Extreme Weather and Mapping

CURRENTS

Hurricanes, tornadoes, gusty winds, storm surges, waterspouts, heavy rain showers, lightning strikes, high temperatures and even dry spells occur in Florida. These forms of extreme weather are part of the never-ending cycle of water that moves through our environment. We are fortunate that advancements in technology have helped meteorologists study and predict these severe weather conditions so that we can better prepare ourselves and our communities for what may naturally occur within our environment.

Table of Contents

	pg
Introduction	1
High-Voltage Bolts	2
A Vortex of Destruction	3
Q&A	3
Hurricanes and Floods	4
Extreme Winds	4
Tracking a Storm	5
Websites to Explore	5

Introduction

As the sun heats the earth, pressure in the atmosphere changes, altering weather patterns and sometimes creating extreme conditions. Almost all weather takes place within the troposphere, the layer of atmosphere extending approximately 5.5 miles from the earth's surface. Florida's subtropical climate and location make it especially attractive for many types of weather disturbances. Extreme weather events have had a direct impact on shaping our state's history.

Hurricanes, tornadoes and thunderstorms are extreme weather events well recognized in Florida. Thunder and lightning are also frequent in our region. Thunder is the sound lightning makes as it suddenly heats the air. You may know that we can determine how far away a storm is by counting the seconds between seeing the flash and hearing the thunder. For every five seconds counted, a storm is one mile away. This counting method may give you enough warning to head for cover in a storm.

Although we can't prevent a hazardous weather event, there are lots of things we can do to prepare and protect our families, pets and homes.

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High-Voltage Bolts
Types of Lightning

Lightning is one of the deadliest forces in nature and it strikes the earth's surface on a frequent basis. In fact, every second about 100 lightning bolts strike different places around the world.

What is lightning? In simple terms, lightning is an electrical discharge that occurs between particles within storm clouds. The friction caused by the rapidly moving particles creates strong charges of electricity, both positive and negative, which are attracted to each other. The electrically charged sparks can exert enough power to kill people, livestock and wildlife, destroy buildings and ignite huge fires in forested areas. Throughout the United States, approximately 100 people are killed by lightning strikes every year and many others are seriously injured. The majority of these people struck by lightning are outdoors in open fields or on golf courses. About 24 percent are killed or injured while standing under trees that get zapped by lightning.

Florida experiences a lot of lightning. In fact, 1 out of every 10 lightning casualties occurs in Florida. Each year most of the state receives between 20 to 40 lightning flashes per square mile. An area that really gets a lot of lightning is Pasco County, which is located north of Tampa. It receives more than 40 lightning strikes per square mile annually.

Intra-Cloud Lightning

Flashes formed inside a storm cloud are the most common type of lightning. Oppositely charged centers within the same cloud create a flash that becomes diffused on the outside. Flickering lights spew from the cloud. Intra-cloud lightning occurs 10 times more often than cloud-to-ground lightning described below.

Cloud-to-Ground Lightning

The most damaging form of lightning is cloud-to-ground lightning. It is also the lightning that scientists understand the most. Flashes typically begin at a negative charge center and send a negative charge to the earth's surface. However, sometimes the flashes can carry positive charges, especially during the winter season. The average length of the lightning channel can range from 2 to 10 miles.

Cloud-to-Cloud Lightning

Electrically charged sparks can occur between different clouds. Lightning is formed when oppositely charged areas from two different clouds are attracted to each other. The discharge of electricity connects the gap of clear air that lies between them.

Cloud-to-Air Lightning

Positively charged regions of clouds are attracted to negative charges in the air to create cloud-to-air lightning. This type of lightning is not as powerful as the cloud-to-ground lightning, but it is visible from great distances.

Ball Lightning

Ball lightning, which has puzzled meteorologists for years, has never been scientifically recorded or simulated in laboratories. Lightning balls may be as small as one inch to as large as six feet or more in diameter. They are often seen in shades of white, yellow or orange and typically last just a few seconds.

A bolt of lightning can give off up to 30 million volts of electricity!

What Do You Think?

Which type of lightning could be paired with these various terms used to describe lightning?

- heat lightning
- red sprites
- elves
- sheet lightning
- ribbon lightning
- tubular lightning
- silent lightning
- stratospheric lightning

Try searching the Internet for additional information about these extreme forces in nature!

A Vortex of Destruction

The vertical spinning funnel that extends below a thundercloud can become a real killer. Tornadoes, which are also known as *twisters*, occur throughout Florida. They can strike during the day or at night with a violently spinning vortex that may be as narrow as a rope or as big as a shopping mall. Tornadoes are classified according to the destruction they leave in their paths. The Fujita Tornado Intensity Scale, or F-scale, is used to describe the various levels of destructive power produced by these violent twisters. The most common types of tornadoes rank F0–F2 on the scale. No tornado has ever been reported on an F6 level.

Twister Quiz

Circle *True* or *False* for each statement below.

True False 1. Tornadoes with an F3 rating are the most common.

True False 2. A tornado with wind speeds of 100 kilometers per hour will produce light damage.

True False 3. The length of an F2 tornado ranges from 4.8–16 miles.

True False 4. A tornado with wind speeds greater than 200 miles per hour is at level F3 or higher.

True False 5. The highest level reported for a tornado is an F5.

Categories of Tornadoes

F Rating	Winds Per Hour	Length of Path	Amount of Damage
0	40–72 miles 64–116 kilometers	under 1 mile under 1.6 kilometers	light
1	73–112 miles 117–180 kilometers	1–3 miles 1.6–4.8 kilometers	moderate
2	113–157 miles 181–253 kilometers	3–10 miles 4.8–16 kilometers	considerable
3	158–206 miles 254–331 kilometers	10–31 miles 16–50 kilometers	severe
4	207–260 miles 332–418 kilometers	31–99 miles 50–159 kilometers	devastating
5	261–318 miles 419–512 kilometers	99–315 miles 159–507 kilometers	incredible
6	319–380 miles 513–611 kilometers	315–999 miles 507–1,607 kilometers	inconceivable

Q&A

Question:

I already know that droughts are a form of extreme weather. But, since we seem to have a lot of annual rainfall in our region and many water resources, do we ever experience droughts?

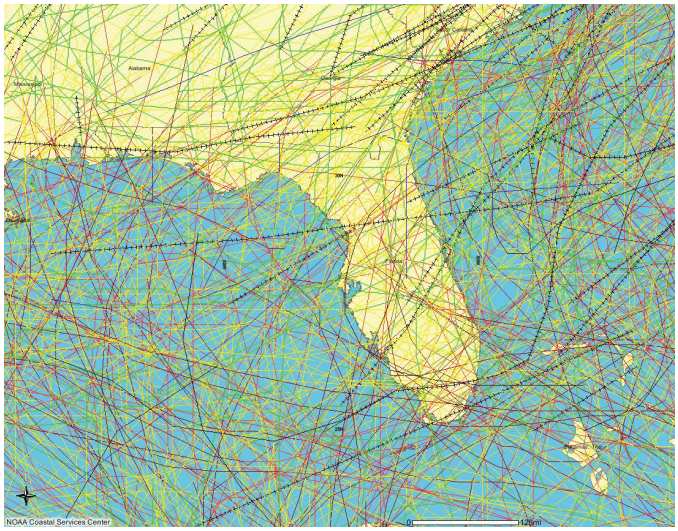
Answer:

Absolutely! In fact, within the last 10 years, Florida experienced severe drought conditions that lasted for a few years. Keep in mind that a drought occurs when a region receives 30 percent or less of its normal rainfall. Our state typically receives about 53 inches of rainfall annually, which is a lot of rain. We depend on heavy rainfalls to replenish our surface water resources and our underground aquifers. Although droughts are a natural aspect of Florida's weather patterns, extended or severe drought conditions can have a devastating effect on the environment and all living things that dwell within the region.

Hurricane Basics

Florida is almost completely surrounded by warm water, which makes it especially vulnerable to hurricanes. In fact, more hurricanes have hit Florida than any other state. In 2004, hurricanes Charley, Frances, Ivan and Jeanne produced widespread wind and flooding damage estimated at more than $20 billion. Florida has had a long and harsh hurricane history. Over the centuries, thousands of its residents have perished from the deadly effects of hurricane winds and flooding.

A hurricane is a low-pressure system that forms in the tropics. It begins with a storm developing over warm surface waters. As warm air rises within the center of a storm, it creates an updraft. The surrounding air is attracted to the storm's center, where it rises and causes the pressure to drop. The updraft continues to spin and strengthen as more air is drawn in from larger and larger areas surrounding the storm system. As the column of air turns faster and faster, it becomes a tropical revolving storm and can potentially develop into a hurricane with various levels of intensity (see chart below). When a powerful hurricane approaches coastal areas, violent winds and heavy rains pound everything in its path. Also, a dome of water known as a storm surge may cause extensive flooding inland. The hurricane eventually loses its energy as it passes over land.



Hurricane Tracks 1886 – 2008

Categories of Hurricanes Using the Saffir-Simpson Scale

Category	Wind Speed	Height of Tide Above Normal	Damaging Effects
1	74–95 mph (119–153 km/h)	4–5 ft (1.2–1.5 m)	shrubs, mobile homes, docks, small boats damaged
2	96–110 mph (154–177 km/h)	6–8 ft (1.8–2.4 m)	small trees uprooted; roofs and mobile homes damaged; coastal roads flooded
3	111–130 mph (178–209 km/h)	9–12 ft (2.7–3.7 m)	large trees uprooted; mobile homes destroyed; roofs and parts of homes damaged; coastal areas flooded
4	131–155 mph (210–249 km/h)	13–18 ft (4.0–5.5 m)	roofs, windows and parts of homes seriously damaged; beach erosion; inland flooding
5	More than 155 mph (More than 249 km/h)	More than 18 ft (More than 5.5 m)	some buildings destroyed, many homes damaged; massive evacuations

Write About It

Select one of the hurricane categories from the chart. Explain how a hurricane is created and describe its damaging effects on an area.

Extreme Winds

The destructive power of winds increases dramatically with any increase in wind speed. The power of wind force is equal to the square of the wind speed. If a wind speed doubles, then its destructive power will increase by four times. For example, a 20-mph wind carries four times more force than a 10-mph wind. Now use your math skills to solve the problems below.

1. A 60-mph wind carries _____ times more force than a 20-mph wind.
2. A 90-mph wind carries 36 times more force than a _____ -mph wind.
3. A 50-mph wind carries _____ times more force than a 25-mph wind.
4. A 120-mph wind carries _____ times more force than a 12-mph wind.
5. A 40-mph wind carries 16 times more force than a _____ -mph wind.

For an extra challenge, create a problem of your own.

Longitudes and Latitudes

Background

Maps are often used to provide tracking information about tropical storms and hurricanes. The Atlantic hurricane season (June 1 through November 30) typically experiences 10 tropical storms and 6 hurricanes. In this activity, you will use clues to determine the path of a tropical storm that develops into a hurricane. If you don't have the opportunity to create your own map, then use the one here and begin with step 3 of the activity.

Learning Goals

- To gain a better understanding of tropical storms and hurricanes
- To develop strategies of measurement for solving real-world problems

Subjects

- Science
- Mathematics

Materials

- graph paper
- highlighter
- pencil
- map

Activity

1. Use graph paper to construct a map similar to the one shown here.
2. Label all parts of the map including latitudes, longitudes and a compass to indicate north, south, east and west.
3. Read the following clues that describe the current location of the storm. Locate each position on your map and label it with the correct letter.
4. Connect the dots by shading with a highlighter to show the path of the storm. Then compare your map with others to find out if your hurricane landed in the same place.

Storm Path Clues

a. A tropical storm forms north of Puerto Rico at 20°N and 67°W.

b. The storm moves directly west 5 degrees.

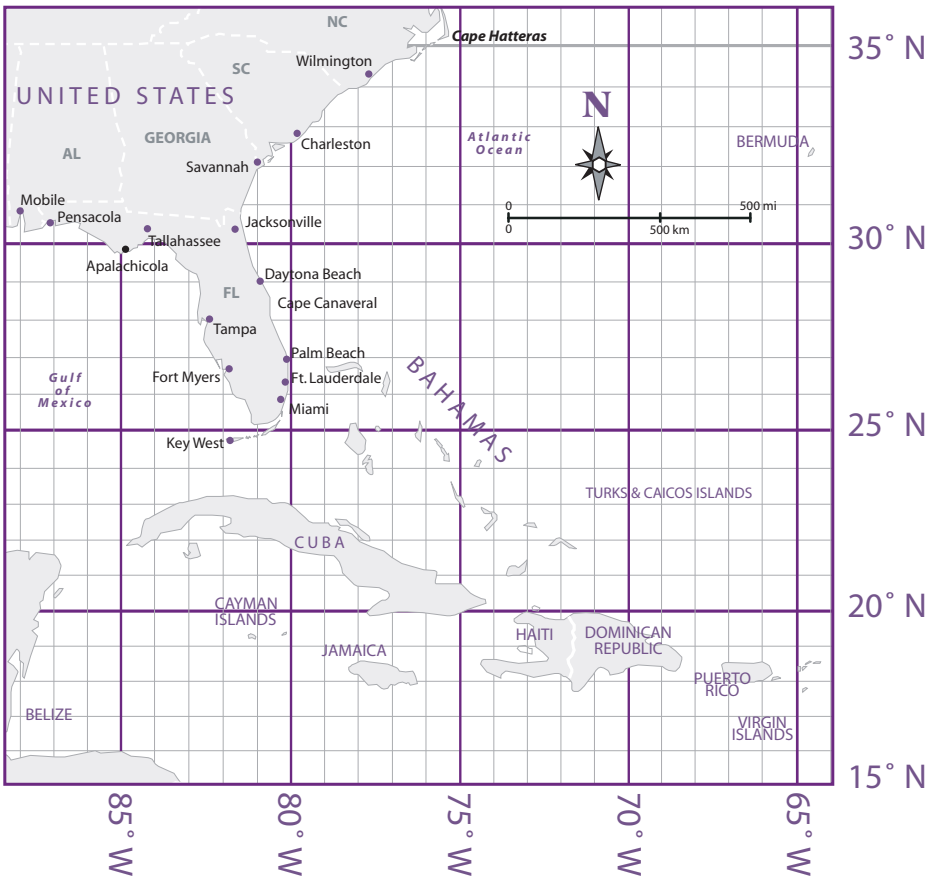
c. The storm increases speed and moves 7 degrees west and 2 degrees north.

d. The 100 mph winds cause the storm to become a Category 2 hurricane as it moves north to 79°W and 25°N.

e. The hurricane's 120 mph winds increase its status to a Category 3 as it threatens the coastal area near 26°N and 80°W.

f. Instead of moving inland, however, the hurricane weakens, turns and moves in a northeast direction away from the coast, passing over 75°W and 29°N.

g. After weakening to a tropical depression, it gets absorbed by a cold front at 70°W and 34°N.



Websites to Explore

An abundance of information is available on topics related to extreme weather and mapping. Your local library most likely has several books waiting to be checked out, or use the Internet. Use the space below to jot down some key words contained in this issue that you may want to use in your search.

Terms for Searching

_____ _____ _____ _____ _____

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