PM2 and PM10 concentrations

Erdenebayar Munkhtsetseg[1,2], Atsushi Shimizu[3]

[1]National University of Mongolia (NUM), Mongolia,
[2]Kanazawa University, Japan,
[3]National Institute for Environmental Studies (NIES), Japan,

Corresponding author: Atsushi Shimizu, shimizua@nies.go.jp

Abstract

In September 2021, a significant jump in seismic activity on the island of La Palma (Canary Islands, Spain) signaled the start of a volcanic crisis that still continues at the time of writing. Earthquake data is continually collected and published by the Instituto Geográphico Nacional (IGN). …

Plain Language Summary

Earthquake data for the island of La Palma from the September 2021 eruption is found …

0.1 Introduction

Source: Article Notebook

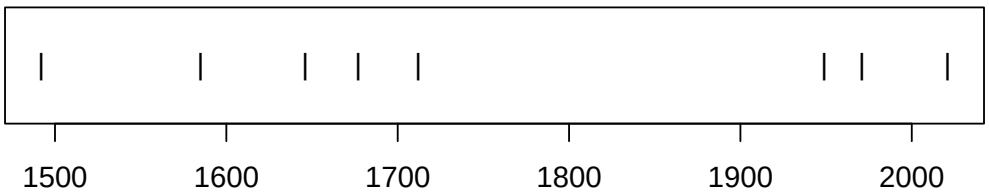

Figure 1: Timeline of recent earthquakes on La Palma

Source: Article Notebook

Source: Article Notebook

Based on data up to and including 1971, eruptions on La Palma happen every 79.8 years on average.

Studies of the magma systems feeding the volcano, such as Marrero et al. (2019), have proposed that there are two main magma reservoirs feeding the Cumbre Vieja volcano; one in the mantle (30-40km depth) which charges and in turn feeds a shallower crustal reservoir (10-20km depth).

Eight eruptions have been recorded since the late 1400s (Figure 1).

Data and methods are discussed in Section 4.3.

Let x denote the number of eruptions in a year. Then, x can be modeled by a Poisson distribution

$$p(x) = \frac{e^{-\lambda}\lambda^x}{x!} \tag{1}$$

where λ is the rate of eruptions per year. Using Equation 1, the probability of an eruption in the next t years can be calculated.

Table 1: Recent historic eruptions on La Palma

Name	Year
Current	2021

Name	Year
Teneguía	1971
Nambroque	1949
El Charco	1712
Volcán San Antonio	1677
Volcán San Martin	1646
Tajuya near El Paso	1585
Montaña Quemada	1492

Table 1 summarises the eruptions recorded since the colonization of the islands by Europeans in the late 1400s.

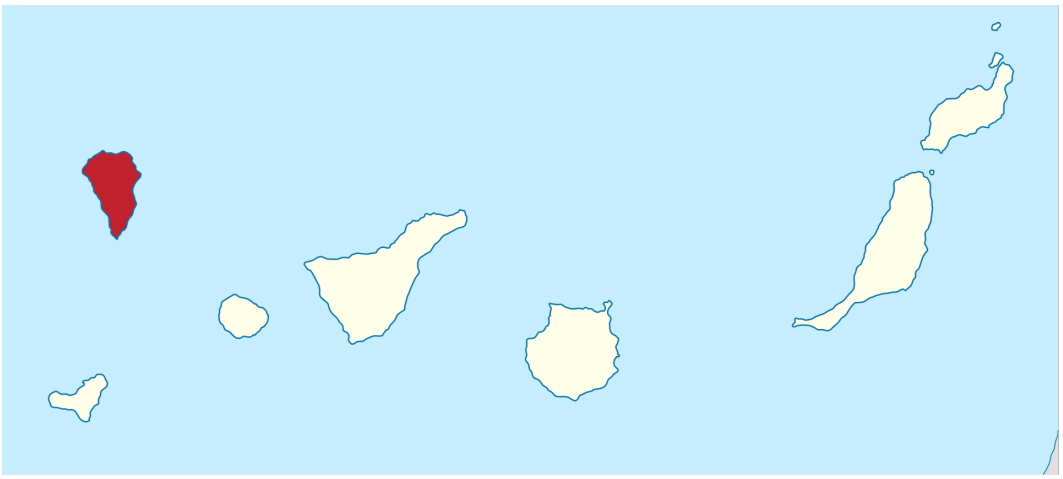

Figure 2: Map of La Palma

La Palma is one of the west most islands in the Volcanic Archipelago of the Canary Islands (Figure 2).

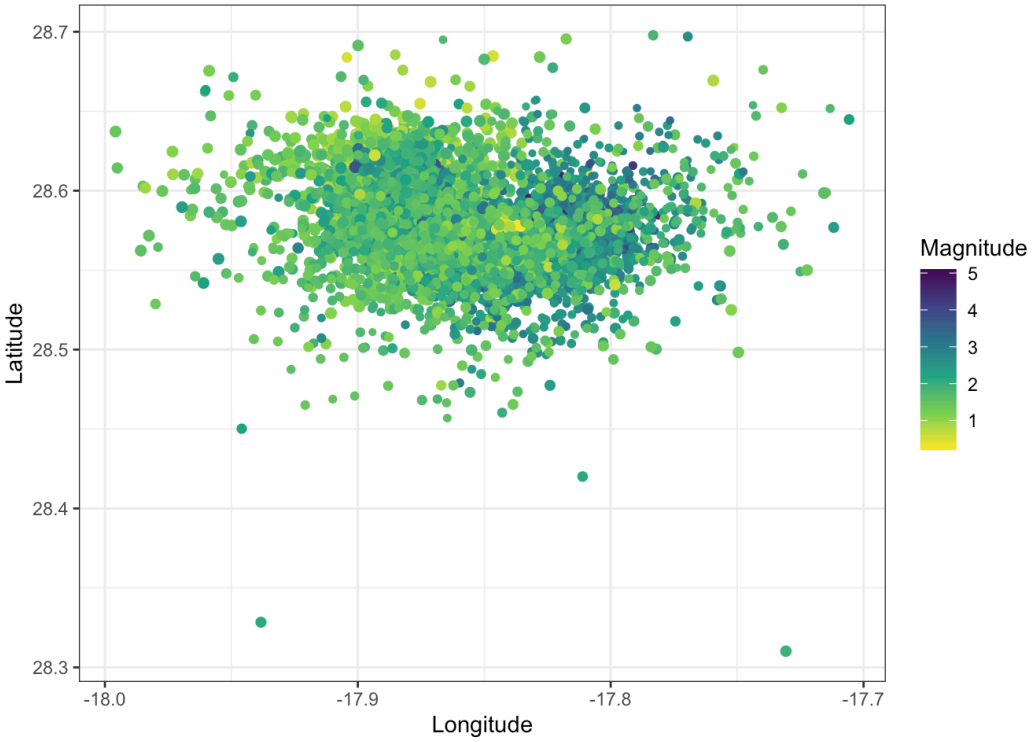

Figure 3: Locations of earthquakes on La Palma since 2017

Source: Explore Earthquakes

kk

1 Explore Earthquakes

Munkhtsetseg

Library

2 Import the dataset and remove the duplicates

Import the dataset from the directory of: ~/Data Input/Preprocessing data/Preprocessing data.csv, assign the dataset as object of df:

Remove the duplicates with the function of distinct(), assign the dataset as df_01:

2.1 Produce a table with missing data

For date options as year, month, etc:

```
# A tibble: 52 × 9
# Groups:   Station.name [4]
   Station.name  Year NA_date NA_PM2 NA_PM10 NA_Vis NA_WD NA_WS NA_OPC
   <chr>        <int>   <int>  <int>   <int>  <int> <int> <int>  <int>
 1 Dalanzadgad   2008    4630   1543    1672   1463  1566  1566   4630
 2 Dalanzadgad   2009    8760    715     929    659   748   748   8760
 3 Dalanzadgad   2010    8784    921    1086    756   787   787   8784
 4 Dalanzadgad   2011    8760   2652    3309   1759  2394  2394   8760
 5 Dalanzadgad   2012    5088   1074    3016    693  1412  1412   5088
 6 Dalanzadgad   2013    6096   1766    1809   2479  1240  1240   6096
 7 Dalanzadgad   2014    7800    843     921   6068  1482  1482   7800
```

```
 8 Dalanzadgad   2015    8760   1539    1587   8115  2635  2635   8760
 9 Dalanzadgad   2016    6288   1654    1613   5995  3306  3306   6288
10 Dalanzadgad   2017    3264     36      45   3264  3264  3264   3264
#   42 more rows
```

For station

```
# A tibble: 4 × 8
  Station.name NA_date NA_PM2 NA_PM10 NA_Vis NA_WD NA_WS NA_OPC
  <chr>          <int>  <int>   <int>  <int> <int> <int>  <int>
1 Dalanzadgad    69454  13081   16327  32475 20058 20058  69454
2 Sainshand     101230  27588   36117  28986 13768 13768 101230
3 UB             95662   7895    8785   3775  4121  4121  62421
4 Zamynuud       99742  32281   33597  22525  5373  5373  99742
```

By percentages

```
# A tibble: 4 × 2
# Groups:   Station.name [4]
  Station.name   sdq
  <chr>        <dbl>
1 Dalanzadgad   10.7
2 Sainshand     25.9
3 UB            17.9
4 Zamynuud      39.6
```

Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R code that generated the plot.

3 Remove the spikes, and produce an extended table

Remove the spikes in the datasets, and produce the table with NA, with removed spikes; express it in a percentages.

3.0.1 Remove the spikes Method 1. Mean value +- (3-5)SD

Method 2. Seasonal variations, and trend-mean

3.1 Save dataset in folder: 01_data_raw

4 Tidy data

4.1 Fill the missing data

Method 1. Fill the gap Method 2. Relationship equation Method 3. Look-up table

4.2 Save dataset in folder: 02_data_tidy

Read a clean version of data:

Create spatial plot:

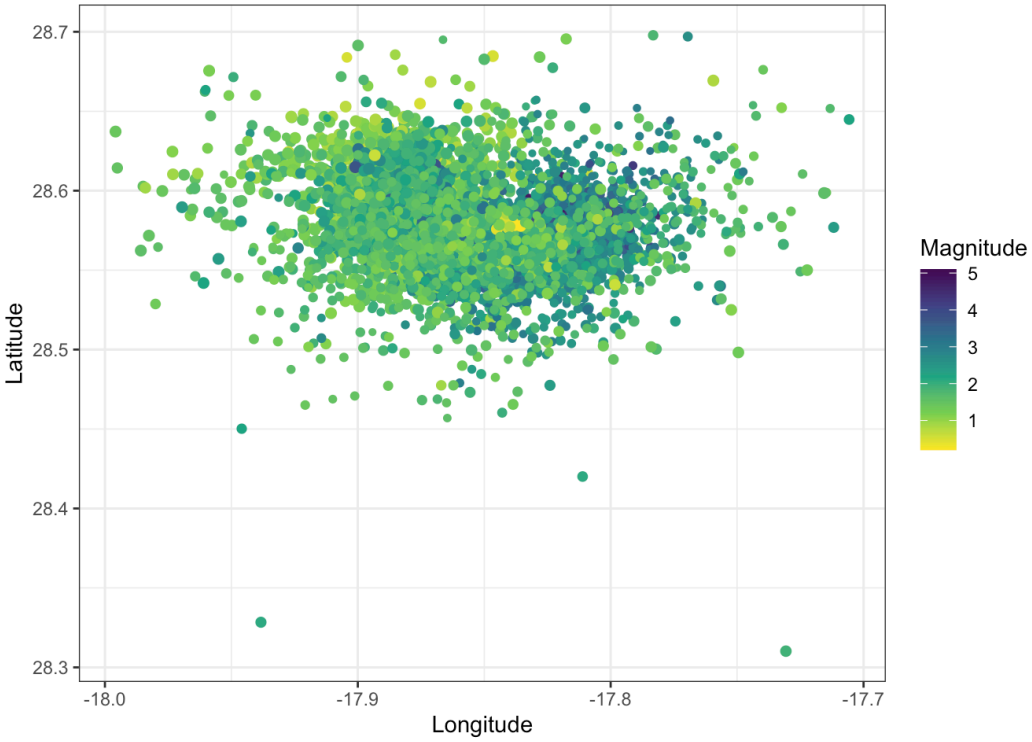

Figure 4: Locations of earthquakes on La Palma since 2017

Source: Explore Earthquakes

Figure 4 shows the location of recent Earthquakes on La Palma.

4.3 Data & Methods
4.4 Results
4.5 Discussion
4.6 Conclusions
References

Marrero, J., García, A., Berrocoso, M., Llinares, Á., Rodríguez-Losada, A., & Ortiz, R. (2019). Strategies for the development of volcanic hazard maps in monogenetic volcanic fields: The example of La Palma (Canary Islands). *Journal of Applied Volcanology*, *8*. https://doi.org/10.1186/s13617-019-0085-5