5	Moderate
6	High

HISTORICAL EXAMPLES

- In October 1991, brush fires swept through the Oakland, California suburbs, which abutted a grassland area. Many analysts attributed the extensive damage to the century-old practice of planting eucalyptus trees in the area. Eucalyptus trees are oily and volatile, creating a serious fire hazard. Strong winds and extended drought contributed to the rapid spread of this fire. Preliminary estimates put damages between $2.5 and $5 billion. Twenty-three people died and 148 were injured.

SOURCES OF INFORMATION

U.S. Forest Service manages fire fighting activities on National Forest land, though interagency cooperation is the rule in wildland fire fighting. Other Federal agencies that may be involved with fire management on Federal land include the:

- ❒ Bureau of Land Management.
- ❒ National Park Service.
- ❒ Bureau of Indian Affairs.
- ❒ Fish and Wildlife Service.
- ❒ Bureau of Reclamation.
- ❒ Department of Defense.

PRODUCTS

The following table lists NWS products that provide planning and preparedness information on fire weather conditions. Appendix A describes the dissemination systems of these products, as well as other sources (such as the Internet or private online services).

PRODUCT	*IDENTIFIER*	*SOURCE*	DESCRIPTION
Outlooks			
Outlook and Extended Forecast	__FWF___	Local Weather Service Fire Weather Office (FWO)	This forecast is issued as part of the routine Fire Weather Forecast to cover 2 or 3 days beyond the basic forecast period. General terms are used to highlight weather elements critical to the user agency's operation. Longer range outlooks also may be issued on request for advance planning by fire managers.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	DESCRIPTION
Watches			
Fire Weather Watch	__FWF___	Local Weather Service Office FWO	This product is used to advise of the possible development of a red flag event in the near future. It is issued by a fire weather forecaster for all or any portion of his or her area of responsibility when he or she is reasonably confident that a red flag event will occur. It should be issued 12 to 48 hours in advance but not more than 72 hours in advance of expected onset of critical weather conditions. It remains in effect until the: ❒ Forecaster determines that the event will not occur and the watch will be canceled; or ❒ Watch is upgraded to a red flag warning.
Statements			
Rangeland and Fire Danger Statement	__RDF__	Local Weather Service Office FWO	This product describes weather conditions as they relate to fire danger in rangeland.
Advisories/ Warnings			
Red Flag Warning	__RFW__ __FWF__	Local Weather Service Office FWO	This is used to warn of an impending or actual occurrence of a red flag event. It is issued by the fire weather forecaster for any portion of or all of his or her area of responsibility. The warning remains in effect until critical weather conditions cease or fail to develop as forecast. The Warning includes a brief description of the conditions causing the ongoing or forecast event.

PRODUCTS (Continued)

PRODUCT	*IDENTIFIER*	*SOURCE*	DESCRIPTION
Advisories/ Warnings (Continued)			Red Flag Warnings are issued solely for the purpose of advising land management agencies of critical fire weather conditions. They should not be confused with other agencies' red flag alert program.
Discussions	__FWF__	Local Weather Service Office FWO	A discussion of relevant weather patterns is included as part of every presuppression or land management forecast.
Short Term Forecasts Spot Forecast For Wildfires and Prescribed Burning	__FWF__	Local Weather Service Office FWO	This forecast is a sit-specific, localized forecast of weather including a detailed 12-hour forecast and an additional 12-hour outlook of the: ❒ Winds (including the time of wind shifts due to terrain effects). ❒ Maximum and minimum temperature. ❒ Maximum and minimum humidity. Spot forecasts initially are issued only upon request; additional forecasts or revisions are issued as necessary.

AMPLE PRODUCTS

The sample products listed below are shown on the following pages:

- ❒ Outlook and Extended Forecast.
- ❒ Fire Weather Watch.
- ❒ Public Fire Danger Statement.
- ❒ Red Flag Warning.
- ❒ Fire Weather Discussion.
- ❒ Spot Forecast.

OUTLOOK AND EXTENDED FORECAST

FWFBOI

BOISE FIRE WEATHER OFFICE...AFTERNOON FORECAST
NATIONAL WEATHER SERVICE BOISE, IDAHO
ISSUED AT 1600 MDT MONDAY TULY 26, 1999

WESTERN IDAHO / SOUTHEAST OREGON

...HOT AND DRY WEATHER TO CONTINUE...

...ISOLATED THUNDERSTORMS OVER THE MOUNTAINS WEDNESDAY...

...RADIO BROADCAST DISCUSSION...
UPPER LEVEL RIDGE BUILDING OVER THE GREAT BASIN WILL RESULT IN HOT AND DRY WEATHER OVER THE NEXT FEW DAYS. MONSOONAL MOISTURE WILL MOVE NORTHWARD AND CAUSE ISOLATED AFTERNOON AND EVENING THUNDERSTORMS OVER THE MOUNTAINS WEDNESDAY.

...DISCUSSION...
AN UPPER LEVEL RIDGE BUILDING OVER THE GREAT BASIN WILL BRING EVEN HOTTER WEATHER THE NEXT COUPLE DAYS. SOME SOUTHERN VALLEY READINGS OF NEAR 100 DEGREES ARE LIKELY TUESDAY AND WEDNESDAY. SOME MONSOONAL MOISTURE WILL MOVE NORTHWARD THROUGH NEVADA AND UTAH...AND WILL COMBINE WITH THE STRONG SURFACE HEATING TO PRODUCE ISOLATED THUNDERSTORMS OVER THE MOUNTAINS WEDNESDAY AFTERNOON AND EVENING. THE BEST MOISTURE WILL BE AT MID AND HIGH LEVELS...THUS DRY STORMS WILL BE POSSIBLE. LONG RANGE MODELS SHOW THE VERY WARM TEMPS CONTINUING THROUGH NEXT WEEKEND...AS WELL AS ENOUGH MONSOONAL MOISTURE FOR A SLIGHT CHANCE OF THUNDERSTORMS OVER THE MOUNTAINS EACH DAY.

WEST CENTRAL IDAHO MOUNTAINS...(zones 401-404)
INCLUDES PAYETTE NF AND BOISE NF

TONIGHT...
- SKY/WEATHER .....CLEAR.
- LAL .....1.
- TEMPERATURE .....LOWS IN THE 40S HIGH ELEVATION BASINS. 50S ELSEWHERE.
- HUMIDITY .....MODERATE RECOVERY...MAX 45-60 PCT VALLEYS.
  POOR RECOVERY...MAX 30-40 PCT RIDGES.
- WIND - 20 FT
  - VALLEYS.....BECOMING DOWNSLOPE 2 TO 5 MPH AFTER SUNSET.
  - RIDGES.....SOUTHWEST WINDS 10 MPH.
- HAINES INDEX ....5 MODERATE.
- SMOKE DISPERSAL:

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   MIXING HEIGHT..LOWERING TO AROUND 500 FT AGL.
   TRANSPORT WIND..SOUTHWEST 6 MPH.

TUESDAY...
  SKY/WEATHER .....SUNNY AND WARMER.
  LAL .............1.
  TEMPERATURE .....UP 3-7. HIGHS 80S HIGHER ELEVATIONS AND LOWER TO MID
                   90S LOWEST VALLEYS.
  HUMIDITY ........DOWN 1-3. MIN 7-16 PCT.
  WIND - 20 FT..
    VALLEYS........BECOMING UPSLOPE 4 TO 9 MPH IN THE AFTERNOON.
    RIDGES.........SOUTHWEST WINDS 10 MPH.
  HAINES INDEX ....6 HIGH.
  SMOKE DISPERSAL:
    MIXING HEIGHT...INCREASING TO 9000 FT AGL.
    TRANSPORT WIND..SOUTHWEST 10 MPH.

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SOUTHWEST IDAHO/SOUTHEAST OREGON...(ZONES 408, 409, 637)
INCLUDES IDAHO LOWER SNAKE RIVER BLM, SHOSHONE BLM, VALE BLM
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TONIGHT...
  SKY/WEATHER .....CLEAR.
  LAL .............1.
  TEMPERATURE .....LOWS 50S TO LOWER 60S.
  HUMIDITY ........MODERATE RECOVERY...MAX 40-55 PCT VALLEYS.
                   POOR RECOVERY...MAX 30-39 PCT RIDGES.
WIND - 20 FT..
     VALLEYS.......BECOMING DOWNSLOPE 3-9 MPH BY MIDNIGHT.
     RIDGES........SOUTHWEST 10 MPH.
HAINES INDEX......5 HIGH
SMOKE DISPERSAL
  MIXING HEIGHT ...LOWERING TO 1000 FT AGL.
  TRANSPORT WINDS .SOUTH 6 MPH.

TUESDAY
  SKY/WEATHER .....SUNNY AND HOT. A FEW AFTERNOON FLAT CUMULUS OVER THE
                   SOUTHERN HIGHLANDS.
  LAL .............1.
  TEMPERATURE .....UP 3-6. HIGHS 90S TO AROUND 100.
  HUMIDITY ........DOWN 1-4. MIN 5 TO 13 PCT.
  WIND - 20 FT.
     VALLEYS.......SOUTHWEST TO NORTHWEST 5 TO 10 MPH DURING THE
                   AFTERNOON.
     RIDGES........SOUTHWEST WINDS 10 MPH
  HAINES INDEX ....6 HIGH
  SMOKE DISPERSAL:
    MIXING HEIGHT ..INCREASING TO 11000 FT AGL.
    TRANSPORT WIND .SOUTHWEST 10 MPH.

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OUTLOOK WEDNESDAY...
MOSTLY SUNNY. ISOLATED LATE AFTERNOON AND EVENING THUNDERSTORMS OVER THE SOUTHERN HIGHLANDS AND THE IDAHO WEST CENTRAL MOUNTAINS. HIGHS 80S TO LOWER 90S MOUNTAINS AND 90S TO LOWER 100S VALLEYS.

EXTENDED FORECAST...THURSDAY THROUGH SATURDAY
MOSTLY SUNNY. ISOLATED AFTERNOON AND EVENING THUNDERSTORMS OVER THE MOUNTAINS. HIGHS 80S TO LOWER 90S MOUNTAINS AND 90S TO LOWER 100S VALLEYS.

EXTENDED OUTLOOK FOR SUNDAY AUGUST 1 THROUGH THURSDAY AUGUST 5 CALLS FOR NEAR NORMAL TEMPERATURES AND NO PRECIPITATION.

~~EASTERN IDAHO~~

...ISOLATED THUNDERSTORMS MAINLY EAST PORTION NEXT COUPLE DAYS...

...DISCUSSION...
HIGH PRESSURE CONTINUES TO BUILD WESTWARD OVER COLORADO AND UTAH WITH SOUTHERLY WINDS BEGINNING TO BRING MOISTURE NORTH INTO IDAHO. ISOLATED THUNDERSTORMS ARE POSSIBLE TUESDAY AND WEDNESDAY AFTERNOON...MAINLY EAST OF A BURLEY-ISLAND PARK LINE.

EASTERN IDAHO MOUNTAINS (ZONES 405, 406, 407)
~~INCLUDES SALMON-CHALLIS NG AND NORTHERN SAWTOOTH NF~~

TONIGHT...
- SKY/WEATHER .....CLEAR.
- LAL 1
- TEMPERATURE .....LOWS 40 TO 50 VALLEYS...50 TO 60 RIDGES.
- HUMIDITY .....MAX 70 TO 85% VALLEYS...35 TO 50% RIDGES.
- WIND – 20 FT.
  - VALLEYS.....DOWNSLOPE 5 TO 10 MPH.
  - RIDGES.....SOUTHEAST 5 TO 10 MPH.
- HAINES INDEX ....6 HIGH
- SMOKE DISPERSAL
  - MIXING HEIGHT..1000 TO 2000 FT...DECREASING TO 500 FT AGL LATE.
  - TRANSPORT WINDS SOUTHEAST 4 TO 8 MPH.

TUESDAY...
- SKY/WEATHER .....SUNNY.
- LAL 1
- TEMPERATURE .....HIGH 85 TO 95.
- HUMIDITY .....MIN 11 TO 20%
- WIND - 20 FT...
  - VALLEYS.....UPSLOPE 5 TO 10 MPH.

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    RIDGES........SOUTHWEST 10 TO 15 MPH.
  HAINES INDEX ....6 HIGH
  SMOKE DISPERSAL:
   MIXING HEIGHT ..11000 TO 13000 FT AGL.
---TRANSPORT WINDS SOUTHWEST 15 TO 20 MPH.----------


IDAHO UPPER SNAKE RIVER PLAIN (ZONE 410)----------
INCLUDES PORTIONS OF IDAHO UPPER SNAKE RIVER BLM


TONIGHT
  SKY/WEATHER .....MOSTLY CLEAR.
  LAL .............1
  TEMPERATURE .....LOWS IN THE MID TO UPPER 40S.
  HUMIDITY ........MAX 55 TO 65%
  WIND - 20 FT...
     VALLEYS.......EAST OR DOWNSLOPE 5 TO 10 MPH.
     RIDGES........SOUTHEAST 5 TO 10 MPH.
  HAINES INDEX ....6 HIGH
  SMOKE DISPERSAL:
   MIXING HEIGHT ..LOWERING TO AROUND 2000 FT.
   TRANSPORT WINDS SOUTHEAST 5 TO 10 MPH.

TUESDAY...
  SKY/WEATHER .....PARTLY CLOUDY. A SLIGHT CHANCE OF AFTERNOON SHOWERS
                   AND THUNDERSTORMS.
  LAL .............2
  TEMPERATURE .....HIGHS 90 TO 95.
  HUMIDITY ........MIN 12 TO 22%
  WIND - 20 FT...
     VALLEYS.......SOUTHWEST 5 TO 15 MPH.
     RIDGES........SOUTHWEST 10 TO 15 MPH.
  HAINES INDEX ....5 MODERATE
  SMOKE DISPERSAL:
   MIXING HEIGHT ..7000 TO 8000 FT AGL.
---TRANSPORT WINDS SOUTHWEST AROUND 10 MPH.----------


SOUTHEAST IDAHO HIGHLANDS (ZONES 411, 412, 413)----------
INCLUDES SOUTHERN SAWTOOTH NF CARIBOU NF AND TARGHEE NF


TONIGHT...
  SKY/WEATHER .....MOSTLY CLEAR.
  LAL .............1
  TEMPERATURE .....LOWS IN THE LOWER 40S NORTH TO AROUND 50 SOUTH.
  HUMIDITY ........MAX 60 TO 70% VALLEYS...40 TO 50% RIDGES.
  WIND - 20 FT...
     VALLEYS.......DOWNSLOPE 4 TO 8 MPH.
     RIDGES........SOUTHEAST 5 TO 10 MPH.
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  HAINES INDEX ....5 MODERATE
  SMOKE DISPERSAL:
    MIXING HEIGHT..DECREASING TO 1000 TO 1200 FT.
    TRANSPORT WINDS SOUTH 5 TO 10 MPH.

TUESDAY...
  SKY/WEATHER .....PARTLY CLOUDY. A SLIGHT CHANCE OF AFTERNOON SHOWERS
                   AND THUNDERSTORMS.
  LAL .............2
  TEMPERATURE .....HIGHS IN THE MID 80S NORTH TO MID 90S SOUTH.
  HUMIDITY ........MIN 17 TO 30% NORTH...15 TO 25% SOUTH.
  WIND - 20 FT...
     VALLEYS.......UPSLOPE 5 TO 10 MPH.
     RIDGES........SOUTH-SOUTHWEST 5 TO 15 MPH.
  HAINES INDEX ....5 MODERATE.
  SMOKE DISPERSAL:
    MIXING HEIGHT..7000 TO 9000 FT AGL.
    TRANSPORT WINDS SOUTHWEST 15 TO 20 MPH.



OUTLOOK WEDNESDAY...MOSTLY CLEAR MORNING...PARTLY CLOUDY AFTERNOON. A
SLIGHT CHANCE OF AFTERNOON SHOWERS AND THUNDERSTORMS...MAINLY EAST.
VALLEY LOWS FROM 45 TO 55 AND HIGHS IN THE 90S. MOUNTAINS LOWS IN THE
40S AND HIGHS IN THE 80S.

EXTENDED FORECAST...FOR THURSDAY THROUGH SATURDAY...

 THURSDAY...PARTLY CLOUDY. A CHANCE OF MAINLY AFTERNOON AND EVENING
SHOWERS AND THUNDERSTORMS. VALLEY LOWS IN THE 50S AND HIGHS IN THE
90S. MOUNTAIN LOWS IN THE 40S AND HIGHS IN THE 80S.
 FRIDAY AND SATURDAY...MOSTLY CLEAR NIGHTS. PARTLY CLOUDY DAYS WITH A
SLIGHT CHANCE OF AFTERNOON AND EARLY EVENING SHOWERS AND
THUNDERSTORMS. VALLEY LOWS FROM 45 TO 55 AND HIGHS FROM THE UPPER 80S
TO MID 90S. MOUNTAIN LOWS IN THE 40S AND HIGHS FROM THE UPPER 70S TO
UPPER 80S.

EXTENDED OUTLOOK...FOR SUNDAY AUGUST 1 THROUGH THURSDAY AUGUST
5...TEMPERATURES WILL BE NEAR NORMAL WITH LITTLE OR NO PRECIPITATION.
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WESTERN WYOMING


...WARM AND MAINLY DRY THIS WEEK...

DISCUSSION...A RIDGE OF HIGH PRESSURE WILL CONTINUE TO BRING WARM AND
MAINLY DRY WEATHER TO WYOMING THROUGH THE WEEK. ISOLATED AFTERNOON AND
EARLY EVENING THUNDERSTORMS ARE POSSIBLE...BUT MOST AREAS WILL REMAIN
DRY.
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FIRE WEATHER ZONES...414...415...416
 INCLUDING...SOUTHERN BRIDGER TETON NF-NORTHERN BRIDGER TETON NF/GRAND
TETON NP-YELLOWSTONE NP
TONIGHT
 SKY/WEATHER .....CLEAR.
 LAL .............1.
 TEMPERATURE .....LOWS IN THE UPPER 30S TO MIDDLE 40S.
 RELATIVE HUMIDITY MAX 68 TO 75 PERCENT. RECOVERY...FAIR.
 WIND - 20 FOOT...
    VALLEYS.......SOUTHWEST 3 TO 8 MPH EVENING...THEN BECOMING DOWN
                  VALLEY 3 TO 8 MPH.
    RIDGES........SOUTHWEST 5 TO 10 MPH EVENING...THEN BECOMING
                  DOWNSLOPE 3 TO 8 MPH.
 CHANCE OF WETTING RAIN...ZERO PERCENT.
 STABILITY .......THE LOWER AIR MASS WILL BECOME VERY STABLE BY 10 PM.
 SMOKE DISPERSAL: BECOMING POOR BY 9 PM.
 MIXING HEIGHT ...DECREASING BELOW 1000 FEET AGL.
 TRANSPORT WINDS .SOUTHWEST 3 TO 8 MPH.

TUESDAY
 SKY/WEATHER .....MOSTLY SUNNY. ISOLATED AFTERNOON THUNDERSTORMS.
 LAL .............2.
 TEMPERATURE .....HIGHS IN THE 70S TO LOWER 80S.
 RELATIVE HUMIDITY...MIN 35 TO 43 PERCENT.
 WIND - 20 FOOT...
    VALLEYS.......UP VALLEY 4 TO 8 MPH MORNING...SOUTH TO SOUTHWEST 5
                  TO 10 MPH DURING THE AFTERNOON.
    RIDGES........UPSLOPE 4 TO 8 MPH MORNING...SOUTH TO SOUTHWEST 10
                  TO 15 MPH DURING THE AFTERNOON.
 CHANCE OF WETTING RAIN...ZERO PERCENT.
 STABILITY .......HAINES INDEX 6. AIR MASS BECOMING UNSTABLE BY 11 AM.
 SMOKE DISPERSAL .BECOMING EXCELLENT.
 MIXING HEIGHT ...INCREASING TO 12000 FEET AGL BY NOON
 TRANSPORT WINDS .FROM 260 DEGREES AT 15 MPH.
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 EXTENDED FORECAST
 TUESDAY NIGHT...MOSTLY CLEAR. LOWS IN THE 40S.
 WEDNESDAY THROUGH FRIDAY...VERY WARM WITH A SLIGHT CHANCE OF LATE DAY
 THUNDERSTORMS. LOWS IN THE 40S. HIGHS IN THE MIDDLE 70S TO MIDDLE
 80S.

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FIRE WEATHER ZONES...417 INCLUDING...ROCK SPRINGS BLM
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TONIGHT
 SKY/WEATHER .....MOSTLY CLEAR.
 LAL .............1.
 TEMPERATURE .....LOWS IN THE MIDDLE 50S.
 RELATIVE HUMIDITY...MAX 39 TO 44 PERCENT. RECOVERY...POOR.
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  WIND - 20 FOOT...
     VALLEYS.......SOUTHWEST 5 TO 10 MPH EVENING...THEN BECOMING SOUTH
                   TO SOUTHWEST 2 TO 7 MPH.
     RIDGES........SOUTHWEST 5 TO 10 MPH EVENING...THEN BECOMING SOUTH
                   TO SOUTHWEST 2 TO 7 MPH.
  CHANCE OF WETTING RAIN...ZERO PERCENT.
  STABILITY .......THE LOWER AIR MASS WILL BECOME VERY STABLE BY 10 PM.
  SMOKE DISPERSAL .BECOMING POOR BY 9 PM.
  MIXING HEIGHT ...DECREASING BELOW 1000 FEET AGL.
  TRANSPORT WINDS .FROM 250 DEGREES AT 8 MPH.

TUESDAY
  SKY/WEATHER .....MOSTLY SUNNY. ISOLATED AFTERNOON THUNDERSTORMS.
  LAL .............2.
  TEMPERATURE .....HIGHS IN THE UPPER 80S.
  RELATIVE HUMIDITY...MIN 20 TO 25 PERCENT.
  WIND 20 FOOT...
     VALLEYS.......SOUTH WIND 3 TO 7 MPH MORNING...THEN BECOMING
                   SOUTHWEST 8 TO 12 MPH.
     RIDGES........SOUTH WIND 3 TO 7 MPH MORNING...THEN BECOMING
                   SOUTHWEST 8 TO 12 MPH.
  CHANCE OF WETTING RAIN...ZERO PERCENT.
  STABILITY .......HAINES INDEX 6. AIR MASS BECOMING UNSTABLE BY 11 AM.
  SMOKE DISPERSAL .BECOMING EXCELLENT.
  MIXING HEIGHT ...INCREASING TO 13000 FEET AGL BY NOON.
  TRANSPORT WINDS .FROM 250 DEGREES AT 15 MPH.

EXTENDED FORECAST
TUESDAY NIGHT.....PARTLY CLOUDY. LOWS IN THE MIDDLE 50S.
WEDNESDAY THROUGH FRIDAY...HOT WITH A SLIGHT CHANCE OF LATE DAY
THUNDERSTORMS. LOWS 55 TO 60. HIGHS IN THE UPPER 80S AND LOWER 90S.
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FIRE WEATHER WATCH

GTFFWFMSO
TTAA00 KMSO 081205
NATIONAL WEATHER SERVICE MISSOULA MONTANA
FIRE WEATHER FORECAST

...FIRE WEATHER WATCH FOR SCATTERED DRY LIGHTNING NEXT TWO EVENINGS...

DISCUSSION...A STRONG RIDGE OF HIGH PRESSURE WILL CONTINUE OVER WESTERN MONTANA THROUGH TUESDAY. VERY HOT TEMPERATURES THE NEXT TWO AFTERNOONS SHOULD CAUSE SCATTERED DRY THUNDERSTORMS TO DEVELOP.

ALL ZONES...

TODAY...
WEATHER...SUNNY...ISOLATED CLOUD BUILDUPS TOWARD EVENING.
LAL...2 CWR...LESS THAN 10 PCT
MAX TEMPERATURES...86 TO 96
MIN HUMIDITY...18 TO 28 PCT.
SURFACE WINDS...MOSTLY SLOPE WINDS 5 TO 10 MPH...GUSTY NEAR THUNDERSTORMS.
FREE AIR WIND...LIGHT AND VARIABLE 5 MPH.

TONIGHT...FIRE WEATHER WATCH UNTIL MIDNIGHT FOR SCATTERED DRY LIGHTNING. WEATHER...SCATTERED THUNDERSTORMS...DISSIPATING AFTER MIDNIGHT.
LAL...6 CWR...LESS THAN 10 PCT.
MIN TEMPERATURES...48 TO 56.
MAX HUMIDITY...VALLEYS ABOVE 70 PCT...MID TO UPPER SLOPES 55 TO 70 PCT.
SURFACE WINDS...LIGHT SLOPE WINDS...EXCEPT GUSTY NEAR ANY THUNDERSTORMS.
FREE AIR WINDS...SOUTHWEST 5 MPH.

TUESDAY...FIRE WEATHER WATCH FOR DRY LIGHTNING LATE IN THE DAY.
EATHER...PARTLY CLOUDY...SCATTERED THUNDERSTORMS LATE AFTERNOON.
LAL...6 CWR...LESS THAN 10 PCT
MAX TEMPERATURES...86 TO 96
MIN HUMIDITY...18 TO 28 PCT.

SURFACE WINDS...LIGHT AND VARIABLE 5 TO 10 MPH...EXCEPT GUSTY NEAR ANY THUNDERSTORMS.
FREE AIR WINDS...SOUTHWEST 10 MPH.

PUBLIC FIRE DANGER STATEMENT

RFDFAR

PUBLIC FIRE DANGER STATEMENT
NATIONAL WEATHER SERVICE EASTERN ND/GRAND FORKS ND
1111 AM CDT FRI MAY 28 1999

MNZ001-004-005-007-008-013-014-282000-
EAST MARSHALL COUNTY-KITTSON COUNTY-PENNINGTON COUNTY-
RED LAKE COUNTY-ROSEAU COUNTY-WEST MARSHALL COUNTY-WEST POLK COUNTY-
INCLUDING HALLOCK...THIEF RIVER FALLS...ROSEAU...CROOKSTON

...CRITICAL BURNING CONDITIONS ARE LIKELY FOR A PORTION OF
NORTHWESTERN MINNESOTA THIS AFTERNOON...

THE AREA OF CONCERN IS NORTHWEST OF A LINE FROM BELTRAMI TO
WARROAD...INCLUDING THE CITIES OF
CROOKSTON...WARREN...HALLOCK...ROSEAU...THIEF RIVER FALLS AND RED LAKE
FALLS.

AN AREA OF LOW PRESSURE...CENTERED IN SOUTHERN SASKATCHEWAN...IS
MOVING TOWARD THE REGION TODAY. AS THE LOW MOVES EAST...THE SOUTHWEST
WIND WILL INCREASE AND GUST OVER 25 MPH. IN ADDITION...HUMIDITIES ARE
EXPECTED TO DROP INTO THE UPPER TEENS TO LOWER 20S AND TEMPERATURES
CLIMB INTO THE LOWER TO MIDDLE 80S...CREATING CRITICAL BURNING
CONDITIONS.

PLEASE BE ADVISED TO TAKE NECESSARY PRECAUTIONS TO AVOID WILDFIRES.

RED FLAG WARNING

RFWBOI

RED FLAG WARNING
NATIONAL WEATHER SERVICE BOISE, IDAHO
ISSUED 1610 MDT SATURDAY JULY 24, 1999 LESTER

****
RED FLAG WARNING FOR PORTIONS OF SOUTHEAST IDAHO (ZONES 410-411) AND SOUTHWEST WYOMING (ZONE 417) CONTINUES UNTIL 9PM THIS EVENING FOR GUSTY WINDS AND LOW HUMIDITIES. THIS INCLUDES UPPER SNAKE RIVER BLM, TARGHEE NF AND ROCK SPRINGS BLM.
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...DISCUSSION...
Sustained winds of 15-25 mph and gusts to 30-40 mph will persist across the warning area into the evening hours. Winds will then decrease after sunset as the upper trough weakens and begins to exit the region. As a result...the warning will expire at 9pm this evening.

FIRE WEATHER DISCUSSION

FWFBOI

BOISE FIRE WEATHER OFFICE...AFTERNOON FORECAST
NATIONAL WEATHER SERVICE BOISE, IDAHO
ISSUED AT 1600 MDT MONDAY TULY 26, 1999

WESTERN IDAHO / SOUTHEAST OREGON

...HOT AND DRY WEATHER TO CONTINUE...

...ISOLATED THUNDERSTORMS OVER THE MOUNTAINS WEDNESDAY

...RADIO BROADCAST DISCUSSION...
UPPER LEVEL RIDGE BUILDING OVER THE GREAT BASIN WILL RESULT IN HOT AND DRY WEATHER OVER THE NEXT FEW DAYS. MONSOONAL MOISTURE WILL MOVE NORTHWARD AND CAUSE ISOLATED AFTERNOON AND EVENING THUNDERSTORMS OVER THE MOUNTAINS WEDNESDAY.

...DISCUSSION...
AN UPPER LEVEL RIDGE BUILDING OVER THE GREAT BASIN WILL BRING EVEN HOTTER WEATHER THE NEXT COUPLE DAYS. SOME SOUTHERN VALLEY READINGS OF NEAR 100 DEGREES ARE LIKELY TUESDAY AND WEDNESDAY. SOME MONSOONAL MOISTURE WILL MOVE NORTHWARD THROUGH NEVADA AND UTAH...AND WILL COMBINE WITH THE STRONG SURFACE HEATING TO PRODUCE ISOLATED THUNDERSTORMS OVER THE MOUNTAINS WEDNESDAY AFTERNOON AND EVENING. THE BEST MOISTURE WILL BE AT MID AND HIGH LEVELS...THUS DRY STORMS WILL BE POSSIBLE. LONG RANGE MODELS SHOW THE VERY WARM TEMPS CONTINUING THROUGH NEXT WEEKEND...AS WELL AS ENOUGH MONSOONAL MOISTURE FOR A SLIGHT CHANCE OF THUNDERSTORMS OVER THE MOUNTAINS EACH DAY.

WEST CENTRAL IDAHO MOUNTAINS...(zones 401-404)
INCLUDES PAYETTE NF AND BOISE NF

TONIGHT...
- SKY/WEATHER .....CLEAR.
- LAL .....1.
- TEMPERATURE .....LOWS IN THE 40S HIGH ELEVATION BASINS. 50S ELSEWHERE.
- HUMIDITY .....MODERATE RECOVERY...MAX 45-60 PCT VALLEYS. POOR RECOVERY...MAX 30-40 PCT RIDGES.
- WIND - 20 FT
  - VALLEYS.....BECOMING DOWNSLOPE 2 TO 5 MPH AFTER SUNSET.
  - RIDGES.....SOUTHWEST WINDS 10 MPH.
- HAINES INDEX ....5 MODERATE.
- SMOKE DISPERSAL:

FIRE WEATHER DISCUSSION (Continued)

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   MIXING HEIGHT ..LOWERING TO AROUND 500 FT AGL.
   TRANSPORT WIND .SOUTHWEST 6 MPH.

TUESDAY...
  SKY/WEATHER .....SUNNY AND WARMER.
  LAL .............1.
  TEMPERATURE .....UP 3-7. HIGHS 80S HIGHER ELEVATIONS AND LOWER TO MID
                   90S LOWEST VALLEYS.
  HUMIDITY ........DOWN 1-3. MIN 7-16 PCT.
  WIND - 20 FT..
    VALLEYS........BECOMING UPSLOPE 4 TO 9 MPH IN THE AFTERNOON.
    RIDGES.........SOUTHWEST WINDS 10 MPH.
  HAINES INDEX ....6 HIGH.
  SMOKE DISPERSAL:
    MIXING HEIGHT...INCREASING TO 9000 FT AGL.
    TRANSPORT WIND..SOUTHWEST 10 MPH.

-------------------------------------------------------------------------------
SOUTHWEST IDAHO/SOUTHEAST OREGON...(ZONES 408, 409, 637)
INCLUDES IDAHO LOWER SNAKE RIVER BLM, SHOSHONE BLM, VALE BLM
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TONIGHT...
  SKY/WEATHER .....CLEAR.
  LAL .............1.
  TEMPERATURE .....LOWS 50S TO LOWER 60S.
  HUMIDITY ........MODERATE RECOVERY...MAX 40-55 PCT VALLEYS.
                   POOR RECOVERY...MAX 30-39 PCT RIDGES.
WIND - 20 FT..
     VALLEYS.......BECOMING DOWNSLOPE 3-9 MPH BY MIDNIGHT.
     RIDGES........SOUTHWEST 10 MPH.
HAINES INDEX......5 HIGH
SMOKE DISPERSAL
  MIXING HEIGHT ...LOWERING TO 1000 FT AGL.
  TRANSPORT WINDS .SOUTH 6 MPH.

TUESDAY
  SKY/WEATHER .....SUNNY AND HOT. A FEW AFTERNOON FLAT CUMULUS OVER THE
                   SOUTHERN HIGHLANDS.
  LAL .............1.
  TEMPERATURE .....UP 3-6. HIGHS 90S TO AROUND 100.
  HUMIDITY ........DOWN 1-4. MIN 5 TO 13 PCT.
  WIND ............20 FT.
     VALLEYS.......SOUTHWEST TO NORTHWEST 5 TO 10 MPH DURING THE
                   AFTERNOON.
     RIDGES........SOUTHWEST WINDS 10 MPH
  HAINES INDEX ....6 HIGH
  SMOKE DISPERSAL:
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FIRE WEATHER DISCUSSION (Continued)

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   MIXING HEIGHT ..INCREASING TO 11000 FT AGL.
   TRANSPORT WIND .SOUTHWEST 10 MPH.

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OUTLOOK WEDNESDAY...
MOSTLY SUNNY. ISOLATED LATE AFTERNOON AND EVENING THUNDERSTORMS OVER
THE SOUTHERN HIGHLANDS AND THE IDAHO WEST CENTRAL MOUNTAINS. HIGHS 80S
TO LOWER 90S MOUNTAINS AND 90S TO LOWER 100S VALLEYS.

EXTENDED FORECAST...THURSDAY THROUGH SATURDAY
MOSTLY SUNNY. ISOLATED AFTERNOON AND EVENING THUNDERSTORMS OVER THE
MOUNTAINS. HIGHS 80S TO LOWER 90S MOUNTAINS AND 90S TO LOWER 100S
VALLEYS.

EXTENDED OUTLOOK FOR SUNDAY AUGUST 1 THROUGH THURSDAY AUGUST 5 CALLS
FOR NEAR NORMAL TEMPERATURES AND NO PRECIPITATION.

-------------------------------------------------------------------------------
EASTERN IDAHO
-------------------------------------------------------------------------------

...ISOLATED THUNDERSTORMS MAINLY EAST PORTION NEXT COUPLE DAYS...

...DISCUSSION...
HIGH PRESSURE CONTINUES TO BUILD WESTWARD OVER COLORADO AND UTAH WITH
SOUTHERLY WINDS BEGINNING TO BRING MOISTURE NORTH INTO IDAHO. ISOLATED
THUNDERSTORMS ARE POSSIBLE TUESDAY AND WEDNESDAY AFTERNOON...MAINLY
EAST OF A BURLEY-ISLAND PARK LINE.

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EASTERN IDAHO MOUNTAINS (ZONES 405, 406, 407)
INCLUDES SALMON-CHALLIS NG AND NORTHERN SAWTOOTH NF
-------------------------------------------------------------------------------

TONIGHT...
 SKY/WEATHER .....CLEAR
 LAL .............1.
 TEMPERATURE .....LOWS 40 TO 50 VALLEYS...50 TO 60 RIDGES.
 HUMIDITY ........MAX 70 TO 85% VALLEYS...35 TO 50% RIDGES.
 WIND - 20 FT.
    VALLEYS.......DOWNSLOPE 5 TO 10 MPH.
    RIDGES........SOUTHEAST 5 TO 10 MPH.
 HAINES INDEX ....6 HIGH
 SMOKE DISPERSAL
  MIXING HEIGHT ..1000 TO 2000 FT...DECREASING TO 500 FT AGL LATE.
  TRANSPORT WINDS SOUTHEAST 4 TO 8 MPH.
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FIRE WEATHER DISCUSSION (Continued)

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TUESDAY...
 SKY/WEATHER .....SUNNY
 LAL .............1
 TEMPERATURE .....HIGH 85 TO 95
 HUMIDITY ........MIN 11 TO 20%
 WIND ............20 FT...
    VALLEYS.......UPSLOPE 5 TO 10 MPH
    RIDGES........SOUTHWEST 10 TO 15 MPH
 HAINES INDEX ....6 HIGH
 SMOKE DISPERSAL:
  MIXING HEIGHT ..11000 TO 13000 FT AGL
  TRANSPORT WINDS SOUTHWEST 15 TO 20 MPH

-------------------------------------------------------------------------------
IDAHO UPPER SNAKE RIVER PLAIN (ZONE 410)
INCLUDES PORTIONS OF IDAHO UPPER SNAKE RIVER BLM
-------------------------------------------------------------------------------

TONIGHT
 SKY/WEATHER .....MOSTLY CLEAR.
 LAL .............1
 TEMPERATURE .....LOWS IN THE MID TO UPPER 40S.
 HUMIDITY ........MAX 55 TO 65%
 WIND - 20 FT...
    VALLEYS.......EAST OR DOWNSLOPE 5 TO 10 MPH.
    RIDGES........SOUTHEAST 5 TO 10 MPH.
 HAINES INDEX ....6 HIGH
 SMOKE DISPERSAL:
  MIXING HEIGHT ..LOWERING TO AROUND 2000 FT.
  TRANSPORT WINDS SOUTHEAST 5 TO 10 MPH.

TUESDAY...
 SKY/WEATHER .....PARTLY CLOUDY. A SLIGHT CHANCE OF AFTERNOON SHOWERS
                  AND THUNDERSTORMS.
 LAL .............2
 TEMPERATURE .....HIGHS 90 TO 95.
 HUMIDITY ........MIN 12 TO 22%
 WIND - 20 FT...
    VALLEYS.......SOUTHWEST 5 TO 15 MPH.
    RIDGES........SOUTHWEST 10 TO 15 MPH.
 HAINES INDEX ....5 MODERATE
 SMOKE DISPERSAL:
  MIXING HEIGHT ..7000 TO 8000 FT AGL.
  TRANSPORT WINDS SOUTHWEST AROUND 10 MPH.
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FIRE WEATHER DISCUSSION (Continued)

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------------------------------------------------------------------------------
SOUTHEAST IDAHO HIGHLANDS (ZONES 411, 412, 413)
INCLUDES SOUTHERN SAWTOOTH NF CARIBOU NF AND TARGHEE NF
------------------------------------------------------------------------------

TONIGHT...
 SKY/WEATHER .....MOSTLY CLEAR.
 LAL .............1
 TEMPERATURE .....LOWS IN THE LOWER 40S NORTH TO AROUND 50 SOUTH.
 HUMIDITY ........MAX 60 TO 70% VALLEYS...40 TO 50% RIDGES.
 WIND - 20 FT...
    VALLEYS.......DOWNSLOPE 4 TO 8 MPH.
    RIDGES........SOUTHEAST 5 TO 10 MPH.
 HAINES INDEX ....5 MODERATE
 SMOKE DISPERSAL:
  MIXING HEIGHT ..DECREASING TO 1000 TO 1200 FT.
  TRANSPORT WINDS SOUTH 5 TO 10 MPH.

TUESDAY...
 SKY/WEATHER .....PARTLY CLOUDY. A SLIGHT CHANCE OF AFTERNOON SHOWERS
                  AND THUNDERSTORMS.
 LAL .............2
 TEMPERATURE .....HIGHS IN THE MID 80S NORTH TO MID 90S SOUTH.
 HUMIDITY ........MIN 17 TO 30% NORTH...15 TO 25% SOUTH.
 WIND - 20 FT...
    VALLEYS.......UPSLOPE 5 TO 10 MPH.
    RIDGES........SOUTH-SOUTHWEST 5 TO 15 MPH.
 HAINES INDEX ....5 MODERATE.
 SMOKE DISPERSAL:
  MIXING HEIGHT ..7000 TO 9000 FT AGL.
  TRANSPORT WINDS SOUTHWEST 15 TO 20 MPH.

------------------------------------------------------------------------------

OUTLOOK WEDNESDAY...MOSTLY CLEAR MORNING...PARTLY CLOUDY AFTERNOON. A
SLIGHT CHANCE OF AFTERNOON SHOWERS AND THUNDERSTORMS...MAINLY EAST.
VALLEY LOWS FROM 45 TO 55 AND HIGHS IN THE 90S. MOUNTAINS LOWS IN THE
40S AND HIGHS IN THE 80S.

EXTENDED FORECAST...FOR THURSDAY THROUGH SATURDAY...

 THURSDAY...PARTLY CLOUDY. A CHANCE OF MAINLY AFTERNOON AND EVENING
SHOWERS AND THUNDERSTORMS. VALLEY LOWS IN THE 50S AND HIGHS IN THE
90S. MOUNTAIN LOWS IN THE 40S AND HIGHS IN THE 80S.
 FRIDAY AND SATURDAY...MOSTLY CLEAR NIGHTS. PARTLY CLOUDY DAYS WITH A
SLIGHT CHANCE OF AFTERNOON AND EARLY EVENING SHOWERS AND
THUNDERSTORMS. VALLEY LOWS FROM 45 TO 55 AND HIGHS FROM THE UPPER 80S
TO MID 90S. MOUNTAIN LOWS IN THE 40S AND HIGHS FROM THE UPPER 70S TO
UPPER 80S.
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FIRE WEATHER DISCUSSION (Continued)

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EXTENDED OUTLOOK...FOR SUNDAY AUGUST 1 THROUGH THURSDAY AUGUST
5...TEMPERATURES WILL BE NEAR NORMAL WITH LITTLE OR NO PRECIPITATION.

-------------------------------------------------------------------------------
WESTERN WYOMING
-------------------------------------------------------------------------------

...WARM AND MAINLY DRY THIS WEEK...

DISCUSSION...A RIDGE OF HIGH PRESSURE WILL CONTINUE TO BRING WARM AND
MAINLY DRY WEATHER TO WYOMING THROUGH THE WEEK. ISOLATED AFTERNOON AND
EARLY EVENING THUNDERSTORMS ARE POSSIBLE...BUT MOST AREAS WILL REMAIN
DRY.

-------------------------------------------------------------------------------
FIRE WEATHER ZONES...414...415...416
  INCLUDING...SOUTHERN BRIDGER TETON NF-NORTHERN BRIDGER TETON NF/GRAND
TETON NP-YELLOWSTONE NP
-------------------------------------------------------------------------------

TONIGHT
  SKY/WEATHER .....CLEAR.
  LAL .............1.
  TEMPERATURE .....LOWS IN THE UPPER 30S TO MIDDLE 40S.
  RELATIVE HUMIDITY MAX 68 TO 75 PERCENT. RECOVERY...FAIR.
  WIND - 20 FOOT...
     VALLEYS.......SOUTHWEST 3 TO 8 MPH EVENING...THEN BECOMING DOWN
                   VALLEY 3 TO 8 MPH.
     RIDGES........SOUTHWEST 5 TO 10 MPH EVENING...THEN BECOMING
                   DOWNSLOPE 3 TO 8 MPH.
  CHANCE OF WETTING RAIN...ZERO PERCENT.
  STABILITY .......THE LOWER AIR MASS WILL BECOME VERY STABLE BY 10 PM.
  SMOKE DISPERSAL: BECOMING POOR BY 9 PM.
  MIXING HEIGHT ...DECREASING BELOW 1000 FEET AGL.
  TRANSPORT WINDS .SOUTHWEST 3 TO 8 MPH.

TUESDAY
  SKY/WEATHER .....MOSTLY SUNNY. ISOLATED AFTERNOON THUNDERSTORMS.
  LAL .............2.
  TEMPERATURE .....HIGHS IN THE 70S TO LOWER 80S.
  RELATIVE HUMIDITY...MIN 35 TO 43 PERCENT.
  WIND - 20 FOOT...
     VALLEYS.......UP VALLEY 4 TO 8 MPH MORNING...SOUTH TO SOUTHWEST 5
                   TO 10 MPH DURING THE AFTERNOON.
     RIDGES........UPSLOPE 4 TO 8 MPH MORNING...SOUTH TO SOUTHWEST 10
                   TO 15 MPH DURING THE AFTERNOON.
  CHANCE OF WETTING RAIN...ZERO PERCENT.
  STABILITY .......HAINES INDEX 6. AIR MASS BECOMING UNSTABLE BY 11 AM.
```

FIRE WEATHER DISCUSSION (Continued)

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 SMOKE DISPERSAL .BECOMING EXCELLENT.
 MIXING HEIGHT ...INCREASING TO 12000 FEET AGL BY NOON
 TRANSPORT WINDS .FROM 260 DEGREES AT 15 MPH.
.
 EXTENDED FORECAST
 TUESDAY NIGHT...MOSTLY CLEAR. LOWS IN THE 40S.
 WEDNESDAY THROUGH FRIDAY...VERY WARM WITH A SLIGHT CHANCE OF LATE DAY
 THUNDERSTORMS. LOWS IN THE 40S. HIGHS IN THE MIDDLE 70S TO MIDDLE
 80S.

-------------------------------------------------------------------
FIRE WEATHER ZONES...417 INCLUDING...ROCK SPRINGS BLM
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TONIGHT
 SKY/WEATHER .....MOSTLY CLEAR.
 LAL .............1.
 TEMPERATURE .....LOWS IN THE MIDDLE 50S.
 RELATIVE HUMIDITY...MAX 39 TO 44 PERCENT. RECOVERY...POOR.
 WIND - 20 FOOT...
    VALLEYS.......SOUTHWEST 5 TO 10 MPH EVENING...THEN BECOMING SOUTH
                  TO SOUTHWEST 2 TO 7 MPH.
    RIDGES........SOUTHWEST 5 TO 10 MPH EVENING...THEN BECOMING SOUTH
                  TO SOUTHWEST 2 TO 7 MPH.
 CHANCE OF WETTING RAIN...ZERO PERCENT.
 STABILITY .......THE LOWER AIR MASS WILL BECOME VERY STABLE BY 10 PM.
 SMOKE DISPERSAL .BECOMING POOR BY 9 PM.
 MIXING HEIGHT ...DECREASING BELOW 1000 FEET AGL.
 TRANSPORT WINDS .FROM 250 DEGREES AT 8 MPH.

TUESDAY
 SKY/WEATHER .....MOSTLY SUNNY. ISOLATED AFTERNOON THUNDERSTORMS.
 LAL .............2.
 TEMPERATURE .....HIGHS IN THE UPPER 80S.
 RELATIVE HUMIDITY...MIN 20 TO 25 PERCENT.
 WIND 20 FOOT...
    VALLEYS.......SOUTH WIND 3 TO 7 MPH MORNING...THEN BECOMING
                  SOUTHWEST 8 TO 12 MPH.
    RIDGES........SOUTH WIND 3 TO 7 MPH MORNING...THEN BECOMING
                  SOUTHWEST 8 TO 12 MPH.
 CHANCE OF WETTING RAIN...ZERO PERCENT.
 STABILITY .......HAINES INDEX 6. AIR MASS BECOMING UNSTABLE BY 11 AM.
 SMOKE DISPERSAL .BECOMING EXCELLENT.
 MIXING HEIGHT ...INCREASING TO 13000 FEET AGL BY NOON.
 TRANSPORT WINDS .FROM 250 DEGREES AT 15 MPH.
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FIRE WEATHER DISCUSSION (Continued)

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EXTENDED FORECAST
TUESDAY NIGHT.....PARTLY CLOUDY. LOWS IN THE MIDDLE 50S.
WEDNESDAY THROUGH FRIDAY...HOT WITH A SLIGHT CHANCE OF LATE DAY
THUNDERSTORMS. LOWS 55 TO 60. HIGHS IN THE UPPER 80S AND LOWER 90S.
```

SPOT FORECAST

BOISPSBOI
TTAA00 KBOI 081205
NATIONAL WEATHER SERVICE BOISE IDAHO
SPECIAL FIRE WEATHER FORECAST

SPOT FORECAST FOR THE GREEN RIVER BURN...BRIDGER-TETON NF ISSUED AT 1300 MDT TUESDAY MAY 9, 1989, GORSKI

DISCUSSION...LOW PRESSURE TROUGH STARTING TO MOVE ONTO THE WEST COAST. WARM AND UNSTABLE AIR AHEAD OF TROUGH COULD TOUCH OFF A FEW THUNDERSTORMS THIS EVENING. SATELLITE PICTURES SHOW LARGE AREA OF HEAVY MOISTURE COVERING SOUTHERN CALIFORNIA AND SOUTHERN NEVADA. THIS MOISTURE SHOULD SWING INTO WESTERN WYOMING ON WEDNESDAY...AS A MAJOR LOW PRESSURE TROUGH MOVES INTO THE ROCKIES. A FRONT ALSO TRACKS INTO WESTERN WYOMING WEDNESDAY NIGHT. THIS COMBINATION SHOULD TOUCH OFF A COOL SHOWERY REGIME. AIR MASS SHOULD BEGIN TO DRY OUT BUT REMAIN UNSTABLE LATE THURSDAY AND FRIDAY.

FIRST BURN PERIOD...THIS AFTERNOON

SKY/WEATHER...PARTLY SUNNY. FEW BUILDUPS WITH SLIGHT CHANCE OF THUNDERSTORM BY THIS EVENING.
TEMPERATURE...MAX 68-71.
HUMIDITY...MIN 35-40 PCT.
WINDS...EYE LEVEL...SOUTHERLY 4-6 MPH AFTERNOON. CHANCE OF GUST TO 35 MPH NEAR BUILDUPS.

SECOND BURN PERIOD...TONIGHT

KY/WEATHER...CHANCE OF A THUNDERSTORM EARLY TONIGHT. TEMPERATURE...MIN NEAR 40.
HUMIDITY RECOVERY ABOVE 70 PCT.
WINDS...EYE LEVEL...NORTHERLY 5 TO 8 MPH AFTER SUNSET. BECOMING 2 TO 5 MPH LATE TONIGHT.

OUTLOOK FOR THIRD BURN PERIOD...WEDNESDAY

SCATTERED SHOWERS AND WET THUNDERSHOWERS. HIGHS IN THE 60S. RELATIVE HUMIDITY 40S. SOUTHERLY WINDS 8 TO 16 MPH WITH GUSTS TO 22 MPH. GUSTS TO 40 MPH NEAR THUNDERSTORMS. EXTENDED FORECAST THURSDAY AND FRIDAY...DECREASING THUNDERSTORMS.

INDEX FOR NWS PRODUCTS IN FACT SHEETS

This index lists all NWS products contained in the fact sheets in Section III.

Warnings	Fact Sheet	Page
Excessive Heat Warning	Excessive Heat	III-136
High Wind Warning	Windstorms	III-149
Red Flag Warning	Fire Weather	III-165

Advisories	Fact Sheet	Page
Urban and Small Stream Flood Advisory	Flash Floods	III-37
Public Advisory	Tropical Cyclones	III-77
Intermediate Public Advisory	Tropical Cyclones	III-79
Tropical Cyclone Forecast/Advisory	Tropical Cyclones	III-81
Tsunami Advisory Bulletin	Tsunamis	III-99
Wind Chill Advisory	Winter Storms, Excessive Cold	III-122
Dense Fog Advisory	Fog	III-128
Blowing Dust Advisory	Duststorms	III-142

Forecast	Fact Sheet	Page
Short Term Forecast	Thunderstorms	III-19
Short Term Forecast	Coastal Floods	III-62
Strike Probability Forecast	Tropical Cyclones	III-83
Tropical Cyclone Forecast/Advisory	Tropical Cyclones	III-81
Short Term Forecast	Tropical Cyclones	III-86
Short Term Forecast	Winter Storms	III-115
Outlook and Extended Forecast	Fire Weather	III-156
Spot Forecast	Fire Weather	III-175

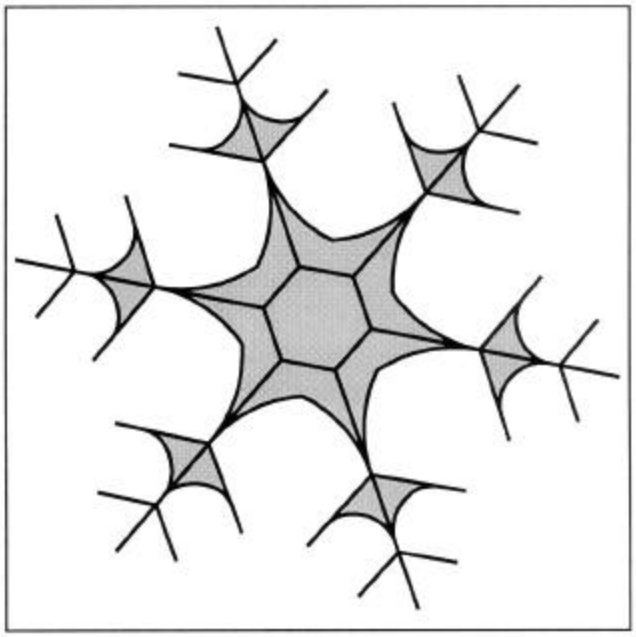
Statements	Fact Sheet	Page
Severe Weather Statement (Tornado)	Thunderstorms	III-20
Severe Weather Statement (Thunderstorm)	Thunderstorms	III-21
Coastal Flood Statements	Coastal Floods	III-57

Statements	Fact Sheet	Page
Marine Weather Statement/Heavy Surf Advisory	Coastal Floods	III-30
Lakeshore Statement	Coastal Floods	III-64
Hurricane Local Statement	Tropical Cyclones	III-85
Special Weather Statement	Winter Storms	III-113
Rangeland Fire Danger Statement	Fire Weather	III-164

Discussion/Reports/Bulletins	Fact Sheet	Page
Mesoscale Discussion	Thunderstorms	III-14
Preliminary Storm Report	Tropical Cyclones	III-87
Tropical Cyclone Discussion	Tropical Cyclones	III-89
Tsunami Advisory Bulletin	Tsunamis	III-99
Tsunami Information Bulletin	Tsunamis	III-100
Winter Storm Message	Winter Storms	III-112
Fire Weather Discussion	Fire Weather	III-167

APPENDIX A: SOURCES OF WEATHER INFORMATION

State Climatologist
NWS Organization
NWS Dissemination Systems
NWS Technology
Internet/World Wide Web Information
University Services
Private Sector Meteorologist



APPENDIX A: SOURCES OF WEATHER INFORMATION

The list below and on the following pages presents additional sources of information that you can consult when planning for hazardous weather.

❒ **STATE CLIMATOLOGIST**

Most States have an office of Climatology; their responsibilities vary greatly from providing public assistance and training to simply research. Contact your State office to learn the extent of help the office may provide.

❒ **NATIONAL WEATHER SERVICE ORGANIZATION**

The National Weather Service is in the process of modernization and is reorganizing its local offices. Offices are shown in Figure 1.

CURRENT STRUCTURE

In the current structure, there are three types of offices with responsibilities at the local level:

❒ **Weather Service Forecast Offices (WSFOs).** NWS' 52 WSFOs are responsible for warnings and forecasts for States or large portions of States.

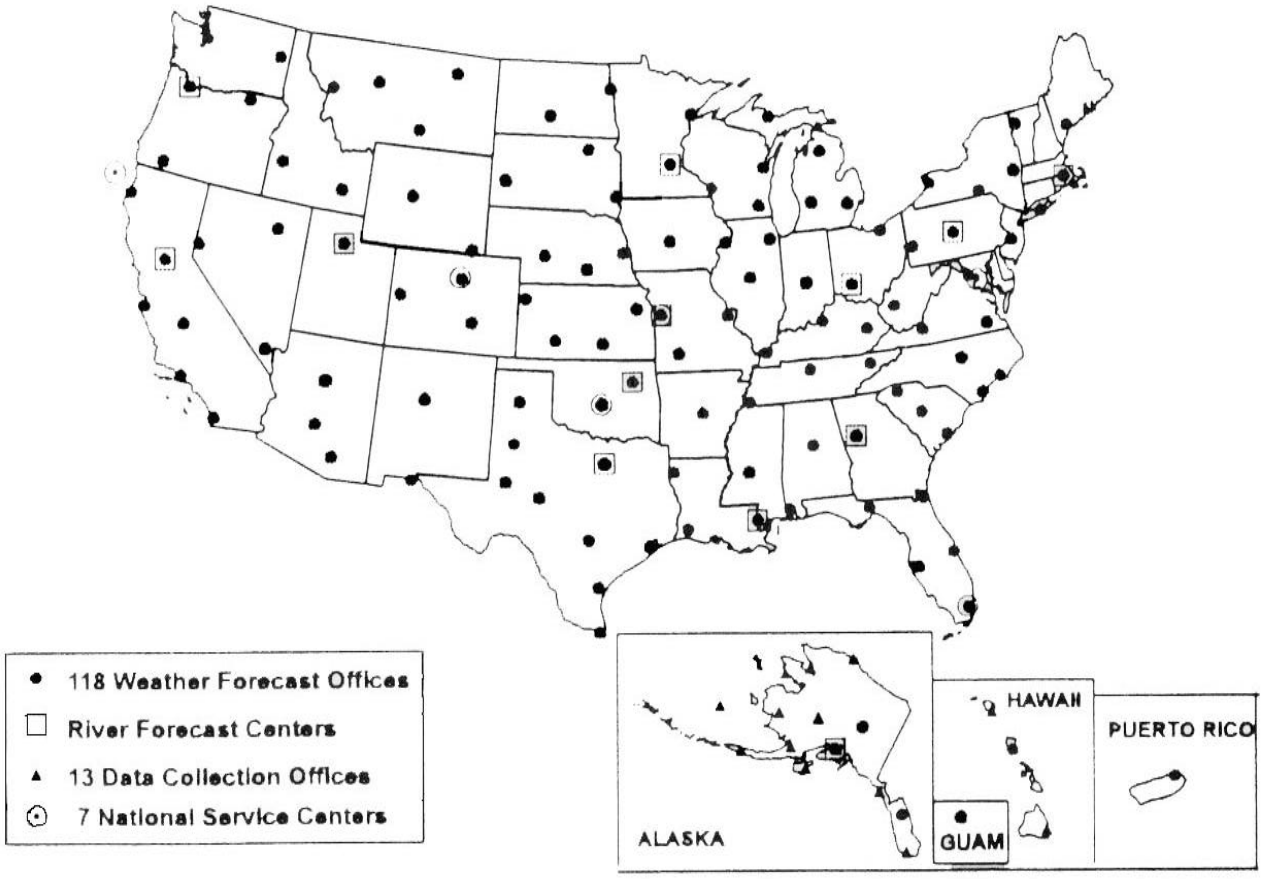
WSFOs provide weather and hydrologic services in four major areas:

- ❒ **Aviation forecasts.** WSFOs issue local aviation watches and warnings, terminal forecasts, and domestic aviation en route forecasts.
- ❒ **Hydrologic services.** WSFOs issue flash flood watches and warnings and assist in developing community-supported surveillance systems.
- ❒ **Marine forecasts.** WSFOs that are located in coastal areas or near the Great Lakes issue marine warnings and forecasts.
- ❒ **General public forecasts.** WSFOs issue a range of public forecast products, including severe weather outlooks, watches, warnings, and advisories; local weather statements; short-term forecasts; and fire weather forecasts, where applicable.

❒ **Weather Service Offices (WSOs).** Nearly 200 WSOs issue local adaptive forecasts and are responsible for issuing and distributing local severe weather warnings. Typically, several WSOs are served by a single WSFO.

❒ **NATIONAL WEATHER SERVICE ORGANIZAITON** (Continued)

MODERNIZED NATIONAL WEATHER SERVICE FIELD STRUCTURE



Figure

Website for this map is located at ***http://www.wrh.noaa.gov/wrhq/us_offices.jpg.***

❒ **NATIONAL WEATHER SERVICE ORGANIZATION** (Continued)

NWS STRUCTURE

The NWS has 121 modernized high-tech Weather Forecast Offices (WFOs) strategically located across the United States receiving data from national centers. (See Figure.)

Weather Forecast Offices

The WFOs of the NWS provide weather and hydrologic services in four major areas:

- ❒ Watches and warnings for severe local storms, floods, flash floods, and winter storms. Local and zone forecasts.
- ❒ Local aviation watches and warnings, terminal forecasts, and domestic aviation enroute forecasts.
- ❒ Marine warnings and forecasts for coastal areas.
- ❒ Hydrologic services.

National Centers

Other specialized centers in the NWS organization provide specific products and data to support the current WSFO/WSO structure and will support the modernized and restructured NWS of the future. National centers include the organization of the National Centers for Environmental Prediction (NCEP) and the River Forecast Centers.

❒ **National Centers for Environmental Prediction** (NCEP)
These 9 centers are responsible for producing and processing hydrometeorological and oceanographic information for users throughout the Northern Hemisphere. NCEP products include discussions for various types of hazardous weather and NCEP supports its users with graphical products.

NCEP is composed of the following centers:

❒ **Storm Prediction Center (SPC)**
Located in Norman, Oklahoma - The Storm Prediction Center provides short-term guidance products for hazardous weather over the contiguous United States.

❒ **NATIONAL WEATHER SERVICE ORGANIZATION** (Continued)

❒ **Tropical Prediction Center (TPC)**
Located in Miami, Florida - The National Hurricane Center (NHC) employs rapid advances in technology and research to issue increasingly accurate and timely watches, warnings, forecasts, and analyses for tropical weather conditions for the protection of life and property.

❒ **NCEP Central Operations (NOC)**
Located in Camp Springs, Maryland - The NCEP Central Operations is responsible for all aspects of NCEP's operations, including access to real-time data and its quality control and use in numerical weather prediction systems.

❒ **Environmental Modeling Center (EMC)**
Located in Camp Springs, Maryland - EMC, formerly known as the Development Division, improves numerical weather, marine and climate predictions at NCEP through a broad program of data assimilation and computer modeling.

❒ **Hydrometeorological Prediction Center (HPC)**
Located in Camp Springs, Maryland - The Hydrometeorological Prediction Center supports the hydrometeorological forecast functions of the National Weather Service.

❒ **Marine Prediction Center (MPC)**
Located in Camp Springs, Maryland - The Marine Predictions Center produces a variety of marine meteorological and oceanographic analysis and forecast products for a diverse user community, including fisheries, mariners, and recreational boaters.

❒ **Climate Predictions Center (CPC)**
Located in Camp Springs, Maryland - Formerly known as the Climate Analysis Center (CAC), the Climate Prediction Center provides climate services to the users in government, the research community, private industry, and the public, both in this country and abroad.

❒ **Aviation Weather Center (AWC)**
Located in Kansas City, Missouri - The Aviation Weather Center enhances aviation safety by issuing accurate warnings, forecasts, and analyses of hazardous weather for aviation interests.

❒ **NATIONAL WEATHER SERVICE ORGANIZATION** (Continued)

- ❒ **Space Environmental Center (SEC)**
  Located in Boulder, Colorado - The Space Center provides national and international forecasts, alerts, and warnings of extraordinary conditions in the global space environment, such as solar radio noise, solar energetic particles, solar X-ray radiation, geomagnetic activity, and conditions of stratospheric warming.

❒ **River Forecast Centers (RFCs).** There are 13 RFCs that provide hydrologic forecasts and guidance information on mainstream river conditions and flooding, and flash floods. The RFCs also provide information on long-term seasonal outlooks related to snowmelt and water supply.

In the modernized NWS, the operations of RFCs are expected to change in a number of important ways. Each of the 13 RFCs will be co-located with a WFO to foster hydro-meteorological interaction. Hydrometeorological Analysis and Support (HAS) functions will be established at each RFC, which will include the assimilation of precipitation estimates from multiple WSR-88D radars in each RFC area of responsibility. Hydrologic models will be run on-site and river forecast guidance will be produced using a multi-featured interactive forecast system. Flash Flood procedures will be more sophisticated, and guidance for WFOs will be updated more frequently.

RFCs provide hydrologic forecast guidance information in three major categories:

- ❒ **Mainstream river and flood forecast guidance** for conditions at approximately 3,000 locations with lead times ranging from six hours to several days.

- ❒ **Flash flood and headwater guidance to WFOs** for warning services involving small drainage basins with response times under six hours.

- ❒ **Long-term, seasonal forecasts** providing estimates of snowmelt and water supply outlooks (from excess to drought) at approximately 1,000 locations for periods up to several months in advance.

❒ NATIONAL WEATHER SERVICE ORGANIZATION (Continued)

The products issued by the RFCs include:

- ❒ **Water Supply Outlooks,** which contain long-term river stage and flow forecasts.
- ❒ **Flood Potential Outlooks,** which contain information on weather conditions that could lead to long-term flooding.
- ❒ **Headwater and Flash Flood Advisories,** which contain flash flood producing threshold values for forecast zones, counties or by headwater river.
- ❒ **River and Flood Forecasts,** which are primarily intended as internal products issued by the RFCs to the local forecast offices containing river stage or flow forecasts for specific forecast points. If flooding is expected, these products contain flood crest forecasts.
- ❒ **Water Supply Outlooks,** which contain long-term river stage and flow forecasts.

❒ NATIONAL WEATHER SERVICE DISSEMINATION SYSTEMS

The National Weather Service has responsibility for collecting data and forecasting all weather. The Tropical Prediction Center (TPC), the Storm Prediction Center (SPC), River Forecast Centers, and Weather Forecast Offices (WFOs) issue forecasts, watches and warnings for hazardous weather events—hurricanes, tornadoes, thunderstorms, and others.

When a forecast, watch, or warning is issued, the information is released through the the NOAA Weather Wire Serve (NWWS), the NOAA Weather Radio, the National Warning System, and the Emergency Manager's Weather Information Network. Information on tsunamis is disseminated through the International Tsunami Information Center.

- ❒ **NOAA Weather Wire Service** distributes NWS public information throughout its satellite-based system to its subscribers throughout the country. It is the fastest way to receive NWS information. Each State has at least one down-link site; contact the local NWS office to determine how to access the service. For more information on NWWS, contact:

  GTE Federal Systems Division
  15000 Conference Center Drive
  Chantilly, VA 22021-3808
  (800) 633-2340

❒ **NATIONAL WEATHER SERVICE DISSEMINATION SYSTEMS** (Continued)

❒ **NOAA Weather Radio** is a network of more than 400 stations that broadcast weather information on a continuous basis.

❒ The **National Warning System** is a telephone-based system managed by FEMA. Information from the NWS and other sources are related to State (and sometimes county and city) contacts, usually at the State Emergency Operations Center.

❒ The **Emergency Manager's Weather Information Network (EMWIN)** is a low speed data broadcast using an audio signal. The NWS and FEMA will work in partnership to explore numerous possibilities for delivery of the signal to the emergency management community including direct satellite broadcast, VHF radio, and NOAA Weather Wire Service. It was designed as a non-proprietary system to run at minimal cost to the NWS and at no recurring cost to any user in range of the signal.

❒ The **International Tsunami Information Center (ITIC)** provides educational information on tsunamis. It provides videos, a computer bulletin board service, watches, warning, and bulletins. Contact ITIC through the Internet: ***http://itic@ptwc.noaa.gov***

❒ **NEXRAD Information Dissemination Service (NIDS).** The NWS has awarded the real time, direct dissemination of its suite of unaltered products off its 120 WSR88-D radars to four weather service information providers. These providers offer a variety of radar products communications services. Check with each for a complete list of services and costs. Also, each State is offered a special subscriber status to one agency in the State to provide emergency managers access to NIDS products at a reduced cost. Contact your WCM for the agency in your State.

❒ Alden Electronics, Incorporated
40 Washington Street
Westborough, Massachusetts 01581-0500
(508) 366-8851, extension 2408

❒ Kavouras, Incorporated
11400 Rupp Drive
Burnsville, Minnesota 55337
(612) 726-9515

❒ NATIONAL WEATHER SERVICE DISSEMINATION SYSTEMS (Continued)

- ❒ Unisys Weather Information Services
  P.O. Box 1226
  221 Gale Lane
  Kennett Square, Pennsylvania 19348-1226
  (610) 444-2406

- ❒ WSI Corporation
  4 Federal Street
  Billerica, Massachusetts 01821
  (508) 670-5000

❒ NATIONAL WEATHER SERVICE TECHNOLOGY

Technological advances have increased forecast reliability greatly over the past few years. Radar, satellite, and computer technology have made forecasting more reliable than ever before. Weather and atmospheric conditions now are being observed from multiple perspectives—the upper atmosphere, the lower atmosphere, and the ground surface—providing more complete coverage.

Doppler radar (NEXRAD) can detect wind and invisible water vapor without the presence of precipitation. NEXRAD technology makes it possible to detect nonprecipitation hazardous weather, such as pre-tornadic conditions, wind shear, and microbursts.

GOES (Geostationary Operational Environmental Satellites) allow observation data to be transmitted quickly to ground stations and updated as often as every 6 minutes. GOES technology improves the accuracy of severe weather and flood warnings and short-range forecasts.

The use of **supercomputers, mathematical models,** and sensitive **observation data** makes it possible to predict farther into the future. Automated Surface Observing Systems (ASOS) is the largest and most modern complement of weather sensors. ASOS is a joint effort of the NWS, Federal Aviation Administration, and the Department of Defense.

❒ INTERNET/WORLD WIDE WEB INFORMATION

The Internet is not considered a primary dissemination tool for weather information because, as a voluntary system, access may not always be reliable and NWS cannot ensure the integrity of its data. However, the Internet does provide a vast amount of forecasting and historical weather data. The NWS Watches and Warnings are posted, as are many university and Government forecasting data. A partial listing of Government Internet site addresses follows.

❒ **INTERNET/WORLD WIDE WEB INFORMATION** (Continued)

❒ **NWS Home Page.** This site provides access to all other NWS web pages and many university services.
Address: ***http://www.nws.noaa.gov***

❒ **Emergency Manger's Weather Information Network (EMWIN)**
Address: ***http://iwin.nws.noaa.gov/iwin/main.hmtl***

❒ **Storm Prediction Center** (SPC)
Address: ***http://www.awc-kc.noaa.gov/spc/Storm_Prediction_Center.html***

❒ **NWS Tallahassee, FL Forecast Office Weather Information Superhighway**
Address: ***http://www.met.fsu.edu/~nws/wxhwy.html***

❒ **UNIVERSITY SERVICES**

Many land grant, State, and private universities provide a myriad of information on hazardous weather. A few are described below; contact the land grant university in your State if it is not included in this listing. Where available, Internet addresses are included.

Northeast (WV, MD, DE, PA, NJ, NY, CT, RI, MA, VT, NH, ME)

❒ Pennsylvania State University. Penn State's Weather Station provides forecasting for much of the Northeast and distributes the information through various channels: *Weather World* television station, radio broadcasts, its own ***telnet system PSU meteo,*** and several newspaper forecasts, including the *New York Times*.

❒ SUNY Brockport. SUNY at Brockport's Weather Center provides local forecasts, computer model output, and output on the Oswego Lake Effect Model.
Internet address: ***gopher://vortex.weather.brockport.edu***

❒ SUNY Albany. The Atmospheric Sciences Department at SUNY at Albany provides local weather information and Gempak help files over the Internet.
Internet address: ***http://www.atmos.albany.edu***

❒ Massachusetts Institute of Technology. MIT's Center for Meteorology and Physical Oceanography maintains an Internet site with information on the center and weather data. This includes NWS watches, warnings, and forecasts and radar images. Internet address: ***http:/www-cmpo.mit.edu***

❒ **UNIVERSITY SERVICES** (Continued)

Southeast (VA, NC, SC, GA, AL, FL)

❒ University of North Carolina at Charlotte. UNC/Charlotte maintains an earth science Internet service including McIDAS images and NWS text products for the Southeastern U.S. Internet address: ***gopher://mcidas.uncc.edu***

❒ North Carolina State University. Internet address: ***http://meawx1.nrrc.ncsu.edu***

❒ Florida State University. FSU's Internet site provides various data, including satellite images from their Direct Readout Ground Station, GIF images of radar and weather data produced by the WXP program at Purdue, and Gempak gridded data files. Internet address: ***gopher://metlab1.met.fsu.edu/1***

Midwest (KY, OH, IN, IL, Ml, WI, MN, IA, MO)

❒ University of Kentucky. The university provides local and national weather data and images and provides agricultural forecasts. Internet address: ***gopher://shelley.ca.udy.edu/11/weather***

❒ Ohio State University. OSU provides access to most NWS text products and graphics and information on the OSU Atmospheric Science Department. Internet address: ***http://asp1.sps.ohio-state.menu***

❒ Purdue University. Purdue's Weather Processor (WXP) provides images and weather maps. Internet address: ***http://thunder.atms.purdue.edu***

❒ University of Illinois. U of I's Weather Machine Internet service provides severe weather warning and advisories, special statements, and forecasts by State. Internet address: ***gopher://wx.atmos.uiuc.edu/11/severe***

❒ Northern Illinois University. Northern IL provides a Storm Chaser Homepage on the Internet with input from independent storm chasers. Internet address: ***http://taiga.geog.niu.edu/chaser/chaser.html***

❒ University of Michigan. Michigan's Weather Underground provides a large amount of weather data, including forecasts, severe weather reports, and current weather conditions. Internet address: ***gopher://downwind. sprl.umich.edu***

❒ University of Wisconsin at Madison. U of W's Forecast Model Output focuses on radar and satellite imagery. Internet address: ***http://java.meteor.wisc.edu/index.html***

❒ **UNIVERSITY SERVICES** (Continued)

South (TX, OK, AR, LA, MS, TN)

❒ Texas A&M. A&M's Weather Data Retrieval interface provides data on weather observations, forecasts, watches, warnings, numerical model output, and other data from the NWS. Internet address: ***http://www. tamu.edu/met/weather/weather.html***

❒ University of Oklahoma at Norman. In cooperation with NWS Severe Storm Laboratory, UOK provides research and weather data. Internet address: ***http://www.nssl.uokor.edu***

High Plains (NM, CO, WY, ND, SD, MT, KS, NE)

❒ University of Colorado. In cooperation with the National Center for Atmospheric Research, UC can provide research data, forecasting data, fact sheets, and weather maps. Internet address: ***http://www.ucar.edu***

❒ Colorado State University. In cooperation with the State Climatologist, CO State provides climatic data to assist in the preparation and planning for severe weather events, especially tornadoes and hail storms. Internet address: ***http://www.atmos.colostate.edu/html/index.html***

❒ University of Wyoming. Internet address: ***gopher://grizzly.uwyo.edu***

❒ University of Nebraska. The university provides an Internet site with local and national weather and climate data. Internet address: ***gopher://kossava.unl.edu***

West (AZ, UT, NV, ID, CA, OR, WA, HI, AK)

❒ University of California at Davis Weather Sources. The Atmospheric Science Department at UC Davis provides a homepage on the Internet that has links to other weather servers, local area extended forecasts, and climate data. Internet address: ***http://atm2l.ucdavis.edc***

❒ University of Oregon. The university's Current Weather Page on the Internet provides national satellite and analysis maps and local weather data. Internet address: ***http://zebu.uoregon.edu/weather.html***

❒ University of Hawaii. The university's Internet site contains current warnings, watches, storm damage reports.
Internet address: ***http://lumahai.soest.hawaii.edu***

❒ PRIVATE SECTOR METEOROLOGISTS

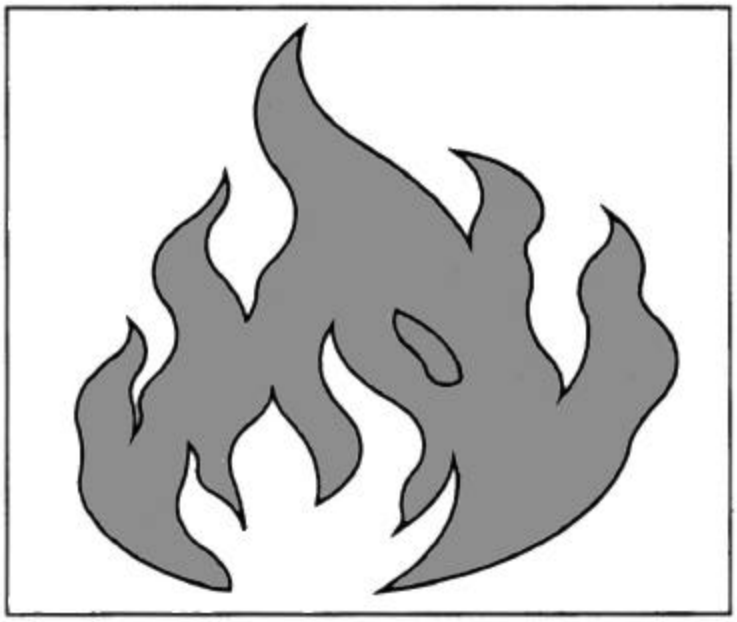
For additional weather forecasts and information for your specific jurisdiction, there are hundreds of professional private-sector meteorologists available to provide tailored services. Their role is to augment the National Weather Service Warnings and Forecasts to provide the detailed information to support your daily operations. For a list of private meteorologists contact the National Weather Service Office of Industrial Meteorology. Internet address: **http://www.nws.noaa.gov/IM/dirintro.htm**

or:

Office of Industrial Meteorology
National Weather Service, NOAA
Room 18462 (W/IM)
1325 East-West Highway
Silver Spring, MD 20910-3283

APPENDIX B: NWS ABBREVIATIONS

Product Identifier List Codes
NWS Office Codes



APPENDIX B: NWS ABBREVIATIONS

- Product Identifier List (PIL) codes

  The PIL codes cited in the heading of all NWS products consist of a 7-, 8-, or 9-character alphanumeric code. The code is formatted CCCNNNXXX.

  - The first 3 positions (CCC) indicate the forecast office, known as the node; e.g., WBC is the Sterling, VA forecast office. The NWS office abbreviations are listed below.

  - The middle 3 positions (NNN) indicate the product; e.g., WSW is Winter Storm Watch.

  - The final positions (XXX) indicate issuing office or state, or the number of the issuance for the day for national products. Examples include:

WBCNOWWBC	WBC	=	Washington, D.C. forecast office node
	NOW	=	Short term forecast
	WBC	=	Washington, D.C. issuing office
WBCWSWMD	WBC	=	Sterling, VA forecast office node
	WSW	=	Winter Storm Warning
	MD	=	Maryland
	This forecast is issued for Maryland from the Sterling, VA office.		
MKCSEL1	MKC	=	Storm Prediction Center, Kansas City
	SEL	=	Severe Thunderstorm or Tornado Watch
	1	=	First watch issued for this day

- Lists of node offices (CCC), products (NNN), and cities of issuing offices (XXX), are contained on the following pages.

❒ LIST OF NODE OFFICES

(CCC of a code formatted as CCCNNNXXX)

ABQ	Albuquerque, NM
ALB	Albany, NY
ANC	Anchorage, AK and Alaska Tsunami Warning Center
ARB	Ann Arbor, Ml
ATL	Atlanta, GA
BHM	Birmingham, AL
BIS	Bismarck, ND
BOI	Boise, ID
BOS	Boston, MA
BUF	Buffalo, NY
CAE	Columbia, SC
CHI	Chicago, IL
CLE	Cleveland, OH
CRW	Charleston, WV
CYS	Cheyenne, WY
DEN	Denver, CO
DSM	Des Moines, IA
FAI	Fairbanks, AK
FSD	Sioux Falls, SD
FTW	Fort Worth, TX
GTF	Great Falls, MT
HNL	Honolulu, HI, and Central Pacific Hurricane Center, and Central Pacific Tsunami Warning Center
IND	Indianpolis, IN
JAN	Jackson, MS
JNU	Juneau, AK
LAX	Los Angeles, CA
LBB	Lubbock, TX
LIT	Little Rock, AR
MEM	Memphis, TN
MIA	Miami, FL and National Hurricane Center and Storm Prediction Center
MKC	Kansas City, MO
MKE	Milwaukee, WI
MSP	Minneapolis, MN
NEW	New Orleans, LA
NMC and NMD	Camp Springs, MD National Meteorological Center, and National Centers for Environmental Predictions
NYC	New York, NY
OKC	Oklahoma City, OK
OMA	Omaha, NE
PDX	Portland, OR
PHL	Philadelphia, PA
PHX	Phoenix, AZ
PIT	Pittsburgh, PA
PWM	Portland, ME
RDU	Raleigh, NC
RNO	Reno, NV
SAT	San Antonio, TX
SDF	Louisville, KY
SEA	Seattle, WA
SFO	San Francisco, CA
SJU	San Juan, PR
SLC	Salt Lake City, UT
STL	St. Louis, MO
TOP	Topeka, KS
WBC	Washington, DC
WSH	Weather Service Headquarters, Washington, DC

❒ PARTIAL LIST OF PRODUCT CODES

(NNN of code formatted as CCCNNNXXX)

CFA Coastal Flood Watch
CFS Coastal Flood Statement
CFW Coastal Flood Warning
ESF Flood Potential Outlook
FFA Flash Flood Watch
FFS Flash Flood Statement
FFW Flash Flood Warning
FLS Flood Statement
FLW Flood Warning
FWF Fire Weather Outlook, Watch, or Warning
GPH Excessive Rain Outlook
HLS Hurricane Local Statements
HMD Hydrometeorological Discussion
LSH Lakeshore Warning, or Statement
MWS Marine Weather Statement
NOW Short Term Forecast
NPW Watch, Warning, or Advisory for Fog, Excessive Heat, Blowing Dust or Sand, or High Wind
PSH Preliminary Post-Storm Report
RFD Rangeland and Fire Danger Statement
RFW Red Flag Warning (Fire Weather)
RVI River Ice Statement
RVS River Statement
SEL Severe Thunderstorm or Tornado Watch
SLS Severe Thunderstorm or Tornado Watch Redefining Statement
SMW Special Marine Warning
SPF Strike Probability Forecast
SPS Special Weather Statement or Outlook
SVR Severe Thunderstorm or Tornado Warning
SVS Severe Weather Statement
SWO Convective Outlook or Mesoscale Discussion
TCD Tropical Weather Discussion
TCP Tropical Advisories
TSU Tsunami Watch, or Warning
TWO Tropical Weather Outlook
WSW Winter Storm Watch, Warning, or Advisory

❒ LIST OF CITIES OF ISSUING OFFICE CODES

(XXX of a code formatted as CCCNNNXXX)

ABQ	Albuquerque NM
ABR	Aberdeen SD
ADQ	Kodiak AK
AKN	King Salmon AK
AKQ	Norfolk/Richmond VA
ALB	Albany NY
AMA	Amarillo TX
ANC	Anchorage AK
ANN	Annette AK
APN	North Central Lower Michigan MI
ATL	Atlanta GA
BET	Bethel AK
BGM	Binghamton NY
BHM	Birmingham AL
BIL	Billings MT
BIS	Bismarck ND
BNA	Nashville TN
BOI	Boise ID
BOS	Boston MA
BRO	Brownsville TX
BRW	Barrow AK
BTV	Burlington VT
BUF	Buffalo NY
CAE	Columbia SC
CAR	Caribou ME
CDB	Cold Bay AK
CHI	Chicago IL
CHS	Charleston SC
CLE	Cleveland OH
CRP	Corpus Christi TX
CRW	Charleston WV
CTP	Central Pennsylvania PA
CYS	Cheyenne WY
DDC	Dodge City KS
DEN	Denver/Boulder CO
DLH	Duluth MN
DSM	Des Moines IA
DTX	Detroit MI
EKA	Eureka CA
EKO	Elko NV
ELP	El Paso TX
FAI	Fairbanks AK
FAR	Eastern North Dakota ND
FAT	San Joaquin Valley CA
FLG	Flagstaff AZ
FSD	Sioux Falls SD
FTW	Dallas/Ft. Worth TX
FWA	Fort Wayne IN
GEG	Spokane MT
GGW	Glasgow MT
GJT	Grand Junction CO
GLD	Goodland KS
GRB	Green Bay WI
GRI	Hastings NE
GRR	Grand Rapids Ml
GSP	Greenville/Spartanburg SC
GTF	Great Falls MT
HNL	Honolulu HI
HOM	Homer AK
HOU	Houston/Galveston TX
HSV	Huntsville AL
ICT	Wichita KS
ILM	Wilmington NC
ILN	Cincinnati OH
IND	Indianapolis IN
ISN	Williston ND
ITO	Hilo HI
JAN	Jackson MS
JAX	Jacksonville FL
JKL	Jackson KY
JNU	Juneau AK
LAS	Las Vegas NV
LAX	Los Angeles CA
LBB	Lubbock TX
LBF	North Platte NE
LCH	Lake Charles LA
LIH	Lihue HI
LIT	Little Rock AR
LSE	La Crosse WI
MAF	Midland/Odessa TX
MCG	McGrath AK
MCI	Kansas City/Pleasant Hill MO
MEM	Memphis TN

❒ **LIST OF CITIES OF ISSUING OFFICE CODES** (Continued)

MFR	Medford OR
MHX	Morehead City NC
MIA	Miami FL
MKE	Milwaukee WI
MLB	Melbourne FL
MLI	Quad Cities IA
MOB	Mobile AL
MQT	Marquette MI
MRX	Knoxville/Tri Cities TN
MSO	Missoula MT
MSP	Minneapolis MN
NEW	New Orleans/Baton Rouge LA
NYC	New York City NY
OGG	Kahului HI
OKC	Oklahoma City OK
OMA	Omaha NE
OME	Nome AK
OTZ	Kotzebue AK
PAH	Paducah KY
PDT	Pendleton OR
PDX	Portland OR
PHL	Philadelphia PA
PHX	Phoenix AZ
PIH	Pocatello/Idaho Falls ID
PIT	Pittsburgh PA
PUB	Pueblo CO
PWM	Portland ME
RAP	Rapid City SD
RDU	Raleigh/Durham NC
RIW	Riverton WY
RNK	Roanoke VA
RNO	Reno NV
SAC	Sacramento CA
SAN	San Diego CA
SAT	Austin/San Antonio TX
SDF	Louisville KY
SEA	Seattle/Tacoma WA
SFO	San Francisco Bay Area CA
SGF	Springfield MO
SHV	Shreveport LA
SJT	San Angelo TX
SJU	San Juan PR
SLC	Salt Lake City UT
SNP	St. Paul Island AK
SPI	Central Illinois IL
STL	St. Louis MO
TBW	Tampa Bay Area FL
TLH	Tallahassee FL
TOP	Topeka KS
TUL	Tulsa OK
TUS	Tucson AZ
UNK	Unalakleet AK
VWS	Valdez AK
WBC	Baltimore MD/Washington DC
YAK	Yakutat AK

APPENDIX C: TEMPERATURE, RELATIVE **HUMIDITY, AND DEW** *POINT CONVERSION*

APPENDIX C: CONVERTING RELATIVE HUMIDITY AND TEMPERATURE TO DEW POINT

To convert relative humidity and temperature to dew point, find the closest value in the table for relative humidity. Use the corresponding formula with temperature to calculate dew point.

RH = relative humidity, DP = dew point, T = temperature (ºF)

RH (%)	DP (ºF)
97	T – 1
94	T – 2
91	T – 3
88	T – 4
85	T – 5
82	T – 6
79	T – 7
76	T – 8
73	T – 9
70	T – 10
68	T – 11
66	T – 12
64	T – 13
62	T – 14
60	T – 15
58	T – 16
56	T – 17
54	T – 18
52	T – 19
50	T – 20

For example, if relative humidity is 70% and the temperature is 65ºF the dew point can be calculated by using the formula corresponding to RH = 70, which is T-10. This gives a dew point of 55ºF.

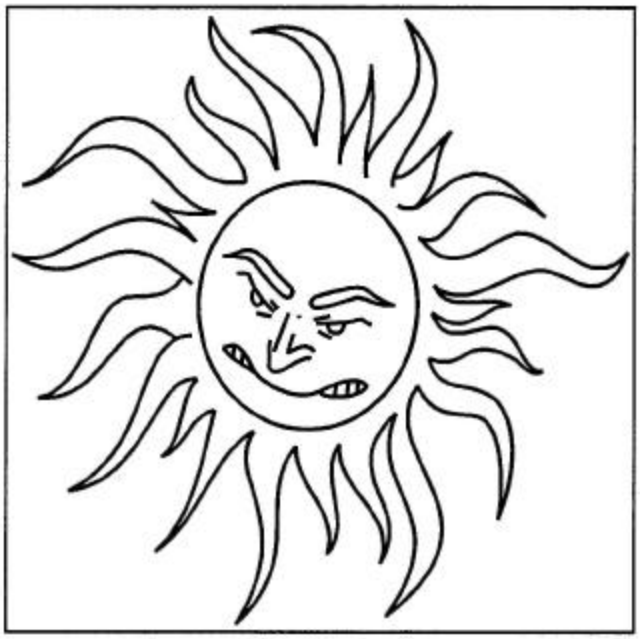
APPENDIX D: BIBLIOGRAPHY

Textbooks

Reference Books

General Interest/Weather Lore Books

Periodicals



APPENDIX D: BIBLIOGRAPHY

This appendix includes a list of climate- and weather-related publications that are suitable for laypersons. The bibliography is grouped into four categories:

- ❒ Textbooks.
- ❒ Reference Books.
- ❒ General Interest/Weather Lore Books.
- ❒ Periodicals.

Where possible, ISBN and ISSN numbers are included in the citation to help you locate the publications.

TEXTBOOKS

Ahrens, D.C., 1991: *Meteorology Today*. (4th ed.) West Publishing Company., St. Paul, MN. (ISBN 0-314-80905-8)

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Gedzelman, S.D., 1980: *The Science and Wonders of The Atmosphere*. John Wiley and Sons, New York. (ISBN 0-471-02972-6)

Griffiths, J.F. and D.M. Driscoll, 1982: *Survey of Climatology*. Charles E. Merrill Publishing Co., Columbus, OH. (ISBN 0-675-09994-3)

Lutgens, F.K., and E.J. Tarback, 1992: *The Atmosphere: An Introduction to Meteorology*. (5th ed.) Prentice-Hall., Englewood Cliffs, NJ. (ISBN 0-13-051476-6)

TEXTBOOKS (Continued)

Miller, A; J.C. Thompson; R.E. Peterson, and D.R. Haragan, 1983: *Elements of Meteorology*. (4th ed.) Charles E. Merrill Publishing Co., Columbus, OH. (ISBN 0-675-0-20005-9)

Moran, J.M. and M.D. Morgan, 1991: *Meteorology: The Atmosphere and Science of Weather*. (3rd ed.) Macmillan Publishing Co., New York. (ISBN 0-02-383841-8)

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Houghton, D.D., (Ed.), 1985: *Handbook of Applied Meteorology*. John Wile & Sons, New York. (ISBN 0-471-08404-2)

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Allaby, M., 1992: *Air: The nature of atmosphere and cilmate*. Facts on File, New York. 208 pp. (ISBN 0-8160-2525-8)

Battan, L.J., 1983: *Weather in your life*. W.H. Freeman and Co. San Francisco. 230 pp. (ISBN 0-7167-1437-X)

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ing, J.R., 1990: *Meteorology in America, 1800-1870*. The Johns Hopkins University Press, Baltimore. 264 pp. (ISBN 0-8018-3958-0)

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Hughes, P., 1976 *American weather stories*. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration. (NOAA-S/T 76-1922) Available from Supt. of Documents. Washington, D.C. 116 pp.

Keen, RA., 1987: *Skywatch: The western weather guide*. Fulcrum, Inc. Golden, CO. 158 pp. (ISBN 1-55591-019-X)

Keen, RA., 1992: *Skywatch: The eastern weather guide*. Fulcrum, Inc. Golden, CO. 204 pp.

NERAL INTEREST/WEATHER LORE BOOKS (Continued)

hart, G., 1988: *The weather companion.* Wiley Science Editions. New York. 230 pp. (ISBN 0-471-62079-3)

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Weiner, J., 1986: *Planet Earth.* Bantam Books, Toronto. 370 pp. (ISBN 0-553-05096-6)

Williams, J., 1992: *The weather book. An easy-to-understand guide to the USA's weather.* Vintage Books. New York. 212 pp. (ISBN 0-679-73669-7)

IODICALS

American Weather Observer (published monthly) (ISSN 8755-9552)

For subscription information, contact:

Association of American Weather Observers (AAWO)
401 Whitney Boulevard
Belvidere, IL 61008

Weather (published monthly) (ISSN 0043-1656)

For subscription information, contact:

Weather
104 Oxford Road
Reading, Berks RG1 7LJ
England

Weatherwise (published bimonthly) (ISSN 0044-1 672)

For subscription information, contact:

Heldref Publishers
4000 Albemarle Street, NW
Washington, DC 20016

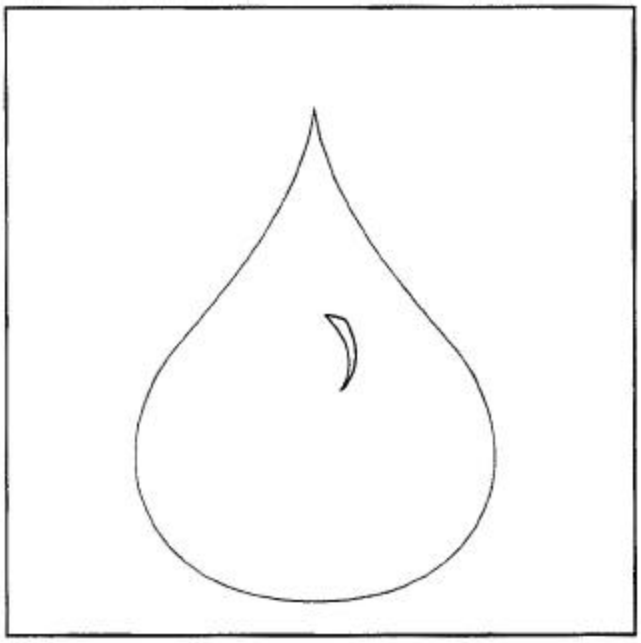
Weather Satellite Report

For subscription information, contact:

R. Meyers Communications
P.O. Box 17108
Fountain Hills, AZ 85269-7108

APPENDIX E: GLOSSARY

Definitions of Key Terms



-A-

Advection. Horizontal movement of any atmospheric element: e.g., air, moisture, or heat.

Air Mass. An extensive body of air whose horizontal distribution of temperature and moisture is nearly uniform.

Airstream. A substantial body of air with the same properties flowing along with the general circulation.

Alberta Clipper. A small, fast-moving cyclonic storm that forms on the Pacific front, usually over the Rocky Mountains of Alberta, Canada. The Clipper travels southeast into the Great Plains; it is followed by an outbreak of cold, polar air.

Anticyclone. An area of high atmospheric pressure characterized by a center of maximum pressure and outflowing winds blowing clockwise in the Northern Hemisphere. Also called a **high-pressure system** or **high.**

Arctic Front. The leading edge of arctic air in northern latitudes where it meets polar air or modified tropical air from the south.

Atmospheric Pressure. The weight per unit of the total mass of air above a given point. Also called **barometric pressure.**

-B-

Bermuda High. A semipermanent high-pressure area in the North Atlantic Ocean that migrates east and west with varying central pressure. In summertime, it causes a southerly circulation over the Atlantic States, bringing heat and humidity northward.

Blizzard. A severe winter storm characterized by low temperatures (10º F or below), wind speeds of 32 miles per hour or greater, blowing snow, and visibility of 500 feet or less.

-C-

Ceiling. The height of the lowest layer of clouds or obscuring phenomena when 6/10 or more of the sky is covered. When less than 6/10 covered, the ceiling is called **unlimited.**

Circulation. The flow pattern of moving air. The **general circulation** is the large-scale flow characteristic of the semipermanent pressure systems in the atmosphere. The **secondary circulation** occurs in more temporary, migrant high- and low-pressure systems.

Cloudburst. In popular terminology, any sudden and heavy fall of rain.

Coastal Storm. A low-pressure disturbance forming along the South Atlantic coast and moving northeast along the Middle Atlantic and New England coasts to the Atlantic Provinces of Canada. Also called a **northeaster.**

Cold Front. The leading edge of an advancing cold air mass that is displacing a retreating warmer air mass.

Condensation. The process whereby a substance changes from vapor to liquid.

Convection. The circulating motion of warm and cold currents of air. Convection is predominantly seen in the vertical motion of warmer air.

Convergence. A distribution of wind movement that results in a net inflow of air into a particular region.

Coriolis Force. The deflective effect of the Earth's rotation on all free-moving objects, including the atmosphere and oceans. Deflection is to the right in the Northern Hemisphere and to the left in the Southern Hemisphere.

Cyclone. A system of atmospheric pressure characterized by minimum pressure at its center and winds blowing inward (counterclockwise, in the Northern Hemisphere). Also known as a **low-pressure system** or **low.**

-D-

Depression. An area of low atmospheric pressure.

Dew. Water droplets that form on objects as a result of radiational cooling and condensation of water vapor from the air.

Dew Point. The temperature to which a parcel of air must be cooled at a constant pressure and water vapor content for saturation to occur.

Disturbance. An area of low pressure attended by storm conditions.

Divergence. A distribution of wind movement resulting from a net outflow of air from an area.

Doppler Radar. A type of radar used in meteorology to directly detect the motion of an air parcel.

Downburst. A concentrated, strong downdraft from a severe thunderstorm that induces an outward burst of often damaging winds at the surface.

Downdraft. A sudden descent of a stream of cool air from aloft, often causing windshear.

Drought. A prolonged and damaging condition of subnormal precipitation in a given area.

-E-

Evaporation. The change in a substance from liquid or solid to a gaseous state.

Extratropical Cyclone. A low-pressure disturbance in the middle or northern latitudes with a system of fronts.

Eye. The roughly circular area of lowest pressure, relatively light winds, and often clear weather at the center of a tropical cyclone.

Eye Wall. The vertical bank of clouds, containing high winds, that surrounds the eye of a tropical cyclone.

-F-

Filling. The increase in pressure at the center of a storm system.

Flash Flood. A sudden rise in the level of water in a small river or stream, brought on by intense rainfall.

Fog. A visible aggregate of minute water droplets suspended in the atmosphere near the surface of the Earth.

Freezing. The transformation of a substance from a liquid to a solid state.

Front. The interface or transition zone between air masses of different properties.

Frost. Ice crystals formed on grass or other objects by the direct transfer of water vapor from the air at below-freezing temperatures.

-G-

Greenhouse Effect. The heating of the lower atmosphere that results when shortwave solar radiation reflected from the surface of the Earth is trapped in the atmosphere by water vapor and carbon dioxide.

-H-

Hail. Precipitation, in the form of ice balls, produced by cumulonimbus clouds.

Haze. Fine dust, salt, pollen, or other minute particles dispersed through the atmosphere. Haze reduces visibility and gives the atmosphere a white appearance.

High Pressure. See Anticyclone.

Hurricane. A severe tropical disturbance in the North Atlantic Ocean, Caribbean Sea, or Gulf of Mexico that achieves a sustained wind force of at least 74 miles per hour.

-I-

Instability. A condition of the atmosphere whereby a parcel of air, given an initial impulse, will tend to continue to move upward. The upward current often forms cumulus clouds that may grow into thunderstorms.

Inversion. A reversal of the normal regime of temperature decreasing with increasing altitude, resulting in warmer air overlying colder air.

Isobar. A line drawn on a weather map connecting points of equal barometric pressure (as adjusted for elevation).

Isotherm. A line drawn on a weather map connecting points of equal temperatures.

-J-

Jet Stream. A zone of relatively strong winds, concentrated in a narrow zone of the upper atmosphere, usually between 25,000 and 45,000 feet.

-L-

Lake Effect Mechanism. A turbulent action of the atmosphere when a cool airstream passes over a warm body of water. It may result in rain showers or snow showers, sometimes heavy, on the lee shore of a lake.

Lifting. The forced ascent of an airflow by a rise in terrain or by an air mass of denser properties.

Low-Pressure System. See Cyclone.

-M-

Mean Temperature. The average of any series of temperature readings taken over a period of time.

-N-

. The average value of a meteorological element over a fixed period of years. **Northeaster. See Coastal Storm.**

-O-

Occluded Front. A composite of two fronts produced when a cold front overtakes a warm front and forces the warm air aloft.

Overrunning. The ascent of warm air over cooler air, usually in advance of a warm front.

-P-

Pacific High. A large high-pressure system extending along the middle latitudes of the Pacific Ocean north of the Hawaiian Islands.

Polar Air. An air mass conditioned over tundra or snow-covered terrain of high latitudes.

olar Front. A semipermanent discontinuity separating cold, polar easterly winds and relatively warm westerly winds of the middle latitudes.

Pressure Gradient. The change in atmospheric pressure over a given distance at a particular time.

-R-

Radiation. The transfer of heat, or other forms of energy, through space without the agency of intervening matter.

Relative Humidity. The ratio (expressed as a percentage) of the actual amount of water vapor in the air to the amount the air could hold if saturated and if the temperature remained constant.

Ridge. An elongated area of high atmospheric pressure.

-S-

anta Ana. A wind originating over the elevated deserts of eastern Southern California, the Santa Ana wind warms rapidly in its descent through mountain passes to the coastal plain.
It arrives at the lower levels as a hot, very dry, gusty wind.

aturation. The condition in which a parcel of air holds the maximum possible amount of water vapor or, hydrologically, the condition in which a parcel of land holds the maximum possible amount of water.

econdary Cold Front. A cold front that sometimes follows a primary front and brings an even colder air mass.

Secondary Depression. An area of low pressure that forms in a trough to the south or east of a primary storm center.

emipermanent (High or Low). A relatively stationary and stable pressure-and-wind system. Examples include the Islandic Low and the Bermuda High.

iberian Express. A popular term for fierce, cold cyclonic storms that descend from Alaska and northern Canada into the United States.

leet. Small pellets of ice formed when raindrops fall through a layer of below-freezing air and congeal. Sleet often falls in a transition zone between snow and rain.

now. Precipitation in the form of white or translucent ice crystals, chiefly in complex, branched hexagonal form and clustered into snowflakes.

quall Line. A well-marked line of instability, usually accompanied by gusty winds, turbulence, and often heavy showers.

tationary Front. A zone where cold and warm air meet that exhibits little or no movement.

torm Track. The patch usually followed by cyclonic disturbance in a region.

-T-

Temperature-Humidity Index. A guide to human comfort or discomfort based on conditions of temperature and relative humidity.

-W-

Waterspout. A tornado-like formation over water. Waterspouts are usually much smaller and less vigorous than a true tornado. Waterspouts tend to occur most frequently in tropical, not subtropical, waters.

Water Vapor. Atmospheric moisture existing as a gas.

Wave. A usually small cyclonic center in the early state of development. Waves usually move along a cold front. Also referred to as a **wave cyclone.**

Whiteout. A condition occurring in the Arctic regions on a sunless day when clouds and surface snow seem to merge so that no horizon is perceptible. The term is also applied to blizzard conditions in which blowing snow restricts visibility to near zero.

Wind. Air in motion parallel to the surface of the ground.

Windchill Factor. A figure used to express the cooling effect of the combination of particular temperatures and wind speeds on exposed human skin.

Windshear. A sudden variation in the vector of wind flow that is especially dangerous to aircraft during takeoff and landing.