USA Wildfires

This activity focuses on the spread of the 2020 wildfires along the West Coast of the USA, including the conditions preceding the event, methods of preventing the spread and the impacts on the environment

🕐 30 – 45 mins

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Introduction

This activity will guide students through the devastating wildfires along the West Coast of the USA in the late summer of 2020.

These fires were estimated to have been the worst the area has seen in 18 years, with five of the top 20 largest fires in California's history occurring during this period (source: BBC News).

The total area of burned land totalled an estimated 6.7 million acres. For context, this area is shown overlayed on top of London for scale.

Area of land affected by USA wildfires overlayed on London for scale (source: BBC News/National Interagency Fire Centre)

However, these extreme fires were not unexpected. In the 40 years from 1979 to 2019, the number of wildfire 'weather days' per year has increased by on average eight days on average across the globe. Furthermore, in California the number of autumn days with extreme wildfire conditions has doubled in that period. These observed increases can be explained by a change in climate, with warmer and longer periods of weather becoming both more extreme, longer and more frequent, a direct consequence of climate change.

During the 2020 wildfires, the emissions produced by wildfires were 3 times the yearly average from such events in previous years. This is adding to the positive feedback loop of climate change, where increasing emissions cause increasing global temperatures, which further drives more wildfire events, and thus wildfires drive more wildfires.

Learning Outcomes

In this practical, students will learn how to:

- Use free online maps
- Overlay multiple data layers to assess risk factors
- Change the symbology of attributes
- Examine details within attributes to uncover information about individual fire events
- Access and manipulate live datasets online

This activity is aimed at KS4 – KS5 students, however students of all ages are welcome to complete the activity.
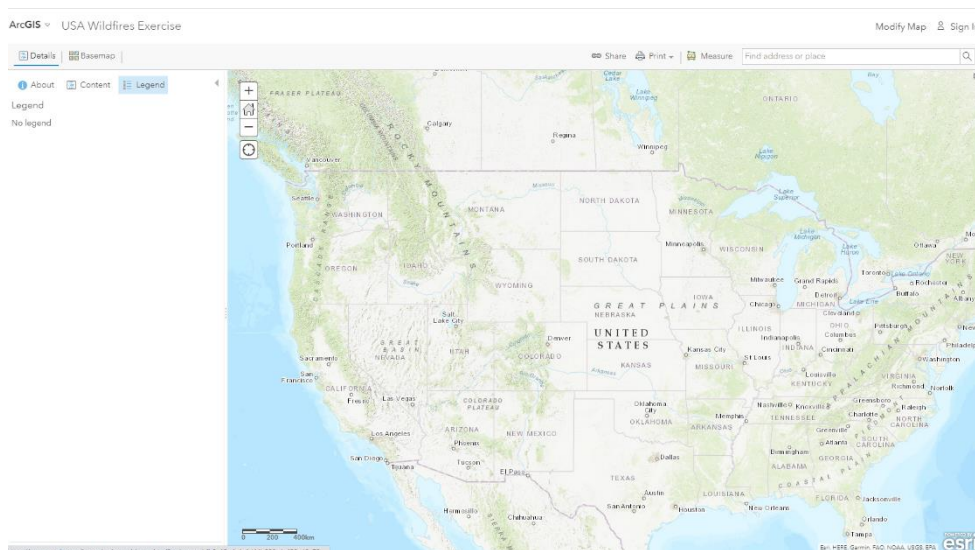
Contents

Section 1: Analysing Potential Risk and Causes

This section will introduce using an interactive map how we can identify locations of potential wildfire risk areas using various datasets together.

1.1. Accessing ArcMap Online

a. To begin, open the following link in a web-browser: https://arcg.is/1qOn0r

   This will open a map which will look something like this:

   Use the mouse to move around the map. Drag the mouse to change position and use the scroll wheel to zoom in and out (you can also use the '+' and '-' buttons in the corner of the map to zoom). Get comfortable with movement before beginning the rest of the practical.

b. To locate California and Oregon (the location of the majority of the fires on the US East coast), click on the 'Content' tab:
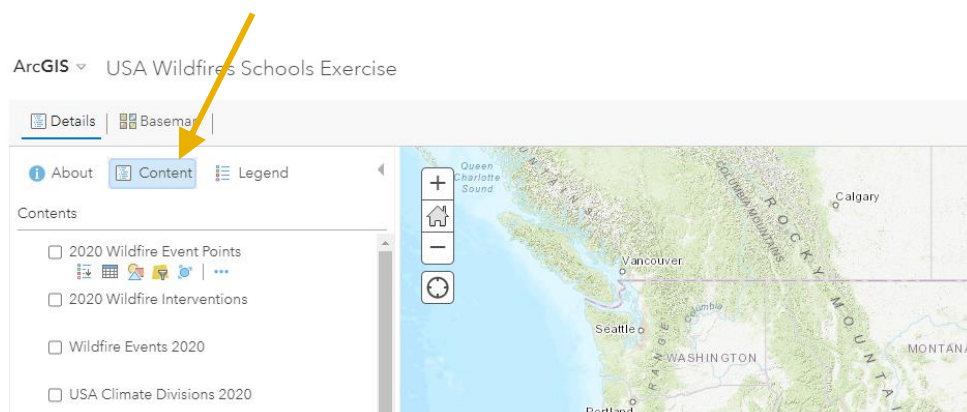
From this table of contents, find the layer called 'USA States' and tick the box next to it to enable it on the map:
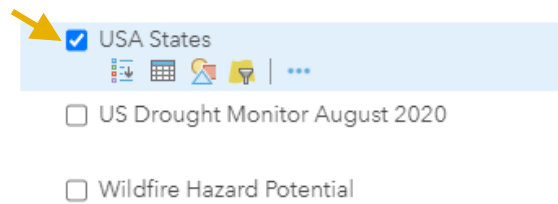
From this map locate Oregon and California. Practice turning this layer on and off using the tick box as this skill will be required throughout the exercise.

1.2. Assessing Risk Factors

a. Next, we will investigate which areas we think are mostly likely to have wildfires. First, enable the layer called 'Forest Cover':
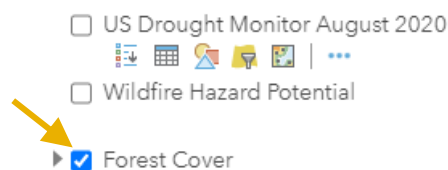

This shows the forest and plant cover throughout the US. From this, can you tell what the forest cover is like across California and Oregon? What does this mean if a wildfire occurred?

b. Next, open the layer titled 'US Drought Monitor August 2020'. This shows the intensity of drought conditions across the US at the beginning of the major part of the 2020 wildfires. The US Drought Monitor classes drought by 4 categories:
   1. Moderate Drought
   2. Serve Drought
   3. Extreme Drought
   4. Exceptional Drought

Click the legend button to display the legend for the layer.

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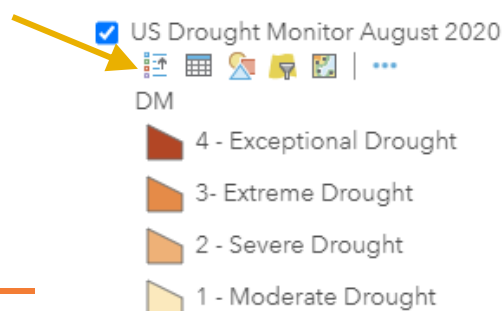
To investigate further, use the transparency slider. This can be found by clicking here:
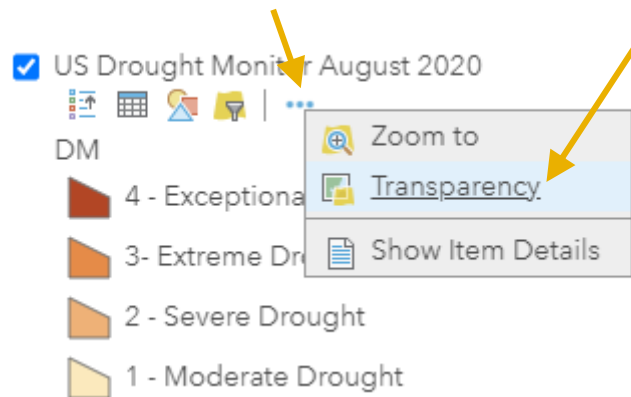
Drag the slider across to increase the transparency, allowing the layer beneath to be viewed.

Investigate where the most serve drought is. Is it in regions you expected based on the forest cover of the US?

c. Now remove the 'Forest Cover' and 'US Drought Monitor August 2020' layers by unselecting the boxes. Sometimes this is referred to as turning the layers 'off'.
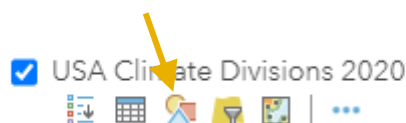

1.3. Assessing Hazard Potential

a. Enable the layer 'USA Climate Divisions 2020' from the contents. This data is taken from August 2020, at the beginning of the wildfires.

We want to investigate the rainfall and temperature, as these are factors in the occurrence and severity of wildfires. To do this, click on the symbology button:

From the drop-down menu, select either 'Temperature' or 'Rainfall' depending on which variable you want to investigate:
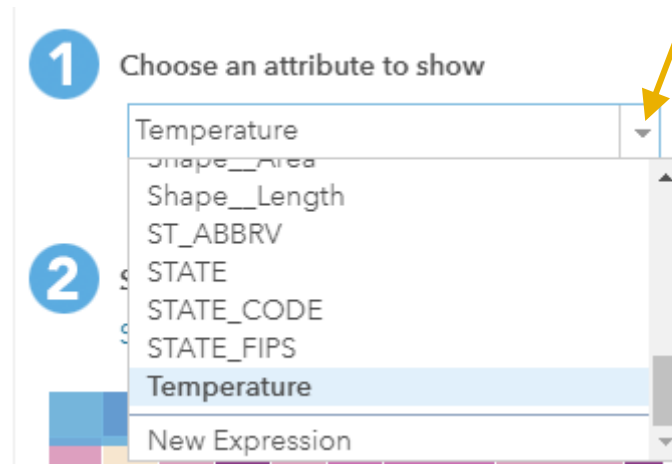
Ensure that Counts and Amounts (Colour) is ticked. Then click Done.

b. Use the legend button to understand the data you are seeing better.

Temperature is measured in °C and Rainfall in mm. Both are monthly averages. You can also use the transparency slider to find areas of particular levels of heat, dryness and forest cover using the previous layers.

Based on these layers, which areas do you think are at most risk from wildfires?

c. Turn off all layers and enable the 'Wildfire Hazard Potential' layer. This a dataset produced for the US government to monitor the risk of wildfires.

Do the areas of high-risk match approximately with areas you have found to be potentially at risk?
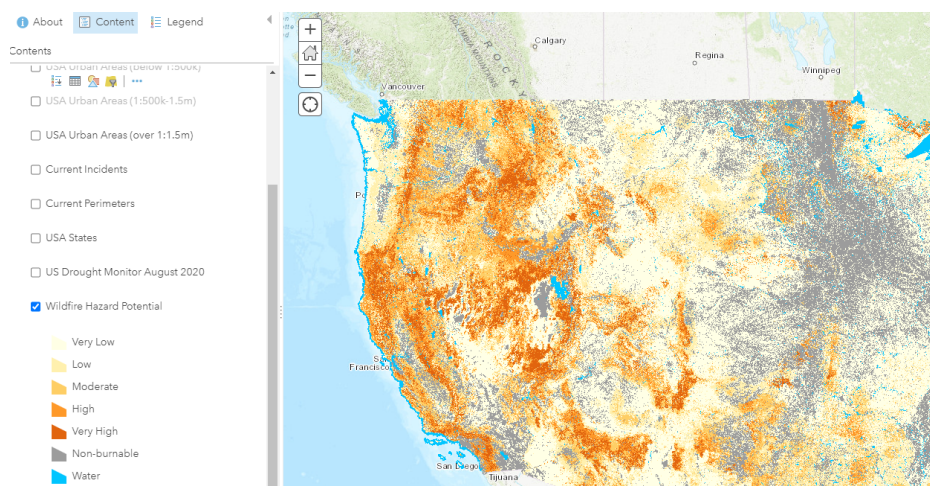
Section 2: 2020 USA Wildfire Locations

In this section we will look at where the wildfires were located, and how the spread of the fires was stopped.

2.1. Locations of wildfires

a. Turn on the layer 'Wildfire Events 2020'. You may need to zoom in and wait a moment for this to load as it is a very large dataset. While it is loading you can also enable the 3 other layers with names beginning with 'USA Urban Areas'. These will be useful later.

   The after the data loads, the map will look like this:
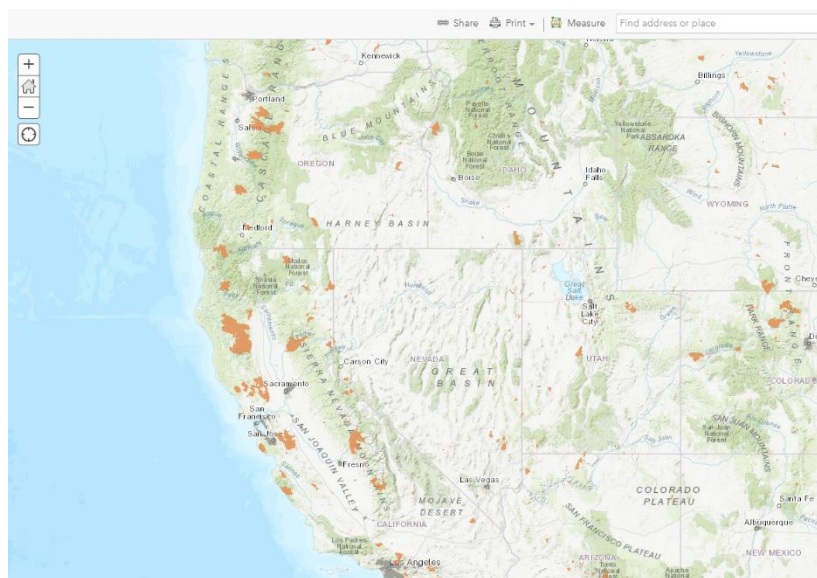
   Look at the locations of the wildfires. Are they in the areas you expected them to be in?

b. Locate the San Francisco area. How close did the fires get to urban areas where people live? Can you find areas where the fire destroyed people's houses?

   You can find these areas quickly be changing the symbology. Click the symbology button.

Then select the attribute to show as "NEAR_DIST". This displays how far from the nearest fire a town or city was, measured in $\frac{km}{100}$.
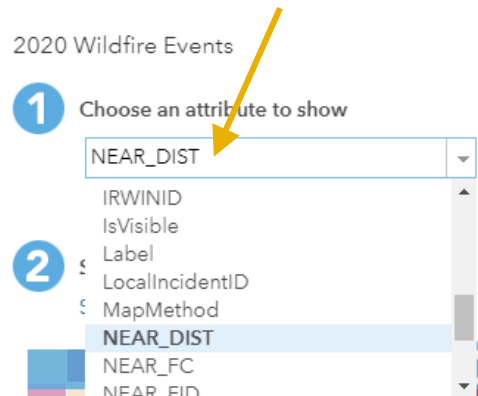

Ensure Counts and Amounts (Colour) is ticked then click 'Done'. Now you have a map to easily find the wildfires which came closest to civilisation.

2.2.   Containing the wildfires

a.   We can look at how the fires were contained. Enable the layer '2020 Wildfire Interventions'. This shows how the authorities attempted to contain the fires.

You can find out how the fire was stopped by click on any line and looking at what appears as under 'FeatureCategory'.
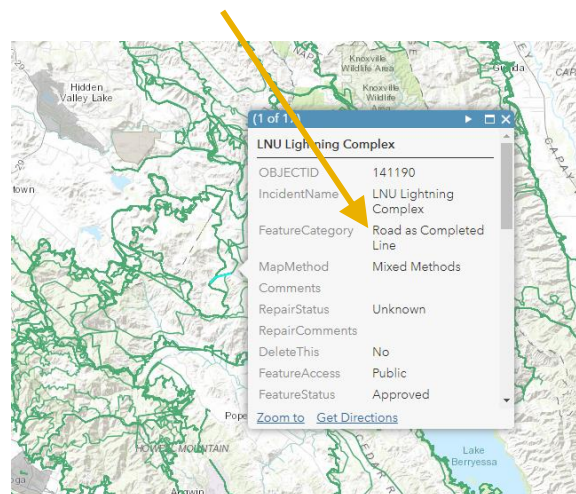
b.   Many of the fires were stopped by bulldozing lines of trees to act as a break. Others relied on other features such as natural breaks, like lakes and rivers.

Try and locate a river and/or lake which acted as a barrier to prevent further spread (hint: try changing the symbology as we have done for previous layers to make this easier).

Section 3: Impacts of the wildfire

Apart from damaging an estimated total area of 6.7 million acres, there are a number of other impacts that the wildfires had which we are still dealing with today. This section will highlight some of these impacts and introduce you to live update websites which you can use to conduct your own investigations.
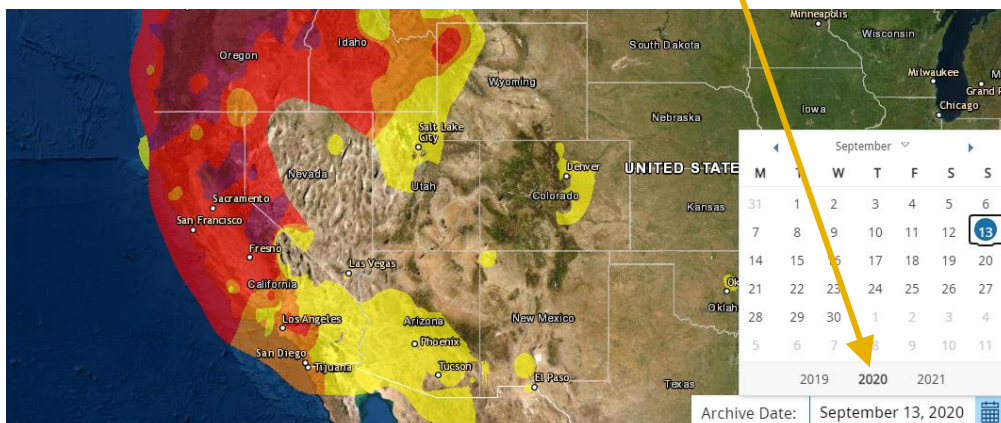
3.1. Air Quality

a. One of the largest reaching consequences of the wildfires was the damage to the quality of air.

   Go to: https://gispub.epa.gov/airnow/index.html?tab=3

   This website shows the air quality throughout the USA. It will open on today's date. Click the legend to find out what the colours on screen show.
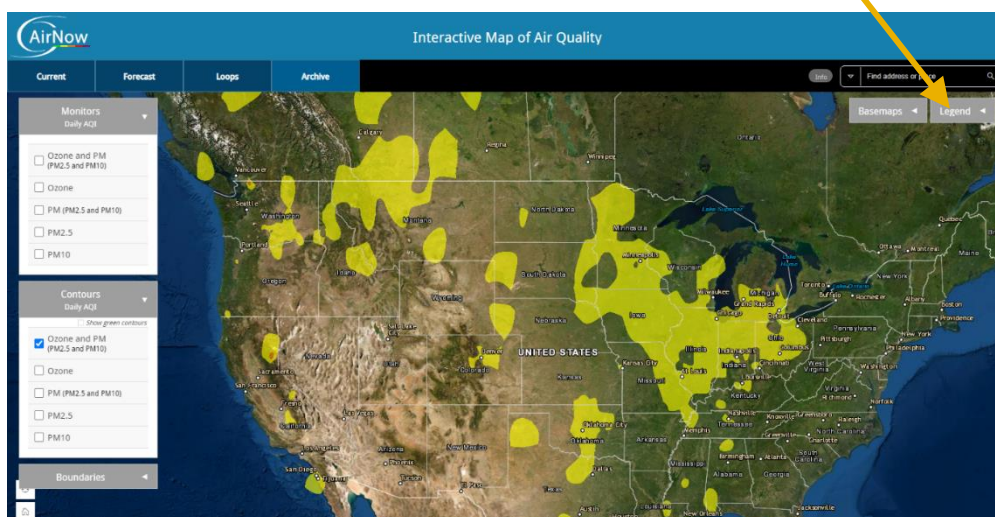
b. Once you are comfortable with what the map shows, click the calendar at the bottom of the screen and find a date during the peak of the wildfires (for example, mid-September).

c. Try moving the date back and forth to find how the air quality changed over time. See if you can spot where the fires started by looking for noticeable areas of poor air quality.

d. Keep this map open. Go back to the Wildfire Exercise map on ArcMaps Online (Section 1.1). Turn on the layer 'Current Incidents'.

This layer is a live-updating layer which will show where current wildfires are located. You can find more information about a fire by clicking on it.

e. Now, by looking between the wildfires map and the air pollution map, you should be able to see that wildfires are a major threat to public health in terms of air quality:
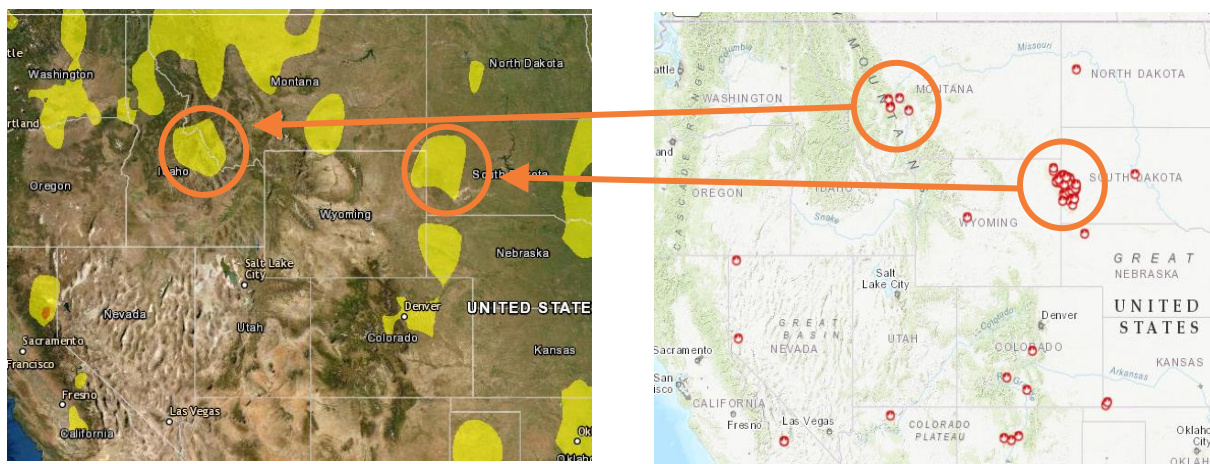

3.2. Damage to habitats

a. The fires caused over $19 billion in damages, 46 confirmed deaths and 13887 buildings were reported to be destroyed.

We can also use satellite imagery to look at the damage caused by wildfires, both in towns and cities, and in the countryside.

b. Using the 'Satellite' view in Google Maps (https://www.google.com) can you find any areas which were damaged due to the wildfires?
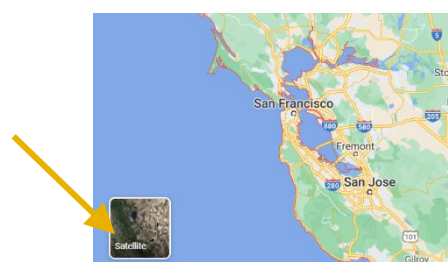
Before 2020 fires


10 September 2020

Aerial photography of the destroyed neighbourhood in Phoenix, Oregon (source: Google Earth, Maxar Technologies)

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a. The damage to wildlife, nature and the natural environment was also great, with thousands of acres of woodland and habitat destroyed directly by the fires, with air and river pollution (from water used to extinguish fires) also impacting local wildlife and environments. Look at how the ground has been scorched by the fires from these aerial images. The once green forests have been replaced with burnt earth.
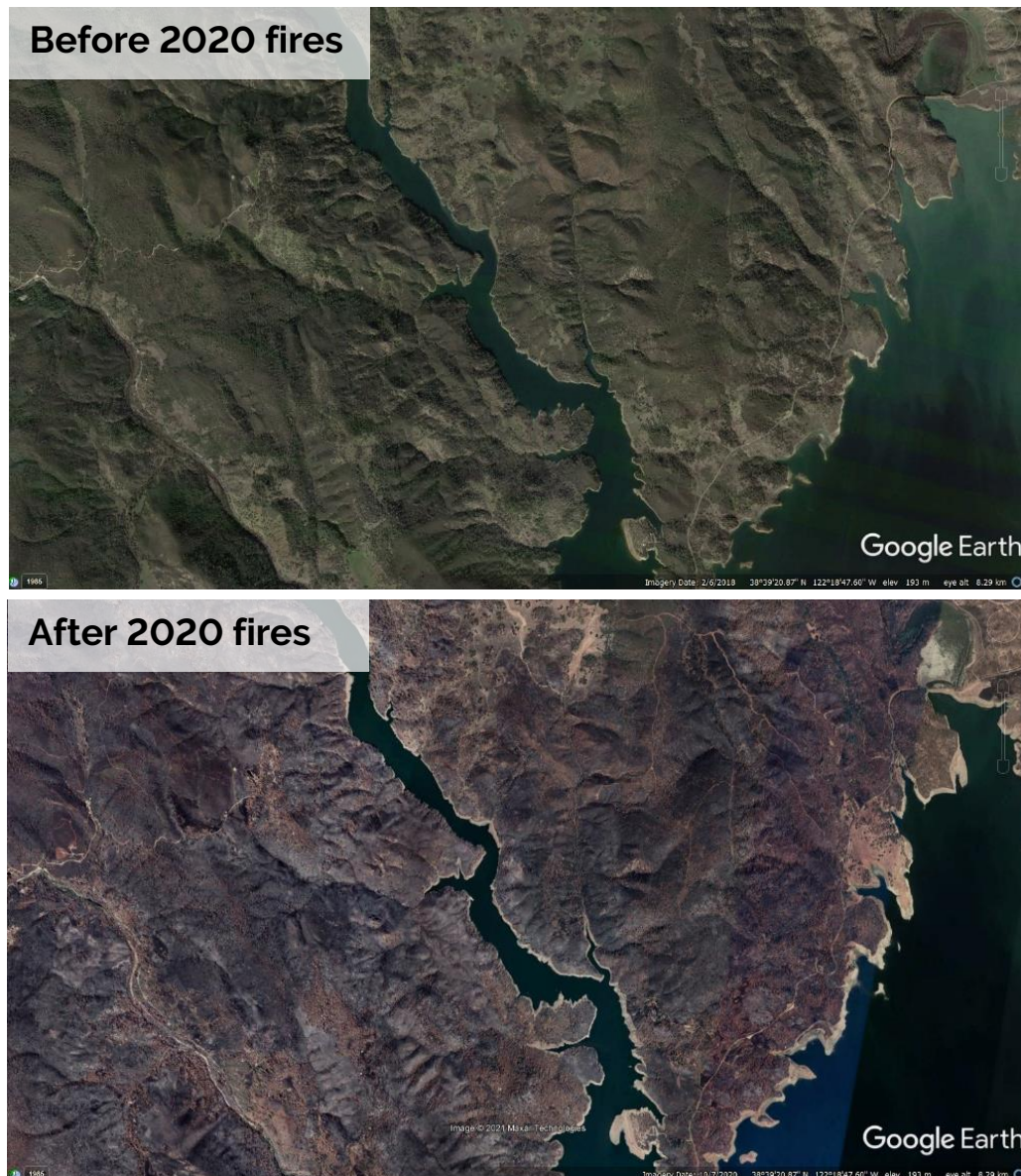
Aerial photography of the destroyed forested area in Lake Berryessa, California (source: Google Earth Pro)

It is estimated the fires have killed 50% of the state's endangered pygmy rabbits, which inhabited the now burnt sagebrush flats. It is believed only about 50 of North America's smallest rabbit remain. Officials estimate the flames have also killed 30% to 70% of the state's sage grouse and sharp-tailed grouse, birds that also depend on sagebrush.

b. What other impacts do you think the wildfires had on wildlife?

Section 4: Summary

This exercise has shown an array of factors which led to the record-breaking 2020 Western USA wildfires, along with the locations of the fires and their impacts on the area.

Whilst these fires were far beyond the size of ones found in Britain, the factors leading into them are the same. For example, the Saddleworth Moor fire in 2018 occurred during a period of drought and extreme temperatures. It also posed risk to human health, as air quality dipped dramatically, and residents of Stalybridge and Ashton-under-Lyne were advised to stay indoors at all times.

Both the UK and USA fires are adding to a positive feedback loop. As the global temperatures rise, the occurrence of wildfires increases. As wildfires release greenhouse gasses, the atmosphere will continue to trap more heat in and temperatures will rise again, continuing the cycle.

If you want to investigate further, you can look at the level of current risk in the USA by using these links to examine a range of factors in real time:

Drought   https://droughtmonitor.unl.edu/

Temperature   https://www.climate.gov/maps-data/data-snapshots/averagetemp-monthly-cmb-2021-01-00?theme=Temperature

Rainfall   https://www.climate.gov/maps-data/data-snapshots/averageprecip-monthly-1981-2010-cmb-0000-02-00?theme=Precipitation

Wind Speed   http://hint.fm/wind/ or
and Direction   https://www.ncdc.noaa.gov/societal-impacts/wind/

This concludes the exercise.

Geospatial UK

This activity was created by Newcastle University on behalf of Geospatial UK.

For more resources or activities, visit

www.geospatialuk.org