Differential Equations

$$\frac{d\,[\mathrm{EGF}]}{dt} = \mathrm{cell}\cdot\mathrm{kruEGF}\cdot[\mathrm{boundEGFReceptor}] - \mathrm{cell}\cdot\mathrm{krbEGF}\cdot[\mathrm{EGF}]\cdot[\mathrm{freeEGFReceptor}]$$

$$\frac{d\,[\mathrm{NGF}]}{dt} = \mathrm{kruNGF}\cdot[\mathrm{boundNGFReceptor}]\cdot\mathrm{cell} - \mathrm{krbNGF}\cdot[\mathrm{NGF}]\cdot[\mathrm{freeNGFReceptor}]\cdot\mathrm{cell}$$

$$\frac{d\,[\mathrm{freeEGFReceptor}]}{dt} = \mathrm{cell}\cdot\mathrm{kruEGF}\cdot[\mathrm{boundEGFReceptor}] - \mathrm{cell}\cdot\mathrm{krbEGF}\cdot[\mathrm{EGF}]\cdot[\mathrm{freeEGFReceptor}]$$

$$\frac{d\,[\mathrm{boundEGFReceptor}]}{dt} = \mathrm{cell}\cdot\mathrm{krbEGF}\cdot[\mathrm{EGF}]\cdot[\mathrm{freeEGFReceptor}] - \mathrm{cell}\cdot\mathrm{kruEGF}\cdot[\mathrm{boundEGFReceptor}]$$

$$\frac{d\,[\mathrm{freeNGFReceptor}]}{dt} = \mathrm{kruNGF}\cdot[\mathrm{boundNGFReceptor}]\cdot\mathrm{cell} - \mathrm{krbNGF}\cdot[\mathrm{NGF}]\cdot[\mathrm{freeNGFReceptor}]\cdot\mathrm{cell}$$

$$\frac{d\,[\mathrm{boundNGFReceptor}]}{dt} = \mathrm{krbNGF}\cdot[\mathrm{NGF}]\cdot[\mathrm{freeNGFReceptor}]\cdot\mathrm{cell} - \mathrm{kruNGF}\cdot[\mathrm{boundNGFReceptor}]\cdot\mathrm{cell}$$

$$\frac{d\,[\mathrm{SosInactive}]}{dt} = \frac{\mathrm{cell}\cdot\mathrm{kdSos}\cdot[\mathrm{P90RskActive}]\cdot[\mathrm{SosActive}]}{([\mathrm{SosActive}]+\mathrm{KmdSos})} - \frac{\mathrm{cell}\cdot\mathrm{kEGF}\cdot[\mathrm{boundEGFReceptor}]\cdot[\mathrm{SosInactive}]}{([\mathrm{SosInactive}]+\mathrm{KmEGF})} - \frac{\mathrm{cell}\cdot\mathrm{kNGF}\cdot[\mathrm{boundNGFReceptor}]\cdot[\mathrm{SosInactive}]}{([\mathrm{SosInactive}]+\mathrm{KmNGF})}$$

$$\frac{d\,[\mathrm{SosActive}]}{dt} = \frac{\mathrm{cell}\cdot\mathrm{kEGF}\cdot[\mathrm{boundEGFReceptor}]\cdot[\mathrm{SosInactive}]}{([\mathrm{SosInactive}]+\mathrm{KmEGF})} + \frac{\mathrm{cell}\cdot\mathrm{kNGF}\cdot[\mathrm{boundNGFReceptor}]\cdot[\mathrm{SosInactive}]}{([\mathrm{SosInactive}]+\mathrm{KmNGF})} - \frac{\mathrm{cell}\cdot\mathrm{kdSos}\cdot[\mathrm{P90RskActive}]\cdot[\mathrm{SosActive}]}{([\mathrm{SosActive}]+\mathrm{KmdSos})}$$

$$\frac{d\,[\mathrm{P90RskInactive}]}{dt} = -\left(\frac{\mathrm{cell}\cdot\mathrm{kpP90Rsk}\cdot[\mathrm{ErkActive}]\cdot[\mathrm{P90RskInactive}]}{([\mathrm{P90RskInactive}]+\mathrm{KmpP90Rsk})}\right)$$

$$\frac{d\,[\mathrm{P90RskActive}]}{dt} = \frac{\mathrm{cell}\cdot\mathrm{kpP90Rsk}\cdot[\mathrm{ErkActive}]\cdot[\mathrm{P90RskInactive}]}{([\mathrm{P90RskInactive}]+\mathrm{KmpP90Rsk})}$$

$$\frac{d\,[\mathrm{RasInactive}]}{dt} = \frac{\mathrm{cell}\cdot\mathrm{kRasGap}\cdot[\mathrm{RasGapActive}]\cdot[\mathrm{RasActive}]}{([\mathrm{RasActive}]+\mathrm{KmRasGap})} - \frac{\mathrm{cell}\cdot\mathrm{kSos}\cdot[\mathrm{SosActive}]\cdot[\mathrm{RasInactive}]}{([\mathrm{RasInactive}]+\mathrm{KmSos})}$$

$$\frac{d\,[\mathrm{RasActive}]}{dt} = \frac{\mathrm{cell}\cdot\mathrm{kSos}\cdot[\mathrm{SosActive}]\cdot[\mathrm{RasInactive}]}{([\mathrm{RasInactive}]+\mathrm{KmSos})} - \frac{\mathrm{cell}\cdot\mathrm{kRasGap}\cdot[\mathrm{RasGapActive}]\cdot[\mathrm{RasActive}]}{([\mathrm{RasActive}]+\mathrm{KmRasGap})}$$

$$\frac{d\,[\text{Raf1Inactive}]}{dt} = \frac{\text{cell}\cdot\text{kdRaf1}\cdot[\text{Raf1PPtase}]\cdot[\text{Raf1Active}]}{([\text{Raf1Active}]+\text{KmdRaf1})} + \frac{\text{cell}\cdot\text{kdRaf1ByAkt}\cdot[\text{AktActive}]\cdot[\text{Raf1Active}]}{([\text{Raf1Active}]+\text{KmRaf1ByAkt})} - \frac{\text{cell}\cdot\text{kRasToRaf1}\cdot[\text{RasActive}]\cdot[\text{Raf1Inactive}]}{([\text{Raf1Inactive}]+\text{KmRasToRaf1})}$$

$$\frac{d\,[\text{Raf1Active}]}{dt} = \frac{\text{cell}\cdot\text{kRasToRaf1}\cdot[\text{RasActive}]\cdot[\text{Raf1Inactive}]}{([\text{Raf1Inactive}]+\text{KmRasToRaf1})} - \frac{\text{cell}\cdot\text{kdRaf1}\cdot[\text{Raf1PPtase}]\cdot[\text{Raf1Active}]}{([\text{Raf1Active}]+\text{KmdRaf1})} - \frac{\text{cell}\cdot\text{kdRaf1ByAkt}\cdot[\text{AktActive}]\cdot[\text{Raf1Active}]}{([\text{Raf1Active}]+\text{KmRaf1ByAkt})}$$

$$\frac{d\,[\text{BRafInactive}]}{dt} = \frac{\text{cell}\cdot\text{kdBRaf}\cdot[\text{Raf1PPtase}]\cdot[\text{BRafActive}]}{([\text{BRafActive}]+\text{KmdBRaf})} - \frac{\text{cell}\cdot\text{kRap1ToBRaf}\cdot[\text{Rap1Active}]\cdot[\text{BRafInactive}]}{([\text{BRafInactive}]+\text{KmRap1ToBRaf})}$$

$$\frac{d\,[\text{BRafActive}]}{dt} = \frac{\text{cell}\cdot\text{kRap1ToBRaf}\cdot[\text{Rap1Active}]\cdot[\text{BRafInactive}]}{([\text{BRafInactive}]+\text{KmRap1ToBRaf})} - \frac{\text{cell}\cdot\text{kdBRaf}\cdot[\text{Raf1PPtase}]\cdot[\text{BRafActive}]}{([\text{BRafActive}]+\text{KmdBRaf})}$$

$$\frac{d\,[\text{MekInactive}]}{dt} = \frac{\text{cell}\cdot\text{kdMek}\cdot[\text{PP2AActive}]\cdot[\text{MekActive}]}{([\text{MekActive}]+\text{KmdMek})} - \frac{\text{cell}\cdot\text{kpRaf1}\cdot[\text{Raf1Active}]\cdot[\text{MekInactive}]}{([\text{MekInactive}]+\text{KmpRaf1})} - \frac{\text{cell}\cdot\text{kpBRaf}\cdot[\text{BRafActive}]\cdot[\text{MekInactive}]}{([\text{MekInactive}]+\text{KmpBRaf})}$$

$$\frac{d\,[\text{MekActive}]}{dt} = \frac{\text{cell}\cdot\text{kpRaf1}\cdot[\text{Raf1Active}]\cdot[\text{MekInactive}]}{([\text{MekInactive}]+\text{KmpRaf1})} + \frac{\text{cell}\cdot\text{kpBRaf}\cdot[\text{BRafActive}]\cdot[\text{MekInactive}]}{([\text{MekInactive}]+\text{KmpBRaf})} - \frac{\text{cell}\cdot\text{kdMek}\cdot[\text{PP2AActive}]\cdot[\text{MekActive}]}{([\text{MekActive}]+\text{KmdMek})}$$

$$\frac{d\,[\text{ErkInactive}]}{dt} = \frac{\text{cell}\cdot\text{kdErk}\cdot[\text{PP2AActive}]\cdot[\text{ErkActive}]}{([\text{ErkActive}]+\text{KmdErk})} - \frac{\text{cell}\cdot\text{kpMekCytoplasmic}\cdot[\text{MekActive}]\cdot[\text{ErkInactive}]}{([\text{ErkInactive}]+\text{KmpMekCytoplasmic})}$$

$$\frac{d\,[\text{ErkActive}]}{dt} = \frac{\text{cell}\cdot\text{kpMekCytoplasmic}\cdot[\text{MekActive}]\cdot[\text{ErkInactive}]}{([\text{ErkInactive}]+\text{KmpMekCytoplasmic})} - \frac{\text{cell}\cdot\text{kdErk}\cdot[\text{PP2AActive}]\cdot[\text{ErkActive}]}{([\text{ErkActive}]+\text{KmdErk})}$$

$$\frac{d\,[\text{PI3KInactive}]}{dt} = -\left(\frac{\text{cell}\cdot\text{kPI3K}\cdot[\text{boundEGFReceptor}]\cdot[\text{PI3KInactive}]}{([\text{PI3KInactive}]+\text{KmPI3K})}\right) - \frac{\text{cell}\cdot\text{kPI3KRas}\cdot[\text{RasActive}]\cdot[\text{PI3KInactive}]}{([\text{PI3KInactive}]+\text{KmPI3KRas})}$$

$$\frac{d\,[\text{PI3KActive}]}{dt} = \frac{\text{cell}\cdot\text{kPI3K}\cdot[\text{boundEGFReceptor}]\cdot[\text{PI3KInactive}]}{([\text{PI3KInactive}]+\text{KmPI3K})} + \frac{\text{cell}\cdot\text{kPI3KRas}\cdot[\text{RasActive}]\cdot[\text{PI3KInactive}]}{([\text{PI3KInactive}]+\text{KmPI3KRas})}$$

$$\frac{d\,[\text{AktInactive}]}{dt} = -\left(\frac{\text{cell}\cdot\text{kAkt}\cdot[\text{PI3KActive}]\cdot[\text{AktInactive}]}{([\text{AktInactive}]+\text{KmAkt})}\right)$$

$$\frac{d\,[\text{AktActive}]}{dt} = \frac{\text{cell}\cdot\text{kAkt}\cdot[\text{PI3KActive}]\cdot[\text{AktInactive}]}{([\text{AktInactive}]+\text{KmAkt})}$$

$$\frac{d\,[\text{C3GInactive}]}{dt} = -\left(\frac{\text{cell}\cdot\text{kC3GNGF}\cdot[\text{boundNGFReceptor}]\cdot[\text{C3GInactive}]}{([\text{C3GInactive}]+\text{KmC3GNGF})}\right)$$

$$\frac{d\,[\text{C3GActive}]}{dt} = \frac{\text{cell}\cdot\text{kC3GNGF}\cdot[\text{boundNGFReceptor}]\cdot[\text{C3GInactive}]}{([\text{C3GInactive}]+\text{KmC3GNGF})}$$

$$\frac{d\,[\text{Rap1Inactive}]}{dt} = \frac{\text{cell}\cdot\text{kRapGap}\cdot[\text{RapGapActive}]\cdot[\text{Rap1Active}]}{([\text{Rap1Active}]+\text{KmRapGap})} - \frac{\text{cell}\cdot\text{kC3G}\cdot[\text{C3GActive}]\cdot[\text{Rap1Inactive}]}{([\text{Rap1Inactive}]+\text{KmC3G})}$$

$$\frac{d\,[\text{Rap1Active}]}{dt} = \frac{\text{cell}\cdot\text{kC3G}\cdot[\text{C3GActive}]\cdot[\text{Rap1Inactive}]}{([\text{Rap1Inactive}]+\text{KmC3G})} - \frac{\text{cell}\cdot\text{kRapGap}\cdot[\text{RapGapActive}]\cdot[\text{Rap1Active}]}{([\text{Rap1Active}]+\text{KmRapGap})}$$

Optimizable Parameters

krbEGF	$2.18503e-05$
kruEGF	0.0121008
krbNGF	$1.38209e-07$
kruNGF	0.00723811
kEGF	694.731
KmEGF	6086070.0
kNGF	389.428
KmNGF	2112.66
kdSos	1611.97
KmdSos	896896.0
kSos	32.344
KmSos	35954.3
kRasGap	1509.36
KmRasGap	1432410.0
kRasToRaf1	0.884096
KmRasToRaf1	62464.6
kpRaf1	185.759
KmpRaf1	4768350.0
kpBRaf	125.089
KmpBRaf	157948.0
kdMek	2.83243
KmdMek	518753.0
kpMekCytoplasmic	9.85367
KmpMekCytoplasmic	1007340.0
kdErk	8.8912
KmdErk	3496490.0
kpP90Rsk	0.0213697

KmpP90Rsk	763523.0
kPI3K	10.6737
KmPI3K	184912.0
kPI3KRas	0.0771067
KmPI3KRas	272056.0
kAkt	0.0566279
KmAkt	653951.0
kdRaf1ByAkt	15.1212
KmRaf1ByAkt	119355.0
kC3GNGF	146.912
KmC3GNGF	12876.2
kC3G	1.40145
KmC3G	10965.6
kRapGap	27.265
KmRapGap	295990.0
kRap1ToBRaf	2.20995
KmRap1ToBRaf	1025460.0
kdRaf1	0.126329
KmdRaf1	1061.71
kdBRaf	441.287
KmdBRaf	10879500.0