# importing libraries

# this code loads the processed city data and does some comparison of the London and other city time series

from netCDF4 import Dataset

from netcdftime import utime

import numpy as np

import matplotlib.pyplot as plt

import pylab

from matplotlib.dates import DateFormatter, MonthLocator

import datetime

import sys

# get command line arguments

city\_name=str(sys.argv[1])

city\_name=city\_name.replace(" ","\_")

fname='proc\_data/'+city\_name+'\_max.nc'

# read in data

nc=Dataset(fname,'r')

london=nc.variables['London'][:]

city=nc.variables[city\_name][:]

london\_clim=nc.variables['London Climatology'][:]

city\_clim=nc.variables[city\_name+' Climatology'][:]

# time information

time=nc.variables['time']

cdftime = utime(time.units,'standard')

time=cdftime.num2date(nc.variables['time'][:])

day=np.fromiter((time[x].day for x in range(0,len(time))),np.int)

month=np.fromiter((time[x].month for x in range(0,len(time))),np.int)

year=np.fromiter((time[x].year for x in range(0,len(time))),np.int)

nc.close()

# difference in max temperature (positive values mean London T higher)

diff=london-city

# four different example plots

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# plot 1 - for all time percentage of London exceedence per month

# count number of positive days (and total number of days) per month

prop=np.empty([12])

for m in range(1,13):

ind=np.where(month == m)

prop[m-1]=sum(diff[ind] > 0)/float(len(ind[0]))

fig1, ax1 = plt.subplots(figsize=(7,7))

month\_names=['J','F','M','A','M','J','J','A','S','O','N','D']

pos=np.arange(len(month\_names))+0.5

p1 = ax1.bar(pos,prop,color='r', align='center')

ax1.set\_title('Days with temperature in London greater than '+city\_name)

ax1.set\_ylabel('Percentage of days 1880-2010')

pylab.xticks(pos,month\_names)

fig1.savefig('plots/'+city\_name+'\_months.png')

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# plot 2 - has number of exceedences changed over the dataset time period

# count number of positive days (and total number of days) per month

prop\_ann=np.empty(13)

for y in range(0,13):

ind=np.where((year >= 1880+(y\*10)) & (year < 1889+(y\*10)))

prop\_ann[y-1]=sum(diff[ind] > 0)/float(len(ind[0]))

fig2, ax2 = plt.subplots(figsize=(10,5))

dec\_names=['1880s','1890s','1900s','1910s','1920s','1930s',

'1940s','1950s','1960s','1970s','1980s','1990s',

'2000s']

pos=np.arange(len(dec\_names))+0.5

p1 = ax2.bar(pos,prop\_ann,color='g', align='center')

ax2.set\_title('Days with temperature in London greater than '+city\_name)

ax2.set\_ylabel('Percentage of days 1880-2010')

pylab.xticks(pos,dec\_names)

fig2.savefig('plots/'+city\_name+'\_decades.png')

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# plot 3 - scatter plot of exceedence vs. London temperature during April

# where is month equal to April (4)

ind=np.where(month == 4)

fig3, ax3 = plt.subplots(figsize=(7,7))

p1 = ax3.plot(london[ind],diff[ind],'m+')

ax3.set\_ylabel('Difference with '+city\_name)

ax3.set\_xlabel('Temperature in London')

fig3.savefig('plots/'+city\_name+'\_scatter.png')

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# plot 4 - daily climatology of two cities

# make datetime array for climatology

clim\_time=[datetime.datetime(1993,1,1,12)+datetime.timedelta(x)

for x in range(0,365)]

months=MonthLocator(range(1,13),bymonthday=15)

monthFormatter=DateFormatter('%b')

london\_std=np.empty([12])

for i in np.arange(1,13):

ind=np.where(month == i)

london\_std[i-1]=np.std(london[ind])

city\_std=np.empty([12])

for i in np.arange(1,13):

ind=np.where(month == i)

city\_std[i-1]=np.std(city[ind])

fig4, ax4 = plt.subplots(figsize=(7,7))

p1 = ax4.plot(clim\_time,london\_std,'b',label='London')

p2 = ax4.plot(clim\_time,city\_std,'r',label=city\_name)

ax4.xaxis.set\_major\_locator(months)

ax4.xaxis.set\_major\_formatter(monthFormatter)

ax4.xaxis\_date()

ax4.set\_ylabel('Climatological maximum temperature / $^\circ$C')

ax4.legend()

fig4.savefig('plots/'+city\_name+'\_clim.png')

# show all figures can be commented out

plt.show()

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per\_above\_thresh=np.empty([31])

for temp in np.arange(0,31):

ind=np.where(london > temp)

diff=london[ind] - city[ind]

pos=np.sum(diff > 0)

prop=float(pos)/float(len(diff))

per\_above\_thresh[temp] = prop

fig5, ax5 = plt.subplots(figsize=(7,7))

ax5.plot((np.arange(0,31)),per\_above\_thresh)

ax5.set\_ylabel('percentage of days 1880 - 2010')

ax5.set\_xlabel('Temperature Difference')

plt.show()