POLITECNICO DI MILANO

Convenzione DPC – INGV 2007-09
Progetti Sismologici
Giornata di Lavoro sul tema "Relazioni di Attenuazione"
Milano, 26.06.09





Progetto S2 - Contributo alla discussione

a cura di C. Cauzzi ed E. Faccioli

D 3.1 – Objectives

- To provide preference criteria for the selection of ground motion prediction equations (GMPEs) to be used as input for probabilistic seismic hazard analyses (PSHA), as well as for deterministic evaluation of ground motions characteristics.

- Identify a list of GMPEs, suitable of being implemented as additional (built-in) models in the computer program *CRISIS++*

D 3.1 – Preference criteria

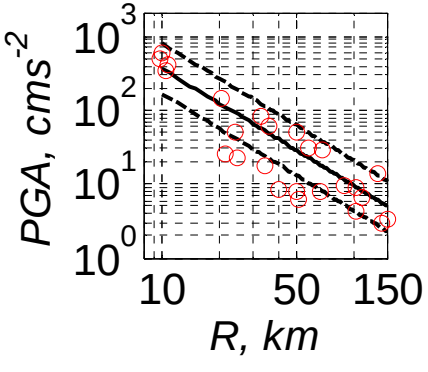
- The GMPEs should be recent: a significant number of digital records should be present in the reference dataset; state-of-the-art correction techniques were likely used for data processing; well consolidated methods were used for regressions on data.
- The GMPEs should deal with response spectral ordinates: primary descriptors of the seismic demand in building codes.
- The GMPEs should reliably cover a broad vibration period range, as a minimum up to T = 4 s (but preferably up to T = 10 s): performance-based design concepts (DDBD); large scale structures.
- The GMPEs should represent a notable improvement with respect to previous models by the same authors or for the same region.
- The GMPEs should be developed on the basis of large datasets consisting of earthquake records from extended regions or even worldwide. This maximizes the flexibility of usage of the equations.
- The GMPEs should include terms describing the influence of local ground categories, e.g. as contemplated in NEHRP Provisions (BSSC, 2003) or in the Eurocode 8 (CEN, 2004).
- The GMPEs should include style-of-faulting terms (see Bommer et al., 2003), since the style of rupture of future earthquakes in a particular seismic source zone can usually be defined with some confidence.

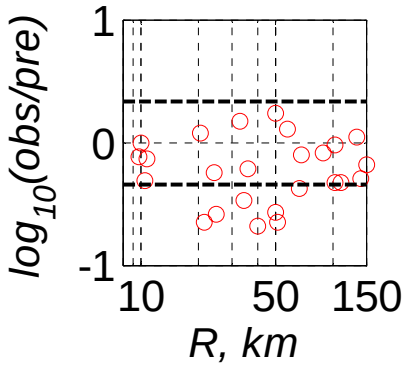
Note: conversions among different measures of ground motions will be made available in CRISIS++

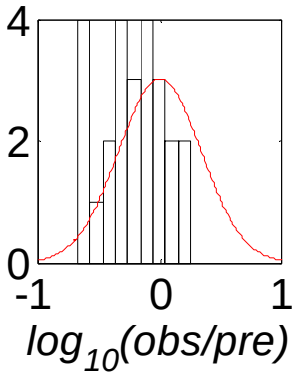
D 3.1 – List of suggested GMPEs

		Database	Response var.	Main Pred. Var.	Period range
HORIZONTAL	Sabetta and Pugliese (1996) only for historical reasons	Italy	*PGA*, *PGV* and *PSV*	R_E,R_F, M_{S-L}, ground type	$T \leq 4$ s
	Atkinson & Boore (2003) subduction zones	Including Japan, Mexico and Central America	*PGA* and *PSA*	R_F, M_W, ground type	$T \leq 3$ s
	Boore and Atkinson (2008) NGA representative	World (NGA), but mainly WUS and Taiwan	*PGA*, *PGV* and *PSA*	R, R_F, M_W, V_{S30}, ground type, style of faulting	$T \leq 10$ s
	Akkar and Bommer (2007) overdamped spectra and ESMD data	Eurasia (IC databank)	*PGA*, *PGV* and *DRS*	R_{JB}, M_W, ground type, style of faulting	$T \leq 4$ s
	Cauzzi and Faccioli (2008) with updates overdamped spectra and fully digital	World, but maily Japan	*PGA* and *DRS*	R, R_F, M_W, V_{S30}, ground type, style of faulting	$T \leq 20$ s
VERTICAL	Bozorgnia & Campbell (2004) V/H, if problematic SP96?	World, near-source	*V/H*, *PGA* and *PSA*	R_F, M_W, ground type, $\sigma=\sigma(PGA,M_W)$?	$T \leq 4$ s
	Cauzzi and Faccioli (2008)	World, but maily Japan	*DRS*	R, M_W, ground type	$T \leq 20$ s

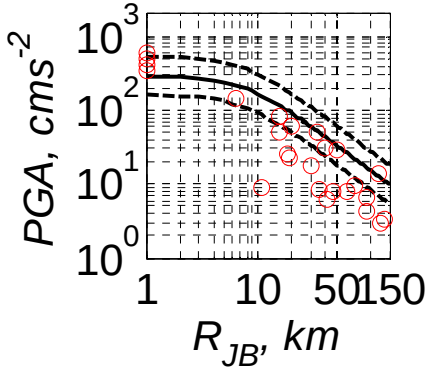
Cauzzi & Faccioli (2008)

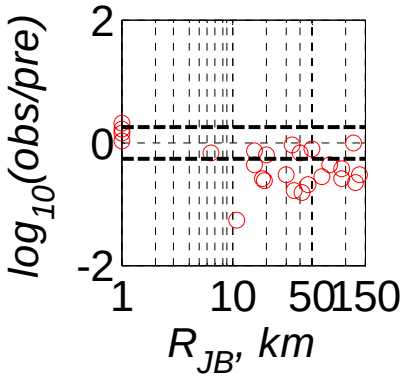


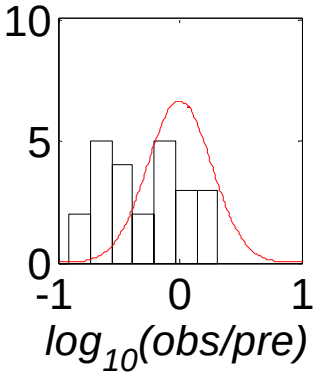




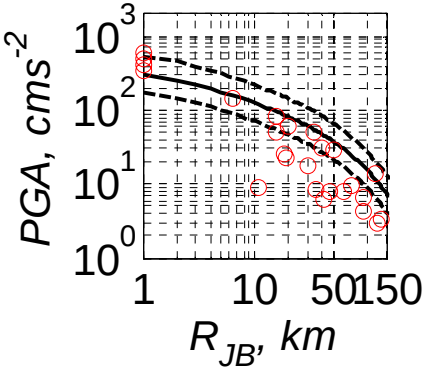
Akkar & Bommer (2007)







Boore & Atkinson (2008)



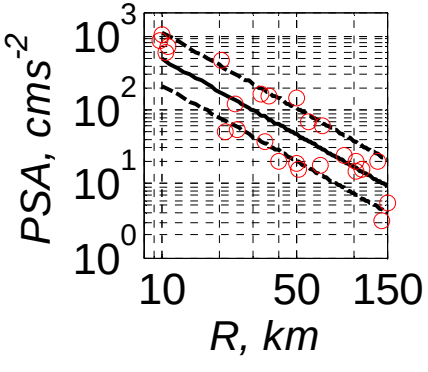
L'Aquila mainshock (M_W 6.3)

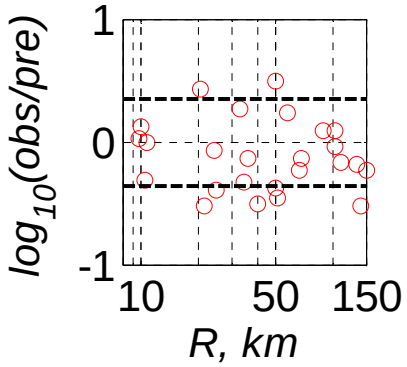
PGA

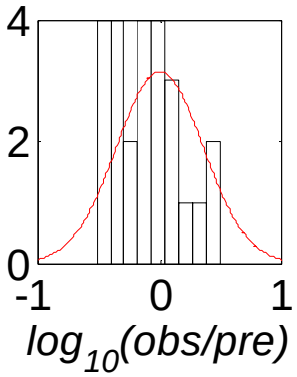
Data *vs* GMPEs (rock)

Ground types considered for residual plots

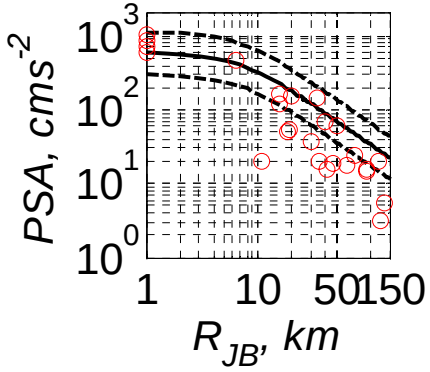
Cauzzi & Faccioli (2008)

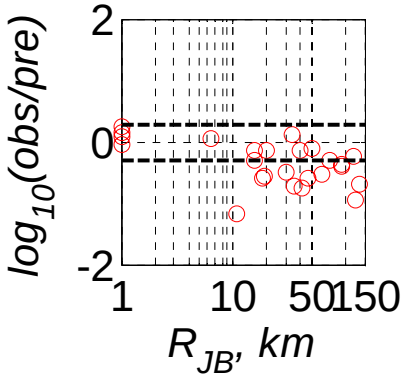


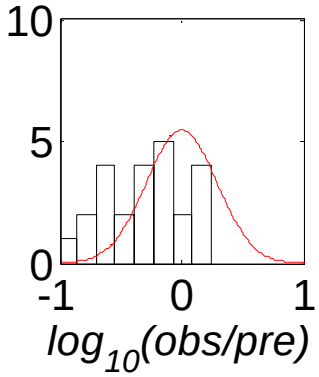




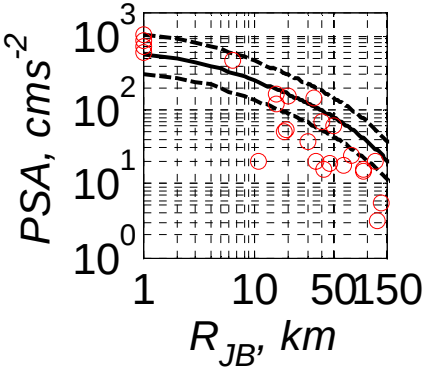
Akkar & Bommer (2007)







Boore & Atkinson (2008)



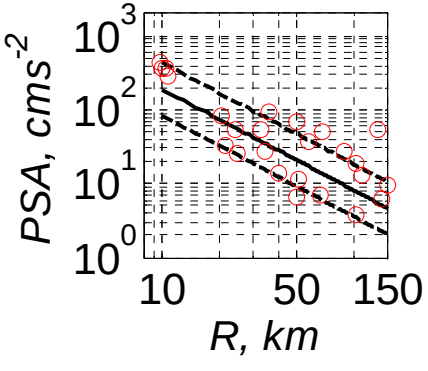
L'Aquila mainshock (M_W 6.3)

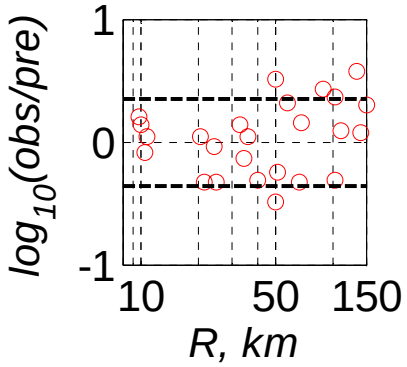
***PSA* @ 0.3 s**

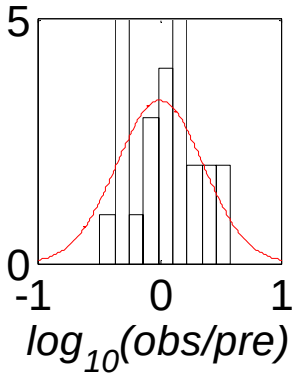
Data *vs* GMPEs (rock)

Ground types considered for residual plots

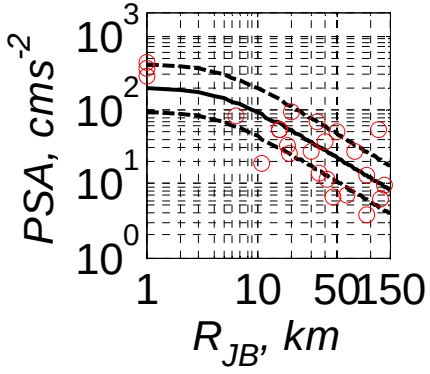
Cauzzi & Faccioli (2008)

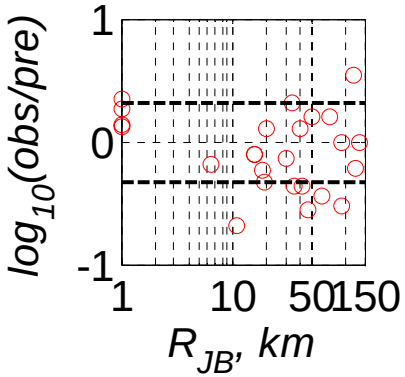


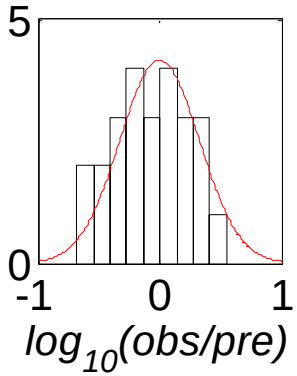




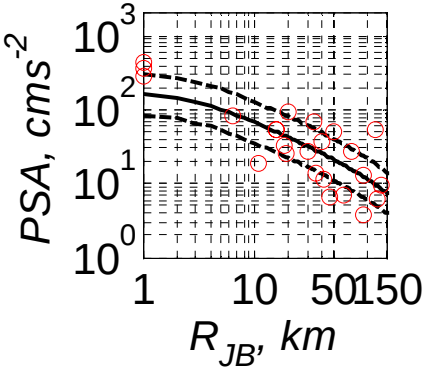
Akkar & Bommer (2007)







Boore & Atkinson (2008)



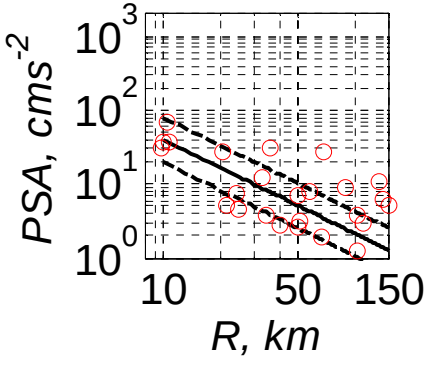
L'Aquila mainshock (M_W 6.3)

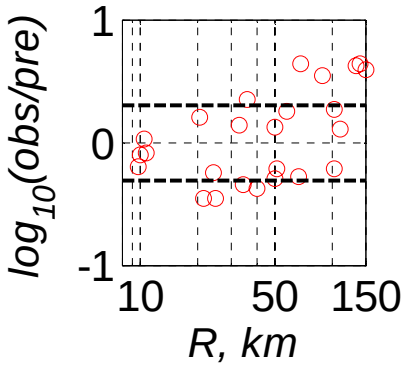
***PSA* @ 1 s**

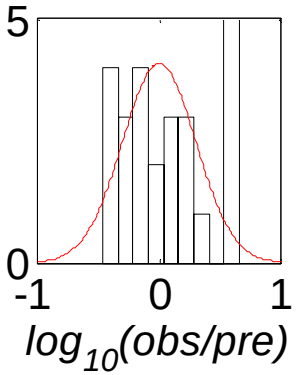
Data *vs* GMPEs (rock)

Ground types considered for residual plots

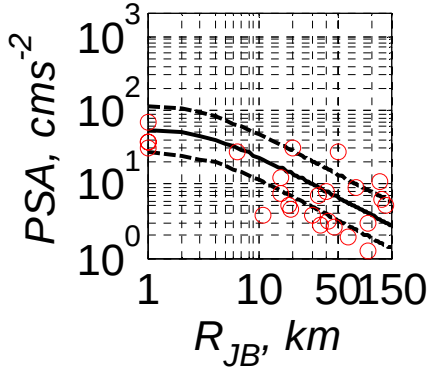
Cauzzi & Faccioli (2008)

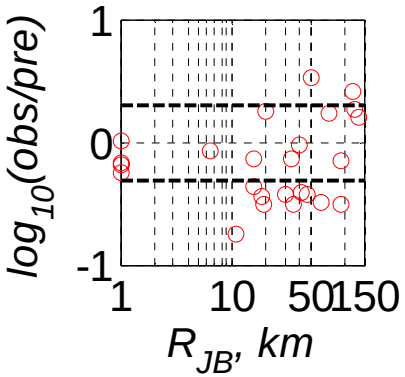


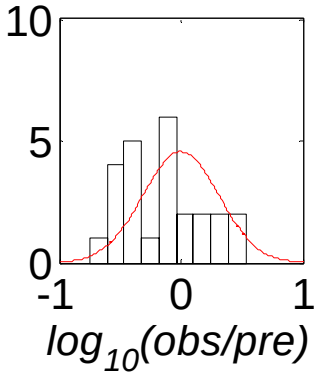




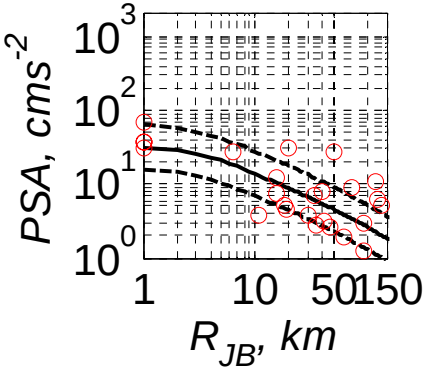
Akkar & Bommer (2007)







Boore & Atkinson (2008)



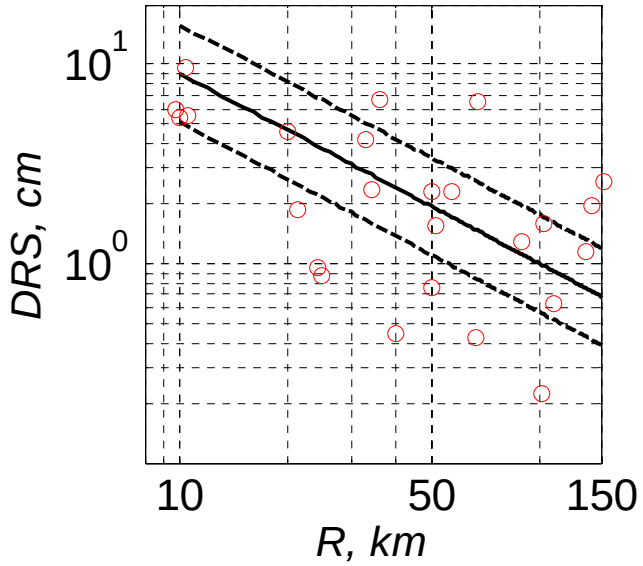
L'Aquila mainshock (M_W 6.3)

***PSA* @ 3 s**

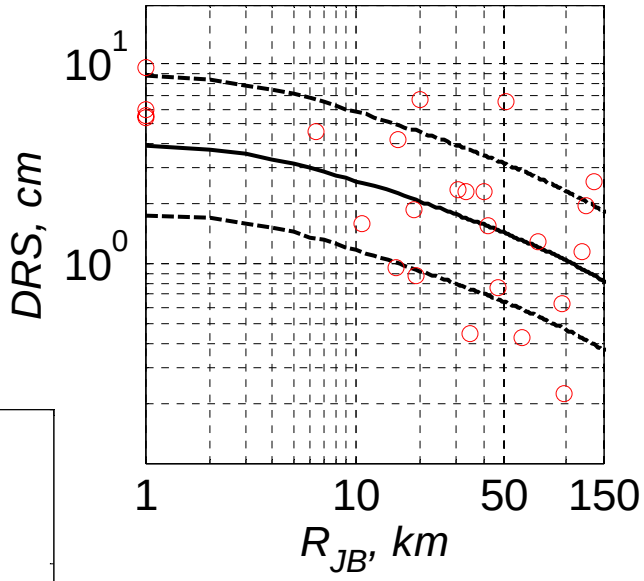
Data *vs* GMPEs (rock)

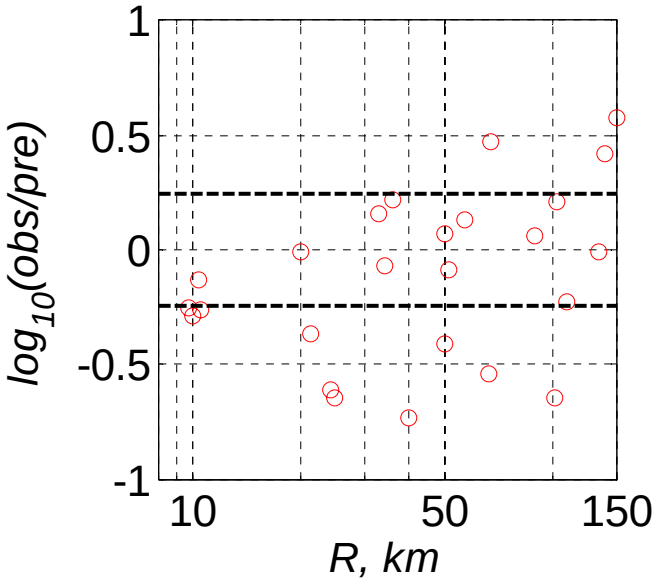
Ground types considered for residual plots

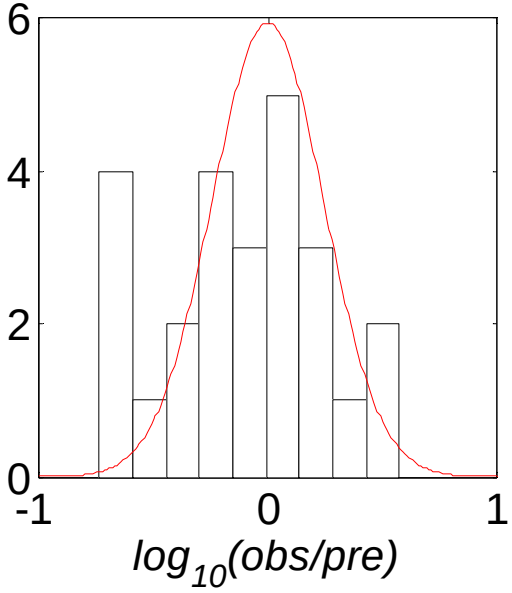
Cauzzi & Faccioli (2008)



Boore & Atkinson (2008)







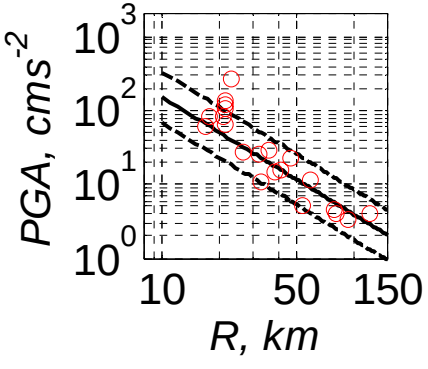
L'Aquila mainshock (M_W 6.3)

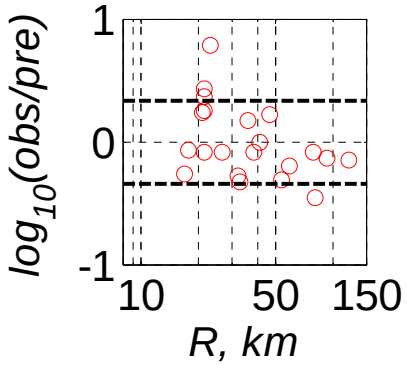
DRS @ 10 s

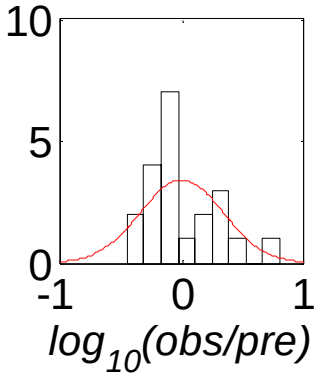
Data *vs* GMPEs (rock)

Ground types considered for residual plots

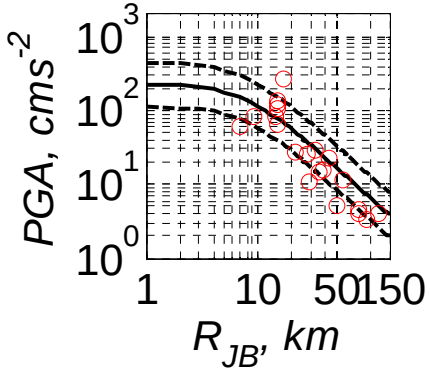
Cauzzi & Faccioli (2008)

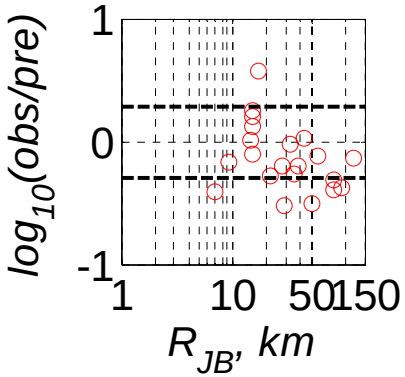


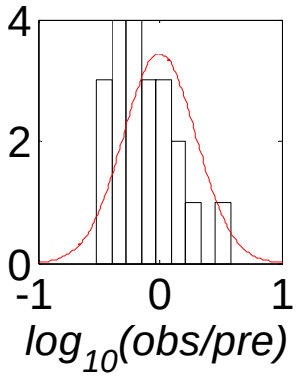




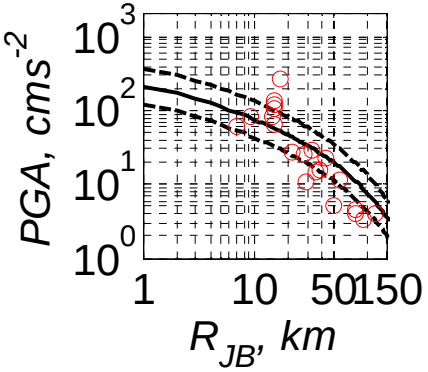
Akkar & Bommer (2007)







Boore & Atkinson (2008)



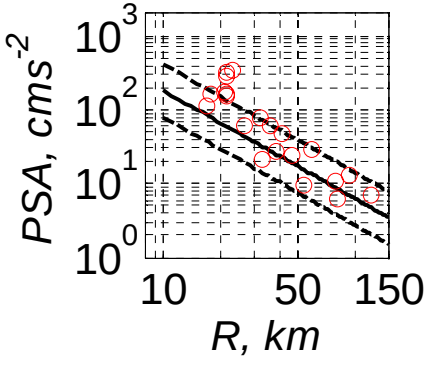
L'Aquila 7/4 aftershock (M_W 5.6)

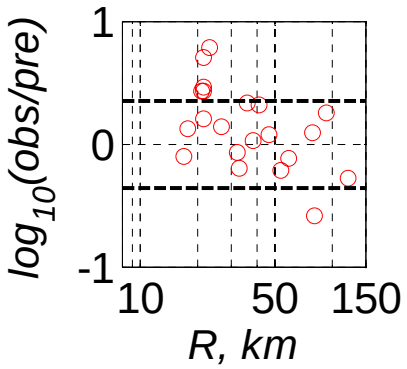
PGA

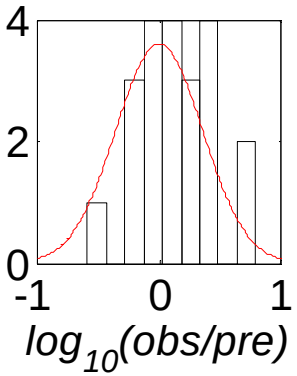
Data *vs* GMPEs (rock)

Ground types considered for residual plots

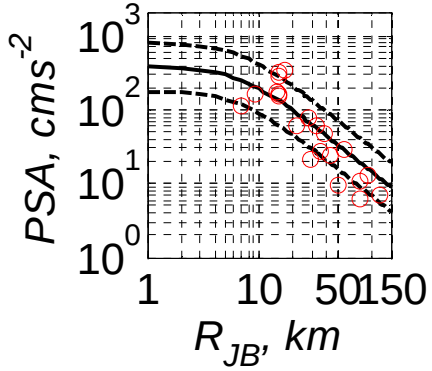
Cauzzi & Faccioli (2008)

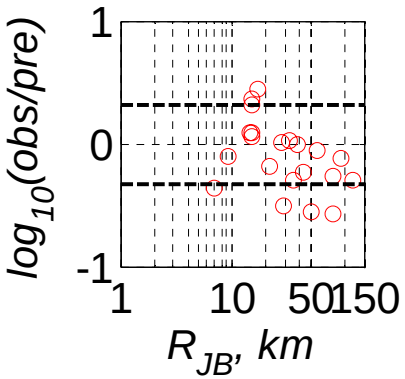


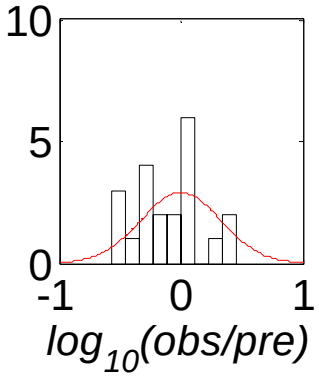




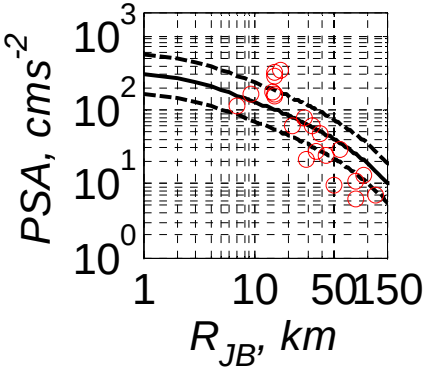
Akkar & Bommer (2007)







Boore & Atkinson (2008)



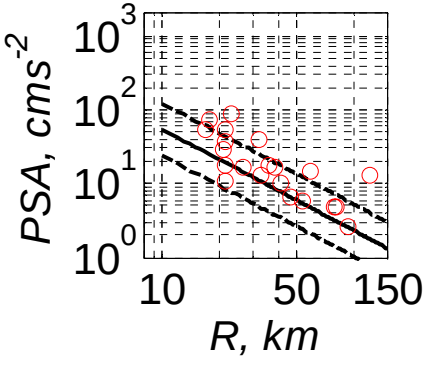
L'Aquila 7/4 aftershock (M_W 5.6)

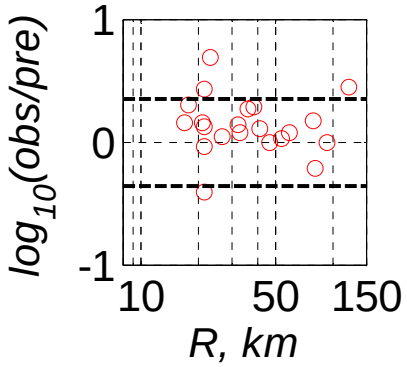
***PSA* @ 0.3 s**

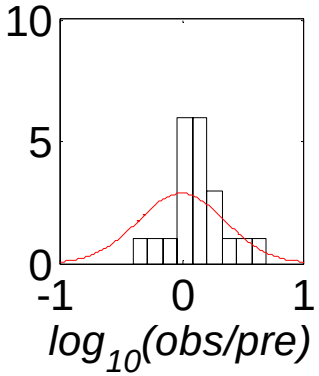
Data *vs* GMPEs (rock)

Ground types considered for residual plots

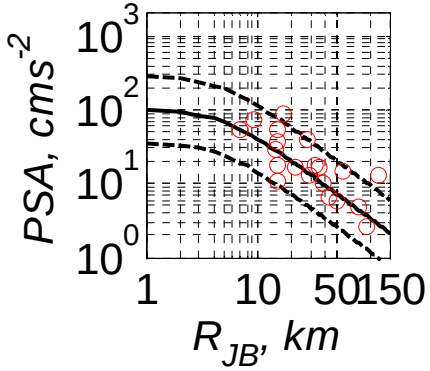
Cauzzi & Faccioli (2008)

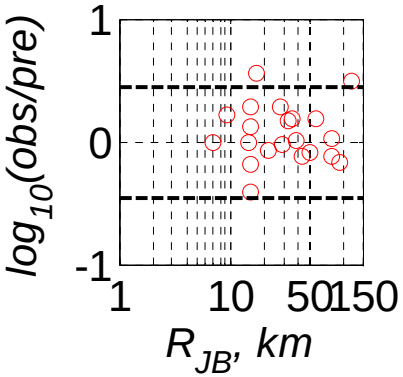


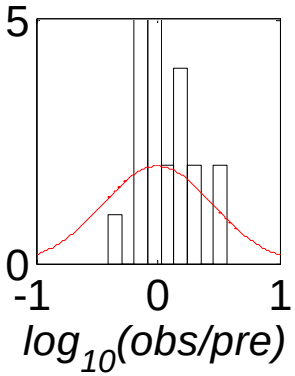




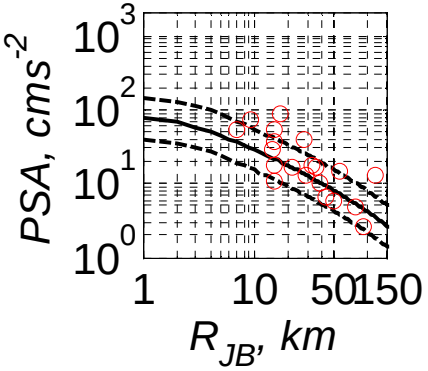
Akkar & Bommer (2007)







Boore & Atkinson (2008)



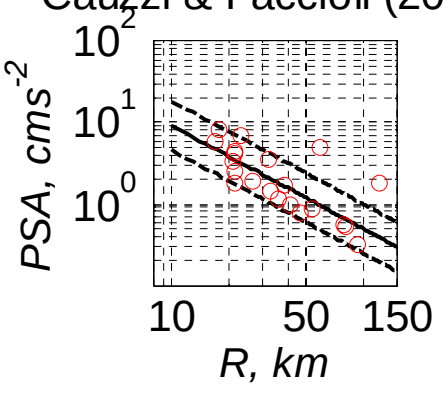
L'Aquila 7/4 aftershock (M_W 5.6)

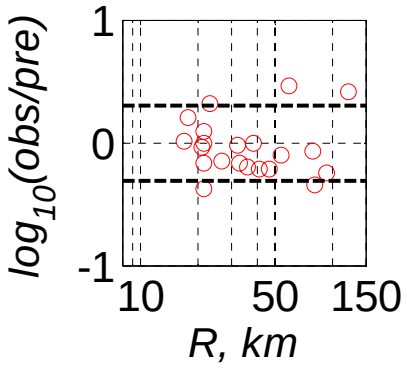
***PSA* @ 1 s**

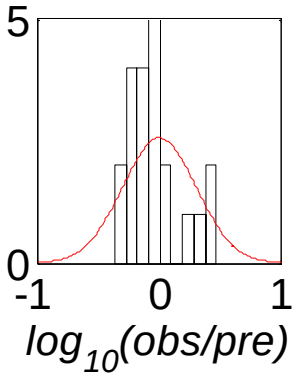
Data *vs* GMPEs (rock)

Ground types considered for residual plots

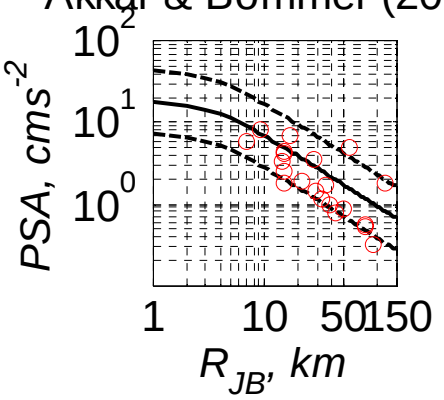
Cauzzi & Faccioli (2008)

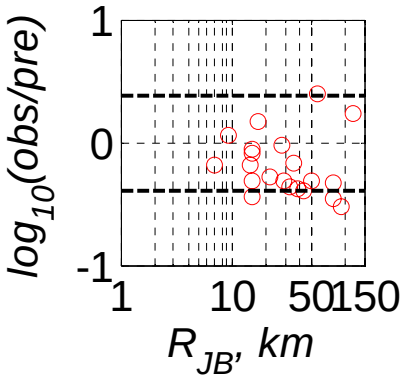


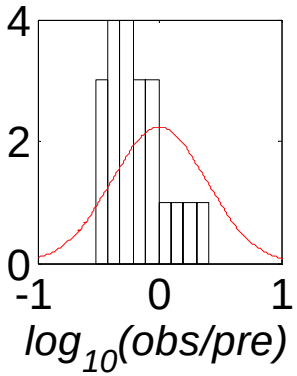




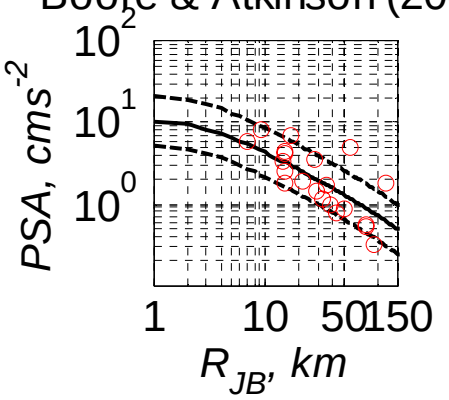
Akkar & Bommer (2007)







Boore & Atkinson (2008

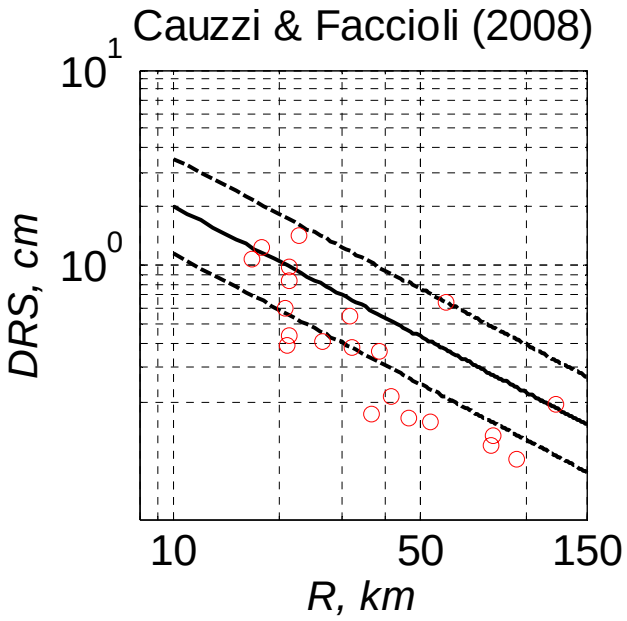


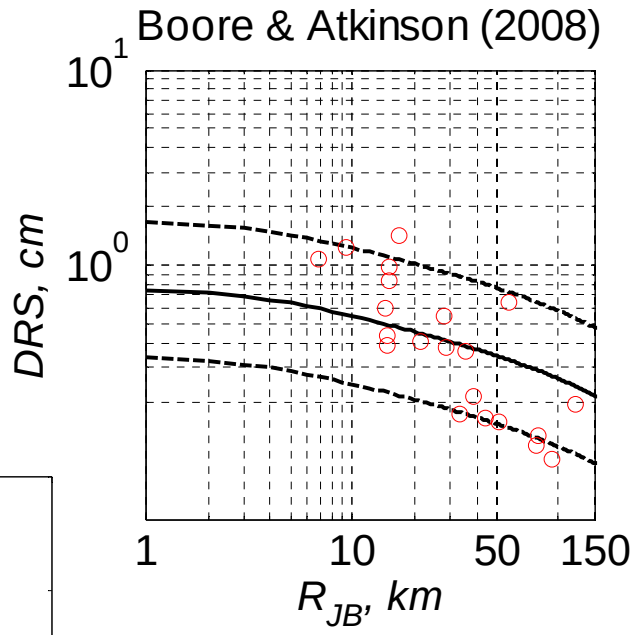
L'Aquila 7/4 aftershock (M_W 5.6)

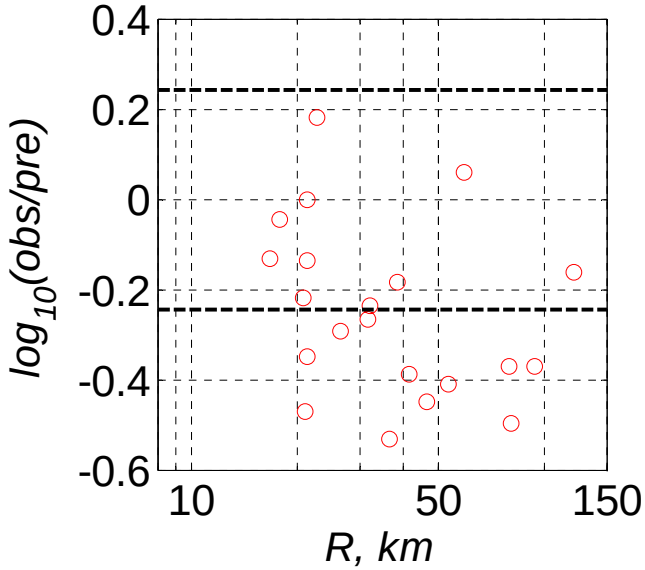
***PSA* @ 3 s**

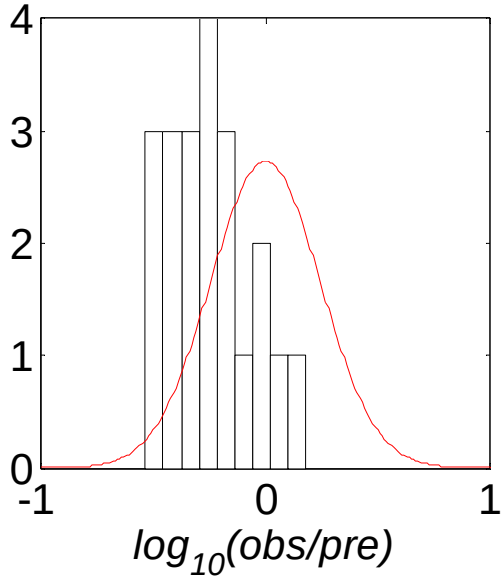
Data *vs* GMPEs (rock)

Ground types considered for residual plots









L'Aquila 7/4 aftershock (M_W 5.6)

DRS @ 10 s

Data *vs* GMPEs (rock)

Ground types considered for residual plots

- **Should the S projects use the same GMPEs?**

NO, but projects dealing with strong ground motions (M_W > 5) should choose among a list of preferable models.

- **Should we move towards homogeneous models?**

(?)
Not necessarily, but preferably in terms of main predictors.
(?)

- **What should be done within the framework of the S projects?**

Compile a list of preferable/suggested/consolidated models for strong ground motion prediction. Model performance with respect to L'Aquila sequence (and Parma eq.) should play a significant role, as well as the quality of the data used for regressions (i. e. analog vs digital).