ModelDB: a database of published computational neuroscience models

Tom Morse[1], Robert McDougal[2], Michael Hines[1], Ted Carnevale[1], Gordon Shepherd[1]

[1] Neuroscience Department, Yale University

[2] Center for Medical Informatics, Yale University

modeldb.yale.edu

ModelDB's design goals

Facilitate neuroscience research and education by promoting

- discovery
- reproducibility and replicability
- verification and validation
- attributed re-use
- understanding

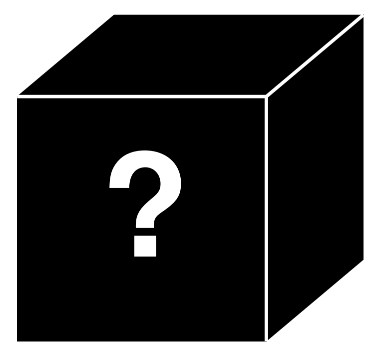
of published models

Is reproducibility a special problem for computational neuroscience?

What's the difference between

. . . a mouse

. . . and a model?



Computational experiments are potentially 100% reproducable.

Challenges to reproducibility

Published computational models are hard to find.

Articles do not provide adequate model descriptions.

Journal model sharing policies are weak,
enforcement is lax.

Authors don't [want | have time] to be bothered.

They can't find their own source code anyway.

Even if they do find it, it'll be hard to run,
let alone understand.

How ModelDB helps

Discovers, solicits, and curates published models

Web-based GUI simplifies

- submitting new models
- finding relevant model entries
- downloading and running source code
- discovering citing/cited literature
- understanding model entries

search

Advanced search

SenseLab ModelDB SimToolDB

- ModelDB Help

User account

- Login
- Register

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)

Submit Model

ModelDB provides an accessible location for storing and efficiently retrieving computational neuroscience models. ModelDB is tightly coupled with NeuronDB . Models can be coded in any language for any environment. Model code can be viewed before downloading and browsers can be set to auto-launch the models. For further information, see model sharing in general and ModelDB in particular.

Browse or search through over 1480 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: GLMCC validation neural network model (Kobayashi et al. 2019) modeldb.yale.edu/258807

Nov 7, 2019

SenseLab
@SenseLabProject
New in #ModelDB: The APP in C-terminal domain alters CA1 neuron firing (Pousinha et al 2019) modeldb.yale.edu/256388

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

Accession: 87284

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.

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. *Front Neural Circuits* [PubMed]

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;

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
    - kdrca1.mod
    - na3n.mod
    - naxn.mod *
    - zcaquant.mod
    - aBeta.hoc
    - add_ca.hoc

```
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"
run the simulation with the command "nrngui mosinit.hoc"

Under Windows systems:
----------------------
Compile the mod files using the "mknrndll" program.
A double click on the simulation file
mosinit.hoc
will open the simulation window.
```

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

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* [PubMed]

References and models cited by this paper

Acker CD, White JA (2007) Roles of IA and morphology in action potential propagation in CA1 pyramidal cell dendrites. *J Comput Neurosci* **23**:201-16 [Journal] [PubMed]

- **Roles of I(A) and morphology in AP prop. in CA1 pyramidal cell dendrites (Acker and White 2007) [Model]**

Anderton BH, Callahan L, Coleman P, Davies P, Flood D, Jicha GA, Ohm T, Weaver C (1998) Dendritic changes in Alzheimer's disease and factors that may underlie these changes. *Prog Neurobiol* **55**:595-609 [PubMed]

Andrásfalvy BK, Makara JK, Johnston D, Magee JC (2008) Altered synaptic and non-synaptic properties of CA1 pyramidal neurons in Kv4.2 knockout mice. *J Physiol* **586**:3881-92 [Journal] [PubMed]

Byrne JH, Shepherd GM (2009) Complex information processing in dendrites *From Molecules to Networks:*

References and models that cite this paper

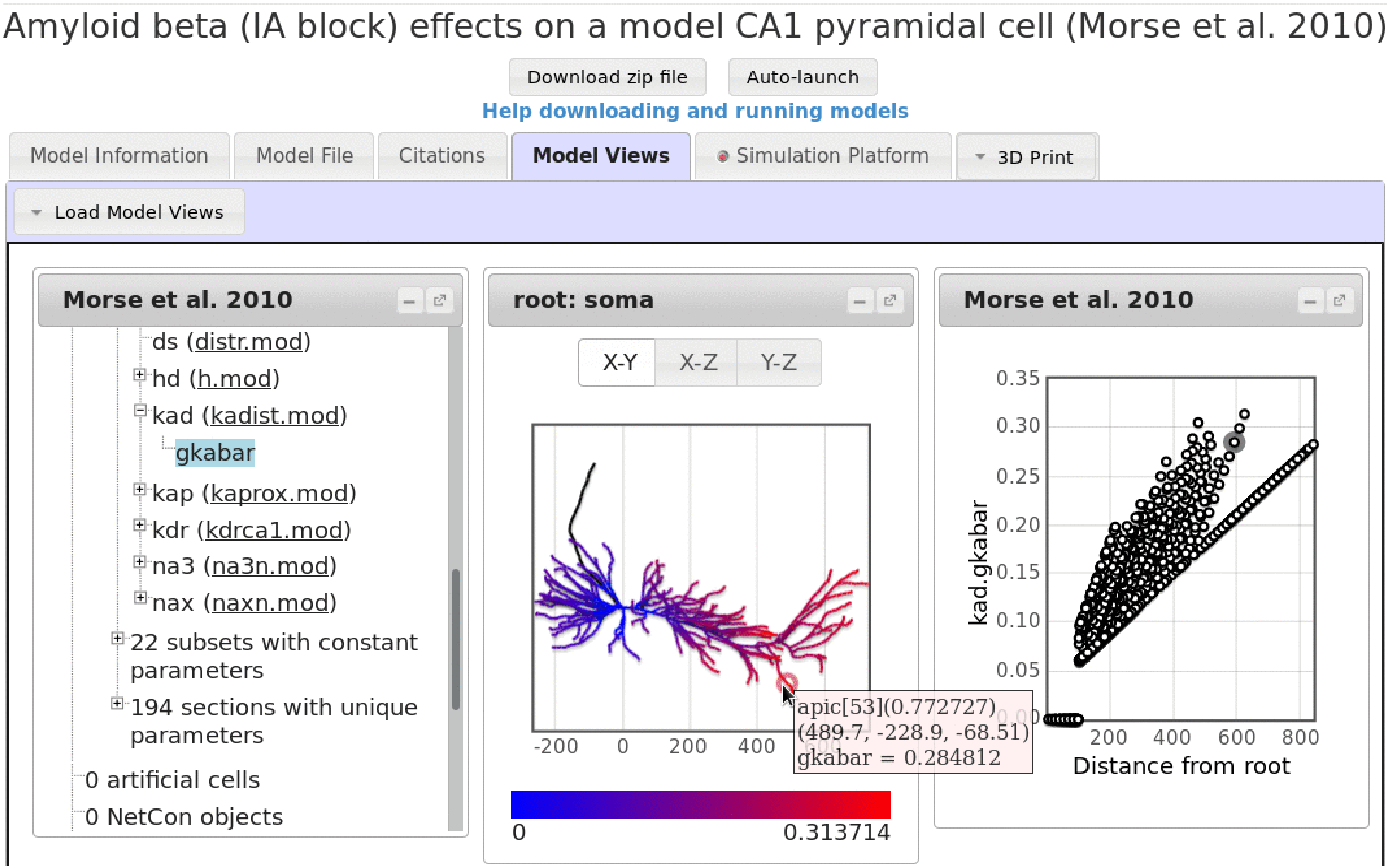
Culmone V, Migliore M (2012) Progressive effect of beta amyloid peptides accumulation on CA1 pyramidal neurons: a model study suggesting possible treatments. *Front Comput Neurosci* **6**:52 [Journal] [PubMed]

- **CA1 pyramidal neurons: effects of Alzheimer (Culmone and Migliore 2012) [Model]**

McDougal RA, Dalal I, Morse TM, Shepherd GM (2019) Automated Metadata Suggestion During Repository Submission. *Neuroinformatics* **17(3)**:361-371 [Journal] [PubMed]

- **Automated metadata suggester (McDougal et al 2018) [Model]**

McDougal RA, Morse TM, Hines ML, Shepherd GM (2015) ModelView for ModelDB: Online Presentation of Model Structure. *Neuroinformatics* **13**:459-70 [Journal] [PubMed]



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
Load Model Views
Morse et al. 2010
ds (distr.mod)
hd (h.mod)
kad (kadist.mod)
gkabar
kap (kaprox.mod)
kdr (kdrca1.mod)
na3 (na3n.mod)
nax (naxn.mod)
22 subsets with constant parameters
194 sections with unique parameters
0 artificial cells
0 NetCon objects
root: soma
X-Y
X-Z
Y-Z
-200
0
200
400
apic[53](0.772727)
(489.7, -228.9, -68.51)
gkabar = 0.284812
0
0.313714
Morse et al. 2010
0.35
0.30
0.25
0.20
0.15
0.10
0.05
kad.gkabar
200
400
600
800
Distance from root

ModelDB promotes discoverability

Twitter feed

Links between ModelDB entries
and related online resources e.g.

- original articles
- PubMed LinkOuts
- Allen Institute
- IonChannelGenealogy
- NeuroMorpho.org

Outreach, education, user support

Publications and posters about ModelDB

Courses and workshops

- Society for Neuroscience
- Organization for Computational Neuroscience
- NEURON Summer Course

NEURON Forum

- > 1000 registered users
- 100's of threads refer to specific model entries

How are we doing?

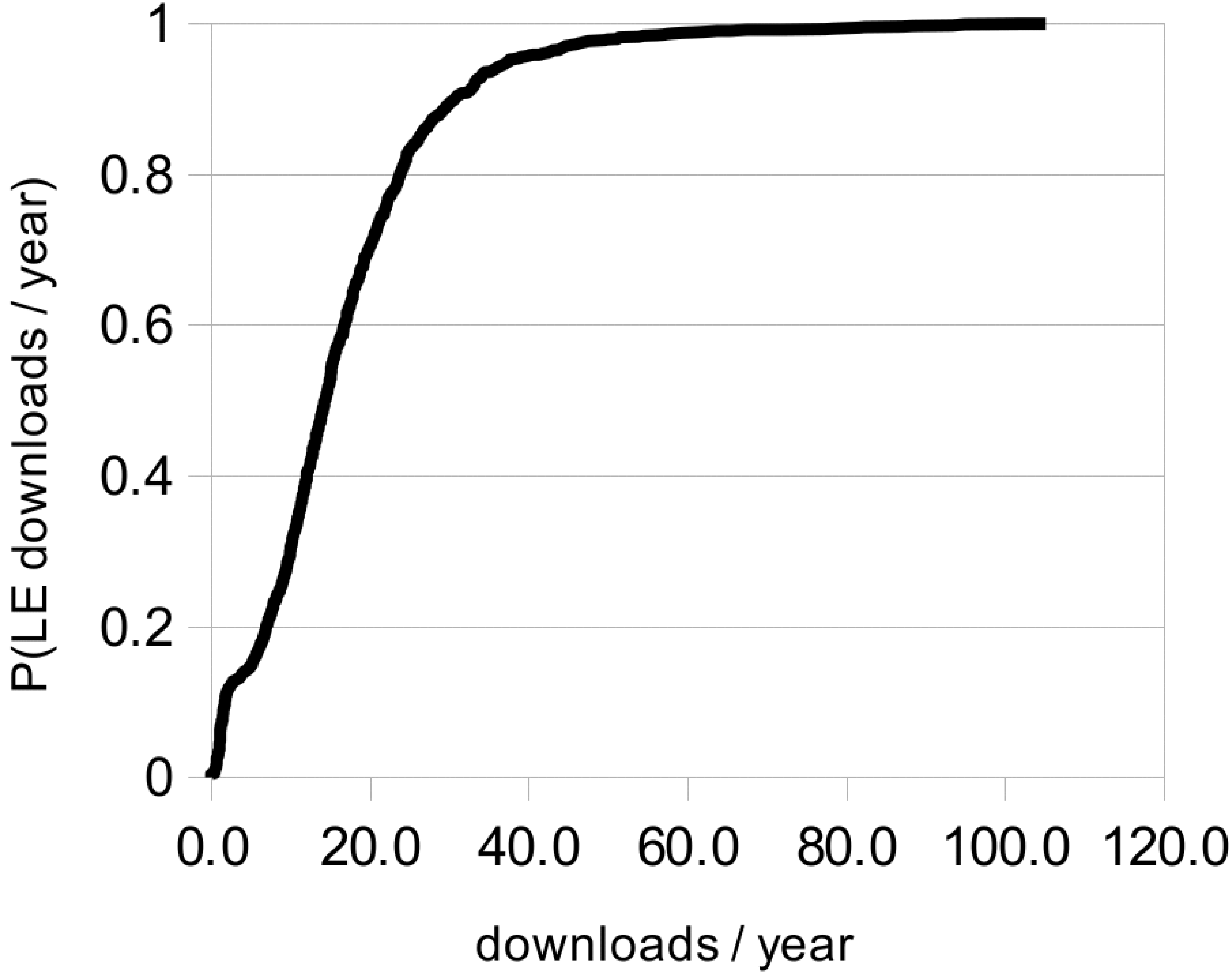
Contents: 1486 models as of 20191119

Uploads

- 571 papers report submitting models
- ~ 50% of new entries are spontaneous submissions by model authors

Downloads

- 199 papers report obtaining models
- total downloads of individual models range from 0 to 1713
- ~ 50% are downloaded 10-20 times / year (range 0 to 105)



1
0.8
0.6
0.4
0.2
0
P(LE downloads / year)
0.0
20.0
40.0
60.0
80.0
100.0
120.0
downloads / year