

Model sharing and knowledge discovery with ModelDB

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What is ModelDB?

- design goals
- what's in it?

Why use ModelDB?

Finding what you want,
and understanding what you found

Sharing your own models

modeldb.yale.edu

A resource for sharing and finding published models and related knowledge in the domain of computational neuroscience

Enables model

- discovery and understanding
- replication and reproduction
- attributed reuse and extension

Each entry includes

- citation(s) and concise model description
- source code
- metadata to help find entries of interest

Why use ModelDB?

Help others discover and understand your own models

Discover:

- and understand models published by others
- how modeling is being used to address a given topic
- models for new computational experiments, or starting points for new models
- reusable model components (channels, cell classes . . .)
- programming examples, e.g. FInitializeHandler usage
- models for regression testing of simulators

You can help by:

- *citing ModelDB and model authors when you find something useful*
- *using ModelDB to share your own published models*

ModelDB as a knowledge discovery tool

Every model is a selective review of the literature

Models reflect what researchers judge to be important.

Example:

131 models of Hippocampus Ca1 pyramidal neurons

I_A 73 models: 2796, 7386, 9769 . . .

$I_{K,Ca}$ 23 models: 7907, 20212, 87284 . . .

I_M 31 models: 2937, 7907, 20212 . . .

modeldb.yale.edu

1620 model entries as of 7/21/2020

- 515 network models
- 181 types of neurons, including
 - 9 varieties of artificial spiking cells
 - biological neurons from
 - > 21 animal species
 - > 25 mammalian brain regions

Simulator-agnostic

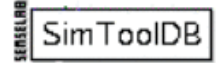
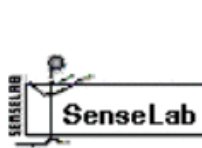
96 simulators | programming languages

~1500 for NEURON, MATLAB, XPP, Python, or C++

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Find models by

[Model name](#)

[First author](#)

[Each author](#)

[Region\(circuits\)](#)

Find models for

[Cell type](#)

[Current](#)

[Receptor](#)

[Gene](#)

[Transmitters](#)

[Concept](#)

[Simulators](#)

[Methods](#)

[Submit Model](#)

ModelDB provides an accessible location for storing and efficiently retrieving computational neuroscience models. A ModelDB entry contains a model's source code, concise description, and a citation of the article that published it. The source code can be in any language for any environment, can be viewed before downloading, and optionally can be auto-launched on download. For further information, see [model sharing in general](#) and [ModelDB in particular](#).

ModelDB is tightly coupled with [NeuronDB](#), a database of neuronal properties that are used to constrain models based on experimental observations.

Browse or search through over [1610 models](#) using the navigation on the left bar or in the menu button on a mobile device. To search papers instead of models, go [here](#); this may be used to identify models whose paper cites or is cited by a given paper.

Tweets by [@SenseLabProject](#)



SenseLab

[@SenseLabProject](#)

New in [#ModelDB](#): Inhibitory microcircuits for top-down plasticity of sensory representations (Wilmes & Clopath 2019)



Finding models: preconfigured searches

Find models by

Model name

First author

Each author

Region(circuits)

Find models for

Cell type

Current

Receptor

Gene

Transmitters

Concept

Simulators

Methods

Find models of

Realistic Networks

Neurons

Electrical synapses (gap junctions)

Chemical synapses


Ion channels

Neuromuscular junctions

Axons

Pathophysiology

Finding models: search box

<input type="text" value="mag "/>	
magnitude	
magee	
magenta	
mag	
magnesium	
Authors	
Magee JC	>
Magosso E	>
Magalhães BR	>
Magalhães B	>
Magistretti J	>
4 more...	
Concept	
Magnetoencephalography	
Magnetic stimulation	

Top left corner of each page

- full text or attribute search
- word completion,
live update as you type

Also available: browse and custom search

View all
Basal Ganglia and Levodopa Pharmacodynamics model for parameter estimation in PD (Ursino et al 2020)
A neural mass model for critical assessment of brain connectivity (Ursino et al 2020)
Multisensory integration in the superior colliculus: a neural network model (Ursino et al. 2009)

"Front page" of a model entry

Amyloid beta (IA block) effects on a model CA1 pyramidal cell
(Morse et al. 2010)

(1) Download zip file Auto-launch (2)
Help downloading and running models

Model Information	Model File	Citations	Model Views	Simulation Platform	3D Print
Accession: 87284	(3)	(4)	(5)	(6)	(7)
The model simulations provide evidence oblique dendrites in CA1 pyramidal neurons are susceptible to hyper-excitability by amyloid beta block of the transient K+ channel, IA. See paper for details. (8)					
Reference:					
1 . Morse TM, Carnevale NT, Mutalik PG, Migliore M, Shepherd GM (2010) Abnormal Excitability of Oblique Dendrites Implicated in Early Alzheimer's: A Computational Study. <i>Front Neural Circuits</i> [PubMed] (9)					
Model Information (Click on a link to find other models with that property)					
Model Type:	Neuron or other electrically excitable cell;				
Brain Region(s)/Organism:					
Cell Type(s):	Hippocampus CA1 pyramidal GLU cell;				
Channel(s):	I Na,t; I L high threshold; I N; I T low threshold; I A; I K; I h; I K,Ca;				
Gap Junctions:					
Receptor(s):					
Gene(s):					
Transmitter(s):					
Simulation Environment:	NEURON;				
Model Concept(s):	Dendritic Action Potentials; Active Dendrites; Detailed Neuronal Models; Pathophysiology; Aging/Alzheimer`s;				
Implementer(s):	Carnevale, Ted [Ted.Carnevale at Yale.edu]; Morse, Tom [Tom.Morse at Yale.edu];				
Search NeuronDB for information about: Hippocampus CA1 pyramidal GLU cell; I Na,t; I L high threshold; I N; I T low threshold; I A; I K; I h; I K,Ca; (11)					

- 1 download link
- 2 autolaunch simulation
- 3 view model files
- 4 cited and citing models and papers
- 5 ModelView: visualize model structure
- 6 Simulation platform (external site)
- 7 printable 3D cells from this model
- 8 description of model
- 9 papers that describe or use the model
- 10 searchable metadata
- 11 links to NeuronDB (properties of biological cell types)

based on McDougal et al., *J. Comp. Neurosci.* 2017

A model entry's "readme" file

Amyloid beta (IA block) effects on a model CA1 pyramidal cell
(Morse et al. 2010)

Download zip file

Auto-launch

Help downloading and running models

Model Information

Model File

Citations

Model Views

Simulation Platform

3D Print

Download the displayed file

- /
- CA1_abeta
 - translate
 - readme.html**
 - cacumm.mod
 - cagk.mod *
 - cal2.mod *
 - can2.mod *
 - cat.mod *
 - distr.mod *
 - h.mod
 - ipulse2.mod *
 - kadist.mod
 - kaprox.mod

This is the readme for a model used in the paper

[Morse TM, Carnevale NT, Mutalik PG, Migliore M, Shepherd GM \(2010\) Abnormal excitability of oblique dendrites implicated in early Alzheimer's: a computational study Front. Neural Circuits 4:16](#)

The model code was contributed by Tom Morse. It was created (see paper for details) from earlier models (especially Migliore et al. 2005 and calcium channels from Hemond et al. 2008) with modifications and additions by Tom Morse and Ted Carnevale with interaction with the other authors. It requires the NEURON simulator to be installed (available at <http://www.neuron.yale.edu>).

To recreate figures from the paper, start the simulator by auto-launching from ModelDB *OR*

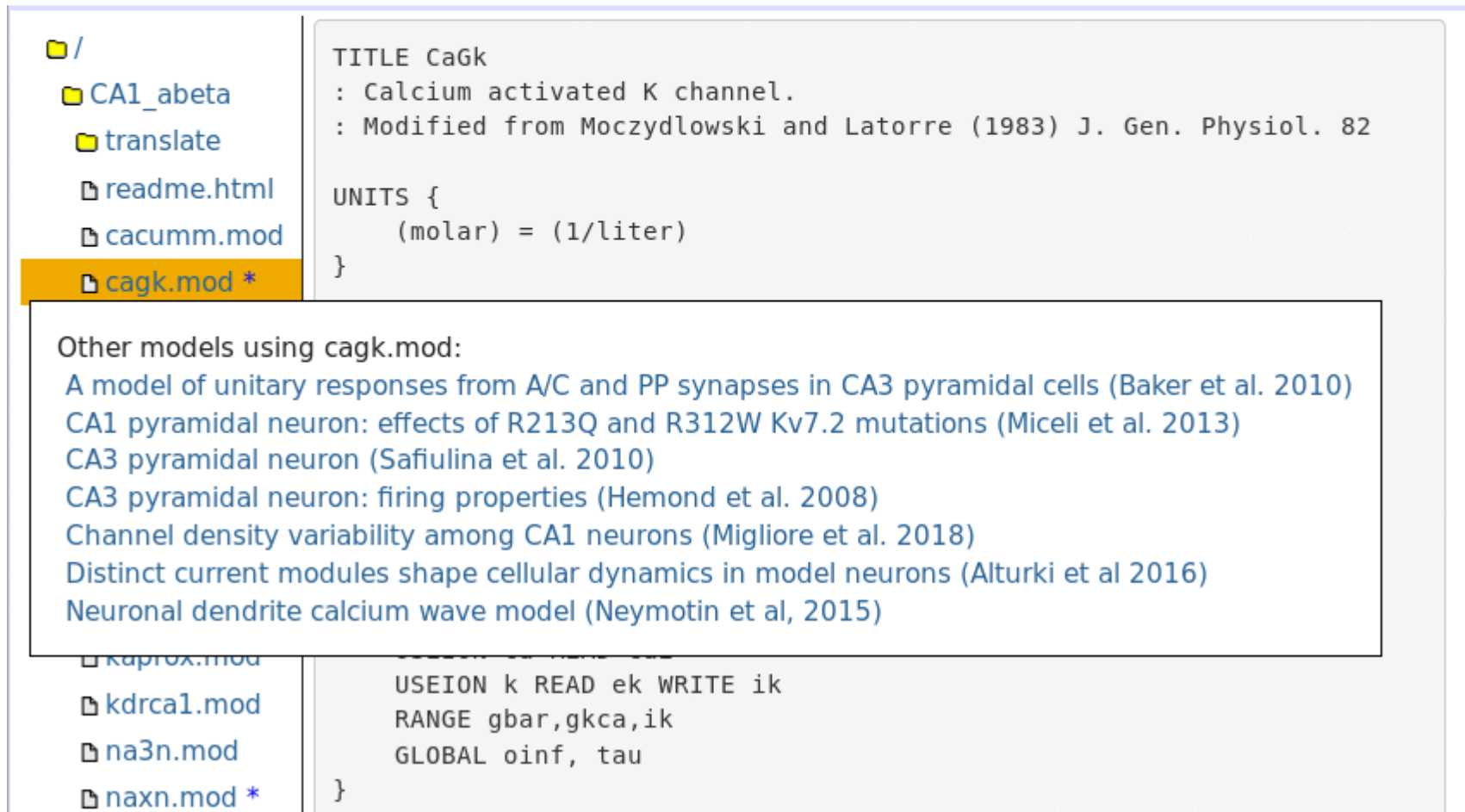
Under unix systems:

In the expanded archive's folder compile the mod files using the command "nrnivmodl"

based on McDougal et al., *J. Comp. Neurosci.* 2017

Asterisks mark reuse

Click asterisk to see by whom and for what



The screenshot shows a file browser interface with a directory tree on the left and a code editor on the right. The directory tree includes folders like 'CA1_abeta' and 'translate', and files like 'readme.html', 'cacumm.mod', and 'cagk.mod *'. The 'cagk.mod *' file is highlighted in orange. The code editor shows the following content:

```
TITLE CaGk
: Calcium activated K channel.
: Modified from Moczydlowski and Latorre (1983) J. Gen. Physiol. 82

UNITS {
    (molar) = (1/liter)
}
```

A tooltip box is overlaid on the 'cagk.mod *' file, containing the following text:

Other models using cagk.mod:
[A model of unitary responses from A/C and PP synapses in CA3 pyramidal cells \(Baker et al. 2010\)](#)
[CA1 pyramidal neuron: effects of R213Q and R312W Kv7.2 mutations \(Miceli et al. 2013\)](#)
[CA3 pyramidal neuron \(Safiulina et al. 2010\)](#)
[CA3 pyramidal neuron: firing properties \(Hemond et al. 2008\)](#)
[Channel density variability among CA1 neurons \(Migliore et al. 2018\)](#)
[Distinct current modules shape cellular dynamics in model neurons \(Alturki et al 2016\)](#)
[Neuronal dendrite calcium wave model \(Neymotin et al, 2015\)](#)

Below the tooltip, the code editor shows the following content:

```
USEION k READ ek WRITE ik
RANGE gbar,gkca,ik
GLOBAL oinf, tau
}
```

Ion channels linked to ICGenealogy.org

Model Information **Model File** Citations Model Views Simulation Platform 3D Print

Download the displayed file **ICGenealogy**

Model File Content:

```
TITLE CaGk
: Calcium activated K chan
: Modified from Moczydlows

UNITS {
    (molar) = (1/liter)
}
```

Most ion channel mod files have a button that loads the corresponding page in the ICGenealogy database.

General data

- **ICG id:** 2464
- **ModelDB id:** 87284
- **Reference:** Morse TM, Carnevale NT, Mutalik PG, Migliore M, Shepherd GM (2010): [Abnormal Excitability of Oblique Dendrites Implicated in Early Alzheimer's: A Computational Study.](#)

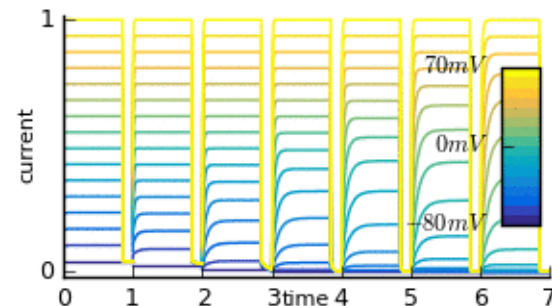
Metadata classes

- **Animal Model:** rat
- **Brain Area:** hippocampus, CA1
- **Neuron Region:** unspecified
- **Neuron Type:** pyramidal cell
- **Runtime Q:** Q4 (slow)
- **Subtype:** not specified

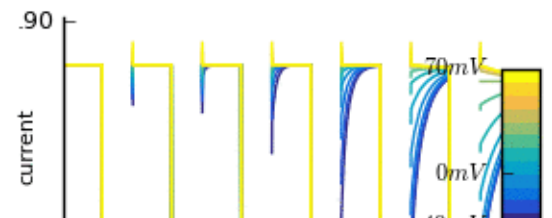
Metadata generic

Current Response Traces

Activation

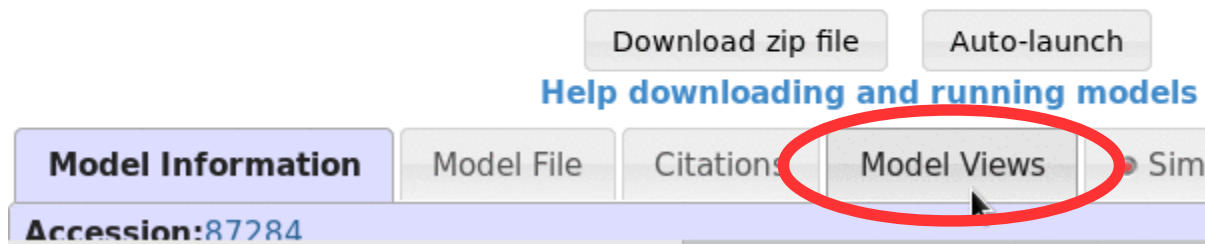


Inactivation



Model Views: interactive model analysis

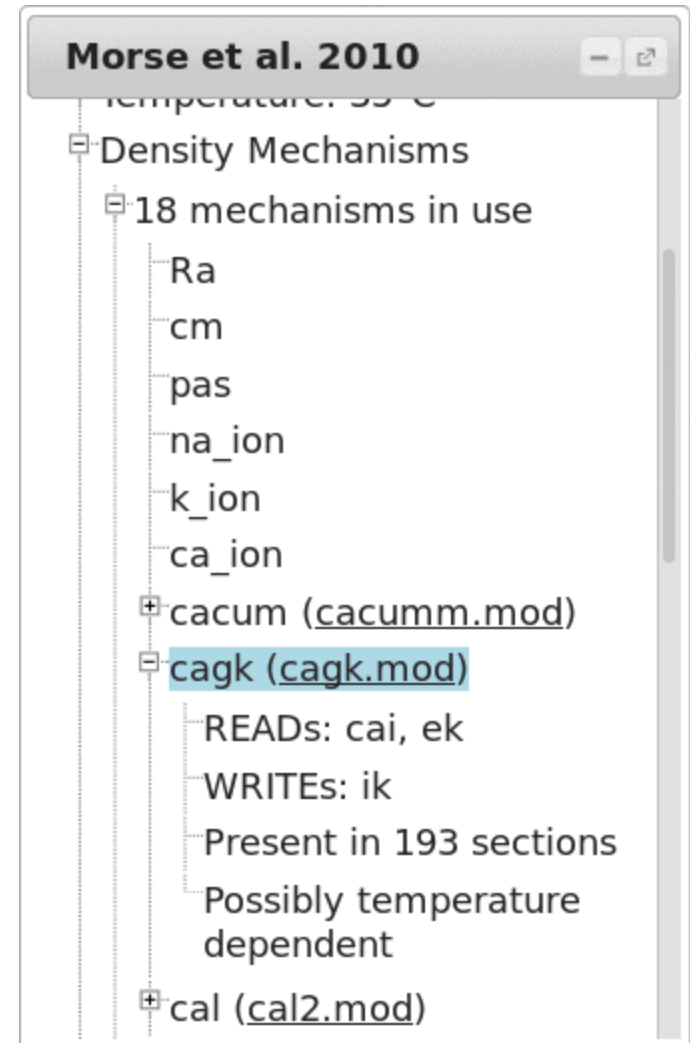
Amyloid beta (IA block) effects on a model CA1 pyramidal cell
(Morse et al. 2010)



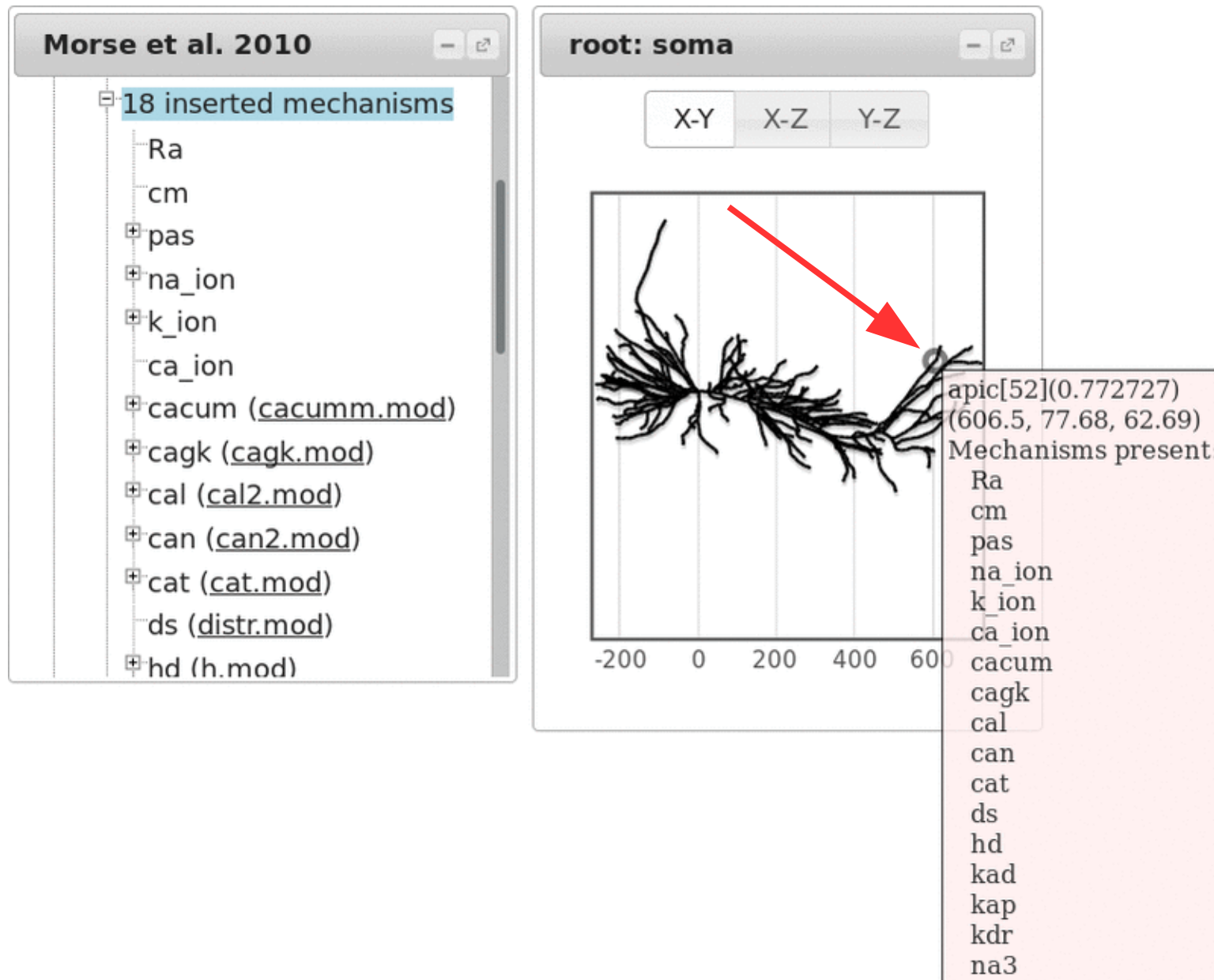
Click the Model Views tab to reveal . . .

. . . an expandable outline . . .

. . . with interactive graphics

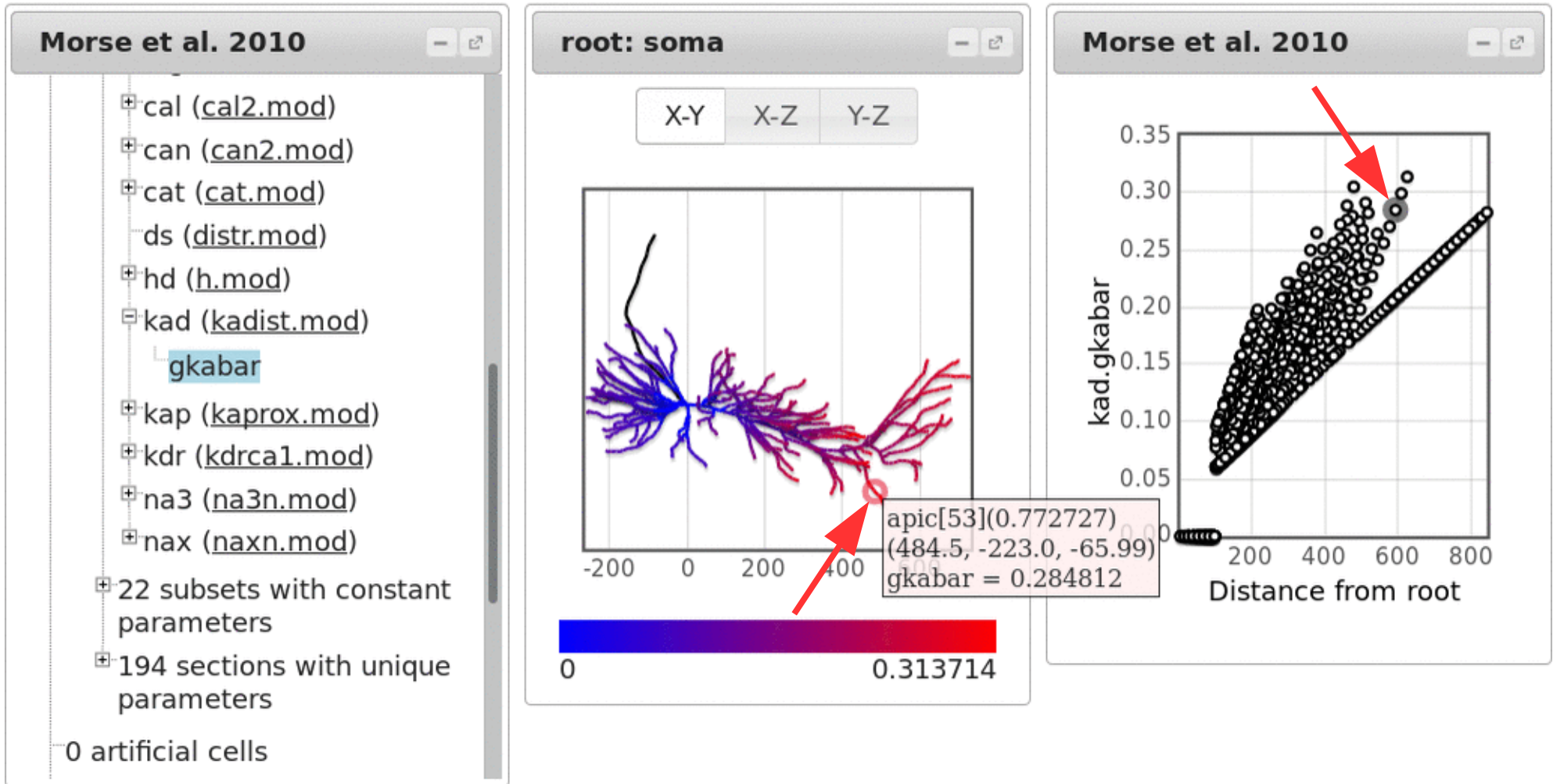


ModelView: discover what's where



based on McDougal et al., *Neuroinformatics* 2015

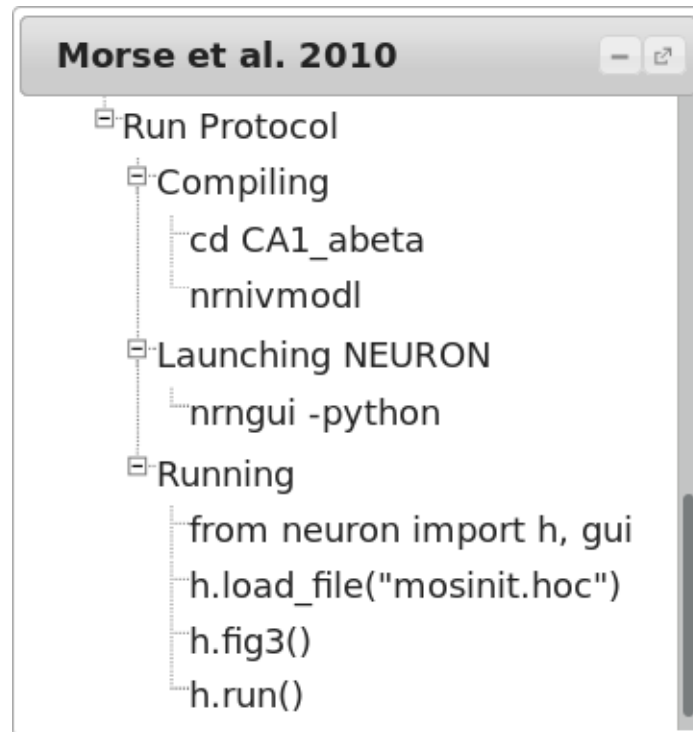
ModelView: inhomogeneous params



based on McDougal et al., *Neuroinformatics* 2015

Model View: run protocol

Answering one of life's vexing, if smaller, questions . . .



```
Morse et al. 2010
├─ Run Protocol
│   └─ Compiling
│       ├── cd CA1_abeta
│       └─ nrnivmodl
│   └─ Launching NEURON
│       └─ nrngui -python
│   └─ Running
│       ├── from neuron import h, gui
│       ├── h.load_file("mosinit.hoc")
│       ├── h.fig3()
│       └─ h.run()
```

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Sharing your models



Submit Model

ModelDB provides an accessible location for storing and efficiently retrieving computational neuroscience models. A ModelDB entry contains a model's source code, concise description, and a citation of the article that published it. The source code can be in

Submit New Model

Required information:

Your full name:

W.M. Bellman

Your email address:

bellmanwm@dodgson.net

Zip file of model code:

Browse...

No file selected.

Read-Write access code (15 character max):

●●●●●●●●●●●●●●●

Used as a password to only access this model

PubMed ID(s) or citation(s) associated with the model:

Only required for publicly shared models.

Citation(s) can be in any bibliographic format.

Sharing your models *continued*

Let us find ModelDB keywords for you!

Click the button to automatically find, approve, and populate model entry keywords based on your paper abstract.

Automatic keyword identifier



Please paste your paper abstract here.

We used a large scale mechanistic model of snark wulst to explore the role of asynchronous dopaminergic and serotonergic signaling in triggering the boojum state. Our model relates this phenomenon to spillover of these neurotransmitters into adjacent neural circuits, activating D1, D2, and 5HT receptors throughout the brain. Simulations reveal acceleration of axonal conduction, sometimes to supraluminal levels. This is accompanied by local violations of causality, granger and otherwise, including temporary conversion of Hebbian to anti-Hebbian plasticity and vice-versa. In-vivo experiments are now under way to determine how this is related to the tendency of nearby organisms to revert to uncoupled pairs of gametes through the process known|as

Cancel

Submit

Sharing your models *continued*

Automatic keyword identifier: results



Deselect keywords that do not describe the model, then press the button to accept the rest.

- Serotonin**
- Hebbian plasticity**
- Synaptic Plasticity**
- Dopamine**

Accept selected keywords



References

SenseLab (including ModelDB) Twitter feed: @SenseLabProject

*** McDougal RA, Morse TM, Carnevale T, Marengo L, Wang R, Migliore M, Miller PL, Shepherd GM, Hines M. Twenty years of ModelDB and beyond: building essential modeling tools for the future of neuroscience. J. Comput. Neurosci. 42:1-10, 2017.**

McDougal RA, Morse TM, Hines ML, Shepherd GM. ModelView for ModelDB: online presentation of model architecture. Neuroinformatics 13:459-470, 2015.

[ICGenealogy] Podlaski WF, Seeholzer A, Groschner LN, Miesenböck G, Ranjan R, Vogels T. Mapping the function of neuronal ion channels in model and experiment. eLife 6:e22152, doi: 10.7554/eLife.22152, 2017

***--How to cite ModelDB.** For more specific information, see "How to cite ModelDB" link at modeldb.yale.edu