



# Kepler

SEEK Early Career Faculty Workshop  
Samantha Romanello  
LTER Network Office



# Kepler:

<http://kepler.ecoinformatics.org>

Kepler: Kepler Project - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

http://kepler-project.org/

Stop loading this page

Firefox Help Firefox Support This in FAQ Google Search: Cal... Google Search: Cal... humanistic Jewish

## Kepler Project

Your trail:

Scientists in a variety of disciplines (e.g., biology, ecology, astronomy) need access to scientific data and flexible means for executing complex analyses on those data. Such analyses can be captured as 'scientific workflows' in which the flow of data from one analytical step to another is captured in a formal workflow language. The Kepler project's overall goal is to produce an open-source scientific workflow system that allows scientists to design scientific workflows and execute them efficiently using emerging Grid-based approaches to distributed computation.

Kepler is currently based on the Ptolemy II system for heterogeneous, concurrent modeling and design. Ptolemy II was developed by the members of the Ptolemy project at UC Berkeley. Although not originally intended for scientific workflows, it provides a mature platform for building and executing workflows, and supports multiple models of computation.

### News

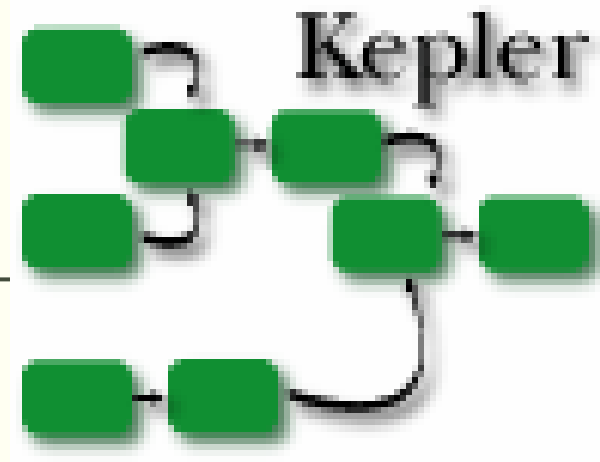
December 3, 2004 New [Kepler web site](#) released

### The Kepler Collaboration

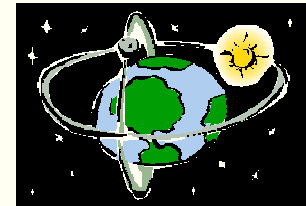
The Kepler project is a cross-project collaboration to develop open source tools for Scientific Workflows. Currently this collaboration includes contributing members from the following projects:

- SEEK: Science Environment for Ecological Knowledge





- framework for design, execution and deployment of scientific workflows
- ... based on Ptolemy II





# Kepler Interface

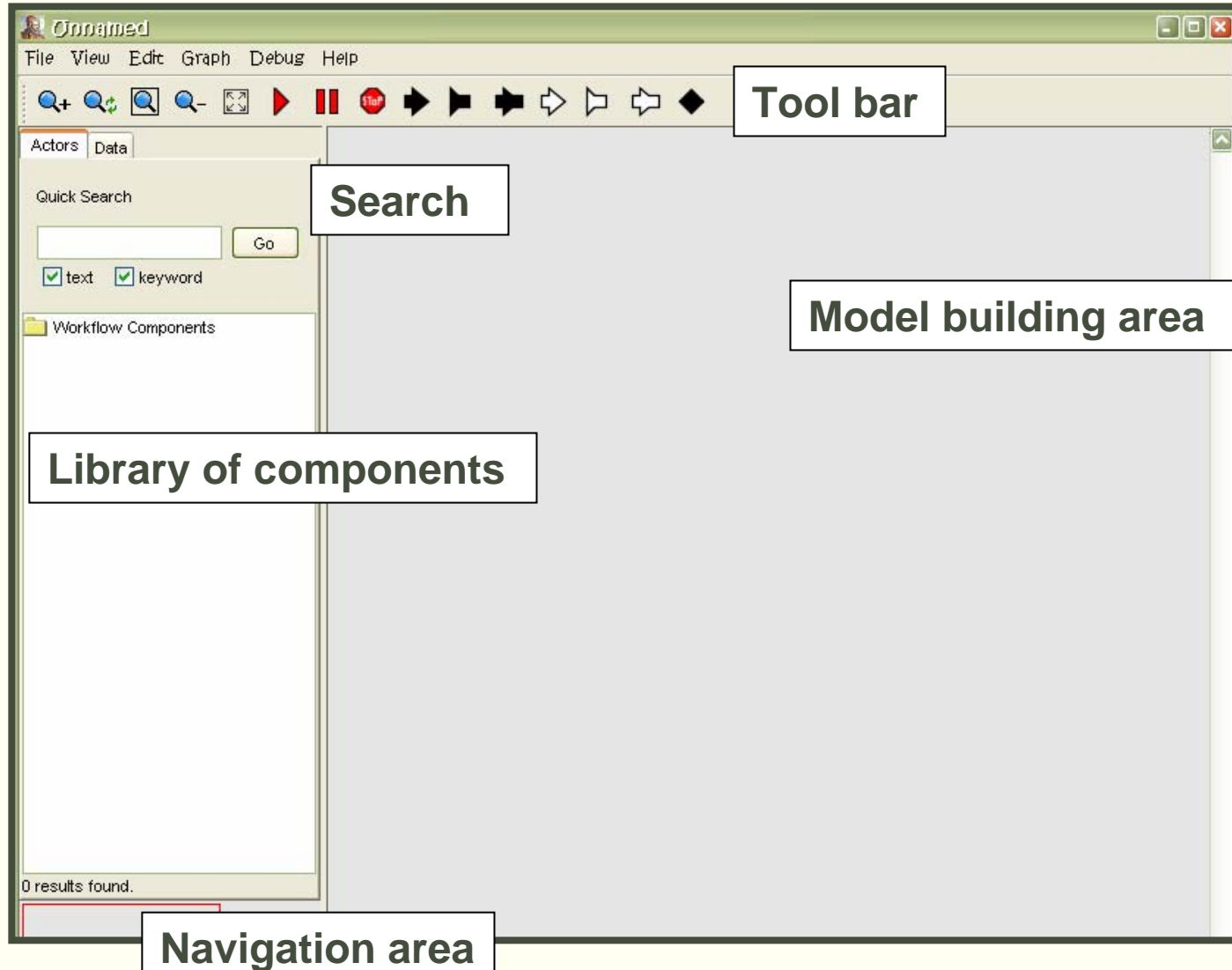
---

- The graph editor
  - Tool bar
  - Actor library
  - Director library





# Graph Editor





# Tool Bar



• Viewing

• Running  
model

• Adding ports





# Viewing



•Zoom In

•Zoom Reset

•Zoom Fit

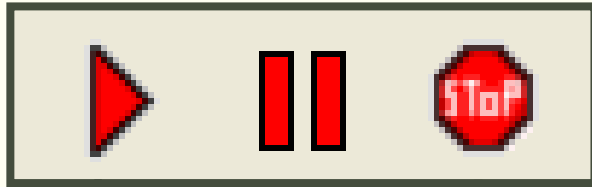
•Zoom Out

•Full Screen





# Running Model



- Run or resume model
- Pause the model
- Stop the model





# Running Model

View Edit Graph Debug Help

Graph Editor

Run Window

Tree View

XML View

JVM Properties

New Actor

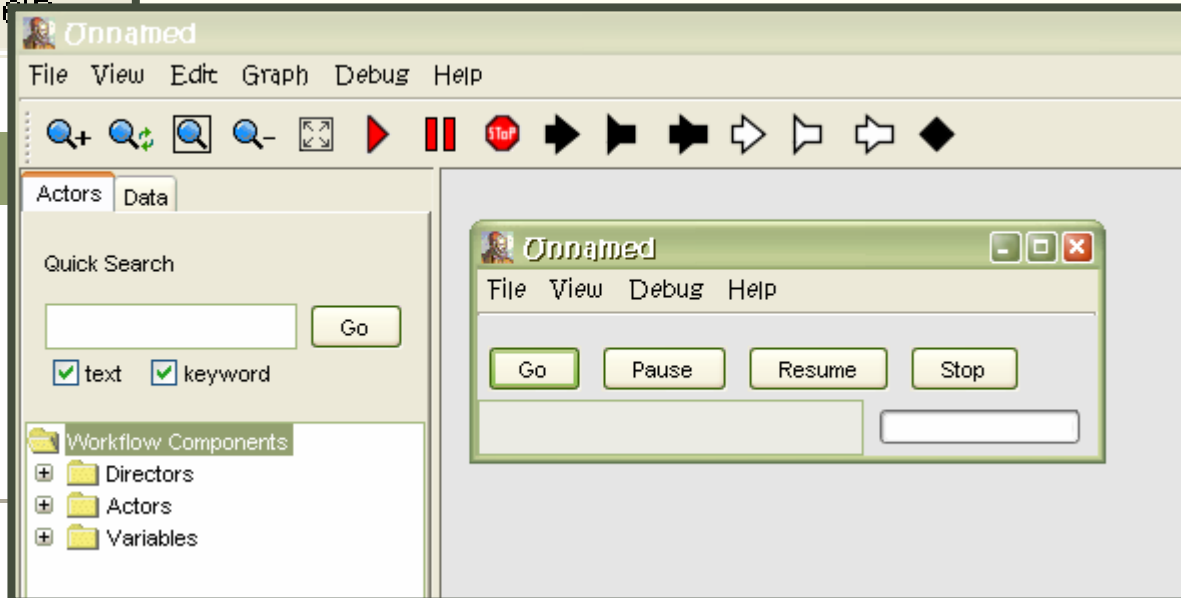
Zoom In Ctrl+Shift+=

Zoom Reset Ctrl+=

Zoom Fit Ctrl+Shift+Minus

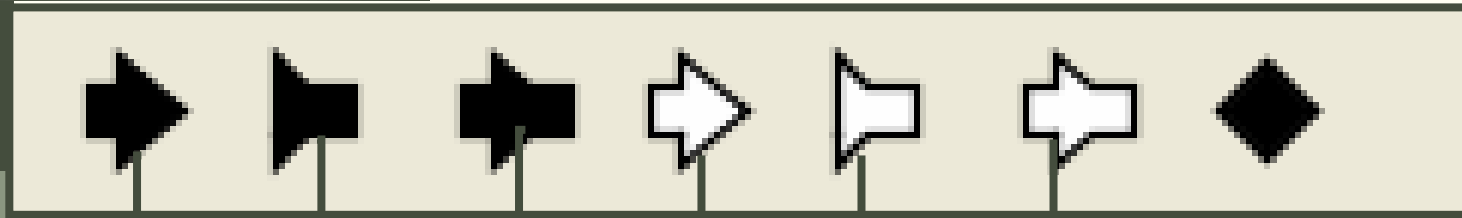
Zoom Out Ctrl+Minus

Full Screen





# Adding Ports



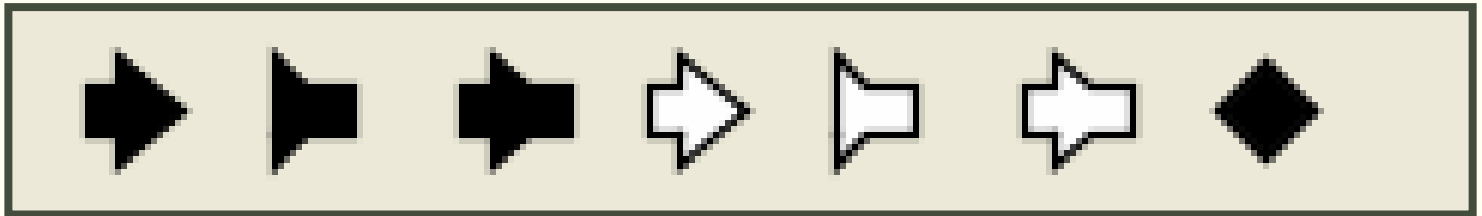
- New input port
- New output port
- New input/output port
- New input multiport
- New output multiport
- New input/output multiport

Graph	Debug	Help
Automatic Layout	Ctrl+T	
Save In Library		
Import Library		
Instantiate Entity		
Create Hierarchy		
New Input port		
New output port		
New input/output port		
New input multiport		
New output multiport		
New input/output multiport		
New Relation		

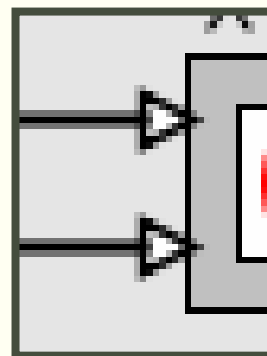
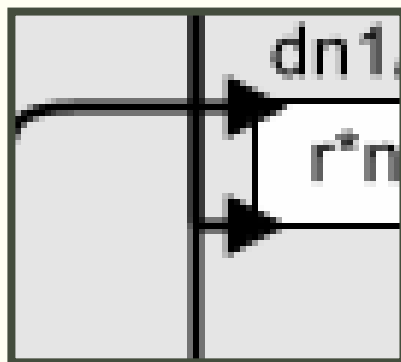


# Adding Ports

- There are two ways to add ports
  - One to connect workflows (AKA composite actors)

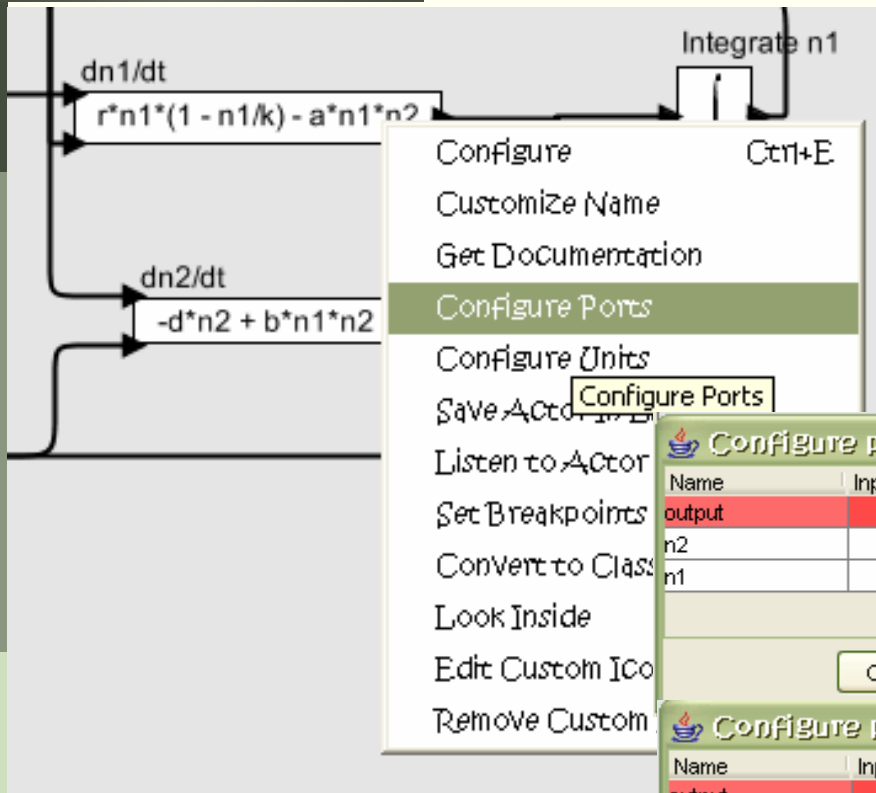


- One to connect actors within workflows





# Adding ports to actors



**Configure ports for dn1/dt**

Name	Input	Output	Multipoint	Type	Direction	Show Name	Hide	Units
output	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	double	EAST	<input type="checkbox"/>	<input type="checkbox"/>	
n2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	unknown	WEST	<input type="checkbox"/>	<input type="checkbox"/>	
n1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	unknown	WEST	<input type="checkbox"/>	<input type="checkbox"/>	

Buttons: Commit, Apply, Add, Remove, Help, Cancel

**Configure ports for dn1/dt**

Name	Input	Output	Multipoint	Type	Direction	Show Name	Hide	Units
output	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	double	EAST	<input type="checkbox"/>	<input type="checkbox"/>	
n2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	unknown	WEST	<input type="checkbox"/>	<input type="checkbox"/>	
n1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	unknown	WEST	<input type="checkbox"/>	<input type="checkbox"/>	
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	unknown	DEFAULT	<input type="checkbox"/>	<input type="checkbox"/>	

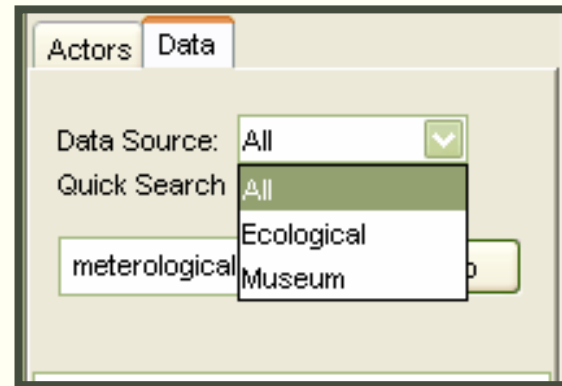
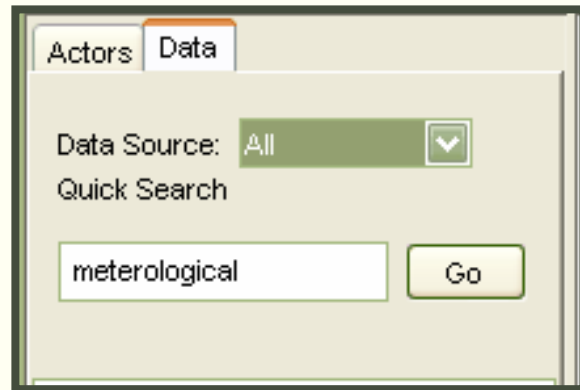
Buttons: Commit, Apply, Add, Remove, Help, Cancel





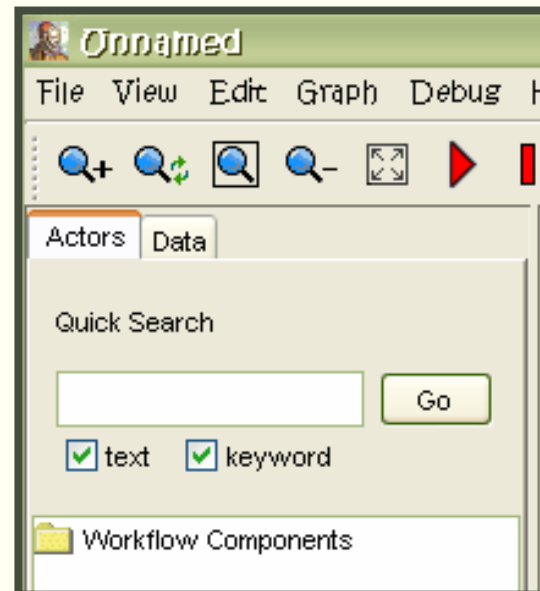
# Searching

## □ Data

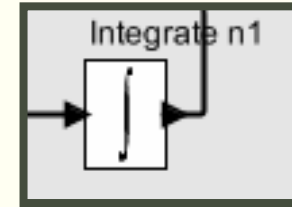


## □ Actors

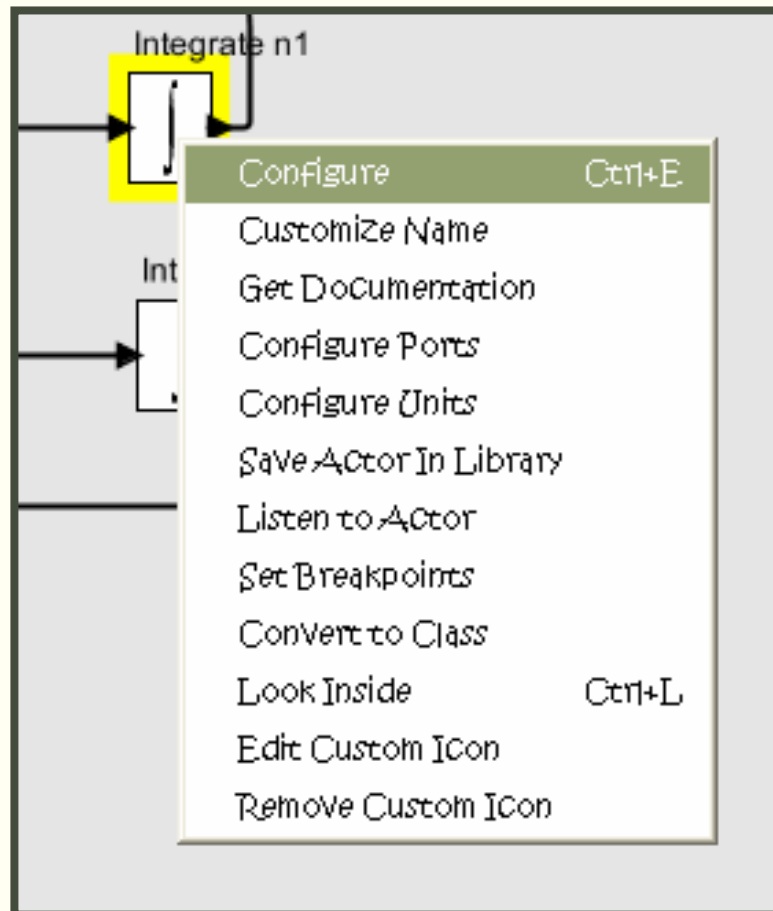
## □ Directors



# Actors



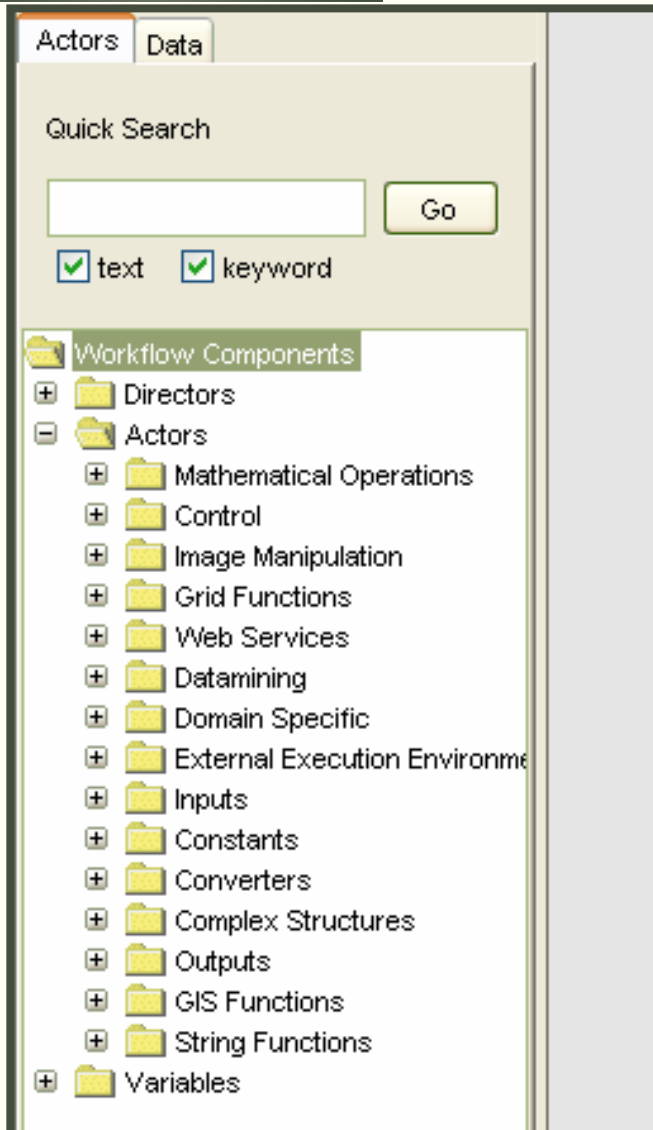
- Actors are components that execute and communicate with other actors in a model.





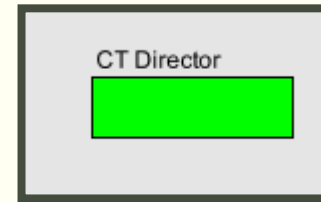
# Actor Library

- Variety of Actors grouped based on the type of functions

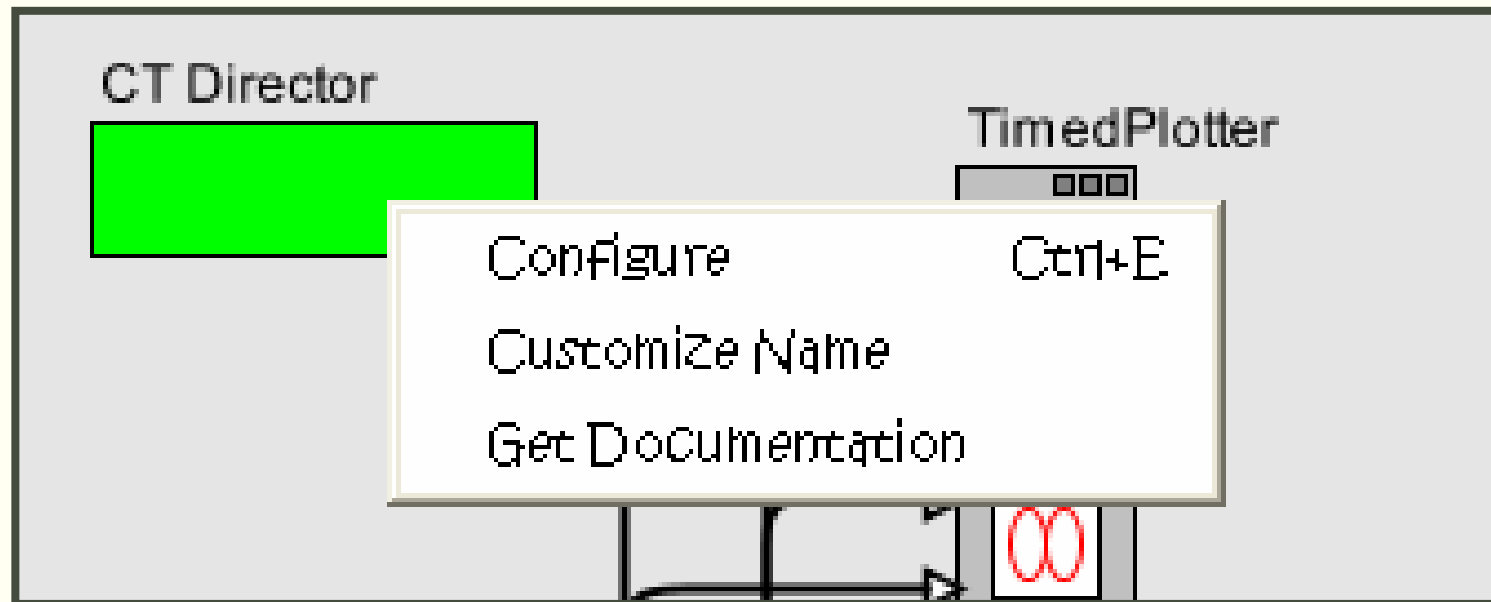




# Director



- Governs the execution of a workflow.







# Configuring the Director

Edit parameters for CT Director

? startTime: 0.0

stopTime: 1000

initStepSize: 0.1

minStepSize: 1.0E-5

maxStepSize: 1.0

maxIterations: 20

errorTolerance: 1.0E-4

valueResolution: 1.0E-6

timeResolution: 1.0E-10

synchronizeToRealTime: ☐

ODESolver: "ptolemy.domains.ct.kernel.solver.ExplicitRK23Solver" ▼

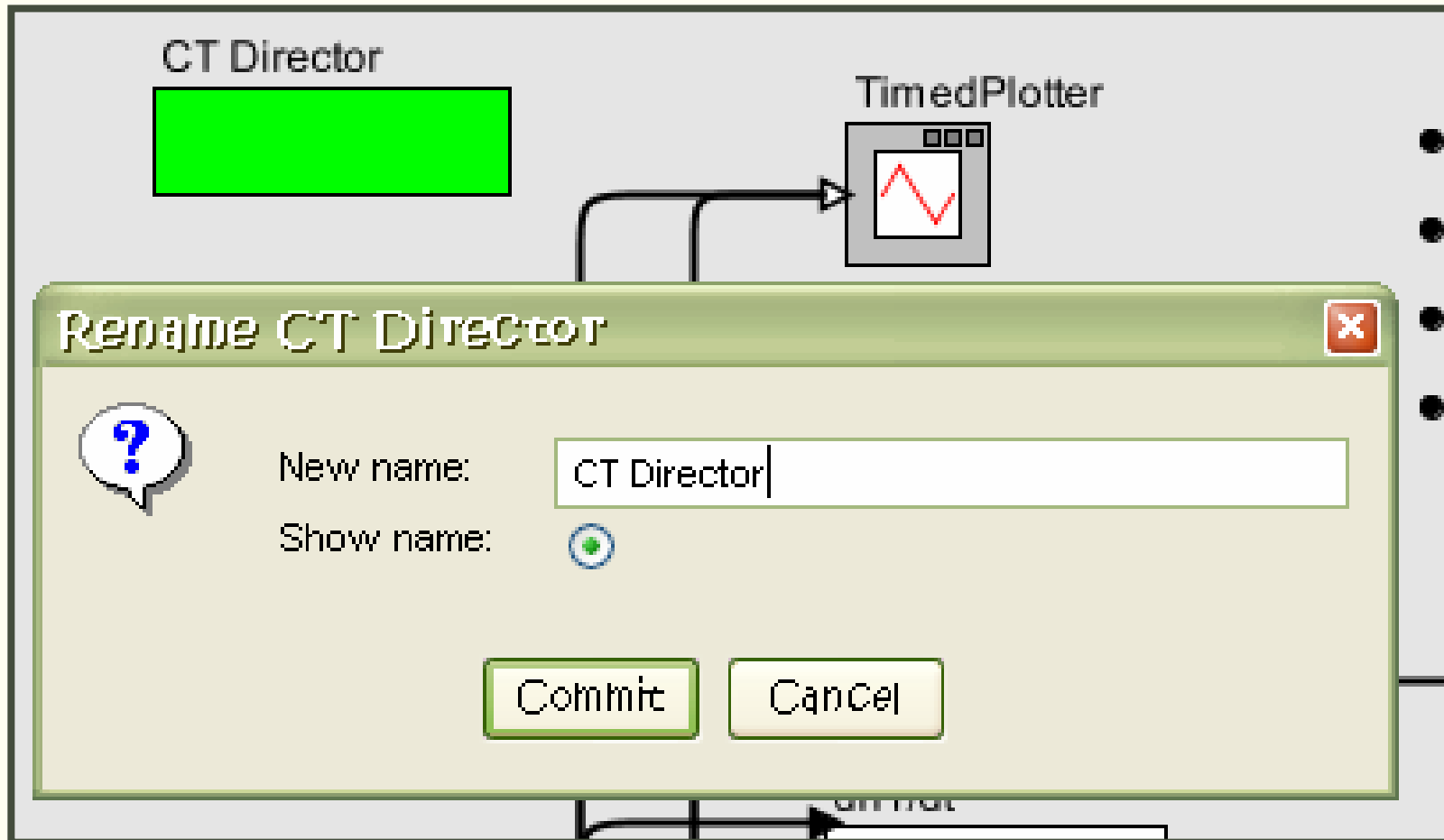
breakpointODESolver: "ptolemy.domains.ct.kernel.solver.DerivativeResolver" ▼

runAheadLength: 0.1

Commit Add Remove Restore Defaults Preferences Help Cancel



# Renaming the Director





# Get documentation

jar:file:/C:/Kepler/ptII4.o.1/build/p...s/ct/kernel/CTMixedSignalDirector.html

File View Help

[Overview](#) [Package](#) [Class](#) [Tree](#) [Deprecated](#) [Index](#) [Help](#)

[PREV CLASS](#) [NEXT CLASS](#) [FRAMES](#) [NO FRAMES](#) [All Classes](#)

SUMMARY: [NESTED](#) | [FIELD](#) | [CONSTR](#) | [METHOD](#)      DETAIL: [FIELD](#) | [CONSTR](#) | [METHOD](#)

---

**ptolemy.domains.ct.kernel**

**Class CTMixedSignalDirector**

java.lang.Object

- ↳ [ptolemy.kernel.util.NamedObj](#)
  - ↳ [ptolemy.kernel.util.Attribute](#)
    - ↳ [ptolemy.actor.Director](#)
      - ↳ [ptolemy.actor.sched.StaticSchedulingDirector](#)
        - ↳ [ptolemy.domains.ct.kernel.CTDirector](#)
          - ↳ [ptolemy.domains.ct.kernel.CTMultiSolverDirector](#)
            - ↳ **ptolemy.domains.ct.kernel.CTMixedSignalDirector**

**All Implemented Interfaces:**

[Changeable](#), java.lang.Cloneable, [Debuggable](#), [DebugListener](#), [Derivable](#), [Executable](#), [ModelErrorHandler](#), [MoMLExportable](#), [Nameable](#), java.io.Serializable

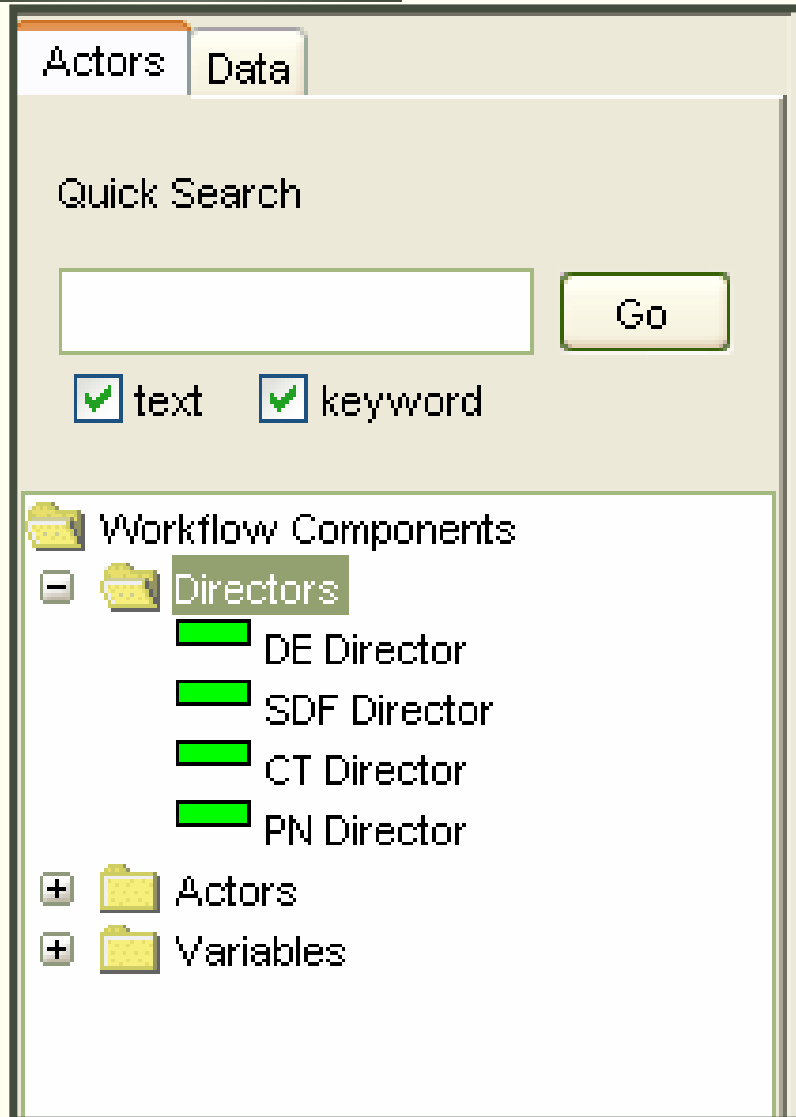
---

public class **CTMixedSignalDirector**  
extends [CTMultiSolverDirector](#)





# Director Library



- A variety of directors depending upon the type of model being executed.





# Using Kepler

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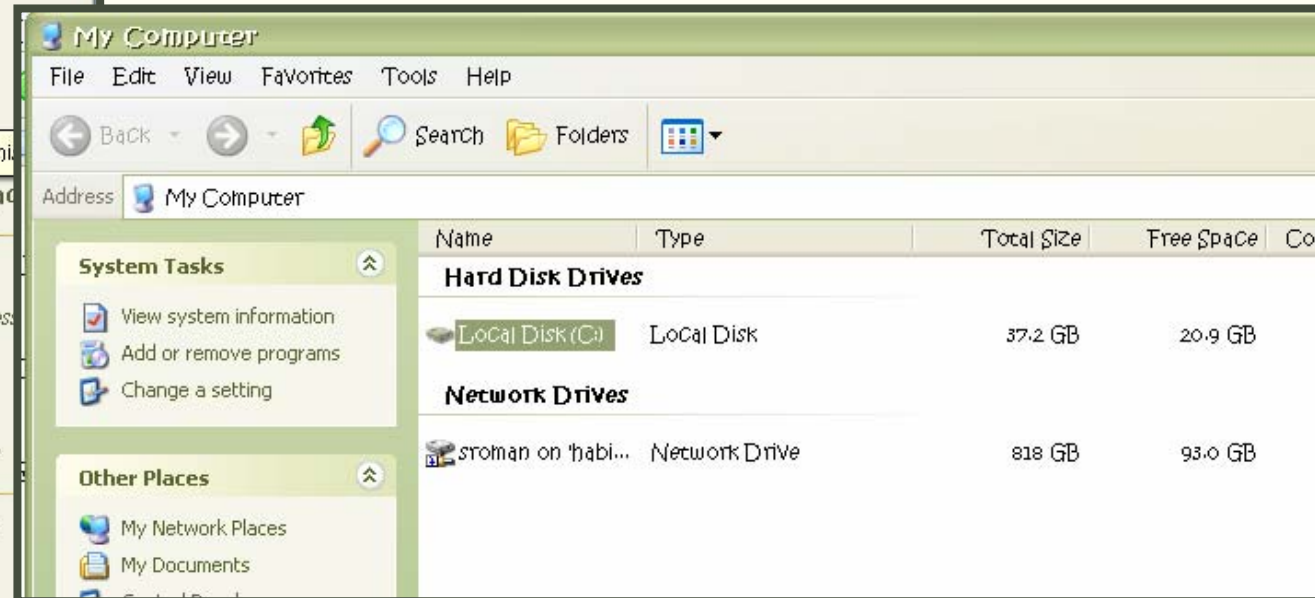
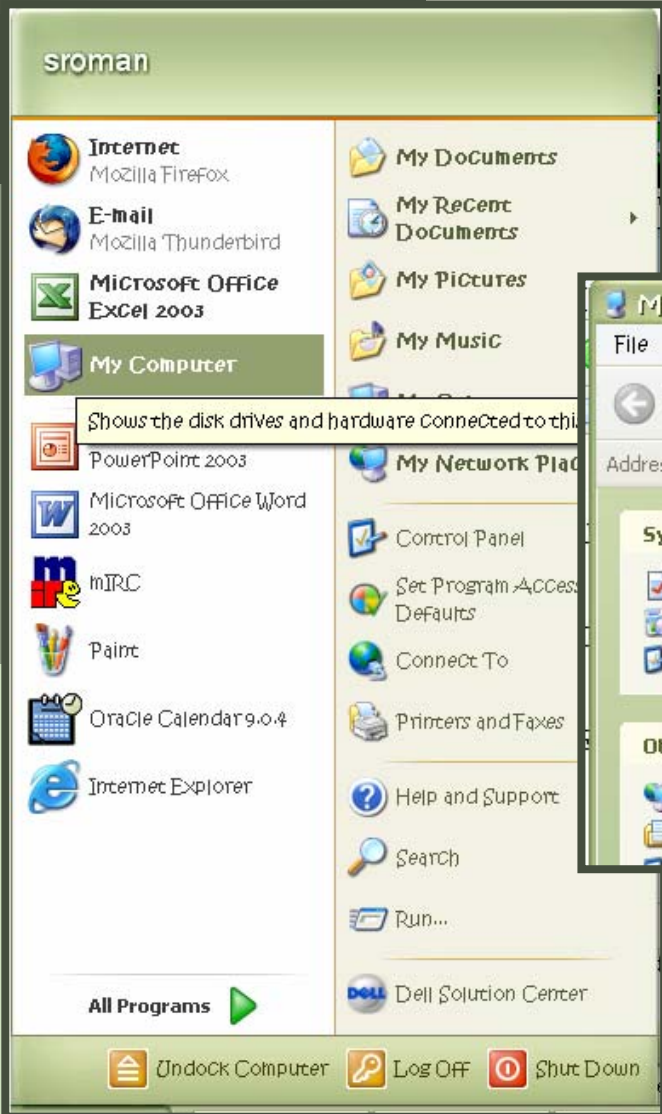
- Executing a ready to run workflow
- Building a model
  - Choosing actors
  - Making connections
  - Choosing a director
  - Building composite actors
  - Saving and running the model





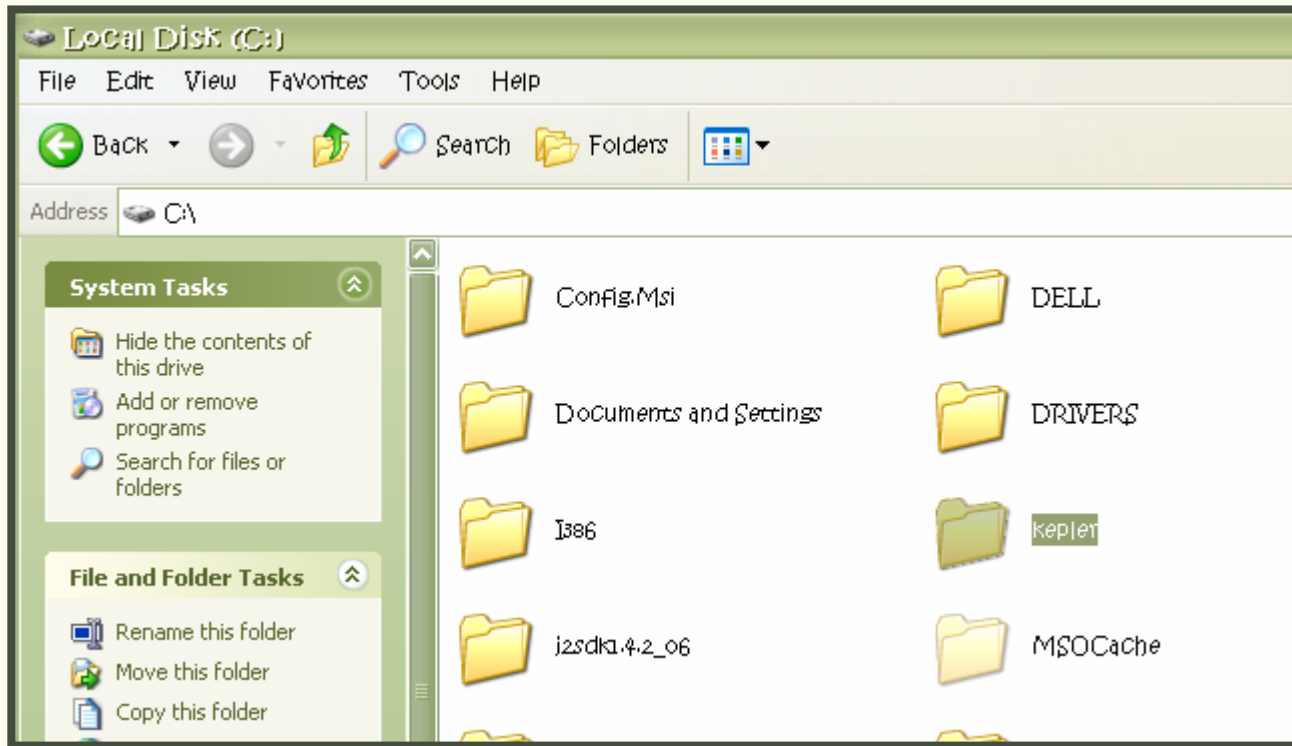
# Open Kepler

- ❑ Click on my computer
- ❑ Then C Drive





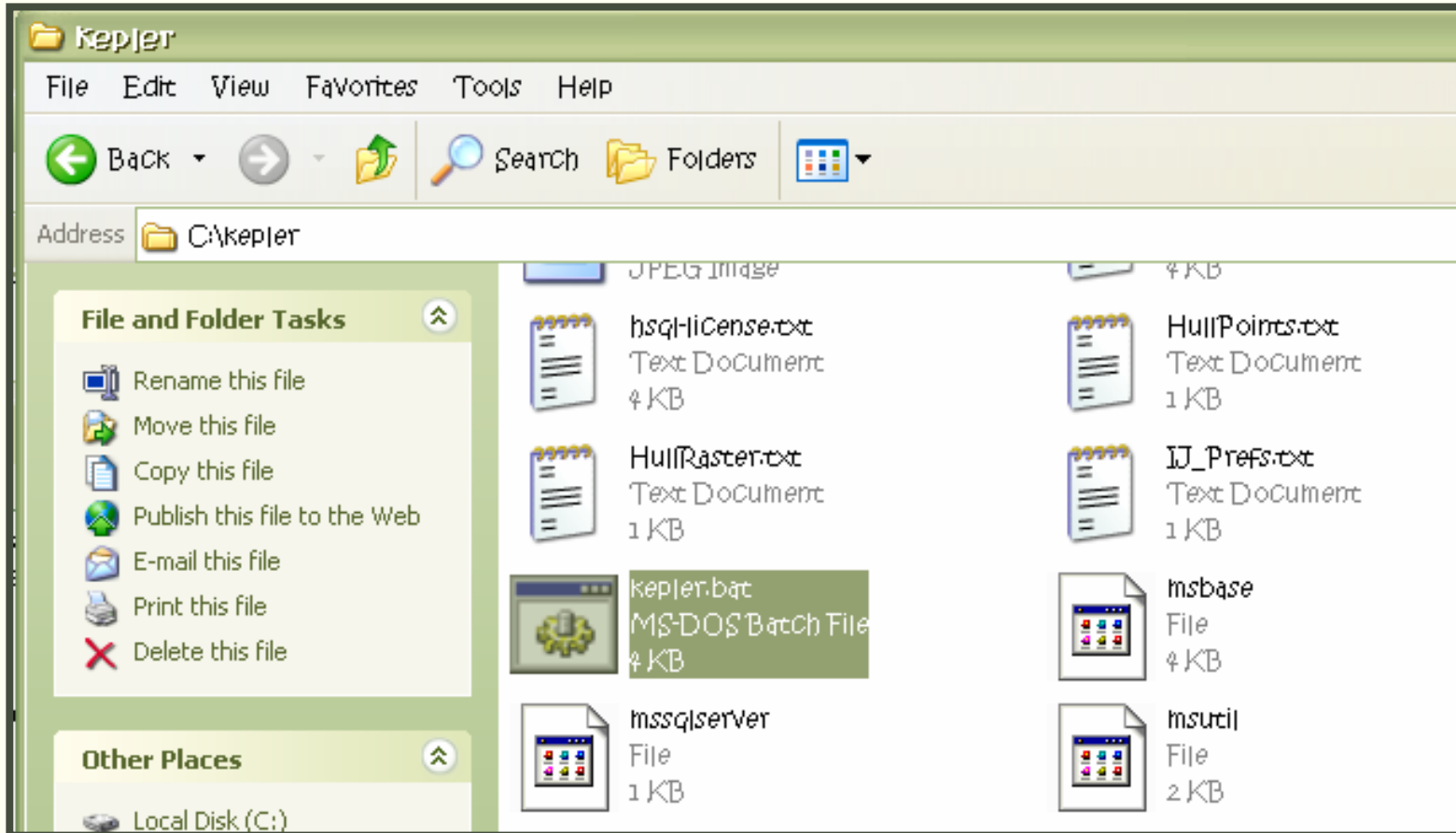
# Opening Kepler



- Locate and open the folder Kepler



# Opening Kepler



- ❑ Double click on Kepler.bat







# Opening Kepler

jar:file:/C:/Kepler/build/kepler-configs.jar!/ptolemy/configs/kepler/intro.htm

File Help

## Kepler: A System for Scientific Workflows



Version: 1.0.0alpha3



Welcome to the Kepler scientific workflow tool. You can select from one of the example workflows below or create your own by going to the file menu and selecting new/graph editor. Please send any questions/comments to our developer mailing list at [kepler-dev@ecoinformatics.org](mailto:kepler-dev@ecoinformatics.org).

Kepler is a collaboration between computer and domain scientists with the SEEK project (<http://seek.ecoinformatics.org>), the SDM Center (<http://sdm.lbl.gov/sdmcenter>), the Ptolemy II project (<http://ptolemy.eecs.berkeley.edu>), the GEON project (<http://www.geongrid.org>), the ROADNet project (<http://roadnet.ucsd.edu>), and the EOL project (<http://eol.sdsc.edu>).

{ \$Revision: 1.23 \$, \$Date: 2004/12/03 22:55:22 \$ }

### Ready-to-run Workflows

Workflow	Description
<a href="#">ENM (GARP) Workflows</a>	A link to a collection of Environmental Niche Model Workflows

- This is the Kepler software





# Opening the LV model

jar:file:/C:/Kepler/build/Kepler-Configs.jar!/ptolemy/Configs/Kepler/intro.htm

File Help

- Open File Ctrl+O
- Open URL
- New
- Save Ctrl+S
- SaveAs
- Print Ctrl+P
- Close Ctrl+W
- Exit

**GEON**  
CYBERINFRASTRUCTURE  
FOR THE GEOSCIENCES

**Ptolemy II**

**ROADNet**

**EOL**

(http://roadnet.ucsd.edu), and the EOL project (http://eol.sdsc.edu).  
{ \$Revision: 1.23 \$, \$Date: 2004/12/03 22:55:22 \$ }

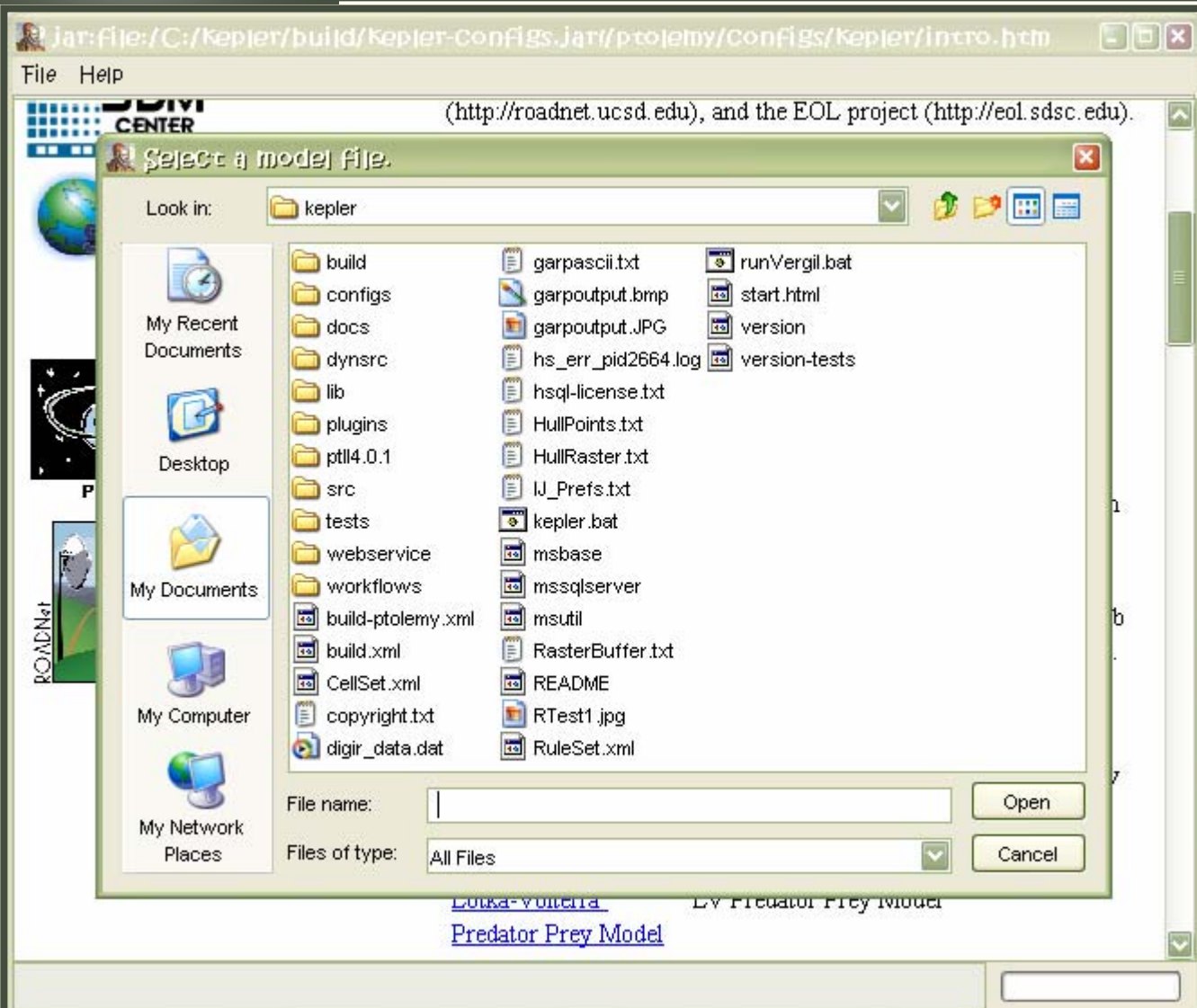
## Ready-to-run Workflows

Workflow	Description
<a href="#">ENM (GARP) Workflows</a>	A link to a collection of Environmental Niche Model Workflows
<a href="#">EML2 Simple Plot Example</a>	A workflow to test the EML 2.0 ingestion actor.
<a href="#">Promotor Identification Workflow</a>	A workflow that tests a number of the SciDAC actors including the genbank web service query actor and the BLAST actor.
<a href="#">GEON Mineral Classifier</a>	A workflow for modal classification of Igneous rocks.
<a href="#">GEON Map Workflow</a>	GEON geology map integration workflow using web services.
<a href="#">Discrete Logistic</a>	Single species Discrete Logistic model
<a href="#">Lotka-Volterra Predator Prey Model</a>	LV Predator Prey Model



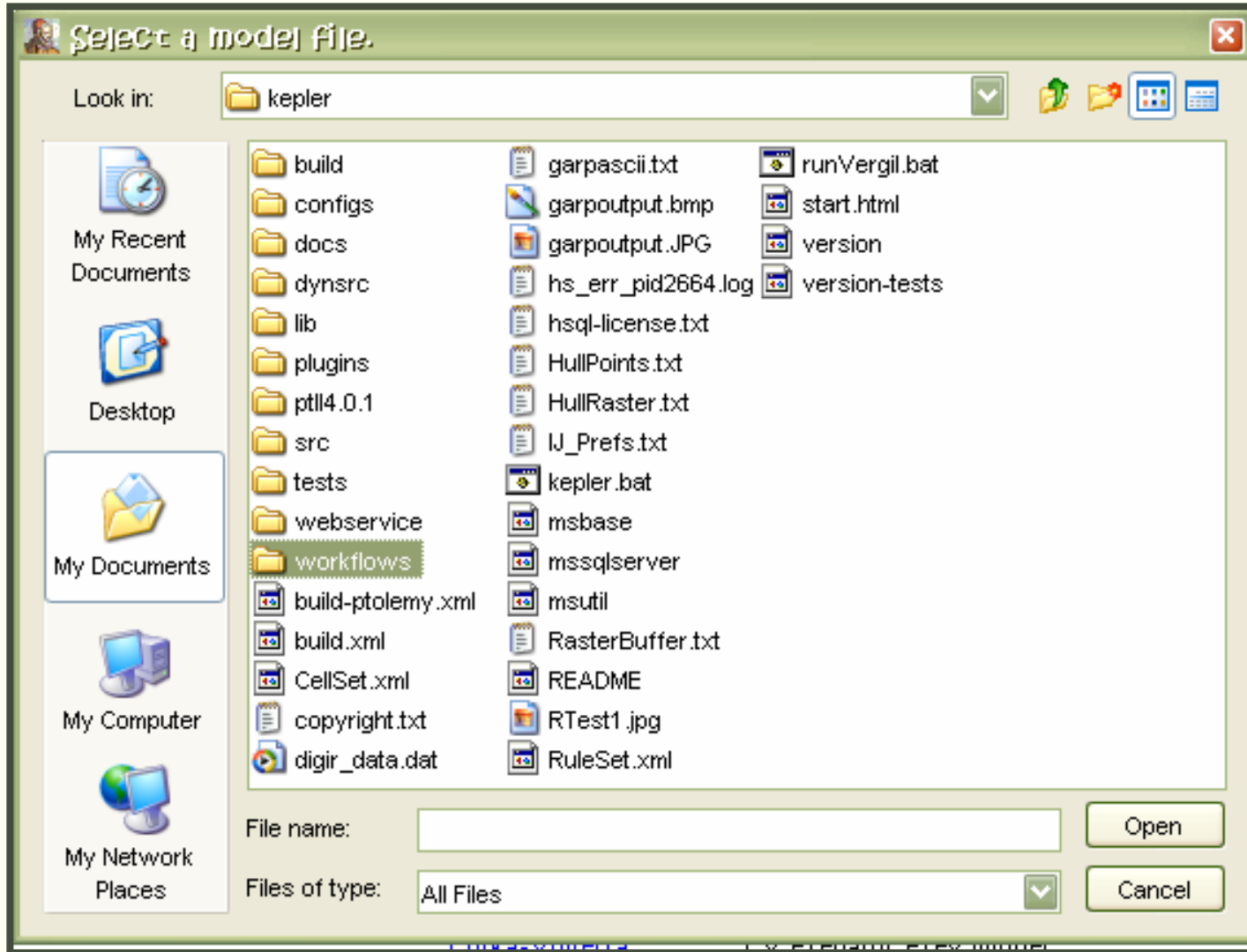


# Open Kepler



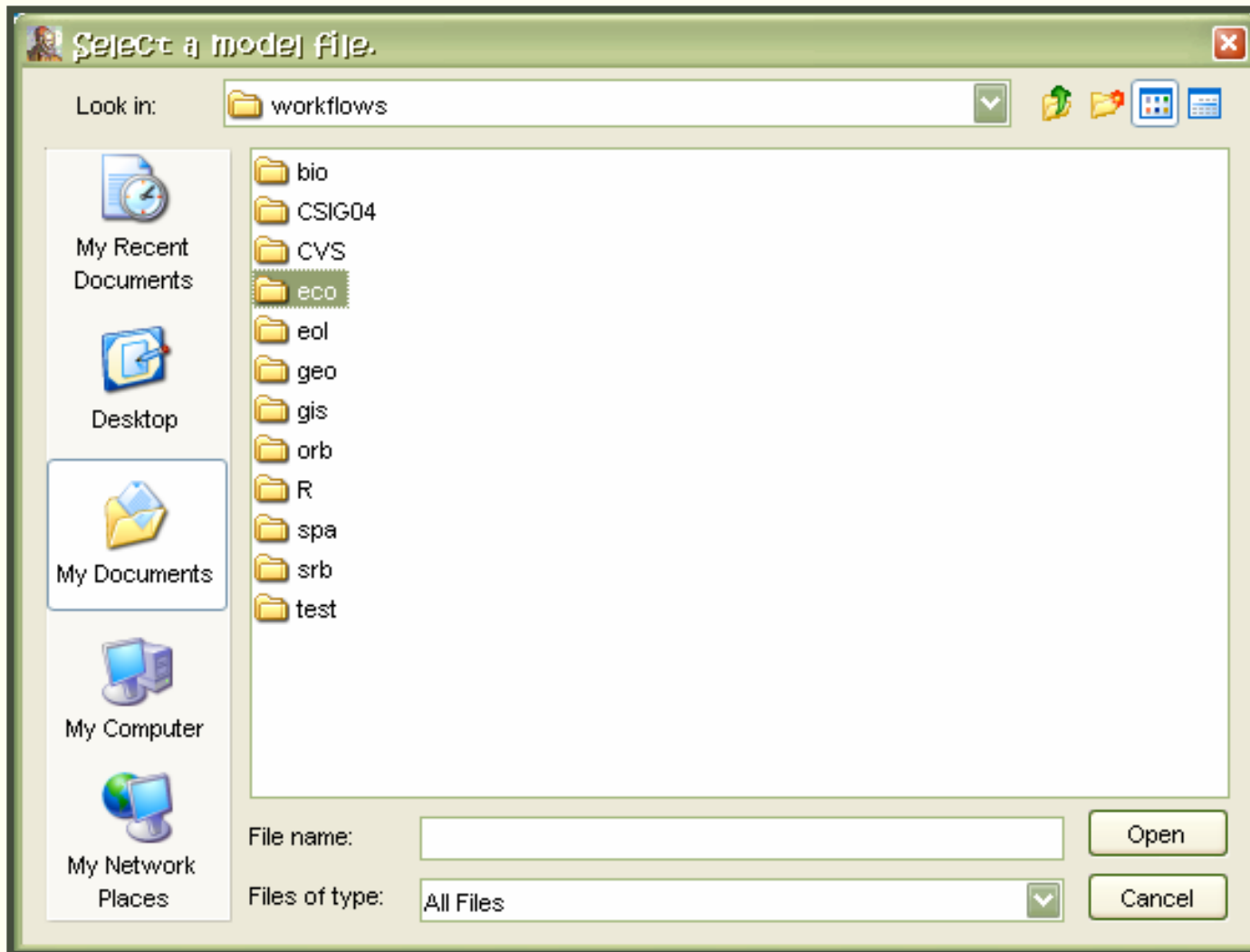


# Open workflows



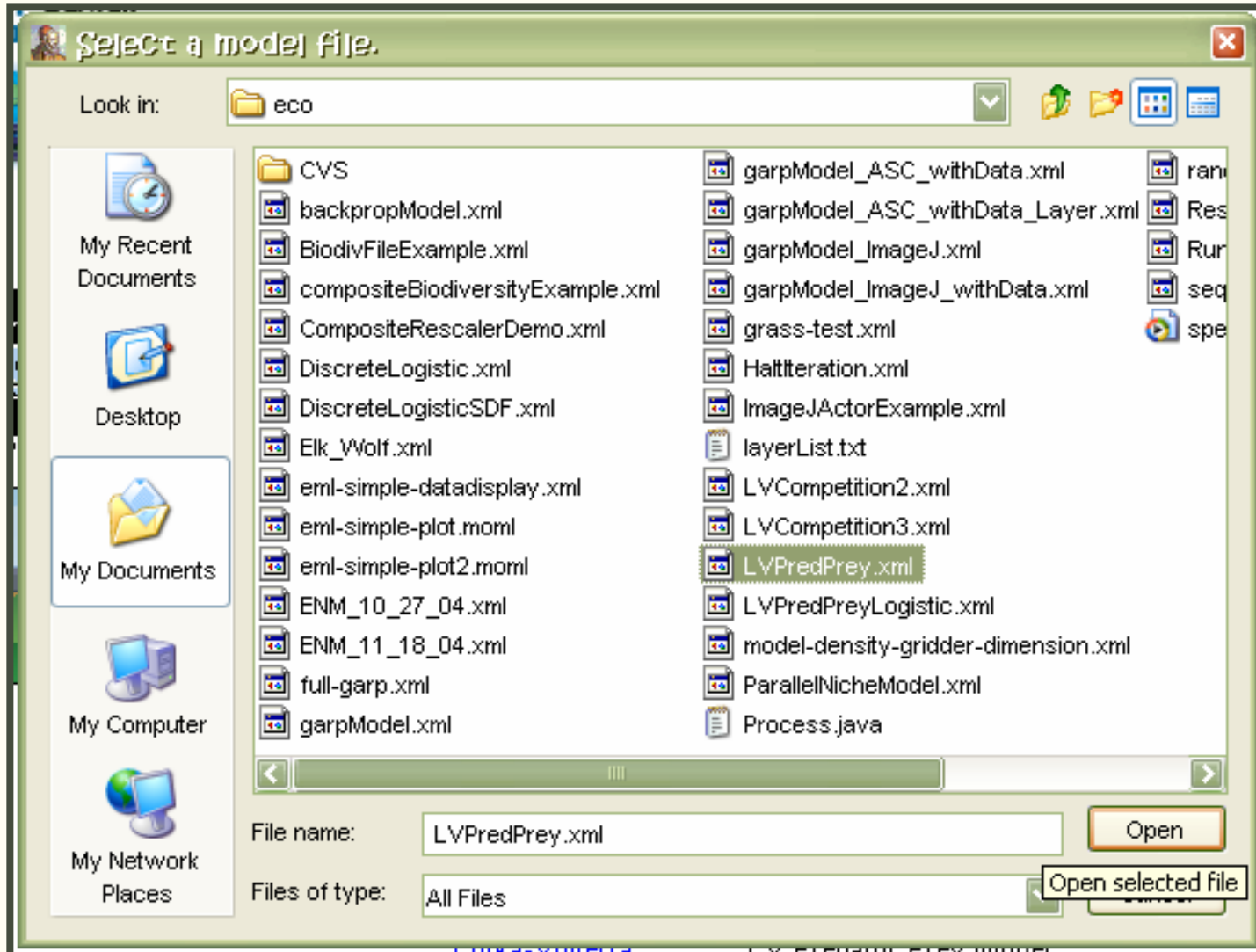


# Open the eco folder





# Open LVPredPrey.xml

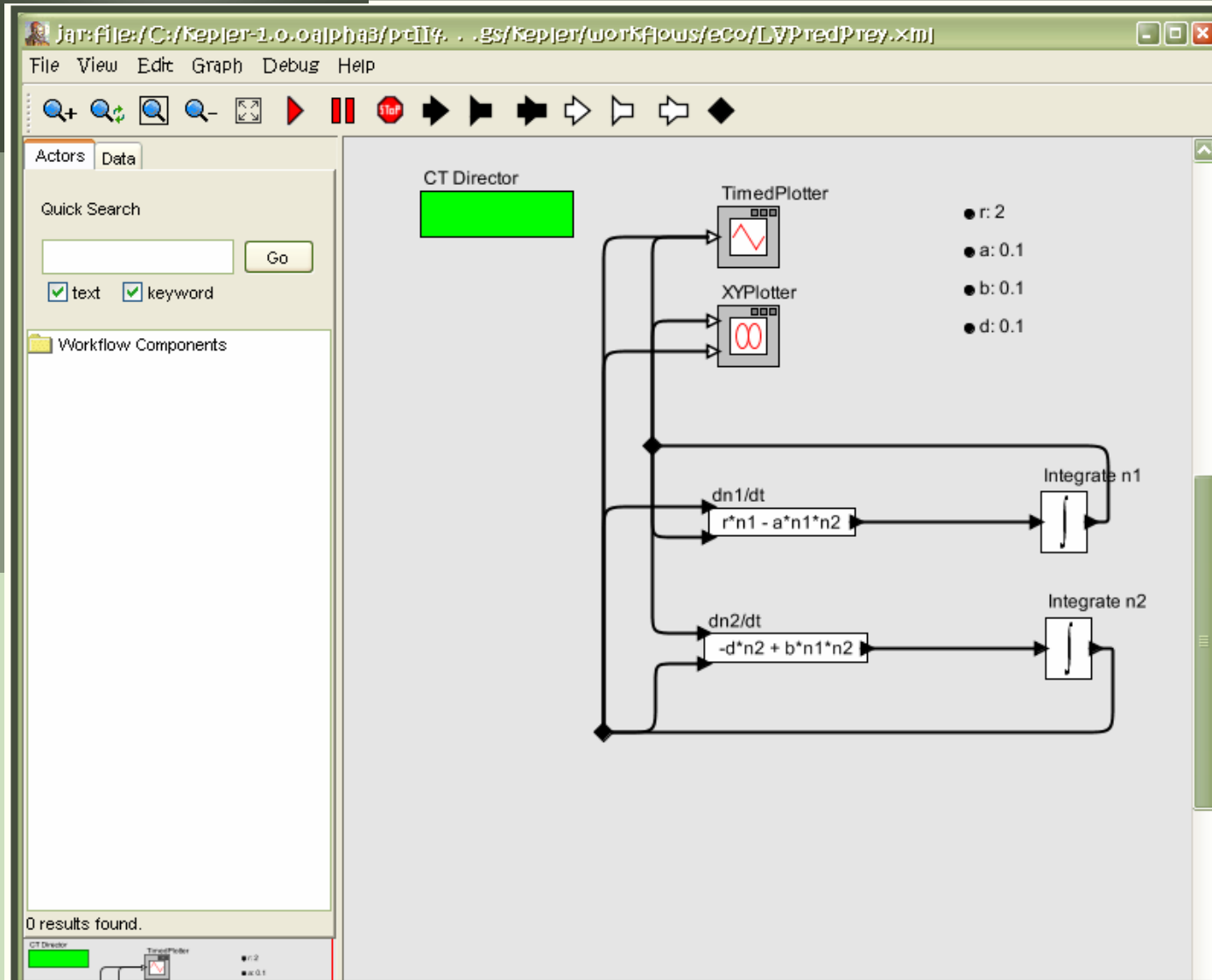


ER





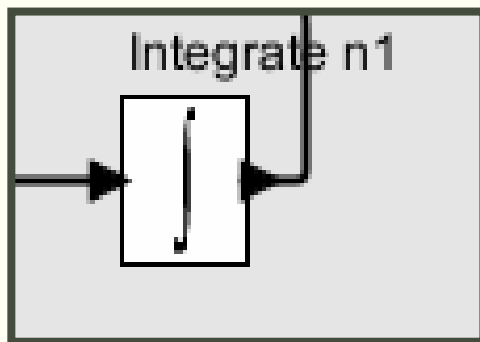
# Lotka-Volterra Predator Prey Model







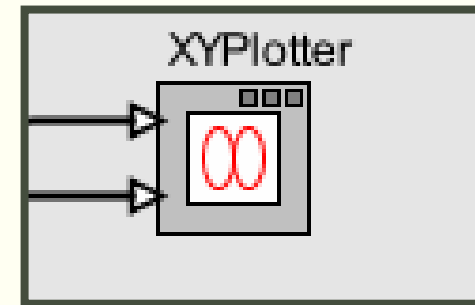
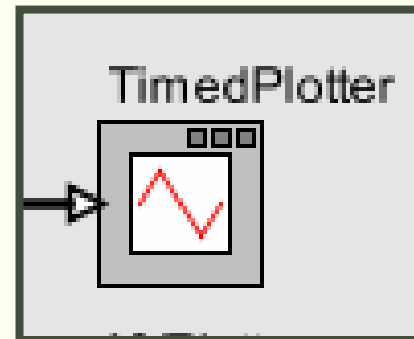
# Actors



□ Integral

□ The population growth of species 1 (prey)

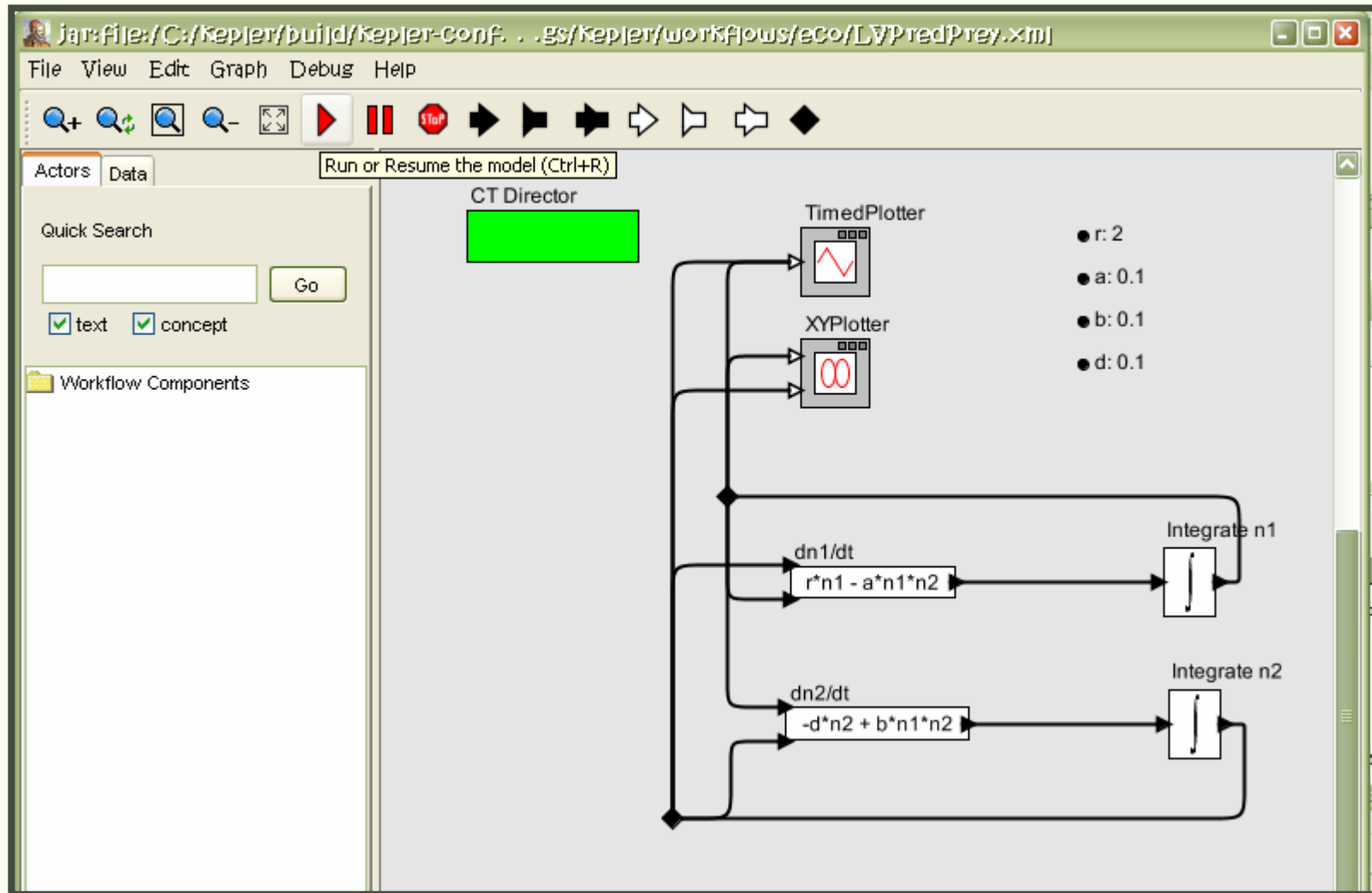
□ The population growth of species 2 (predator)







# Running the model





# Running the model

jar:file:/C:/kepler/build/kepler-conf...gs/kepler/workflows/eCo/LVPredPrey.xml

File View Debug Help

Go Pause Resume Stop

Model parameters:

r: 2

a: 0.1

b: 0.1

d: 0.1

Director parameters:

startTime: 0.0

stopTime: 1000

initStepSize: 0.1

minStepSize: 1.0E-5

maxStepSize: 1.0

maxIterations: 20

errorTolerance: 1.0E-4

valueResolution: 1.0E-6

timeResolution: 1.0E-10

synchronizeToRealTime: ☐

ODESolver: "ptolemy.domains.ct.kernel.solver.ExplicitRK23Solver"

breakpointODESolver: "ptolemy.domains.ct.kernel.solver.DerivativeResolver"

runAheadLength: 0.1

XYPlotter

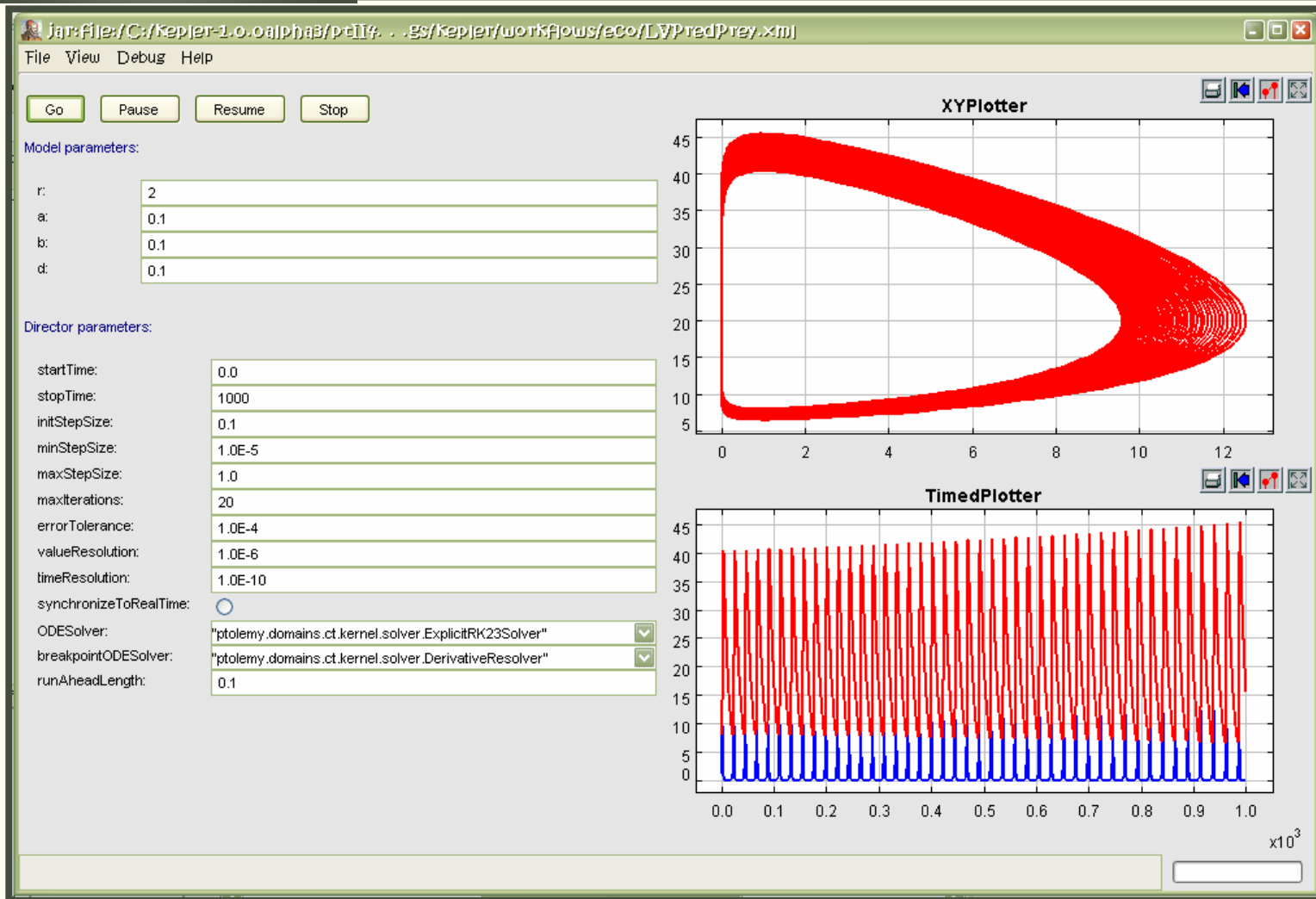
TimedPlotter

x10<sup>3</sup>



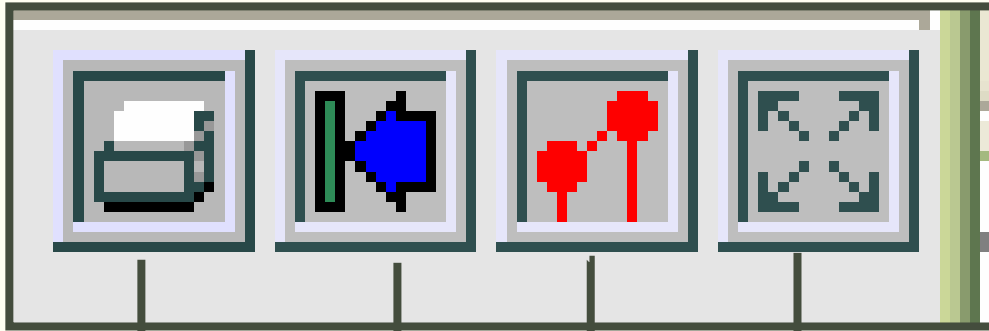


# Running the model





# Plotting Tool bar



printing

Reset X and Y ranges to  
their original values

Set plot format

Rescale plot to fit  
the data





# Setting the Plot format

**Set plot format** [X]

? Title: TimedPlotter

X Label:

Y Label:

X Range: 0.0, 1000.0

Y Range: 7.240265797121016E-4, 40.150381910313484

Marks: ☒ none ☐ points ☐ dots ☐ various ☐ pixels

X Ticks:

Y Ticks:

Grid: ☒

Stems: ☐

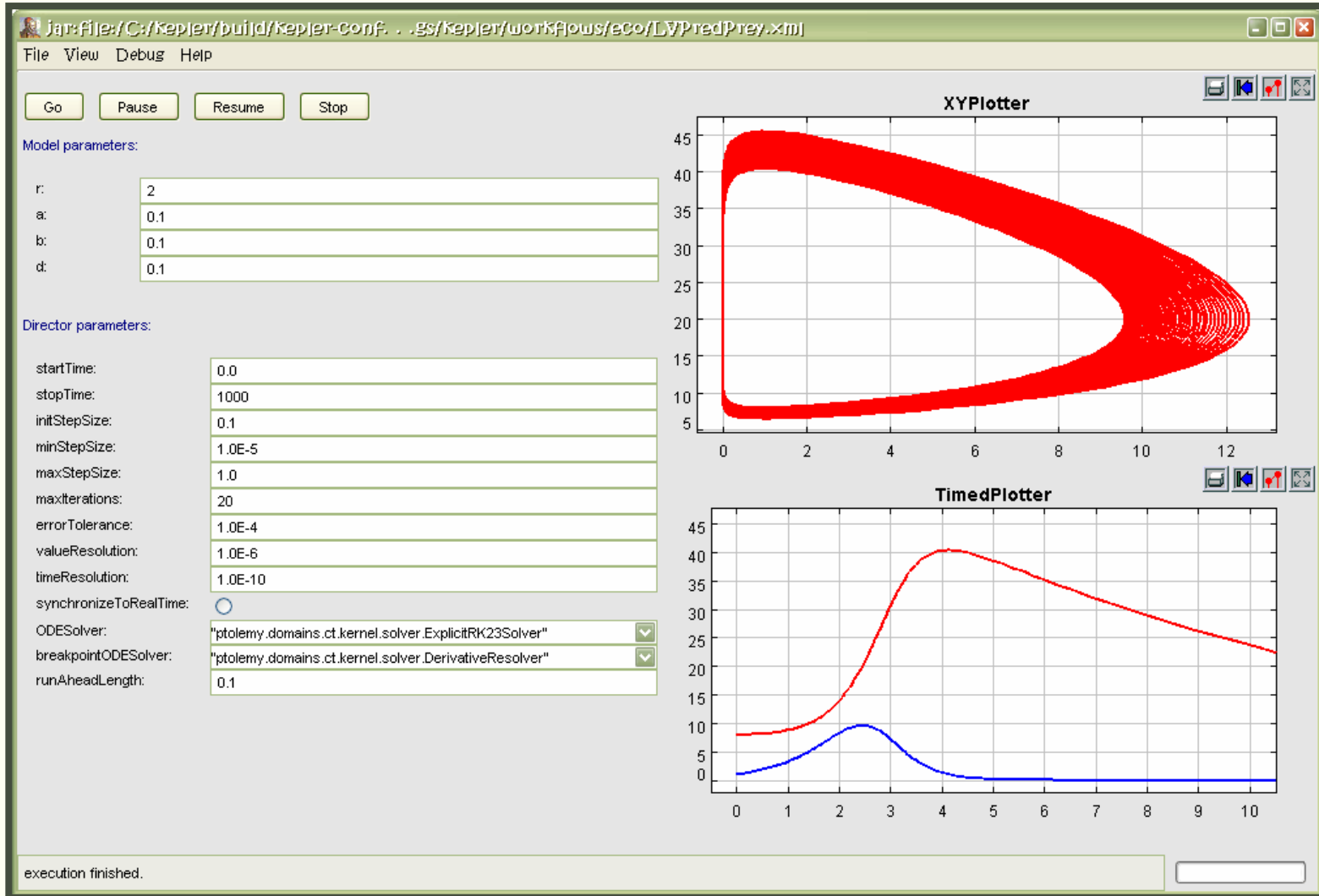
Connect: ☒

Use Color: ☒

Apply Cancel



# Running the model





# Opening the LV logistic model

jar:file:/C:/kepler-1.0.alpha3/ptII4...jar!/ptolemy/Configs/kepler/intro.htm

File Help



Ptolemy II



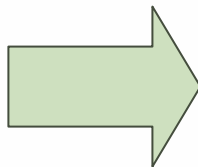
ROADNet



GEON  
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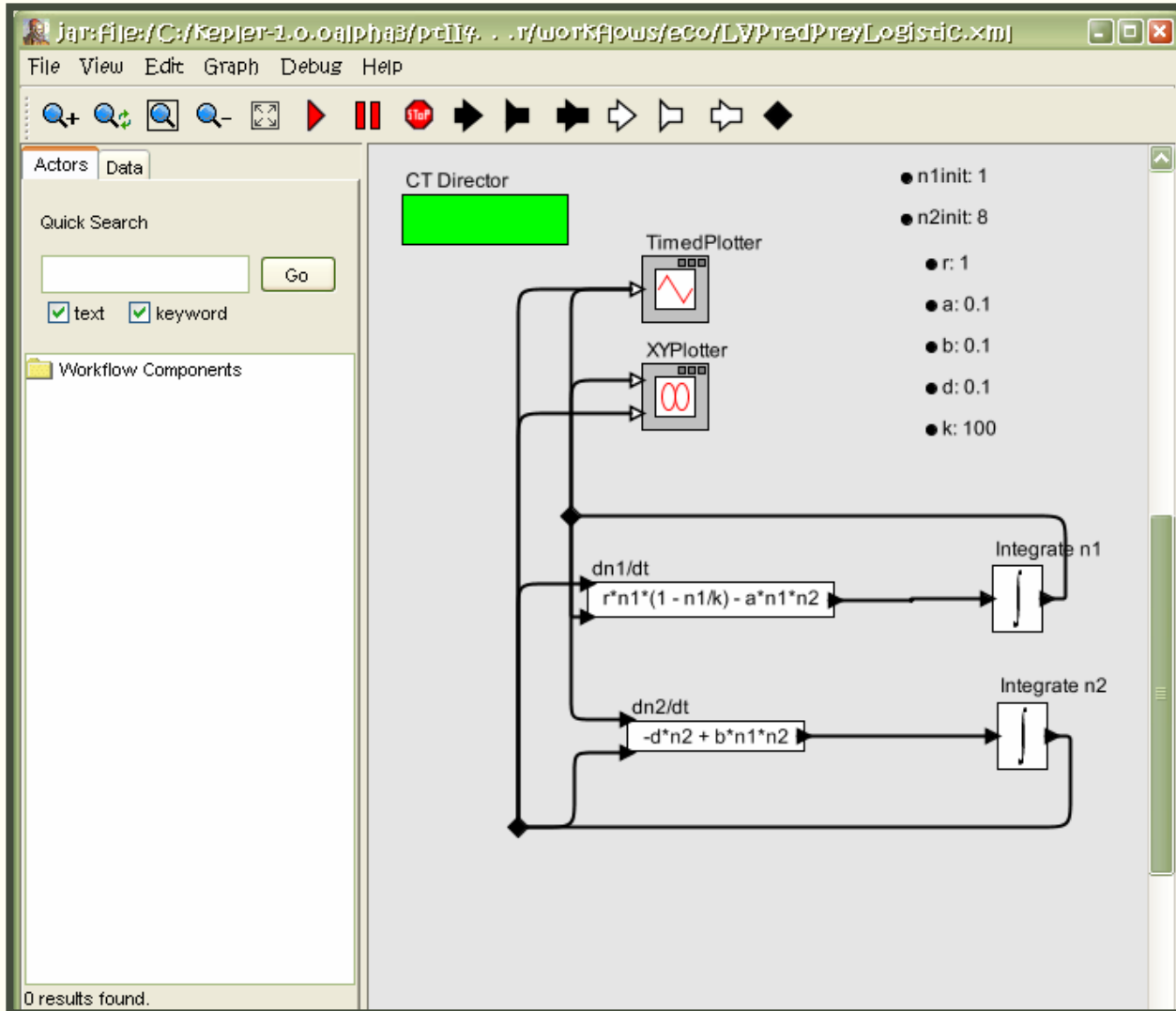
Workflow	Description
<a href="#">EML2 Simple Plot Example</a>	A workflow to test the EML 2.0 ingestion actor.
<a href="#">Promotor Identification Workflow</a>	A workflow that tests a number of the SciDAC actors including the genbank web service query actor and the BLAST actor.
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<a href="#">GEON Map Workflow</a>	GEON geology map integration workflow using web services.
<a href="#">Discrete Logistic</a>	Single species Discrete Logistic model
<a href="#">Lotka-Volterra Predator Prey Model</a>	LV Predator Prey Model
<a href="#">Lotka-Volterra Predator Prey Model with logistic growth</a>	Logistic version of the LV Predator Prey Model
<a href="#">Elk/Wolf Predator Prey Model</a>	Elk/Wolf Predator Prey Model
<a href="#">Biodiversity Index Calculator</a>	Example of Calculations of Various Biodiversity Indices
<a href="#">Orh Image Viewer</a>	A workflow that displays image data

kepler-1.0.alpha3/ptII4.0.1/lib/kepler-configs.jar!/ptolemy/configs/kepler/workflows/eco/LVPredPreyLogistic.xml





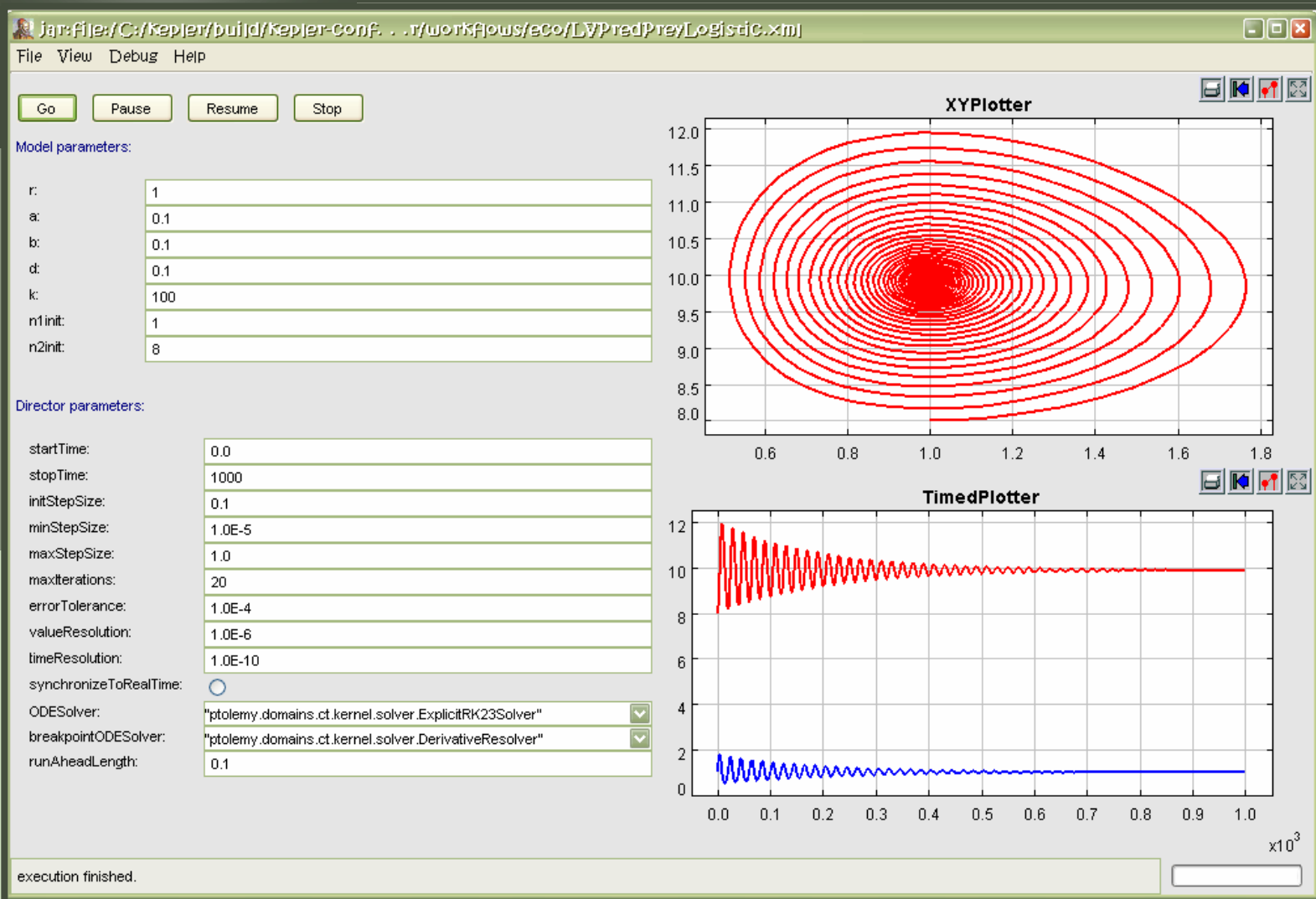
# Lotka-Volterra Predator Prey Model with logistic growth







# Running the model





# Opening the Elk/wolf model

jar:file:/C:/kepler-1.0.alpha3/ptll4...jar!/ptolemy/Configs/kepler/intro.htm

File Help



Ptolemy II



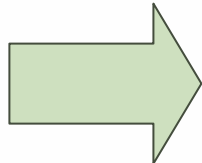
ROADNet



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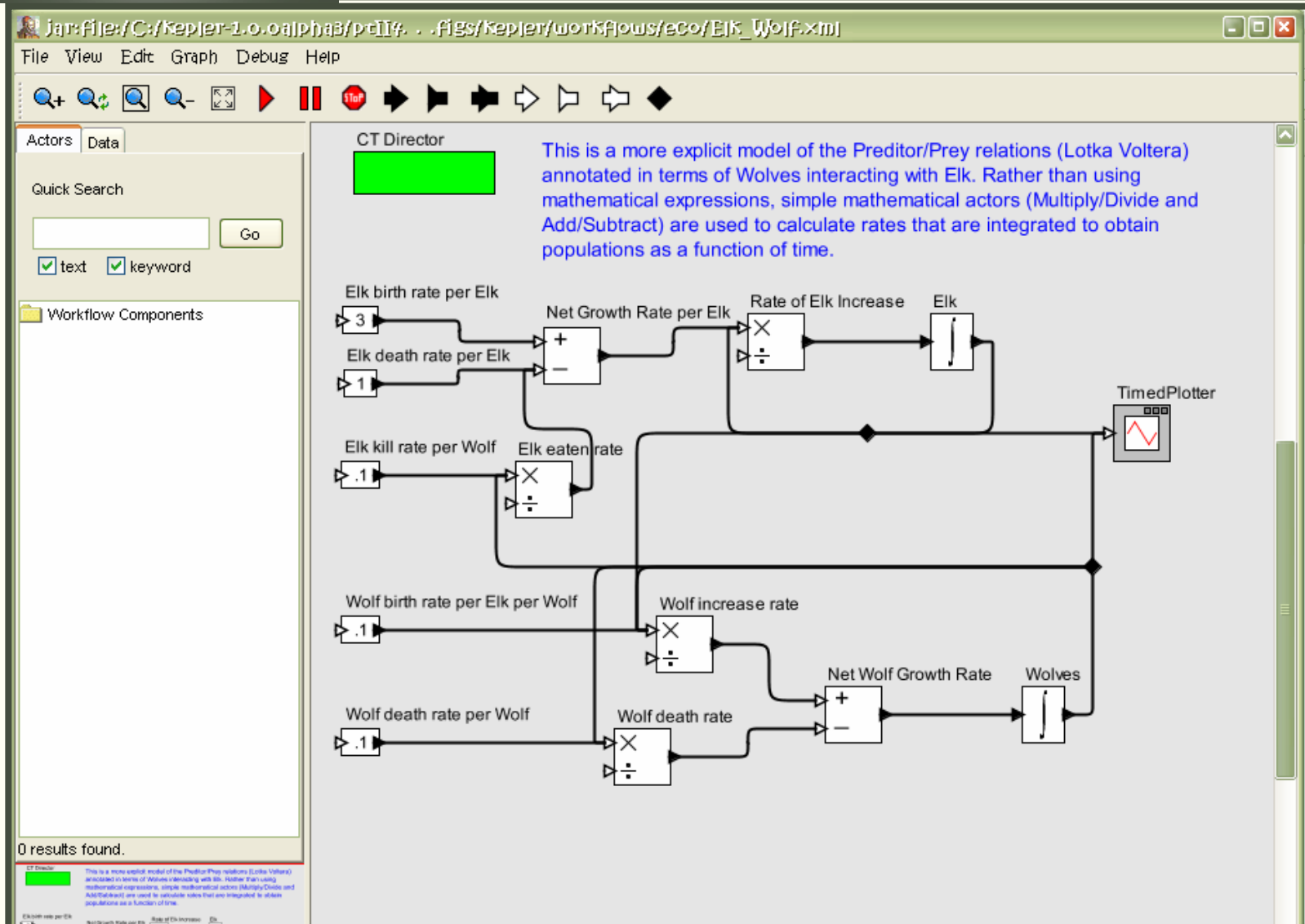
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<a href="#">Biodiversity Index Calculator</a>	Example of Calculations of Various Biodiversity Indices
<a href="#">Orh Image Viewer</a>	A workflow that displays image data

kepler-1.0.alpha3/ptll4.0.1/lib/kepler-configs.jar!/ptolemy/configs/kepler/workflows/eco/LVPredPreyLogistic.xml





# Elk/Wolf Predator Prey Model





# Running the model

