

## Project S4

# The Italian strong motion database

**Coordinators:** F. Pacor (INGV-MI)

R. Paolucci (Politecnico-MI)

**Advisors from DPC:** A. Gorini - A. De Sortis



INGV



General Meeting of Projects S

Sala convegni del Rettorato - Università Roma Tre, Via Ostiense 159

Roma, 19-21 Ottobre 2009

# Project S4 - Overview

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## Objective

To update the Italian ACcelerometric Archive (ITACA), starting from the alpha version released by Project S6 of the 2004-06 DPC-INGV agreement

## Research units

<b>RU</b>	<b>Resp.</b>
1: INGV-Milano Pavia	L. Luzi
2: INGV-Roma	G. Milana
3: Poli-Milano	R. Paolucci
4: Poli-Torino	S. Foti
5: Uni-Basilicata	M. Mucciarelli
6: Uni-Roma1	G. Lanzo
7: Uni-Siena	D. Albarello
8: GFZ - Postdam	S. Parolai



# Project S4 - Overview

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**Task 1** – ITACA update

**Task 2** – Compilation of geological-geotechnical station reports

**Task 3** – Seismic characterization of selected sites by surface waves methods

**Task 4** – Identification of stations with distinctive features in their seismic response

**Task 5** – Seismic classification of ITACA stations



# Project S4 – L'Aquila earthquake

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## Publication of records

Corrected and uncorrected records of the mainshock published on Apr 22, 2009

Corrected and uncorrected records of the 12  $M_W > 4$  aftershocks published on May 18, 2009

About 900 waveforms included from 65 digital stations

# Project S4 – L'Aquila earthquake



Istituto Nazionale  
di Geofisica  
e Vulcanologia




Itaca  
Italian Accelerometric Archive



PROFESSIONE CIVILE  
NATIONALE





2009, 6 April (Mw 6.3)

## L'AQUILA EARTHQUAKE DATA

Aftershocks now available

**EXPRESS DOWNLOAD** of strong motion data:

1. [2009-04-06 01:32:39 UTC \(archive size 49.9MB\)](#)
2. [2009-04-07 17:47:37 UTC \(archive size 23.6MB\)](#)
3. [2009-04-09 00:52:59 UTC \(archive size 16.9MB\)](#)

[PRELIMINARY ANALYSIS OF STRONG MOTION RECORDS IN THE PROJECT S4 WEBSITE](#)

You can access [the unprocessed data from the ITDPC network](#) at the DPC site.

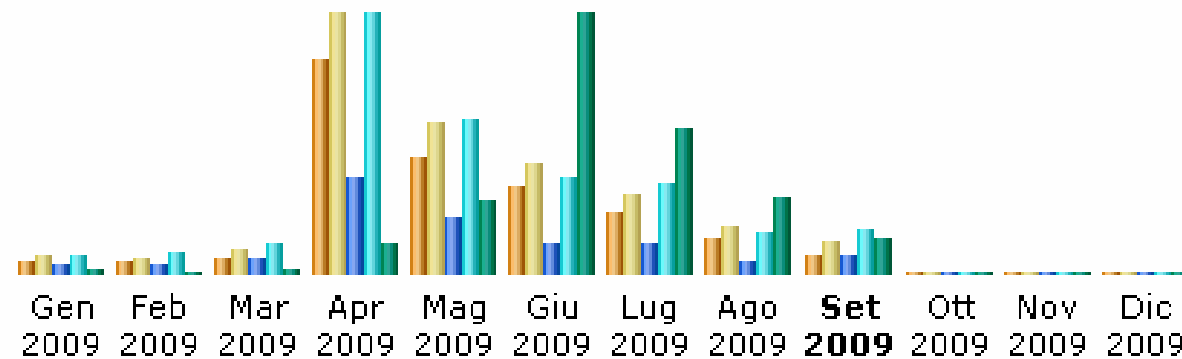
Type	Mw	MAGNITUDE	TIME	DEPTH
ML	ML from ING catalogue	<a href="#">INGV-CNT Seismic Bulletin</a>	5.8	0.3
Mw	Mw from RCMT	<a href="#">RCMT-INGV</a>	6.3	



Municipality	L'AQUILA	Province	L'Aquila	
<b>Focal Mechanism</b>				
Type	NF	Method	RCMT	
Strike	127.0	Dip	50.0	
Fault		Surf. Rupt.		
<b>Other faults</b>				
I <sub>0</sub>		Other I <sub>0</sub>		
<b>Located</b>				
<b>WAVEFORMS</b>				
Station	R epi. [km]	PGA [cm/s <sup>2</sup> ]	PGV [cm/s]	Detail
<a href="#">ANT</a>	23.000	25.977	2.474	
<a href="#">AQA</a>	4.600	461.055	32.029	
<a href="#">AQQ</a>	4.400	506.864	35.538	
<a href="#">AQK</a>	5.600	365.336	36.212	
<a href="#">AQV</a>	4.900	646.068	42.826	
<a href="#">ASS</a>	101.700	6.042	0.432	
<a href="#">AVL</a>	198.000	1.246	0.388	

# Project S4 – L'Aquila earthquake








Many visits  
and data  
downloads ...



Mese	Visitatori diversi	Numero di visite	Pagine	Accessi	Banda usata
Gen 2009	346	483	9155	15282	432.97 MB
Feb 2009	305	439	7246	16847	269.69 MB
Mar 2009	409	607	13176	23869	541.38 MB
Apr 2009	5420	6588	78999	214661	3.21 GB
Mag 2009	2964	3849	46316	128590	7.52 GB
Giu 2009	2233	2834	25764	78773	26.28 GB
Lug 2009	1572	2017	24411	74274	14.66 GB
Ago 2009	881	1182	11231	33819	7.70 GB
<b>Set 2009</b>	495	864	15596	36510	3.70 GB
Ott 2009	0	0	0	0	0
Nov 2009	0	0	0	0	0
Dic 2009	0	0	0	0	0
<b>Totale</b>	<b>14625</b>	<b>18863</b>	<b>231894</b>	<b>622625</b>	<b>64.28 GB</b>

# Project S4 – L'Aquila earthquake

... from many countries ...

Domini o nazioni dei visitatori (Prime 10) - <a href="#">Elenco completo</a>					
	Domini/Nazioni		Pagine	Accessi	Banda usata
	Italy	it	15475	48688	17.80 GB
	Sconosciuti	ip	6389	19589	6.40 GB
	USA Educational	edu	736	2016	98.70 MB
	Network	net	609	1813	497.95 MB
	France	fr	565	2176	356.12 MB
	Germany	de	481	769	24.10 MB
	Commercial	com	389	876	136.01 MB
	Switzerland	ch	191	361	12.15 MB
	Japan	jp	187	502	289.45 MB
	USA Government	gov	152	368	20.17 MB



# Project S4 – L'Aquila earthquake

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**... and many words of appreciation !**

(...) By the way, members of the CESMD staff, both at the USGS and CGS, have commented on the effectiveness and level of station metadata, and the rapidity with which the Italian network collected and preliminarily processed the L'Aquila earthquake data.

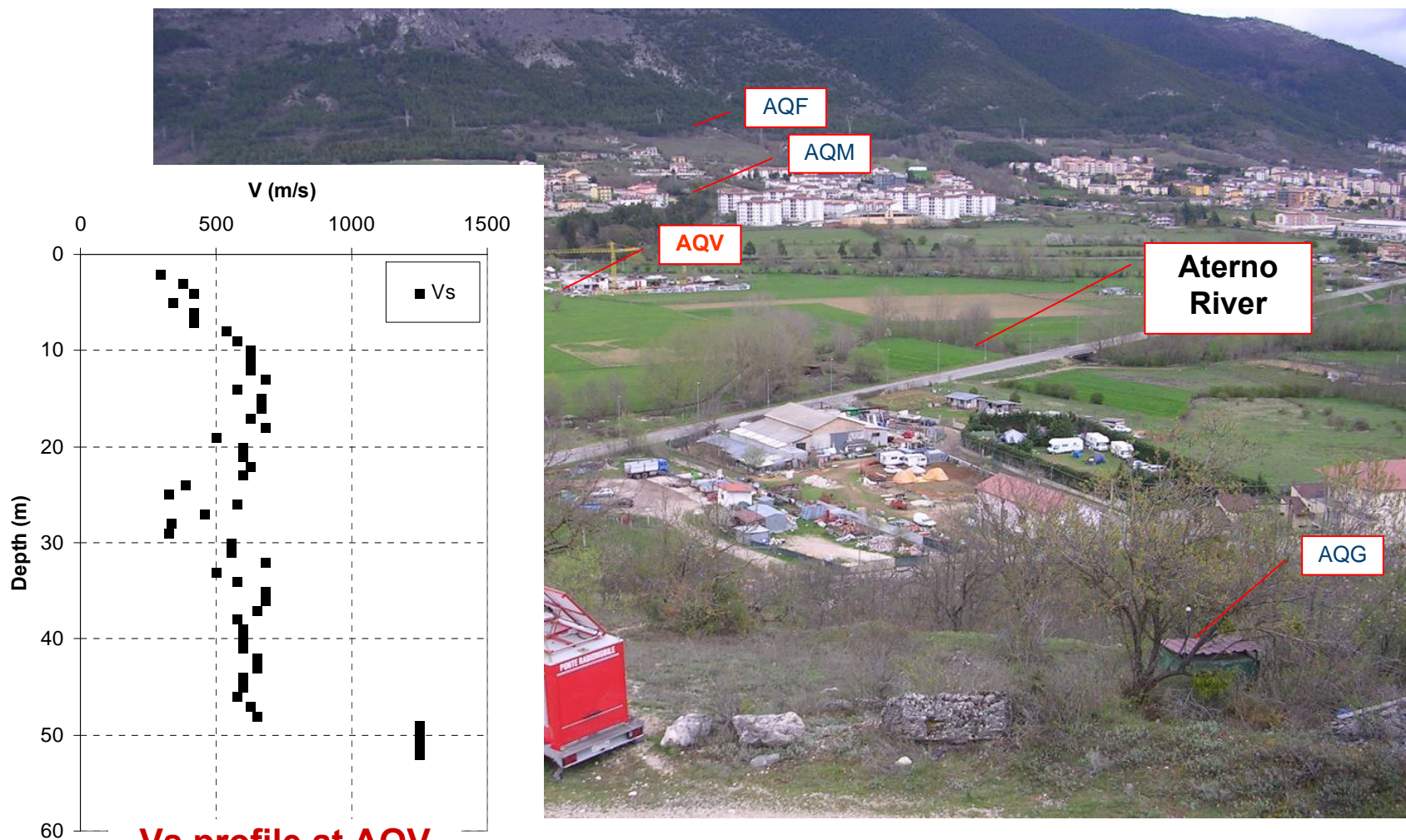
**Christopher Stephens**

**Center for Engineering Strong Motion Data (CESMD)**



# Project S4 – L'Aquila earthquake

## Characterization of recording stations

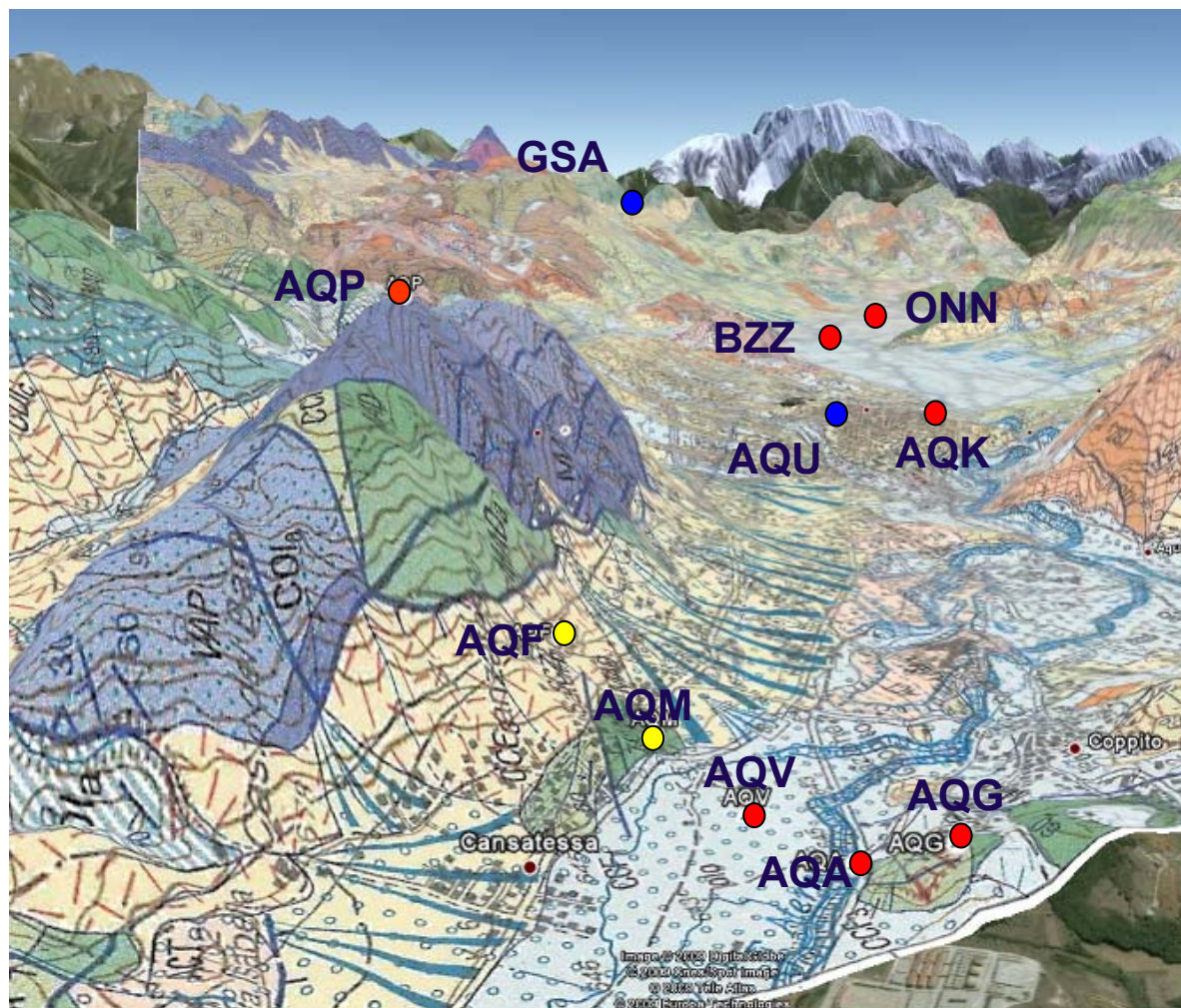


**Vs profile at AQV  
from Project S6**

# Project S4 – L'Aquila earthquake

## Characterization of recording stations

- Stations with surveys already performed
- Survey likely to be performed within S4 end
- Survey not planned





# Project S4 – L'Aquila earthquake

## Characterization of recording stations

### Surveys at near-fault stations

Station	Survey	Institution	Notes
AQA	MASW	POLITO	
	DH	DPC – UNIRM1	Borehole at 30 m depth
AQG	ESAC+HVSR	UNISI	
AQK	DH	DPC - (UNIRM1)	Borehole to 54 m depth DH still to be performed
AQM			
AQP	ESAC+HVSR	UNISI	
AQU	MASW	INGV – RM (?)	INGV Station to be included in ITACA
AQV	CH		Available in ITACA from Project S6
BZZ	ESAC	GFZ	
ONN	ESAC	GFZ	Confirmed by HVSR inversion
GSA	MASW	INGV – RM (?)	Planned in spring 2010

# Project S4 – L'Aquila earthquake

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## **Other contributions of Project S4 RUs to the investigations on L'Aquila earthquake (see posters)**

- ✓ Strong ground motion studies ⇒ INGV-MI, INGV-RM, POLIMI
- ✓ Geological/Geotechnical investigations ⇒ INGV-RM, UNIRM1, POLITO
- ✓ In-field instrumental surveys ⇒ INGV-MI, INGV-RM, UNIBAS, UNISI, GFZ

# Project S4 – Task1 – ITACA update

**ITACA 1.0 under testing phase.** Release planned within mid-November

**News**

**October 19, 2009.** A new version of the database will be soon released. Check [main updates](#).

**Data of latest earthquakes**

**2009, 6 April (Mw=6.3) L'Aquila**

- [L'Aquila seismic sequence strong motion records](#) Source: ITACA archive
- [Preliminary analysis of strong motion records](#) Source: project S4 website
- [Unprocessed data from the ITDPC network](#) Source: DPC website

**2008, 23 December (Mw=5.4) Appennino Parmense**

- [Data](#) Source: ITACA archive

**ITACA - Italian Accelerometric Archive**

ITACA contains more than 2000 three component waveforms generated by about 1000 earthquakes. Strong motion data come mainly from National Accelerometric Network, operated by Dipartimento della Protezione Civile - DPC. You can download corrected and uncorrected time-series and spectral data in ASCII format. Use ITACA interface to set parameters of interest and retrieve specific events, stations, waveforms and their metadata.

[Search for data](#)

- [waveforms](#)
- [stations](#)
- [events](#)
- [REXELite](#): search response spectrum compatible records

[User manual](#)

[Disclaimer](#)

[Contacts](#)

[Links](#)

**Reference**

ITACA is developed in the framework of the agreement between INGV and DPC:

- **Project S6 (2004-2006)** - [Data Base of the Italian strong motion records \(1972-2004\)](#), coordinated by [Lucia Luzi](#) and [Fabio Sabetta](#)
- **Project S4 (2007-2009)** - [Italian Strong Motion Data-Base](#), coordinated by [Francesca Pacor](#) and [Roberto Paolucci](#) DPC Advisors: [Antonella Gorini](#) and [Adriano De Sortis](#)

If you use any record or parameter released by this site in a publication or report, please reference: *Working Group ITACA (2009) - Data Base of the Italian strong motion records: <http://itaca.mi.ingv.it>*

# Project S4 – Task1 – ITACA update

## ITACA 1.0 – Main updates

- ✓ REXELite, software for automatic selection of a suite of 7 accelerograms from the ITACA database compatible with a target spectrum
- ✓ re-processed and corrected records
- ✓ new header of files
- ✓ re-sampled response spectra
- ✓ improved download procedure

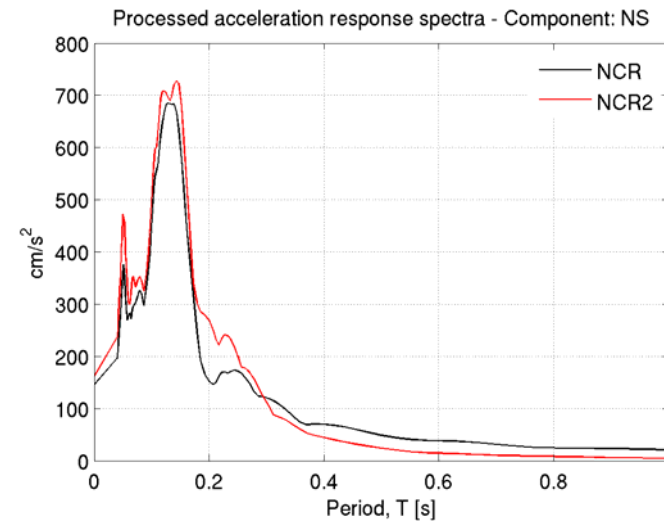
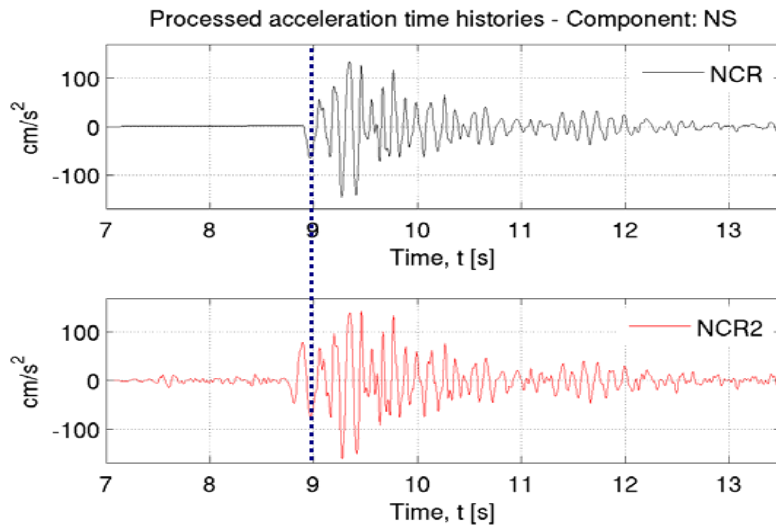
```
EVENT_NAME: FRIULI
EVENT_DATE_YYYYMMDD: 19760608
EVENT_TIME_HHMMSS: 121438
EVENT_LATITUDE_DEGREE: 46.300000
EVENT_LONGITUDE_DEGREE: 13.230000
EVENT_DEPTH_KM: 19.0
MAGNITUDE_L: 4.5
MAGNITUDE_S:
MAGNITUDE_W: 4.6
FOCAL_MECHANISM: NF
STATION_CODE: GMN
STATION_NAME: GEMONA
STATION_LATITUDE_DEGREE: 46.291960
STATION_LONGITUDE_DEGREE: 13.123130
STATION_ELEVATION_M: 222.0
SITE_CLASSIFICATION_ECS:
MORPHOLOGIC_CLASSIFICATION:
EPICENTRAL_DISTANCE_KM: 8.3
EARTHQUAKE_BACKAZIMUTH_DEGREE: 83.0
TIME_FIRST_SAMPLE_S: 0.00000
SAMPLING_INTERVAL_S: 0.005000
NDATA: 1806
DURATION_S: 9.025000
COMPONENT: NS
UNITS: cm/s^2
INSTRUMENT: KINEMATRICS SMA-1
INSTRUMENTAL_FREQUENCY_HZ:
INSTRUMENTAL_DAMPING:
SENSITIVITY_V/G:
FULL_SCALE_G:
N_BIT_DIGITAL_CONVERTER:
PGA_CM/S^2: -34.841671
TIME_PGA_S: 2.055000
OWNER_RECORD:
INSTRUMENT_ANALOG/DIGITAL: A
BASELINE_CORRECTION: BASELINE REMOVED
FILTER_TYPE: BUTTERWORTH
FILTER_ORDER: 2
LOW_CUT_FREQUENCY_HZ: 0.500
HIGH CUT FREQUENCY_HZ: 25.000
LATE/NORMAL_TRIGGERED: NT
DATA_VERSION: ITACA 1.0
```



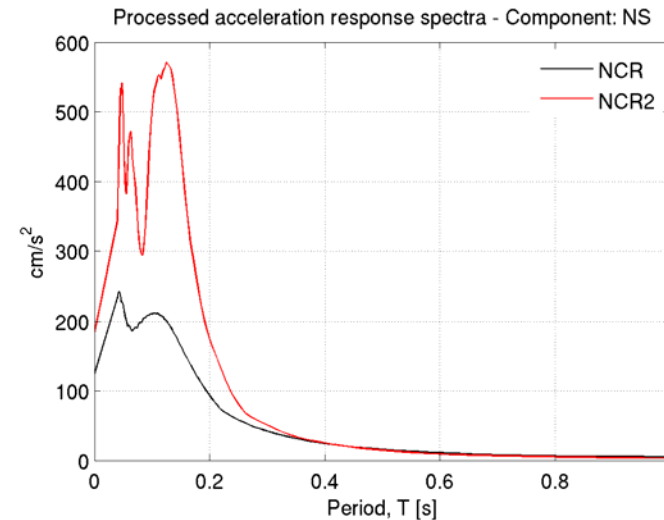
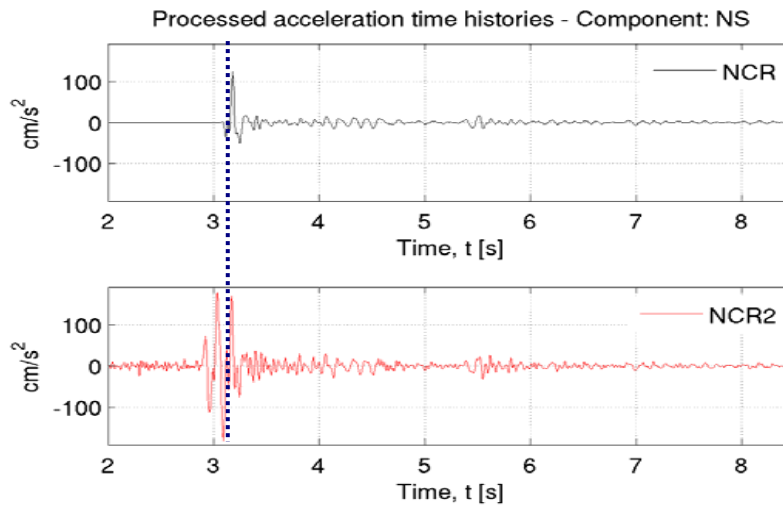
# Project S4 – Task1 – ITACA update

## Example of co-located analog (NCR) and digital (NCR2) records

(a)  $M_W=4.8$ , 1998-04-05 15:52



(b)  $M_L=3.3$ , 1997-10-14 07:54





# Project S4 – Task1 – ITACA update

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## Problems and solutions for processing strong-motion records in the Italian ITACA database

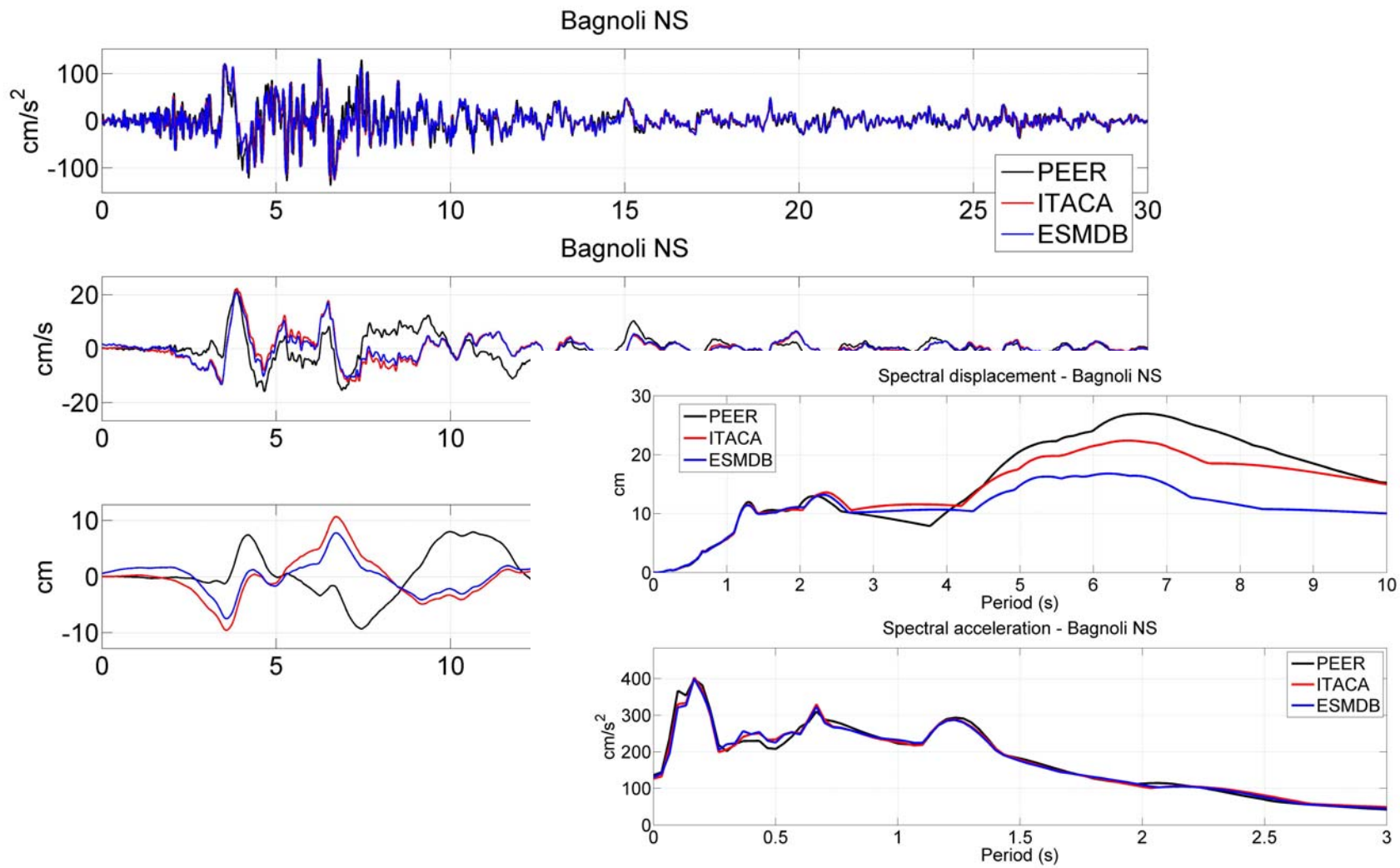
Paolucci R., F. Pacor, R. Puglia, G. Ameri, C. Cauzzi, L. Luzi, M. Massa

- ✓ to **ensure the compatibility of corrected accelerograms**, so that the no further correction is required to obtain by single and double integration the velocity and displacement traces;
- ✓ to **check the accuracy and reliable frequency range of corrected records** and compare them with the corresponding records available within other international databases, such as the PEER and the European Strong Motion Database;
- ✓ to **identify in ITACA the late-triggered records** and to provide whenever possible meaningful and usable corrected waveforms from analog instruments that recorded most of the Italian earthquakes up to 1990.



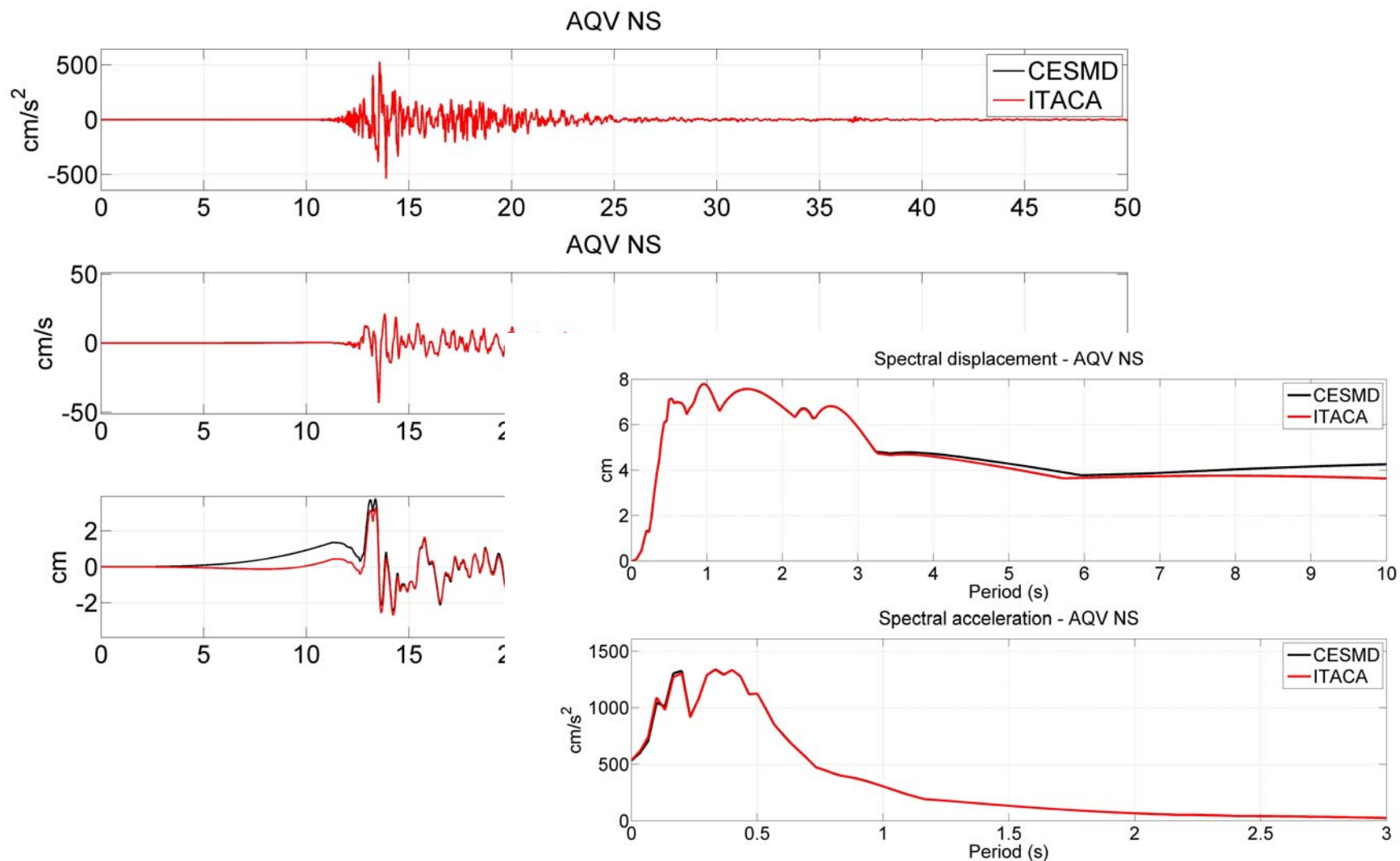
# Project S4 – Task1 – ITACA update

## Comparison with records available from other data sources



# Project S4 – Task1 – ITACA update

## Comparison with records available from other data sources



# Project S4 – Task1 – ITACA update

## REXELite, internet-based record selection in ITACA

Iunio Iervolino <sup>1</sup>, Carmine Galasso <sup>2</sup>, Andrea Spinelli <sup>3</sup>, Roberto Paolucci <sup>4</sup>, Francesca Pacor <sup>5</sup>

### REXELITE

↑ Image of the REXEL (v 2.5 beta) GUI - <http://www.reluis.it/>

The procedure implemented in REXELite for record selection deploys in four basic steps

#### ① Target Spectrum

Definition of the design horizontal or vertical spectra the set of records has to match on average according to EC8 or NIBC.

#### ③ Analysis options

Assigning the period range where the average spectrum of the set has to be compatible with the target spectrum and specification of tolerances in compatibility .

The screenshot shows the REXELite input data form with the following fields and values:

- Session title: UntitledSession
- Target spectrum: (empty)
- Latitude [degrees]: 45.48 Longitude: 9.23
- Site classification (EC8): A response spectrum, A-site stations
- Topography: T1 - flat surfaces, isolated cliffs and slopes with average slope angle not greater than 15°
- Nominal life [years]: 50 years - ordinary structures
- Building functional type: 2 - ordinary structures (Cu=1.0)
- Limit state probability: Damage (P=63%)
- Ground motion components: One horizontal component
- Preliminary record search: (empty)
- Station site classification: Same site class as target spectrum
- Magnitude (Ml) min: 5.5 max: 6.5
- Epicentral distance [km] min: 0 max: 50
- Include late trigger events: Yes
- Include analog: Yes
- Spectrum matching parameters and analysis options:
  - Period range [s] from: 0.15 to: 2
  - Tolerance [%] from: 10 to: 30
  - Non-dimensional:

Buttons: Accept parameters...

The entered coordinates are plotted on map when you accept input parameters...

Parameters required by the NIBC to define the return period of the seismic action.

Design earthquake (source) parameters

#### ② Preliminary search

Choosing to search for combination coming from specific moment magnitude and epicentral distance ranges (this choice may be driven by disaggregation of seismic hazard). It is possible to select records from any site class for a given target spectrum or records belonging to the same site class as target spectrum.

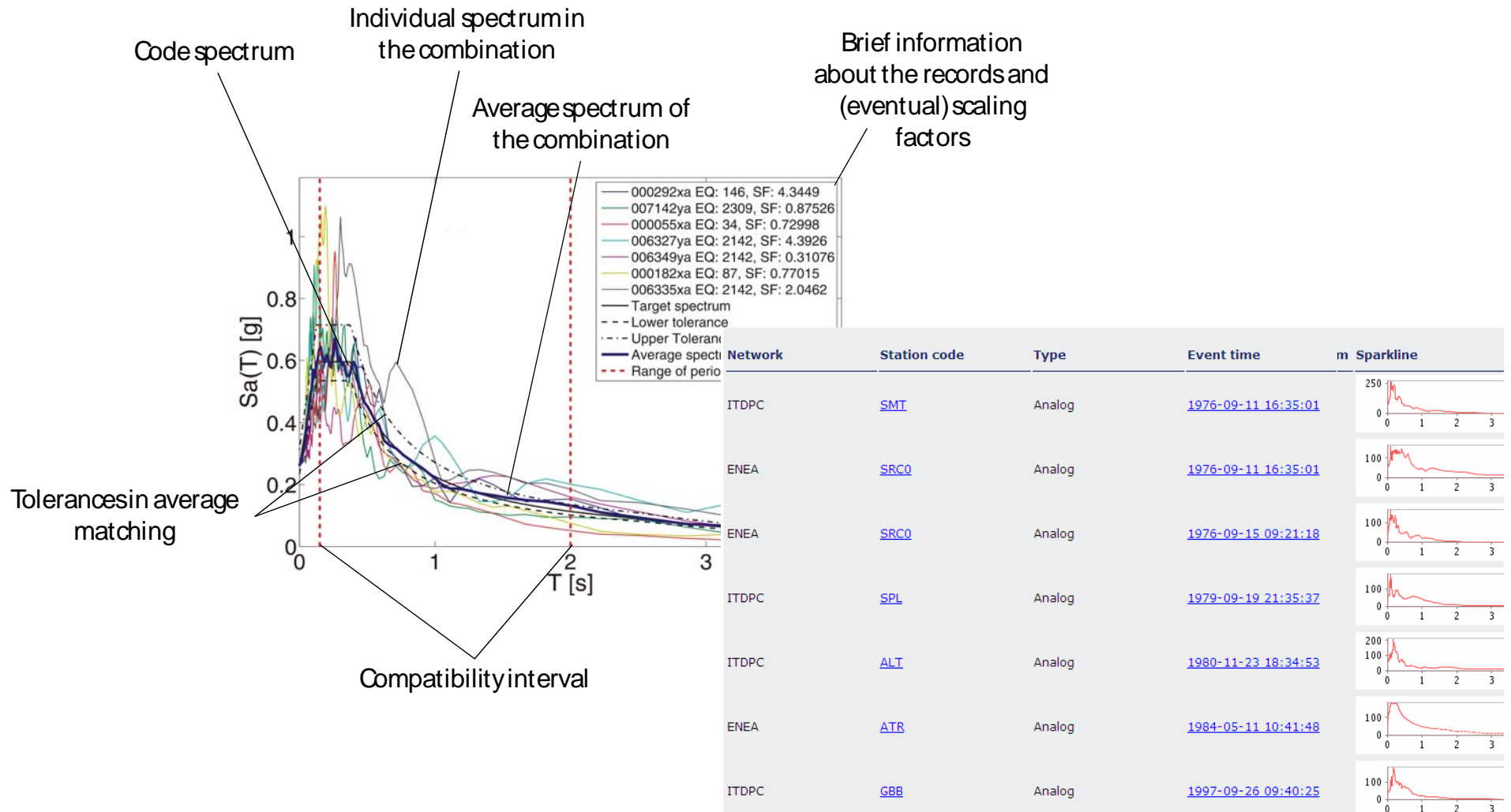
↑ Image of the REXELite GUI - <http://itaca.mi.ingv.it/>

... and ④ Run REXELite ...

Individual spectrum in

# Project S4 – Task1 – ITACA update

## REXELite – example of output



# Project S4 – Task1 – ITACA update

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## Present situation of ITACA



Poster by Pacor et al.

### Events

1002 earthquake from 1972 to 2004.

2 events from the 2008 Parma seismic sequence

13 from the 2009 L'Aquila seismic sequences

### Waveforms

2550 3-component waveforms in the uncorrected version

2401 3-component waveforms in the corrected version together with acceleration velocity and displacement time series and acceleration 5% damped response spectra

### Stations

616 presently in ITACA, each one characterized by: name, code, address, coordinates, topographic map location, EC8 classification, type of installation, etc.

About 100 sites to be characterized by the end of S4 by geotechnical or geophysical parameters, such as: stratigraphy logs, NSPT logs, Vs/Vp profiles, dispersion curves, fundamental frequencies, site response functions, etc.

# Project S4 – Task1 – ITACA update

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## Comments on Task 1 progress


- ✓ ITACA 1.0 about to be released, including REXELite. Under testing phase
- ✓ re-process and check of the whole records (more than 2500!) accomplished, together with metadata
- ✓ records from Parma and L'Aquila earthquakes processed and released
- ✓ old unpublished records of the Friuli earthquake processed and added
- ✓ contacts for ITACA to be linked with COSMOS and NERIES activated
- ✓ process and release of 2005-07 RAN records in progress
- ✓ addition of records from INGV, Basilicata region and Trento province in progress



# Project S4 – Task2

## Geological-geotechnical catalogue of ITACA stations



### RAN

*Rete Accelerometric Nazionale*

*(National Accelerometric Network)*

Recording Station

L'Aquila – Valle Aterno – Fiume Aterno

Station Code

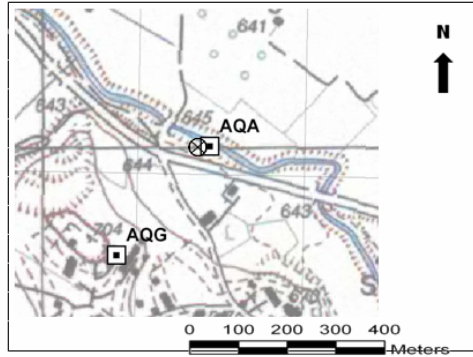
AQA

First compilation	17	October	2006
Last update	24	May	2009

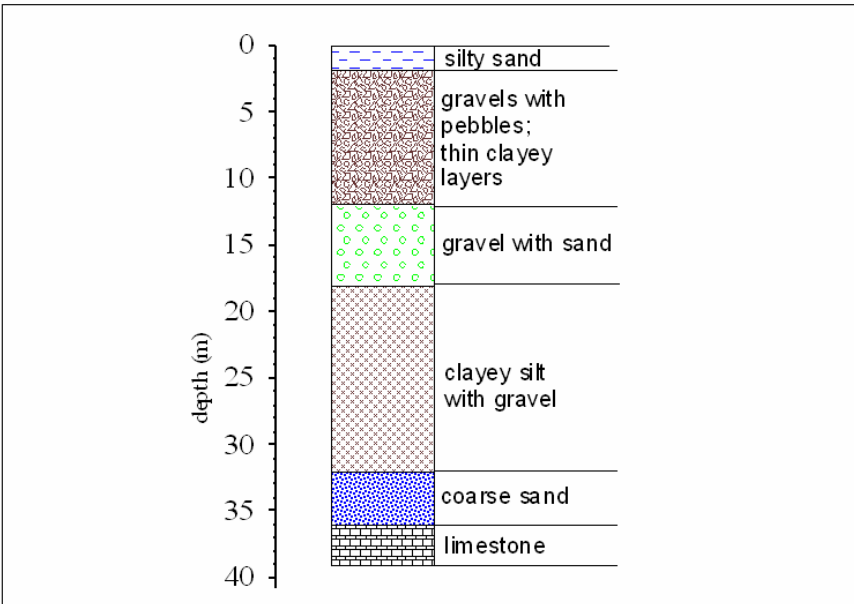
### Geotechnical, Geomechanical & Geophysical Information (1/1)

**Test summary and location**

	⊗ Borehole
	P Piezometer
	▲ Penetration tests (SPT, CPT)
	⊕ Down-Hole, Cross-Hole (DH, CH)
	∇-∇ Seismic refraction/reflection
	○ SASW, MASW, NASW, ESAC, FK
	◇-◇ Geoelectric
	▽ Schmidt Hammer Test
	▼ Point Load Test
	⊙ Dilatometer
	— Flat / Hydraulic Jack Test
	Lab tests



**Stratigraphic profile**



0		silty sand
5		gravels with pebbles; thin clayey layers
10		
15		gravel with sand
20		
25		clayey silt with gravel
30		
35		coarse sand
40		limestone



# Project S4 – Task2

## Geological-geotechnical catalogue of ITACA stations

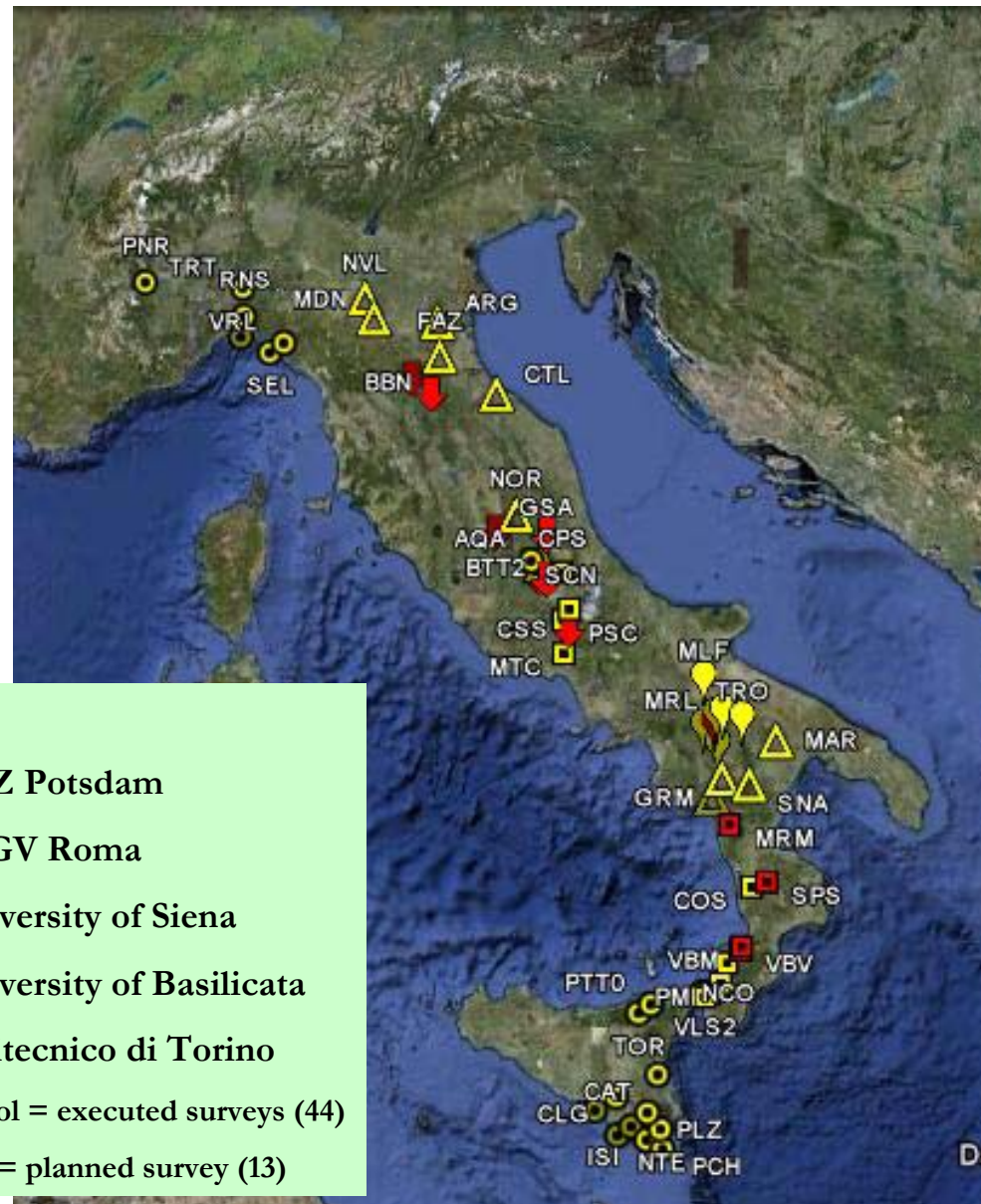
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### Comments on Task 2 progress

- ✓ new format for the ITACA station reports completed
- ✓ module for dynamic online compilation of station reports developed and made available to RUs;
- ✓ detailed geological-geotechnical investigation of L'Aquila station sites
- ✓ 16 fully updated reports of stations recording the Irpinia earthquake completed;
- ✓ 57 reports of stations recording the L'Aquila earthquake in progress;
- ✓ Re-compilation of reports for the other stations in the new format, including 150 recent HVSR noise measurements made by DPC, in progress;
- ✓ This activity has suffered an important delay owing to the L'Aquila earthquake. Actions have been taken to recover the delay.



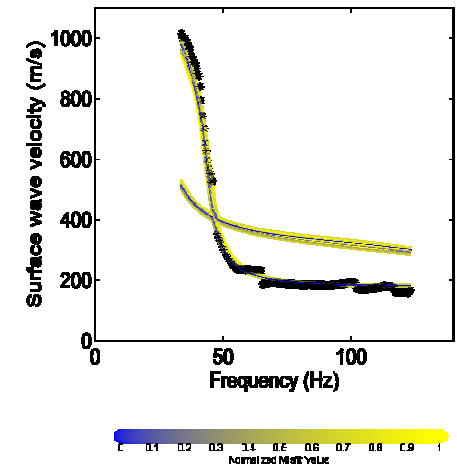
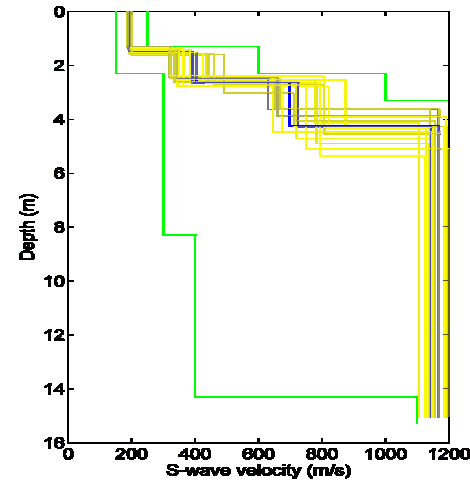
# Project S4 – Task3 – Seismic characterization of ITACA stations by surface wave methods



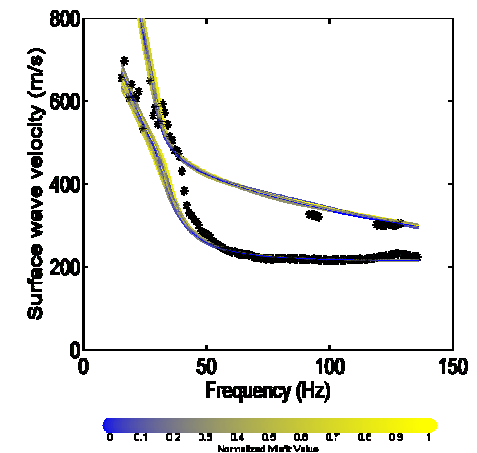
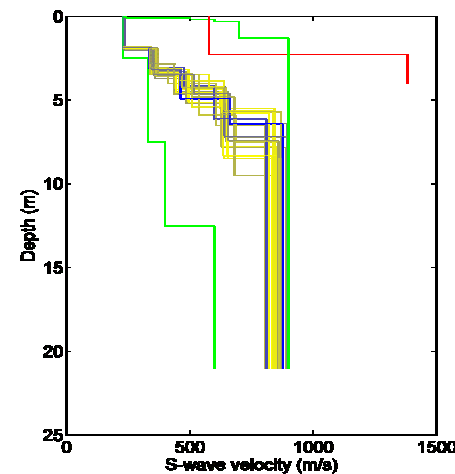
# Project S4 – Task3 – Seismic characterization of ITACA stations by surface wave methods

Multimodal inversion of surface waves (RU4 - POLITO)

Santa Croce



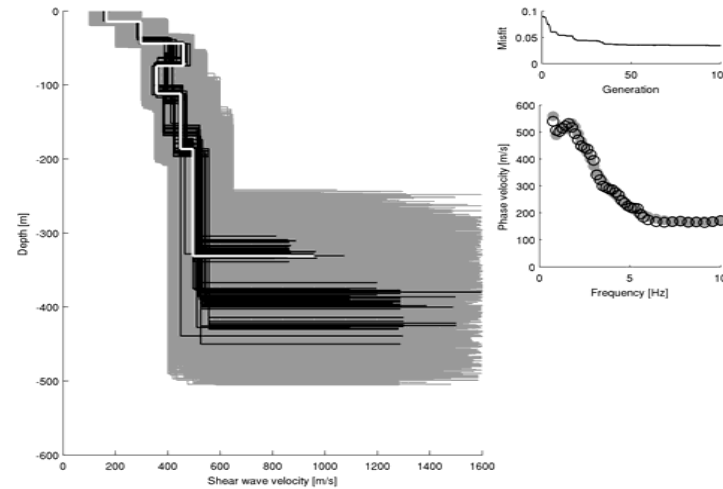
Noto



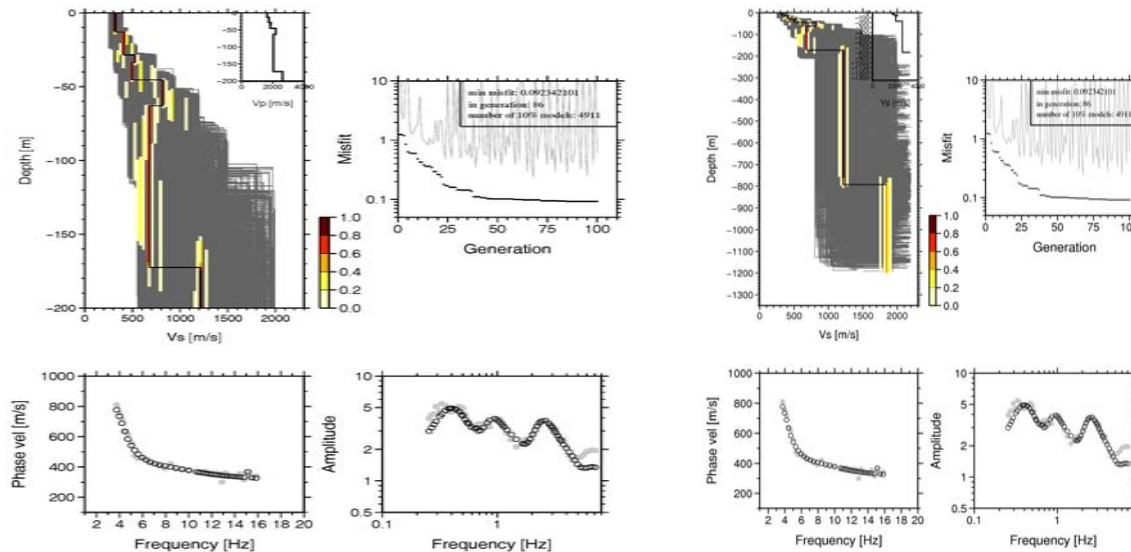
# Project S4 – Task3 – Seismic characterization of ITACA stations by surface wave methods

ESAC technique (RU8 - GFZ)

## Modena



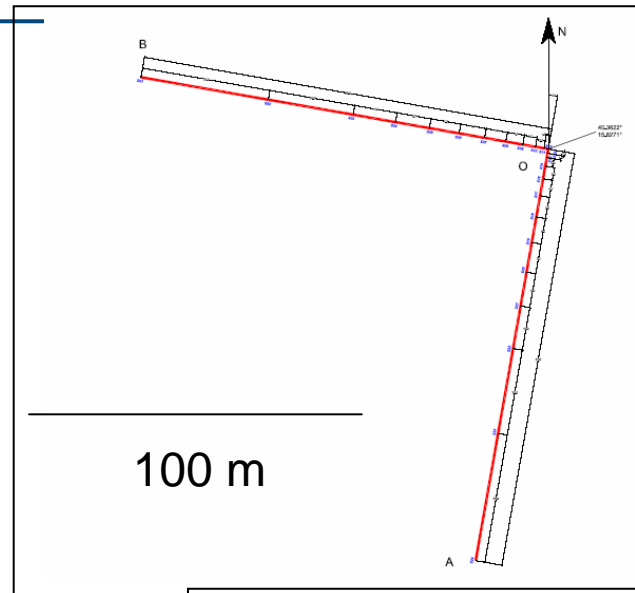
## Onna





# Project S4 – Task3 – Seismic characterization of ITACA stations by surface wave methods

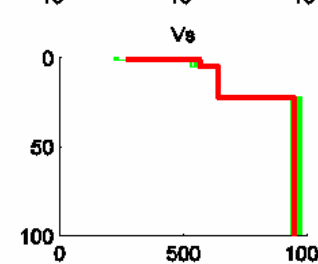
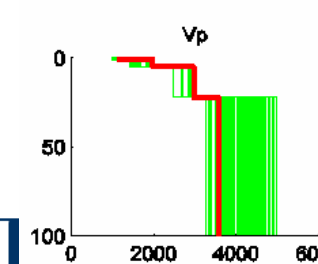
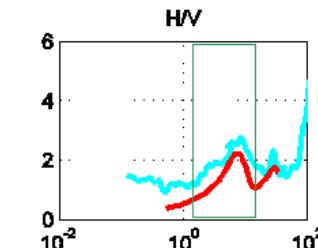
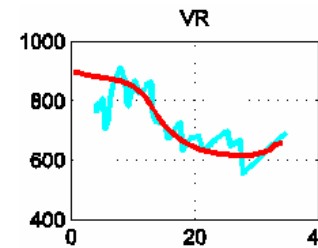
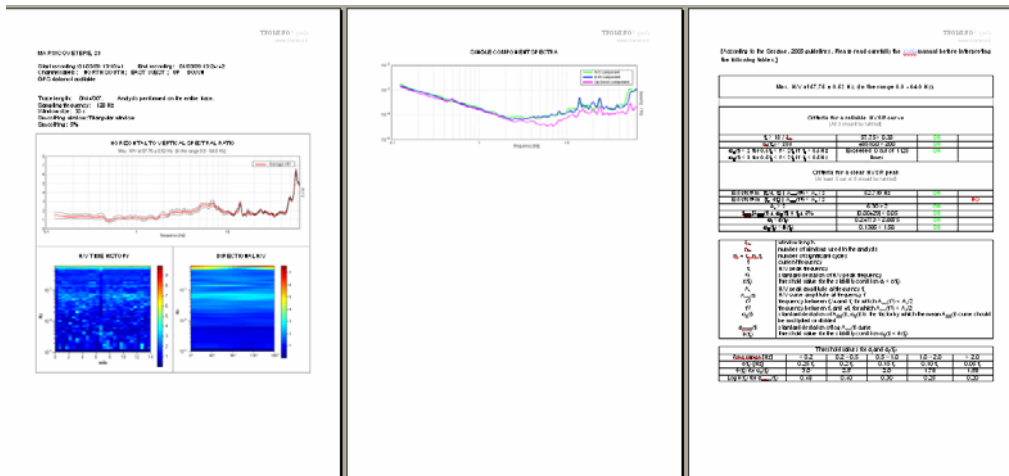
MASW + HVSR (RU5+RU7)



H(m)	Vp(m/s)	Vs(m/s)
1	1167	276
4	1974	567
17	2977	642
Sub	3578	947

Joint Inversion (Genetic Alg.)

HVSR test



# Project S4 – Task3 – Seismic characterization of ITACA stations by surface wave methods

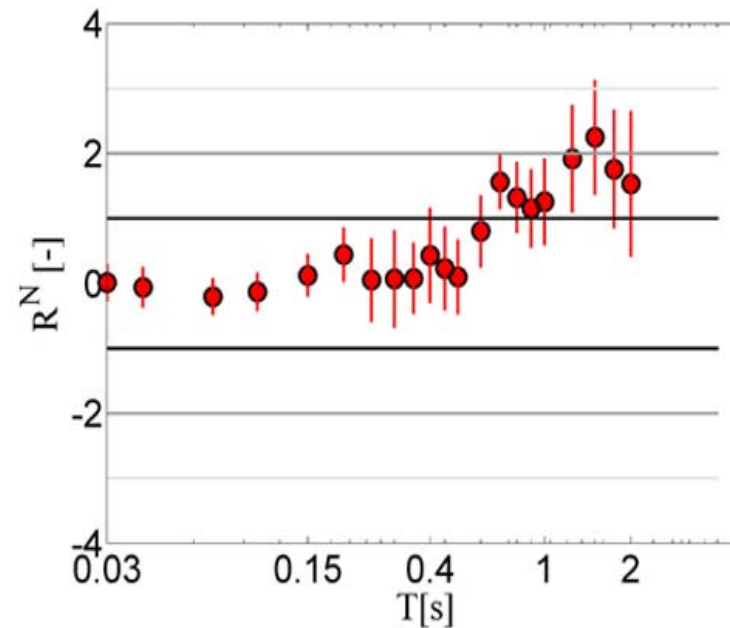
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## Comments on Task 3 progress

- ✓ of the planned 57 in-field surveys, 44 have already been performed. The results will be available shortly, and included in the station reports.
- ✓ as for the 13 missing surveys, these were mainly due because the INGV-RM teams were forced to move their instruments for the microzonation of L'Aquila. These surveys will be delayed to the last months of the project.
- ✓ aside from the previous problem, the progress of this task is fully satisfactory.

# Project S4 – Task4 – Identification of ITACA stations with distinctive features in their seismic response

✓ Analysis of ITACA strong motion records  Poster by Bindi et al.



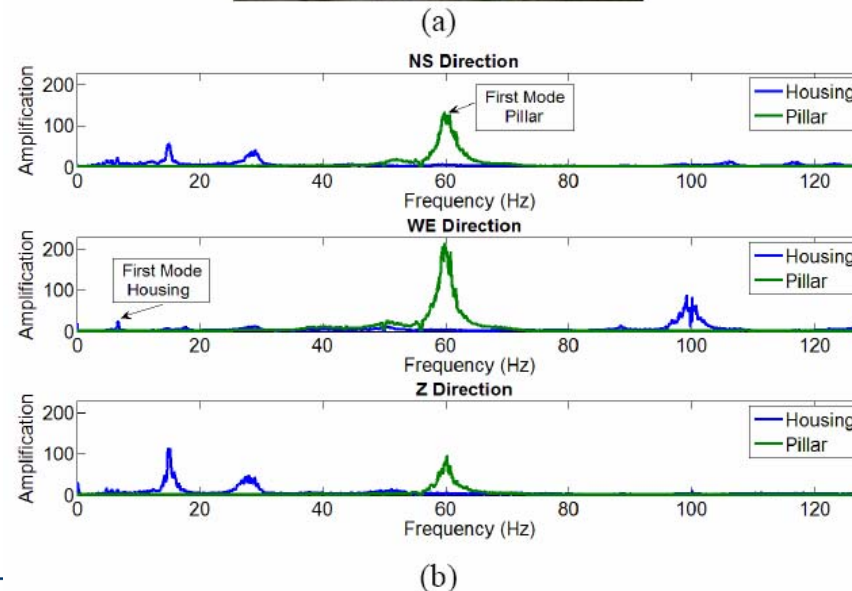
Residuals corrected for the inter-event variability for the representative station of Rieti (RTI) located on deep alluvium (soil classification 2 according to Sabetta & Pugliese, 1996). Filled dots indicate the median value, while the vertical bars denote the 16°-84° percentiles.

# Project S4 – Task4 – Identification of ITACA stations with distinctive features in their seismic response

✓ Identification of building-soil interaction effects → activity by UNIBAS

Transfer functions evaluated to the San Demetrio housing.  
The estimated frequencies are: 6.7 Hz and 60 Hz respectively for the housing and for the pillar.

Other stations investigated in Abruzzo: Cittaducale, Bussi, Scafa

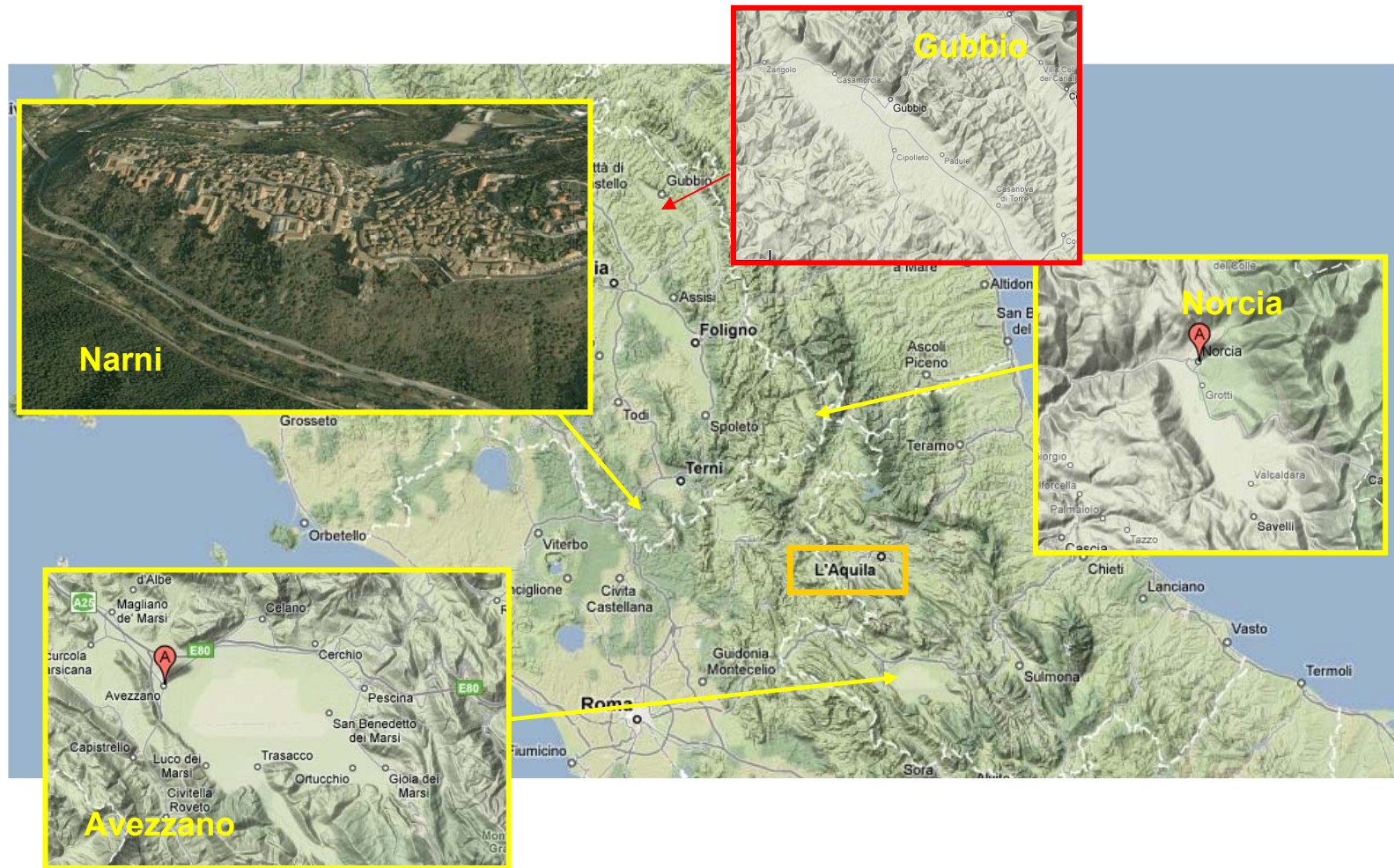


Pilz M. <sup>1</sup>, Bindi D. <sup>1,2</sup>, Strollo A. <sup>1</sup>  
<sup>1</sup> Potsdam Germany, parolai@gfz-potsdam.de



# Project S4 – Task4 – Identification of ITACA stations with distinctive features in their seismic response

## ✓ Monitoring and numerical modelling





# Project S4 – Task4 – Identification of ITACA stations with distinctive features in their seismic response

✓ **Monitoring of a hill in central Italy to study possible topographical effects: the case of Narni (TR) ridge**



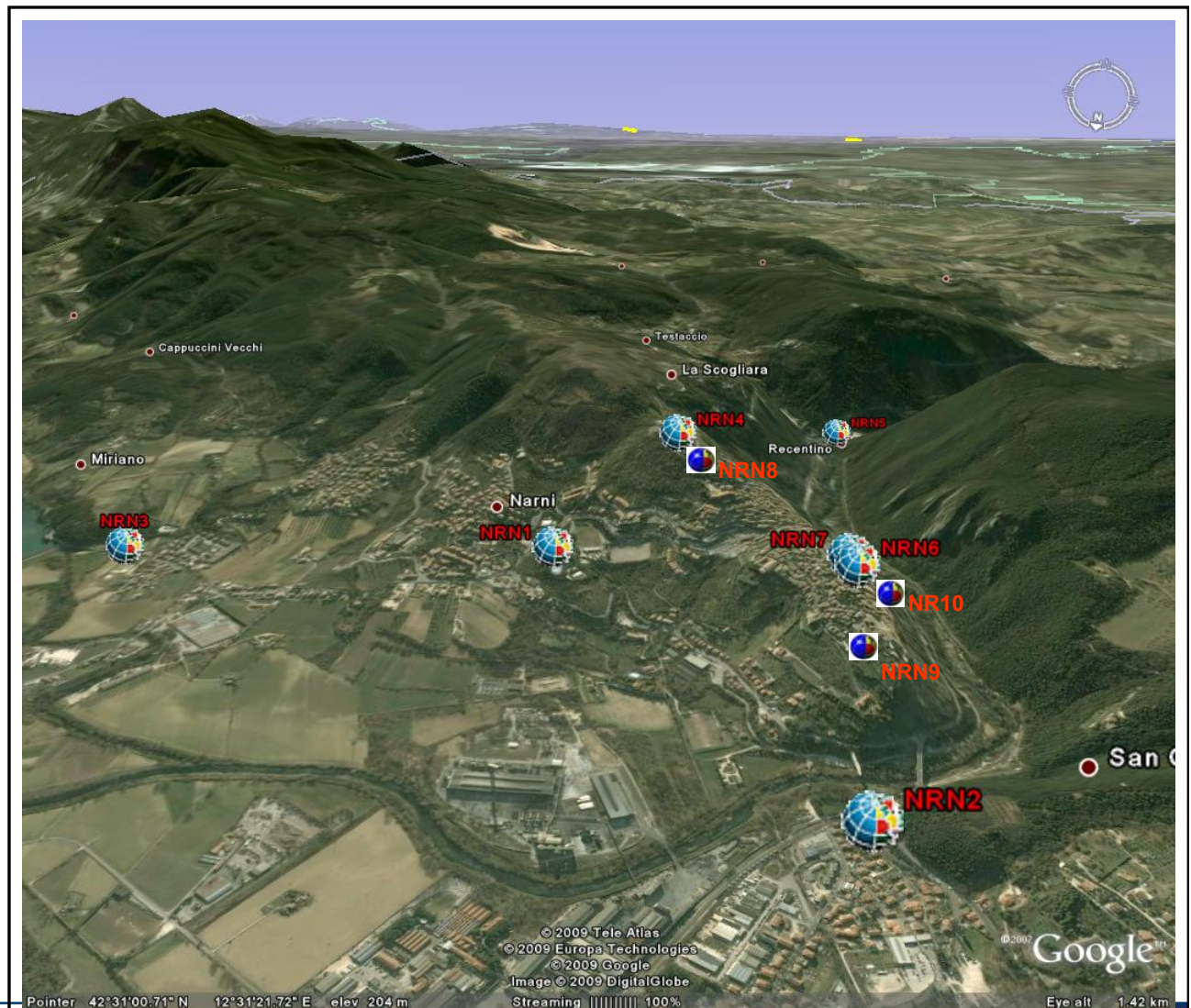
**Poster by Lovati et al.**

## Instrumentation

7 Lennartz LE3D-5s  
Seismometer

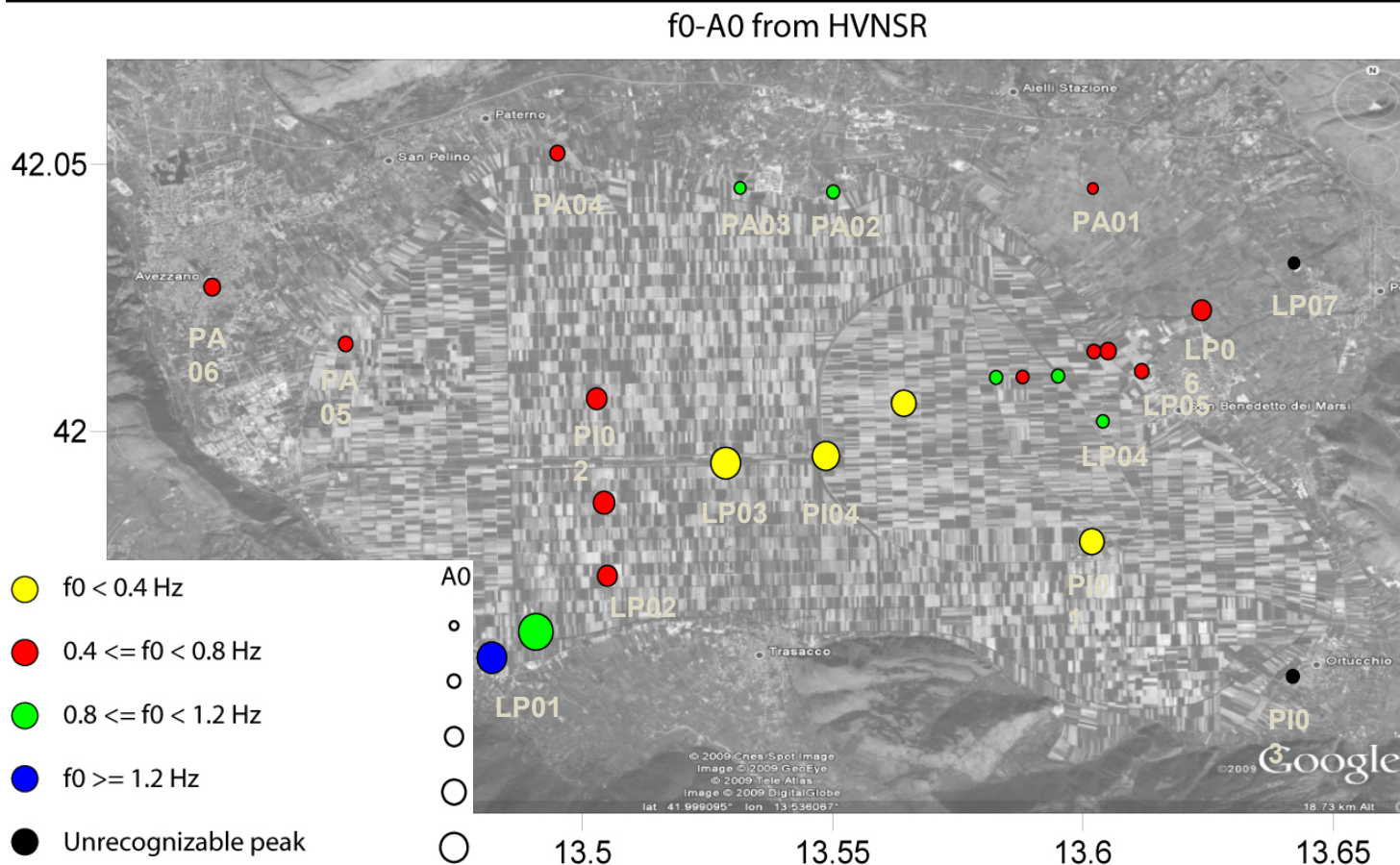
5 Reftek 130/01 24  
bits Data Logger

2 Lennartz Mars-Lite  
24 bits data Logger



# Project S4 – Task4 – Identification of ITACA stations with distinctive features in their seismic response

✓ **Fucino basin seismic monitoring** → activity by INGV RM (oct 2008 → oct 2009)

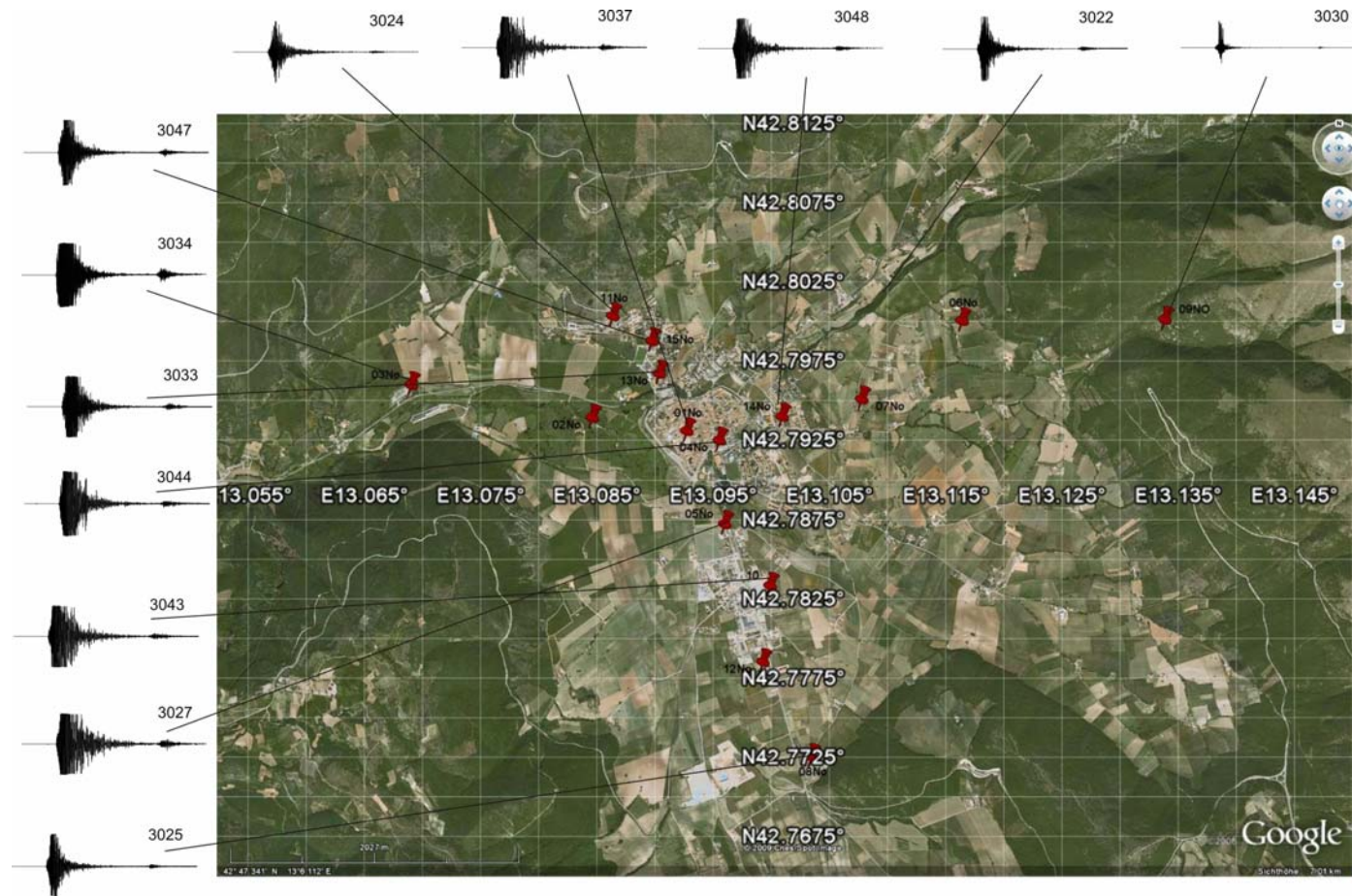


HVNSR results for Fucino Basin. The colored dots indicate the position of stations. Dots colors are related to  $f_0$  value, dots size to HVNSR amplitude.



# Project S4 – Task4 – Identification of ITACA stations with distinctive features in their seismic response

✓ **Norcia basin seismic monitoring** → activity by GFZ (mar 2009 → may 2009)

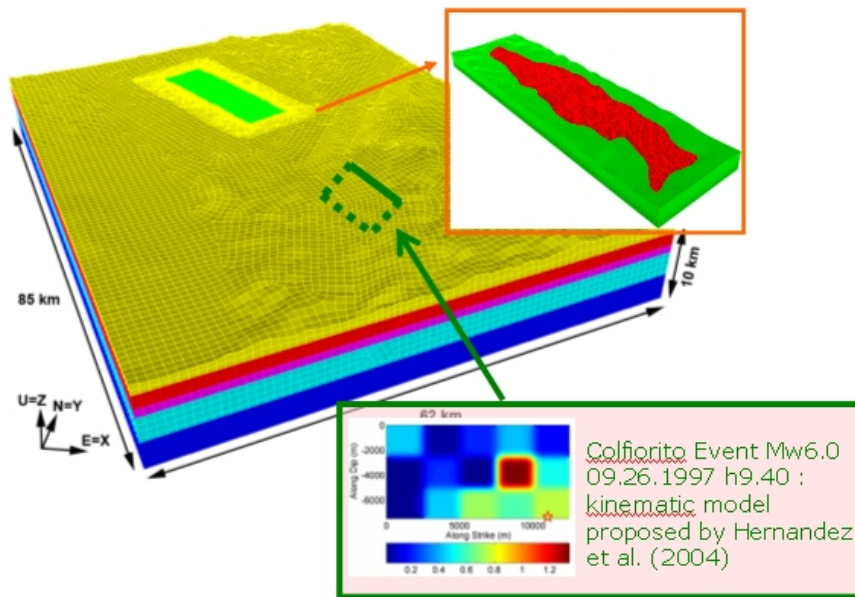


Temporary seismic array in Norcia. The recordings of the 6 April 2009 mainshock of the l'Aquila sequence and of an aftershock are shown. Note the variability of ground motion within the basin, also clear in the clipped recordings of the mainshock.

Parolai S.<sup>1</sup>, Picozzi M.<sup>1</sup>, Di Giacomo D.<sup>1</sup>, Pilz M.<sup>1</sup>, Bindi D.<sup>1,2</sup>, Strollo A.<sup>1</sup>  
<sup>1</sup>Deutsches GeoForschungsZentrum GFZ, Telegrafenberg 14473 Potsdam Germany, parolai@gfz-potsdam.de  
<sup>2</sup>INGV, via di Messina 301

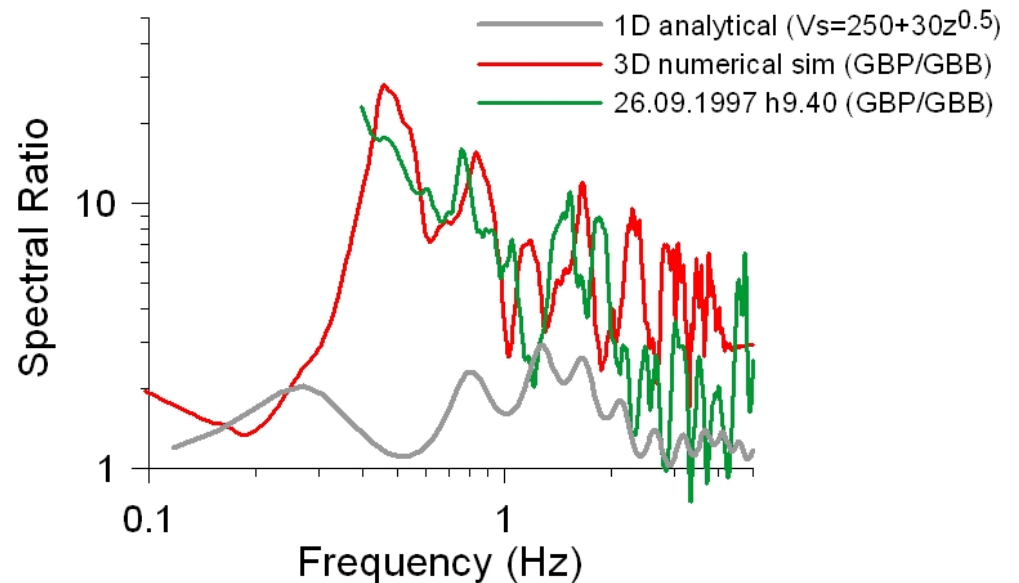
# Project S4 – Task4 – Identification of ITACA stations with distinctive features in their seismic response

✓ 3D Numerical simulations: the Gubbio basin → Poster by Smerzini et al.



Spectral element model including the Gubbio basin and the Umbria-Marche earthquake fault

Observed SSR vs. 1D and 3D numerical simulations



Parolai S.<sup>1</sup>, Picozzi M.<sup>1</sup>, Di Giacomo D.<sup>1</sup>, Pilz M.<sup>1</sup>, Bindi D.<sup>1,2</sup>, Strollo A.<sup>1</sup>  
<sup>1</sup>Deutsches GeoForschungsZentrum GFZ, Telegrafenberg 14473 Potsdam Germany, parolai@gfz-potsdam.de  
<sup>2</sup>INGV, Venezia, Italy

# Project S4 – Task5 – Characterization of Italian strong-motion recording sites in the perspective of a new soil classification

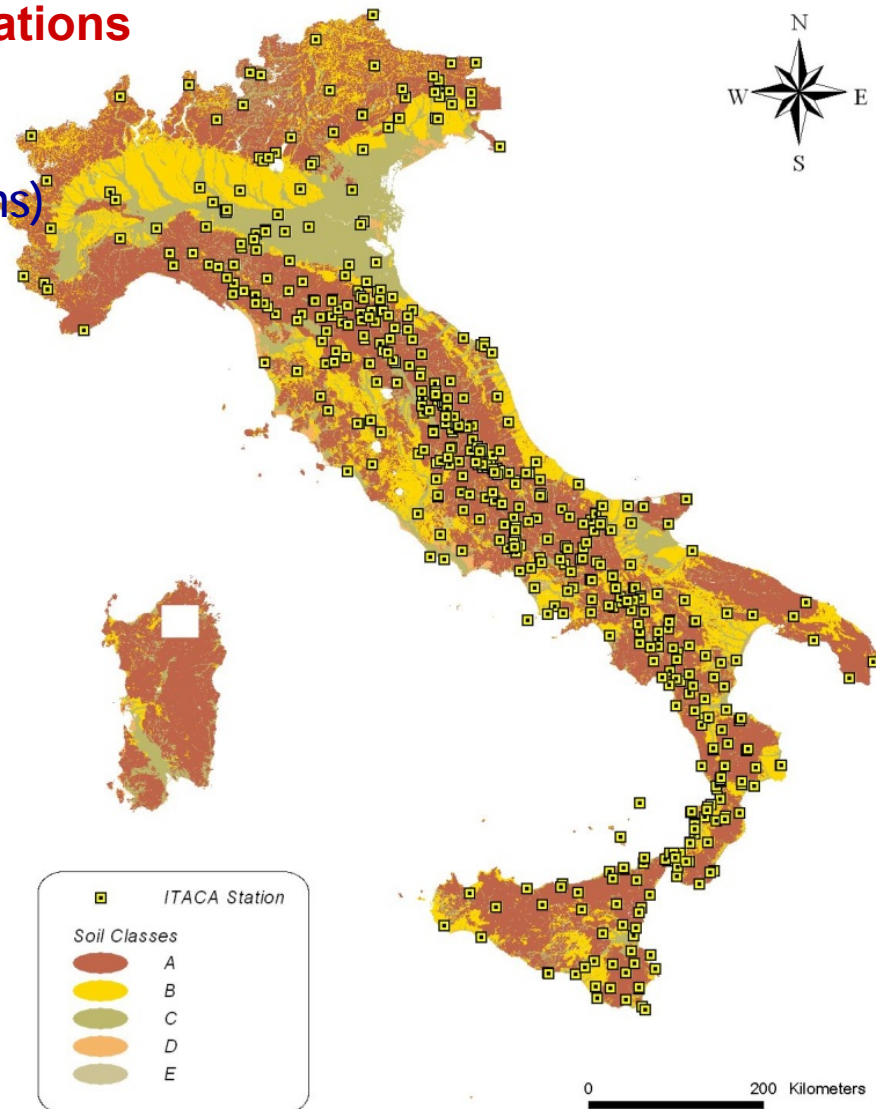
## ✓ EC8 seismic classification of all ITACA stations

(a) based on  $V_{s,30}$  if available (only for ~ 100 stations)

(b) based on an expert evaluation if  $V_{s,30}$  is not available, taking account of:

- detailed geology and available and stratigraphy profiles
- H/V from noise and/or earthquake data
- 1:100,000 lithological map

A tentative seismic classification of ITACA stations has already been proposed, for use within REXELite (estimated classifications denoted by “\*”)



Task 5: Preliminary site classification

# Project S4 – Task5 – Characterization of Italian strong-motion recording sites in the perspective of a new soil classification

✓ **EC8 seismic classification of all ITACA stations**

Example of classification report in the station monography (AQA)

## Site classification (EC8 – NTC2008)

### *Lithostratigraphic classification*

*Estimated*

Method <sup>1</sup>	Soil class <sup>2</sup>	Notes
<b>GEO, HV</b>	<b>B</b>	

1 Legend	GEO	Geological data
	EC	Empirical correlation
	HV	H/V spectral ratio

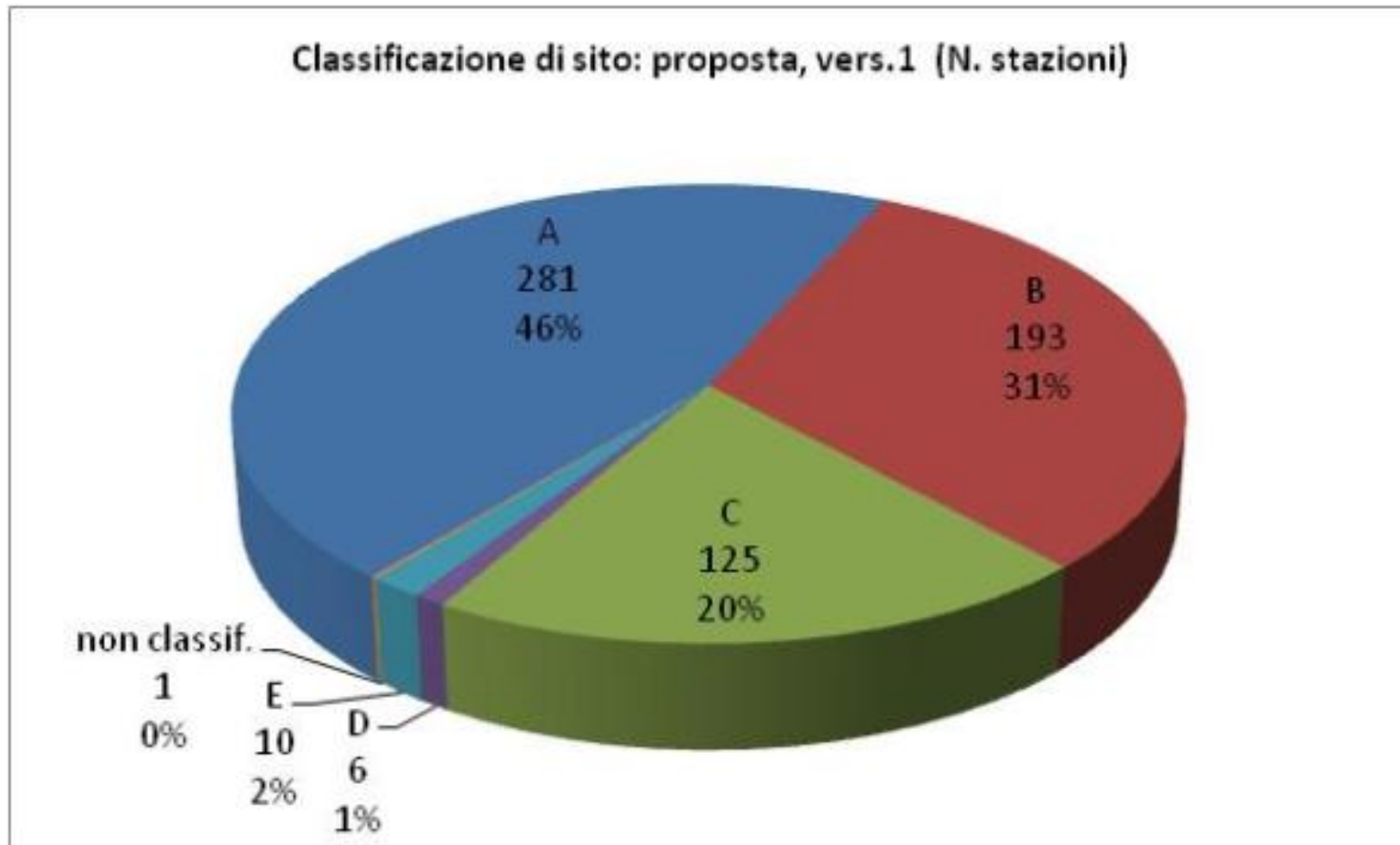
*Based on in-situ measurements*

Method <sup>3</sup>	$V_{s30}$ (m/s)	Soil class <sup>2</sup>



# Project S4 – Task5 – Characterization of Italian strong-motion recording sites in the perspective of a new soil classification

✓ EC8 seismic classification of all ITACA stations



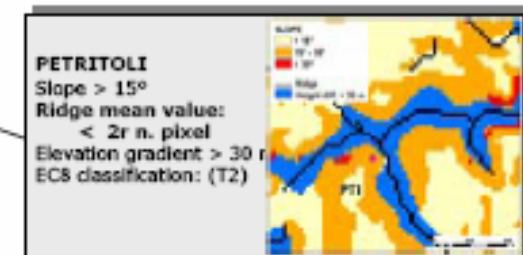
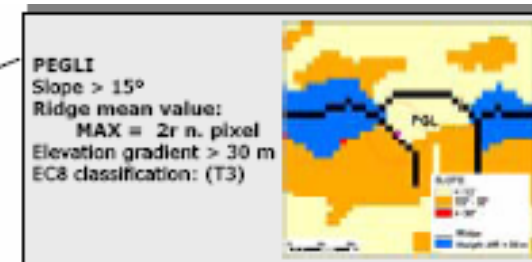
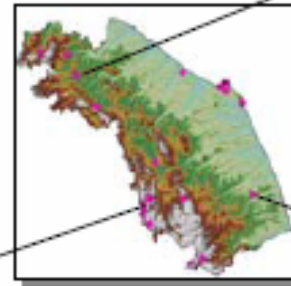
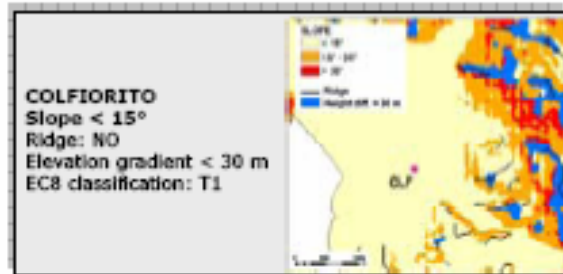
# Project S4 – Task5 – Characterization of Italian strong-motion recording sites in the perspective of a new soil classification

✓ GIS-based topographic classification of ITACA recording stations



Poster by Pessina et al.

Application to Marche region



Morphometric analyses of high resolution 20x20m digital elevation models (DEM), with the support of Geographic Information Systems (GIS), have been implemented to provide a practical tool for the identification of topographic sites possibly affected by relevant seismic amplification effects.

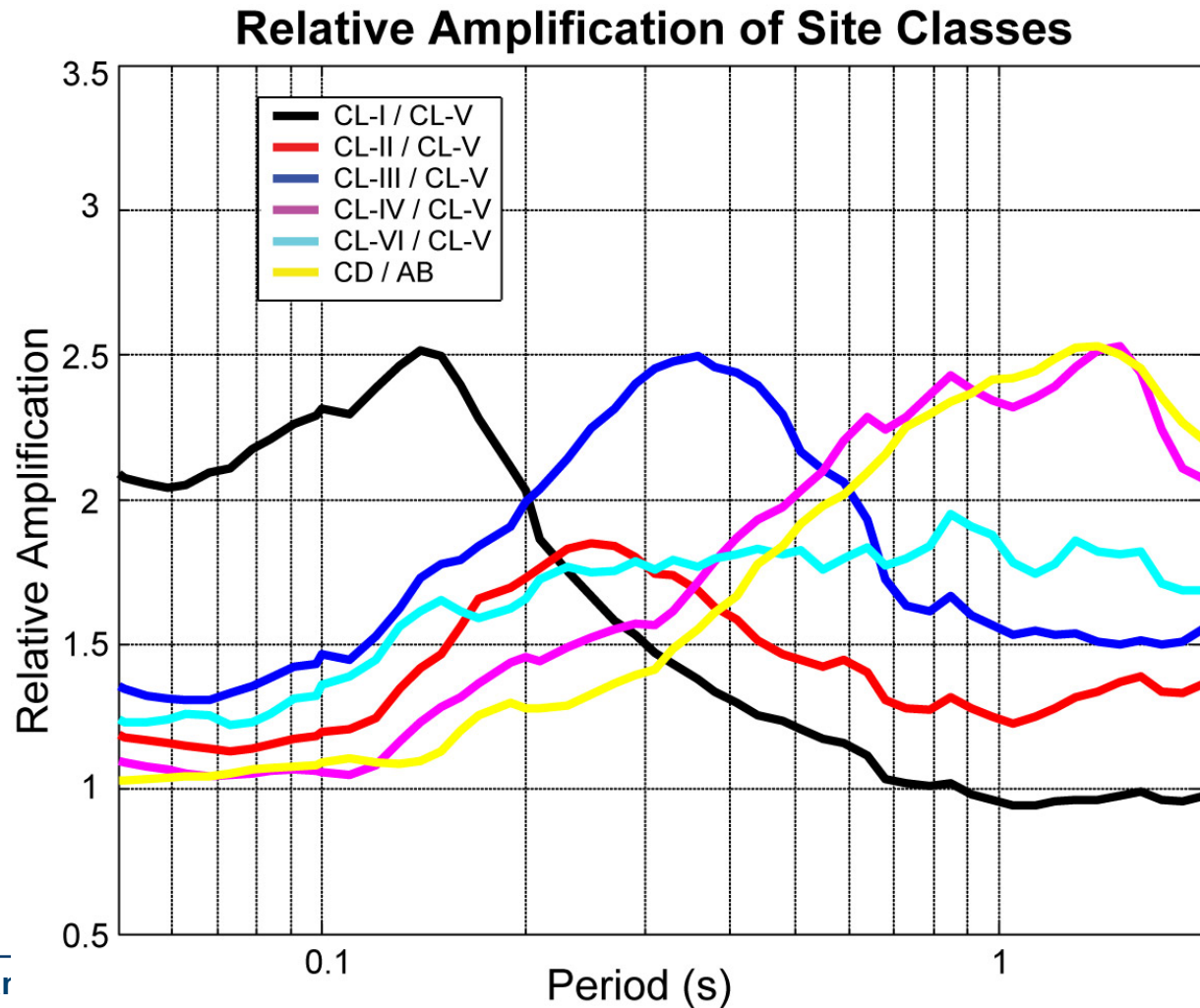


# Project S4 – Task5 – Characterization of Italian strong-motion recording sites in the perspective of a new soil classification

Proposals of a novel seismic classification of ITACA sites (a)

➡ Poster by Di Alessandro et al.

Definition of site classes based on the predominant period of H/V response spectral ratio



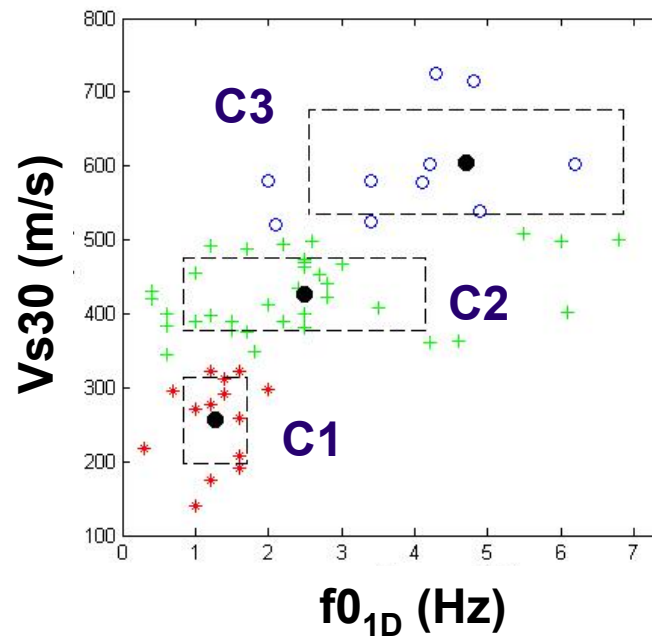
# Project S4 – Task5 – Characterization of Italian strong-motion recording sites in the perspective of a new soil classification

## Proposals of a novel seismic classification of ITACA sites (b)

➡ Oral presentation by Luzi et al.

Collection of a set of well documented recording station

- Evaluation of soil parameters correlated to site effects
- Statistical data analysis
- Test soil classification through error distribution in GMPE



	Mean $f_0$	Std $f_0$
<b>C1</b>	1.27	0.43
<b>C2</b>	2.48	1.65
<b>C3</b>	4.70	2.14

	Mean Vs30	Std Vs30
<b>C1</b>	255.77	58.96
<b>C2</b>	426.70	48.96
<b>C3</b>	605.11	71.11



## Final remarks on the S4 progress (1)

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- ✓ The successful progress of ITACA, with the beta version on line and the 1.0 release about to be published, is a product of a positive interaction between DPC, seismologists and engineers, which ensured the quality of the advancement achieved so far.
- ✓ The S4 Project has benefited, on one side, from the L'Aquila earthquake, and from the previous Parma earthquake as well, since these events have been demanding but successful benchmarks for the Project and have dramatically increased the worldwide visibility of ITACA.
- ✓ As a consequence, some of the Project activities have been moved towards the immediate needs highlighted by the L'Aquila earthquake emergency, such as the geological-geotechnical characterization of the Abruzzo region sites, and the improvement of the quality of ITACA accelerograms, such as the new correction and check of available data, new file headers, re-sampling of response spectra, implementation of RexelLite, improvement of downloading procedures.

## Final remarks on the S4 progress (2)

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- ✓ At this stage of the Project, it is the opinion of the coordinators that the future of ITACA is an a important issue to be addressed.
- ✓ This point should be discussed together with the other main actors involved, in order to plan the best way to promote and maintain ITACA, and to provide the due support both from a scientific and from an operational point of view.
- ✓ For this purpose, a “permanent” task force should be recommended, including both scientific and operational personnel from DPC and INGV and from the other research institutions that mainly contributed to the development of ITACA.

Thanks to everybody ...  
... and especially to the S4 teams!

