SBML Model Report

Model name: "Vinod2011_MitoticExit"

May 6, 2016

1 General Overview

This is a document in SBML Level 2 Version 4 format. This model was created by the following two authors: Vijayalakshmi Chelliah[1] and Bela Novak[2] at November tenth 2011 at 4:53 p. m. and last time modified at March eighth 2012 at 12:34 a. m. Table 1 provides an overview of the quantities of all components of this model.

Table 1: Number of components in this model, which are described in the following sections.

Element	Quantity	Element	Quantity
compartment types	0	compartments	1
species types	0	species	32
events	0	constraints	0
reactions	0	function definitions	0
global parameters	105	unit definitions	5
rules	42	initial assignments	0

Model Notes

This model is from the article:
Computational modelling of mitotic exit in budding yeast: the role of separase and Cdc14 endocycles
Vinod PK, Freire P, Rattani A, Ciliberto A, Uhlmann F, Novak B. J R Soc Interface. 2011 Aug 7;8(61):1128-41. Epub 2011 Feb 2. 21288956 ,
Abstract:

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The operating principles of complex regulatory networks are best understood with the help of mathematical modelling rather than by intuitive reasoning. Hereby, we study the dynamics of the mitotic exit (ME) control system in budding yeast by further developing the Queralt's model. A comprehensive systems view of the network regulating ME is provided based on classical experiments in the literature. In this picture, Cdc20-APC is a critical node controlling both cyclin (Clb2 and Clb5) and phosphatase (Cdc14) branches of the regulatory network. On the basis of experimental situations ranging from single to quintuple mutants, the kinetic parameters of the network are estimated. Numerical analysis of the model quantifies the dependence of ME control on the proteolytic and non-proteolytic functions of separase. We show that the requirement of the non-proteolytic function of separase for ME depends on cyclin-dependent kinase activity. The model is also used for the systematic analysis of the recently discovered Cdc14 endocycles. The significance of Cdc14 endocycles in eukaryotic cell cycle control is discussed as well.

2 Unit Definitions

This is an overview of ten unit definitions of which five are predefined by SBML and not mentioned in the model.

2.1 Unit area_1

Name area

Definition m^2

2.2 Unit length_1

Name length

Definition m

2.3 Unit substance_1

Name substance

Definition mol

2.4 Unit time_1

Name time

Definition s

2.5 Unit volume_1

Name volume

Definition l

2.6 Unit substance

Notes Mole is the predefined SBML unit for `substance`.

Definition mol

2.7 Unit volume

Notes Litre is the predefined SBML unit for `volume`.

Definition l

2.8 Unit area

Notes Square metre is the predefined SBML unit for `area` since SBML Level 2 Version 1.

Definition m^2

2.9 Unit length

Notes Metre is the predefined SBML unit for `length` since SBML Level 2 Version 1.

Definition m

2.10 Unit time

Notes Second is the predefined SBML unit for `time`.

Definition s

3 Compartment

This model contains one compartment.

Table 2: Properties of all compartments.

Id	Name	SBO	Spatial Dimensions	Size	Unit	Constant	Outside
cell_1	cell	0000290	3	1	litre	☑	

3.1 Compartment cell_1

This is a three dimensional compartment with a constant size of one litre.

Name cell

SBO:0000290 physical compartment

4 Species

This model contains 32 species. Section 7 provides further details and the derived rates of change of each species.

Table 3: Properties of each species.

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
Clb2T_1	Clb2T	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Clb5T_1	Clb5T	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Cln_1	Cln	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Cdc20_1	Cdc20	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Cdh1_1	Cdh1	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Sic1T_1	Sic1T	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Trim2_1	Trim2	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Trim5_1	Trim5	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Swi5_1	Swi5	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Mcm_1	Mcm	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
MBF_1	MBF	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Pds1T_1	Pds1T	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Esp1T_1	Esp1T	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
PoloT_1	PoloT	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Polo_1	Polo	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Net1dep_1	Net1dep	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Net1pp_1	Net1pp	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
RENT_1	RENT	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
RENTp_1	RENTp	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Cdc14n_1	Cdc14n	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Tem1_1	Tem1	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Cdc15_1	Cdc15	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
MEN_1	MEN	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Clb2_2	Clb2	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Clb5_1	Clb5	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Sic1_1	Sic1	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Pds1_1	Pds1	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Esp1b_1	Esp1b	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Esp1_1	Esp1	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Net1p_1	Net1p	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Net1_2	Net1	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟
Cdc14c_1	Cdc14c	cell_1	$\mathrm{mol} \cdot \mathrm{l}^{-1}$	⊟	⊟

5 Parameters

This model contains 105 global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
PP_1	PP		0.000		☐
PPT_1	PPT		1.000		☑
kpp_1	kpp		0.100		☑
ki_1	ki		40.000		☑
V2_1	V2		0.000		☐
kdclb2_1	kdclb2		0.020		☑
kdclb2_2	kdclb2’		0.100		☑
kdclb2_3	kdclb2”		0.400		☑
V6_1	V6		0.000		☐
kdclb5_1	kdclb5		0.010		☑
kdclb5_2	kdclb5’		1.000		☑
Vdsic_1	Vdsic		0.000		☐
kdsic_1	kdsic’		2.000		☑
kdsic_2	kdsic”		2.000		☑
kdsic_3	kdsic		0.040		☑
kdsic_4	kdsic”’		1.500		☑
Vacdh_1	Vacdh		0.000		☐
kdcdh_1	kdcdh		0.030		☑
kdcdh_2	kdcdh’		0.300		☑
Vicdh_1	Vicdh		0.000		☐
kpcdh_1	kpcdh		0.001		☑
kpcdh_2	kpcdh’		0.040		☑
kpcdh_3	kpcdh”		0.750		☑
Vaswi_1	Vaswi		0.000		☐
kaswi_1	kaswi		0.200		☑
kaswi_2	kaswi’		1.000		☑
Viswi_1	Viswi		0.000		☐
kiswi_1	kiswi		0.010		☑
kiswi_2	kiswi’		0.500		☑
kiswi_3	kiswi”		0.750		☑
Vd_1	Vd		0.000		☐
kd_1	kd’		0.100		☑
kd_2	kd		0.450		☑
Jnet_1	Jnet		0.050		☑
Net1T_1	Net1T		1.000		☑
Vp_1	Vp		0.000		☐
kp_3	kp”		0.200		☑

Id	Name	SBO	Value	Unit	Constant
kp_4	kp”’		3.000		☑
Vexp_1	Vexp		0.000		☐
kexp_1	kexp		0.010		☑
kexp_2	kexp’		20.000		☑
ksclb2_1	ksclb2		0.015		☑
ksclb2_2	ksclb2’		0.005		☑
ksclb5_1	ksclb5’		0.010		☑
ksclb5_2	ksclb5		0.002		☑
kscln_1	kscln’		0.100		☑
kscln_2	kscln		0.010		☑
kdcln_1	kdcln		0.250		☑
ks20_1	ks20’		0.050		☑
ks20_2	ks20		0.001		☑
kd20_1	kd20		0.100		☑
kd20_2	kd20’		1.000		☑
Jcdh_1	Jcdh		0.010		☑
kssic_1	kssic’		0.200		☑
kssic_2	kssic		0.004		☑
kasic2_1	kasic2		40.000		☑
kdsic2_1	kdsic2		0.100		☑
kasic5_1	kasic5		10.000		☑
kdsic5_1	kdsic5		0.100		☑
Jswi_1	Jswi		0.100		☑
ksmcm_1	ksmcm’		1.000		☑
ksmcm_3	ksmcm		0.010		☑
kdmcm_1	kdmcm		0.250		☑
Jmcm_1	Jmcm		0.010		☑
Jmbf_1	Jmbf		0.010		☑
kambf_1	kambf		0.100		☑
kimbf_1	kimbf’		0.500		☑
kimbf_2	kimbf		0.000		☑
kimbf_3	kimbf”		0.500		☑
kspds_1	kspds’		0.010		☑
kspds_2	kspds		0.006		☑
kdpds_1	kdpds		0.010		☑
kdpds_2	kdpds’		2.000		☑
ksesp_1	ksesp		0.001		☑
kdesp_1	kdesp		0.004		☑
lapds_1	lapds		500.000		☑
ldpds_1	ldpds		1.000		☑
kspolo_1	kspolo’		0.050		☑
kspolo_2	kspolo		0.001		☑

Id	Name	SBO	Value	Unit	Constant
kdpolo_1	kdpolo		0.050		☑
kdpolo_2	kdpolo'		0.500		☑
Jpolo_1	Jpolo		0.100		☑
kapolo_1	kapolo		0.000		☑
kapolo_2	kapolo'		1.000		☑
kipolo_1	kipolo		0.100		☑
kp_1	kp'		2.000		☑
lanet_1	lanet		500.000		☑
ldnet_1	ldnet		1.000		☑
kimp_1	kimp		1.000		☑
Jtem1_1	Jtem1		0.005		☑
katem_1	katem		0.000		☑
katem_2	katem'		0.600		☑
kitem_1	kitem"		20.000		☑
kitem_2	kitem'		1.000		☑
kitem_3	kitem		0.100		☑
Jcdc15_1	Jcdc15		1.000		☑
kac15_1	kac15		0.030		☑
kac15_2	kac15'		0.500		☑
kic15_1	kic15		0.030		☑
kic15_2	kic15'		0.200		☑
lamen_1	lamen		100.000		☐
ldmen_1	ldmen		0.100		☑
Cdc14T_1	Cdc14T		0.500		☑
Clb2nd_1	Clb2nd		0.000		☑
Swi5T_1	Swi5T		1.000		☑

6 Rules

This is an overview of 42 rules.

6.1 Rule Clb2_2

Rule Clb2_2 is an assignment rule for species Clb2_2:

$$\text{Clb2\_2} = [\text{Clb2T\_1}] + \text{Clb2nd\_1} - [\text{Trim2\_1}] \tag{1}$$

6.2 Rule Clb5_1

Rule Clb5_1 is an assignment rule for species Clb5_1:

$$\text{Clb5\_1} = [\text{Clb5T\_1}] - [\text{Trim5\_1}] \tag{2}$$

Derived unit $\text{mol} \cdot \text{l}^{-1}$

6.3 Rule Sic1_1

Rule Sic1_1 is an assignment rule for species Sic1_1:

$$\text{Sic1\_1} = [\text{Sic1T\_1}] - [\text{Trim2\_1}] - [\text{Trim5\_1}] \tag{3}$$

Derived unit $\text{mol} \cdot \text{l}^{-1}$

6.4 Rule Pds1_1

Rule Pds1_1 is an assignment rule for species Pds1_1:

$$\text{Pds1\_1} = [\text{Pds1T\_1}] - [\text{Esp1b\_1}] \tag{4}$$

Derived unit $\text{mol} \cdot \text{l}^{-1}$

6.5 Rule Esp1_1

Rule Esp1_1 is an assignment rule for species Esp1_1:

$$\text{Esp1\_1} = [\text{Esp1T\_1}] - [\text{Esp1b\_1}] \tag{5}$$

Derived unit $\text{mol} \cdot \text{l}^{-1}$

6.6 Rule Net1_2

Rule Net1_2 is an assignment rule for species Net1_2:

$$\text{Net1\_2} = \text{Net1T\_1} - [\text{Net1p\_1}] - [\text{RENT\_1}] - [\text{Net1pp\_1}] \tag{6}$$

6.7 Rule Cdc14c_1

Rule Cdc14c_1 is an assignment rule for species Cdc14c_1:

$$\text{Cdc14c\_1} = \text{Cdc14T\_1} - [\text{Cdc14n\_1}] - [\text{RENT\_1}] \tag{7}$$

6.8 Rule PP_1

Rule PP_1 is an assignment rule for parameter PP_1:

$$\text{PP\_1} = \text{PPT\_1} \cdot \frac{1 + \text{kpp\_1} \cdot \text{ki\_1} \cdot [\text{Esp1\_1}]}{1 + \text{ki\_1} + [\text{Esp1\_1}]} \tag{8}$$

6.9 Rule V2_1

Rule V2_1 is an assignment rule for parameter V2_1:

$$\text{V2\_1} = \text{kdclb2\_1} + \text{kdclb2\_2} \cdot [\text{Cdc20\_1}] + \text{kdclb2\_3} \cdot [\text{Cdh1\_1}] \tag{9}$$

6.10 Rule V6_1

Rule V6_1 is an assignment rule for parameter V6_1:

$$\mathrm{V6\_1} = \mathrm{kdclb5\_1} + \mathrm{kdclb5\_2} \cdot [\mathrm{Cdc20\_1}] \tag{10}$$

6.11 Rule Vdsic_1

Rule Vdsic_1 is an assignment rule for parameter Vdsic_1:

$$\mathrm{Vdsic\_1} = \mathrm{kdsic\_3} + \mathrm{kdsic\_1} \cdot [\mathrm{Clb5\_1}] + \mathrm{kdsic\_2} \cdot [\mathrm{Clb2\_2}] + \mathrm{kdsic\_4} \cdot [\mathrm{Cln\_1}] \tag{11}$$

6.12 Rule Vacdh_1

Rule Vacdh_1 is an assignment rule for parameter Vacdh_1:

$$\mathrm{Vacdh\_1} = \mathrm{kdcdh\_1} \cdot [\mathrm{Cdc14n\_1}] + \mathrm{kdcdh\_2} \cdot [\mathrm{Cdc14c\_1}] \tag{12}$$

6.13 Rule Vicdh_1

Rule Vicdh_1 is an assignment rule for parameter Vicdh_1:

$$\mathrm{Vicdh\_1} = \mathrm{kpcdh\_1} + \mathrm{kpcdh\_2} \cdot [\mathrm{Clb2\_2}] + \mathrm{kpcdh\_3} \cdot [\mathrm{Clb5\_1}] \tag{13}$$

6.14 Rule Vaswi_1

Rule Vaswi_1 is an assignment rule for parameter Vaswi_1:

$$\mathrm{Vaswi\_1} = \mathrm{kaswi\_1} \cdot [\mathrm{Cdc14n\_1}] + \mathrm{kaswi\_2} \cdot [\mathrm{Cdc14c\_1}] \tag{14}$$

6.15 Rule Viswi_1

Rule Viswi_1 is an assignment rule for parameter Viswi_1:

$$\mathrm{Viswi\_1} = \mathrm{kiswi\_1} + \mathrm{kiswi\_2} \cdot [\mathrm{Clb2\_2}] + \mathrm{kiswi\_3} \cdot [\mathrm{Clb5\_1}] \tag{15}$$

6.16 Rule Vd_1

Rule Vd_1 is an assignment rule for parameter Vd_1:

$$\mathrm{Vd\_1} = \frac{\mathrm{kd\_2} \cdot \mathrm{PP\_1} + \mathrm{kd\_1} \cdot [\mathrm{Cdc14n\_1}]}{\mathrm{Jnet\_1} + \mathrm{Net1T\_1} - [\mathrm{Net1dep\_1}]} \tag{16}$$

6.17 Rule Vp_1

Rule Vp_1 is an assignment rule for parameter Vp_1:

$$\mathrm{Vp\_1} = \frac{\mathrm{kp\_3} \cdot [\mathrm{Clb2\_2}] + \mathrm{kp\_4} \cdot [\mathrm{MEN\_1}]}{\mathrm{Jnet\_1} + [\mathrm{Net1dep\_1}]} \tag{17}$$

6.18 Rule Vexp_1

Rule Vexp_1 is an assignment rule for parameter Vexp_1:

$$\text{Vexp\_1} = \text{kexp\_1} + \text{kexp\_2} \cdot [\text{MEN\_1}] \tag{18}$$

6.19 Rule Clb2T_1

Rule Clb2T_1 is a rate rule for species Clb2T_1:

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{Clb2T\_1} = \text{ksclb2\_1} + \text{ksclb2\_2} \cdot [\text{Mcm\_1}] - \text{V2\_1} \cdot [\text{Clb2T\_1}] \tag{19}$$

6.20 Rule Clb5T_1

Rule Clb5T_1 is a rate rule for species Clb5T_1:

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{Clb5T\_1} = \text{ksclb5\_2} + \text{ksclb5\_1} \cdot [\text{MBF\_1}] - \text{V6\_1} \cdot [\text{Clb5T\_1}] \tag{20}$$

6.21 Rule Cln_1

Rule Cln_1 is a rate rule for species Cln_1:

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{Cln\_1} = \text{kscln\_2} + \text{kscln\_1} \cdot [\text{MBF\_1}] - \text{kdcln\_1} \cdot [\text{Cln\_1}] \tag{21}$$

6.22 Rule Cdc20_1

Rule Cdc20_1 is a rate rule for species Cdc20_1:

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{Cdc20\_1} = \text{ks20\_2} + \text{ks20\_1} \cdot [\text{Mcm\_1}] - (\text{kd20\_1} + \text{kd20\_2} \cdot [\text{Cdh1\_1}]) \cdot [\text{Cdc20\_1}] \tag{22}$$

6.23 Rule Cdh1_1

Rule Cdh1_1 is a rate rule for species Cdh1_1:

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{Cdh1\_1} = \frac{\text{Vacdh\_1} \cdot (1 - [\text{Cdh1\_1}])}{\text{Jcdh\_1} + 1 - [\text{Cdh1\_1}]} - \frac{\text{Vicdh\_1} \cdot [\text{Cdh1\_1}]}{\text{Jcdh\_1} + [\text{Cdh1\_1}]} \tag{23}$$

6.24 Rule Sic1T_1

Rule Sic1T_1 is a rate rule for species Sic1T_1:

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{Sic1T\_1} = \text{kssic\_2} + \text{kssic\_1} \cdot [\text{Swi5\_1}] - \text{Vdsic\_1} \cdot [\text{Sic1T\_1}] \tag{24}$$

6.25 Rule Trim2_1

Rule Trim2_1 is a rate rule for species Trim2_1:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Trim2\_1} = \mathrm{kasic2\_1} \cdot [\mathrm{Clb2\_2}] \cdot [\mathrm{Sic1\_1}] - (\mathrm{kdsic2\_1} + \mathrm{V2\_1} + \mathrm{Vdsic\_1}) \cdot [\mathrm{Trim2\_1}] \quad (25)$$

6.26 Rule Trim5_1

Rule Trim5_1 is a rate rule for species Trim5_1:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Trim5\_1} = \mathrm{kasic5\_1} \cdot [\mathrm{Clb5\_1}] \cdot [\mathrm{Sic1\_1}] - (\mathrm{kdsic5\_1} + \mathrm{V6\_1} + \mathrm{Vdsic\_1}) \cdot [\mathrm{Trim5\_1}] \quad (26)$$

6.27 Rule Swi5_1

Rule Swi5_1 is a rate rule for species Swi5_1:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Swi5\_1} = \frac{\mathrm{Vaswi\_1} \cdot (\mathrm{Swi5T\_1} - [\mathrm{Swi5\_1}])}{\mathrm{Jswi\_1} + \mathrm{Swi5T\_1} - [\mathrm{Swi5\_1}]} - \frac{\mathrm{Viswi\_1} \cdot [\mathrm{Swi5\_1}]}{\mathrm{Jswi\_1} + [\mathrm{Swi5\_1}]} \quad (27)$$

6.28 Rule Mcm_1

Rule Mcm_1 is a rate rule for species Mcm_1:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Mcm\_1} = \frac{(\mathrm{ksmcm\_3} + \mathrm{ksmcm\_1} \cdot [\mathrm{Clb2\_2}]) \cdot (1 - [\mathrm{Mcm\_1}])}{\mathrm{Jmcm\_1} + 1 - [\mathrm{Mcm\_1}]} - \frac{\mathrm{kdmcm\_1} \cdot [\mathrm{Mcm\_1}]}{\mathrm{Jmcm\_1} + [\mathrm{Mcm\_1}]} \quad (28)$$

6.29 Rule MBF_1

Rule MBF_1 is a rate rule for species MBF_1:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{MBF\_1} = \frac{\mathrm{kambf\_1} \cdot (1 - [\mathrm{MBF\_1}])}{\mathrm{Jmbf\_1} + 1 - [\mathrm{MBF\_1}]} - \frac{(\mathrm{kimbf\_1} \cdot [\mathrm{Clb2\_2}] + \mathrm{kimbf\_3} \cdot [\mathrm{Clb5\_1}]) \cdot [\mathrm{MBF\_1}]}{\mathrm{Jmbf\_1} + [\mathrm{MBF\_1}]} \quad (29)$$

6.30 Rule Pds1T_1

Rule Pds1T_1 is a rate rule for species Pds1T_1:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Pds1T\_1} = \mathrm{kspds\_2} + \mathrm{kspds\_1} \cdot [\mathrm{MBF\_1}] - (\mathrm{kdpds\_1} + \mathrm{kdpds\_2} \cdot [\mathrm{Cdc20\_1}]) \cdot [\mathrm{Pds1T\_1}] \quad (30)$$

6.31 Rule Esp1T_1

Rule Esp1T_1 is a rate rule for species Esp1T_1:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Esp1T\_1} = \mathrm{ksesp\_1} - \mathrm{kdesp\_1} \cdot [\mathrm{Esp1T\_1}] \quad (31)$$

6.32 Rule Esp1b_1

Rule Esp1b_1 is a rate rule for species Esp1b_1:

$$\begin{aligned}\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Esp1b\_1} = {} & \mathrm{lapds\_1}\cdot[\mathrm{Pds1\_1}]\cdot[\mathrm{Esp1\_1}] \\ & -(\mathrm{ldpds\_1}+\mathrm{kdesp\_1}+\mathrm{kdpds\_1}+\mathrm{kdpds\_2}\cdot[\mathrm{Cdc20\_1}])\cdot[\mathrm{Esp1b\_1}]\end{aligned} \tag{32}$$

6.33 Rule PoloT_1

Rule PoloT_1 is a rate rule for species PoloT_1:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{PoloT\_1} = \mathrm{kspolo\_2}+\mathrm{kspolo\_1}\cdot[\mathrm{Mcm\_1}]-(\mathrm{kdpolo\_1}+\mathrm{kdpolo\_2}\cdot[\mathrm{Cdh1\_1}])\cdot[\mathrm{PoloT\_1}] \tag{33}$$

6.34 Rule Polo_1

Rule Polo_1 is a rate rule for species Polo_1:

$$\begin{aligned}\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Polo\_1} = {} & \frac{(\mathrm{kapolo\_1}+\mathrm{kapolo\_2}\cdot[\mathrm{Clb2\_2}])\cdot([\mathrm{PoloT\_1}]-[\mathrm{Polo\_1}])}{\mathrm{Jpolo\_1}+[\mathrm{PoloT\_1}]-[\mathrm{Polo\_1}]} \\ & -\frac{\mathrm{kipolo\_1}\cdot[\mathrm{Polo\_1}]}{\mathrm{Jpolo\_1}+[\mathrm{Polo\_1}]}-(\mathrm{kdpolo\_1}+\mathrm{kdpolo\_2}\cdot[\mathrm{Cdh1\_1}])\cdot[\mathrm{Polo\_1}]\end{aligned} \tag{34}$$

6.35 Rule Net1dep_1

Rule Net1dep_1 is a rate rule for species Net1dep_1:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Net1dep\_1} = \mathrm{Vd\_1}\cdot(\mathrm{Net1T\_1}-[\mathrm{Net1dep\_1}])-\mathrm{Vp\_1}\cdot[\mathrm{Net1dep\_1}] \tag{35}$$

6.36 Rule Net1pp_1

Rule Net1pp_1 is a rate rule for species Net1pp_1:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Net1pp\_1} = \mathrm{kp\_1}\cdot[\mathrm{Polo\_1}]\cdot(\mathrm{Net1T\_1}-[\mathrm{Net1dep\_1}]-[\mathrm{Net1pp\_1}])-\mathrm{Vd\_1}\cdot[\mathrm{Net1pp\_1}] \tag{36}$$

6.37 Rule RENT_1

Rule RENT_1 is a rate rule for species RENT_1:

$$\begin{aligned}\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{RENT\_1} = {} & \mathrm{lanet\_1}\cdot(\mathrm{Net1T\_1}-[\mathrm{Net1pp\_1}]-[\mathrm{RENT\_1}])\cdot[\mathrm{Cdc14n\_1}] \\ & -\mathrm{ldnet\_1}\cdot[\mathrm{RENT\_1}]-\mathrm{kp\_1}\cdot[\mathrm{Polo\_1}]\cdot[\mathrm{RENTp\_1}]\end{aligned} \tag{37}$$

6.38 Rule RENTp_1

Rule RENTp_1 is a rate rule for species RENTp_1:

$$\begin{aligned}\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{RENTp\_1} = {} & \mathrm{Vp\_1}\cdot([\mathrm{RENT\_1}]-[\mathrm{RENTp\_1}])-\mathrm{Vd\_1}\cdot[\mathrm{RENTp\_1}]+\mathrm{lanet\_1}\\ & \cdot(\mathrm{Net1T\_1}-[\mathrm{Net1dep\_1}]-[\mathrm{Net1pp\_1}]-[\mathrm{RENTp\_1}])\\ & \cdot[\mathrm{Cdc14n\_1}]-\mathrm{ldnet\_1}\cdot[\mathrm{RENTp\_1}]-\mathrm{kp\_1}\cdot[\mathrm{Polo\_1}]\cdot[\mathrm{RENTp\_1}]\end{aligned} \tag{38}$$

6.39 Rule Cdc14n_1

Rule Cdc14n_1 is a rate rule for species Cdc14n_1:

$$\begin{aligned}\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Cdc14n\_1} = {} & \mathrm{kp\_1}\cdot[\mathrm{Polo\_1}]\cdot[\mathrm{RENTp\_1}]-\mathrm{lanet\_1}\cdot(\mathrm{Net1T\_1}-[\mathrm{Net1pp\_1}]-[\mathrm{RENT\_1}])\\ & \cdot[\mathrm{Cdc14n\_1}]+\mathrm{ldnet\_1}\cdot[\mathrm{RENT\_1}]-\mathrm{Vexp\_1}\cdot[\mathrm{Cdc14n\_1}]+\mathrm{kimp\_1}\cdot[\mathrm{Cdc14c\_1}]\end{aligned} \tag{39}$$

6.40 Rule Tem1_1

Rule Tem1_1 is a rate rule for species Tem1_1:

$$\begin{aligned}\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Tem1\_1} = {} & \frac{(\mathrm{katem\_1}+\mathrm{katem\_2}\cdot[\mathrm{Polo\_1}])\cdot(1-[\mathrm{Tem1\_1}])}{\mathrm{Jtem1\_1}+1-[\mathrm{Tem1\_1}]}\\ & -\frac{\mathrm{kitem\_3}+\frac{\mathrm{kitem\_2}}{1+\mathrm{kitem\_1}\cdot[\mathrm{Esp1\_1}]}}{\mathrm{Jtem1\_1}+[\mathrm{Tem1\_1}]}\cdot[\mathrm{Tem1\_1}]\end{aligned} \tag{40}$$

6.41 Rule Cdc15_1

Rule Cdc15_1 is a rate rule for species Cdc15_1:

$$\begin{aligned}\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Cdc15\_1} = {} & \frac{(\mathrm{kac15\_1}+\mathrm{kac15\_2}\cdot[\mathrm{Cdc14c\_1}])\cdot(1-[\mathrm{Cdc15\_1}])}{\mathrm{Jcdc15\_1}+1-[\mathrm{Cdc15\_1}]}\\ & -\frac{(\mathrm{kic15\_1}+\mathrm{kic15\_2}\cdot[\mathrm{Clb2\_2}])\cdot[\mathrm{Cdc15\_1}]}{\mathrm{Jcdc15\_1}+[\mathrm{Cdc15\_1}]}\end{aligned} \tag{41}$$

6.42 Rule MEN_1

Rule MEN_1 is a rate rule for species MEN_1:

$$\begin{aligned}\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{MEN\_1} = {} & \mathrm{lamen\_1}\cdot([\mathrm{Tem1\_1}]-[\mathrm{MEN\_1}])\cdot([\mathrm{Cdc15\_1}]-[\mathrm{MEN\_1}])-\mathrm{ldmen\_1}\cdot[\mathrm{MEN\_1}]\\ & -\frac{\mathrm{kitem\_3}+\frac{\mathrm{kitem\_2}}{1+\mathrm{kitem\_3}\cdot[\mathrm{Esp1\_1}]}}{\mathrm{Jtem1\_1}+[\mathrm{Tem1\_1}]}\cdot[\mathrm{MEN\_1}]-\frac{\mathrm{kic15\_1}+\mathrm{kic15\_2}\cdot[\mathrm{Clb2\_2}]}{\mathrm{Jcdc15\_1}+[\mathrm{Cdc15\_1}]}\cdot[\mathrm{MEN\_1}]\end{aligned} \tag{42}$$

7 Derived Rate Equations

When interpreted as an ordinary differential equation framework, this model implies the following set of equations for the rates of change of each species.

7.1 Species Clb2T_1

Name Clb2T

SBO:0000252 polypeptide chain

Initial concentration 0.999107 $\mathrm{mol} \cdot \mathrm{l}^{-1}$

Involved in rule Clb2T_1

One rule which determines this species' quantity.

7.2 Species Clb5T_1

Name Clb5T

SBO:0000252 polypeptide chain

Initial concentration 0.201977 $\mathrm{mol} \cdot \mathrm{l}^{-1}$

Involved in rule Clb5T_1

One rule which determines this species' quantity.

7.3 Species Cln_1

Name Cln

SBO:0000252 polypeptide chain

Initial concentration 0.04079 $\mathrm{mol} \cdot \mathrm{l}^{-1}$

Involved in rule Cln_1

One rule which determines this species' quantity.

7.4 Species Cdc20_1

Name Cdc20

SBO:0000252 polypeptide chain

Initial concentration 0 $\mathrm{mol} \cdot \mathrm{l}^{-1}$

Involved in rule Cdc20_1

One rule which determines this species' quantity.

7.5 Species Cdh1_1

Name Cdh1

SBO:0000252 polypeptide chain

Initial concentration $0\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

Involved in rule Cdh1_1

One rule which determines this species' quantity.

7.6 Species Sic1T_1

Name Sic1T

SBO:0000252 polypeptide chain

Initial concentration $0.001683\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

Involved in rule Sic1T_1

One rule which determines this species' quantity.

7.7 Species Trim2_1

Name Trim2

SBO:0000297 protein complex

Initial concentration $0.00145\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

Involved in rule Trim2_1

One rule which determines this species' quantity.

7.8 Species Trim5_1

Name Trim5

SBO:0000297 protein complex

Initial concentration $0\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

Involved in rule Trim5_1

One rule which determines this species' quantity.

7.9 Species Swi5_1

Name Swi5

SBO:0000252 polypeptide chain

Initial concentration $0\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

Involved in rule Swi5_1

One rule which determines this species' quantity.

7.10 Species Mcm_1

Name Mcm

SBO:0000297 protein complex

Initial concentration $0.996743\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

Involved in rule Mcm_1

One rule which determines this species' quantity.

7.11 Species MBF_1

Name MBF

SBO:0000252 polypeptide chain

Initial concentration $0.001977\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

Involved in rule MBF_1

One rule which determines this species' quantity.

7.12 Species Pds1T_1

Name Pds1T

SBO:0000252 polypeptide chain

Initial concentration $0.601977\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

Involved in rule Pds1T_1

One rule which determines this species' quantity.

7.13 Species Esp1T_1

Name Esp1T

SBO:0000252 polypeptide chain

Initial concentration $0.25\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

Involved in rule Esp1T_1

One rule which determines this species' quantity.

7.14 Species PoloT_1

Name PoloT

SBO:0000252 polypeptide chain

Initial concentration $1\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

Involved in rule PoloT_1

One rule which determines this species' quantity.

7.15 Species Polo_1

Name Polo

SBO:0000252 polypeptide chain

Initial concentration $1\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

Involved in rule Polo_1

One rule which determines this species' quantity.

7.16 Species Net1dep_1

Name Net1dep

SBO:0000252 polypeptide chain

Initial concentration $0.0119\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

Involved in rule Net1dep_1

One rule which determines this species' quantity.

7.17 Species Net1pp_1

Name Net1pp

SBO:0000252 polypeptide chain

Initial concentration 0.0119 $\mathrm{mol} \cdot \mathrm{l}^{-1}$

Involved in rule Net1pp_1

One rule which determines this species' quantity.

7.18 Species RENT_1

Name RENT

SBO:0000297 protein complex

Initial concentration 0.483 $\mathrm{mol} \cdot \mathrm{l}^{-1}$

Involved in rule RENT_1

One rule which determines this species' quantity.

7.19 Species RENTp_1

Name RENTp

SBO:0000297 protein complex

Initial concentration 0.014 $\mathrm{mol} \cdot \mathrm{l}^{-1}$

Involved in rule RENTp_1

One rule which determines this species' quantity.

7.20 Species Cdc14n_1

Name Cdc14n

SBO:0000252 polypeptide chain

Initial concentration 0.00214 $\mathrm{mol} \cdot \mathrm{l}^{-1}$

Involved in rule Cdc14n_1

One rule which determines this species' quantity.

7.21 Species Tem1_1

Name Tem1

SBO:0000252 polypeptide chain

Initial concentration $1\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

Involved in rule Tem1_1

One rule which determines this species' quantity.

7.22 Species Cdc15_1

Name Cdc15

SBO:0000252 polypeptide chain

Initial concentration $0.933\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

Involved in rule Cdc15_1

One rule which determines this species' quantity.

7.23 Species MEN_1

Name MEN

SBO:0000297 protein complex

Initial concentration $0\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

Involved in rule MEN_1

One rule which determines this species' quantity.

7.24 Species Clb2_2

Name Clb2

SBO:0000252 polypeptide chain

Involved in rule Clb2_2

One rule which determines this species' quantity.

7.25 Species Clb5_1

Name Clb5

SBO:0000252 polypeptide chain

Involved in rule Clb5_1

One rule which determines this species' quantity.

7.26 Species Sic1_1

Name Sic1

SBO:0000252 polypeptide chain

Involved in rule Sic1_1

One rule which determines this species' quantity.

7.27 Species Pds1_1

Name Pds1

SBO:0000252 polypeptide chain

Involved in rule Pds1_1

One rule which determines this species' quantity.

7.28 Species Esp1b_1

Name Esp1b

SBO:0000252 polypeptide chain

Initial concentration $0.24857\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

Involved in rule Esp1b_1

One rule which determines this species' quantity.

7.29 Species Esp1_1

Name Esp1

SBO:0000252 polypeptide chain

Involved in rule Esp1_1

One rule which determines this species' quantity.

7.30 Species Net1p_1

Name Net1p

SBO:0000252 polypeptide chain

Initial concentration $0.013\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species does not take part in any reactions. Its quantity does hence not change over time:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Net1p\_1} = 0 \tag{43}$$

7.31 Species Net1_2

Name Net1

SBO:0000252 polypeptide chain

Involved in rule Net1_2

One rule which determines this species' quantity.

7.32 Species Cdc14c_1

Name Cdc14c

SBO:0000252 polypeptide chain

Involved in rule Cdc14c_1

One rule which determines this species' quantity.

A Glossary of Systems Biology Ontology Terms

SBO:0000252 polypeptide chain: Naturally occurring macromolecule formed by the repetition of amino-acid residues linked by peptidic bonds. A polypeptide chain is synthesized by the ribosome. CHEBI:1654

SBO:0000290 physical compartment: Specific location of space, that can be bounded or not. A physical compartment can have 1, 2 or 3 dimensions

SBO:0000297 protein complex: Macromolecular complex containing one or more polypeptide chains possibly associated with simple chemicals. CHEBI:3608

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