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AN INTEGRATED PLATTFORM FOR FOR PROBABILISTIC AND DETERMINISTIC HAZARD ASSESSMENT

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Georgia Institute of Technology

Project Team

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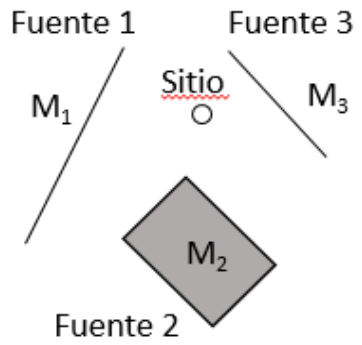
Dr. Carolina Magna
(University Adolfo Ibañez, Chile)

DSHA and PSHA

(DSHA-Deterministic seismic hazard assesment):

Magnitude



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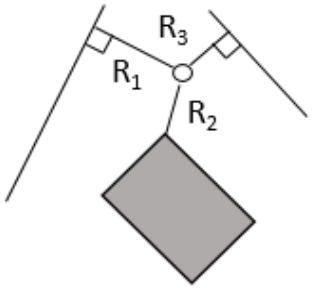
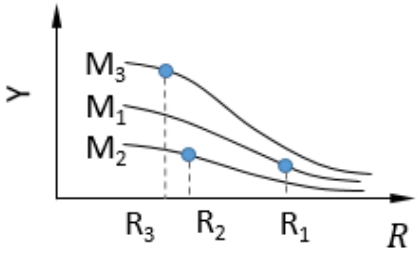


Intensity meassure (GMM)

$$\log Y_i = \mu(M_i, R_i) + \varepsilon_i \sigma$$



Select Design scenario

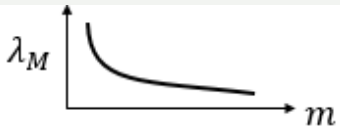
$$\mathbf{Y} = max \begin{Bmatrix} Y_1 \\ Y_2 \\ Y_3 \end{Bmatrix}$$

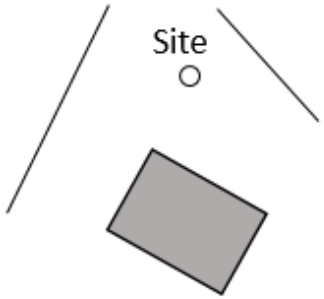
Adapted from S. Kramer

DSHA and PSHA

(PSHA-Probabilistic seismic hazard assesment):

Magnitude





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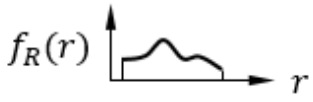
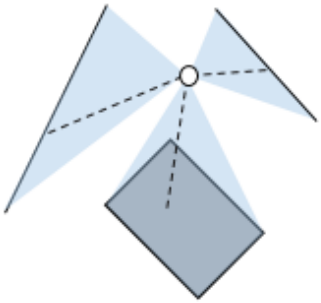
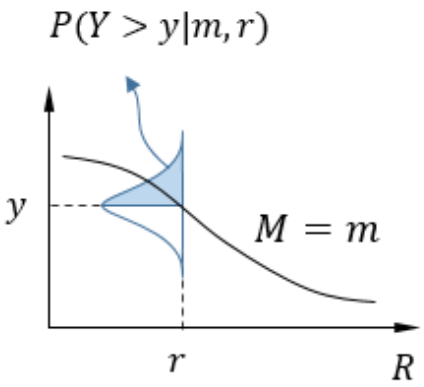
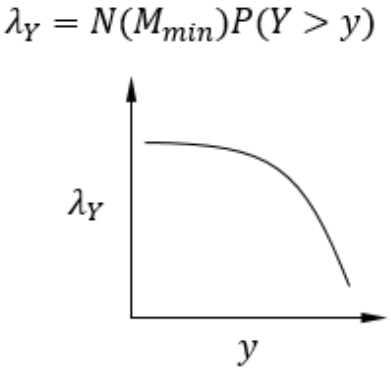




Ground motions

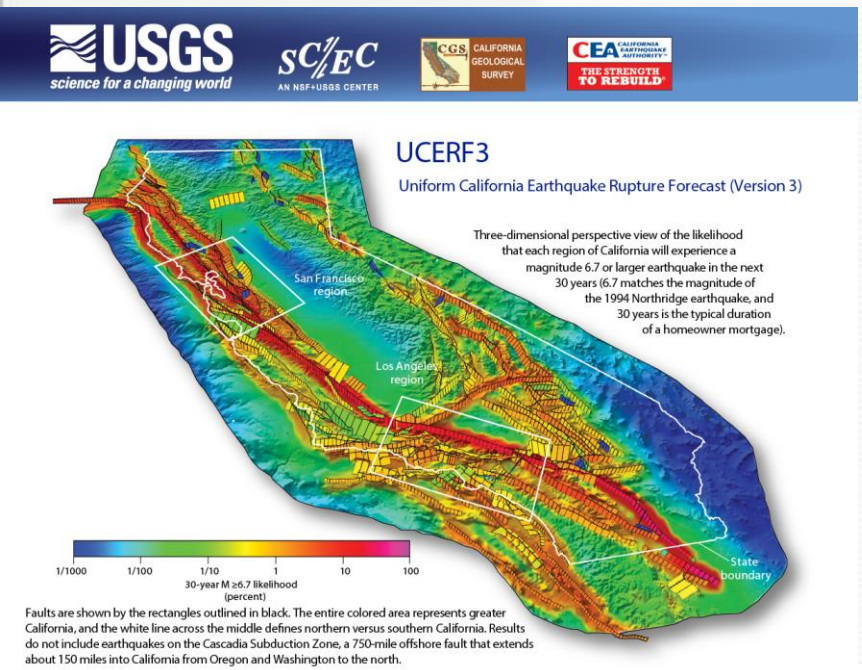


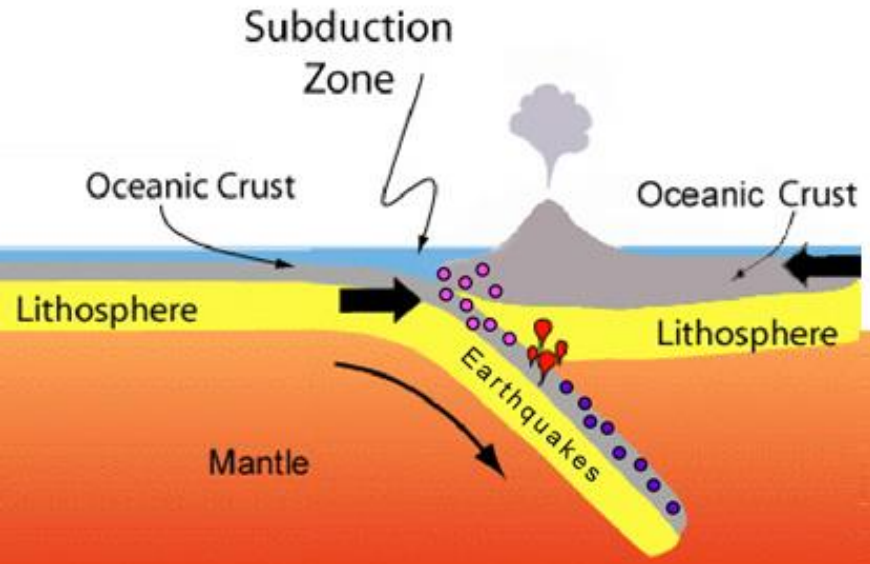
Hazard Curve

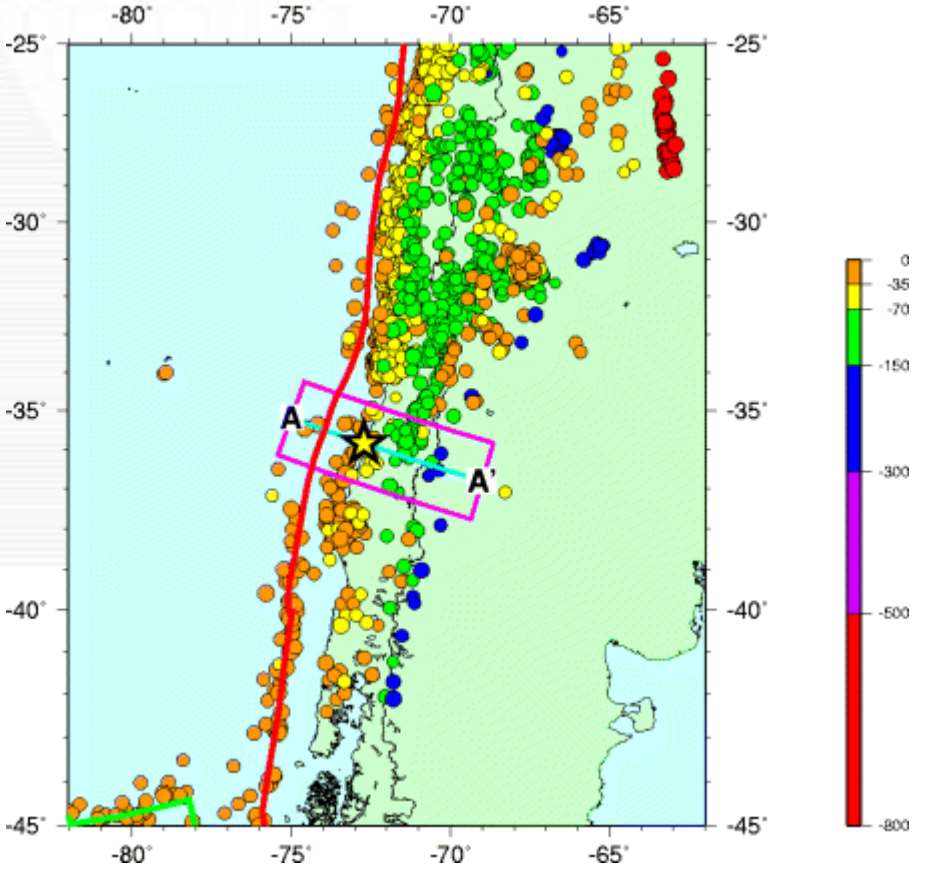


DSHA and PSHA:

Seismic Sources:







Seismic Hazard Assesment

DSHA: Given (M, R, ε), a GMM, an intensity measure Y_1 can be evaluated as:

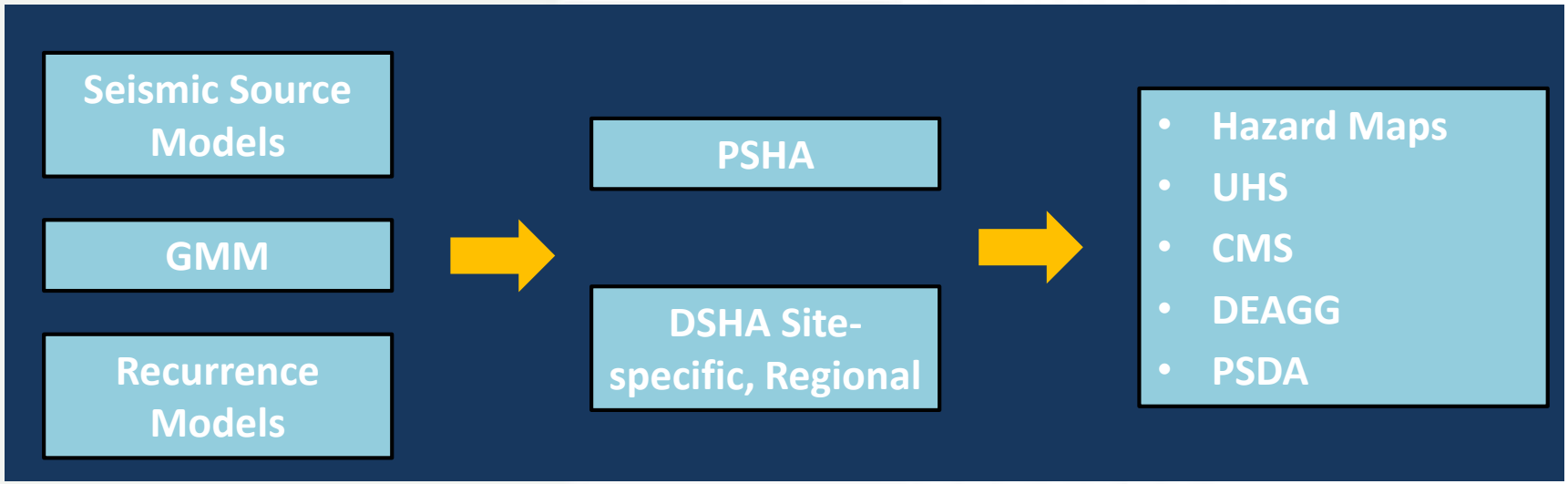
$$\mathrm{Y}_1 = \mu(R, M, \theta) + \varepsilon$$

Using spatial and inter-period spectral acceleration correlations a regional DSHA can be evaluated according to

$$\begin{bmatrix} \mathrm{Y}_1 \\ \mathrm{Y}_2 \\ \vdots \\ \mathrm{Y}_n \end{bmatrix} = \begin{bmatrix} \mu_{\log}\mathrm{IM}_1 \\ \mu_{\log}\mathrm{IM}_2 \\ \vdots \\ \mu_{\log}\mathrm{IM}_n \end{bmatrix} + \mathrm{L} \begin{bmatrix} \mathrm{Z}_1 \\ \mathrm{Z}_2 \\ \vdots \\ \mathrm{Z}_n \end{bmatrix}$$

SeismicHazard Platform

General Structure – basic capabilities



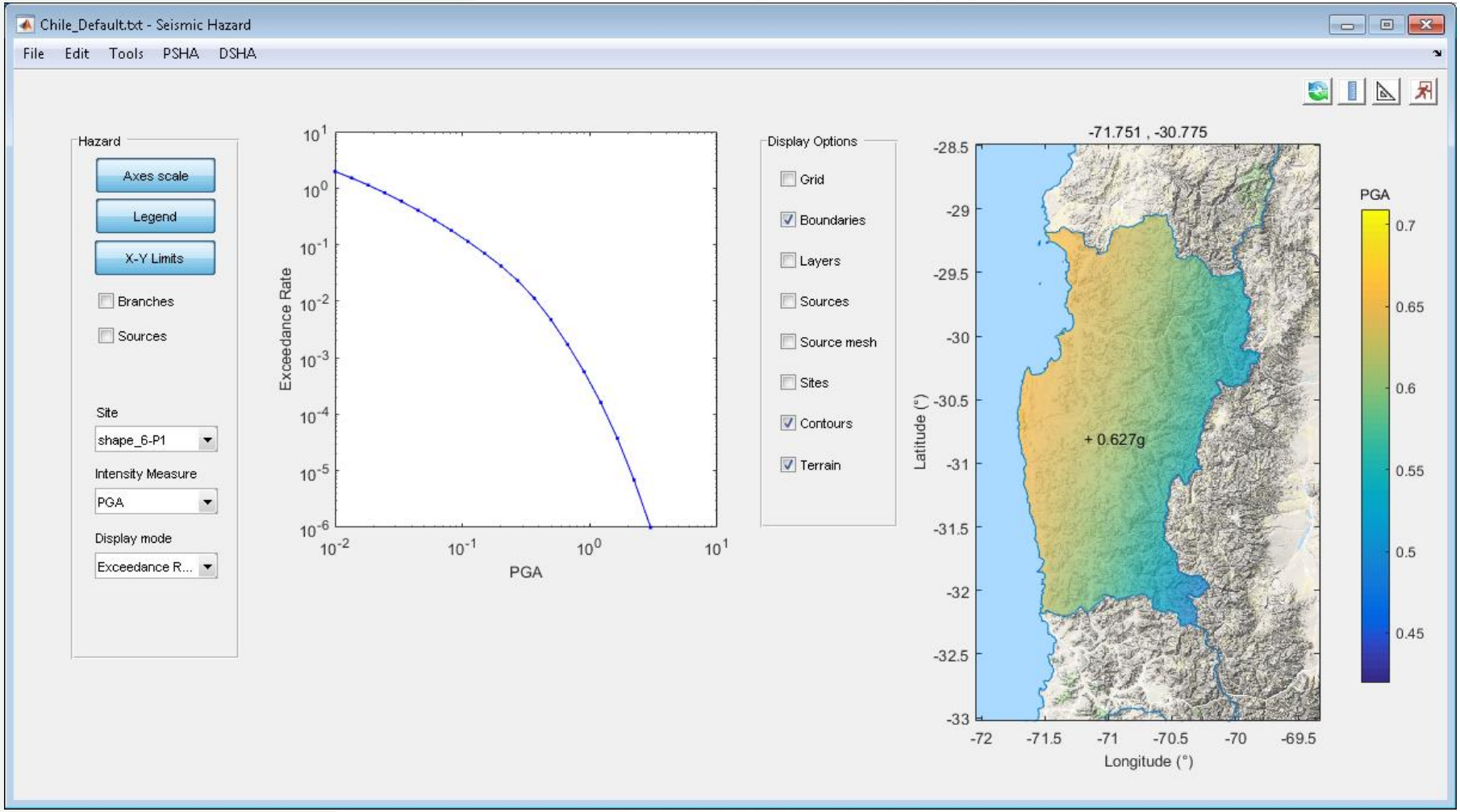
SeismicHazard Platform

General Structure – basic capabilities

```
Option 0 - Global Parameters
Projection    : Sphere
Image         : bayarea.mat
Boundary      : CAL_adm1.shp
ShearModulus : 3e11       #dyne/cm2
IM            : 0
im            : 0.001 0.01 0.05 0.1 0.15 0.2 0.25 0.3 0.35 0.4 0.45 0.5

Option 1 - Logic Tree Weights
Geom Weight : 1
Gmpe Weight : 1
Mscl Weight : 1

Option 2 - Source Geometry
geometry 1 Strike-Slip Fault
S1 type area mechanism crustal gmpe 1 vertices ...
38.00000 -122 0  38.00000 -122 -12 38.22500 -122 -12 38.22500 -122 0

Option 3 - GMPE Library
Sadigh97 handle Sadigh1997 mechanism strike-slip media rock sigma overwrite 0

Option 4 - GMPE GROUPS
Sadigh 1997 pointers 1

Option 5 - MAGNITUDE SCALING RELATIONS
seismicity 1 Criterio III  #SlipRate in mm/year
S1 handle delta sliprate 2 bvalue 0.9 M 6.5

Option 6 - RUPTURE AREA SCALING #log10(A)=a*M-b, sigmaA
S1 type rectangular spacing 0.2 RA custom 1 4 0 aratio 2 taper true
```

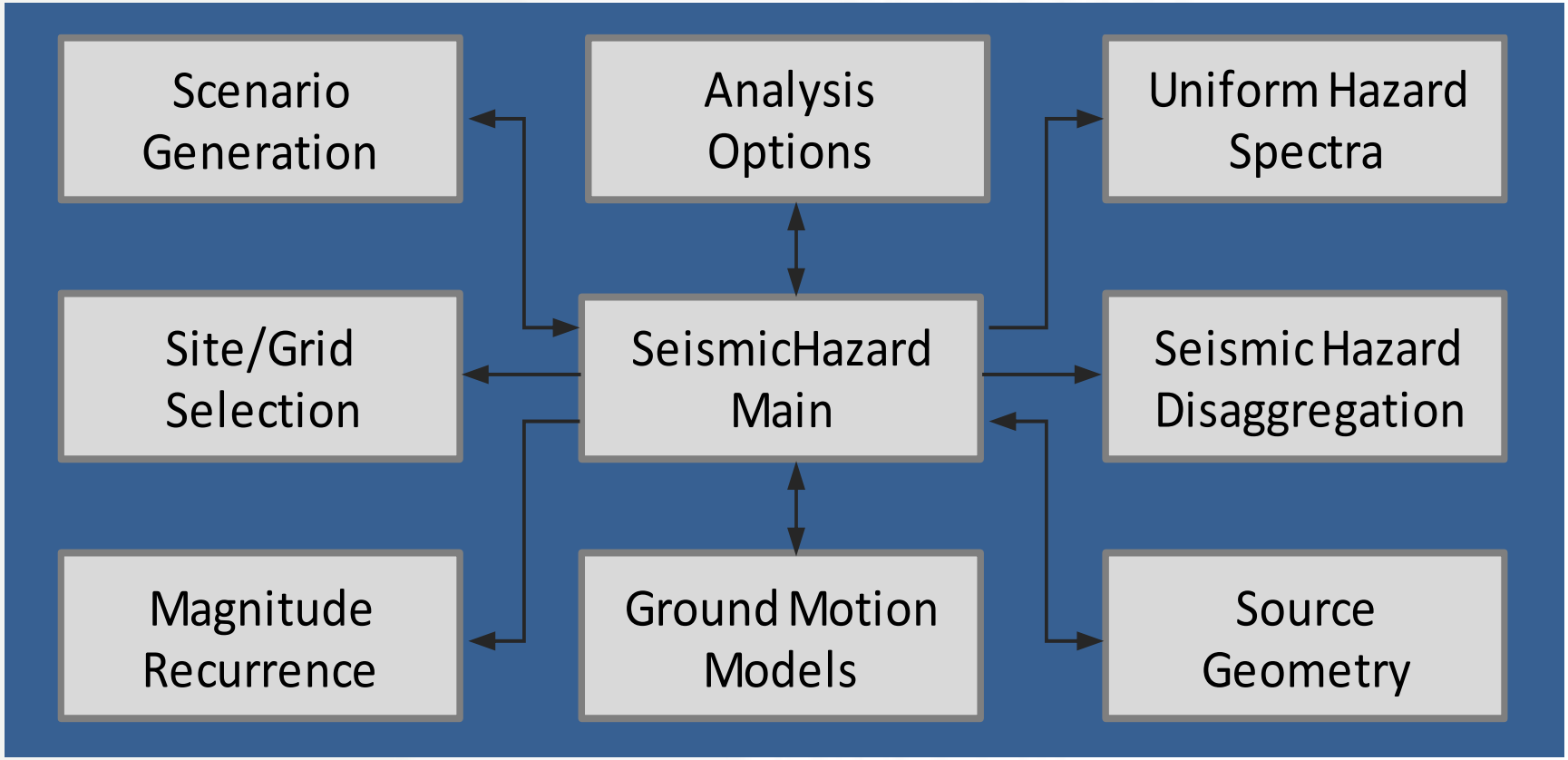
SeismicHazard Platform

General Structure – basic capabilities



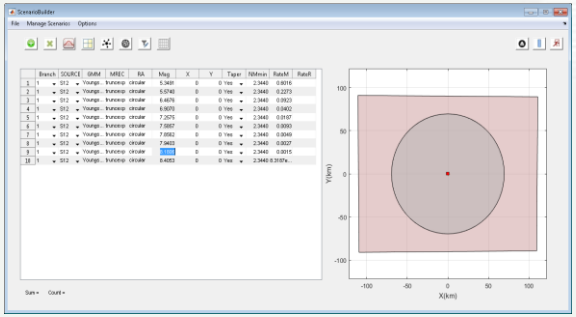
SeismicHazard Platform

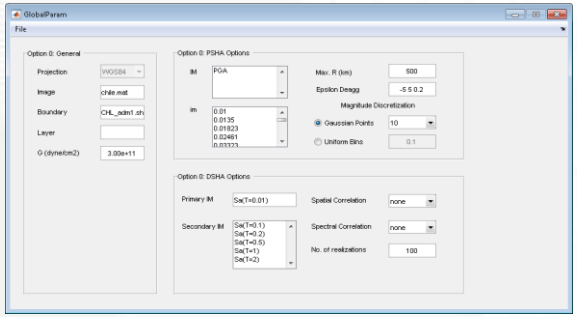
General Structure – basic capabilities

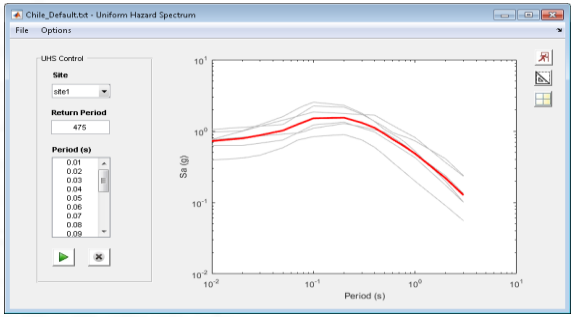


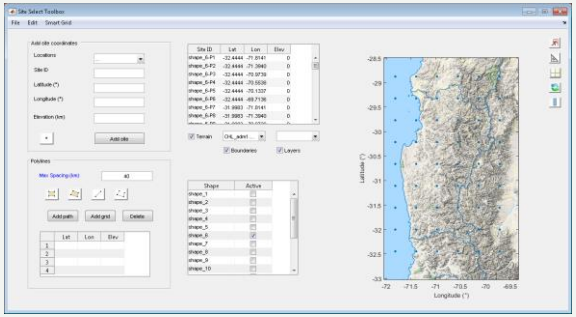
SeismicHazard Platform

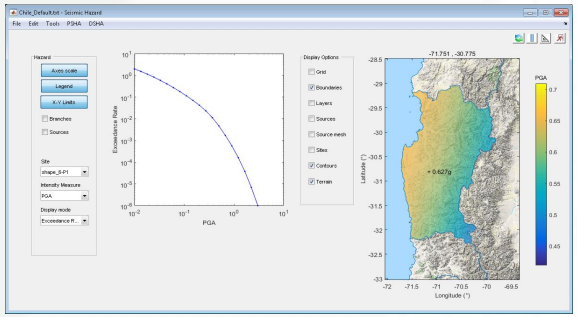
General Structure – basic capabilities

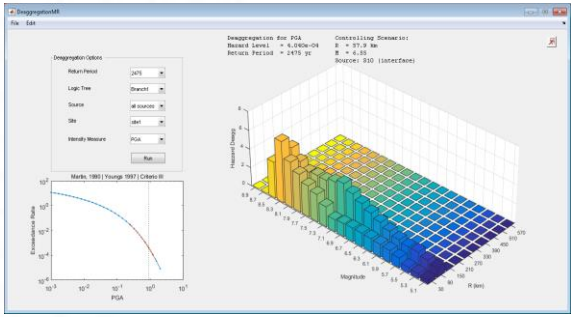


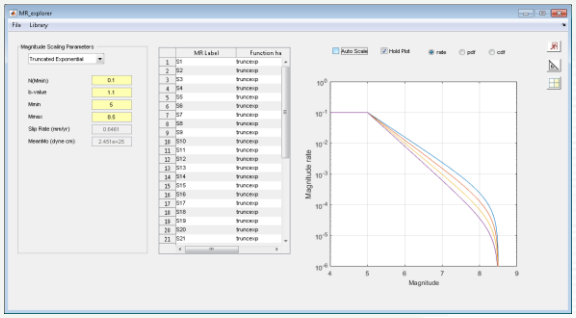


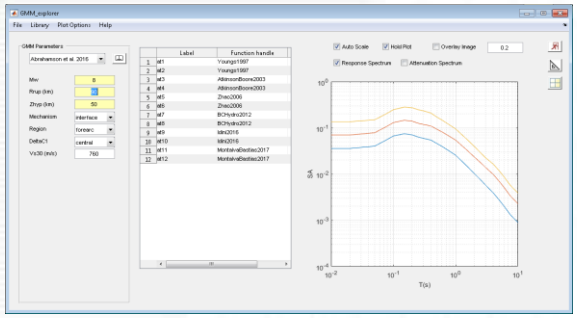


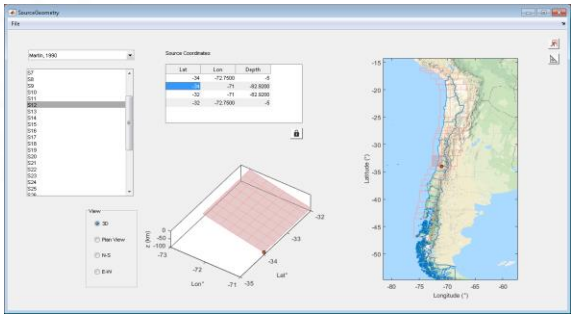












SeismicHazard Platform

General Structure – basic capabilities

Seismic Sources

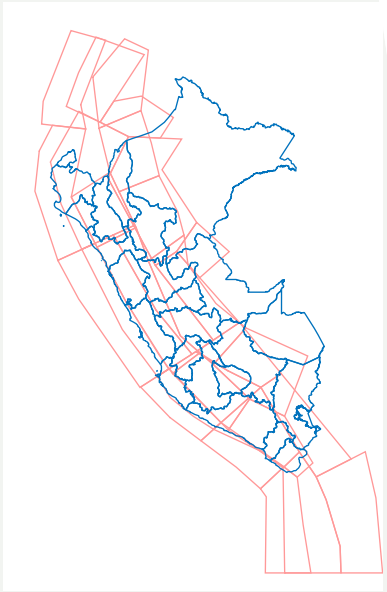
- Interface
- Intraslab
- Shallow Crustal
- Background

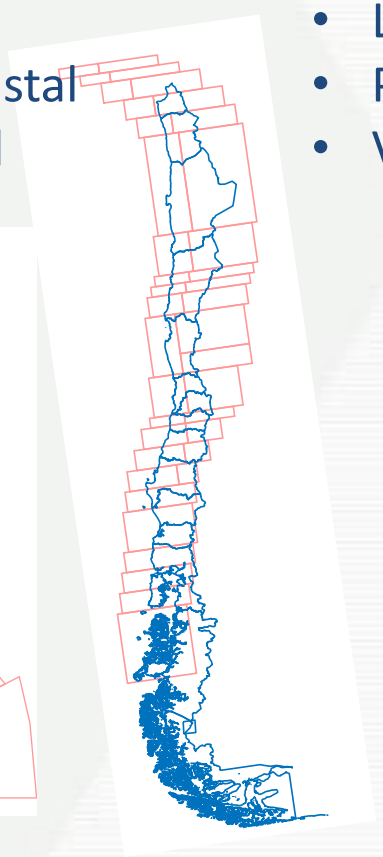
Geometry

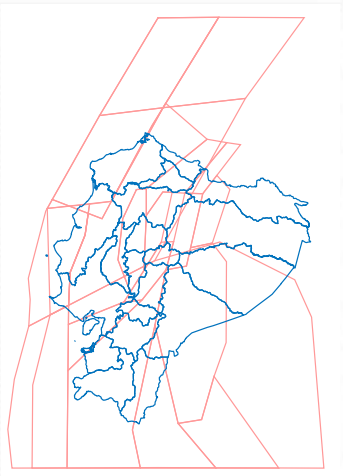
- Point
- Line
- Poligons (2D)
- Volumns (3D)

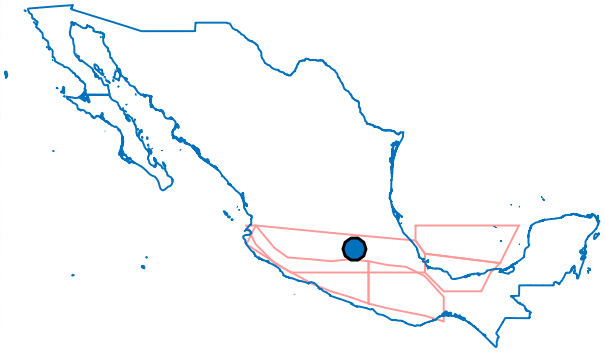
Deafault Models

- Chile
- Peru
- Ecuador
- South Mexico
- PEER Validation examples









SeismicHazard Platform

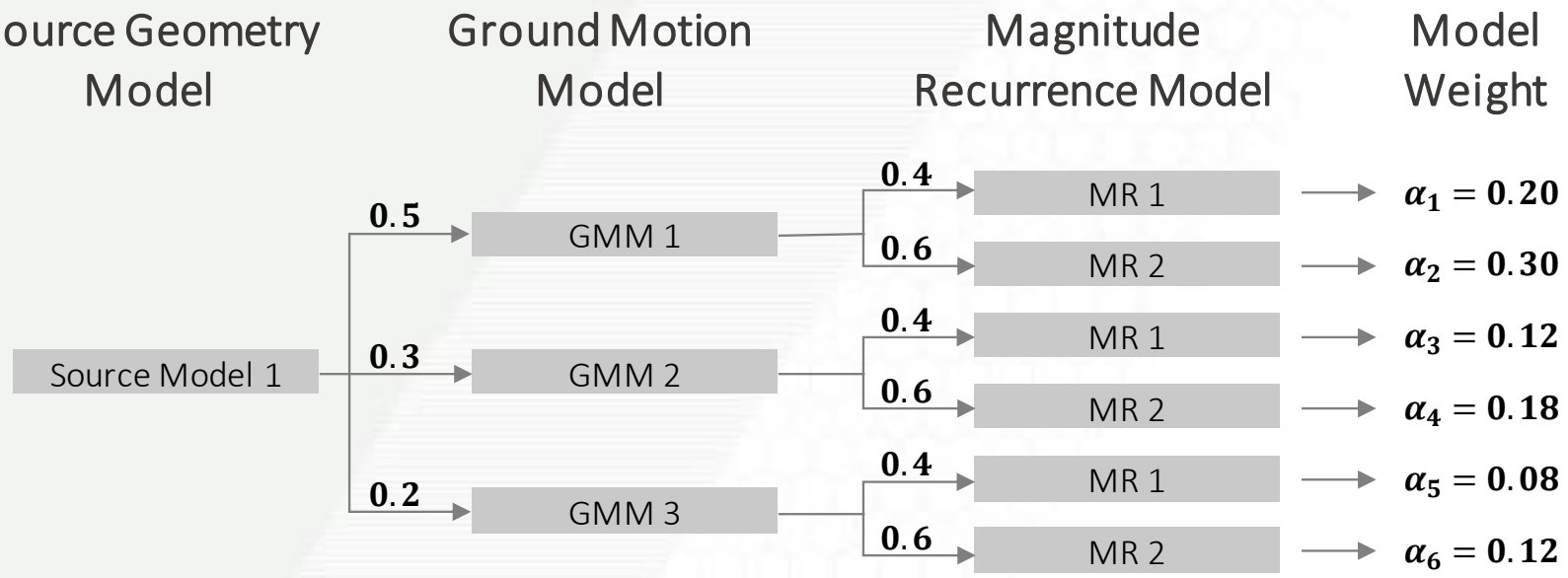
General Structure – basic capabilities

Numerical Efficiency

- Reduced integration
- Logic tres parallelization

Epistemic Uncertainty

- Logic trees
- Seismic catalogs treatment



SeismicHazard Platform

General Structure

Numerical Efficiency

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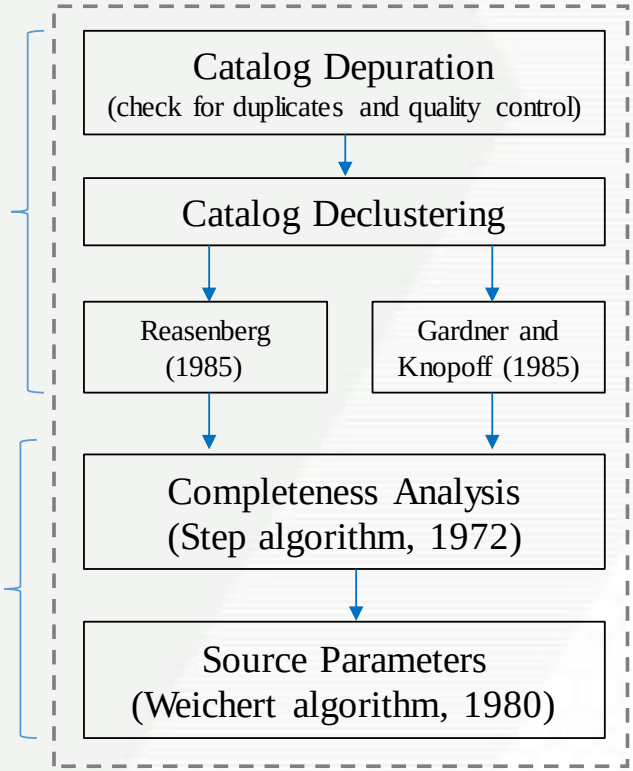
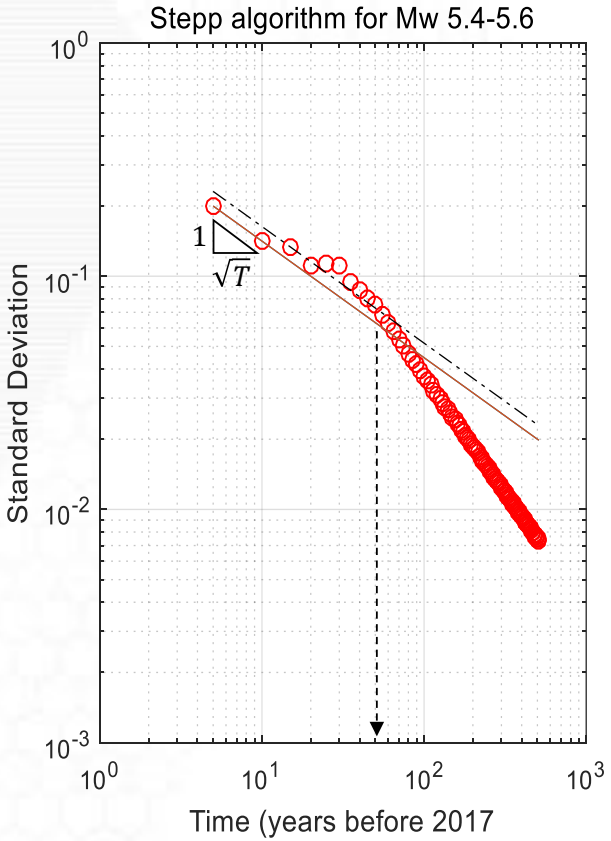


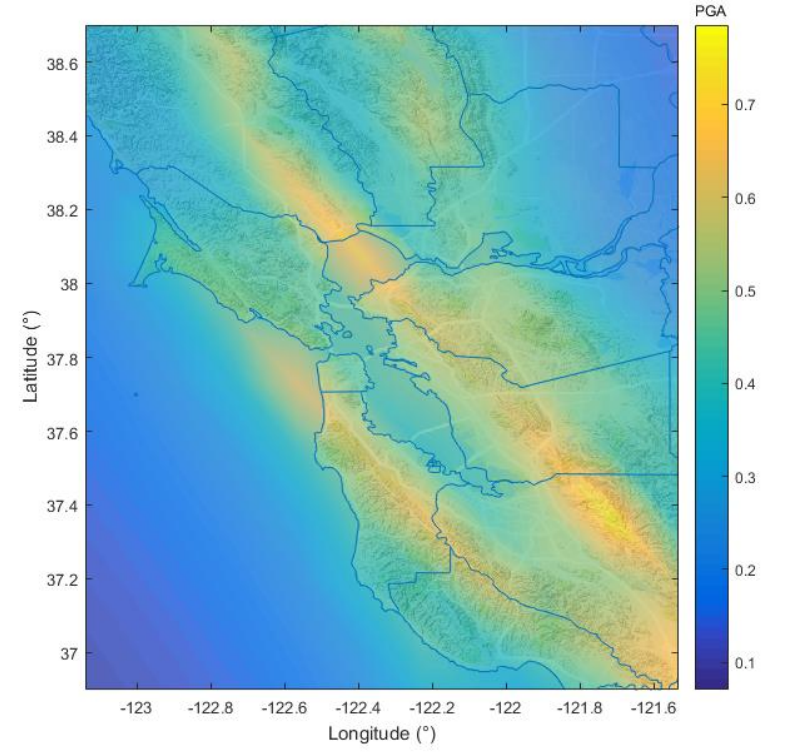


SeismicHazard Platform

General Structure

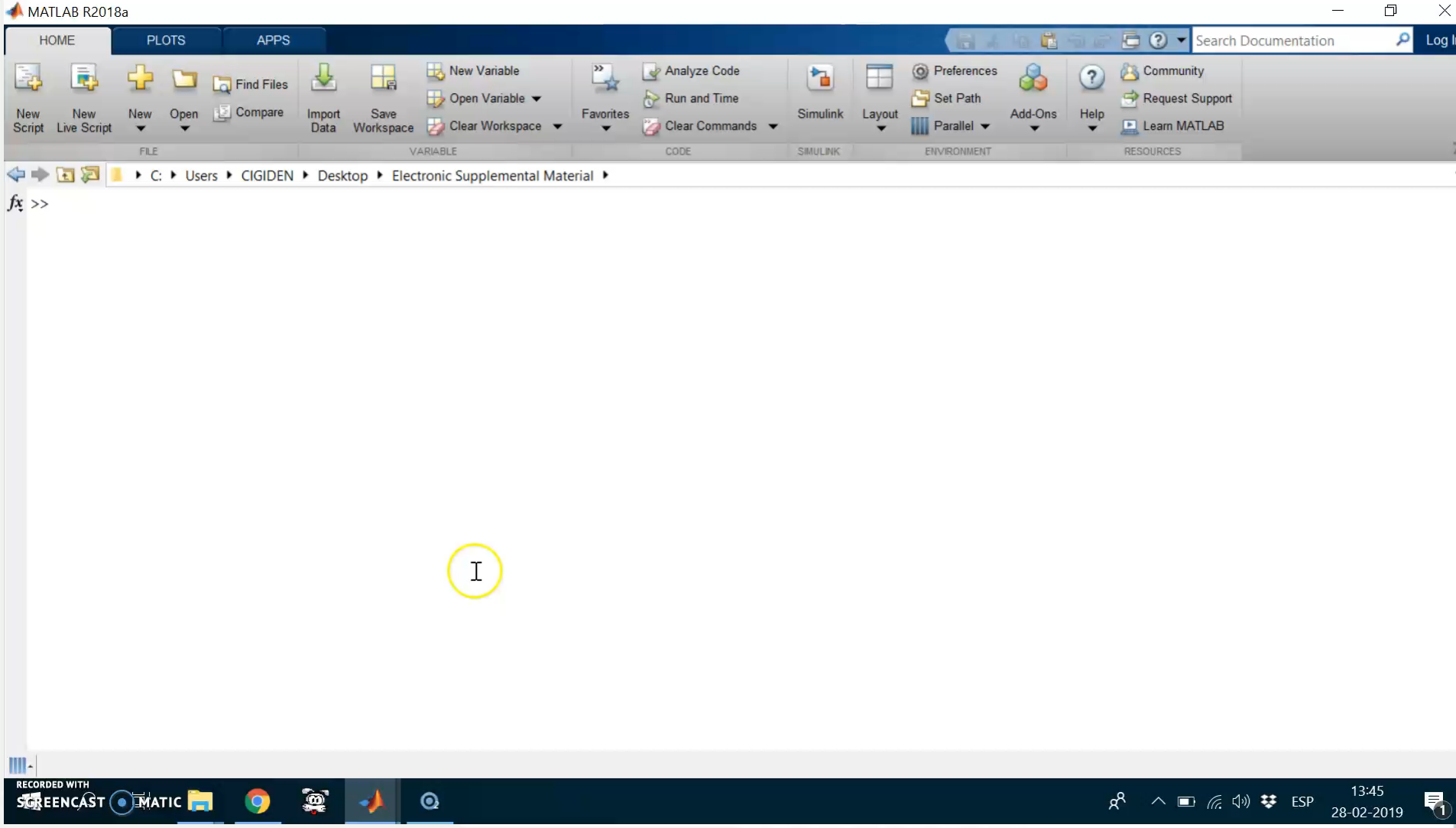
USGS Connect

- Compatibility with the USGS-JSON
- National Seismic Hazard Maps 2008 & 2014



Deterministic Scenarios

- Geration of scenarios with "important sampling (M,R,ε)"
- Spatial Correlation
  - Jayaram Baker 2009
  - Loth & Baker 2011
- Inter-spectral period correlations
  - Baker & Cornell 2006
  - Baker & Jayaram 2008
  - Jayaram et al. 2011
  - Candia et al. 2018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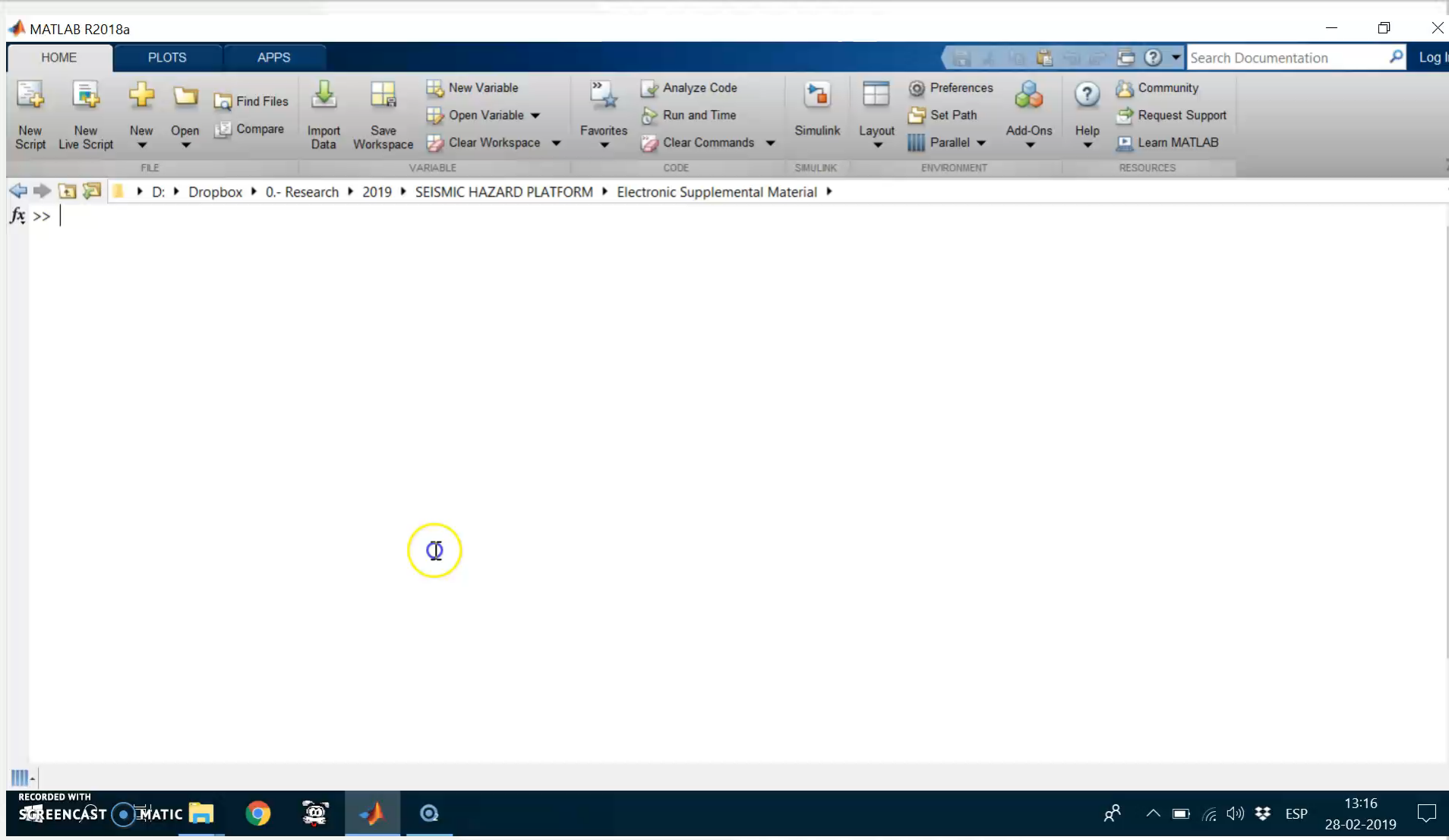
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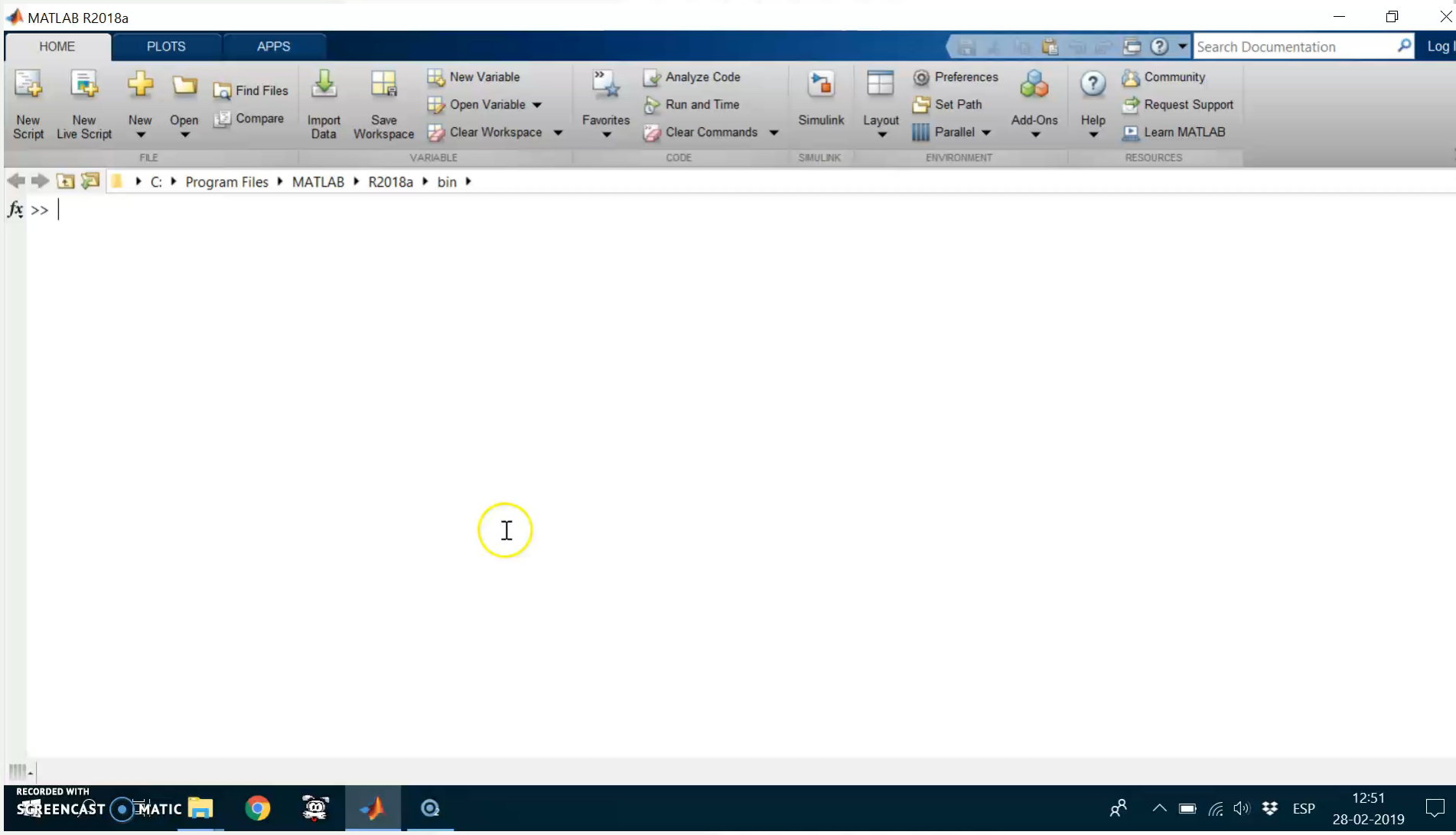
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