

The Aladdin-2 Launchpad

Engaging the User Community and Broadening Access to the GENIE Model on Local and Remote Computing Resources

Andrew R. Price, Sudipta Goswami, Martin Johnson, Ibrahim Almajai,
Gethin Williams, Simon Müller, Will Rawes, Simon J. Cox and Neil R.
Edwards

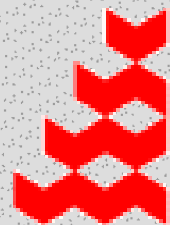
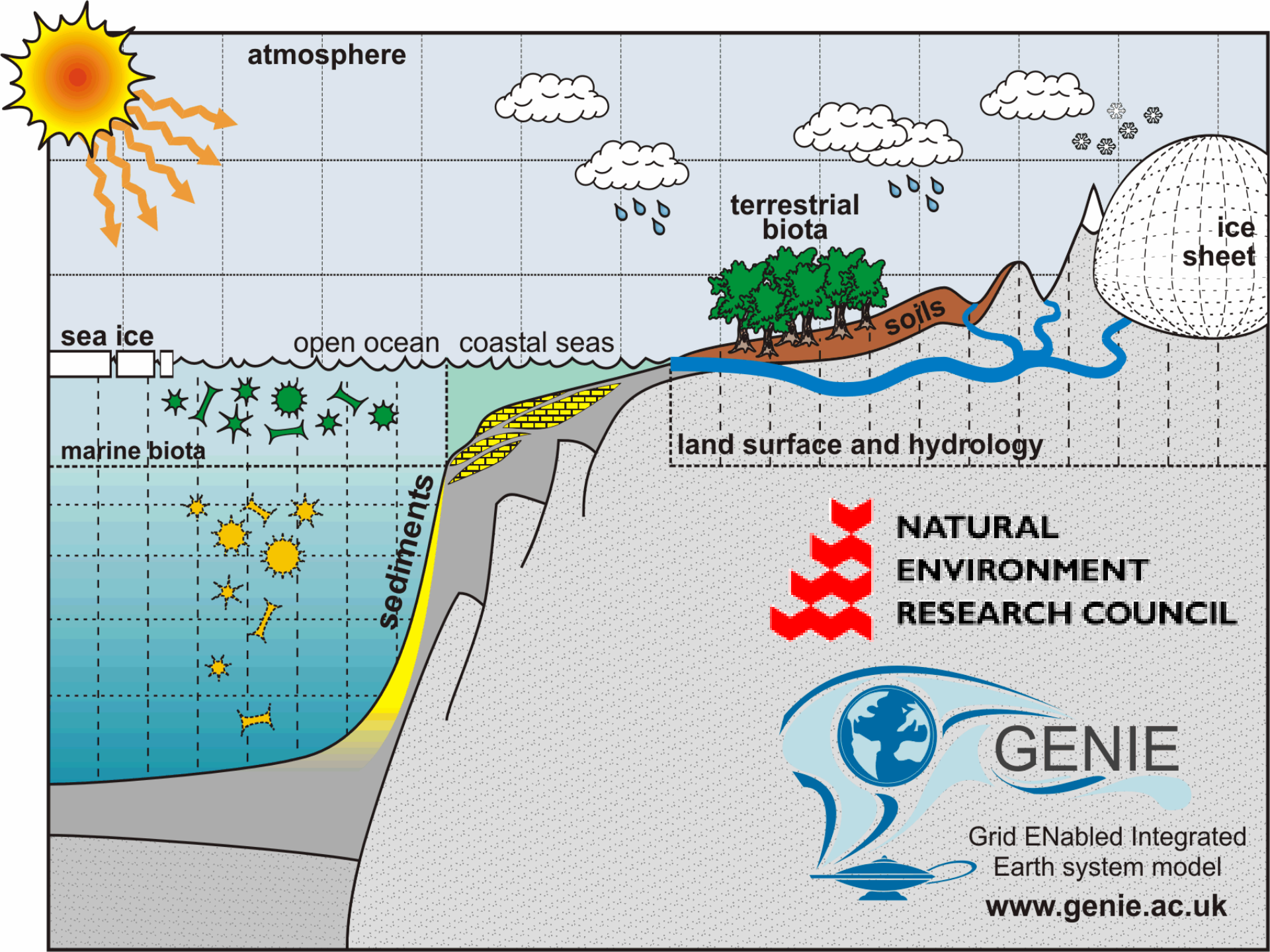
07 Dec 2009

Overview

- GENIE
- User's view of GENIE
- The Open University Climate Simulator
- ENGAGE Project: Aladdin2 launch-pad
- Research Support Tool Development
- Conclusions

GENIE

- Grid ENabled Integrated Earth system model
- GENIE is a Grid-enabled computing framework enabling users to:
 - Flexibly couple together state-of-the-art components to form a unified Earth System Model (ESM)
 - Execute the resultant ESMs across computational Grid infrastructure
 - Share the resultant data produced by simulation runs
 - Provide high-level open access to the system, creating and supporting virtual organisations of Earth System modellers
- The central scientific goal of the GENIE project is to study the forcing and feedbacks driving the glacial-interglacial cycles that dominated the Earth's climate over the last 1 million years
- By better understanding the processes (physical and biogeochemical) which regulated these cycles in the past, we can be more confident about the predictions climate models make for the future



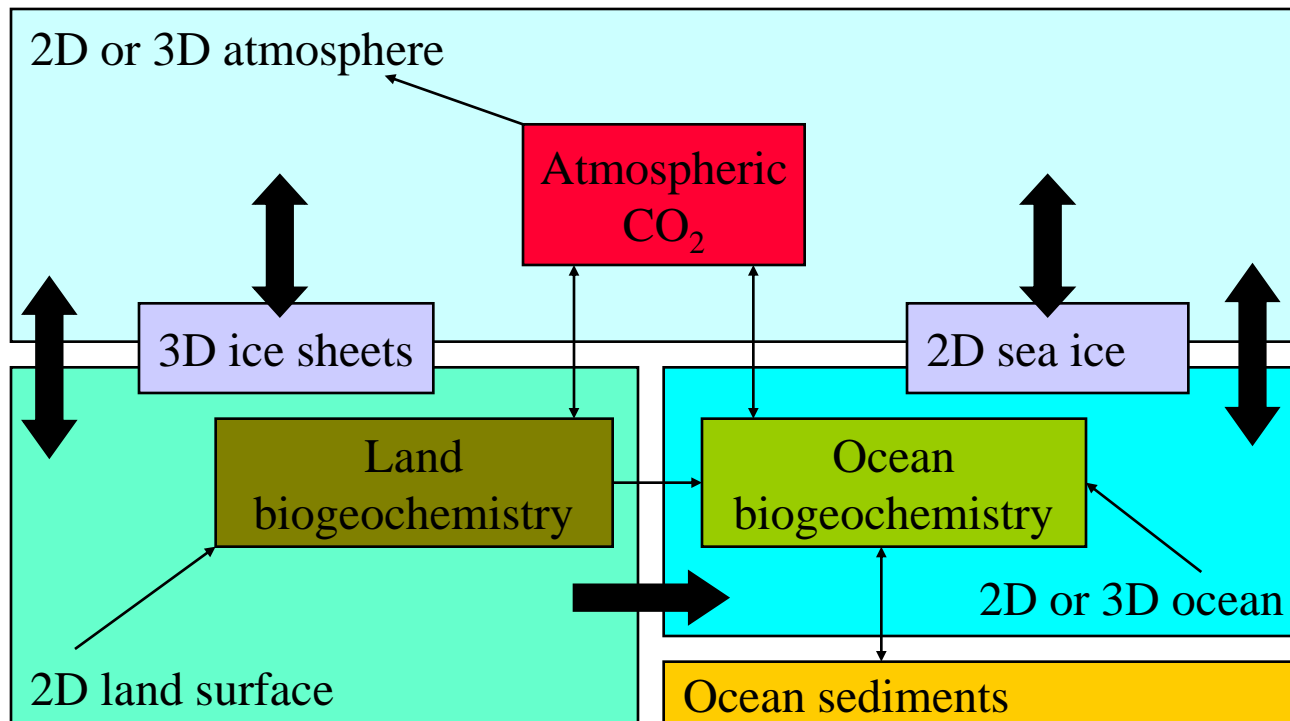
**NATURAL
ENVIRONMENT
RESEARCH COUNCIL**



GENIE
Grid ENabled Integrated
Earth system model
www.genie.ac.uk

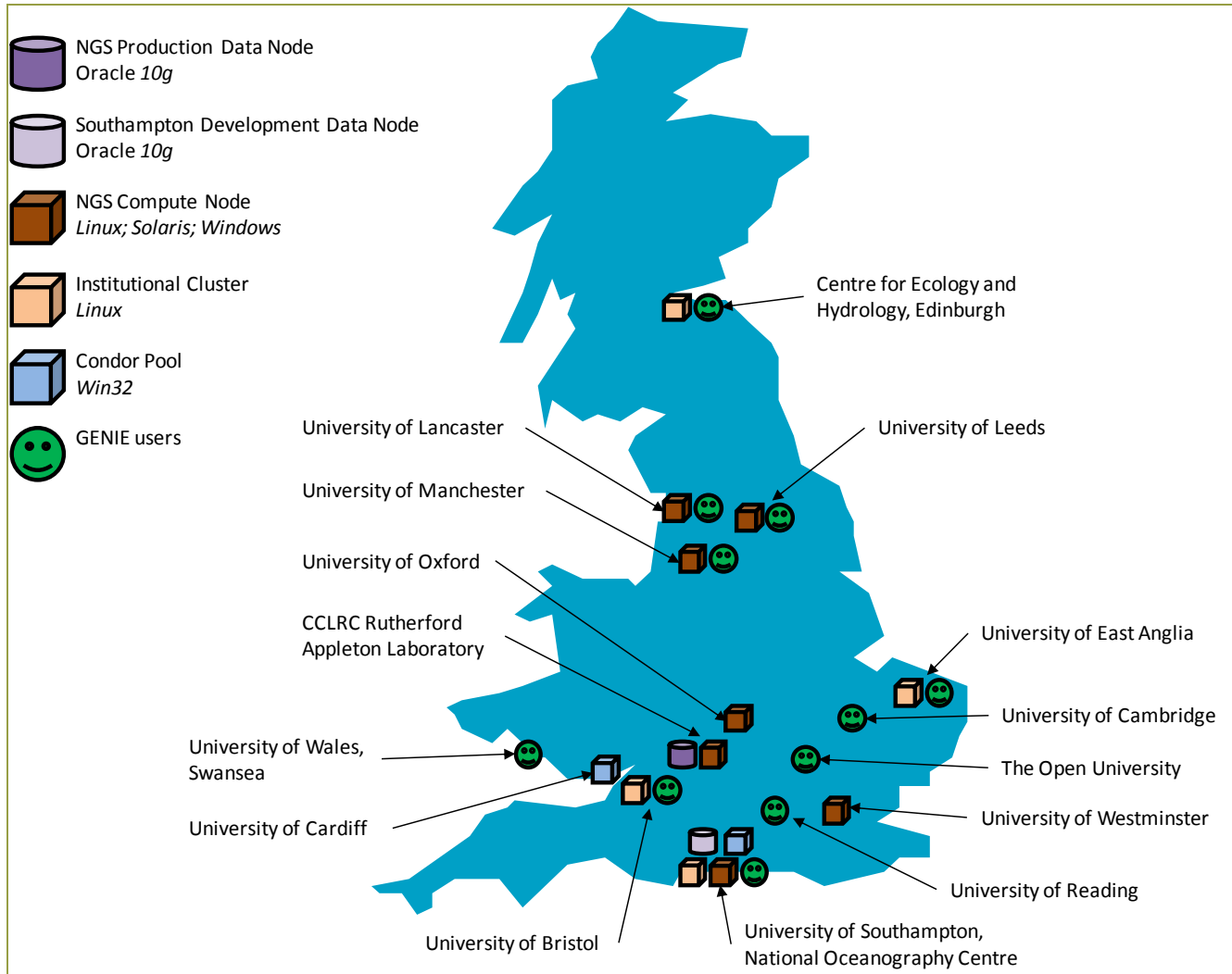
GENIE Modelling Framework

- Integrates component models of varying resolution, dimensionality & complexity
- Modular, scalable and traceable to more complex models



Schematic of the major component codes that are integrated to form climate models in the GENIE framework.

GENIE UK Community



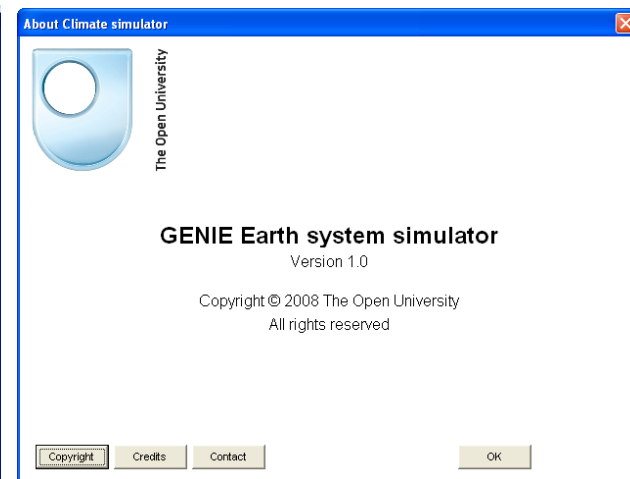
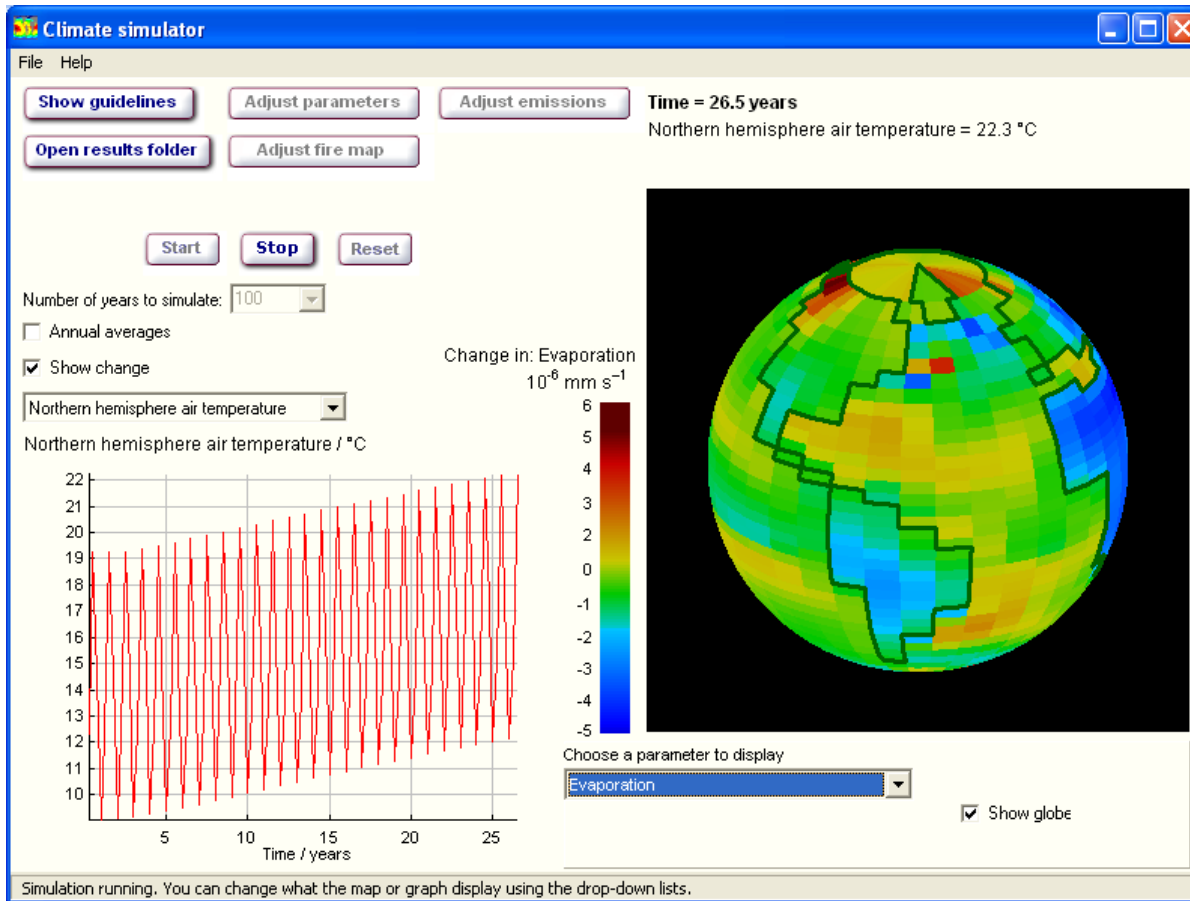
The GENIE user base is primarily UK based with a growing number of international collaborators and users. The Grid computing software is used to exploit compute and data resources on the UK National Grid Service and institutional clusters and Condor pools.

A User's view of GENIE

- GENIE code base is open to the community
 - Managed under Source Control - SubVersion
 - Users are expected to adhere to best practice
- Most research involving GENIE involves some modification of the code base
 - Users are expected to branch and tag code modifications
 - Mergers to the trunk must pass a comprehensive test suite
- Build environment
 - GNU make, Bash Shell (CygWin), C++ and Fortran Compilers, Python, Perl
- Third party library dependencies
 - NetCDF libraries often need to be built locally
 - ASCII and/or NetCDF data formats used for output
 - NetCDF data analysis tools
- Model Configuration
 - User typically selects a pre-existing XML configuration file
 - Advanced users create new XML configuration files
 - Currently about 23 model components with ~1200 configurable parameters

Open University Climate Simulator

- S396 Ecosystems – GENIE Earth system simulator



Open University Climate Simulator

- Provides intuitive access to a GENIE model
- Designed as a teaching tool for S396 Ecosystems course enabling users to prescribe CO₂ forcing scenarios
- Visualisation of model fields to provide immediate feedback
- However, of limited use to the GENIE community:
 - Tied to a single build of a legacy GENIE model
 - Platform specific Win32 application
 - Processes ASCII based output files



engage
Engaging research with
e-Infrastructure

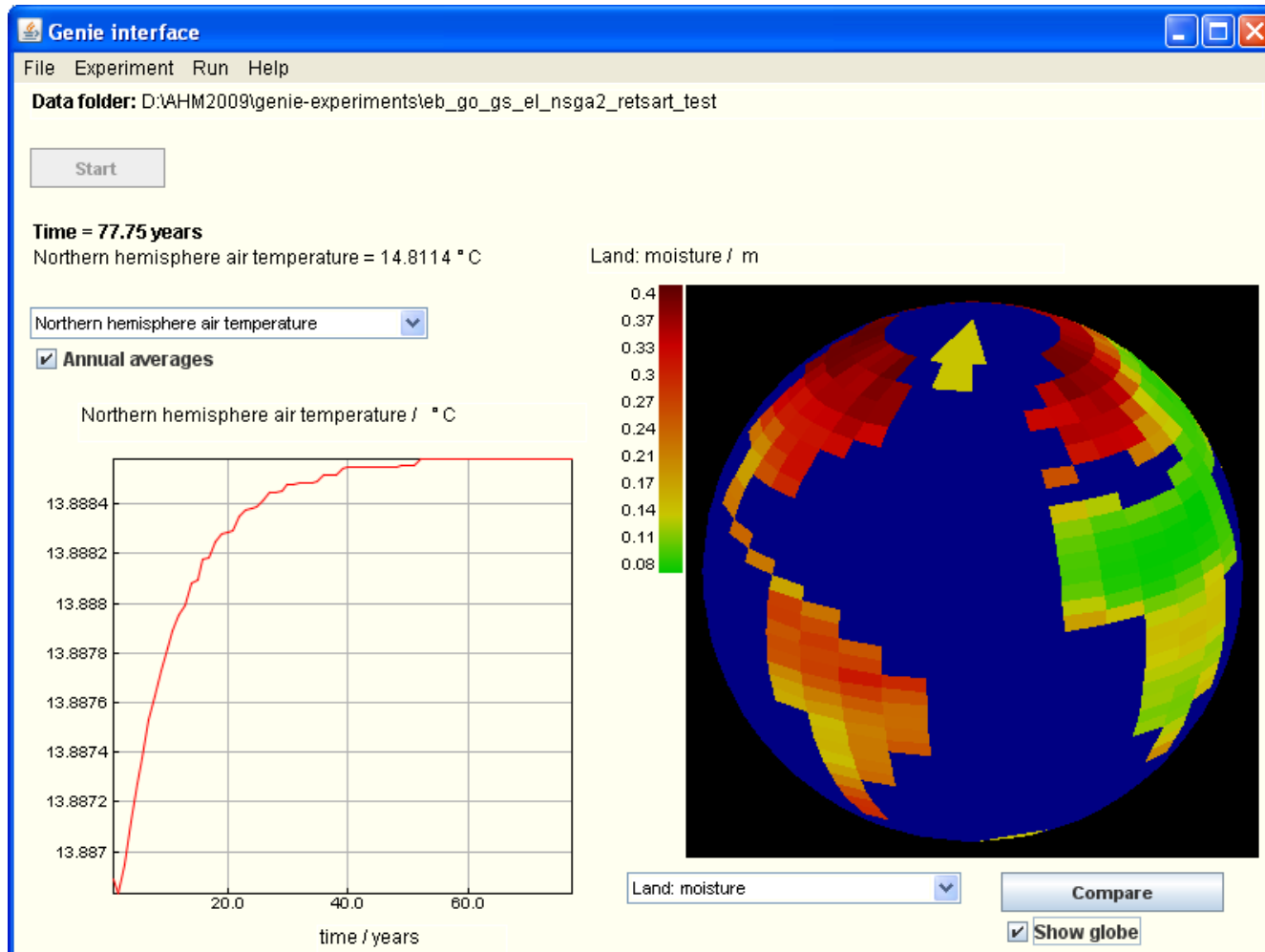


omii-uk
Software Solutions
for e-Research

UNIVERSITY OF
Southampton
School of Engineering Sciences

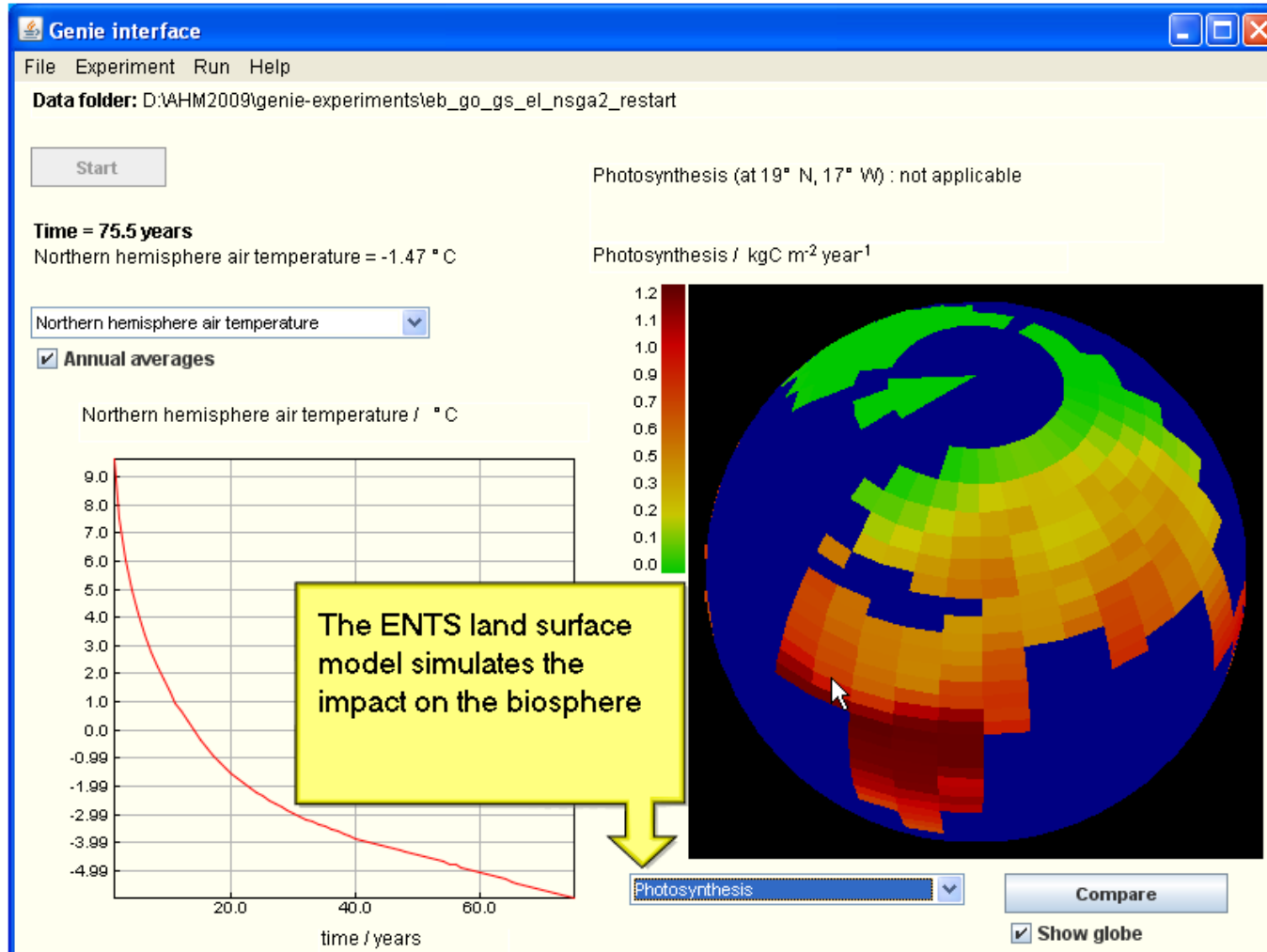
- Approached the ENGAGE project to extend the functionality of the OU Climate Simulator for wider benefit to the GENIE community
- (From the case for support) The key differences will be:
 1. it will be coded in Java for cross-platform functionality
 2. it will include a selection of model 'flavours' precompiled from tagged releases of GENIE source code
 3. dynamic selection of available parameters from XML configuration files
 4. coherent data output to NetCDF and ASCII for visualisation using other software

Aladdin2 Teaching Tool



Primary development
carried out by Will Rawes
and Simon Müller, Open
University.

OMII-UK Booth Demonstration



Key gains for the GENIE User Community

- Immediate appealing out-of-the-box usability for standard GENIE builds
- Platform independence
- Supports various ‘flavours’ of GENIE model
- Real-time visualisation of model output
- Configurable to target specific teaching tasks
 - Instructor exposes a subset of configurable parameters
 - Enables simple forcing scenarios to be investigated

e-Science Considerations

- Models are a community asset
 - Users often augment the code for their own needs
 - Requires an accessible Fortran code base
 - Science carried out with tagged releases of the code
- Must remain possible to build and execute in a standard working environment (Fortran compiler + libraries)
- e-Science infrastructure therefore provides additional functionality but is not integral to the framework


GENIELab

- GENIELab provides a set of Matlab functions to manage GENIE models on the Grid
- Built upon the Geodise toolboxes
- Provides routines to automatically manage metadata creation for archival of simulation output
- Scripted workflows available for
 - collaborative study of ensembles of simulations
 - parameter estimation studies exploiting OptionsMatlab
 - visualisation of simulation and ensemble output

Research Support Tool Development

- Java GUI code base being extended into a research support tool
 - Research Support Tool will enable users to compose and configure the model ‘flavour’ and generate portable experiment builds
 - XML configuration libraries and visualisation routines can be directly exploited
 - ASCII I/O replaced with NetCDF routines
 - Support for definition of ensembles (the primary need for distributed computing)
- GENIELab
 - Port of GENIELab scripted workflows for job submission, job monitoring and results retrieval to Java GUI
 - Integration of GEODISE Java classes to interface with the National Grid Service

Research Support Tool Prototype

 Aladdin-2

Aladdin-2 Research Support Tool for GENIE

Experiment

Primary Activity: Choose one of the following... Experiment ID: Create Unique ID

GENIE Code Base Location: Enter genie root folder... ...

Base Configuration: Select config file... Save Config. changes

Model setup

Module configuration

Ensemble Definition

Execution Environment

Results

Archive

Ocean

☐ GOLDSTEIN

☐ FIXEDOCEAN

☐ SLABOCEAN

Atmosphere

☐ EMBM

☐ FIXEDATMOS

☐ IGCN

Sea-ice

☐ GOLD-SEAICE

☐ FIXEDSEAICE

☐ SLABSEAICE

Ice Sheet

☐ GLIMMER

☐ FIXEDICESHEET

Land

☐ MOSES-LAND

☐ FIXEDLAND

☐ ENTS

Chemistry

☐ BIOGEM

☐ FIXEDCHEM

☐ ICHEM

☐ ATCHEM

☐ SEDGEM

Exit

Research Support Tool Prototype

Aladdin-2

Aladdin-2 Research Support Tool for GENIE

Experiment

Primary Activity: Experiment ID:

GENIE Code Base Location: ...

Base Configuration:

Model setup | Module configuration | Results | Archive

Ocean

☒ **GOLDSTEIN**

☐ FIXEDOCEAN ☐ FIXEDATMOS ☐ FIXEDSEAICE

☐ SLABOCEAN ☐ IGCN ☐ SLABSEAICE

Ice Sheet

☐ GLIMMER ☐ FIXEDICESHEET

Land

☐ MOSES-LAND ☐ FIXEDLAND


☒ **ENTS**

Chemistry

☐ BIOGEM ☐ FIXEDCHEM ☐ ICHEM

☐ ATCHEM ☐ SEDGEM

Research Support Tool Prototype

 Aladdin-2

Aladdin-2 Research Support Tool for GENIE

Experiment

Primary Activity:

Set an experiment

Experiment ID:

eb_go_gs_el_tuning

Create Unique ID

GENIE Code Base Location:

D:\GENIE\trunk

...

Base Configuration:

eb_go_gs_el_test.xml

Save Config. changes

Model setup

Module configuration

Ensemble Definition

Execution Environment

Results

Archive

Ocean

☒ GOLDSTEIN

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☐ ICHEM

☐ ATCHEM

☐ SEDGEM

Exit

Research Support Tool Prototype

Aladdin-2

Aladdin-2 Research Support Tool for GENIE

Experiment

Primary Activity: Experiment ID:

GENIE Code Base Location: ...

Base Configuration:


Model setup | **Module configuration** | Ensemble Definition | Execution Environment | Results | Archive

Module Parameter:

- adrag
- adrag**
- albocn
- ans
- ascout
- cmip_model
- conserv_per
- ctrl_diagend
- dirnetout

Base Value:

Research Support Tool Prototype

 Aladdin-2

Aladdin-2 Research Support Tool for GENIE

Experiment

Primary Activity:

Experiment ID:

GENIE Code Base Location:

Base Configuration:

Model setup

Module configuration

Ensemble Definition

Execution Environment

Results

Archive

Design of Experiment

Number of variables:

Generating function:

Number of Samples:

Module	Parameter	Scale	Minimum	Maximum	Samples

Exit

Research Support Tool Prototype

Aladdin-2

Aladdin-2 Research Support Tool for GENIE

Experiment

Primary Activity: Experiment ID:

GENIE Code Base Location: ...

Base Configuration:

Model setup
Module configuration
Ensemble Definition
Execution Environment
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Archive

Design of Experiment

Number of variables: Generating function: Number of Samples:

Module	Parameter	Type	Scale	Minimum	Maximum
goldstein	adrag	Range	Linear	0.5	5.0
goldstein	scf	Range	Linear	1.0	3.0
embm	diffin	Range	Linear	0.0	0.25
embm	diffwid	Range	Linear	0.5	2.0
embm	scl_fwif	Range	Linear	0.0	2.0
goldstein					
goldsteinseai					
embm					
ents					

Exit

Research Support Tool Prototype

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Primary Activity: Experiment ID:

GENIE Code Base Location: ...

Base Configuration:

Model setup
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embm	diffwid	Range	Linear	0.5	2.0
embm	scl_fwf	Range	Linear	0.0	2.0
goldsteinseice					
	ans				
	ascout				
	conserv_per				
	diffsic				
	dirnetout				
	dosc				
	filenetin				
	ianav				

Exit

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Primary Activity: Experiment ID:

GENIE Code Base Location: ...

Base Configuration:

Model setup
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embm	scl_fwif	Range	Linear	0.0	2.0
goldsteinseice	diffsic	Range	<div> Linear Log10 Log2 Ln </div>		

Exit

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Primary Activity: Experiment ID:

GENIE Code Base Location: ...

Base Configuration:

Model setup
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embm	diffwid	Range	Linear	0.5	2.0
embm	scl_fwf	Range	Linear	0.0	2.0
goldsteinseice	diffsic	Range	Linear	500.0	8000.0

Exit

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Set an experiment
Experiment ID:
eb_go_gs_el_tuning
Create Unique ID

GENIE Code Base Location:
D:\GENIE\trunk
...

Base Configuration:
eb_go_gs_el_test.xml
Save Config. changes

Model setup
Module configuration
Ensemble Definition
Execution Environment
Results
Archive

Ensemble Size: 100
Number of Incomplete Simulations: 100
Submit
Reset

☐ Local Machine (fork)
Number of Jobs: 1
☐ Condor (condor-submit)
Number of Jobs: 1
☐ Geodise (gd_jobsubmit)

Proxy Certificate Management:
Certificate Subject: /C=UK/O=eScience/OU=Southampton/L=SeSC/CN=andrew price/CN=proxy
Create Proxy Certificate
Proxy Time Left: 1 h, 22 min, 7 sec
Destroy Proxy Certificate

Globus Gateway	Job Manager	Path	Number of Jobs	
				Add
				Remove
				Move Up
				Move Down

Active / Complete Simulations

■ Initialised
■ Pending
■ Active
■ Complete
■ Failed
■ Suspended
■ Unknown

Exit

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Experiment

Primary Activity: Experiment ID:

GENIE Code Base Location: ...

Base Configuration:

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Archive

Ensemble Size: 100

☐ Local Machine (fork) Number of Jobs:
☐ Condor (condor-submit) Number of Jobs:
☒ Geodise (gd_jobsubmit)

Proxy Certificate Management

Certificate Subject: /C=UK/O=eScience/OU=Southampton/L=SeSC/CN=andrew price/CN=proxy

Proxy Time Left: 1 h, 12 min, 52 sec

Globus Gateway	Job Manager	Path	Number of Jobs	
ngs.oerc.ox.ac.uk	jobmanager-pbs	/home/ngs0043/Aladdin/	8	<input type="button" value="Add"/> <input type="button" value="Remove"/> <input type="button" value="Move Up"/> <input type="button" value="Move Down"/>
ngs.leeds.ac.uk	jobmanager-pbs	/home/ngs0044/Aladdin/	8	
ngs.rl.ac.uk	jobmanager-lsf	/home/ngs0165/Aladdin/	8	
ngs.oerc.ox.ac.uk ngs.leeds.ac.uk ngs.rl.ac.uk vidar.ngs.manchester.ac.uk cluster1.uea.ac.uk ccsglobusgateway.soton.ac.uk				

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Ensemble Size: 100
Submit
Reset

☐ Local Machine (fork)
Number of Jobs:
1
☐ Condor (condor-submit)
Number of Jobs:
1
☒ Geodise (gd_jobsubmit)

Proxy Certificate Management:
Certificate Subject: /C=UK/O=eScience/OU=Southampton/L=SeSC/CN=andrew price/CN=proxy
Create Proxy Certificate
Proxy Time Left: 1 h, 49 sec
Destroy Proxy Certificate

Globus Gateway	Job Manager	Path	Number of Jobs
ngs.oerc.ox.ac.uk	jobmanager-pbs	/home/ngs0043/Aladdin/	8
ngs.leeds.ac.uk	jobmanager-pbs	/home/ngs0044/Aladdin/	8
ngs.rl.ac.uk	jobmanager-lsf	/home/ngs0165/Aladdin/	8
vidar.ngs.manchester.ac.uk	jobmanager-pbs	/nfs/users/ngs0041/Aladdin/	8

Add
Remove
Move Up
Move Down

Active / Complete Simulations

■ Initialised
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■ Suspended
■ Unknown

Exit

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Results
Archive

Ensemble Size: 100
Submit
Reset

☐ Local Machine (fork)
Number of Jobs:
1
☐ Condor (condor-submit)
Number of Jobs:
1
☒ Geodise (gd_jobsubmit)

Proxy Certificate Management:
Certificate Subject: /C=UK/O=eScience/OU=Southampton/L=SeSC/CN=andrew price/CN=proxy
Create Proxy Certificate
Proxy Time Left: 59 min, 45 sec
Destroy Proxy Certificate

Globus Gateway	Job Manager	Path	Number of Jobs
ngs.oerc.ox.ac.uk	jobmanager-pbs	/home/ngs0043/Aladdin/	8
ngs.leeds.ac.uk	jobmanager-pbs	/home/ngs0044/Aladdin/	8
ngs.rl.ac.uk	jobmanager-lsf	/home/ngs0165/Aladdin/	8
vidar.ngs.manchester.ac.uk	jobmanager-pbs	/nfs/users/ngs0041/Aladdin/	8

Add
Remove
Move Up
Move Down

Active / Complete Simulations

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■ Active
■ Complete
■ Failed
■ Suspended
■ Unknown

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Create Unique ID

GENIE Code Base Location:
D:\GENIE\trunk
...

Base Configuration:
eb_go_gs_el_test.xml
Save Config. changes

Model setup
Module configuration
Ensemble Definition
Execution Environment
Results
Archive

Ensemble Size: 100
Submit
Reset

☐ Local Machine (fork) Number of Jobs: 1
☐ Condor (condor-submit) Number of Jobs: 1
☒ Geodise (gd_jobsubmit)

Proxy Certificate Management:
Certificate Subject: /C=UK/O=eScience/OU=Southampton/L=SeSC/CN=andrew price/CN=proxy
Proxy Time Left: 58 min, 33 sec
Create Proxy Certificate
Destroy Proxy Certificate

Globus Gateway	Job Manager	Path	Number of Jobs
ngs.oerc.ox.ac.uk	jobmanager-pbs	/home/ngs0043/Aladdin/	8
ngs.leeds.ac.uk	jobmanager-pbs	/home/ngs0044/Aladdin/	8
ngs.rl.ac.uk	jobmanager-lsf	/home/ngs0165/Aladdin/	8
vidar.ngs.manchester.ac.uk	jobmanager-pbs	/nfs/users/ngs0041/Aladdin/	8

Add
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Ensemble Size: 100
Submit
Reset

☐ Local Machine (fork)
Number of Jobs:
1
☐ Condor (condor-submit)
Number of Jobs:
1
☒ Geodise (gd_jobsubmit)

Proxy Certificate Management:
Certificate Subject: /C=UK/O=eScience/OU=Southampton/L=SeSC/CN=andrew price/CN=proxy
Create Proxy Certificate
Proxy Time Left: 55 min, 59 sec
Destroy Proxy Certificate

Globus Gateway	Job Manager	Path	Number of Jobs
ngs.oerc.ox.ac.uk	jobmanager-pbs	/home/ngs0043/Aladdin/	8
ngs.leeds.ac.uk	jobmanager-pbs	/home/ngs0044/Aladdin/	8
ngs.rl.ac.uk	jobmanager-lsf	/home/ngs0165/Aladdin/	8
vidar.ngs.manchester.ac.uk	jobmanager-pbs	/nfs/users/ngs0041/Aladdin/	8

Add
Remove
Move Up
Move Down

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Exit

Future Work

- Development under way to deliver NetCDF data visualisation methods for the Research Support Tool
- Continuing timeline:
 - Q1 2010 → Continue development to deliver software beta
 - GENIE-LAMP Entry-level workshop (Easter 2010)
 - Obtain feedback on the alpha release
 - Q2 2010 → Respond to feedback to deliver beta release
 - GENIE-LAMP Intermediate level workshop (Summer 2010)
 - Obtain feedback on RST beta release

Summary

- GENIE lacks immediate “out-of-the-box” usability
- New users face a steep learning curve to make use of the models
- Distributed and Grid Computing is an added complication
- ENGAGE funded activities have enabled us to develop a platform independent front-end for standard builds of the model
- Work is on-going to extend this tool to support research activities requiring remote computing services

The GENIE Team (2002 – 2009)

Principal Investigator – GENIEfy (2005-2009):

Tim Lenton

– UEA Norwich

Research Team and Collaborators:

Ibrahim Almajai	– UEA Norwich
James Annan	– FRSGC, Japan
Chris Armstrong	– Manchester
Chris Brockwell	– UEA Norwich
David Cameron	– CEH Edinburgh
Peter Cox	– Hadley Centre (UKMO)
Neil Edwards	– Open University
Sudipta Goswami	– UEA Norwich
Robin Hankin	– NOC Southampton
Julia Hargreaves	– FRSGC, Japan
Phil Harris	– CEH Wallingford
Zhuoan Jiao	– Southampton e-Science Centre
Martin Johnson	– UEA Norwich
Eleftheria Katsiri	– London e-Science Centre
Valerie Livina	– UEA Norwich
Dan Lunt	– Bristol
Simon Müller	– Open University
Richard Myerscough	– NOC Southampton
Kevin Oliver	– NOC Southampton
Sofia Panagiotidi	– London e-Science Centre
Andrew Price	– Southampton e-Science Centre
Will Rawes	– Open University
Andy Ridgwell	– Bristol
Ian Rutt	– Bristol
Gethin Williams	– Bristol
Mark Williamson	– UEA Norwich
Gang Xue	– Southampton e-Science Centre
Andrew Yool	– NOC Southampton

Principal Investigator – GENIE (2002-2005):

Paul Valdes

– Bristol

Co-Investigators / Management team:

Peter Challenor	– NOC Southampton
Trevor Cooper-Chadwick	– Southampton e-Science Centre
Simon Cox	– Southampton e-Science Centre
John Darlington	– London e-Science Centre
Rupert Ford	– Manchester
Eric Guilyardi	– Reading
John Gurd	– Manchester
Richard Harding	– CEH Wallingford
Robert Marsh	– NOC Southampton
Tony Payne	– Bristol
Graham Riley	– Manchester
John Shepherd	– NOC Southampton
Rachel Warren	– UEA Norwich
Andrew Watson	– UEA Norwich



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