In [1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import os

plt.style.use("default")
```

In [2]:

```
np.random.seed(42)

dates = pd.date_range(start="2023-01-01", end="2024-12-31")

data = {
    "Date": dates,
    "Temperature": np.random.normal(30, 5, len(dates)),
    "Rainfall": np.random.exponential(5, len(dates)),
    "Humidity": np.random.randint(40, 95, len(dates))
}

df = pd.DataFrame(data)

df["Month"] = df["Date"].dt.month
df["Year"] = df["Date"].dt.year

os.makedirs("../../data/weather", exist_ok=True)
df.to_csv("../../data/weather/weather_data.csv", index=False)

df.head()
```

Out[2]:

	Date	Temperature	Rainfall	Humidity	Month	Year
0	2023-01-01	32.483571	1.601407	63	1	2023
1	2023-01-02	29.308678	4.039178	81	1	2023
2	2023-01-03	33.238443	5.269443	69	1	2023
3	2023-01-04	37.615149	8.852196	53	1	2023
4	2023-01-05	28.829233	1.156013	45	1	2023

In [3]:

```
df = pd.read_csv("../../data/weather/weather_data.csv", parse_dates=["Date"])

df.info()
df.describe()
```

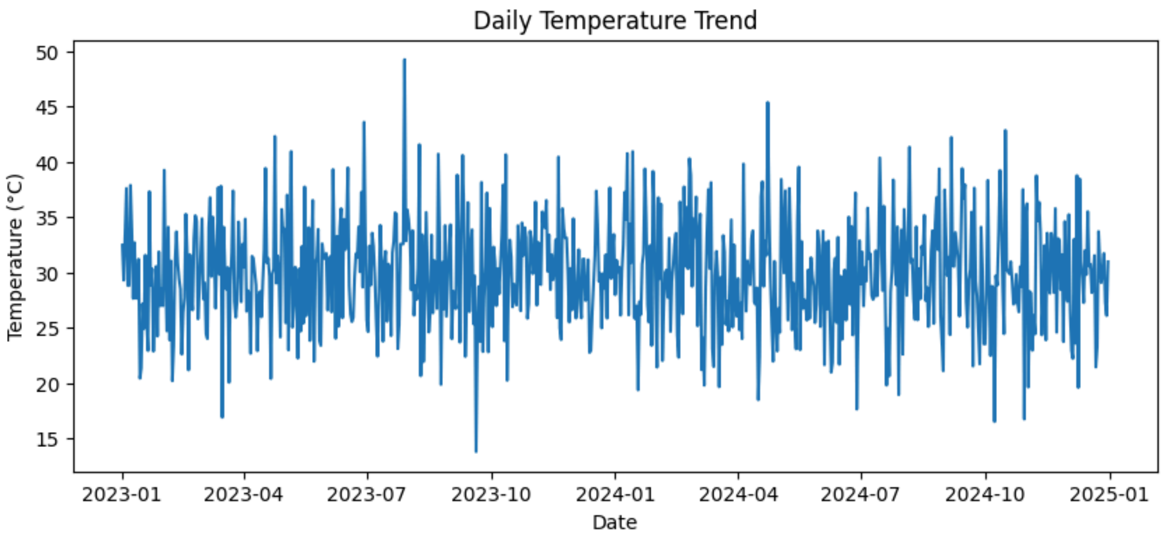
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 731 entries, 0 to 730
Data columns (total 6 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   Date         731 non-null    datetime64[ns]
 1   Temperature  731 non-null    float64
 2   Rainfall     731 non-null    float64
 3   Humidity     731 non-null    int64
 4   Month        731 non-null    int64
 5   Year         731 non-null    int64
dtypes: datetime64[ns](1), float64(2), int64(3)
memory usage: 34.4 KB
```

Out[3]:

	Date	Temperature	Rainfall	Humidity	Month	Year
count	731	731.000000	731.000000	731.000000	731.000000	731.000000
mean	2024-01-01 00:00:00	29.931266	5.193390	66.854993	6.519836	2023.500684
min	2023-01-01 00:00:00	13.793663	0.024761	40.000000	1.000000	2023.000000
25%	2023-07-02 12:00:00	26.518412	1.401323	54.000000	4.000000	2023.000000
50%	2024-01-01 00:00:00	29.960137	3.723922	66.000000	7.000000	2024.000000
75%	2024-07-01 12:00:00	33.135032	7.077650	80.000000	10.000000	2024.000000
max	2024-12-31 00:00:00	49.263657	37.208615	94.000000	12.000000	2024.000000
std	NaN	4.916842	5.205246	15.636830	3.451913	0.500342

In [4]:

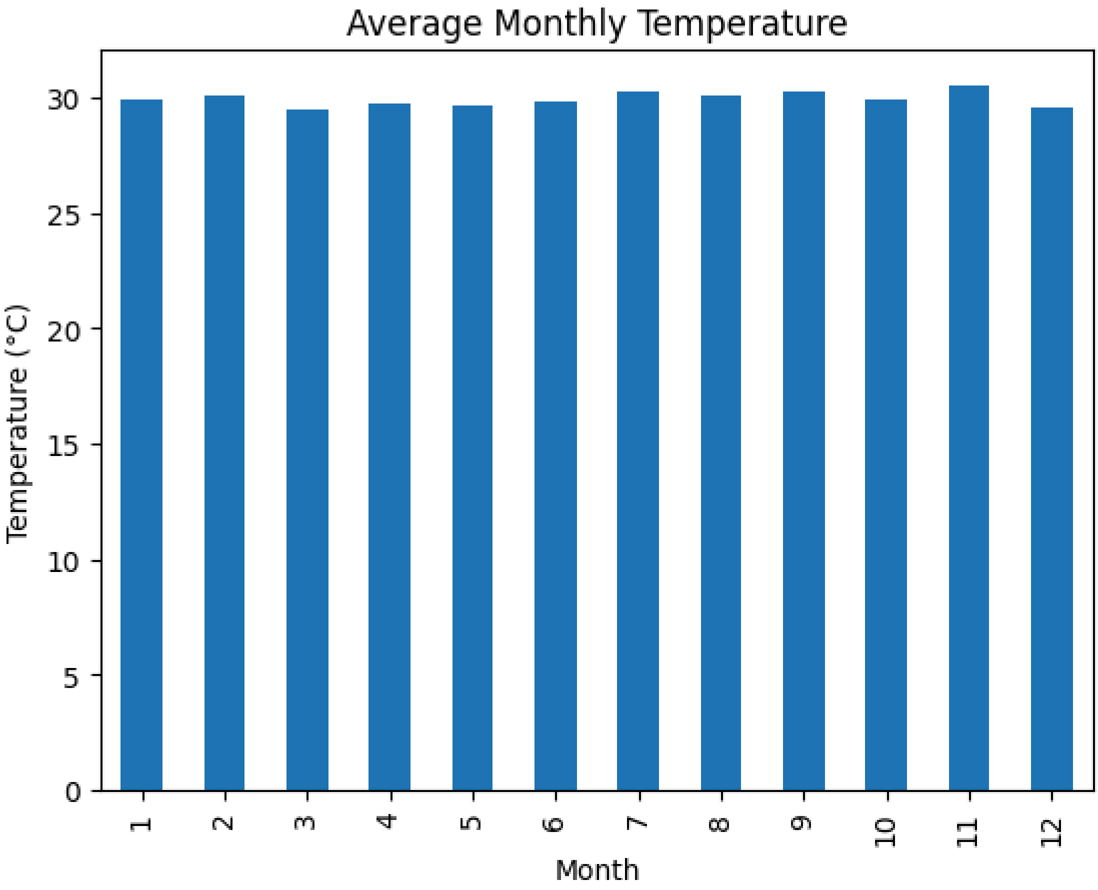
```
plt.figure(figsize=(10,4))
plt.plot(df["Date"], df["Temperature"])
plt.title("Daily Temperature Trend")
plt.xlabel("Date")
plt.ylabel("Temperature (°C)")
plt.show()
```



In [5]:

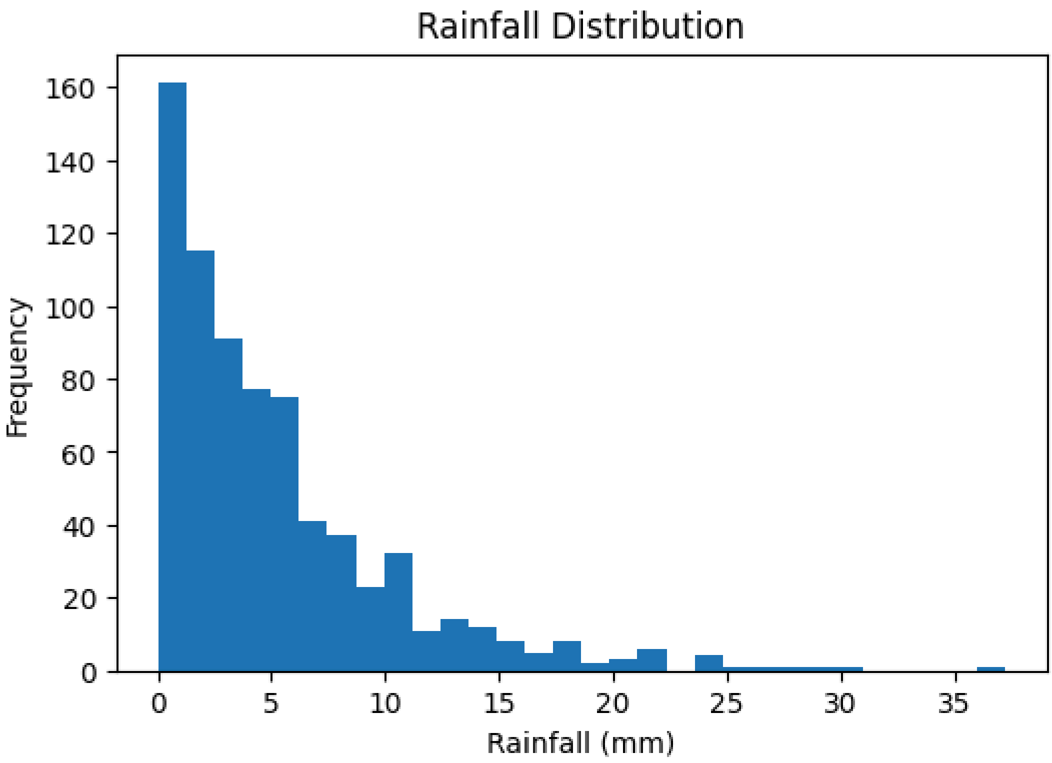
```
monthly_temp = df.groupby("Month")["Temperature"].mean()

monthly_temp.plot(kind="bar", title="Average Monthly Temperature")
plt.ylabel("Temperature (°C)")
plt.show()
```



In [6]:

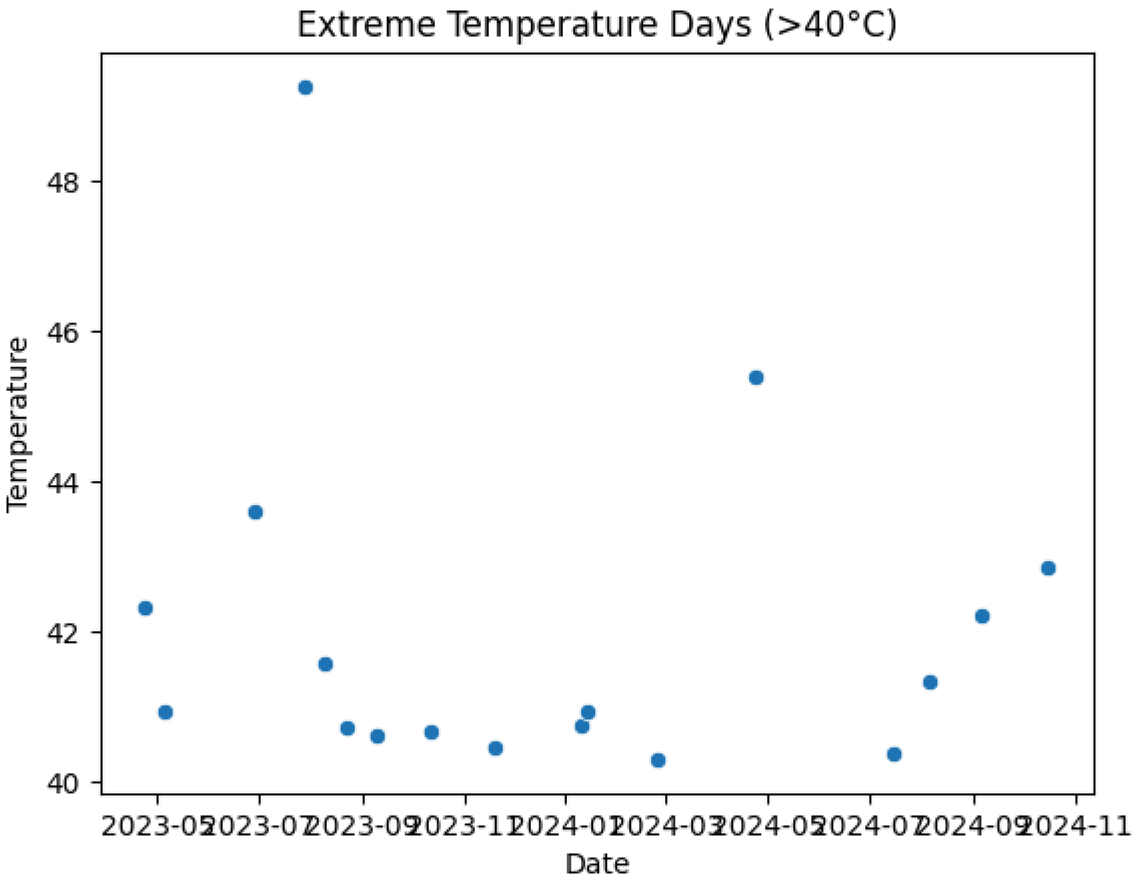
```
plt.figure(figsize=(6,4))
plt.hist(df["Rainfall"], bins=30)
plt.title("Rainfall Distribution")
plt.xlabel("Rainfall (mm)")
plt.ylabel("Frequency")
plt.show()
```



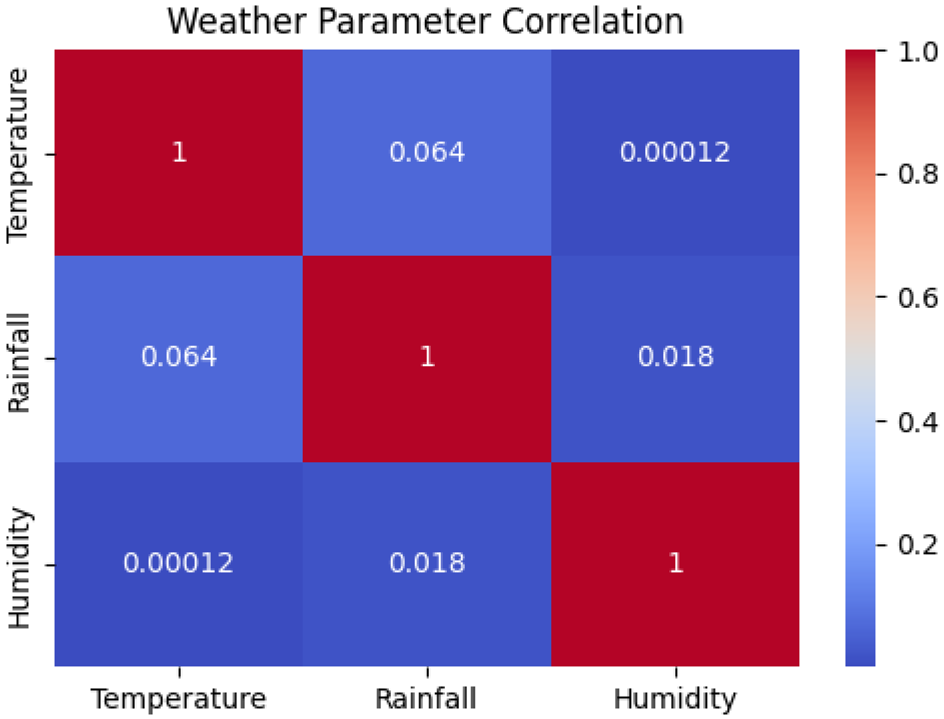
In [7]:
```
extreme_days = df[df["Temperature"] > 40]
len(extreme_days)
```

Out[7]:
```
17
```

In [8]:
```
sns.scatterplot(x="Date", y="Temperature", data=extreme_days)
plt.title("Extreme Temperature Days (>40°C)")
plt.show()
```



In [9]:
```
plt.figure(figsize=(6,4))
sns.heatmap(
    df[["Temperature", "Rainfall", "Humidity"]].corr(),
    annot=True,
    cmap="coolwarm"
)
plt.title("Weather Parameter Correlation")
plt.show()
```



In [10]:

```
os.makedirs("../../visualizations/project3_weather_analysis", exist_ok=True)
print("Weather visualization directory ready")
```

```
Weather visualization directory ready
```

📌 Key Insights

1. Temperature shows clear seasonal variation across months.
2. Extreme temperature events are limited but increasing during summer months.
3. Rainfall distribution is highly skewed, indicating irregular rainfall patterns.
4. Humidity shows moderate correlation with rainfall.

🎯 Recommendations

- Implement early warning systems for extreme heat days.
- Plan water resource management based on rainfall variability.
- Use long-term trend analysis for climate adaptation strategies.