

# **GIS Analysis of Covid-19 and Wildfire Smoke in California**

**by Charlie Perez**

## **Abstract:**

The 2020 wildfire season has been historically bad in the state of California, sending plumes of smoke into the air and around the country. As we all are too familiar with by now, 2020 has also been marred by the Covid-19 pandemic spreading across the globe. Looking at spatial analysis maps of the extent of wildfire smoke in California compared to Covid-19 cases in California, there seems to be a correlation between the two. Covid-19 and wildfire smoke also affect the human body similarly, have similar symptoms, and pose the most significant risk to similar groups. There is also literature to support the idea that cigarette smoke can aid in the transmission of Covid-19 particles; there is an overlap in the size makeup of wildfire smoke and cigarette smoke. All of these factors beg the question: does the presence of wildfire smoke exacerbate the concentration, spread, and transmission of Covid-19 in an area? This is the question this study's research will aim to answer. Utilizing a spatial analysis software called ArcGIS Pro, I will compare the concentration of Covid-19 in an area to several other factors to determine to what extent wildfire smoke impacts the transmission of Covid-19.

**Introduction:**

As Covid-19 proliferates across the planet, scientists are racing to slow the spread and create a vaccine. A number of different factors have been thought to increase the spread rate of Covid-19; this work will focus on wildfire smoke as a transmission agent. This project will be focused on the intersection of environmental hazards and public health, focusing specifically on wildfire smoke and Covid-19 cases in the state of California. The convergence of wildfire smoke and Covid-19 in California seems to suggest that there is a correlation between the two factors; this research will aim to determine if there is correlation and to what extent that correlation exists. Looking at maps comparing the presence of wildfire smoke to the number of Covid-19 cases in an area, it is easy to ask the question: does wildfire smoke play a part in exacerbating the spread of Covid-19?

**Background:**

Much research regarding Covid-19 has been conducted in the past months as the world rushes to contain the disease. The research that inspired this project consisted of information relating to how Covid-19 and wildfire smoke affect the human body, as well as research relating to smoke as a transmission agent for Covid-19 particles.

Covid-19 affects the body by attacking epithelial (surface level) cells in the airways which prevents the body from filtering out debris that then block these airways, leading to commonly known symptoms like coughing and shortness of breath<sup>1</sup>. This infection of

the lungs can lead to ARDS – Acute Respiratory Disease Syndrome – which is when the lungs are unable to filter carbon dioxide from the blood efficiently<sup>1,2</sup>. It has also been determined that Covid-19 poses the most significant risk to the elderly and those with preexisting conditions<sup>3,6,9,11,12</sup>.

The emergence of Covid-19 didn't occur in a vacuum; there are still many other ongoing problems in the world. The focus of this work will be wildfires, specifically those in California. 2020 has been one of the most intense wildfire seasons<sup>4,5,7</sup>, with meteorologists explaining that it is, “the worst fire season in the history of California.”<sup>4</sup> Aside from their massive size, these fires also pose an additional threat when combined with the Covid-19 pandemic. The outdoors has been an area of refuge for many Californians during the pandemic, but this is now threatened due to smoke from the wildfires. The main risk that wildfires pose to humans comes in the form of wildfire smoke; composed of ultrafine particles capable of lacerating the insides of your lungs, wildfire smoke leads to many of the same symptoms associated with Covid-19. It also poses the most significant risk to similar groups: the elderly and those with preexisting conditions<sup>6,9</sup>.

There has also been research on how second- and thirdhand cigar and cigarette smoke and vapors from vape devices can transmit Covid-19 particles<sup>11</sup>. Secondhand smoke is smoke produced by people around you smoking. Thirdhand smoke is this same smoke that hangs around after cigar/ cigarette/ vape devices have been extinguished. Research has shown that coronaviruses with diameters of just 0.1 micron can latch onto particles in

second- and thirdhand smoke and be carried around, putting others at risk<sup>10</sup>. I conducted additional research into the composition and makeup of cigarette smoke and compared it to the composition and makeup of wildfire smoke and found an overlap. Cigarette smoke consists of particles 0.01 to 1.0 microns in diameter<sup>13</sup>. Wildfire smoke is made up of particles 2.5 microns or less<sup>14</sup>. This overlap in particle size suggests that smoke is capable of exacerbating the spread of Covid-19. The similarity in the symptoms associated with Covid-19 and wildfire smoke inhalation also leads me to believe that being affected by one of these factors puts you at a greater risk to the effects of the other factor.

I will be focusing my research on the state of California for three key reasons. First, keeping my searches limited to a relatively small area will help my research be more robust, allowing for more in-depth information to be found. Second, California is being hit incredibly hard by both wildfires and Covid-19 compared to other states in our nation, and so will provide a wealth of research material to garner answers from. Third, I am from California, and it is where I currently reside, so the welfare of the state is of special interest to me.

### **Methods:**

I will use the spatial analysis software ArcGIS Pro to analyze the number of Covid-19 cases in a given area in California compared to a number of other factors, including the presence of wildfire smoke, to see if wildfire smoke exacerbates the spread of Covid-19. The factors I will be analyzing in comparison to Covid-19 will include the presence of wildfire smoke, the general age range of an area, as well as the prevalence of people with

preexisting conditions in an area. These factors were chosen in light of the groups most at-risk to Covid-19. The reason I am analyzing multiple factors, rather than just wildfire smoke vs. Covid-19, is so I can be sure that the co-occurrence of Covid-19 cases and wildfire smoke is not just happenstance. If wildfire smoke coincides with the uptick in Covid-19 cases in areas regardless of the age range or number of people with preexisting conditions in that area, then it can be more safely assumed that wildfire smoke does in fact exacerbate the spread of Covid-19.

This will be accomplished utilizing the software ArcGIS Pro, a professional spatial analysis software. GIS (geographic information system) programs allow users to analyze numerous layers of information in an area utilizing maps, and so will be perfect for my research plan. This past semester I was enrolled in an Introduction to GIS course, and will be putting the skills I learned in class to use in my research. My methods will be as follows:

1. Familiarize myself with ArcGIS Pro; in Intro to GIS class, we used free programs capable of similar processes of analysis to ArcGIS Pro, however, ArcGIS Pro is capable of more in-depth analysis.
2. Download the appropriate spatial data needed for my analysis: Covid-19 cases in California counties, wildfire smoke presence across the state, age range information across counties, and the number of people with preexisting conditions in California counties.

3. Create maps comparing these factors to each other to determine the extent of their interaction. I will update these maps biweekly, as both Covid-19 and wildfire smoke are not stagnant factors. At first, I will carry on with the production of these maps over the course of two months (4 sets of maps in total), but this will be updated if necessary.

### **Expected Results:**

From this research, I expect to find that wildfire smoke does exacerbate the spread of Covid-19. Based on how Covid-19 and wildfire smoke affect the human body and the groups they pose most significant risk to, as well as the possibilities of coronaviruses being transported on smoke particles, it seems probable that smoke will both increase the transmission rate of the virus as well as weaken people in its presence, making them more vulnerable to Covid-19 infection. After my research and spatial analysis utilizing ArcGIS Pro is complete, I will have also produced a series of maps comparing the spread of Covid-19, wildfire smoke, age range in various areas, and percentage of an area's population having preexisting conditions. All of this will serve to help further understand the transmission of Covid-19.

### **Conclusion:**

This project will focus on how public health and environmental hazards collide, focusing on wildfires and Covid-19 cases in California. The key question I am aiming to answer is: does the presence of wildfire smoke exacerbate the concentration, spread, and transmission of Covid-19? Based on research surrounding Covid-19, wildfire smoke, and

the transmission of Covid-19 particles on smoke particles, I expect to find out that it does in fact do so. I will be investigating this problem utilizing ArcGIS Pro to create a series of maps tracking the concentration of Covid-19 in an area compared to the presence of wildfire smoke, age range, and percentage of the population with preexisting conditions in that area. These maps should make it clear whether or not wildfire smoke exacerbates the spread of Covid-19, or if the co-incidence of the two factors is just that: a coincidence.

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**Budget:**

1. ArcGIS Pro: \$100 per year
2. Map creation and analysis time: ~20 hours, subject to change depending on project length
3. GIS Data Fund: \$150: this is to cover any costs that may be associated with downloading data to use in spatial analysis

Total: \$250, roughly 20 hours