Célébrons 175 ans

Program: Geoscience Public Safety (2014/19)
Project: National Scale Geohazard Risk Project

Regional Seismic Risk Assessment – ER² web application

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ER² project description

The **Problem** we are trying to solve is threefold:

i) existing seismic risk assessment tools ill-suited for adaptation for Canadian hazard & exposure settings,

ii) inadequate for application by the broader non-expert public safety community, and

iii) no direct communication of the risk results to end users.

Objective: Reduce the communication gap between scientists and engineers and community needs to support informed emergency response and mitigation planning

Method: Development of a Canadian web-based application for easy to use multiple hazard risk assessment and mapping

i) limited user input

ii) standardized and internationally accepted risk computation methods

iii) leverage open source data

Output: State of the art knowledge translated into an intuitive & easy to use software

Public safety community needs

Earthquakes, Floods, ...

a) Emergency response

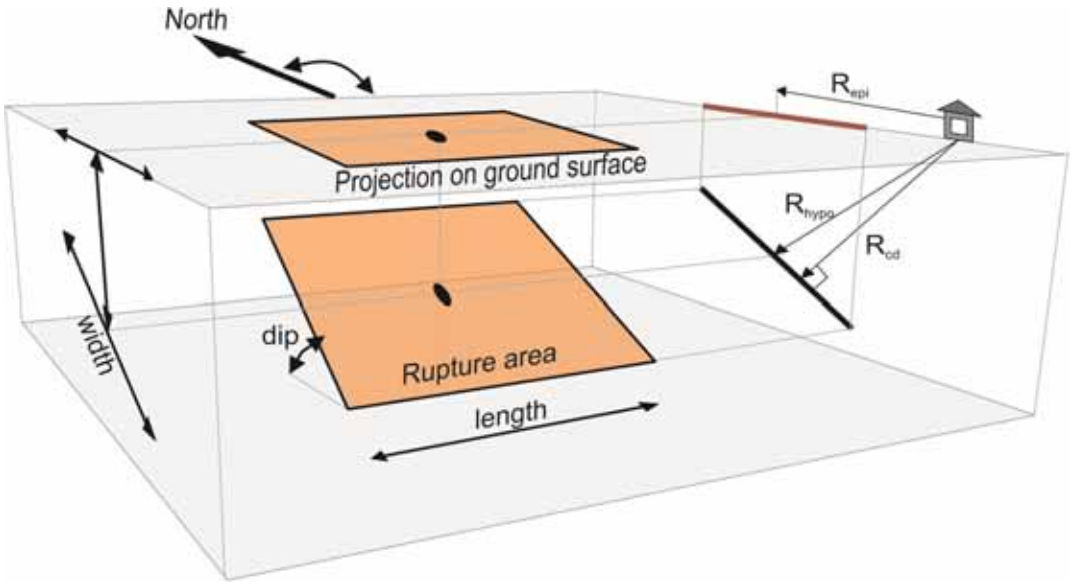
Rapid risk assessment

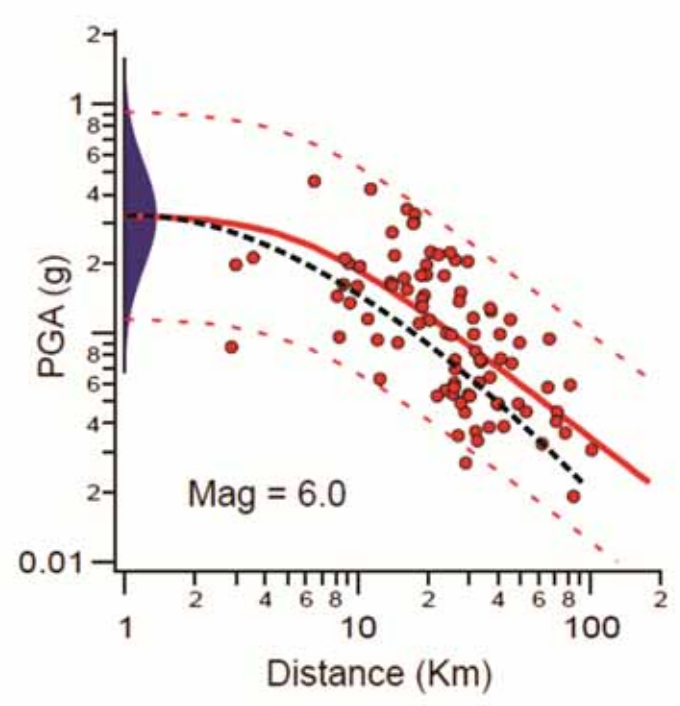
b) Mitigation planning

Modelling interactive scenarios

Risk assessment process → hazard x exposure x vulnerability

Seismic hazard (fault mechanisms & attenuation)





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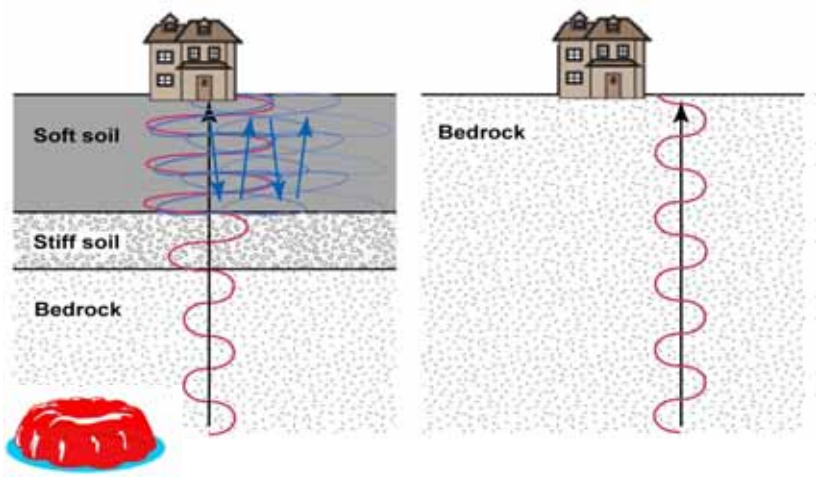
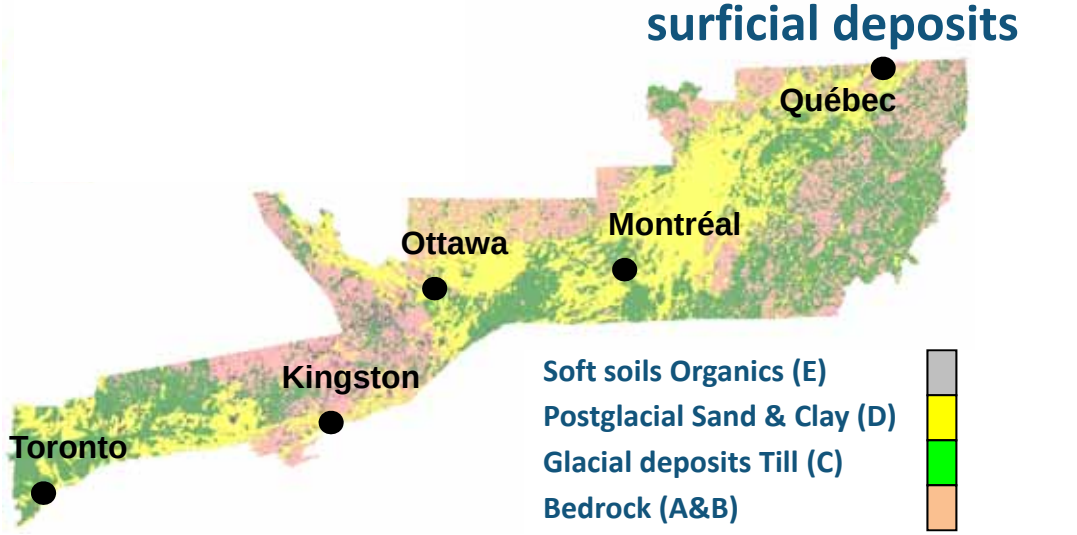
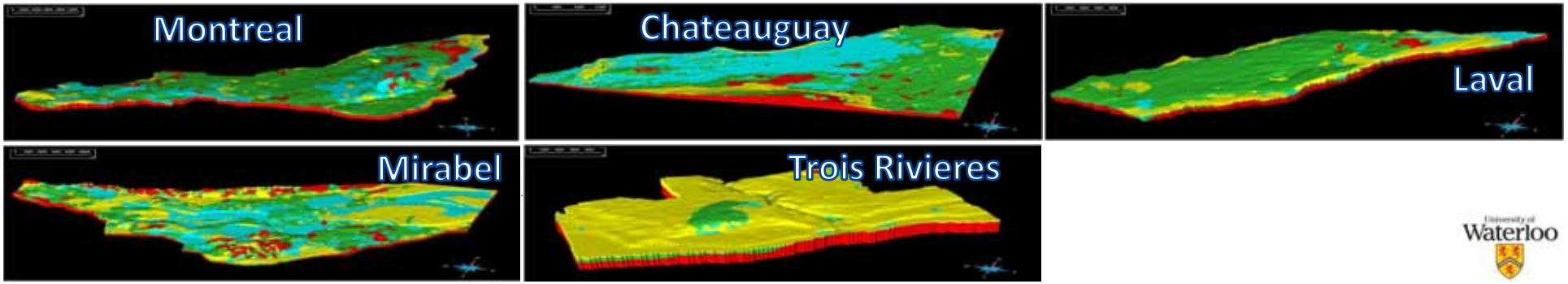
Seismic hazard (local site effects)



surficial deposits



3D geological models



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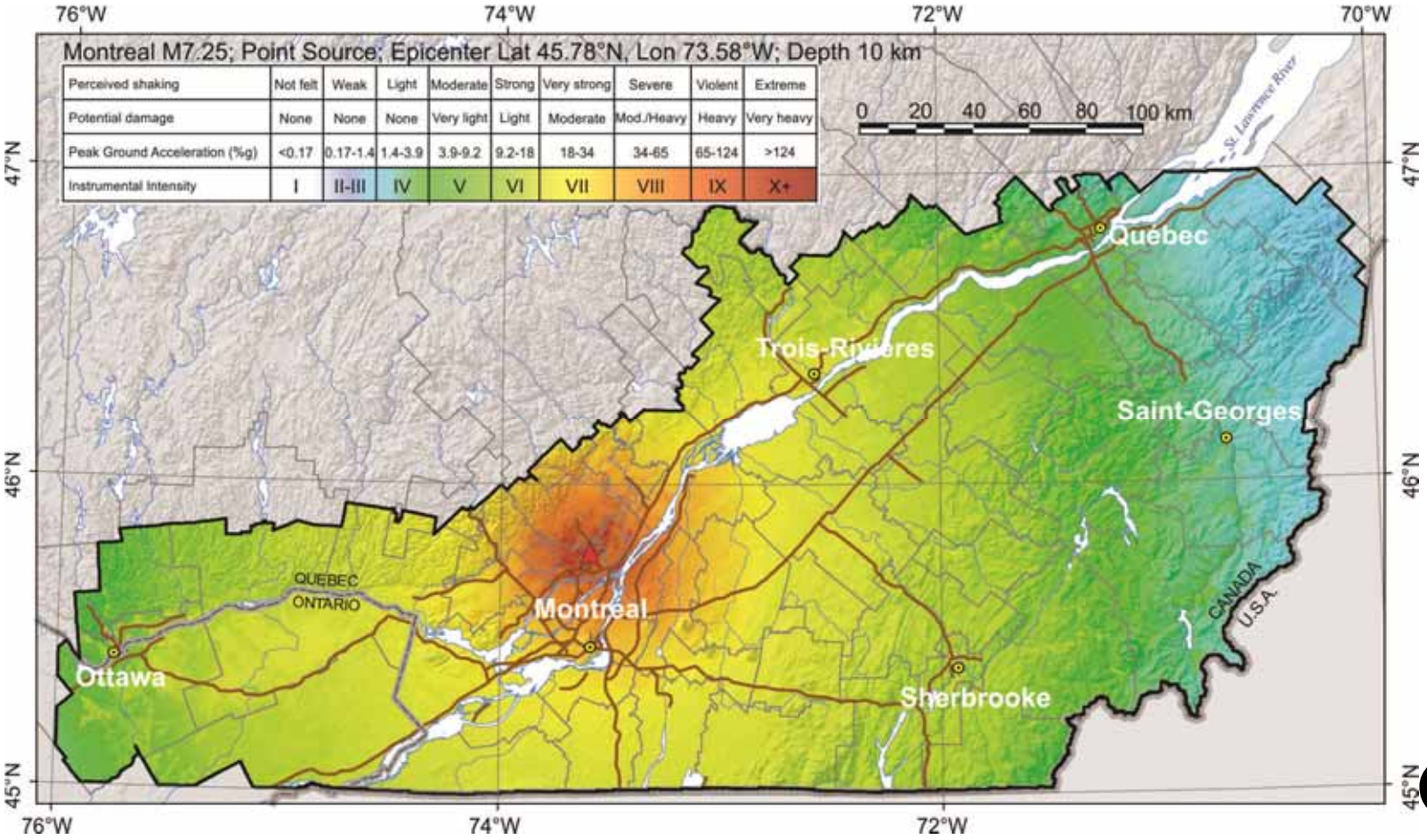
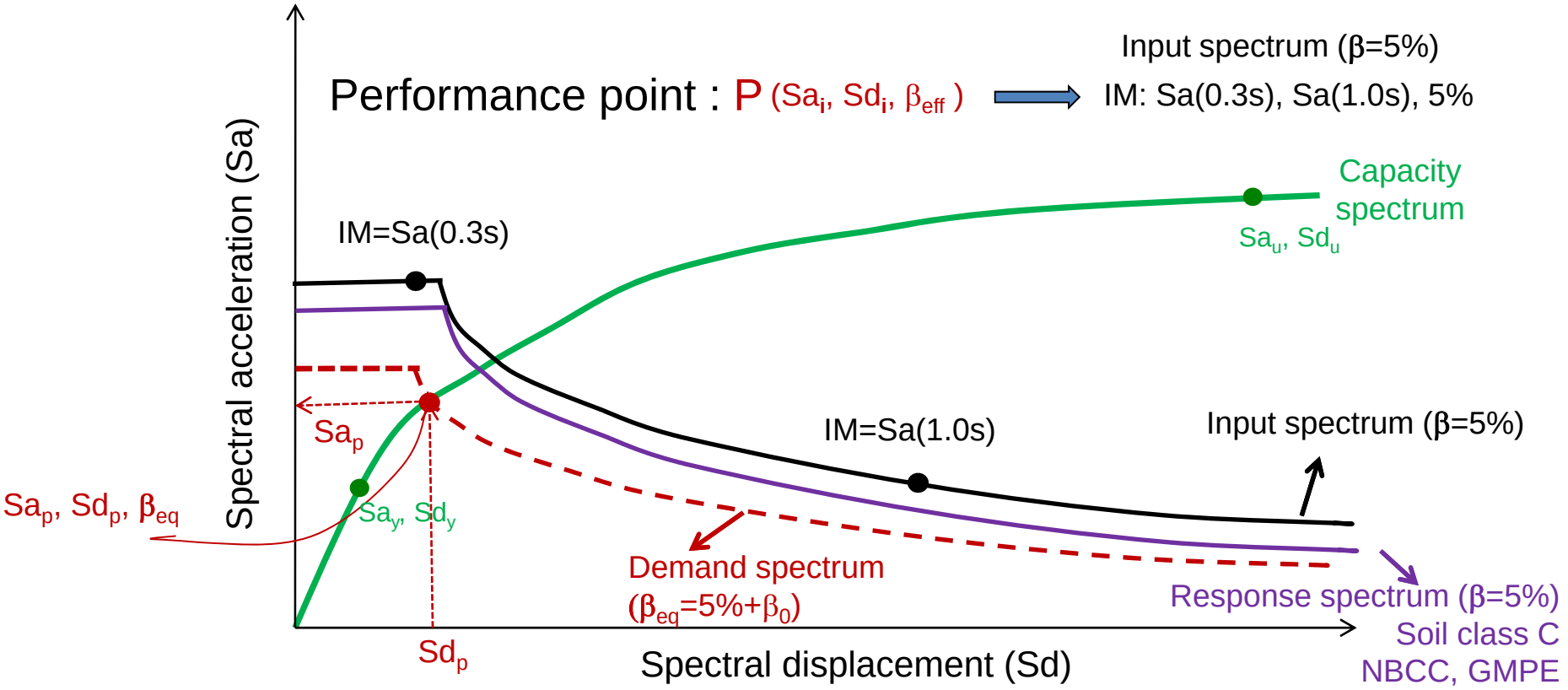
Seismic hazard (M7.25 scenario)



Canada

Building inventory

Vulnerability



Vulnerability

Slight (DS1):
First wall Flexural cracking

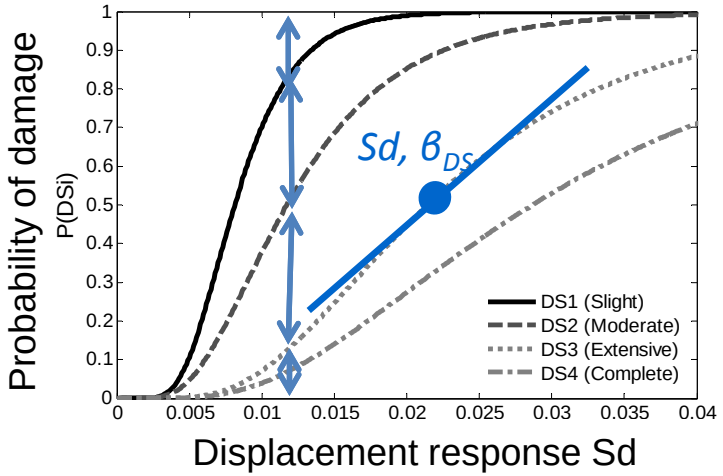
Moderate (DS2):
First wall Shear cracking

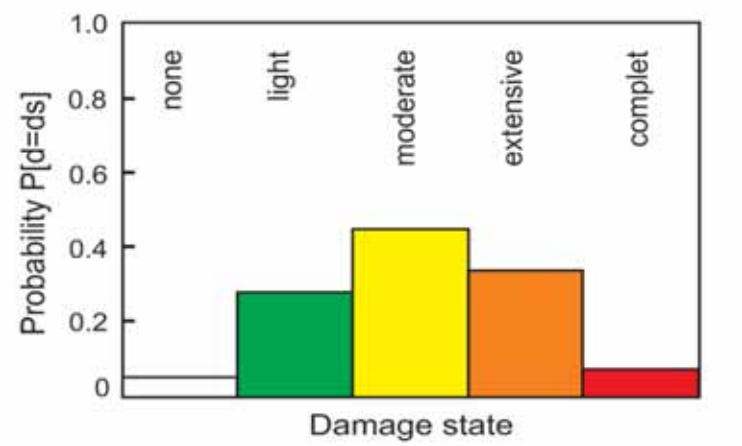
Extensive (DS3):
Maximum base shear capacity of the building

Complete (DS4):
20% reduction in base shear capacity

Collapse (DS5)

Fragility curve concept





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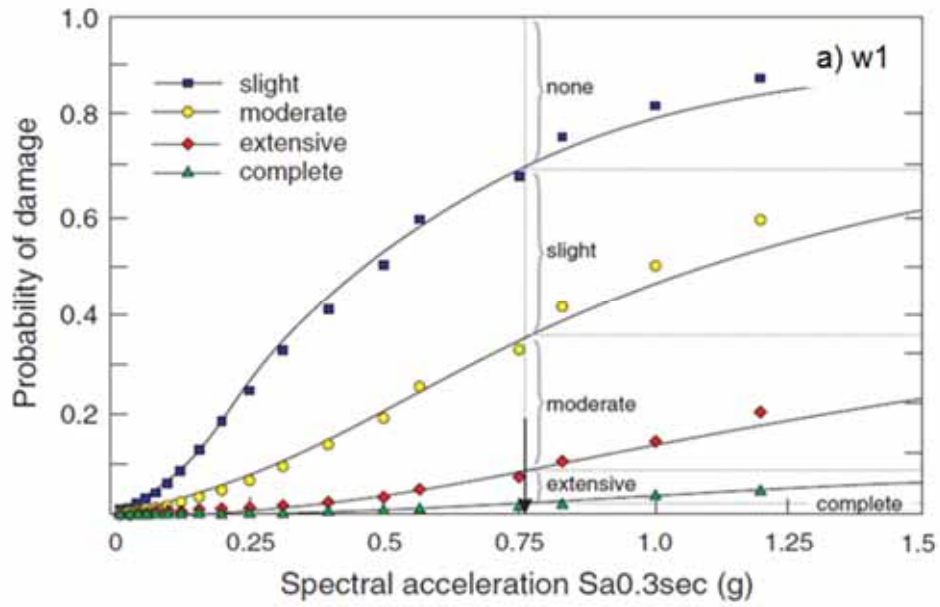
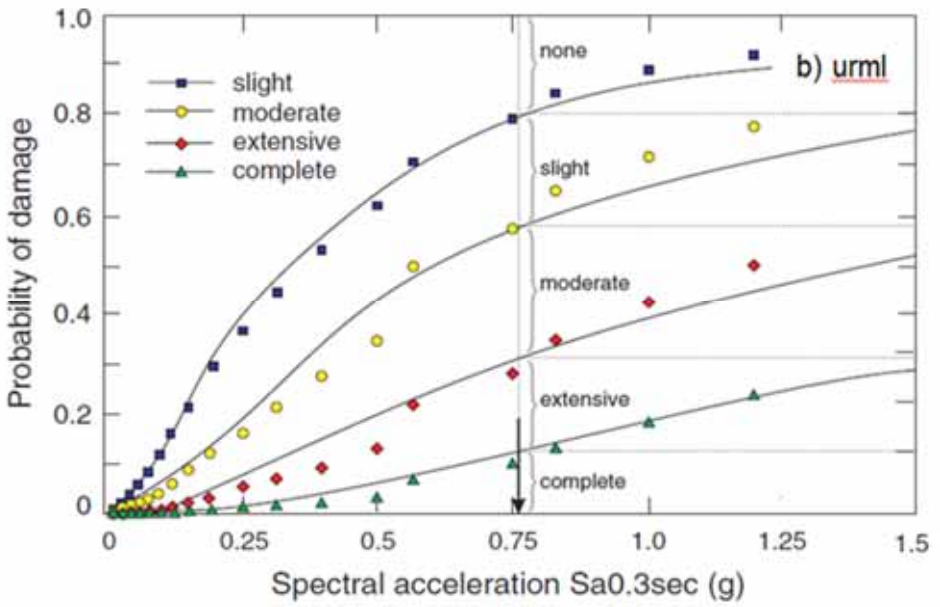
Vulnerability

Examples of fragility curves used in ER^2:





Vulnerability: ER^2 damage database

- *Generated 3 tables for different GMPEs (AB06, AA13, B97)*
- *Structural, non-structural drift and non-structural acceleration damages and human losses*
- *128 building types*
- *x 4 magnitudes: 5, 6, 7, 8*
- *x 5 distances: 10km, 20km, 30km, 40km, 60km*
- *x 5 NEHRP soil types: A, B, C, D, E*
- *x 51 spectral displacement values: 0.25mm – 25m*
- *= 652,800 records per GMPE*

Validation against Hazus results

- *HAZUS parameters + two tables for GMPE: AB06 and B97*
- *Structural damage, and casualties for:*

  13 building types: "W1-h", "W1-m", "S1L-m", "S2L-m", "C1M-m", "W1-p", "S1L-p", "S1M-p", "S2L-p", "S2M-p", "S5L-p","URML-p", "URMM-p"
- *x 4 magnitudes: 5, 6, 7, 8*
- *x 5 distances: 10km, 20km, 30km, 40km, 60km*
- *x 5 NEHRP soil types: A, B, C, D, E*
- *x 51 spectral displacement values: 10^{-2} – 10^{3}in*
- *= 66,300 records per GMPE*

Validation against Hazus results

- *At lower magnitudes the results were almost identical to those from HAZUS*
- *In average, the deviation from Hazus results for structural damage and indoor casualties was $\leq 1\%$.*
- *The maximum observed deviation was 11.8% for one M8 scenario*

Building type	M6		M7		M8	
	Avg	Max	Avg	Max	Avg	Max
W1-m	0.24	1.71	0.53	1.94	0.82	2.94
URML-p	0.28	2.49	0.46	2.01	0.30	3.46
W1-p	0.28	1.64	0.69	2.09	0.85	3.50
S1L-p	0.31	1.85	0.80	1.86	1.75	4.18
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W2-m	0.68	6.16	1.33	4.56	1.99	6.39
W2-p	0.78	3.18	1.78	4.18	3.89	9.59
MAX DEV	1.33	6.16	2.03	5.20	4.88	11.81
AVG DEV	0.22	-	0.59	-	1.00	-

Conclusions

- Rapid Risk Assessment methodology has been successfully developed and tested ;
- Precomputed databases consist of:
  - thickness and type of soil materials
  - number of building categories, occupancy, value….
- Vulnerability database consists of fragility curves with respect to earthquake Ims : Sa0.3sec and Sa1.0sec ;
- Web application is under development ;
- High interest among the public safety community.

ER² web application

Questions ?

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