Global River Systems Dataset
Geospatial Analysis of 1,000+ Rivers by Length and Country

August 7, 2025

[355]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import folium
```

[356]:
```
df = pd.read_csv('../data/global_rivers_dataset.csv')
print(df.head())
print(df.info())
```

```
  river_name  river_length_km    source_lat    source_lon     mouth_lat  \
0     Rungwa       302.552145 -8.038326e+05  3.562224e+06 -8.038435e+05
1    Ligonha       339.003357 -1.892915e+06  4.355690e+06 -1.703609e+06
2     Dongwe       259.307674 -1.630475e+06  2.842354e+06 -1.559692e+06
3      Cuito       764.221869 -2.024344e+06  2.309879e+06 -1.419870e+06
4      Bagoé       466.222413  1.042907e+06 -7.730508e+05  1.296021e+06

      mouth_lon             countries_passed continent  \
0  3.562224e+06  United Republic of Tanzania    Africa
1  4.160865e+06                   Mozambique    Africa
2  2.664439e+06                       Zambia    Africa
3  2.041473e+06              Angola, Namibia    Africa
4 -7.303820e+05            Ivory Coast, Mali    Africa

                  main_country length_category
0  United Republic of Tanzania           Short
1                   Mozambique           Short
2                       Zambia           Short
3                       Angola          Medium
4                         Mali           Short
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1387 entries, 0 to 1386
Data columns (total 10 columns):
 #   Column            Non-Null Count  Dtype
---  ------            --------------  -----
 0   river_name        1387 non-null   object
 1   river_length_km   1387 non-null   float64
 2   source_lat        1387 non-null   float64
 3   source_lon        1387 non-null   float64
 4   mouth_lat         1387 non-null   float64
 5   mouth_lon         1387 non-null   float64
 6   countries_passed  1387 non-null   object
 7   continent         1387 non-null   object
 8   main_country      1387 non-null   object
 9   length_category   1387 non-null   object
dtypes: float64(5), object(5)
memory usage: 108.5+ KB
None
```

[357]:

```
# Missing values are checked for each column
print("Missing values:\n", df.isna().sum())
```

```
Missing values:
 river_name          0
river_length_km     0
source_lat          0
source_lon          0
mouth_lat           0
mouth_lon           0
countries_passed    0
continent           0
main_country        0
length_category     0
dtype: int64
```

[358]:

```
#number of rivers in each continent
river_count_by_continent = df["continent"].value_counts()
print(river_count_by_continent)
```

```
continent
North America    330
Europe           319
Asia             268
Africa           218
South America    149
Oceania          103
Name: count, dtype: int64
```

[359]:

```
#average river length for each continent
avg_length_by_continent = df.groupby("continent")["river_length_km"].mean()
print(avg_length_by_continent)
```

```
continent
Africa           496.266690
Asia             588.629933
Europe           879.656895
North America    545.362963
```

```
Oceania          208.962998
South America    702.811497
Name: river_length_km, dtype: float64
```

[360]:
```
#the top 10 longest rivers
top_rivers_by_length = df.nlargest(10, "river_length_km")[["river_name",␣
 ↪"river_length_km"]]
print(top_rivers_by_length)
```

```
          river_name  river_length_km
705             Lena      8546.624429
1365           Yukon      6316.047696
540           Olenëk      5798.862238
578   Lower Tunguska      5505.924178
616           Kolyma      4960.321130
644            Huang      4609.768331
639            Niger      4589.678489
499           Vilyuy      4430.012600
608          Yenisey      4208.033832
601            Aldan      4172.429459
```

[361]:
```
#number of rivers in each length category
length_cat_count = df["length_category"].value_counts()
print(length_cat_count)
```

```
length_category
Short     815
Medium    513
Long       59
Name: count, dtype: int64
```

[362]:
```
#average source coordinates per continent
avg_source_coords = df.groupby("continent")[["source_lat", "source_lon"]].mean()
print(avg_source_coords)
```

```
                 source_lat    source_lon
continent
Africa        -1.824473e+05  2.413865e+06
Asia           3.515053e+06  1.041582e+07
Europe         7.683393e+06  5.681488e+06
North America  5.467524e+06 -1.099083e+07
Oceania       -4.138989e+06  1.776004e+07
South America -1.689703e+06 -6.768312e+06
```

[363]:

```
#Total river length per main country
total_length_by_country = df.groupby("main_country")["river_length_km"].sum()
print(total_length_by_country)
```

```
main_country
Afghanistan     3613.683543
Albania          391.607009
Angola          5799.295541
Argentina      17239.291859
Australia      11557.740653
                    ...
Uzbekistan      2969.954047
Venezuela       5808.842085
Vietnam         1857.290645
Zambia          6546.558769
Zimbabwe        1867.081120
Name: river_length_km, Length: 123, dtype: float64
```

[364]:

```
#number of countries they pass through
countries_passed_count = df["countries_passed"].str.split(", ").apply(len).
 ↪value_counts()
print(countries_passed_count)
```

```
countries_passed
1    1106
2     214
3      52
4      11
5       2
7       1
6       1
Name: count, dtype: int64
```

[365]:

```
#River that passes through the highest number of countries
max_countries_river = df.loc[df["countries_passed"].str.split(", ").apply(len).
 ↪idxmax(), ["river_name", "countries_passed"]]
print(max_countries_river)
```

```
river_name                                                              Zambezi
countries_passed    Angola, Botswana, Democratic Republic of the C...
Name: 648, dtype: object
```

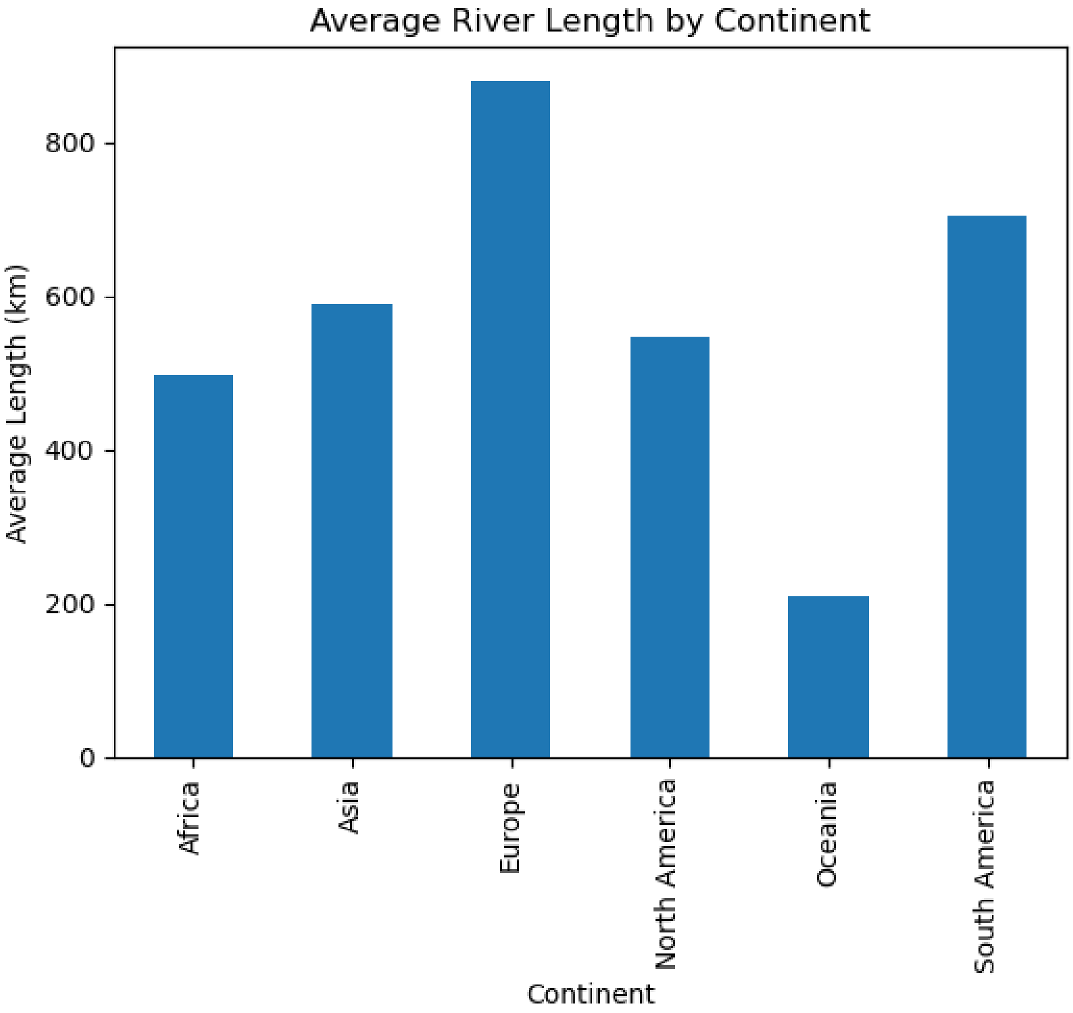
[366]:

```
#average length of rivers in Africa
avg_length_africa = df[df["continent"] == "Africa"]["river_length_km"].mean()
print(f"Average River Length in Africa: {avg_length_africa:.2f} km")
```

```
Average River Length in Africa: 496.27 km
```

[367]:

```
df.groupby("continent")["river_length_km"].mean().plot(kind="bar")
plt.title("Average River Length by Continent")
plt.xlabel("Continent")
plt.ylabel("Average Length (km)")
plt.show()
```



[368]:

```
#rivers by main country
main_country_count = df["main_country"].value_counts()
print(main_country_count)
```

```
main_country
Russia                      173
United States of America    161
Canada                      117
China                       110
Brazil                       75
```

```
                           ...
Guinea                        1
Equatorial Guinea             1
Jordan                        1
Mauritania                    1
Honduras                      1
Name: count, Length: 123, dtype: int64
```

[369]:

```
#average mouth coordinates per continent
avg_mouth_coords = df.groupby("continent")[["mouth_lat", "mouth_lon"]].mean()
print(avg_mouth_coords)
```

```
                  mouth_lat     mouth_lon
continent
Africa        -1.858833e+05  2.392007e+06
Asia           3.460783e+06  1.044506e+07
Europe         7.777293e+06  5.710170e+06
North America  5.435083e+06 -1.095321e+07
Oceania       -4.124674e+06  1.773346e+07
South America -1.618015e+06 -6.622104e+06
```

[370]:

```
#Number of rivers longer than 500 km
long_rivers_count = len(df[df["river_length_km"] > 500])
print(f"Rivers Longer than 500 km: {long_rivers_count}")
```

```
Rivers Longer than 500 km: 572
```

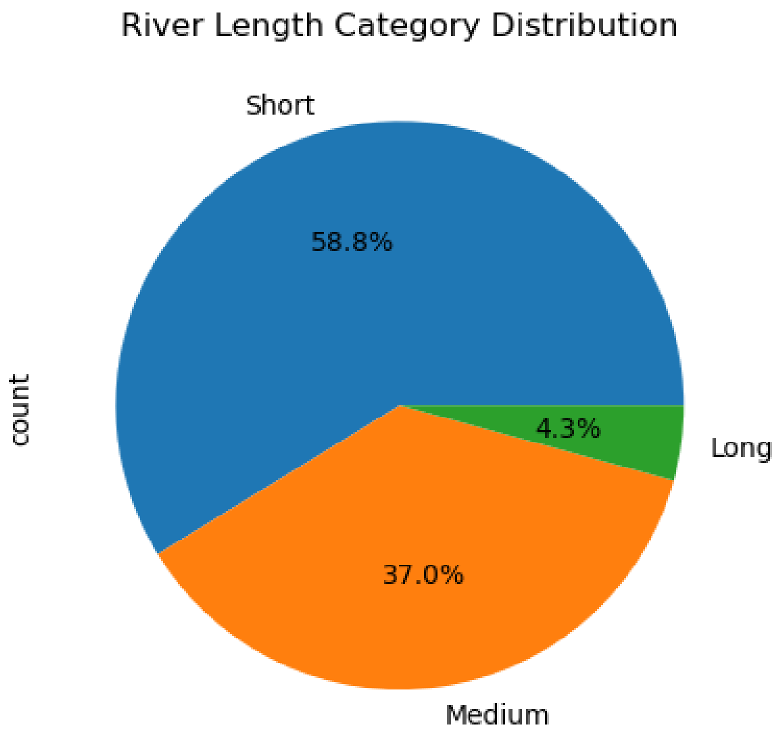
[371]:

```
#Average river length for each length category
avg_length_by_cat = df.groupby("length_category")["river_length_km"].mean()
print(avg_length_by_cat)
```

```
length_category
Long      3082.465560
Medium     939.079392
Short      232.083673
Name: river_length_km, dtype: float64
```

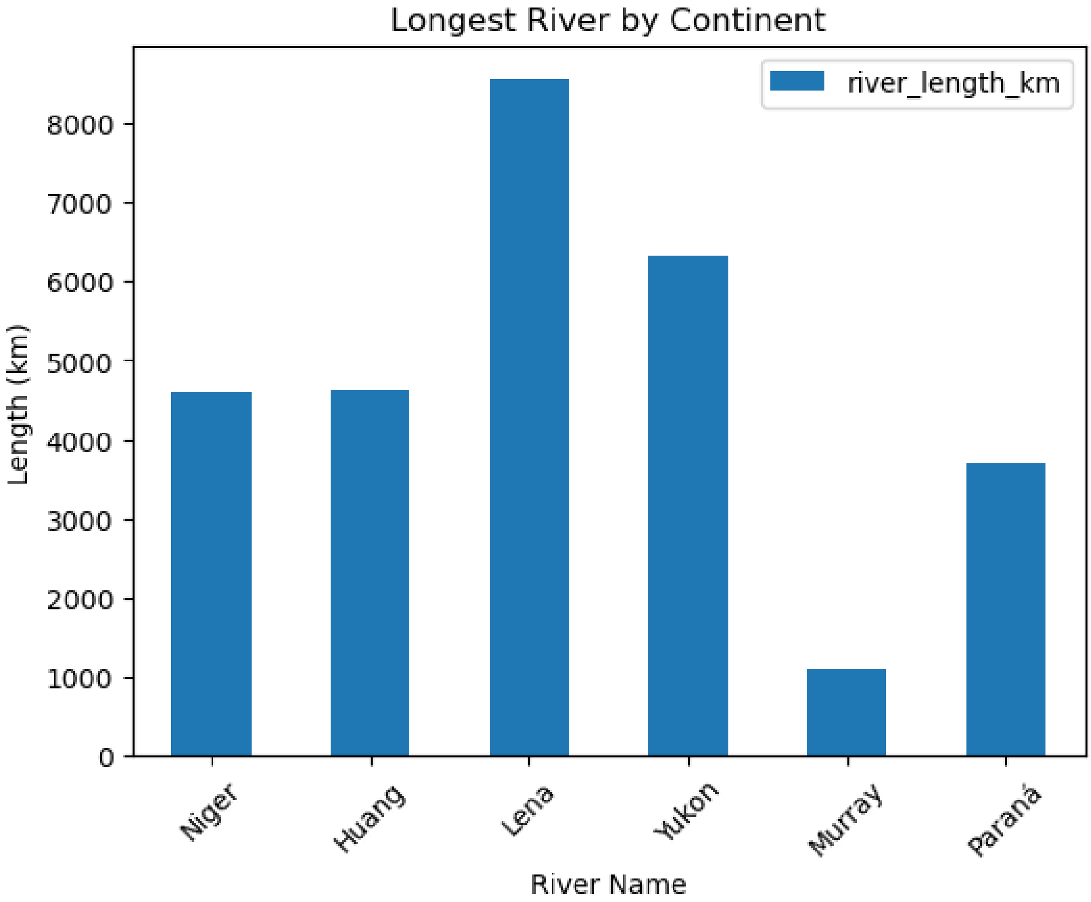
[372]:

```
df["length_category"].value_counts().plot(kind="pie", autopct='%1.1f%%')
plt.title("River Length Category Distribution")
plt.show()
```



[480]:

```
top_idx = df.groupby("continent")["river_length_km"].idxmax()
top_rivers_continent = df.loc[top_idx]

top_rivers_continent.plot(x="river_name", y="river_length_km", kind="bar")
plt.title("Longest River by Continent")
plt.xlabel("River Name")
plt.ylabel("Length (km)")
plt.xticks(rotation=45)
plt.show()
```



[482]:

```
#Top 5 continents by average river length
top_continents_by_length = df.groupby("continent")["river_length_km"].mean().
 ↪nlargest(5)
print(top_continents_by_length)
```

```
continent
Europe           879.656895
South America    702.811497
Asia             588.629933
North America    545.362963
Africa           496.266690
Name: river_length_km, dtype: float64
```

[375]:

```
#Average coordinates (source and mouth) for a specific river
rungwa_coords = df[df["river_name"] == "Rungwa"][["source_lat", "source_lon",␣
 ↪"mouth_lat", "mouth_lon"]].mean()
print(f"Rungwa Average Coordinates: {rungwa_coords}")
```

```
Rungwa Average Coordinates: source_lat   -8.038326e+05
source_lon    3.562224e+06
mouth_lat    -8.038435e+05
mouth_lon     3.562224e+06
dtype: float64
```

[376]:

```
#Total river length per continent
total_length_by_continent = df.groupby("continent")["river_length_km"].sum()
print(total_length_by_continent)
```

```
continent
Africa           108186.138471
Asia             157752.822091
Europe           280610.549447
North America    179969.777697
Oceania           21523.188836
South America    104718.912992
Name: river_length_km, dtype: float64
```

[377]:

```
#Minimum river length in each continent
min_length_by_continent = df.groupby("continent")["river_length_km"].min()
print(min_length_by_continent)
```

```
continent
Africa            3.145794
Asia              8.648038
Europe            3.933863
North America     9.987952
Oceania           3.230623
```

```
South America    10.815222
Name: river_length_km, dtype: float64
```

[378]:

```
#Average number of countries rivers pass through in each continent
avg_countries_by_continent = df.groupby("continent")["countries_passed"].
 ↪apply(lambda x: x.str.split(", ").apply(len).mean())
print(avg_countries_by_continent)
```

```
continent
Africa           1.504587
Asia             1.332090
Europe           1.304075
North America    1.087879
Oceania          1.019417
South America    1.288591
Name: countries_passed, dtype: float64
```

[379]:

```
#rivers classified as Medium in length category
hybrid_rivers_count = len(df[df["length_category"] == "Medium"])
print(f"Medium Length Rivers: {hybrid_rivers_count}")
```

```
Medium Length Rivers: 513
```

[380]:

```
#Average source coordinates for rivers longer than 300 km
long_rivers_source = df[df["river_length_km"] > 300][["source_lat",␣
 ↪"source_lon"]].mean()
print(f"Average Source Coordinates for Rivers > 300 km: {long_rivers_source}")
```

```
Average Source Coordinates for Rivers > 300 km: source_lat    3.741821e+06
source_lon    1.285403e+06
dtype: float64
```

[450]:

```
# Longest river in Sudan
sudan_river = df[df["main_country"] == "Sudan"].nlargest(1,␣
 ↪"river_length_km")[["river_name", "river_length_km"]]
print(sudan_river)
```

```
    river_name  river_length_km
696       Nile      2561.763539
```

```
[452]: #earch for Specific Country
       df[df['countries_passed'].str.contains("Sudan")]
```

```
[452]:
           river_name  river_length_km    source_lat    source_lon  \
48             Kangen       284.082958  6.008701e+05  3.872592e+06
91              Pibor       151.660385  8.749342e+05  3.673190e+06
350             Akobo       446.249725  7.469433e+05  3.991152e+06
446             Sobat       387.947267  9.364820e+05  3.695905e+06
492            Atbara        38.629631  1.634626e+06  3.995859e+06
493            Atbara       431.533965  1.670769e+06  3.996544e+06
548             Setit       322.559797  1.549675e+06  4.209730e+06
555    Bahr el  Zeraf       226.134951  1.047039e+06  3.466385e+06
653  El Bahr el Azraq        75.580518  1.257378e+06  3.871423e+06
654  El Bahr el Azraq       816.859292  1.128225e+06  3.935236e+06
696              Nile      2561.763539  2.081417e+06  3.750717e+06
697              Nile       421.299736  2.448940e+06  3.460987e+06
702       Albert Nile       193.619037  2.655347e+05  3.503765e+06
707     Bahr el Jebel       414.604245  3.998445e+05  3.563990e+06
709     Bahr el Jebel       487.055449  1.047797e+06  3.464792e+06
710  El Bahr el Abyad       900.726345  1.047797e+06  3.464792e+06

        mouth_lat     mouth_lon          countries_passed continent  \
48   7.400657e+05  3.699009e+06               South Sudan    Africa
91   7.400657e+05  3.699009e+06     Ethiopia, South Sudan    Africa
350  8.783006e+05  3.672347e+06     Ethiopia, South Sudan    Africa
446  9.364820e+05  3.696671e+06     Ethiopia, South Sudan    Africa
492  1.670769e+06  3.996544e+06                     Sudan    Africa
493  1.792954e+06  3.961126e+06                     Sudan    Africa
548  1.634626e+06  3.995859e+06  Eritrea, Ethiopia, Sudan    Africa
555  8.615312e+05  3.399223e+06               South Sudan    Africa
653  1.312311e+06  3.827124e+06                     Sudan    Africa
654  1.750706e+06  3.616644e+06           Ethiopia, Sudan    Africa
696  3.498038e+06  3.477277e+06              Egypt, Sudan    Africa
697  2.734540e+06  3.660117e+06              Egypt, Sudan    Africa
702  3.998445e+05  3.563990e+06       South Sudan, Uganda    Africa
707  7.570031e+05  3.467417e+06               South Sudan    Africa
709  7.570031e+05  3.467417e+06               South Sudan    Africa
710  1.750930e+06  3.616785e+06        South Sudan, Sudan    Africa

    main_country length_category      lat_diff       lon_diff
48   South Sudan           Short  1.391957e+05  173583.395434
91   South Sudan           Short  1.348685e+05   25818.729554
350     Ethiopia           Short  1.313572e+05  318804.237012
446  South Sudan           Short  0.000000e+00     766.408604
492        Sudan           Short  3.614317e+04     684.875773
493        Sudan           Short  1.221846e+05   35417.861426
548     Ethiopia           Short  8.495141e+04  213871.484582
```

```
555  South Sudan          Short  1.855080e+05   67161.309973
653        Sudan          Short  5.493278e+04   44299.504393
654        Sudan         Medium  6.224805e+05  318592.251654
696        Sudan           Long  1.416622e+06  273439.370305
697        Egypt          Short  2.856006e+05  199130.348887
702       Uganda          Short  1.343099e+05   60225.583886
707  South Sudan          Short  3.571586e+05   96572.919576
709  South Sudan          Short  2.907942e+05    2625.357132
710  South Sudan         Medium  7.031326e+05  151993.502005
```

[383]:

```
# Longest river in Ireland
ireland_river = df[df["main_country"] == "Ireland"].nlargest(1,␣
 ↪"river_length_km")[["river_name", "river_length_km"]]
print(ireland_river)
```

```
    river_name  river_length_km
769    Shannon       245.975123
```

[384]:

```
#Average river length for rivers crossing more than one country
multi_country_avg_length = df[df["countries_passed"].str.
 ↪contains(",")]["river_length_km"].mean()
print(f"Avg Length of Multi-Country Rivers: {multi_country_avg_length:.2f} km")
```

```
Avg Length of Multi-Country Rivers: 841.57 km
```

[385]:

```
#multi-country rivers in Africa
africa_multi_country = len(df[(df["continent"] == "Africa") &␣
 ↪(df["countries_passed"].str.contains(","))])
print(f"Multi-Country Rivers in Africa: {africa_multi_country}")
```

```
Multi-Country Rivers in Africa: 82
```

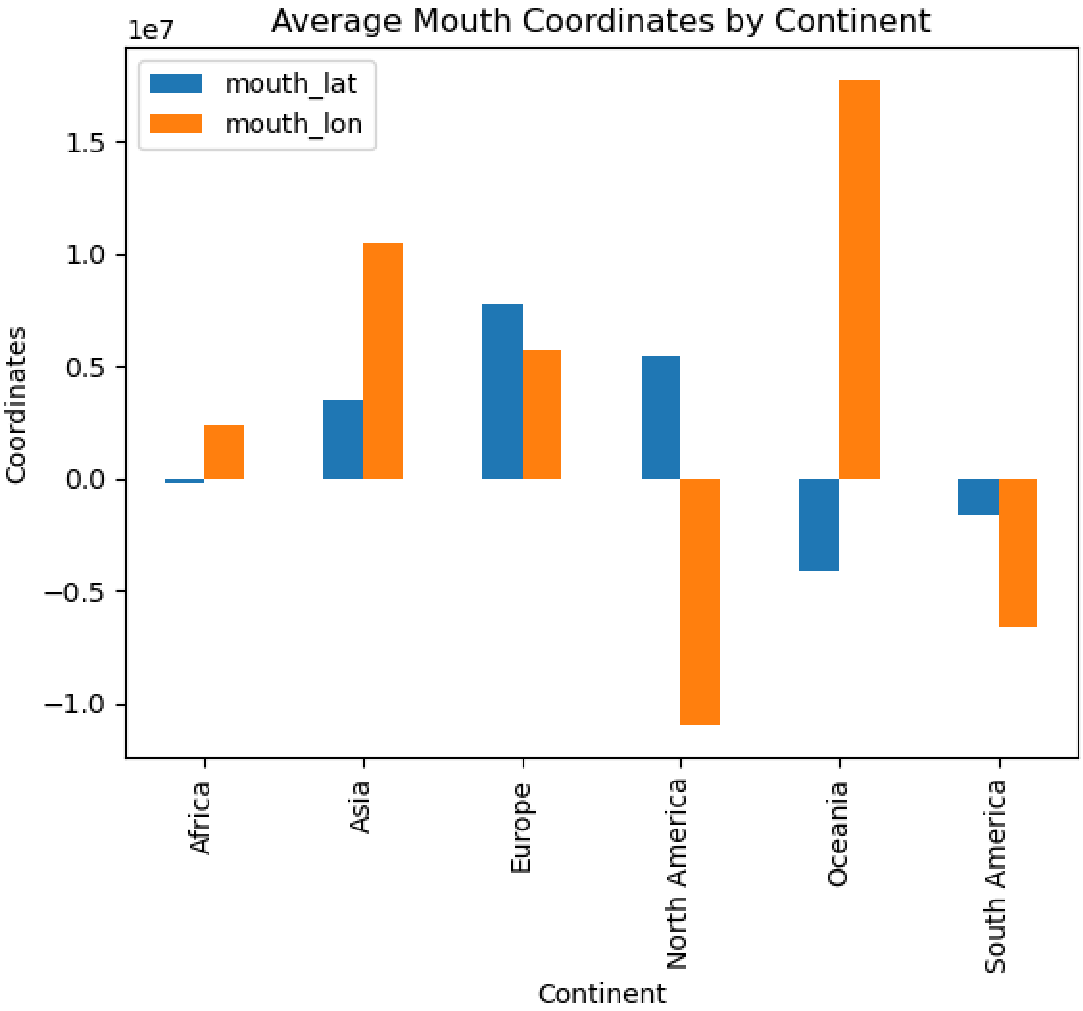
[386]:

```
#Average mouth coordinates for short rivers
short_rivers_mouth = df[df["length_category"] == "Short"][["mouth_lat",␣
 ↪"mouth_lon"]].mean()
print(f"Average Mouth Coordinates for Short Rivers: {short_rivers_mouth}")
```

```
Average Mouth Coordinates for Short Rivers: mouth_lat    2.520558e+06
mouth_lon    1.947937e+06
dtype: float64
```

[468]:

```
df.groupby("continent")[["mouth_lat", "mouth_lon"]].mean().plot(kind="bar")
plt.title("Average Mouth Coordinates by Continent")
plt.xlabel("Continent")
plt.ylabel("Coordinates")
plt.show()
```

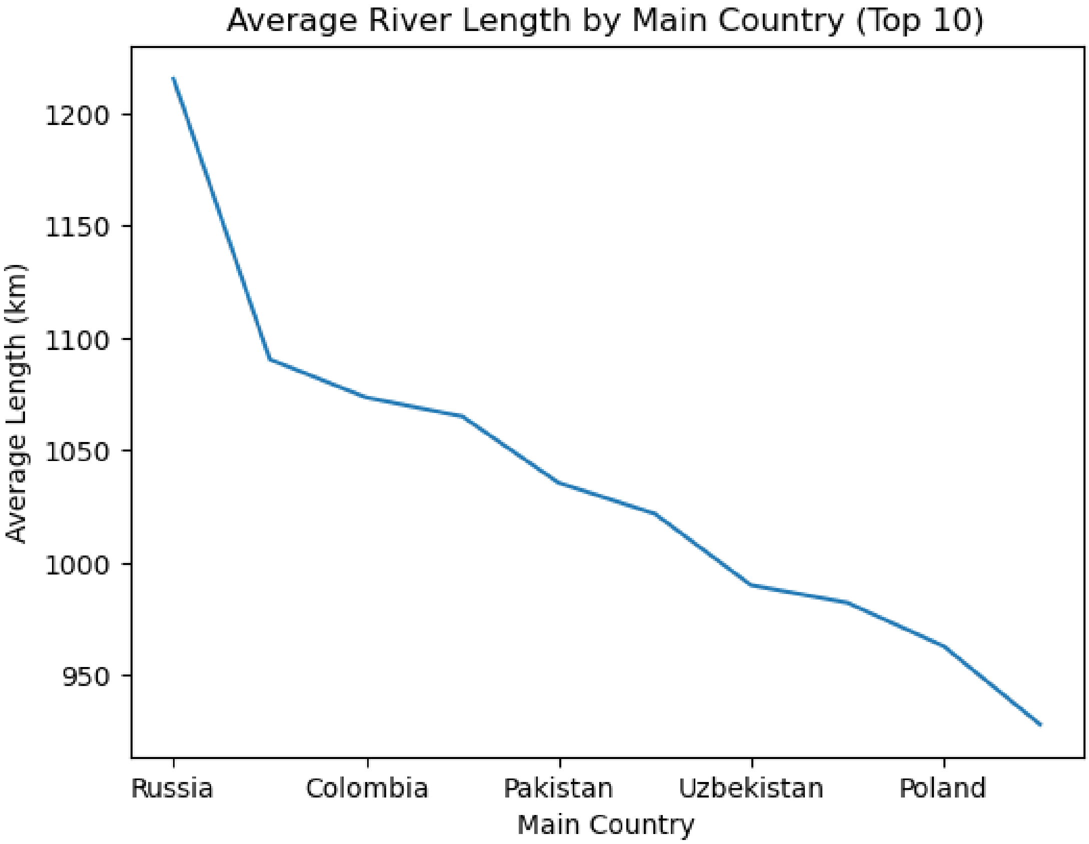


[387]:

```
#Top 10 rivers by difference between source and mouth coordinates
df['lat_diff'] = abs(df['source_lat'] - df['mouth_lat'])
df['lon_diff'] = abs(df['source_lon'] - df['mouth_lon'])
top_distance_rivers = df.nlargest(10, ['lat_diff', 'lon_diff'])[["river_name",␣
 ↪"lat_diff", "lon_diff"]]
print(top_distance_rivers)
```

```
          river_name      lat_diff      lon_diff
705             Lena  4.682971e+06  2.082745e+06
608          Yenisey  3.103515e+06  1.093301e+06
582        Indigirka  2.495448e+06  5.590543e+05
681           Paraná  2.378778e+06  4.576519e+05
1378       Mackenzie  2.040299e+06  1.911119e+06
935            Volga  1.907710e+06  1.696878e+06
578   Lower Tunguska  1.831410e+06  1.973421e+06
616           Kolyma  1.789615e+06  1.730138e+06
540           Olenëk  1.759961e+06  1.738421e+06
683          Lancang  1.732687e+06  5.145483e+05
```

[388]:
```
df.groupby("main_country")["river_length_km"].mean().nlargest(10).
 ↪plot(kind="line")
plt.title("Average River Length by Main Country (Top 10)")
plt.xlabel("Main Country")
plt.ylabel("Average Length (km)")
plt.show()
```



[476]:
```
# Will create map with average coordinates
m = folium.Map(location=[df['source_lat'].mean(), df['source_lon'].mean()],␣
 ↪zoom_start=2)

#one river as example
folium.Marker(
    location=[df.iloc[0]['source_lat'], df.iloc[0]['source_lon']],
    popup="River Source"
).add_to(m)
m
```

[476]:
```
<folium.folium.Map at 0x2a54b750290>
```

[390]:

```
#function to extract river information based on its name
def get_river_info(river_name):
    #the specific river and select the first match
    river = df[df["river_name"] == river_name].iloc[0]

    #dictionary with selected river details
    info = {
        "River Name": river["river_name"],
        "Length (km)": river["river_length_km"],
        "Continent": river["continent"],
        "Countries Passed": river["countries_passed"],
        "Source Coordinates": (river["source_lat"], river["source_lon"]),
        "Mouth Coordinates": (river["mouth_lat"], river["mouth_lon"])
    }
    return info

# Exampl Retrieve information about the Nile River
nile_info = get_river_info("Nile")
print(nile_info)
```

```
{'River Name': 'Nile', 'Length (km)': 2561.763538872077, 'Continent': 'Africa',
'Countries Passed': 'Egypt, Sudan', 'Source Coordinates': (2081416.8197280483,
3750716.7376957503), 'Mouth Coordinates': (3498038.3719413616,
3477277.367390747)}
```

[391]:

```
# General River Statistics
def get_rivers_stats():
    stats = {
        "Total Rivers": len(df),
        "Longest River": df.loc[df["river_length_km"].idxmax()]["river_name"],
        "Average Length": df["river_length_km"].mean(),
        "Rivers Crossing Multiple Countries": len(df[df["countries_passed"].str.
 ↪contains(",")]),
        "Continent with Most Rivers": df["continent"].value_counts().idxmax()
    }
    return stats

print(get_rivers_stats())
```

```
{'Total Rivers': 1387, 'Longest River': 'Lena', 'Average Length':
614.8243615957364, 'Rivers Crossing Multiple Countries': 281, 'Continent with
Most Rivers': 'North America'}
```

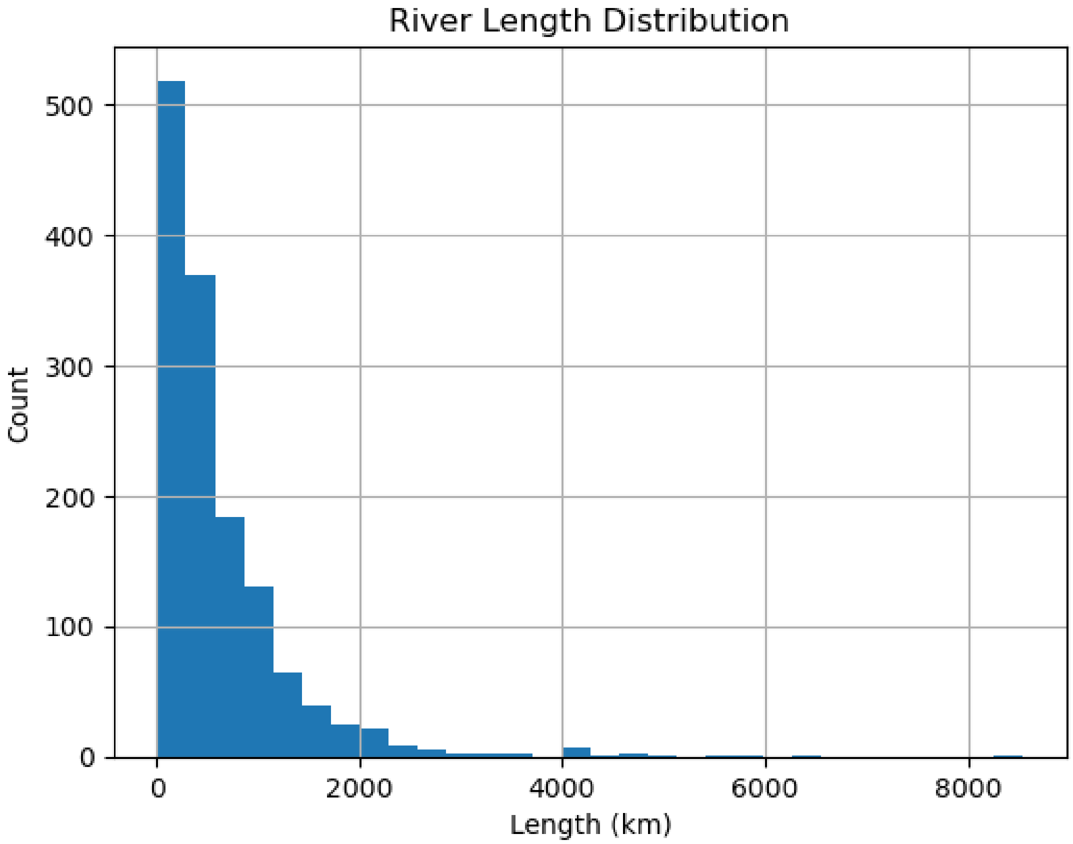
[392]:

```
#Filter Rivers by Length

def filter_rivers_by_length(min_length, max_length):
    filtered = df[(df["river_length_km"] >= min_length) & (df["river_length_km"]␣
 ↪<= max_length)]
    return filtered[["river_name", "river_length_km", "continent"]]

# Example for rivers between 500-1000 km
print(filter_rivers_by_length(500, 1000))
```

```
        river_name  river_length_km      continent
3            Cuito       764.221869         Africa
7      Oum Er Rbia       506.372279         Africa
8       San Miguel       748.734513  South America
19         Cojedes       552.292571  South America
20          Vaupés       729.383643  South America
...            ...              ...            ...
1358     La Grande       733.316398  North America
1362  Saskatchewan       704.876896  North America
1367        Teslin       519.815010  North America
1370     Allegheny       567.426425  North America
1379         Slave       833.799728  North America

[340 rows x 3 columns]
```

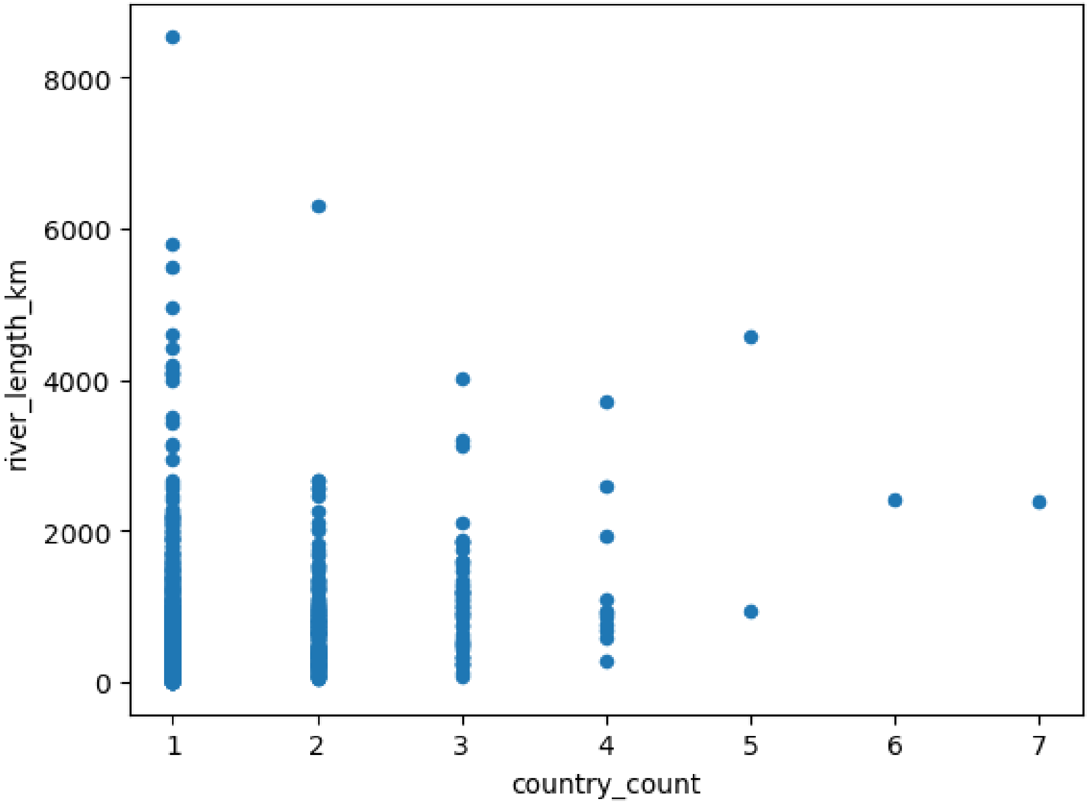
[436]:

```
df['river_length_km'].hist(bins=30)
plt.title("River Length Distribution")
plt.xlabel("Length (km)")
plt.ylabel("Count")
plt.show()
```



```
[466]: #River Length vs Number of Countries Passed
       df['country_count'] = df['countries_passed'].str.count(',') + 1
       df.plot.scatter(x='country_count', y='river_length_km')
```

```
[466]: <Axes: xlabel='country_count', ylabel='river_length_km'>
```


river_length_km
country_count