SBML Model Report

Model name: “Fribourg2014 - Dynamics of viral antagonism and innate immune response (H1N1 influenza A virus - Cal/09)”

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 Miguel Fribourg[2] at April third 2014 at 1:51 p. m. and last time modified at February 24th 2015 at 8:30 p. 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	3
species types	2	species	13
events	0	constraints	0
reactions	12	function definitions	0
global parameters	49	unit definitions	5
rules	5	initial assignments	0

Model Notes

Fribourg2014 - Dynamics of viral antagonism and innate immune response (H1N1 influenza A virus - Cal/09)

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The dynamics of the interplay between the viral antagonism and the innate immune response has been studied using modelling approaches. The responses of human monocyte-derived dendritic cells infected by two influenza A H1N1 strains (the pandemic swine-origin A/California/4/2009 (Cal/09) and the seasonal A/New Caledonia/20/1999 (NC/99)) that have different clinical outcomes have been modelled. From the time course gene expression measurements of a set of selected genes, the dynamic features of viral antagonism and innate immune response are extracted. It is found that the strength and the time scale of action of viral antagonism is significantly different between the two viruses. This model describes the viral infection by seasonal Cal/09.

This model is described in the article:Model of influenza A virus infection: Dynamics of viral antagonism and innate immune response.Fribourg M, Hartmann B, Schmolke M, Marjanovic N, Albrecht RA, Garca-Sastre A, Sealfon SC, Jayaprakash C, Hayot F.J Theor Biol. 2014 Mar 2;351C:47-57.

Abstract:

Viral antagonism of host responses is an essential component of virus pathogenicity. The study of the interplay between immune response and viral antagonism is challenging due to the involvement of many processes acting at multiple time scales. Here we develop an ordinary differential equation model to investigate the early, experimentally measured, responses of human monocyte-derived dendritic cells to infection by two H1N1 influenza A viruses of different clinical outcomes: pandemic A/California/4/2009 and seasonal A/New Caledonia/20/1999. Our results reveal how the strength of virus antagonism, and the time scale over which it acts to thwart the innate immune response, differs significantly between the two viruses, as is made clear by their impact on the temporal behavior of a number of measured genes. The model thus sheds light on the mechanisms that underlie the variability of innate immune responses to different H1N1 viruses.

This model is hosted on BioModels Database and identifiedby: MODEL1403310002.

To cite BioModels Database, please use: BioModels Database: An enhanced, curated and annotated resourcefor published quantitative kinetic models.

2 Unit Definitions

This is an overview of five unit definitions.

2.1 Unit substance

Name substance

Definition 10^{-6} mol

2.2 Unit `volume`

Name volume

Definition l

2.3 Unit `area`

Name area

Definition m^2

2.4 Unit `length`

Name length

Definition m

2.5 Unit `time`

Name time

Definition 3600 s

3 Compartments

This model contains three compartments.

Table 2: Properties of all compartments.

Id	Name	SBO	Spatial Dimensions	Size	Unit	Constant	Outside
`default`		0000290	3	1	litre	☑	
`c2`	Environment	0000290	3	1	litre	☑	`default`
`compartment`	Cell	0000290	3	1	litre	☑	`default`

3.1 Compartment `default`

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

SBO:0000290 physical compartment

3.2 Compartment `c2`

This is a three dimensional compartment with a constant size of one litre, which is surrounded by `default`.

Name Environment

SBO:0000290 physical compartment

3.3 Compartment `compartment`

This is a three dimensional compartment with a constant size of one litre, which is surrounded by `default`.

Name Cell

SBO:0000290 physical compartment

4 Species types

This is an overview of two species types.

4.1 Species type `mRNA`

Name mRNA

This model does not contain any species of this type.

4.2 Species type `Protein`

Name Protein

This model does not contain any species of this type.

5 Species

This model contains 13 species. The boundary condition of one of these species is set to `true` so that this species' amount cannot be changed by any reaction. Section 9 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
`w`	w	`compartment`	10^{-6} mol $\cdot$ l^{-1}	☐	☑
`IFNb_mRNA`	IFNb_mRNA	`compartment`	10^{-6} mol $\cdot$ l^{-1}	☐	☐
`IFNb_env`	IFNb_env	`c2`	10^{-6} mol $\cdot$ l^{-1}	☐	☐
`STATP2n`	STATP2n	`compartment`	10^{-6} mol $\cdot$ l^{-1}	☐	☐
`SOCS1m`	SOCS1m	`compartment`	10^{-6} mol $\cdot$ l^{-1}	☐	☐
`IRF7m`	IRF7m	`compartment`	10^{-6} mol $\cdot$ l^{-1}	☐	☐
`IRF7Pn`	IRF7Pn	`compartment`	10^{-6} mol $\cdot$ l^{-1}	☐	☐
`IFNa_mRNA`	IFNa_mRNA	`compartment`	10^{-6} mol $\cdot$ l^{-1}	☐	☐
`IFNa_env`	IFNa_env	`c2`	10^{-6} mol $\cdot$ l^{-1}	☐	☐
`TNFam`	TNFam	`compartment`	10^{-6} mol $\cdot$ l^{-1}	☐	☐
`TNFenv`	TNFenv	`c2`	10^{-6} mol $\cdot$ l^{-1}	☐	☐
`STATm`	STATm	`compartment`	10^{-6} mol $\cdot$ l^{-1}	☐	☐
`STAT`	STAT	`compartment`	10^{-6} mol $\cdot$ l^{-1}	☐	☐

6 Parameters

This model contains 49 global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
NS			0.000		☐
r5			1.000	dimensionless	☑
n3			5.000	10^{-6} mol	☑
bm			6.000	10^{-6} mol	☑
IC1			0.000		☐
sp			0.300	10^{-6} mol	☑
delta1			0.100	10^{-6} mol	☑
n1			1.000	10^{-6} mol	☑
IC2			0.000		☐
sv			0.100	10^{-6} mol	☑
delta2			0.400	10^{-6} mol	☑
n2			5.000	10^{-6} mol	☑
IC2ifa			0.000		☐
TJ			0.000		☐
TJtot			10^{-4}	10^{-6} mol	☑
K3			0.004	10^{-6} mol	☑
K9			780.000	10^{-6} mol	☑
delta			$3 \cdot 10^{-4}$	10^{-6} mol	☑
r0			0.001	10^{-6} mol	☑
k15			$3.6 \cdot 10^{-8}$	10^{-6} mol	☑
tao1			2.500	10^{-6} mol	☑
C			500000.000	10^{-6} mol	☑
vmax2			72000.000	10^{-6} mol	☑
NA			$6.023 \cdot 10^{23}$	10^{-6} mol	☑
K2			0.002	10^{-6} mol	☑
K5			0.010	10^{-6} mol	☑
tao3			0.560	10^{-6} mol	☑
r3			10^{-7}	10^{-6} mol	☑
k8			0.004	10^{-6} mol	☑
tao4			0.460	10^{-6} mol	☑
k11			$3.6 \cdot 10^{-4}$	10^{-6} mol	☑
k14			$3.204 \cdot 10^{-7}$	10^{-6} mol	☑
tao6			1.000		☑
k12			360.000	10^{-6} mol	☑
k16			0.360	10^{-6} mol	☑
tao8			2.000	10^{-6} mol	☑
vmax17			72000.000	10^{-6} mol	☑

Id	Name	SBO	Value	Unit	Constant
K17			0.002	10^{-6} mol	☑
r1			10^{-4}	10^{-6} mol	☑
rmax20			0.001	10^{-6} mol	☑
K20			$6 \cdot 10^{-4}$	10^{-6} mol	☑
tao9			2.000	10^{-6} mol	☑
vmax19			154800.000	10^{-6} mol	☑
K19			0.004	10^{-6} mol	☑
r4			10^{-5}	10^{-6} mol	☑
k26			0.360	10^{-6} mol	☑
tao12			1.000	10^{-6} mol	☑
k28			360.000	10^{-6} mol	☑
tao13			15.000	10^{-6} mol	☑

7 Rules

This is an overview of five rules.

7.1 Rule NS

Rule NS is an assignment rule for parameter NS:

$$\mathrm{NS} = \frac{\mathrm{r5} \cdot \mathrm{time}^{\mathrm{n3}}}{\mathrm{bm}^{\mathrm{n3}} + \mathrm{time}^{\mathrm{n3}}} \tag{1}$$

Derived unit $(3600\ \mathrm{s})^{5} \cdot \left(10^{-6}\ \mathrm{mol}\right)^{-5}$

7.2 Rule IC1

Rule IC1 is an assignment rule for parameter IC1:

$$\mathrm{IC1} = \frac{1 + \mathrm{sp} \cdot \left(\frac{\mathrm{NS}}{\mathrm{delta1}}\right)^{\mathrm{n1}}}{1 + \left(\frac{\mathrm{NS}}{\mathrm{delta1}}\right)^{\mathrm{n1}}} \tag{2}$$

7.3 Rule IC2

Rule IC2 is an assignment rule for parameter IC2:

$$\mathrm{IC2} = 1 \tag{3}$$

7.4 Rule IC2ifa

Rule IC2ifa is an assignment rule for parameter IC2ifa:

$$\mathrm{IC2ifa} = 1 \tag{4}$$

7.5 Rule TJ

Rule TJ is an assignment rule for parameter TJ:

$$\mathrm{TJ} = \frac{\frac{\mathrm{TJtot}\cdot([\mathrm{IFNb\_env}]+[\mathrm{IFNa\_env}])}{\mathrm{K3}+[\mathrm{IFNb\_env}]+[\mathrm{IFNa\_env}]}\cdot 1}{1+\frac{\mathrm{K9}\cdot[\mathrm{SOCS1m}]}{\mathrm{delta}}} \tag{5}$$

8 Reactions

This model contains twelve reactions. All reactions are listed in the following table and are subsequently described in detail. If a reaction is affected by a modifier, the identifier of this species is written above the reaction arrow.

Table 5: Overview of all reactions

№	Id	Name	Reaction Equation	SBO
1	J1	J1	$w \xrightarrow{\text{IRF7Pn}} \text{IFNb\_mRNA}$	
2	J2	J2	$w \xrightarrow{\text{IFNb\_mRNA}} \text{IFNb\_env}$	
3	J3	J3	$w \xrightarrow{\text{STAT}} \text{STATP2n}$	
4	J4	J4	$w \xrightarrow{\text{STATP2n}} \text{SOCS1m}$	
5	J5	J5	$w \xrightarrow{\text{STATP2n, IRF7Pn}} \text{IRF7m}$	
6	J6	J6	$w \xrightarrow{\text{IRF7m}} \text{IRF7Pn}$	
7	J7	J7	$w \xrightarrow{\text{IRF7Pn}} \text{IFNa\_mRNA}$	
8	J8	J8	$w \xrightarrow{\text{IFNa\_mRNA}} \text{IFNa\_env}$	
9	J9	J9	$w \xrightarrow{\text{TNFenv}} \text{TNFam}$	
10	J10	J10	$w \xrightarrow{\text{TNFam}} \text{TNFenv}$	
11	J11	J11	$w \xrightarrow{\text{STATP2n}} \text{STATm}$	
12	J12	J12	$w \xrightarrow{\text{STATm}} \text{STAT}$	

8.1 Reaction J1

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

Name J1

Reaction equation

$$\mathrm{w} \xrightarrow{\mathrm{IRF7Pn}} \mathrm{IFNb\_mRNA} \tag{6}$$

Reactant

Table 6: Properties of each reactant.

Id	Name	SBO
w	w	

Modifier

Table 7: Properties of each modifier.

Id	Name	SBO
IRF7Pn	IRF7Pn	

Product

Table 8: Properties of each product.

Id	Name	SBO
IFNb_mRNA	IFNb_mRNA	

Kinetic Law

Derived unit contains undeclared units

$$v_1 = (\mathrm{r0} \cdot \mathrm{IC1} + \mathrm{k15} \cdot [\mathrm{IRF7Pn}]) \cdot \mathrm{IC2} - \frac{[\mathrm{IFNb\_mRNA}] \cdot \ln 2}{\mathrm{tao1}} \tag{7}$$

8.2 Reaction J2

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

Name J2

Reaction equation

$$\mathrm{w} \xrightarrow{\mathrm{IFNb\_mRNA}} \mathrm{IFNb\_env} \tag{8}$$

Reactant

Table 9: Properties of each reactant.

Id	Name	SBO
w	w	

Modifier

Table 10: Properties of each modifier.

Id	Name	SBO
IFNb_mRNA	IFNb_mRNA	

Product

Table 11: Properties of each product.

Id	Name	SBO
IFNb_env	IFNb_env	

Kinetic Law

Derived unit contains undeclared units

$$v_2 = \frac{\frac{1000000000 \cdot \mathrm{C} \cdot \mathrm{vmax2}}{\mathrm{NA}} \cdot [\mathrm{IFNb\_mRNA}]}{\mathrm{K2} + [\mathrm{IFNb\_mRNA}]} \tag{9}$$

8.3 Reaction J3

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

Name J3

Reaction equation

$$\mathrm{w} \xrightarrow{\mathrm{STAT}} \mathrm{STATP2n} \tag{10}$$

Reactant

Table 12: Properties of each reactant.

Id	Name	SBO
w	w	

Modifier

Table 13: Properties of each modifier.

Id	Name	SBO
STAT	STAT	

Product

Table 14: Properties of each product.

Id	Name	SBO
STATP2n	STATP2n	

Kinetic Law

Derived unit contains undeclared units

$$v_3 = \frac{\frac{\mathrm{K5} \cdot \mathrm{TJ} \cdot [\mathrm{STAT}]}{2}}{\mathrm{K5} + [\mathrm{STAT}]} - \frac{[\mathrm{STATP2n}] \cdot \ln 2}{\mathrm{tao3}} \tag{11}$$

8.4 Reaction J4

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

Name J4

Reaction equation

$$\mathrm{w} \xrightarrow{\mathrm{STATP2n}} \mathrm{SOCS1m} \tag{12}$$

Reactant

Table 15: Properties of each reactant.

Id	Name	SBO
w	w	

Modifier

Table 16: Properties of each modifier.

Id	Name	SBO
STATP2n	STATP2n	

Product

Table 17: Properties of each product.

Id	Name	SBO
SOCS1m	SOCS1m	

Kinetic Law

Derived unit contains undeclared units

$$v_4 = (\mathrm{r3} \cdot \mathrm{IC1} + \mathrm{k8} \cdot [\mathrm{STATP2n}]) \cdot \mathrm{IC2} - \frac{[\mathrm{SOCS1m}] \cdot \ln 2}{\mathrm{tao4}} \tag{13}$$

8.5 Reaction J5

This is an irreversible reaction of one reactant forming one product influenced by two modifiers.

Name J5

Reaction equation

$$\mathrm{w} \xrightarrow{\mathrm{STATP2n},\ \mathrm{IRF7Pn}} \mathrm{IRF7m} \tag{14}$$

Reactant

Table 18: Properties of each reactant.

Id	Name	SBO
w	w	

Modifiers

Table 19: Properties of each modifier.

Id	Name	SBO
STATP2n	STATP2n	
IRF7Pn	IRF7Pn	

Product

Table 20: Properties of each product.

Id	Name	SBO
IRF7m	IRF7m	

Kinetic Law

Derived unit contains undeclared units

$$v_5 = (\mathrm{k11} \cdot [\mathrm{STATP2n}] + \mathrm{k14} \cdot [\mathrm{IRF7Pn}]) \cdot \mathrm{IC2} - \frac{[\mathrm{IRF7m}] \cdot \ln 2}{\mathrm{tao6}} \tag{15}$$

8.6 Reaction J6

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

Name J6

Reaction equation

$$\mathrm{w} \xrightarrow{\mathrm{IRF7m}} \mathrm{IRF7Pn} \tag{16}$$

Reactant

Table 21: Properties of each reactant.

Id	Name	SBO
w	w	

Modifier

Table 22: Properties of each modifier.

Id	Name	SBO
IRF7m	IRF7m	

Product

Table 23: Properties of each product.

Id	Name	SBO
IRF7Pn	IRF7Pn	

Kinetic Law

Derived unit contains undeclared units

$$v_6 = \mathrm{k12} \cdot \mathrm{IC1} \cdot [\mathrm{IRF7m}] \tag{17}$$

8.7 Reaction J7

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

Name J7

Reaction equation

$$\mathrm{w} \xrightarrow{\mathrm{IRF7Pn}} \mathrm{IFNa\_mRNA} \tag{18}$$

Reactant

Table 24: Properties of each reactant.

Id	Name	SBO
w	w	

Modifier

Table 25: Properties of each modifier.

Id	Name	SBO
IRF7Pn	IRF7Pn	

Product

Table 26: Properties of each product.

Id	Name	SBO
IFNa_mRNA	IFNa_mRNA	

Kinetic Law

Derived unit contains undeclared units

$$v_7 = \mathrm{k16} \cdot [\mathrm{IRF7Pn}] \cdot \mathrm{IC2ifa} - \frac{[\mathrm{IFNa\_mRNA}] \cdot \ln 2}{\mathrm{tao8}} \tag{19}$$

8.8 Reaction J8

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

Name J8

Reaction equation

$$\mathrm{w} \xrightarrow{\mathrm{IFNa\_mRNA}} \mathrm{IFNa\_env} \tag{20}$$

Reactant

Table 27: Properties of each reactant.

Id	Name	SBO
w	w	

Modifier

Table 28: Properties of each modifier.

Id	Name	SBO
IFNa_mRNA	IFNa_mRNA	

Product

Table 29: Properties of each product.

Id	Name	SBO
IFNa_env	IFNa_env	

Kinetic Law

Derived unit contains undeclared units

$$v_8 = \frac{\frac{1000000000 \cdot \mathrm{C} \cdot \mathrm{vmax17}}{\mathrm{NA}} \cdot [\mathrm{IFNa\_mRNA}]}{\mathrm{K17} + [\mathrm{IFNa\_mRNA}]} \tag{21}$$

8.9 Reaction J9

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

Name J9

Reaction equation

$$\mathrm{w} \xrightarrow{\mathrm{TNFenv}} \mathrm{TNFam} \tag{22}$$

Reactant

Table 30: Properties of each reactant.

Id	Name	SBO
w	w	

Modifier

Table 31: Properties of each modifier.

Id	Name	SBO
TNFenv	TNFenv	

Product

Table 32: Properties of each product.

Id	Name	SBO
TNFam	TNFam	

Kinetic Law

Derived unit contains undeclared units

$$v_9 = \left(\mathrm{r1} \cdot \mathrm{IC1} + \frac{\mathrm{rmax20} \cdot [\mathrm{TNFenv}]}{\mathrm{K20} + [\mathrm{TNFenv}]}\right) \cdot \mathrm{IC2} - \frac{[\mathrm{TNFam}] \cdot \ln 2}{\mathrm{tao9}} \tag{23}$$

8.10 Reaction J10

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

Name J10

Reaction equation

$$\mathrm{w} \xrightarrow{\mathrm{TNFam}} \mathrm{TNFenv} \tag{24}$$

Reactant

Table 33: Properties of each reactant.

Id	Name	SBO
w	w	

Modifier

Table 34: Properties of each modifier.

Id	Name	SBO
TNFam	TNFam	

Product

Table 35: Properties of each product.

Id	Name	SBO
TNFenv	TNFenv	

Kinetic Law

Derived unit contains undeclared units

$$v_{10} = \frac{\frac{1000000000 \cdot \mathrm{C} \cdot \mathrm{vmax19}}{\mathrm{NA}} \cdot [\mathrm{TNFam}]}{\mathrm{K19} + [\mathrm{TNFam}]} \tag{25}$$

8.11 Reaction J11

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

Name J11

Reaction equation

$$\mathrm{w} \xrightarrow{\mathrm{STATP2n}} \mathrm{STATm} \tag{26}$$

Reactant

Table 36: Properties of each reactant.

Id	Name	SBO
w	w	

Modifier

Table 37: Properties of each modifier.

Id	Name	SBO
STATP2n	STATP2n	

Product

Table 38: Properties of each product.

Id	Name	SBO
STATm	STATm	

Kinetic Law

Derived unit contains undeclared units

$$v_{11} = (\mathrm{r4} \cdot \mathrm{IC1} + \mathrm{k26} \cdot [\mathrm{STATP2n}]) \cdot \mathrm{IC2} - \frac{[\mathrm{STATm}] \cdot \ln 2}{\mathrm{tao12}} \tag{27}$$

8.12 Reaction J12

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

Name J12

Reaction equation

$$\mathrm{w} \xrightarrow{\mathrm{STATm}} \mathrm{STAT} \tag{28}$$

Reactant

Table 39: Properties of each reactant.

Id	Name	SBO
w	w	

Modifier

Table 40: Properties of each modifier.

Id	Name	SBO
STATm	STATm	

Product

Table 41: Properties of each product.

Id	Name	SBO
STAT	STAT	

Id	Name	SBO

Kinetic Law

Derived unit $\left(10^{-6}\ \mathrm{mol}\right)^{2} \cdot \mathrm{l}^{-1}$

$$v_{12} = \mathrm{k28} \cdot [\mathrm{STATm}] - \frac{[\mathrm{STAT}] \cdot \ln 2}{\mathrm{tao13}} \tag{29}$$

9 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.

Identifiers for kinetic laws highlighted in gray cannot be verified to evaluate to units of SBML `substance` per `time`. As a result, some SBML interpreters may not be able to verify the consistency of the units on quantities in the model. Please check if

- parameters without an unit definition are involved or
- volume correction is necessary because the `hasOnlySubstanceUnits` flag may be set to `false` and `spacialDimensions`> 0 for certain species.

9.1 Species `w`

Name w

SBO:0000291 empty set

Initial concentration $0\ 10^{-6}\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

This species takes part in twelve reactions (as a reactant in `J1`, `J2`, `J3`, `J4`, `J5`, `J6`, `J7`, `J8`, `J9`, `J10`, `J11`, `J12`), which do not influence its rate of change because this species is on the boundary of the reaction system:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{w} = 0 \tag{30}$$

9.2 Species `IFNb_mRNA`

Name IFNb_mRNA

Initial concentration $0\ 10^{-6}\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

This species takes part in two reactions (as a product in `J1` and as a modifier in `J2`).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{IFNb\_mRNA} = v_{1} \tag{31}$$

9.3 Species IFNb_env

Name IFNb_env

Initial concentration $0\ 10^{-6}\ \text{mol} \cdot \text{l}^{-1}$

This species takes part in one reaction (as a product in J2).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{IFNb\_env} = v_2 \tag{32}$$

9.4 Species STATP2n

Name STATP2n

Initial concentration $0\ 10^{-6}\ \text{mol} \cdot \text{l}^{-1}$

This species takes part in four reactions (as a product in J3 and as a modifier in J4, J5, J11).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{STATP2n} = v_3 \tag{33}$$

9.5 Species SOCS1m

Name SOCS1m

Initial concentration $0\ 10^{-6}\ \text{mol} \cdot \text{l}^{-1}$

This species takes part in one reaction (as a product in J4).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{SOCS1m} = v_4 \tag{34}$$

9.6 Species IRF7m

Name IRF7m

Initial concentration $0\ 10^{-6}\ \text{mol} \cdot \text{l}^{-1}$

This species takes part in two reactions (as a product in J5 and as a modifier in J6).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{IRF7m} = v_5 \tag{35}$$

9.7 Species IRF7Pn

Name IRF7Pn

Initial concentration $0\ 10^{-6}\ \text{mol} \cdot \text{l}^{-1}$

This species takes part in four reactions (as a product in J6 and as a modifier in J1, J5, J7).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{IRF7Pn} = v_6 \tag{36}$$

9.8 Species IFNa_mRNA

Name IFNa_mRNA

Initial concentration $0 \ 10^{-6} \ \text{mol} \cdot \text{l}^{-1}$

This species takes part in two reactions (as a product in J7 and as a modifier in J8).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{IFNa\_mRNA} = v_7 \tag{37}$$

9.9 Species IFNa_env

Name IFNa_env

Initial concentration $0 \ 10^{-6} \ \text{mol} \cdot \text{l}^{-1}$

This species takes part in one reaction (as a product in J8).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{IFNa\_env} = v_8 \tag{38}$$

9.10 Species TNFam

Name TNFam

Initial concentration $0 \ 10^{-6} \ \text{mol} \cdot \text{l}^{-1}$

This species takes part in two reactions (as a product in J9 and as a modifier in J10).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{TNFam} = v_9 \tag{39}$$

9.11 Species TNFenv

Name TNFenv

Initial concentration $0 \ 10^{-6} \ \text{mol} \cdot \text{l}^{-1}$

This species takes part in two reactions (as a product in J10 and as a modifier in J9).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{TNFenv} = v_{10} \tag{40}$$

9.12 Species STATm

Name STATm

Initial concentration $0 \ 10^{-6} \ \text{mol} \cdot \text{l}^{-1}$

This species takes part in two reactions (as a product in J11 and as a modifier in J12).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{STATm} = v_{11} \tag{41}$$

9.13 Species STAT

Name STAT

Initial concentration $0.1\ 10^{-6}\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

This species takes part in two reactions (as a product in J12 and as a modifier in J3).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{STAT} = v_{12} \tag{42}$$

A Glossary of Systems Biology Ontology Terms

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:0000291 empty set: Entity defined by the absence of any actual object. An empty set is often used to represent the source of a creation process or the result of a degradation process.

SBML2LaTeX was developed by Andreas Dräger[a], Hannes Planatscher[a], Dieudonné M Wouamba[a], Adrian Schröder[a], Michael Hucka[b], Lukas Endler[c], Martin Golebiewski[d] and Andreas Zell[a]. Please see http://www.ra.cs.uni-tuebingen.de/software/SBML2LaTeX for more information.

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