

# Computational Working Group

NSHM CWG

Te Taura Matapae Pūmate Rū i Aotearoa  
**NSHM** The New Zealand  
National Seismic  
Hazard Model  
A GNS Science Led Research Programme

*E mahi ana me*  
**In collaboration with**



Ngā hoa tuku pūtea  
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MINISTRY OF BUSINESS,  
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# Who's Here?



**Oakley Jurgens**

Java developer  
rupture builder *extraordinaire*



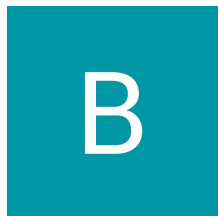
**David Thompson**

Python developer



**Chris DiCaprio**

General dogsbody



**Ben Chamberlain**

Front-end developer



**Chris Chamberlain**

Solution architect  
DevOps

# Discussion from Oct 2022 Workshop

- ➔ • **Don't forget the Tech debt**
- **User Features**
  - User API - what are user needs?
  - ➔ – Rupture set exploration - what form does this take? How do we deal with multiple source branches?
  - ➔ – Map layers - faults, cities, etc.
  - ➔ – Usability - Make parts of stack available/ usable to outside groups so they can run/experiment for themselves
- **Science Features**
  - ➔ – Streamline / automate source to hazard workflow. Speed up work and test hazard implications of changes to source quickly
  - Incorporate DSM into API and workflow - speed up and test changes to DSM easily
  - Risk calculations. Test risk implications of e.g. inversions
  - Core model/reduced LT to estimate mean model
  - Explore LT

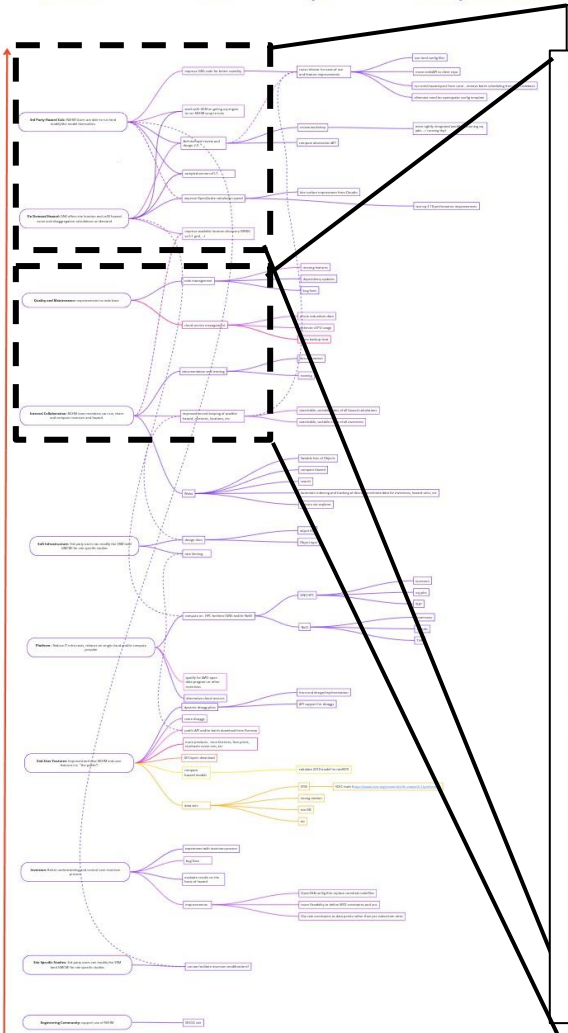
# SD CWG Work Plan: as presented to TAG 7/7/2023

- Disaggregations by parent fault
- User Tools [not all addressed this year]:
  - ◦ Generate OQ input files from rupture map tool [higher priority]
  - Scenario generation [lower priority]
  - Footprints [lower priority]
  - Time series [lower priority]
- • The future of hazard calculation:
  - Collaborate with GEM on improving our workflow with OQ-engine
  - Refactor of runzi to handle batch processing of inversions and hazard calcs
    - Split CLI and API?
- Explore alternatives to AWS
- • Interactive disaggregations
- Inversion method (all listed in SRM deliverables):
  - Use hazard as metric for evaluating inversion
- • TUI refactor to support inversion and hazard science

... how do all the parts fit together ... ?

Priority

Themes Means Epics Sub-epics and tickets



**Quality and Maintenance:** Improvements to code base

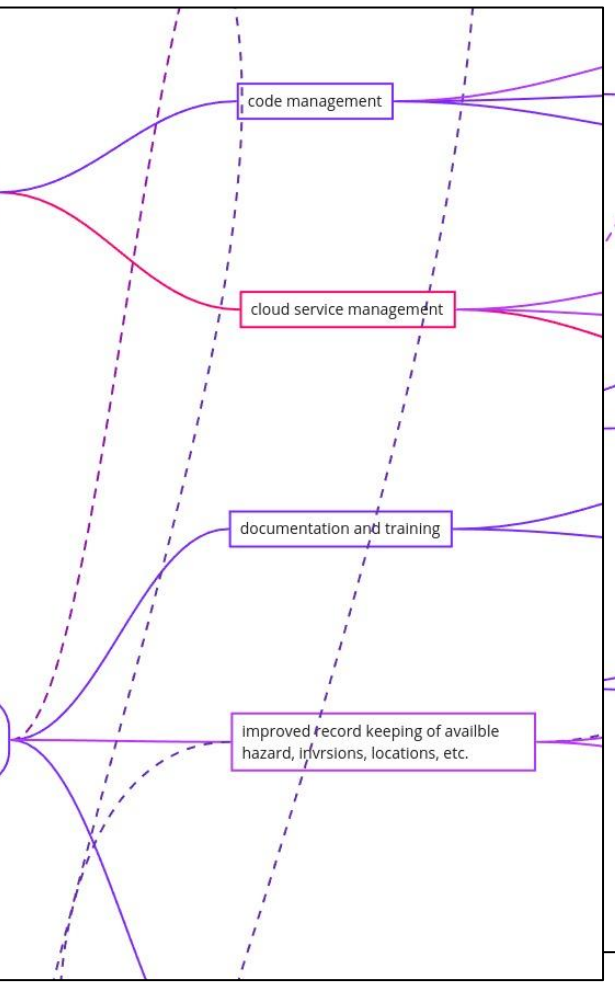
**Internal Collaboration:** NSHM team members can run, share and compare inversion and hazard.

code management

cloud service management

documentation and training

improved record keeping of available hazard, invrsions, locations, etc.



# What's New

## Front End

- Rupture Explorer
- Weka: the new TUI

## Hazard calculation

- toshi-hazard-store v2
- toshi-hazard-post v2
- Public (Python) Libraries

## Code Improvements (paying off that technical debt)

- Public (Python) Libraries
- Documentation
- Improved APIs
- Improved test coverage
- Merged NZ gsims into main OpenQuake codebase

## Use of NSHM by SRWG and Structural Engineering

- Custom hazard calculations for SRWG
- Spectra library used for draft TS

## Model updates

- v1.0.1: toshi-hazard-post aggregation bug fixed
- v1.0.2: Kermadec interface location bug fixed
- v1.0.3: crustal fault dip bug fixed
- v1.0.4: Puysegur dip orientation bug fixed

## Grand Inversion

- OpenSHA bug fixes and improvements
- Joint crustal-subduction interface rupture sets

## Special Studies

- Cyclone response

# NSHM python libraries for research

Library	Hazard pipeline	NSHM user website	Researcher
solvis	Yes	Yes	geospatial investigation of NSHM inversion solutions (both individual inversions and the composite model)
nzshm-common	Yes	Yes	handle coded locations, bins and grids.
nzshm-model	Yes	Yes	identify, filter and build branches and logic trees. Build hazard engine inputs and configs.
toshi-hazard-post	Yes	Not yet	Building all realizations and calculating aggregate statistics (hazard curves or disaggregations)
toshi-hazard-store	Yes	Yes	not needed if using parquet, but maybe useful in other cases.



# Documentation

Every library and application will have documentation hosted on github pages

Project: <https://gns-science.github.io/nzshm-documentation/>

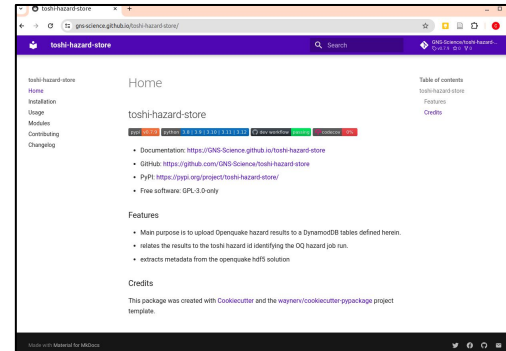
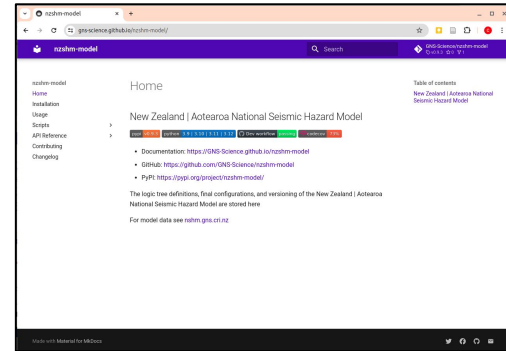
nzshm-model: <https://gns-science.github.io/nzshm-model/>

toshi-hazard-store: <https://gns-science.github.io/toshi-hazard-store/>

toshi-hazard-post: in development

nzshm-common: in development

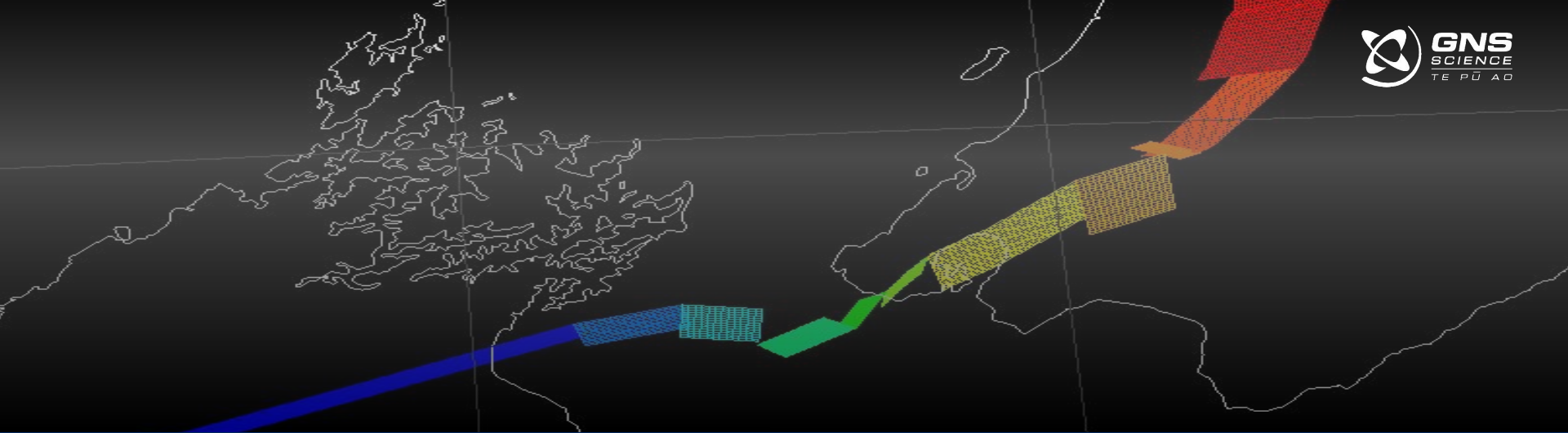
solvis: in development



# What's Up Next (with demos)

**Weka** - the new TUI

**Re-engineering the Hazard Calculation**



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# NSHM

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# Rupture Explorer

The screenshot shows the NSHM Rupture Explorer web application. The browser address bar shows the URL `nshm.gns.cri.nz/RuptureMap`. The page header includes the NSHM logo and navigation links for Hazard, Ruptures, Coming Features, Resources, and Help. The GNS Science logo is also present.

The main interface is divided into a left sidebar and a central map area. The sidebar, titled "Rupture Explorer", contains the following controls:

- Fault System:** Crustal
- Faults (optional):** A dropdown menu.
- Locations:** A dropdown menu.
- Radius:** A dropdown menu.
- Magnitude:** A slider ranging from 6 to 10.
- Rate (1eN/yr):** A slider ranging from -20 to 0.
- SUBMIT** button and a download icon.
- MAP OPTIONS** and **ANIMATION OPTIONS** buttons.

The central map area displays a map of New Zealand with numerous colored lines representing fault ruptures. A red dot on the map indicates the selected rupture. A pop-up window on the right provides details for "Rupture 1 of 3884":

- Mean Rate:  $1.01 \times 10^{-5}$  per year
- Magnitude: 7.2
- Area: 1090 km<sup>2</sup>
- Length: 35 km

Below the map, a "Magnitude Frequency Distribution" plot is shown. The y-axis is "Rate (1/yr)" on a logarithmic scale from  $10^{-7}$  to  $10^{-1}$ . The x-axis is "Magnitude" from 7.0 to 9.5. The plot includes a bar chart for "Incremental" rates and a line for "Cumulative" rates. A "Participation Rate (1/yr)" color scale is located below the plot, ranging from  $10^{-7}$  (black) to  $10^{-3}$  (yellow).

At the bottom of the map area, there is a navigation bar with left and right arrows, a play button, and a "1fps" speed control.

Technical Info: This site provides only seismic hazard results.

# The Workplan

Goals	Applicable Themes
Improve GNS Hazard code for better useability	3rd party hazard calc on demand hazard internal collaboration
work with GEM on getting oq-engine to run NZ NSHM soup-to-nuts	3rd party hazard calc on demand hazard
Architectural review	3rd party hazard calc on demand hazard platform
sampled version of logic tree	3rd party hazard calc on demand hazard
Improve oq-engine calculation speed	3rd party hazard calc on demand hazard
improved available location discovery	on demand hazard internal collaboration
Code Management	quality and maintainance
Cloud service management	quality and maintainance
documentation and training	internal collaboration
improved record keeping of available hazard, inversion, locations, etc.	on demand hazard internal collaboration



# Making the Model Reproducible

**Story of what that means ...**

**Why, who, where**