

## Module 4, Lesson 2

# Analyzing historical tornadoes

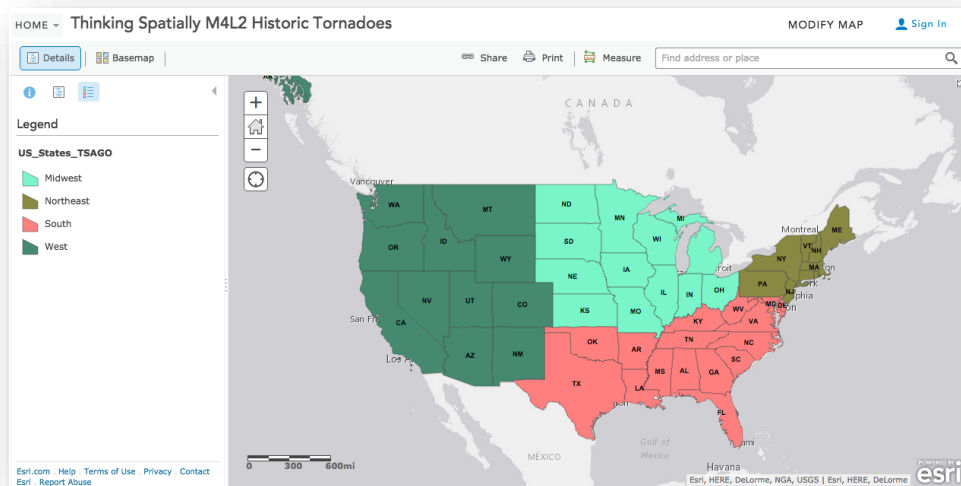
Meteorologists study storms that produce tornadoes. They use tools such as forecasting (predicting the weather), research (observing and trying to understand the weather), and storm chasing (following and watching storms close-up). Some tornadoes and tornado outbreaks may stick even in your memory. Some students grow up to study the science of tornadoes because of a personal experience or out of curiosity about a particular outbreak. Perhaps you will decide to be a meteorologist yourself one day!

In this GIS activity, you will see how tornadoes are classified into weak, strong, and violent categories. You will also take a close look at some of the memorable tornado outbreaks in history. Let's explore Tornado Alley.

### Task 1: Open the map

1. If you do **not** intend to save your work:
  - a) Launch an Internet browser.
  - b) Go to this link:
  - c) <http://arcg.is/1K6fPOb>
  - d) Skip Step 2 and proceed with the lesson.
2. If you wish to save in a Public or Organization account, go to <http://esriurl.com/SaveAGO> and follow the directions.

A map document has been created for you to use in this exercise. When the map document opens, you see a map of the world. The ArcGIS Online Map Viewer title is in the top left corner of the window.



You see states in four regions of the United States. The States legend shows you the name of each region.

3. Look at the ArcGIS Online map window and observe the following:
  - On the right side you see a map.
  - On the left side you see a column that displays the legend for the map.
  - In the top right corner you will see a “Modify Map” link.
4. Click on the Modify Map link.
5. Look at the top of the ArcGIS Online map viewer window and notice the different buttons. You will use some of these buttons as you progress through this lesson.



## Task 2: Enlarge the ArcGIS Online window

If the ArcGIS Online Map Viewer window is small when the map document first opens, you may wish to enlarge it.

6. In the upper right corner (PC) or upper left corner (Mac) of your ArcGIS Online window there are three buttons. Click the middle button (PC) or the right green button (Mac).

PC



Mac



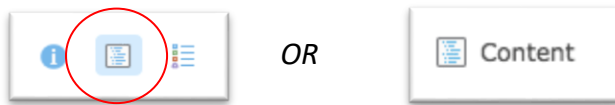
Now the ArcGIS Online Map Viewer window fills your whole screen.

You can also change the size of your ArcGIS Online window by stretching it. Stretching the window instead of maximizing it allows you to organize other windows and dialog boxes as they appear.

7. Place the cursor on any corner of the ArcGIS Online window that is not at the edge of your screen. The cursor changes to a diagonal double-headed arrow. Click and drag the window outward until the ArcGIS Online window fills about two-thirds of the screen. Let go of the mouse button.

### Task 3: Tornadoes of the United States

8. Hover over and click on Show Contents of Map button.



In ArcGIS Online Map Viewer, a map is made up of layers.

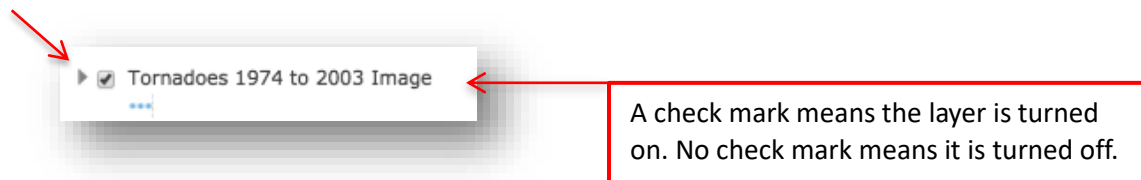
9. Look at the Contents area on the left of the map and observe the following:

- There are thirteen layers: Cities 3, Cities 2, Cities 1, May 1-10 2003, May 3 1999, April 3-4 1974, Violent Tornadoes, Strong Tornadoes, Weak Tornadoes, Tornadoes 1974 to 2003, US States, US States-Outlines, Tornadoes 1974 to 2003 Image and Light Gray Canvas basemap.
- Each layer except the last layer (the Light Gray Canvas basemap) has a small box to the left.
- The box for US States is checked.
- The other boxes in front of the layers are unchecked.

### Task 3: Thirty years of tornadoes.

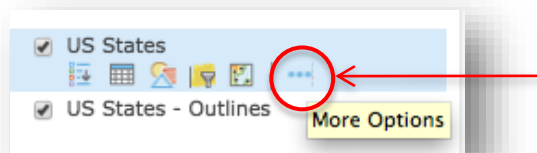
From 1974 to 2003, the United States had three memorable tornado outbreaks. A tornado outbreak occurs when many tornadoes form from a single storm. Before looking at these particular outbreaks, you will look at the tornadoes in this 30-year time period.

10. Turn on the **Tornadoes 1974 to 2003 Image** layer by clicking the box next to the layer name. Each dot represents a tornado that occurred from 1974 to 2003 (a period of 30 years). (If you see a message that says “Layer did not draw completely” just click OK.)

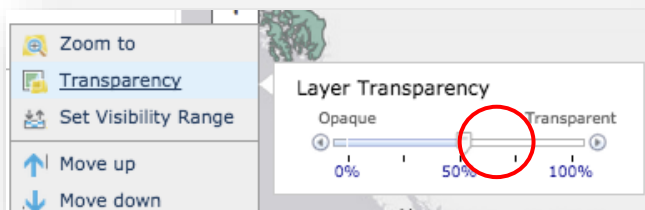


This is called turning on a layer. The **US States** layer is above the **Tornadoes 1974 to 2003 Image** so you need to make the region more transparent so you can see the tornadoes through the US State regions.

11. Click on the **US States** layer and click on the **More Options** ellipses.



12. Click on **Transparency** and move the slider to 60% or just until you can see the tornadoes and the US States regions.



🌐 **Q1: Which region had the fewest tornadoes between 1974 and 2003?**

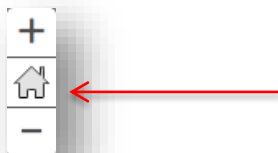
- a. *Midwest*
- b. *Northeast*
- c. *South*
- d. *West*

13. Click the Minus zoom once.



🌐 **Q2: Which state had no tornadoes between 1974 and 2003?** \_\_\_\_\_

14. Click the Home button to zoom back in to the 48 states.



15. Click on the **US States** layer name and click on the **More Options** icon.

Change the transparency back to 0% (Opaque).

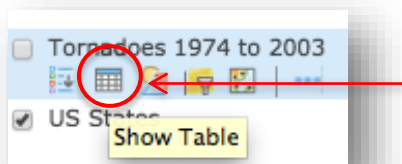
16. Turn off the **Tornadoes 1974 to 2003 Image** layer.



17. Turn on the **Tornadoes 1974 to 2003** layer. If you get a “Layer did not draw completely” box, click OK.



18. Click on the **Tornadoes 1974 to 2003** layer and click on the **Show Table** icon. This brings up the table of state tornado data.




The table has one record (row) for each tornado. The total number of records tells you the number of tornadoes in this layer.

A screenshot of the 'Tornadoes 1974 to 2003' table. At the top of the table, there is a gray bar containing the number '14,985.00'. The table itself has columns for TORNADOX020, YEAR, NUM, STATE, MONTH, DAY, DATE\_, and TOR\_NO. The first five rows of data are visible.

TORNADOX020	YEAR	NUM	STATE	MONTH	DAY	DATE_	TOR_NO
14,985.00	1974	1.00	01	1.00	20.00	1/20/1974	6.00
14,986.00	1974	2.00	01	1.00	26.00	1/26/1974	9.00
14,987.00	1974	3.00	01	1.00	28.00	1/28/1974	19.00
14,988.00	1974	4.00	01	1.00	28.00	1/28/1974	18.00
14,989.00	1974	5.00	01	1.00	28.00	1/28/1974	20.00

19. Look at the number in the gray bar at the top of the table.



 **Q3: How many tornadoes occurred between 1974 and 2003? (Write the number here. You will use this number in the next step.)** \_\_\_\_\_

20. Close the table of attributes.

#### Task 4: Weak tornadoes.

A tornado is like a spinning wind tunnel. It extends from the thundercloud in the sky to the ground below. (To be a tornado, it must touch the ground.) The strength of a tornado is measured by the speed of the spinning wind and the amount of damage to things on the ground — houses, cars, trains, trees, and roads. Tornado strength is measured on a scale called the Fujita Tornado Damage Scale, or F-Scale for short.

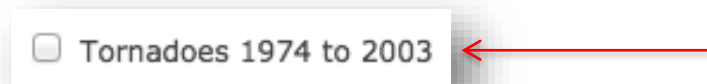
21. Take out the “Historical Tornadoes” handout that your teacher gave you. It shows six different tornado F-Scale strengths, from the weakest (F0) to the most violent (F5). For each size, you see the wind speed and a description of the damage.

Tornadoes may also be described as weak, strong, or violent:

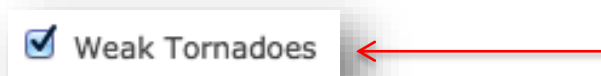
- F0 and F1 tornadoes are considered weak.
- F2 and F3 tornadoes are considered strong
- F4 and F5 tornadoes are considered violent.

22. Return to the map on your computer screen.

23. Turn off the **Tornadoes 1974 to 2003** layer by clicking the check mark next to the layer name.




24. Turn on the **Weak Tornadoes** by clicking the box next to the layer name. If you receive a “Layer did not draw completely” message, click OK.




You see all the weak (F0 and F1) tornadoes that occurred between 1974 and 2003. Weak tornadoes cause very few deaths. Weak tornadoes can last from about 1 minute to 10 minutes. Their winds are from 40 to 112 miles per hour.

 **Q4: Which region had the fewest weak tornadoes between 1974 and 2003?**

- a. Midwest
- b. Northeast
- c. South
- d. West

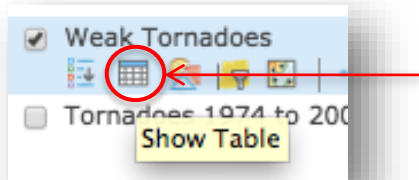
 **Q5:** Look at your “Historical Tornado” F-scale handout. Write down two examples of damage that occurs with F0 tornadoes.

- a. \_\_\_\_\_
- b. \_\_\_\_\_

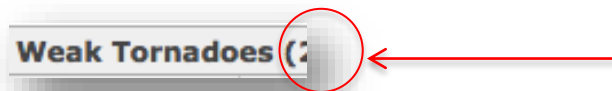
 **Q6:** Look at your “Historical Tornado” F-scale handout again. Write down two examples of damage that occurs with F1 tornadoes.

- a. \_\_\_\_\_
- b. \_\_\_\_\_

25. Click on the **Weak Tornadoes** layer name and click on the **Show Table** icon. This brings up the table of state tornado data.




26. Look at the number in the gray bar at the top of the table.



 **Q7:** How many weak tornadoes occurred in the United States between 1974 and 2003?

\_\_\_\_\_

 **Q8:** What percentage of all tornadoes, were weak? To answer this question, you will divide the number of weak tornadoes by the total number of tornadoes (you wrote this number down in Q3). Then you will multiply the answer by 100. You may need to use a calculator.

**Weak tornadoes ÷ total tornadoes = 0.\_\_\_\_ X 100 = \_\_\_\_ percent (without the decimal)**

27. Close the table of attributes.

### Task 5: Strong tornadoes.

Strong tornadoes are responsible for nearly one-third of all the deaths caused by tornadoes. Strong tornadoes can last 20 minutes or longer. Their winds are from 113 to 206 miles per hour.

How do the wind speeds of strong tornadoes compare to other speeds?

- a. A cheetah, the fastest land animal, can run as fast as 70 miles per hour.
- b. The fastest roller coaster in the world can go 120 miles per hour.
- c. The fastest road car can reach speeds of 240 miles per hour.
- d. The fastest NASA jet plane can travel up to 2,274 miles per hour.

28. Turn off the **Weak Tornadoes** layer by clicking the check mark next to the layer name.




29. Turn on the **Strong Tornadoes** by clicking the box next to the layer name. If you receive a “Layer did not draw completely” message, click OK.



You see all the strong (F2 and F3) tornadoes that occurred between 1974 and 2003.

 **Q9: Which region had the fewest strong tornadoes between 1974 and 2003?**

- a. *Midwest*
- b. *Northeast*
- c. *South*
- d. *West*

 **Q10: Look at the map. Does it look like there were more strong tornadoes or weak tornadoes from 1974 to 2003? (Hint: Turn the layers on and off to compare them.)**

- a. *More strong tornadoes*
- b. *More weak tornadoes*

 **Q11:** Look at your “Tornado F-scale” handout. Write down two examples of damage that occurs with F2 tornadoes.

a. \_\_\_\_\_

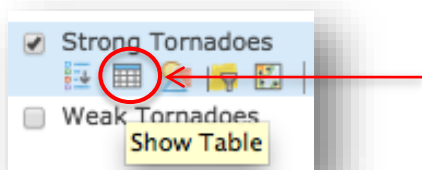
b. \_\_\_\_\_

 **Q12:** Look at your “Tornado F-scale” handout again. Write down two examples of damage that occurs with F3 tornadoes.

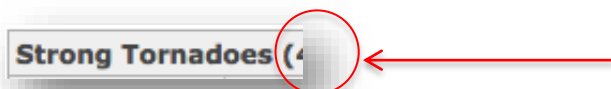
a. \_\_\_\_\_

b. \_\_\_\_\_

30. Click on the **Strong Tornadoes** layer name and click the **Show Table** icon.




31. Look at the number in the gray bar at the top of the table.



 **Q13:** How many strong tornadoes occurred in the United States between 1974 and 2003?

\_\_\_\_\_

 **Q14:** What percentage of all tornadoes were strong? To answer this question, you will divide the number of strong tornadoes by the total number of tornadoes (you wrote this number down in Q3). Then you will multiply the answer by 100. You may need to use a calculator.

**Strong tornadoes ÷ total tornadoes = 0. \_\_ \_\_ X 100 = \_\_ \_\_ percent (without the decimal)**

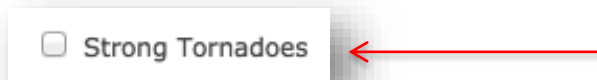
32. Close the table of attributes.

## Task 6: Violent tornadoes.

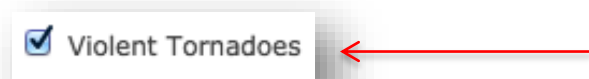
Violent tornadoes are responsible for more than two-thirds of all the deaths caused by tornadoes. A

violent tornado can last more than one hour. The winds from a violent tornado range from 207 to 318 miles per hour. The most violent tornadoes create the strongest known winds on earth!

33. Turn off the **Strong Tornadoes** layer by clicking the check mark next to the layer name.



34. Turn on the **Violent Tornadoes** by clicking the box next to the layer name.




You see all the violent (F4 and F5) tornadoes that occurred between 1974 and 2003.

 **Q15: Which region had the fewest violent tornadoes between 1974 and 2003?**

- a. Midwest
- b. Northeast
- c. South
- d. West

 **Q16: Which regions had the most violent tornadoes between 1974 and 2003? (Circle all the correct answers.)**

- a. Midwest
- b. Northeast
- c. South
- d. West

 **Q17: Were there more violent tornadoes or strong tornadoes from 1974 to 2003? Hint: Turn the layers on and off to compare them.)**

- a. More violent tornadoes
- b. More strong tornadoes

 **Q18: Look at your “Tornado F-scale” handout. Write down two examples of damage that occurs with F4 tornadoes.**

- a. \_\_\_\_\_
- b. \_\_\_\_\_

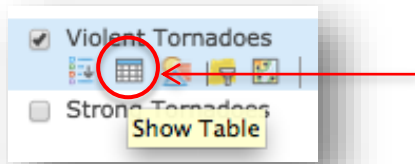
 **Q19: Look at your “Tornado F-scale” handout again. Write down two examples of damage**

that occurs with F5 tornadoes.

a. \_\_\_\_\_

b. \_\_\_\_\_

35. Click on the **Violent Tornadoes** layer name and click the **Show Table** icon.



36. Look at the number in the gray bar at the top of the table.



🌐 **Q20: How many violent tornadoes occurred in the United States between 1974 and 2003?**

\_\_\_\_\_

🌐 **Q21: What percentage of all tornadoes were violent? You already calculated the percentage of weak and strong tornadoes. Write those down here.**

Percentage of weak tornadoes: \_\_\_\_ percent (from Q8)

Percentage of strong tornadoes: \_\_\_\_ percent (from Q14)

Add these two numbers together: \_\_\_\_ percent

Subtract this number from 100%.

What is the percentage of violent tornadoes?

a. 1 percent

b. 2 percent

c. 3 percent

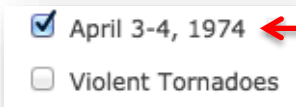
d. 4 percent

37. Close the table of attributes.

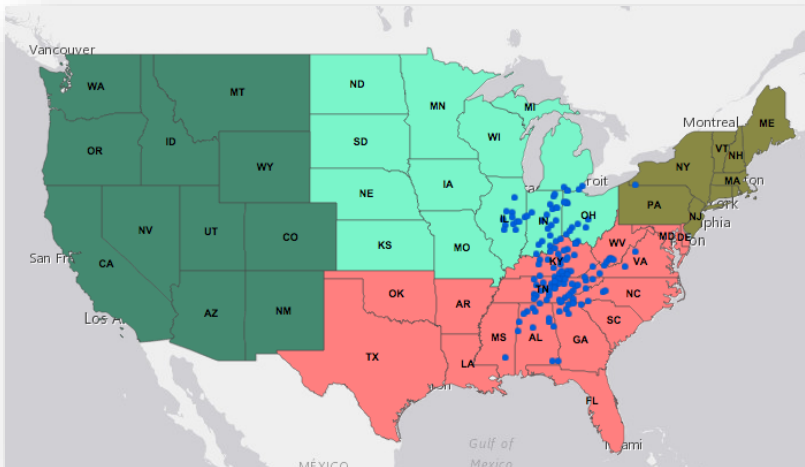
**Step 7: One of the most violent tornado outbreaks that we know about in History happened on April 3-4, 1974.**

38. Turn off the **Violent Tornadoes** layer.

39. Turn on the **April 3-4, 1974** layer.



Your map shows all the tornadoes that took place in these two days.



40. Turn on the **Cities 1** layer. You see the city of Xenia, Ohio, where the worst tornado during that time took place.

1. icon      41. Click on the **Cities 1** layer name and choose the **Show Table** . You see one

Cities 1 (1 feature, 0 selected)									Table Options ▼
FEATURE	NAME	ST_ABBREV	FIPS	PLACE_FIPS	POP_2000	STATUS	CLASS	ST	STFIPS
10,000 - 49,999	Xenia	OH	39057	86772		County Seat	City	OH	39

record (row) in the table.

42. Look at the POP\_2000 field. This field contains the population for the year 2000.

**Q22: How many people lived in Xenia in 2000?** \_\_\_\_\_

43. Close the table of attributes.

The tornado that hit Xenia was then classified as an F5. It destroyed half the town and caused 100 million dollars in property damage.

44. Take out the “Historical tornadoes” worksheet that your teacher gave you.

45. Look at the column called EVENT 1. There is a lot of information about the April 3–4, 1974, tornado outbreak. Use this information to answer the questions below.

🌐 **Q23: How many tornadoes occurred during this 24-hour period?** \_\_\_\_\_

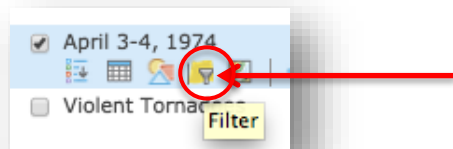
🌐 **Q24: How many states were affected?** \_\_\_\_\_

🌐 **Q25: How many F5 tornadoes occurred on April 3 and 4?** \_\_\_\_\_

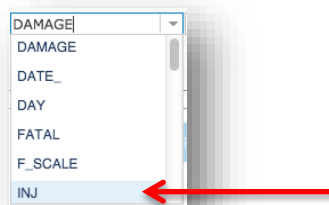
The total number of injuries and deaths is not filled in. You will use the GIS to get this information.

46. Turn off the **Cities 1** layer.

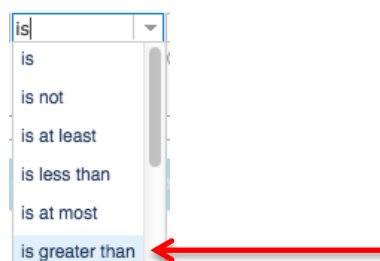
47. Click on the **April 3-4, 1974** layer name and choose the Filter icon.



48. Click the down arrow next to DAMAGE and choose **INJ**.

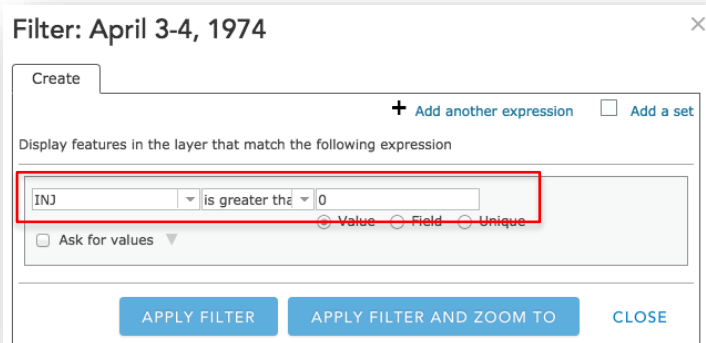


49. Choose “is greater than” in the second box.



50. The Value radio button is selected as the default in the third box. Type “0” in the third box.

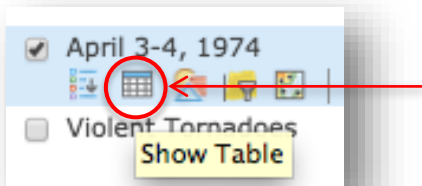
51. Your filter should look like this: “INJ” is greater than 0.



52. Click **Apply Filter**.


Only the tornadoes that had more than 0 (zero) injuries will now be shown in the table when you open it.

53. Click on the **April 3-4, 1974** layer name and click on the **Show Table** icon.

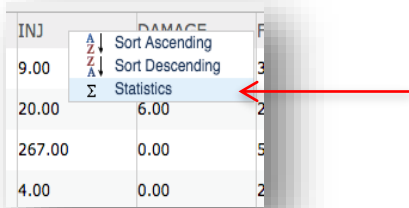


54. Look at the number in the gray bar at the top of the table.



 **Q26: How many tornadoes caused injuries? (Hint: Look at the number of records are now at the top of the table.)** \_\_\_\_\_

55. Scroll to the right in the table and click on the field heading **INJ**. Choose **Statistics**. A window with information opens.



INJ	DAMAGE	FATAL
9.00		3
20.00	6.00	2
267.00	0.00	5
4.00	0.00	2

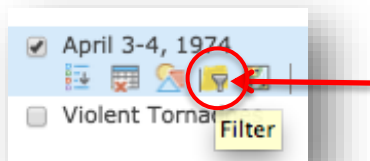
56. Look at the row that says **Sum of Values**.

 **Q27: What is the total number of injuries that occurred? Write this number on your "Historical tornadoes" worksheet.**

57. Close the **Statistics** window.

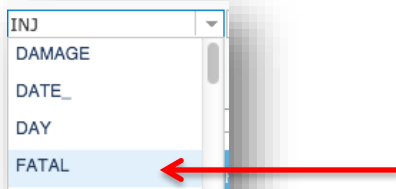
Now you will find out the total number of deaths that occurred.

58. Click on the **April 3-4, 1974** layer name and click on the Filter icon.



59. Click on the Edit tab.

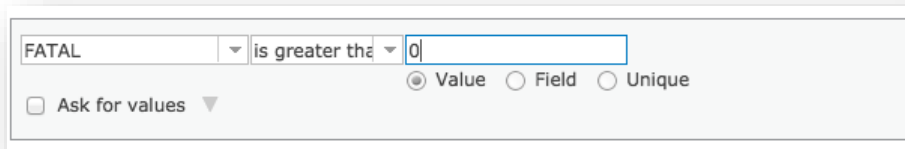
60. Click the down arrow next to **INJ** and choose **FATAL**.



61. Choose “is greater than” in the second box.

62. The Value radio button is chosen as the default for the third box. Type “0” in the third box.

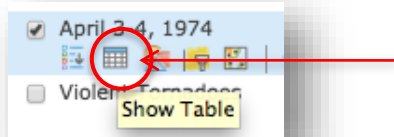
63. Your filter should look like this: “FATAL” is greater than 0.



64. Click **Apply Filter**.


You selected all the tornadoes that had more than 0 (zero) deaths.

65. If the table is closed, hover over the **April 3-4, 1974** layer and choose the **Show Table** button.

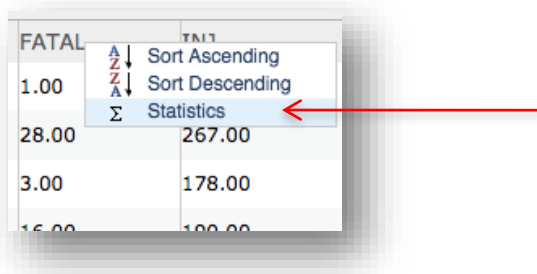


66. Look at the number in the gray bar at the top of the table.



 **Q28: How many tornadoes caused deaths? (Hint: Look at the number of selected records at the top of the table.)** \_\_\_\_\_

67. Scroll to the right in the table and click on the field heading **FATAL**. Choose **Statistics**. A window with a chart and other information opens.



68. Look at the row that says **Sum of Values**.


 **Q29:** *What is the total number of deaths that occurred? Write this number on your “Historical tornadoes” worksheet.*

69. Close the Statistics window.

70. Close the table of attributes.

71. Click on the **April 3-4, 1974** layer name and click on the **Filter** icon. Click on the **Remove Filter** button.

Now you have filled in the missing information for Event 1.

 **Q30:** *Look at your map, and look at your “Historical tornadoes” worksheet. Why do you think the tornado outbreak of April 3–4, 1974, is considered the most violent tornado outbreak in history? List two reasons.*

- a. \_\_\_\_\_
- b. \_\_\_\_\_

Notice that the total damage for this tornado outbreak was more than 600 million dollars. This is the amount it costs to launch the space shuttle!

## Task 8: The most costly tornado of all time occurred on May 3, 1999

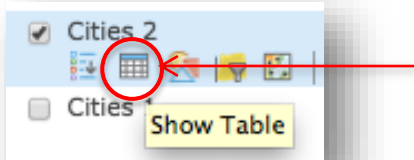
72. Turn off the **April 3-4, 1974** layer.

73. Turn on the **May 3, 1999** layer.

Your map shows 71 tornadoes that took place on that day.

74. Turn on the tornado **Cities 2** layer. You see the city of Moore, a suburb of Oklahoma City, Oklahoma. This is where the worst tornado of that time took place.

75. Click on the **Cities 2** layer name and click on the **Show Table** icon. There is one record (row) in the table.



 **Q31: How many housing units (houses) are in Moore?** \_\_\_\_\_

76. Close the attribute table.

The tornado that hit Moore destroyed more than 3,000 of these houses and caused one billion dollars in damage.

77. Click on the **May 3, 1999** layer name and click on the **Show Table** icon.

78. Scroll to the **F\_SCALE** field (column).

79. Click on the **F\_SCALE** field header and choose **Sort Descending**. This reorders the tornadoes from the highest F-scale to the lowest F-scale.

 **32: What is the F-scale of the strongest tornado on this day?** \_\_\_\_\_

80. Click the first record to highlight it in the table. It is also highlighted on the map.

81. Look at the map on your screen.


You see a blue box around a dot representing the F5 tornado very close to a white square representing the suburb of Moore. This F5 tornado hit the suburb of Moore on May 3, 1999.

While moving through the area, this F5 tornado created a visible path called a track.


- You can estimate how far this tornado traveled by measuring the length of its track.
- You can estimate the width of this tornado by measuring the width of its track.

82. In the Table, scroll back until you see the **LGTH** field.

The numbers in this field represent tenths of a mile. That means that you need to divide the number in the table by 10 to get the actual length (Example:  $146 \div 10 = 14.6$  miles).


 **Q33: How far did this F5 tornado travel? Divide the answer by 10.**  
**Length value in table =  $\_\_\_ \div 10 = \_\_\_.$  miles**

83. In the **Table**, click on the **LGTH** name and choose **Sort Descending**. This reorders the tornadoes from the longest track to the shortest.


 **Q34: Did this F5 (highlighted) tornado have the longest track of any tornado that occurred that day (May 3, 1999)?**  
**a. Yes**  
**b. No**

84. In the Table, find the **WIDTH** field (it is right next to the **LGTH** field).

The numbers in this field represent tens of feet. That means that you need to multiply the number in the table by 10 to get the actual length (Example:  $528 \times 10 = 5,280$  feet or 1 mile). Tornadoes can be more than a mile wide.

 **Q35: What was the width of the F5 tornado?**  
**Multiply the answer by 10. (You can ignore the number after the decimal.) Width value in table =  $\_\_\_ \times 10 = \_\_\_\_\_$  feet**

85. In the Table, click **WIDTH** and choose **Sort Descending**. This reorders the tornadoes from widest to the narrowest.

 **Q36: Was this F5 tornado you identified in Step 76 the widest tornado that occurred that day?**  
**a. Yes**  
**b. No**

 **Q37: How many tornadoes were wider? \_\_\_\_\_**

86. Look at your **Historical tornadoes** worksheet.

87. Look under the column called **EVENT2**.

You see many details of the May 3, 1999, tornado outbreak.

Notice that the number of states, the names of states, and the regions affected are filled in.

 **Q38:** *How many states were hit by tornadoes on May 3, 1999? Write your answer on your Historical tornadoes worksheet.*

 **Q39:** *Look at the map and identify the region(s) that the tornadoes on May 3, 1999 were located in. Write your answer on your Historical tornadoes worksheet.*

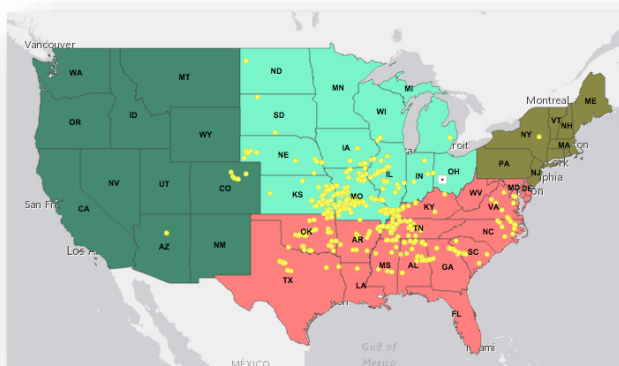
Now you have filled in the missing information for Event 2.

You can see on your worksheet that the total damage for the May 3, 1999, tornado outbreak was 1.6 billion dollars. The single F5 tornado that hit the Oklahoma City suburb of Moore caused on billion dollars in damage all by itself—it was one of the most expensive tornadoes of its time.


**Task 9: More tornadoes occurred between May 1 and May 10, 2003, than any other ten-day period since record keeping began.**

88. Turn off the **May 3, 1999** layer.

89. Turn on the **May 1-10, 2003** layer.



Your map shows nearly 400 tornadoes that hit the central and southern United States from May 1-10, 2003.

 **Q40:** Look at your map. Describe in your own words how this tornado outbreak looks different from outbreak of April 3-4, 1974 you have already looked at and the outbreak of May 3, 1999. (Hint: Turn the April 3-4, 1974 and May 3, 1999 layers on and off to compare them to the May 1-10, 2003 tornado outbreak. How far do the tornadoes extend in all directions? Which regions and states were hit?)

---

---

---

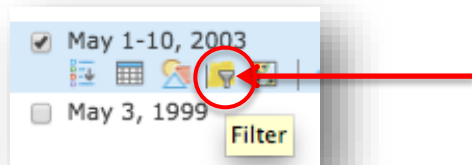
90. Take out your “Historical tornadoes” worksheet.

91. Look at the column called EVENT 3.

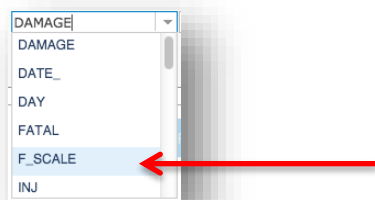
You see information about the tornado outbreak of May 1 to May 10, 2003.

On your worksheet, the F-scale and total number of strong and violent tornadoes information is missing. You will use the GIS to get this information.

92. Click on the **May 1-10, 2003** layer name and click on the **Filter** icon.



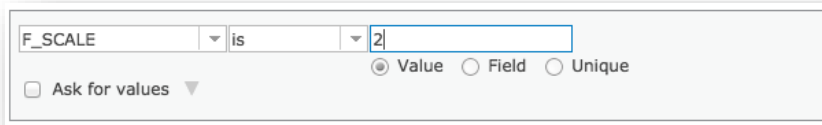
93. Click the down arrow next to **DAMAGE** and choose **F\_SCALE**.



94. Choose “is” in the second box.

95. The Value radio button is the default in the third box. Type “2” in the third box.

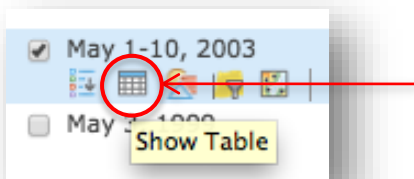
96. Your filter should look like this: “**F\_SCALE**” is 2.



97. Click **Apply Filter**.

You selected all the tornadoes that had an F Scale that is equal to 2.

98. Click on the **May 1-10, 2003** layer name and click on the **Show Table** icon.



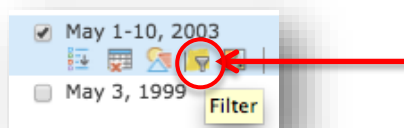
99. Look at the number in the gray bar at the top of the table.



 **Q41:** *How many F2 tornadoes occurred between May 1 and May 10, 2003? Write the number on your “Historical tornadoes” worksheet.*

Now you will change the filter to find out the number of F3 tornadoes.

100. Click again on the **May 1-10, 2003** layer name and click on the **Filter** icon.



101. Click on the **Edit** tab.

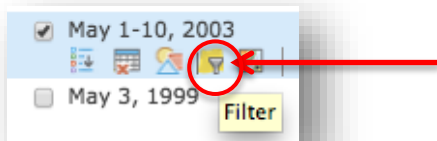
102. Change the number “2” in the third box to “3”.
103. Your filter should look like this: “F\_SCALE” is 3.
104. Click **Apply Filter**.
105. Look at the results in the gray bar at the top of the table of attributes.



 **Q42: How many F3 tornadoes occurred between May 1 and May 10, 2003? Write the number on your “Historical tornadoes” worksheet.**


Now you will change the filter to find out the number of F4 tornadoes.

106. Hover again over the **May 1-10, 2003** layer and click on the **Filter** button.



107. Click on the **Edit** tab.
108. Change the number “3” in the third box to “4”.
109. Your filter should look like this: “F\_SCALE” is 4.
110. Click **Apply Filter**.
111. Look at the results in the gray bar at the top of the table of attributes.



 **Q43: How many F4 tornadoes occurred from May 1-10, 2003? Write the number on your “Historical tornadoes” worksheet.**

112. There were no F5 tornadoes that took place, so write “0” on your handout.

Now that you know the number of F2, F3, F4, and F5 tornadoes, you can use simple addition to find out the number of strong and violent tornadoes. You learned that strong tornadoes have an F-scale of 2 or 3, and violent tornadoes have an F-scale of 4 or 5.

 **Q44: Add the number of F2 and F3 tornadoes together.**

\_\_\_ (number of F2s) + \_\_\_ (number of F3s) = \_\_\_ Strong tornadoes. Write this number on your “Historical tornadoes” worksheet.


 **Q45: Add the number of F4 and F5 tornadoes together.**

\_\_\_ (number of F4s) + \_\_\_ (number of F5s) = \_\_\_ Violent tornadoes. Write this number on your “Historical tornadoes” worksheet.

113. Close the table of attributes.

You have filled in the missing information for Event 3.

Your worksheet shows that the total damage for this tornado outbreak was 3.4 billion dollars, more than the previous two events combined.

 **Q46: Look at your “Historical tornadoes” worksheet. Why do you think the 2003 tornado outbreak caused more damage than the other two outbreaks? Discuss this with your classmates, and write your answer here.**

---

---

---

### **Task 10: Save your work and exit ArcMap.**

114. Ask your teacher where and how to save your work.

115. Close the ArcGIS Online browser tab.

### **Conclusion:**

Tornadoes and other natural disasters are events that affect many people in the United States. People are working together to create more effective warning and tracking systems for these disasters in hopes of saving lives.

GIS is one of many tools that help researcher and scientists make educated and effective decisions on predicting when and where these weather patterns will form as well as assist in the recovery process after a disaster has struck.

## Module 4, Lesson 2

# Analyzing historical tornadoes

### Worksheet: Historical tornadoes

	Event 1	Event 2	Event 3
Date	April 3-4, 1974	May 3, 1999	May 1-10, 2003
Why is it remembered?	Largest outbreak	Most expensive single tornado	More tornadoes than any other 10-day period
Total number of tornadoes	148 tornadoes	71 tornadoes	401 – 412 tornadoes
Cities most affected	Xenia, Ohio	Moore, Oklahoma, (suburb of Oklahoma City)	Kansas City, Kansas; Oklahoma City, Oklahoma; Pierce City, Missouri; Jackson, Tennessee
Total number of states	13 states	_ states	26 states
Names of states	Alabama, Georgia, Illinois, Indiana, Kentucky, Michigan, Mississippi, New York, North Carolina, Ohio, Tennessee, Virginia, West Virginia	South Dakota Nebraska Kansas Oklahoma Texas	Alabama, Arizona, Arkansas, Colorado, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Michigan, Mississippi, Missouri, Nebraska, New York, North Carolina, North Dakota, Oklahoma, South Carolina, South Dakota, Tennessee, Texas, Virginia, Wisconsin
Regions	Midwest, Northeast, South		Midwest, Northeast, South, West
F-scale	F2 = 34 F3 = 33 F4 = 23 F5 = 7	F2 = 7 F3 = 6 F4 = 3 F5 = 1	F2 = F3 = F4 = F5 =
Total number of strong and violent tornadoes	Strong = 67 Violent = 30	Strong = 13 Violent = 4	Strong = Violent =
Total number of injuries	injuries	825 injuries	637 injuries
Total number of deaths	deaths	46 deaths	40+ deaths
Total damage in dollars	>600 million	1.6 billion	3.4 billion

## Module 4, Lesson 2

# Analyzing historical tornadoes

---

### Worksheet: Historical tornadoes

Tetsuya T. Fujita, also known as “Mr. Tornado,” invented the Fujita Scale (F-scale) at the University of Chicago in the early 1970s. The F-scale describes different levels of damage caused by tornadoes based on their estimated wind speeds. The scale goes from light damage (F-0) to incredible damage (F-5).

F-scale	Wind speed (miles per hour)	Damage
F0	40-72 mph	<b>Light damage</b> —Some damage to chimneys; breaks twigs and tree branches; pushes over some trees; damages signboards; breaks some windows
F1	73-112 mph	<b>Moderate damage</b> —Peels surfaces off roofs; mobile homes pushed off foundations; moving autos pushed off the roads; trees snapped or broken
F2	113-157 mph	<b>Considerable damage</b> —Roofs torn off houses; mobile homes destroyed; some houses lifted and moved; railroad cars pushed over; large trees snapped or pulled out; light objects take flight
F3	158-206 mph	<b>Severe damage</b> —Roofs and walls torn off houses; whole trains turned over; most forest trees pulled out; heavy cars lifted off the ground and thrown; pavement blown off roads
F4	207-260 mph	<b>Devastating damage</b> —Houses flattened; weak buildings blown some distance; cars thrown and destroyed; large objects take flight; forest trees pulled out and blown away
F5	261-318 mph	<b>Incredible damage</b> —Strong houses lifted and blown away; objects the size of autos fly through the air; bark blown off trees; incredible things happen