COPERNICUS MASTER IN DIGITAL EARTH
PARIS LODRON UNIVERSITY SALZBURG
Palacký University Olomouc
With the support of the Erasmus+ Programme of the European Union

LIGHTNING DATA VISUALIZATION

INTERNSHIP REPORT

∞∞RISCOGNITION

Muhammad Bilal

May – August 2023

Contents

Introduction

I started the internship with Recognition as “Research Intern” in May 2023. I was assigned to project of visualization of lightning data using Maplibre Javascript library and overlay with landcover, wildfire layers to visualize lightning relation with wildfire. My first task was to understand the format of PMtiles and identify tools that convert vector or raster data into PMtiles format that is basically single-file archive format for pyramids of tiled data. There are two platforms that I used for PMtile generation, one is Tippecanoe and other one is PMtiles Command line utility.

Tippecanoe

Tippecanoe is open-source command line software available on GitHub. It optimizes the process of creating vector tiles (MVT + PMtiles) from large datasets, enabling fast and efficient rendering of map data in online and offline mapping applications. Tippecanoe, you can generate vector tiles at various zoom levels, create custom tilesets, and control the appearance and content of your map data efficiently.

Tippecanoe uses geojson data format as an input to convert into PMtile format so therefore Tippecanoe also allows you to convert standard format like shapefile to geojson using ogr2ogr function.

For configuration of Tippecanoe in my local computer that require Linux base environment therefore I used Cygwin it’s a little program which provide a Unix-like environment and command-line interface for Microsoft Windows. Below in resources section the step-by-step guide to configure Tippecanoe in your local machine. Windows subsystem for Linux can also be useful to configure Tippecanoe tool in your machine.

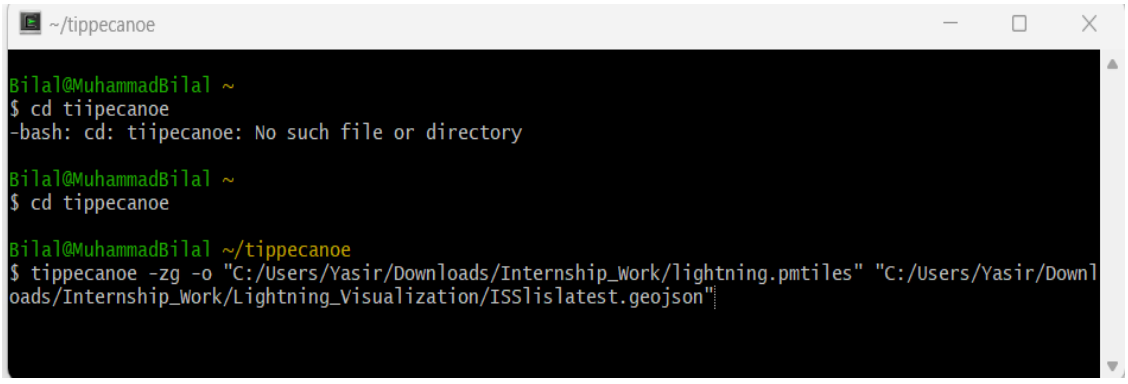

Figure 1: Tippecanoe Configuration

$ tippecanoe -zg -o out.pmtiles in.geojson

-zg: Automatically choose a max zoom that should be sufficient to clearly distinguish the features and the detail within each feature
-o: output=file.pmtiles: Name the output file
out.pmtiles: Path of the Output file
in.geojson: Path of the Input file that must be in geojson.

PMtile Command Line Utility

It is an open-source command line software available on GitHub that can easily download pre-compiled binaries for windows system. You did not need to install or configure this tool like Tippecanoe it's just needed to connect through command line of windows system and from that you can convert data into pmtiles format, but this software only use mbtiles as an input to convert into pmtile format.

Step 1: locate the download pmtile folder in CMD.

cd .\go-pmtiles_1.7.1_Windows_x86_64\

Step 2: After locating the folder of go-pmtile folder then use this command to convert mbtile data into pmtiles format.

./pmtiles convert input.mbtiles output.pmtiles

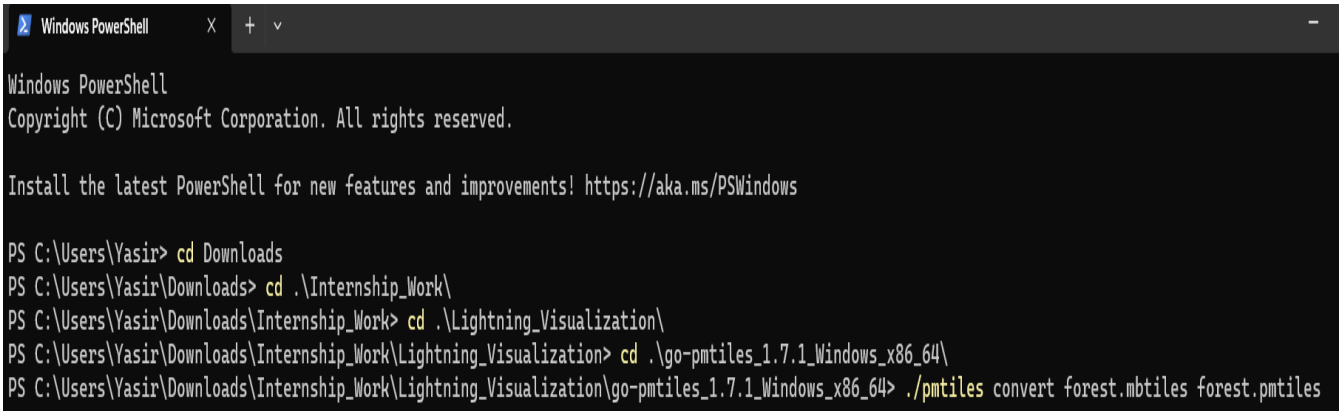

Figure 2: PMtile Command Line Interface

PMtile Viewer

After converting data into Pmtiles format using above mentioned platforms we can visualize that data on Pmtile Viewer platform that is provided by protomaps. This

platform takes data as URL and local file that can upload manually from system then it will display data on the map as well as attributes of the data and tiling structure in which data encodes. This platform is very useful for checking that your data is converted correctly or not.

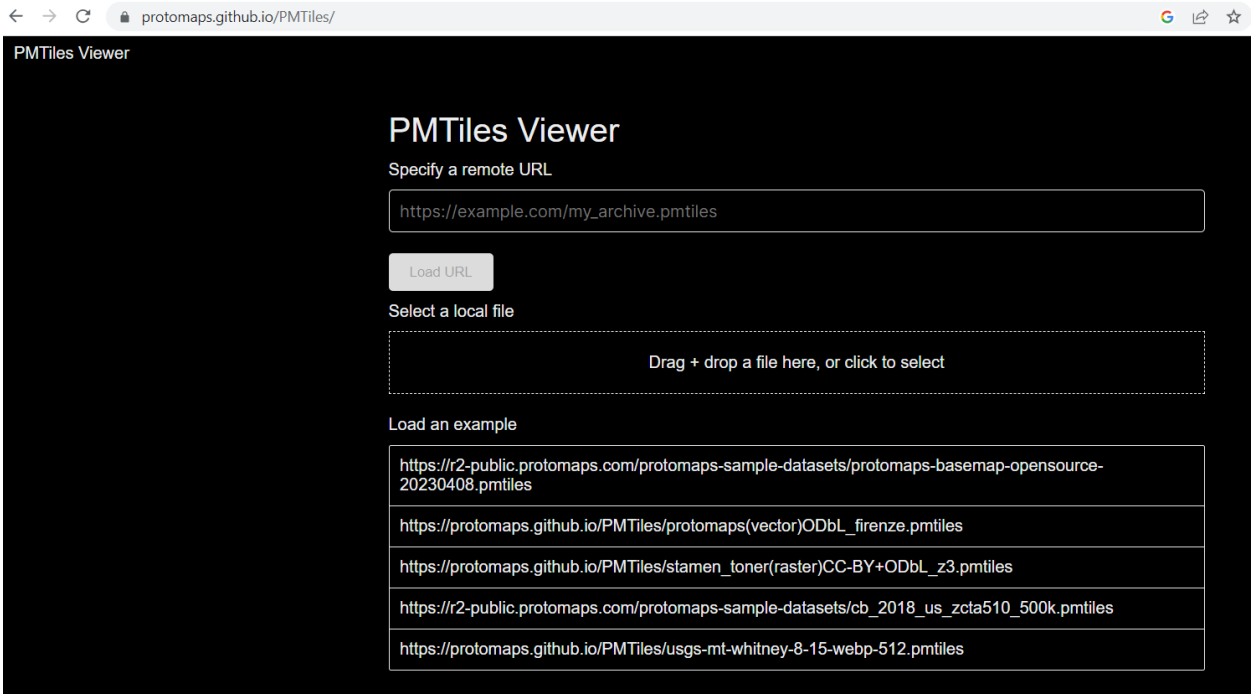

Figure 3: PMtile Viewer Platform

Mini.io Configuration

It's high performance, S3 compatible object store and useful to store data lake and database workload. It can be configured on both public and private networks. This Cloud storage is used for storing Pmtile data because pmtile needs a range of requests to be called on the web therefore I configured mini.io in my local machine. It has a friendly user interface and is easy to configure in any operating system. Below is the command where you can type in command line tool to get the mini.io executable file.

wget https://dl.min.io/server/minio/release/windows-amd64/minio.exe

After getting the executable file run another command that starts the mini.io cloud storage platform in your local machine browser. Note that first you need to connect to the folder where you save executable file.

.\minio.exe server C:\minio --console-address :9090

Then in your browser the interface will be looked like figure below.

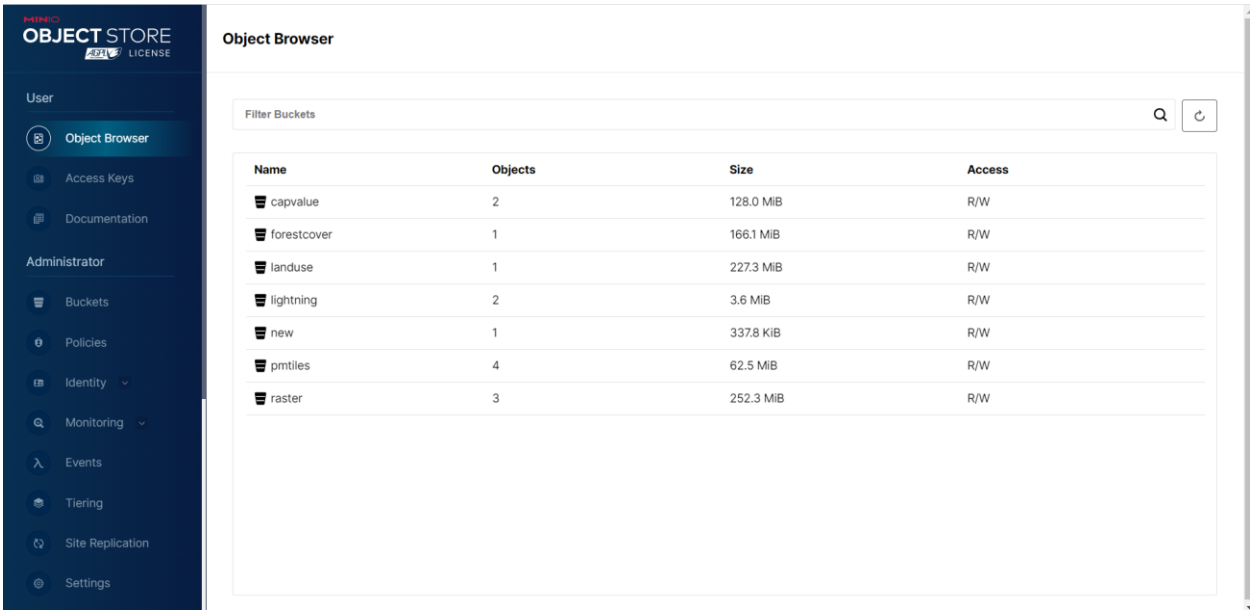

Figure 4: Mini.io Platform Viewer (Local Host)

Visualization of Lightning Data

After Configuring the PMtiles environment and Cloud storage platforms. The task was to display lightning data on the map using Maplibre JavaScript library. Maplibre GL JS is an open-source library for publishing maps over the web. I converted lightning data that was acquired from NASA Earth platform into Pmtiles using Tippecanoe platform. Then I hosted those lightning pmtiles data on mini.io cloud storage platform so that it can easily be called over the web as shown in figures below.

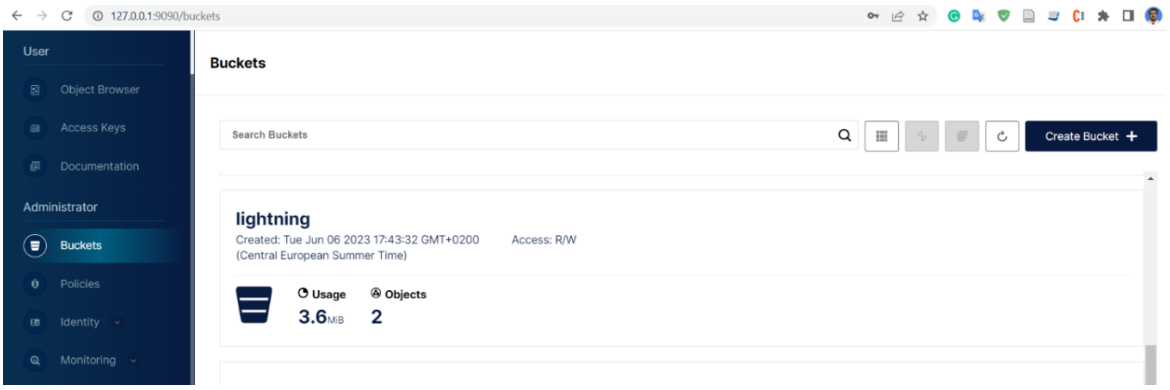

Figure 5: Mini.io Bucket List

Then I created a code file that will display lightning data on the map, which consists of html+Maplibre JS code. This web interface allows you to change lightning data based on date and allow you to see lightning data of different period. The output of the code is shown below.

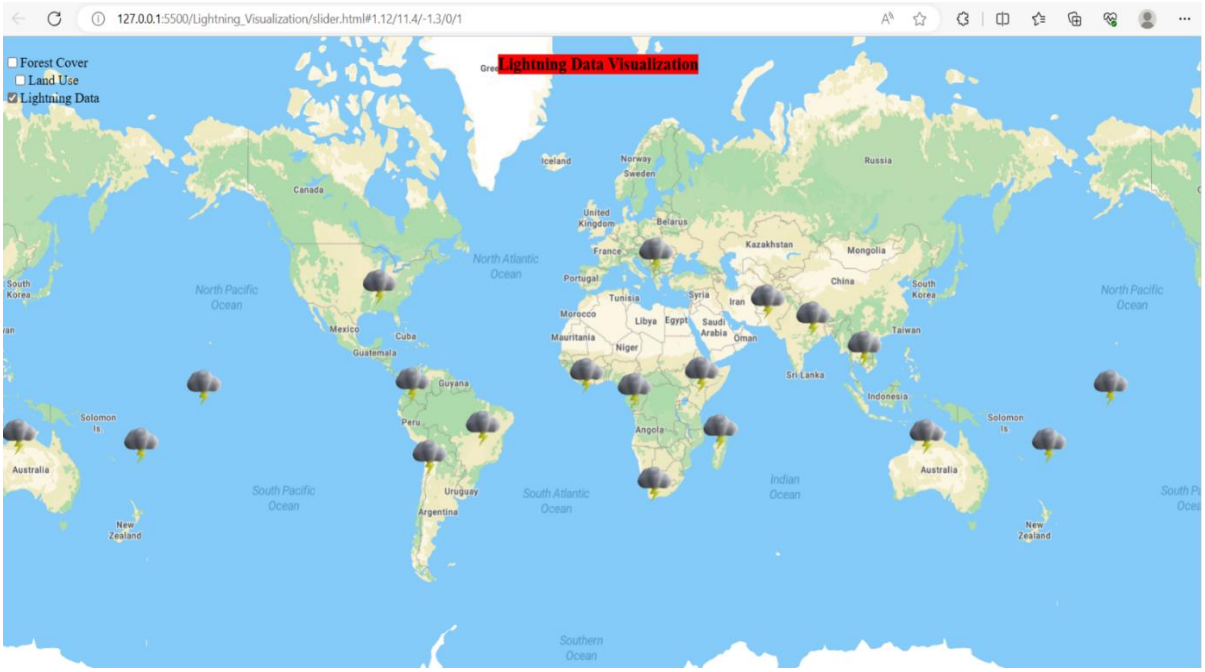

Figure 6: Lightning Data Visualization

I also integrated the land Cover data of Europe and Cape value data that is the forecast lightning potential energy. By overlaying these data on top of each other to visualize and analyze wildfire effect on forest caused by lightning.

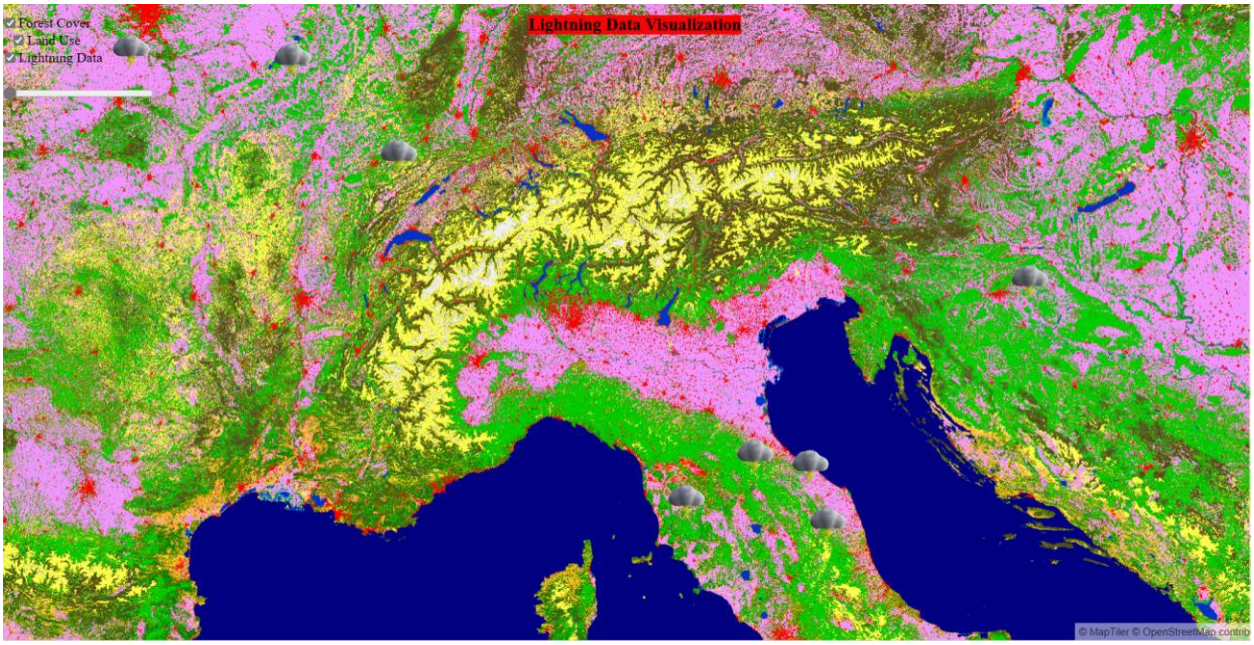

Figure 7: Lightning Data overlay with landcover Data

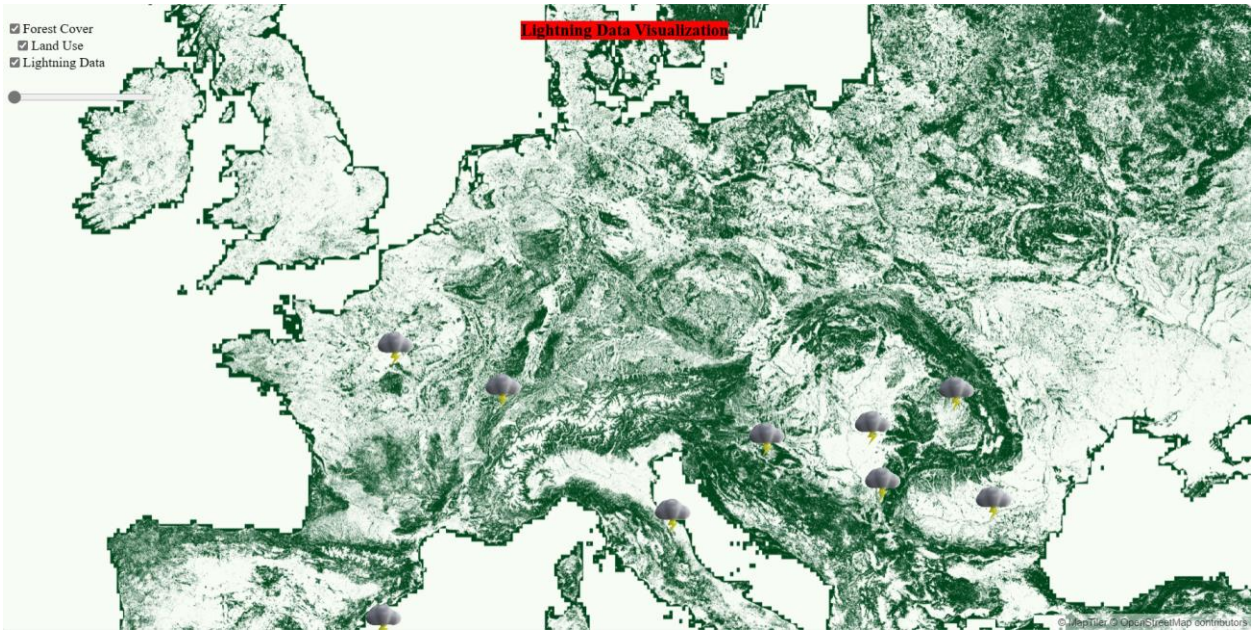

Figure 8: Lightning Data Overlay with Forest Cover

The figure 7 and 8 visualizing lightning strikes overlay with landcover and forest dataset. The time slider is also implemented in this web platform, so it's easy to see lightning strikes in different period of time for analysis purpose.

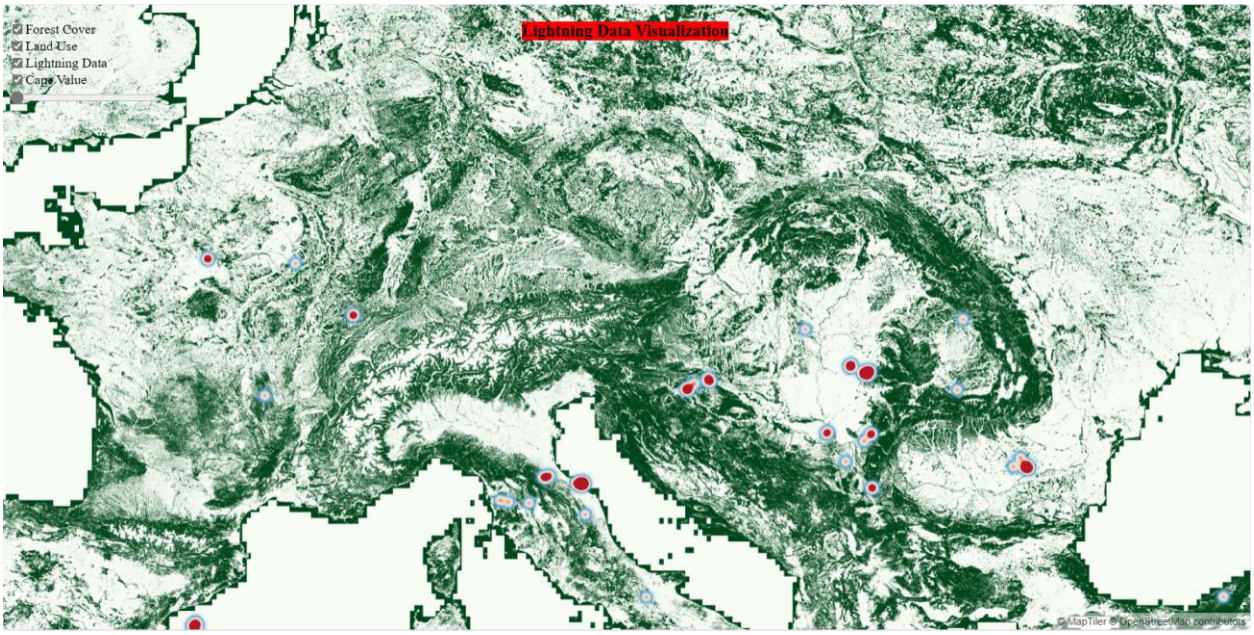

Figure 9:Hotspots of Lightning Strikes

In figure red hotspot representing the number of lightning strikes at specific places and the low color intensity hotspot represent fewer lightning strikes in those area.

Future Work

- Cloud Optimized Geotiff format for Raster files Visualization in Maplibre JS
- Automatic generation of Lightning Pmtiles Data through Script
- Live Dashboard where Real time lightning data visualization and predicting wildfires based on potential energy**.**

Resources:

https://tonyhauck.com/blog/en/2019/11/26/making-your-own-vector-tiles-on-windows-in-3-steps/

https://github.com/felt/tippecanoe

https://maplibre.org/maplibre-gl-js/docs/examples/

https://github.com/protomaps/go-pmtiles

https://min.io/download#/windows

https://www.youtube.com/watch?v=0pFvc_q_SV4

https://www.youtube.com/watch?v=dF9UuVKOf34

https://www.youtube.com/watch?v=oqyQ3wo7n18

https://www.youtube.com/watch?v=rfq6SuQcDmE

https://www.youtube.com/watch?v=_8zi3ghXv_E

https://www.youtube.com/watch?v=Ix-4L2dRmRg

https://www.youtube.com/watch?v=WLKrSD3LmHs