RISCOS A CAUSA DE FENÒMENS CLIMÀTICS

Curs d'Especialista Universitari en Gestió i Direcció d'Emergències i Protecció Civil

UIB
Universitat de les Illes Balears

Romualdo Romero (Febrer 2006)

OVERVIEW

1) **Weather.-** Provides a basic introduction to meteorology, particularly as it relates to hazardous weather (Global scale, Synoptic scale and Mesoscale)

2) **Hazards.-** Presents the most common hazardous weather events (Description, Characteristics and Examples)

3) **Mediterranean cyclones and heavy precipitations.-** Analyses in higher detail this problem owing to its high social impact in the region

NOTE: Scientific basis rather than vulnerability analysis or emergency management procedures !!!

Amazing Shots of Katrina before She Hit New Orleans

Amazing Shots of

Katrina

before She Hit New Orleans

????????????????

INPUT 1

Course

“Anticipating Hazardous Weather and Community Risk” (NWS, NOAA and FEMA from USA)

http://meted.ucar.edu/hazwx/index.htm

More hazardous weather events occur annually in the United States than in any other nation in the world. In addition, we have the widest variety of hazardous weather—extreme heat, extreme cold, drought, floods, tornadoes, blizzards, hurricanes, and more. **Ninety-five percent of all Presidentially Declared Disasters are weather or flood related**.

INPUT 2

Web page

"JetStream – An Online Weather School"
(NWS, NOAA from USA)

http://www.srh.weather.gov/srh/jetstream/index.htm

www.srh.weather.gov

JETSTREAM

AN ONLINE WEATHER SCHOOL

Welcome to JetStream, the National Weather Service Online Weather School. This site is designed to help educators, emergency managers, or anyone interested in learning about weather and weather safety.

OVERVIEW

1) Weather.- Provides a basic introduction to meteorology, particularly as it relates to hazardous weather (Global scale, Synoptic scale and Mesoscale)

2) Hazards.- Presents the most common hazardous weather events (Description, Characteristics and Examples)

3) Mediterranean cycloness and heavy precipitations.- Analyses in higher detail this problem owing to its high social impact in the region

NOTE: Scientific basis rather than vulnerability analysis or emergency management procedures !!!

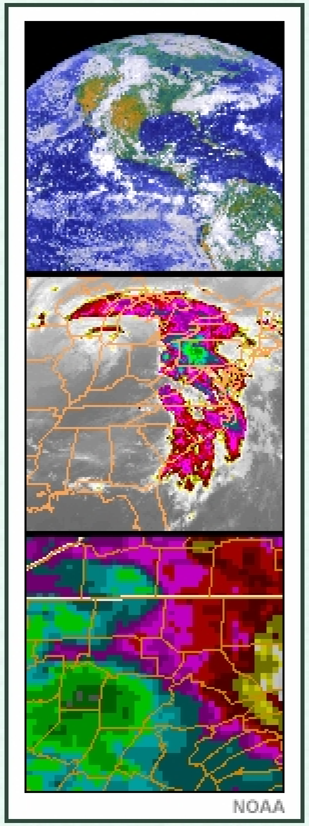
From the Big Picture to Your Back Yard

To organize this discussion, we will focus on three different scales of events and how they interact. The largest weather features occur on the **global scale**. At this scale, forecasters are thinking about large patterns of winds, temperature, and pressure.

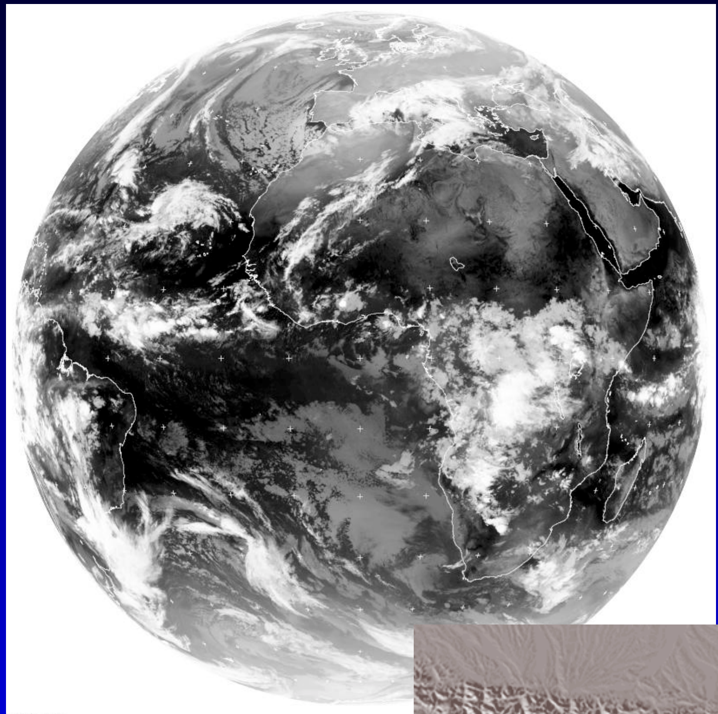
Weather patterns that affect one or several states are called **synoptic scale** events. Examples are circulations around high and low pressure areas, large snowstorms, large-scale droughts, and hurricanes.

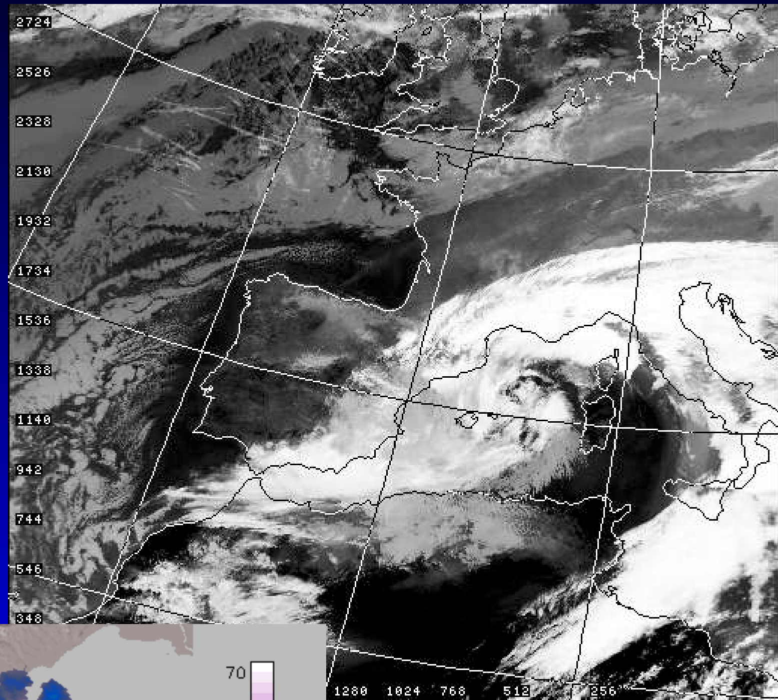
Smaller and shorter-term weather events such as tornadic storms, flash floods, and similar "local" events are what meteorologists call **mesoscale** phenomena. These events are often the most hazardous—and the most difficult to forecast, as discussed in the Forecasting Section.

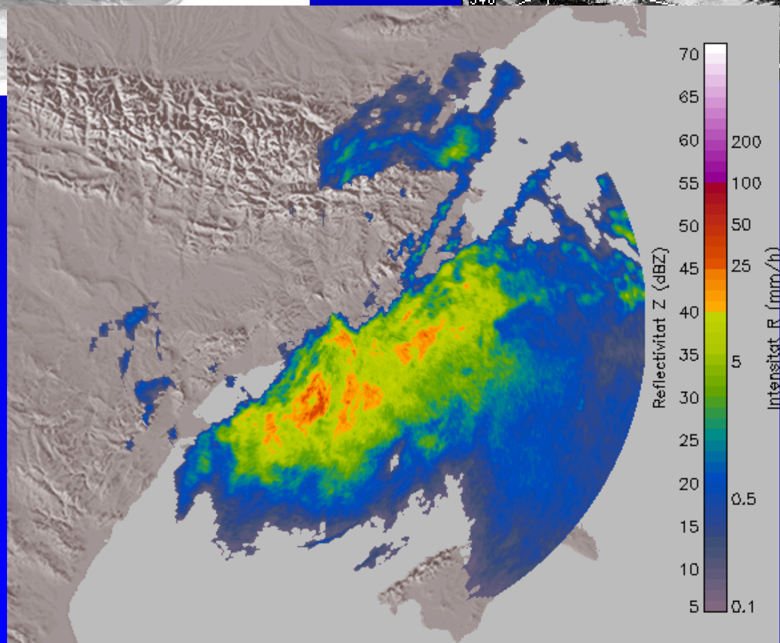
All these scales are interrelated, so a mesoscale event will have its roots in global and synoptic patterns. Likewise, a synoptic scale event will have a variety of consequences on the mesoscale. These complex connections explain why forecasting is so difficult.



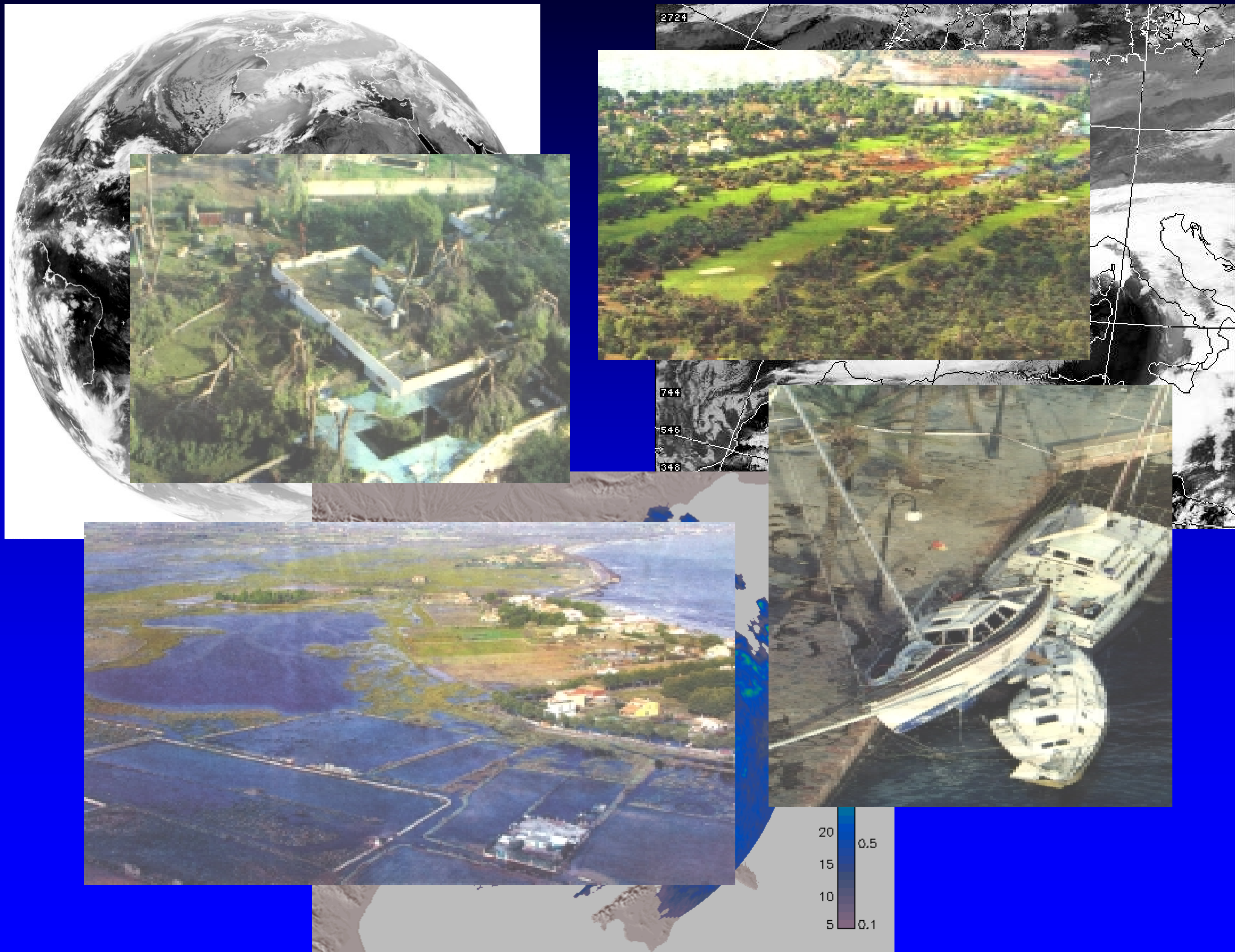
An example: The November 2001 superstorm



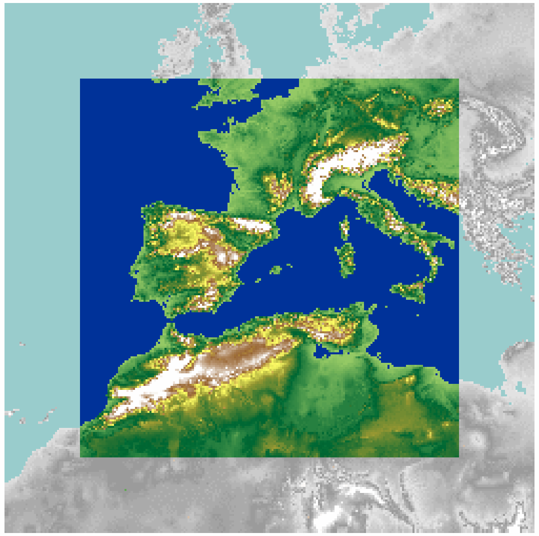




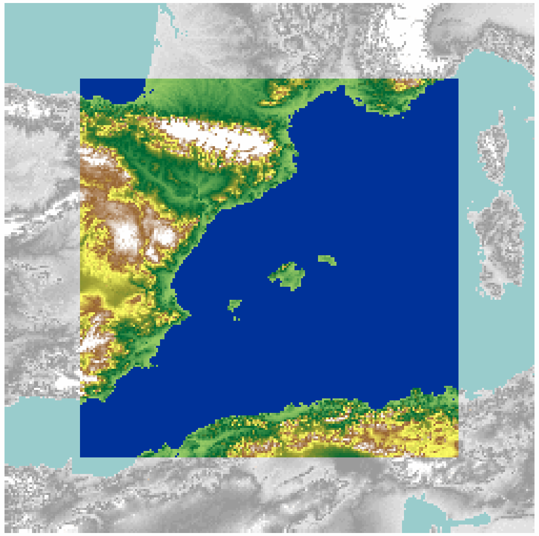
An example: The November 2001 superstorm



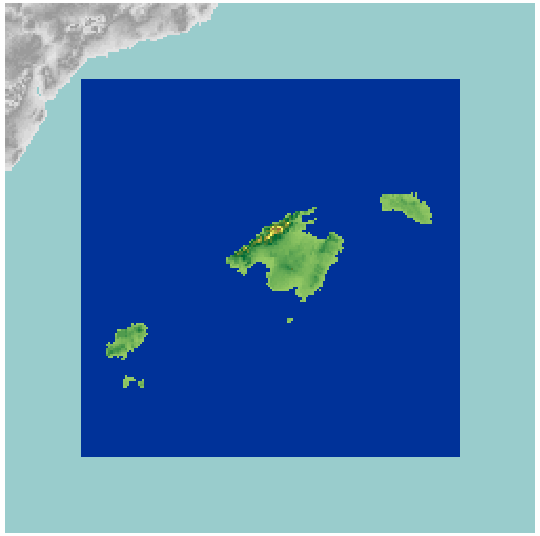
Multiscale analysis -and forecast- of hazardous weather events



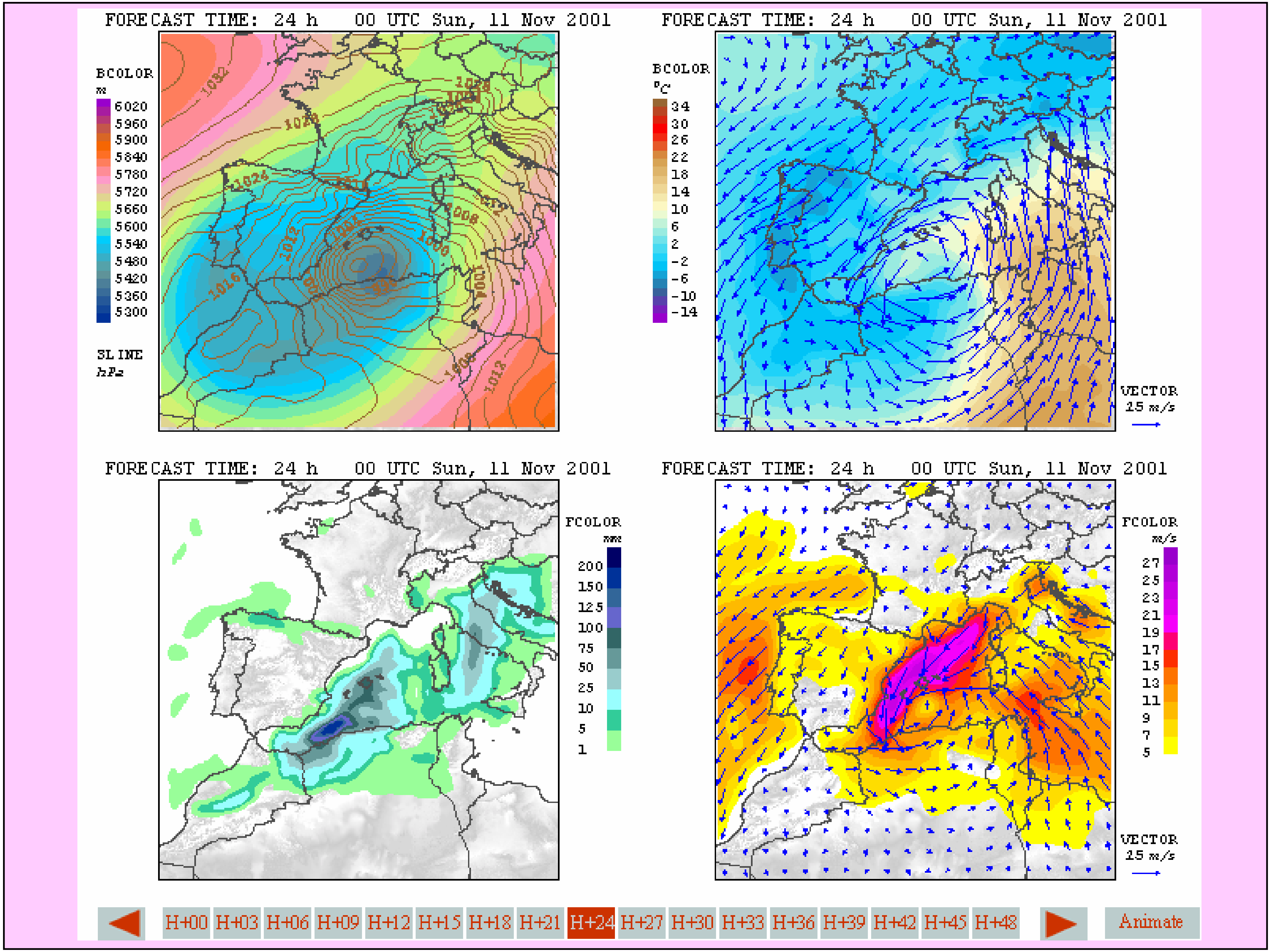
DOMAIN 1 (22.5 km resolution)

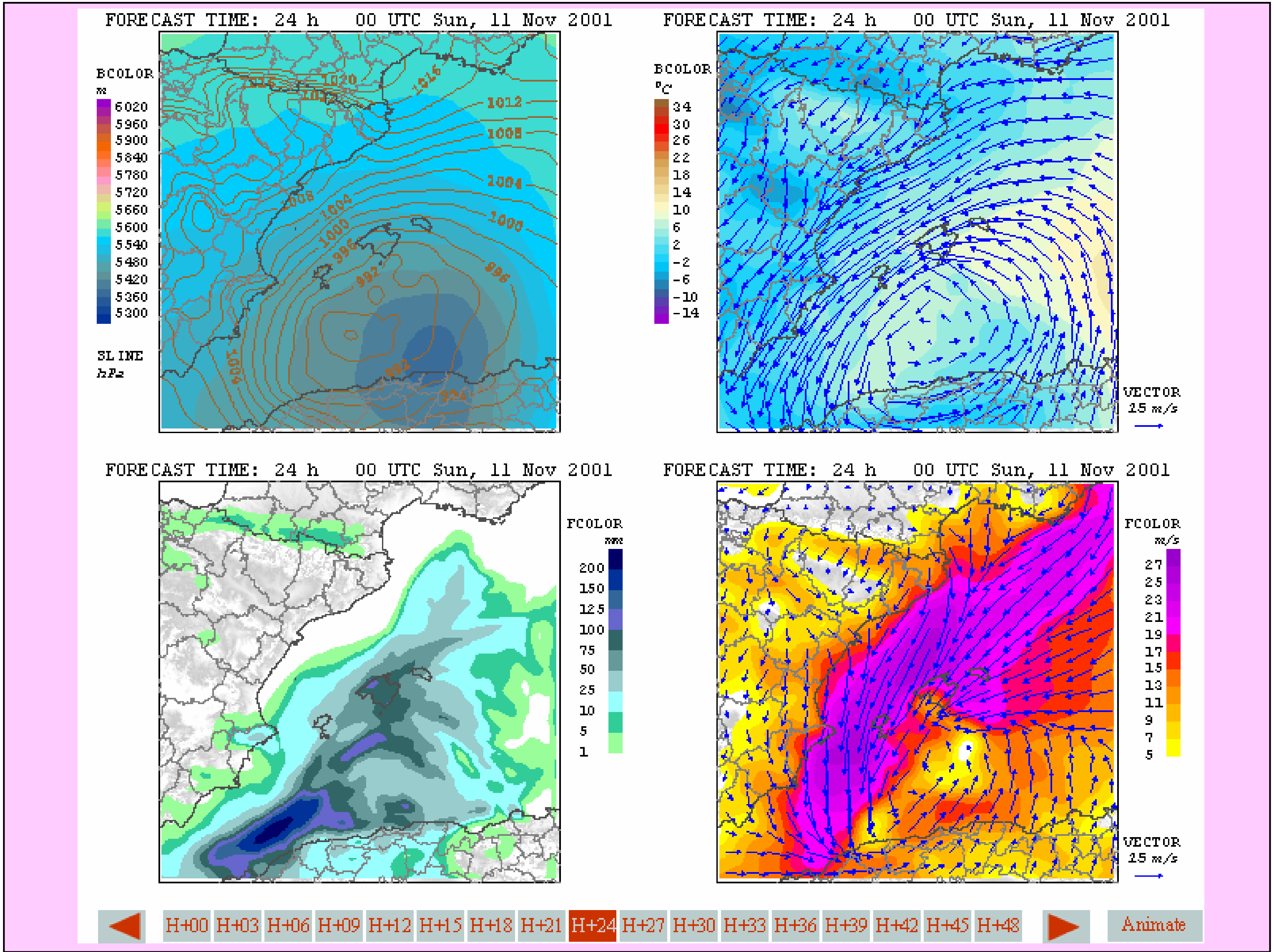


DOMAIN 2 (7.5 km resolution)

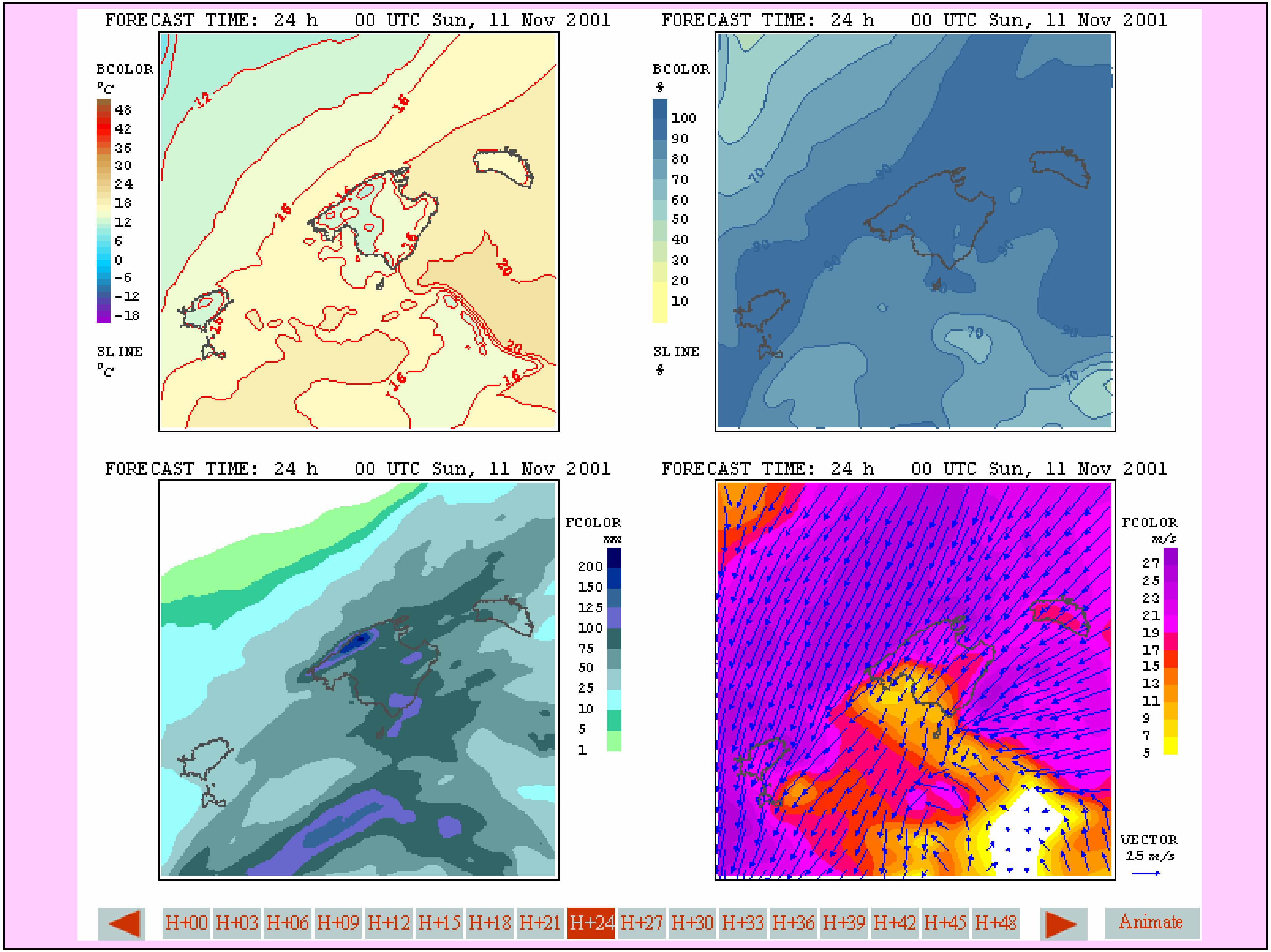


DOMAIN 3 (2.5 km resolution)


FORECAST TIME: 24 h 00 UTC Sun, 11 Nov 2001
BCOLOR m
6020 5960 5900 5840 5780 5720 5660 5600 5540 5480 5420 5360 5300
SLINE hPa
1032 1028 1024 1020 1016 1012 1008 1004 1000 996
FORECAST TIME: 24 h 00 UTC Sun, 11 Nov 2001
BCOLOR °C
34 30 26 22 18 14 10 6 2 -2 -6 -10 -14
VECTOR 15 m/s
FORECAST TIME: 24 h 00 UTC Sun, 11 Nov 2001
FCOLOR mm
200 150 125 100 75 50 25 10 5 1
FORECAST TIME: 24 h 00 UTC Sun, 11 Nov 2001
FCOLOR m/s
27 25 23 21 19 17 15 13 11 9 7 5
VECTOR 15 m/s
H+00 H+03 H+06 H+09 H+12 H+15 H+18 H+21 H+24 H+27 H+30 H+33 H+36 H+39 H+42 H+45 H+48
Animate

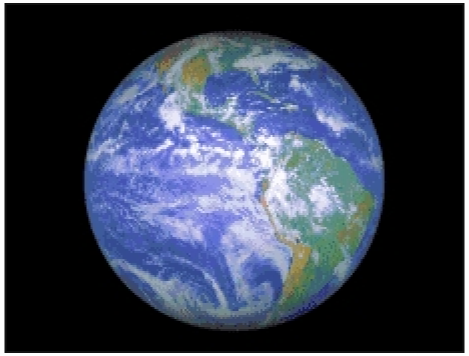


FORECAST TIME: 24 h 00 UTC Sun, 11 Nov 2001
BCOLOR
m
6020
5960
5900
5840
5780
5720
5660
5600
5540
5480
5420
5360
5300
SLINE
hPa
1020
1016
1012
1008
1004
1000
996
992
FORECAST TIME: 24 h 00 UTC Sun, 11 Nov 2001
BCOLOR
°C
34
30
26
22
18
14
10
6
2
-2
-6
-10
-14
VECTOR
15 m/s
FORECAST TIME: 24 h 00 UTC Sun, 11 Nov 2001
FCOLOR
mm
200
150
125
100
75
50
25
10
5
1
FORECAST TIME: 24 h 00 UTC Sun, 11 Nov 2001
FCOLOR
m/s
27
25
23
21
19
17
15
13
11
9
7
5
VECTOR
15 m/s
H+00 H+03 H+06 H+09 H+12 H+15 H+18 H+21 H+24 H+27 H+30 H+33 H+36 H+39 H+42 H+45 H+48
Animate



FORECAST TIME: 24 h 00 UTC Sun, 11 Nov 2001
BCOLOR
°C
48
42
36
30
24
18
12
6
0
-6
-12
-18
SLINE
°C
FORECAST TIME: 24 h 00 UTC Sun, 11 Nov 2001
BCOLOR
%
100
90
80
70
60
50
40
30
20
10
SLINE
%
FORECAST TIME: 24 h 00 UTC Sun, 11 Nov 2001
FCOLOR
mm
200
150
125
100
75
50
25
10
5
1
FORECAST TIME: 24 h 00 UTC Sun, 11 Nov 2001
FCOLOR
m/s
27
25
23
21
19
17
15
13
11
9
7
5
VECTOR
25 m/s
H+00 H+03 H+06 H+09 H+12 H+15 H+18 H+21 H+24 H+27 H+30 H+33 H+36 H+39 H+42 H+45 H+48
Animate

Global Scale



NOAA

Weather on Planet Earth is the result of basically **four main features: the sun, the planet's atmosphere, moisture, and the structure of the planet**. These ingredients create dust devils and hurricanes, floods and droughts, heat waves and blizzards, and everything in between. We'll take a closer look on the following pages.

The Sun

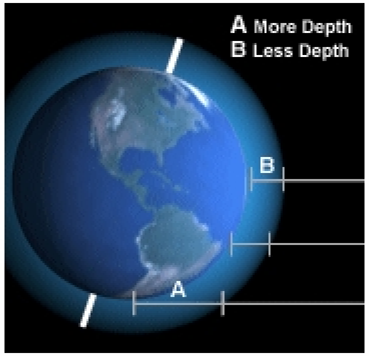
The weather on our planet is largely due to the sun heating areas of the planet unequally. This unequal distribution occurs because

1. The sun's radiation reaches only half the planet at any one time.
2. The amount of radiation reaching the surface varies at different places.
3. The planet tilts as it revolves around the sun.

The first cause listed above refers to the temperature difference between night and day. The part of the planet that faces the sun heats up during the day as the **earth rotates every 24 hours**. Meanwhile, the other half loses heat during the night.

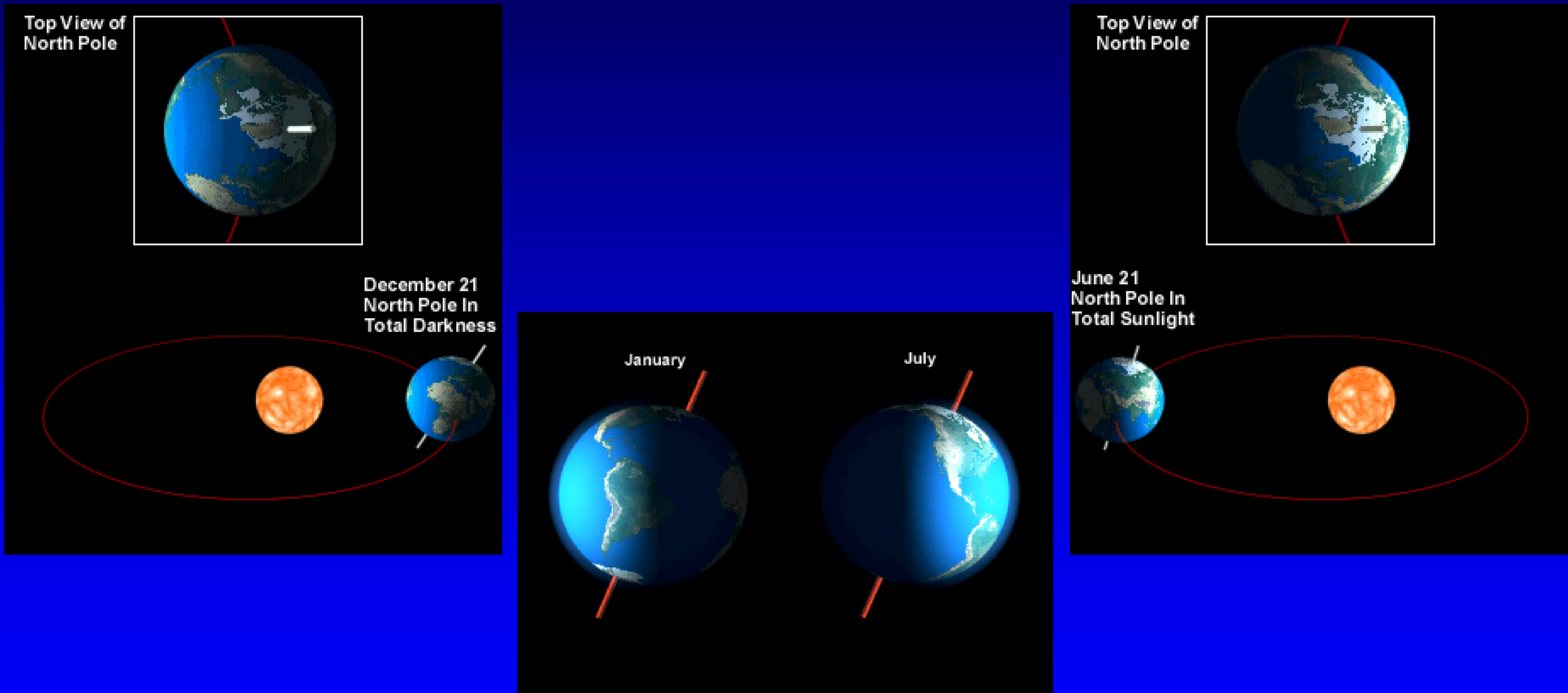
Second, **the spherical shape of the planet causes an unequal distribution of radiation**. The sun's rays must penetrate a larger volume of the atmosphere at the poles (Point A) than at the equator (Point B). Consequently, more radiation is diffused by the atmosphere before it reaches the ground in higher latitudes.

In addition, the rays are more concentrated at the equator than at the poles where they strike at a more oblique angle. The net result is higher temperatures at the equator—another imbalance in the distribution of heat.



The COMET Program

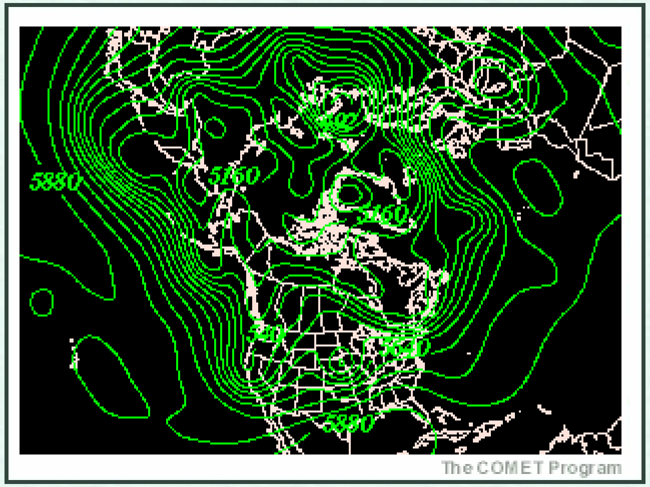
Third, **the earth revolves around the sun** every 365 days (see figure below), and as it does, different parts of the planet tilt toward the sun and receive more radiation. For example, on June 21 (the summer solstice), the North Pole is tilted toward the sun and has continuous daylight.
Notice that on December 21, the North Pole is tilted away from the sun. In April, the planet has relatively little tilt, meaning that day and night are about equal length in most places. This **tilt causes the seasons**.



The variations in temperature, both on a daily and seasonal basis, cause the circulation of the atmosphere

Temperature, Pressure, and Winds

The temperature differences discussed earlier also cause pressure differences in the atmosphere. So, for example, we have cold, dense air at the poles and warm, lighter air near the equator. The same processes that try to equalize temperature differences over the globe also try to balance the pressure differences between denser and lighter air. **This creates winds that blow from areas with higher pressure to those with lower pressure.**



When pressure changes rapidly between two areas, we say that there is a "tight pressure gradient." In general, the tighter the pressure gradient, the stronger the winds tend to be. In other words, the greater the pressure differences for a given distance across the ground, the stronger the wind.)

These movements, plus the planet's rotation, create the large-scale wind patterns that transport weather systems. For example, trade winds propel tropical storms from the coast of Africa westward to the coast of the U.S., while the prevailing westerlies on the North American continent can carry Pacific Northwest rainstorms all the way to the East Coast.

Winds tend to increase with height, reaching their maximum about 8 miles (11 km) above the Earth's surface at the tropopause, which is the top of the troposphere. These maximum winds concentrate in narrow bands called **jet streams**, where wind speeds may reach more than 200 mph. Jet streams exist because of temperature contrasts, and they are stronger in the winter when that contrast is greatest. They are an important factor in heat transfer in the atmosphere and in the development and movement of low- and high-pressure systems.

The Planet's Structure

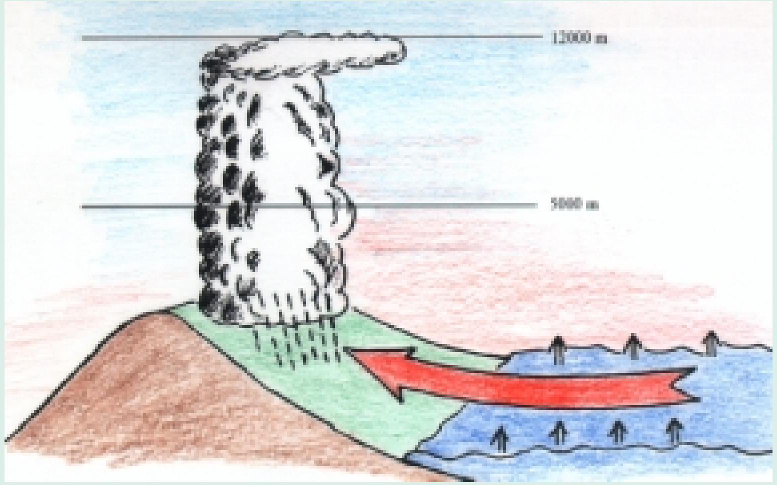
Moisture

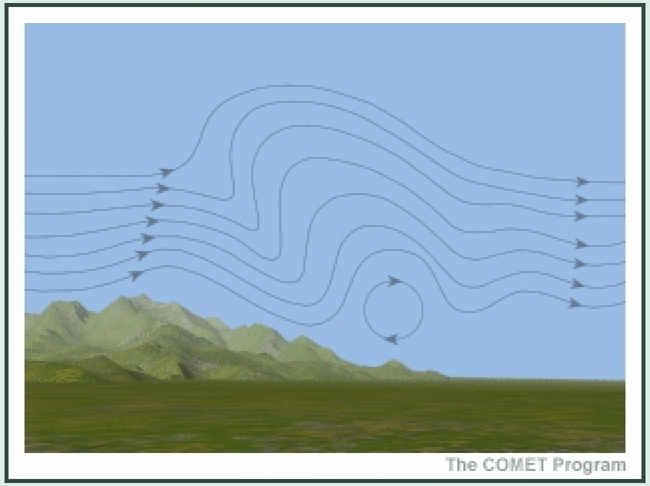
While water vapor is not the most abundant gas in the atmosphere, it is very important in terms of weather. In addition to forming liquid and solid particles in clouds that fall as rain or snow, the process of changing from the gaseous state into liquid water or ice releases large amounts of heat that is an energy source for weather systems, particularly thunderstorms and hurricanes. In addition, the vapor absorbs some of the earth's outgoing radiation, which affects the heat balance of the planet.

Topography

The **basic structure** of the planet—landforms, oceans and other bodies of water, mountains, deserts, vegetation, and even urban areas—is also important in determining weather. The oceans are particularly important in weather because they provide much of the water that evaporates into the atmosphere. This **moisture**, transported by the "rivers of air," **condenses to form clouds**. In addition, the oceans collect heat and release it more slowly than the land. This also affects the distribution of temperature.

Topographical variations affect weather in many important ways. For example, the presence of mountain ranges affects the distribution of moisture. If the prevailing winds blow from the ocean toward high terrain (as is the case in the Pacific Northwest, for example), a "rain shadow" effect is often produced where the slopes facing the prevailing winds (the windward side) receive much more rain or snow than on the leeward side. We'll talk more about topographical effects when we discuss the mesoscale.



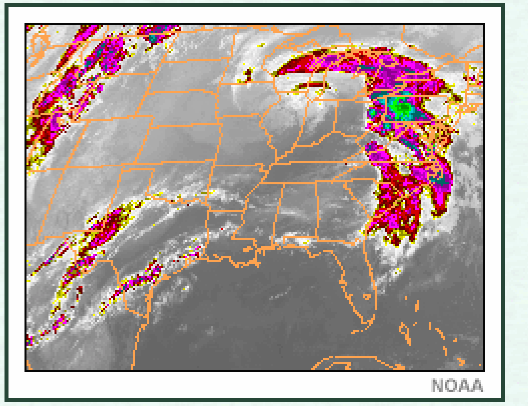


Climate

The **climate** in your area is a function of your location on the planet, topography, proximity to water bodies, etc. It is essentially the **average** weather conditions over 30 years or more. This average will contain some extreme conditions along with a larger number of more normal conditions. So knowing your average precipitation, for example, does not tell you anything about the likelihood of an extreme event—the kind that results in problems for your community. Historical and statistical analyses can give you a better idea of extremes for your locale, and we'll talk more about these in the Hazards Section.

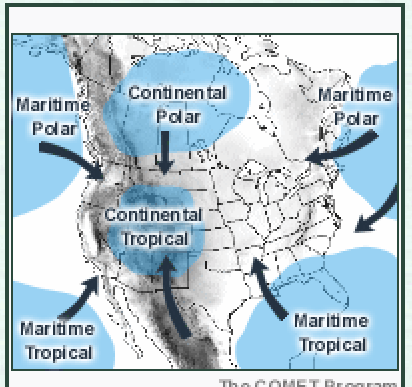
Synoptic Scale

In the previous section we talked about a number of factors that are relatively constant—the shape and rotation of the earth, its revolution around the sun, the positions of the oceans and landforms. We also mentioned **three important things that are variable: pressure, temperature, and moisture**. On the synoptic scale, these variables are also key to producing weather. To them, we will add one more important concept—"**lift**," which describes the forces that cause air to rise and clouds to form.



NOAA

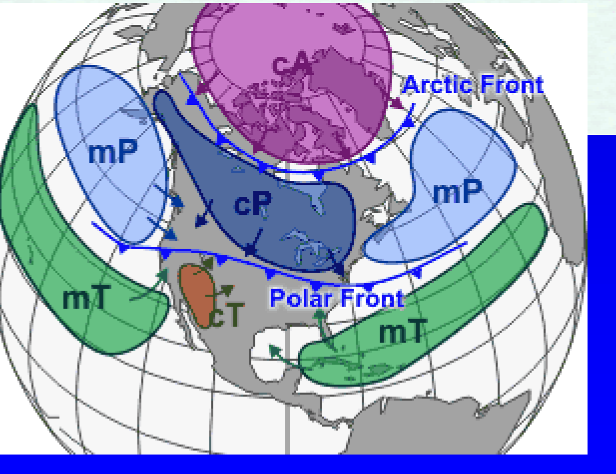
Temperature: Air Masses



The COMET Program

If a body of air moves slowly or stays over an extensive area that has fairly uniform temperature and moisture characteristics, the air takes on those characteristics and is called an **air mass**. Four main types of air masses affect U.S. weather:

- Continental polar (cold, dry)
- Maritime polar (cool, moist)
- Continental tropical (hot, dry)
- Maritime tropical (hot, moist)

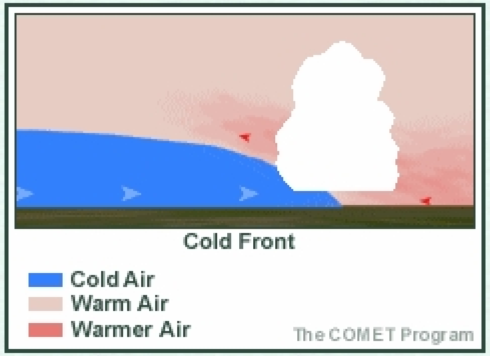


Masa de aire	Origen	Nombre	Características	Temperatura media	Humedad absoluta
Ártica	Indistinto	A	muy fría y seca	-46 °C	0,1 g/m³
Polar	Continental	PC	fría y seca	-11 °C	1,4 g/m³
Polar	Marítimo	PM	fría y húmeda	4 °C	4 g/m³
Tropical	Continental	TC	cálida y seca	24 °C	11 g/m³
Tropical	Marítimo	TM	cálida y húmeda	24 °C	1 7 g/m³
Ecuatorial	Indistinto	E	cálida y húmeda	28 °C	19 g/m³

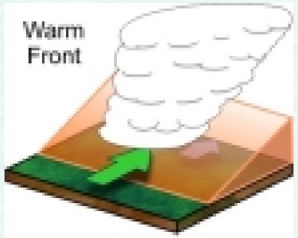
Temperature: Fronts

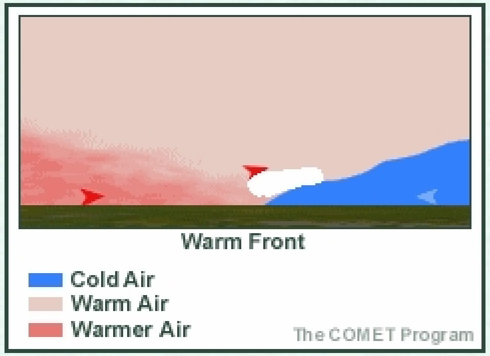
As air masses move out of the area in which they form, they come in contact with other air masses with different characteristics. The **boundaries between different air masses are called fronts**. Across a front (which extends vertically as well as horizontally), temperature, humidity, pressure, and/or wind often change rapidly over short distances. Abrupt changes indicate a narrow frontal zone, while gradual changes indicate a broad, more diffuse zone.

A **cold front is the leading edge of an advancing cold air mass**. At the surface, these fronts mark where cold air overtakes and replaces warmer air. During the summer, cold fronts often initiate thunderstorms and other severe weather. In cold weather, they produce hazardous winter conditions. Because the slope of the cold air mass is steep, temperature, pressure, and weather tend to change dramatically near the front.

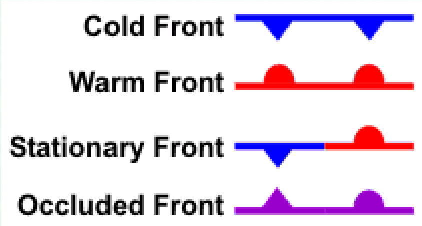


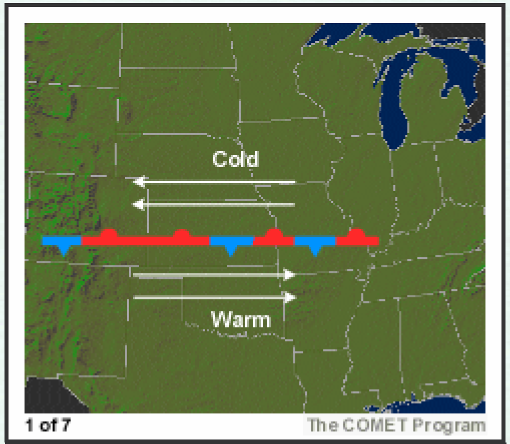
The **edge of an advancing warm air mass is a warm front**. At the frontal boundary, warmer air overtakes and replaces colder air. Warm fronts generally bring light or moderate, but steady, precipitation. Notice the slope of the warm air mass is relatively gentle. Consequently, warm fronts are seldom as distinct on the surface as cold fronts, and they usually move much more slowly.

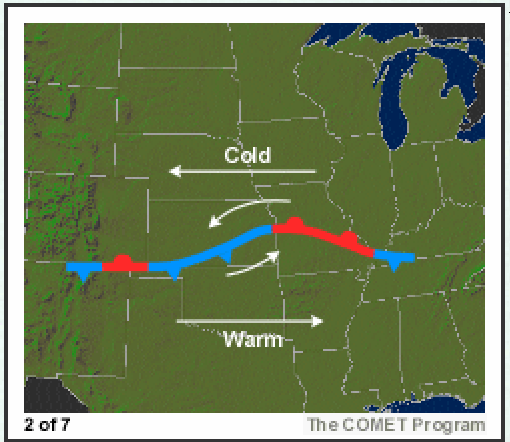


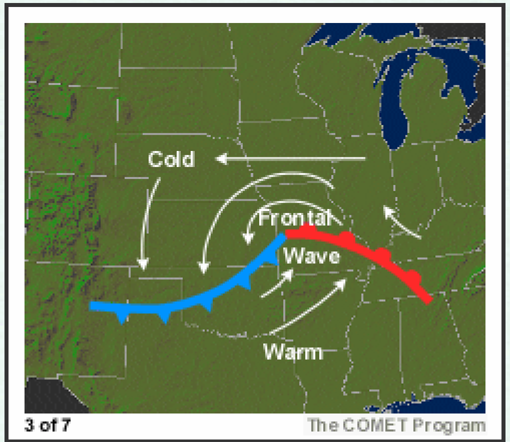


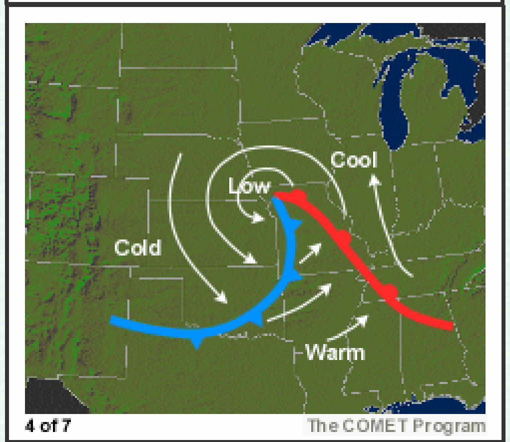
Because the atmosphere is out of balance in the area of a front, a wave-like bend may form.

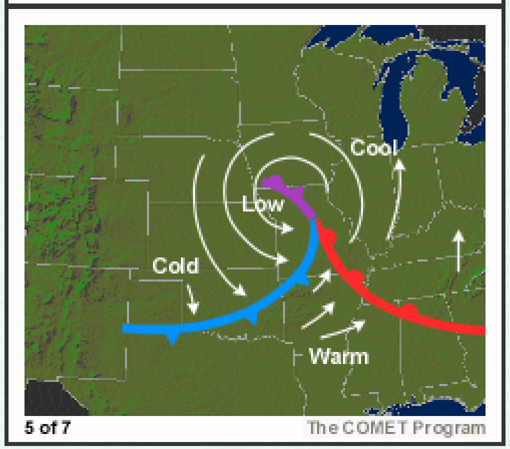


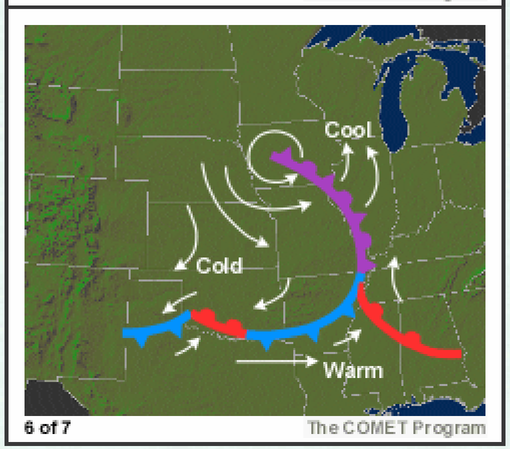


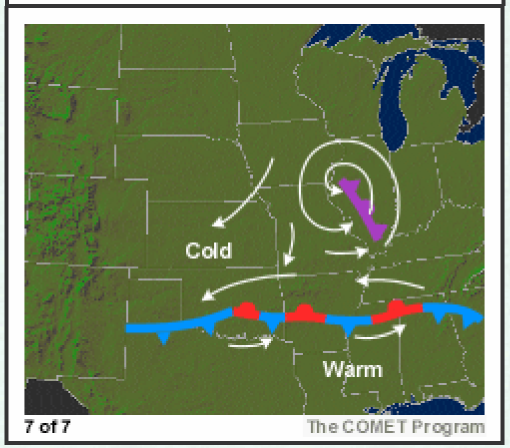








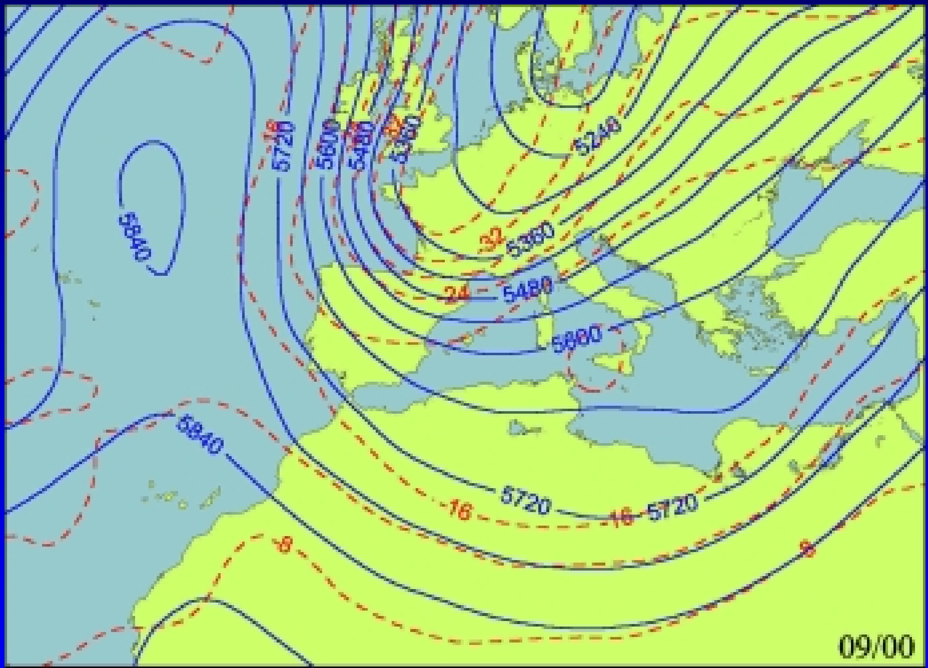


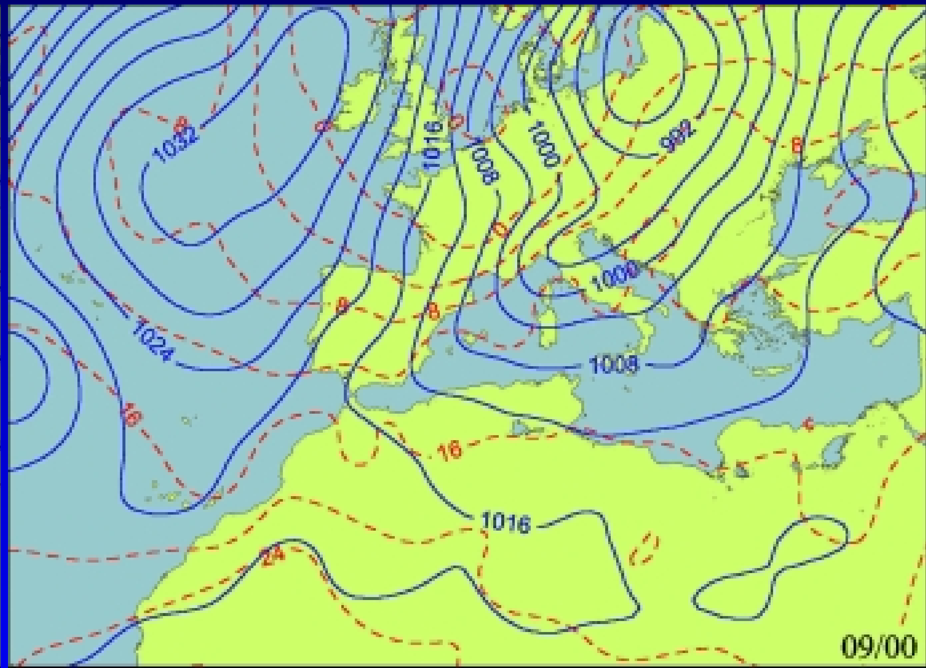


An example: The November 2001 superstorm

Mid-Upper levels (H 500 / T 500)

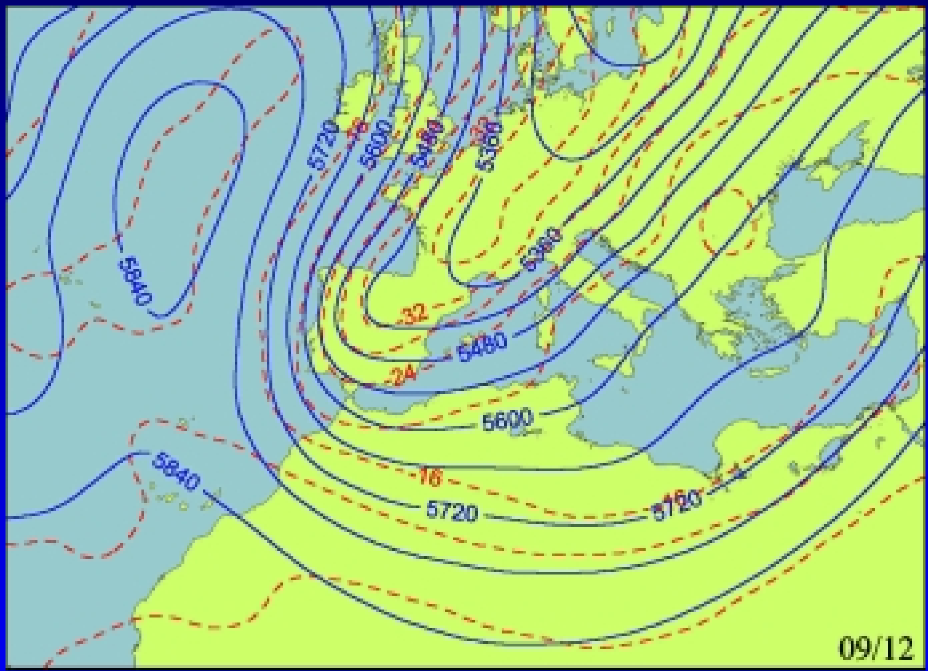
Low levels (SLP / T 925)



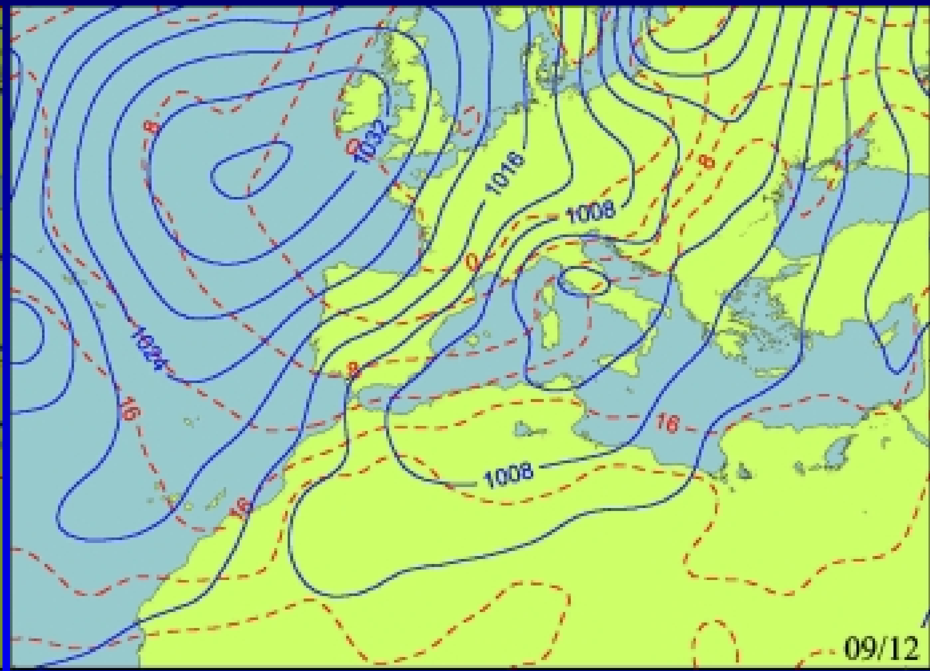


An example: The November 2001 superstorm

Mid-Upper levels (H 500 / T 500)



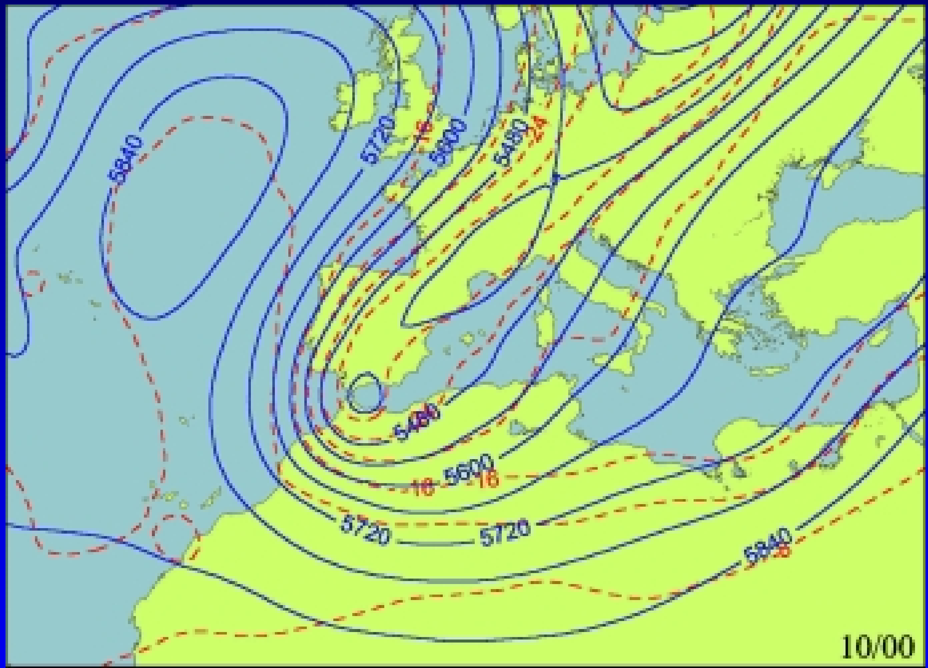
Low levels (SLP / T 925)

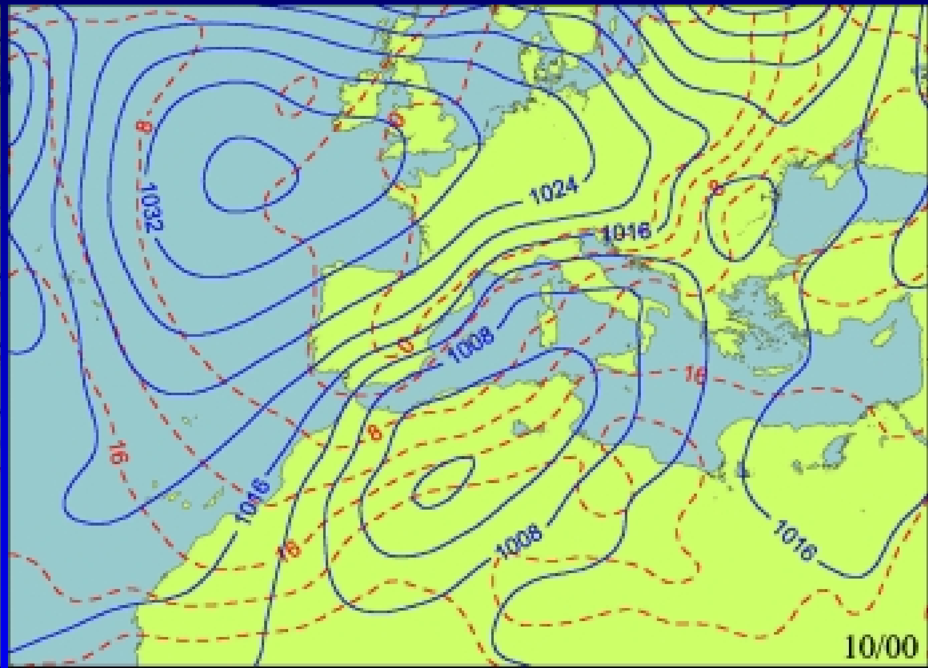


An example: The November 2001 superstorm

Mid-Upper levels (H 500 / T 500)

Low levels (SLP / T 925)

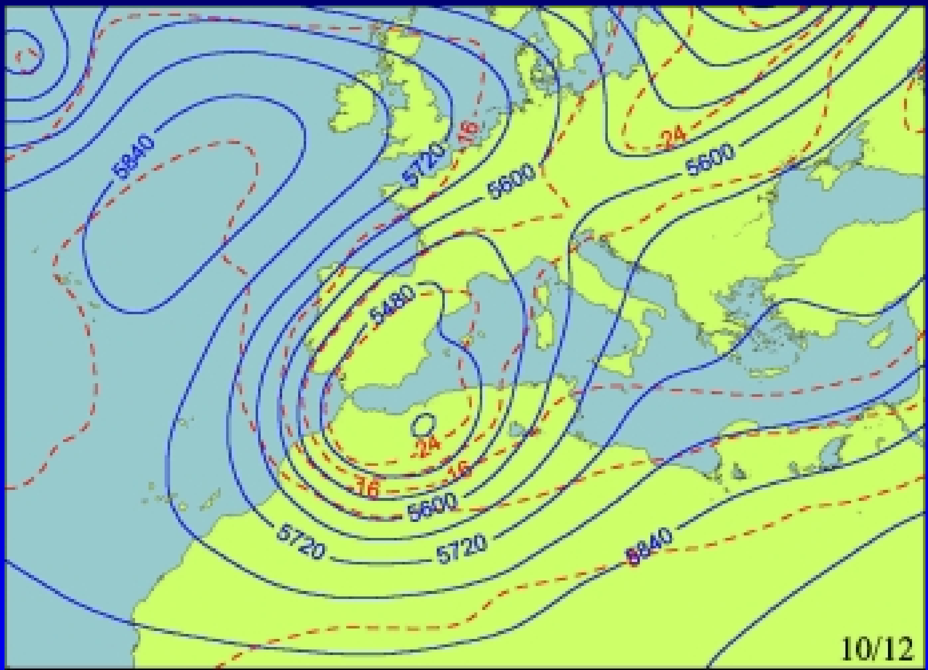


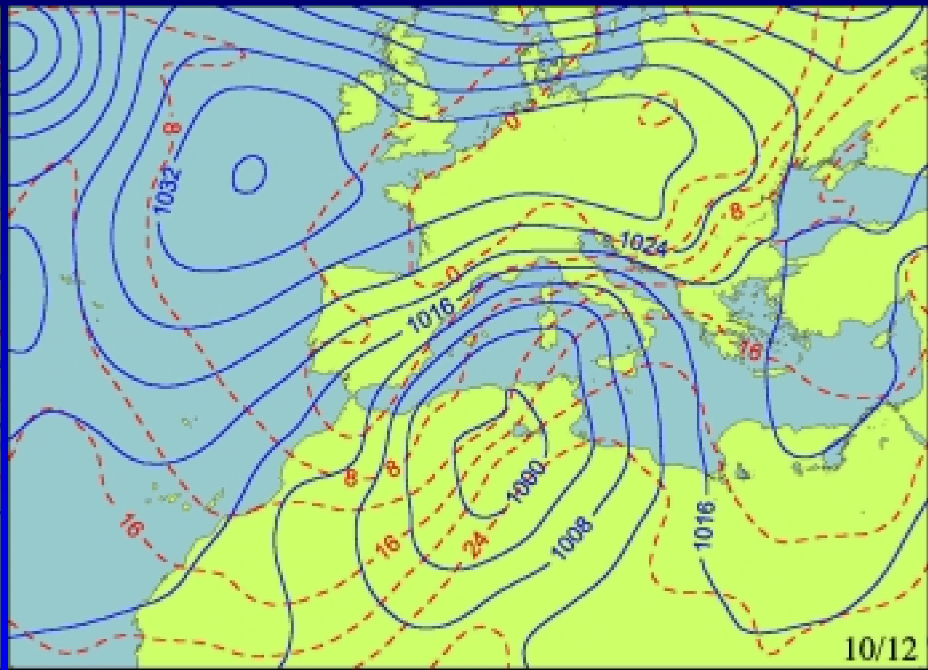


An example: The November 2001 superstorm

Mid-Upper levels (H 500 / T 500)

Low levels (SLP / T 925)

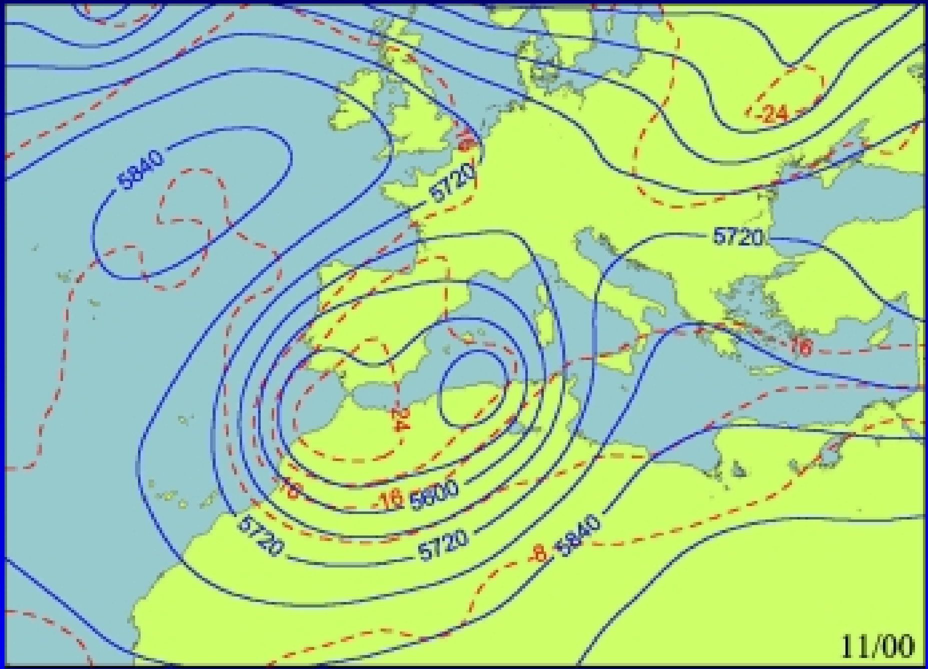


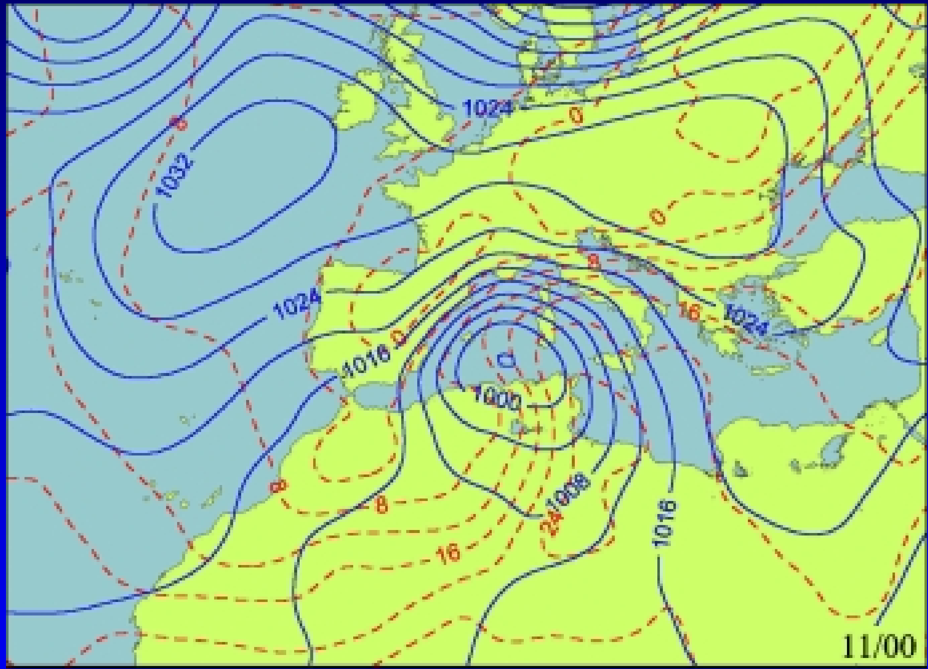


An example: The November 2001 superstorm

Mid-Upper levels (H 500 / T 500)

Low levels (SLP / T 925)

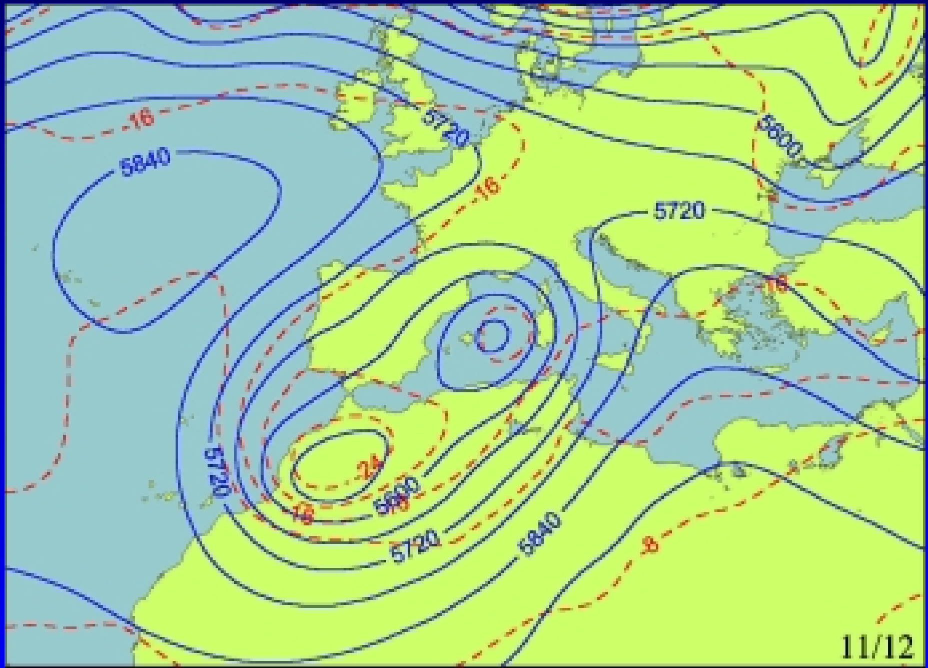


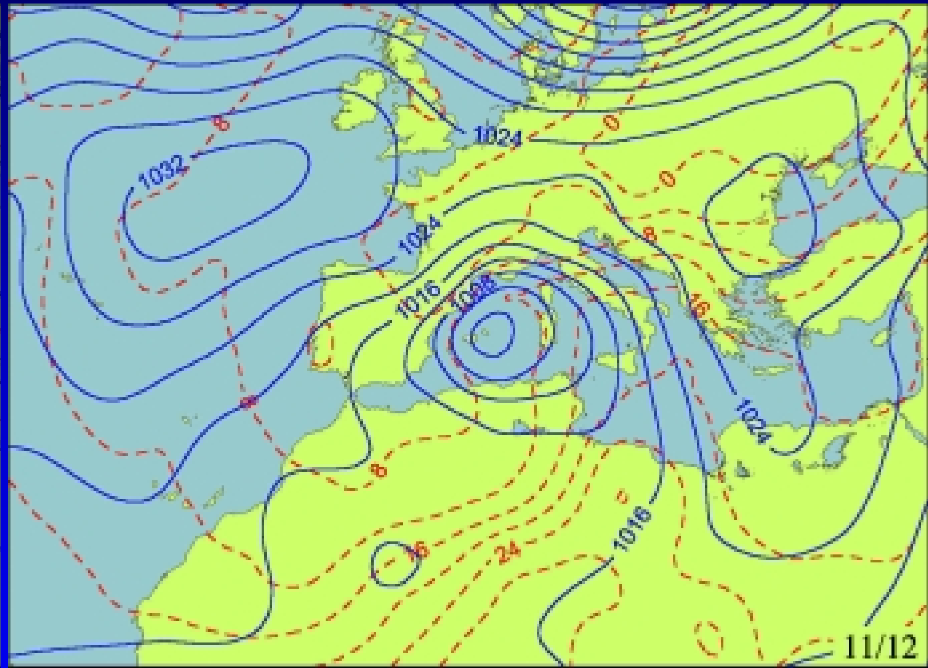


An example: The November 2001 superstorm

Mid-Upper levels (H 500 / T 500)

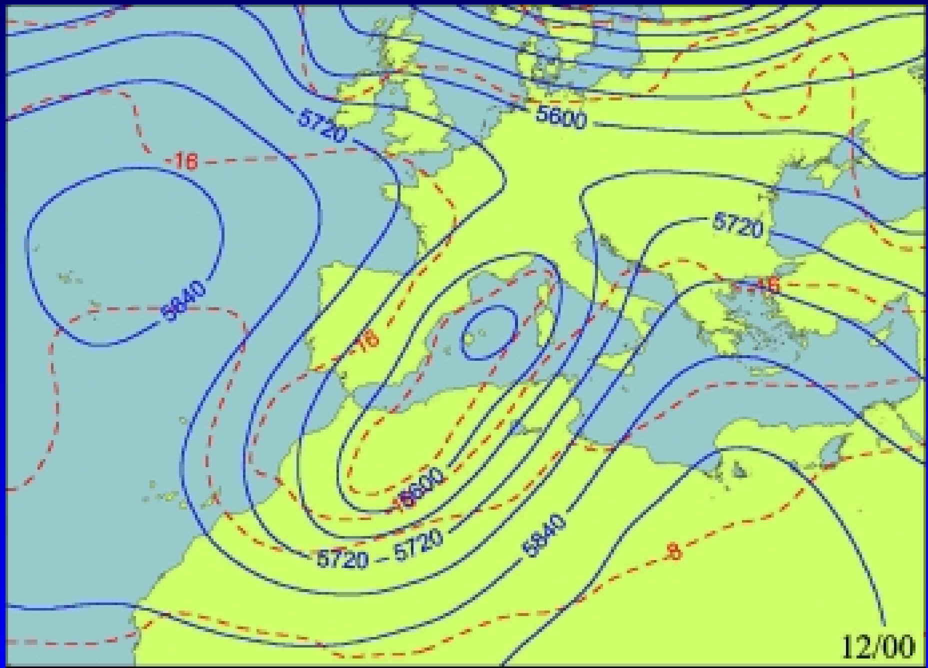
Low levels (SLP / T 925)



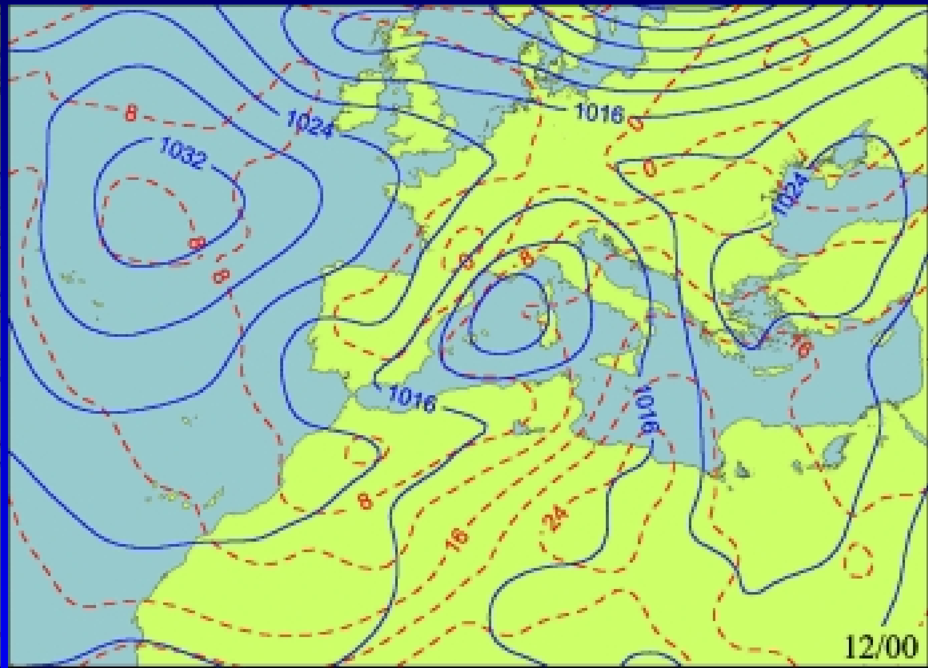


An example: The November 2001 superstorm

Mid-Upper levels (H 500 / T 500)

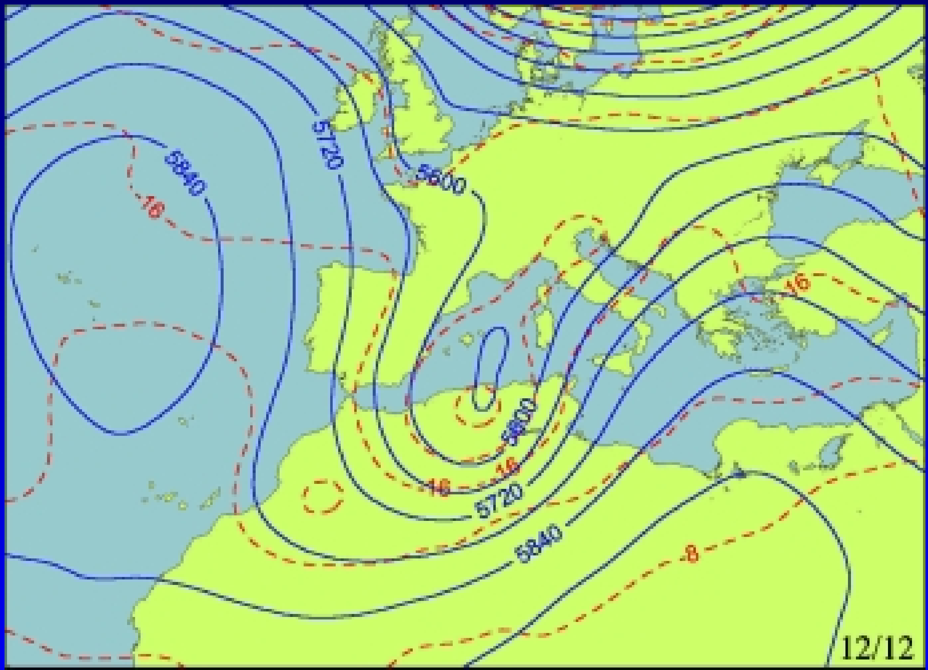


Low levels (SLP / T 925)

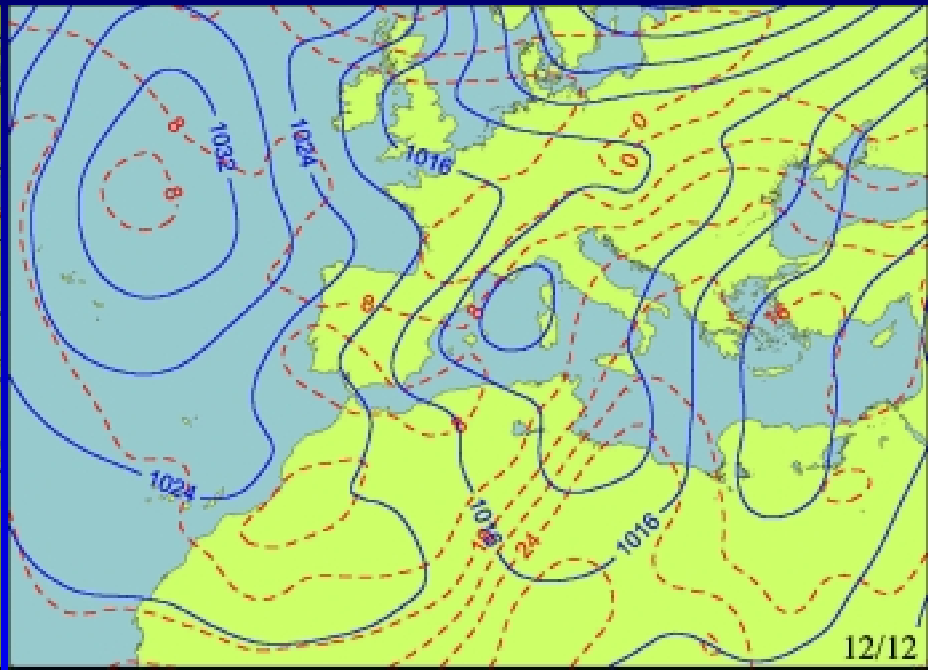


An example: The November 2001 superstorm

Mid-Upper levels (H 500 / T 500)



Low levels (SLP / T 925)

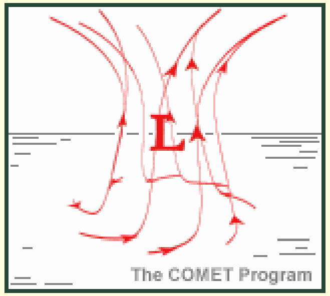
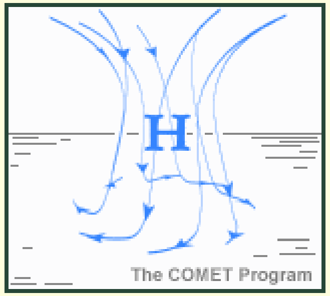


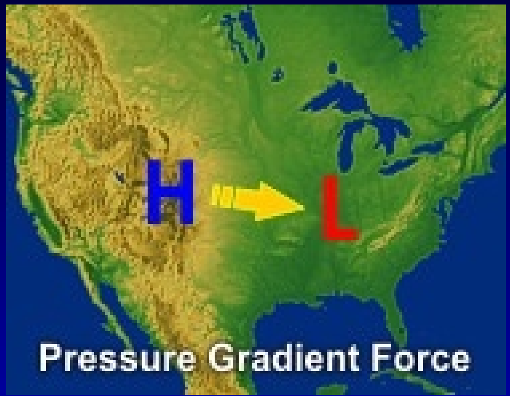
Pressure: Surface Highs and Lows

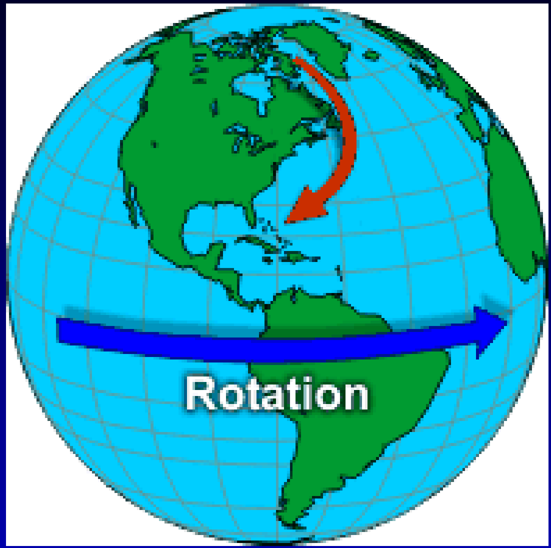
You are probably already familiar with **highs and lows** shown on weather maps on TV. These are areas with maximum or minimum pressures relative to their surroundings. Lines around the highs and lows, called "**isobars**," connect pressure observations that are the same.

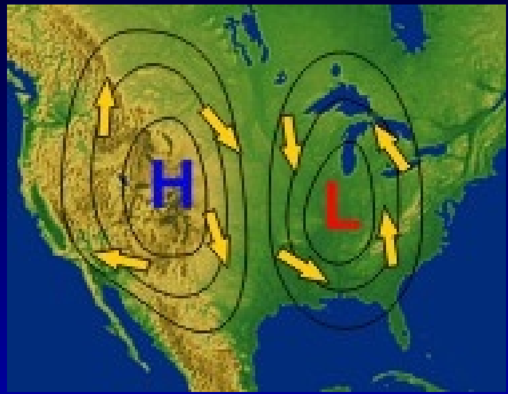
As mentioned in the Global Scale subsection, pressure varies considerably with altitude. So, while the surface pressure at San Diego is typically around 1000 mb, it is closer to 800 mb in Colorado. In order to compare pressures in different locations, the NWS adjusts surface pressure readings at locations above sea level to what the reading would be if the station were actually at sea level.

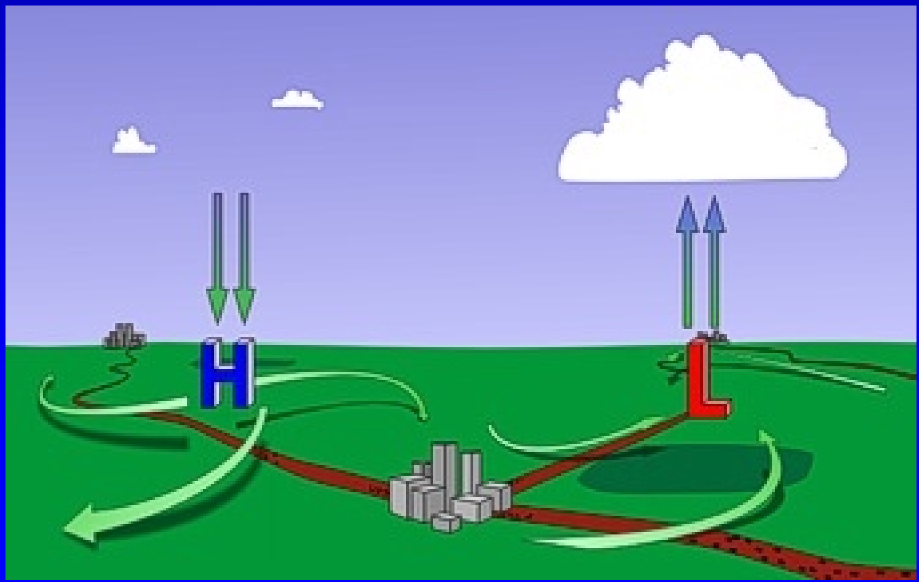
Here is a comparison of important points about **low pressure and high pressure systems**:

Lows	Highs
Center of pressure surrounded on all sides by ***higher*** pressure	Center of pressure surrounded on all sides by ***lower*** pressure
Also called a ***cyclone***	Also called an ***anticyclone***
Air moves ***counterclockwise*** (cyclonically) around the center (in the Northern Hemisphere) 	Air moves ***clockwise*** (anticyclonically) around the center (in the Northern Hemisphere) 
Area of ***rising*** air	Area of ***sinking*** air
Often ***produces*** cloudy skies and precipitation	Often ***suppresses*** clouds and precipitation

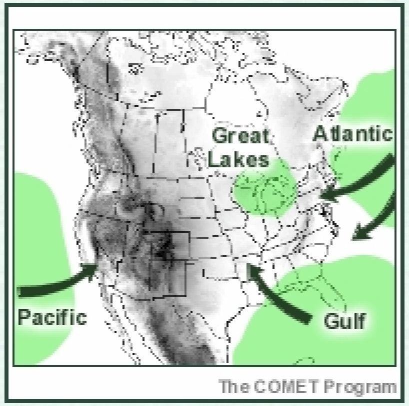

H
L
Pressure Gradient Force


Rotation


H
L

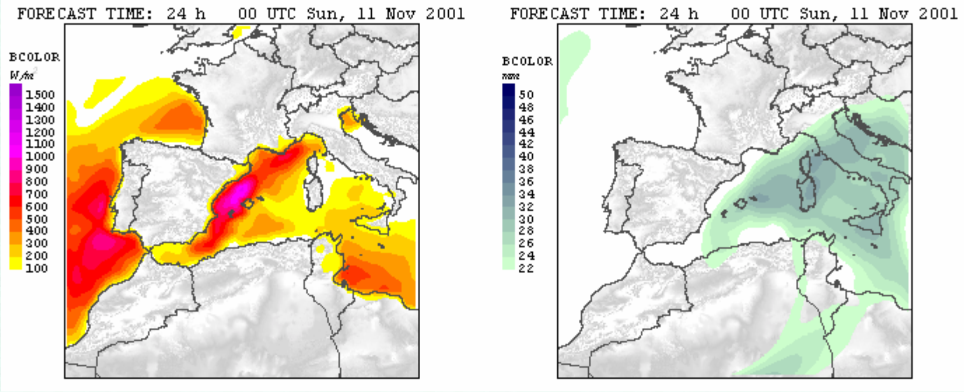

H
L

Moisture



Moisture is the fuel for severe weather. It enters the atmosphere as water vapor, mostly from water evaporating from the oceans. The main sources of moisture for the U.S. are shown in the figure to the right.

When the air is saturated, it cannot hold any more vapor. The moisture condenses into either cloud droplets or ice particles. Precipitation occurs when these cloud droplets or particles grow large enough that the atmosphere can no longer hold them up.

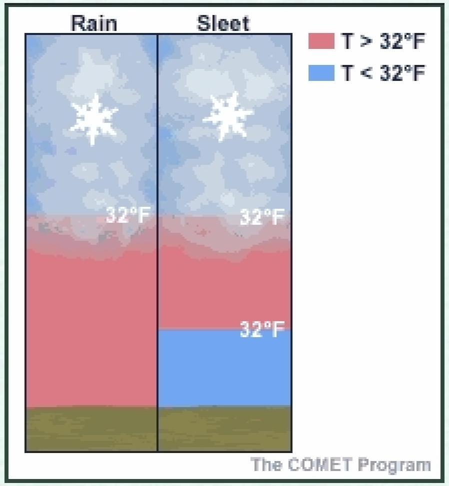


Precipitation

Precipitation exists in two forms:

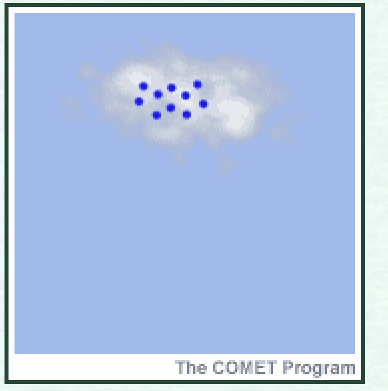
- Frozen, including snow, sleet, hail, and ice pellets
- Liquid, including drizzle and rain

Which form of precipitation ends up on the ground depends on the temperature in the air above. Obviously, if the atmosphere is entirely below freezing, all of the precipitation will fall as snow. If it's above freezing, the precipitation will be rain. Forecasting can be tricky because the atmosphere can have several layers of warmer and colder air. In the left-hand figure, the layer nearest the surface is deep enough to melt the snow before it reaches the surface. In the right-hand figure, the rain freezes into ice pellets. **The more layers of warm and cold air, the more complicated the process and the more difficult to forecast**.



Lift

Most hazardous weather conditions require some sort of mechanism for lifting air. **When air parcels rise, they cool**. And if they contain enough moisture and cool enough to become saturated (to where the dewpoint temperature equals the air temperature), the **water vapor in the air condenses** onto small particles called condensation nuclei. The resulting ice particles or cloud droplets **form clouds**. If the particles or droplets grow large enough, it rains or snows (or some variation of the two).



There are many ways that air can be lifted. We have already talked about several of these:

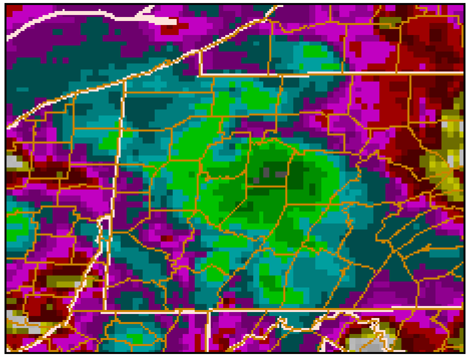
1. Air rises in areas of low pressure.
2. Fronts can act like a wedge to lift air.
3. The jet stream can pull air up.

Another lifting mechanism is a "dryline." This is a boundary, similar to a front, that separates dry and moist air. Because dry air is more dense than moist air, the dry air acts like a wedge, pushing the moist air up. As the moist air rises, the water vapor condenses and forms clouds that can turn into severe storms.

There are many other ways that air can be lifted on a smaller scale, so we'll discuss the concept of lift in more detail in the Mesoscale subsection.

Mesoscale

The **global scale** sets the stage for the weather event, the **synoptic scale** organizes the large-scale pattern, and the **mesoscale** provides the focusing mechanisms and the details that determine what kind of hazardous weather you will deal with. However, the divisions between the mesoscale and the synoptic scale are a bit arbitrary. Some storms can start out small and grow into systems that cover a large area. Conversely, a synoptic-scale storm has local, mesoscale effects that can be quite different in adjacent locations.

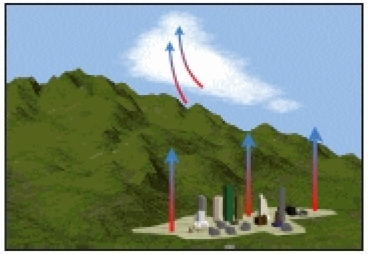


NOAA

Mesoscale meteorology operates essentially the same as synoptic meteorology, only on a smaller scale. The same factors are important: **temperature, pressure, moisture, topography, lift**.

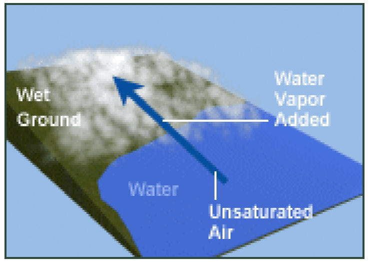
Pressure, Temperature, Moisture

Pressure, temperature, and moisture influence mesoscale weather just as they do on the synoptic scale. However, the small scale patterns and changes in these variables overlay the larger ones, modifying their effects. As a result you might have heavy snowfall in one town and only light snow in its closest neighbor. Or you might have a few miles of dense fog on a road, followed by perfectly clear conditions.



The COMET Program

Small-scale changes in pressure, temperature, and moisture can occur for many reasons. Topography plays an important role on the mesoscale. For example, mountain slopes warm when the sun hits them, creating thermals of less dense air that rise and condense into clouds if enough moisture is present. In the evening, the slopes cool faster than the valley floor, and the cold, dense air flows back down the slopes. Large paved surfaces in urban areas can also heat and cool at rates different from those over vegetated areas. These kinds of temperature changes cause local changes in pressure as well.



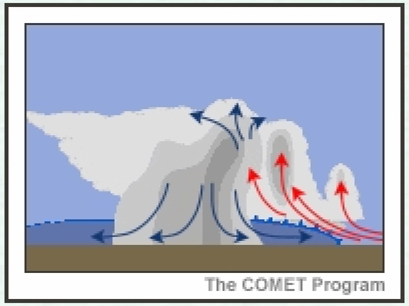
The COMET Program

As far as local moisture sources are concerned, consider as just one example the lake effect snowstorms that can produce over 60 inches of snow in a month in places like Buffalo, NY. However, much smaller sources of moisture can also affect the weather. Scientists have evidence that moisture that has soaked into the soil from thunderstorms on one day can evaporate during the next day and provide the fuel for new storms.

Mechanisms of Lift

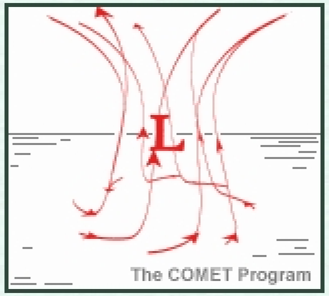
As is the case when talking about pressure, temperature, and moisture, the distinction between lift on the synoptic scale and lift on the mesoscale is blurry. Most of the processes that we will talk about in this section can occur on either scale—it's just a question of the size. Some of them have already been mentioned.

Fronts



You know from the Synoptic Scale subsection that a front is the boundary between two air masses with different characteristics. **Fronts also exist on the mesoscale**. One example is the boundary between the warm environment and a cold pool of air flowing out of a thunderstorm, called a **gust front**. In this case, the cold downdraft can act just like a synoptic-scale cold front, lifting the warm air around it and spawning new thunderstorms. Frequently, the surface observation networks are too far apart to pick up these kinds of "mini-fronts," so forecasters have to rely on other tools, such as radar, to help identify these features.

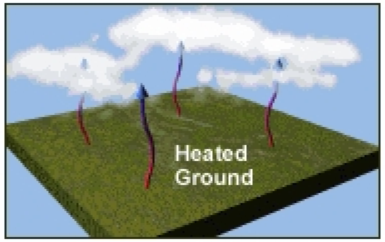
Convergence



Convergence is a term used to describe a situation **where winds from different directions or different speeds meet**. Convergence at the surface is instrumental in producing lift because converging winds can only rise since downward motions are blocked by the surface.

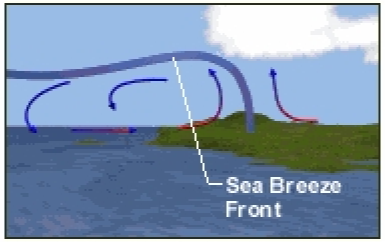
Recall from the Synoptic Scale subsection that falling surface pressure means that air is rising and these upward vertical motions result in cloudiness and storms. Recall also that the **surface wind pattern associated with lows is a spiraling in toward the center in a cyclonic (counterclockwise) pattern**. This is one type of convergence. Fronts that exhibit changes in wind direction are also examples of convergence. Convergence can even occur when the gust fronts from nearby thunderstorms intersect.

Convection



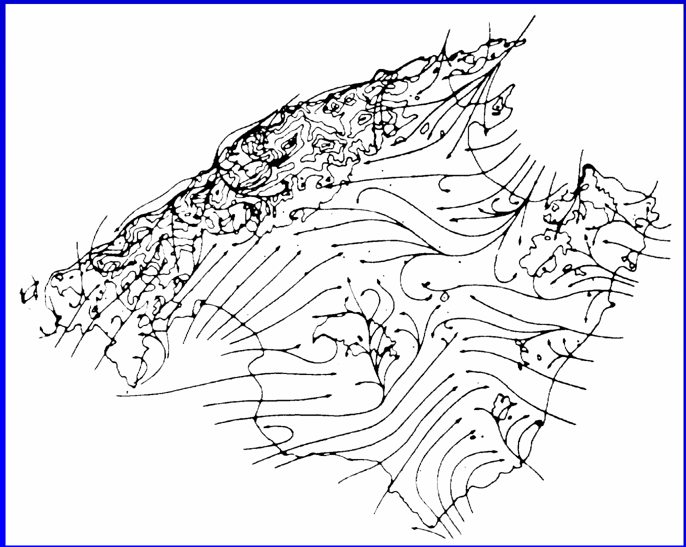
The COMET Program

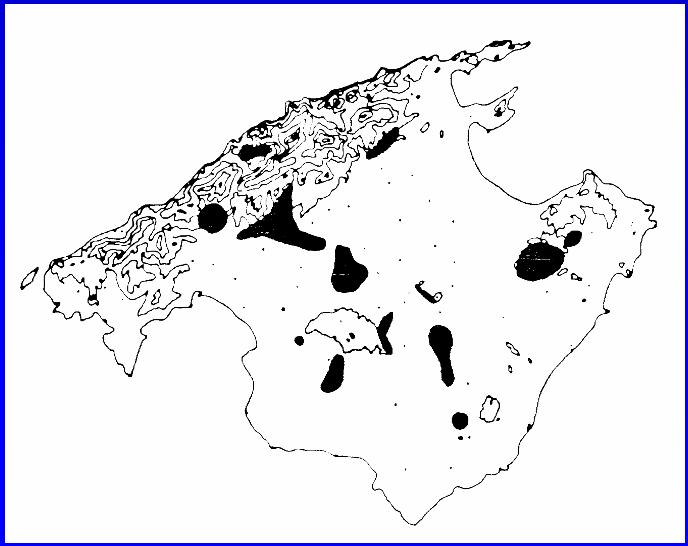
As the sun heats the earth's surface, **parcels of air rise** like bubbles. These are called "thermals," and they will continue to rise until they either cool to the same temperature as their surroundings or they encounter a layer of warmer air. As the air rises and cools, it can produce clouds if it becomes saturated. Under the proper conditions (adequate moisture, no warmer layers of air), **lifting by convection allows the extensive vertical development** of summertime cumulus clouds that can grow into the storms that produce some of this country's most hazardous weather. In contrast, large-scale lifting by convergence alone usually produces clouds with much less vertical development.



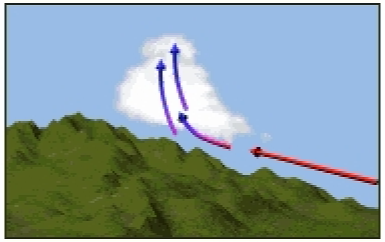
The COMET Program

Lift that results from a combination of convection, convergence, and a front is shown in the figure to the left. As the sun heats the land, thermals rise, lowering the pressure. The air over the water is colder and denser, and therefore is an area of relatively higher pressure. The sea breeze (or it could be a lake breeze) front marks the boundary between the two. As the air from the higher pressure flows toward the lower pressure, it converges and rises, and clouds develop over the land. If the air is saturated, low clouds and fog can form along the coast. If atmospheric conditions are favorable, lines of convective storms can also form along the sea breeze front. When the sun goes down, the process reverses, with clouds typically forming offshore.





Topography


The COMET Program

Various topographical features (such as being near a lake or ocean, the character of the rural/urban interface, and the presence of hills or mountains affect mesoscale weather. On the previous page, we mentioned how the heating and cooling of mountain slopes generates thermals. **Another example is air forced up a slope when the wind blows toward terrain**. As it rises, the air cools, the vapor condenses, and a cloud forms, just as happens with the other lifting mechanisms. Clouds and precipitation that result from air being lifted as it passes over terrain are called "**orographic**."

Drylines

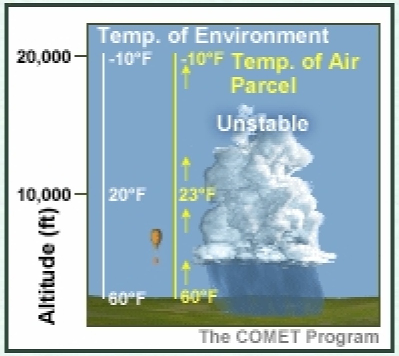
As discussed in the Synoptic Scale section, dry air is more dense than moist, so dry air boundaries (called **drylines**) can act like fronts to push up moist air. **A dryline can be a strong lifting mechanism** that triggers severe weather.

Lift is important, but it is not sufficient. In order to have enough vertical motion for water vapor to condense and form clouds that grow into storms, you need an atmosphere that will **sustain** rising motions. Such an atmosphere is called "**unstable**," and is discussed on the next page.

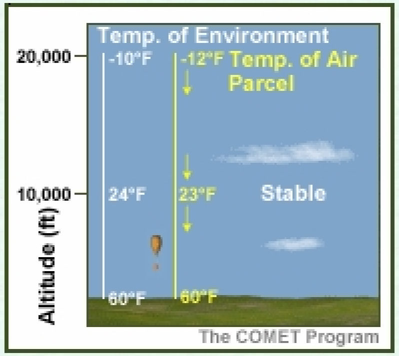
Lift and Atmospheric Stability

An **unstable environment** is one in which **air parcels continue to rise**, even after the lifting forces stop. Instability is important because rising air is conducive to vertical cloud development that can result in severe storms. A **stable environment** is one in which **air that is forced up will either sink or tend to spread out**, rather than rise. You will frequently see terms related to stability or instability in forecast discussions.

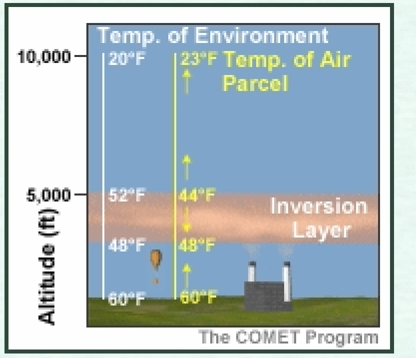
The diagram to the right shows an example of an **unstable** environment. The temperature of an air parcel (orange balloon) starts out at the same temperature as its surroundings (white line). As it rises, the parcel cools (yellow line). In this case, the environment at 10,000 ft is only 20°F compared to the parcel's temperature of 23°F (temperatures and heights are chosen only as an example). Because it is warmer than its environment, the parcel will continue to rise until it is no longer warmer (at 20,000 ft in this case).



In a **stable** environment, air parcels that are forced upward are colder than their surroundings and tend to sink or spread out. Because the air resists being moved upward, few clouds may form, and those that do will be more horizontal than the one shown in the unstable case. In the example to the right, a parcel lifted to either 10,000 ft or 20,000 ft would be colder than the surroundings, and would not rise further.



A special case of stability is the **temperature inversion**, which is a layer of warmer air on top of colder air. In the graphic to the right, the inversion layer is that region where the environmental temperature (white line) warms from 48°F to 52°F. Inversions inhibit vertical motions because, a parcel that reaches the inversion layer is cooling while the environment is warming. Eventually, the parcel will be colder than its surroundings. Inversions are key factors in air pollution incidents and fog events because they act like lids, trapping the pollutants or fog. They are common early in the day, but if the atmosphere heats up enough, the inversion can be destroyed. If this happens, usually the fog will dissipate and air pollutants will disperse.



Because inversions prevent rising motions, they also inhibit the development of severe storms **in the summer**. However, if the inversion is destroyed as the atmosphere heats up, the **pent-up energy and moisture can be released almost explosively, resulting in huge thunderstorms**. Sometimes the difference between a nice day and one with a severe thunderstorm or tornado depends on how strong the inversion is, whether there is enough heating to erode it, and, if it is destroyed, whether there is enough moisture to fuel the growing storm. Forecasting all these conditions is a real challenge.

What Creates Local Weather

The relationships among pressure, temperature, moisture, topography, stability, and lifting mechanisms are very complex, and they are further complicated by the interactions on all the scales we have discussed. It is difficult to make generalizations. For example, high pressure systems are usually associated with good weather. However, along the eastern slopes of the Rocky Mountains, a high located in just the right place can cause heavy upslope precipitation, if temperature and moisture conditions are also just right. Similarly, while we said that cold fronts often trigger severe thunderstorms, warm fronts can also generate strong convective storms if the atmosphere is very unstable.

The best advice is to

- Understand the basics of meteorology
- Understand the hazards in your area for the different seasons (discussed in the next section)
- Talk to your NWS office about which weather patterns are likely to mean trouble for you
- Understand what forecast products will tip you off to potential problems (discussed in the Forecasting section)
- Access the forecasts every day and be sure to look for updates when the weather is changing rapidly

OVERVIEW

1) Weather.- Provides a basic introduction to meteorology, particularly as it relates to hazardous weather (Global scale, Synoptic scale and Mesoscale)

2) Hazards.- Presents the most common hazardous weather events (Description, Characteristics and Examples)

3) Mediterranean cyclones and heavy precipitations.- Analyses in higher detail this problem owing to its high social impact in the region

NOTE: Scientific basis rather than vulnerability analysis or emergency management procedures !!!

Thunderstorms

Definition

A local storm

- Produced by a cumulonimbus cloud
- Always accompanied by lightning and thunder
- Often accompanied by gusty winds, heavy rain, and occasionally by hail
- Sometimes violent at the surface

Category	Wind Speed	Precipitation
Ordinary	< 35 knots (40 mph)	Variable
Approaching Severe	> 35 knots (40 mph)	Hail > 1/2 inch
Severe	> 50 knots (58 mph)	Hail > 3/4 inch

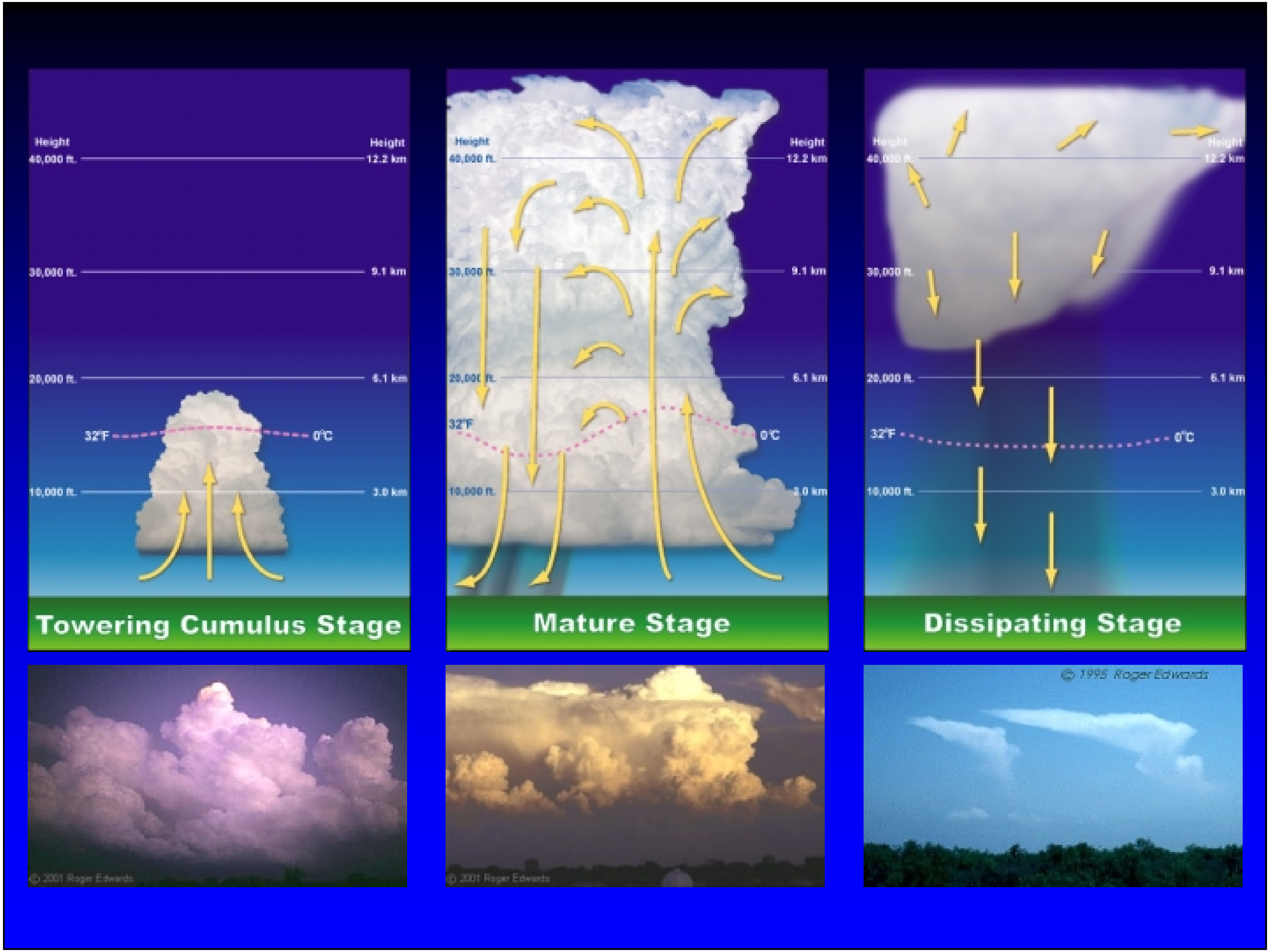
Characteristics

Contributing Factors

- **Moisture** comes from large bodies of water, large vegetated or irrigated areas, or previous storms.
- **Instability** is related to the temperature profile of the atmosphere relative to the moisture of the air mass. If the mid to upper atmosphere is cool (more dense) while the lower atmosphere is moist (less dense), then the lower atmosphere becomes buoyant and unstable and wants to rise, thereby initiating convection. The more unstable the air mass, the more severe the convection. The NWS uses Lifted Index (LI) and Convective Available Potential Energy (CAPE) to indicate atmospheric instability.
- **Lift** is required to initiate convection. Lift can be caused by fronts, heat rising from the earth's surface, topography (upslope flow), dryline boundaries, outflow boundaries from previous storms, and sea breezes.

Stages of Development

- **Developing** - A towering cumulus cloud develops 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 occasionally lightning occurs during this stage, which lasts about 10 minutes.
- **Mature** - 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 mature stage lasts an average of 10 to 20 minutes, but may last much longer.
- **Dissipating** - 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.


Height
40,000 ft.
30,000 ft.
20,000 ft.
10,000 ft.
Height
12.2 km
9.1 km
6.1 km
3.0 km
32°F
0°C
Towering Cumulus Stage
Mature Stage
Dissipating Stage
© 2001 Roger Edwards
© 2001 Roger Edwards
© 1995 Roger Edwards

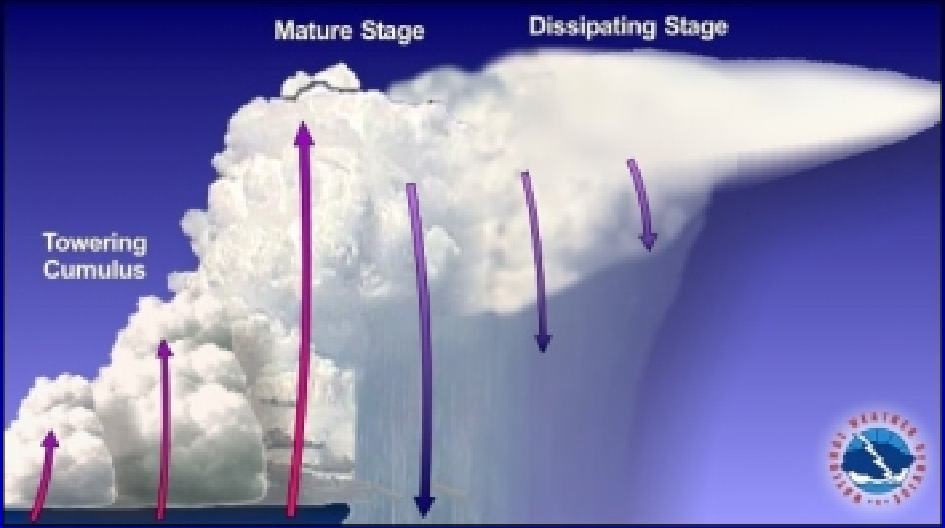
Types

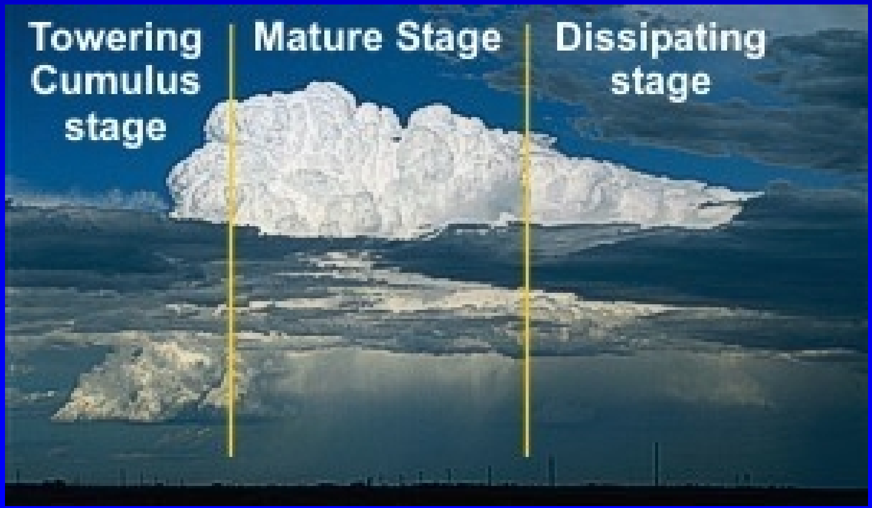
- **Single Cell** - Short-lived storms (20 to 30 minutes) that cover a limited area (a few square miles). These storms are relatively uncommon.
- **Multicell** - The most common type, multicell thunderstorms are an organized cluster of two or more single cell storms. Air flowing out of one storm fuels other storms, causing new storms to develop on the right or rear storm flank every 5 to 15 minutes.
- **Supercell** - Supercells are relatively uncommon but produce the most severe weather, last the longest (1 to 6 hours), and travel 200 miles or more. These storms can cause winds of more than 78 mph, giant hail (e.g., 2 inches), and significant tornado activity. Supercells produce updrafts of 56 to 112 mph that coexist with sustained downdrafts. Together, the updrafts and downdrafts act to extend the storm's duration.
- **Squall Lines** - A line or 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 any combination of types (ordinary to severe, single cell to supercell). Squall lines 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.

Associated Hazards

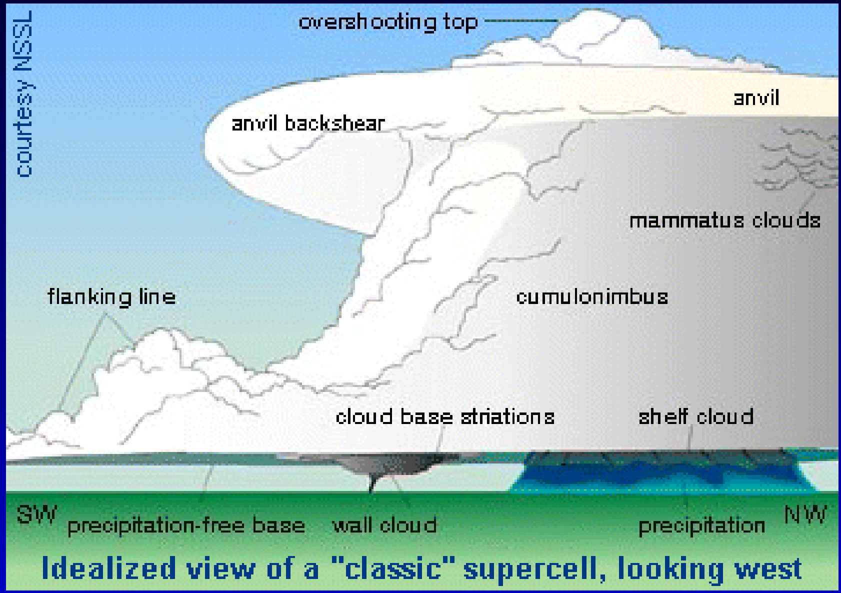
- Lightning
- Hail
- Damaging winds
- Heavy rain causing flash flooding
- Tornadoes
- Lightning-caused fire

Multicell

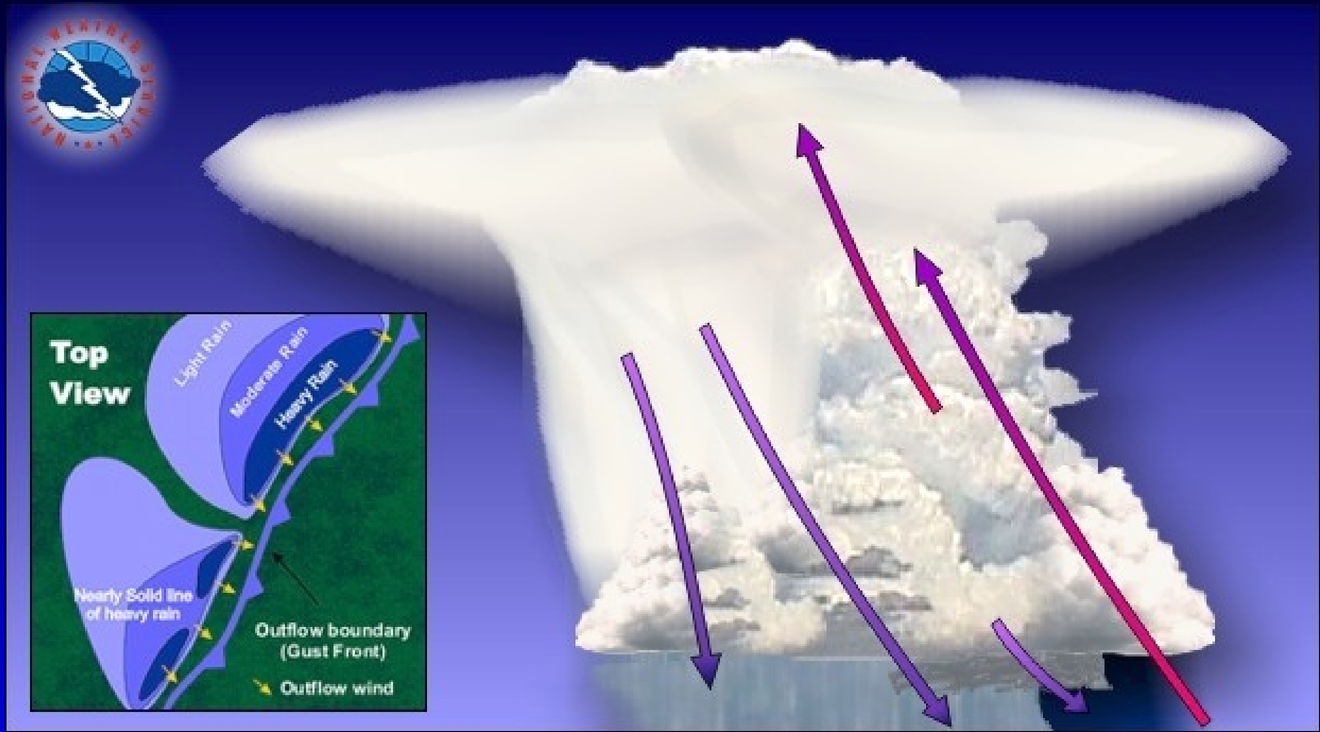




Supercell



Squall Line


Top View
Light Rain
Moderate Rain
Heavy Rain
Nearly Solid line of heavy rain
Outflow boundary (Gust Front)
Outflow wind


© Roger Edwards

THE EVENTS

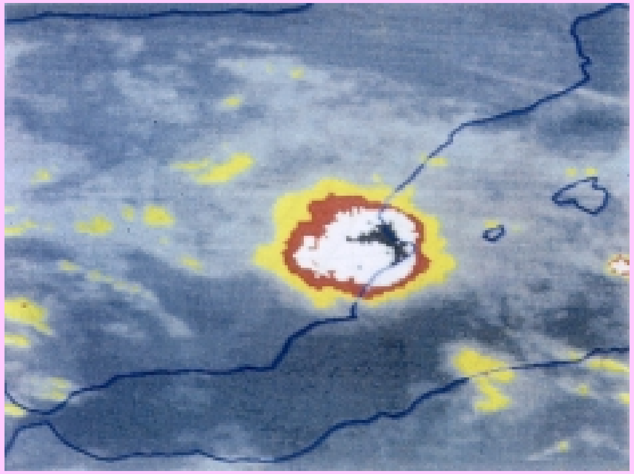
GANDIA (3-4 Nov. 1987)

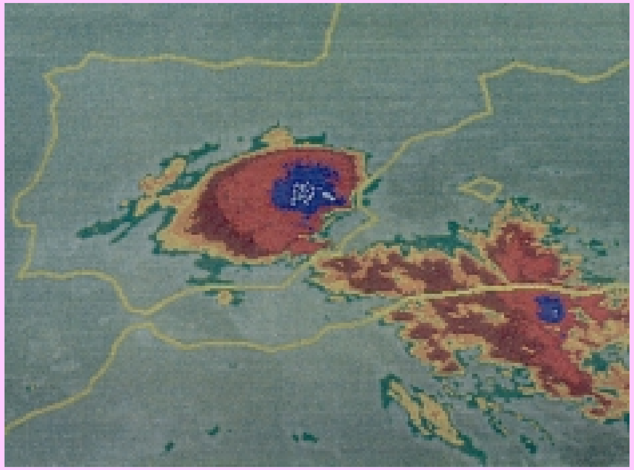
MCS (33 h)
Circular shape (~200 km diameter)
1000 mm / 36 h in **Gandia**

TOUS (20 Oct. 1982)

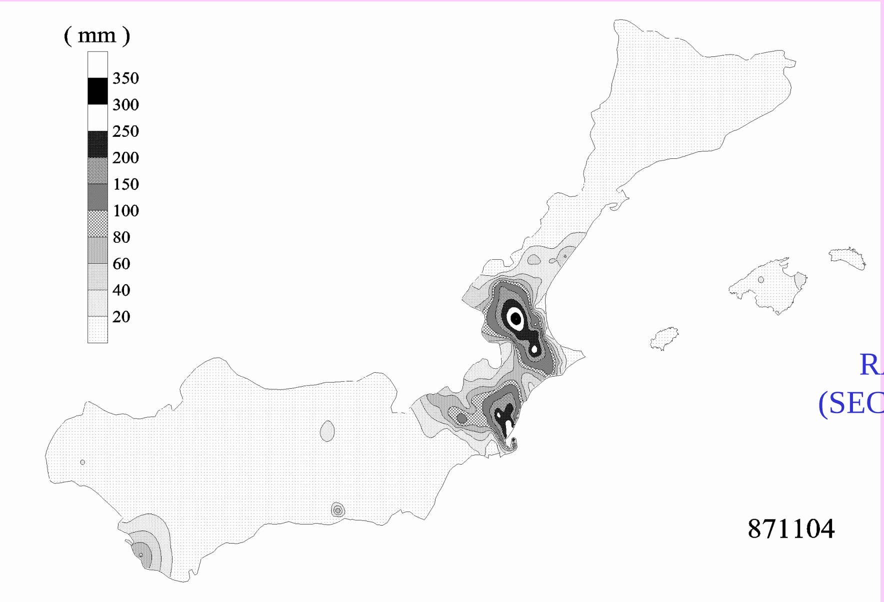
MCC (>12 h)
>400 mm
Dam breaking in **Tous**

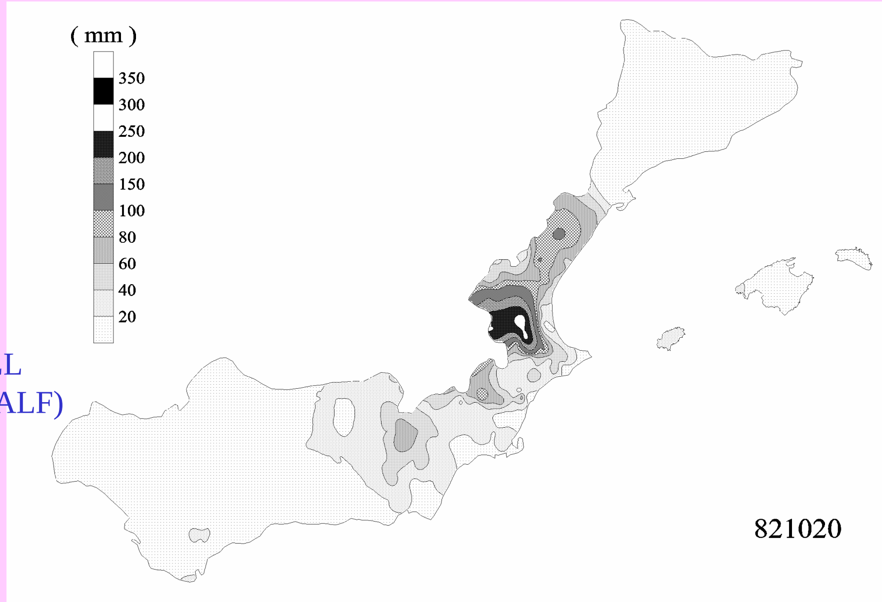
INFRARED METEOSAT



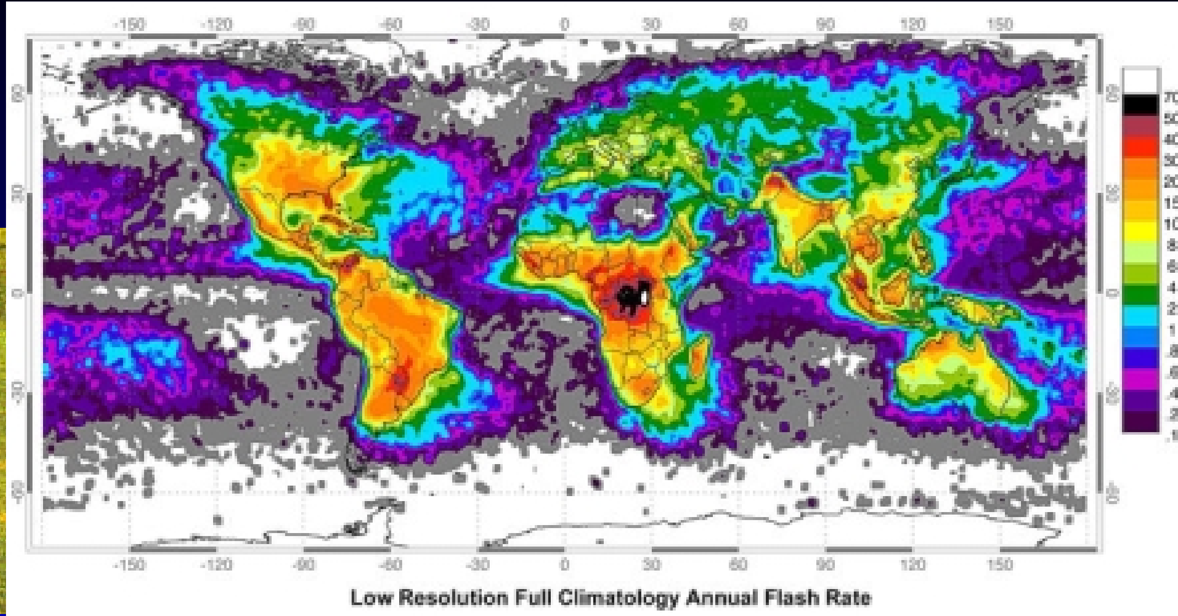


RAINFALL (SECOND HALF)

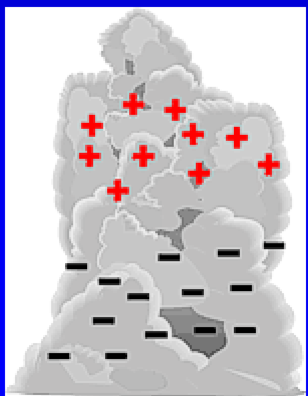


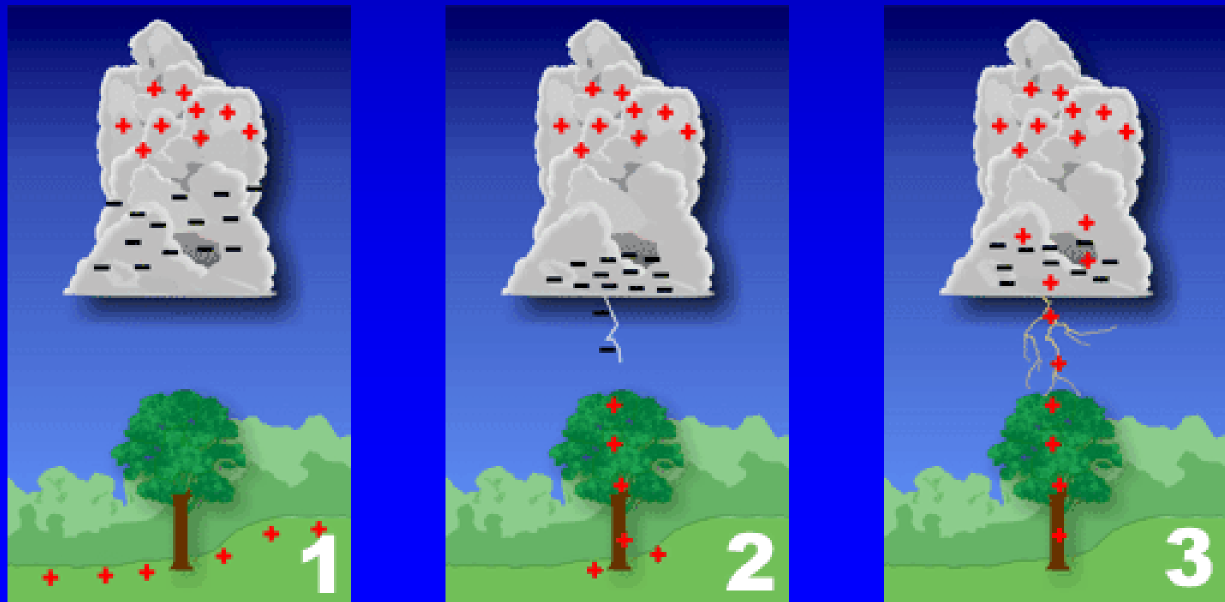


Lightning

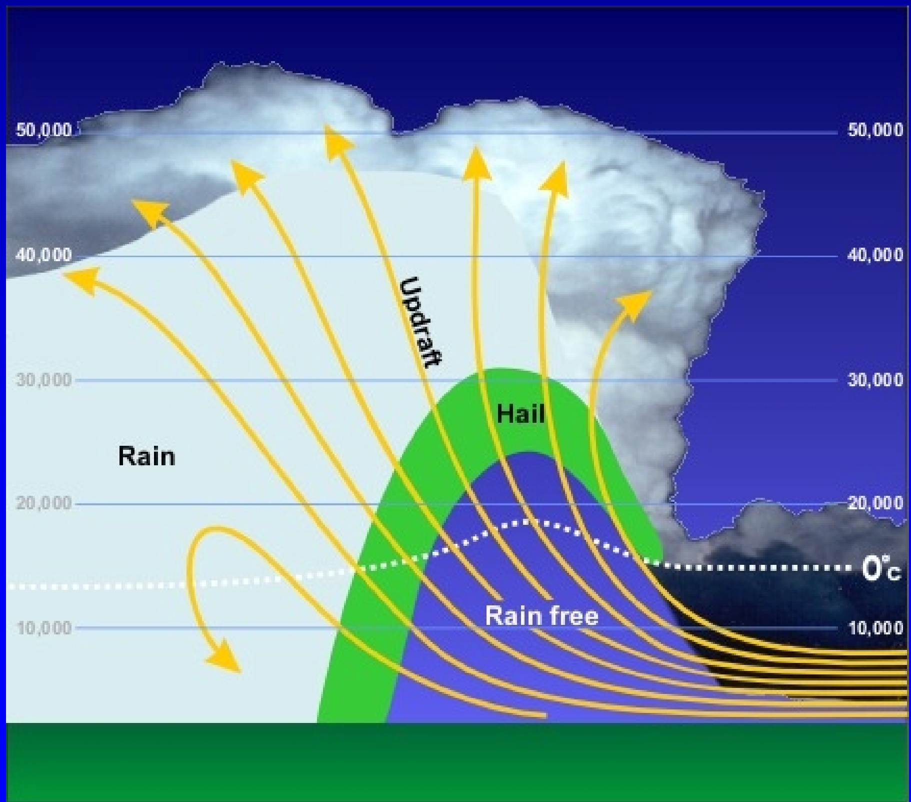


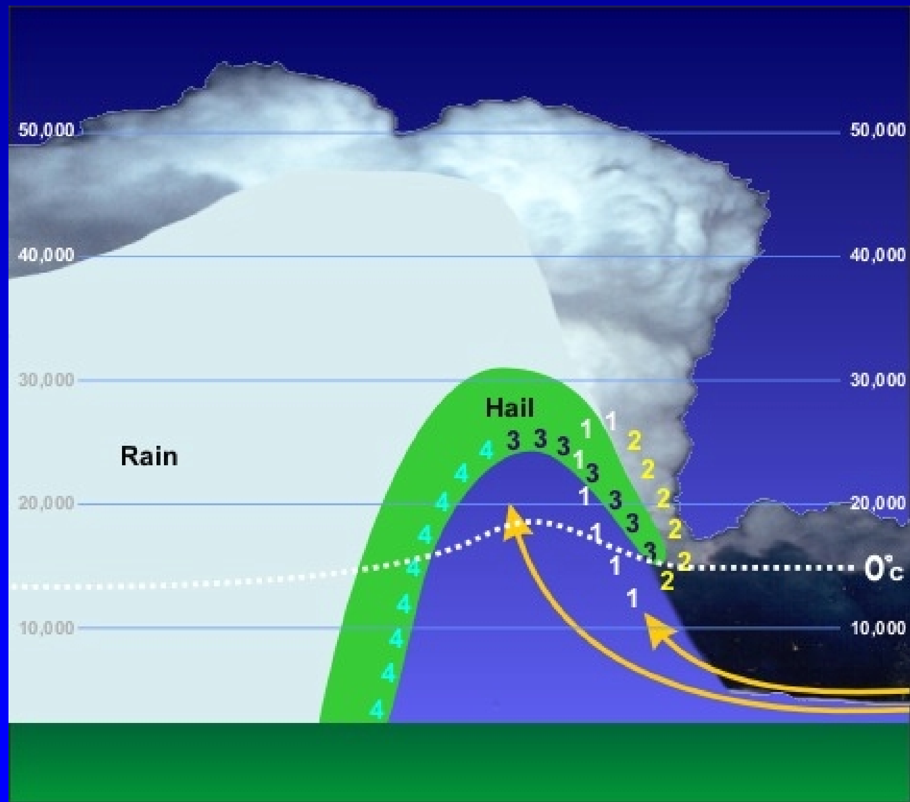
Global distribution of lightning April 1995-February 2003 from the combined observations of the NASA OTD (4/95-3/00) and LIS (1/98-2/03) instruments.






Hail

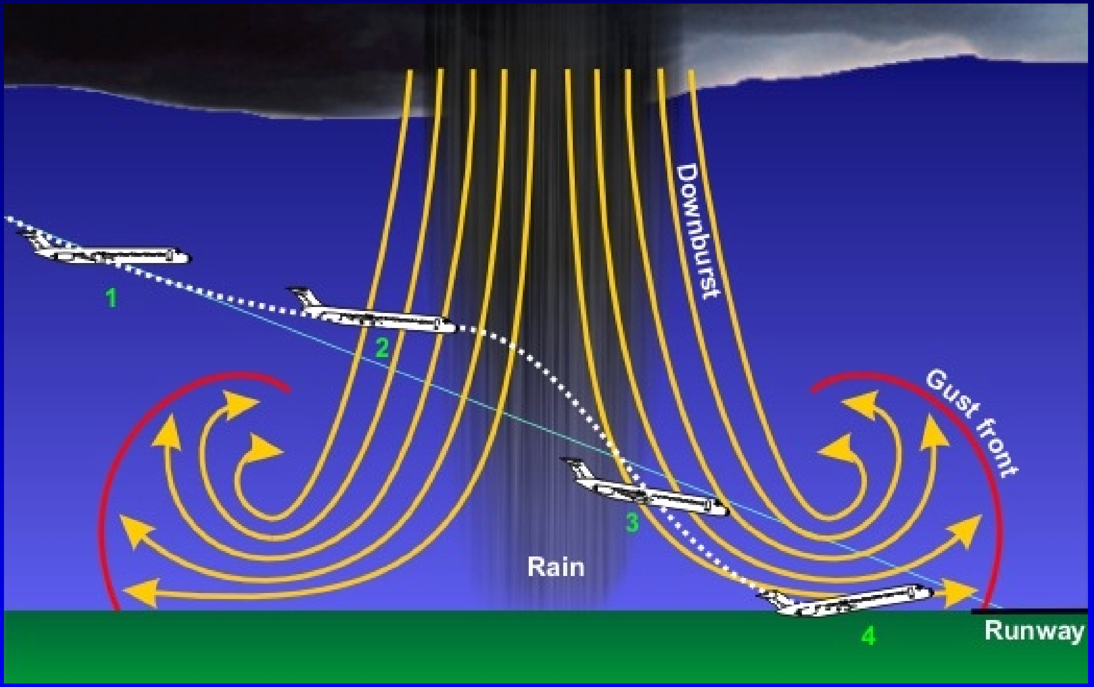

50,000
40,000
30,000
20,000
10,000
Updraft
Hail
Rain
Rain free
0°c


50,000
40,000
30,000
20,000
10,000
Hail
Rain
0°c

An example: The severe hail storm in Alcañiz (16th August 2003)

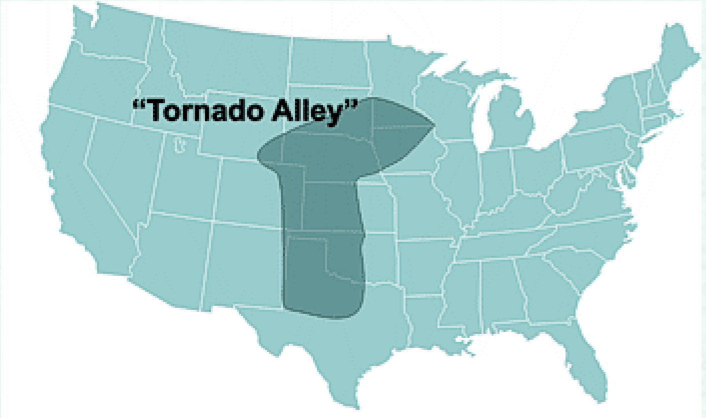
Damaging winds

Damaging wind from thunderstorms is much more common than damage from tornados. In fact, many confuse damage produced by "straight-line" winds and often erroneously attribute it to tornados. Wind speeds can reach up to 100 mph (161 km/h) with a damage path extending from hundreds of miles.



Tornadoes


NCAR / UCAR / NSF



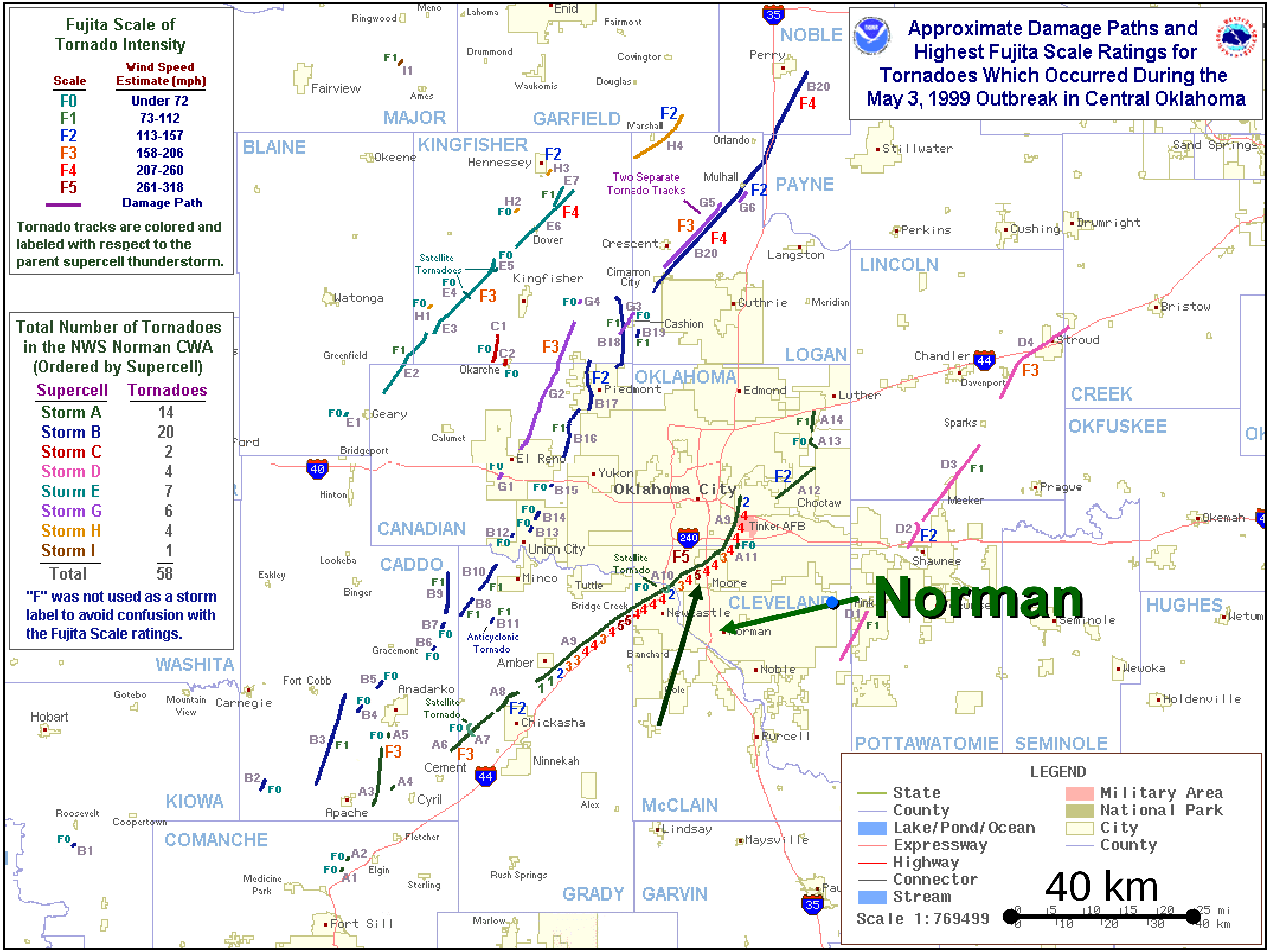
Definition

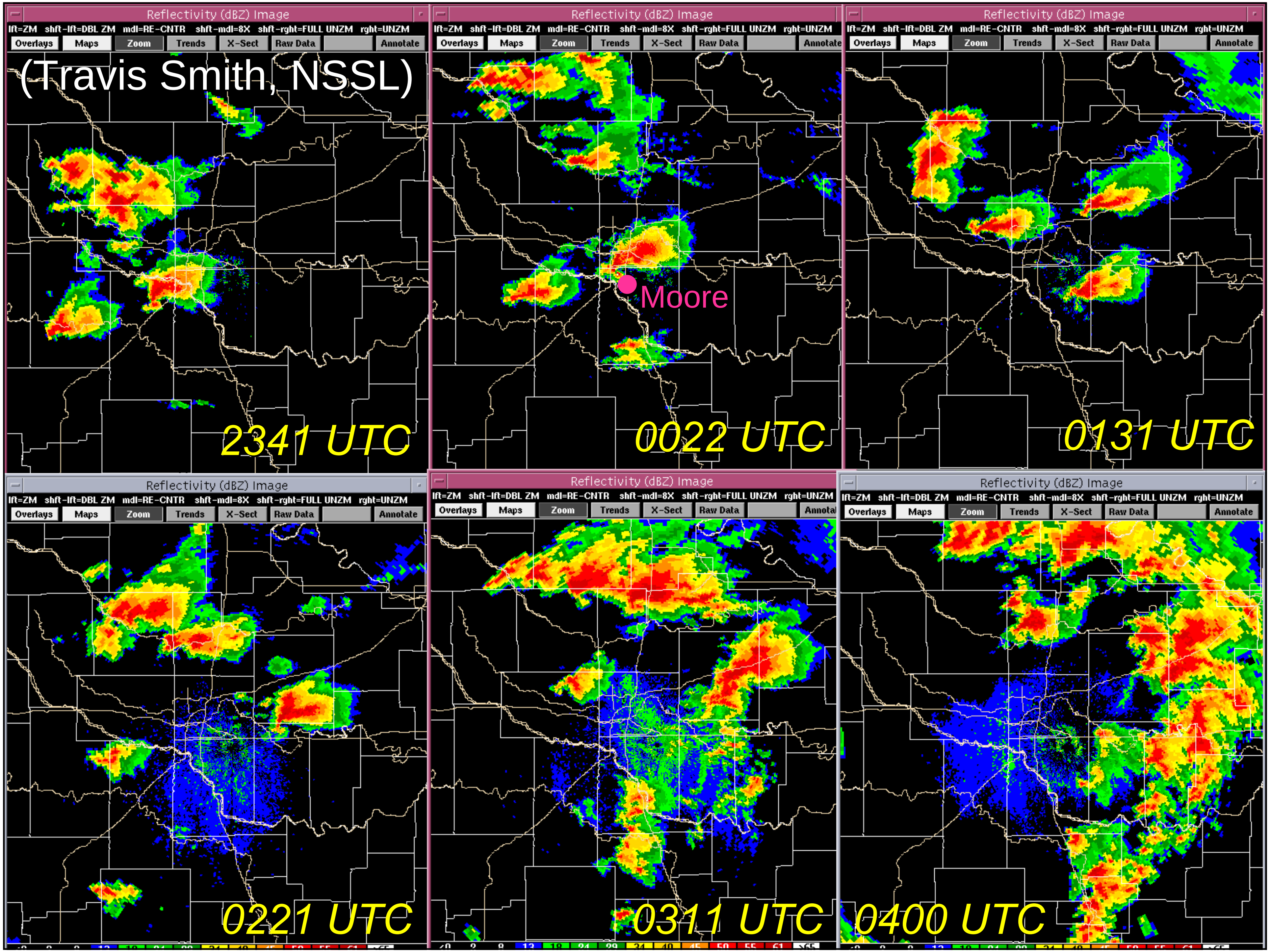
Tornadoes are the most violent storms on earth, with estimated wind speeds as high as 300 miles per hour or more. A tornado is a violently rotating column of air that extends from the base of a thunderstorm and comes in contact with the ground. The spinning motion of a tornado is almost always counterclockwise.

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.


Approximate Damage Paths and Highest Fujita Scale Ratings for Tornadoes Which Occurred During the May 3, 1999 Outbreak in Central Oklahoma
Fujita Scale of Tornado Intensity
Scale
Wind Speed Estimate (mph)
F0 Under 72
F1 73-112
F2 113-157
F3 158-206
F4 207-260
F5 261-318
Damage Path
Tornado tracks are colored and labeled with respect to the parent supercell thunderstorm.
Total Number of Tornadoes in the NWS Norman CWA (Ordered by Supercell)
Supercell Tornadoes
Storm A 14
Storm B 20
Storm C 2
Storm D 4
Storm E 7
Storm G 6
Storm H 4
Storm I 1
Total 58
"F" was not used as a storm label to avoid confusion with the Fujita Scale ratings.
Norman
Two Separate Tornado Tracks
Satellite Tornadoes
Satellite Tornado
Anticyclonic Tornado
MAJOR
GARFIELD
NOBLE
BLAINE
KINGFISHER
PAYNE
LINCOLN
LOGAN
OKLAHOMA
CREEK
OKFUSKEE
CANADIAN
CADDO
CLEVELAND
HUGHES
WASHITA
POTTAWATOMIE
SEMINOLE
KIOWA
McCLAIN
COMANCHE
GRADY
GARVIN
Oklahoma City
Tinker AFB
Moore
Newcastle
Chickasha
Anadarko
Edmond
Guthrie
Kingfisher
Shawnee
Stillwater
LEGEND
State
County
Lake/Pond/Ocean
Expressway
Highway
Connector
Stream
Military Area
National Park
City
County
40 km
Scale 1:769499


(Travis Smith, NSSL)
Reflectivity (dBZ) Image
Moore
2341 UTC
0022 UTC
0131 UTC
0221 UTC
0311 UTC
0400 UTC


(Jarboe)
(Schultz)
(Jarboe)
(Lindley)
(Schultz)
(Lindley)
(Peppler)
(Carey)
(Zaras)

1989-1999: 27 tornadoes and 54 waterspouts

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 comes in contact with the ground, it becomes, 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 vortices) 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.

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

F-scale	Class	Wind speed		Description
		mph	km/h	
F0	weak	40-72	64-116	gale
F1	weak	73-112	117-180	moderate
F2	strong	113-157	182-253	Significant
F3	strong	158-206	254-332	severe
F4	violent	207-260	333-419	devastating
F5	violent	261-318	420-512	incredible

12/10/2004

7/9/2005

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.
- **Destruction** - Total destruction of homes, especially mobile homes, businesses, and cars, causing many deaths; extensive tree damage along roadways, which may inhibit or block access; extensive damage to electric and telephone lines; utility line breaks; damaged or destroyed radio and television towers.

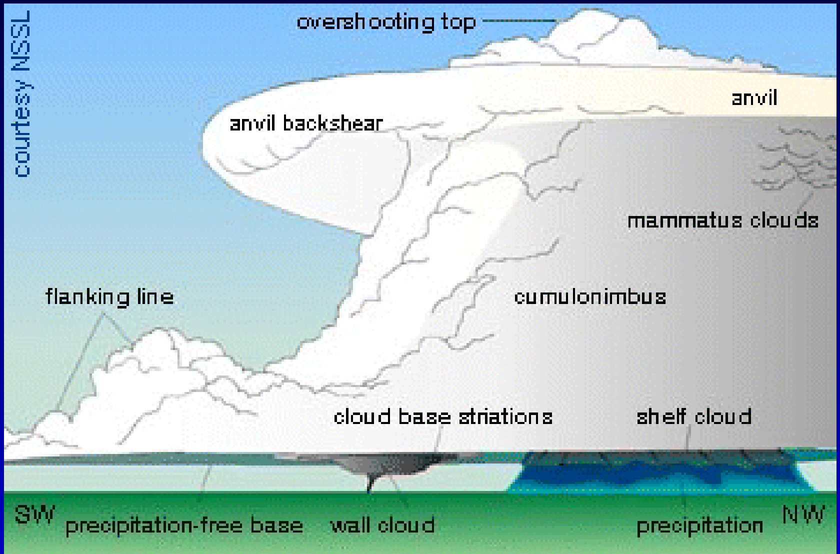
Tornadoes develop as an outgrowth of thunderstorms. Large, strong, and long-lasting tornadoes are spawned by supercells. Once a thunderstorm has formed, given the right ingredients, a tornado can develop.

- 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.

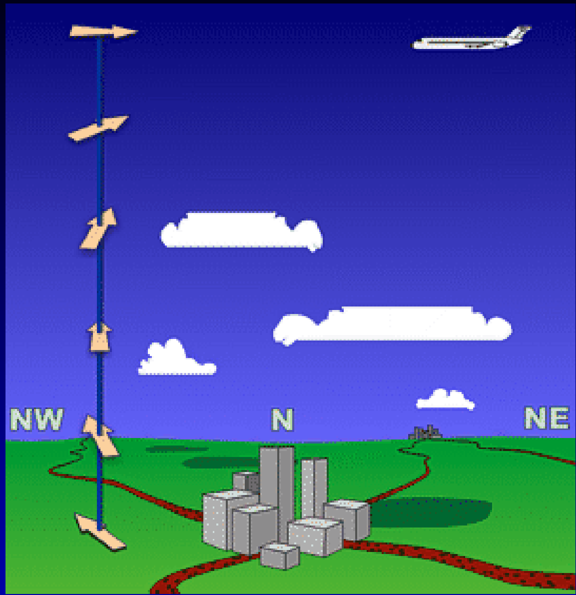
Each year, approximately 800 tornadoes touch down in the U.S., the highest frequency in the world. Tornadoes occur most often when the lower layer of air is warm, which varies according to the time of year:

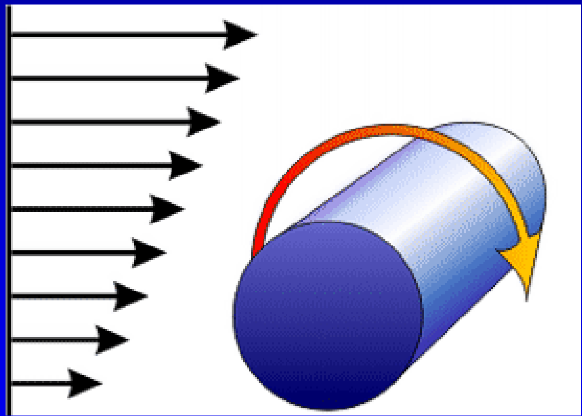
- April, May, and June: Midwestern U.S.
- May, June, July, August, and September: Southwest and North Central U.S.
- March, April, May, and June: Southeastern U.S.
- April, May, June, July, and August: Western U.S.

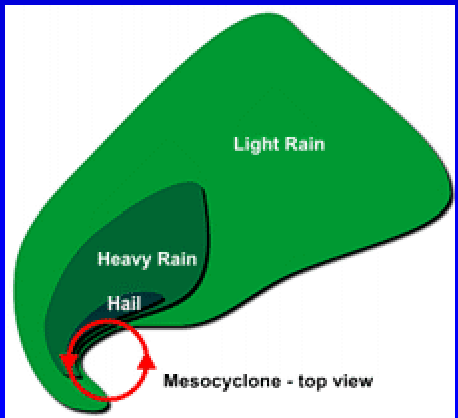
Supercell Mesocyclone

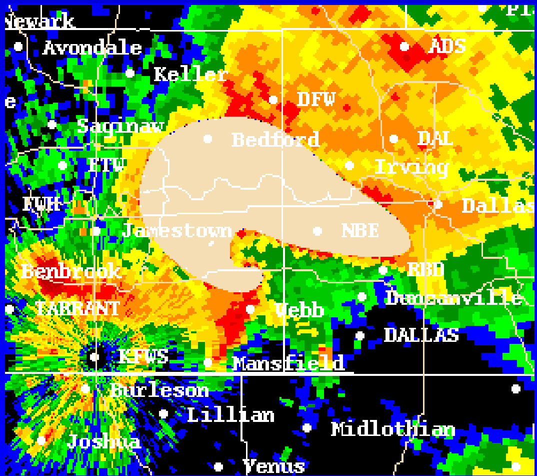


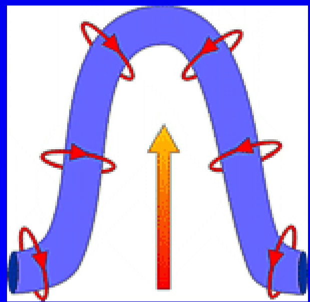
Idealized view of a "classic" supercell, looking west











Flash Floods

NCAR / UCAR / NSF

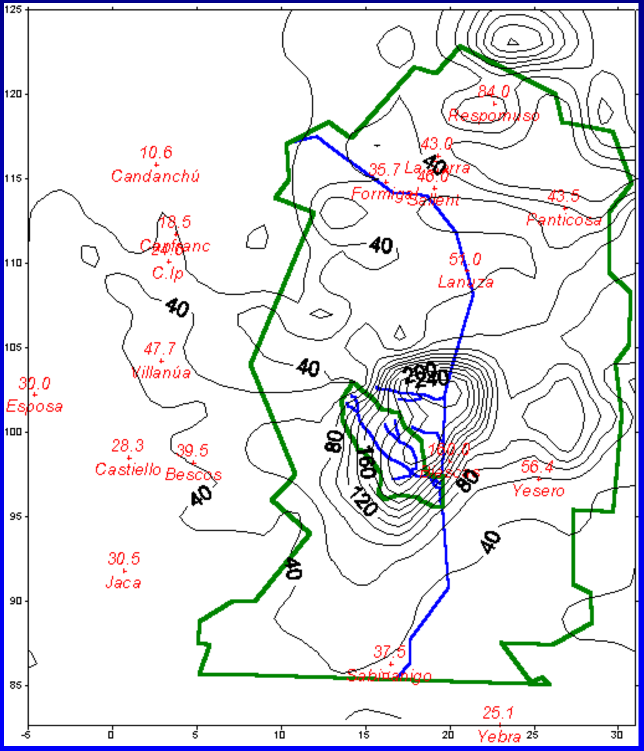
Definition

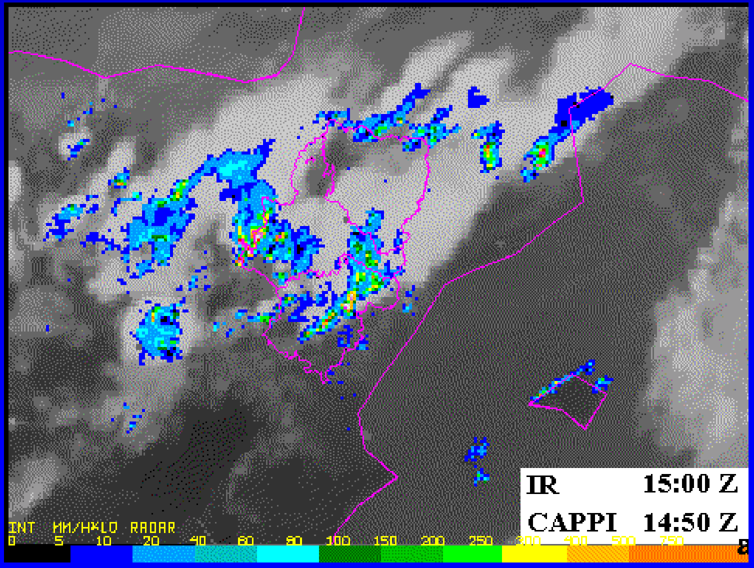
A flash flood occurs suddenly, within a short time (from minutes to less than 6 hours) after a causative event. Flash floods are the number one weather-related killer in the U.S. Nearly half of all flash-flood fatalities are auto related.

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.

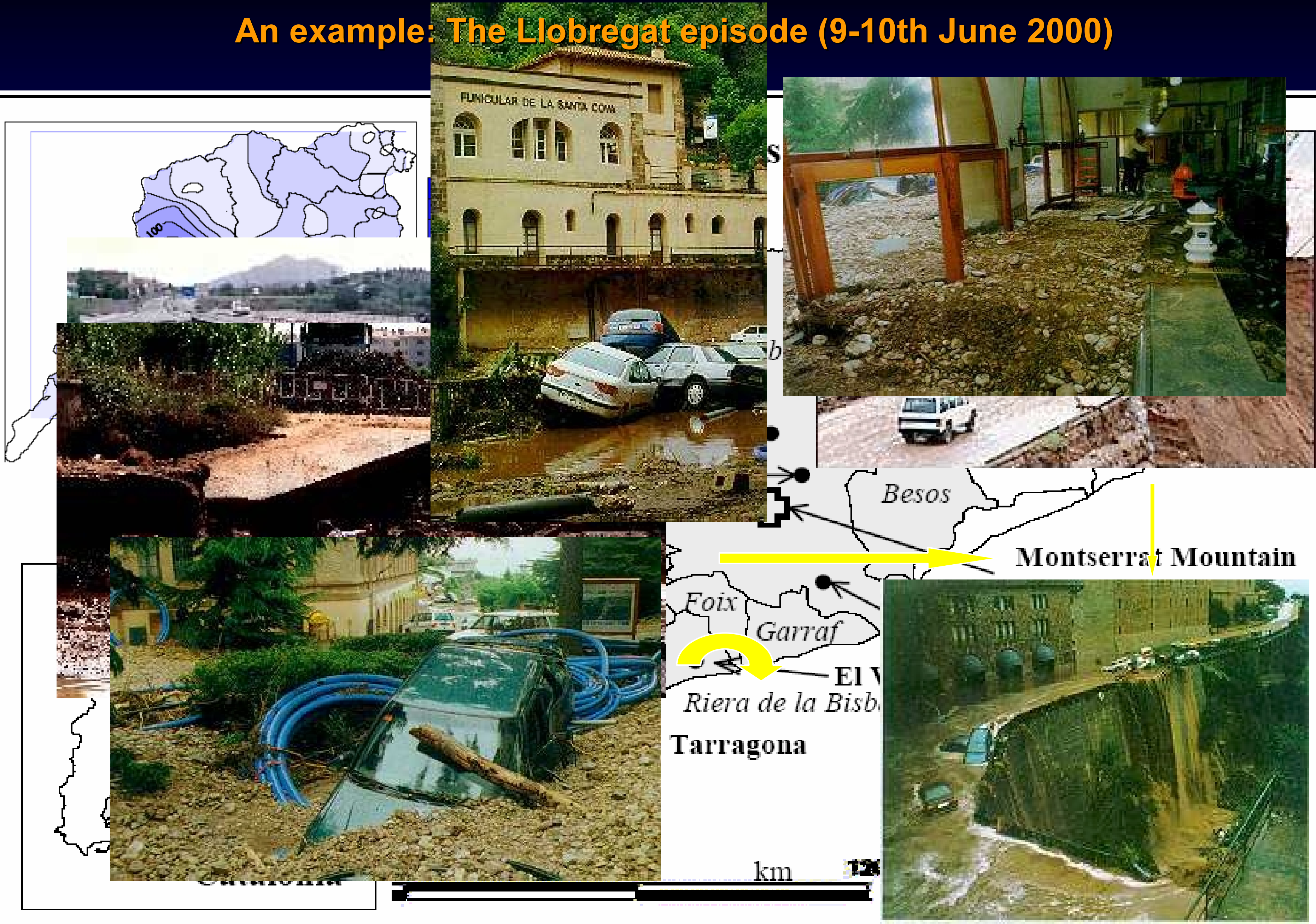
Flash floods are most prevalent on small streams, generally draining areas ranging in size from a few square miles to several hundred square miles. The most dangerous flash floods are usually associated with steep mountain streams, canyons, and desert washes where they can manifest themselves as a wall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

An example: The Biescas event (7th August 1996)





An example: The Llobregat episode (9-10th June 2000)



Characteristics

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.

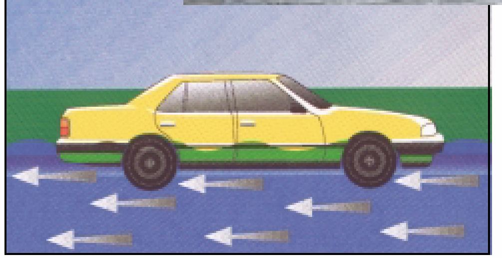
Topography is important, especially when there are steep slopes. Gravity rapidly moves the water to the lowest point(s), reducing the time the runoff is susceptible to being absorbed by the ground, as well as funneling water from larger areas into the lowest region.

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.

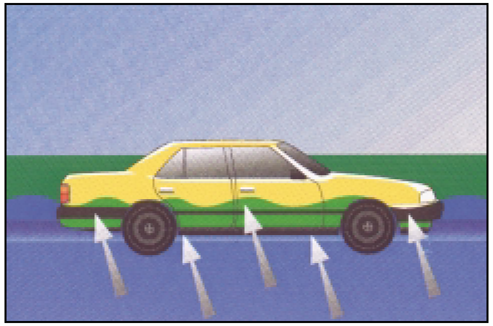
The most severe flash floods can roll boulders, tear out trees, destroy buildings and bridges, and scour out new channels. However, less serious flash flooding is still capable of taking lives. As little as a foot of moving water is enough to sweep a car into deeper flood waters. Also, children playing 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.
- **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.

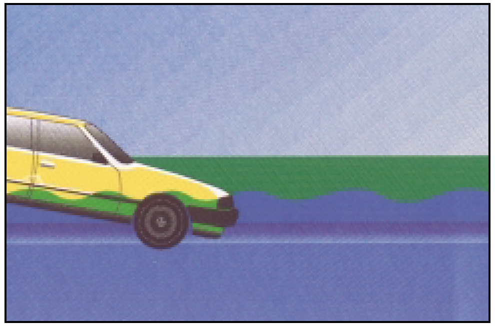
Water weighs 62.4 lbs. per cubic foot and typically flows downstream at 6 to 12 miles an hour.



When a vehicle stalls in the water, the water's momentum is transferred to the car. For each foot the water rises, 500 lbs. of lateral force are applied to the car.



But the biggest factor is buoyancy. For each foot the water rises up the side of the car, the car displaces 1,500 lbs. of water. In effect, the car weighs 1,500 lbs. less for each foot the water rises.



Two feet of water will carry away most automobiles.

Riverine Floods

NCAR / UCAR / NSF

Definition

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 non-leveed 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.

Characteristics

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

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

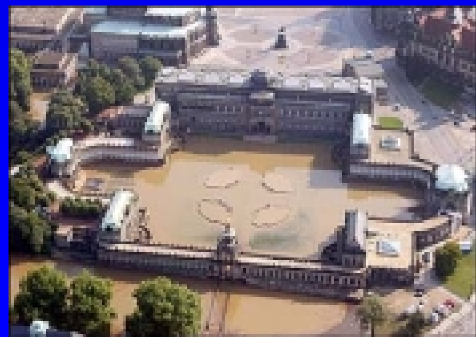
- Damaged or destroyed buildings and vehicles
- Uprooted trees causing power and utility outages
- Drowning, especially people trapped in cars
- Contamination of drinking water
- Dispersion of hazardous materials
- Interruption of communications and/or transportation systems

An example: The Central Europe Floods (August 2002)

Bratislava

Prague

Dresden



METEOROLOGIA

La 'gota fría' amenaza a las comunidades del Mediterráneo

Fuertes vientos y lluvias torrenciales serán los protagonistas de las próximas horas

!!!

2.1. La gota fría como "comodín" meteorológico

Se entiende, coloquialmente, como gota fría a ***cualquier situación meteorológica*** que lleve o pueda llevar asociada lluvias intensas, efectos desastrosos, preferentemente en la época otoñal y en la zona mediterránea, independientemente del marco sinóptico donde se desarrollan las precipitaciones. Esta "entidad" o concepto (¡¡¡que no definición!!!) no está basada en aspectos meteorológicos precisos.

Este término está arraigado, sobre todo, en algunos medios de comunicación que tratan de explicar de forma llana y simplista situaciones de lluvias fuertes y dañinas.

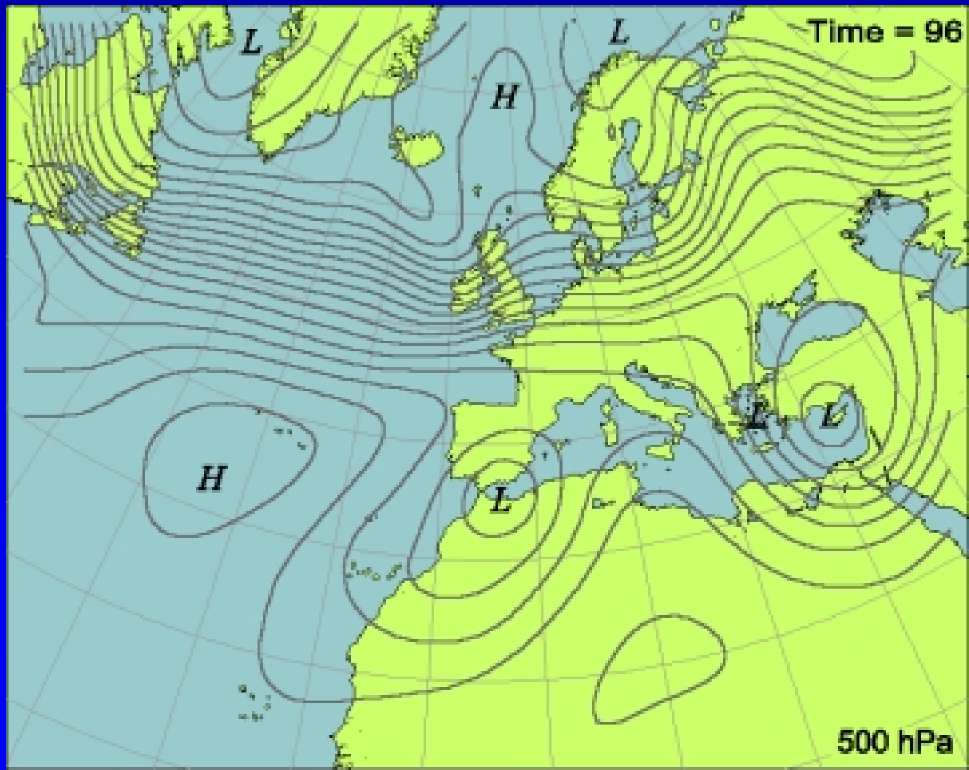
Estamos acostumbrados a oír que lluvias cuantiosas, que se han registrado en un lugar determinado, se han producido porque la gota fría ha barrido o afectado a dicha zona. La gota fría se asocia vulgarmente con inestabilidad atmosférica. En esta acepción subyace el hecho de que la gota fría es sinónimo de la presencia de aire muy frío en niveles medios y esto, unido al aire cálido de Mediterráneo en la época otoñal (o incluso durante la primavera-verano sobre las tierras soleadas peninsulares), bastaría para explicar los acontecimientos de fuerte inestabilidad y de carácter tormentoso. ***La gota fría es, conceptualmente, una perturbación o ente "comodín".***

Es fácil de demostrar, puntualmente y climatológicamente, que **muchas situaciones de gota fría no llevan asociadas lluvias intensas y catastróficas**. De la mismas forma, **episodios adversos de lluvias y vientos fuertes en el área mediterránea pueden estar ligados a otro tipo de fenomenología distinta a las gotas frías,** donde las

"Una depresión cerrada en altura que se ha aislado y separado completamente de la circulación asociada al chorro, y que se mueve independientemente de tal flujo llegando, a veces, a ser estacionaria o, incluso, retrograda (su desplazamiento es, en estos casos, de dirección este-oeste)".

Caso real (21 de Octubre de 2000, 00 UTC):

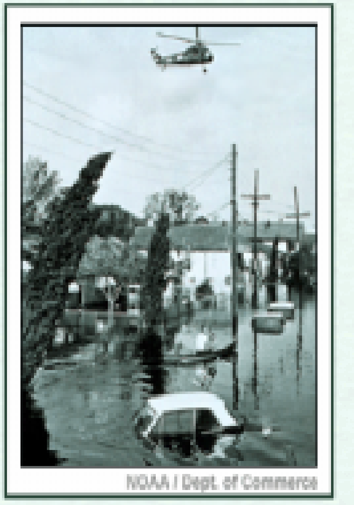
- Formación de una "gota fría" al sur de la Península Ibérica que dura varios días
- Lluvias intensas sobre el este peninsular que provocan inundaciones y graves daños



Definition

Coastal flooding is the inundation of land areas along the oceanic coast by sea waters over and above normal tidal action. Such flooding can originate from the ocean front, back bays, sounds, 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 Floods



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 runoff
- Presence or absence of offshore reefs or other barriers

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.

Characteristics

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 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.
- **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 datum. 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

elmundo-eldia.com ILLES BALEARS

Hemeroteca | Agenda cultural | Cartelera | Titulares | Tienda | Restaurantes | De copas | Loterías | Clasificados

BALEARES 24HORAS
Opinión
Illes Balears
Palma

illes balears

Sábado, 1 de noviembre de 2003 Actualizado a las 00:46

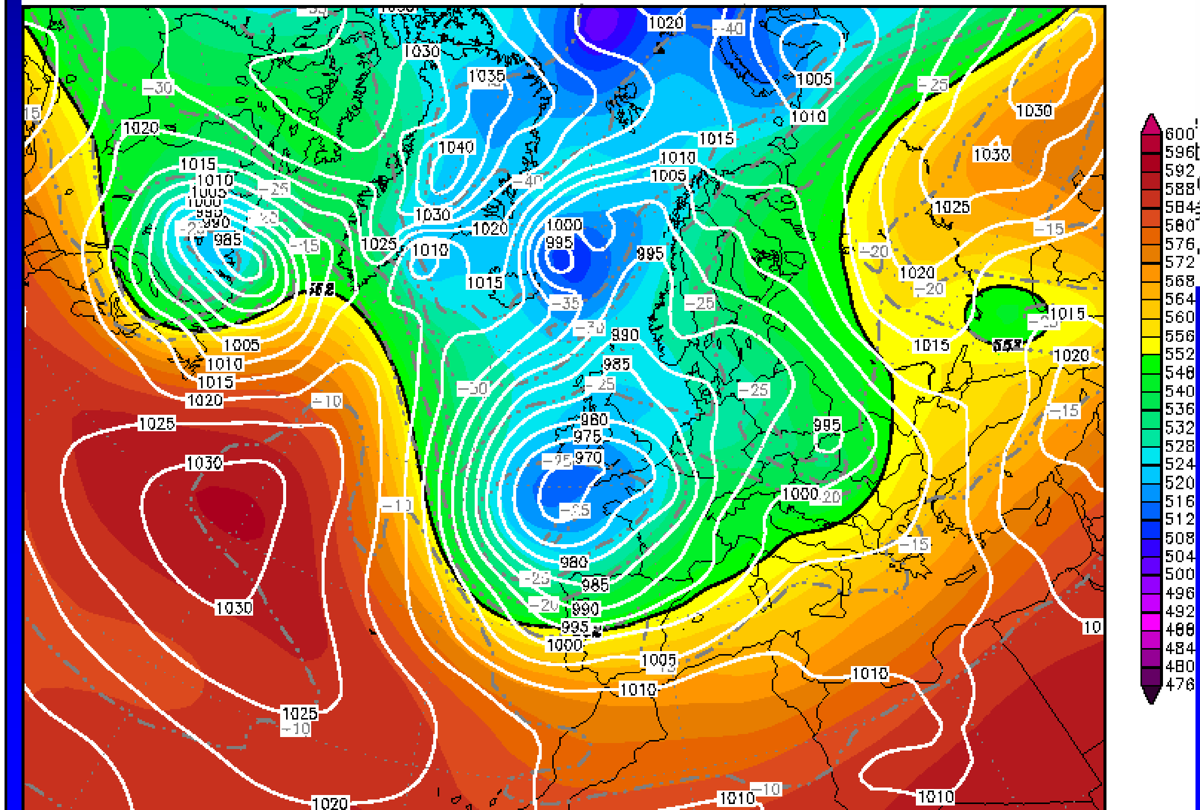
SIN PRECEDENTES.

El mar inunda Es Molinar y arroja rocas de más de un kilo a las calles de Ciutadella

«Nunca había visto así la playa de Cala Galdana», reconoce el alcalde de Ferreries - Una 'lluvia' de plásticos procedentes del vertedero cayó sobre los habitantes de Formentera

Init : Fri,31OCT2003 00Z Valid: Fri,31OCT2003 00Z

500 hPa Geopot.(gpdm), T (C) und Bodendr. (hPa)

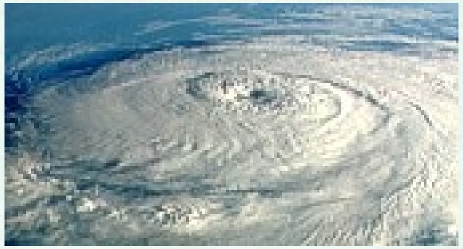


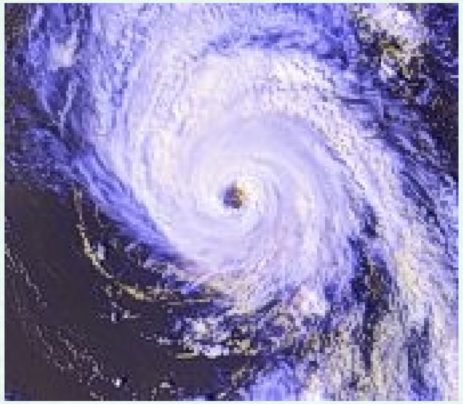
...ra línea de Es Molinar ...te barrio de Palma ya ...cada vez que solpa ...ás y muchos de los ..., que deja entra el agua,

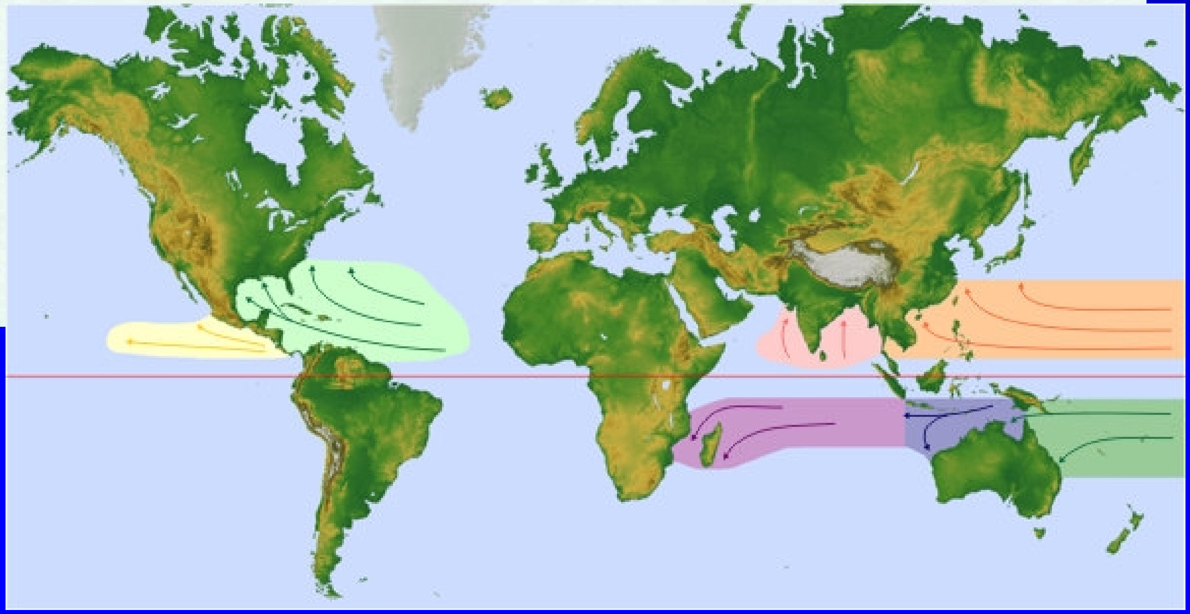
Olas de cinco metros y vientos de hasta 100 km/h obligan a cerrar todos los puertos de Baleares

Todos los puertos del archipiélago cerrados, tejas, cornisas y árboles caídos por doquier, barcos a la deriva tras soltarse de sus amarres... Estas fueron las principales causas del vendaval con vientos de 100 kilómetros por hora que todo el día de ayer azotó las Islas.

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.

Tropical Cyclones:

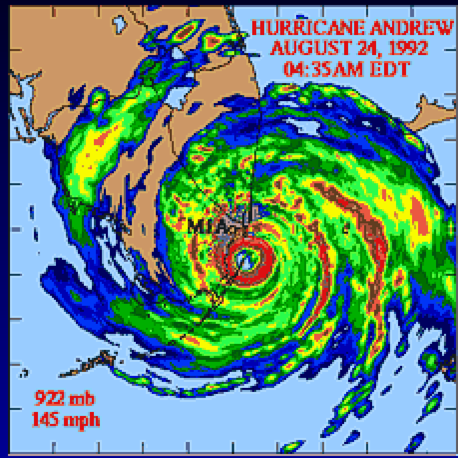
- Form over a tropical ocean
- Cover a smaller area (200-500 miles across)
- Have a storm center warmer than the surrounding air
- Have the strongest winds at about 10,000 feet

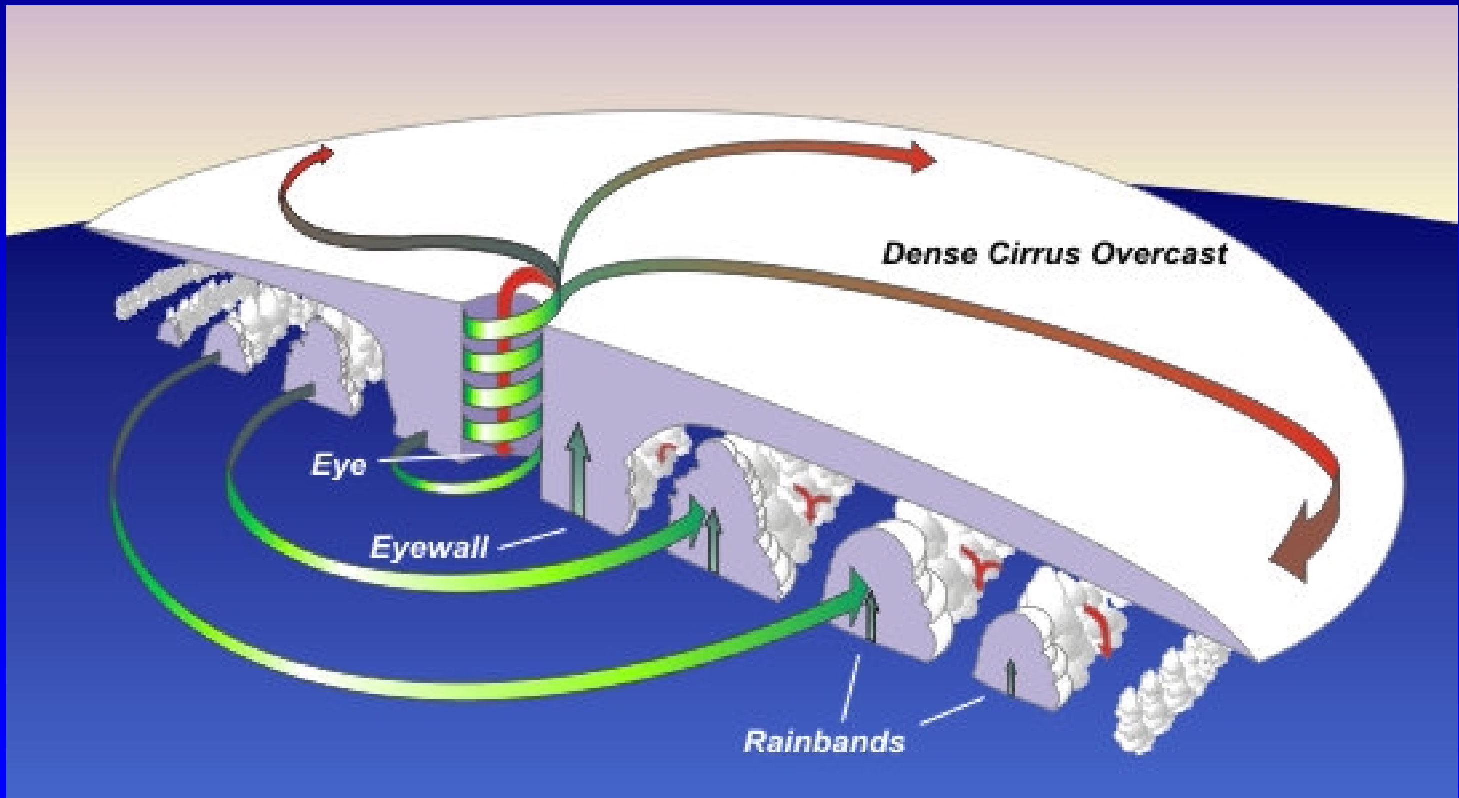
Tropical cyclones are categorized by wind speed as shown in the next table.

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

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


Super Typhoon Tip
Tropical Cyclone Tracy


HURRICANE ANDREW
AUGUST 24, 1992
04:35AM EDT
MIA
922 mb
145 mph


Dense Cirrus Overcast
Eye
Eyewall
Rainbands

The letters Q, U, X, Y, and Z are not included because of the scarcity of names beginning with those letters. If over 21 named tropical cyclones occur in a year, the Greek alphabet will be used following the "W" name. In addition, after major land-falling storms having major economic impact, the names are retired.

2006	2007	2008	2009	2010	2011*
Alberto	Andrea	Arthur	Ana	Alex	Arlene
Beryl	Barry	Bertha	Bill	Bonnie	Bret
Chris	Chantal	Cristobal	Claudette	Colin	Cindy
Debby	Dean	Dolly	Danny	Danielle	Dennis
Ernesto	Erin	Edouard	Erika	Earl	Emily
Florence	Felix	Fay	Fred	Fiona	Franklin
Gordon	Gabrielle	Gustav	Grace	Gaston	Gert
Helene	Humberto	Hanna	Henri	Hermine	Harvey
Isaac	Iris	Isidore	Ida	Igor	Irene
Joyce	Jerry	Josephine	Joaquin	Julia	Jose
Kirk	Karen	Kyle	Kate	Karl	Katrina
Leslie	Lorenzo	Lili	Larry	Lisa	Lee
Michael	Michelle	Marco	Mindy	Matthew	Maria
Nadine	Noel	Nana	Nicholas	Nicole	Nate
Oscar	Olga	Omar	Odette	Otto	Ophelia
Patty	Pablo	Paloma	Peter	Paula	Philippe
Rafael	Rebekah	Rene	Rose	Richard	Rita
Sandy	Sebastien	Sally	Sam	Shary	Stan
Tony	Tanya	Teddy	Teresa	Tomas	Tammy
Valerie	Van	Vicky	Victor	Virginie	Vince
William	Wendy	Wilfred	Wanda	Walter	Wilma

Greek Alphabet: Alpha, Beta, Gamma, Delta, Epsilon, Zeta, Eta, Theta, Iota, Kappa, Lambda, Mu, Nu, Xi, Omicron, Pi, Rho, Sigma, Tau, Upsilon, Phi, Chi, Psi, Omega

*This is also the names of storms for the 2005 hurricane season. Some of the names in this list may be retired when the Regional Association IV - Hurricane Committee, of the World Meteorological Organization, meets later this spring.

Characteristics

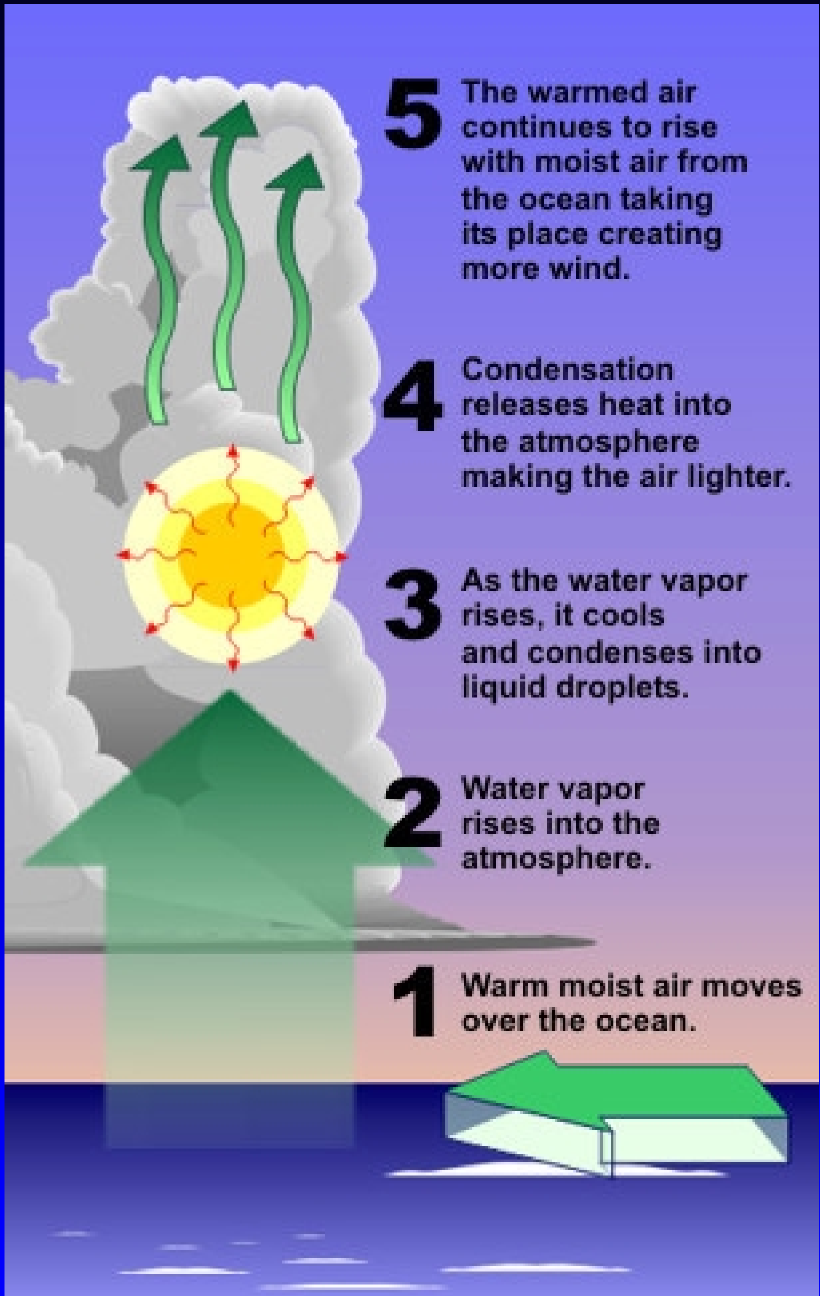
Hurricanes are generated by the rising and cooling of humid air over the ocean. They need the following ingredients to develop:

- 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.

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	945 - 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



Cat.	Speed	Damage
1	**74-95 mph** 64-82 kts 119-153 km/hr	No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Some damage to poorly constructed signs.
2	**96-110 mph** 83-95 kts 154-177 km/hr	Some roofing material, door, and window damage of buildings. Considerable damage to shrubbery and trees with some trees blown down. Considerable damage to mobile homes, poorly constructed signs, and piers.
3	**111-130 mph** 96-113 kts 178-209 km/hr	Some structural damage to small residences and utility buildings with a minor amount of curtainwall failures. Damage to shrubbery and trees with foliage blown off trees and large tress blown down. Mobile homes and poorly constructed signs are destroyed.
4	**131-155 mph** 114-135 kts 210-249 km/hr	More extensive curtainwall failures with some complete roof structure failures on small residences. Shrubs, trees, and all signs are blown down. Complete destruction of mobile homes. Extensive damage to doors and windows.
5	Greater than **155 mph** 135 kts 249 km/hr	Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. All shrubs, trees, and signs blown down. Complete destruction of mobile homes. Severe and extensive window and door damage.

Hydrometeorological hazards associated with hurricanes include the following:

- **Coastal Flooding** caused by storm surge
- **Windstorms** due to extremely strong winds
- **Riverine flooding** caused by heavy rains
- **Tornadoes**

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

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.

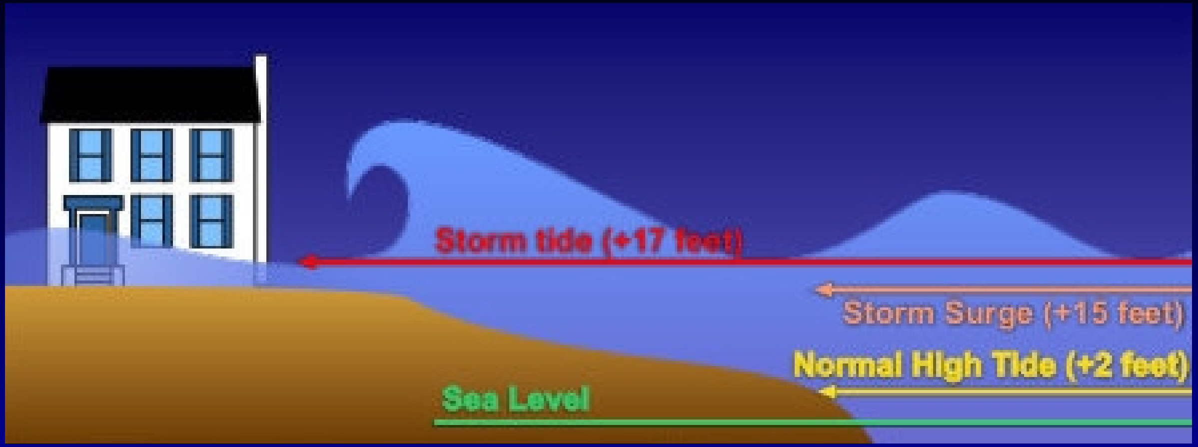
When a hurricane reaches land, it begins to weaken as it loses its warm-water energy source and encounters greater surface friction over land. This weakening process is gradual, so even though wind speeds may be reduced by 50 percent within 12 hours, hurricane-force winds can penetrate far inland in 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:

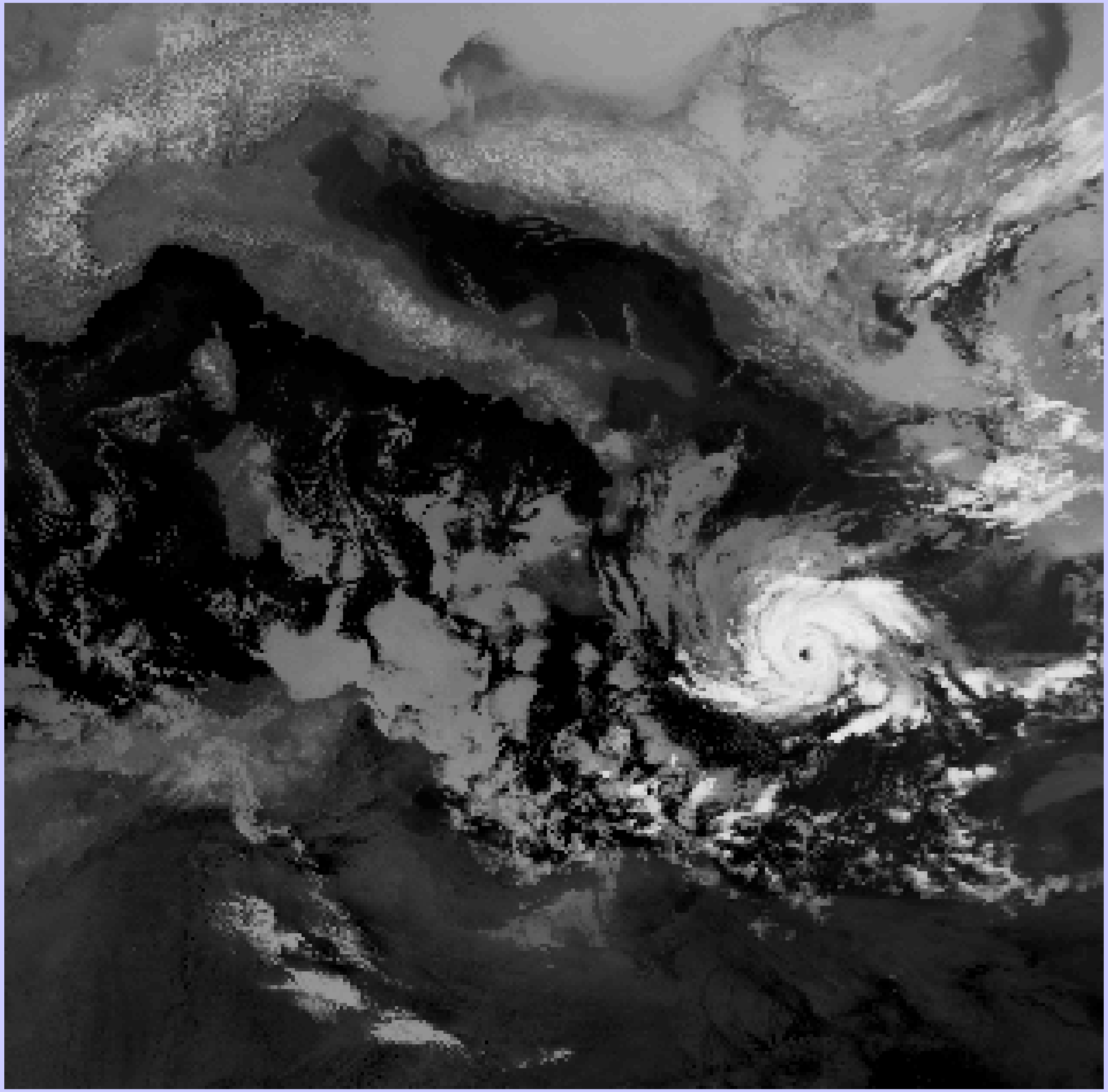
- Widespread damage to homes (especially mobile homes) and businesses
- Extensive tree damage along roadways, which may inhibit or block access
- Extensive damage to electric and telephone lines, especially if large trees are uprooted
- Damaged and/or destroyed signs and traffic-control devices
- Damaged 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.

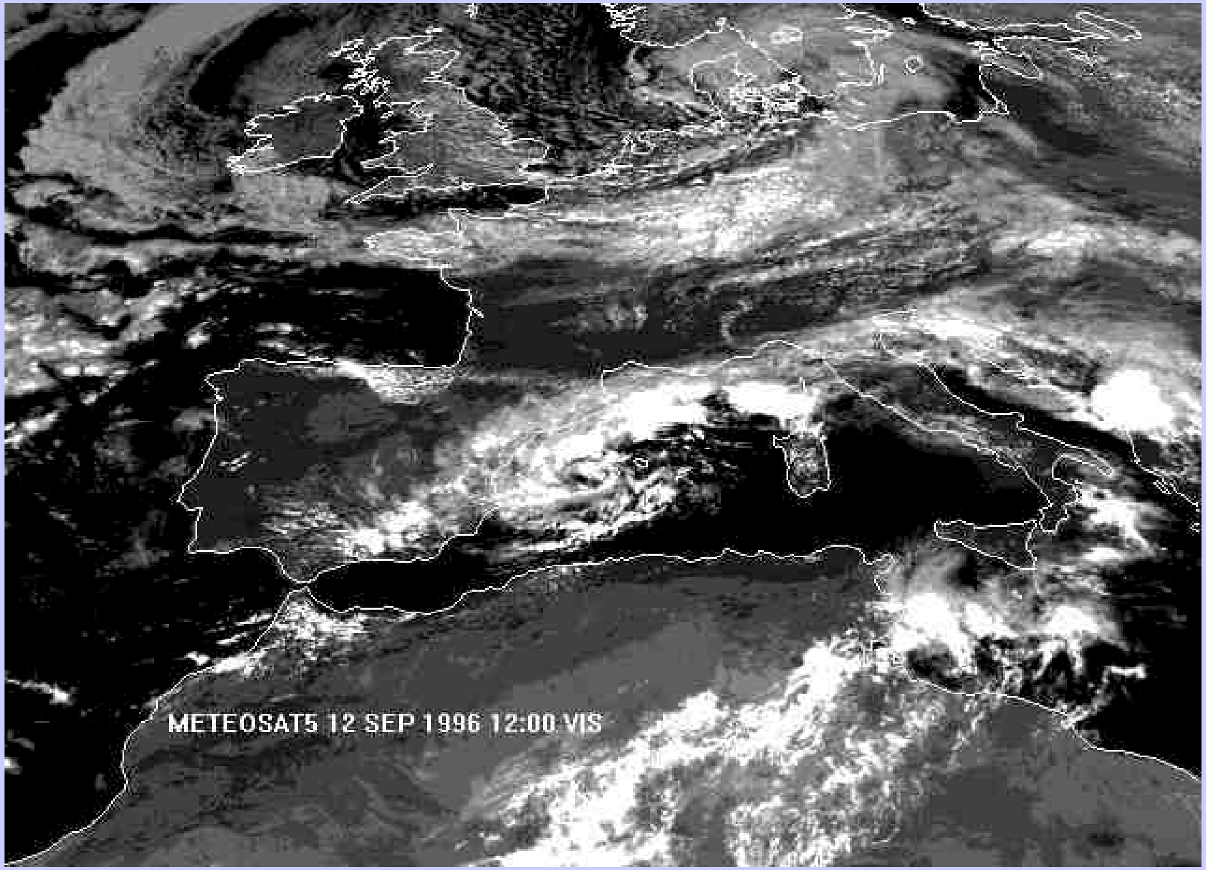
Hurricanes may also spawn tornadoes, which add to the hurricane's destructive power. These tornadoes most often occur in the thunderstorms embedded in rain bands out from the right front quadrant of the hurricane, although they can also occur near the eyewall.

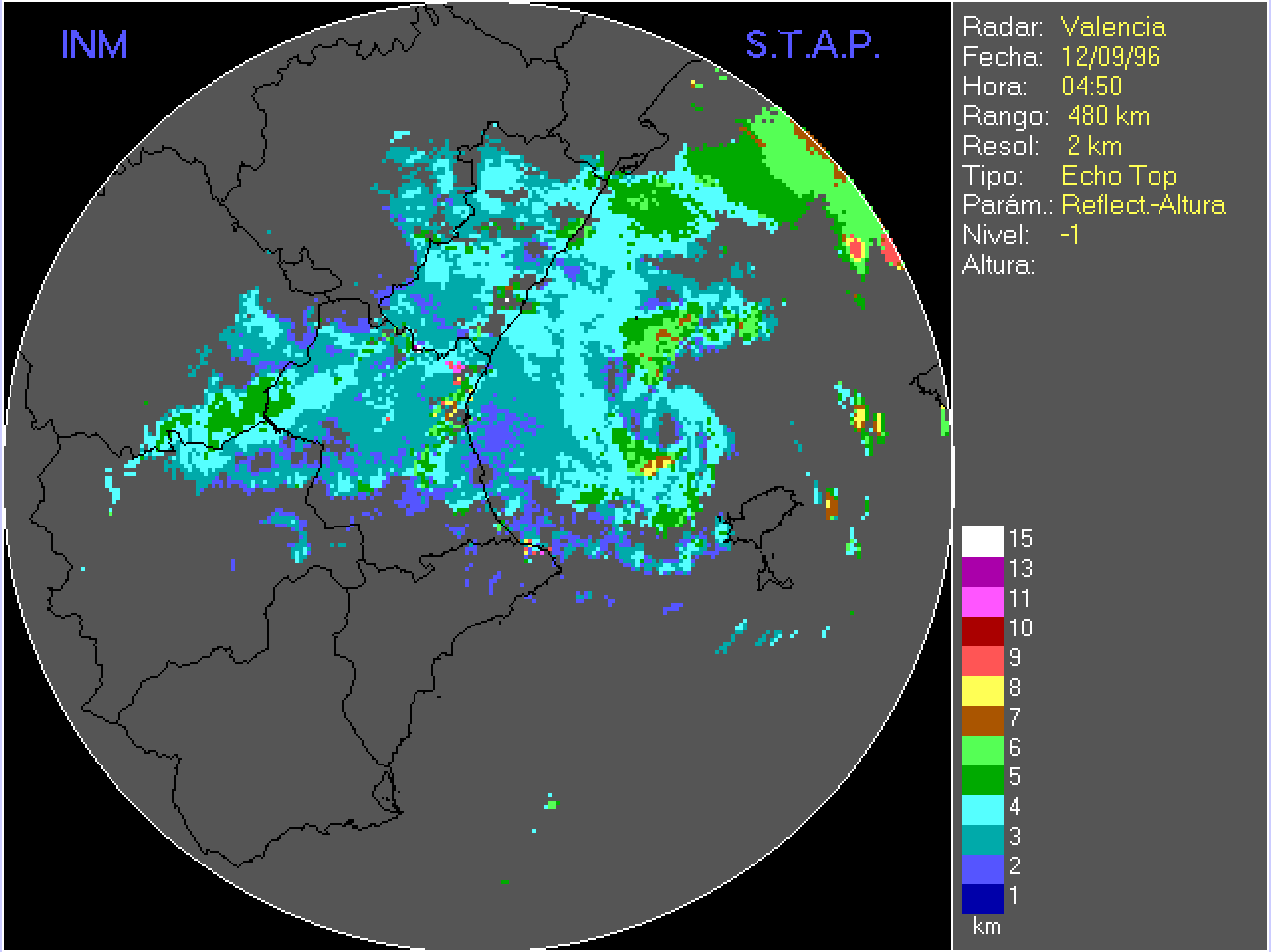

Storm tide (+17 feet)
Storm Surge (+15 feet)
Normal High Tide (+2 feet)
Sea Level

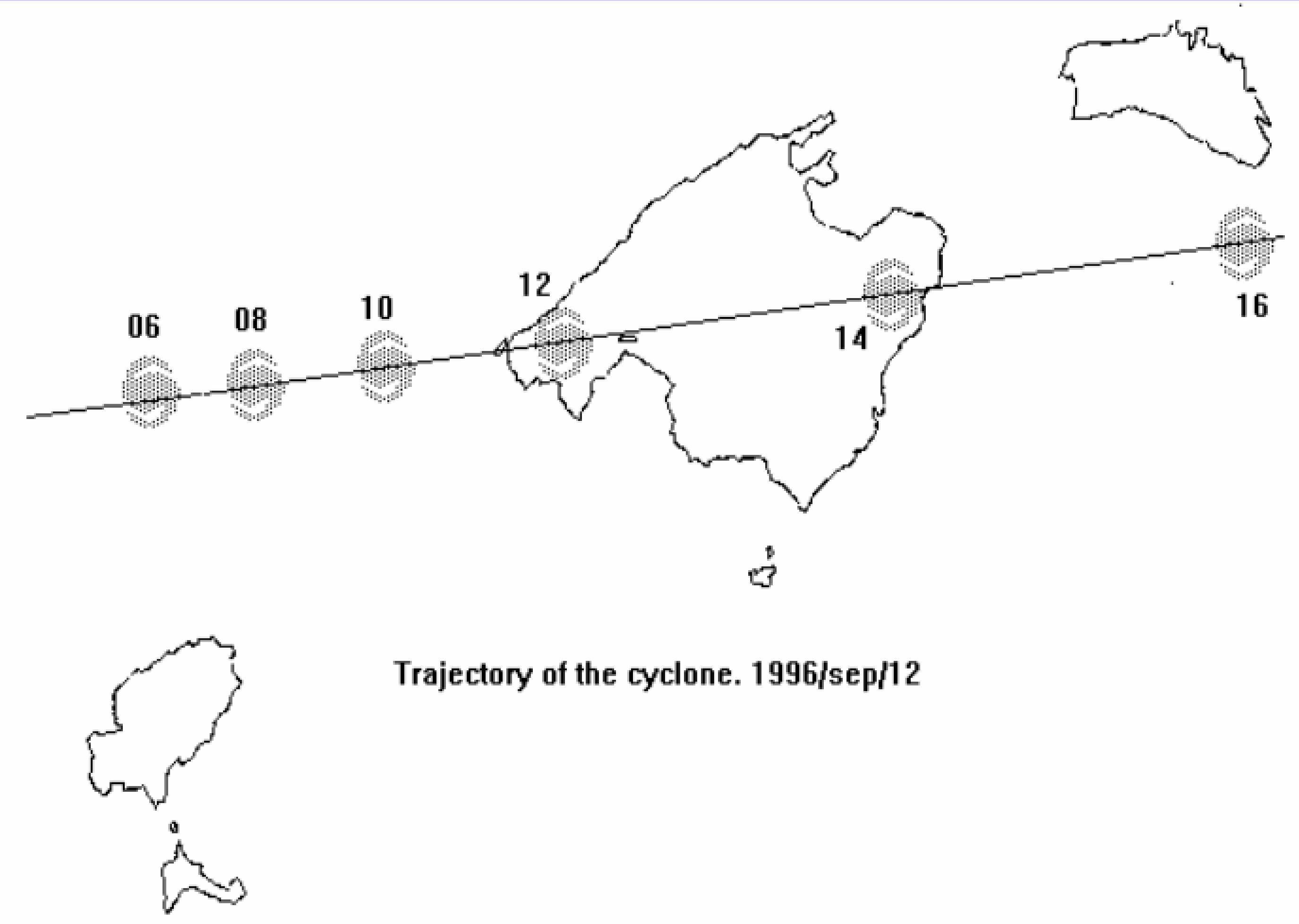
Medicane of 15-17 January 1995



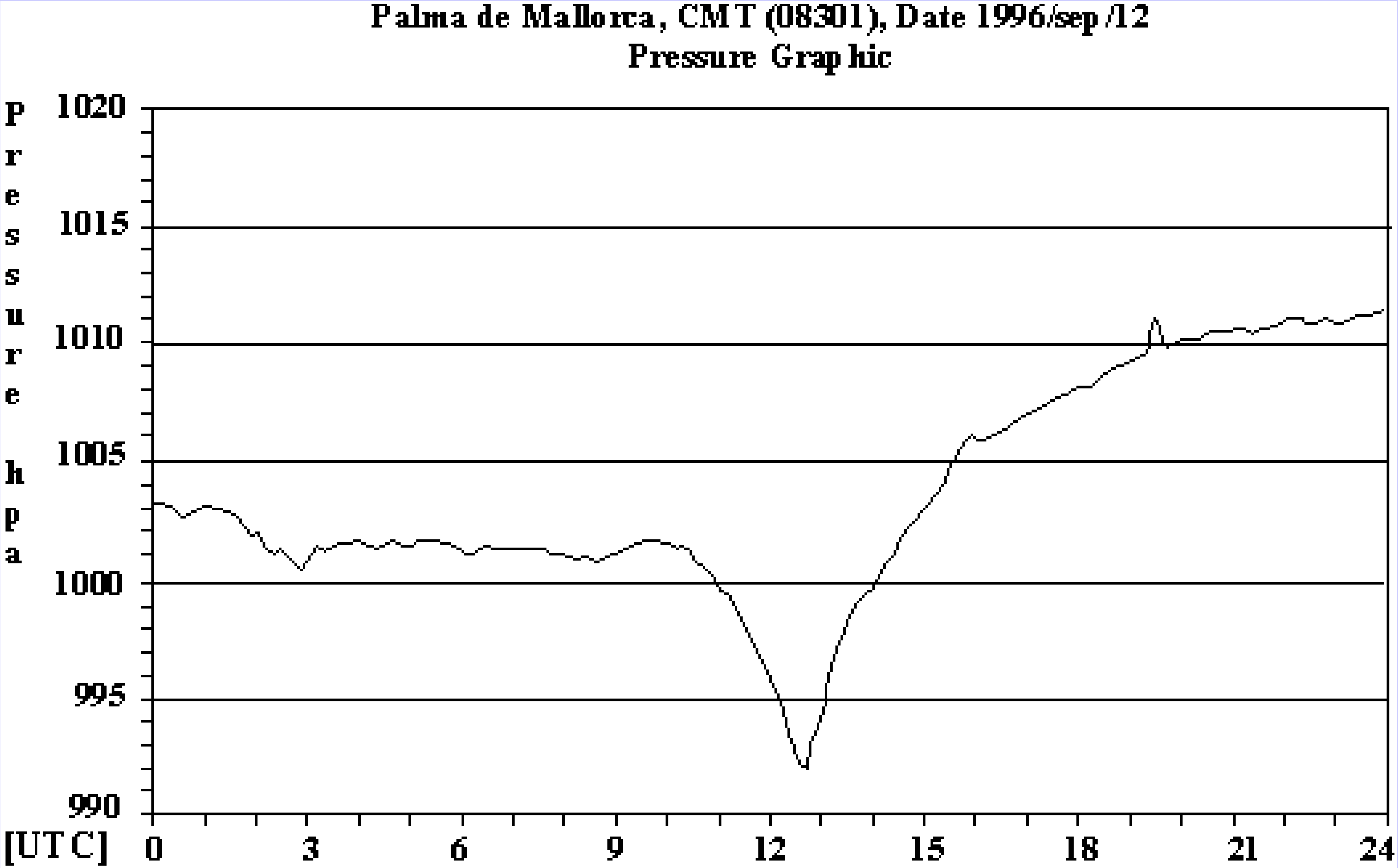
Medicane of 12 September, 1996




INM
S.T.A.P.
Radar: Valencia
Fecha: 12/09/96
Hora: 04:50
Rango: 480 km
Resol: 2 km
Tipo: Echo Top
Parám.: Reflect.-Altura
Nivel: -1
Altura:
15
13
11
10
9
8
7
6
5
4
3
2
1
km

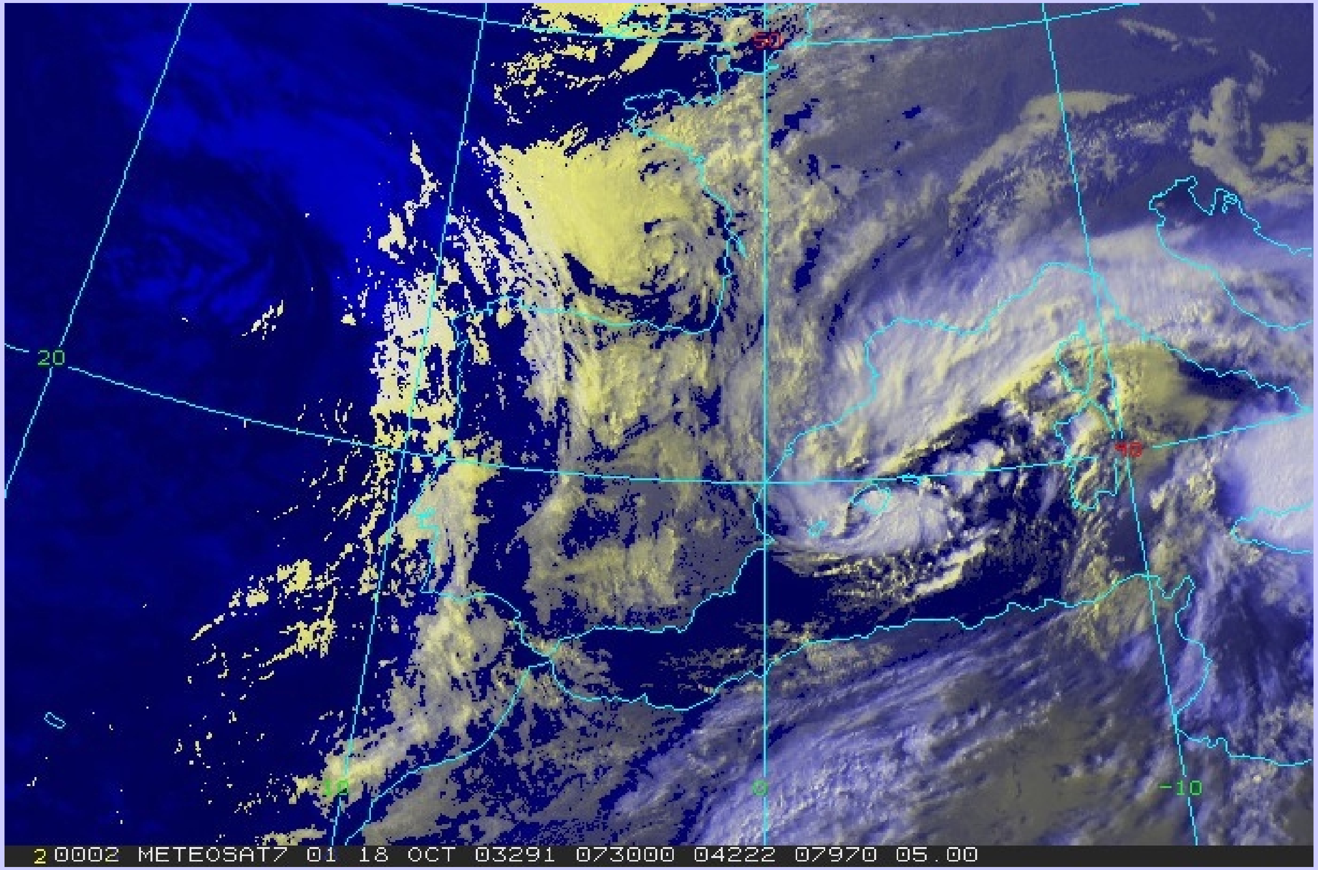


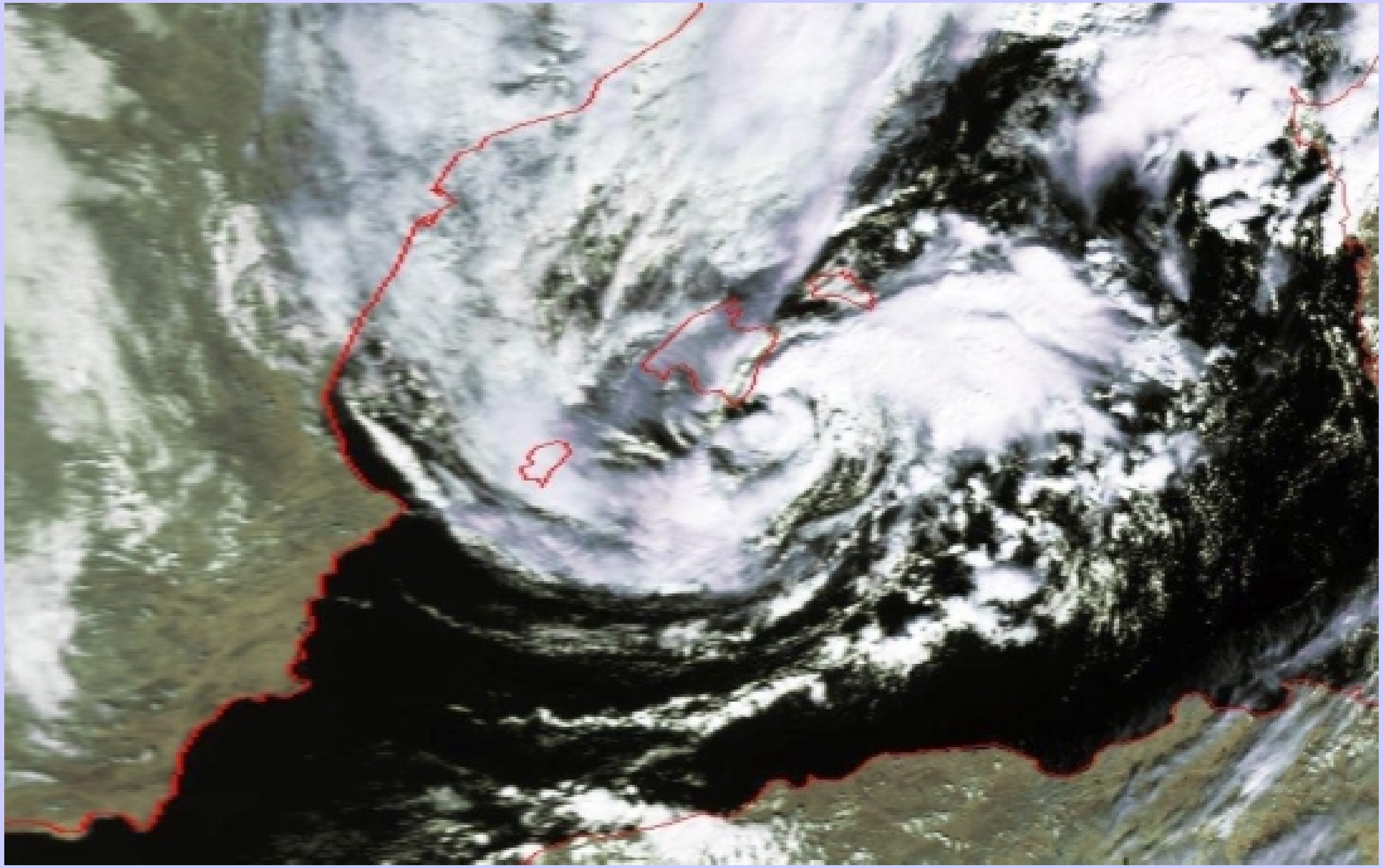
Trajectory of the cyclone. 1996/sep/12

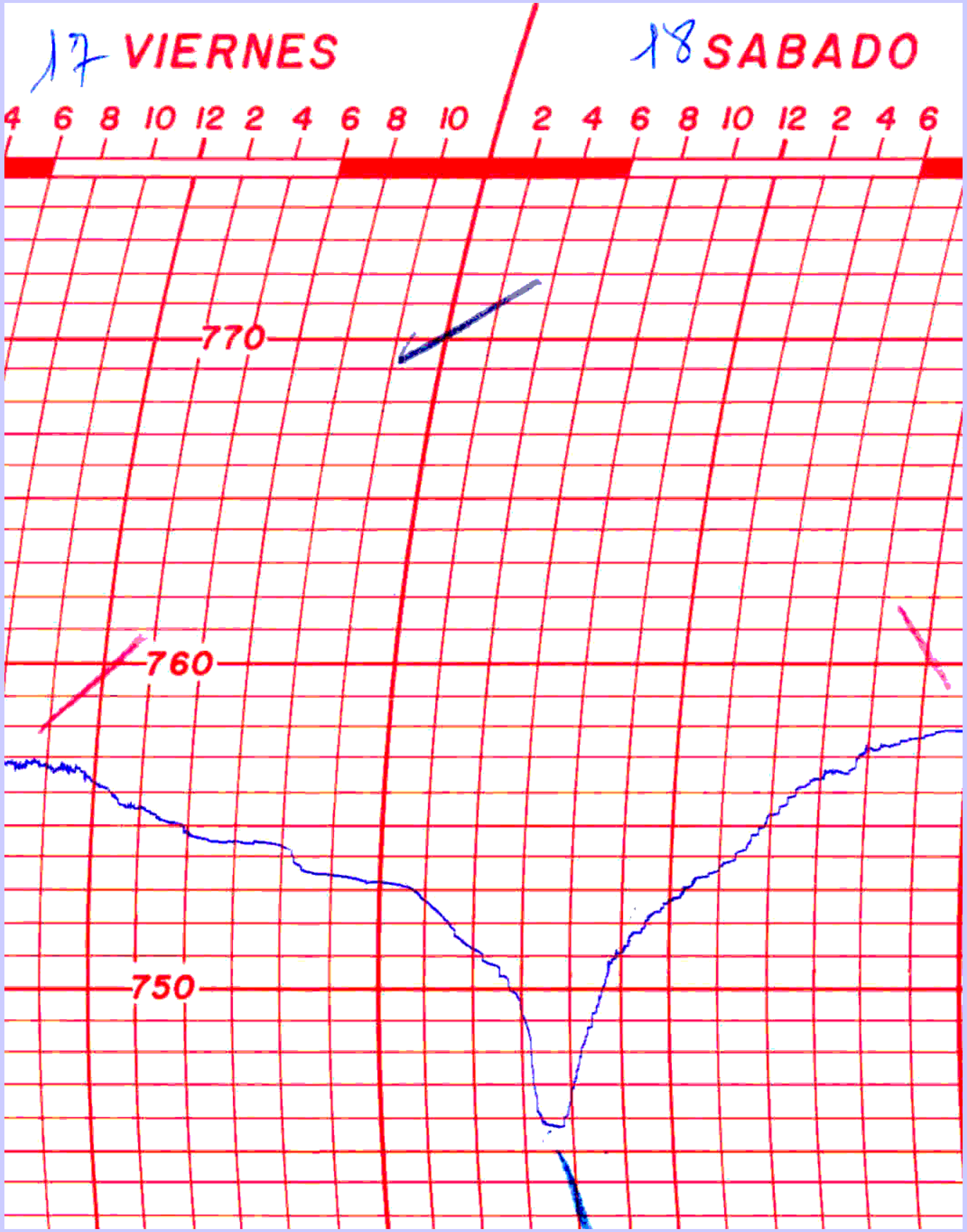


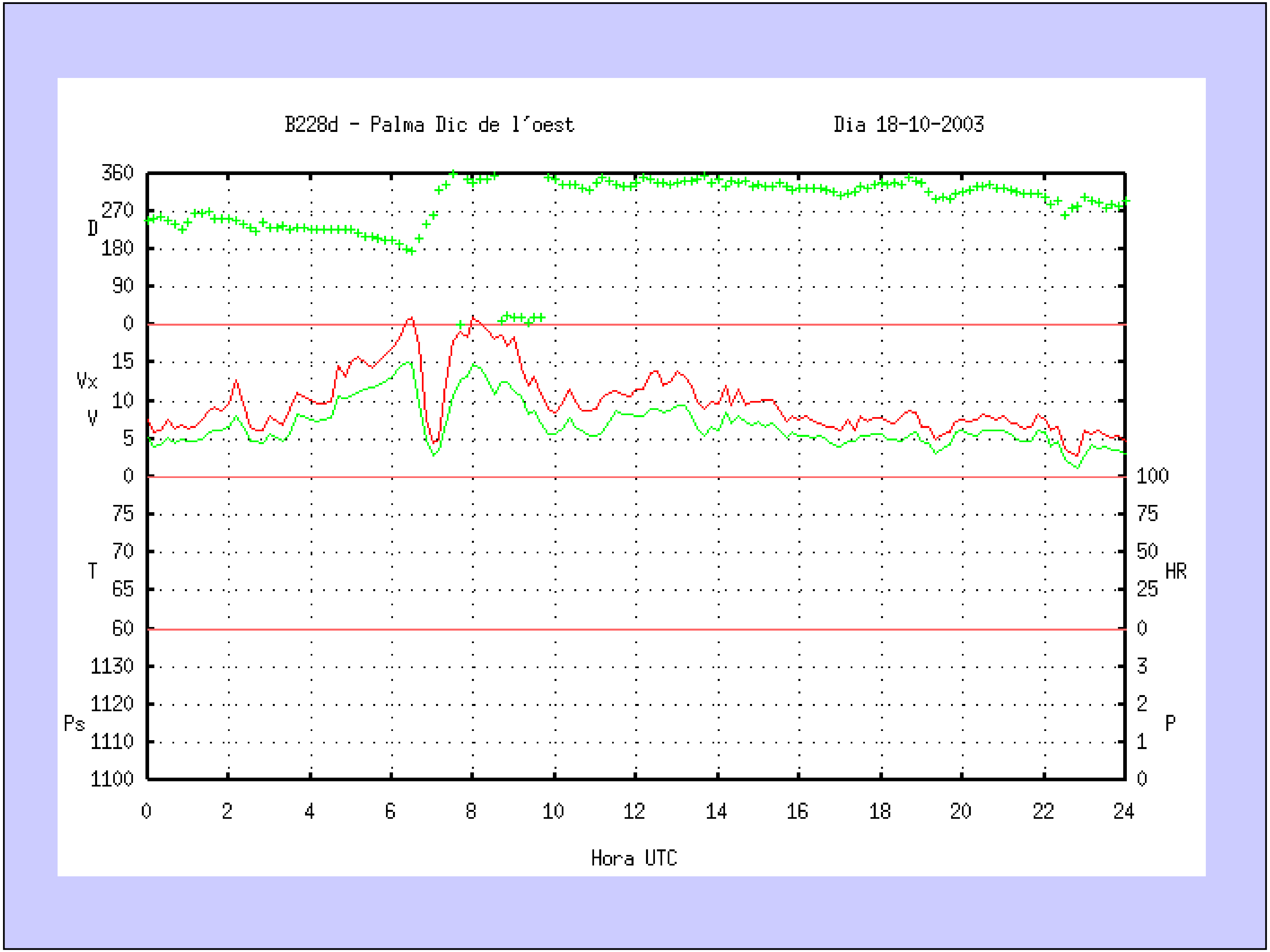
Palma de Mallorca, CMT (08301), Date 1996/sep/12
Pressure Graphic
Pressure hpa
1020
1015
1010
1005
1000
995
990
[UTC]
0
3
6
9
12
15
18
21
24

Medicane of 18 October, 2003

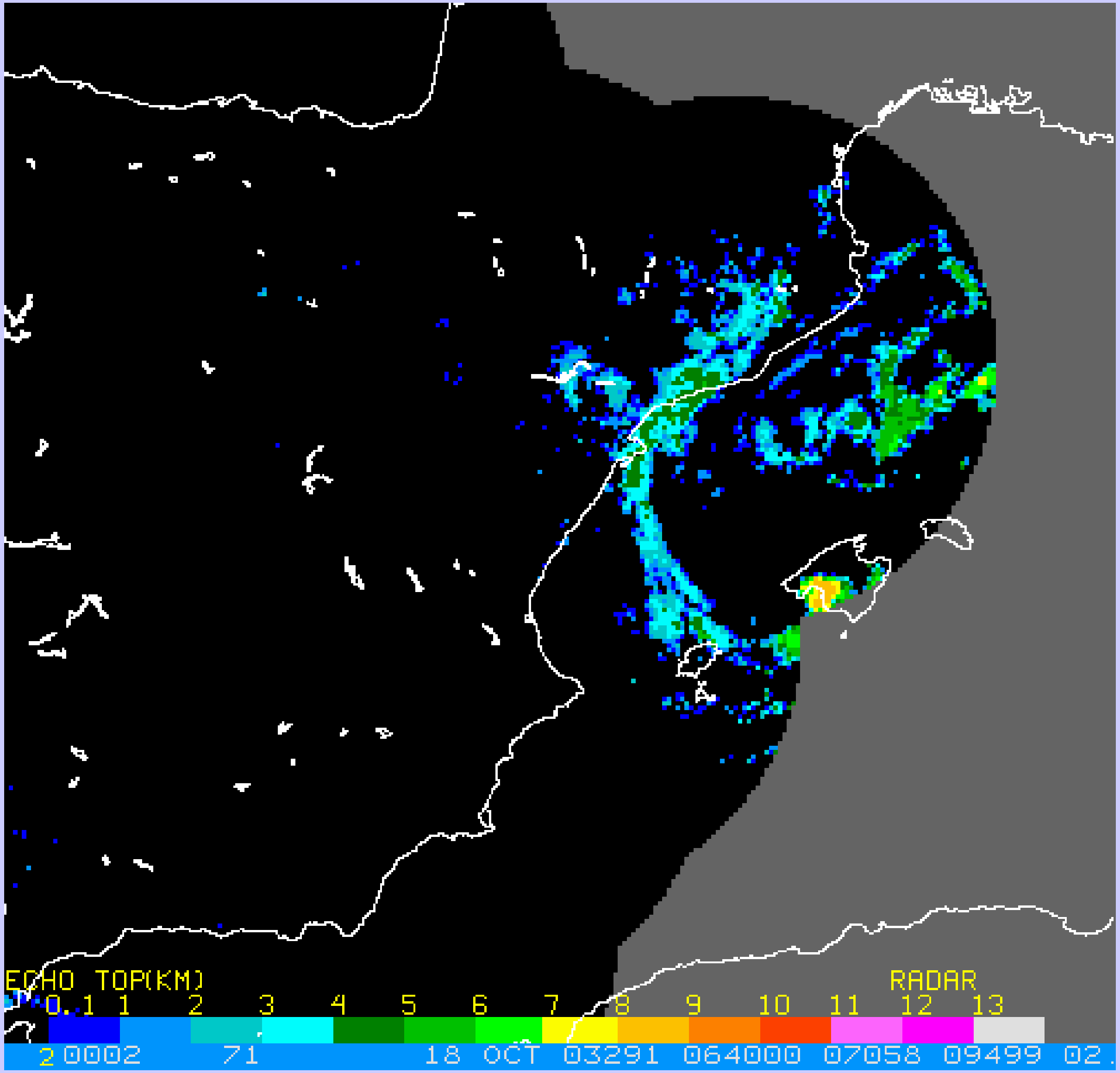




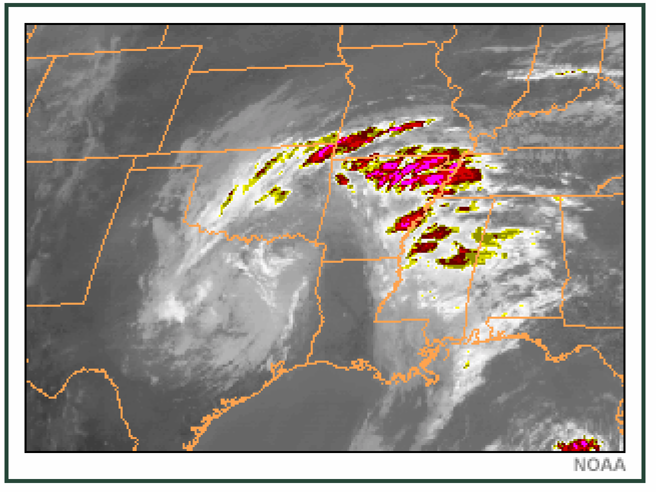

17 VIERNES
18 SABADO
4 6 8 10 12 2 4 6 8 10 2 4 6 8 10 12 2 4 6
770
760
750



B228d - Palma Dic de l'oest
Dia 18-10-2003
D
360
270
180
90
0
Vx
V
15
10
5
0
T
75
70
65
60
Ps
1130
1120
1110
1100
100
75
50
25
0
HR
3
2
1
0
P
0 2 4 6 8 10 12 14 16 18 20 22 24
Hora UTC


ECHO TOP(KM)
RADAR
0.1 1 2 3 4 5 6 7 8 9 10 11 12 13
2 0002 71 18 OCT 03291 064000 07058 09499 02.

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 cyclones:

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

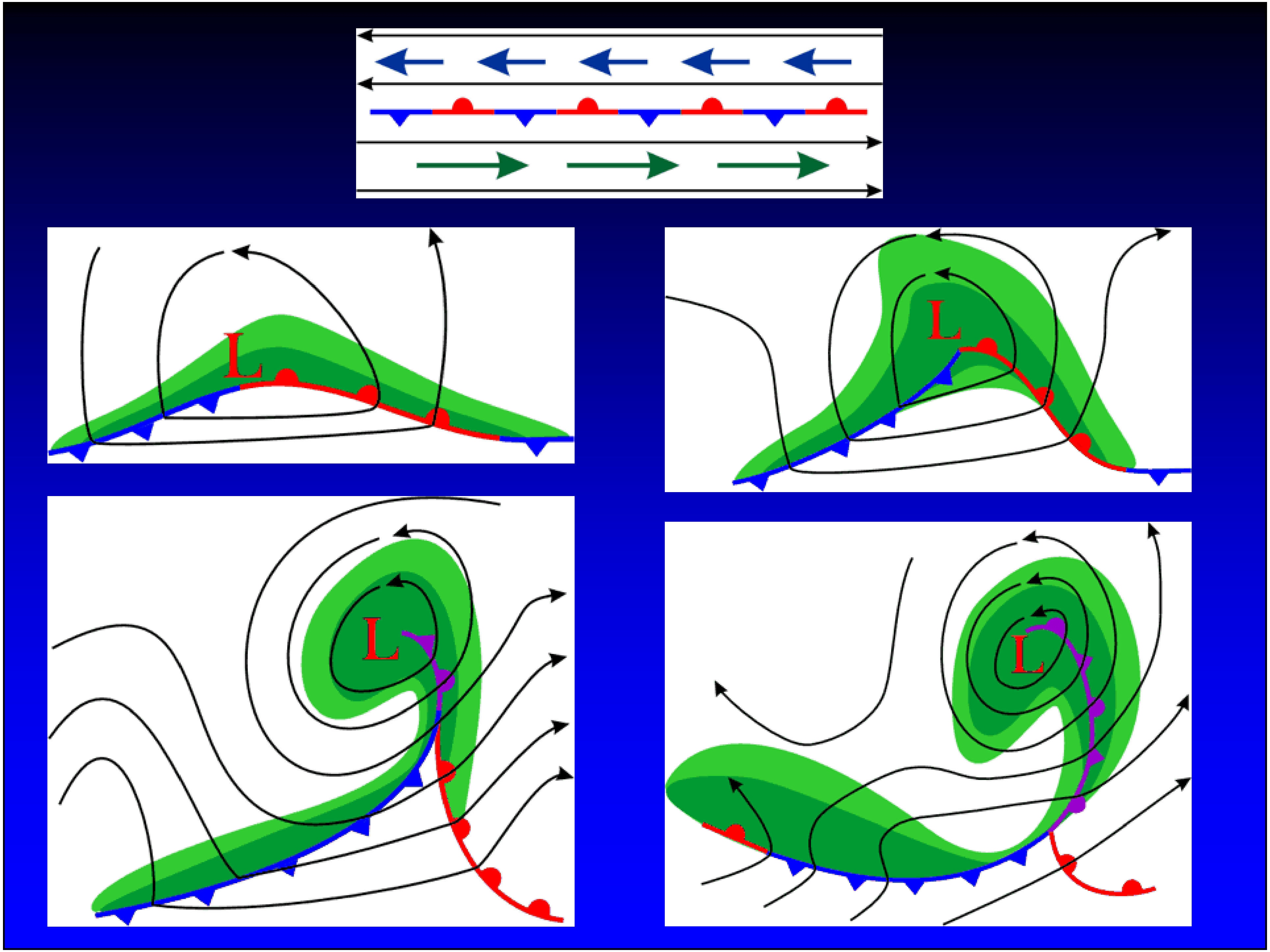
Characteristics

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. Less weather data is 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 pressure gradients
- Coastal flooding
- Heavy rains, flooding, and flash flooding
- Heavy snow
- Mud slides
- Downbursts
- Tornadoes

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


L
L
L
L

Winter Storms

NCAR / UCAR / NSF

Definition

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 12 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.

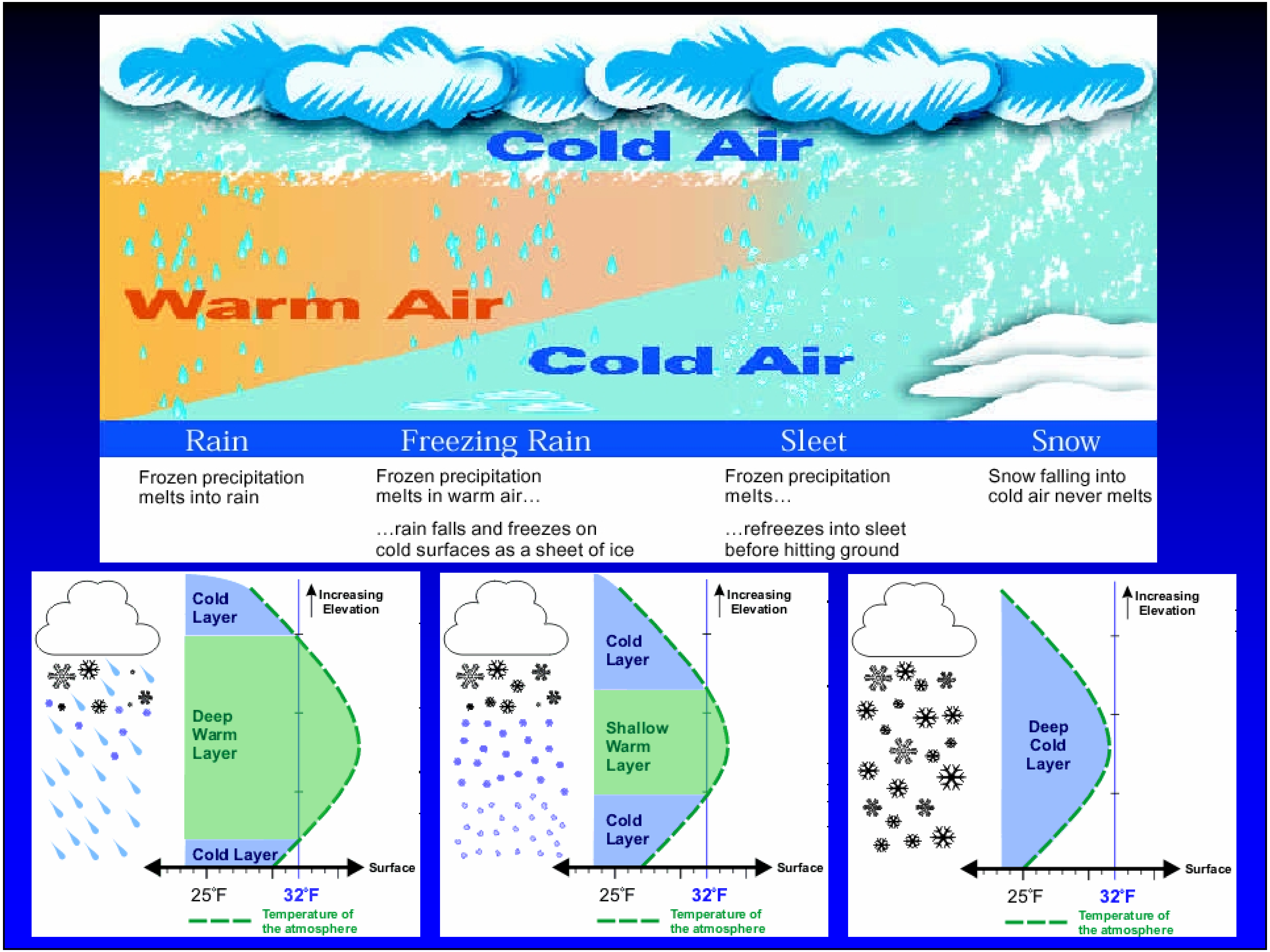
The term **Ice Storm** is used to describe occasions when damaging accumulations of ice are expected during freezing rain situations.

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 32ºF or below over a widespread area for a climatologically significant period of time. Use of the term is usually 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 objects on the earth fall below 32ºF. Because frost is primarily an event that occurs as the result of radiational cooling, it frequently occurs with a temperature in the mid-30s.

Wind Chill describes 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.


Cold Air
Warm Air
Cold Air
Rain
Freezing Rain
Sleet
Snow
Frozen precipitation melts into rain
Frozen precipitation melts in warm air…
…rain falls and freezes on cold surfaces as a sheet of ice
Frozen precipitation melts…
…refreezes into sleet before hitting ground
Snow falling into cold air never melts
Cold Layer
Deep Warm Layer
Cold Layer
Increasing Elevation
Surface
25°F
32°F
Temperature of the atmosphere
Cold Layer
Shallow Warm Layer
Cold Layer
Increasing Elevation
Surface
25°F
32°F
Temperature of the atmosphere
Deep Cold Layer
Increasing Elevation
Surface
25°F
32°F
Temperature of the atmosphere

Characteristics

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

- **Cold air** - Subfreezing temperatures (below 32ºF, 0ºC) in the clouds and/or 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

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 increased 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.

elmundo-eldia.com ILLES BALEARS

Hemeroteca | Agenda cultural | Cartelera | Titulares | Tienda | Restaurantes | De copas | Loterías

BALEARES 24HORAS
Opinión
Illes Balears
Palma
Menorca
Part Forana
Deporte
Cultura
Ibiza y Formentera

Miércoles, 26 de Enero de 2005 Actualizado a las 20:32

ULTIMA HORA / TEMPORAL

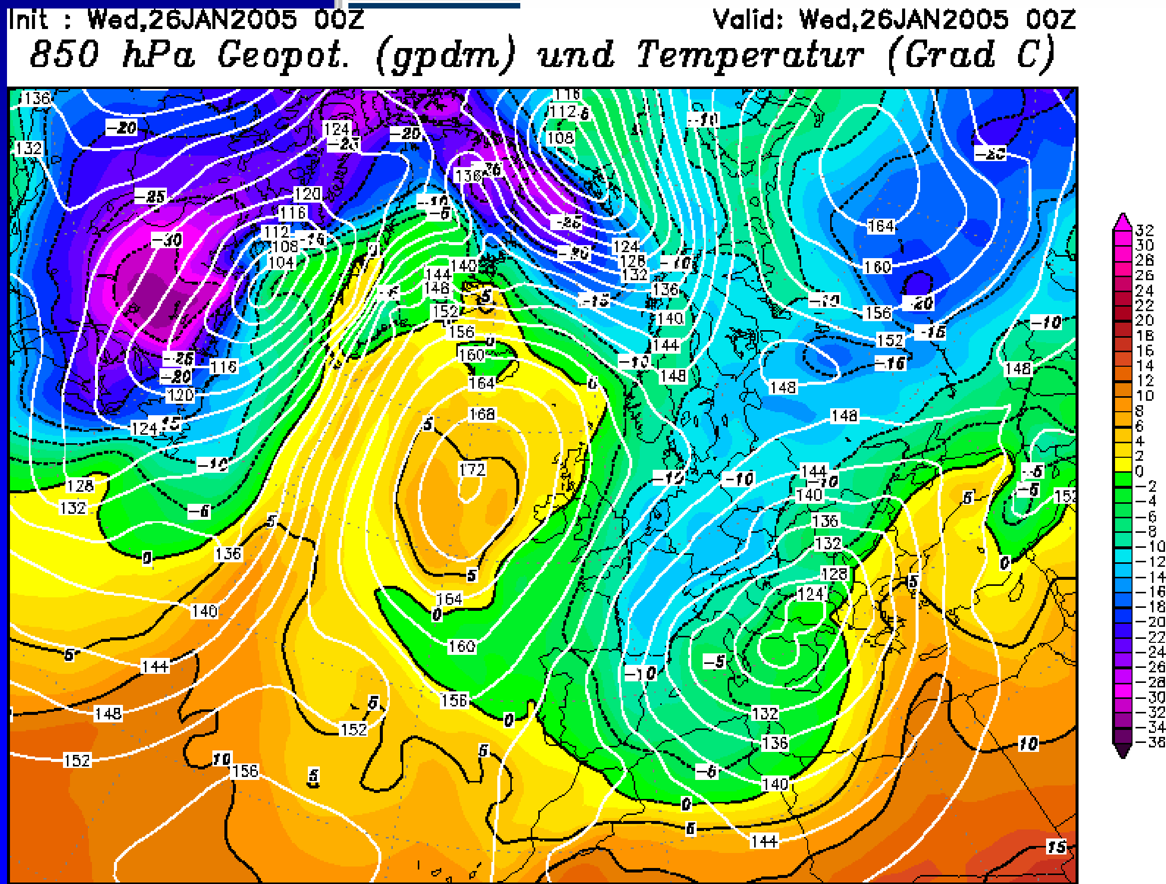
Baleares registra la tercera nevada más importante en los últimos 100 años

Una nevada histórica

La ola de frío que se ha instalado en la mayor parte de España está generando graves problemas en las comunicaciones. Hacia quince años que Baleares no recibía tanta cantidad de nieve. Los termómetros de Palma llegaban a registrar esta mañana hasta -3 grados. La nieve ha llegado a pie de playa./ PEP VICENS

BUSQUEDAS
Internet by ARIADNA
Buscar
otros buscadores

NO TE LO PIERDAS
MundOcio de Baleares
MUNDOCIO
La web del ocio en las Islas Baleares
Fora Vila Verd
L'aigua de Sa Costera
La Economía Balear
'Notable' para la política económica
NAUTICA
Llegamos a puerto
Tribuna de la Mediterrània
Hacia un nuevo



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.

Of winter 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 below.

Wind-Chill Index						
Temperatures						
Wind	25°	20°	15°	10°	5°	0°
15 mph	2°	-5°	-11°	-18°	-25°	-31°
20 mph	-3°	-10°	-17°	-24°	-31°	-39°
25 mph	-7°	-15°	-22°	-29°	-36°	-44°
30 mph	-10°	-18°	-25°	-33°	-41°	-49°

Air Temperature (°C)

WIND SPEED km/h	Calm	4	2	-1	-4	-7	-9	-12	-15	-18	-21	-23	-26	-29	-32	-34	-37	-40	-43
	8	2	-1	-4	-7	-11	-14	-17	-21	-24	-27	-30	-33	-37	-40	-43	-47	-49	-53
	16	1	-3	-6	-9	-13	-16	-20	-23	-27	-30	-33	-37	-41	-44	-47	-51	-54	-58
	24	0	-4	-7	-11	-14	-18	-22	-25	-28	-32	-36	-39	-43	-46	-50	-53	-57	-61
	32	-1	-4	-8	-12	-15	-19	-23	-26	-30	-34	-37	-41	-44	-48	-52	-56	-59	-63
	40	-1	-5	-9	-13	-16	-20	-24	-27	-31	-35	-38	-42	-46	-50	-53	-57	-61	-64
	48	-2	-6	-9	-13	-17	-21	-24	-28	-32	-36	-39	-43	-47	-51	-55	-58	-62	-66
	56	-2	-6	-10	-14	-18	-22	-26	-29	-33	-37	-41	-44	-48	-52	-56	-60	-63	-67
	64	-3	-7	-11	-14	-18	-22	-26	-30	-34	-38	-42	-46	-49	-53	-57	-61	-64	-68
	72	-3	-7	-11	-15	-19	-23	-27	-31	-34	-38	-42	-46	-50	-54	-58	-62	-66	-69
	80	-3	-7	-11	-16	-19	-23	-27	-31	-35	-39	-43	-47	-51	-55	-59	-63	-67	-71
	89	-4	-8	-12	-15	-19	-24	-28	-32	-36	-39	-43	-48	-52	-56	-59	-63	-67	-72
	97	-4	-8	-12	-16	-20	-24	-28	-32	-36	-40	-44	-48	-52	-56	-60	-64	-68	-72

What is important about the wind chill besides feeling colder than the actual air temperature? The lower the wind chill temperature, the greater you are at risk for developing frost bite and/or hypothermia.

Frostbite occurs when your body tissue freezes. The most susceptible parts of the body are fingers, toes, ear lobes, and the tip of the nose. Hypothermia occurs when body core temperature, normally around 98.6°F (37°C) falls below 95°F (35°C). The following table shows how fast frostbite can occur at various wind chill temperatures.

Wind Chill	Cold Threat
-6°C to 4°C	COLD. Unpleasant.
-17°C to -7°C	VERY COLD. Very unpleasant.
-28°C to -18°C	BITTER COLD. Frostbite possible. Exposed skin can freeze within 5 minutes.
-56°C to -29°C	EXTREMELY COLD. Frostbite likely. Exposed skin can freeze within 1 minute. Outdoor activity becomes dangerous.
-57°C and lower	FRIGIDLY COLD. Exposed skin can freeze in 30 seconds.

elmundo.es

BÚSQUEDAS | En Internet | Buscar

60 segundos | Edición impresa | Cartelera | Callejero | Servicios | Gráficos | Blogs | Tienda | Loterías | Clasificados | Calendario

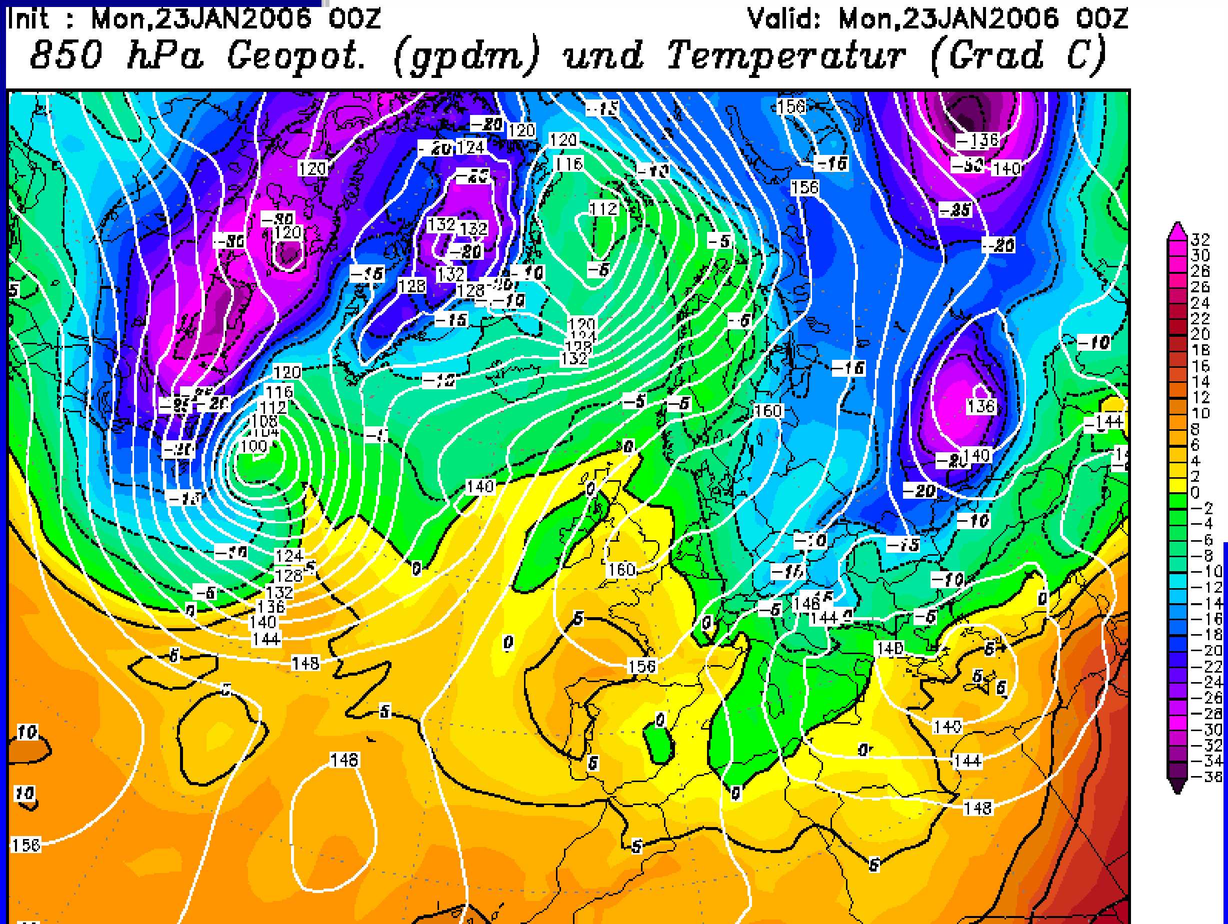
Portada > Sociedad

Otras secciones

ZONAS A MENOS DE 35 GRADOS BAJO CERO

La ola de frío en Europa Central deja casi 200 muertos

Actualizado miércoles 25/01/2006 12:40 (CET)



Un hombre descansa tumbado sobre agua mineral caliente en la playa de Barna (Bulgaria). (Foto: EFE)

ADEMÁS

Excessive Heat


NCAR / UCAR / NSF

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.

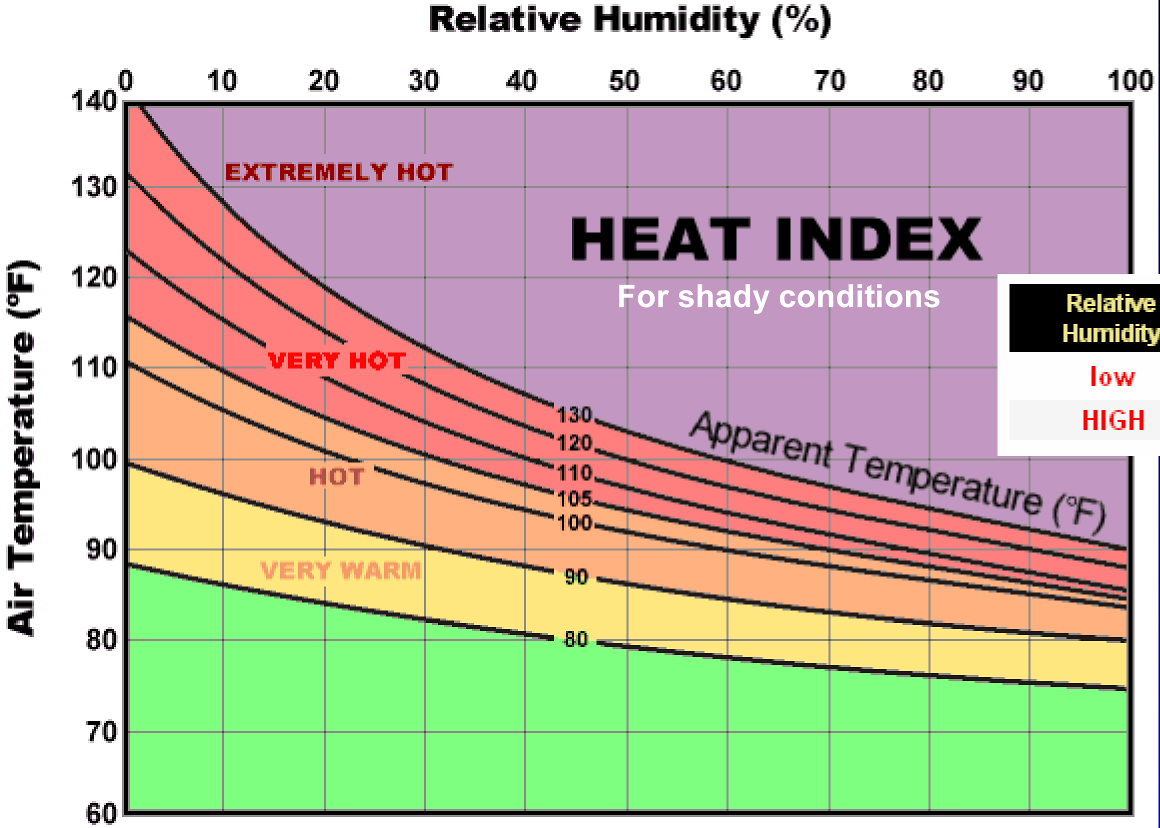
Characteristics

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.

When the air is humid, the "apparent temperature" is even higher. Forecasters use the Heat Index (also called the Humidity Index) to show apparent temperature.

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



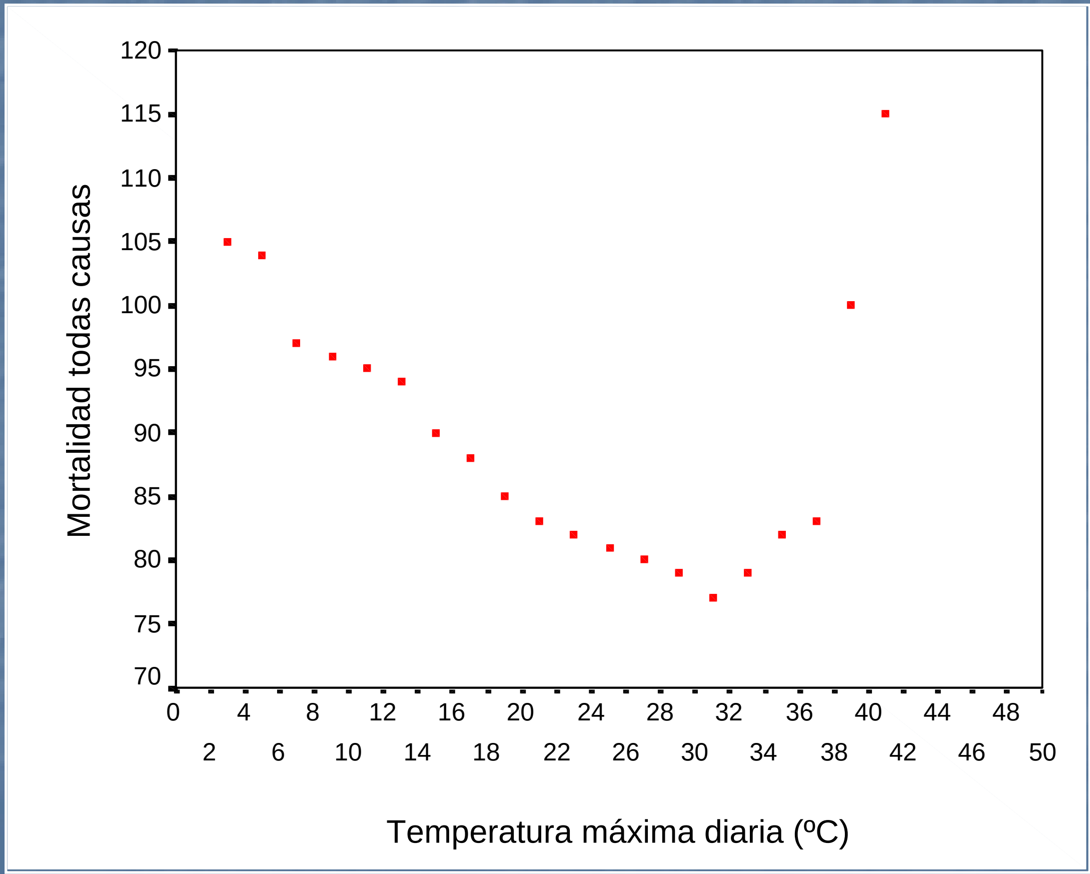
Relative Humidity	Capacity for air to hold water	Amount of Evaporation	HEAT removed from the body
low	LARGER	HIGHER	MORE
HIGH	smaller	lower	less

Farenheit	Celsius
0.00	-17.78
8.00	-13.33
16.00	-8.89
24.00	-4.44
32.00	0.00
40.00	4.44
48.00	8.89
56.00	13.33
64.00	17.78
72.00	22.22
80.00	26.67
88.00	31.11
96.00	35.56
104.00	40.00
112.00	44.45
120.00	48.89
128.00	53.34
136.00	57.78
144.00	62.23

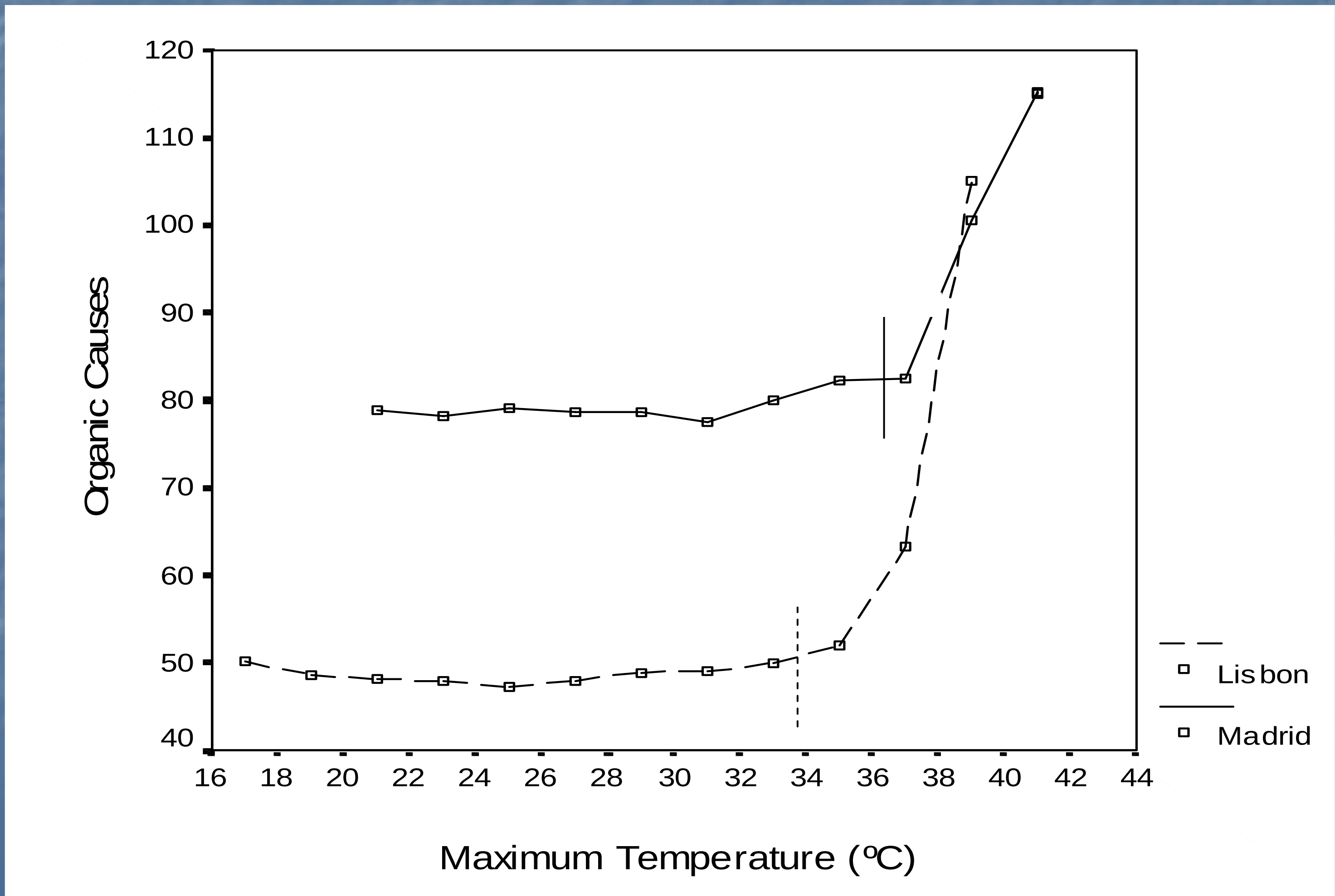
The chart below tells you the risk to the body from continued exposure to the excessive heat.

	Classification		General Affect on People in High Risk Groups
I	Extremely Hot	130°F or Higher	Heat/Sunstroke **HIGHLY LIKELY** with continued exposure
II	Very Hot	105°F - 130°F	Sunstroke, heat cramps, or heat exhaustion **LIKELY**, and heatstroke **POSSIBLE** with prolonged exposure and/or physical activity
III	Hot	90°F - 105°F	Sunstroke, heat cramps, or heat exhaustion **POSSIBLE** with prolonged exposure and/or physical activity
IV	Very Warm	80°F - 90°F	Fatigue **POSSIBLE** with prolonged exposure and/or physical activity

RELACIÓN ENTRE LA TEMPERATURA Y LA MORTALIDAD. MADRID.

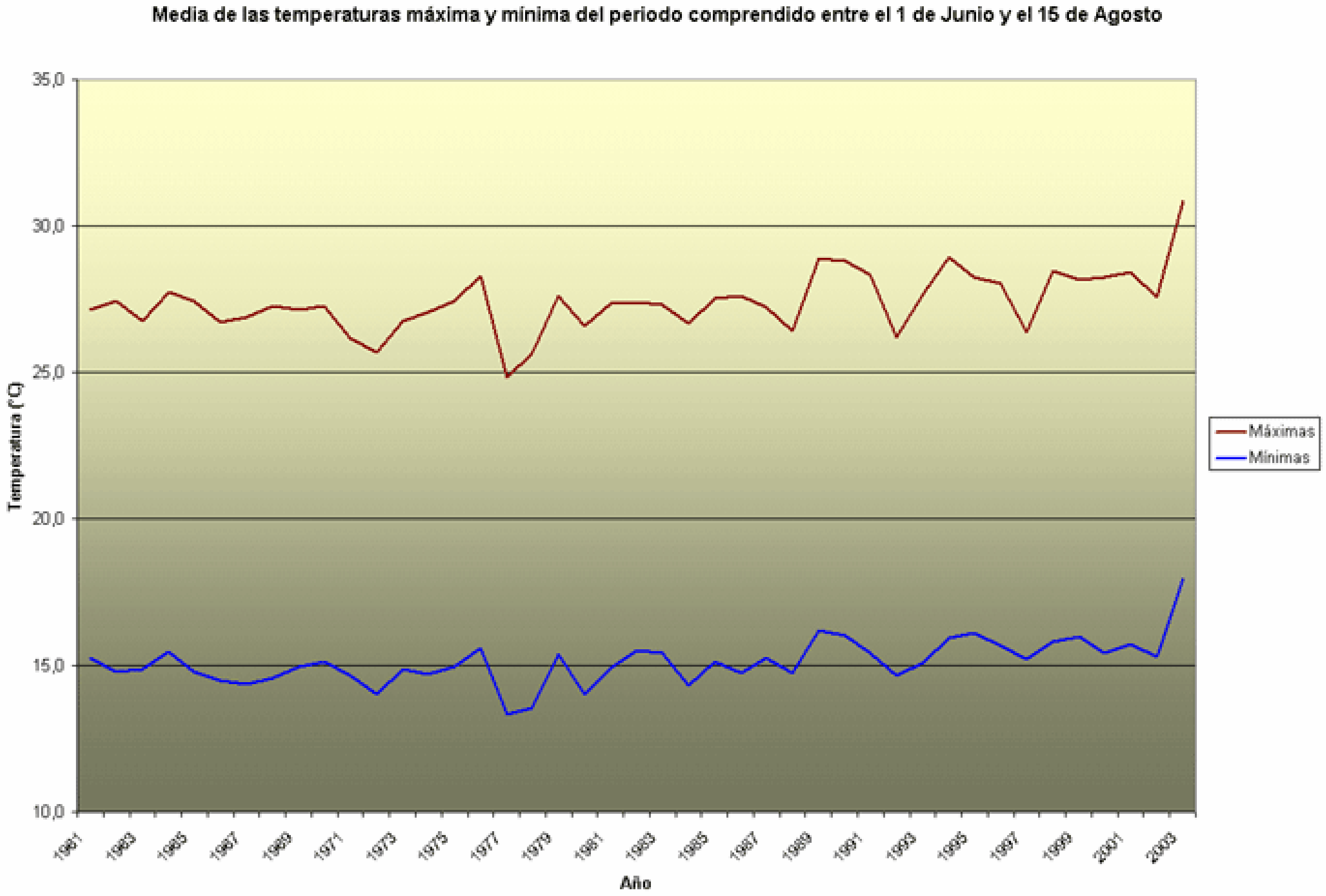


Relación entre la mortalidad y la temperatura en días extremadamente cálidos en Lisboa - Madrid.



Ola de calor. Verano de 2003

La ola de calor que ha afectado a prácticamente toda España en este verano ha constituido sin duda un episodio excepcional desde el punto de vista climatológico. Una de sus características más acusadas ha sido la persistencia de las altas temperaturas. En la mayor parte de la cuenca mediterránea las altas temperaturas, tanto máximas como mínimas, han estado por encima de los valores propios del clima prácticamente sin solución de continuidad desde primeros de junio hasta finales de agosto. En otras áreas el fin de la ola ha tenido lugar hacia mediados de agosto, y hubo alguna semana de "respiro" al principio de julio.



Fog


NCAR / UCAR / NSF

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 below summarizes several scenarios for the formation, intensity, and duration of fog.

Type of Fog	Factors	Description	Effects
Ground Fog	• Clear nights • Stable air (winds less than 5 mph) • Small temperature-dewpoint spread	Heat radiates away from the ground, cooling the ground and surface air. When the air cools to its dewpoint, fog forms (usually a layer of less than 100-200 feet).	Common in many areas, ground fog burns off with the morning sun.
Valley Fog	• Cold surface air and weak winter sun • May follow a winter storm or 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 cold ground or water, where it cools to the dewpoint and forms fog.	Advection fog can cover wide areas of the central U.S. in winter. It may be thick enough to close airports.
Upslope Fog	• Winds blowing up hills or mountains • Humid air	As humid air pushed up hills and mountains, it cools to its dewpoint 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 dewpoint. Vapor condenses, forming a layer of fog 1 to 2 feet thick over the water.	This type of fog forms on fall days over ponds and streams.
Precipitation Fog	• Warmer air • Cool rain	Some rain evaporates, and the added vapor increases the air to its dewpoint. The vapor then condenses into fog.	Precipitation fog forms on cool, rainy days.

elmundo-eldia.com ILLES BALEARS

Hemeroteca | Agenda cultural | Cartelera | Titulares | Tienda | Restaurantes | De copas | Loterías | Clasificados

publicidad

elmundotienda.com

BALEARES 24HORAS

Opinión

Illes Balears

Palma

illes balears

Domingo, 21 de marzo de 2004 Actualizado a las 01:49

PALMA

La niebla en Son Sant Joan obliga a cancelar un vuelo y a desviar otros 13 a Maó y Eivissa

La bruma impidió varios aterrizajes en las pistas del aeropuerto palmesano desde las 5.30 hasta las 9 horas La compañía más afectada fue Air Berlin, que tuvo que redirigir 7 aviones

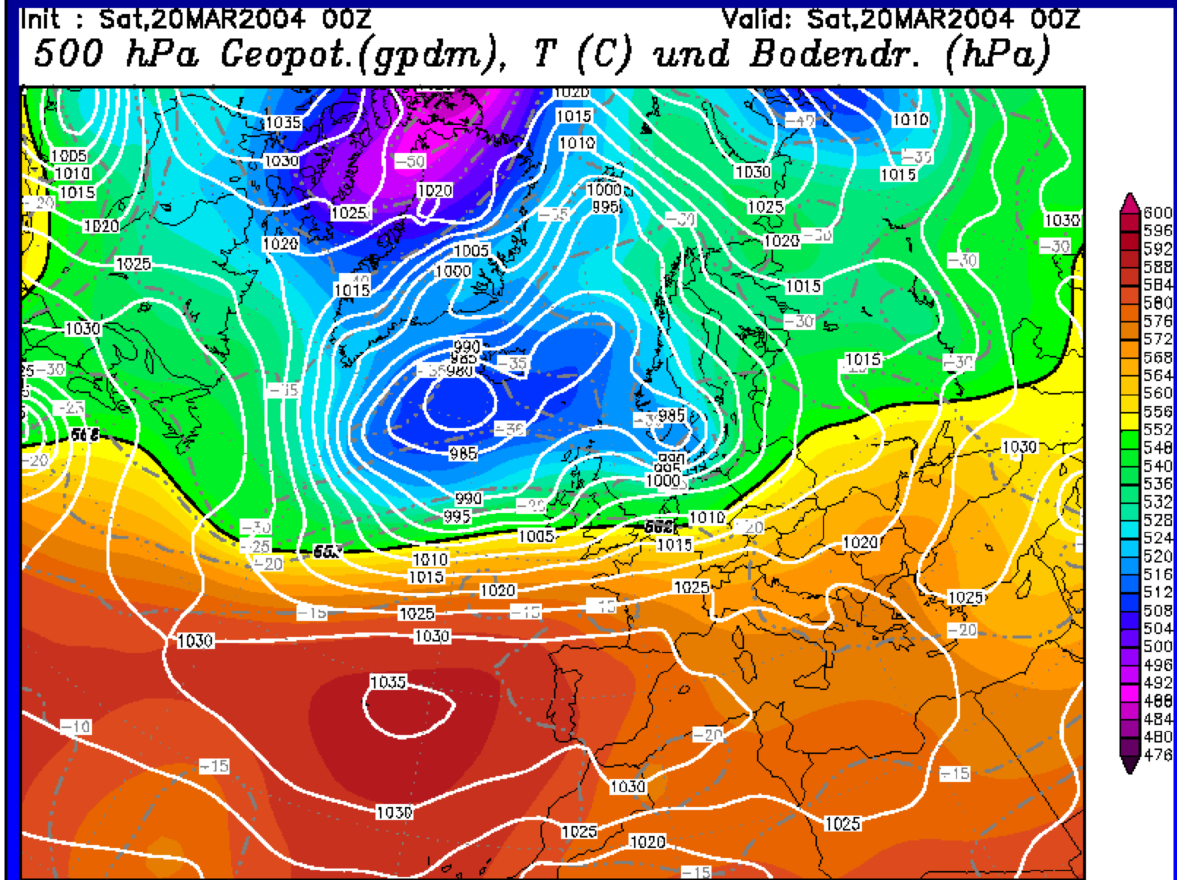
BUSQUEDAS

ARIADN@ by Google

Buscar

otros buscadores

LA VIDA MÁS FÁCIL



elmundo.es

BÚSQUEDAS | En Intern

60 segundos | Edición impresa | Opinión | Callejero | Servicios | Gráficos | Charlas | Tienda | Juegos

Fotos del día
Álbum
Vídeos
Versión texto

ÚLTIMA HORA
España

sociedad

Viernes, 14 de Marzo de 2003
Actualizado a las 07:42 (CET) - Internet time @320 by swatch

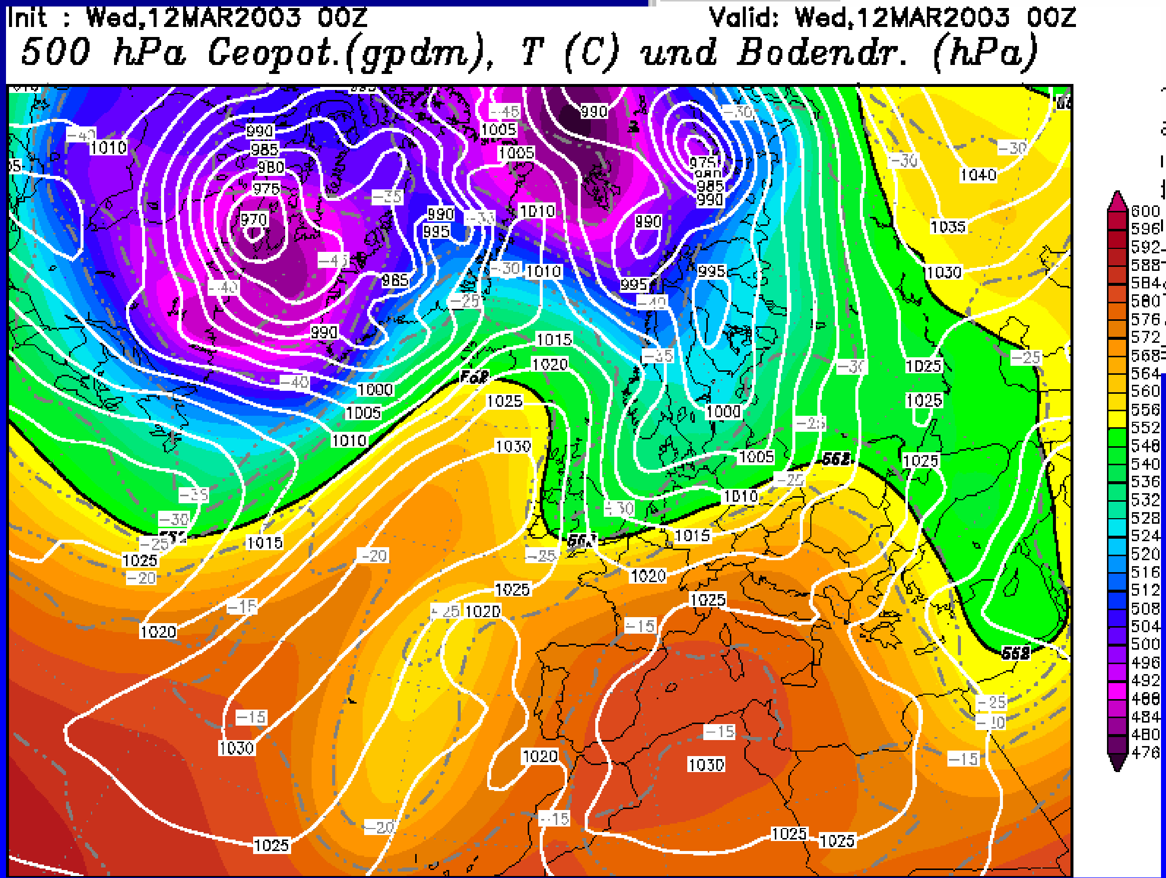
LA CAUSA PARECE SER LA NIEBLA

Al menos 14 muertos en el choque de 250 vehículos en Italia

El suceso ha tenido lugar en la A4, que recorre parte del norte del país

...rsonas han muerto y ...as -10 de ellas ...icular accidente **en el** ...de 250 vehículos han ... un momento de ...demás, un camión que ...s de hidrógeno **ha** ...aunque un helicóptero ...explotara.

Un camión con bombonas de gas, accidentado. (AP)



Duststorms

NOAA / Dept. of Commerce

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 effect on machinery. Duststorms that reduce the visibility to 1/4 mile or less often pose hazards for travelers, cause damage and injury, and affect commerce.

Characteristics

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 microbursts. In this situation, the event is usually sudden and 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 below.

Factors	Large Scale, Nonconvective Events	Convective Events
Speed of onset	Recognizable weather patterns are easily identified 24 to 36 hours in advance	• Predictable over an area 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	• Microbursts - a few seconds • Macrobursts - 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.

Windstorms

NCAR / UCAR / NSF

Definition

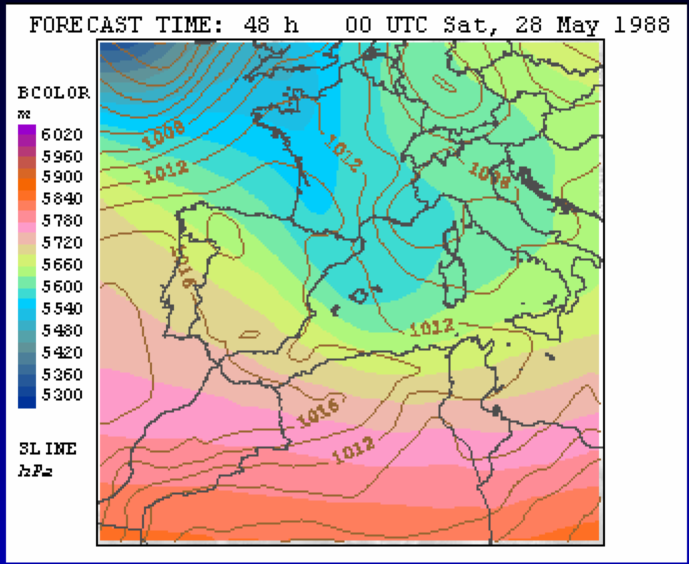
High winds not associated with convective events (severe local storms, hurricanes, and winter storms) require a warning when one of the following occurs:

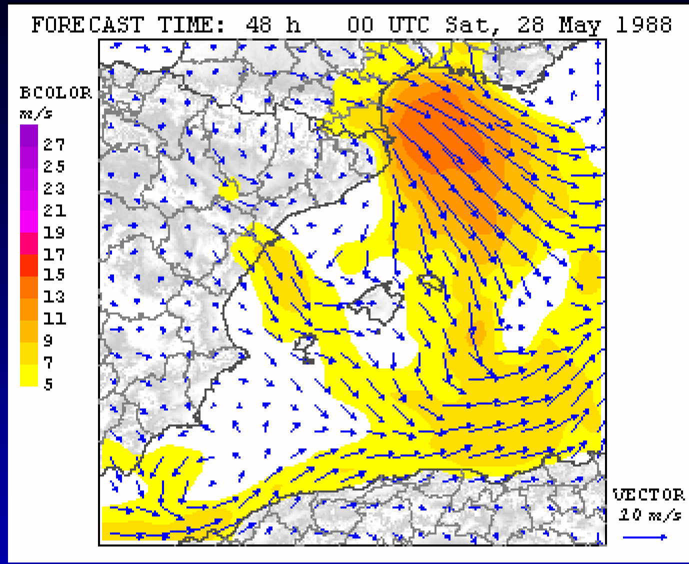
- Sustained wind speeds of 40 mph or greater lasting for 1 hour or longer
- Winds of 58 mph or greater for any duration

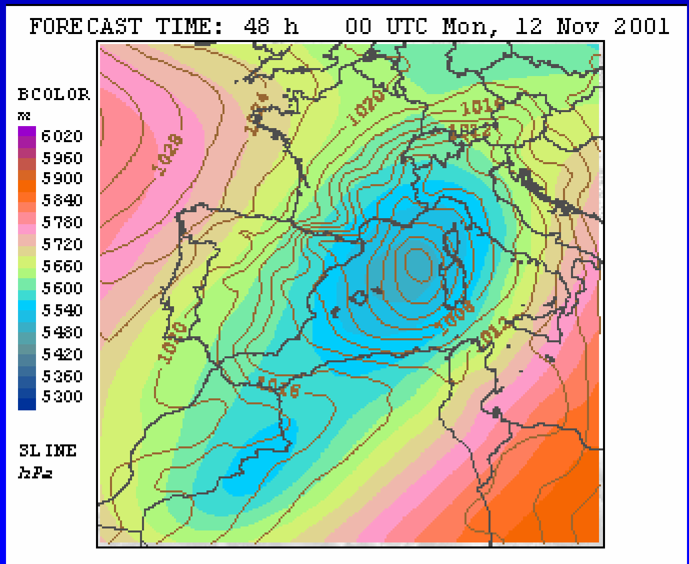
The above thresholds generally are increased for locations at higher elevations because of the lower air density and subsequent reduction in damage from less force.

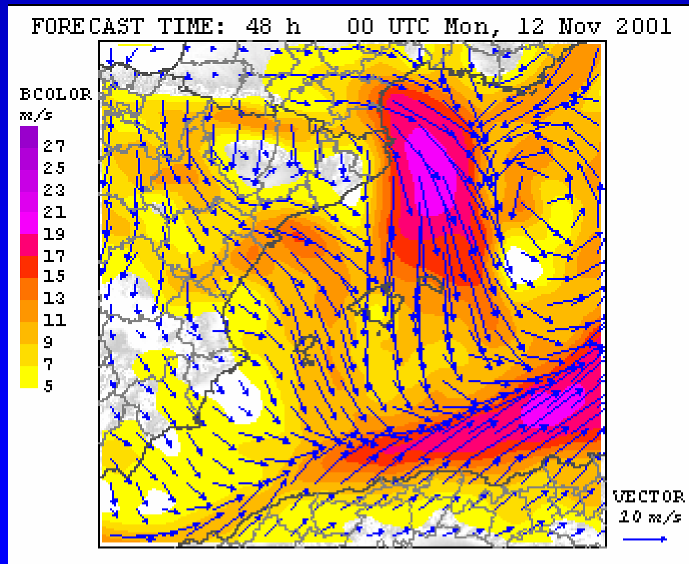
The types of wind that do not involve the mechanism of convection include:

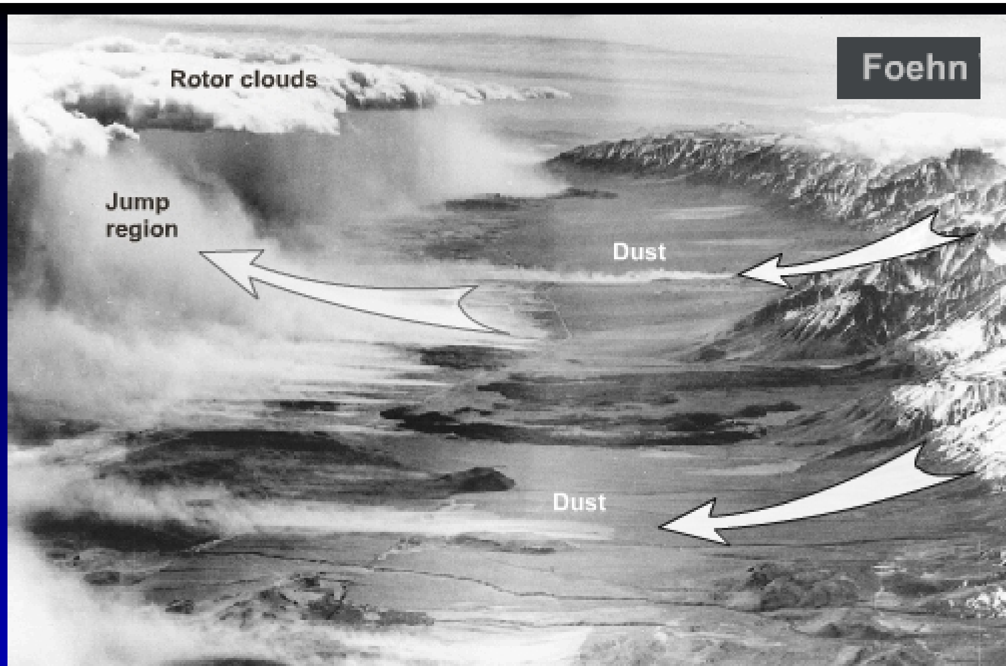
- **Gradient High Winds** - High winds that usually cover a large area and are due to large-scale pressure systems.
- **Mesoscale High Winds** - These high winds usually follow the passage of organized convective systems and are associated with wake depressions or strong mesoscale high pressure.
- **Channeled 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 Winds** - 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.

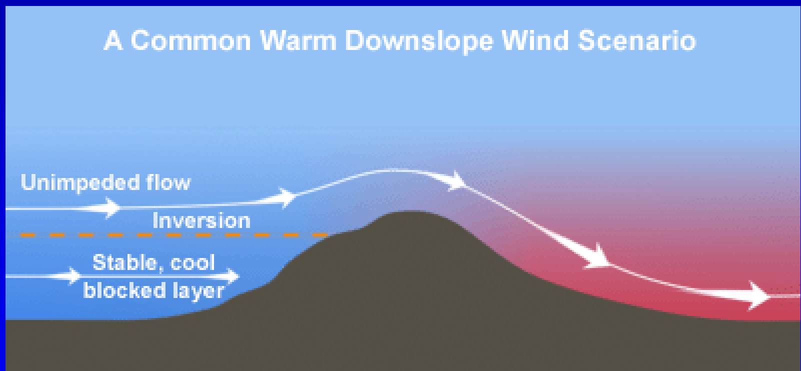

FORECAST TIME: 48 h 00 UTC Sat, 28 May 1988
BCOLOR
m
6020
5960
5900
5840
5780
5720
5660
5600
5540
5480
5420
5360
5300
SLINE
hPa
1008
1012
1016

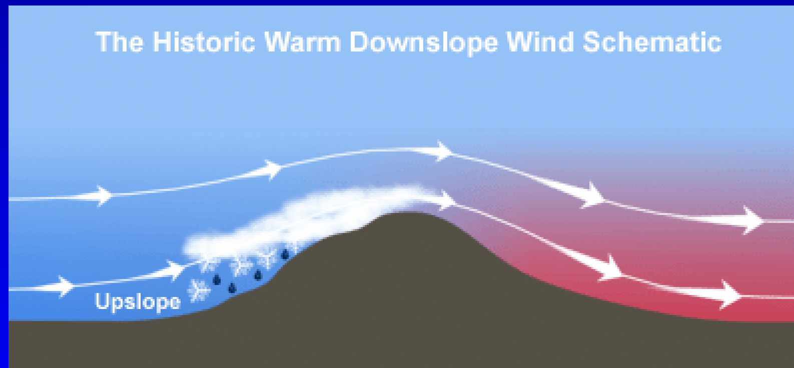

FORECAST TIME: 48 h 00 UTC Sat, 28 May 1988
BCOLOR
m/s
27
25
23
21
19
17
15
13
11
9
7
5
VECTOR
10 m/s

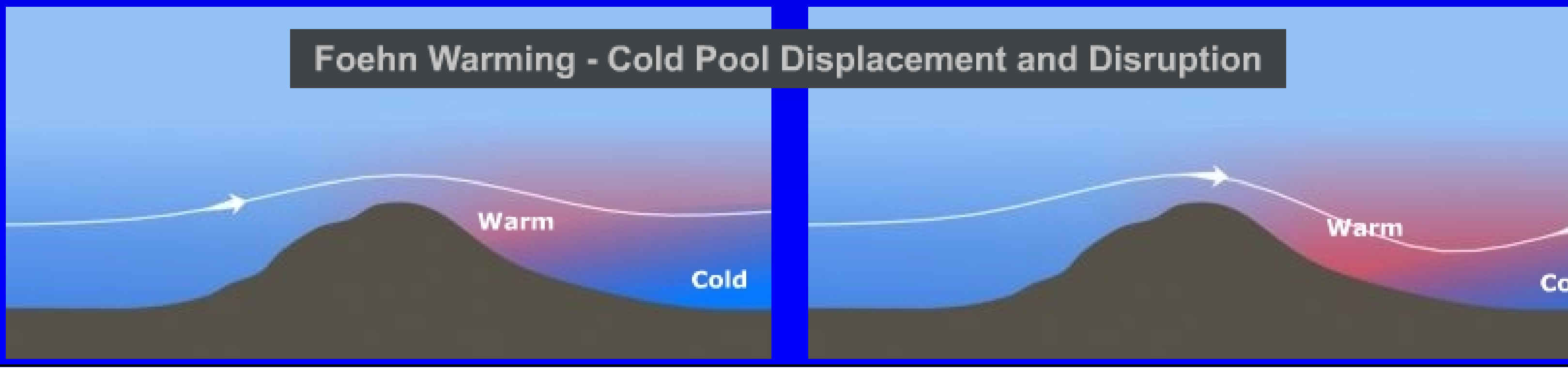

FORECAST TIME: 48 h 00 UTC Mon, 12 Nov 2001
BCOLOR
m
6020
5960
5900
5840
5780
5720
5660
5600
5540
5480
5420
5360
5300
SLINE
hPa
1028
1020
1016
1008
1012


FORECAST TIME: 48 h 00 UTC Mon, 12 Nov 2001
BCOLOR
m/s
27
25
23
21
19
17
15
13
11
9
7
5
VECTOR
10 m/s


Foehn
Rotor clouds
Jump region
Dust
Dust


A Common Warm Downslope Wind Scenario
Unimpeded flow
Inversion
Stable, cool blocked layer


The Historic Warm Downslope Wind Schematic
Upslope


Foehn Warming - Cold Pool Displacement and Disruption
Warm
Cold
Warm

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

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 and may extend horizontally for hundreds of miles.

Windstorms are nonconvective 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, nonconvective 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.

Fire Weather


Bob Kambitsch, National Interagency Fire Center

Definition

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

Fire Weather Offices are those WFOs 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) in order to achieve land management objectives.

Wildfire is any free-burning and uncontainable wildland fire that is not a prescribed prescribed burn and 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

The following 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

Other factors 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.
- **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 U.S. 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 (below) to indicate the potential for large fire growth.

Haines Index	**Risk**
2 or 3	Very low
4	Low
5	Moderate
6	HIgh

MINISTERIO
DE MEDIO
AMBIENTE

INM

Instituto Nacional de Meteorología - España

Avisos Meteorológicos Criterios de Emisión

La Dirección General del Instituto Nacional de Meteorología en su condición de autoridad meteorológica del Estado, en virtud del Real Decreto 1415/2000, asume, entre otras, la función de "elaborar y difundir predicciones y avisos meteorológicos a distintos plazos temporales en todo el territorio nacional y en las zonas costeras y de alta mar bajo responsabilidad del Instituto"

Dentro de esa función esencial de la VIGILANCIA METEOROLÓGICA permanente, el Instituto Nacional de Meteorología elabora y difunde los AVISOS METEOROLÓGICOS cuando se observan o preven fenómenos meteorológicos especialmente relevantes por superar determinados valores preestablecidos para cada uno de ellos en un zona geográfica definida.

Debido a las diferentes características de cada fenómeno meteorológico, así como a su distinta incidencia o frecuencia en cada zona geográfica, se han definido umbrales distintos para cada una de estas zonas.

Los umbrales considerados para estos avisos meteorológicos de corto plazo, muy corto plazo y observados son los reseñados en el desplegable que aparece a continuación:

Illes Balears

De acuerdo con ello, se elabora y emite un aviso meteorológico cuando se prevea que un fenómeno vaya a alcanzar el umbral correspondiente o bien cuando ya lo haya alcanzado, especialmente en el caso de que no hubiera sido previsto con anterioridad (fenómeno observado).

Debe advertirse que en los **Boletines ordinarios de predicción nacional de c. autónomas** figura el apartado de **fenómenos significativos**, que contiene información relativa a otras situaciones meteorológicas dignas de mención, aun cuando no alcancen los umbrales preestablecidos para emitir un aviso meteorológico.

COMUNIDAD AUTÓNOMA DE ILLES BALEARS

LLUVIA ACUMULADA en mm

Calvia, Palma y el Arenal, 1/2 hora y 1 hora	Resto,1/2 hora y 1 hora	12 horas
15	30	60

VIENTO en km/h (racha máxima)

Cumbres de la sierra y cabos de la costa norte de Mallorca	Resto
100	80

TORMENTAS OBSERVADAS

Efectos en el suelo

- Precipitaciones localmente muy fuertes
- Granizo superior a 1 cm.
- Rachas de viento muy fuerte superiores a 80 km/h.

MAR

Viento (Escala Beaufort)	Mar de Viento: 15 junio a 15 septiembre	Mar de Viento: Resto del año
6	Fuerte marejada	Mar gruesa

NIEVE (en 24 horas) a diferentes alturas

Por debajo de 200 m	Entre 200 y 800 m	Entre 800 y 1200 m
2 cm	5 cm	10 cm

OLAS DE FRIO Descenso de 6°C en 24 horas alcanzando ...

Menorca por debajo de 200 m	Mallorca por debajo de 300 m	Mallorca entre 300 y 600 m	Mallorca entre 600 y 1000 m	Ibiza y Formentera por debajo de 200 m
Tmínima inferior a 1°C o Tmáxima inferior a 8°C	Tmínima inferior a -1°C o Tmáxima inferior a 9°C	Tmínima inferior a -4°C o Tmáxima inferior a 7°C	Tmínima inferior a -6°C o Tmáxima inferior a 3°C	Tmínima inferior a 2°C o Tmáxima inferior a 10°C

RISSAGAS

Puerto de Ciutadella
75 cm

OLAS DE CALOR

Mallorca	Menorca e Ibiza
Tmínima 37°C Tmínima 23°C	Tmínima 34°C Tmínima 23°C

COMUNIDAD AUTÓNOMA DE GALICIA

LLUVIA ACUMULADA en mm

1/2 hora	1 hora	12 horas	Pontevedra y S de A Coruña, en 36 horas	Resto, en 36 horas
30	30	60	130	90

VIENTO en km/h (racha máxima)

Zona Ortegal y Estaca de Bares, Finisterre-Islas Sisargas	Resto: Litoral	Resto: Interior
110	90	80

TORMENTAS OBSERVADAS

Efectos en el suelo

- Precipitaciones localmente muy fuertes
- Granizo superior a 1 cm.
- Rachas de viento muy fuerte superiores a 80 km/h.

MAR

Viento (Escala Beaufort): Junio a septiembre	Viento (Escala Beaufort): Resto año	Mar de viento	Mar de fondo
7	9	Muy gruesa	4 m

NIEVE (en 24 horas) a diferentes alturas

Por debajo de 200 m	Entre 200 y 800 m	Entre 800 y 1200 m
2 cm	5 cm	10 cm

OLAS DE FRIO Descenso de 6°C en 24 horas alcanzando ...

En el litoral	Por debajo de 200 m	Entre 200 y 800 m	Entre 800 y 1200 m
Tmínima inferior o igual a 0°C	Tmínima inferior a 0°C	Tmínima inferior a -5°C	Tmínima inferior a -10°C

OLAS DE CALOR

Ourense	A Coruña, Lugo y Pontevedra
Tmáxima 36°C ó Tmínima 23°C	Tmáxima 34°C ó Tmínima 22°C

OVERVIEW

1) Weather.- Provides a basic introduction to meteorology, particularly as it relates to hazardous weather (Global scale, Synoptic scale and Mesoscale)

2) Hazards.- Presents the most common hazardous weather events (Description, Characteristics and Examples)

3) Mediterranean cyclones and heavy precipitations.- Analyses in higher detail this problem owing to its high social impact in the region

NOTE: Scientific basis rather than vulnerability analysis or emergency management procedures !!!