

## SBML Model Report

**Model name:**  
**“Maurya2005\_GTPaseCycle\_reducedOrder”**



May 6, 2016

### 1 General Overview

This is a document in SBML Level 2 Version 1 format. This model was created by Enuo He<sup>1</sup> at November 29<sup>th</sup> 2006 at 5:40 p. m. and last time modified at February thirteenth 2014 at 3:47 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	1
species types	0	species	17
events	0	constraints	0
reactions	17	function definitions	0
global parameters	2	unit definitions	0
rules	2	initial assignments	0

### Model Notes

This model is according to the paper Reduced-order modeling of biochemical networks: application to the GTPase-cycle signalling module by Maurya et al 2006. The figure 4c is reproduced by Copasi 4.0.19 (development). It is three-dimensional logarithmic plots show the output of simulations of Z at various concentrations of R and GAP.

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<sup>1</sup>University of Oxford, [enuo.he@wolfson.ox.ac.uk](mailto:enuo.he@wolfson.ox.ac.uk)

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## 2 Unit Definitions

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

### 2.1 Unit substance

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

**Definition** mol

### 2.2 Unit volume

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

**Definition** l

### 2.3 Unit area

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

**Definition** m<sup>2</sup>

### 2.4 Unit length

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

**Definition** m

### 2.5 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
compartment_0	cell		3	1	litre	<input checked="" type="checkbox"/>	

#### 3.1 Compartment `compartment_0`

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

**Name** cell

## 4 Species

This model contains 17 species. Section 8 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
species_0	A	compartment_0	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_1	G	compartment_0	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_2	GA	compartment_0	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_3	T	compartment_0	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_4	R	compartment_0	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_5	G*T	compartment_0	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_6	GD	compartment_0	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_7	Pi	compartment_0	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_8	D	compartment_0	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_9	RG	compartment_0	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_10	RG*T	compartment_0	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_11	G*AT	compartment_0	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_12	GAD	compartment_0	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_13	RGD	compartment_0	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_14	RGA	compartment_0	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_15	RG*AT	compartment_0	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$
species_16	RGAD	compartment_0	$\text{mol} \cdot \text{l}^{-1}$	$\square$	$\square$

## 5 Parameters

This model contains two global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
parameter_0	Z		0.0		<input type="checkbox"/>
parameter_1	v		0.0		<input type="checkbox"/>

## 6 Rules

This is an overview of two rules.

### 6.1 Rule parameter\_0

Rule parameter\_0 is an assignment rule for parameter parameter\_0:

$$\text{parameter\_0} = \frac{[\text{species\_5}] + [\text{species\_10}] + [\text{species\_15}] + [\text{species\_11}]}{1.0E - 8} \quad (1)$$

### 6.2 Rule parameter\_1

Rule parameter\_1 is an assignment rule for parameter parameter\_1:

$$\text{parameter\_1} = \frac{25 \cdot [\text{species\_15}] + 25 \cdot [\text{species\_11}] + 0.013 \cdot [\text{species\_10}] + 0.013 \cdot [\text{species\_5}]}{1.0E - 8} \quad (2)$$

## 7 Reactions

This model contains 17 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

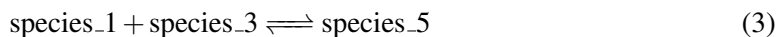
Nº	Id	Name	Reaction Equation	SBO
1	reaction_1	G protein binding GTP	$\text{species\_1} + \text{species\_3} \rightleftharpoons \text{species\_5}$	
2	reaction_3	G*T hydrolysis	$\text{species\_5} \rightleftharpoons \text{species\_6} + \text{species\_7}$	
3	reaction_4	GD dissociation	$\text{species\_6} \rightleftharpoons \text{species\_1} + \text{species\_8}$	
4	reaction_5	RG binding GTP	$\text{species\_9} + \text{species\_3} \rightleftharpoons \text{species\_10}$	
5	reaction_6	G*T binding Receptor	$\text{species\_5} + \text{species\_4} \rightleftharpoons \text{species\_10}$	
6	reaction_7	G*T binding GAP	$\text{species\_5} + \text{species\_0} \rightleftharpoons \text{species\_11}$	
7	reaction_8	GD binding GAP	$\text{species\_6} + \text{species\_0} \rightleftharpoons \text{species\_12}$	
8	reaction_9	GD binding Receptor	$\text{species\_6} + \text{species\_4} \rightleftharpoons \text{species\_13}$	
9	reaction_10	RG*T hydrolysis	$\text{species\_10} \rightleftharpoons \text{species\_13} + \text{species\_7}$	
10	reaction_11	RGD dissociation	$\text{species\_13} \rightleftharpoons \text{species\_9} + \text{species\_8}$	
11	reaction_13	G*AT hydrolysis	$\text{species\_11} \rightleftharpoons \text{species\_12} + \text{species\_7}$	
12	reaction_14	GAD dissociation	$\text{species\_12} \rightleftharpoons \text{species\_2} + \text{species\_8}$	
13	reaction_16	GA binding Receptor	$\text{species\_2} + \text{species\_4} \rightleftharpoons \text{species\_14}$	
14	reaction_17	RGA binding GTP	$\text{species\_14} + \text{species\_3} \rightleftharpoons \text{species\_15}$	
15	reaction_19	RG*T binding GAP	$\text{species\_10} + \text{species\_0} \rightleftharpoons \text{species\_15}$	
16	reaction_20	RG*AT hydrolysis	$\text{species\_15} \rightleftharpoons \text{species\_16} + \text{species\_7}$	
17	reaction_23	RGAD dissociation	$\text{species\_16} \rightleftharpoons \text{species\_14} + \text{species\_8}$	

## 7.1 Reaction `reaction_1`

This is a reversible reaction of two reactants forming one product.

**Name** G protein binding GTP

### Reaction equation



### Reactants

Table 6: Properties of each reactant.

Id	Name	SBO
species_1	G	
species_3	T	

### Product

Table 7: Properties of each product.

Id	Name	SBO
species_5	G*T	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_1 = \text{vol}(\text{compartment\_0}) \cdot (k_1 \cdot [\text{species\_1}] \cdot [\text{species\_3}] - k_2 \cdot [\text{species\_5}]) \quad (4)$$

Table 8: Properties of each parameter.

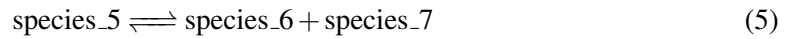
Id	Name	SBO	Value	Unit	Constant
k1			529000.000		✓
k2			$8.38 \cdot 10^{-6}$		✓

## 7.2 Reaction `reaction_3`

This is a reversible reaction of one reactant forming two products.

**Name** G\*T hydrolysis

### Reaction equation



### Reactant

Table 9: Properties of each reactant.

Id	Name	SBO
species_5	G*T	

### Products

Table 10: Properties of each product.

Id	Name	SBO
species_6	GD	
species_7	Pi	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_2 = \text{vol}(\text{compartment\_0}) \cdot (k_1 \cdot [\text{species\_5}] - k_2 \cdot [\text{species\_6}] \cdot [\text{species\_7}]) \quad (6)$$

Table 11: Properties of each parameter.

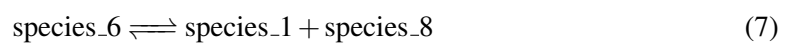
Id	Name	SBO	Value	Unit	Constant
k1			0.013		<input checked="" type="checkbox"/>
k2			$9.03 \cdot 10^{-7}$		<input checked="" type="checkbox"/>

## 7.3 Reaction [reaction\\_4](#)

This is a reversible reaction of one reactant forming two products.

**Name** GD dissociation

### Reaction equation





## Reactant

Table 12: Properties of each reactant.

Id	Name	SBO
species_6	GD	

## Products

Table 13: Properties of each product.

Id	Name	SBO
species_1	G	
species_8	D	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_3 = \text{vol}(\text{compartment}_0) \cdot (k_1 \cdot [\text{species}_6] - k_2 \cdot [\text{species}_1] \cdot [\text{species}_8]) \quad (8)$$

Table 14: Properties of each parameter.

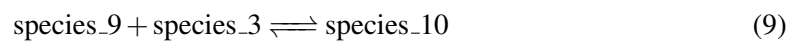
Id	Name	SBO	Value	Unit	Constant
k1			$10^{-4}$		<input checked="" type="checkbox"/>
k2			62.300		<input checked="" type="checkbox"/>

## 7.4 Reaction `reaction_5`

This is a reversible reaction of two reactants forming one product.

**Name** RG binding GTP

### Reaction equation



## Reactants

Table 15: Properties of each reactant.

Id	Name	SBO
species_9	RG	
species_3	T	

## Product

Table 16: Properties of each product.

Id	Name	SBO
species_10	RG*T	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_4 = \text{vol}(\text{compartment}_0) \cdot (k_1 \cdot [\text{species}_9] \cdot [\text{species}_3] - k_2 \cdot [\text{species}_{10}]) \quad (10)$$

Table 17: Properties of each parameter.

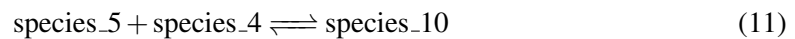
Id	Name	SBO	Value	Unit	Constant
k1			853000.000		<input checked="" type="checkbox"/>
k2			0.005		<input checked="" type="checkbox"/>

## 7.5 Reaction `reaction_6`

This is a reversible reaction of two reactants forming one product.

**Name** G\*T binding Receptor

### Reaction equation



## Reactants

Table 18: Properties of each reactant.

Id	Name	SBO
species_5	G*T	

Id	Name	SBO
species_4	R	

## Product

Table 19: Properties of each product.

Id	Name	SBO
species_10	RG*T	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_5 = \text{vol}(\text{compartment}_0) \cdot (k_1 \cdot [\text{species}_5] \cdot [\text{species}_4] - k_2 \cdot [\text{species}_{10}]) \quad (12)$$

Table 20: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1			$1.32 \cdot 10^8$		<input checked="" type="checkbox"/>
k2			1.280		<input checked="" type="checkbox"/>

## 7.6 Reaction `reaction_7`

This is a reversible reaction of two reactants forming one product.

**Name** G\*T binding GAP

## Reaction equation



## Reactants

Table 21: Properties of each reactant.

Id	Name	SBO
species_5	G*T	
species_0	A	

## Product

Table 22: Properties of each product.

Id	Name	SBO
species_11	G*AT	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_6 = \text{vol}(\text{compartment}_0) \cdot (k1 \cdot [\text{species}_5] \cdot [\text{species}_0] - k2 \cdot [\text{species}_{11}]) \quad (14)$$

Table 23: Properties of each parameter.

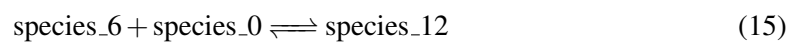
Id	Name	SBO	Value	Unit	Constant
k1			386000.000		✓
k2			0.041		✓

## 7.7 Reaction `reaction_8`

This is a reversible reaction of two reactants forming one product.

**Name** GD binding GAP

### Reaction equation



## Reactants

Table 24: Properties of each reactant.

Id	Name	SBO
species_6	GD	
species_0	A	

## Product

Table 25: Properties of each product.

Id	Name	SBO
species_12	GAD	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_7 = \text{vol}(\text{compartment}_0) \cdot (k_1 \cdot [\text{species}_6] \cdot [\text{species}_0] - k_2 \cdot [\text{species}_{12}]) \quad (16)$$

Table 26: Properties of each parameter.

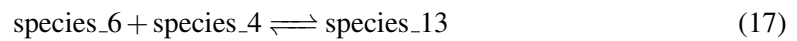
Id	Name	SBO	Value	Unit	Constant
k1			64100.00		<input checked="" type="checkbox"/>
k2			0.95		<input checked="" type="checkbox"/>

### 7.8 Reaction `reaction_9`

This is a reversible reaction of two reactants forming one product.

**Name** GD binding Receptor

### Reaction equation



### Reactants

Table 27: Properties of each reactant.

Id	Name	SBO
species_6	GD	
species_4	R	

### Product

Table 28: Properties of each product.

Id	Name	SBO
species_13	RGD	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_8 = \text{vol}(\text{compartment}_0) \cdot (k_1 \cdot [\text{species}_6] \cdot [\text{species}_4] - k_2 \cdot [\text{species}_{13}]) \quad (18)$$

Table 29: Properties of each parameter.

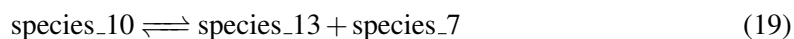
Id	Name	SBO	Value	Unit	Constant
k1			$9.47 \cdot 10^7$		<input checked="" type="checkbox"/>
k2			0.002		<input checked="" type="checkbox"/>

## 7.9 Reaction `reaction_10`

This is a reversible reaction of one reactant forming two products.

**Name** RG\*T hydrolysis

### Reaction equation



### Reactant

Table 30: Properties of each reactant.

Id	Name	SBO
species_10	RG*T	

### Products

Table 31: Properties of each product.

Id	Name	SBO
species_13	RGD	
species_7	Pi	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_9 = \text{vol}(\text{compartment}_0) \cdot (k_1 \cdot [\text{species}_{10}] - k_2 \cdot [\text{species}_{13}] \cdot [\text{species}_7]) \quad (20)$$

Table 32: Properties of each parameter.

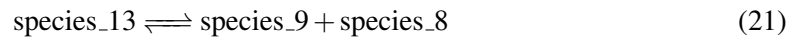
Id	Name	SBO	Value	Unit	Constant
k1			0.013		<input checked="" type="checkbox"/>
k2			$2.22 \cdot 10^{-9}$		<input checked="" type="checkbox"/>

## 7.10 Reaction `reaction_11`

This is a reversible reaction of one reactant forming two products.

**Name** RGD dissociation

### Reaction equation



### Reactant

Table 33: Properties of each reactant.

Id	Name	SBO
species_13	RGD	

### Products

Table 34: Properties of each product.

Id	Name	SBO
species_9	RG	
species_8	D	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{10} = \text{vol}(\text{compartment\_0}) \cdot (k1 \cdot [\text{species\_13}] - k2 \cdot [\text{species\_9}] \cdot [\text{species\_8}]) \quad (22)$$

Table 35: Properties of each parameter.

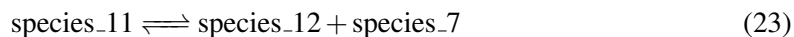
Id	Name	SBO	Value	Unit	Constant
k1			2.0		<input checked="" type="checkbox"/>
k2			1470000.0		<input checked="" type="checkbox"/>

### 7.11 Reaction `reaction_13`

This is a reversible reaction of one reactant forming two products.

**Name** G\*AT hydrolysis

#### Reaction equation



#### Reactant

Table 36: Properties of each reactant.

Id	Name	SBO
species_11	G*AT	

#### Products

Table 37: Properties of each product.

Id	Name	SBO
species_12	GAD	
species_7	Pi	

#### Kinetic Law

**Derived unit** contains undeclared units

$$v_{11} = \text{vol}(\text{compartment}_0) \cdot (k_1 \cdot [\text{species\_11}] - k_2 \cdot [\text{species\_12}] \cdot [\text{species\_7}]) \quad (24)$$

Table 38: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1			25.000		<input checked="" type="checkbox"/>
k2			0.244		<input checked="" type="checkbox"/>

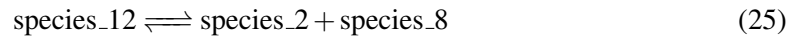
### 7.12 Reaction `reaction_14`

This is a reversible reaction of one reactant forming two products.

**Name** GAD dissociation



### Reaction equation



### Reactant

Table 39: Properties of each reactant.

Id	Name	SBO
species_12	GAD	

### Products

Table 40: Properties of each product.

Id	Name	SBO
species_2	GA	
species_8	D	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{12} = \text{vol}(\text{compartment\_0}) \cdot (k1 \cdot [\text{species\_12}] - k2 \cdot [\text{species\_2}] \cdot [\text{species\_8}]) \quad (26)$$

Table 41: Properties of each parameter.

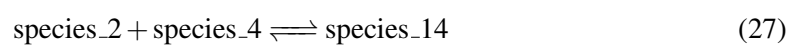
Id	Name	SBO	Value	Unit	Constant
k1			10 <sup>-4</sup>		<input checked="" type="checkbox"/>
k2			3.830		<input checked="" type="checkbox"/>

### 7.13 Reaction [reaction\\_16](#)

This is a reversible reaction of two reactants forming one product.

**Name** GA binding Receptor

### Reaction equation



## Reactants

Table 42: Properties of each reactant.

Id	Name	SBO
species_2	GA	
species_4	R	

## Product

Table 43: Properties of each product.

Id	Name	SBO
species_14	RGA	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{13} = \text{vol}(\text{compartment}_0) \cdot (k1 \cdot [\text{species}_2] \cdot [\text{species}_4] - k2 \cdot [\text{species}_{14}]) \quad (28)$$

Table 44: Properties of each parameter.

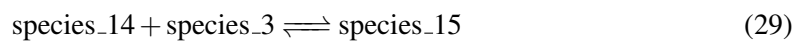
Id	Name	SBO	Value	Unit	Constant
k1			$3.96 \cdot 10^9$		<input checked="" type="checkbox"/>
k2			$5.43 \cdot 10^{-5}$		<input checked="" type="checkbox"/>

### 7.14 Reaction `reaction_17`

This is a reversible reaction of two reactants forming one product.

**Name** RGA binding GTP

#### Reaction equation



## Reactants

Table 45: Properties of each reactant.

Id	Name	SBO
species_14	RG	A
species_3	T	

## Product

Table 46: Properties of each product.

Id	Name	SBO
species_15	RG*T	A

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{14} = \text{vol}(\text{compartment}_0) \cdot (k_1 \cdot [\text{species}_14] \cdot [\text{species}_3] - k_2 \cdot [\text{species}_15]) \quad (30)$$

Table 47: Properties of each parameter.

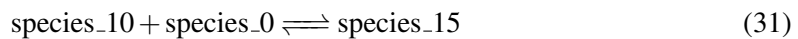
Id	Name	SBO	Value	Unit	Constant
k1			1620000.000		<input checked="" type="checkbox"/>
k2			0.009		<input checked="" type="checkbox"/>

## 7.15 Reaction `reaction_19`

This is a reversible reaction of two reactants forming one product.

**Name** RG\*T binding GAP

## Reaction equation



## Reactants

Table 48: Properties of each reactant.

Id	Name	SBO
species_10	RG	T

Id	Name	SBO
species_0	A	

## Product

Table 49: Properties of each product.

Id	Name	SBO
species_15	RG*AT	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{15} = \text{vol}(\text{compartment}_0) \cdot (k_1 \cdot [\text{species}_{10}] \cdot [\text{species}_0] - k_2 \cdot [\text{species}_{15}]) \quad (32)$$

Table 50: Properties of each parameter.

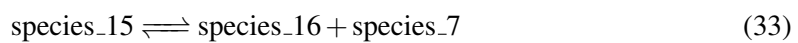
Id	Name	SBO	Value	Unit	Constant
k1			6300000.000		<input checked="" type="checkbox"/>
k2			0.478		<input checked="" type="checkbox"/>

## 7.16 Reaction [reaction\\_20](#)

This is a reversible reaction of one reactant forming two products.

**Name** RG\*AT hydrolysis

## Reaction equation



## Reactant

Table 51: Properties of each reactant.

Id	Name	SBO
species_15	RG*AT	

## Products

Table 52: Properties of each product.

Id	Name	SBO
species_16	RGAD	
species_7	Pi	

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{16} = \text{vol}(\text{compartment}_0) \cdot (k1 \cdot [\text{species}_{15}] - k2 \cdot [\text{species}_{16}] \cdot [\text{species}_7]) \quad (34)$$

Table 53: Properties of each parameter.

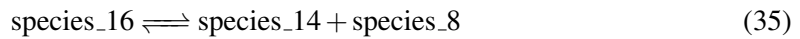
Id	Name	SBO	Value	Unit	Constant
k1			25.000		<input checked="" type="checkbox"/>
k2			0.003		<input checked="" type="checkbox"/>

### 7.17 Reaction [reaction\\_23](#)

This is a reversible reaction of one reactant forming two products.

**Name** RGAD dissociation

#### Reaction equation



#### Reactant

Table 54: Properties of each reactant.

Id	Name	SBO
species_16	RGAD	

#### Products

Table 55: Properties of each product.

Id	Name	SBO
species_14	RGA	

Id	Name	SBO
species_8	D	

## Kinetic Law

**Derived unit** contains undeclared units

$$v_{17} = \text{vol}(\text{compartment}_0) \cdot (k1 \cdot [\text{species}_{16}] - k2 \cdot [\text{species}_{14}] \cdot [\text{species}_8]) \quad (36)$$

Table 56: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1			2.75		✓
k2			2940.00		✓

## 8 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.

### 8.1 Species `species_0`

**Name** A

**Notes** GAP

**Initial concentration** 0 mol · l<sup>-1</sup>

This species takes part in three reactions (as a reactant in [reaction\\_7](#), [reaction\\_8](#), [reaction\\_19](#)).

$$\frac{d}{dt} \text{species}_0 = -v_6 - v_7 - v_{15} \quad (37)$$

## 8.2 Species `species_1`

**Name** G

**Notes** inactive G protein

**Initial concentration**  $10^{-8} \text{ mol} \cdot \text{l}^{-1}$

This species takes part in two reactions (as a reactant in [reaction\\_1](#) and as a product in [reaction\\_4](#)).

$$\frac{d}{dt}\text{species\_1} = v_3 - v_1 \quad (38)$$

## 8.3 Species `species_2`

**Name** GA

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

This species takes part in two reactions (as a reactant in [reaction\\_16](#) and as a product in [reaction\\_14](#)).

$$\frac{d}{dt}\text{species\_2} = v_{12} - v_{13} \quad (39)$$

## 8.4 Species `species_3`

**Name** T

**Notes** GTP

**Initial concentration**  $4.68 \cdot 10^{-4} \text{ mol} \cdot \text{l}^{-1}$

This species takes part in three reactions (as a reactant in [reaction\\_1](#), [reaction\\_5](#), [reaction\\_17](#)).

$$\frac{d}{dt}\text{species\_3} = -v_1 - v_4 - v_{14} \quad (40)$$

## 8.5 Species `species_4`

**Name** R

**Notes** Receptor

**Initial concentration**  $10^{-5} \text{ mol} \cdot \text{l}^{-1}$

This species takes part in three reactions (as a reactant in [reaction\\_6](#), [reaction\\_9](#), [reaction\\_16](#)).

$$\frac{d}{dt}\text{species\_4} = -v_5 - v_8 - v_{13} \quad (41)$$

## 8.6 Species `species_5`

**Name** G\*T

**Notes** active G protein

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

This species takes part in four reactions (as a reactant in [reaction\\_3](#), [reaction\\_6](#), [reaction\\_7](#) and as a product in [reaction\\_1](#)).

$$\frac{d}{dt} \text{species\_5} = v_1 - v_2 - v_5 - v_6 \quad (42)$$

## 8.7 Species `species_6`

**Name** GD

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

This species takes part in four reactions (as a reactant in [reaction\\_4](#), [reaction\\_8](#), [reaction\\_9](#) and as a product in [reaction\\_3](#)).

$$\frac{d}{dt} \text{species\_6} = v_2 - v_3 - v_7 - v_8 \quad (43)$$

## 8.8 Species `species_7`

**Name** Pi

**Initial concentration**  $0.0044 \text{ mol} \cdot \text{l}^{-1}$

This species takes part in four reactions (as a product in [reaction\\_3](#), [reaction\\_10](#), [reaction\\_13](#), [reaction\\_20](#)).

$$\frac{d}{dt} \text{species\_7} = v_2 + v_9 + v_{11} + v_{16} \quad (44)$$

## 8.9 Species `species_8`

**Name** D

**Notes** GDP

**Initial concentration**  $1.49 \cdot 10^{-4} \text{ mol} \cdot \text{l}^{-1}$

This species takes part in four reactions (as a product in [reaction\\_4](#), [reaction\\_11](#), [reaction\\_14](#), [reaction\\_23](#)).

$$\frac{d}{dt} \text{species\_8} = v_3 + v_{10} + v_{12} + v_{17} \quad (45)$$



### 8.10 Species `species_9`

**Name** RG

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

This species takes part in two reactions (as a reactant in [reaction\\_5](#) and as a product in [reaction\\_11](#)).

$$\frac{d}{dt}\text{species\_9} = v_{10} - v_4 \quad (46)$$

### 8.11 Species `species_10`

**Name** RG\*T

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

This species takes part in four reactions (as a reactant in [reaction\\_10](#), [reaction\\_19](#) and as a product in [reaction\\_5](#), [reaction\\_6](#)).

$$\frac{d}{dt}\text{species\_10} = v_4 + v_5 - v_9 - v_{15} \quad (47)$$

### 8.12 Species `species_11`

**Name** G\*AT

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

This species takes part in two reactions (as a reactant in [reaction\\_13](#) and as a product in [reaction\\_7](#)).

$$\frac{d}{dt}\text{species\_11} = v_6 - v_{11} \quad (48)$$

### 8.13 Species `species_12`

**Name** GAD

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

This species takes part in three reactions (as a reactant in [reaction\\_14](#) and as a product in [reaction\\_8](#), [reaction\\_13](#)).

$$\frac{d}{dt}\text{species\_12} = v_7 + v_{11} - v_{12} \quad (49)$$

### 8.14 Species `species_13`

**Name** RGD

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

This species takes part in three reactions (as a reactant in [reaction\\_11](#) and as a product in [reaction\\_9](#), [reaction\\_10](#)).

$$\frac{d}{dt}\text{species\_13} = v_8 + v_9 - v_{10} \quad (50)$$

### 8.15 Species `species_14`

**Name** RGA

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

This species takes part in three reactions (as a reactant in [reaction\\_17](#) and as a product in [reaction\\_16](#), [reaction\\_23](#)).

$$\frac{d}{dt}\text{species\_14} = v_{13} + v_{17} - v_{14} \quad (51)$$

### 8.16 Species `species_15`

**Name** RG\*AT

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

This species takes part in three reactions (as a reactant in [reaction\\_20](#) and as a product in [reaction\\_17](#), [reaction\\_19](#)).

$$\frac{d}{dt}\text{species\_15} = v_{14} + v_{15} - v_{16} \quad (52)$$

### 8.17 Species `species_16`

**Name** RGAD

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

This species takes part in two reactions (as a reactant in [reaction\\_23](#) and as a product in [reaction\\_20](#)).

$$\frac{d}{dt}\text{species\_16} = v_{16} - v_{17} \quad (53)$$

SBML<sup>2</sup>TeX was developed by Andreas Dräger<sup>a</sup>, Hannes Planatscher<sup>a</sup>, Dieudonné M Wouamba<sup>a</sup>, Adrian Schröder<sup>a</sup>, Michael Hucka<sup>b</sup>, Lukas Endler<sup>c</sup>, Martin Golebiewski<sup>d</sup> and Andreas Zell<sup>a</sup>. Please see <http://www.ra.cs.uni-tuebingen.de/software/SBML2LaTeX> for more information.

<sup>a</sup>Center for Bioinformatics Tübingen (ZBIT), Germany

<sup>b</sup>California Institute of Technology, Beckman Institute BNMC, Pasadena, United States

<sup>c</sup>European Bioinformatics Institute, Wellcome Trust Genome Campus, Hinxton, United Kingdom

<sup>d</sup>EML Research gGmbH, Heidelberg, Germany