

Assignment Rules

$$\begin{aligned} [\text{TotalPMEGFR}] &= [\text{PMEGFR}] \\ &+ [\text{PMBoundEGFR}] \\ &+ [\text{PMBoundEGFRCbl}] \\ &+ [\text{PMBoundEGFRCblActive}] \\ &+ [\text{PMBoundEGFRCoolActiveCbl}] \end{aligned}$$

$$\begin{aligned} [\text{TotalPMBoundEGFR}] &= [\text{PMBoundEGFR}] \\ &+ [\text{PMBoundEGFRCbl}] \\ &+ [\text{PMBoundEGFRCblActive}] \\ &+ [\text{PMBoundEGFRCoolActiveCbl}] \end{aligned}$$

$$\begin{aligned} [\text{TotalInternalEGFR}] &= [\text{EndosomalEGFR}] \\ &+ [\text{EndosomalEGFRCbl}] \\ &+ [\text{EndosomalEGFRCblActive}] \\ &+ [\text{EndosomalEGFRCoolActiveCbl}] \\ &+ [\text{UbiEndosomalEGFRCblActive}] \\ &+ [\text{UbiEndosomalEGFR}] \\ &+ [\text{LysoEGFRCblActive}] \\ &+ [\text{LysoEGFR}] \end{aligned}$$

$$\begin{aligned} [\text{TotalInternalEGF}] &= [\text{EndosomalEGF}] \\ &+ [\text{LysoEGF}] \end{aligned}$$

$$\begin{aligned} [\text{TotalEGFR}] &= [\text{TotalPMEGFR}] \\ &+ [\text{TotalInternalEGFR}] \end{aligned}$$

$$\begin{aligned} [\text{TotalUbiEGFR}] &= [\text{UbiEndosomalEGFRCblActive}] \\ &+ [\text{UbiEndosomalEGFR}] \\ &+ [\text{LysoEGFR}] \\ &+ [\text{LysoEGFRCblActive}] \end{aligned}$$

$$\begin{aligned} [\text{TotalCdc42GDP}] &= [\text{Cdc42GDP}] \\ &+ [\text{CoolActiveCdc42GDP}] \\ &+ [\text{CoolActiveCblCdc42GDP}] \end{aligned}$$

$$\begin{aligned} [\text{TotalCdc42GTP}] &= [\text{Cdc42GTP}] \\ &+ [\text{CoolActiveCdc42GTP}] \\ &+ [\text{CoolActiveCblCdc42GTP}] \end{aligned}$$

$$\begin{aligned} [\text{TotalCoolActive}] &= [\text{CoolActive}] \\ &+ [\text{PMBoundEGFRCoolActiveCbl}] \\ &+ [\text{EndosomalEGFRCoolActiveCbl}] \\ &+ [\text{CoolActiveCdc42GDP}] \\ &+ [\text{CoolActiveCdc42GTP}] \\ &+ [\text{CoolActiveCblCdc42GDP}] \\ &+ [\text{CoolActiveCblCdc42GTP}] \end{aligned}$$

$$\begin{aligned}
& + [\text{CoolActiveCbl}] \\
[\text{TotalCblActive}] &= [\text{CblActive}] \\
& + [\text{PMBoundEGFRCblActive}] \\
& + [\text{EndosomalEGFRCblActive}] \\
& + [\text{UbiEndosomalEGFRCblActive}] \\
& + [\text{LysoEGFRCblActive}] \\
[\text{TotalCbl}] &= [\text{TotalCblActive}] \\
& + [\text{Cbl}] \\
& + [\text{PMBoundEGFRCbl}] \\
& + [\text{PMBoundEGFRCoolActiveCbl}] \\
& + [\text{EndosomalEGFRCbl}] \\
& + [\text{EndosomalEGFRCoolActiveCbl}] \\
& + [\text{CoolActiveCblCdc42GDP}] \\
& + [\text{CoolActiveCblCdc42GTP}] \\
& + [\text{CoolActiveCbl}]
\end{aligned}$$

Differential Equations

$$\begin{aligned}
\frac{d[\text{EGF}]}{dt} &= \text{kuEGF} \cdot [\text{PMBoundEGFR}] \\
& - \text{kbEGF} \cdot [\text{EGF}] \cdot [\text{PMEGFR}]
\end{aligned}$$

$$\begin{aligned}
\frac{d[\text{PMEGFR}]}{dt} &= \text{kuEGF} \cdot [\text{PMBoundEGFR}] \\
& + \text{kRec} \cdot [\text{EndosomalEGFR}] \\
& + \text{ktEGFR} \\
& - \text{kbEGF} \cdot [\text{EGF}] \cdot [\text{PMEGFR}] \\
& - \text{kdEGFR} \cdot [\text{PMEGFR}]
\end{aligned}$$

$$\begin{aligned}
\frac{d[\text{PMBoundEGFR}]}{dt} &= \text{kbEGF} \cdot [\text{EGF}] \cdot [\text{PMEGFR}] \\
& + \frac{\text{kPPaseCool} \cdot [\text{PPase}] \cdot [\text{PMBoundEGFRCoolActiveCbl}]}{(\text{KmPPaseCool} + [\text{PMBoundEGFRCoolActiveCbl}])} \\
& + \text{kuCoolCblEGFR} \cdot [\text{PMBoundEGFRCoolActiveCbl}] \\
& + \text{kuCbl} \cdot [\text{PMBoundEGFRCbl}] \\
& + \text{kuCbl} \cdot [\text{PMBoundEGFRCblActive}] \\
& - \text{kuEGF} \cdot [\text{PMBoundEGFR}] \\
& - \text{kbCoolCblEGFR} \cdot [\text{CoolActiveCblCdc42GTP}] \cdot [\text{PMBoundEGFR}] \\
& - \text{kbCoolCblEGFR} \cdot [\text{CoolActiveCbl}] \cdot [\text{PMBoundEGFR}] \\
& - \text{kbCbl} \cdot [\text{PMBoundEGFR}] \cdot [\text{Cbl}] \\
& - \text{kbCbl} \cdot [\text{PMBoundEGFR}] \cdot [\text{CblActive}]
\end{aligned}$$

$$\begin{aligned}
\frac{d[\text{PMBoundEGFRCbl}]}{dt} &= \text{kbCbl} \cdot [\text{PMBoundEGFR}] \cdot [\text{Cbl}] \\
& + \frac{\text{kPPaseCbl} \cdot [\text{PPase}] \cdot [\text{PMBoundEGFRCblActive}]}{([\text{PMBoundEGFRCblActive}] + \text{KmPPaseCbl})} \\
& - \text{kuCbl} \cdot [\text{PMBoundEGFRCbl}]
\end{aligned}$$

$$- k_{Cbl} \cdot [PMBoundEGFRCbl]$$

$$\begin{aligned} \frac{d [PMBoundEGFRCblActive]}{dt} = & kb_{Cbl} \cdot [PMBoundEGFR] \cdot [CblActive] \\ & + k_{Cbl} \cdot [PMBoundEGFRCbl] \\ & - k_{Endo} \cdot [PMBoundEGFRCblActive] \\ & - k_{u_{Cbl}} \cdot [PMBoundEGFRCblActive] \\ & - \frac{k_{PPaseCbl} \cdot [PPase] \cdot [PMBoundEGFRCblActive]}{([PMBoundEGFRCblActive] + Km_{PPaseCbl})} \end{aligned}$$

$$\begin{aligned} \frac{d [PMBoundEGFRCoolActiveCbl]}{dt} = & kb_{CoolCblEGFR} \cdot [CoolActiveCblCdc42GTP] \cdot [PMBoundEGFR] \\ & + kb_{CoolCblEGFR} \cdot [CoolActiveCbl] \cdot [PMBoundEGFR] \\ & - \frac{k_{PPaseCool} \cdot [PPase] \cdot [PMBoundEGFRCoolActiveCbl]}{(Km_{PPaseCool} + [PMBoundEGFRCoolActiveCbl])} \\ & - k_{u_{CoolCblEGFR}} \cdot [PMBoundEGFRCoolActiveCbl] \end{aligned}$$

$$\begin{aligned} \frac{d [Cbl]}{dt} = & \frac{k_{PPaseCool} \cdot [PPase] \cdot [CoolActiveCbl]}{(Km_{PPaseCool} + [CoolActiveCbl])} \\ & + \frac{k_{PPaseCool} \cdot [PPase] \cdot [PMBoundEGFRCoolActiveCbl]}{(Km_{PPaseCool} + [PMBoundEGFRCoolActiveCbl])} \\ & + \frac{k_{PPaseCool} \cdot [PPase] \cdot [CoolActiveCblCdc42GTP]}{(Km_{PPaseCool} + [CoolActiveCblCdc42GTP])} \\ & + k_{u_{Cool42Cbl}} \cdot [CoolActiveCblCdc42GTP] \\ & + k_{u_{CoolCbl}} \cdot [CoolActiveCbl] \\ & + k_{u_{Cbl}} \cdot [PMBoundEGFRCbl] \\ & + \frac{k_{PPaseCbl} \cdot [PPase] \cdot [CblActive]}{([CblActive] + Km_{PPaseCbl})} \\ & + k_{u_{Cbl}} \cdot [EndosomalEGFRCbl] \\ & - kb_{Cool42Cbl} \cdot [CoolActiveCdc42GTP] \cdot [Cbl] \\ & - kb_{CoolCbl} \cdot [CoolActive] \cdot [Cbl] \\ & - kb_{Cbl} \cdot [PMBoundEGFR] \cdot [Cbl] \\ & - kb_{Cbl} \cdot [EndosomalEGFR] \cdot [Cbl] \end{aligned}$$

$$\begin{aligned} \frac{d [CblActive]}{dt} = & k_{u_{Cbl}} \cdot [PMBoundEGFRCblActive] \\ & + k_{u_{Cbl}} \cdot [EndosomalEGFRCblActive] \\ & + k_{u_{CblUbi}} \cdot [UbiEndosomalEGFRCblActive] \\ & - kb_{Cbl} \cdot [PMBoundEGFR] \cdot [CblActive] \\ & - \frac{k_{PPaseCbl} \cdot [PPase] \cdot [CblActive]}{([CblActive] + Km_{PPaseCbl})} \\ & - kb_{Cbl} \cdot [EndosomalEGFR] \cdot [CblActive] \\ & - kb_{CblUbi} \cdot [UbiEndosomalEGFR] \cdot [CblActive] \end{aligned}$$

$$\begin{aligned} \frac{d [Cool]}{dt} = & \frac{k_{PPaseCool} \cdot [PPase] \cdot [CoolActive]}{([CoolActive] + Km_{PPaseCool})} \\ & + \frac{k_{PPaseCool} \cdot [PPase] \cdot [CoolActiveCbl]}{(Km_{PPaseCool} + [CoolActiveCbl])} \\ & + \frac{k_{PPaseCool} \cdot [PPase] \cdot [PMBoundEGFRCoolActiveCbl]}{(Km_{PPaseCool} + [PMBoundEGFRCoolActiveCbl])} \\ & + \frac{k_{PPaseCool} \cdot [PPase] \cdot [CoolActiveCblCdc42GTP]}{(Km_{PPaseCool} + [CoolActiveCblCdc42GTP])} \\ & + \frac{k_{PPaseCool} \cdot [PPase] \cdot [CoolActiveCdc42GTP]}{(Km_{PPaseCool} + [CoolActiveCdc42GTP])} \end{aligned}$$

$$\begin{aligned}
& + \frac{kPPaseCool \cdot [PPase] \cdot [CoolActiveCdc42GDP]}{(KmPPaseCool + [CoolActiveCdc42GDP])} \\
& - \frac{kFAKCool \cdot [FAKActive] \cdot [Cool]}{([Cool] + KmFAKCool)} \\
\frac{d[CoolActive]}{dt} & = kuCool42 \cdot [CoolActiveCdc42GDP] \\
& + kuCool42GTP \cdot [CoolActiveCdc42GTP] \\
& + \frac{kFAKCool \cdot [FAKActive] \cdot [Cool]}{([Cool] + KmFAKCool)} \\
& + kuCoolCbl \cdot [CoolActiveCbl] \\
& - kbCool42 \cdot [CoolActive] \cdot [Cdc42GDP] \\
& - kbCool42GTP \cdot [CoolActive] \cdot [Cdc42GTP] \\
& - \frac{kPPaseCool \cdot [PPase] \cdot [CoolActive]}{([CoolActive] + KmPPaseCool)} \\
& - kbCoolCbl \cdot [CoolActive] \cdot [Cbl] \\
\frac{d[EndosomalEGF]}{dt} & = kEndo \cdot [PMBoundEGFRCblActive] \\
& - kLyso \cdot [EndosomalEGF] \\
\frac{d[EndosomalEGFR]}{dt} & = kuCoolCblEGFR \cdot [EndosomalEGFRCoolActiveCbl] \\
& + kuCbl \cdot [EndosomalEGFRCbl] \\
& + kuCbl \cdot [EndosomalEGFRCblActive] \\
& - kbCoolCblEGFR \cdot [CoolActiveCblCdc42GTP] \cdot [EndosomalEGFR] \\
& - kbCbl \cdot [EndosomalEGFR] \cdot [Cbl] \\
& - kbCbl \cdot [EndosomalEGFR] \cdot [CblActive] \\
& - kRec \cdot [EndosomalEGFR] \\
\frac{d[EndosomalEGFRCbl]}{dt} & = \frac{kPPaseCbl \cdot [PPase] \cdot [EndosomalEGFRCblActive]}{([EndosomalEGFRCblActive] + KmPPaseCbl)} \\
& + kbCbl \cdot [EndosomalEGFR] \cdot [Cbl] \\
& - kuCbl \cdot [EndosomalEGFRCbl] \\
& - kCbl \cdot [EndosomalEGFRCbl] \\
\frac{d[EndosomalEGFRCblActive]}{dt} & = kEndo \cdot [PMBoundEGFRCblActive] \\
& + kbCbl \cdot [EndosomalEGFR] \cdot [CblActive] \\
& + kCbl \cdot [EndosomalEGFRCbl] \\
& - \frac{kPPaseCbl \cdot [PPase] \cdot [EndosomalEGFRCblActive]}{([EndosomalEGFRCblActive] + KmPPaseCbl)} \\
& - kuCbl \cdot [EndosomalEGFRCblActive] \\
& - kUbi \cdot [EndosomalEGFRCblActive] \\
\frac{d[EndosomalEGFRCoolActiveCbl]}{dt} & = kbCoolCblEGFR \cdot [CoolActiveCblCdc42GTP] \cdot [EndosomalEGFR] \\
& - kuCoolCblEGFR \cdot [EndosomalEGFRCoolActiveCbl] \\
\frac{d[Cdc42GTP]}{dt} & = kuCool42GTP \cdot [CoolActiveCdc42GTP] \\
& + \frac{kPPaseCool \cdot [PPase] \cdot [CoolActiveCblCdc42GTP]}{(KmPPaseCool + [CoolActiveCblCdc42GTP])} \\
& + \frac{kPPaseCool \cdot [PPase] \cdot [CoolActiveCdc42GTP]}{(KmPPaseCool + [CoolActiveCdc42GTP])}
\end{aligned}$$

$$\begin{aligned}
& + k_{uCool42GTP} \cdot [CoolActiveCblCdc42GTP] \\
& + k_{bCoolCblEGFR} \cdot [CoolActiveCblCdc42GTP] \cdot [EndosomalEGFR] \\
& - k_{bCool42GTP} \cdot [CoolActive] \cdot [Cdc42GTP] \\
& - \frac{k_{GAP} \cdot [Cdc42GAP] \cdot [Cdc42GTP]}{([Cdc42GTP] + K_{mGAP})} \\
& - k_{bCool42GTP} \cdot [CoolActiveCbl] \cdot [Cdc42GTP]
\end{aligned}$$

$$\begin{aligned}
\frac{d[Cdc42GDP]}{dt} = & k_{uCool42} \cdot [CoolActiveCdc42GDP] \\
& + \frac{k_{GAP} \cdot [Cdc42GAP] \cdot [Cdc42GTP]}{([Cdc42GTP] + K_{mGAP})} \\
& + \frac{k_{PPaseCool} \cdot [PPase] \cdot [CoolActiveCdc42GDP]}{(K_{mPPaseCool} + [CoolActiveCdc42GDP])} \\
& + k_{uCool42} \cdot [CoolActiveCblCdc42GDP] \\
& + k_{bCoolCblEGFR} \cdot [CoolActiveCblCdc42GTP] \cdot [PMBoundEGFR] \\
& - k_{bCool42} \cdot [CoolActive] \cdot [Cdc42GDP]
\end{aligned}$$

$$\frac{d[Cdc42GAP]}{dt} = 0$$

$$\begin{aligned}
\frac{d[CoolActiveCdc42GDP]}{dt} = & k_{bCool42} \cdot [CoolActive] \cdot [Cdc42GDP] \\
& - k_{Cool42} \cdot [CoolActiveCdc42GDP] \\
& - k_{uCool42} \cdot [CoolActiveCdc42GDP] \\
& - \frac{k_{PPaseCool} \cdot [PPase] \cdot [CoolActiveCdc42GDP]}{(K_{mPPaseCool} + [CoolActiveCdc42GDP])}
\end{aligned}$$

$$\begin{aligned}
\frac{d[CoolActiveCdc42GTP]}{dt} = & k_{Cool42} \cdot [CoolActiveCdc42GDP] \\
& + k_{bCool42GTP} \cdot [CoolActive] \cdot [Cdc42GTP] \\
& + k_{uCool42Cbl} \cdot [CoolActiveCblCdc42GTP] \\
& - k_{uCool42GTP} \cdot [CoolActiveCdc42GTP] \\
& - \frac{k_{PPaseCool} \cdot [PPase] \cdot [CoolActiveCdc42GTP]}{(K_{mPPaseCool} + [CoolActiveCdc42GTP])} \\
& - k_{bCool42Cbl} \cdot [CoolActiveCdc42GTP] \cdot [Cbl]
\end{aligned}$$

$$\begin{aligned}
\frac{d[CoolActiveCblCdc42GDP]}{dt} = & \frac{k_{GAP} \cdot [Cdc42GAP] \cdot [CoolActiveCblCdc42GTP]}{([CoolActiveCblCdc42GTP] + K_{mGAP})} \\
& - k_{uCool42} \cdot [CoolActiveCblCdc42GDP]
\end{aligned}$$

$$\begin{aligned}
\frac{d[CoolActiveCblCdc42GTP]}{dt} = & k_{bCool42GTP} \cdot [CoolActiveCbl] \cdot [Cdc42GTP] \\
& + k_{bCool42Cbl} \cdot [CoolActiveCdc42GTP] \cdot [Cbl] \\
& - \frac{k_{PPaseCool} \cdot [PPase] \cdot [CoolActiveCblCdc42GTP]}{(K_{mPPaseCool} + [CoolActiveCblCdc42GTP])} \\
& - k_{uCool42GTP} \cdot [CoolActiveCblCdc42GTP] \\
& - k_{uCool42Cbl} \cdot [CoolActiveCblCdc42GTP] \\
& - \frac{k_{GAP} \cdot [Cdc42GAP] \cdot [CoolActiveCblCdc42GTP]}{([CoolActiveCblCdc42GTP] + K_{mGAP})} \\
& - k_{bCoolCblEGFR} \cdot [CoolActiveCblCdc42GTP] \cdot [PMBoundEGFR] \\
& - k_{bCoolCblEGFR} \cdot [CoolActiveCblCdc42GTP] \cdot [EndosomalEGFR]
\end{aligned}$$

$$\begin{aligned}
\frac{d[CoolActiveCbl]}{dt} = & k_{uCool42GTP} \cdot [CoolActiveCblCdc42GTP] \\
& + k_{uCool42} \cdot [CoolActiveCblCdc42GDP]
\end{aligned}$$

$$\begin{aligned}
& + kbCoolCbl \cdot [CoolActive] \cdot [Cbl] \\
& + kuCoolCblEGFR \cdot [PMBoundEGFRCoolActiveCbl] \\
& + kuCoolCblEGFR \cdot [EndosomalEGFRCoolActiveCbl] \\
& - \frac{kPPaseCool \cdot [PPase] \cdot [CoolActiveCbl]}{(KmPPaseCool + [CoolActiveCbl])} \\
& - kbCool42GTP \cdot [CoolActiveCbl] \cdot [Cdc42GTP] \\
& - kuCoolCbl \cdot [CoolActiveCbl] \\
& - kbCoolCblEGFR \cdot [CoolActiveCbl] \cdot [PMBoundEGFR] \\
\\
\frac{d[UbiEndosomalEGFR]}{dt} &= kuCblUbi \cdot [UbiEndosomalEGFRCblActive] \\
& - kbCblUbi \cdot [UbiEndosomalEGFR] \cdot [CblActive] \\
& - kLyso \cdot [UbiEndosomalEGFR] \\
\\
\frac{d[UbiEndosomalEGFRCblActive]}{dt} &= kUbi \cdot [EndosomalEGFRCblActive] \\
& + kbCblUbi \cdot [UbiEndosomalEGFR] \cdot [CblActive] \\
& - kuCblUbi \cdot [UbiEndosomalEGFRCblActive] \\
& - kLyso \cdot [UbiEndosomalEGFRCblActive] \\
\\
\frac{d[recycledEGFR]}{dt} &= kRec \cdot [EndosomalEGFR] \\
\\
\frac{d[LysoEGFR]}{dt} &= kLyso \cdot [UbiEndosomalEGFR] \\
& - kProt \cdot [LysoEGFR] \\
\\
\frac{d[LysoEGFRCblActive]}{dt} &= kLyso \cdot [UbiEndosomalEGFRCblActive] \\
& - kProt \cdot [LysoEGFRCblActive] \\
\\
\frac{d[LysoEGF]}{dt} &= kLyso \cdot [EndosomalEGF] \\
& - kProtEGF \cdot [LysoEGF] \\
\\
\frac{d[Src]}{dt} &= \frac{kPPase \cdot [PPase] \cdot [SrcActive]}{([SrcActive] + KmPPase)} \\
& - \frac{kEGFRSrc \cdot [TotalPMBoundEGFR] \cdot [Src]}{([Src] + KmEGFRSrc)} \\
& - \frac{kEGFRSrc \cdot [TotalInternalEGFR] \cdot [Src]}{([Src] + KmEGFRSrc)} \\
\\
\frac{d[SrcActive]}{dt} &= \frac{kEGFRSrc \cdot [TotalPMBoundEGFR] \cdot [Src]}{([Src] + KmEGFRSrc)} \\
& + \frac{kEGFRSrc \cdot [TotalInternalEGFR] \cdot [Src]}{([Src] + KmEGFRSrc)} \\
& - \frac{kPPase \cdot [PPase] \cdot [SrcActive]}{([SrcActive] + KmPPase)} \\
\\
\frac{d[FAK]}{dt} &= \frac{kPPase \cdot [PPase] \cdot [FAKActive]}{([FAKActive] + KmPPase)} \\
& - \frac{kSrcFAK \cdot [SrcActive] \cdot [FAK]}{([FAK] + KmSrcFAK)}
\end{aligned}$$

$$\begin{aligned}
\frac{d [\text{FAKActive}]}{dt} &= \frac{k_{\text{SrcFAK}} \cdot [\text{SrcActive}] \cdot [\text{FAK}]}{([\text{FAK}] + K_{\text{mSrcFAK}})} \\
&\quad - \frac{k_{\text{PPase}} \cdot [\text{PPase}] \cdot [\text{FAKActive}]}{([\text{FAKActive}] + K_{\text{mPPase}})} \\
\\
\frac{d [\text{ERK}]}{dt} &= \frac{k_{\text{dErk}} \cdot [\text{PPase}] \cdot [\text{ErkP}]}{([\text{ErkP}] + K_{\text{mdErk}})} \\
&\quad - \frac{k_{\text{Erk}} \cdot [\text{RasGTP}] \cdot [\text{ERK}]}{([\text{ERK}] + K_{\text{mErk}})} \\
\\
\frac{d [\text{RasGDP}]}{dt} &= \frac{k_{\text{RasGAP}} \cdot [\text{RasGAP}] \cdot [\text{RasGTP}]}{([\text{RasGTP}] + K_{\text{mRasGAP}})} \\
&\quad + \frac{k_{\text{ErkRas}} \cdot [\text{ErkP}] \cdot [\text{RasGTP}]}{([\text{RasGTP}] + K_{\text{mErkRas}})} \\
&\quad - \frac{k_{\text{Ras}} \cdot [\text{TotalPMBoundEGFR}] \cdot [\text{RasGDP}]}{([\text{RasGDP}] + K_{\text{mRas}})} \\
&\quad - \frac{k_{\text{Ras}} \cdot [\text{TotalInternalEGFR}] \cdot [\text{RasGDP}]}{([\text{RasGDP}] + K_{\text{mRas}})} \\
\\
\frac{d [\text{RasGAP}]}{dt} &= 0 \\
\\
\frac{d [\text{ErkP}]}{dt} &= \frac{k_{\text{Erk}} \cdot [\text{RasGTP}] \cdot [\text{ERK}]}{([\text{ERK}] + K_{\text{mErk}})} \\
&\quad - \frac{k_{\text{dErk}} \cdot [\text{PPase}] \cdot [\text{ErkP}]}{([\text{ErkP}] + K_{\text{mdErk}})} \\
\\
\frac{d [\text{RasGTP}]}{dt} &= \frac{k_{\text{Ras}} \cdot [\text{TotalPMBoundEGFR}] \cdot [\text{RasGDP}]}{([\text{RasGDP}] + K_{\text{mRas}})} \\
&\quad + \frac{k_{\text{Ras}} \cdot [\text{TotalInternalEGFR}] \cdot [\text{RasGDP}]}{([\text{RasGDP}] + K_{\text{mRas}})} \\
&\quad - \frac{k_{\text{RasGAP}} \cdot [\text{RasGAP}] \cdot [\text{RasGTP}]}{([\text{RasGTP}] + K_{\text{mRasGAP}})} \\
&\quad - \frac{k_{\text{ErkRas}} \cdot [\text{ErkP}] \cdot [\text{RasGTP}]}{([\text{RasGTP}] + K_{\text{mErkRas}})} \\
\\
\frac{d [\text{PPase}]}{dt} &= 0 \\
\\
\frac{d [\text{DegradedEGFR}]}{dt} &= k_{\text{Prot}} \cdot [\text{LysoEGFRClActive}] \\
&\quad + k_{\text{Prot}} \cdot [\text{LysoEGFR}] \\
\\
\frac{d [\text{DegradedEGF}]}{dt} &= k_{\text{ProtEGF}} \cdot [\text{LysoEGF}]
\end{aligned}$$