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1  ###
2  # Importing libraries
3  import matplotlib.pyplot as plt
4  import numpy as np
5  import matplotlib as mpl
6
7  mpl.rcParams["figure.dpi"] = 100
8  ###
9  # all diameters are in nm
10 S_g = 1.7 # standard deviation of the lognormal distribution
11 N = 1000 # number of particles in the distribution (cm-3)
12 D_pg = 200 # geometric mean diameter (nm)
13
14 Dp = np.geomspace(1e-8, 1e-6, 1000)*1e9 # convert to nm
15 dN_dDp = N/(np.sqrt(2*np.pi)*np.log(S_g)*Dp)*np.exp(-(np.log(Dp/D_pg))
16 )**2/(2*(np.log(S_g))**2))
17
18 dN_dlogDp = dN_dDp*Dp*np.log(10)
19 dN_dlnDp = dN_dDp*Dp
20 ###
21 # Creating subplots
22 fig, axs = plt.subplots(3, 1, figsize=(10, 8))
23
24 # First plot
25 axs[0].plot(Dp, dN_dDp)
26 axs[0].set_xscale('log')
27 axs[0].set_xlabel('Dp (nm)')
28 axs[0].set_ylabel('dN/dDp (cm-3)')
29 axs[0].legend(['dN/dDp'])
30
31 # Second plot
32 axs[1].plot(Dp, dN_dlnDp)
33 axs[1].set_xscale('log')
34 axs[1].set_xlabel('Dp (nm)')
35 axs[1].set_ylabel('dN/dlnDp')
36 axs[1].legend(['dN/dlnDp'])
37
38 # Third plot
39 axs[2].plot(Dp, dN_dlogDp)
40 axs[2].set_xscale('log')
41 axs[2].set_xlabel('Dp (nm)')
42 axs[2].set_ylabel('dN/dlogDp')
43 axs[2].legend(['dN/dlogDp'])
44
45 plt.savefig('1-2.png', bbox_inches='tight')
46 plt.show()
47 ###
48 bin_number = 40
49 bins_lower = np.geomspace(1e-9, 10.3e-6, bin_number + 1) #
50 bins_upper = bins_lower[1:]
51 bins_lower = bins_lower[:-1]
52 bins_mid = np.sqrt(bins_lower * bins_upper) # geometric mean
53 for i in range(bin_number):

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53     print(i, bins_lower[i], bins_upper[i], bins_mid[i])
54     ###
55     # all diameters are in nm
56     S_g = 1.7 # standard deviation of the lognormal distribution
57     N = 1000 # number of particles in the distribution (cm-3)
58     D_pg = 200e-9 # geometric mean diameter (nm)
59
60     Dp = bins_mid
61     dN_dDp = N/(np.sqrt(2*np.pi)*np.log(S_g)*Dp)*np.exp(-(np.log(Dp/D_pg)
62     ))**2/(2*(np.log(S_g))**2))
63     N = dN_dDp * (bins_upper - bins_lower)
64     ###
65     # Creating histogram of N
66     plt.bar(bins_mid*1e9, N, width=(bins_upper - bins_lower)*1e9, align='
67     center', edgecolor='black')
68     plt.xscale('log')
69     # plt.yscale('log')
70     plt.xlabel('Dp (nm)')
71     plt.ylabel('N (cm-3)')
72     plt.suptitle('Histogram of N in each bin')
73     #save the plot
74     plt.savefig('1-3.png', bbox_inches='tight')
75     plt.show()
76
77     #
78     ###
79     # Creating a gamma distribution of droplet sizes
80     # Total number of drops in gamma distribution is N_d = 100 cm-3
81     # The mean diameter is D_pg = 20 um = 20000 nm
82     # Dp_mean_2 = 20000 # nm
83     # gamma = 1
84     # Beta = 2
85
86     N_2 = 100 # cm-3 (total number of droplets)
87     rp_mean_2 = 20e-6 # m (mean diameter of droplets)
88     Dp_2 = np.geomspace(1e-6, 1e-3, 1000) # convert to nm
89     B_2 = 3 / rp_mean_2 # r_mean = 3/B_2
90     A_2 = N_2 * B_2**3 / 2 # N_2 = 2 * A_2 / B_2**3
91     dN2_dr = A_2 * ((Dp_2 / 2)**2) * np.exp(-B_2 * (Dp_2 / 2)) #
92     dN2_dr = A_2 * r^2 * exp(-B_2 * r)
93     dN2_dDp = dN2_dr / 2 # dN2_dDp = dN2_dr / 2
94     dN2_dlnDp = dN2_dDp * Dp_2
95     dN2_dlogDp = dN2_dDp * Dp_2 * np.log(10)
96     ###
97     # Creating subplots
98     fig, axs = plt.subplots(3, 1, figsize=(10, 8))
99
100    # First plot
101    axs[0].plot(Dp_2*1e9, dN2_dDp) # convert to nm
102    axs[0].set_xscale('log')
103    axs[0].set_xlabel('Dp (nm)')
104    axs[0].set_ylabel('dN/dDp (cm-3)')
105    axs[0].legend(['dN/dDp'])

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103
104 # Second plot
105 axs[1].plot(Dp_2*1e9, dN2_dlnDp) # convert to nm
106 axs[1].set_xscale('log')
107 axs[1].set_xlabel('Dp (nm)')
108 axs[1].set_ylabel('dN/dlnDp')
109 axs[1].legend(['dN/dlnDp'])
110
111 # Third plot
112 axs[2].plot(Dp_2*1e9, dN2_dlogDp) # convert to nm
113 axs[2].set_xscale('log')
114 axs[2].set_xlabel('Dp (nm)')
115 axs[2].set_ylabel('dN/dlogDp')
116 axs[2].legend(['dN/dlogDp'])
117 plt.savefig('1-2.png', bbox_inches='tight')
118 plt.show()
```