

# It's Raining, It's Pouring, It's Flooding! In Maricopa County Lesson 2: Weather and Climate

## Key Vocabulary

**Monsoon**—A change in weather pattern that brings moisture from the Gulf of California. The moisture combined with the heat fuels the storms known as the Monsoon. Occurs between June 15 and September 30.

**Haboob**—Violent summer winds that create walls of dust.

**Air Mass**—A body of air that extends hundreds or thousands of miles horizontally, maintaining uniform conditions of temperature and humidity.

**Weather**—Conditions of the atmosphere over short periods of time.

**Climate**—How the atmosphere behaves over a long period of time.



## Outcome

Students will understand the difference between weather and climate.

## Objectives

- I will be able to differentiate between weather and climate.
- I will be able to describe the conditions needed for monsoons.
- I will be able to identify if a condition is weather or climate.

## Essential Questions

What is the difference between weather and climate?

What needs to occur for monsoons to happen?

## Length of Lesson

Two 45-minute



<https://www.worldatlas.com/articles/what-causes-arizona-monsoon.html>

## Materials

- It's Raining, It's Pouring, It's Flooding! In Maricopa County PowerPoint
- Student book
- Match game cards and mat for each group

*Arizona receives 32% of it's annual rainfall during the monsoon season.*

### Before Teaching

Preview PowerPoint

Choose videos to show

### Additional Resources

[What is an AZ monsoon?](#)

[Channel 3 Monsoon 2019](#)

[2018 Time Lapse](#)

[2013 Monsoon](#)

[Monsoons Explained](#)

[Resource Travel](#)

### Books:

*Weather* by Seymour Simon

*Lightning* by Seymour Simon

*Wild Weather* by Chris Oxlade

*Storms: Forces of Nature* by Derek James

## Activities

- ◆ Review vocabulary with students, using TPR
- ◆ Review the remainder of the PowerPoint and what causes the Arizona Monsoons
- ◆ Explain the difference between weather and climate
- ◆ Play "Is it Weather or Is it Climate" game
  - ◆ Pass out a set of game cards and a mat for each group
  - ◆ Students divide cards evenly in their groups
  - ◆ Students place the condition cards in the appropriate spot on the mat
  - ◆ As students place the cards, they will explain to their group why they are placing it in that spot
- ◆ Watch the video about how climate affects the Southwest
- ◆ Read the articles about monsoon storms in the student book
  - ◆ Students annotate both texts. Compare and contrast the articles, then write a summary stating how monsoon storms form. Include 2-4 gists in the summary.

## Extension

Create a weather system model that includes the sun, atmosphere, and bodies of water.

## Differentiation

Students who are struggling can write a summary on just one of the texts.



# **It's Raining, It's Pouring, It's Flooding! In Maricopa County**

Lesson 2: Weather and Climate

# Outcome

- Students will understand the difference between weather and climate.



# Objectives

- I will be able to differentiate between weather and climate.
- I will be able to describe the conditions needed for monsoons.
- I will be able to identify if a condition is weather or climate.



# Essential Question

- What is the difference between weather and climate?
- What needs to occur for monsoons?



# Key Vocabulary

- Monsoon – A change in weather pattern that brings moisture from the Gulf of California. The moisture combined with the heat fuels the storms known as the Monsoon. Occurs between June 15 and September 30.
- Haboob – Violent summer winds that create walls of dust.
- Air Mass – A body of air that extends hundreds or thousands of miles horizontally, maintaining uniform conditions of temperature and humidity.
- Weather – Conditions of the atmosphere over short periods of time.
- Climate – How the atmosphere behaves over a long period of time.



# Arizona Monsoon

- Arizona monsoon season is June 15 – September 30
- Wind shifts to southeasterly flow and brings up moisture from the Gulf of California and the Gulf of Mexico
- Wind shifts trigger dust storms known as haboobs
- What are some possible consequences of the monsoons?



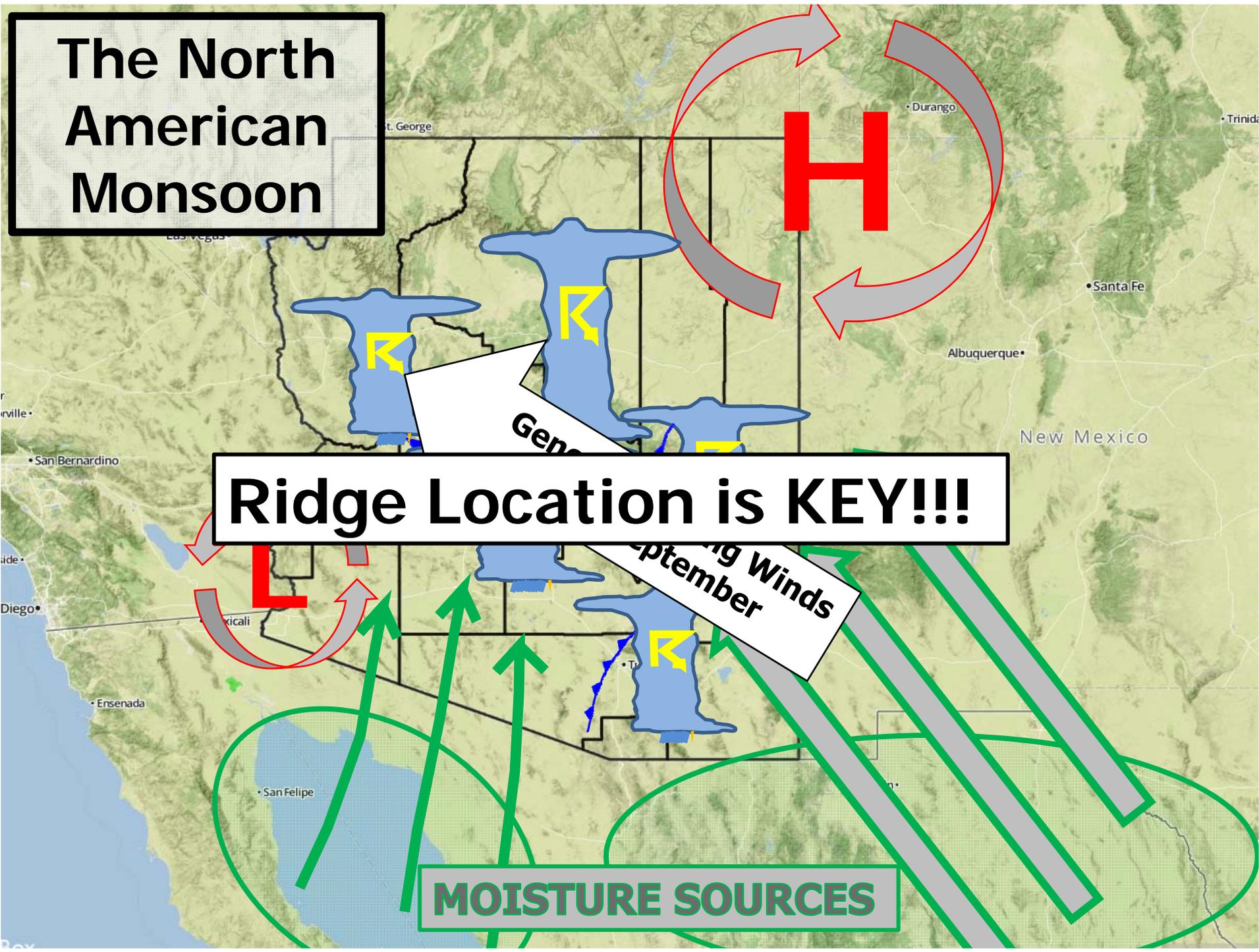
# The North American Monsoon

Ridge Location is KEY!!!

MOISTURE SOURCES

Gen

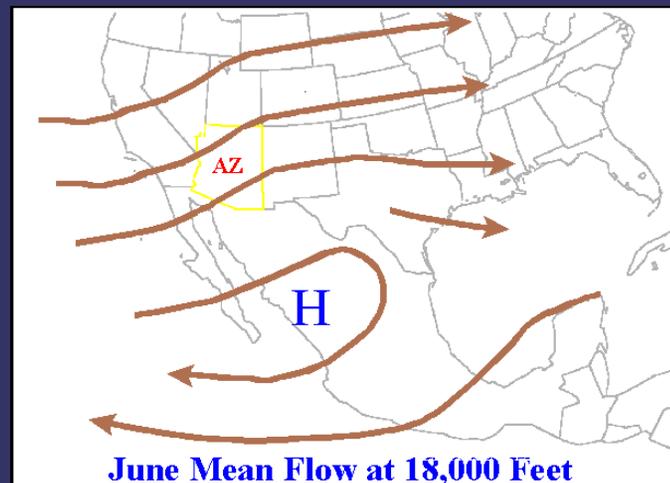
September Winds





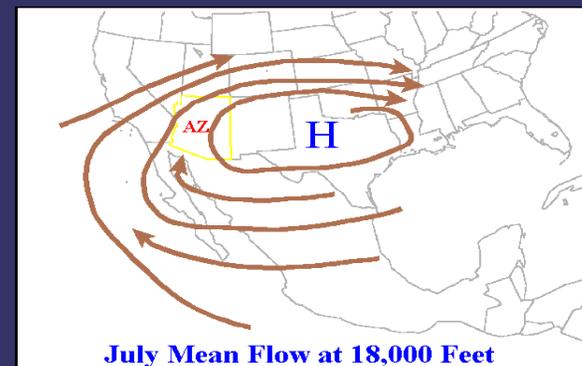
# June Wind Direction

- Air masses pick up some moisture from the Pacific, but because of **the airflow from the Southwest**, most of it is gone by the time it reaches Arizona.



# July Wind Direction

- Air masses pass over the warm waters of the Pacific and Gulf of California, picking up moisture and bringing it to Arizona. This combines with an easterly air flow from Texas and New Mexico, creating thunderstorms.



# Weather vs Climate

- Conditions of the atmosphere over a short period of time is weather.
- Climate is how the atmosphere behaves over a long period of time.
  - Made up of precipitation, humidity, and temperature
  - 5 climate causes
    - Latitude
    - Elevation
    - Ocean and wind current
    - Proximity to large bodies of water
    - Terrain

EAH REV 12/20/2019



# Is it Weather or Climate

- Each group has a set of condition cards and a playing mat
- Divide the cards evenly in your group
  - You will only be allowed to move your cards. If your team does not agree on the placement, they must explain why and the person whose card it is has final say on where it goes.
- Place the condition cards in the appropriate spot on the mat
- As you place the cards, explain why you are placing it in that area
- Be prepared to share with the class



# Monsoon Facts

- The Arizona Monsoon season provides:
  - 60% - 80% of the yearly rainfall for northwestern Mexico.
  - 50% of the precipitation for New Mexico.
  - 31.5% of the total precipitation that Arizona receives.
  - Water that is vital to wildlife.

<http://www.newsweek.com/arizona-flash-floods-strange-weather-phenomenon-monsoon-637916>

EAH REV 12/20/2019



# The difference between spring and the monsoon can be dramatic



<http://www.thisinsider.com/best-us-cities-spring-2017-3>



<https://www.npr.org/sections/thetwo-way/2014/09/08/346904134/floods-hit-phoenix-in-areas-wettest-day-ever-recorded>

EAH REV 12/20/2019



# How Climate Change will Affect the Southwest

- [Watch the video](#)
- Read U of A News – “Monsoon Storms, Fewer but More Extreme”

and

- Climate Central – “Global Warming is Fueling Arizona’s Monstrous Monsoons”



# Climatologist

- A scientist who studies weather over a period of time
  - Studies frequency and trends of weather patterns over time
- Collect and analyze data and use computer models to create forecasts
- Must possess good reading and problem solving skills
- Must be good at math, geography, science, and physics
- Jobs in government, military, and universities



# What does a Climatologist do?

- What is a Climatologist?
- Why study Meteorology and Climatology?



# Environmental Scientist

- Researches and investigates to identify and eliminate sources of pollution and hazards that can affect the environment and health
- Researches ways to keep the environment safe for future generations
- Must be curious, love the outdoors, be concerned about the environment, and good at logical thinking and writing
- Subjects in school include biology, chemistry, physics, geometry, algebra, and calculus



# Watch an Environmental Scientist

- [Charlotte](#)
- [Career Overview](#)



# Hydrologist

- Studies surface and ground water
- Helps environmental scientists preserve and clean up the environment
- Analyze water to determine pollutants
- Help create environmentally responsible water usage regulations
- Must be good in chemistry, biology, physics, calculus, English, and computer science



# Hydrologist

- [Career Overview](#)
- [Katya Hafich](#)
- [Forest Hydrology](#)



# Engineer

- A person who designs and builds systems, structures, and machines
- Wants to know how and why things work
- Can be a civil, electrical, mechanical, or chemical engineer



# Engineers

- [NASA intro to Engineering](#)
- [What's an Engineer?](#)



# Be a Meteorologist

- Work with your partner to research the weather for the next 3 days
- Create “graphics” for a weather report
- Present your weather forecast for another group or to the class



# Make a Rain Gage

(Put picture here)



A change in weather pattern that brings moisture from the Gulf of California. The moisture combined with the heat fuels these storms. Occurs between June 15 and September 30.

Violent summer winds that create walls of dust.

A body of air that extends hundreds or thousands of miles horizontally, maintaining uniform conditions of temperature and humidity.

Conditions of atmosphere over short periods of time.

How the atmosphere behaves over a long period of time.

3<sup>rd</sup> – 5<sup>th</sup> Grade  
Lesson 2



A body of air that extends hundreds or thousands of miles horizontally, maintaining uniform conditions of temperature and humidity.

- Air Mass

Violent summer winds that create walls of dust. - Haboob

A change in weather pattern that brings moisture from the Gulf of California. The moisture combined with the heat fuels these storms. Occurs between June 15 and September 30. - Monsoon

How the atmosphere behaves over a long period of time.

- Climate

Conditions of atmosphere over short periods of time.

- Weather

# Monsoon Storms

## Monsoon Facts

Softschools.com

A monsoon, which is a large sea breeze, occurs when the wind blows from the cooler ocean to the much warmer land mass. This seasonal weather pattern is a result of changes in the circulation of the atmosphere and the rain resulting from the warming of both the land and the sea. Although most people associate monsoons with rain, they can also include dry phases as well. The Asia-Australian

and the West African monsoons are the major monsoon systems, while there are also North- and South-American monsoons. Depending on the location, a monsoon may not cause much change at all in the weather, while in some cases it can turn a desert into lush, green grassland. Monsoon does not mean rain, even though many people believe this is what it means. It is simply strong breezes that blow from cold to hot environments.

## What is a Haboob?

It's an unusual name, and it can be amazing to watch, but it is dangerous if you get caught driving or walking in one. The name comes from the Arabic word *habb*, meaning "wind." A haboob is a wall of dust that is a result of a downburst where

the air is forced downward and pushed forward by the front of a thunderstorm cell, picking up dust as it travels across the terrain.



<https://www.tripsavvy.com/arizona-monsoon-2679966>

## Interesting Monsoon Facts

- It is estimated that there are approximately 500,000 lightning strikes during a monsoon.*
- The word monsoon is believed to be derived from the Arabic word 'mausim,' which means a shift in wind or season.*
- In many parts of the world, life itself depends on the monsoon rains. When the monsoon does not occur in these areas, it can result in widespread famine, and death of both animals and humans.*
- India experiences the most dramatic monsoons in the world.*
- In Europe, they call the monsoon system they experience the 'Return of the Westerlies.'*
- A monsoon storm can range from a violent thunderstorm to only small dust storms.*
- In the United States, Southwest Texas, New Mexico, and Arizona are all part of a monsoon season from June 15th to September 30th each year.*
- During a monsoon, there are weather hazards that people should be aware of including downburst winds, lightning, dust storms, thunderstorms, wildfires, extreme heat, and flash floods.*
- Arizona receives 32% of its total yearly rainfall during the monsoon.*
- In Arizona, during the monsoon, it is not uncommon to see a wall of dust that reaches hundreds of feet in the air.*
- A monsoon always blows from a cold region to a warm region.*

## How Arizona monsoon storms form and reach Phoenix area

AZCentral

Weldon B. Johnson, The Republic—azcentral.com Published 8:24 a.m. MT July 7, 2017, Updated 4:46 p.m. MT July 7, 2017

It's a hot, humid (at least for Phoenix) summer afternoon when, out of the blue, a storm pops up, blowing dust through the Valley, followed by a little rain.

It may seem that such storms develop out of nowhere, but that's not exactly the case. Most of our monsoon storms have their origins elsewhere, and they arrive here a little different than how they began, if they reach us at all.

Phoenix gets 2.71 inches of rain, on average, during the monsoon season. It takes a lot of things going just right for even that little bit of water to get here.

Think of a storm as a living thing, capable of reproducing, to get some understanding to how monsoon rains reach the Valley.

Austin Jamison, a meteorologist with the National Weather Service in Phoenix, explains how winds pushed out by a collapsing storm (called outflow winds), form a mini cold front that helps the next generation move along.

"You tend to have a generational effect where storms will pop up over the mountains, then outflow air coming out of those storms kicks off new, child storms further away from the initial formation area," Jamison said. "It may take another

generation or two after that before these storms are directly over the Valley."

### Forecasting the monsoon is tough

Monsoon storms are such volatile things that they can be difficult to predict. It's often only after a storm dies that meteorologists can get an accurate picture of what happened.

"If you were to look at a loop of thunderstorms with radar through a course of six hours or so, you could backtrack," Jamison said. "If you look at a storm that hit, maybe, north Phoenix, you could look back and say, 'This happened because a storm over here pushed out wind and this happened because a storm over there produced wind and that happened because storms there and there came together.'"

In other words, even if conditions seem right for storms to form, that doesn't mean we'll get rain. That's why meteorologists give forecasts with a probability — not a promise — of rain in a specific area.

"We don't say this part of the metro will get storms and the

rest will be in the clear," Jamison said. "We can't really do that."

### How storms form (the simple version)

First, let's take a look at how storms form.

The first step, at this time of year, is for the area of high pressure often hanging around the Southwest to shift into a position that brings moist air up from the Gulf of California. That moist air is necessary for cloud formation.

The moist air, combined with the heat of the season and other factors, makes the atmosphere unstable, or more conducive to producing storms.

Water vapor in that warm, moist air condenses and forms clouds as it rises into the cooler levels of the atmosphere. If those clouds become laden with enough moisture and the air rises high enough, ice crystals form. Those ice crystals combine with drops of water to become heavy enough to fall and create downward currents of air. As those droplets fall into warmer air, the ice melts and the droplets become rain.

## How Arizona monsoon storms form and reach Phoenix area (con't)

That mixing of water and ice within clouds builds positive and negative electrical charges in different parts of the clouds. When those charges become powerful enough, huge sparks (lightning) form between differently charged clouds or between clouds and the ground.

### Terrain plays a role

That warm air gets some help in forming clouds from the mountains in our state.

State Climatologist Nancy Selover describes Mount Lemmon, near Tucson, as a “sky island” that helps storms form. Warm, moist air cools as it rises up the face of the mountain. As that happens, the water vapor condenses and forms clouds and, given the right conditions, storms.

“If you go down in the summertime and basically watch Mount Lemmon, you’ll see these clouds form and evaporate and grow and evaporate,” Selover said. “Pretty soon in the afternoon they have enough moisture that has gone up the mountain that they just explode. It’s really kind of cool.”

That formula also plays out in other areas of the state such as the Mogollon Rim and the White Mountains, where many of the storms that reach the Valley are born.

### How storms get here

Our storms often start in the surrounding mountains and are blown this way by winds in the layer of the atmosphere where clouds form. However, those storms rarely have the staying power to reach the Valley unchanged.

In many cases we get what are known as multi-celled storms. That means the original cell of the storm collapses, loses power and feeds a new phase of the storm. The downdraft of cool air from the collapsing storm pushes up warm, moist air and that helps start the development cycle all over again.

This cycle can continue several times as long as conditions remain.

Those outflow winds from those collapsing storms also are responsible for many of our dust storms, by the way.

This regeneration helps the storm cover more area. And if the winds are blowing in our direction, the rain gets pushed toward us.

But sometimes that’s still not enough.

On some days the conditions aren’t unstable enough to support storms over the Valley. Or maybe the winds from the collapsing storms aren’t strong enough to create enough lift to form new storm cells. Or the winds at cloud level are blowing in another direction.

“It’s like a sequence of steps that had to come together in order for that one storm to form,” Jamison said. “It’s very difficult to know how that sequence is going to play out.”



Photo: Rob Schumacher/The Republic

## What Causes the Arizona Monsoon?

<https://www.worldatlas.com/articles/what-causes-arizona-monsoon.html>

The Arizona monsoon, also commonly known as the North American monsoon, Mexican monsoon, or Southwest monsoon, is a pattern of intense and significant rainfall and thunderstorms that occurs in northwestern Mexico and the southwestern United States.

The monsoon occurs from July until mid-September and is characterized by increased thunderstorms, rainfall, and even floods. In fact, the US states of New Mexico and Arizona receive about half of their annual rainfall during the summer monsoon. Although rainfall events are short, the water brought by the storm floods rivers and streets. The monsoon can extend as far as the Traverse Ranges and Peninsular Ranges in California but does not reach the coastal strip. The monsoon loses its strength by mid-September when the region becomes much drier and cooler. generation or two after that before these storms are directly over the Valley.”

### Causes of the Arizona Monsoon

The Arizona monsoon is not as strong and persistent as

the monsoons in South Asia, partly due to the fact that the Mexican Plateau does not have the same high elevation as Asia's Tibetan Plateau. However, it shares several characteristics with the South Asian monsoons. The Arizona monsoon forms when the Sun heats the Pacific Ocean and land at different rates. The land warms at a faster rate than the ocean, creating a low-pressure zone as the hot air rises, forcing winds to shift and fill the vacuum that is formed. With the shift in the wind, the Arizona monsoon emerges in northern Mexico, usually in the month of May. The monsoon air, which is full of moisture, travels north towards New Mexico and Arizona and is accelerated by the pressure difference between the hot southwestern air and the cold Mexican air. The Arizona monsoon is affected by a number of factors. One factor that has a significant impact on the monsoon is the El Niño-Southern Oscillation, which brings moisture from the Gulf of Mexico.

### Effects and Rainfall Pattern

Rainfall during the Arizona monsoon is typically most intense in

Arizona and western New Mexico. The strength of the monsoon varies from year to year, as some years produce weak monsoons while others experience substantial rain. Therefore, it is difficult to predict the intensity of future monsoons. Torrential thunderstorms may be experienced, especially over the mountains, and are occasionally enhanced by the passage of tropical waves. Flash flooding is common during the Arizona monsoon, as dry washes can instantly turn into flowing rivers. As a result, tourists are advised not to camp in the dry wash during monsoon season. Rainfall is not continuous but varies considerably depending on a number of factors. There is usually a period of sustained rainfall and a period of relief from the rain. In the Sierra Madre Occidental, rainfall can reach between 10 and 15 inches. Rain during the monsoon is capable of reversing the downward draw from reservoirs, and farmers also depend on the rains for their crops and livestock feed. In addition to rainfall and thunderstorms, the Arizona monsoon also causes lightning, dust storms, strong winds, and sometimes dangerous fires.



Monsoon thunderstorm over the Arizona desert.



<https://www.tripsavvy.com/arizona-monsoon-2679966>

All over Arizona, you will see dry riverbeds called washes. During monsoon season these washes can fill with water very suddenly. In fact, it may not even be raining where you are for a wash to fill with water. The rainstorm may be happening upstream from you. This flash flooding happens during the monsoon and so cars, people and even cattle

*Arizona and New Mexico receive most of their annual rainfall during the summer monsoon.*

## Flood Control District of Maricopa County

Flood Control District of Maricopa County

# STEM



Science Technology Engineering Math

### Turn Around, Don't Drown



[www.fcd.maricopa.gov](http://www.fcd.maricopa.gov)

Tornadoes are relatively uncommon in Arizona, but during the monsoon, there are times when people will report tornado-type activity. If you experience damage, sometimes rotating winds with debris being scattered it is more likely that the phenomenon is a microburst. This type of quick-hitting storm is part of the monsoon season.



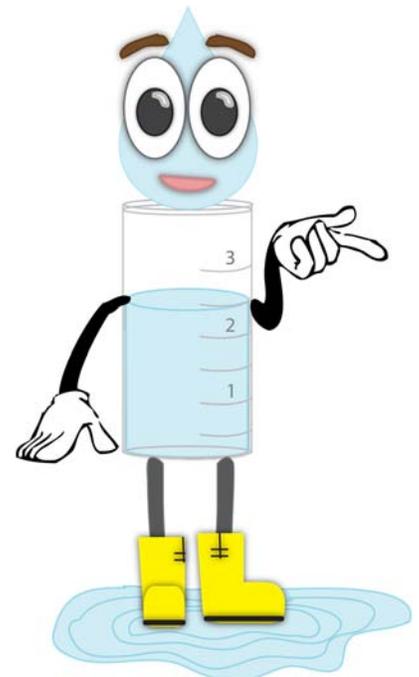
<https://www.tripsavvy.com/arizona-monsoon-2679966>

## Safety



<https://www.tripsavvy.com/arizona-monsoon-2679966>

You might think that the only serious weather issues in the Phoenix area are the temperatures. You'll know differently after you have experienced your first monsoon storm. They can be dangerous, and safety rules are specific to the type of storm. For example, if you are driving and enter a dust storm, or haboob, pull off the road and turn your lights off to wait until it has passed. During the monsoon when flash flooding can occur, avoid entering water flowing over the road. These phenomena are temporary during storms but require extreme caution.





# It's Raining, It's Pouring, It's Flooding! in Maricopa County

## Is it Weather or is it Climate?

Directions: Place the condition cards in the appropriate column. Explain why you are placing the card in that spot. Be prepared to share your explanations with your class.

Weather 	Climate 

Clip art from:

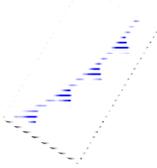
<http://www.weatherclipart.net/free-weather-clipart/weather-icon-partly-cloudy-with-a-chance-of-rain-0515-1011-0603-3310.html>

[https://www.google.com/search?safe=active&biw=1920&bih=935&tbn=isch&sa=1&ei=gdwaW\\_C2E7Lx9AOb\\_az4Cg&q=climate+clip+art&oq=climate+cli+art&gs\\_l=img\\_3\\_0i10k1l3joi8i1oi3ok1.2318424274.024411.9.9.0.0.0.104.719.8j1.9.0...0...1c.1.64.img.0.9.719...0joi67k1joi5i3ok1joi8i3ok1.0.83-W\\_YF1Uzt#imgrc=bElxOnla2VS31M:](https://www.google.com/search?safe=active&biw=1920&bih=935&tbn=isch&sa=1&ei=gdwaW_C2E7Lx9AOb_az4Cg&q=climate+clip+art&oq=climate+cli+art&gs_l=img_3_0i10k1l3joi8i1oi3ok1.2318424274.024411.9.9.0.0.0.104.719.8j1.9.0...0...1c.1.64.img.0.9.719...0joi67k1joi5i3ok1joi8i3ok1.0.83-W_YF1Uzt#imgrc=bElxOnla2VS31M:)



# It's Raining, It's Pouring, It's Flooding! in Maricopa County

*Is it Weather or Is it Climate?*

<p>Annual Rainfall</p> 	<p>Lightning</p> 
<p>Drought</p> 	<p>Heat Wave</p> 
<p>Front</p> 	<p>Flooding</p> 
<p>Wind</p> 	<p>Spring</p> 

[https://www.google.com/search?safe=active&biw=929&bih=884&tbm=isch&sa=1&ei=4eAaW7zEL56R0PEPu\\_OmyAs&q=lightning+clipart&og=lightning+clipart&gs\\_l=img.3..0l9i0i5i30k1.139431.141708.0.141852.17.13.0.4.4.0.201.1358.9i3j1.13.0...0...1c.1.64.img..0.17.1382...0i67k1.0.a-qMhuUNPI4#imgrc=kEamMrYclYeg7M:](https://www.google.com/search?safe=active&biw=929&bih=884&tbm=isch&sa=1&ei=4eAaW7zEL56R0PEPu_OmyAs&q=lightning+clipart&og=lightning+clipart&gs_l=img.3..0l9i0i5i30k1.139431.141708.0.141852.17.13.0.4.4.0.201.1358.9i3j1.13.0...0...1c.1.64.img..0.17.1382...0i67k1.0.a-qMhuUNPI4#imgrc=kEamMrYclYeg7M:)

<http://www.mediacitygroove.com/news-general-info/burbank-breaks-43-year-old-heat-record-during-heat-wave>

<http://www.aviationchief.com/fronts.html>

<https://www.abqjournal.com/458939/cars-engulfed-as-rain-sets-record-for-phoenix.html>

<https://www.ktnv.com/news/get-out-your-coat-wind-brings-chill-to-las-vegas-valley>