1 Generic PDE Model 03 v15.12.15

class II, negative feedback, RyR, closed cell, three variables

$$\frac{\partial c}{\partial t} = D_\mathrm{c}\nabla^2 c + (J_\mathrm{IPR} + J_\mathrm{leak} + k_\mathrm{RyR}P_\mathrm{RyR})(c_\mathrm{e} - c) - J_\mathrm{serca} \tag{1}$$

$$\frac{\partial p}{\partial t} = D_\mathrm{p}\nabla^2 p + V_\mathrm{PLC}(\vec{x}) - V_\mathrm{deg}\left(\frac{c^2}{K_\mathrm{3K}^2 + c^2}\right)p \tag{2}$$

$$\frac{\partial h}{\partial t} = \frac{h_\infty - h}{\tau} \tag{3}$$

$$J_\mathrm{serca} = V_\mathrm{s}\frac{c^2}{K_\mathrm{s}^2 + c^2} \tag{4}$$

$$J_\mathrm{IPR} = k_\mathrm{IPR}(\vec{x})P_O \tag{5}$$

$$P_\mathrm{RyR} = \frac{c^2}{K_\mathrm{RyR}^2 + c^2} \tag{6}$$

$$P_O = \phi_c\phi_p h \tag{7}$$

$$\phi_c = \frac{c^3}{K_\mathrm{a}^3 + c^3} \tag{8}$$

$$\phi_p = \frac{p^4}{K_\mathrm{p}^4 + p^4} \tag{9}$$

$$h_\infty = \frac{K_\mathrm{i}^2}{K_\mathrm{i}^2 + c^2} \tag{10}$$

$$c_\mathrm{e} = (c_\mathrm{t} - c)/\gamma \tag{11}$$

c	0.06(init)	μM	cytosolic Ca^{2+} concentration
p	0.26(init)	μM	IP$_3$ concentration
h	0.334(init)	-	IPR modelling variable
γ	0.185	-	ratio of ER volume to cystolic volume
c_t	5.0	μM	total Ca^{2+} concentration
c_e		μM	ER Ca^{2+} concentration
t		s	time
J_IPR		s^{-1}	calcium from ER
$k_\mathrm{IPR}(\vec{x})$	7.4(max)	s^{-1}	parameter (highest near apical region)
P_RyR			calcium from ER
k_RyR	0.01	s^{-1}	parameter
K_RyR	0.42	μM	parameter
P_O		-	open probability of IPR (range: 0.0 - 1.0)
ϕ_c		-	function of Ca^{2+} concentration
K_a	0.3	μM	parameter
ϕ_p		-	function of IP$_3$ concentration
K_p	0.5	μM	parameter
h_∞		-	function of Ca^{2+} concentration
K_i	0.06	μM	parameter
τ	0.5	s^{-1}	parameter
D_c	5	μm^2 s^{-1}	Ca^{2+} diffusion coefficient
J_serca		μM s^{-1}	calcium flux into ER
V_s	0.25	μM s^{-1}	parameter
K_s	0.1	μM	parameter
J_leak	0.00148	s^{-1}	calcium from ER (to balance J_serca at rest)
$V_\mathrm{PLC}(\vec{x})$	0.012(max)	μM s^{-1}	parameter (highest near basal membrane)
V_deg	0.16	s^{-1}	parameter
K_3K	0.4	μM	parameter
D_p	283	μm^2 s^{-1}	IP$_3$ diffusion coefficient