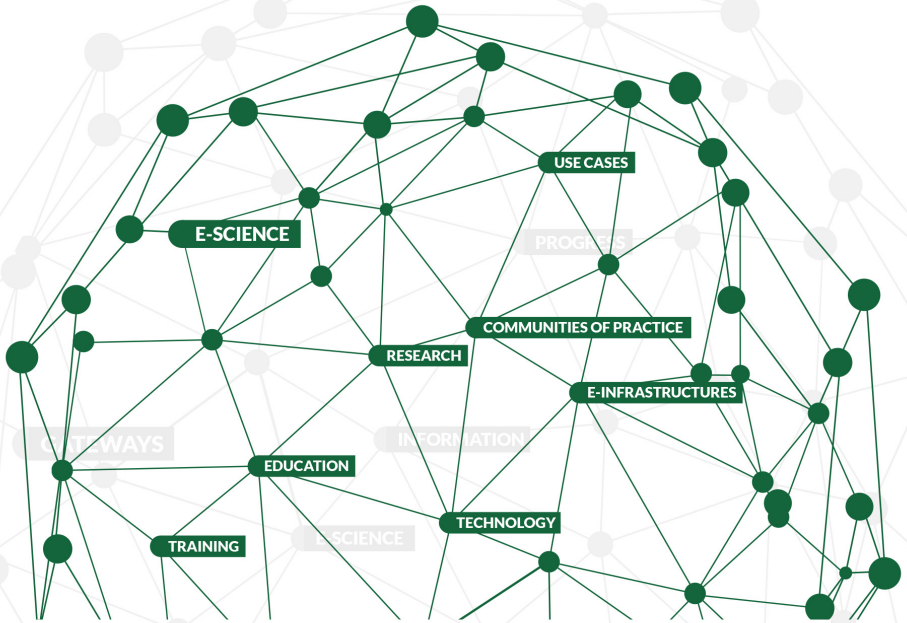
A Case Study of Open Science
The REPAST Infection Model



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Simon J E Taylor, et al.
Modelling & Simulation Group, Brunel University London, UK

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement n° 654237

Aim

- To show how ICT can be used to support Open Science
- Case study
  - A group of researchers have developed an agent-based simulation of an infection network in REPAST SIMPHONY
  - They publish an article paper with the results of their work
  - They would like to have all the software and results of their work available so that other scientists can verify their results and then built on them
  - Case study is simulation but this could be potentially any algorithm, software, etc.

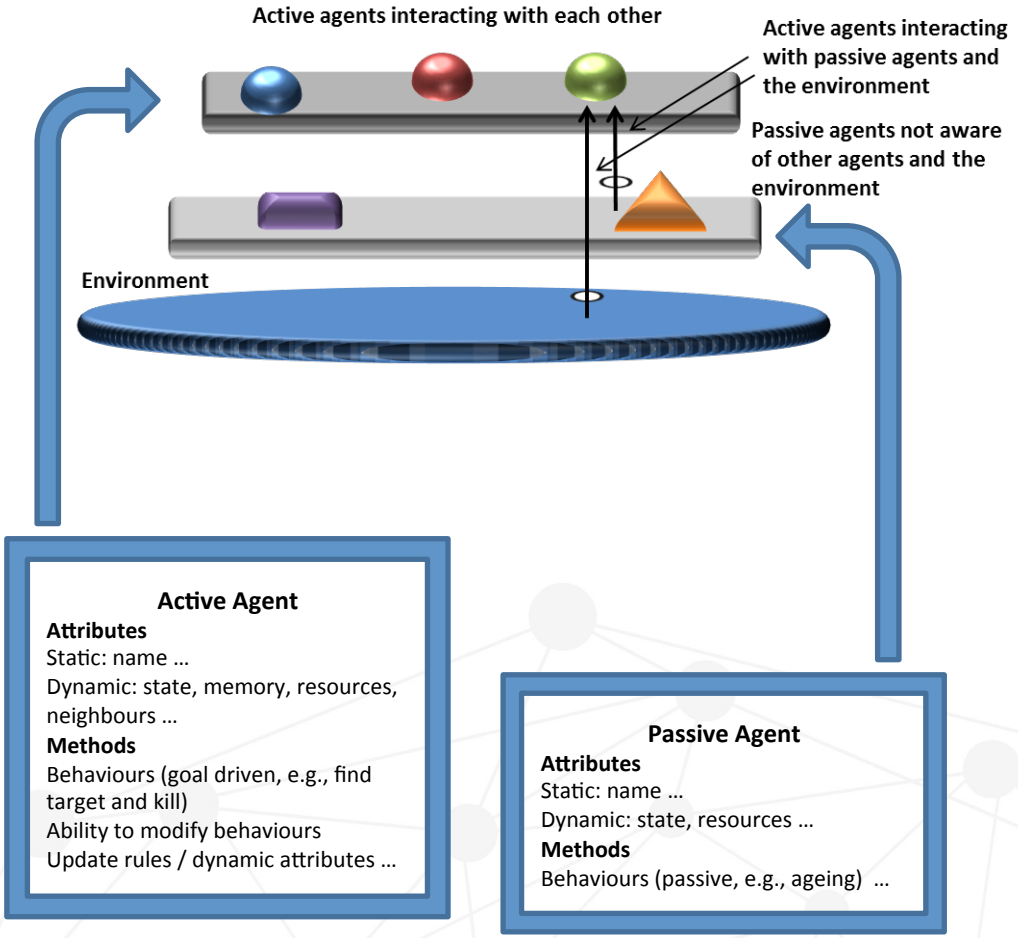
Agent-Based Modelling and Simulation

- Originated from Cellular Automata (CA) and Complex Adaptive Systems (CAS)
  - Network of autonomous agents that interact, adapt and learn
- ABMS studies the behaviour of individual and autonomous agents and their interactions
- Characteristics
  - Autonomy, locality, decentralisation
- State
  - Each agent has its own state with clearly defined boundaries
  - Model state is the collection of agents' states and environment state
- Many application areas
- Many open source tools (REPAST SIMPHONY)

Agent-Based Modelling and Simulation

- ABMS components
  - Agents
    - Active
    - Passive
  - Environment

- Agents characteristics
  - Attributes
  - Behaviours
  - Rules



Macal, C. and North, M. Introductory Tutorial. www.informs-**sim**.org/wsc11papers/130.pd
Simon JE Taylor (2014) "OR Essentials: Agent-Based Modelling and Simulation." Palgrave Macmillan, ISBN-10: 1137453621

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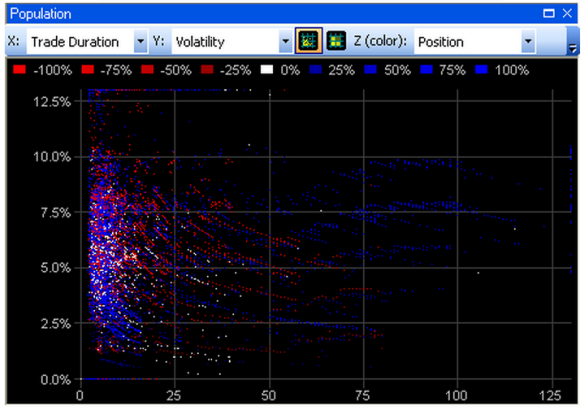
ABMS Examples

- Aspatial
  - Stock market



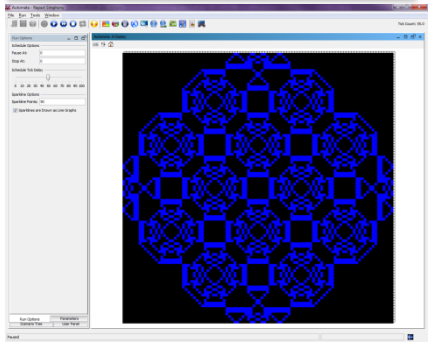
As an illustration of the variety in investment styles of agents, their wealth *Volatility* is plotted here on the Y-axis against their *Trade Duration* (average number of bars between successive transactions) on the X-axis. Each dot represents one agent.

Volatility is used here as a measure of absolute risk and thereby considered an important element of the trading/investment style of an agent.

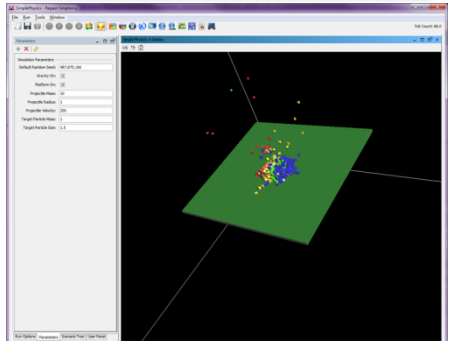
Trade Duration is used here as a measure of the investment/trading horizon of an agent and thereby also considered an important element of the investment/trading style of an agent. Low values (to the left) indicate frequent trading while higher values (to the right) indicate less frequent trading.

The color of the dots indicates the *Position* an agent is holding in the security, ranging from -100% for a short position to 100% for a long position (see legend above chart).

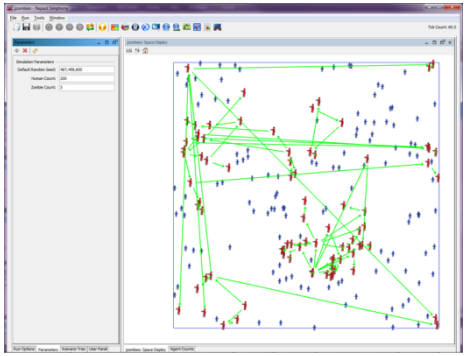
- Grid
  - Cellular automata



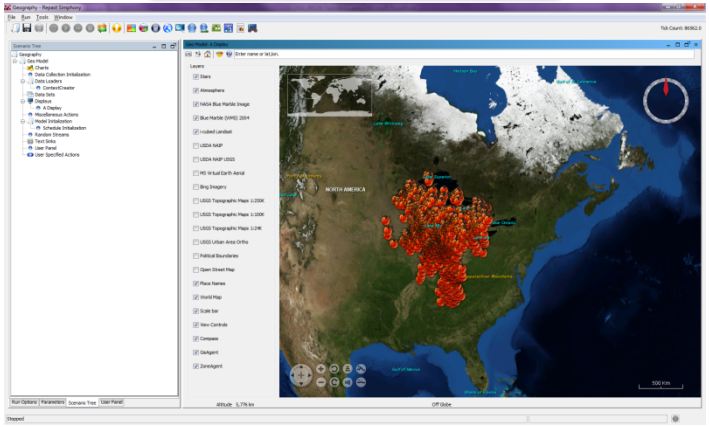
- 3D Euclidean space
  - Simple Physics



- Network
  - JZombies

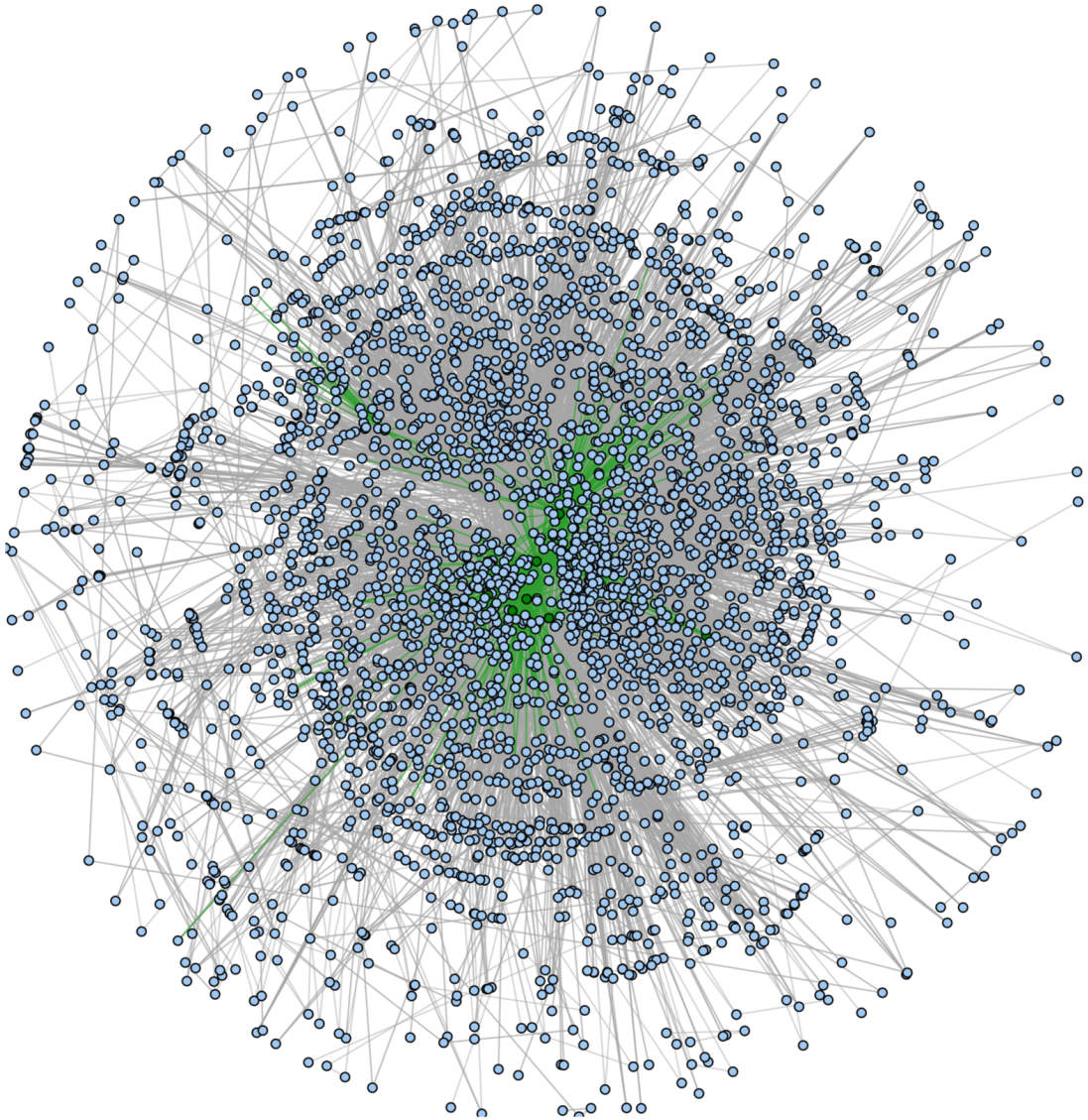


- GIS
  - Geography



www.altreva.com

Repast Simphony example models. repast.sourceforge.net



https://nicholasyager.com/research/2014/04/14/2014-04-14-Edge-based-control-of-disease-propagation-through-the-world-wide-airport-network.html

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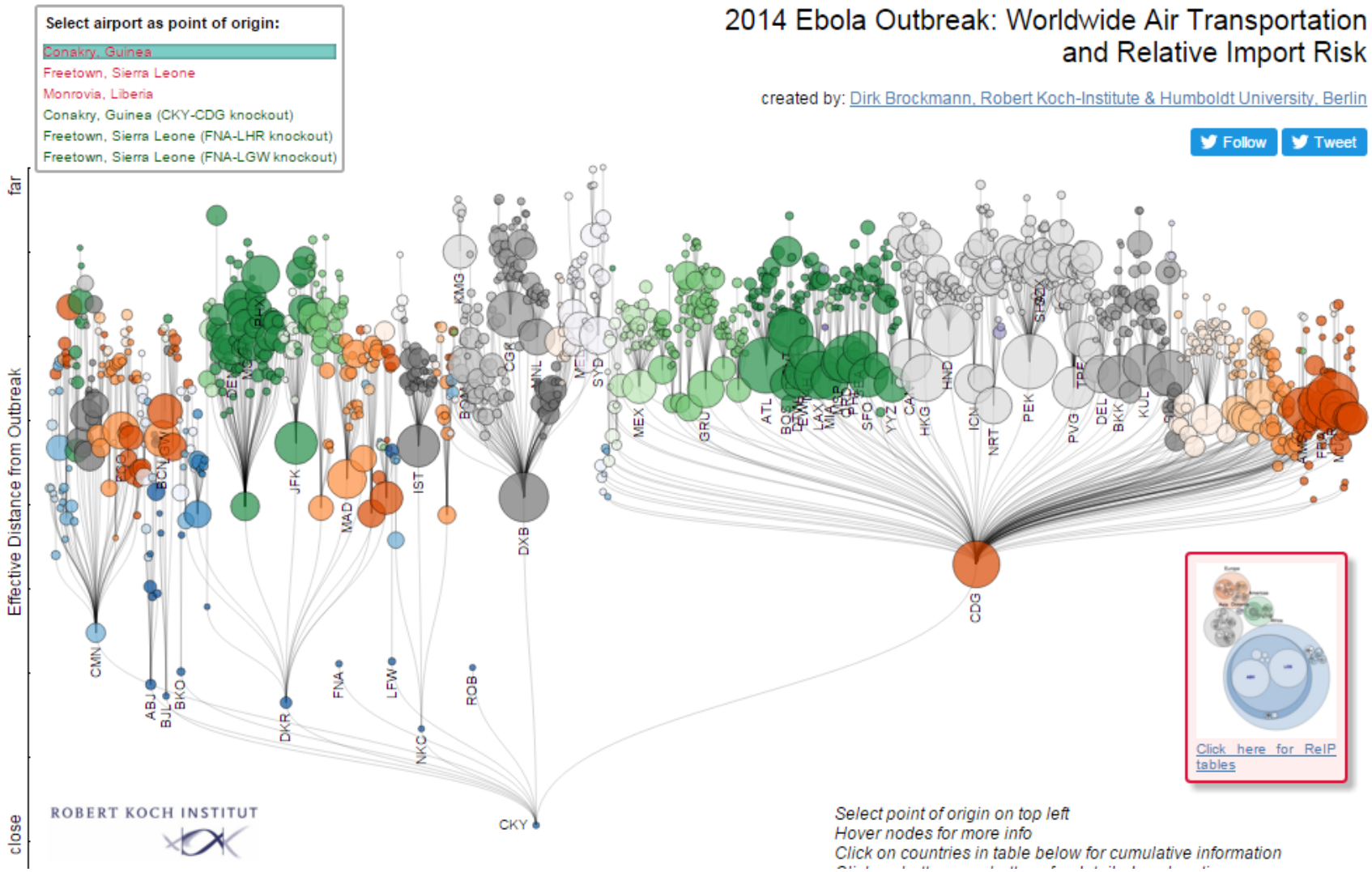

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http://rocs.hu-berlin.de/D3/ebola/

Concept Paper

Proceedings of the XXXX Winter Simulation Conference
A. Tolk, S. D. Diallo, I. O. Ryzhov, L. Yilmaz, S. Buckley, and J. A. Miller, eds.

INVESTIGATING INFECTION NETWORKS USING AGENT-BASED MODELING & SIMULATION WITH REPAST

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ABSTRACT

Infection modelling studies the spread of disease across a population in a region. Agent-based modelling & simulation (ABMS) has emerged from research into Complex Adaptive Systems. It allows models and simulations to be built that capture the behaviour and interactions of individuals. REPAST SIMPHONY (Recursive Porous Agent Simulation Toolkit) is a widely used ABMS system. Open science aims to promote open access to research presented in academic works. Ideally, the software, data and results presented in a scientific article should be available for other scientists to use, validate and build upon for their own research. Using an Infection Model case study created in REPAST, this article shows how Open Access Data Repositories and Science Gateways can be used to support Open Science by making the simulation model and results freely available without the need for potentially complex local implementation.

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So…

- How do you get scientists to easily (openly) access
  - Simulations
  - Models
  - Data
  - Computing resources
- **Store the simulation software, model, data (results) in an Open Access Document Repository assign DOIs**
  - DOI Packages
- Access the software via a Science Gateway

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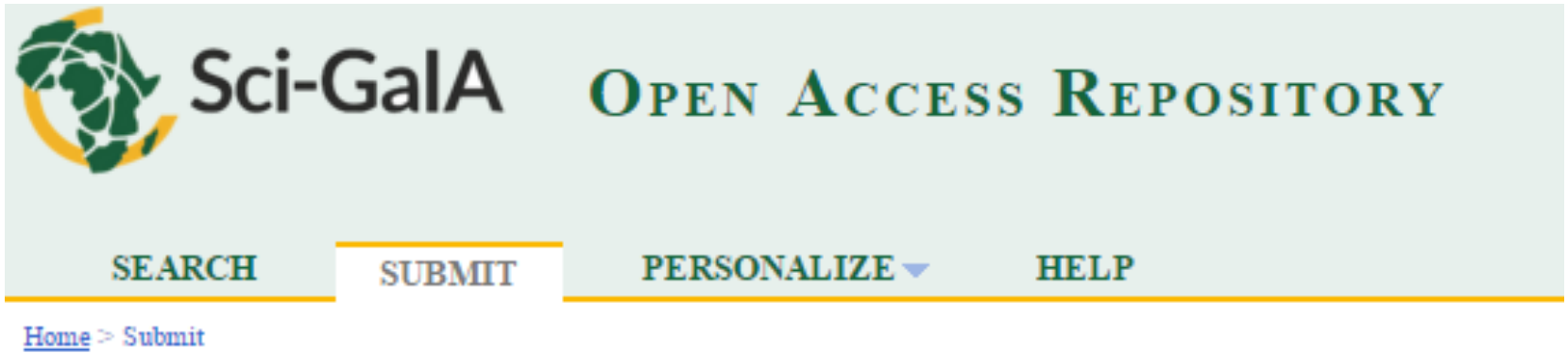
Submit your documents to a OADR



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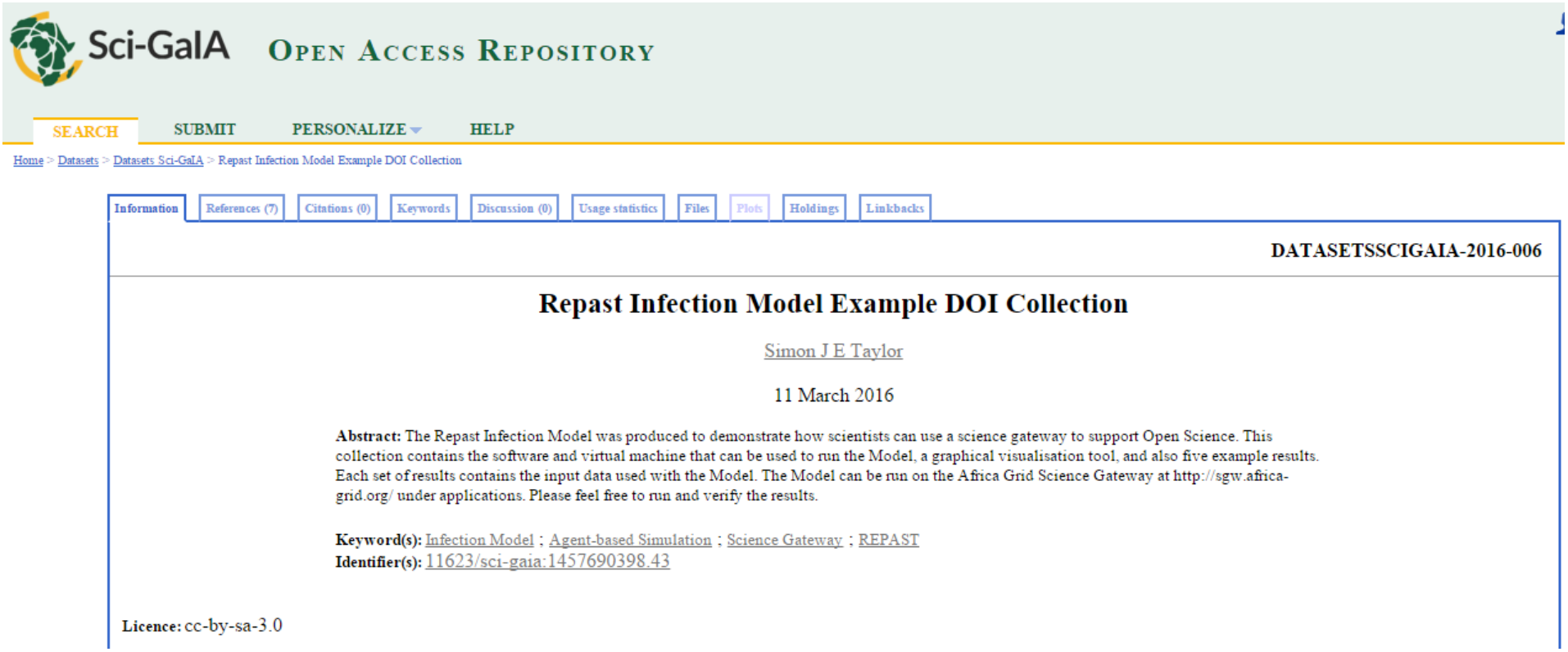

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DATASETSSCIGAIA-2016-006

Repast Infection Model Example DOI Collection

Simon J E Taylor

11 March 2016

Abstract: The Repast Infection Model was produced to demonstrate how scientists can use a science gateway to support Open Science. This collection contains the software and virtual machine that can be used to run the Model, a graphical visualisation tool, and also five example results. Each set of results contains the input data used with the Model. The Model can be run on the Africa Grid Science Gateway at http://sgw.africa-grid.org/ under applications. Please feel free to run and verify the results.

Keyword(s): Infection Model ; Agent-based Simulation ; Science Gateway ; REPAST
Identifier(s): 11623/sci-gaia:1457690398.43

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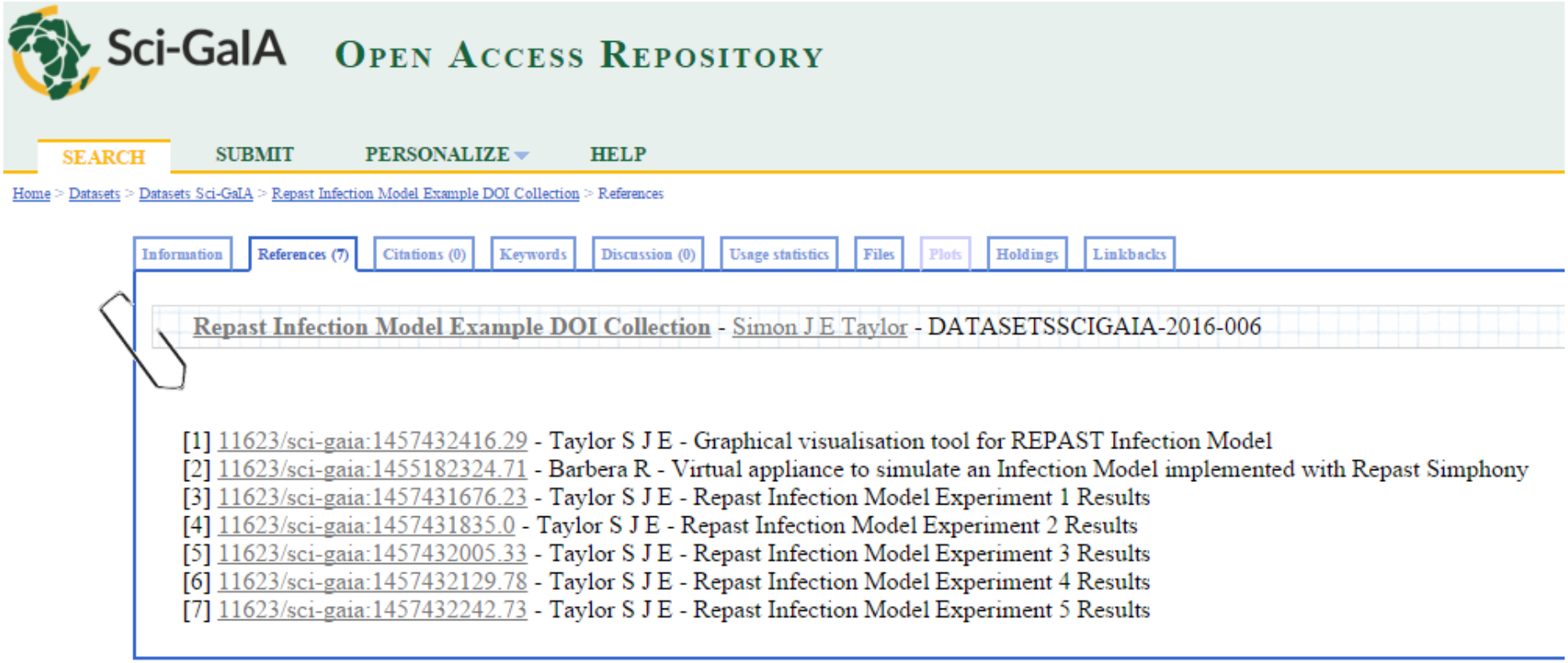
DOI Collection Contents



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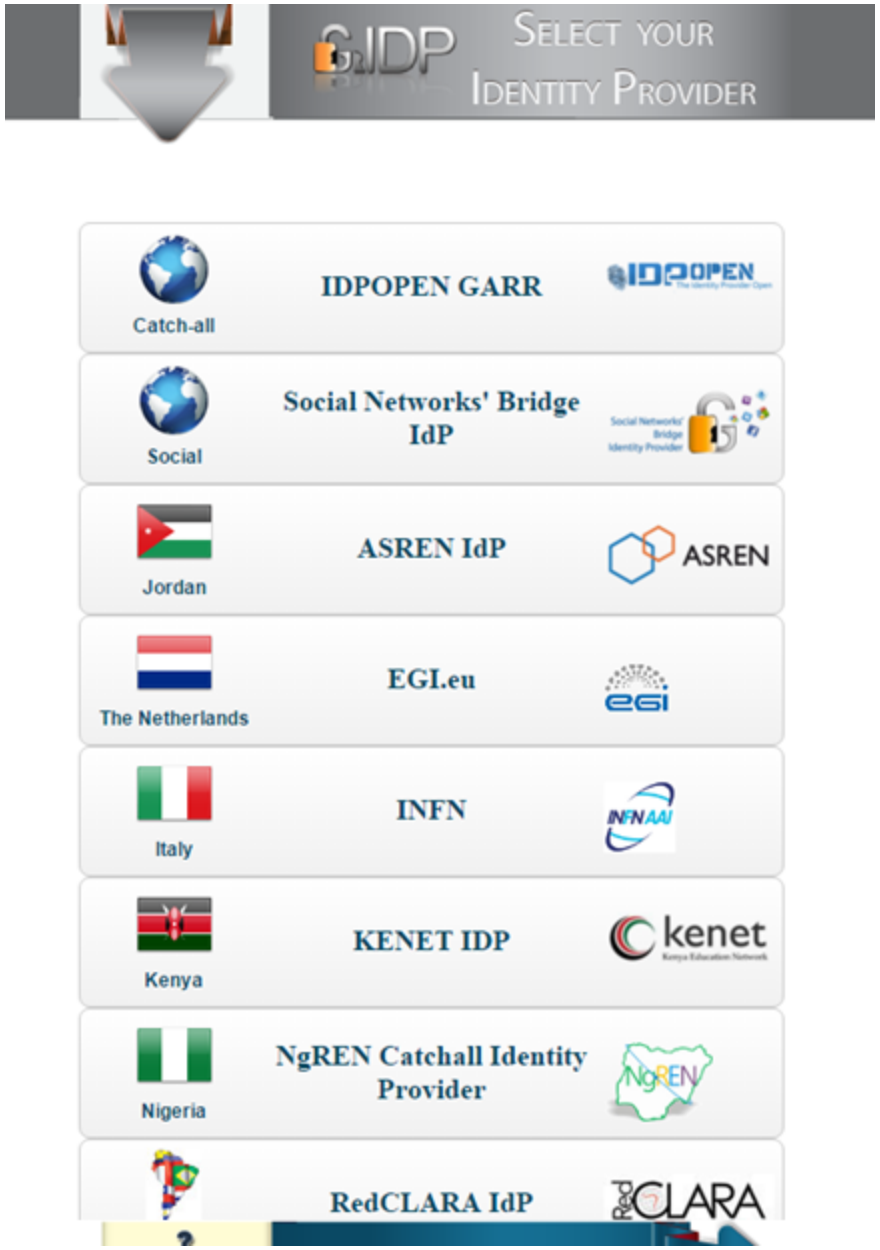
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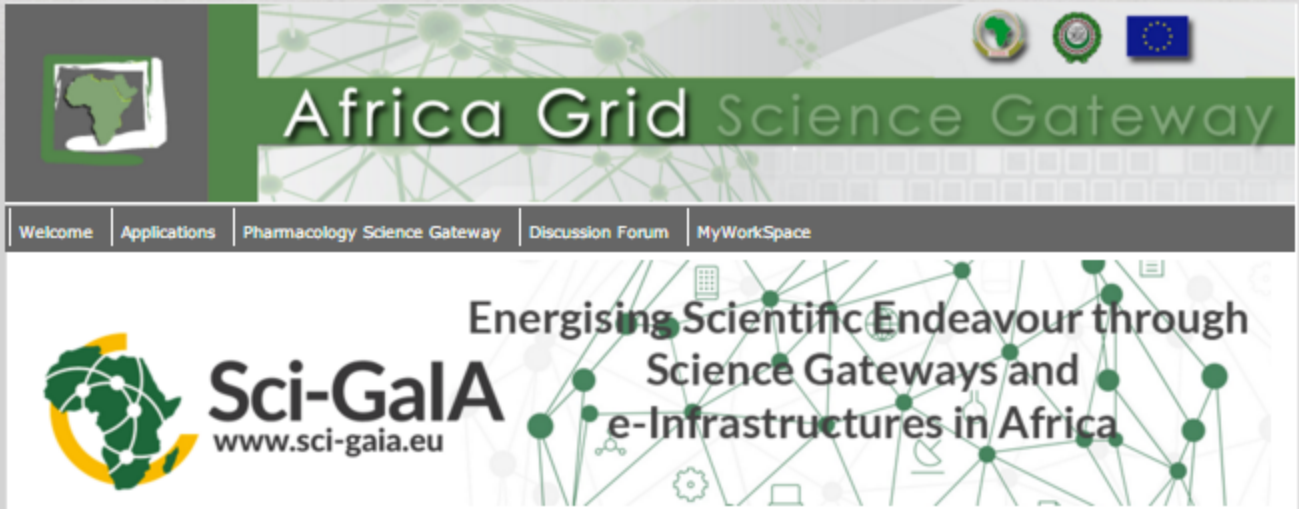

Welcome

The Africa Grid Science Gateway is a standard-based web 2.0 demonstrative platform to show the lighthouse applications identified by the past el4Africa and the current Sci-GaIA projects and execute them on a worldwide (including Africa) e-Infrastructure.

The access to the Africa Science Gateway requires federated credentials issued by an Identity Provider. If the organisation you belong to has an Identity Provider, click on the "Sign In" link which appears in the top right corner of the page. Otherwise, you can get federated credentials registering to the "open" Identity Provider which belongs to the GrIDP "catch-all" federation.

In order to run an application, select it from the Applications menu above. New applications can also be proposed to be included in the Africa Grid Science Gateway. Interested people just need to fill in this online survey.

Contributors

The Africa Grid Science Gateway has been conceived and developed in the context of

el4africa.eu e-Infrastructures for Africa

and it is now actively supported by

Sci-GaIA

Other projects, initiatives, organisations, and single individuals wanting to contribute to the development of the Africa Grid Science Gateway both with human and computing/storage resources, or are interested in developing a science gateway for their own community, are welcome to contact sgwadmin AT africa-grid.org.

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Pharmacology Science Gateway
Discussion Forum
MyWorkSpace
"Hello World!"
Computer Sciences and Mathematics
Cultural Heritage
Earth Sciences
High Energy Physics
Life Sciences and Healthcare
Other
ClustalW2
G-HMMER
GROMACS
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Energising Scientific Endeavour through Science Gateways and e-Infrastructures in Africa
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Applications

"Hello World!"
Computer Sciences and Mathematics
Cultural Heritage
Earth Sciences
High Energy Physics
Life Sciences and Healthcare

- ClustalW2
- G-HMMER
- GROMACS
- Community Health Portal
- Repast

Other

Repast Infection

repast

This is an example of an **Agent-Based Simulation Infection Model** implemented in **Repast Simphony**. The aim of the model is to study the behaviour of infections with an annual outbreak with the appropriate input data. It can be further used in the field of health economics to study the cost effectiveness of various infection preventive strategies.

For the **Default random seed** input field, and if not otherwise specified by users, the timestamp at the start of the simulation would be used as seed for the random number generator.
Use the **Simulation Period** input field to specify how many years the simulation will run for.
Use the **Healthy Count** input field to specify the initial healthy population. Healthy population have immunity and cannot be infected immediately. However, after a number of contacts with infected population, they lose their immunity and become susceptible to infection.
Use the **Infected count** input field to specify the initial infected population. Infected population can infect susceptible population upon contacting them. They recover after a period of time and become healthy.
Use the **Susceptible Count** input field for the initial susceptible population. Susceptible population can be infected when contacted by infected population. If more than one susceptible agent are in the proximity of an infected agent, only one will be infected.
The output of the simulation is the number of each population, i.e **Healthy**, **Infected** and **Susceptible** population for each simulation time unit.

Please fill the following form and then press the "**SUBMIT**" button to launch this application.
Requested inputs are:

Simulation Parameters

Default Random Seed	Random Seed ...
Simulation Period (years)	Simulation Period ...
Healthy Count	Healthy Count ...
Infected Count	Infected Count ...
Susceptible Count	Susceptible Count ...
Simulation Identifier	Repast simulation ...

DEMO SUBMIT RESET

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Please fill the following form and then press the "**SUBMIT**" button to launch this application.
Requested inputs are:

Simulation Parameters

Default Random Seed	1
Simulation Period (years)	85
Healthy Count	0
Infected Count	20
Susceptible Count	1500
Simulation Identifier	testsimRepast Demo Simulation: 22/11/2015 - 8:54:50

DEMO SUBMIT RESET

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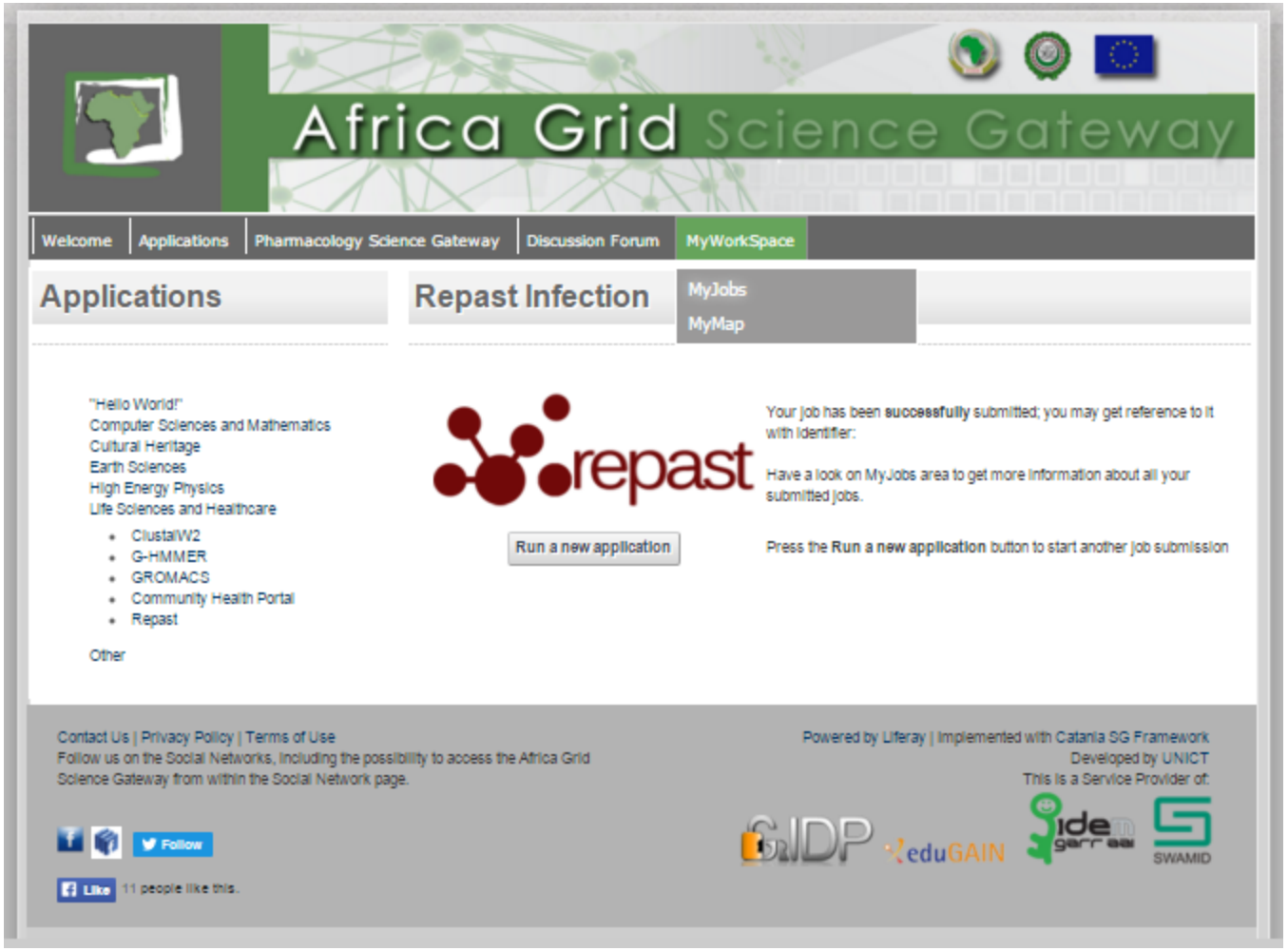
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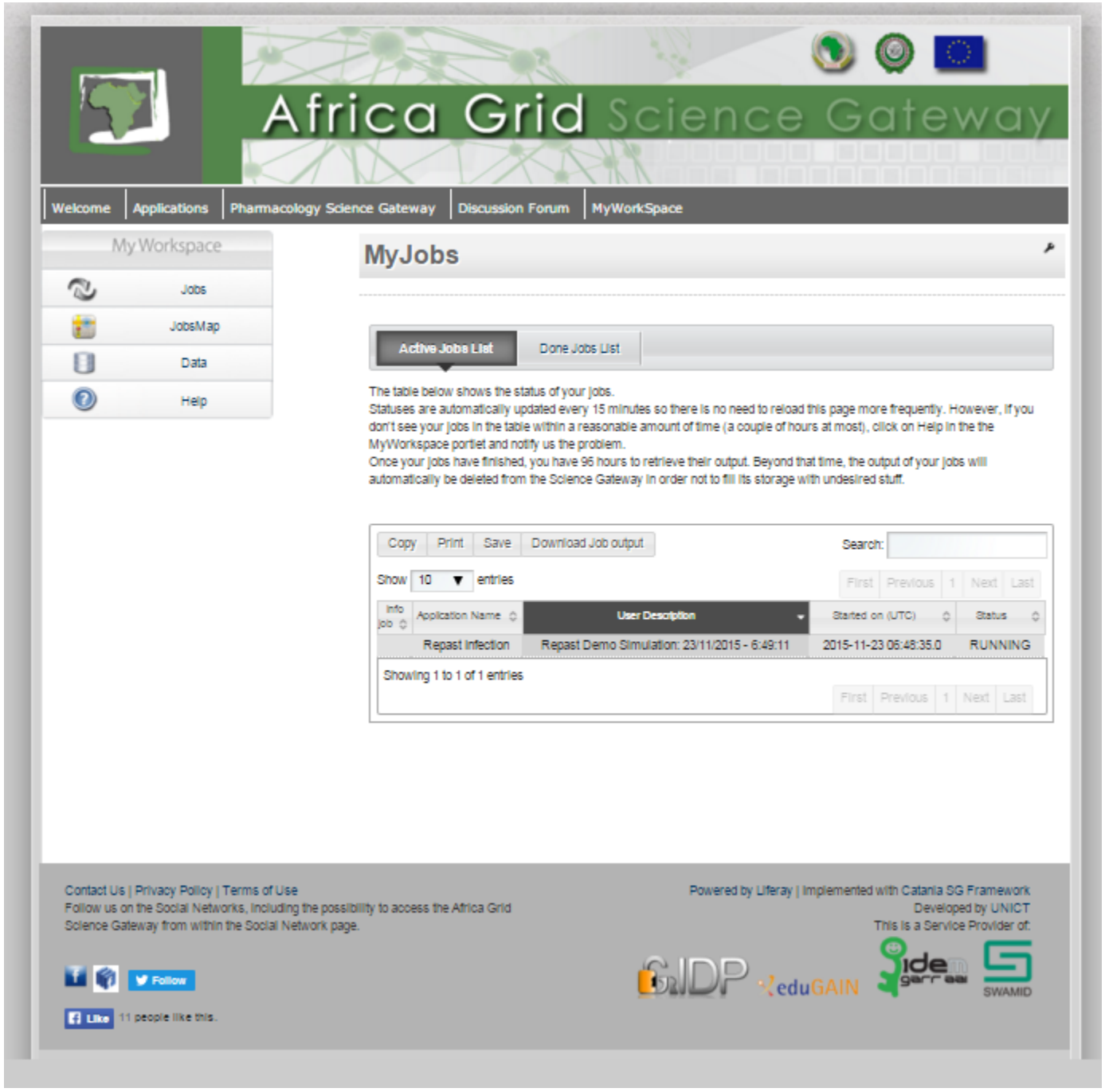

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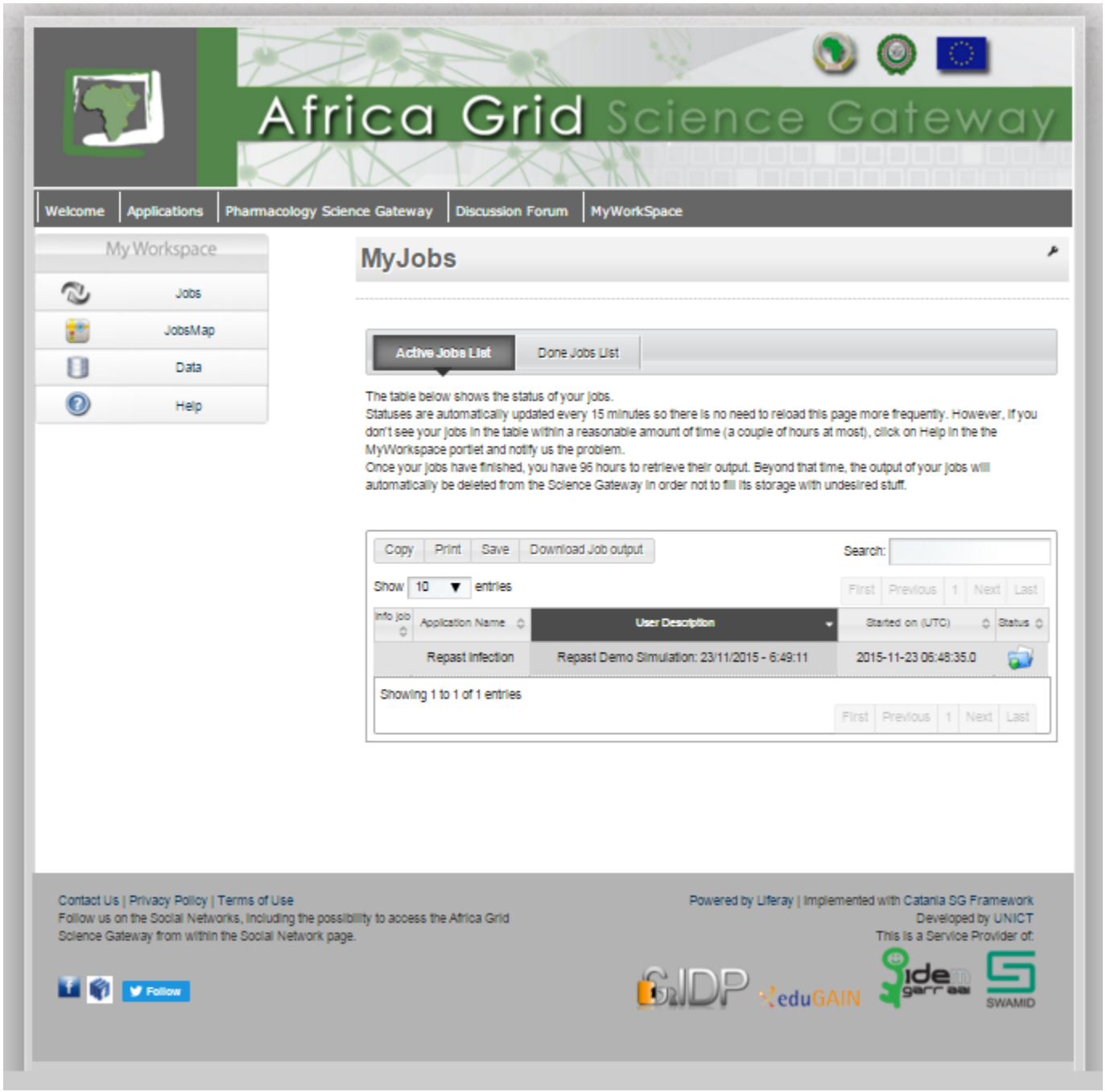

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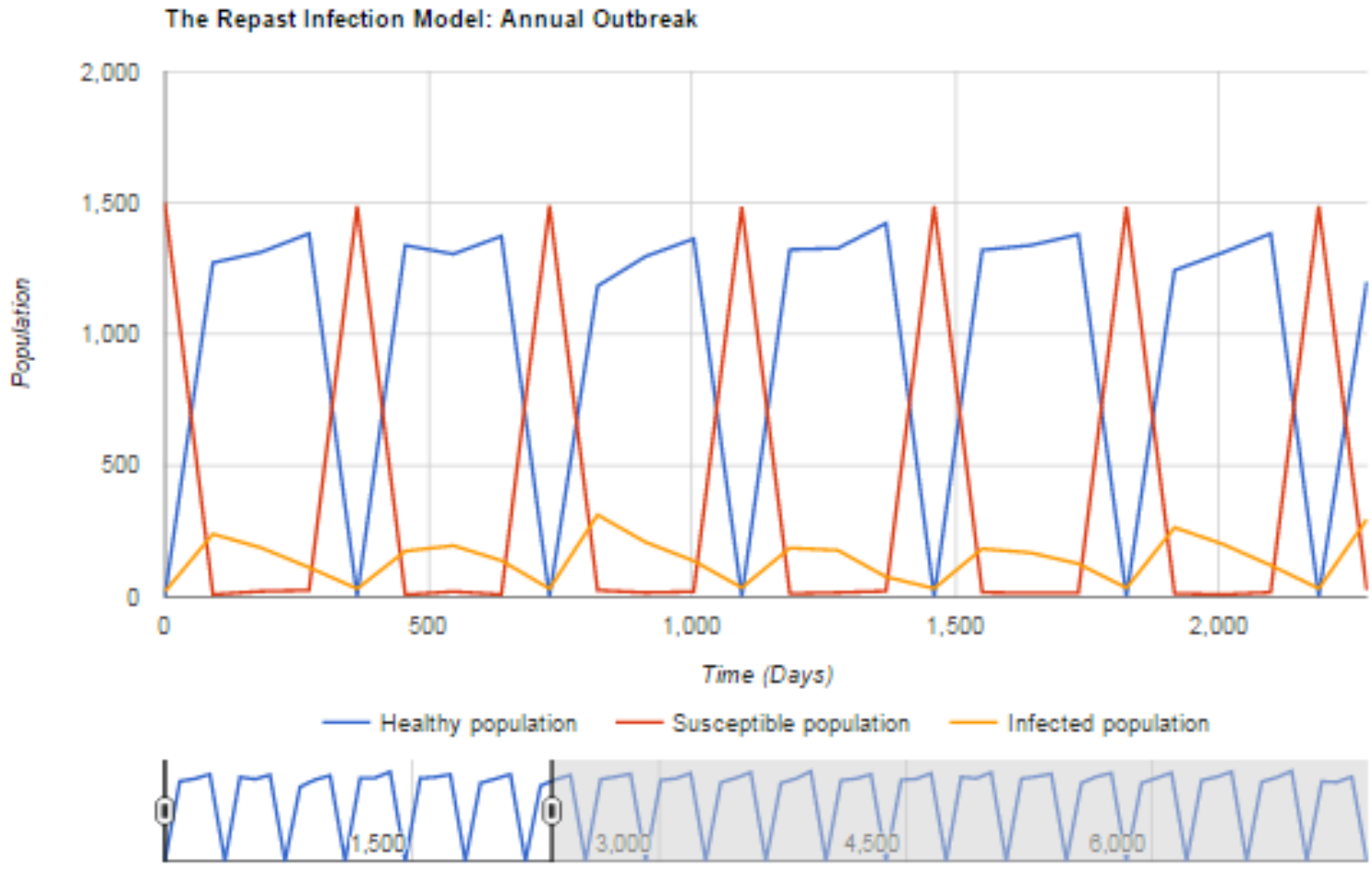
Infection Model Visualisation

This is an example of how a portlet can be used to visualise the output of the infection model. Select the appropriate **output{timestamp}.csv** from your experiments and you will see the results.

Choose File | output.txt | Edit Chart



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Finally - Make it all searchable

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Summary

- Example of how Open Science can be supported by Open Access Data Repositories and Science Gateways
- Used Agent-based simulation as a case study
- Think about your own data and software – can this approach support Open Science for you?

Any questions?

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