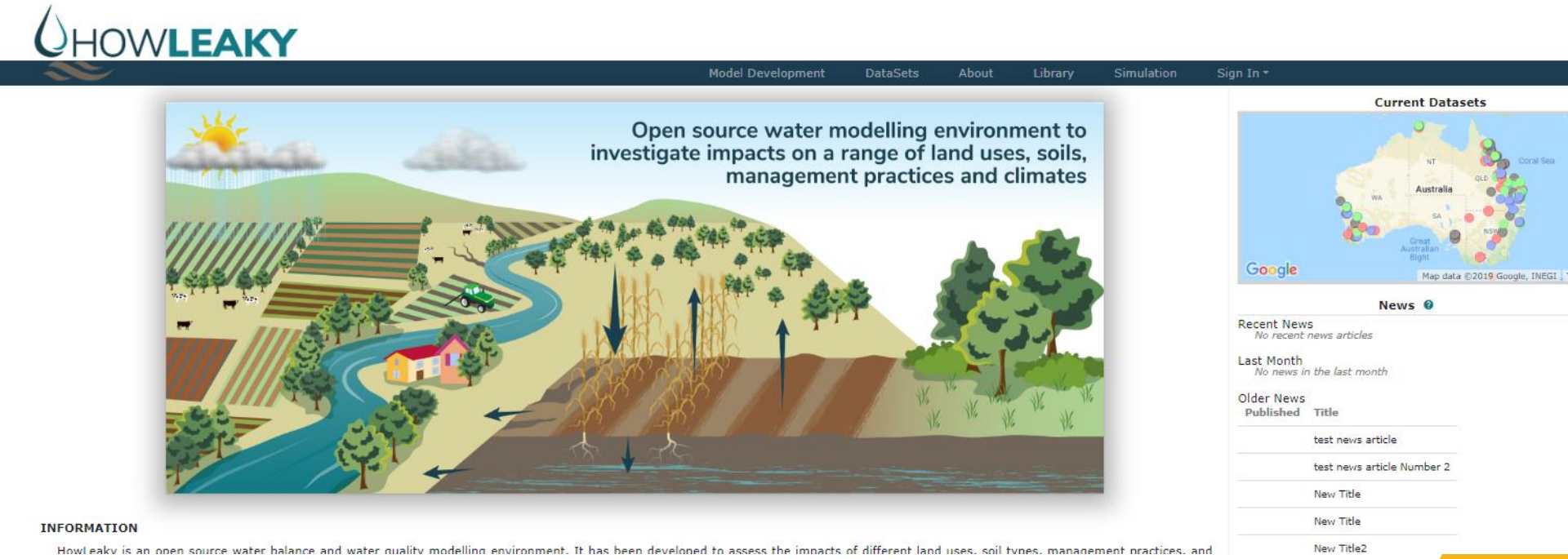
A new era for the HowLeaky agricultural systems and water quality model in an open science platform



Afshin Ghahramani, David Freebairn, Paul Lawrence

MODSIM 2019

Collaborators: David McClymont, Dan Rattray, Jenny Riches, Brett Robinson, Mark Silburn, Keith Pembleton, Sarah Stevens, and Craig Thornton.

In this presentation

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General issues in model governance:

- Redundancy,
- Capability of integration with each other,
- Transparency,
- Reproducibility,
- On-going maintenance.

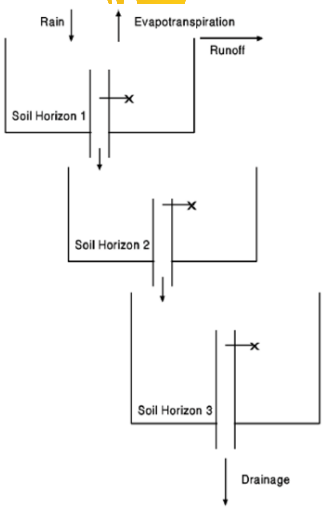
An open source and community driven platform integrates **capabilities of**

- **Model development,**
- **Dataset management,**

Modernisation process of the HowLeaky model, from a desktop application to an open source, cloud based modelling environment with capabilities for code modifications, auto-validation, archiving of validation datasets, and core parameter sets.

HowLeaky

One dimensional water balance model in agricultural systems to assess the impacts of land management, soil, climate-types on water balance and water quality



Applications

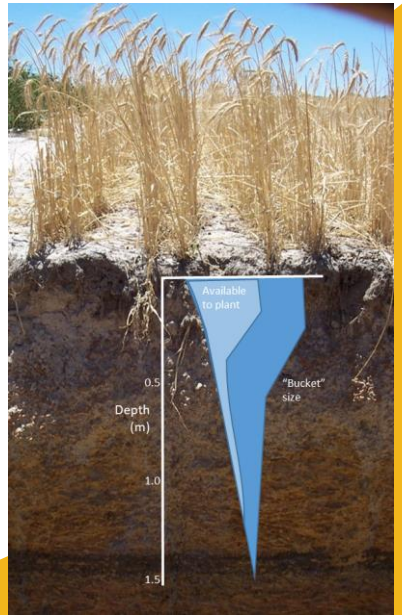
- Paddock modelling
- Catchment scale modelling
- Wide range of water modelling by consultants
- Developing DSS

Cost Effectiveness Calculator

SafeGauge

Capability

- Simplicity,
- computational efficient,
- Covering wide area in discipline from soil water balance to water quality



Shortcoming

- Governance of the HowLeaky model, limiting the development

Response

Thus a web-based platform was developed to address the issues (and created potential opportunities)

Platform

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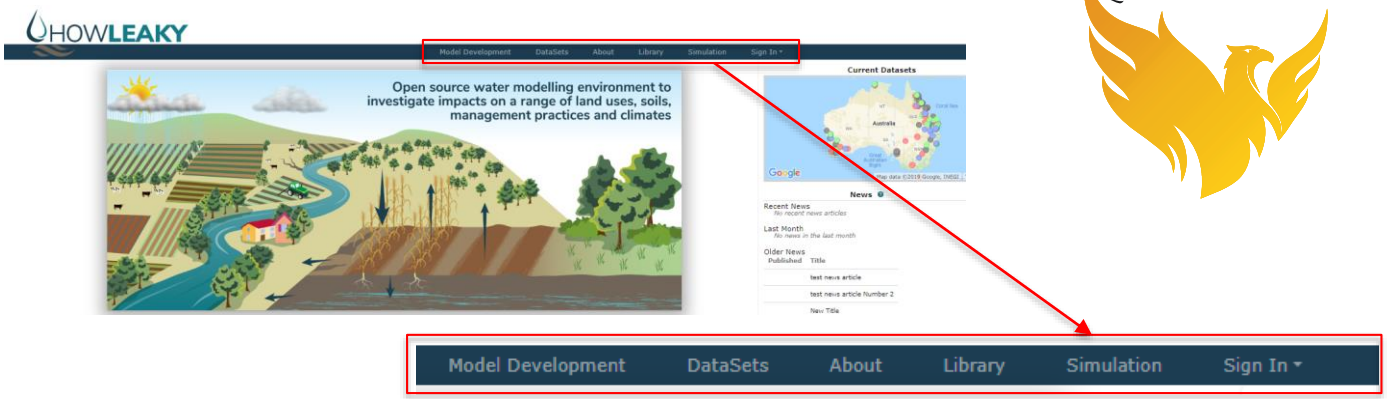
<u>Components</u>
Model development,
Dataset management,
Simulations



Datasets associated with models and parameters are a critical intellectual component of research platforms

Datasets are vital for
Transparent development and verification processes

Accessible data & model parameter sets to community

Model growth by community
Comparison of the models

Shift in the culture to make government data more accessible and usable by public is a priority of the Australian Government (Paterson et al., 2016).

Architecture of the platform

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Modernizing language

Hosting infrastructure
HowLeaky source code placed on GitHub

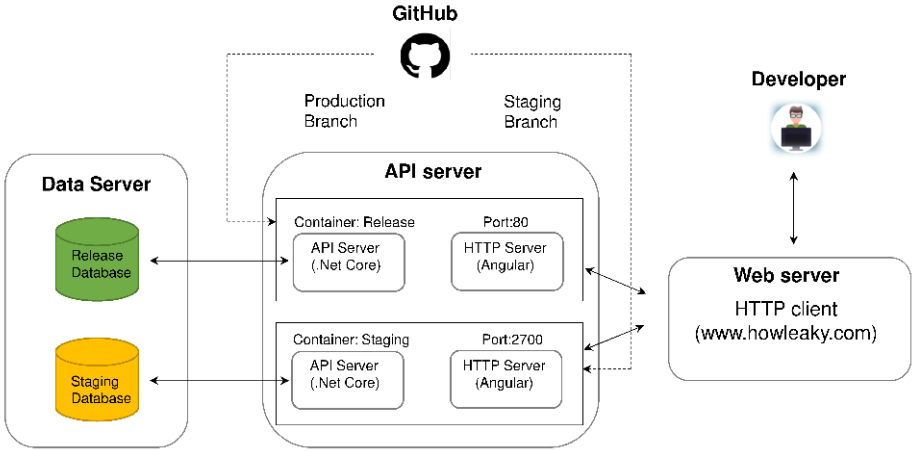
Web-based platform and databases
on three servers hosted by the Australian National eResearch Collaboration Tools and Resources project (Nectar)

Data Server,
Build/Run server,
web Application server.

nectar

Build server automates the building of the HowLeaky Engine using Jenkins.

Platform



Application programming interfaces (APIs)
Developed to support the HowLeaky web application & service to build additional applications
Some of the API services are available for public consumption.

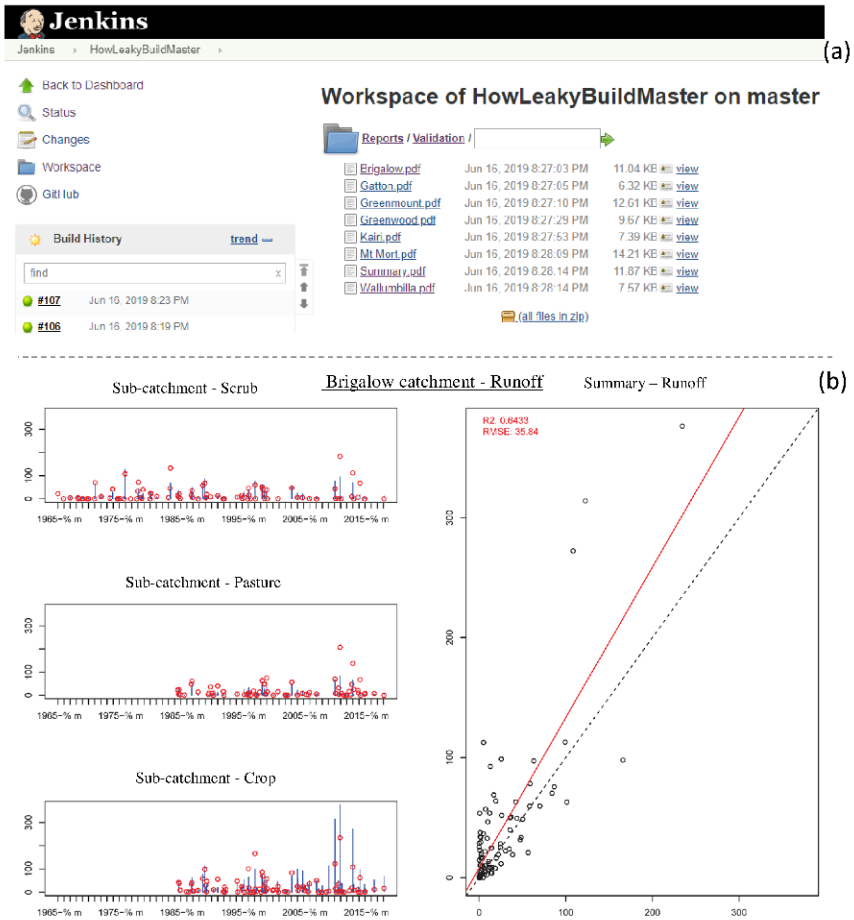
Data

In total, there are 150 datasets in the database and all available data of each datasets are accessible to users via the website;

8 core datasets
Re-development code via an automated validation.

Each site includes

- Observed data
- Model parameter sets
- A compiled simulation model

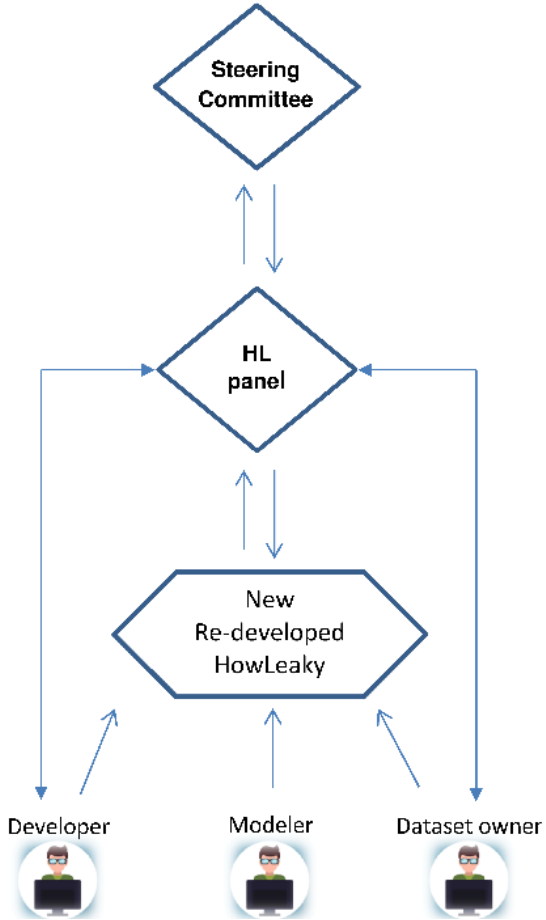


Observed field data of
ground cover, runoff, sediment, plant available water, phosphorous, dissolved inorganic nitrogen, and limited pesticide/herbicide of atrazine, 2, 4 D and Atrazine, and Tebuthiuron.

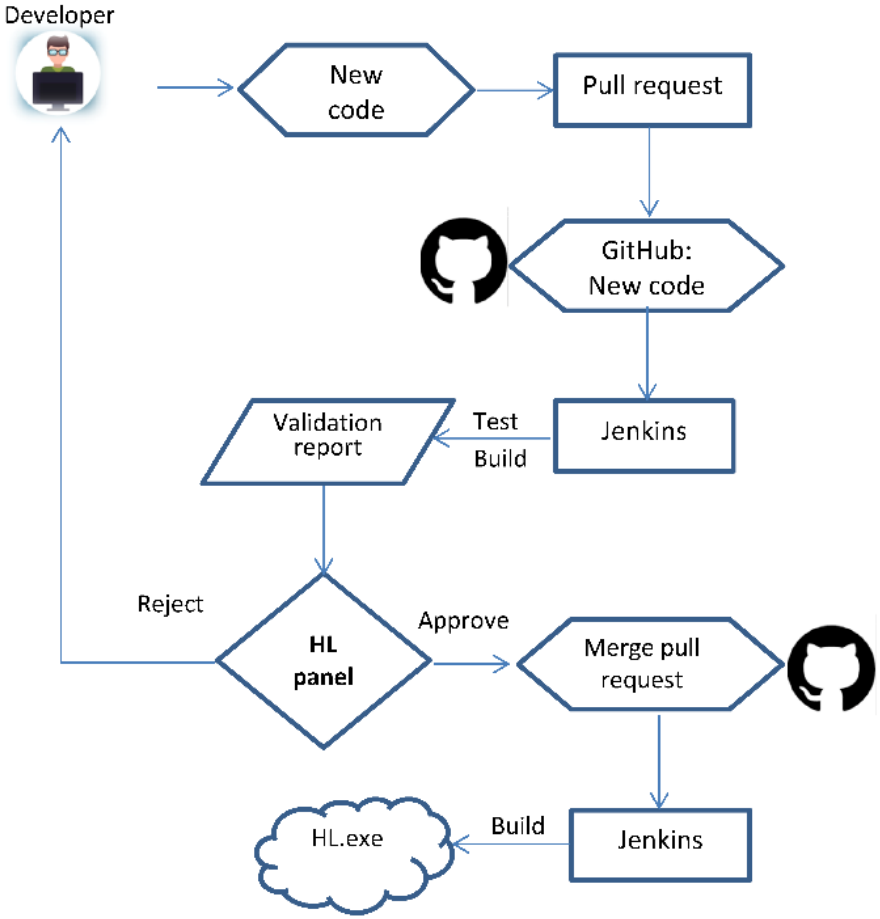
Peer review of model development

HowLeaky Panel and steering committee

Interaction between HowLeaky stakeholders



The processes of code submission and automated review for the model



Opportunities and Challenges

Opportunities

A research platform

- Improved transparency at two levels

(a) an efficient validation process & a peer review of development.

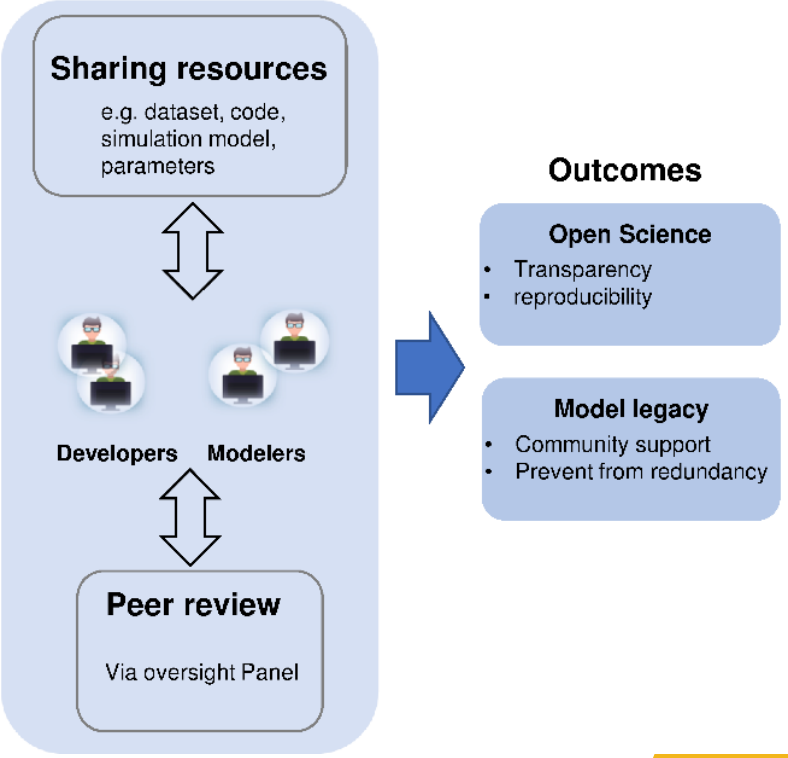
(b) sharing simulation models and datasets (i.e. observed data, parameters, simulation model) which are **reproducible**

0.6% - 6.8% of surveyed publications are reproducible (Stagge et al., 2019)

- Facilitated by developments in technology

cloud computing and access to the public repositories

Connections to SILO, soil grid, etc. and connection to others e.g.?



Opportunities and Challenges

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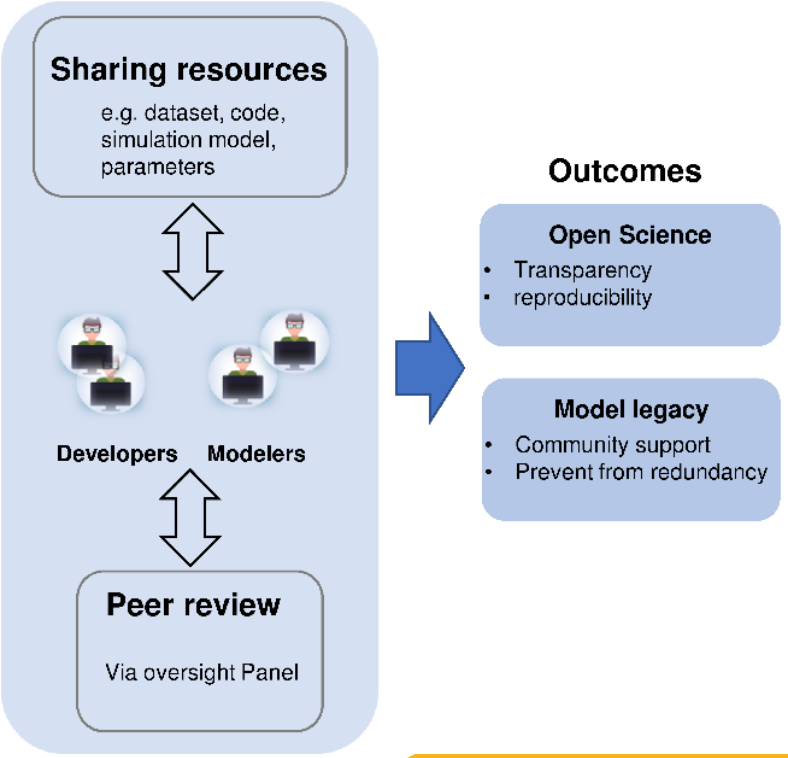
Challenges

- We are at start, the process of testing after first development
- Developing business model
- Making the system self governed? And community driven
- Managing IP/data privacy



Thank you very much

Afshin Ghahramani

University of Southern Queensland

Afshin.Ghahramani@usq.edu.au

Acknowledgment

This project was supported by funding from the Queensland Government Department of Environment and Science (DES) under a partnership between DES and University of Southern Queensland.

David McClymont, Dan Rattray, Jenny Riches, Brett Robinson, Mark Silburn, Keith Pembleton, Sarah Stevens, and Craig Thornton.

Citation

Ghahramani, A., Anderson, R., Doherty, A. (2019) Developing HowLeaky Platform for Improved Governance, Facilitation of Development, and Open Reproducible Science. USQ Centre for Sustainable Agricultural Systems. Final technical report for the Department of Environment and Science, Queensland Government.

A comparison of the new HowLeaky with the old version

Item	New HowLeaky	Old HowLeaky
User interface	Simple and basic	Comprehensive
A formal structure for model development	Developed	Ad hoc since 2007
Dataset management facility	Developed	Available, but not integrated
IP & licence	Creative Commons Attribution	Not clear
Governance and peer review	Established	small group, informal
Transparency of the development	Transparent and defendable	Ad hoc
Sustainability & maintenance	Code managed by USQ	Intermittent support