

PS5

Modeling of carbon cycle

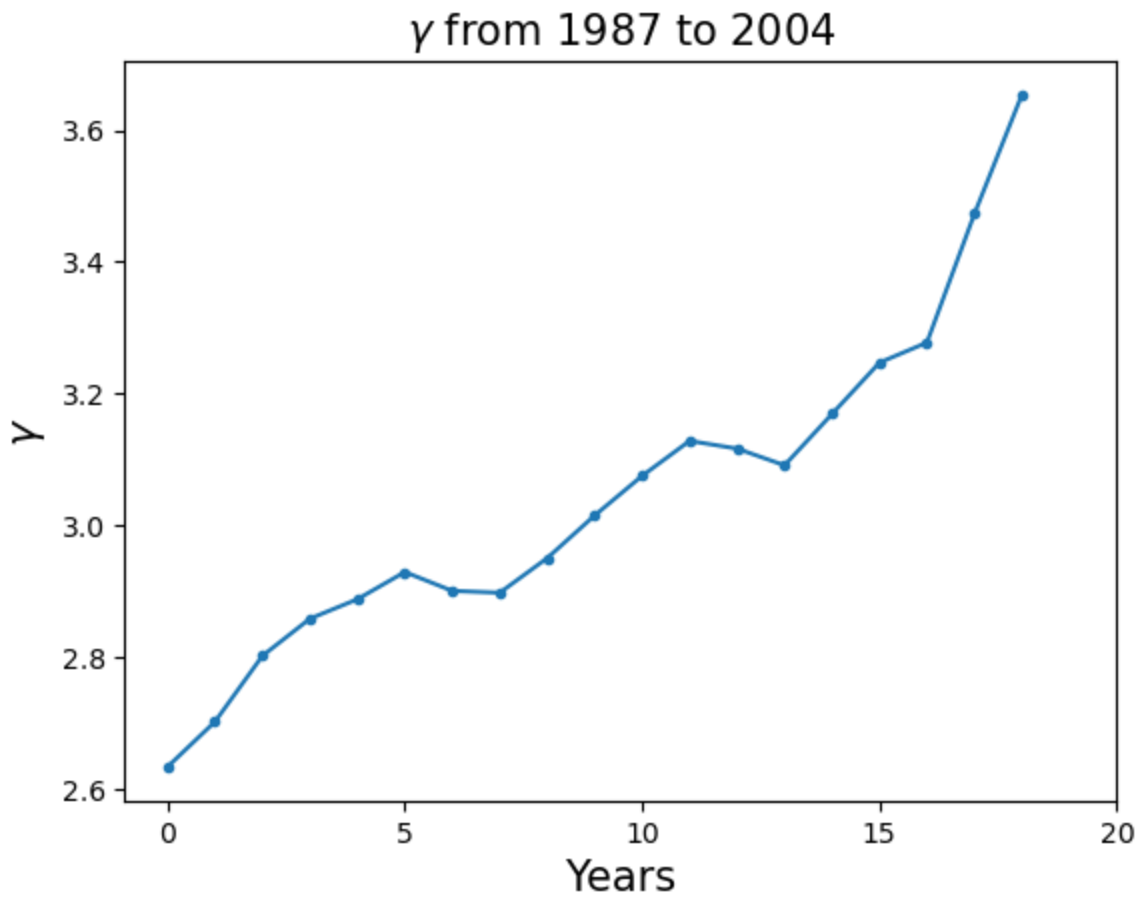
In this problem, we will build a box model to understand the Earth’s carbon cycle based on the framework in [Tomizuka 2009](#).

1.1

Following equation 1-2 (without the buffer effect), build a two-box model to compute the atmospheric CO2 level in ppm (parts per million) from 1987 to 2004.

```
0 2.633333
1 2.701878
2 2.801878
3 2.858216
4 2.887793
Name: Total carbon emissions from fossil-fuels (million metric tons of C), dtype: float64

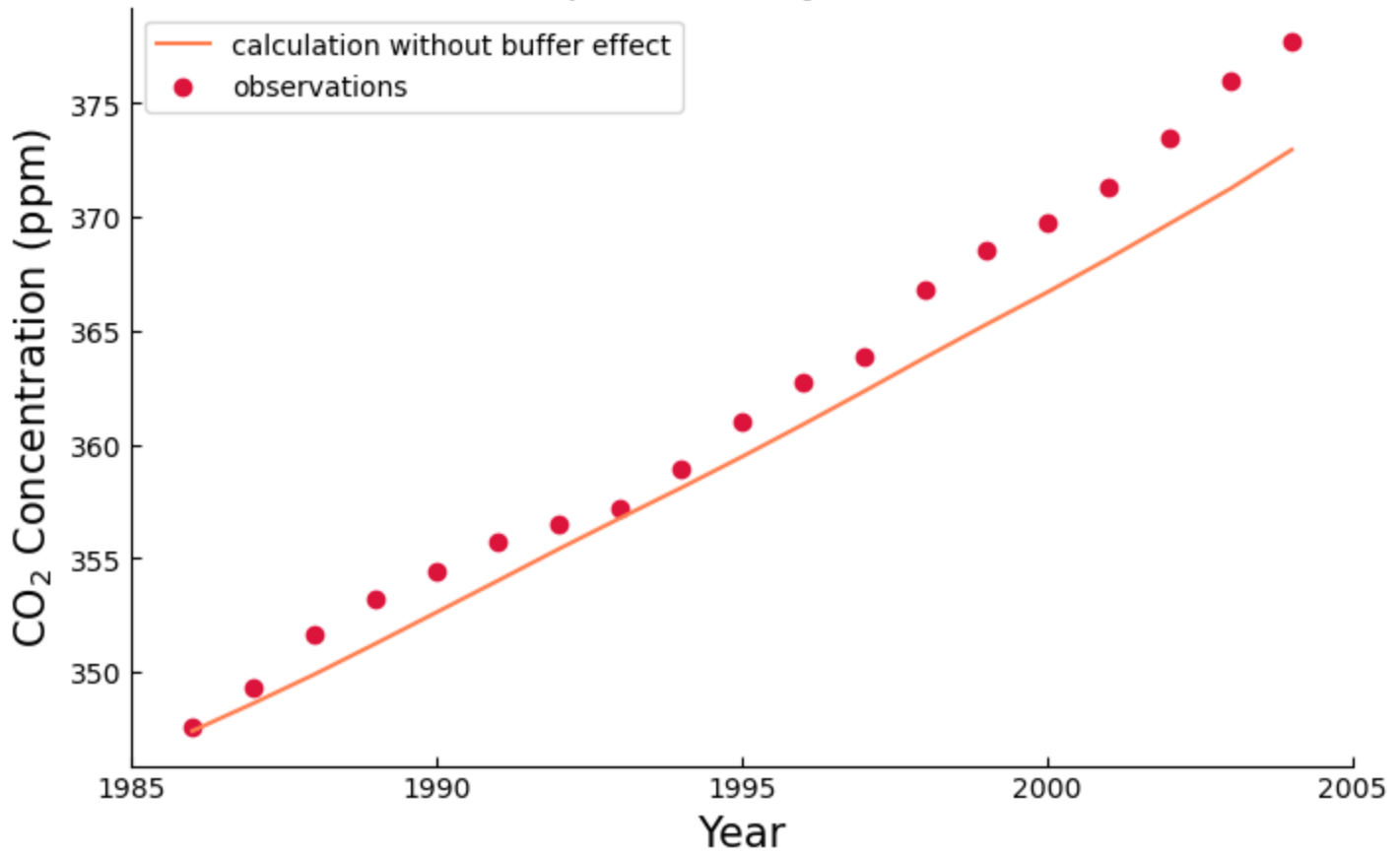
Text(0, 0.5, '$\\gamma$')
```



	Year	Atmos CO2 level (ppm)
0	1986	347.417840
1	1987	348.636202
2	1988	349.907589
3	1989	351.256315
4	1990	352.634155
5	1991	354.015176
6	1992	355.412573
7	1993	356.761422
8	1994	358.093931
9	1995	359.465249
10	1996	360.883343
11	1997	362.339751
12	1998	363.825261
13	1999	365.278079
14	2000	366.691671
15	2001	368.168878
16	2002	369.703166
17	2003	371.245149
18	2004	372.950175

	year	mean
0	1986	347.61
1	1987	349.31
2	1988	351.69
3	1989	353.20
4	1990	354.45

The CO₂ trend predicted by the two-box model



1.2

Following equation 3-4 (with the buffer effect), build a two-box model to compute the atmospheric CO₂ level in ppm from 1987 to 2004.

	Year	Atmos CO2 level (ppm)
0	1986	347.417840
1	1987	370.778493
2	1988	379.125990
3	1989	383.271379
4	1990	386.294622
5	1991	389.029031
6	1992	391.718680
7	1993	394.358466
8	1994	396.992236
9	1995	399.677076
10	1996	402.423829
11	1997	405.227369
12	1998	408.081010
13	1999	410.922917
14	2000	413.742402
15	2001	416.639736
16	2002	419.611602
17	2003	422.611681
18	2004	425.799883

1.3

Based on your results from 1.1 and 1.2, reproduce Figure 2 in Tomizuka (2009) as much as you can.

