RU1 INGV MI-PV: Activities carried out in the framework of the project S4 Italian strong-motion database

Luzi L.[1], and UR1 – S4 working group

[1] Istituto Nazionale di Geofisica e Vulcanologia – Sezione di MILANO - PAVIA

ABSTRACT

The research unit of Milano – Pavia collaborated to all tasks of the S4 project. In detail, Task1 regards the update of the ITACA database (http://itaca.mi.ingv.it), which consisted in the improvement of the web portal facilities and the storage of the strong-motion data relative to 2005-2007. Because of the relevance of the recent Mw 6.3 L'Aquila and Mw 5.4 Parma earthquakes, the priority was given to the storage of the accelerograms relative to these events. A feasibility study has been performed for the interaction between the ITACA database and the software REXEL (http://www.reluis.it/), a tool for the selection of strong-motion data based on average spectral compatibility, with a positive feedback. In Task2 the RU collaborated to the design of the new reports of recording stations and to the implementation of the software for the automatic generation of station reports. In the framework of Task3, the RU collaborated to the execution of the low cost geophysical surveys in Emila Romagna and in Abruzzo (Modena, Faenza, Novellara, Onna among other sites). The activity carried out within Task4 consisted in the individuation of recording sites with peculiar behavior. This activity was conducted through statistical data analyses, to identify the deviation from average values predicted by ground motion prediction equations (GMPE's), and through GIS spatial analysis, in order to detect recording sites located on complex landforms or alluvial basins. Regarding the site monitoring, the RU collaborated to the installation of a temporary network to collect data to investigate the response site of Norcia plian (PG). An additional temporary network was installed by the RU staff in the village of Narni (TR), to detect possible topographic site effects. Finally, in the framework of Task5, a work on site classification has been carried out by the statistical analysis conducted on different geotechnical and geophysical parameters of the recording stations with relevant number of available observations. All the recording stations in the ITACA database have been classified according to the EC8 code and to the Sabetta and Pugliese (1996) criterion. The sensitivity of empirical ground motion models on the proposed classifications has been tested through the variability of the standard deviation of the proposed models.

T1

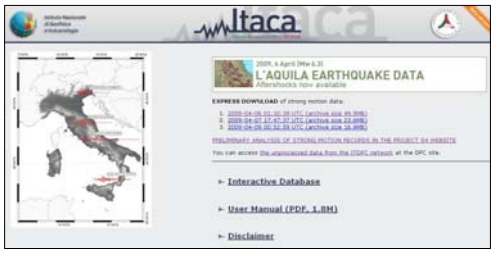
In the first 18 months of the project the update of the ITACA database consisted in:

1) release of the beta version of the web portal containing new facilities for waveform search and definition of the architecture of the new home page;

2) storage of the strong motion records relative to the 13 strongest shocks (Mw > 4) of the Mw 6.3 L'Aquila sequence, achieved after one month since the occurrence of the main event;

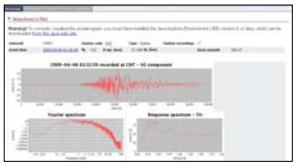
3) set up of a new procedure for data processing and calculation of the response spectra over the 122 periods (from 0s to 4s) used in the ISESD (European strong motion data base), see POSTER S4-14.

A new application has been developed, termed Rexelite, for the interaction between the ITACA database and the software REXEL, a tool for the selection of strong motion data based on spectral compatibility (http://www.reluis.it).



A

B



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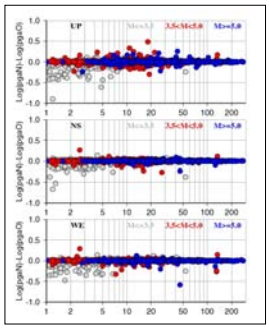

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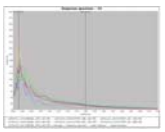
http://itaca.mi.ingv.it



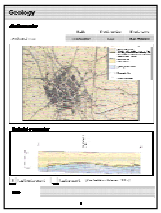
E

Fig.1 A) Home page of the ITACA web portal; B) metadata and recording stations relative to the 06/04/2009 L'Aquila mainshock (Mw 6.3); C) NS component of the acceleration time series recorded at the station Chieti (CHT); D) residuals between the PGA obtained with the old and the new data processing procedure (upper panel: vertical component; middle panel: North-South component; lower panel: East-West component); E) Rexelite: example of selection of strong motion records based on spectral compatibility (in progress).

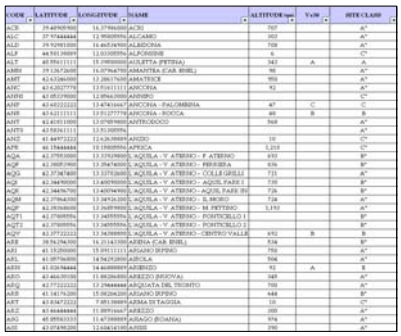
T2

The RU collaborated to the set up of the structure of the new ITACA monographs, thought to store more information than in the previous version of the database (see POSTER S4-5). The new monographs will be automatically generated by the user, in order to match the current version of the database. Moreover, all the recording stations have been classified according to the EC8, to develop new Ground Motion Prediction Equations.

A



B

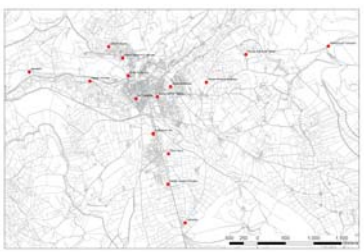


C

Fig.2 A) cover of the monograph; B) page containing the geologic information of the station; C) example of site classification according to the Ec8 (where Vs30 values are available the class is directly estimated, in other case it is inferred from geological, geophysical or geotechnical information.

T3

The RU collaborated to the installation of a temporary array composed of 15 velocimeters in the Norcia plain (central Italy), to study the amplification effects inside the Quaternary (basin see POSTER S4-16). A temporary array was installed by INGV Milano – Pavia across the hill of Narni (central Italy), see POSTER S4-8. Both arrays recorded the Mw 6.3 L'Aquila seismic sequence.



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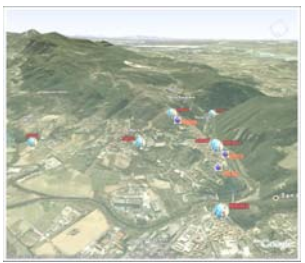

B

Fig.3 A) Array installed in the Norcia plain (central Italy); B) Array installed across the Narni hill (central Italy).

T4

The RU collaborated to the development of an empirical procedure to identify strong motion stations of the ITACA database with seismic response features that cannot be explained by simplified classification schemes. The residuals between observation and predictions for each station are corrected for the inter-event variability. For each station the average corrected residual are evaluated in 4 representative period bands (0.03≤T≤0.15s; 0.20≤T≤0.40s; 0.45≤T≤1s; 1.25≤T≤2.0s) and the residuals exceeding the threshold of 1.65σ have been selected (see Poster S4-3). In addition a GIS-based topographic characterization of recording stations was performed (see POSTER S4-17)

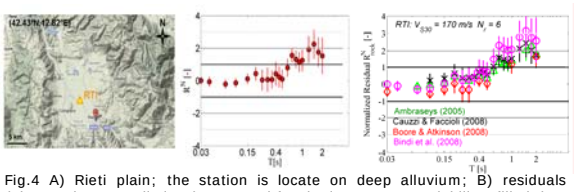

Fig.4 A) Rieti plain; the station is locate on deep alluvium; B) residuals (observation – predictions) corrected for the inter-event variability; filled dots indicate the median value, while the vertical bars denote the 16°-84° percentiles; C) sensitivity analysis performed with different Ground Motion Prediction Equations: Ambraseys et al. (2005), Cauzzi and Faccioli (2008), Boore and Atkinson (2008), Bindi et al. (2008)

ACKNOWLDGEMENTS

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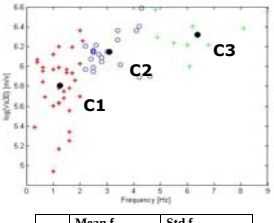
T5

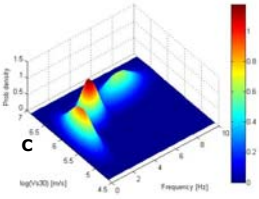
The work on site classification has been carried out through a statistical analysis of the recording station characterized by geological, geophysical and geotechnical data (108 stations). The significant parameters in terms of site classification have been selected (Vs over different depths, resonance frequency and amplitude, from HVSR on earthquake recordings or 1D modelling, etc.). A cluster analysis has been performed, selecting either 1, 2 or 3 variables, and the distribution of variables for each cluster has been calculated. The degree of membership to each cluster, given a set of variables, is evaluated in terms of probability density.

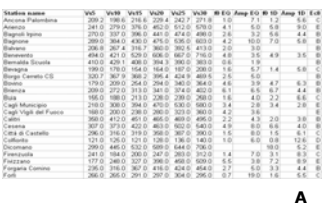


B

	Mean f_0	Std f_0
C1	1.2613	0.5149
C2	3.0905	0.7732
C3	6.3778	1.4016

	Mean Vs30	Std Vs30
C1	331.2884	93.5497
C2	465.4744	91.0291
C3	553.9174	110.421





A

Fig.5 A) subset of the recording stations with the associated parameters; B) cluster analysis (variables: log10(Vs30) and f0): the table show the mean and standard deviation of each variable for each cluster; C) degree of membership to the three classes in terms normal probability density function of the 2 considered variables

$$f(x) = \frac{1}{(2\pi)^{N/2}\left|\Sigma\right|^{1/2}} e^{-\frac{1}{2}(x-\mu)^T \Sigma^{-1}(x-\mu)}$$

Is the normal probability density function of N variables

$$\mu = [\mu_1, \mu_2, \ldots, \mu_N]^T$$

Is the vector of the means of the N variables

Σ is the NxN covariance matrix