

Task 5

Seismic classification of ITACA sites

Task responsables:

L. Luzi (INGV-MI)

M. Mucciarelli (Uni-BAS)

D. Albarello (Uni-SI)

1st semester evaluation by the International Evaluation Committee

Rome, INGV, Via Nizza, 128

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Main activities

5.1 Revised seismic classification of ITACA sites according to EC8 and Italian seismic norms

5.2 Seismic classification of ITACA bedrock sites

- most recently installed RAN stations on rock or stiff soil
- typical V_s profiles at rock sites
- effect of lateral variability (faults) and surface weathering
- identification of reference sites for seismic hazard studies
- need of subdivision in two rock sub-classes?

5.3 Identification and test of alternative criteria for seismic site classification

- literature review, main indications from NERIES project
- identification of suitable parameters (f_0 , $V_{s,10}$, H to bedrock, ...)
- check of proposed methods on well documented ITACA sites
- check of dispersion of EGMPE calibrated on ITACA records

Task 5 – Deliverables

<p>D10 <i>Responsibles</i> RU2-INGV-RM1 RU6-Uni-RM1 <i>Deadline</i> 24m</p>	<p>Revised seismic classification of the ITACA stations, according to the EC8 and the Italian norms site classes (Technical report)</p> <p><i>Product of immediate interest to DPC</i></p>	<p>This report will summarize the work carried out in Task 2 on the collection and filing of geological/geotechnical data about ITACA station. It will provide as well the revised classification with the grade of reliability. Validations of simplified classification criteria based on information from geological maps will be included as well</p>
<p>D11 <i>Responsible</i> RU7-Uni-Siena Deadline 24m</p>	<p>Seismic classification of the ITACA bedrock sites, with the identification of reference sites for seismic hazard studies and engineering applications (Technical report)</p> <p><i>Product of immediate interest to DPC</i></p>	<p>This report will contain the scientific activity and will provide reference results for seismic hazard assessment at regional/national scale (Project S2) and for production of shake maps (Project S3).</p>
<p>D12 <i>Responsibles</i> RU1-INGV-MI RU5-Uni-BAS Deadline 12m</p>	<p>Critical review of methods proposed in the literature for site classification (Technical report).</p> <p><i>Research product, for future applications of interest to DPC</i></p>	<p>This report will summarize available methods and proposals for seismic site classifications alternative to $V_{s,30}$, will check their applicability using the ITACA data set, and will propose new descriptive parameters of site conditions</p>
<p>D13 <i>Responsibles</i> RU1-INGV-MI RU5-Uni-BAS Deadline 24m</p>	<p>Identification of new site parameters for improved seismic classification criteria (Technical report)</p> <p><i>Research product, for future applications of interest to DPC</i></p>	<p>This report will summarize the work carried out in the activity 5.3, and will provide the site information to build new classification schemes.</p>

Task 5 – Statistical analyses on a selected station data set

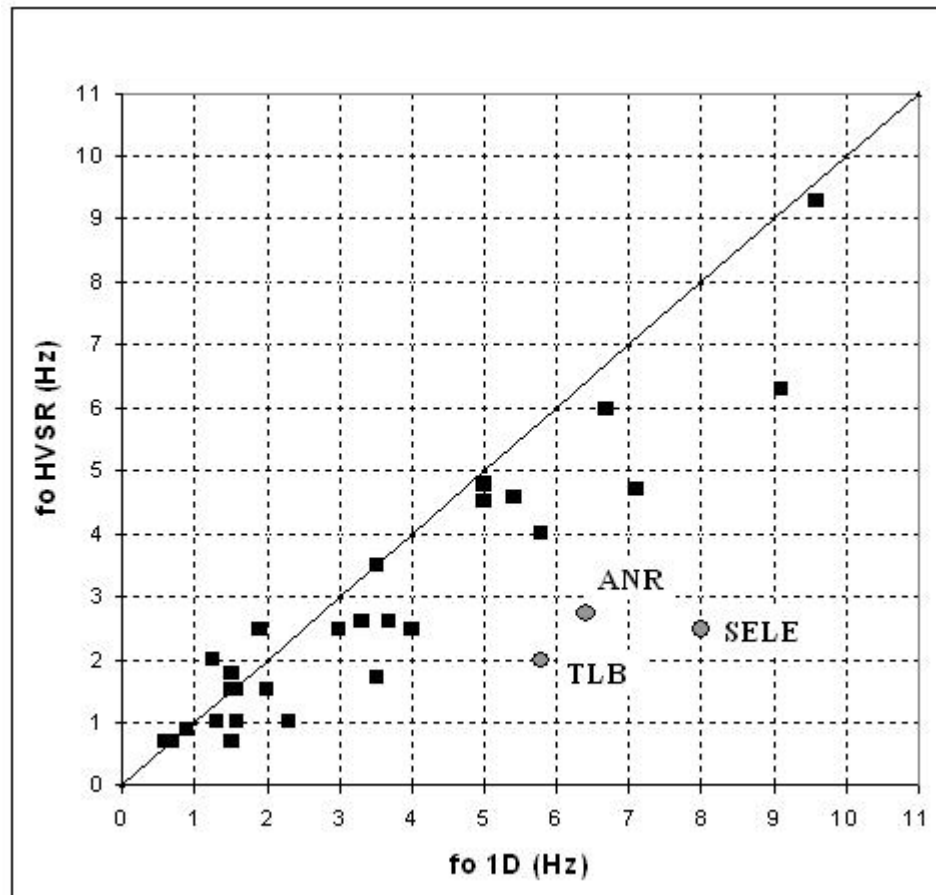
- Select sites (both from the ITACA database and from other research projects) where a V_s profile is available, together with seismic or microtremor records
- Calculation of parameters related to soil amplification
- Statistical analyses

Parameters considered

V_{s30}	Average shear wave velocity in the first 30 m
$V_{s,bedrock}$	Average velocity to the bedrock depth
$V_{s,H}$	Average shear wave velocity for different depth
$f_{0_{hvsr}}$	Resonant frequency obtained for HVSr (earthquakes, microtremors)
$f_{0_{1D}}$	Resonant frequency obtained using 1D models
A_{hvsr}	Amplitude at $f_{0_{hvsr}}$
A_{1D}	Amplitude at $f_{0_{1D}}$
Lito	Lithotechnical class

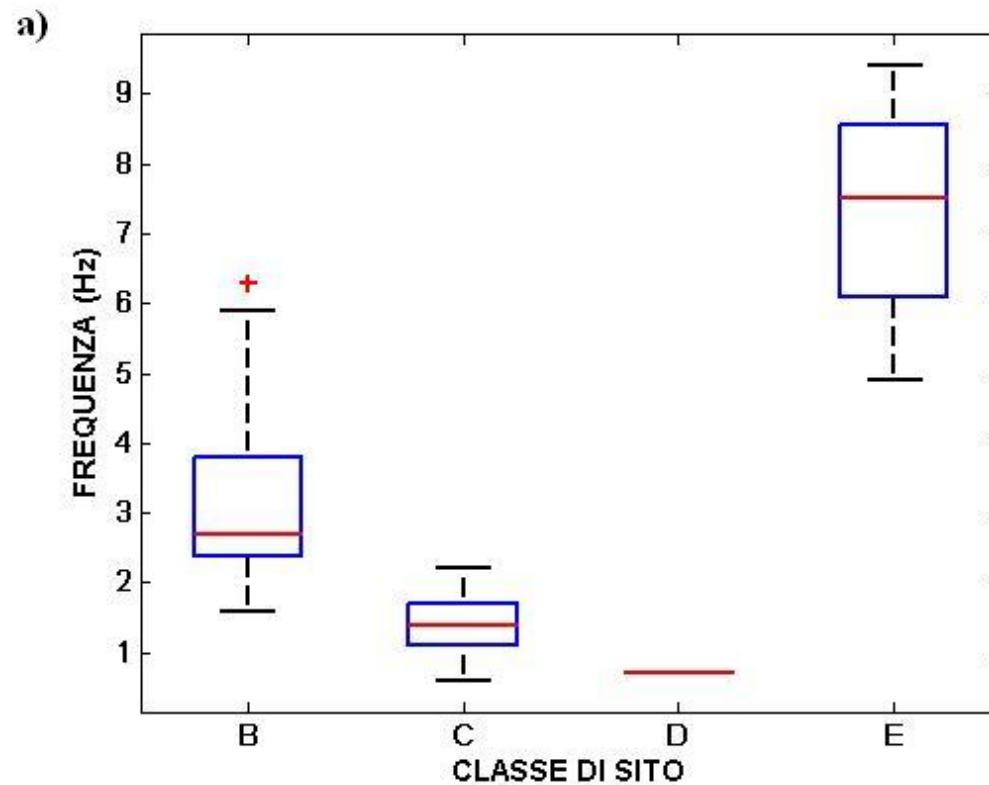
Task 5 – Statistical analyses on a selected station data set

f_0 from HVSR and 1D models



Task 5 – Statistical analyses on a selected station data set

f_0 from HVSR as a function of EC8 site class



Task 5 – Site classification based on HV response spectral ratios

ZHAO et al. (2006)

JAPAN ROAD ASSOCIATION

CAT.	PERIOD T (sec)
SCI	$T < 0.2$
SCII	$0.2 \leq T < 0.4$
SCIII	$0.4 \leq T < 0.6$
SCIV	$T \geq 0.6$

AUTOMATIC CLASSIFICATION
SITE CLASSIFICATION INDEX (SI)

FUKUSHIMA et al. (2007)

CAT.	PERIOD T (sec)
SC1	$T < 0.2$
SC2	$0.2 \leq T < 0.6$
SC3	$T \geq 0.6$
SC4	Generic Rock
SC5	Generic Soil

AUTOMATIC CLASSIFICATION
MANUAL CONTROL

This study

CAT.	PERIOD T (sec)
CL-I	$T < 0.2$
CL-II	$0.2 \leq T < 0.4$
CL-III	$0.4 \leq T < 0.6$
CL-IV	$T \geq 0.6$
CL-V	T not identifiable (flat H/V)
CL-VI	T not identifiable (broad ampl. and / or multiple peaks @ $T > 0.2$)
CL-VII	Not classifiable

Task 5 – Site classification based on HV response spectral ratios

Selection of records

156 Records
DPC-S5 (2005-07)

Digital

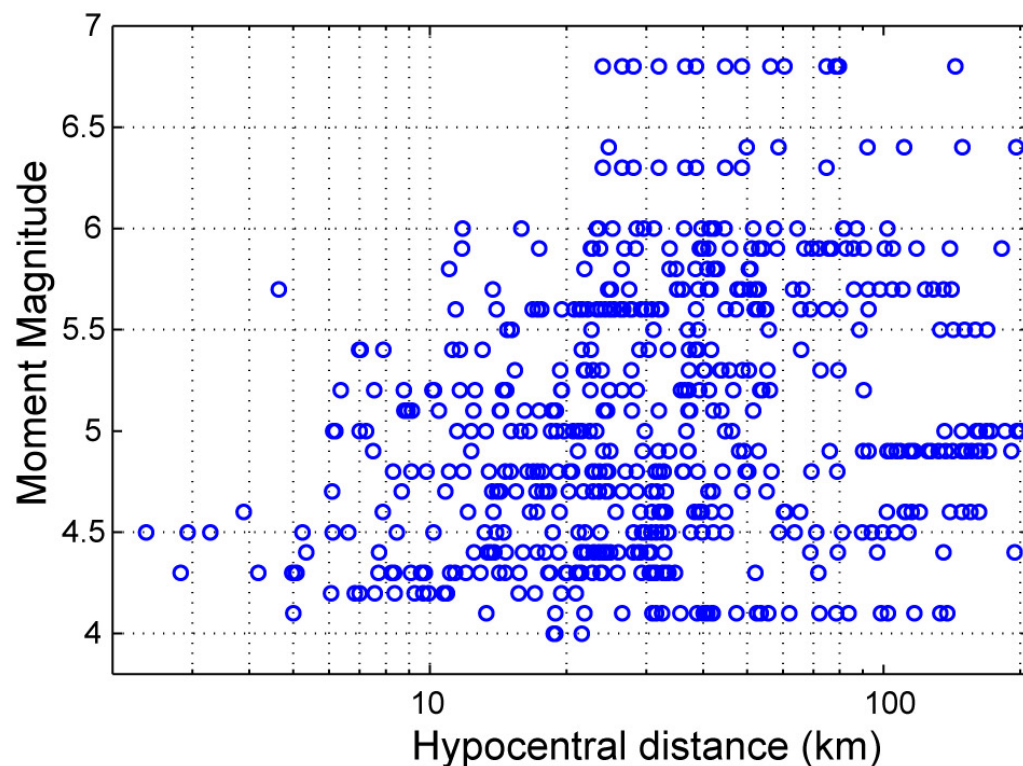
432 Records
I.T.A.C.A.

Digital and analog

22 Records
R.A.N.

Digital

1972 - 2004
Complete Selection
2005 - 2008
Arbitrary Selection

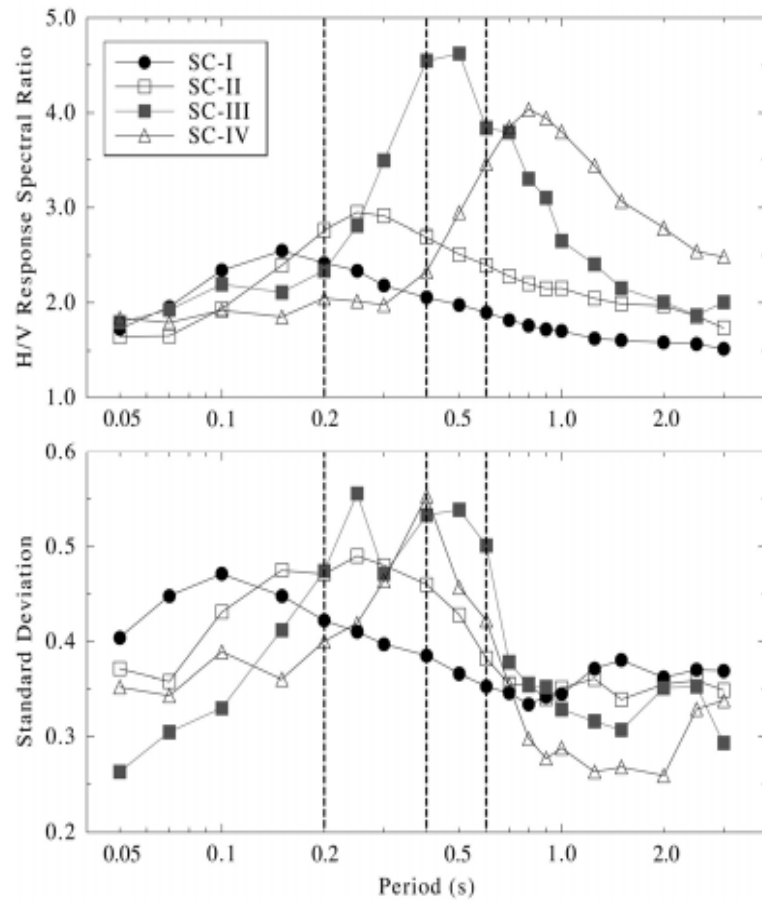


120 events
with $4.0 < M_w < 6.8$

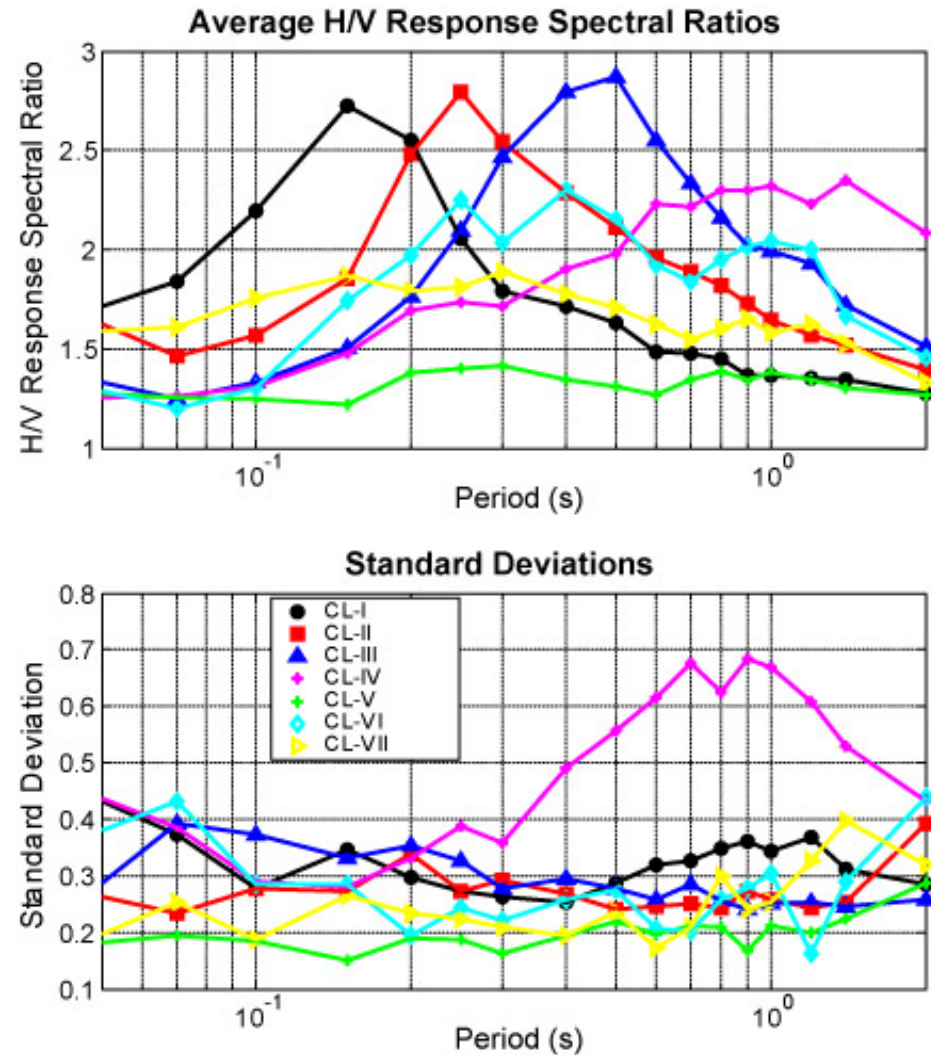
→ { **610** 3-comp records
111 stations

Task 5 – Site classification based on HV response spectral ratios

Site classification results

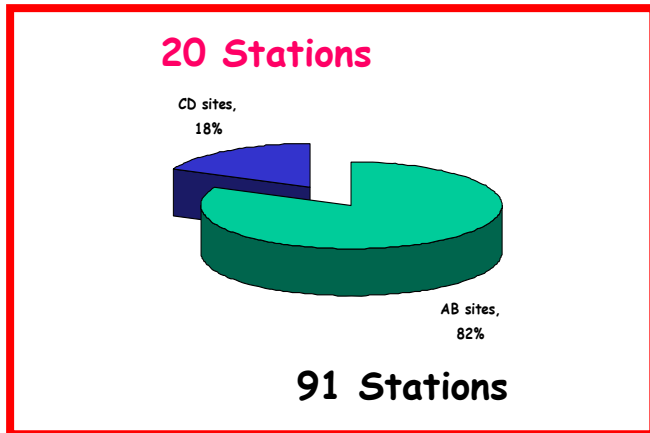


Average H/V response spectral ratio for the ZHAO et al. (2006) site classes (top) and standard deviation for each class (bottom) in natural logarithms.

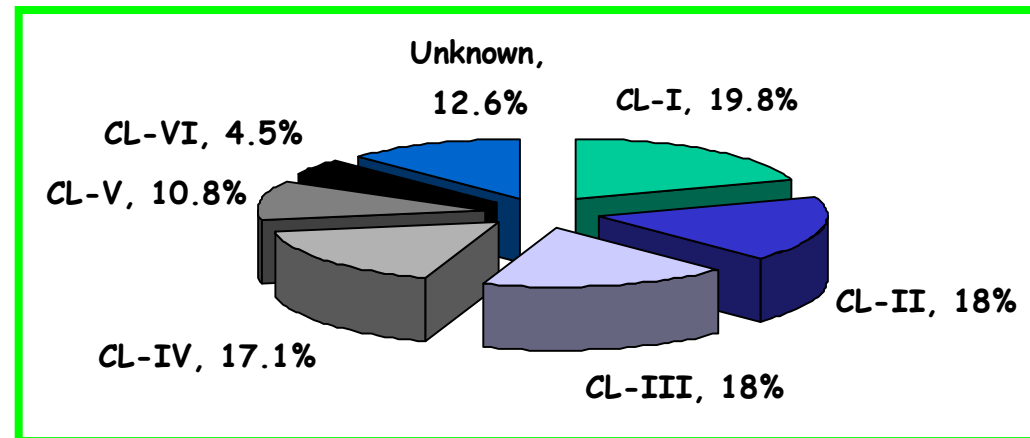


Task 5 – Site classification based on HV response spectral ratios

Site classification results



ORIGINAL SITE CATEGORIES

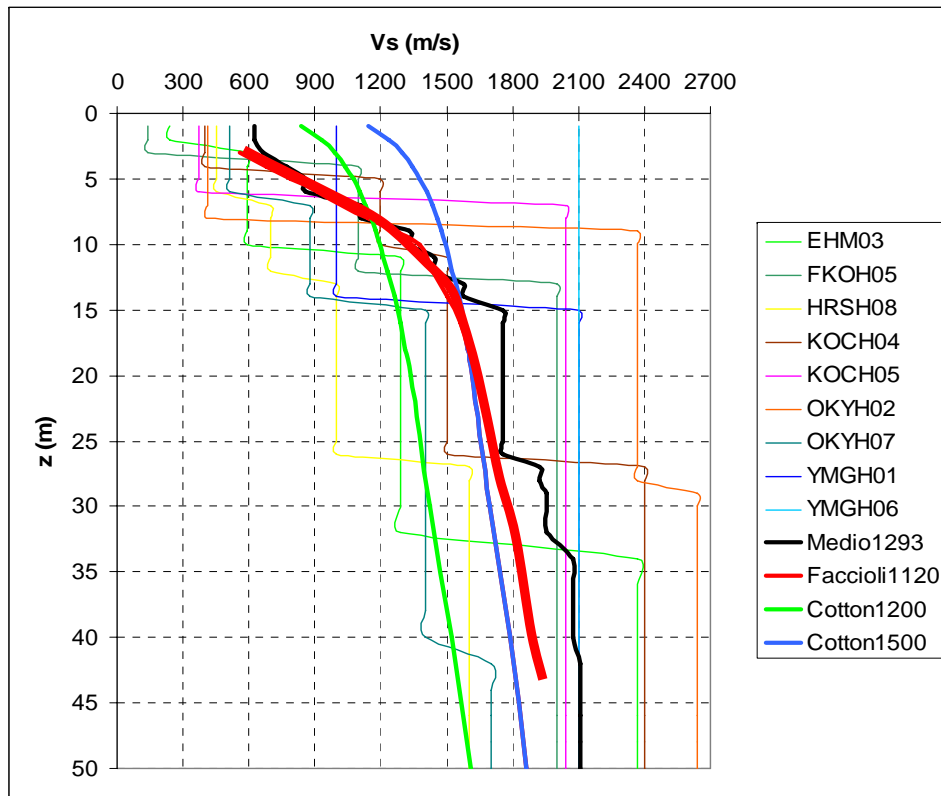


THIS STUDY

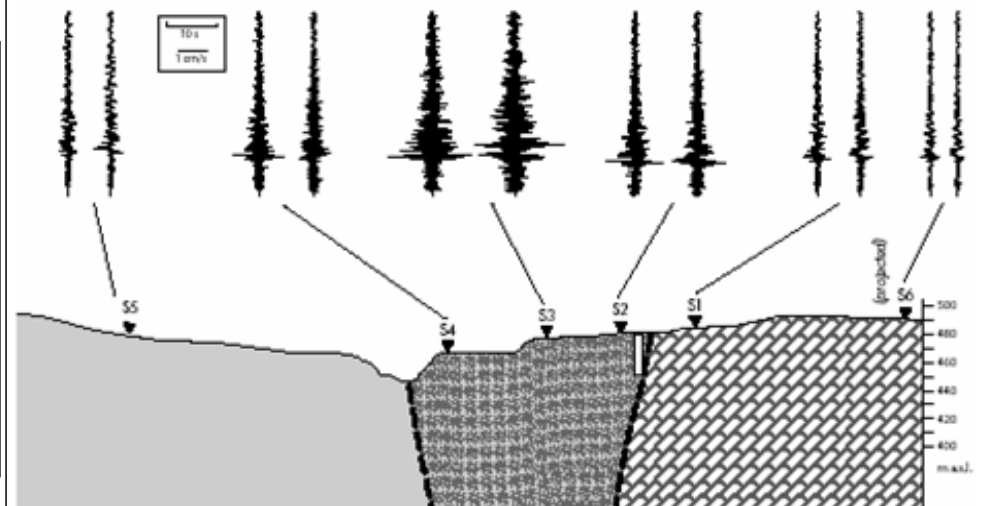
	CL-I	CL-II	CL-III	CL-IV	CL-V	CL-VI	Unknown
AB	19	19	16	11	11	3	12
CD	3	2	4	7	0	2	2

Task 5 – Classification of rock sites

vertical layering at Class A sites (based on KikNet stations, Japan)



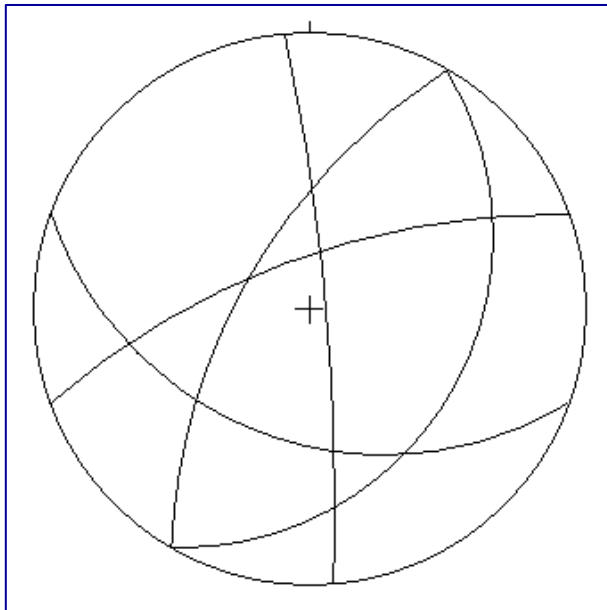
lateral discontinuities at Class A sites



Task 5 – Classification of rock sites

Effect of lateral discontinuities and surface weathering, based on coupled geomechanical and geophysical measurements

Geomechanical measurements



Features of discontinuities (ISRM, 1989)

J_v (n° joint / unit volume)

l_b (average size of rock block)

JCS (joint compressive strength)

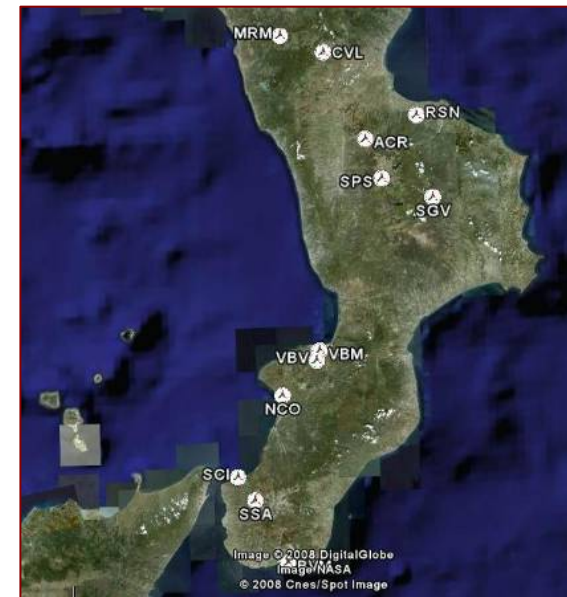
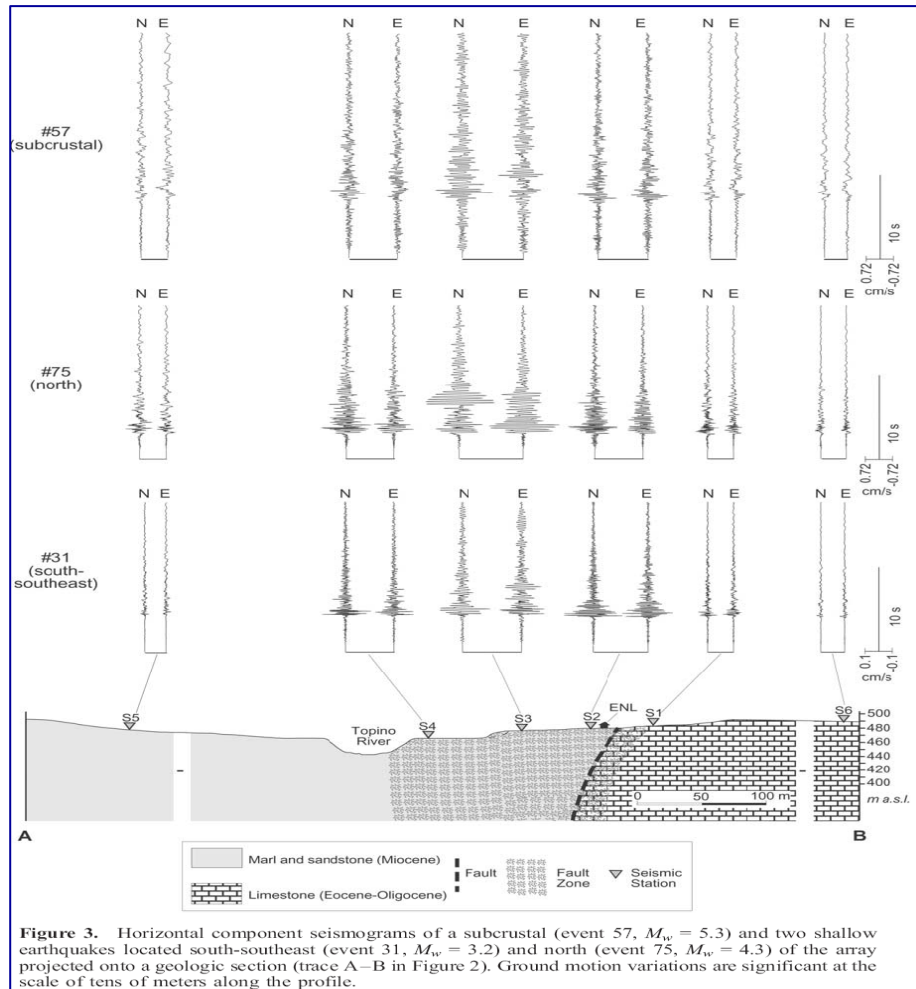
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Classification of the rock mass (RMR)

Geophysical al measurements

Single station (HVSr) and array measurements (ESAC, F-K, BF, Interferometry)

Task 5 – Classification of rock sites

Application of the proposed procedure to 10 sites, in Abruzzi, Lazio and Calabria



Task5 – Work progress

Planned

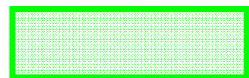
5. Site classification				
Revised site classification at recording stations based on the Italian and European seismic norms	X	X	X	
Check of applicability of simplified classification criteria based on surface geology maps		X	X	
Improved classification of rock sites	X	X	X	X
Bibliographic search and selection of descriptive parameters for site conditions in addition to Vs,30	X			
Statistical analyses to check improved site classification schemes		X	X	X
Synthesis of results and implementation in the database				X



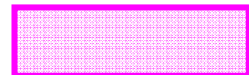
Just started: stations with the most important records considered



To be started soon, with the availability of first results from in-field survey



Completed



Started ahead of schedule

Problems

This task is going on schedule. No major problems found.
Need closer cooperation among partners