Teek and Tom Episode 3

Weather and Climate EXTREMES!

LESSON 5

There's Something in the Air

All URLs were reviewed and accurate at the time of this lesson's publication. If you should come across a non-operational link, contact NOAA Ocean Service Education at oceanserviceseducation@noaa.gov. All images are credited to NOAA unless otherwise noted.

Introduction

The atmosphere, ocean, and land interact with each other in a nonstop cycle, creating daily weather and long-term climate patterns. Storms in the middle of the United States could have started thousands of miles away and with water that was once in the ocean. For example, if cold air from Canada collides with the warm, moist air from the Gulf of Mexico over the central plains of the United States, thunderstorms or snowstorms can result.

Thunderstorms form when warm, moist air meets colder, drier air. As the warm air rises, the water vapor in the air condenses and forms a cloud. As the water vapor condenses, it releases heat, which is a form of energy. Much of a thunderstorm's energy comes from the condensation process that forms the thunderstorm clouds. As the thunderstorm develops, rain falls, cooling things off, and the thunderstorm's energy goes down. Most thunderstorms produce hail, but not all thunderstorms produce hail that ends up on the ground. Temperatures at the upper levels of a thunderstorm are well below freezing, allowing for the creation of hail, but sometimes the hail melts before reaching the ground. Thunderstorms can produce some of nature's most destructive and deadly weather, including tornadoes, hail, strong winds, lightning, and flooding.

Blizzards are dangerous snow storms that occur when a combination of blowing or falling snow and wind results in very low visibility. Heavy snowfall and severe cold often accompany blizzards, but not always. Sometimes, strong winds pick up snow that has already fallen, creating a ground blizzard. NOAA's National Weather Service (NWS) defines a blizzard as a storm that contains large amounts of snow or blowing snow, with winds over 35 mph and visibilities of less than 1/4 mile for an extended period of at least 3 hours.

Lake effect snow is common across the Great Lakes region during the late fall and winter. It occurs when cold air, often originating from Canada, moves across the open waters of the Great Lakes. As the cold air passes over the unfrozen and relatively warm waters of the Great Lakes, warmth and moisture are transferred into the lowest portion of the atmosphere. The air rises, and clouds form, growing into narrow bands that can produce 2 to 3 inches of snow per hour, or more.

A rain shadow effect, common near mountainous regions, is caused when precipitation drops significantly on one side of a mountain. Rainfall and moist air are common on the side of a mountain range facing prevailing winds. Once the rain falls, the air flowing down the mountain's other side is dry. An image of this can be found in the student record sheets.

Atmospheric rivers are long, narrow regions in the atmosphere — like rivers in the sky. They carry most of the water vapor from the tropics. Atmospheric rivers come in all shapes and sizes and are responsible for extreme rainfall and flooding events. The rivers are moved by high-altitude winds that blow from west to east, called the jet stream. These strong winds in the upper levels of the atmosphere are the strongest during winter in both the Northern and Southern hemispheres.

Lesson Summary

Students will investigate four different weather events that are powered by the atmosphere and moisture from the ocean through "recipes" for thunderstorms, snow storms, lake effect snow, and rain shadows. Then, students will be introduced to atmospheric rivers that carry most of the water vapor from the tropics to northern latitudes.

Objectives

- Students will be able to identify how the prevailing winds and air mass movements over the atmosphere, ocean, and land can affect weather and climate far from the ocean.
- Students will be able to explain the impacts of atmospheric rivers in the western United States.

Estimated Time

It is estimated that one to two 45-minute class periods are needed for each lesson. This does not include the time required to view Teek and Tom Episode 3: *"Weather and Climate EXTREMES!"*, 9:53 minutes (https://oceantoday.noaa.gov/teekandtom/episode-3.html).

Education Standards

The lessons that accompany the Teek and Tom series were designed for upper elementary and middle school students. The standards addressed are abbreviated here. A full list of standards is available in Appendix A (https://oceantoday.noaa.gov/teekandtom/educators-guide/appendix-a.pdf).

Next Generation Science Standards

- **MS-ESS2-5: Earth's Systems.** Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.
- ESS2.D: Weather and Climate. Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns.

Common Core English and Language Arts: Writing Standards Grades 4-5

Common Core Mathematics: Measurement and Data - Represent and interpret data.

College, Career, and Civic Life (C3) Framework for Social Studies: Geographic Representations

Materials

For a class of 30

- Red and blue colored pencils or markers for all students
- Students will need printouts of student record sheets, graphs, and/or maps to carry out the activities. Student record sheets are located at the end of this lesson.
- If you would like to provide the maps/graphics on a projection system, students will only need the student record sheets. Depending on the configuration of your classroom, we recommend one set per student or group.
- All maps/graphics presented in the activity are available as a slide set to project or present while teaching these activities. (https://oceantoday.noaa.gov/teekandtom/educators-guide/slide-set-5.zip)

Preparation

No special preparation is needed for this lesson.

InvesTeekation Pathway

ENGAGE

Part 1. Engage

The KWL (Know, Want to Know, Learned) chart is a good way to gauge student ideas before the start of a lesson. Ask students to complete the "What I Know" and "What I Want to Know" sections of the chart before the lesson and save the last one, "What I Learned," for the final part of the lesson. Consider having students complete the columns by themselves first, then in small groups, and finally as a class.

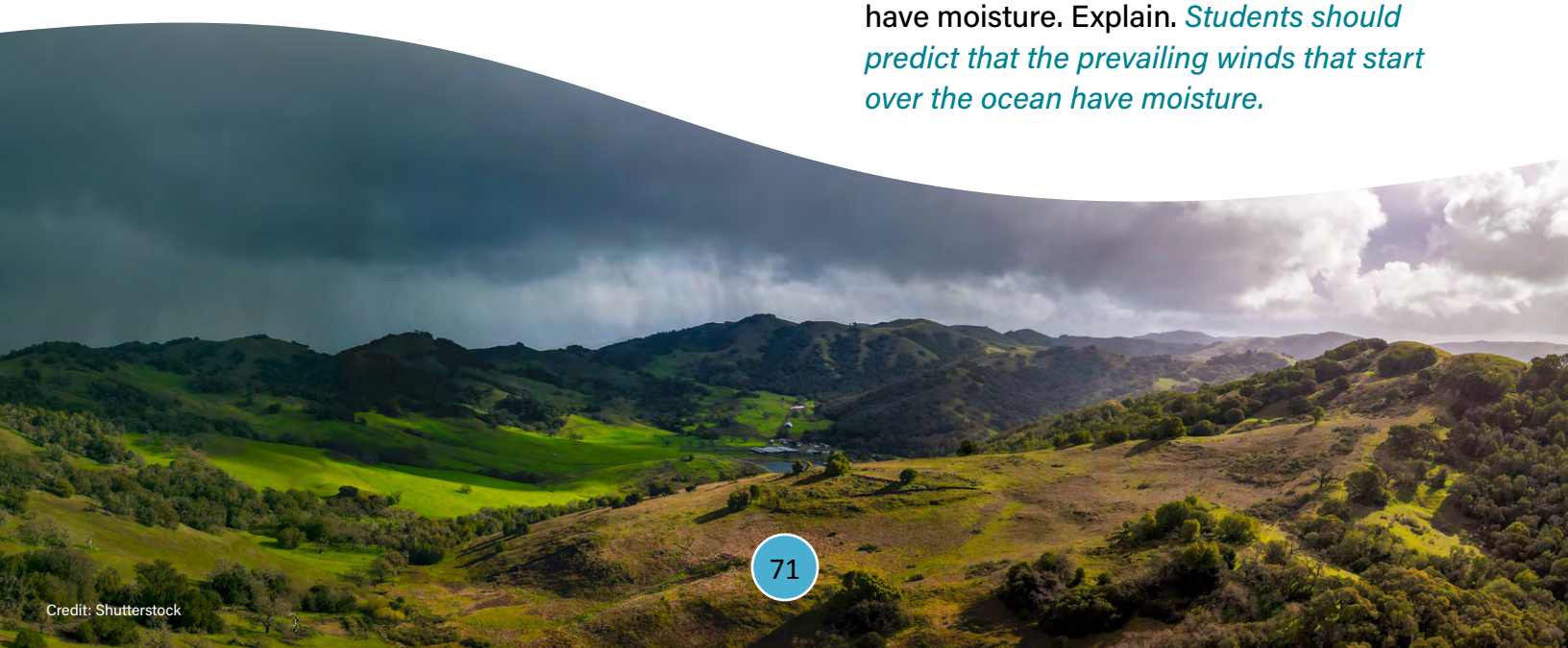
EXPLORE

Part 2. Explore

Remind students of what they learned in lesson 3 - on sea and land breezes, and in lesson 2 - that air over the ocean picks up moisture and transports it.

Discussion questions

1. Based on what you learned from the previous lessons, and from Teek & Tom episode two, predict whether the prevailing winds that start over the ocean are dry or have moisture. Explain. *Students should predict that the prevailing winds that start over the ocean have moisture.*



Credit: Shutterstock

2. Draw the symbol that represents the front edge of the cold, dry air. Draw the symbol that represents the front edge of the warm, moist air. How are they different? *The simple graphic of cold, dry air (the blue line represents a cold front) meeting warm, moist air (the red line represents a warm front) shows several common weather symbols typically seen on weather forecasting maps. Each type of front is represented by a different shape.*

cold front warm front

3. Based on the image, what kinds of weather can happen when cold air meets warm, moist air in the spring or summer? *Thunderstorms and tornadoes can occur in the summer and spring. Students will investigate tornadoes more in the next lesson.*

4. Now imagine that the same interactions from the image above happen in the winter. What kind of weather do you think will happen then? *In the winter, we might expect snowstorms where the air masses meet.*

Part 3. Explain

Students will investigate the conditions (recipes) that cause four different types of weather events to occur. Consider having the students work in pairs or small groups and then discuss the images and questions as a class.

Discussion questions

1. Calculate how far away a storm would be if you saw lightning and heard thunder 15 seconds later. *Sound travels about 1 mile in five seconds, so if you hear thunder 15 seconds after seeing lightning, the storm would be 3 miles (4.8 kilometers) away.*

2. If you are outside and you see a thunderstorm approaching, what actions should you take to protect yourself from lightning? *Ideas might include crouching low to the ground, staying away from metal buildings and trees, and getting off a hill to a lower area.* Appendix C: NOAA NWS Lightning Safety Brochure (https://oceantoday.noaa.gov/teekandtom/educators-guide/appendix-c.pdf).

3. What are the differences between a snowstorm and a blizzard? *A blizzard lasts at least three hours. It has subfreezing temperatures and strong winds of over 35 mph. It may be snowing or blowing around snow that reduces visibility to less than 0.25 miles.*

4. Have students measure how high 70 inches of snow would reach in a doorway to your classroom to visualize how much snow fell during a lake effect storm event in 2022 near Lake Erie in Ohio.

5. Based on what you know about the prevailing winds in the United States, why are the belts of lake effect snow not found all around each lake? *Prevailing winds in the United States usually move from west to east, so the snow would be concentrated on the east side of each lake.*

6. The Buffalo, New York area had a lake effect snow event in November, 2022. Based on the colors from the map, what was the highest amount of snow received in that area? *72-84 inches of snow.*

7. Estimate how much snow the town of Rochester received. *1 to 2 inches*

8. Using the other weather recipes as examples, students should create a recipe for a rain shadow. *Ideas may include warm, moist air rising from the ocean, prevailing*

winds carrying it to land, the moist air rising as it encounters mountains, causing rain or snow to fall on the mountains, and dry air flowing over the other side.

9. *Mojave Desert, California, with 3.5 inches per year, is in a rain shadow.*

10. *Los Angeles, California, with 14 inches of rain per year, is not in a rain shadow.*

11. *Hilo, Hawaii, with 120 inches of rain per year, is not in a rain shadow. Point out that the tradewinds in Hawaii come from the east.*

12. *Captain Cook, Hawaii, with 31 inches of rain per year is in a rain shadow.*

Part 4. Elaborate

Atmospheric rivers are long, narrow regions in the atmosphere that transport large amounts of moisture, like rivers in the sky. They carry most of the water vapor from the tropics to the northern latitudes. Atmospheric rivers are moved by high-altitude winds that blow from west to east, called the jet stream. Consider having the students work in pairs or small groups and then discuss the images and questions as a class.

Discussion questions

1. Ask the students to look at the graphic of an atmospheric river and write a story about how moist air moves from the tropics to drop as rain in California. We would expect that it would contain these basic ideas:

   - *Warm temperatures in the tropics cause ocean water to evaporate and rise into the atmosphere.*
   - *Winds help carry the water vapor through the atmosphere.*
   - *As atmospheric rivers move over land, the water vapor rises over mountains higher into the atmosphere.*
   - *It then cools into water droplets, which fall as rain or snow in California, depending on the temperatures.*

An animation of the images that are used for this activity can be found at NASA's Scientific Visualization Studio (https://svs.gsfc.nasa.gov/vis/a000000/a004300/a004334/tm_atmosphericRiver_waterVapor_Imerg_4xSlow_0.mp4).

2. How many inches of rain is 50 mm/hr? *50mm/25.4mm per inch = 1.96 inches per hour*

3. How much rain would fall if it were to rain for 5 hours in one place? *1.96 x 5 = 9.84 inches*

4. Compare Map A to the map above, which has western states marked. If you were a weather forecaster looking at Map A, which states would you expect to see rain in the future? *It appears that Washington and Oregon are in the path of the atmospheric river.*

5. Look at Map B. The water vapor map has changed in just 17 hours. Which states are getting the rain now? *It appears that Washington, Oregon, and northern California are affected.*

6. Map C shows the water vapor and precipitation levels at midday on December 11. What was the highest rate of precipitation that fell over northern California on that day? *50 mm per hour*

7. Map D shows the water vapor and precipitation pattern early in the morning of December 12. What changes do you see in the water vapor and precipitation patterns, as well as the states being affected - compared to the day before? *The highest amount of water vapor in the air has moved to include most of California.*

8. Are there areas in your neighborhood or city that flood? *Students may be able to identify roads or low-lying areas where water collects during heavy rains. They may also identify rivers or streams that frequently flood in spring or during heavy rains.*

9. What actions should you take to protect yourself and others when a flood warning is issued? *Student responses may include things like moving to higher ground, staying away from flooded areas, and not driving through roads covered with water.*

   This NOAA NWS website (https://www.weather.gov/safety/flood) is designed to teach about staying safe in a flood event. A NOAA NWS Flood Safety Brochure is available in Appendix D (https://oceantoday.noaa.gov/teekandtom/educators-guide/appendix-d.pdf).

EVALUATE

Part 5. Evaluate

We have looked at weather events like thunderstorms, snow storms, lake effect snow, and rain shadows. Some of these events may be common in your area. However, students may not have previously known the causes of these events. Help them understand that moisture from the ocean can travel long distances and affect the weather even in the center of the country. Once they have completed the final column of the KWL chart, discuss what they have learned. Ask the students to list their questions and what they might be curious about.

Discussion questions

1. Depending on where you live in the United States, have you experienced any of these weather events?

2. Now complete the last column, "What I Learned," from the chart at the beginning of the lesson.

3. What new questions do you have about the ocean, weather and climate connections, and the weather events we have discussed?

Credit: Shutterstock

Credit: Getty Images

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Extensions

The University Center for Atmospheric Research's Center for Science Education (https://scied.ucar.edu/globe-weather-curriculum) has developed a free five-week curriculum unit to help middle school students understand weather at local, regional, and global scales.

These Ocean Today Videos will be helpful for student understanding during discussions about their ideas.

- When Lightning Strikes (https://oceantoday.noaa.gov/lightning/)
- El Niño and La Niña Explained (https://oceantoday.noaa.gov/elninolanina/)

Student Record Sheets

PART 1.

Complete the columns below "What I Know" and "What I Want to Know." We will complete the last column, "What I Learned," at the end of the lesson.

What do you know about the weather that you experience where you live?

What I Know	What I Want to Know	What I Learned

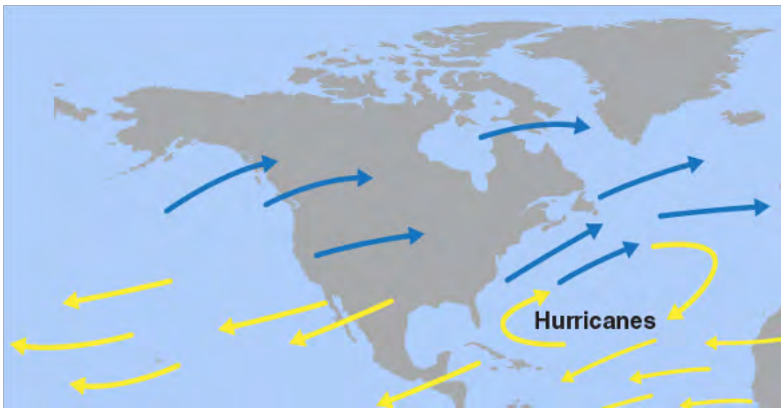
PART 2.

Prevailing Winds

Winds that move from west to east are called the westerlies. In the United States, it is common for weather patterns to follow winds from west to east.

1. Based on what you have learned from previous lessons, predict whether the prevailing winds that start over the ocean are dry or have moisture. Explain.

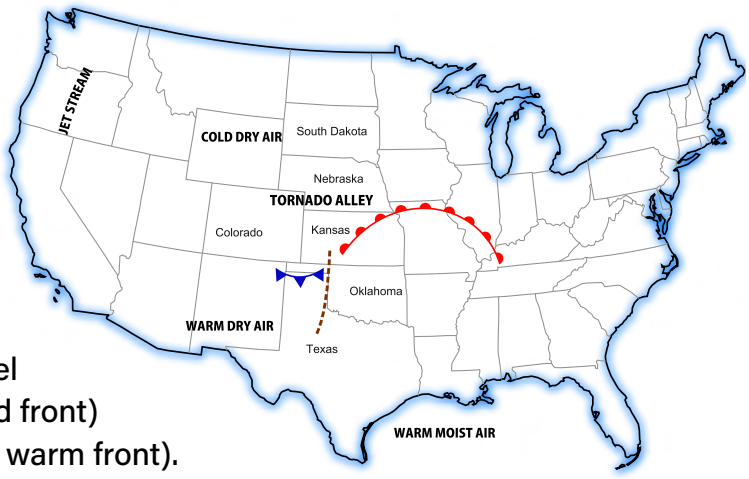
Prevailing winds and weather of North America



Credit: NASA

Meet Me in the Middle

In previous lessons, we saw that the ocean contains about 97% of Earth's water. It is also Earth's largest reservoir for moisture. We saw that water is very effective at absorbing and storing heat. These two factors play a big role in how the ocean impacts our weather. The middle of the United States is often a meeting place for weather-producing systems. This is a simple model of cold, dry air (the dark blue line represents a cold front) meeting warm, moist air (the red line represents a warm front). Southerly winds coming up from the Gulf of Mexico provide most of the moisture for precipitation in the Midwest. This image represents interactions of air masses in spring or summer.



By Dan Craggs - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=7843081

2. Draw the symbol that represents the front edge of the cold, dry air. Draw the symbol that represents the front edge of the warm, moist air. How are they different?

3. Based on the image, what kinds of weather can happen when these cold fronts meet warm, moist air from a warm front in the spring or summer?

4. Now imagine that the same interactions from the image above happen in the winter. What kind of weather do you think will happen then?

PART 3.

Let's look at how ocean and air movements can cause four types of weather events. We will call them "weather makers." Each weather event has a "recipe" — a set of conditions that help these weather events occur.


Credit: Getty Images

Recipe for a Thunderstorm

- Moisture
- Rising, unstable air
- Lifting force (as the sun heats the surface, air is forced to rise)

Thunderstorm

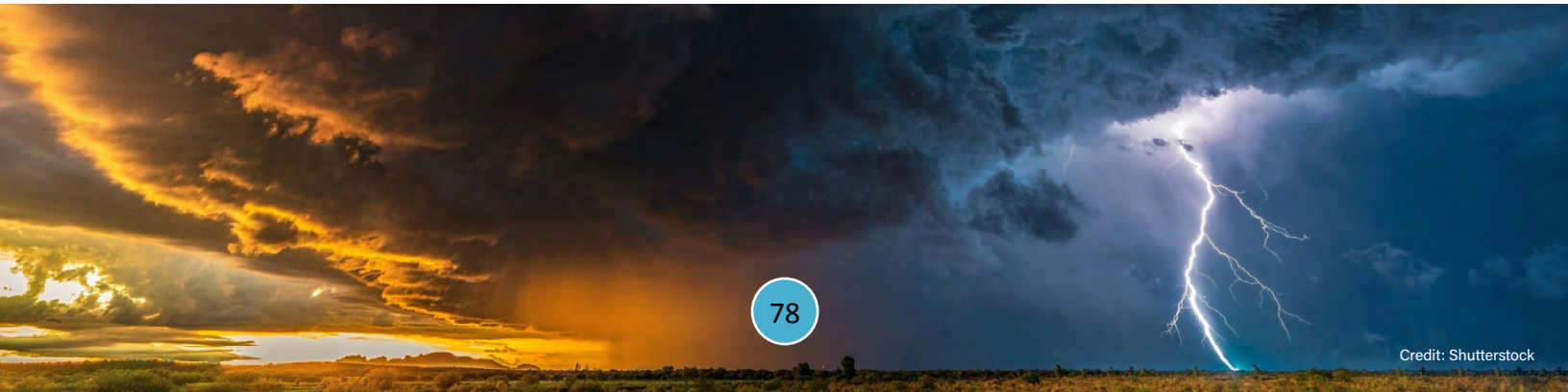
We have seen how winds coming up from the Gulf of Mexico provide moisture for precipitation in the Midwest. In addition, when the sun heats the Earth's surface, the air above it warms. If this warm surface air is forced to rise due to hills or mountains, it will continue to rise as long as it weighs less and stays warmer than the air around it.

As the air rises, the water vapor begins to cool and forms a cloud. The cloud eventually grows upward into areas where the temperature is below freezing. Thunder and lightning usually accompany a thunderstorm. You will see the lightning before you hear the thunder because light moves faster than sound.


Credit: Getty Images

As soon as you see lightning, count the seconds until you hear the thunder. You can count the seconds by saying out loud "1,000, 1,001, 1,002" and so on. Every 5-second gap between the lightning and thunder means that the lighting is about a mile away. Sound travels about 1,000 feet per second (681 miles per hour).

1. Calculate how far away a storm would be if you saw lightning and heard thunder 15 seconds later.



Credit: Shutterstock

Lightning Safety

No place outside is safe when a thunderstorm is in the area. Get inside as soon as you hear thunder. Run to a substantial building or hard-topped metal vehicle as fast as you can. If you can't get to a safe building or vehicle:

- **Avoid open areas.** Don't be the tallest object in the area.
- **Stay away from isolated tall trees, towers or utility poles.** Lightning tends to strike the taller objects in an area.
- **Stay away from metal conductors such as wires or fences.** Metal does not attract lightning, but lightning can travel long distances through it.
- **If you are with a group of people, spread out.** While this actually increases the chance that someone might get struck, it tends to prevent multiple casualties, and increases the chances that someone could help if a person is struck.

What You Might Not Know About Lightning

- **All thunderstorms produce lightning and are dangerous.** Fortunately, people can be safe if they follow some simple guidelines when thunderstorms are forecast.
- **Lightning often strikes outside the area of heavy rain and may strike as far as 10 miles from any rainfall.** Many lightning deaths occur ahead of storms before any rain arrives or after storms have seemingly passed and the rain has ended.
- **If you can hear thunder, you are in danger.** Don't be fooled by blue skies. If you hear thunder, lightning is close enough to pose an immediate threat.
- **Lightning leaves many victims with permanent disabilities.** While only about 10% of lightning victims die, many survivors must live the rest of their lives with intense pain, neurological disabilities, depression, and other health problems.

If you see lightning and hear thunder at the same time, the storm is right above you. Each year, lightning kills 20-30 people in the United States. It injures hundreds more. Tornadoes, hail, and wind gusts get the most attention, but only lightning can strike outside of the storm itself. It is the first thunderstorm hazard to arrive and the last to leave.

2. If you are outside and you see a thunderstorm approaching, what actions should you take to protect yourself from lightning?

Snowstorms and Blizzards

Credit: Getty Images/iStockphoto

Recipe for a Snowstorm

- Moisture
- Cold air in the clouds and on the ground
- Lifting force (something to raise the moist air such as warm air colliding with cold air)

The winter storms that bring precipitation to the western U.S. originate over the North Pacific. As warm, moist air rises, clouds form and cause precipitation. Snow forms when the atmospheric temperature is at or below freezing. The snow will reach the ground if the ground temperature is at or below freezing.

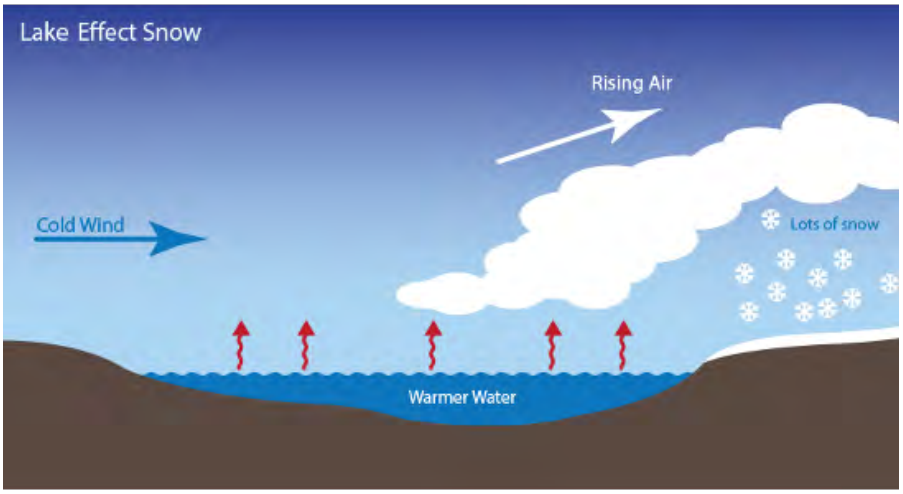
The Blizzard – A special type of snowstorm

A blizzard is a violent winter storm, lasting at least three hours. It has subfreezing temperatures and strong winds over 35 mph (56 kilometers per hour). It may be snowing or blowing around snow that reduces visibility to less than 0.25 miles (0.4 kilometers). Blizzards can create life-threatening conditions. Traveling by automobile can become difficult or even impossible due to "whiteout" conditions and drifting snow.

The strong winds and cold temperatures accompanying blizzards can combine to create another danger. The wind chill is the amount of cooling one "feels" due to the combination of wind and temperature. During blizzards, with the combination of cold temperatures and strong winds, very low wind chill values can occur. It is not uncommon in the Midwest to have wind chills below -60 °F during blizzard conditions.

3. What are the differences between a snowstorm and a blizzard?

Lake Effect Snow



Recipe for Lake Effect Snow

- Cold air passes over a warmer lake
- Air warms up as it passes over the lake and picks up moisture from it
- Air cools down when it passes over land again, and releases its moisture as snow

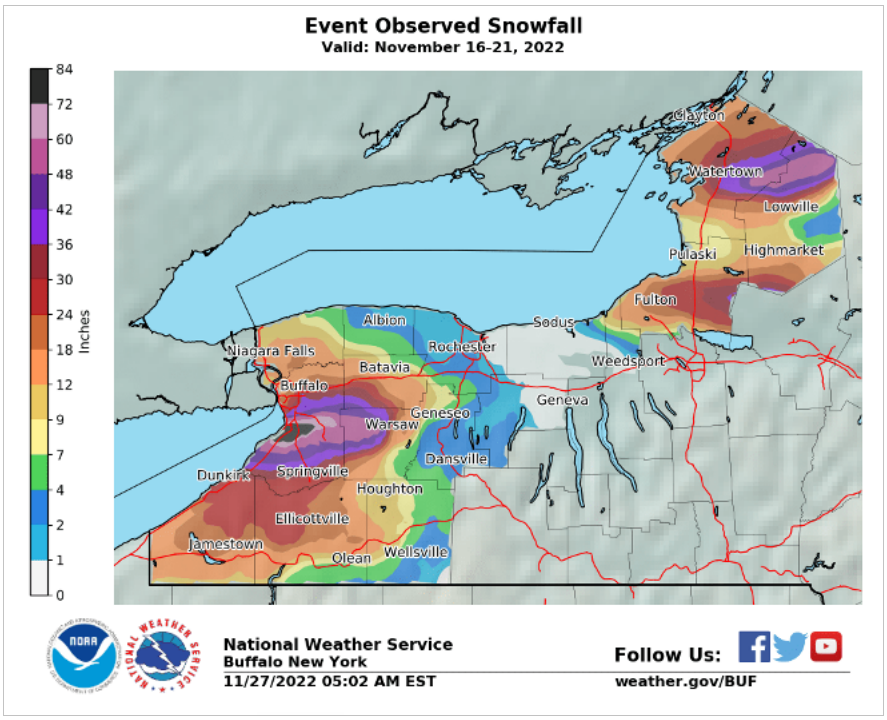
Lake effect snow forms when cold, below-freezing air passes over a lake's warmer waters. Some lake water evaporates and warms the air. Then, the warmer moist air moves away from the lake. As the air passes back over the colder land, it cools, "dumping" its moisture on the ground as snow.

This image shows belts of lake effect snow in the Great Lakes. In the U.S., lake effect snow commonly occurs across parts of Wisconsin, Michigan, New York, Ohio, Pennsylvania, and the Great Salt Lake in Utah. A storm in 1996 in Ohio caused power outages for 160,000 customers as the storm produced isolated snowfall of almost 70 inches (1.78 meters).

Dept. of Geography at Hunter College, CUNY

4. Measure how high 70 inches of snow would reach in a doorway to your classroom.

5. Based on what you know about the prevailing winds in the United States, why are the belts of lake effect snow not found all around each lake?

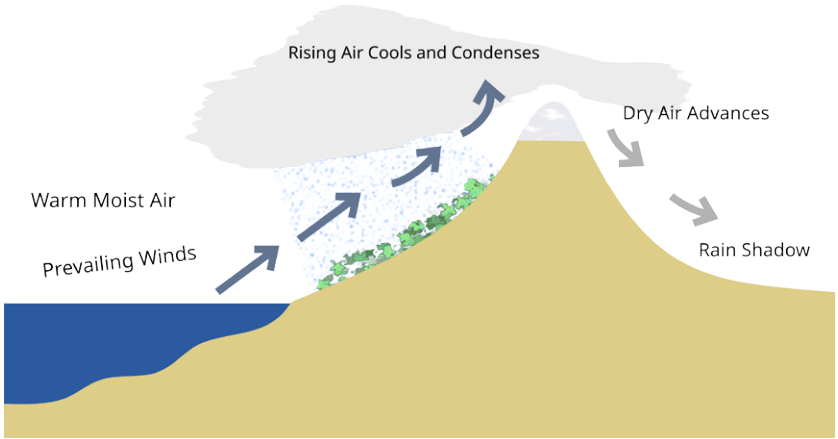


6. The Buffalo, New York area had a lake effect snow event in November 2022. Based on the colors from the map, what was the highest amount of snow received in that area?

7. Estimate how much snow the city of Rochester received.

Rain Shadows

8. From the image, make a recipe for a rain shadow. Notice that when rising air cools, the water vapor condenses and falls as rain or snow.



Credit: By domdomegg - Own work, CC BY 4.0, https://commons.wikimedia.org/w/index.php?curid=45877009

Recipe for a Rain Shadow

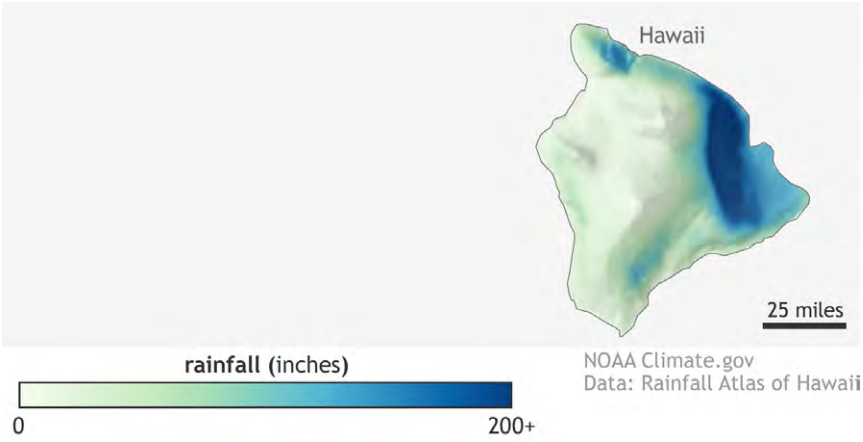
The map below shows cities and areas near a mountain range. Based on the amount of rain that each region receives in a year and the map of prevailing winds, identify whether you think the city lies in a rain shadow.

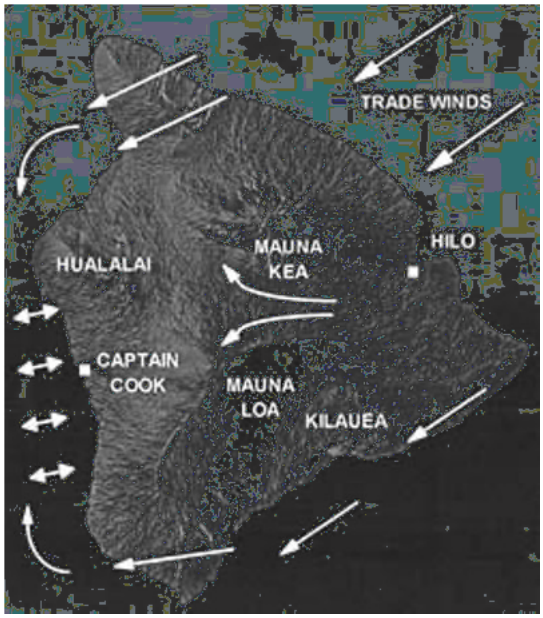
Credit: Kmusser at Wikimedia Commons

9. Mojave Desert, California – 3.5 inches per year

10. Los Angeles, California – 14 inches per year

These Hawaii Island maps show prevailing winds called tradewinds and the rainfall that results. Based on the amount of rain that each city receives in a year, identify whether you think the city is in a rain shadow.





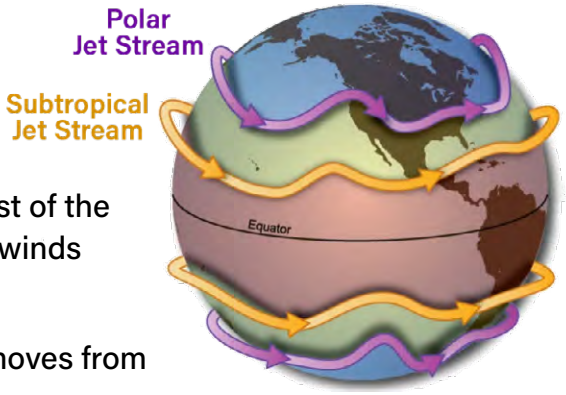
Credit: USGS

11. Hilo, Hawaii – 120 inches per year

12. Captain Cook, Hawaii – 31 inches per year

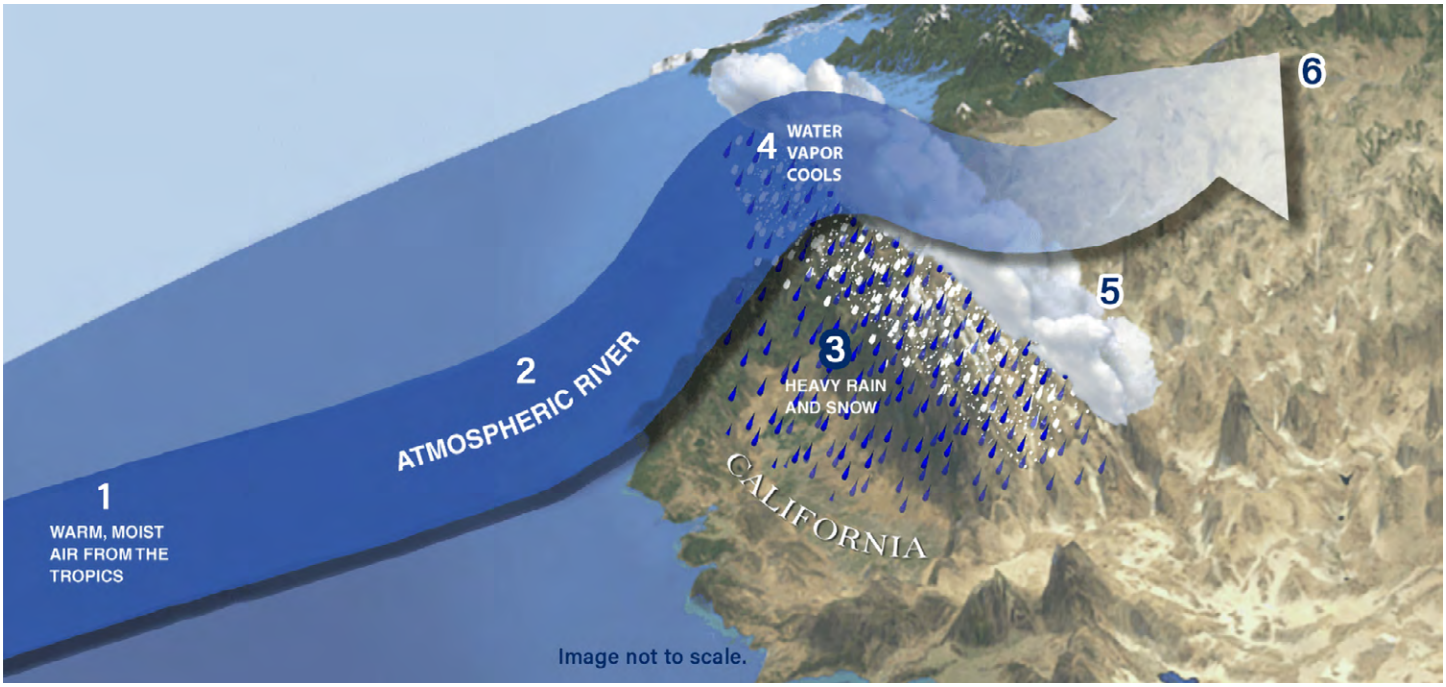
PART 4.

Atmospheric Rivers



Let's investigate how the moisture from the ocean moves toward land to cause events like thunderstorms, snow storms, and flooding. Atmospheric rivers are long, narrow regions in the atmosphere, like rivers in the sky. They carry most of the water vapor from the tropics. They are moved by high-altitude winds that blow from west to east, called the jet stream.

1. Look at the graphic and write a story about how moist air moves from the tropics to drop as rain in California.

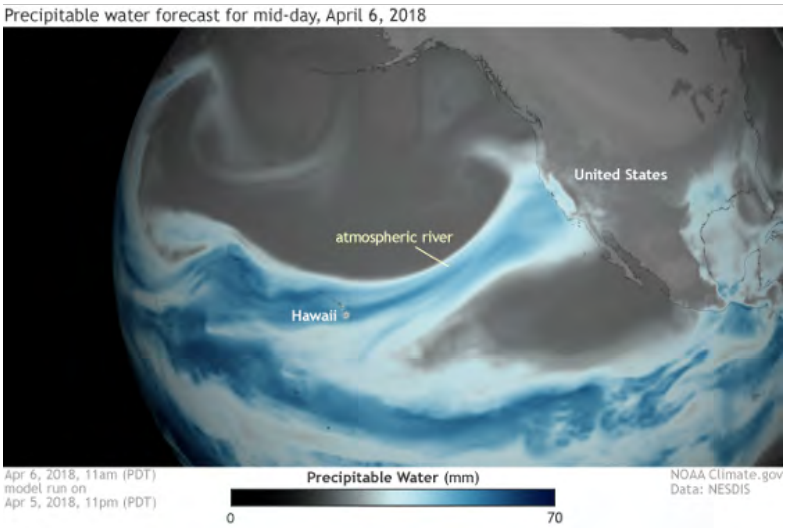


My story about how water moves in an atmospheric river.

Atmospheric rivers come in different sizes and strengths. The average atmospheric river carries the same amount of water vapor as the average water flow at the mouth of the Mississippi River. That is 4,435,973 gallons per second! When the atmospheric rivers reach land, they release their water vapor in the form of rain or snow. Strong atmospheric rivers can create extreme rainfall and floods. These events can disrupt travel, start mudslides, and cause catastrophic damage to life and property.

A well-known example of a strong atmospheric river is called the "Pineapple Express" because moisture builds up in the tropical Pacific around Hawaii and can wallop the U.S. and Canada's west coasts with heavy rainfall and snow.

Prevailing winds cross over warm bands of tropical water vapor to form this "river," which travels across the Pacific. When it reaches the West Coast, the Pineapple Express can dump as much as 5 inches of rain in one day.



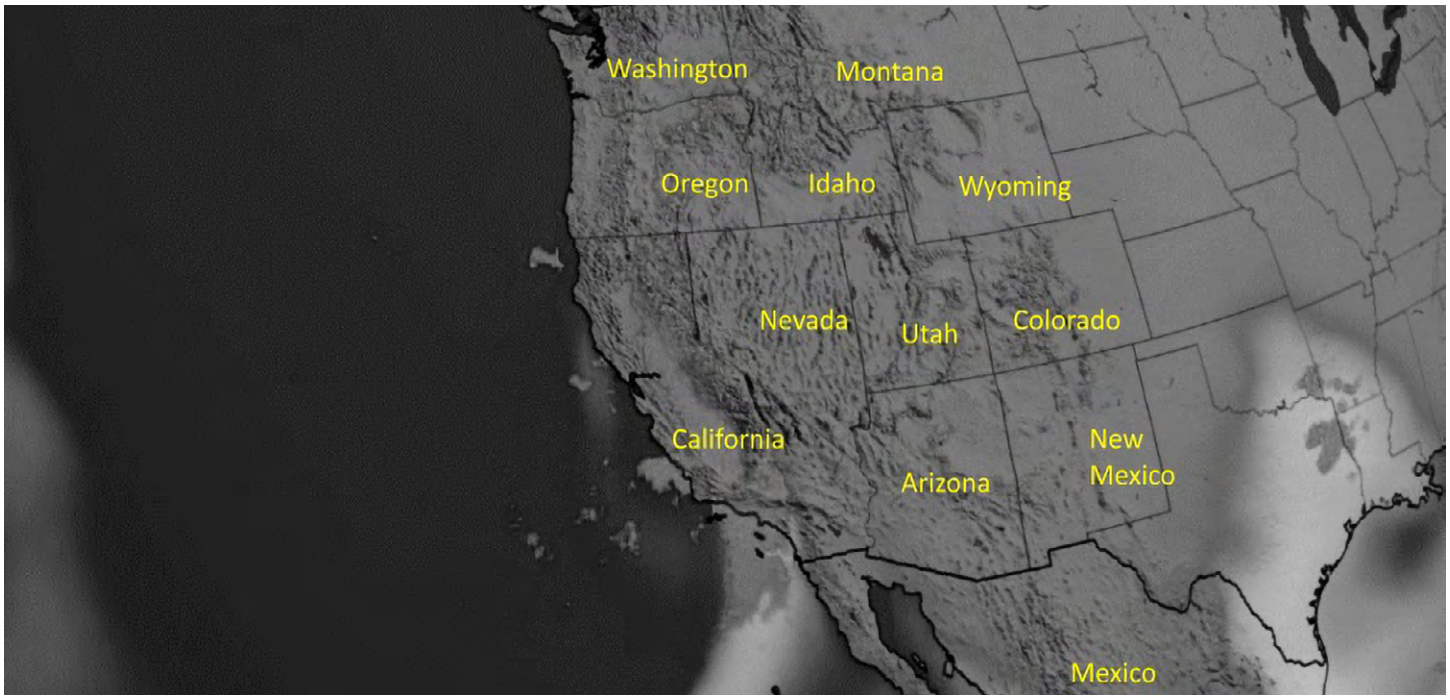
Earth Curiosities

Tornado Alley

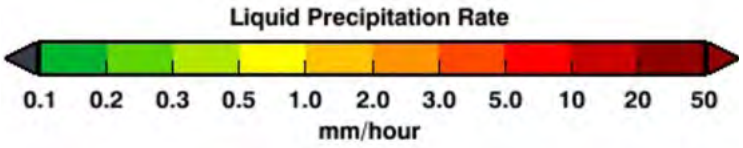
A ten state area of the Midwest has been named "Tornado Alley" in recognition of its attractiveness to tornadoes. The peak "tornado season" for Texas, Oklahoma, and Kansas is from May into early June. In North Dakota, South Dakota, Nebraska, Iowa, and Minnesota, tornado season is in June or July. But remember, tornadoes can happen at any time of year and in any state. Tornadoes can also happen at any time of day or night, but most tornadoes occur between 4–9 p.m.


Credit: iStockphoto

The atmospheric river shown in the images below occurred December 10-12, 2014, over the Pacific Ocean and southwest U.S. (Credit: NASA's Scientific Visualization Studio)



The maps below show how much water vapor is in the atmosphere and the rate of precipitation in the atmosphere. It is a measurement of the amount of water in the air, measured in millimeters (mm) as if it were liquid. There are 25.4 millimeters in an inch. To convert millimeters into inches, divide the length in millimeters by 25.4.

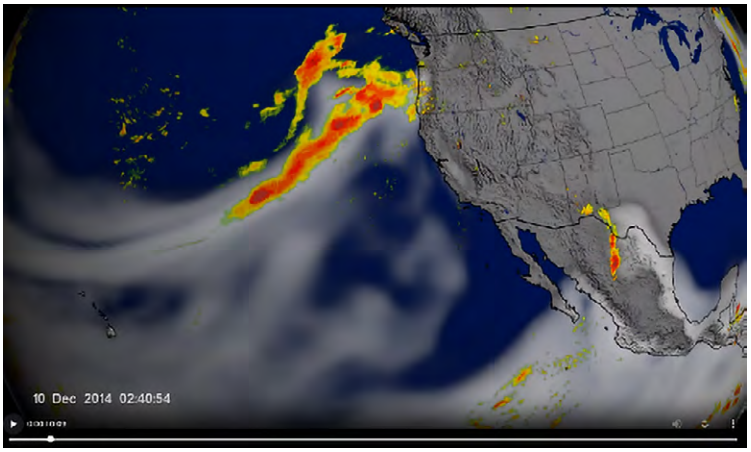


2. How many inches of rain is 50 mm/hr?

3. How much rain would fall if it were to rain that much for five hours in one place?

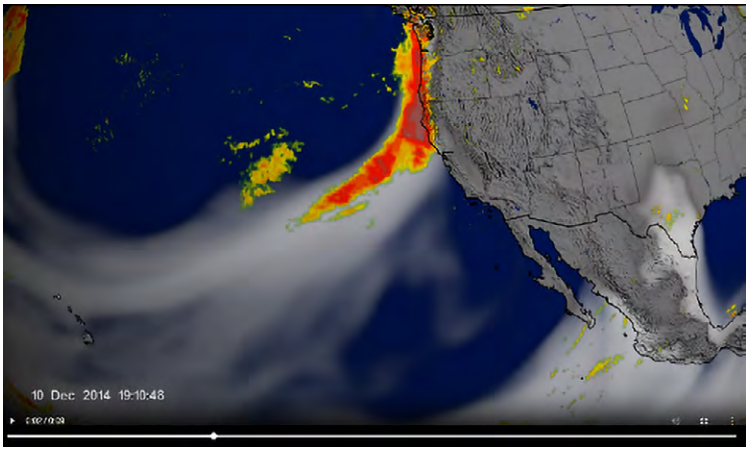
4. Compare Map A to the map above, which has western states marked. If you were a weather forecaster looking at Map A, which states would you expect to see rain in the future?

Map A. Water Vapor & Precipitation Map morning December 10, 2014



Credit: NASA

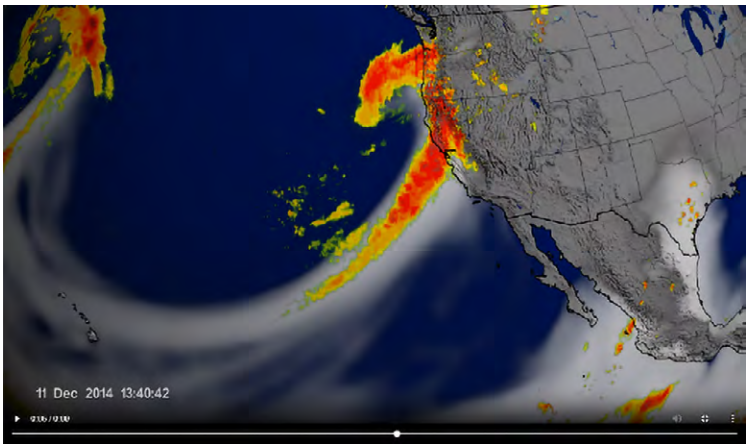
Map B. Water Vapor & Precipitation Map evening December 10, 2014



Credit: NASA

5. Look at Map B. The water vapor and precipitation map has changed in just 17 hours. Which states are getting the rain now?

Map C. Water Vapor & Precipitation Map December 11, 2014



Credit: NASA

6. Map C shows the water vapor and precipitation levels at midday on December 11. What was the highest rate of precipitation over northern California on that day?

Map D. Water Vapor & Precipitation Map December 12, 2014

Credit: NASA

7. Map D shows the water vapor and precipitation pattern for the early morning of December 12. What changes do you see in the water vapor pattern and the states being affected compared to the day before?

Effects of Atmospheric Rivers

Flooding occurs in every U.S. state and territory and is a threat anywhere in the world that receives rain. In the U.S., floods kill more people each year than tornadoes, hurricanes, or lightning. When atmospheric rivers reach land, they often release a lot of rain or snow over short periods of time. The heavy rain has caused rivers to rise and reach major flood levels.

Flash floods are the most dangerous kind of floods because they combine the destructive power of a flood with incredible speed. Flash floods occur when heavy rainfall exceeds the ability of the ground to absorb it. They also occur when water fills normally dry creeks or streams or enough water accumulates for streams to overtop their banks. This rapid rise can happen in a short amount of time, within minutes of the rainfall. People underestimate the force and power of water. Six inches of fast-moving flood water can knock over an adult. Twelve inches of rushing water can carry away most cars, and 2 feet of rushing water can carry away SUVs and trucks. It is NEVER safe to drive or walk into flood waters.

8. Are there areas in your neighborhood or city that flood?

9. What actions should you take to protect yourself and others when a flood warning is issued?

Credit: Shutterstock

PART 5.

We have looked at weather events like thunderstorms, snow storms, lake effect snow, and rain shadows.

1. Depending on where you live in the United States, have you experienced any of these weather events?

2. Now complete the last column, "What I Learned," from the chart at the beginning of the lesson.

3. What new questions do you have about the ocean, weather and climate connections, and the weather events we have discussed?

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