



## Interactive Exercises

### Earth/Sun Interactions

- [Energy Balance Model Interactivity](#)

### The Atmosphere and Oceans

- [Weather Stations Interactivity](#)



### Weather Systems and Global Climates

- [Remote Sensing and Climate Interactivity](#)

### The Biosphere and Soils

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## Automatic Weather Stations

Automatic weather stations allow us to not only continuously monitor weather without the cost of human observers, but also monitor conditions in remote regions such as the Antarctic. This interactive exercise will introduce you to the basic principles of automatic weather stations, and give you some experience with using the kinds of data they provide.

Ovládací prvek aktivujete a umožníte jeho používání klepnutím sem.

[Introduction to Weather Stations](#)

[Weather Conditions: A Review](#)

[Look at the Weather Stations](#)

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## Introduction to Weather Stations

- 1. Monitoring the Weather
- 2. How they work
- 3. Instruments
- 4. Communications
- 5. Applications

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## Monitoring the Weather



Direct observations of meteorological variables provide valuable records that we can use to not only warn of current phenomena, but also use to predict future weather and reconstruct past climatic changes. Although we can reconstruct climate using a variety of proxy data sources, such as tree rings, direct climate observations are by far the most accurate records of the atmospheric environment. In the past, observations were limited to inhabited areas and remote areas were left unmonitored. However, automatic weather stations allow us to monitor such remote regions and so create a balanced view of the Earth's climate.

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## How Automatic Weather Stations Work



Automatic Weather Stations include a cluster of electronic meteorological instruments that record information about temperature, humidity, air pressure, winds and other variables. These instruments are linked to a recording computer that stores the data. The computer can also be programmed to transmit warnings if certain conditions prevail, and may also graphically present the data to reveal trends.

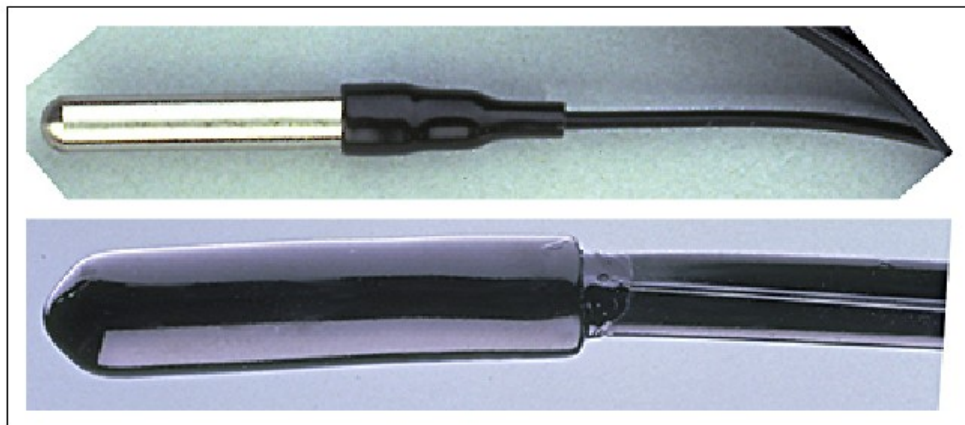
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## Ground Temperature



The temperature of the soil may be measured using temperature probes such as this one and may be situated at a variety of depths. Soil temperature changes lag behind air temperature and so may differ considerably. Soil temperature is of particular interest to farmers because it directly impacts germination.

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## Wind Speed and Direction



Wind speed is measured using an anemometer and direction is measured using a wind vane. The direction of the wind identifies the direction from which the wind is blowing described by the points of the compass. Wind speed and direction can vary quite quickly especially with, for example, the passage of a front.

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## Air Pressure



The barometer, an example of which is shown here, is the traditional instrument to measure atmospheric pressure.

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## Precipitation



A rain gauge measures the depth of water (in millimeters or inches) precipitated over a level surface. It should be sited away from barriers that could create wind effects to prevent wind from blowing rain into or around the gauge. Snow can present some problems especially if the gauge is not well screened and wind blows the snow around. In addition, large depths of snow may exceed the opening of the gauge before it can melt and therefore be measured.

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## Solar Radiation



Solar radiation, measured using a solarimeter, is observed as a total of all wavelengths although in some specialized automatic weather stations, specific wavelengths may be monitored.

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## Communications



Sensors in an automatic weather station require connections to a main recorder to archive and transmit observations. Sensors are usually wired into a central unit which may be connected to a computer also by cables. However, weather stations increasingly have wireless connections that extend the range and convenience of siting them. On-line weather stations (OLWS) send weather observations directly to a web site so that anyone can assess the information. These can be very useful to check, for example, road conditions or weather for mountaineering.

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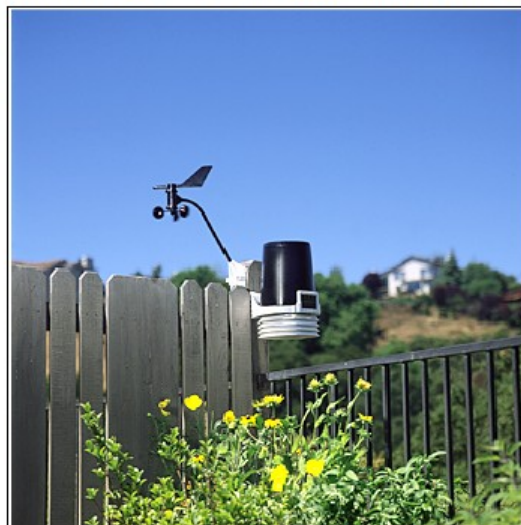
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## Applications

There are many situations in which real-time weather observations are useful. Automatic weather stations for agriculture can be programmed to warn farmers when certain conditions prevail. For example, the risk of frost can alert farmers to use fans to mix the air and so warm it. Other weather conditions such as high humidity levels, can make some crops prone to disease. Any activities impacted by weather can benefit from automatic weather station data, and with improved computer communications, this data can now be conveniently accessed via the Internet.



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## Urban Pollution

Pollution accumulates when it is not diffused by winds associated with unstable air. Stable conditions arising from prevailing high pressures or an inversion, trap atmospheric pollutants which as they accumulate lead to increased atmospheric concentrations. High pollution episodes are often ended by the passage of a front or by the formation of convective cumulonimbus clouds. This removal of pollutants is referred to as venting.

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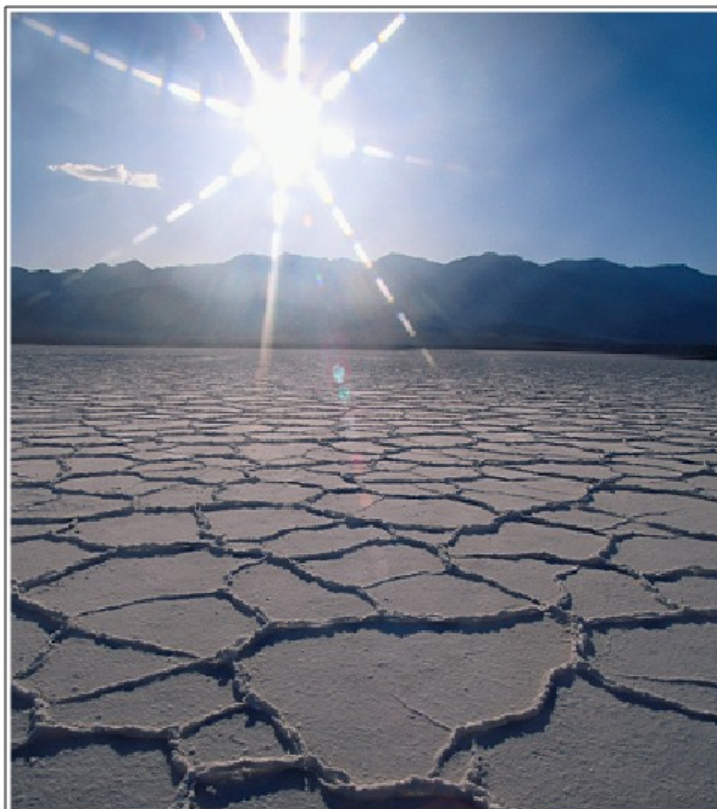
## Wind Chill

Wind, passing over a surface aids in the increased removal of heat. Consequently, temperatures experienced in windy conditions will feel lower than the measured air temperatures. This is of particular concern under very cold conditions where moderate winds can reduce temperatures to dangerous levels.

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## Heat Index

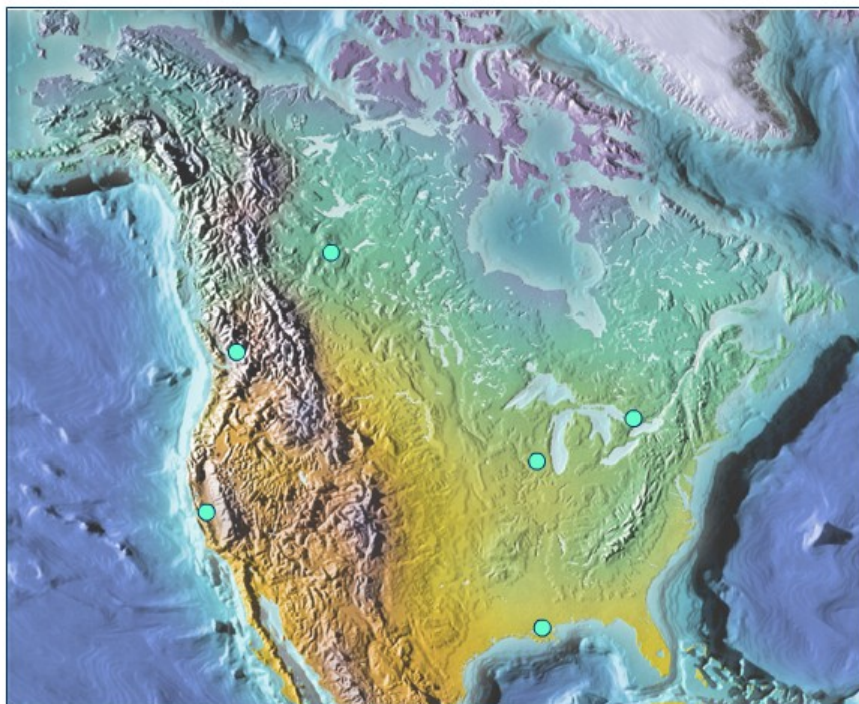
High humidity in combination with high air temperatures can make conditions uncomfortable or even dangerous. Under hot summer weather, an increase in humidity can make even moderate exercise inadvisable.

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## The Weather Stations

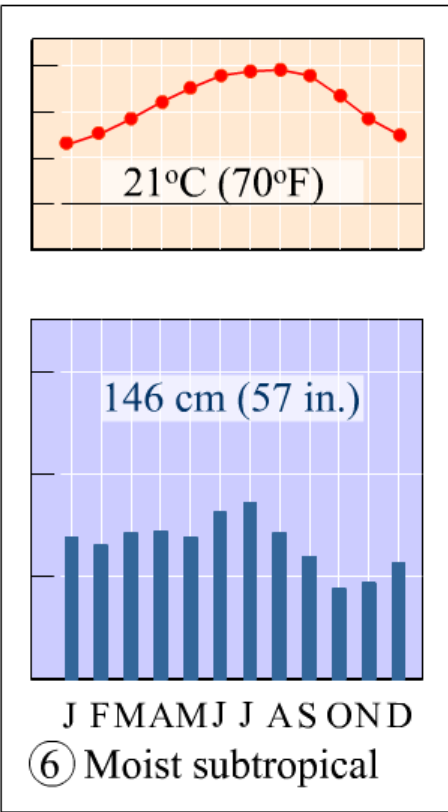


- [New Orleans, Louisiana](#)
- [Madison, Wisconsin](#)
- [Monterey, California](#)
- [Toronto, Ontario](#)
- [Vancouver, British Columbia](#)
- [Fort Vermillion, Alberta](#)

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### New Orleans, Louisiana

New Orleans has a moist subtropical climate. Although seasonal, the winters are usually above freezing. Humidity is generally high due to high amounts of rainfall.

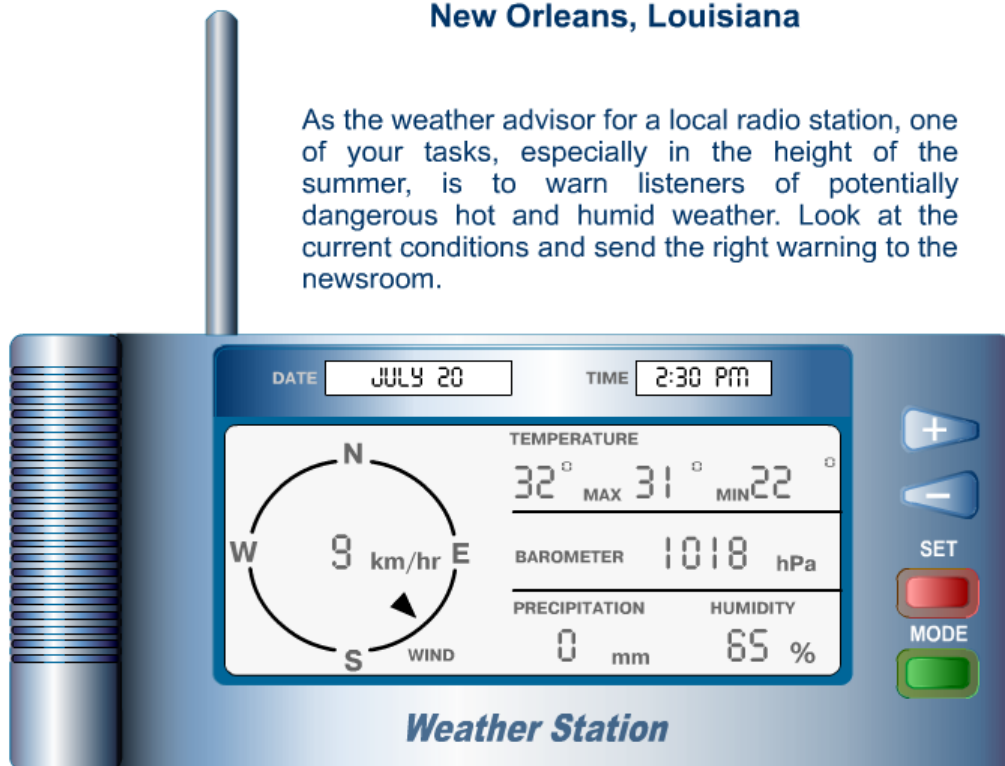
Look at the weather station

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## New Orleans, Louisiana

As the weather advisor for a local radio station, one of your tasks, especially in the height of the summer, is to warn listeners of potentially dangerous hot and humid weather. Look at the current conditions and send the right warning to the newsroom.



Issue Extreme High Risk Heat Index Warning

Issue Severe Heat Index Warning

Issue Moderate Heat Index Warning

Issue Low Risk Heat Index Warning

Do Not Issue Heat Index Warning

Chart for Heat Index

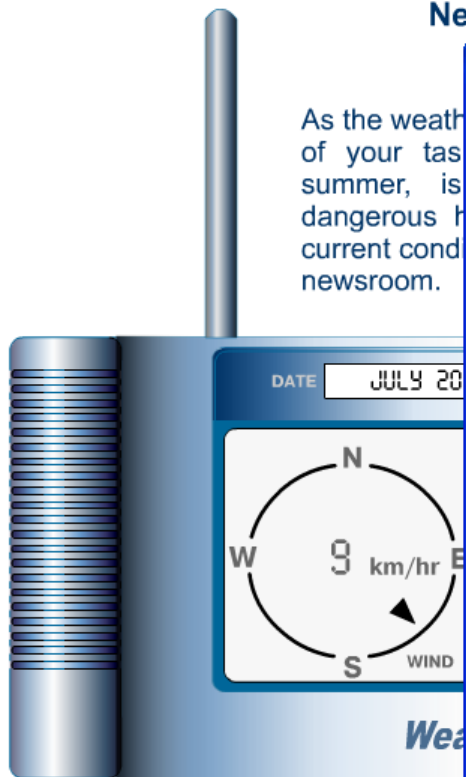
Chart for Heat Disorders

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## New Orleans, Louisiana

As the weather of your task summer, is dangerous current cond newsroom.



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HEAT INDEX °F (°C)													
Temp.	RELATIVE HUMIDITY (%)												
	40	45	50	55	60	65	70	75	80	85	90	95	100
110 (47)	136 (58)												
108 (43)	130 (54)	137 (58)											
106 (41)	124 (51)	130 (54)	137 (58)										
104 (40)	119 (48)	124 (51)	131 (55)	137 (58)									
102 (39)	114 (46)	119 (48)	124 (51)	130 (54)	137 (58)								
100 (38)	109 (43)	114 (46)	118 (48)	124 (51)	129 (54)	136 (58)							
98 (37)	105 (41)	109 (43)	113 (45)	117 (47)	123 (51)	128 (53)	134 (57)						
96 (36)	101 (38)	104 (40)	108 (42)	112 (44)	116 (47)	121 (49)	126 (52)	132 (56)					
94 (34)	97 (36)	100 (38)	103 (39)	106 (41)	110 (43)	114 (46)	119 (48)	124 (51)	129 (54)	135 (57)			

Weather Stations Interactivity. - Microsoft Internet Explorer

Soubor Úpravy Zobrazit Oblíbené Nástroje Nápověda

Zpět Hledat Oblíbené

Adresa [http://www.wiley.com/college/strahler/0471669695/interactivities/flash/atm\\_oceans/atm\\_oceans.htm](http://www.wiley.com/college/strahler/0471669695/interactivities/flash/atm_oceans/atm_oceans.htm) Přejít Odkazy

## New Orleans, Louisiana

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Heat Disorders - Microsoft Internet Explorer

Soubor Úpravy Zobrazit Oblíbené Nástroje Nápověda

Zpět Hledat Oblíbené

Adresa [http://www.wiley.com/college/strahler/0471669695/interactivities/flash/atm\\_oceans/heat\\_disorders.htm](http://www.wiley.com/college/strahler/0471669695/interactivities/flash/atm_oceans/heat_disorders.htm) Přejít Odkazy

Category	Heat Index	Possible heat disorders for people in high risk groups
Extreme Danger	130°F or higher (54°C or higher)	Heat stroke or sunstroke likely.
Danger	105 - 129°F (41 - 54°C)	Sunstroke, muscle cramps, and/or heat exhaustion likely. Heatstroke possible with prolonged exposure and/or physical activity.
Extreme Caution	90 - 105°F (32 - 41°C)	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.
Caution	80 - 90°F (27 - 32°C)	Fatigue possible with prolonged exposure and/or physical activity.

### New Orleans, Louisiana

**Right, this combination of temperature and relative humidity leads to severe risk. Try next. Look at new weather data**

**Weather Station**

DATE: AUGUST 19      TIME: 11:35 AM

TEMPERATURE: 30° MAX 32° MIN 24°

BAROMETER: 1016 hPa

PRECIPITATION: 12 mm      HUMIDITY: 90 %

WIND: 7 km/hr

Buttons: +, -, SET, MODE

- Issue Extreme High Risk Heat Index Warning
- Issue Severe Heat Index Warning
- Issue Moderate Heat Index Warning
- Issue Low Risk Heat Index Warning
- Do Not Issue Heat Index Warning

Chart for Heat Index

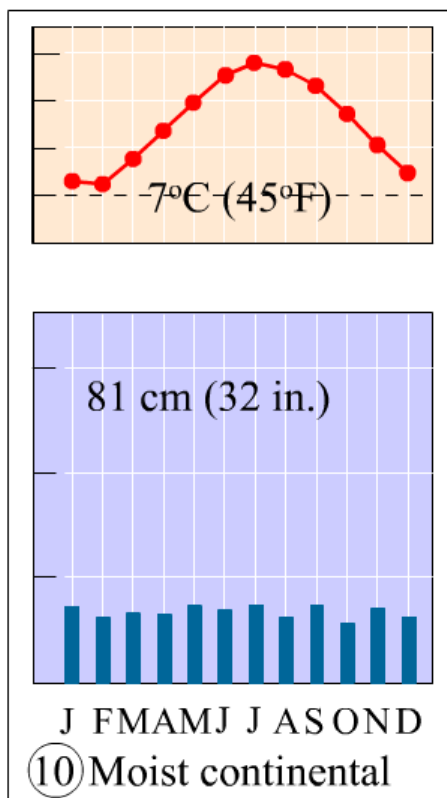
Chart for Heat Disorders

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## Toronto, Ontario

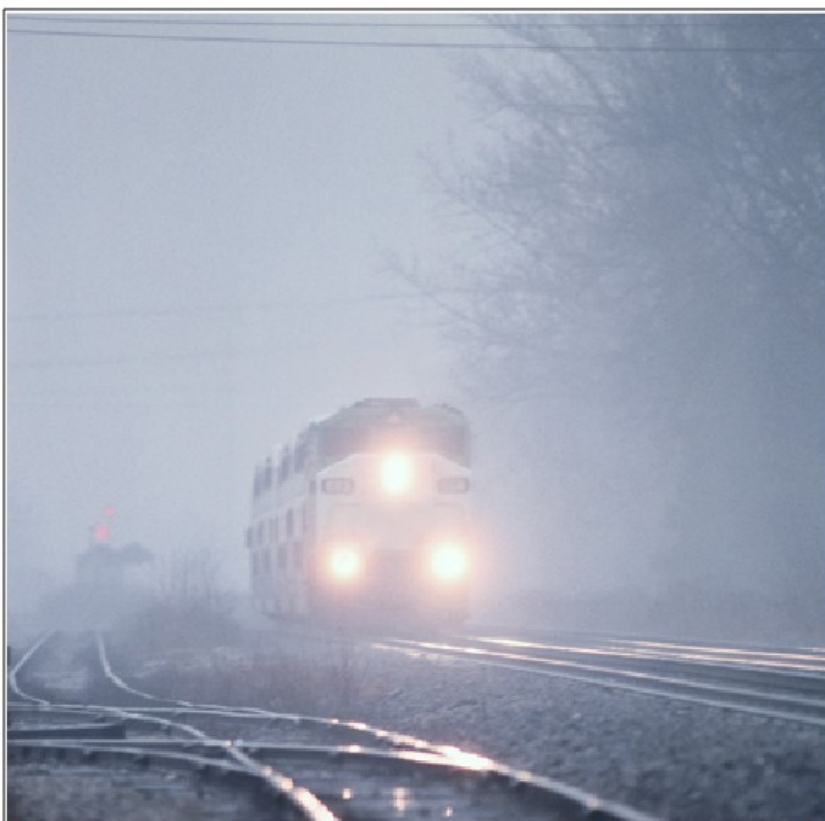
Toronto has a moist continental climate, with warm summers and winters below freezing. Stable conditions in the summer months occur due to the development of an area of high pressure associated with the large belt of high pressure over the mid-Atlantic (Bermuda Azores High). It brings with it marine tropical (mT) air, while in the winter, the area is dominated by continental polar (cP) from the north.



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Look at the weather station



## Fog

Fog is really cloud that is in contact with the ground. When the air next to the Earth's surface is cooled below the dew point by the loss of longwave radiation to space, usually at night, the result is often a radiative fog. Another form of fog is advection fog, whereby the air is cooled to below the dew point by contact with a cooled surface.

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## Frost

Should temperatures fall below 0 degrees C, sensitive plants are damaged by a killing frost (sometimes referred to as an advection frost). Ice may not form on their leaves and stems, but parts of the plant are blackened. Frost which is visible is often referred to as hoar frost. It is apparent as ice crystals and forms when, during an inversion, water is directly deposited as ice onto available surfaces.