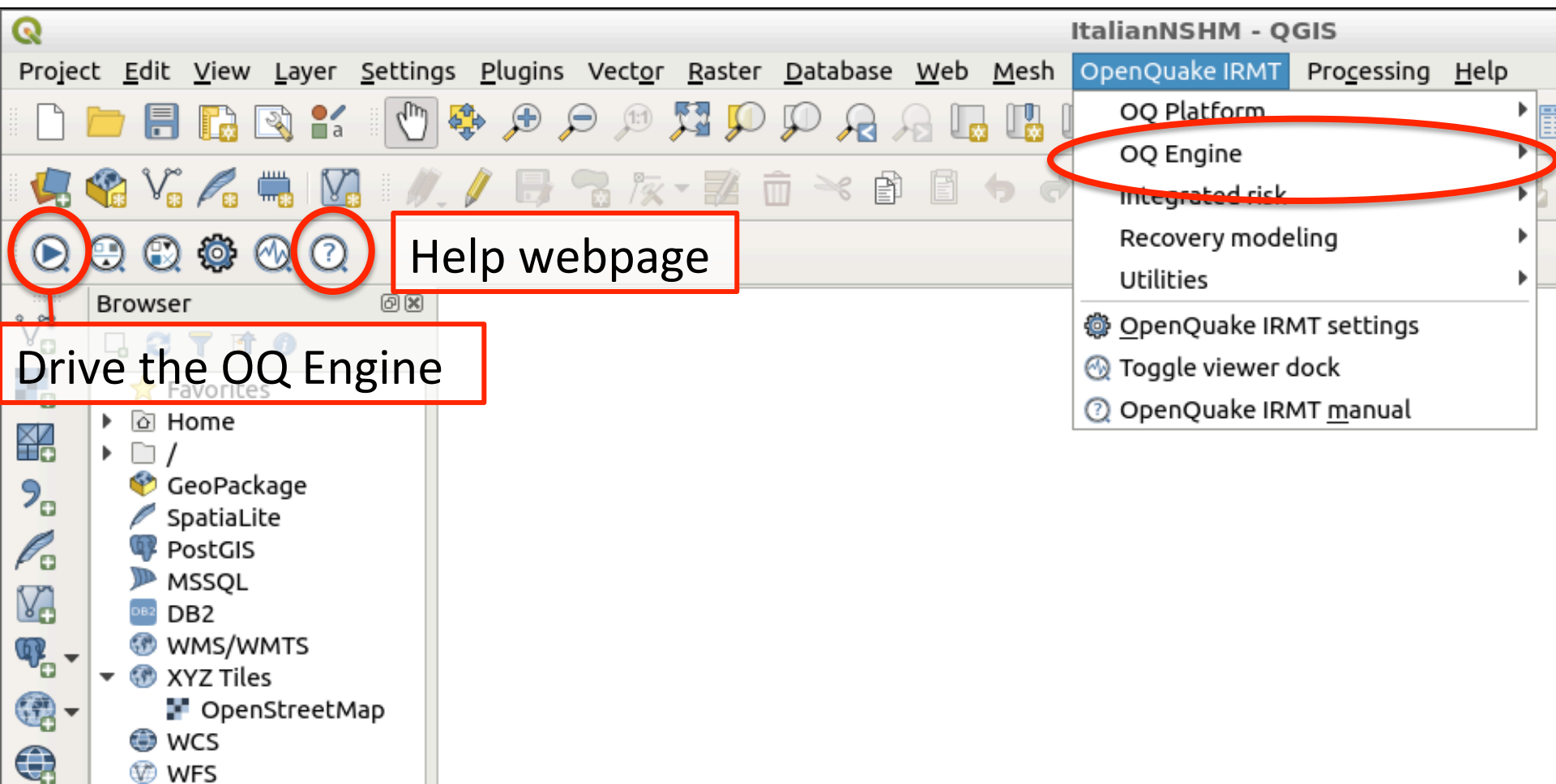


Tutorial 7: Italy demo part 2

- Review how to run OQ in QGIS, and read common errors from the console
- Visualize OQ outputs in QGIS
- Install and run QConsolidate3
- Interpret OQ outputs
- Compare our implementation of the Italian NSHMP to the original publication
- Compute rate from probability

Running OQ in QGIS

- In QGIS, click *OpenQuake IRMT* -> *OQ Engine*
-> *Drive the OQ Engine*



Choose the job files

Drive the OpenQuake Engine v3.4.0 (<http://localhost:8800>)

Run Calculation

List of calculations

Description	Job ID	Calculation Mode	Owner	Status					
Seismic hazard analysis for Italy - simplified model	21	classical	openq...	complete	Console	Remove	Outputs	Continue	
Seismic hazard analysis for Italy - simplified model	19	classical	openq...	complete	Console	Remove	Outputs	Continue	

Select the files needed to run the calculation, or the zip archive containing those files.

Recent
Home
Desktop
Documents
Downloads
Music
Pictures
Videos
sf_vm_shared
Other Locations

openquake Desktop ItalyExample2 job_files

Name	Size	Modified
ssmLT.xml	616 bytes	13:21
new_ssm.xml	59.4 kB	13:21
job.ini	1.0 kB	13:21
gmmLT.xml	675 bytes	13:21

Hold **ctrl** while selecting the files needed to run the job (*job.ini*, *ssmLT.xml*, *new_ssm.xml*, *gmmLT.xml*)
NOTE: the job file can only be named *job.ini*, *job_haz.ini*, or *job_hazard.ini*

Download HDF5 da

All Files

Cancel Open

Using the Console

The screenshot displays the OpenQuake Engine v3.4.0 interface. At the top, there is a "Run Calculation" button. Below it, a "List of calculations" table shows several entries for "Seismic hazard analysis for Italy - simplified model". The first entry (Job ID 21) is highlighted, and its "Console" button is circled in red. Below the table, a "List of outputs for" section is partially visible. In the foreground, a "Console log of calculation 21" window is open, showing a detailed log of the calculation process, including progress percentages and data transfer information. The OpenQuake logo is visible at the bottom of the console window.

Drive the OpenQuake Engine v3.4.0 (http://localhost:8800)

Run Calculation

List of calculations

Description	Job ID	Calculation Mode	Owner	Status	Console	Remove	Outputs	Continue
Seismic hazard analysis for Italy - simplified model	21	classical	openq...	complete	Console	Remove	Outputs	Continue
Seismic hazard analysis for Italy - simplified model	18	classical	openq...	complete	Console	Remove	Outputs	Continue
Seismic hazard analysis for Italy - simplified model	17	classical	openq...	complete	Console	Remove	Outputs	Continue

List of outputs for

Id	Name
103	Full Report
104	Hazard Curves
105	Hazard Maps
106	Input Files
107	Seismic Scenarios
108	Uniform Hazard

Console log of calculation 21

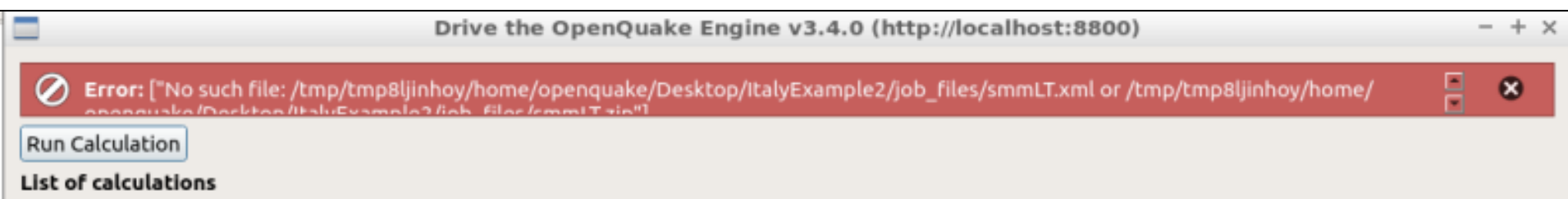
```
2019-04-13T11:23:21.91, INFO, MainProcess/2594, classical 28% [of 7]
2019-04-13T11:23:23.02, INFO, MainProcess/2594, classical 42% [of 7]
2019-04-13T11:23:31.30, INFO, MainProcess/2594, classical 57% [of 7]
2019-04-13T11:23:31.47, INFO, MainProcess/2594, classical 71% [of 7]
2019-04-13T11:23:32.34, INFO, MainProcess/2594, classical 85% [of 7]
2019-04-13T11:23:32.36, INFO, MainProcess/2594, classical 100% [of 7]
2019-04-13T11:23:32.38, INFO, MainProcess/2594, Received 883.69 KB from 7 classical outputs in 31
seconds, biggest output=187.41 KB
2019-04-13T11:23:32.39, INFO, MainProcess/2594, Received {'pmap': '880.58 KB', 'calc_times': '3.31 KB',
'eff ruptures': '538 B', 'rup_data': '133 B'}
2019-04-13T11:23:32.41, INFO, MainProcess/2594, There are 1 realization(s)
2019-04-13T11:23:32.44, INFO, MainProcess/2594, Effective sites per task: 930
2019-04-13T11:23:32.50, INFO, MainProcess/2594, Building hazard statistics
2019-04-13T11:23:33.09, INFO, MainProcess/2594, Sent 31.46 KB of data in 6 build_hazard_stats task(s)
2019-04-13T11:23:34.33, INFO, MainProcess/2594, build_hazard_stats 16% [of 6]
2019-04-13T11:23:35.84, INFO, MainProcess/2594, build_hazard_stats 33% [of 6]
2019-04-13T11:23:35.86, INFO, MainProcess/2594, build_hazard_stats 50% [of 6]
2019-04-13T11:23:35.87, INFO, MainProcess/2594, build_hazard_stats 66% [of 6]
2019-04-13T11:23:35.88, INFO, MainProcess/2594, build_hazard_stats 83% [of 6]
2019-04-13T11:23:35.90, INFO, MainProcess/2594, build_hazard_stats 100% [of 6]
```

Download HDF5 d...

OpenQuake

File errors and job failures

- Errors printed in the console can be intimidating and verbose, so it is good to know what to look for
- What if a file name is spelled wrong in the job file?
 - The Engine gives an error that there is “No such file...<filename>”



File errors and job failures

- What if the logic tree points to a file that does not exist? Job status: **failed**

Drive the OpenQuake Engine v3.4.0 (http://localhost:8800)

Run Calculation


List of calculations

Description	Job ID	Calculation Mode	Owner	Status	Console	Remove	Outputs	Continue
Seismic hazard analysis for Italy - simplified model	25	classical	openq...	failed	Console	Remove		
Seismic hazard analysis for Italy - simplified	21	classical	open...	completed	Console	Remove	Outputs	Continue

Console log of calculation 25

```
self.parse_branchinglevel(branchinglevel_node, depth, validate)
File "/home/openquake/GEM/oq-engine/openquake/commonlib/logictree.py", line 683, in
parse_branchinglevel
self.parse_branches(branchset_node, branchset, validate)
File "/home/openquake/GEM/oq-engine/openquake/commonlib/logictree.py", line 755, in parse_branches
value_node, branchnode, branchset)
File "/home/openquake/GEM/oq-engine/openquake/commonlib/logictree.py", line 946, in
validate_uncertainty_value
raise LogicTreeError(node, self.filename, str(exc)) from exc
openquake.commonlib.logictree.LogicTreeError: filename '/tmp/tmplzew_3v4/home/openquake/Desktop/
ItalyExample2/job_files/ssmLT.xml', line 9: [Errno 2] No such file or directory: '/tmp/tmplzew_3v4/
home/openquake/Desktop/ItalyExample2/job_files/new-ssm.xml'
```

Again, "No such file or directory: ..."



File errors and job failures

- What if an xml file is in the wrong format, for example if we miss an opening or closing tag?

```
self.parse_tree(tree, validate)
File "/home/openquake/GEM/oq-engine/openquake/commonlib/logictree.py", line 655, in parse_tree
self.parse_branchinglevel(branchinglevel_node, depth, validate)
File "/home/openquake/GEM/oq-engine/openquake/commonlib/logictree.py", line 683, in
parse_branchinglevel
self.parse_branches(branchset_node, branchset, validate)
File "/home/openquake/GEM/oq-engine/openquake/commonlib/logictree.py", line 755, in parse_branches
value_node, branchnode, branchset)
File "/home/openquake/GEM/oq-engine/openquake/commonlib/logictree.py", line 946, in
validate_uncertainty_value
raise LogicTreeError(node, self.filename, str(exc)) from exc
openquake.commonlib.logictree.LogicTreeError: filename '/tmp/tmpb62hjq_8/home/openquake/Desktop/
ItalyExample/ssmLT-test.xml', line 9: /tmp/tmpb62hjq_8/home/openquake/Desktop/ItalyExample/
test_ssm.xml: 26: mismatched tag
```

mismatched tag



Viewing OQ Outputs in QGIS

Drive the OpenQuake Engine v3.4.0 (http://localhost:8800)

Run Calculation

List of calculations

Description	Job ID	Calculation Mode	Owner	Status					
Seismic hazard analysis for Italy - one gmm, UHS -> many SA periods	39	classical	openq...	complete	Console	Remove	Outputs	Continue	
Seismic hazard analysis for Italy - one gmm, UHS -> many SA periods	38	classical	openq...	complete	Console	Remove	Outputs	Continue	
Seismic hazard analysis for Italy - one gmm, UHS -> many SA periods	36	classical	openq...	complete	Console	Remove	Outputs	Continue	
Seismic hazard analysis for Italy - simplified model, four gmms	35	classical	openq...	complete	Console	Remove	Outputs	Continue	
Classical PSHA with Simple Fault Source	34	classical	openq...	complete	Console	Remove	Outputs	Continue	
Seismic hazard analysis for Italy - simplified model	33	classical	openq...	complete	Console	Remove	Outputs	Continue	
Classical PSHA with Simple Fault Source	32	classical	openq...	complete	Console	Remove	Outputs	Continue	

List of outputs for calculation 39

Id	Name				
162	Full Report	Download rst	Show		
163	Hazard Curves	Download csv	Download xml	Download npz	Load layer
164	Hazard Maps	Download csv	Download xml	Download npz	Load layer
165	Input Files	Download zip			
166	Seismic Source Groups	Download csv	Load layer		
167	Uniform Hazard Spectra	Download csv	Download xml	Download npz	Load layer

Download HDF5 datastore for calculation 39 (4.45 MB) Show parameters for calculation 39

OPENUAKE

Viewing OQ Outputs in QGIS

- Format the symbology using *right-click* -> *Layer Properties*

Layer Properties - hmap_mean_PGA_poe-0.1_50.0y | Symbology

Graduated

Column: 1.2 PGA-0.1

Symbol: Change...

Legend format: %1 - %2 Precision 2

Method: Color

Color ramp:

Symbol	Values	Legend
<input checked="" type="checkbox"/>	0.0000 - 0.0397	0.00 - 0.04
<input checked="" type="checkbox"/>	0.0397 - 0.0794	0.04 - 0.08
<input checked="" type="checkbox"/>	0.0794 - 0.1191	0.08 - 0.12
<input checked="" type="checkbox"/>	0.1191 - 0.1588	0.12 - 0.16
<input checked="" type="checkbox"/>	0.1588 - 0.1985	0.16 - 0.20
<input checked="" type="checkbox"/>	0.1985 - 0.2382	0.20 - 0.24
<input checked="" type="checkbox"/>	0.2382 - 0.2779	0.24 - 0.28
<input checked="" type="checkbox"/>	0.2779 - 0.3176	0.28 - 0.32

Mode: Equal Interval

Symmetric Classification

Classify Delete All

Link class boundaries

Layer Rendering

Symbol Selector

Marker

Simple marker

Symbol layer type: Simple marker

Size: 0.250000 Map Units

Fill color:

Stroke color:

Stroke style: No Pen

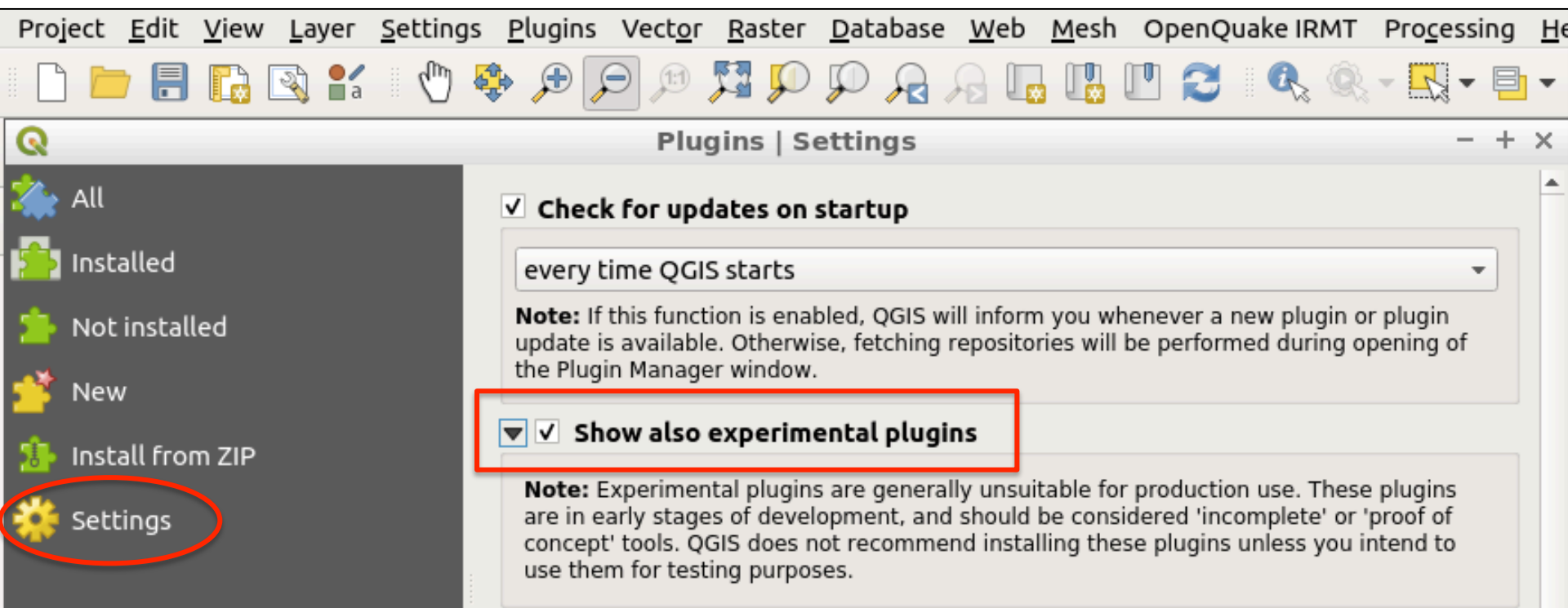
Stroke width: Hairline Millimeter

IMPORTANT! Saving OQ layers

- The OpenQuake engine saves every job you run, but the loaded, formatted layers will not automatically saved into your QGIS project
- Use the QConsolidate plugin to save all your “temporary layers”
- This plugin also helps you save your QGIS job with relative paths, so you can send the whole job to your group

Installing QConsolidate

- Open *Plugins -> Manage and Install Plugins*
- In settings, check the box for **Show also experimental plugins**



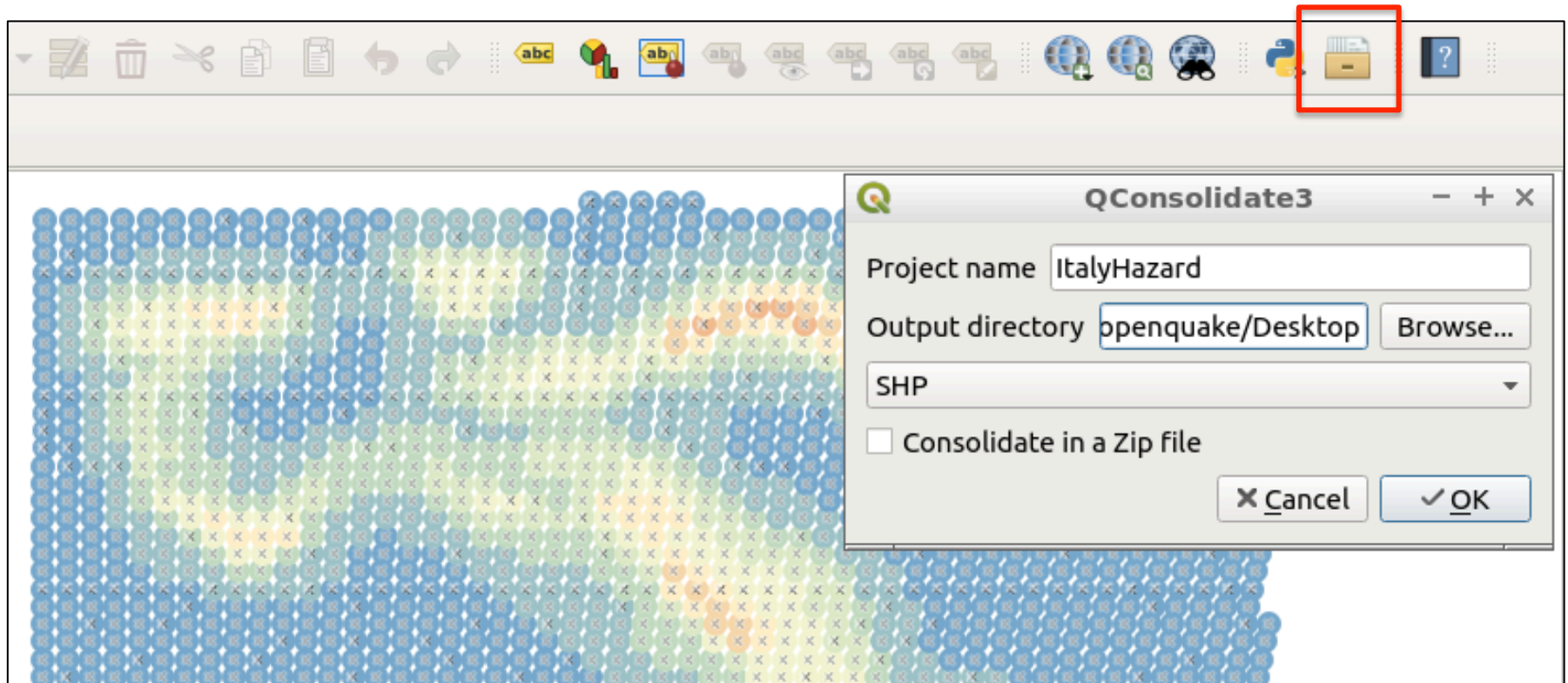
Installing QConsolidate

- In the menu *All* search for 'QConsolidate3'
- Select, and click *Install Plugin*



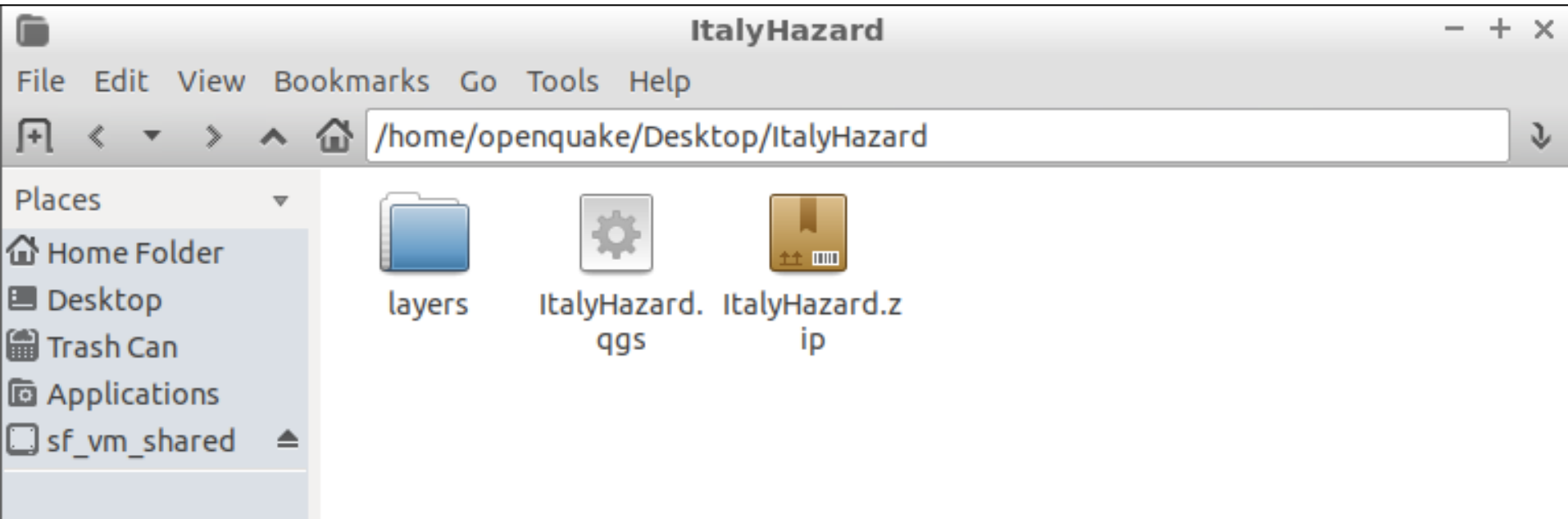
Consolidating project layers

- Open Qconsolidate3
- Give the project a **new** name and specify the output directory
- Click *OK*
- If you want to share the project with your group, check *'Consolidate in a Zip file'*



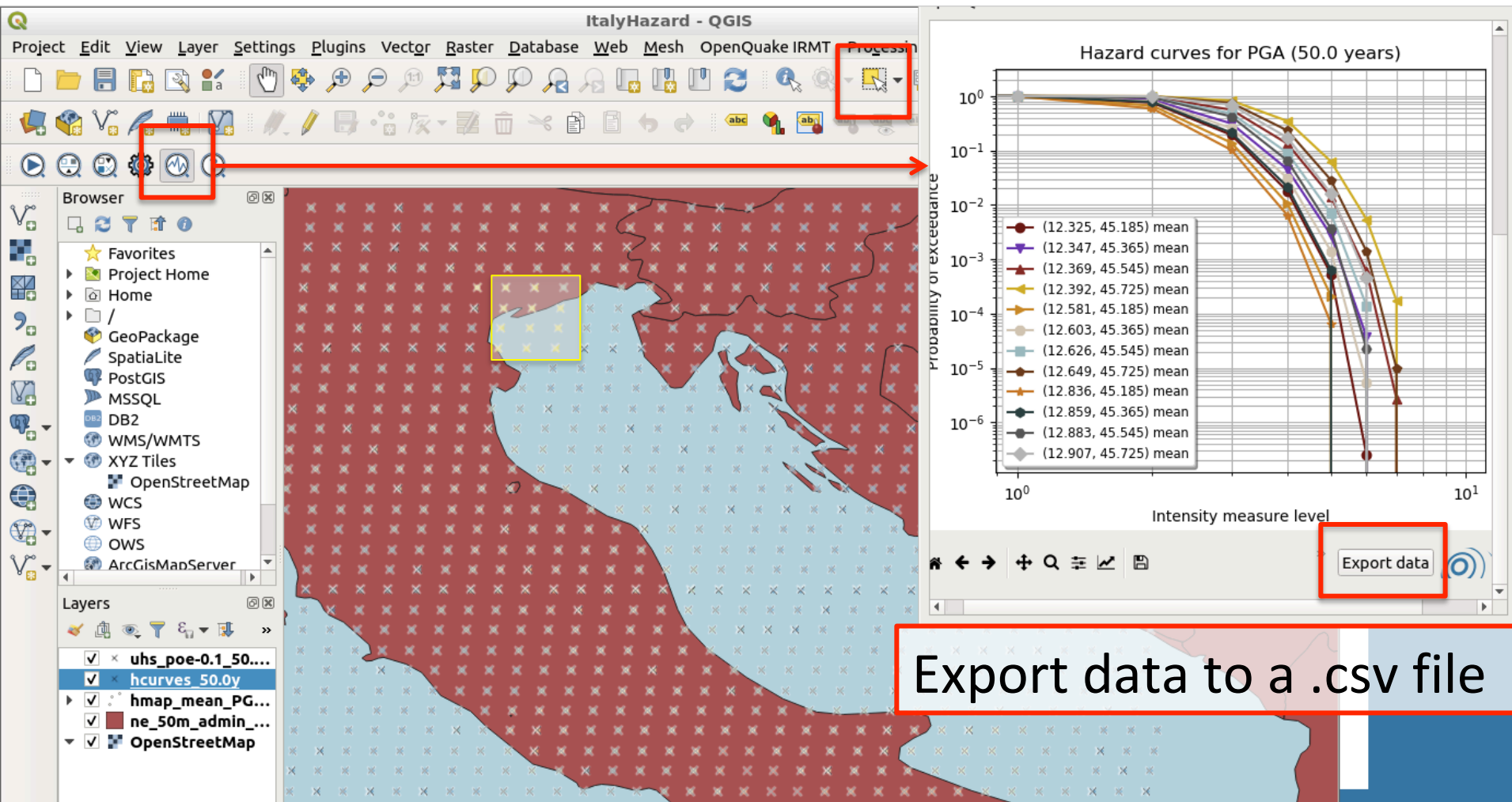
Consolidating project layers

- A new directory appears with:
 - The QGIS project file
 - All the loaded files saved as shapefiles
 - If specified, a zip file for sharing, with *relative* paths saved



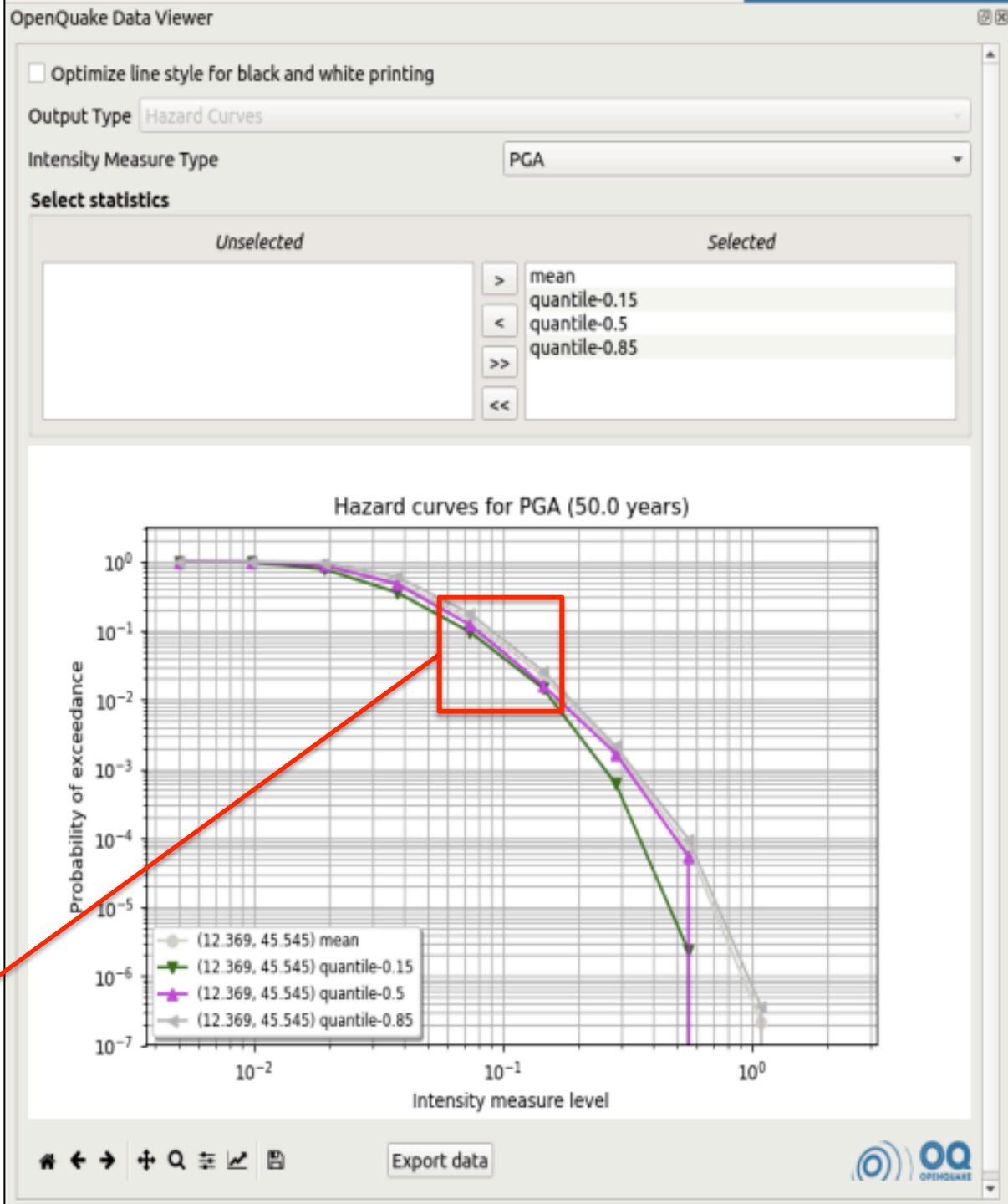
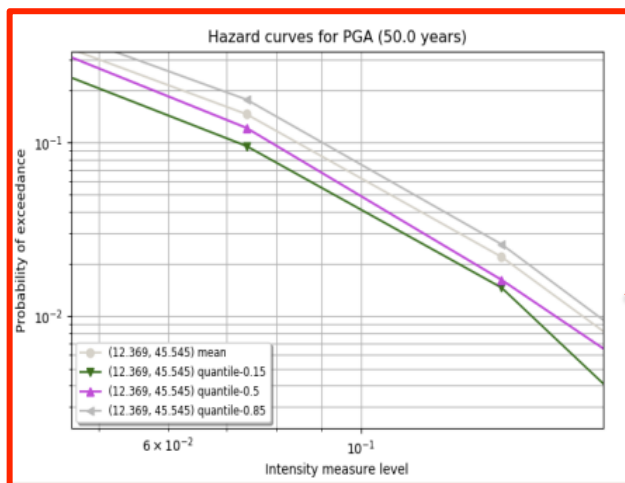
Hazard curves

- With the hazard curves layer highlighted, and the *Viewer Dock* open, select a site or group of sites



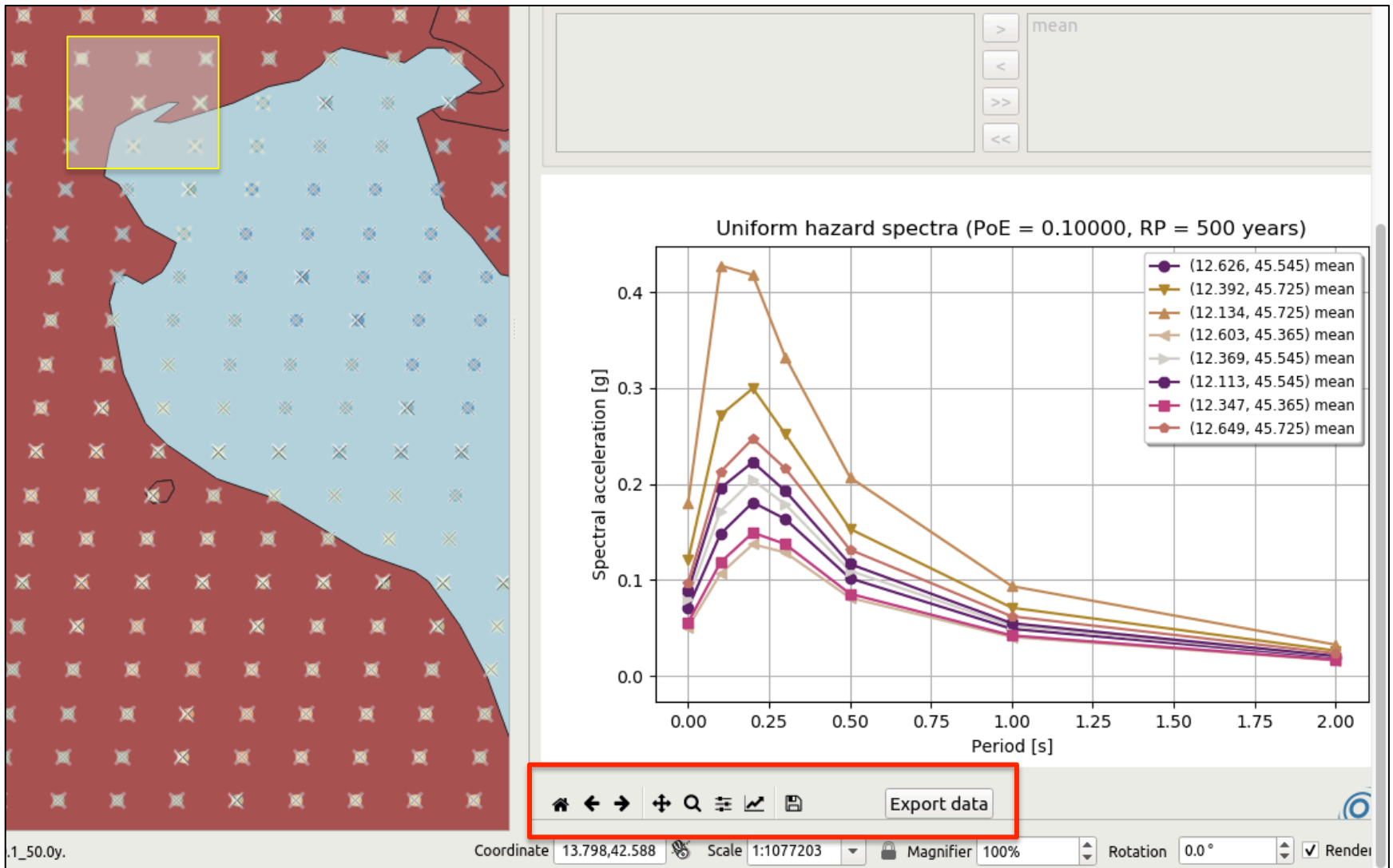
Hazard curves

- For one site and multiple realizations, view quantiles and the mean
- Customize figures
- Zoom



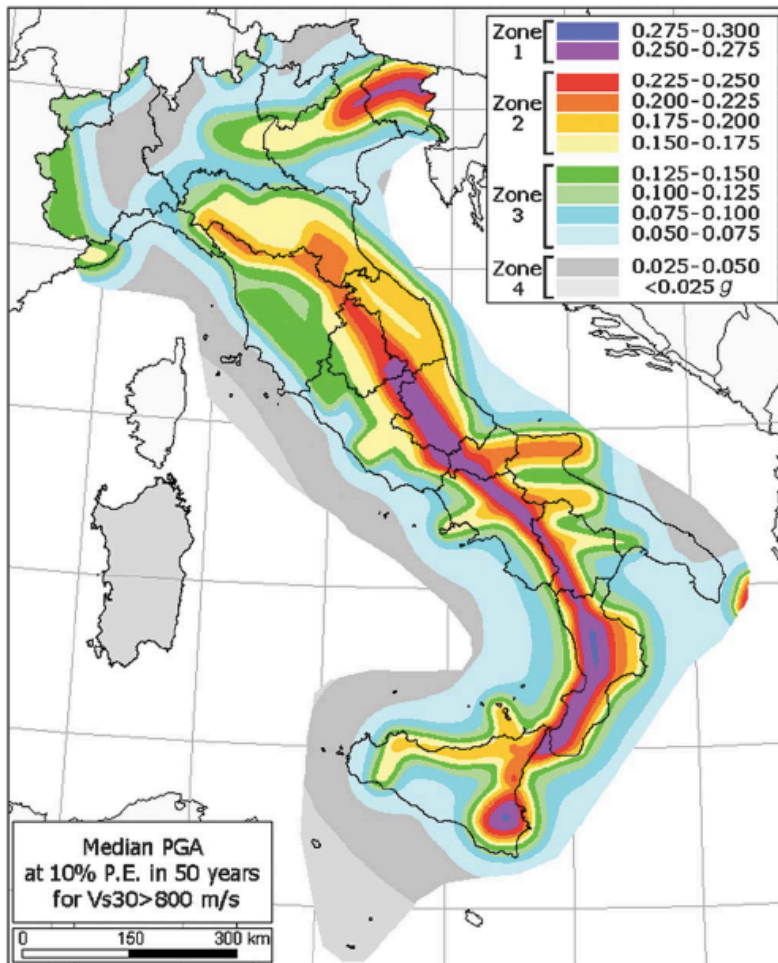
Uniform hazard spectra

- The UHS can be visualized and exported in the same manner as the hazard curves

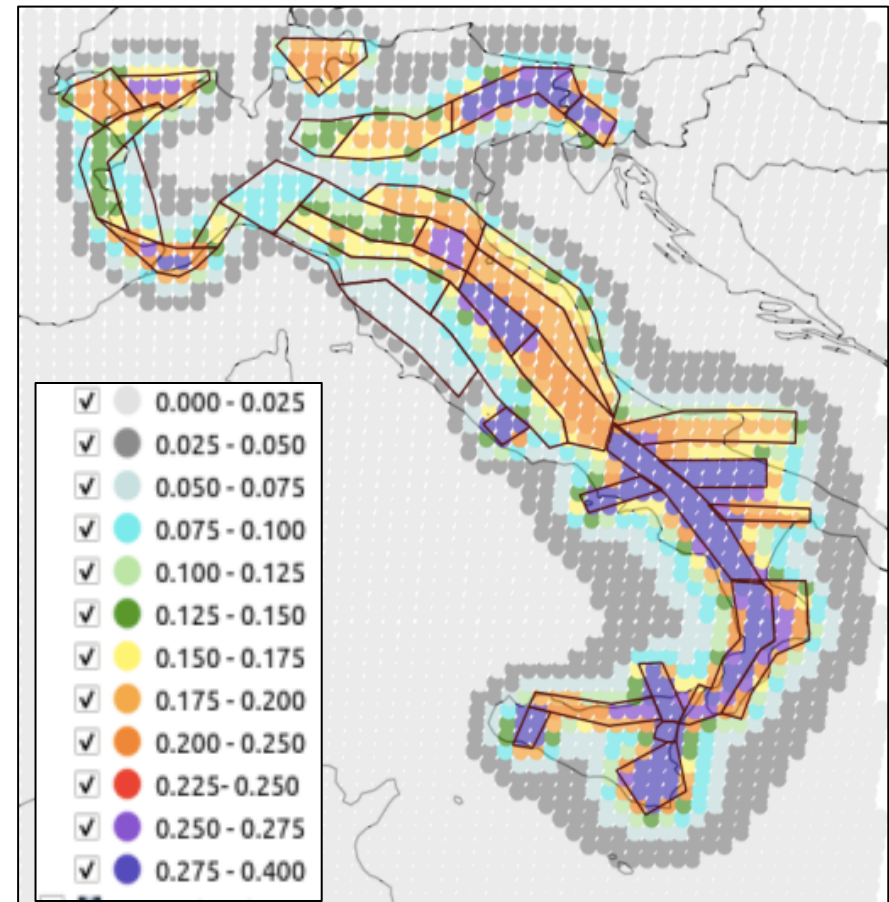


Our Italian NSHM model vs the published version

Stucchi et al., 2011

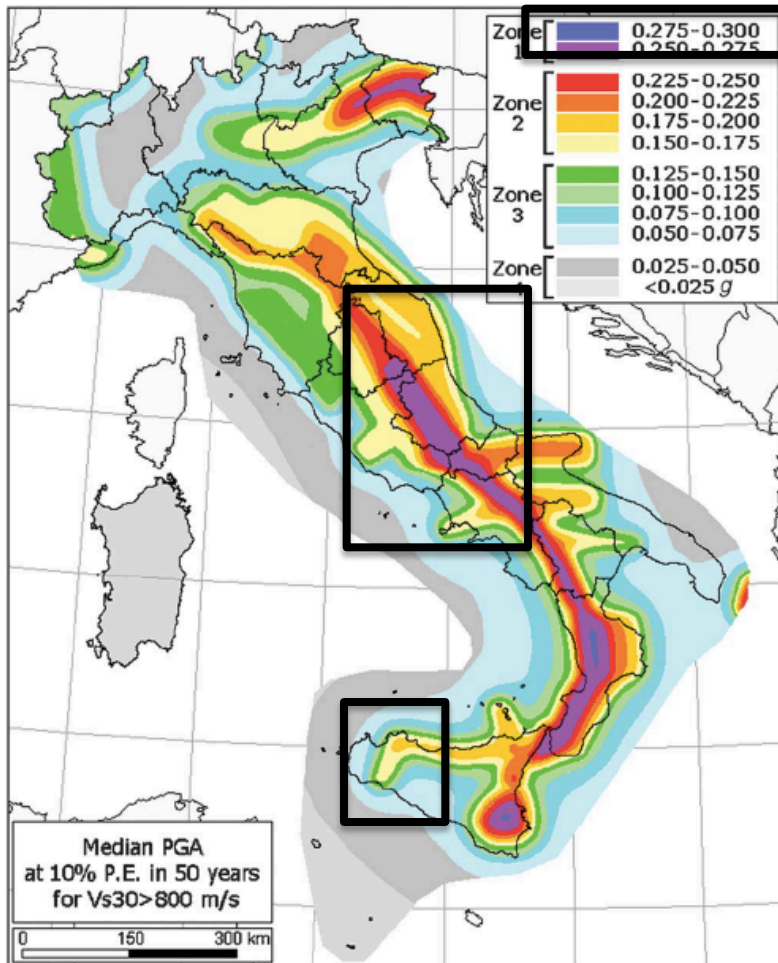


Earthquake Seismology
and PSHA course, 2019

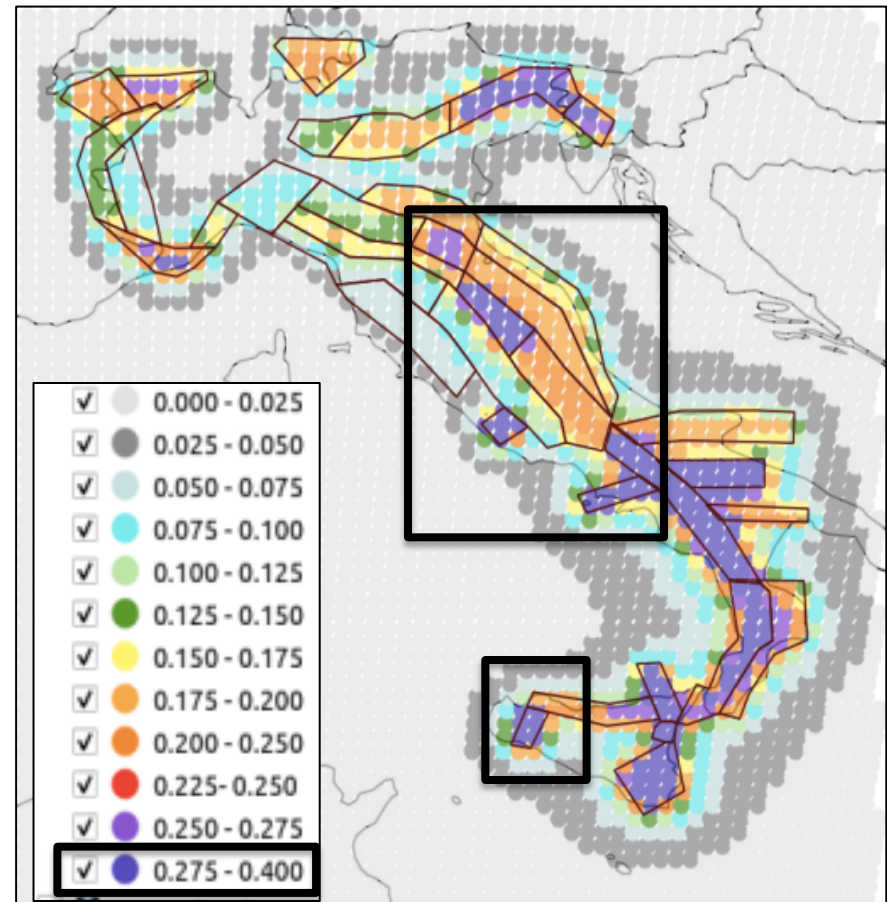


Our Italian NSHM model vs the published version

PGA < 0.3 g



PGA < 0.4 g

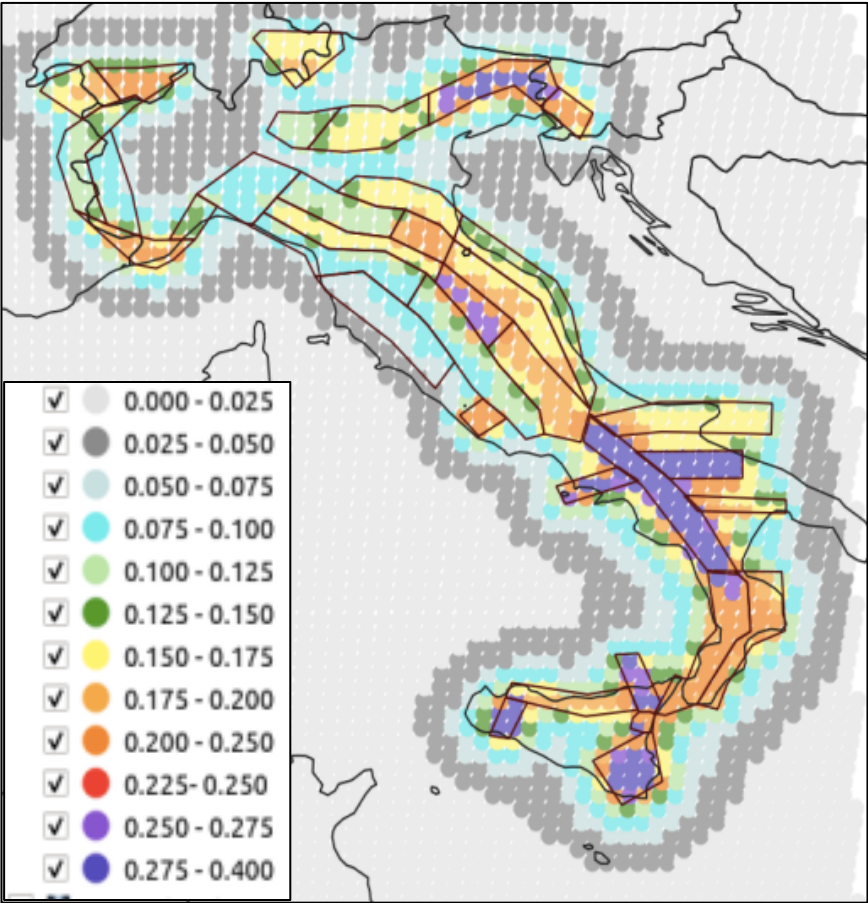


Possible explanations for differences

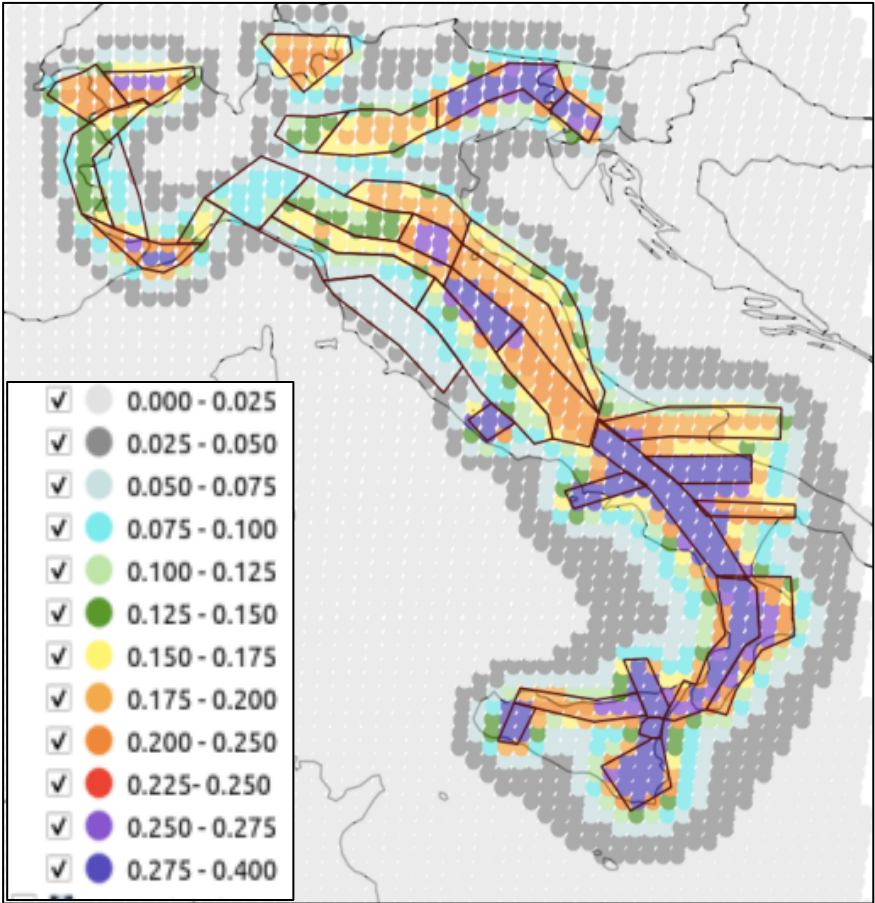
- We use only *one* branch of the logic tree from Stucchi et al. (2011)
 - Varied parameters: M_{max} , *hypocenter depth*, *a-* and *b- values*
- We used only Bindi et al. (2011) in the ground motion model, but they used four
 - Some of the older GMPEs are not region specific
 - More parameters are considered in the newer GMPEs

Comparing GMPEs

Boore and Atkinson (2008)
NGA-West



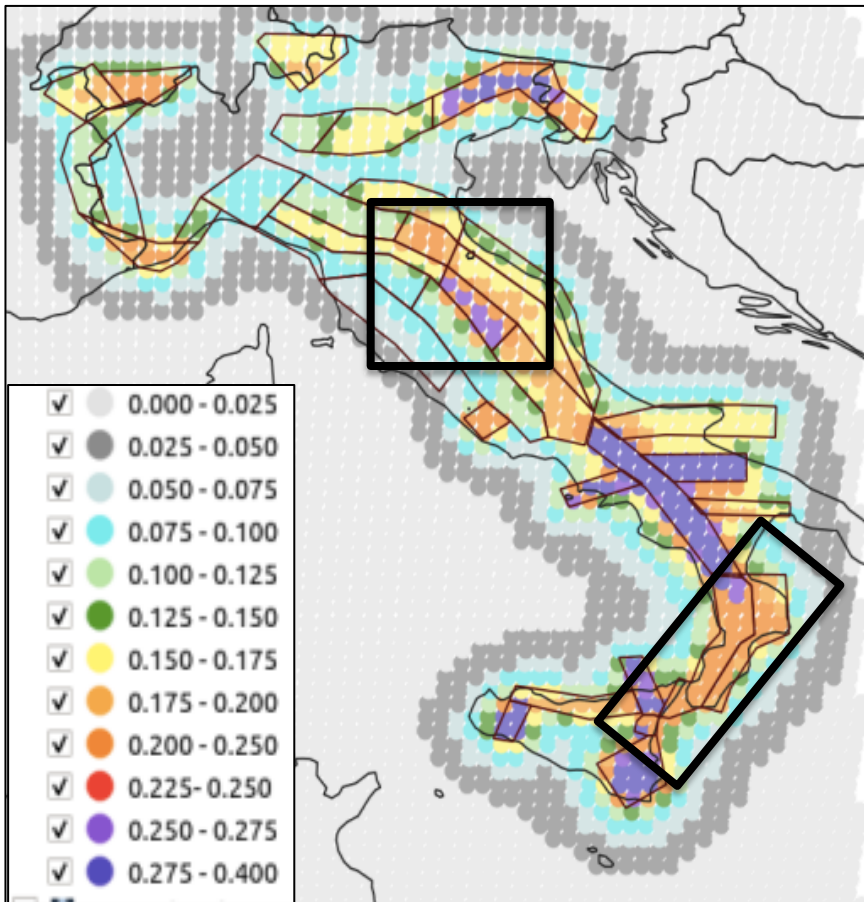
Bindi et al. (2011)
Italy



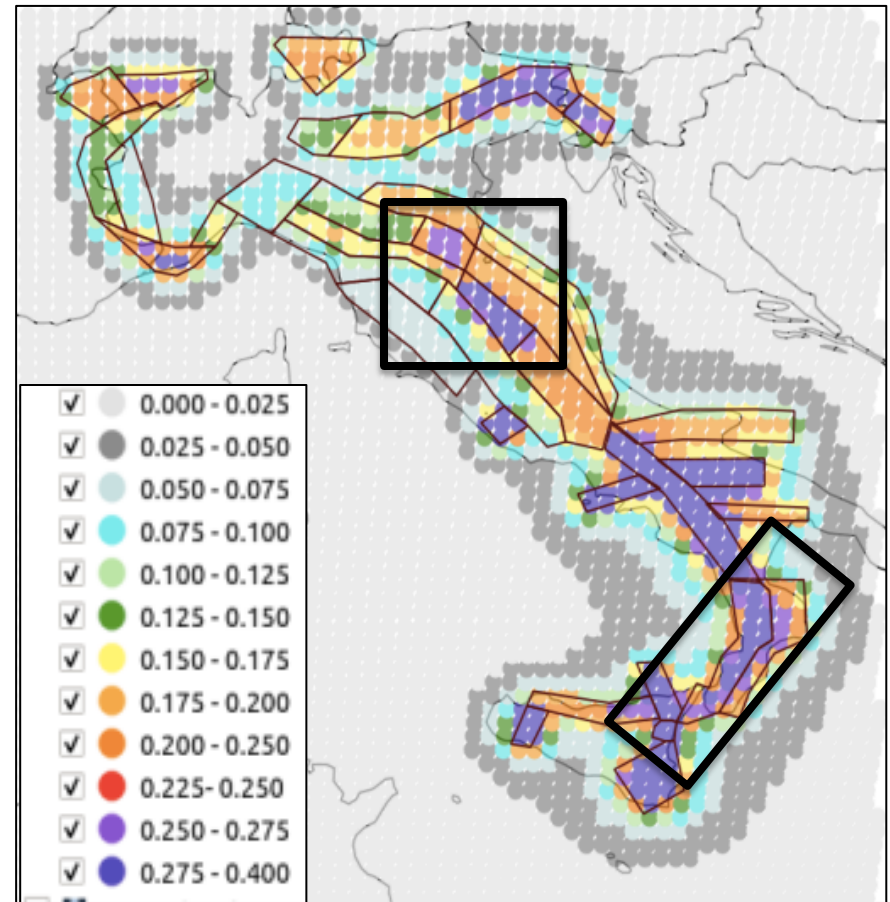
Comparing GMPEs

- The change is not uniform throughout the model
- The color scale is incremental

Boore and Atkinson (2008) NGA-West



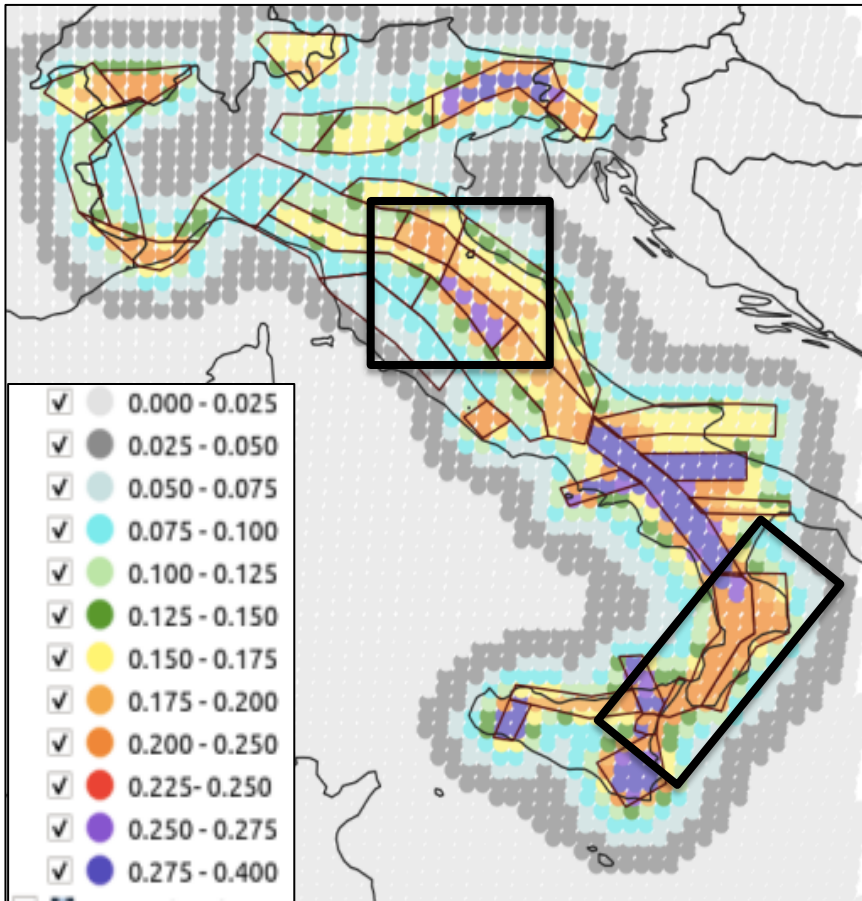
Bindi et al. (2011) Italy



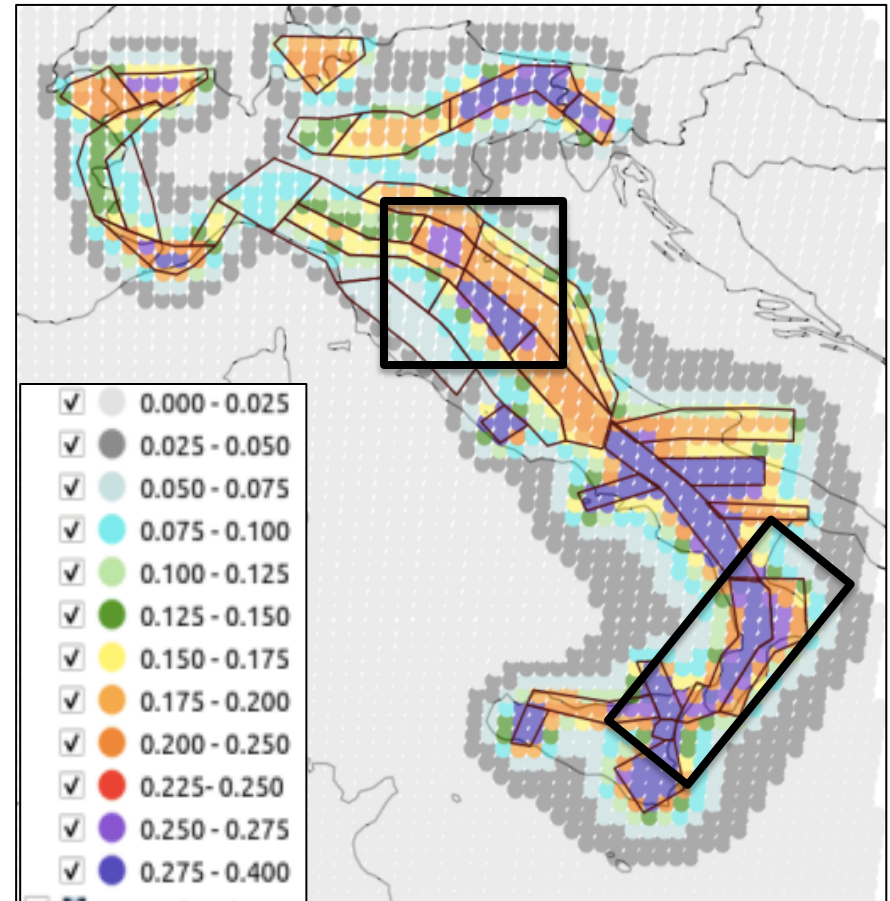
Comparing GMPEs

- Using Bindi et al. (2011), we calculate overall higher ground motions, but not uniformly
- Bindi et al. (2011) appears to attenuate faster

Boore and Atkinson (2008) NGA-West



Bindi et al. (2011) Italy



Comparing GMPEs

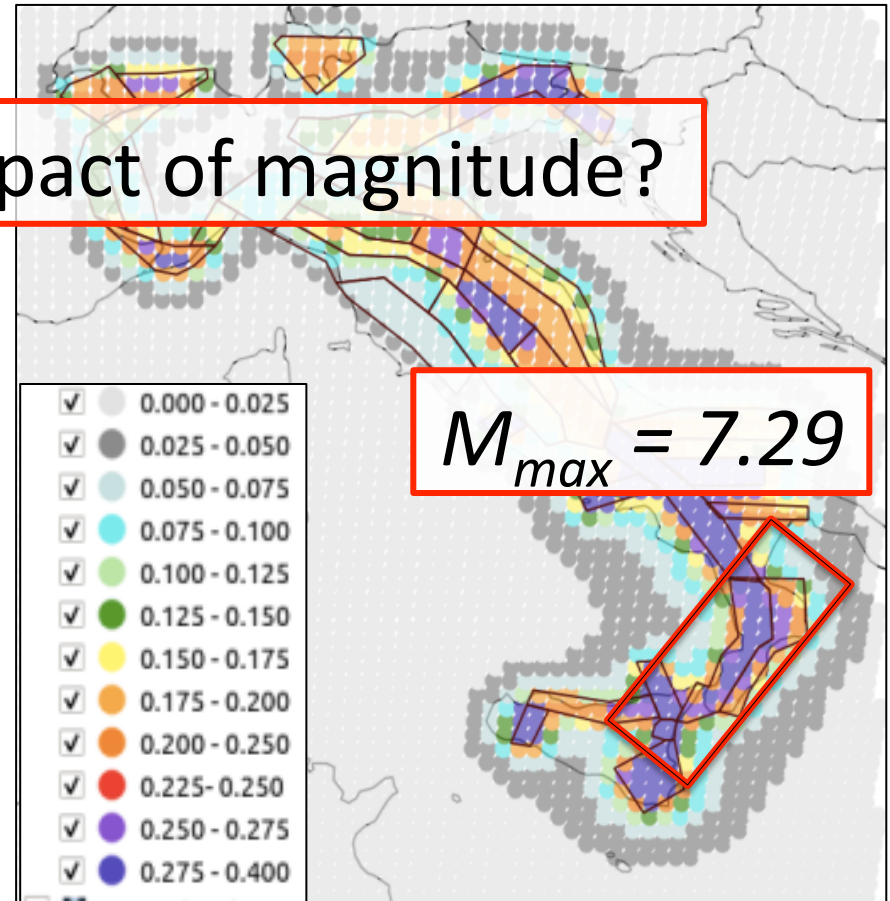
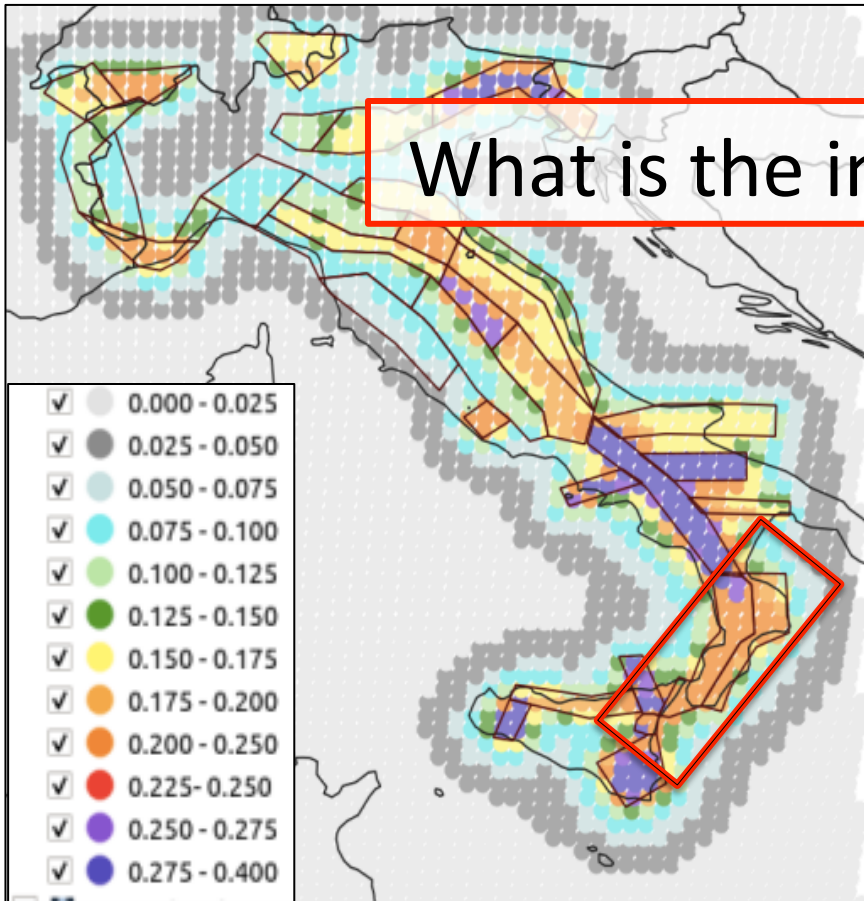
- Using Bindi et al. (2011), we calculate overall higher ground motions, but not uniformly
- Bindi et al. (2011) appears to attenuate faster

Boore and Atkinson (2008) NGA-West

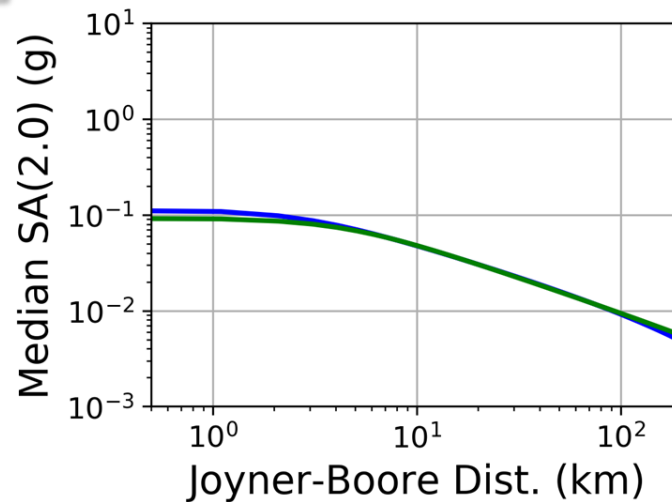
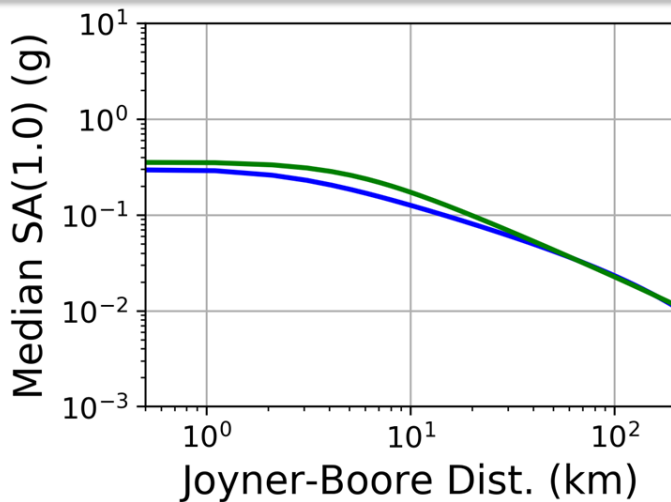
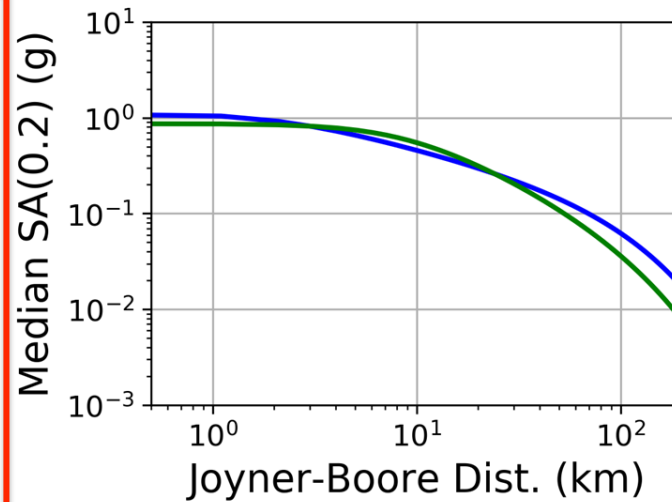
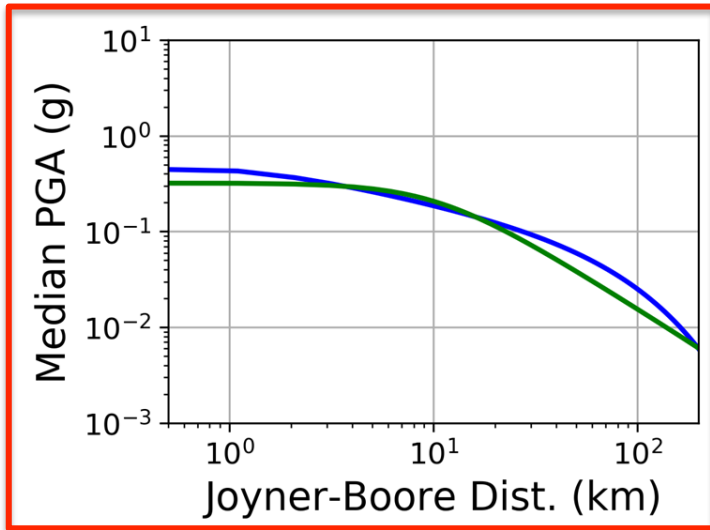
Bindi et al. (2011) Italy

What is the impact of magnitude?

$$M_{max} = 7.29$$



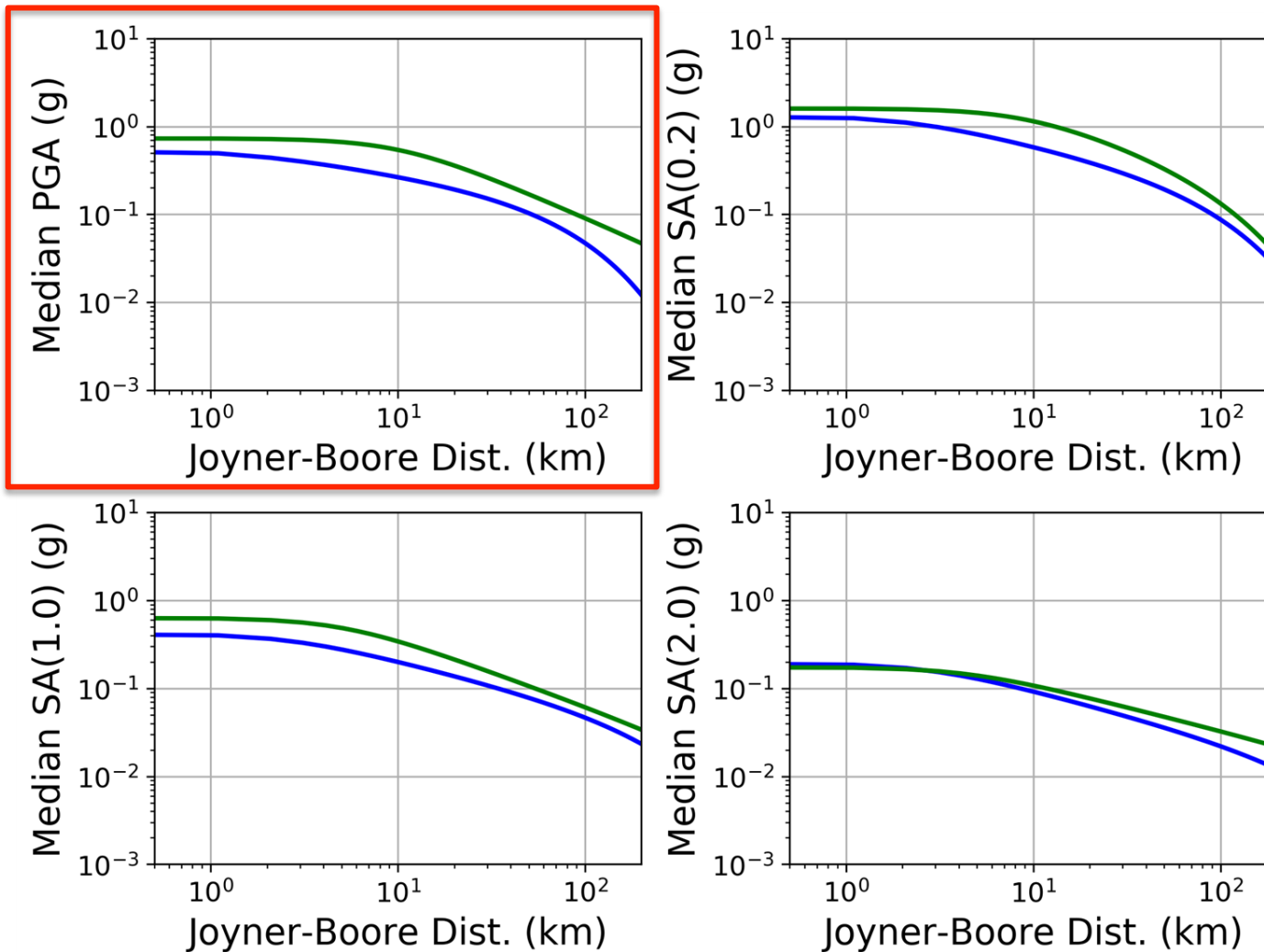
Comparing GMPEs



$M_W = 6.5$

— BooreAtkinson2008
— BindiEtAl2011

Comparing GMPEs



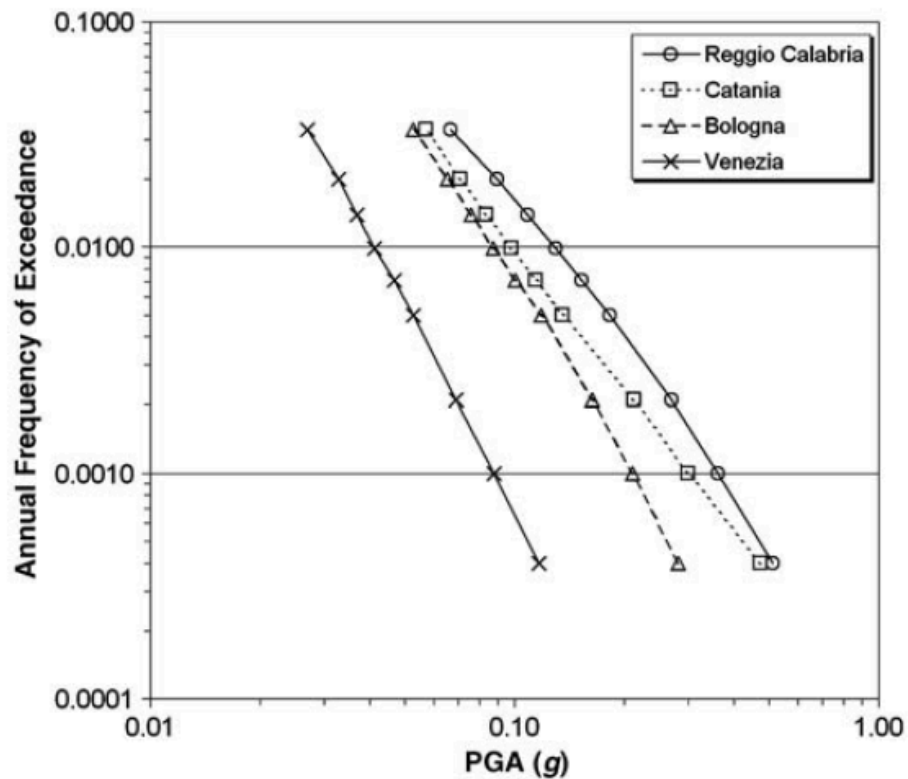
$M_W = 7.5$

— BooreAtkinson2008
— BindiEtAl2011

Probability vs Rate

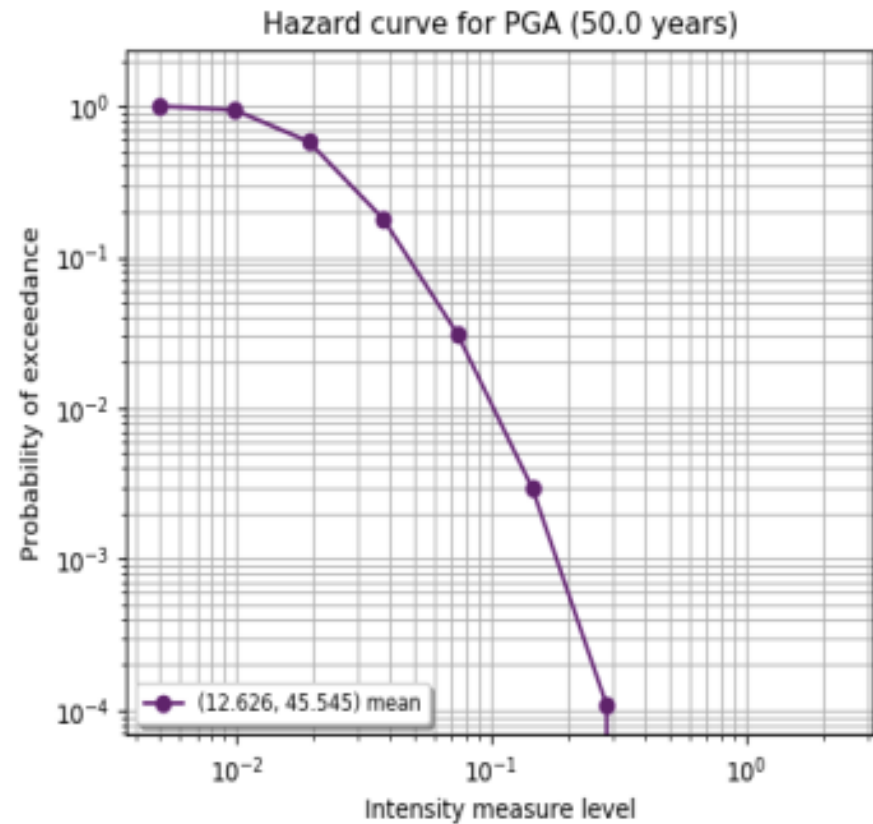
Stucchi et al., 2011

Annual frequency of exceedance



OpenQuake

Probability of exceedance



$$P(N > 1) = 1 - e^{-\lambda t}$$

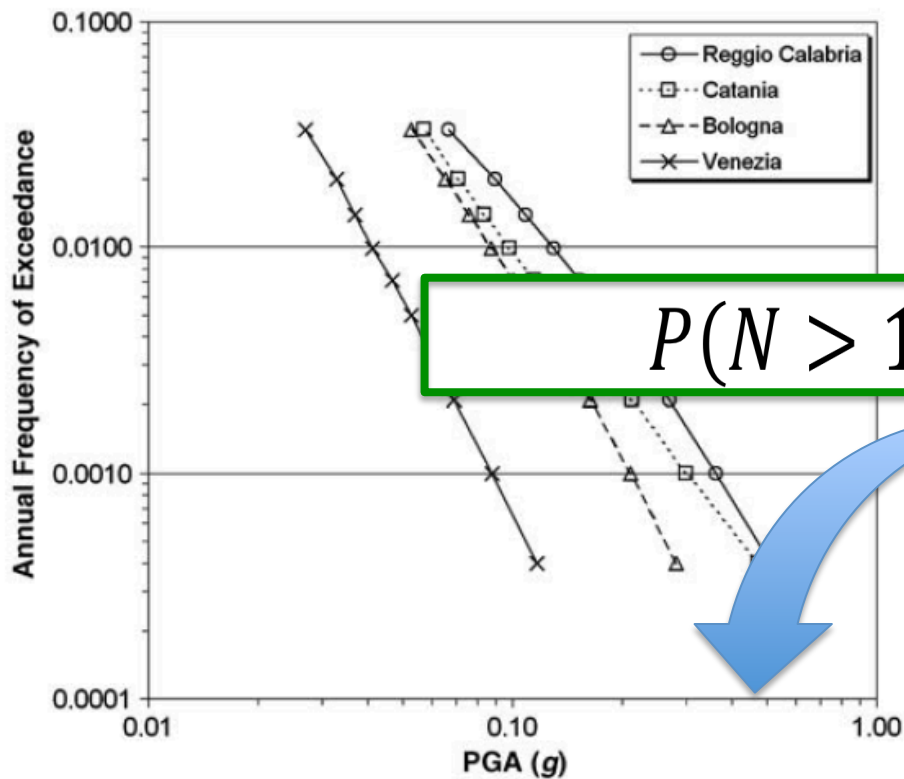
Probability vs Rate

Stucchi et al., 2011

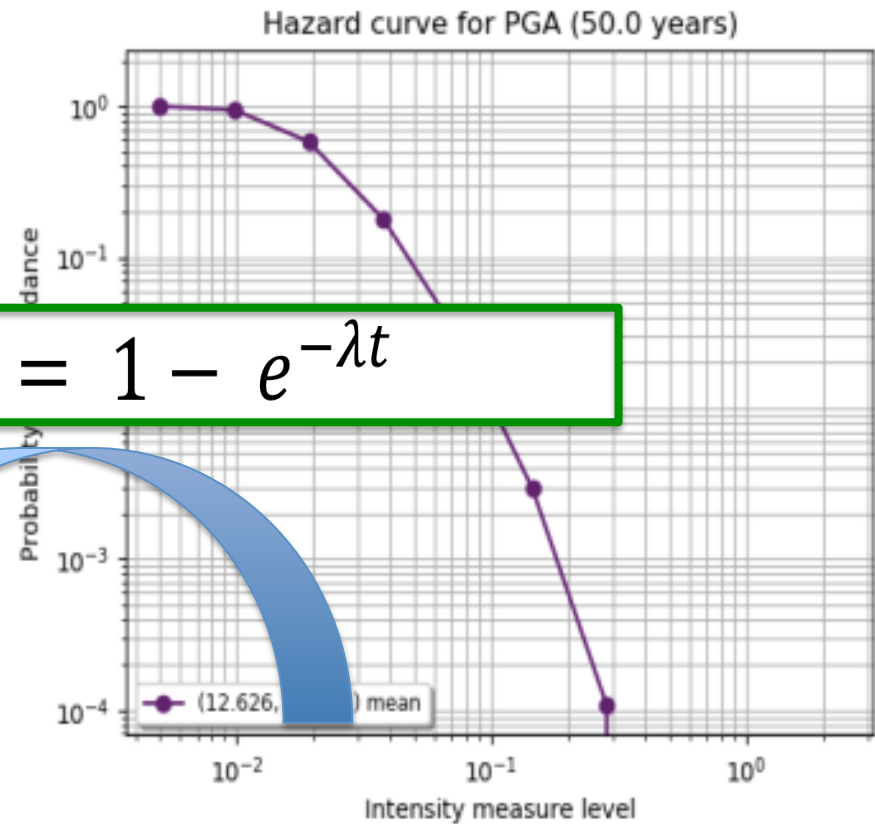
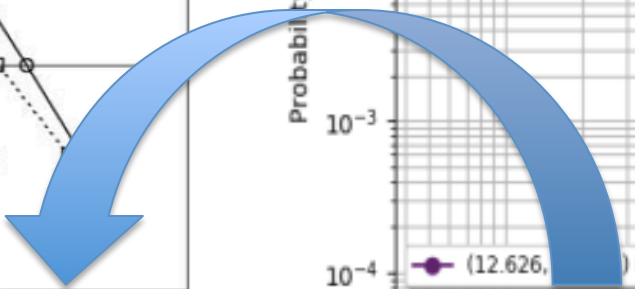
Annual frequency of exceedance

OpenQuake

Probability of exceedance



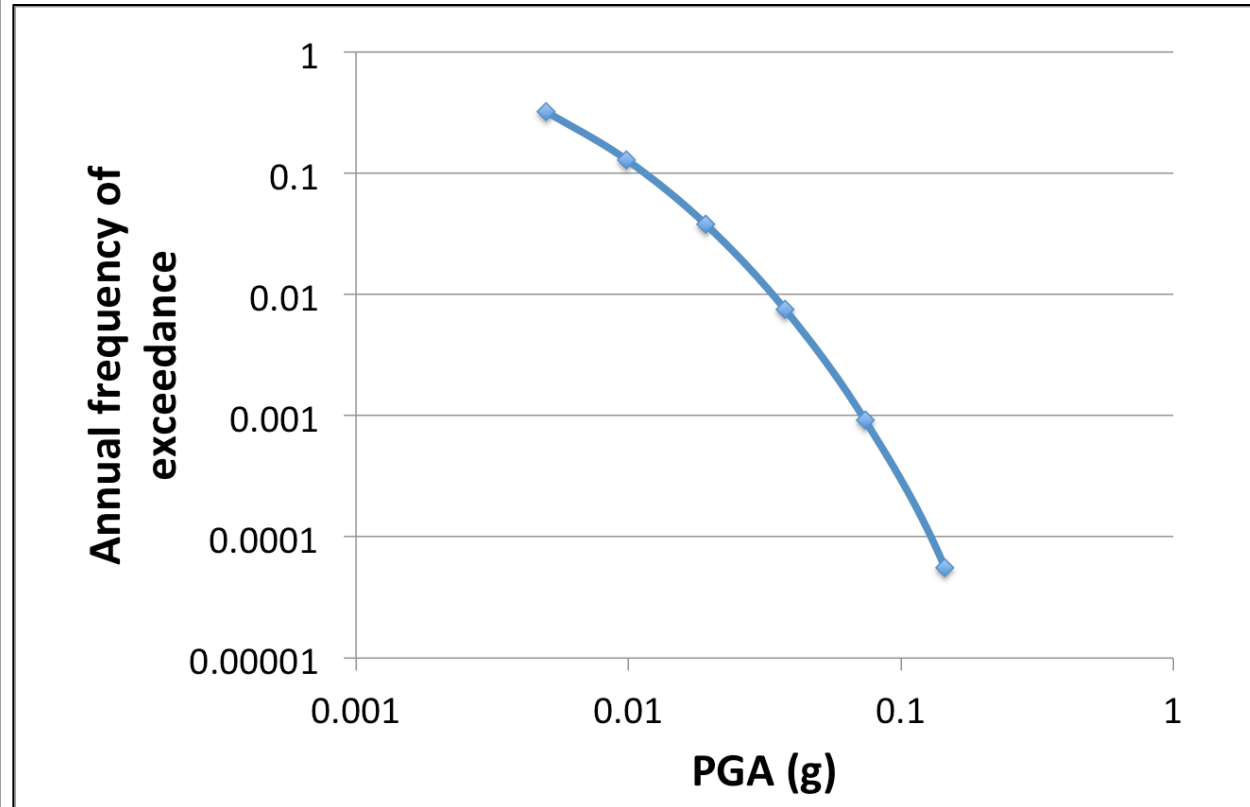
$$P(N > 1) = 1 - e^{-\lambda t}$$



Probability vs Rate

Excel interface showing a table with columns F, G, H, and I. The table contains data for PGA (g), PoE, 50 yrs, and Rate. The interface includes a ribbon with 'Edit', 'Fill', 'Calibri (Body)', 'B', 'I', 'U', 'Paste', and 'Clear' options. The chart area is labeled 'Chart 1'.

	F	G	H	I
13				
14				
15	PGA (g)	PoE, 50 yrs	Rate	
16	0.005	0.9999999	0.32236	
17	0.0098	0.9984788	0.12977	
18	0.0192	0.8496325	0.03789	
19	0.0376	0.3126464	0.0075	
20	0.0738	0.04488463	0.00092	
21	0.145	0.002779804	5.6E-05	
22	0.284	3.75483E-05	7.5E-07	
23				
24				
25				
26				
27				



OQ (2019) vs Stucchi et al. (2011)

