```
'''Geospatial Analysis
Geospatial analysis plays a critical role in understanding the spatial distribution of crimes across districts.
By leveraging a JSON file containing district-level geospatial data, we relate geographical areas to their corresp

Approach
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Mapping Districts to Crime Data: The geospatial JSON file is used to define the boundaries and locations of distri
This data is merged with crime statistics to establish a spatial relationship between districts and their respecti

Visualization with Heatmaps: Heatmaps are generated to highlight regions with varying crime intensities.
Districts with higher crime rates are represented with more intense colors, making it easier to identify crime hot

Identifying High-Crime Areas: Using the heatmap, we pinpoint districts with persistently high crime rates.
These areas are marked for further investigation and targeted interventions by law enforcement and policymakers.

Correlation Analysis: Geospatial correlations are analyzed to explore relationships between crime levels and socio
This helps uncover patterns and potential drivers of crime in specific regions.'''



import pandas as pd
import numpy as np
import geopandas as gpd
from sklearn.cluster import DBSCAN
import matplotlib.pyplot as plt


geojson_path = '/content/india (1).geojson'  # Adjust path if needed
india_geo = gpd.read_file(geojson_path)

# Inspect the loaded GeoDataFrame structure
print("GeoDataFrame Columns:", india_geo.columns)

# Extract the latitude and longitude from the geometry
india_geo['latitude'] = india_geo.geometry.centroid.y
india_geo['longitude'] = india_geo.geometry.centroid.x

# Extract relevant columns for merging (adjust based on your crime data)
geo_coordinates = india_geo[['district', 'latitude', 'longitude']]

#  2: Load the crime dataset
crime_data_path = 'crime.csv'  # Adjust path if needed
crime_data = pd.read_csv(crime_data_path)

# Ensure district names match by cleaning up whitespace and cases
crime_data['DISTRICT'] = crime_data['DISTRICT'].str.strip().str.lower()
geo_coordinates['district'] = geo_coordinates['district'].str.strip().str.lower()

#  3: Merge crime data with geo coordinates on district names
merged_data = crime_data.merge(geo_coordinates, left_on='DISTRICT', right_on='district', how='left')

# Check for any rows with missing latitude or longitude
missing_coords = merged_data[merged_data[['latitude', 'longitude']].isnull().any(axis=1)]
print("Rows with missing coordinates after merge:")
print(missing_coords[['DISTRICT', 'latitude', 'longitude']].head())

# Drop rows with missing coordinates (if any)
merged_data = merged_data.dropna(subset=['latitude', 'longitude'])



#  Convert to GeoDataFrame for visualization
gdf = gpd.GeoDataFrame(
    merged_data,
    geometry=gpd.points_from_xy(merged_data.longitude, merged_data.latitude),
    crs="EPSG:4326"
)
```
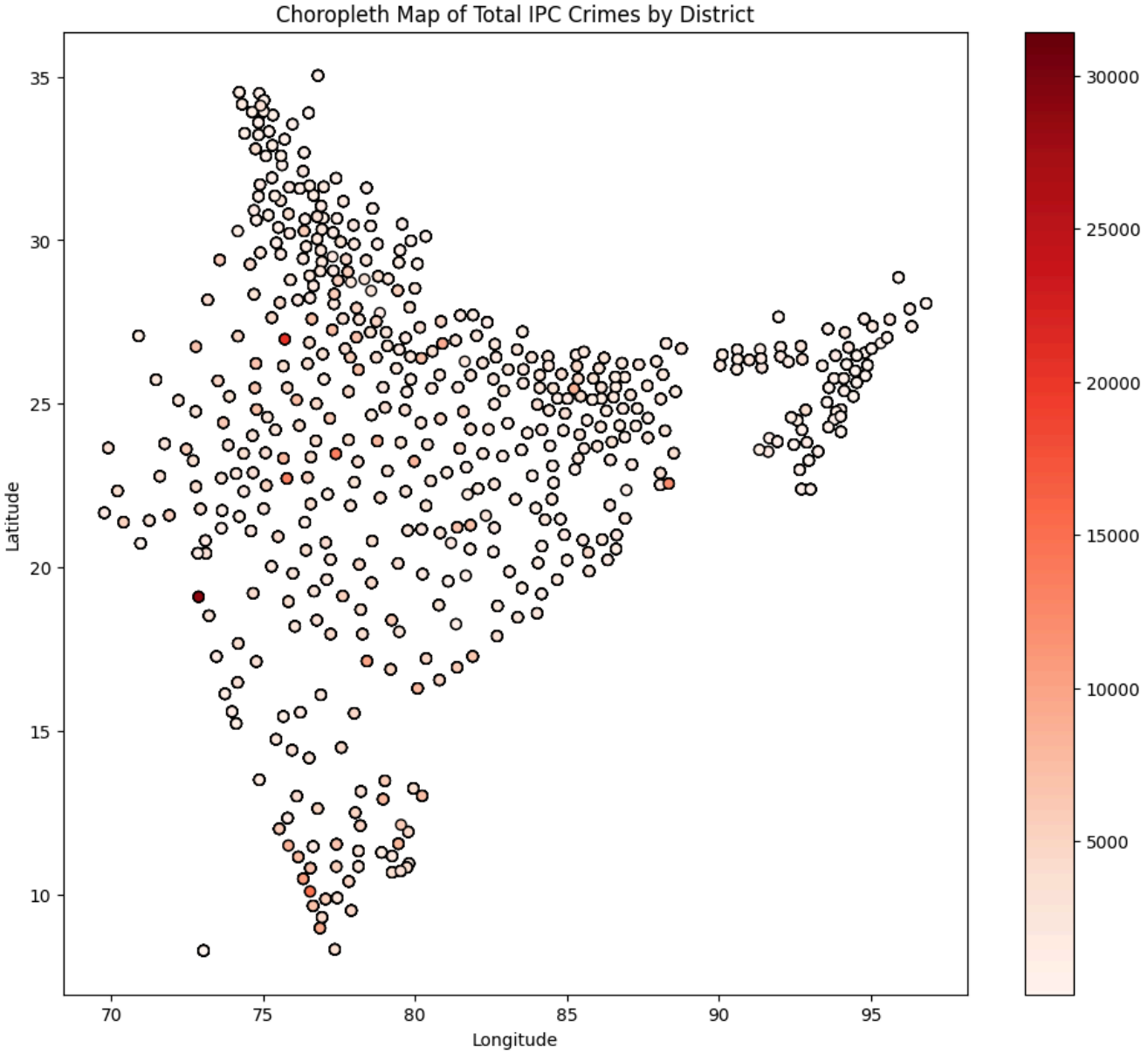
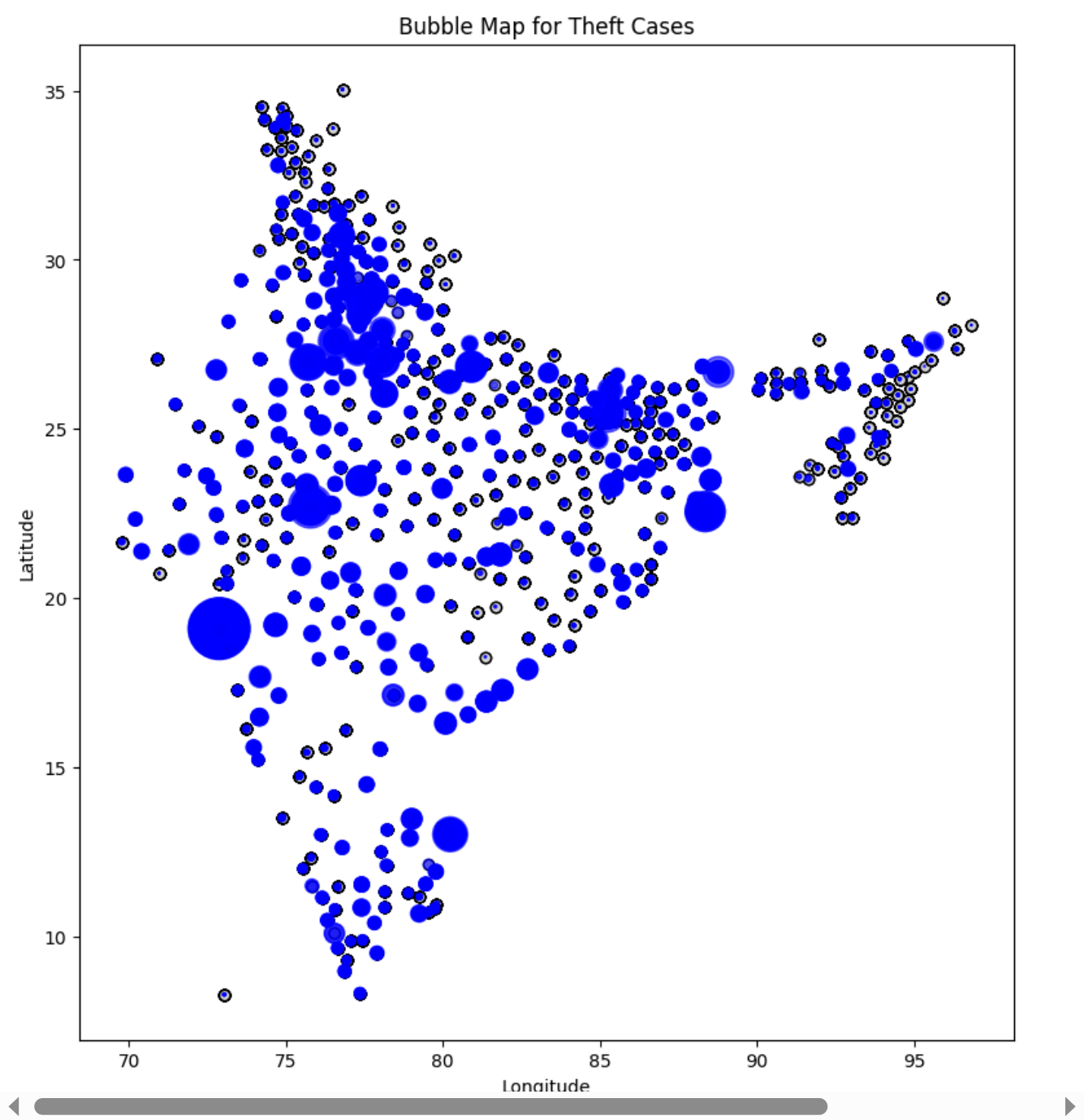

```
GeoDataFrame Columns: Index(['id', 'district', 'dt_code', 'st_nm', 'st_code', 'year', 'geometry'], dtype='obj
Rows with missing coordinates after merge:
         DISTRICT  latitude  longitude
3        cuddapah       NaN        NaN
4       cyberabad       NaN        NaN
6   guntakal rly.       NaN        NaN
8    guntur urban       NaN        NaN
9  hyderabad city       NaN        NaN
<ipython-input-3-835d6de1779e>:15: UserWarning: Geometry is in a geographic CRS. Results from 'centroid' are

  india_geo['latitude'] = india_geo.geometry.centroid.y
<ipython-input-3-835d6de1779e>:16: UserWarning: Geometry is in a geographic CRS. Results from 'centroid' are

  india_geo['longitude'] = india_geo.geometry.centroid.x
<ipython-input-3-835d6de1779e>:27: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#r
  geo_coordinates['district'] = geo_coordinates['district'].str.strip().str.lower()
```

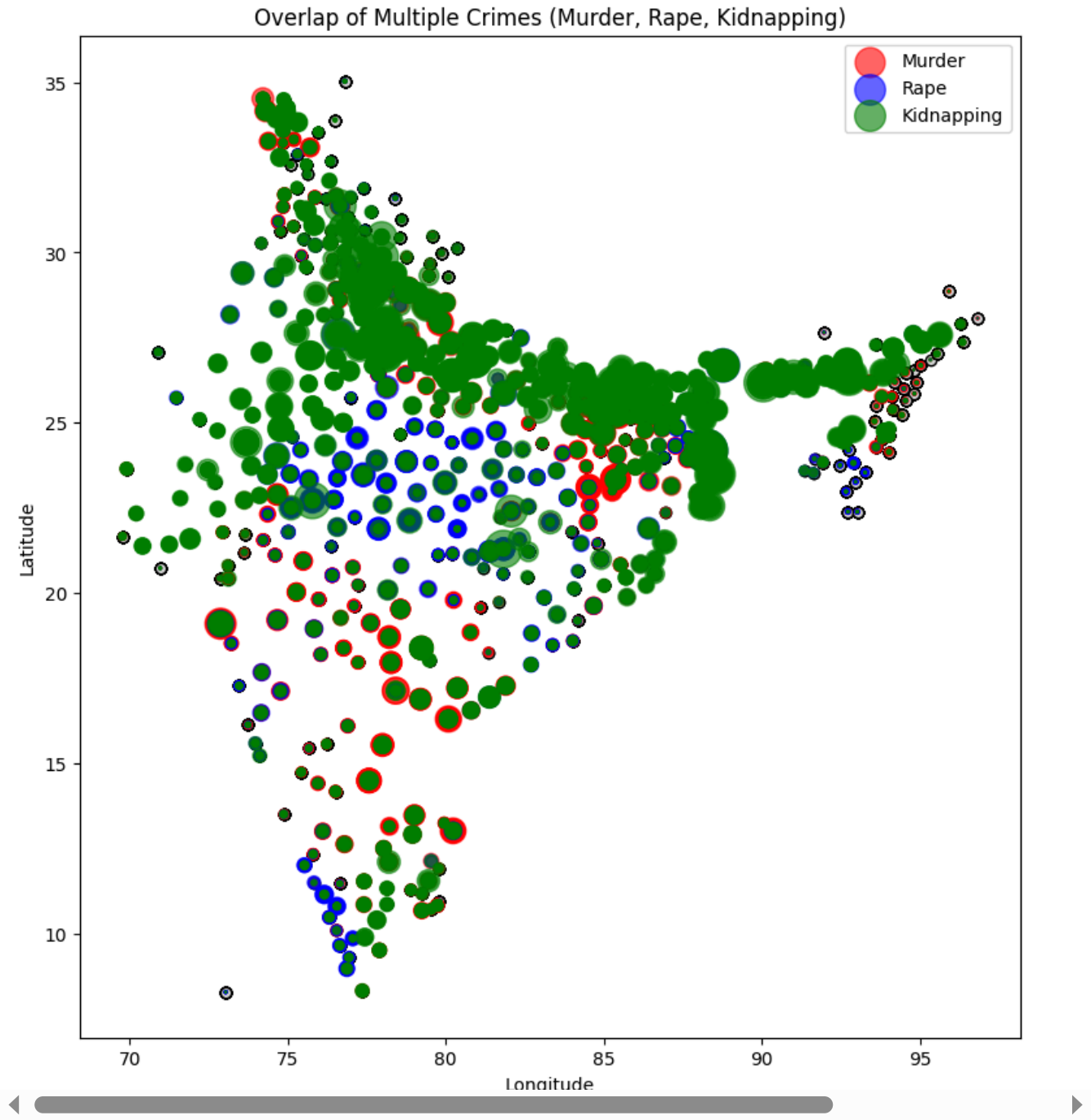
```
fig, ax = plt.subplots(1, 1, figsize=(12, 10))
gdf.plot(column='TOTAL IPC CRIMES',
         cmap='Reds',
         legend=True,
         ax=ax,
         edgecolor='black')
plt.title('Choropleth Map of Total IPC Crimes by District')
plt.xlabel('Longitude')
plt.ylabel('Latitude')
plt.show()
```




```
fig, ax = plt.subplots(figsize=(12, 10))
gdf.plot(ax=ax, color='lightgrey', edgecolor='black')
gdf.plot(ax=ax, markersize=gdf['THEFT'] / 10, alpha=0.6, color='blue', legend=True)
plt.title('Bubble Map for Theft Cases')
plt.xlabel('Longitude')
plt.ylabel('Latitude')
plt.show()
```

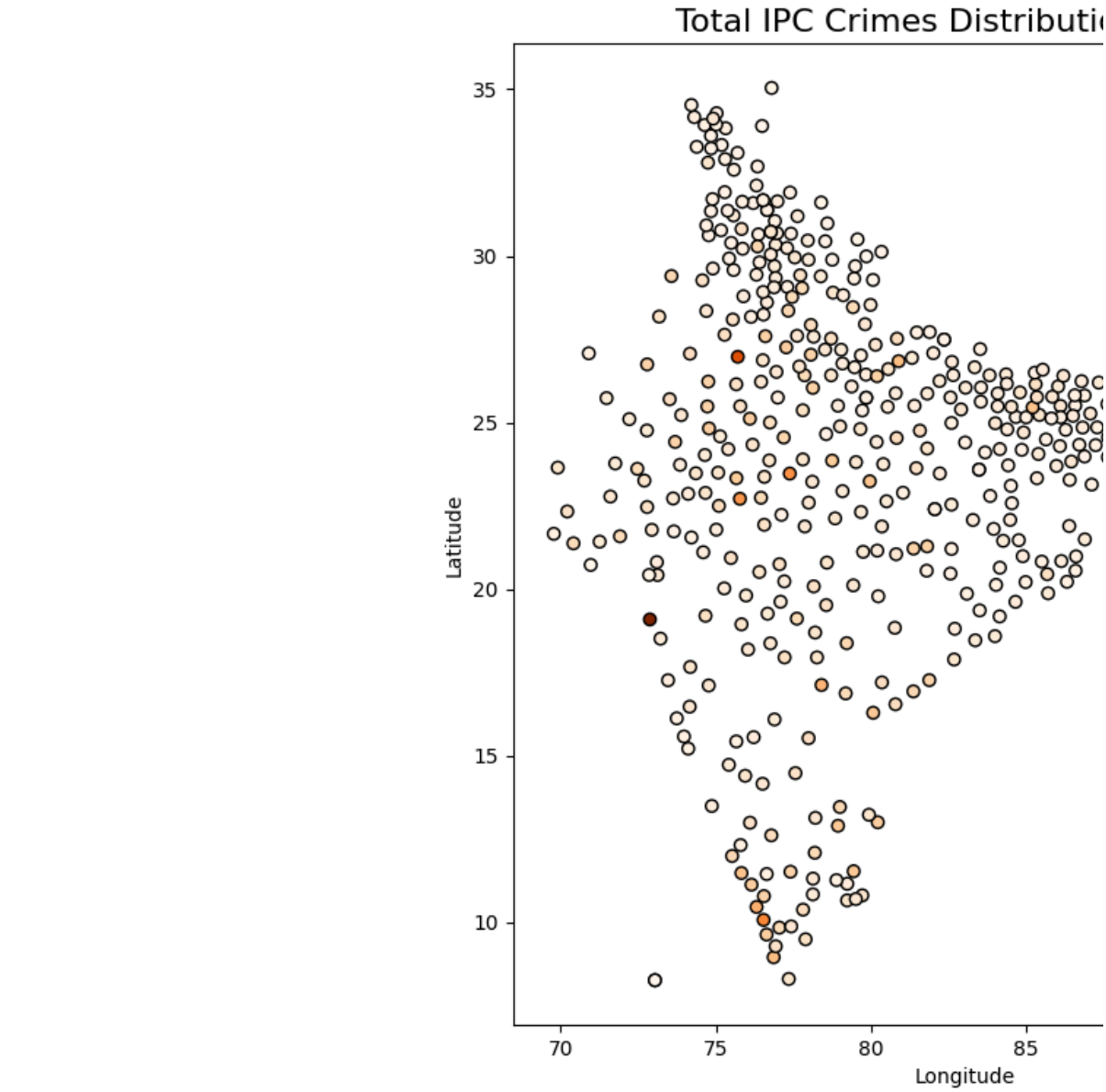


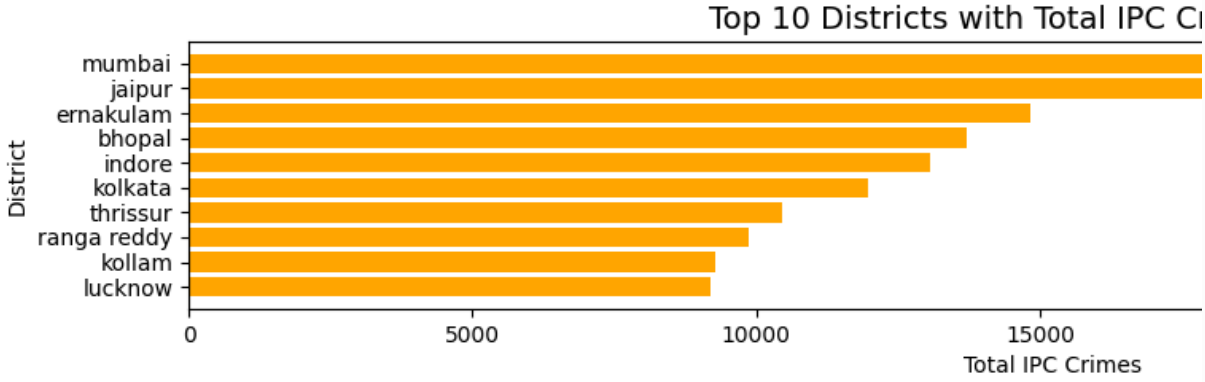

```
fig, ax = plt.subplots(1, 1, figsize=(12, 10))
gdf.plot(ax=ax, color='lightgrey', edgecolor='black')

# Overlay multiple crimes with alpha blending
gdf.plot(ax=ax, markersize=gdf['MURDER'], color='red', alpha=0.6, label='Murder')
gdf.plot(ax=ax, markersize=gdf['RAPE'], color='blue', alpha=0.6, label='Rape')
gdf.plot(ax=ax, markersize=gdf['KIDNAPPING & ABDUCTION'], color='green', alpha=0.6, label='Kidnapping')

plt.legend()
plt.title('Overlap of Multiple Crimes (Murder, Rape, Kidnapping)')
plt.xlabel('Longitude')
plt.ylabel('Latitude')
plt.show()
```




```
'''Animated Visualization of Crime Trends in India
This interactive visualization dynamically showcases the increase in crime rates across India over the years.
It provides two synchronized views: a geospatial map of crime distribution and a bar chart highlighting the top 10


import pandas as pd
import geopandas as gpd
import matplotlib.pyplot as plt
from matplotlib.animation import FuncAnimation
from matplotlib.gridspec import GridSpec
from IPython.display import HTML

# Prepare Data (assuming `gdf` contains merged crime and geospatial data)
years = sorted(merged_data['YEAR'].unique())  # Sorted list of years

# Initialize the figure with fixed layout
fig = plt.figure(figsize=(14, 12))
gs = GridSpec(2, 1, height_ratios=[4, 1], figure=fig)  # More space for the map
ax_map = fig.add_subplot(gs[0])
ax_bar = fig.add_subplot(gs[1])

# Update function for animation
```

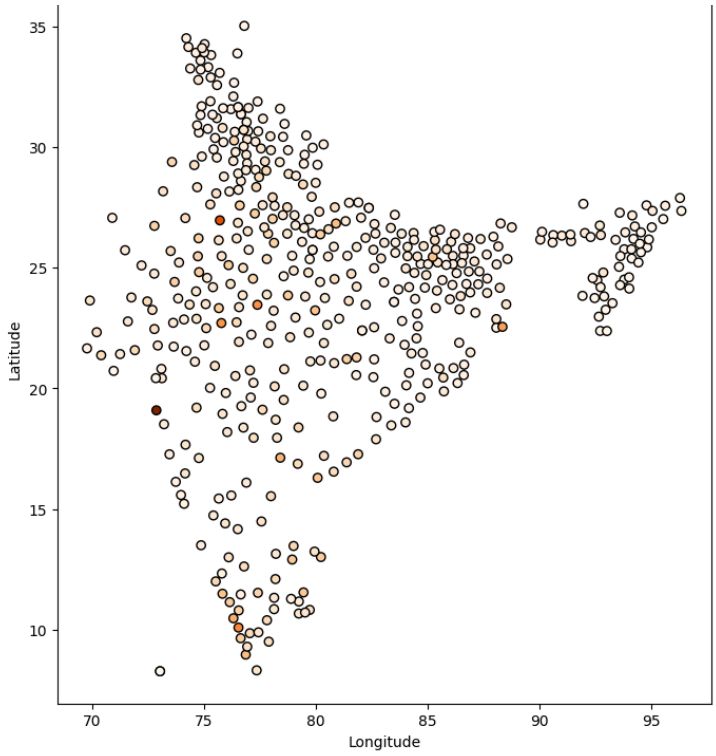
```
    def update(year):
        # Clear axes
        ax_map.clear()
        ax_bar.clear()

        # Filter data for the selected year
        yearly_data = gdf[gdf['YEAR'] == year]

        # Map plot without the legend (scale bar)
        yearly_data.plot(column='TOTAL IPC CRIMES',
                         cmap='Oranges',
                         ax=ax_map,
                         edgecolor='black',
                         legend=False)  # Turn off legend here
        ax_map.set_title(f'Total IPC Crimes Distribution - {year}', fontsize=16)
        ax_map.set_xlabel('Longitude')
        ax_map.set_ylabel('Latitude')

        # Bar chart
        top_districts = yearly_data[['DISTRICT', 'TOTAL IPC CRIMES']].sort_values(by='TOTAL IPC CRIMES', ascending=Fal
        ax_bar.barh(top_districts['DISTRICT'], top_districts['TOTAL IPC CRIMES'], color='orange')
        ax_bar.set_title(f'Top 10 Districts with Total IPC Crimes - {year}', fontsize=14)
        ax_bar.set_xlabel('Total IPC Crimes')
        ax_bar.set_ylabel('District')
        ax_bar.invert_yaxis()  # Highest crime at the top

    # Create animation
    ani = FuncAnimation(fig, update, frames=years, repeat=False)

    # Display animation in notebook
    HTML(ani.to_jshtml())

    # Save the animation as MP4 (optional)
    # from matplotlib.animation import FFMpegWriter
    # writer = FFMpegWriter(fps=2, metadata=dict(artist='Crime Data Animation'))
    # ani.save('crime_map_bar_animation.mp4', writer=writer)
```

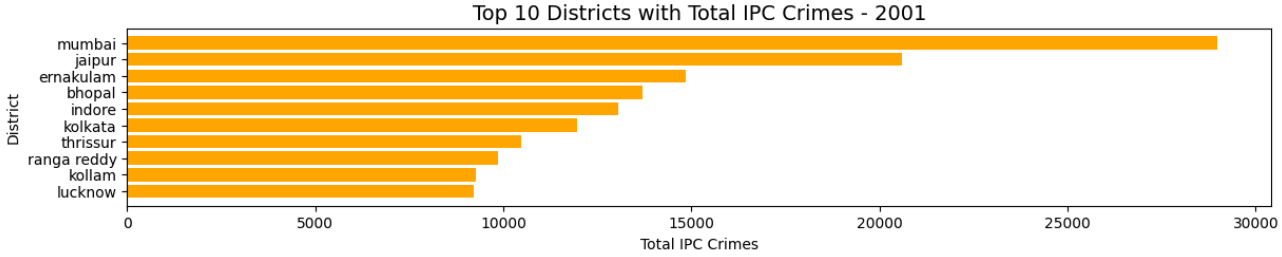




Once Loop Reflect

Total IPC Crimes Distribution - 2001


Latitude
Longitude
35
30
25
20
15
10
70
75
80
85
90
95


Top 10 Districts with Total IPC Crimes - 2001
District
mumbai
jaipur
ernakulam
bhopal
indore
kolkata
thrissur
ranga reddy
kollam
lucknow
0
5000
10000
15000
20000
25000
30000
Total IPC Crimes

```
import pandas as pd
import numpy as np
import geopandas as gpd
import matplotlib.pyplot as plt

#  1: Load the GeoJSON file as a GeoDataFrame
geojson_path = 'india (1).geojson'  # Adjust path if needed
india_geo = gpd.read_file(geojson_path)

# Inspect the loaded GeoDataFrame structure
print("GeoDataFrame Columns:", india_geo.columns)

# Extract the latitude and longitude from the geometry
india_geo['latitude'] = india_geo.geometry.centroid.y
india_geo['longitude'] = india_geo.geometry.centroid.x

# Extract relevant columns for merging (adjust based on your crime data)
geo_coordinates = india_geo[['district', 'latitude', 'longitude']]

#  2: Load the crime dataset
crime_data_path = 'crime.csv'  # Adjust path if needed
crime_data = pd.read_csv(crime_data_path)

# Ensure district names match by cleaning up whitespace and cases
crime_data['DISTRICT'] = crime_data['DISTRICT'].str.strip().str.lower()
geo_coordinates['district'] = geo_coordinates['district'].str.strip().str.lower()

#  3: Merge crime data with geo coordinates on district names
merged_data = crime_data.merge(geo_coordinates, left_on='DISTRICT', right_on='district', how='left')

# Check for any rows with missing latitude or longitude
missing_coords = merged_data[merged_data[['latitude', 'longitude']].isnull().any(axis=1)]
print("Rows with missing coordinates after merge:")
print(missing_coords[['DISTRICT', 'latitude', 'longitude']].head())

# Drop rows with missing coordinates (if any)
merged_data = merged_data.dropna(subset=['latitude', 'longitude'])

#  4: Filter districts with murder cases above a threshold
#murder_threshold = 100 # Set your threshold here

murder_mean = merged_data['MURDER'].mean()
murder_threshold=murder_mean
high_murder_data = merged_data[merged_data['MURDER'] > murder_threshold]

print(f"Number of districts with murder cases above {murder_threshold}: {len(high_murder_data)}")

#  5: Convert to GeoDataFrame for visualization
gdf_high_murder = gpd.GeoDataFrame(
    high_murder_data,
    geometry=gpd.points_from_xy(high_murder_data.longitude, high_murder_data.latitude),
    crs="EPSG:4326"
)

#  6: Plot the districts with high murder cases
fig, ax = plt.subplots(figsize=(12, 10))
india_geo.plot(ax=ax, color='lightgrey', edgecolor='black', alpha=0.7)
gdf_high_murder.plot(ax=ax, color='red', marker='o', label='High Murder Cases')
plt.title(f'Districts with Murder Cases Above {murder_threshold}')
plt.xlabel('Longitude')
plt.ylabel('Latitude')
plt.legend()
plt.show()

from sklearn.cluster import KMeans
from shapely.geometry import MultiPoint
#  7: Prepare data for K-means clustering
coordinates = high_murder_data[['latitude', 'longitude']]
```

```
# Perform K-means clustering
kmeans = KMeans(n_clusters=15, random_state=42)
high_murder_data['cluster'] = kmeans.fit_predict(coordinates)

#  8: Convert the clustered data to a GeoDataFrame
gdf_clusters = gpd.GeoDataFrame(
    high_murder_data,
    geometry=gpd.points_from_xy(high_murder_data.longitude, high_murder_data.latitude),
    crs="EPSG:4326"
)

#  9: Create polygons (convex hulls) for each cluster
cluster_polygons = []
for cluster_id in sorted(high_murder_data['cluster'].unique()):
    cluster_points = gdf_clusters[gdf_clusters['cluster'] == cluster_id].geometry
    if len(cluster_points) >= 3:  # Convex hull requires at least 3 points
        cluster_polygons.append({
            'cluster': cluster_id,
            'geometry': MultiPoint([point.coords[0] for point in cluster_points]).convex_hull
        })

# Convert cluster polygons to a GeoDataFrame
gdf_cluster_polygons = gpd.GeoDataFrame(cluster_polygons, crs="EPSG:4326")

#  10: Visualize the clustered districts with borders
fig, ax = plt.subplots(figsize=(12, 10))
india_geo.plot(ax=ax, color='lightgrey', edgecolor='black', alpha=0.7)
gdf_clusters.plot(ax=ax, column='cluster', cmap='tab10', legend=True, markersize=50, label='Cluster Points')
gdf_cluster_polygons.boundary.plot(ax=ax, color='black', linestyle='--', linewidth=1, label='Cluster Borders')
plt.title('K-means Clustering of High Murder Districts with Cluster Borders (k=15)')
plt.xlabel('Longitude')
plt.ylabel('Latitude')
plt.legend()
plt.show()

# Save the clustered data
clustered_output_path = 'high_murder_districts_clusters_with_borders.csv'
high_murder_data.to_csv(clustered_output_path, index=False)
print(f"Clustered data saved as '{clustered_output_path}'.")



# Save the filtered data for high murder districts
output_path = 'high_murder_districts.csv'
high_murder_data.to_csv(output_path, index=False)
print(f"Filtered data saved as '{output_path}'.")
```

```
GeoDataFrame Columns: Index(['id', 'district', 'dt_code', 'st_nm', 'st_code', 'year', 'geometry'], dtype='obj
Rows with missing coordinates after merge:
         DISTRICT  latitude  longitude
3        cuddapah       NaN        NaN
4       cyberabad       NaN        NaN
6   guntakal rly.       NaN        NaN
8    guntur urban       NaN        NaN
9  hyderabad city       NaN        NaN
Number of districts with murder cases above 48.77164973391388: 2405
<ipython-input-8-b2e6c3c4cfc7>:14: UserWarning: Geometry is in a geographic CRS. Results from 'centroid' are

  india_geo['latitude'] = india_geo.geometry.centroid.y
<ipython-input-8-b2e6c3c4cfc7>:15: UserWarning: Geometry is in a geographic CRS. Results from 'centroid' are

  india_geo['longitude'] = india_geo.geometry.centroid.x
<ipython-input-8-b2e6c3c4cfc7>:26: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#r
  geo_coordinates['district'] = geo_coordinates['district'].str.strip().str.lower()
```