



CHIMNEY TOPS 2 FIRE

A hands-on GIS project



THE CHIMNEY TOPS 2 FIRE

Chimney Tops is one of the few peaks in our Great Smoky Mountains National Park (GSMNP) that has a bare rock summit. The hiking trail that leads up to the summit is one of the most popular trails in the park because it offers outstanding panoramic views.

On November 23, 2016, a fire started on Chimney Tops. The steep and rocky terrain hindered efforts to fight the fire. All was under control until November 28th, when a strong front entered the region and generated extreme southeasterly winds. The strong winds caused the fire to grow rapidly and carried burning embers over long distances. Exceptional regional drought conditions across the region allowed settling embers to ignite new fires. Together, the original and subsequent fires burned substantial portions of the park and of the towns Gatlinburg and Pigeon Forge, Tennessee. At least 14 people were killed.

THE CHIMNEY TOPS 2 FIRE PROJECT

This GIS project offers you a complete hands-on learning experience. It will expose you the type of workflow that a seasoned GIS Analyst or a [GISCorps](#), [Humanitarian OSM](#), or [Google Crisis Response](#) volunteer would use during and after a disaster. This GIS project also offers you opportunities to visualize the wildfire and to assess its destructive power.

The typical GIS workflow requires you to obtain relevant data from trusted data providers, to prepare the data for analysis, to conduct tabular and spatial analyses, and to report and interpret the results. It all starts, however, with a question.

START WITH A QUESTION – A QUESTION DIRECTS YOUR PURPOSE

A well-formed question identifies what we want to learn and clearly establishes the purpose of our project (i.e., to answer the question). Our research question is:

How did the Chimney Tops 2 Fire affect people, property, and forest?

OBJECTIVES HELP US TO FOCUS OUR WORK

Objectives are simple statements that declare what we need to gather, create, derive, predict, or infer in order to answer our question. If you think about it, there must be a 1000 different paths we could take to answer the question above. We must therefore choose our objectives. Here's six:

First – before we can do anything - we need to know when and where the Chimney Tops 2 Fire started and how much area was affected by its end.

Second, we cannot let a fire just blaze hazily in our minds – it has to be grounded in context. So, we need some generally recognizable reference information to develop a sense of place.

Third, we need to assess how people were affected by the fire. We know we can easily get *pre-fire* demographic and economic data from the US Census Bureau. Not much time has passed since the fire though, so there's not going to be much *post-fire* data available (yet).

Fourth, we need to assess how the fire affected property. Where are these properties located? How many properties are we talking about?

Fifth, we need to assess damage to the forest. We need to know how much forest cover existed before the fire, how much was moderately or deeply burned, *and how much change occurred.*

And sixth, we must marshal our best evidences to build a compelling story that answers the research question.

LAB 5: GETTING STARTED & ESTABLISHING A SENSE OF PLACE

We cannot go back in time and re-experience the fire, but we can gather pre- and post-fire data, build a GIS to analyze and visualize those data, and then draw information from observed changes over time. For Lab 5, I want you learn how to: a) use “raw” data obtained from trusted data providers; b) prepare those data for analysis; and c) develop a sense of this Tennessee place.

Advice: *Read everything before doing anything* so you can visualize your workflow and anticipate what comes next. I also recommend printing this handout and taking notes on it as you work. Write down the name of every file you download, what it represents, and from where it came. Take notes as you make new data with your geoprocessing tools. You will appreciate your notes after you take breaks and as you write.

TASK 0: PREPARE A WORKSPACE FOR THE PROJECT

Create a folder for the Chimney Tops 2 Fire project. In it, create: a) a subfolder called “rawData” to store anything you download; and create b) a new file geodatabase to store all of your prepared spatial data. Name your geodatabase `chimneyTops2_<put your initials here>.gdb`

TASK 1: CHOOSE AN APPROPRIATE SPATIAL REFERENCE SYSTEM

Several of our analyses requires us to calculate areas. Fortunately, our study area fits completely within Tennessee’s State Plane mapping zone (see Lab 4 and Bolstad, 2016: p126). So, we’ll use the **metric (NAD83) State Plane Tennessee** spatial reference system (i.e., a projection of NAD83 coordinates) to support our work. Geospatial data representing Tennessee entities (via vectors) or fields (via rasters) that are mapped onto Tennessee’s mapping zone will contain negligible area, length, or tilt distortions.

TASK 2: VISIT TRUSTED DATA PROVIDERS AND SELECT RELEVANT DATA (BOLSTAD, CH. 7)

National park boundary data from the National Park Service

<https://irma.nps.gov/DataStore/>

The National Park Service publishes digital data for all of your national parks. Use your NPS Data Store to find and download the national shapefile of national **park boundaries**.

Population boundary data from the US Census Bureau

<https://www.census.gov/geo/maps-data/data/tiger-cart-boundary.html>

We need polygon data to represent our study area. Access the US Census Bureau to download the 1:500,000 scale and 2017-vintage (or latest available) shapefiles with **State** and **County** polygons.

Chimney Tops 2 Fire data, Tree Canopy data, and a piece of our National Elevation Dataset

<https://webpace.ship.edu/sadrzy/geo363/>

Some of the data we need are not easily accessible or come in massive files, so I assembled anything that required a user account, a researcher’s credentials, or a lot of pre-processing.

Check yourself – at this point, you should have downloaded four (4) ZIP files. Unzip your ZIP files and inspect your spatial data with ArcCatalog.

Question 1: Build a table that presents the name of each spatial dataset that you downloaded and the spatial reference system associated with it. See Table 1 below for an example. (4 pts)

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Table 1: Metadata for the raw data I downloaded.

Dataset title	Data provider	Initial datum /GCS	Projection method* (if any)	Planar Coord. Sys.* (if any)
Title (not filename)	Who made it?	See properties	See properties If none, then "NA"	See properties If none, then "NA"

* If applicable.

TASK 3: PREPARING YOUR SPATIAL DATA FOR ANALYSIS VIA ARCCATALOG

I very strongly recommend doing all of your work in **ArcCatalog**. You can use ArcCatalog to preview each **Geography**, to preview each attribute **Table**, and to consult their metadata **Description**. You can also access the entire toolbox within ArcCatalog. Do NOT use ArcMap.

First, find your US state shapefile, right-click it, then **Export** only the Tennessee state polygon into your geodatabase (SQL expression: "STATEFP" = '47').

Next, **Export** from your US county shapefile (to your geodatabase) the polygon for Sevier County, TN (SQL expression: "STATEFP" = '47' AND "NAME" = 'Sevier').

Next, **Export** from your parks shapefile (to your geodatabase) only the polygon for the GSMNP (SQL expression: "UNIT_NAME" = 'Great Smoky Mountains National Park').

Question 2a: Preview the attribute table of your new **Sevier County** polygon. What is the value stored in the Shape_Area field? (2 pts) Look at your spatial reference system if you forgot which units of measure you're using.

Next, use the **Project** tool to project all three polygons (from NAD83) onto Tennessee's State Plane mapping system. Direct all output to your geodatabase. Do not make shapefiles; make geodatabase feature classes.

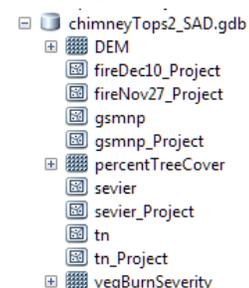
Question 2b: Preview the attribute table of your projected **Sevier County** polygon. What is the value stored in the Shape_Area field? Convert your result into sq.km (and sq.mi in parentheses). (2 pts)

Check yourself – at this point, your geodatabase should contain six (6) feature classes: three (3) unprojected [tn, sevier, gsmnp] and three (3) projected [tn_project, sevier_project, gsmnp_project].

Next, you're going to prepare the data that I assembled for you. Use the GIS workflow illustrated in Figure 1 (page 6) to either **Project** your vectors or to **Project Raster** directly into your geodatabase. Unlike last time, there's no need to import-and-then-project because you aren't re-selecting any features.

Check yourself – at this point, your geodatabase should contain:

- 3 unprojected feature classes [tn, sevier, gsmnp],
- 5 projected feature classes [tn_project, sevier_project, gsmnp_project, fireNov27_project, fireDec10_project],
- and 3 projected rasters [DEM, percentTreeCover, vegBurnSeverity].



Question 3: Both of your projected fire perimeter polygons should, if they're in your geodatabase, contain Shape_Area values. Report the dates and the areas of these features in sq.km (and sq.mi) (3 points)

Question 4: The **Vegetation Burn Severity** raster holds integer codes and, so, has a raster attribute table. Consult your metadata **Description** and the raster attribute **Table**. What does each severity code mean? (3 points)

TASK 4: ESTABLISHING A SENSE OF PLACE USING CENSUS JOBS DATA

Tabular economic data from the US Census Bureau

<https://onthemap.ces.census.gov/>

The US Census Bureau's *OnTheMap* application is useful for pulling jobs data. We're going to pull two (2) sets of jobs data: 1) for the whole State of Tennessee and 2) for just the area affected by fire.

- A. Start by using either the Chrome or the Firefox browser (Internet Explorer has trouble OnTheMap) and follow the URL above.
- B. **Search** among **States** for *Tennessee*; then click the result so the map will zoom to *Tennessee*.
- C. Next, find the pop-up balloon and follow the link to **Perform Analysis on the Selection Area**:
- D. Customize your **Analysis Settings**:
 - a. Home/Work Area: **Work**
 - b. Analysis Type: **Area profile** with the Labor Market Segment: **All workers**
 - c. Year: **2015**
 - d. Job type: **Primary jobs**
 - e. **[GO!]**
 - i. After results appear, use the left-side menu to make a **Detailed Report**, which you can **Export** to Microsoft Excel® format for later use.

Refresh your browser to reload the *OnTheMap* app.

- A. This time, rather than searching among known census geographies, we're going to use the **Import Geography** option to focus on the final burned area.
- B. **Import from SHP**
 - a. When prompted, use the correct parts of the **GSMNP_FireBoundary_20161210** shapefile.
 - b. **[Import]**
- C. Jump through a few hoops
 - a. **Select All Polygons**
 - b. **Continue with Selected Features**
 - c. **[Confirm Selection]**
- D. Find the pop-up balloon and follow the link to **Perform Analysis on the Selection Area**:
- E. Customize your **Analysis Settings**:
 - a. Home/Work Area: **Work**
 - b. Analysis Type: **Area profile** with the Labor Market Segment: **All workers**
 - c. Year: **2015**
 - d. Job type: **Primary jobs**
 - e. **[GO!]**
 - i. After results appear, use the left-side menu to make a **Detailed Report**, which you can **Export** to Microsoft Excel® format for later use.

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GIS2 Lab 5 (Part 1 of 3)

Question 5: Using the employment data you downloaded for the State of Tennessee and the area affected by fire, develop a sense of place by comparing and contrasting the economic base of the pre-fire state and pre-fire local economies. The raw job numbers for the state will - obviously - be larger than the raw job numbers for a small area inside a county, so it makes zero sense to compare absolute values. Focus, instead, on comparing relative shares (%) or the relative concentrations (LQ) of each local employment sector compared to each state employment sector. Students that have completed or are taking *Economic Geography* already know how to calculate and interpret Location Quotients. Others can learn from Emsi (2012) how to measure relative concentration with Location Quotients. (6 points)

DELIVERABLES

Build a well-written report for Lab 5. Include your name, date, and lab title on the first page. Insert page numbers. Your report should be printed on letter size paper. Set all page margins to be 0.7” except for the left margin, which should be set to 1.2.” Use 1.5 line spacing, set the normal font face to be Candara, Book Antiqua, Bookman Old Style, or Georgia, and set the normal font size to be 11 points.

Your report should include five sections with bold and left-justified headings: Purpose, Objectives, Methods and Data, Results and Answers, and Summary. Your *Purpose* and your *Objectives* sections should be written in your own words and must address the specific purpose and the specific objectives of Lab 5 (and not the general purpose or all the objectives of the entire project).

Your *Methods and Data* section will be relatively short because you used only a few tools to handle all the pre-processing. To help you streamline this section even more, build a table that highlights your input data files, your output geodatabase objects, and the tool you used to handle the coordinate projections.

Table 2: Data processing with projection tools.

Input file name	Output raster or output feature class in my geodatabase	The tool I used
Aaaaaaaaaaaa.img	Aaaaaaa_project	Project Raster
Bbbbbbbbbbbb.shp	Bbbbbbb_project	Project
...		
Zzzzzzzzzzzz.xyz		

The *Results and Answers* section should include answers to the questions posed during the lab. Support your claims with evidence, examples, or supporting tables or figures. Always, always, always report your units of measure.

In your *Summary*, discuss what you learned. Also, describe any “light bulb” moment(s) that occurred while you worked. These can include moments when the mental light bulb shined brighter or dimmer.

You want your report to look professional. Proofreading, paying attention to details, and applying a consistent style throughout are effective ways to achieve a professional result. All tables and figures must be numbered, have captions, and be referenced in your text. Table and figure captions should not be orphaned and, when appropriate, should identify units of measure. All tables and figures must be inserted inline with your text. Add a line space before and after each table to buffer them from your adjacent paragraphs. Table columns that contain text strings ought to be left-justified. Table columns that contain numbers should be right-justified with all decimal points aligned (i.e., all values should have the same level of decimal precision). Table records should be sorted in a meaningful way (i.e., ascending or descending by value, not by alphabet).

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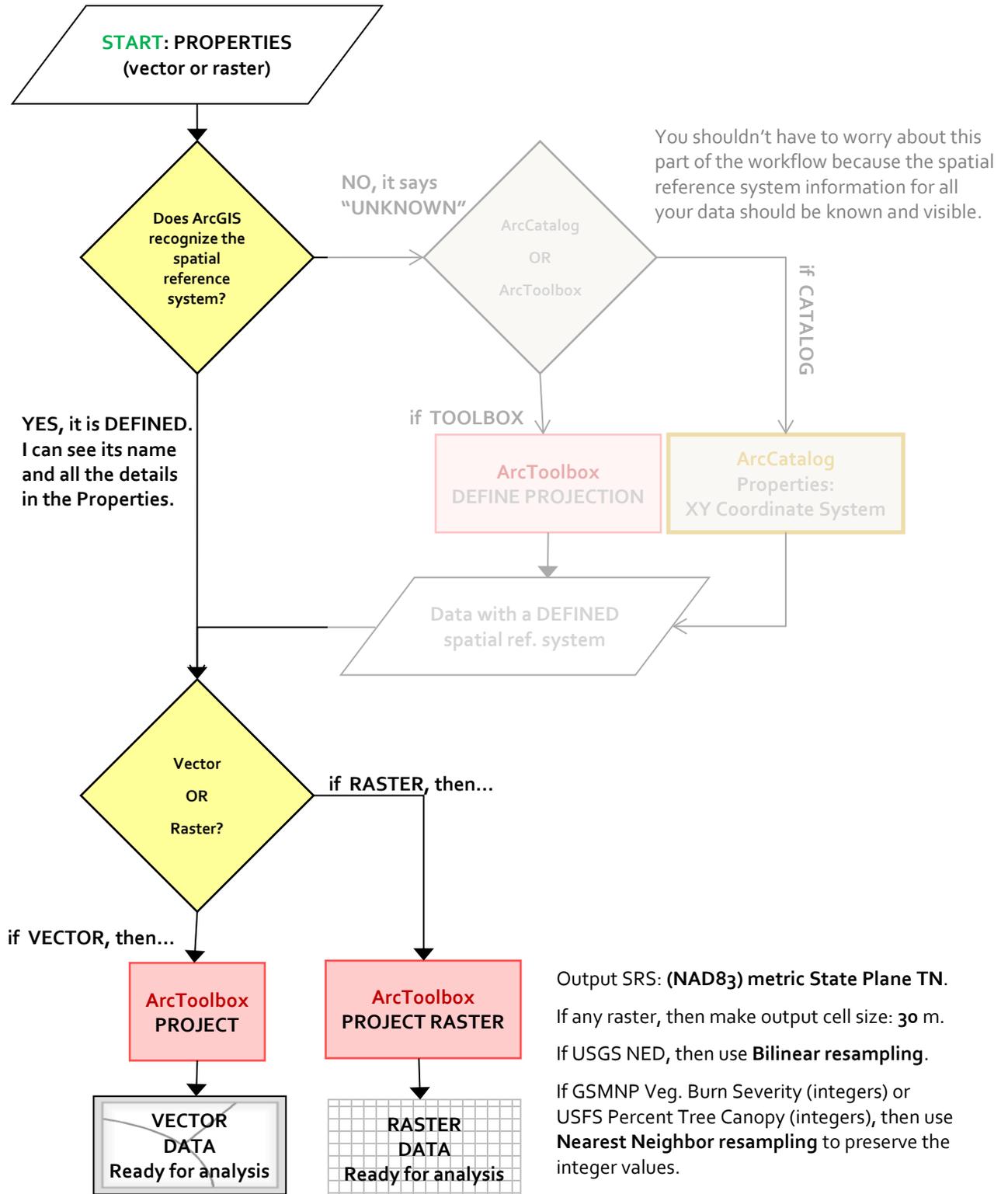


Figure 1. This GIS workflow ensures your geospatial data are plotted on your desired spatial reference system.

DATA AND REFERENCES CITED

- Emsi. 2012. *What is Location Quotient?* [Internet]. YouTube.com; [cited 2017 Nov. 10]. Available from <https://youtu.be/Ri6HPshDnWQ>
- National Park Service. 2016. *Chimney Tops 2 Fire Boundary, Dec. 10, 2016*. National Park Service, Emergency Response Team. Data available from the NPS Integrated Resource Management Applications portal, <https://irma.nps.gov/Portal>
- National Park Service. 2016. *Chimney Tops 2 Fire Boundary, Nov. 27, 2016*. National Park Service, Emergency Response Team. Data available from the NPS Integrated Resource Management Applications portal, <https://irma.nps.gov/Portal>
- National Park Service. 2016. *Vegetation Burn Severity Resulting from the Chimney Tops 2 Fire*. National Park Service, Emergency Response Team. Data available from the NPS Integrated Resource Management Applications portal, <https://irma.nps.gov/Portal>
- Taylor, Richard. 2010. *what is sense of place*. [Internet]. YouTube.com; [cited 2017 Nov. 10]. Available from <https://youtu.be/CHvhzq-Ovj4>
- US Census Bureau. 2016. *Cartographic Boundary Shapefiles – most recent vintage*. US Census Bureau. Data available at <https://www.census.gov/geo/maps-data/data/tiger-cart-boundary.html>
- US Census Bureau, Center for Economic Studies. 2016. *OnTheMap*. [Internet] onthemap.ces.census.gov; [cited 2017 Nov. 10]. Available from <https://onthemap.ces.census.gov/>
- US Department of Agriculture. 2014. *NLCD2011 USFS Tree Canopy Cartographic*. US Department of Agriculture, Forest Service Remote Sensing Applications Center. Data available at https://www.mrlc.gov/nlcd11_data.php
- US Geological Survey. 2016. *National Elevation Dataset (NED), 1 arc-second DEM*. U.S. Geological Survey, Long Term Archive. Data available at <https://lta.cr.usgs.gov/NED>
- Western Carolina University. 2014. *Ron Rash | Sense of Place* [Internet]. YouTube.com; [cited 2017 Nov. 10]. Available from <https://youtu.be/w6X1zqf-4wk>