

# Report of Assignment 05

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## 1.1

- ① 加载所需的年平均、C 排放数据，并筛选出对应年份数据（1986-2004）；
- ② 合并两个表格，并删掉重复数据列；
- ③ 将 Mt 换算为 ppm（1Mt=0.001Pg，再除以 2.13 换算为 ppm），修改列名；
- ④ 增加 2 列，根据 equation 1-2 逐步计算 N1、N2 并填入其中
- ⑤ 画图对比

```
# 加载所需的数据（年平均），从第44行数据开始读取（1-43行为数据来源信息）
data_mean= pd.read_csv(r"D:\ESE5023\HW 5_Data\co2_annmean_mlo.csv",header=43)
# 筛选出对应年份数据（1986-2004），并重新设置索引
data_mean=data_mean[(data_mean['year']>1985)&(data_mean['year']<2005)].reset_index(drop=True)
# 取前2列
data_mean=data_mean.iloc[:,2]
```

```
# 加载所需的数据（C排放），筛选掉数据来源行（第0行）
data1= pd.read_csv(r"D:\ESE5023\HW 5_Data\CSV-FILES\global.1751_2008.csv")
data1=data1.drop([0])
# 将年份、平均排放2列str格式转为int格式，方便后续筛选与计算
data1['Year']=data1['Year'].astype('int')
data1['Total carbon emissions from fossil-fuels (million metric tons of C)']=data1['Total carbon emissions from fossil-fuels (million
# 筛选出对应年份数据（1986-2004），并重新设置索引
data1=data1[(data1['Year']>1985)&(data1['Year']<2005)].reset_index(drop=True)
# 取原数据前2列，新增2列“N1-1”“N2-1”
co2=data1.iloc[:,2]
# 合并mean和emissions表格，并删掉重复数据列（年份）
co2=pd.concat([data_mean,co2],axis=1).drop(['Year'],axis=1)
# 修改列名
co2=co2.rename(columns={'Total carbon emissions from fossil-fuels (million metric tons of C)':'Carbon emissions(ppm)'})
# 将million metric tons 换算为ppm（1MT=0.001Pg，再除以2.13换算为ppm）
co2['Carbon emissions(ppm)']=co2['Carbon emissions(ppm)']/1000/2.13
```

```
# 增加2列“N1-1”“N2-1”
co2.insert(co2.shape[1],'N1-1.1',None)
co2.insert(co2.shape[1],'N2-1.1',None)
# 计算1987年N1和N2（数字索引）
k12=105/740
k21=102/900
N1=740/2.13
N2=900/2.13
co2.iloc[1,3] = -k12*N1+k21*N2+co2.iloc[0,2]+N1
co2.iloc[1,4] = k12*N1-k21*N2+N2
# 计算1988-2004年N1和N2（数字索引）
for i in range(2,19):
    co2.iloc[i,3] = -k12*co2.iloc[i-1,3]+k21*co2.iloc[i-1,4]+co2.iloc[i,2]+co2.iloc[i-1,3]
    co2.iloc[i,4] = k12*co2.iloc[i-1,3]-k21*co2.iloc[i-1,4]+co2.iloc[i-1,4]
```

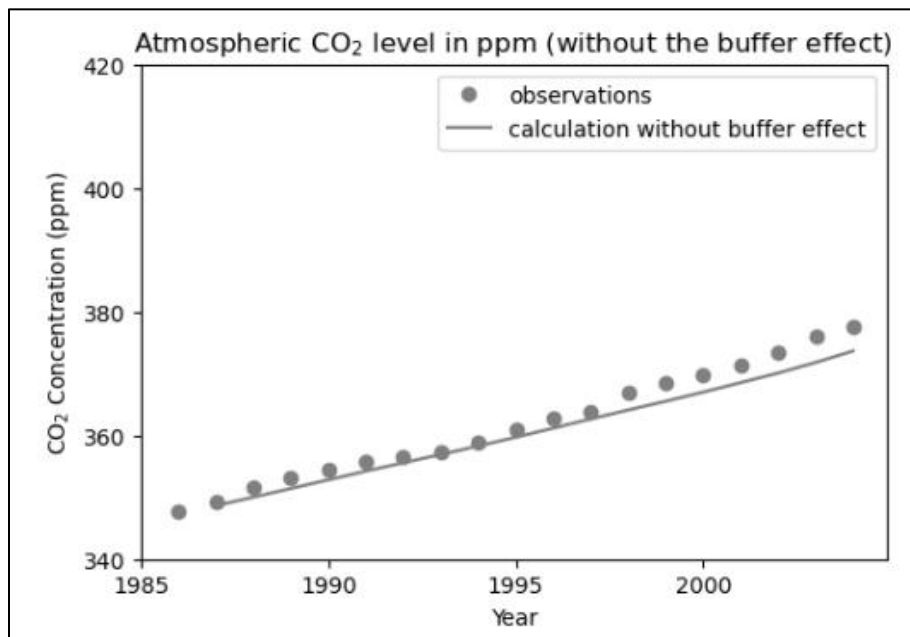
co2

	year	mean	Carbon emissions(ppm)	N1-1.1	N2-1.1
0	1986	347.61	2.633333	None	None
1	1987	349.31	2.701878	348.642723	423.943662
2	1988	351.69	2.801878	350.021974	425.366289
3	1989	353.20	2.858216	351.423089	426.82339
4	1990	354.45	2.887793	352.820113	428.314159
5	1991	355.70	2.929108	354.229179	429.834201
6	1992	356.54	2.900469	355.581943	431.381907
7	1993	357.21	2.897653	356.91535	432.946152
8	1994	358.96	2.950235	358.289421	434.522316
9	1995	360.97	3.015023	359.711943	436.114817
10	1996	362.74	3.075117	361.173199	437.728679
11	1997	363.88	3.128169	362.663069	439.366977
12	1998	366.84	3.116432	364.115476	441.031002
13	1999	368.54	3.091080	365.525036	442.712523
14	2000	369.71	3.169014	367.003097	444.403476
15	2001	371.32	3.246948	368.541009	446.112512
16	2002	373.45	3.277465	370.084911	447.846075
17	2003	375.98	3.472770	371.801521	449.602235
18	2004	377.70	3.653521	373.654341	451.402936

```

# 数据绘图
fig, ax = plt.subplots(figsize=(6, 4))
plt.plot(co2['year'], co2['mean'], 'o', color='grey', label='observations')
plt.plot(co2['year'], co2['N1-1.1'], color='grey', label='calculation without buffer effect')
# 添加xy轴标题
plt.xlabel('Year')
plt.ylabel('CO2 Concentration (ppm)')
# 调整xy轴标题
plt.xticks([1985, 1990, 1995, 2000])
plt.yticks([340, 360, 380, 400, 420])
# 添加标题
plt.title('Atmospheric CO2 level in ppm (without the buffer effect)')
# 绘图
plt.legend()
plt.show()

```



## 1.2

- ① 再在原表格基础上增加 2 列；
- ② 根 equation 3-4 据逐步计算 N1、N2 并填入其中；
- ③ 画图对比

```

# 增加2列 "N1-1" "N2-1"
co2.insert(co2.shape[1], 'N1-1.2', None)
co2.insert(co2.shape[1], 'N2-1.2', None)

```

```

# 计算1987年N1和N2 (数字索引)
k12=105/740
k21=102/900
N1=740/2.13
N2=900/2.13
N2_0=821/2.13
buffer_factor=3.69+1.86*0.01*N1-1.80*0.000001*N1*N1
co2.iloc[1,5] = -k12*N1+k21*(N2_0+buffer_factor*(N2-N2_0))+co2.iloc[1,2]+N1
co2.iloc[1,6] = k12*N1-k21*(N2_0+buffer_factor*(N2-N2_0))+N2
# 计算1988-2004年N1和N2 (数字索引)
for i in range(2,19):
    N1=co2.iloc[i-1,5]
    N2=co2.iloc[i-1,6]
    buffer_factor=3.69+1.86*0.01*N1-1.80*0.000001*N1*N1
    co2.iloc[i,5] = -k12*N1+k21*(N2_0+buffer_factor*(N2-N2_0))+co2.iloc[i,2]+N1
    co2.iloc[i,6] = k12*N1-k21*(N2_0+buffer_factor*(N2-N2_0))+N2

```

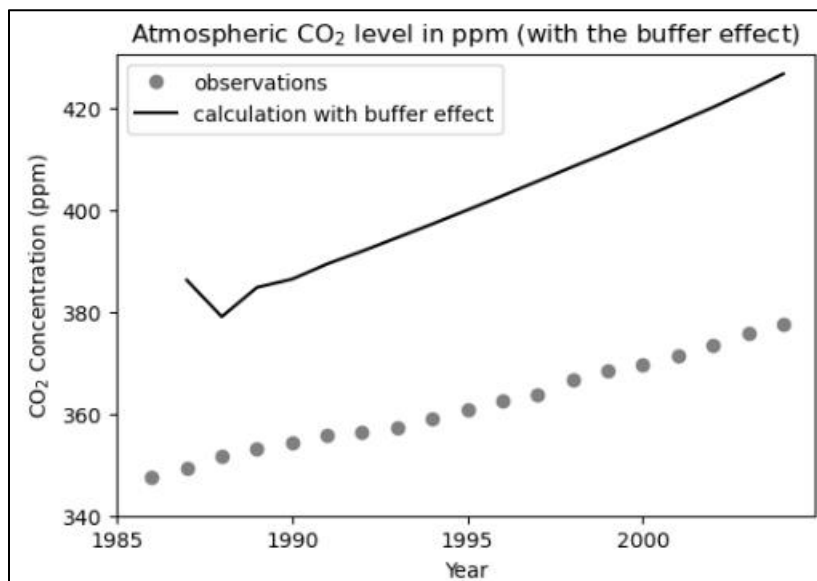
```
co2
```

	year	mean	Carbon emissions(ppm)	N1-1.1	N2-1.1	N1-1.2	N2-1.2
0	1986	347.61	2.633333	None	None	None	None
1	1987	349.31	2.701878	348.642723	423.943662	386.267825	386.387105
2	1988	351.69	2.801878	350.021974	425.366289	379.076522	396.380285
3	1989	353.20	2.858216	351.423089	426.82339	384.820421	393.494602
4	1990	354.45	2.887793	352.820113	428.314159	386.441004	394.761813
5	1991	355.70	2.929108	354.229179	429.834201	389.422032	394.709893
6	1992	356.54	2.900469	355.581943	431.381907	391.942855	395.089539
7	1993	357.21	2.897653	356.91535	432.946152	394.609222	395.320825
8	1994	358.96	2.950235	358.289421	434.522316	397.281681	395.598601
9	1995	360.97	3.015023	359.711943	436.114817	400.030946	395.864359
10	1996	362.74	3.075117	361.173199	437.728679	402.831075	396.139347
11	1997	363.88	3.128169	362.663069	439.366977	405.683067	396.415525
12	1998	366.84	3.116432	364.115476	441.031002	408.520311	396.694712
13	1999	368.54	3.091080	365.525036	442.712523	411.337736	396.968367
14	2000	369.71	3.169014	367.003097	444.403476	414.237116	397.238002
15	2001	371.32	3.246948	368.541009	446.112512	417.206599	397.515467
16	2002	373.45	3.277465	370.084911	447.846075	420.203334	397.796197
17	2003	375.98	3.472770	371.801521	449.602235	423.396183	398.076117
18	2004	377.70	3.653521	373.654341	451.402936	426.749742	398.376079

```

# 数据绘图
fig, ax = plt.subplots(figsize=(6, 4))
plt.plot(co2['year'], co2['mean'], 'o', color='grey', label='observations')
plt.plot(co2['year'], co2['N1-1.2'], 'k', label='calculation with buffer effect')
# 添加xy轴标题
plt.xlabel('Year')
plt.ylabel('CO2 Concentration (ppm)')
# 调整xy坐标轴
plt.xticks([1985, 1990, 1995, 2000])
plt.yticks([340, 360, 380, 400, 420])
# 添加标题
plt.title('Atmospheric CO2 level in ppm (with the buffer effect)')
# 绘图
plt.legend()
plt.show()

```



### 1.3

- ① 用 mean 和 1.1、1.2 所得数据绘图;
- ② 添加 xy 轴标题, 调整坐标轴范围和标记;
- ③ 添加文字说明, 隐藏右侧和上面的图脊;
- ④ 绘图

```
# 数据绘图
fig, ax = plt.subplots(figsize=(6, 4))
plt.plot(co2['year'], co2['mean'], 'o', color='grey')
plt.plot(co2['year'], co2['NI-1.1'], color='grey')
plt.plot(co2['year'], co2['NI-1.2'], 'k')
# 添加xy轴标题
plt.xlabel('Year')
plt.ylabel('CO2 Concentration (ppm)')
# 调整xy坐标轴
plt.xlim(1984, 2005)
plt.ylim(340, 430)
plt.xticks([1985, 1990, 1995, 2000])
plt.yticks([360, 380, 400, 420])
# 调整minor tick
ax.tick_params(axis='y', which='major', direction='in', width=1, length=3.5)
ax.tick_params(axis='y', which='minor', direction='in', width=1, length=2)
ax.tick_params(axis='x', which='major', direction='in')
ax.tick_params(axis='x', which='minor', color='none')
ax.minorticks_on()
# 添加数据的text
plt.text(1987, 415, 'calculation with buffer effect')
plt.text(1994, 355, 'calculation without buffer effect')
plt.text(1999, 380, 'observations')
# 隐藏右侧和上面的图脊
ax.spines['right'].set_color('none')
ax.spines['top'].set_color('none')
# 绘图
plt.show()
```

