Comparison between the seismic amplification values obtained from the Italian second-level microzonation (SM2) abacuses and numerical simulation

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X1.80

INTRODUCTION

The purpose of this work was to evaluate if the amplification factors (AF) defined into the abacuses obtained from Italian second level seismic microzonation were representative of the real AF for the Friuli Venezia Giulia (FVG) Region.

The Seismic Microzonation (SM) is a process aimed at identifying and mapping the subsoil local response in a given area in terms of ground shaking parameters and susceptibility to ground instabilities. In Italy, the Guidelines for Seismic Microzonation (ICSM 2008) defines tree levels of in-depth analysis and this work is focused on the second one. The second level quantifies the seismic amplification (AF) through table of correspondences called abacuses retrieved from the guidelines. The results were compared with the AFs obtained from the numerical simulations.

METHODS

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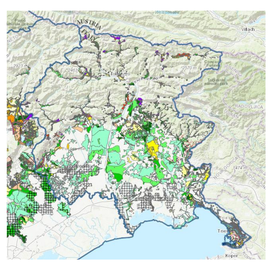
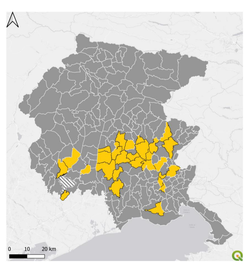
The preliminary phase allowed us to individuate the FVG municipalities that satisfy the conditions necessary for applying the second level that are: the 1D condition of the subsoil and the absence of shear velocity inversion. At the date of September 2022, 190 municipalities over 224 have carried out level 1 SM studies whose data were analyzed for this work. Among all 224 municipalities only 28 municipalities satisfied the conditions and reached the seismic bedrock, therefore they were considered for further analyses.

To obtain the AF we proceeded in two ways:

a) The AFs from abacuses (AF,ab) were obtained from the ICMS2008;
b) The AFs from numerical simulation (AF,sim) were performed by means of STRATA that applies a linear equivalent procedure to obtain the 1D seismic response analysis.



Municipalities with SM1 from https://www.webms.it/servizi/viewer.php



Resultant municipalities

Parameter	Source	Abacuses	1D seismic response analysis
ag, F0, Tc*	NTC18	x (only the ag value)	
Vseq or Vs30	MASW/ReMi	x	
Vs-depth profiles (i.e. layers thickness and seismic wave velocities)	MASW/ReMi		x
Slope of the Vs-depth profile	MASW/ReMi	x	
Bedrock depth	MASW/ReMi	x	x
Soil type of the cover layer (i.e. silt, sand, or gravel)	Boreholes and literature data	x	
Physical properties (i.e. materials densities)	Soil sample analysis and literature data		x
G/G0 and D/D0 curves	Working Group ICMS 2008		x
Accelerograms	SEISM-HOMe		x

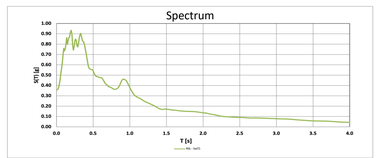
Parameters that were considered and their source in order to obtain the Afs.

a)

Amplification factor: FA — Lithology: Silt — a_g (g): 0.06 — Vs-depth curve: Costant

#	V_{seq} (m/s)									
	150	200	250	300	350	400	450	500	600	700
5	2.37	1.94	1.64	1.47	1.34	1.23	1.13	1.07	1.02	1.00
10	2.39	2.25	1.99	1.75	1.54	1.38	1.27	1.17	1.08	1.03
15	1.76	2.05	1.99	1.85	1.69	1.53	1.40	1.29	1.13	1.05
20	1.53	1.61	1.80	1.76	1.68	1.57	1.46	1.36	1.19	1.07
25	1.49	1.47	1.49	1.61	1.58	1.52	1.45	1.36	1.21	1.08
30	1.45	1.44	1.40	1.39	1.47	1.44	1.39	1.33	1.21	1.08
35	1.39	1.42	1.40	1.34	1.33	1.36	1.33	1.29	1.18	1.08
40	1.30	1.39	1.36	1.31	1.27	1.25	1.27	1.24	1.16	1.07
50	1.24	1.32	1.32	1.30	1.27	1.22	1.17	1.14	1.10	1.04
60	1.16	1.24	1.26	1.27	1.24	1.22	1.18	1.13	1.06	1.01
70	1.14	1.23	1.23	1.23	1.23	1.19	1.17	1.13	1.06	0.99
80	1.08	1.15	1.19	1.18	1.19	1.16	1.14	1.13	1.06	1.00
90	1.02	1.15	1.17	1.18	1.15	1.14	1.12	1.10	1.06	1.00
100	0.96	1.12	1.12	1.17	1.15	1.11	1.09	1.08	1.05	1.00
110	0.89	1.03	1.11	1.13	1.13	1.14	1.09	1.05	1.03	0.99
120	0.85	1.02	1.11	1.09	1.12	1.12	1.09	1.05	1.01	0.98
130	0.81	0.98	1.06	1.09	1.08	1.09	1.09	1.05	1.00	0.96
140	0.78	0.93	0.99	1.08	1.06	1.08	1.06	1.06	1.00	0.95
150	0.73	0.91	1.00	1.06	1.07	1.04	1.05	1.03	1.00	0.95

b)



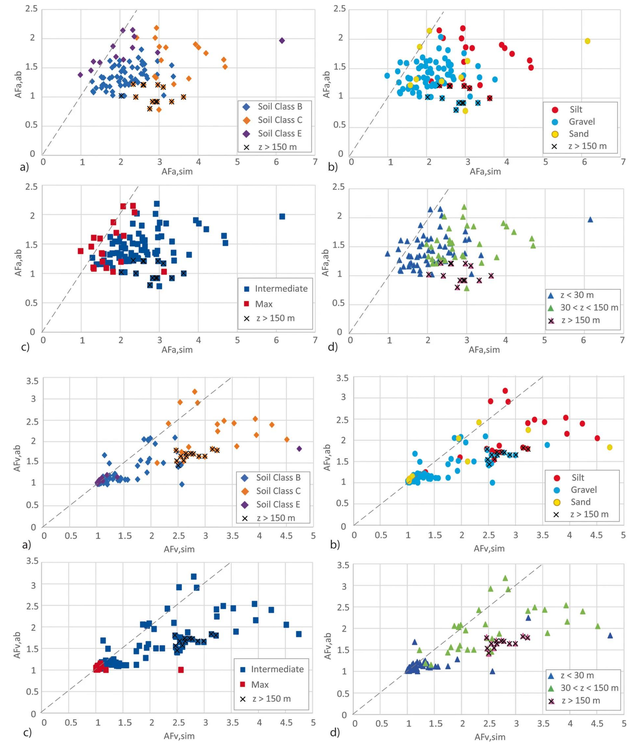
$$AF = \frac{\int output\ spectrum}{\int input\ spectrum}$$

AF,ab

AF,sim

RESULTS AND CONCLUSIONS

- Results show that:
  - the AF,sim values are in general higher than the AF,ab;
  - AF from the silt soils have the highest values;
  - AF,ab are greater than AF,sim except for the sites where the slope of the Vs-depth curve is maximum, i.e. where the bedrock is shallow
- This means that, in general, the abacuses underestimate the seismic site response.
- This assumption is not true for those sites that have a shallow seismic bedrock or in soil class E.
- In conclusion, SM2 national abacuses are not applicable in FVG. For this reason, if the authorities want to proceed with SM2, it is necessary to develop regional abacuses.



Definitions: the AFa corresponds to the low period amplification factor and is determined around the proper period for which there is the maximum acceleration response and the AFv corresponds to the amplification factor over long periods for which there is the maximum pseudo-speed response.

For the spectra analysis see the poster X1.81 "Evaluating the applicability of the microzonation simplified approach (national abacuses) in the plain of the Friuli Venezia Giulia region (Italy)"

References:

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- Pazzi, V., Beltrame, C., Taverna, P. et al. Are the Italian microzonation level 2 abacuses applicable in the Friuli Venezia Giulia (Italy) plain? Comparison between the national abacuses and the numerically simulated amplification factors and between the derived elastic response spectra. J Seismol (2024). https://doi.org/10.1007/s10950-024-10212-9