Notes

January 23, 2021

1 Equations

According to the given paper, we want to solve a set of six simultaneous differential equations. Please note:

1. In order to avoid confusions, symbols C_J and d_J are used in place of C_I and d_I, respectively.
2. Symbols highlighted in red denote time-dependent variables.
3. Symbols highlighted in blue denote functions.

Following is the set of 6 equations:

$$\begin{aligned}\frac{\mathrm{d}C_v}{\mathrm{d}t} &= Q_v - K_{iv}C_vC_i - K_{vN}(\rho_N)D_vC_v \\ &\quad - K_{vL}(\pi C_J d_J)D_vC_v - k_{gb}^2 D_vC_v - \frac{4\pi a_0^2 D_v}{\Omega}C_vC_{2i}\end{aligned} \tag{1}$$

$$\begin{aligned}\frac{\mathrm{d}C_i}{\mathrm{d}t} &= Q_i - K_{iv}C_vC_i - K_{iN}(\rho_N)D_iC_i \\ &\quad - K_{iL}(\pi C_J d_J)D_iC_i - k_{gb}^2 D_iC_i - 16\pi r_{iv}D_iC_i^2 + \frac{4\pi a_0^2 D_v}{\Omega}C_vC_{2i}\end{aligned} \tag{2}$$

$$\frac{\mathrm{d}C_{2i}}{\mathrm{d}t} = Q_{2i} + 8\pi\frac{r_{iv}D_iC_i^2}{\Omega^2} - 4\pi\frac{r_{iv}D_iC_vC_{2i}}{\Omega} - \frac{\pi v_{2i}C_{2i}}{b_v} \tag{3}$$

$$\frac{\mathrm{d}\rho_N}{\mathrm{d}t} = f_1\frac{|v_D|}{d_N}\pi d_J C_J - f_2\frac{|v_N|}{d_N}\rho_N \tag{4}$$

$$\frac{\mathrm{d}C_J}{\mathrm{d}t} = \frac{\pi v_I C_{2i}}{2a_0} - \frac{4v_I C_J d_J}{d_N^2} - 8v_I d_J^2 C_J^2 - f_1\frac{|v_D|}{d_N}C_J \tag{5}$$

$$\frac{\mathrm{d}d_J}{\mathrm{d}t} = v_I - (d_J - 2a_0)\frac{\pi v_{2i}}{2a_0}\frac{C_{2i}}{C_J} - (d_N - d_J)\frac{4v_I}{P_{sl}d_N^2}d_J - 8v_I d_J^3 C_J \tag{6}$$