How the Code works:

Main File: ETASSimulation.py

First, setup the parameters.

Set the parameters for the ETAS model

mu = 3.29 # Minimum magnitude

K = 1.0 # Aftershock productivity parameter >>>>>>>>>>> Usually have K = 1

alpha = 1.0 # Exponent in the productivity relation, multiplies bval

qval = 1.5 # Spatial Omori exponent

sigma = 0.5 # Could be used in the spatial dependence part (not used in this code)

ntmax =20500 # Number of earthquakes requested

mag_large = 7.0 # Magnitude of large earthquakes for re-clustering or for stacked aftershock plots

rate_bg = 5.0 # Background rate

bval = 0.95 # GR b value

pval = 1.2 # Omori p-value >>>>>>>>> Usually pval = 1.2 or so

corr_length = 100 # Parameter in the spatial Omori relation (km)

corr_time = 1 # Parameter in the temporal Omori relation (natural time)

dt_ratio_exp = 1.5 # Used in the equation that computes time to next event

t = 0.0 # Initial time

kk=0 # Counter for large earthquakes

time_main = 0. # Used in the re-clustering

m = mu # Initial magnitude is the minimum magnitude

scale_factor = 0.004 # Controls the (re)clustering, this is basically 2 x standard deviation

```
step_factor_aftrshk = 0.04            #   In degrees, controls the lat-lng steps for the random walk
aftershocks

BathNumber = 1.2                      #   Bath's law value.  Note that this can be used to determine the

                                #  the effective number of aftershocks for a given mainshock magnitude

                                #   and thus the ratio of aftershocks to mainshocks


scale_mag = 1.                        #   Scaling the aftershocks is from mu+scale_mag up to mag_large

mag_threshold = mu + BathNumber        #   Only events with mags larger than this can have
aftershocks

plot_params =  False                  #   Used to display the params in the boxes on the plots

plot_USGS_data  = False               #   If we want to plot real data, first converts the

                                #    USGS files to the correct format and file name then runs the functions

pfit_lo = 80                          #   Low value of the parameters to fit a line to the Omori scaling plot

pfit_hi = 600                         #   High value of the parameters to fit a line to the Omori scaling plot

NSteps  = 36                          #   Used for the Exponential Moving Average in the number-
timeseries

#################################################

#################################################
```

Next, setup the flags for running code and generating output.

```
generate_and_write_new_catalog     = True   #Creates a new random catalog

write_new_adjusted_file            = True   #Creates scale invariant aftershocks


plot_magnitude_time                = False  #Plots the raw catalog

plot_magnitude_time_clustered      = False  #Plots the clustered catalog

plot_magnitude_frequency           = False  #GR diagram
```

plot_scale_invariant_omori_plot = False #Omori Plot

plot_number_events_vs_time = False #Monthly number of events vs. time for scale invariant catalog

plot_LA_seismicity_map = True #Spatial locations of earthquakes

download_USGS_catalog = False #Input data from USGS

##

##

Last, wait for the plots and simulations with exact locations in USGS_regional.catalog.

Explanation of other Files:

ETASPlotV3.py #Files that include all the function to make the plots

ETASFileWriter.py #Files that include the function to write the data saved in text file to csv file

ETASCalcV5.py #Files that includes functions to do various calculations such as calculating earthquake rate function and cluster function for magnitudes

ETASFileMethods.py #Files with function that downloads catalog from USGS site

##

Wiring Diagram: