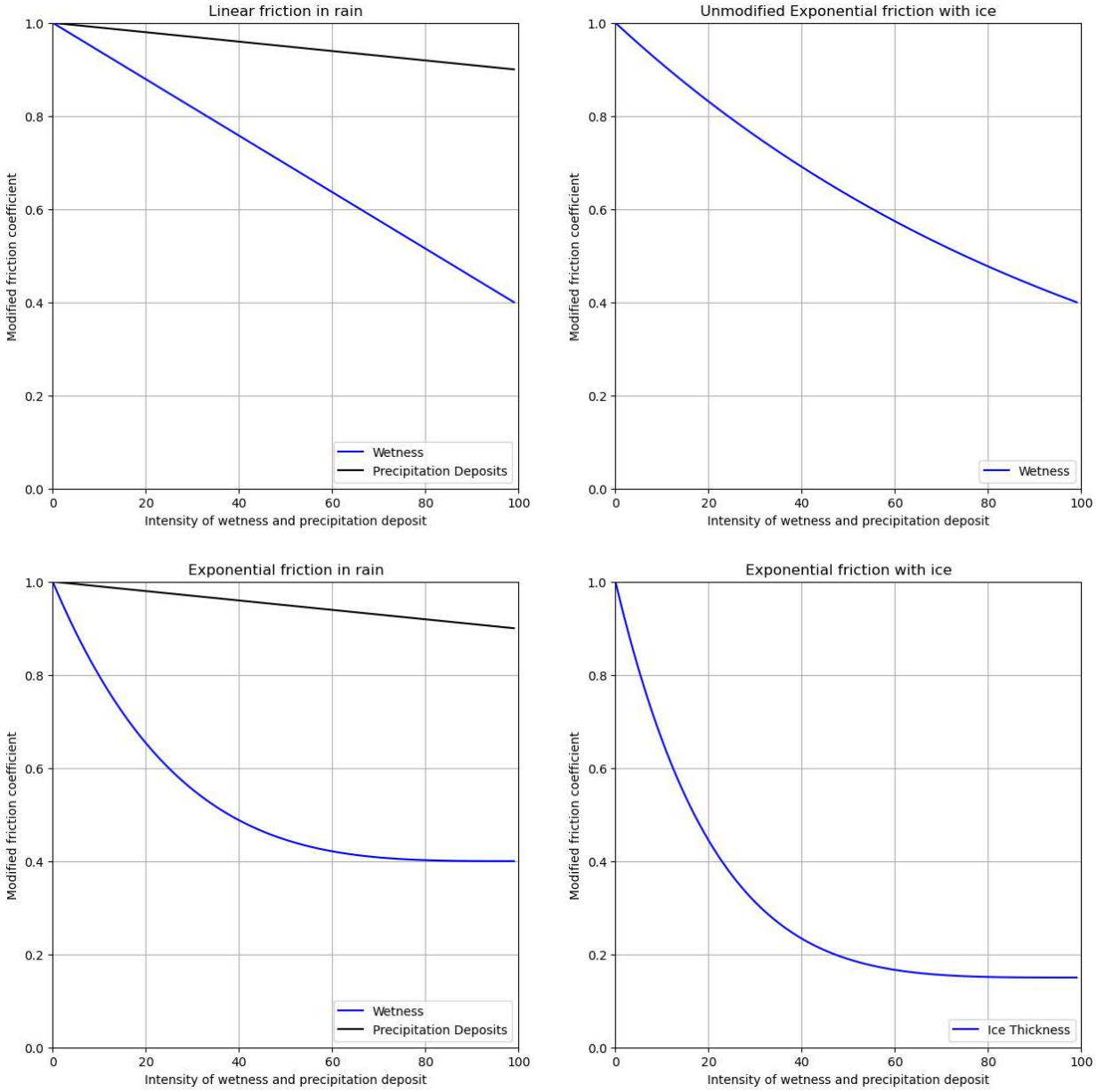
In [1]:
```
import os
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
import scipy.stats
from scipy.stats import norm, binom, poisson
from dtaidistance import dtw
import json
from mpl_toolkits.mplot3d import Axes3D
import math
```

In [2]:
```
fig = plt.figure(figsize=(15, 15))

wetness = np.linspace(0, 100, 100)
precipitation_deposits = np.linspace(0, 100, 100)
ice_thickness = np.linspace(0, 100, 100)

ax = fig.add_subplot(221)
ax2 = fig.add_subplot(223)
ax3 = fig.add_subplot(224)
ax4 = fig.add_subplot(222)

ax.set_title('Linear friction in rain')
ax.set_xlim([0, 100])
ax.set_ylim([0, 1])
ax.set_box_aspect(1)
ax2.set_title('Exponential friction in rain')
ax2.set_xlim([0, 100])
ax2.set_ylim([0, 1])
ax2.set_box_aspect(1)
ax3.set_title('Exponential friction with ice')
ax3.set_xlim([0, 100])
ax3.set_ylim([0, 1])
ax3.set_box_aspect(1)
ax4.set_title('Unmodified Exponential friction with ice')
ax4.set_xlim([0, 100])
ax4.set_ylim([0, 1])
ax4.set_box_aspect(1)

ax.plot(1 - 0.6*wetness/100, color='blue', label='Wetness')
ax.plot(1 - 0.1*precipitation_deposits/100, color='black', label='Precipitation Deposi
ax.legend(loc="lower right")
ax.set_xlabel('Intensity of wetness and precipitation deposit')
ax.set_ylabel('Modified friction coefficient')
ax.grid(True)

ax2.plot(np.exp(-0.916*wetness/100) * (1-wetness/100)**3 * 0.6 + 0.4, color='blue', la
ax2.plot(1-0.1*precipitation_deposits/100, color='black', label='Precipitation Deposit
ax2.legend(loc="lower right")
ax2.set_xlabel('Intensity of wetness and precipitation deposit')
ax2.set_ylabel('Modified friction coefficient')
ax2.grid(True)

ax3.plot(np.exp(-1.89711*ice_thickness/100) * (1-ice_thickness/100)**3 * 0.85 + 0.15,
ax3.legend(loc="lower right")
ax3.set_xlabel('Intensity of wetness and precipitation deposit')
ax3.set_ylabel('Modified friction coefficient')
```

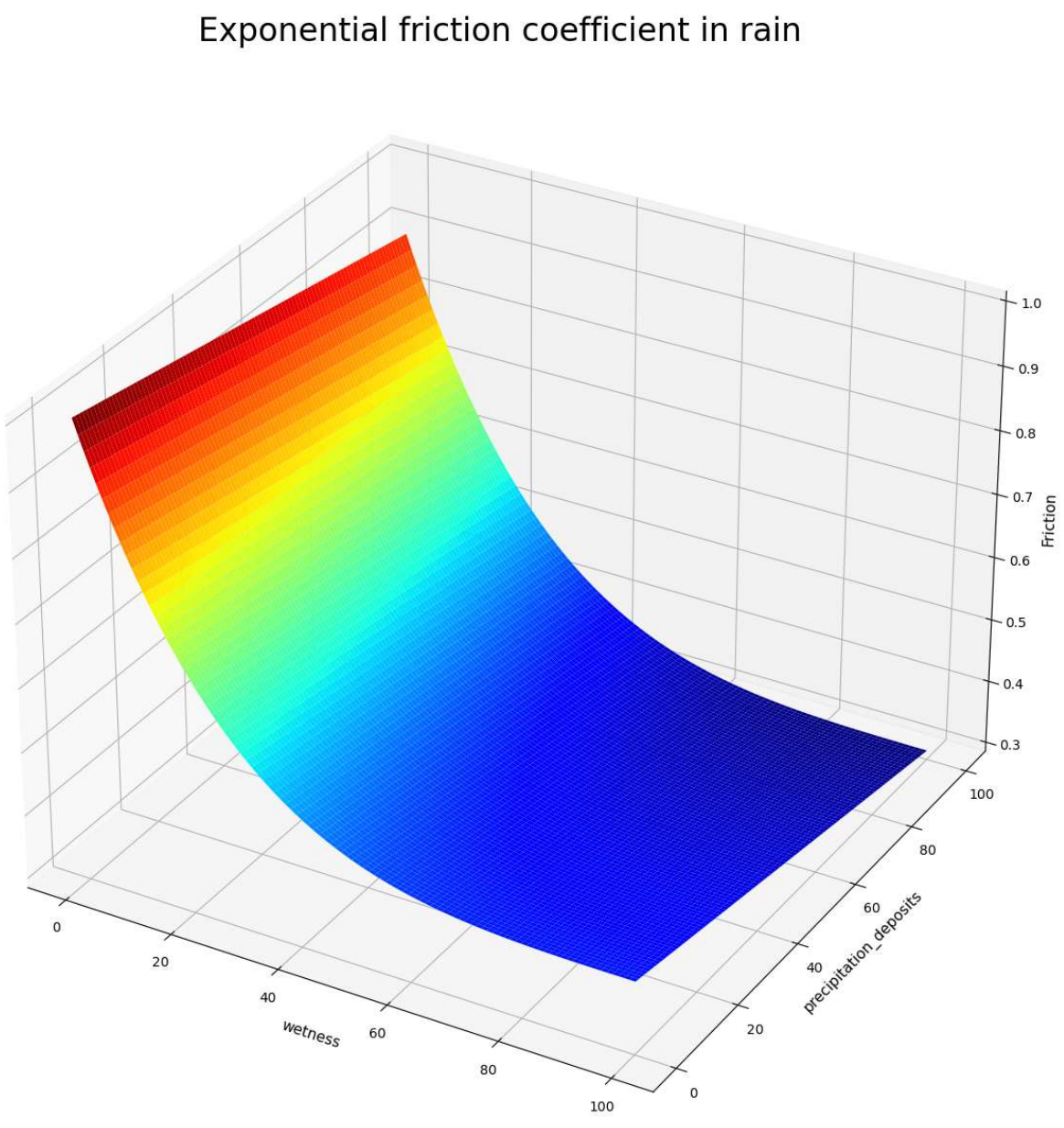
```
ax3.grid(True)

ax4.plot(np.exp(-0.9162*wetness/100), color='blue', label='Wetness')
ax4.legend(loc="lower right")
ax4.set_xlabel('Intensity of wetness and precipitation deposit')
ax4.set_ylabel('Modified friction coefficient')
ax4.grid(True)
```



In [3]:
```
import matplotlib.pyplot as plt
import numpy as np

def f(wetness, precipitation_deposits):
    return np.exp(-0.916*wetness/100) * (1-wetness/100)**3 * 0.6 + 0.4 - 0.1 * precipi

x = np.linspace(0, 100, 100)
y = np.linspace(0, 100, 100)
wetness, precipitation_deposits = np.meshgrid(x, y)

Z = f(wetness,precipitation_deposits)
fig = plt.figure(figsize = (15,15))
ax = plt.axes(projection='3d')
```

```
ax.plot_surface(wetness, precipitation_deposits, Z, cmap='jet', edgecolor='None', rstr
ax.set_title("Exponential friction coefficient in rain", fontsize = 24)
ax.set_xlabel('wetness', fontsize = 11)
ax.set_ylabel('precipitation_deposits', fontsize = 11)
ax.set_zlabel('Friction', fontsize = 11)
```

Out[3]: Text(0.5, 0, 'Friction')



In [ ]: