# Project S4

# The Italian strong motion database

**Coordinators:** F. Pacor (INGV-MI)
R. Paolucci (Politecnico-MI)

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

Final Meeting of Projects S

ISPRA Conference Room – via Curtatone 7, Roma

30 June – 2 July 2010

# Project S4 - Overview

## 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

| RU | Resp. |
|---|---|
| 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

**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

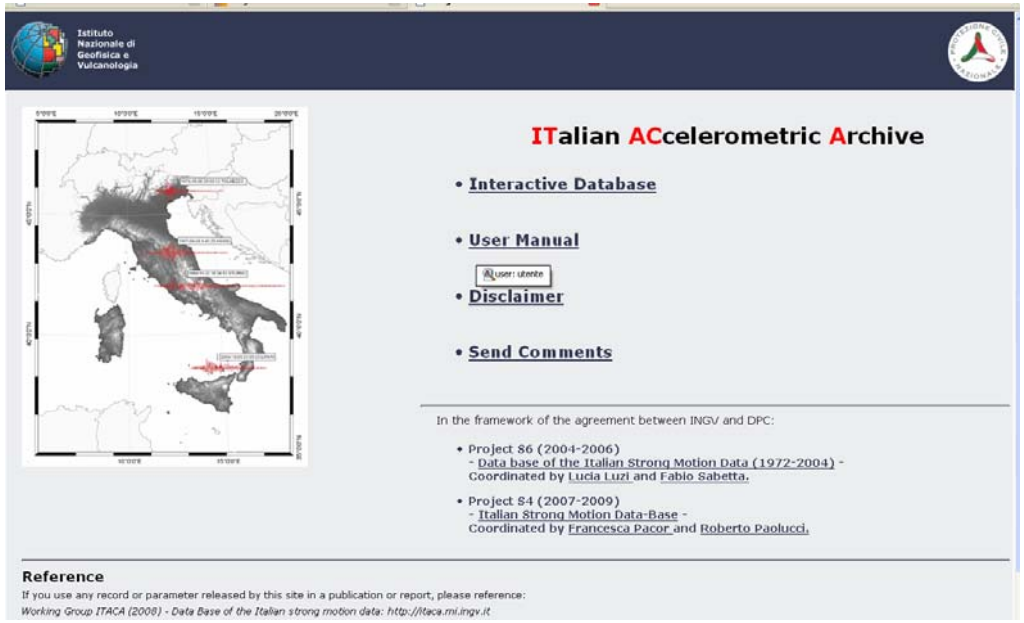
# Background – S6 Project

*http://esse6.mi.ingv.it*

**S6**: *Database dei dati accelerometrici italiani nel periodo 1972-2004 (DPC-INGV 2004-06)*

**Coordinators**

L. Luzi (INGV) e F. Sabetta (DPC-SAPE)




1. Creation of the database structure
2. Waveform collection and processing
3. Revision of the seismic events, recording stations and instruments
4. Database implementation and data dissemination

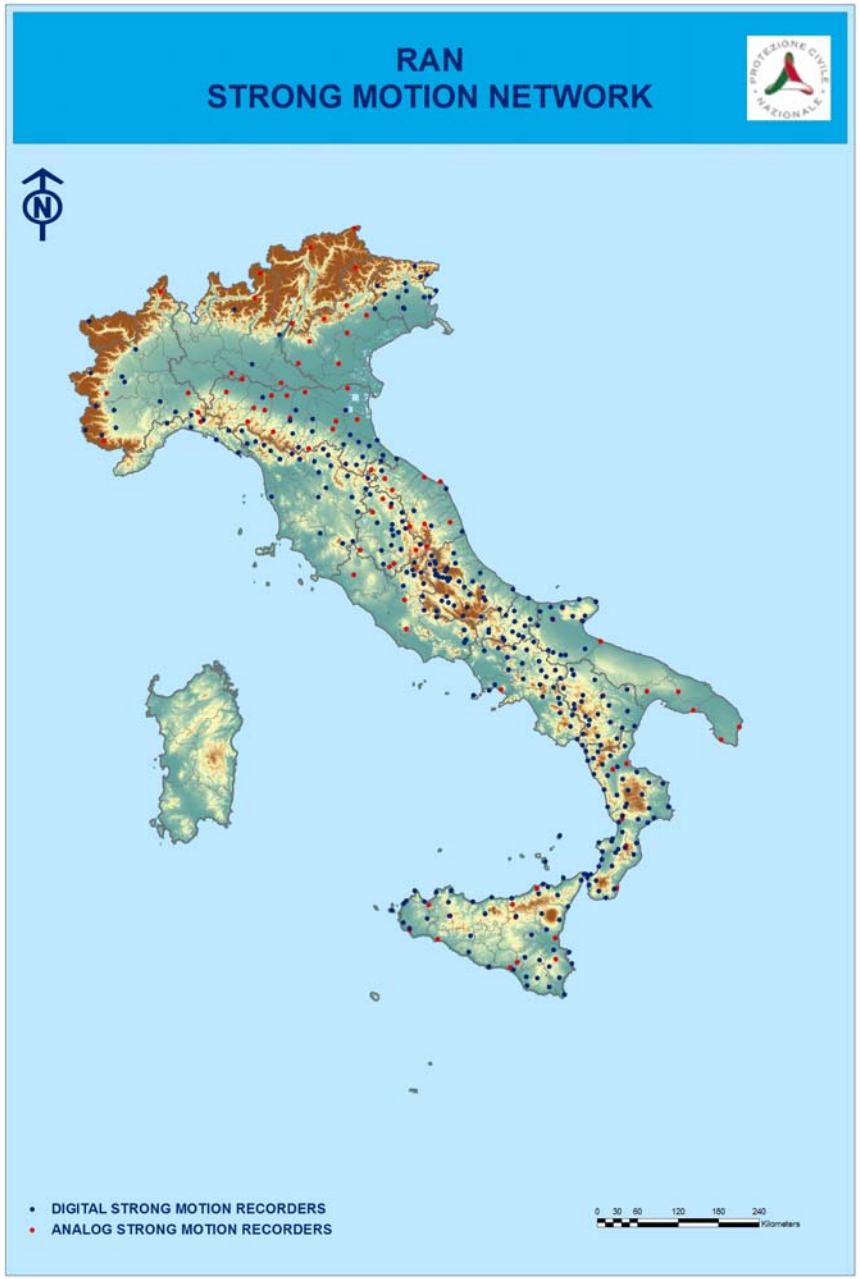
# Italian strong motion network (RAN)

RAN is operated by the Department of Civil Protection and presently consists of 418 stations spread over the Italian territory, namely:

- 334 digital free-field stations.

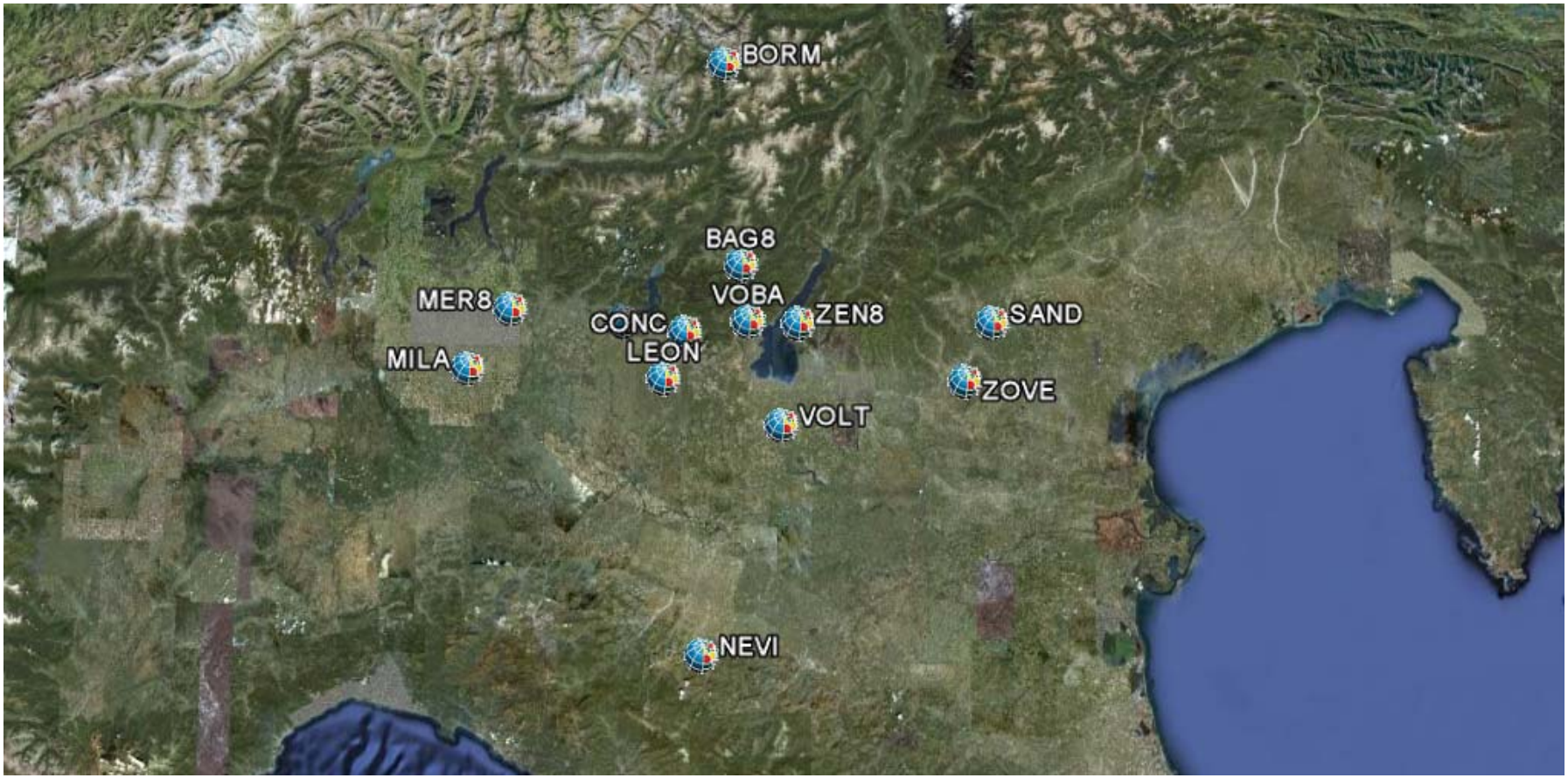
- 84 analogue stations of the former ENEL network, under replacement with digital stations.

The final RAN configuration will likely include 511 digital stations within 2011, (plus the analog stations that will not be replaced), with an average interstation distance of 20-30 km in the mostly seismically active areas in Italy.



# ITACA 1.0 – Adding Local Networks

**RAIS – Rete Accelerometrica Italia Settentrionale**
**(12 stations + 5 temporary – 109 records)**

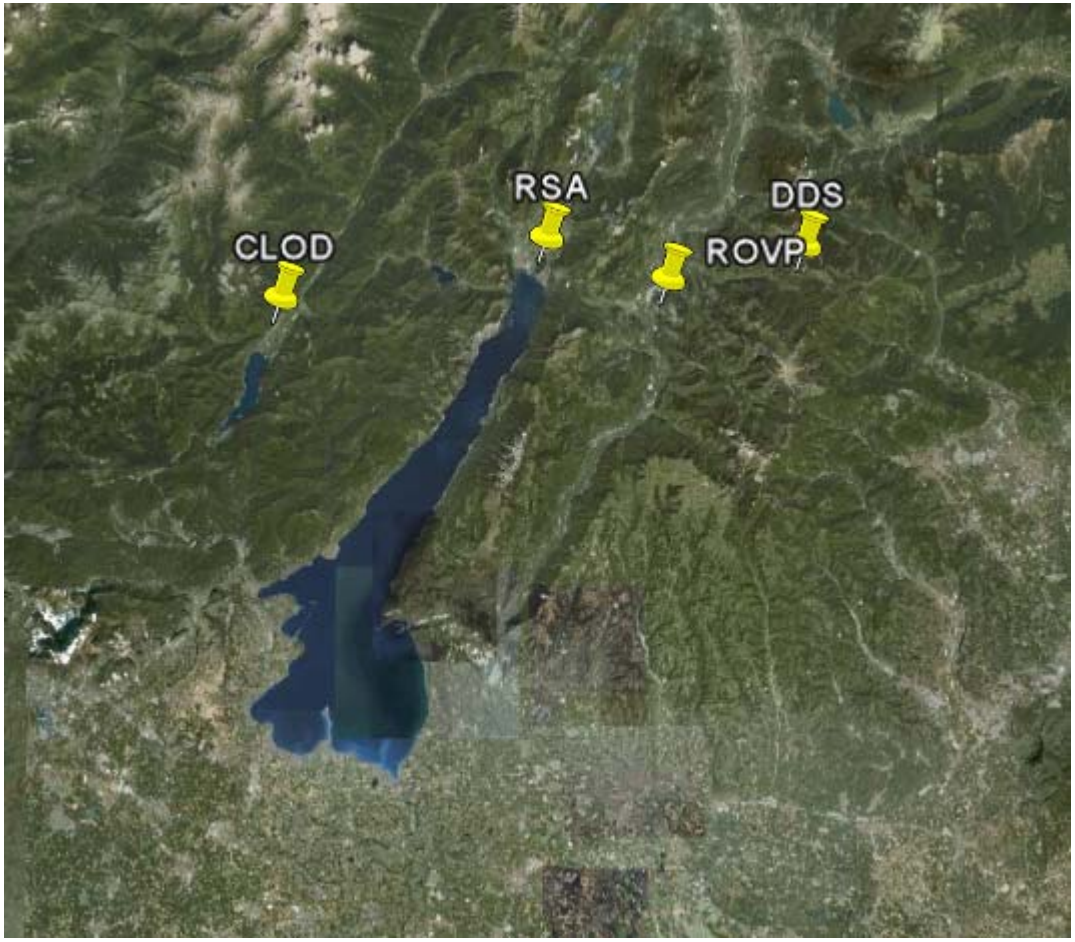


# ITACA 1.0 – Adding Local Networks

**BAS – Rete accelerometrica Regione Basilicata (21 stations – 148 records)**

# ITACA 1.0 – Adding Local Networks

**PVTR – Provincia di Trento (4 stations – 26 records)**



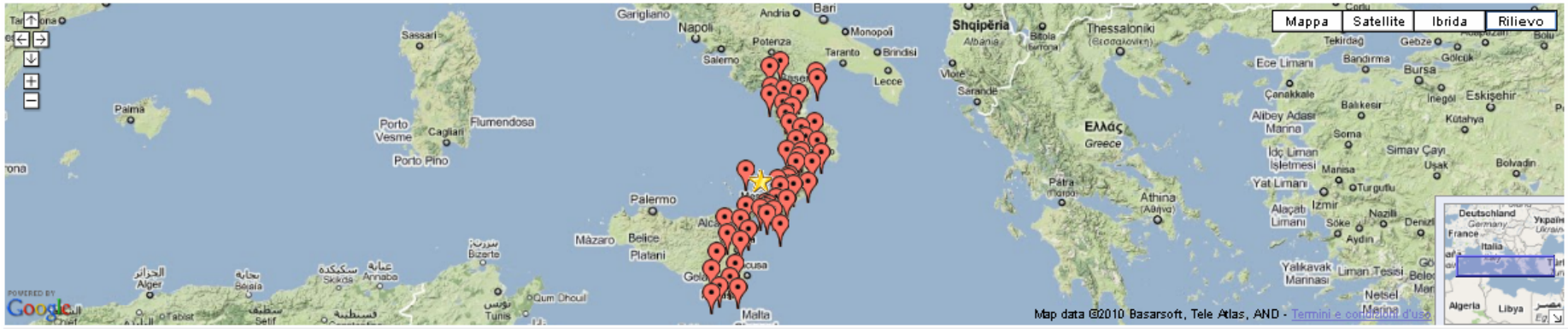
# ITACA 1.0 – Adding RAN records from 2005 to 2007

**1347** records from 2005 to 2007 (651 corrected records with M > 3), from **751** events

## Mw 5.8 Mar Tirreno earthquake, Oct 2006

MAGNITUDE

| Type | Method | Reference | Value | Error |
|---|---|---|---|---|
| Mb | | Global CMT Catalog | 5.8 | |
| ML | ML from the Bollettino Sismico Italiano (since Apr.16.2005 ) | ISIDe | 5.7 | 0.4 |
| MS | | Global CMT Catalog | 5.8 | |
| Mw | | Global CMT Catalog | 5.8 | |




| | | | | | |
|---|---|---|---|---|---|
| **Municipality** | | **Province** | | | |
| **Focal Mechanism** | | | | | |
| **Type** | NF | **Method** | CMT | **ref.** | Global CMT Catalog |
| **Strike** | 251.0 | **Dip** | 12.0 | **Rake** | -98.0 |
| **Fault** | No | **Surf. Rupt.** | No | **ref.** | |
| **Other faults** | | | | | |
| **$I_0$** | | **Other $I_0$** | | **ref.** | |
| **Located** | Location OK | | | | |

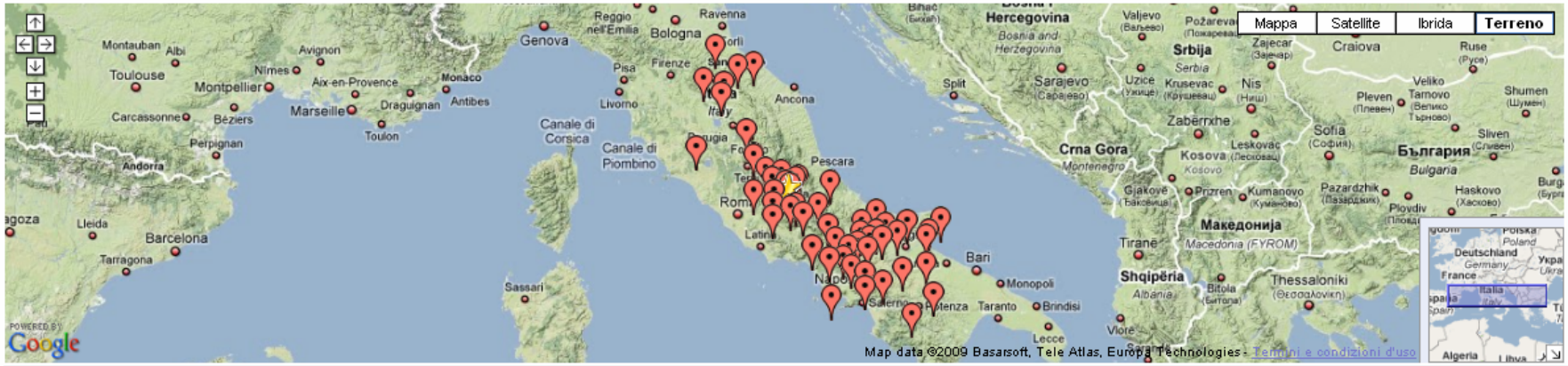
# ITACA 1.0 – Adding Parma and L'Aquila earthquakes

## Event Detail

| | | | | | |
|---|---|---|---|---|---|
| **Date** | 2009-04-06 01:32:39 | **Event name** | L'Aquila Mainshock | | |
| **Lat** | 42.33 ± 0.79km | **Long** | 13.33 ± 0.79km | **Depth [km]** | 8.8 ± 1.49 |
| **Hypocenter reference** | INGV-CNT Seismic Bulletin | **Other hypocenter** | | | |

### MAGNITUDE

| Type | Method | Reference | Value | Error |
|---|---|---|---|---|
| ML | ML from ING catalogue | INGV-CNT Seismic Bulletin | 5.8 | 0.3 |
| Mw | Mw from RCMT | RCMT-INGV | 6.3 | |




| | | | | | |
|---|---|---|---|---|---|
| **Municipality** | L'AQUILA | **Province** | L'Aquila | | |
| **Focal Mechanism** | | | | | |
| **Type** | NF | **Method** | RCMT | **ref.** | RCMT-INGV |
| **Strike** | 127.0 | **Dip** | 50.0 | **Rake** | -109.0 |
| **Fault** | | **Surf. Rupt.** | | **ref.** | |
| **Other faults** | | | | | |
| **$I_0$** | | **Other $I_0$** | | **ref.** | |
| **Located** | | | | | |

### WAVEFORMS

| Station | R epi. [km] | PGA [cm/s$^2$] | PGV [cm/s] | Detail |
|---|---|---|---|---|
| ANT | 23.017 | 11.474 | 2.468 | |
| AQA | 4.634 | 467.737 | 9.367 | |
| AQG | 4.392 | 253.118 | 10.400 | |
| AQK | 5.650 | 360.004 | 20.061 | |
| AQV | 4.870 | 649.256 | 12.444 | |
| ASS | 101.740 | 6.047 | 0.436 | |
| AVL | 198.073 | 1.269 | 0.370 | |

# ITACA 1.0 – Updated record processing

**Record processing in ITACA, the new Italian strong-motion database**

**Roberto Paolucci[1], Francesca Pacor[2], Rodolfo Puglia[2], Gabriele Ameri[2], Carlo Cauzzi[1] and Marco Massa[2]**

[1] Department of Structural Engineering, Politecnico di Milano

[2] Istituto Nazionale di Geofisica e Vulcanologia, Milano

Earthquake data in engineering seismology: networks, data management and predictive models.

Editors: S. Akkar, P. Gulkan and T. van Eck.

*Geotechnical, Geological and Earthquake Engineering series. Springer*

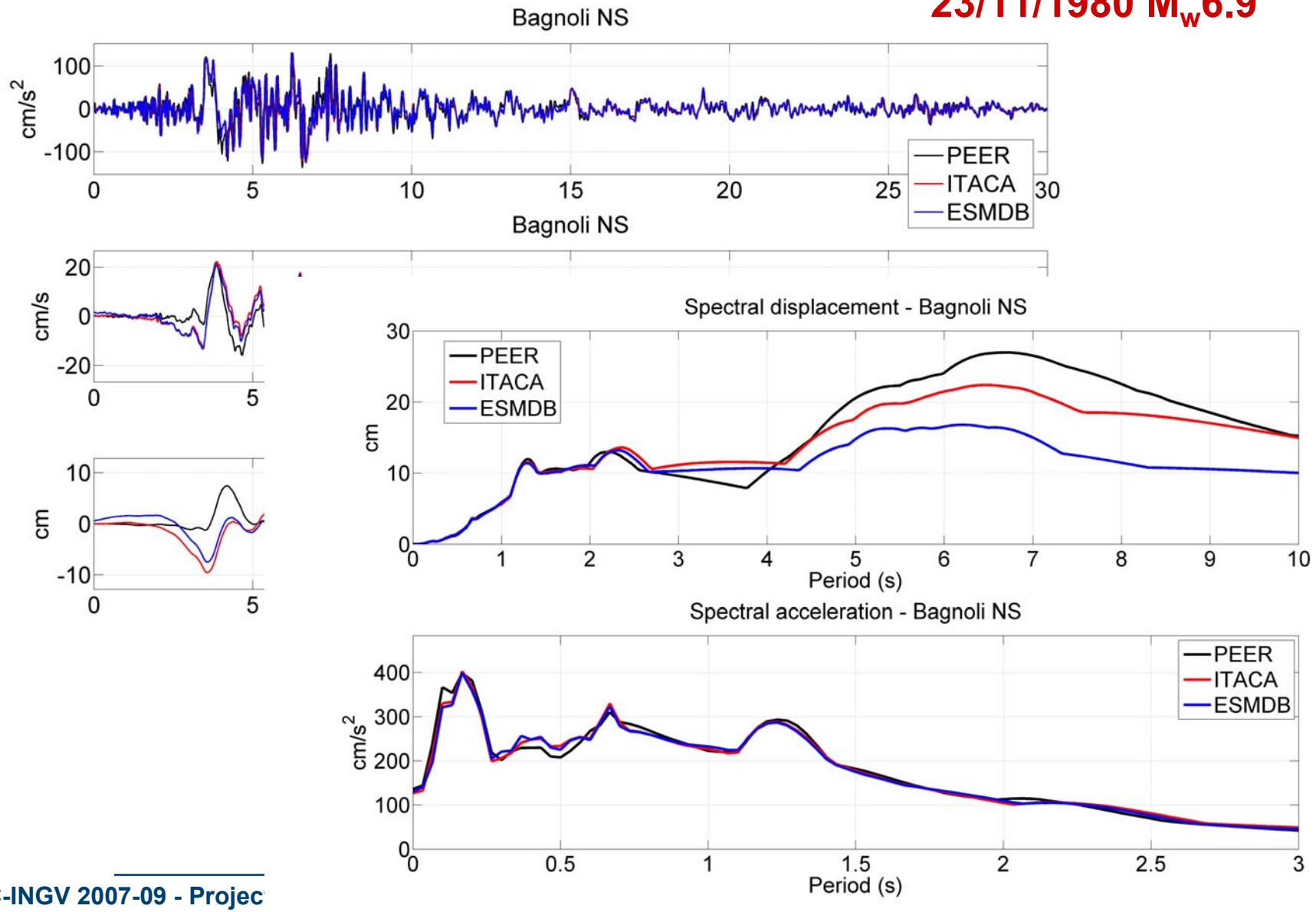
✓ to **ensure the compatibility of corrected accelerograms**, so that the no further correction is required to obtain by single and double integration de-trended velocity and displacement traces;

✓ 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.

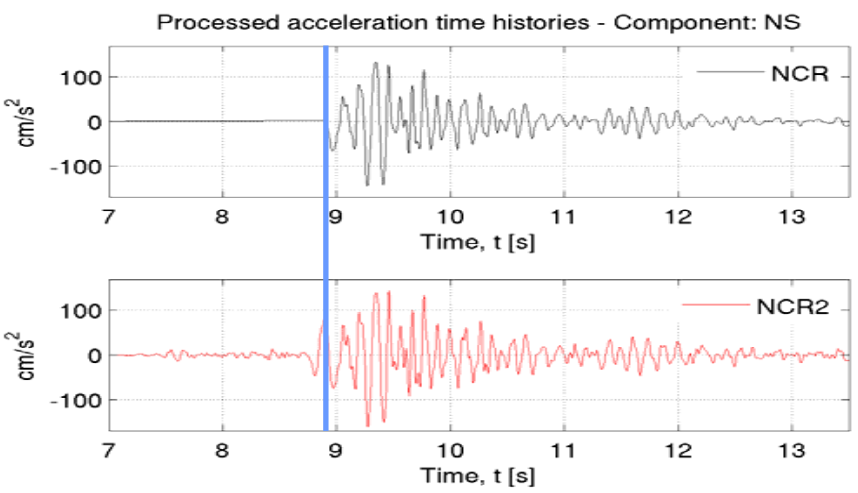
# Comparison with records from other data sources

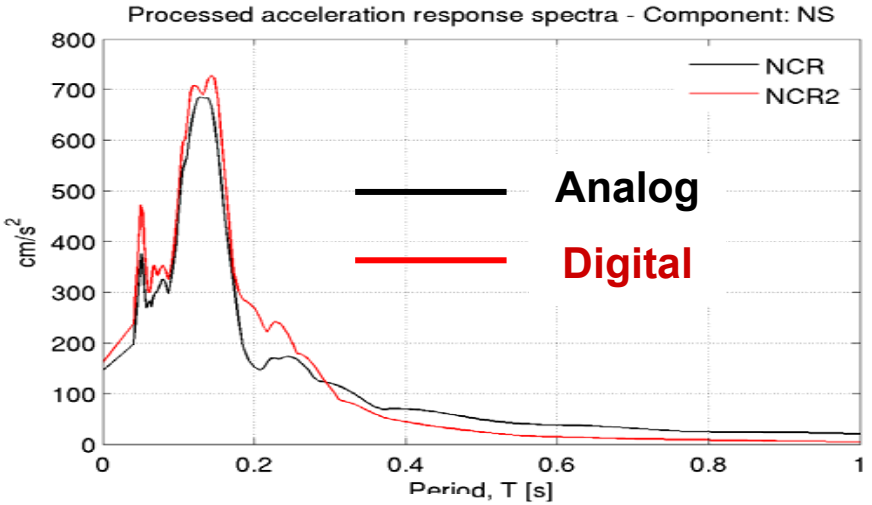
## Bagnoli, Irpinia
## 23/11/1980 $M_w$6.9



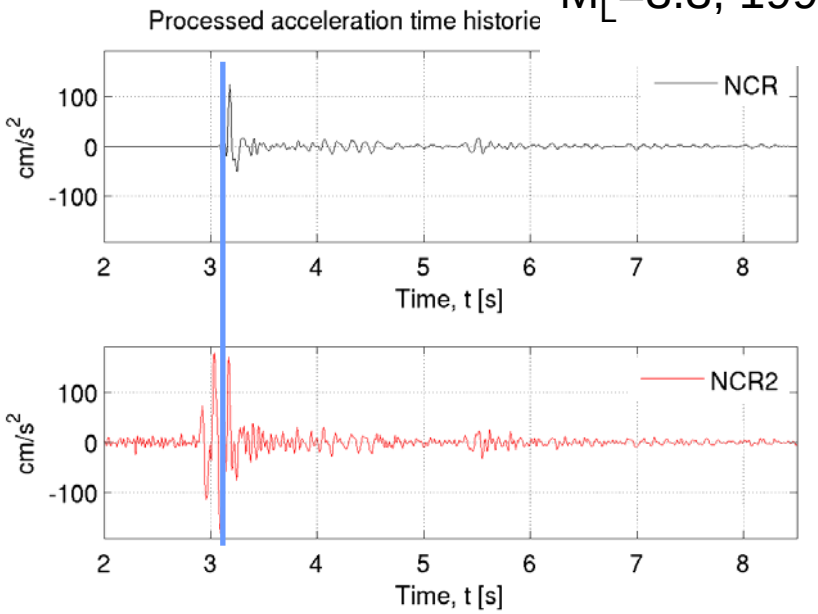
# Late-triggered records: corrected accelerations from two co-located analog and digital accelerographs

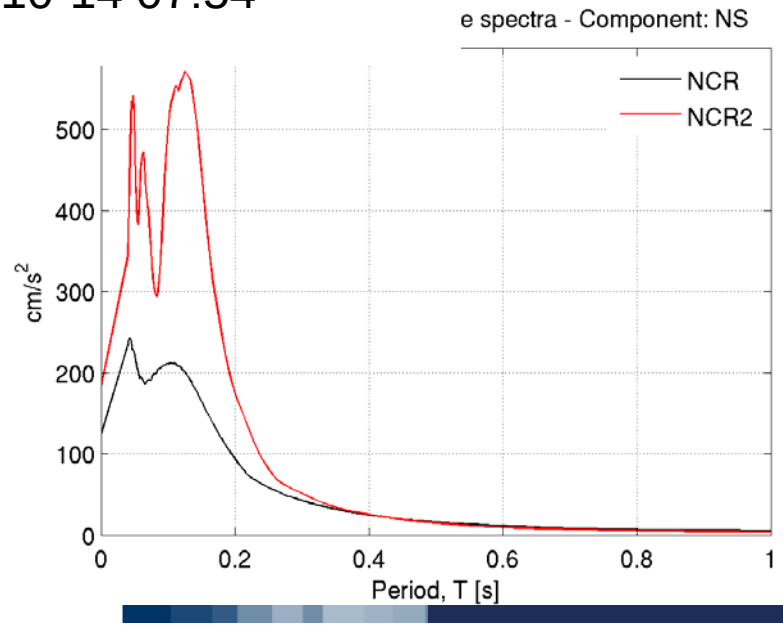
$M_W$=4.8, 1998-04-05 15:52



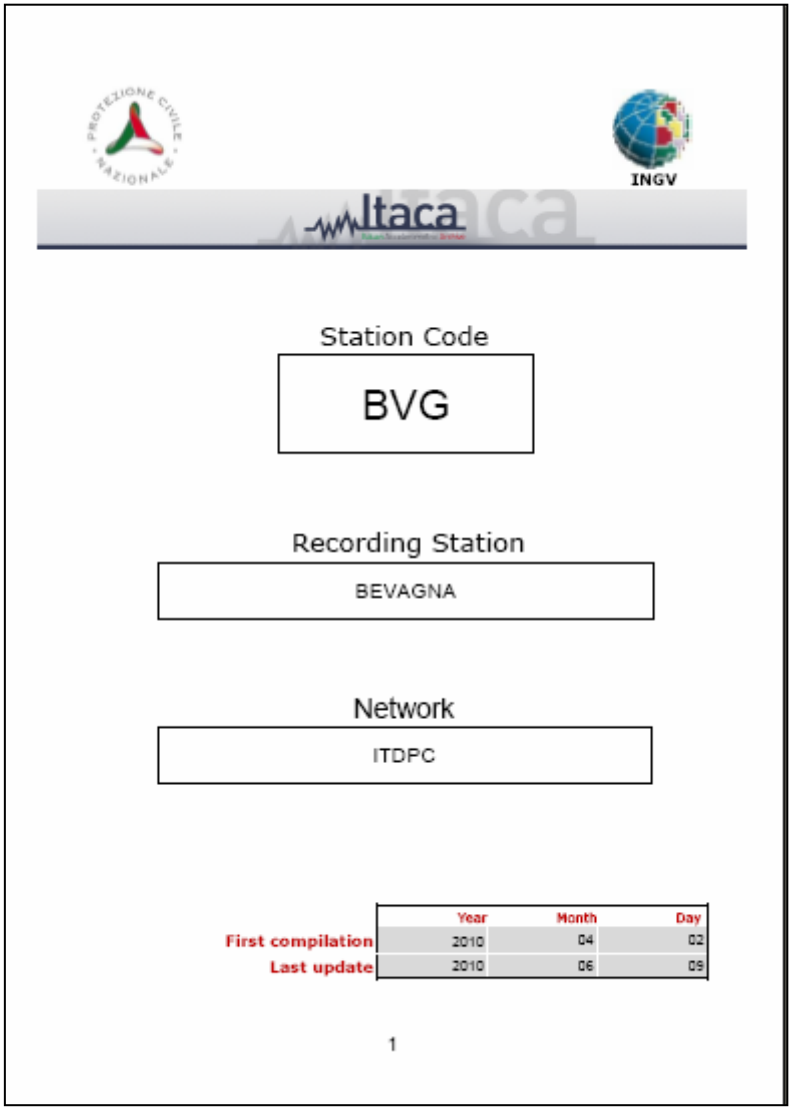

$M_L$=3.3, 1997-10-14 07:54



# ITACA 1.0 – Updated station report

- General information
- Geographical information
- Geomorpholgy
- Geology
- Geotechnical and Geophysical Information
- Microtremor H/V spectral ratio
- Earthquake H/V spectral ratio
- Site Classification (EC8-NTC2008)
- Synthesis of information
- References and Enclosures



# ITACA 1.0 – Updated station report

## General Information

| | |
|---|---|
| Station photograph | |
| Code | BVG |
| Owner | Dipartimento Della Protezione Civile |
| Type of station | ENEL Box |
| Activation date | 1974-12-11 |
| Removal date | |
| Instrument type | Analog |
| Instrument model | SMA-1 |
| Housing | |
| Notes | |

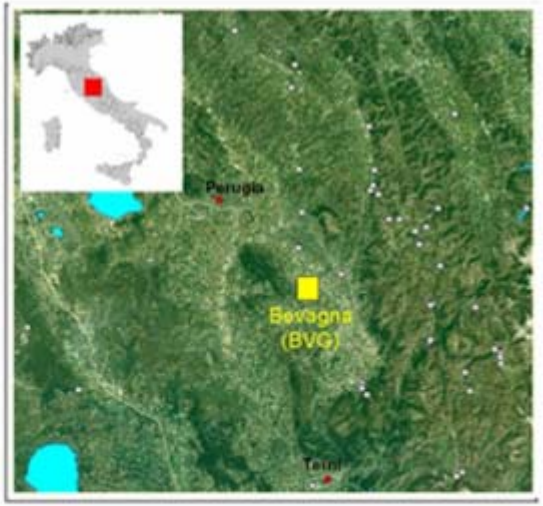
2

**100 % of ITACA stations**

## Geographical Information (1/2)

*Location*

| | |
|---|---|
| Region | UMBRIA |
| Province | Perugia |
| City | BEVAGNA |
| Place / Address | Cabina di trasformazione ENEL n. PG4E07 sita lungo la strada vicinale per Cantagalli |
| ISTAT Code | 054004 |
| Notes | |




Location map
(Italy and Region)

3

**100 % of ITACA stations**

# ITACA 1.0 – Updated station report

## Geographical Information (2/2)

*Coordinates*

| | Latitude | Longitude |
|---|---|---|
| Geographic (WGS84) | 42.932389 | 12.611056 |
| Elevation (m a.s.l.) | 205 | |

*Cartography*

| | Scale | Code |
|---|---|---|
| Topographic map (I.G.M.I.) | 1:25.000 | 131 IV NE |
| | Scale | Element number |
| Regional technical map (C.T.R.) | | |

I.G.M.I. or C.T.R. map


4

## Geomorphology

*Site morphology*

| | | | |
|---|---|---|---|
| Plain | Valley (centre) | X Valley (edge) | Alluvial fan |
| Saddle | Slope | Edge of scarp | Ridge |

*Landslides*

☐ Not present

Present ☐ Active or quiescent ☐ Inactive or stabilized — Distance (m)

Image not available

I.F.F.I. map

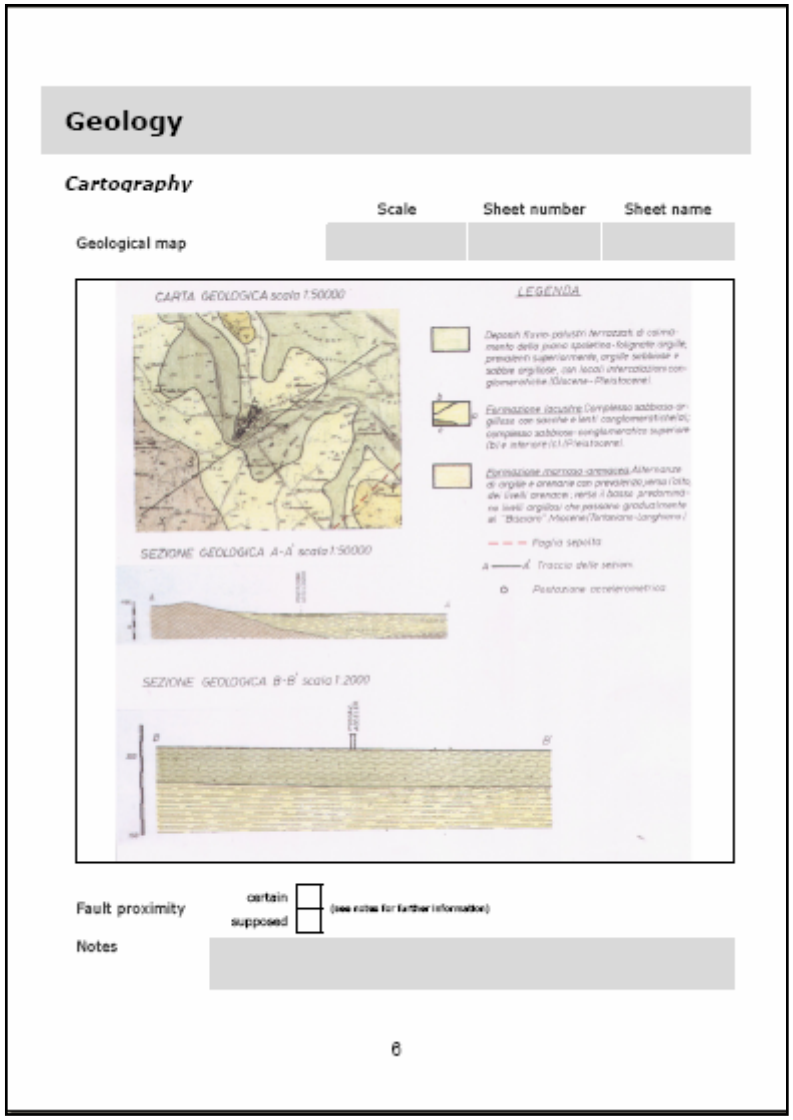
Notes

5

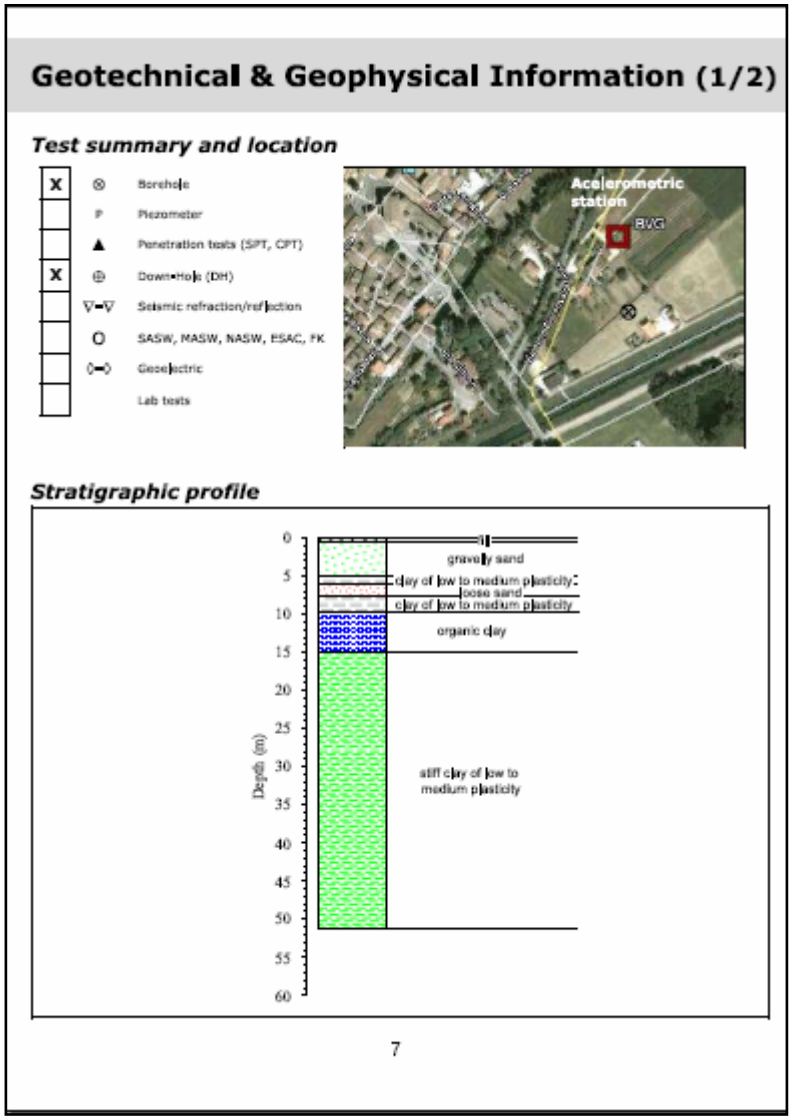
**90 % of ITACA stations**

**29 % of ITACA stations**

# ITACA 1.0 – Updated station report




79 % of ITACA stations



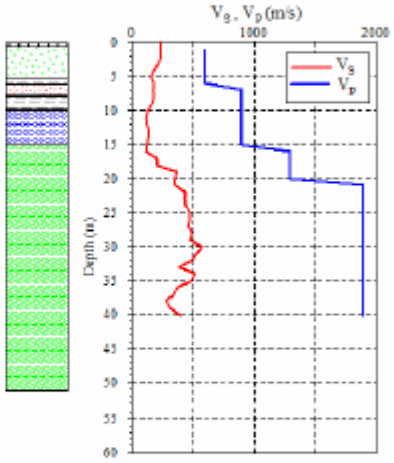

16 % of ITACA stations

# ITACA 1.0 – Updated station report

## Geotechnical & Geophysical Information (2/2)

***In situ Tests:*** *Down-Hole*

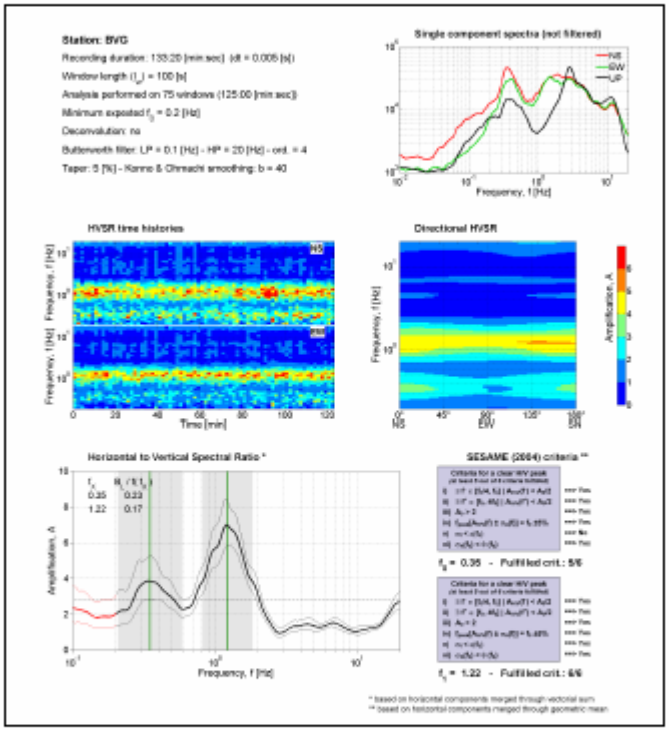
| depth (m) | Vs (m/s) | Vp (m/s) |
|---|---|---|
| 0 | 237 | |
| 1 | 237 | 600 |
| 2 | 237 | 600 |
| 3 | 221 | 600 |
| 4 | 178 | 600 |
| 5 | 153 | 600 |
| 6 | 176 | 600 |
| 7 | 174 | 900 |
| 8 | 177 | 900 |
| 9 | 159 | 900 |
| 10 | 131 | 900 |
| 11 | 106 | 900 |
| 12 | 124 | 900 |
| 13 | 138 | 900 |
| 14 | 127 | 900 |
| 15 | 115 | 900 |
| 16 | 111 | 1300 |
| 17 | 203 | 1300 |
| 18 | 204 | 1300 |
| 19 | 366 | 1300 |
| 20 | 348 | 1300 |
| 21 | 349 | 1900 |
| 22 | 438 | 1900 |
| 23 | 426 | 1900 |
| 24 | 440 | 1900 |
| 25 | 471 | 1900 |
| 26 | 472 | 1900 |
| 27 | 458 | 1900 |
| 28 | 492 | 1900 |
| 29 | 477 | 1900 |
| 30 | 574 | 1900 |
| 31 | 534 | 1900 |
| 32 | 483 | 1900 |
| 33 | 383 | 1900 |
| 34 | 522 | 1900 |
| 35 | 483 | 1900 |
| 36 | 368 | 1900 |
| 37 | 337 | 1900 |
| 38 | 276 | 1900 |
| 39 | 318 | 1900 |
| 40 | 356 | 1900 |




8

16 % of ITACA stations

## Microtremor H/V spectral ratio

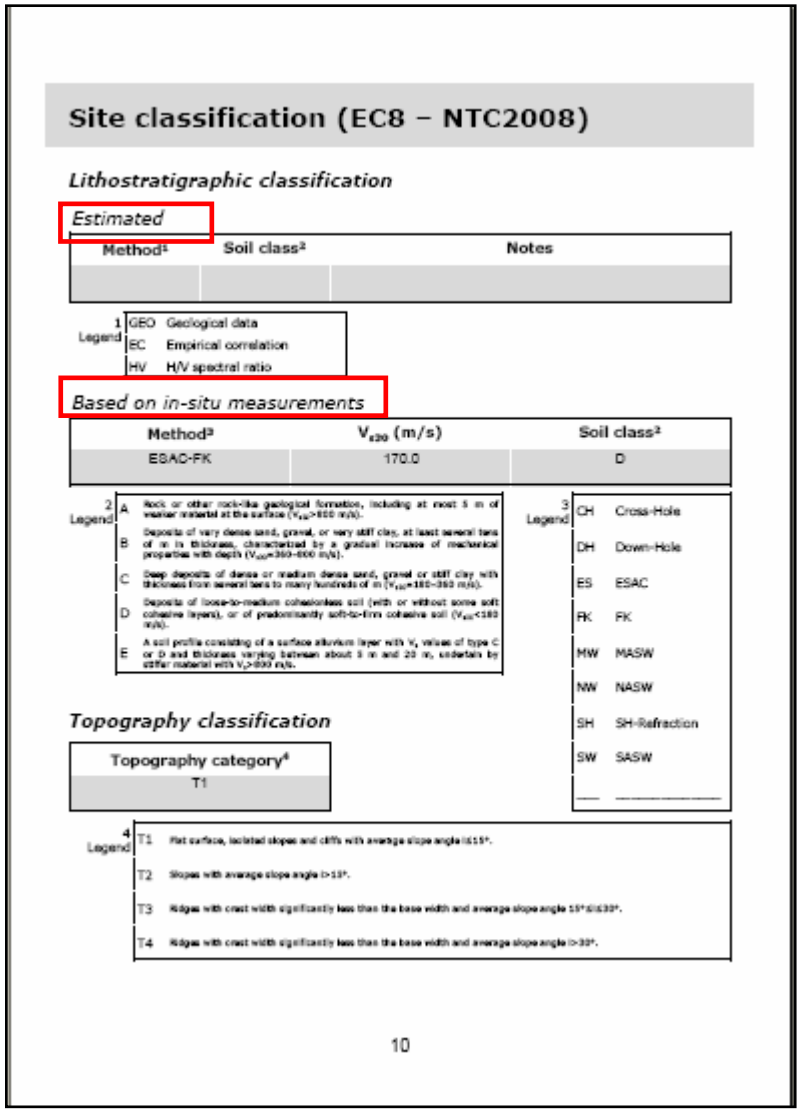



$f_{0\ (mt)}$ (Hz) 0.35

9

32 % of ITACA stations

# ITACA 1.0 – Updated station report



## Site classification (EC8 – NTC2008)

*Lithostratigraphic classification*

*Estimated*

| Method[1] | Soil class[2] | Notes |
|---|---|---|
| | | |

Legend 1

| | |
|---|---|
| GEO | Geological data |
| EC | Empirical correlation |
| HV | H/V spectral ratio |

*Based on in-situ measurements*

| Method[3] | $V_{s30}$ (m/s) | Soil class[2] |
|---|---|---|
| ESAC-FK | 170.0 | D |

Legend 2

| | |
|---|---|
| A | Rock or other rock-like geological formation, including at most 5 m of weaker material at the surface ($V_{s30}$>800 m/s). |
| B | Deposits of very dense sand, gravel, or very stiff clay, at least several tens of m in thickness, characterized by a gradual increase of mechanical properties with depth ($V_{s30}$=360–800 m/s). |
| C | Deep deposits of dense or medium dense sand, gravel or stiff clay with thickness from several tens to many hundreds of m ($V_{s30}$=180–360 m/s). |
| D | Deposits of loose-to-medium cohesionless soil (with or without some soft cohesive layers), or of predominantly soft-to-firm cohesive soil ($V_{s30}$<180 m/s). |
| E | A soil profile consisting of a surface alluvium layer with $V_s$ values of type C or D and thickness varying between about 5 m and 20 m, underlain by stiffer material with $V_s$>800 m/s. |

Legend 3

| | |
|---|---|
| CH | Cross-Hole |
| DH | Down-Hole |
| ES | ESAC |
| FK | FK |
| MW | MASW |
| NW | NASW |
| SH | SH-Refraction |
| SW | SASW |
| ___ | _____ |

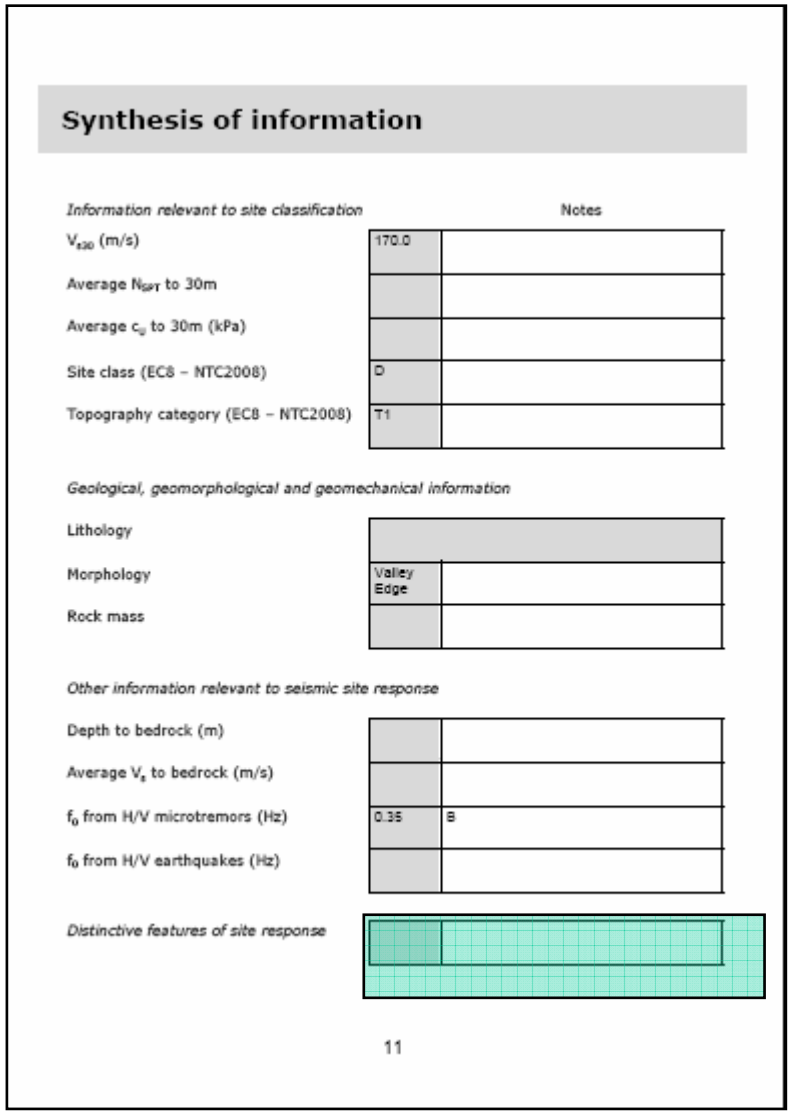
*Topography classification*

| Topography category[4] |
|---|
| T1 |

Legend 4

| | |
|---|---|
| T1 | Flat surface, isolated slopes and cliffs with average slope angle ≤15°. |
| T2 | Slopes with average slope angle >15°. |
| T3 | Ridges with crest width significantly less than the base width and average slope angle 15°≤i≤30°. |
| T4 | Ridges with crest width significantly less than the base width and average slope angle i>30°. |

10



## Synthesis of information

| *Information relevant to site classification* | | Notes |
|---|---|---|
| $V_{s30}$ (m/s) | 170.0 | |
| Average $N_{SPT}$ to 30m | | |
| Average $c_u$ to 30m (kPa) | | |
| Site class (EC8 – NTC2008) | D | |
| Topography category (EC8 – NTC2008) | T1 | |

*Geological, geomorphological and geomechanical information*

| | | |
|---|---|---|
| Lithology | | |
| Morphology | Valley Edge | |
| Rock mass | | |

*Other information relevant to seismic site response*

| | | |
|---|---|---|
| Depth to bedrock (m) | | |
| Average $V_s$ to bedrock (m/s) | | |
| $f_0$ from H/V microtremors (Hz) | 0.35 | B |
| $f_0$ from H/V earthquakes (Hz) | | |

*Distinctive features of site response*

11

**16 % with $V_{s30}$, 84% without $V_{s30}$ (*), 97% with topography class**

# ITACA 1.0 – New station surveys


53 more stations with Vs profiles

(SW techniques)

+ 3 DH (L'Aquila)

+ 4 DH from other projects

# ITACA 1.0 – Surveys related to L'Aquila earthquake

| Station | Survey | RU | Vs30 (m/s) | Notes |
|---|---|---|---|---|
| **AQA** | MASW | RU3 | 495 | |
| | DH | RU6 + DPC | 552 | Borehole at 30 m depth |
| **AQG** | ESAC+HVSR | RU7 | 1150 | DH survey close to station. ESAC at the foot of the hill. |
| | DH | RU6 | 685 | Borehole at 40 m depth |
| **AQK** | DH | RU6 + DPC | 717 | Borehole at 50 m depth |
| **AQP** | ESAC+HVSR | RU7 | 830 | |
| **AQV** | CH | - | 474 | Available in ITACA from Project S6 |
| **BZZ** | ESAC | RU8 | 679 | |
| **MI03 (Onna)** | ESAC | RU8 | 378 | |
| **GSA** | MASW | RU2 | 488 | |

# ITACA 1.0 – Stations

**742** total number of stations (**446** with at least 1 rec and **162** with at least 6 recs)

| DPC | BAS | RAIS | ENEA | PVTR | Temp. |
|---|---|---|---|---|---|
| 634 | 21 | 12 | 56 | 4 | 15 |

**693** with site classification (remaining are RAN stations recently installed)

| A | B | C | D | E | Total |
|---|---|---|---|---|---|
| 298 | 197 | 170 | 17 | 11 | 693 |
| **43** | **28** | **25** | **2.4** | **1.6** | **100%** |

**131** with Vs profile (**18**% of total) – remaining stations classified on surface geology

| A | B | C | D | E | Total |
|---|---|---|---|---|---|
| 19 | 64 | 33 | 8 | 7 | 131 |
| **15** | **49** | **25** | **6** | **5** | **100%** |

**572** with topography NTC 08 classification (**77**% of total)

| T1 | T2 | T3 | T4 | Total |
|---|---|---|---|---|
| 452 | 89 | 22 | 9 | 572 |
| **79** | **15.5** | **4** | **1.5** | **100%** |

# ITACA 1.0 – Records and Events

**3955** 3-component records from **1825** events

**2215** from 1972 to 2004, from **1050** events

**1347** from 2005 to 2007 (651 corrected records with M > 3), from **751** events

**63** from Dec 23, 2008 Parma earthquake (**2** events)

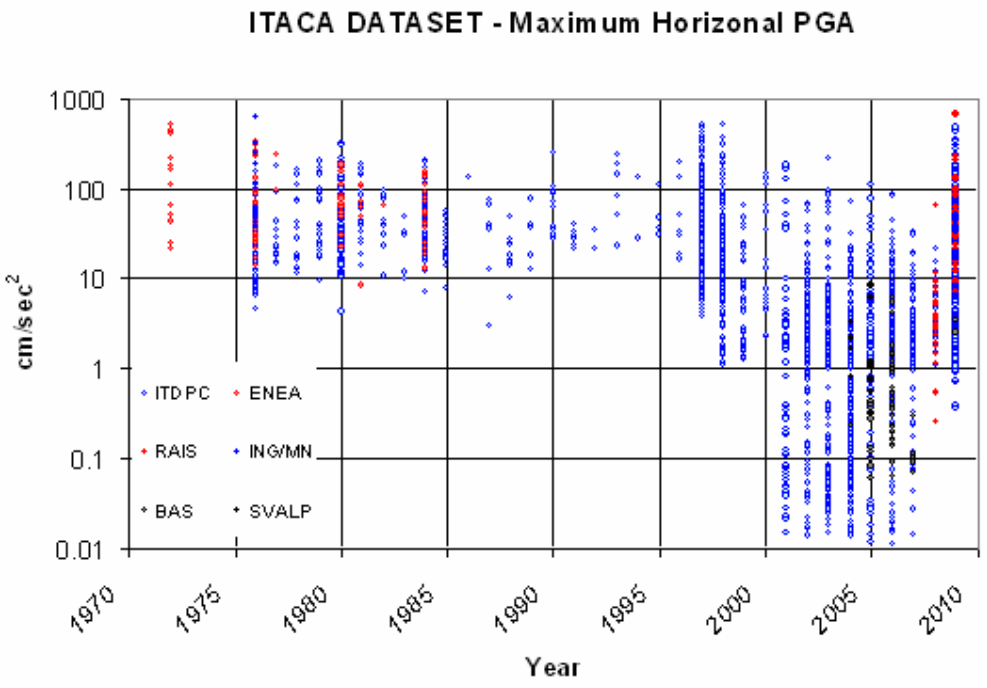
**319** from L'Aquila earthquake sequence (**13** events with M > 4)

| RAN | BAS | ENEA | ING (GMN) | MN (AQU) | PVTR | RAIS | SVALP |
|---|---|---|---|---|---|---|---|
| 3505 | 148 | 91 | 13 | 11 | 26 | 109 | 18 |

All events revised by a seismologist (F. Mele, CNT)

# ITACA 1.0 – Records

| | Total | Analog | Digital |
|---|---|---|---|
| **M ≥ 3** | **2416** (**191** with PGA > 0.1g) | **648** (**317** late triggered) | **1768** |
| **M ≥ 4** | **1487** (**160** with PGA > 0.1g) | **533** (**252** late triggered) | **954** |
| **M ≥ 5** | **736** (**103** with PGA > 0.1g) | **264** (**106** late triggered) | **472** |
| **M ≥ 6** | **125** (**19** with PGA > 0.1g) | **51** (**13** late triggered) | **74** |



# ITACA – release 1.0 – http://itaca.mi.ingv.it

# ITACA - User's registration

## Register or login to Itaca

Free registration is required in order to access the required object, please register or login using one of the forms below.

### Returning users: login

Email address: paolucci@stru.polimi.it

Login

### New users: registration

Please provide the following data in order to have full access to the Itaca database:

First Name:

Last Name:

Email address:

Profession: University/Research

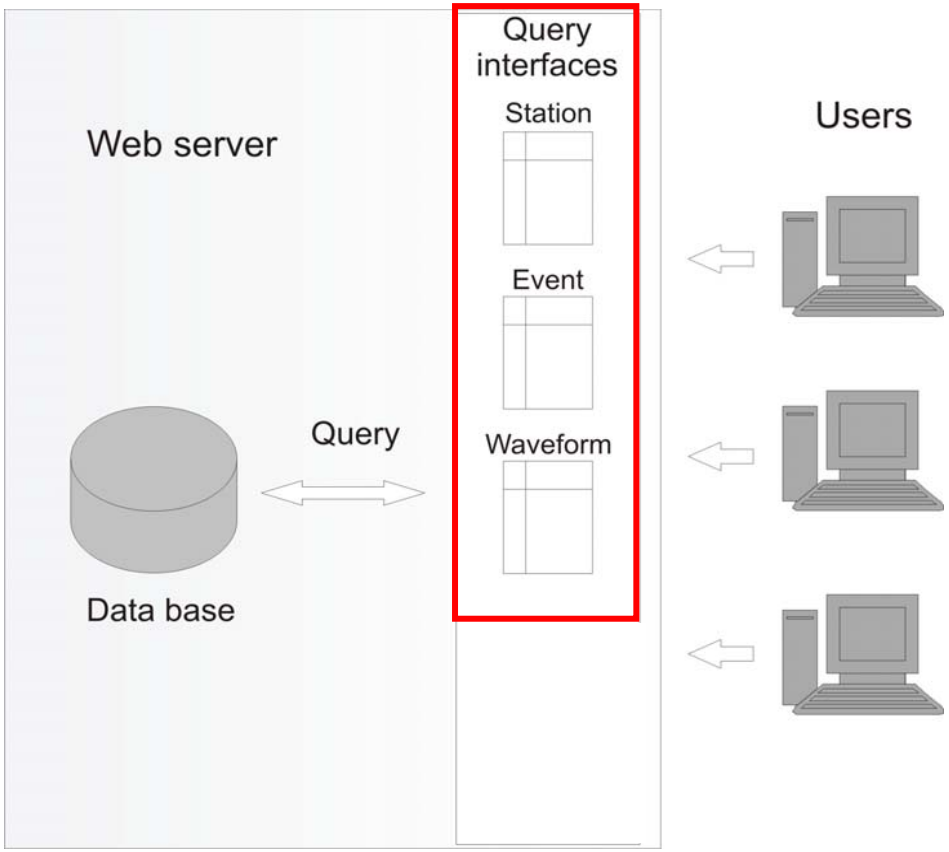
Work field (optional):

Affiliation:

Motivation for using Itaca (optional):

Register

# ITACA - How it works




The database can be explored through **29** key fields: **9** for the stations, **10** for the seismic events and **10** for the waveforms.
Each query produces a list of outcomes which can be explored in detail

# WAVEFORM SEARCH

**Waveform** click to show-hide

| | | | | |
|---|---|---|---|---|
| Magnitude ($M_W$ or $M_L$) | from [≥]: | 5.5 | to [<]: | |
| Epicentral distance [Km] | from [≥]: | | to [<]: | 20 |
| Fault distance [km] | from [≥]: | | to [<]: | |
| Corrected PGA [cm/s$^2$] | from [≥]: | | to [<]: | |
| Uncorrected PGA [cm/s$^2$] | from [≥]: | | to [<]: | |
| PGV [cm/s] | from [≥]: | | to [<]: | |
| PGD [cm] | from [≥]: | | to [<]: | |
| Housner Int. [cm] | from [≥]: | | to [<]: | |
| Duration [s] | from [≥]: | | to [<]: | |
| Arias intensity [cm/s] | from [≥]: | | to [<]: | |
| Late triggered record? | -- Any value -- | | | |
| Instrument type | -- Any value -- | | | |

**Events** click to show-hide

**Stations** click to show-hide

| | | | | |
|---|---|---|---|---|
| Network | -- Any value -- | | | |
| Station Code | | | | |
| Station Name | buia | | | |
| Latitude (e.g. 45.27) | from [≥]: | | to [<]: | |
| Longitude (e.g. 12.7) | from [≥]: | | to [<]: | |
| Region | | | | |
| Province | | | | |
| Municipality | | | | |
| EC8 | -- Any value -- | | | |
| Housing | -- Any value -- | | | |

Search Criteria

Link to event and station

## Query visualization

New Search | Export to Excel | Search | Search / Select

Waveform detail

Results 1 - 3 of 3

| Date | $M_W$ | $M_L$ | Stat. Code | EC8 | R epi. [km] | PGA [cm/s$^2$] | PGV [cm/s] | PGD [cm] | Detail |
|---|---|---|---|---|---|---|---|---|---|
| 1976-09-11 16:35:01 | 5.6 | 5.8 | BUI | C | 19.528 | 229.004 | 22.713 | 2.8789 | |
| 1976-09-15 03:15:18 | 5.9 | 6.1 | BUI | C | 11.616 | 108.702 | 12.019 | 2.3171 | |
| 1976-09-15 09:21:18 | 5.9 | 6.0 | BUI | C | 11.266 | 87.181 | 8.226 | 2.1424 | |

# WAVEFORM SEARCH

## Search + Select option


Selects waveforms to export

| Export? | Date | $M_W$ | $M_L$ | Stat. Code | EC8 | R epi. [km] | PGA [cm/s$^2$] | PGV [cm/s] | PGD [cm] | Detail |
|---|---|---|---|---|---|---|---|---|---|---|
| ☐ | 1976-09-11 16:35:01 | 5.6 | 5.8 | BUI | C | 19.528 | 229.004 | 22.713 | -2.8789 | |
| ☐ | 1976-09-15 03:15:18 | 5.9 | 6.1 | BUI | C | 11.616 | 108.702 | 12.019 | 2.3171 | |
| ☐ | 1976-09-15 09:21:18 | 5.9 | 6.0 | BUI | C | 11.266 | 87.181 | 8.226 | -2.1424 | |

Back to Search | Export Corrected | Export Uncorrected | Export Both

# WAVEFORM DETAIL

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Network** | ENEA | **Station code** | BUI | **Type** | Analog | **Station records** | |
| **Event time** | 1976-09-15 03:15:18 | $M_W$ | 5.9 | $M_L$ | 6.1 | **R epi. [km]** | 11.616 |
| **Late triggered record?** | NO | **Instrument type** | Analog | | | | |

Waveform Plots NS | Waveform Plots WE | Waveform Plots UP

Plot

**UNCORRECTED** **time step [s]** 0.00244

**CORRECTED** **time step [s]** 0.0050 **filter type** BUTTERWORTH

**units** cm/s^2

| | NS | UP | WE |
|---|---|---|---|
| **UNCORRECTED** | | | |
| **points** | 10838 | 10843 | 10836 |
| **peak acceleration [cm/s$^2$]** | 109.3815 | 76.8123 | 92.6064 |
| **peak at [s]** | 3.0500 | 2.9280 | 3.5868 |
| **CORRECTED** | | | |
| **points** | 5288 | 5288 | 5288 |
| **peak acceleration [cm/s$^2$]** | 108.7025 | 67.8987 | -91.1525 |
| **peak at [s]** | 3.0450 | 2.9250 | 3.5800 |
| **Housner Int. [cm]** | 53.5777 | 22.3826 | 34.8479 |
| **peak velocity [cm/s]** | -10.8103 | -7.7332 | 12.0189 |
| **peak displacement [cm]** | 2.3171 | -1.5320 | 2.1394 |
| **Arias intensity [cm/s]** | 15.3810 | 3.4038 | 11.7411 |
| **T90 Effective duration [s]** | 8.1350 | 7.8200 | 10.2400 |
| **high pass [Hz]** | 0.1500 | 0.1500 | 0.1500 |
| **low pass [Hz]** | 29.0000 | 29.0000 | 29.0000 |

Export in Zip file

Corrected records (only corrected time histories and response spectra) - ascii format

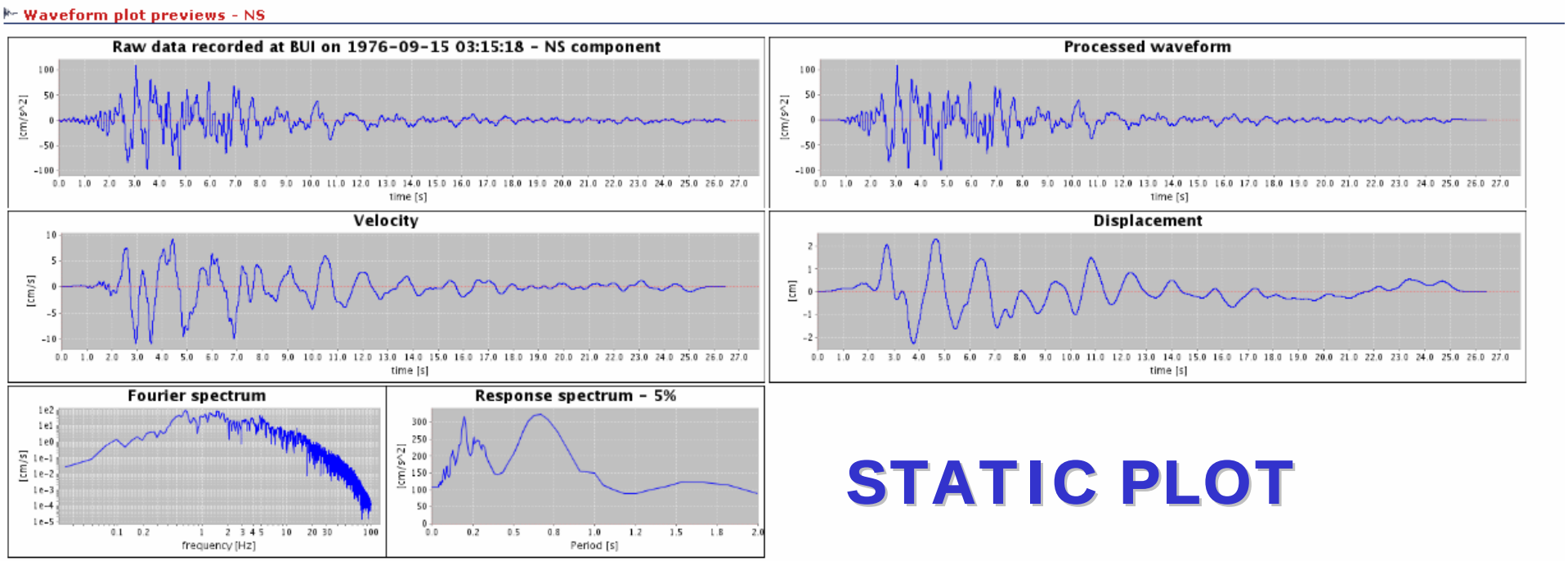
Uncorrected records (only acceleration time histories) - ascii and sac format

Both corrected an uncorrected records - ascii format

Download

Search Again

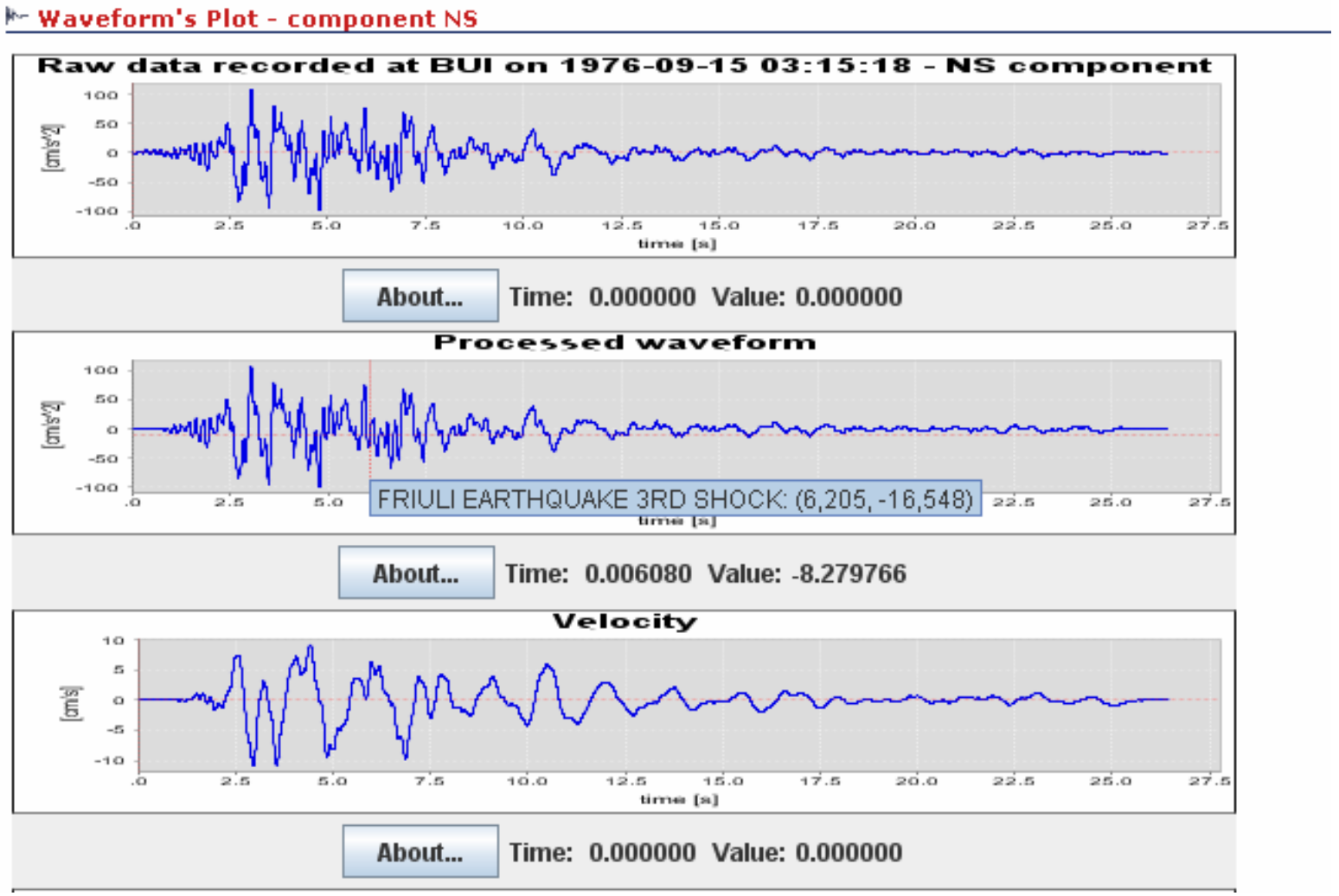
# WAVEFORM PLOT




## STATIC PLOT

# WAVEFORM PLOT

## JAVA APPLET



# STATION SEARCH


o Nazionale
fisica
anologia

Homepage | Waveforms | Stations | Events | Reference | REXELite | Glossary

**Stations search**

| | | |
|---|---|---|
| Network | | – Any value – |
| Station Code | contains | |
| Station Name | contains | buia |
| Latitude (e.g. 45.27) | | from [≥]: to [<]: |
| Longitude (e.g. 12.7) | | from [≥]: to [<]: |
| Region | contains | – Any value – |
| Province | contains | |
| EC8 | | – Any value – |
| Topography | = | – Any value – |
| Housing | | – Any value – |
| Morphology | | – Any value – |
| Number of Records | >= | |
| Export in Google Earth format | | Export in Google Earth format |

Search

Results 1 - 1 of 1

| Network | Stat. Code | Station Name | Latitude | Longitude | Municipality | EC8 | Instr. type | Topography | Housing | Morph. | Rec. | Records |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ENEA | BUI | BUIA | 46.221667 | 13.090278 | BUIA | C | Analog | T1 | | Plain | 7 | |

Station Detail

EC8 site class

NTC08 topography class, based on GIS

Morphology

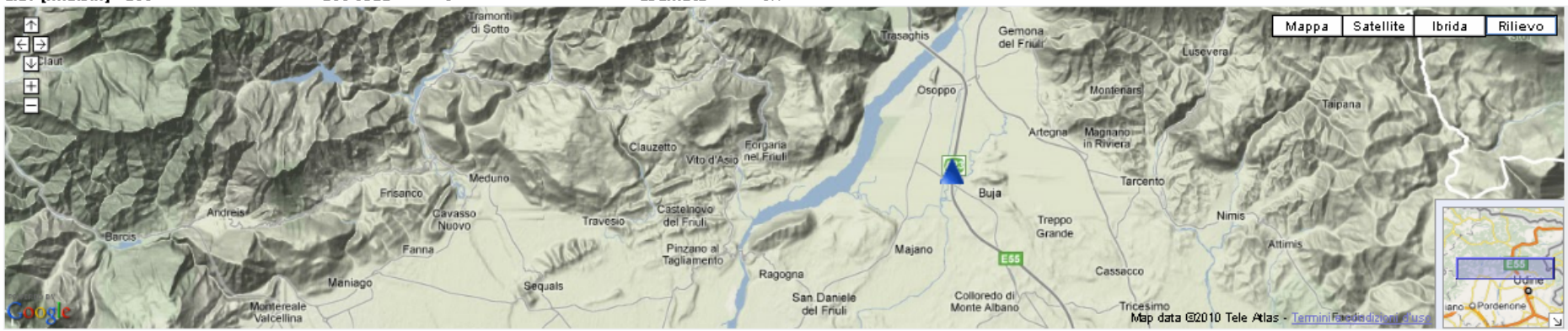
# STATION SEARCH

Stations of Basilicata region (RAN + BAS networks)

# STATION DETAIL

## Station detail

| | | | | | |
|---|---|---|---|---|---|
| **Network** | ENEA | **Station Code** | BUI | | |
| **Station Name** | BUIA | | | | |
| **Instr. Type** | Analog | | | | |
| **Lat** | 46.221667 | **Long** | 13.090278 | **Projection** | GEOWGS84 |
| **Elev [m.a.s.l.]** | 163 | **EC8 Code** | C | **Estimate** | CH |




| | | | | | |
|---|---|---|---|---|---|
| **Install. Date** | 1976-07-16 00:00:00 | **Removal date** | 1977-05-30 00:00:00 | | |
| **Address** | | | | | |
| **Municipality** | BUIA | | | | |
| **Proximity** | No information | | | | |
| **Permanent** | Temporary | **Housing** | | | |
| **Installation** | Directly on the ground | | | | |
| **IGM sheet** | 25 | **Sector** | IV | **Orientation** | SE |
| **Morphology** | Plain | | | | |
| **Topography** | T1 - Flat surface, isolated slopes and cliffs with average slope angle i<=15° | | | | |

Soil profile

### GEOTECHNICAL LOGS

| Code | Reference | Latitude | Longitude | Nspt profile | Vs/Vp profile | Cu profile |
|---|---|---|---|---|---|---|
| 1 | ENEA | | | | | |

Station report

### STRATIGRAPHY

| Code | Reference | Latitude | Longitude | Detail |
|---|---|---|---|---|
| 1 | ENEA | | | |

Download station monography...

Station Records | Search Again ← All records

# STATION WAVEFORMS

## Station records

| | |
|---|---|
| **Network** | ENEA |
| **Station Code** | BUI |
| **Municipality** | BUIA |
| **Station Name** | BUIA |
| **Instr. Type** | Analog |
| **Latitude** | 46.221667 |
| **Longitude** | 13.090278 |

Instrument Detail

INSTRUMENTS

| Instrument | Installed | Removed | Detail |
|---|---|---|---|
| Sensor:Kinemetrics - SMA-1 Digitizer: - | 1976-07-16 00:00:00 | 1977-05-30 00:00:00 | |

RECORDS

| Export? | Date | $M_W$ | $M_L$ | R epi. [km] | PGA [cm/s$^2$] | PGV [cm/s] | PGD [cm] | Detail |
|---|---|---|---|---|---|---|---|---|
| ☑ | 1976-09-11 16:35:01 | 5.6 | 5.8 | 19.528 | 229.004 | 22.713 | 2.879 | |
| ☑ | 1976-09-15 03:15:18 | 5.9 | 6.1 | 11.616 | 108.702 | 12.019 | 2.317 | |
| ☑ | 1976-09-15 09:21:18 | 5.9 | 6.0 | 11.266 | 87.181 | 8.226 | 2.142 | |
| ☑ | 1976-09-13 18:54:45 | 4.6 | 4.3 | 10.866 | 63.133 | 1.981 | 0.185 | |
| ☑ | 1976-09-11 16:31:10 | 5.1 | 5.5 | 10.274 | 43.880 | 2.911 | 0.306 | |
| ☑ | 1976-09-15 04:38:53 | 4.9 | 4.8 | 7.772 | 34.821 | 1.506 | 0.114 | |
| ☑ | 1976-09-06 19:28:12 | | 3.6 | 12.759 | 31.154 | 0.882 | 0.055 | |

# INSTRUMENT DETAIL

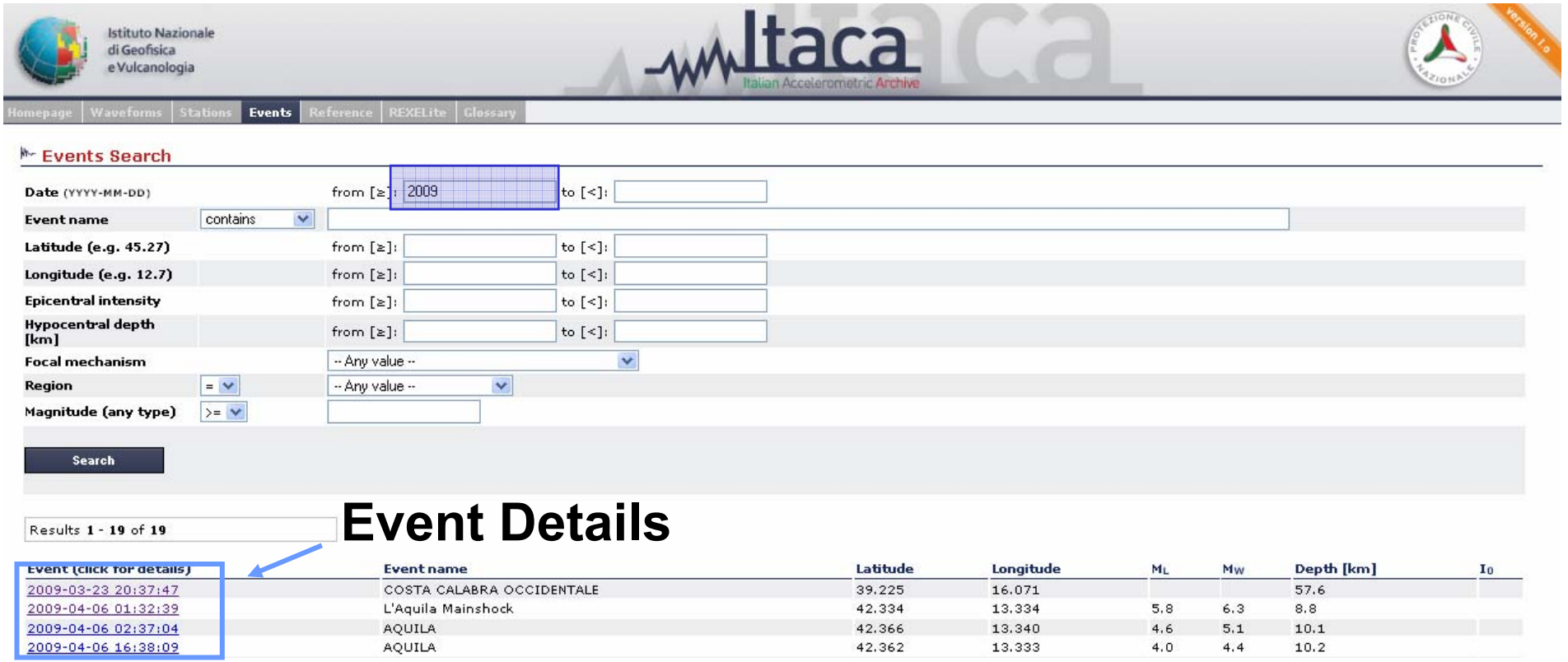
## Instrument Detail

| | |
|---|---|
| **Network** | ENEA |
| **Station** | BUI **Station** |
| **Sensor manufacturer** | Kinemetrics |
| **Sensor model** | SMA-1 |
| **Digitizer manufacturer** | |
| **Digitizer model** | |
| **Instrument type** | Analog |
| **Sensor serial number** | 0 |
| **Digitizer serial number** | K2688 |
| **Installed** | 1976-07-16 00:00:00 |
| **Removed** | 1977-05-30 00:00:00 |
| **Samples per sec** | 0.0 |
| **Number of bits ADC** | |

CHANNELS

| Orientation | Azimuth | Inclination | Sensitivity | Units sensitivity | Gain | Frequency [Hz] | Damping | Full scale | Detail |
|---|---|---|---|---|---|---|---|---|---|
| NS | 0.0 | 0.0 | 1.84 | cm/g | | 25.7 | 0.61 | | |
| UP | 0.0 | 90.0 | 1.68 | cm/g | | 26.3 | 0.58 | | |
| WE | 90.0 | 0.0 | 1.72 | cm/g | | 26.4 | 0.6 | | |

# EVENT SEARCH




**Event Details**

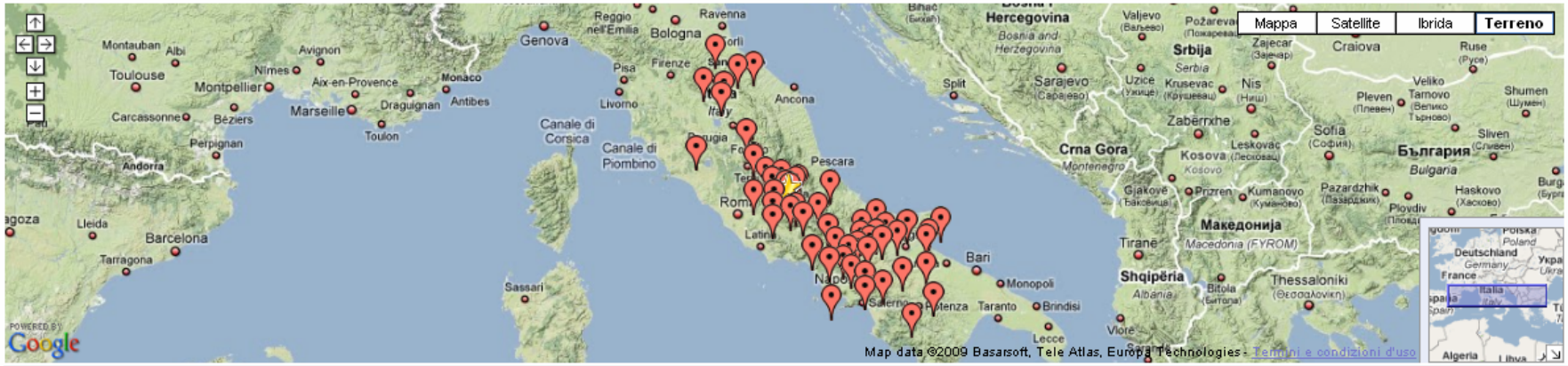
# EVENT DETAIL

## Event Detail

| | | | | | |
|---|---|---|---|---|---|
| **Date** | 2009-04-06 01:32:39 | **Event name** | L'Aquila Mainshock | | |
| **Lat** | 42.33 ± 0.79km | **Long** | 13.33 ± 0.79km | **Depth [km]** | 8.8 ± 1.49 |
| **Hypocenter reference** | INGV-CNT Seismic Bulletin | **Other hypocenter** | | | |

### MAGNITUDE

| Type | Method | Reference | Value | Error |
|---|---|---|---|---|
| ML | ML from ING catalogue | INGV-CNT Seismic Bulletin | 5.8 | 0.3 |
| Mw | Mw from RCMT | RCMT-INGV | 6.3 | |




| | | | | | |
|---|---|---|---|---|---|
| **Municipality** | L'AQUILA | **Province** | L'Aquila | | |
| **Focal Mechanism** | | | | | |
| **Type** | NF | **Method** | RCMT | **ref.** | RCMT-INGV |
| **Strike** | 127.0 | **Dip** | 50.0 | **Rake** | -109.0 |
| **Fault** | | **Surf. Rupt.** | | **ref.** | |
| **Other faults** | | | | | |
| **$I_0$** | | **Other $I_0$** | | **ref.** | |
| **Located** | | | | | |

Recording Stations

### WAVEFORMS

| Station | R epi. [km] | PGA [cm/s²] | PGV [cm/s] | Detail |
|---|---|---|---|---|
| ANT | 23.017 | 11.474 | 2.468 | |
| AQA | 4.634 | 467.737 | 9.367 | |
| AQG | 4.392 | 253.118 | 10.400 | |
| AQK | 5.650 | 360.004 | 20.061 | |
| AQV | 4.870 | 649.256 | 12.444 | |
| ASS | 101.740 | 6.047 | 0.436 | |
| AVL | 198.073 | 1.269 | 0.370 | |

# ITACA GLOSSARY

INGV

Itaca

## GLOSSARY[1]

| Key Word | Meaning |
|---|---|
| *Accelerometer (Analog or Digital)* | Instrument to measure strong motion acceleration. It can be of two types:<br>*analog*: ground acceleration is reproduced by a mechanical instrument on a physical support, typically paper or photographic film, and it is digitized at a later stage.<br>*digital*: it is typically based on either electro-magnetic or force-balance transducers. The electric signal is then properly conditioned, sampled and digitized. The digital instruments are operating from about the mid-80s. The picture of a digital accelerometer widely used also in the Italian Accelerometric Network is illustrated in Fig. 1.<br><br>The most representative parameters defining the characteristics of the recording instrument response are as follows:<br>- the sensor undamped natural vibration frequency (*frequency*);<br>- the sensor damping coefficient with respect to critical (*damping*);<br>- the frequency band for which the sensor gives a flat response (*frequency band*);<br>- the generator constant of the sensor (*gain*);<br>- an expression of the smallest signal that can be resolved by the sensor (*sensitivity*);<br>- the maximum signal that can be resolved by the sensor (*full scale*);<br>- the number of bits of the recorder (*number of bits*). |

[1] Part of texts and figures are adapted from Faccioli E. and R. Paolucci: "Elementi di Sismologia applicata all'Ingegneria", Pitagora, 2005, in Italian.



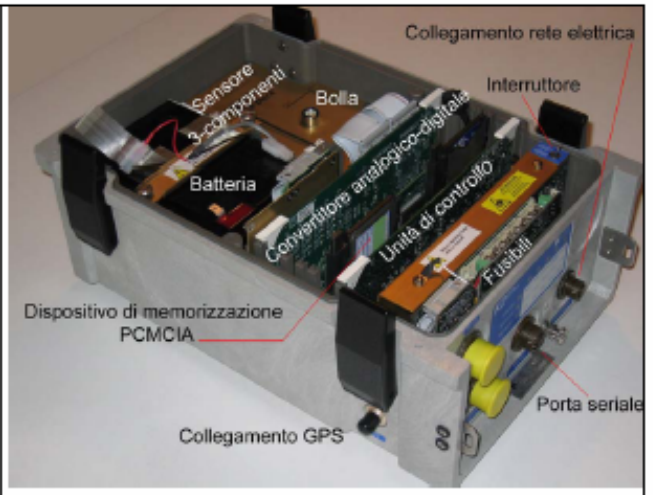



Figure 1– The digital accelerometer K2 with its main components.

| | |
|---|---|
| *Arias Intensity* | The Arias Intensity is an integral parameter of severity of ground motion. Introducing the function of motion intensity:<br>$I(t) = \frac{\pi}{2g}\int_0^t a^2(\tau)d\tau$<br>where $a(t)$ is the acceleration at time $t$ and $g$ the gravity acceleration, the Arias Intensity is the maximum value of this function, i.e.:<br>$I_A = I(T_d)$<br>where $T_d$ is the accelerogram total duration. Arias Intensity is dimensionally a velocity (cm/s). A sample of calculation of the Arias Intensity is shown in Fig. 2b (see *Duration*). |
| *Baseline Correction* | Baseline correction is a procedure to correct certain types of long period disturbances on accelerometric signals, both analog and digital. The simplest procedure is to subtract from the accelerogram its average value (which theoretically should be zero to ensure a zero velocity at the end of the seismic motion). Alternatively, in the case of digital accelerograms with pre-event, it is possible to remove from the entire signal the average value calculated only on the pre-event portion. Finally, in the case of more complex instrumental disturbances, more sophisticated baseline correction procedures can be used, for instance by first sub-dividing the velocity signal (obtained by integrating the initial accelerogram) into multiple ranges, by estimating subsequently the drifts relative to each range using least square regression, and finally by removing them.<br>In processing the accelerometric data contained in ITACA, the standard |

# ITACA – REXELite

## REXELITE

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

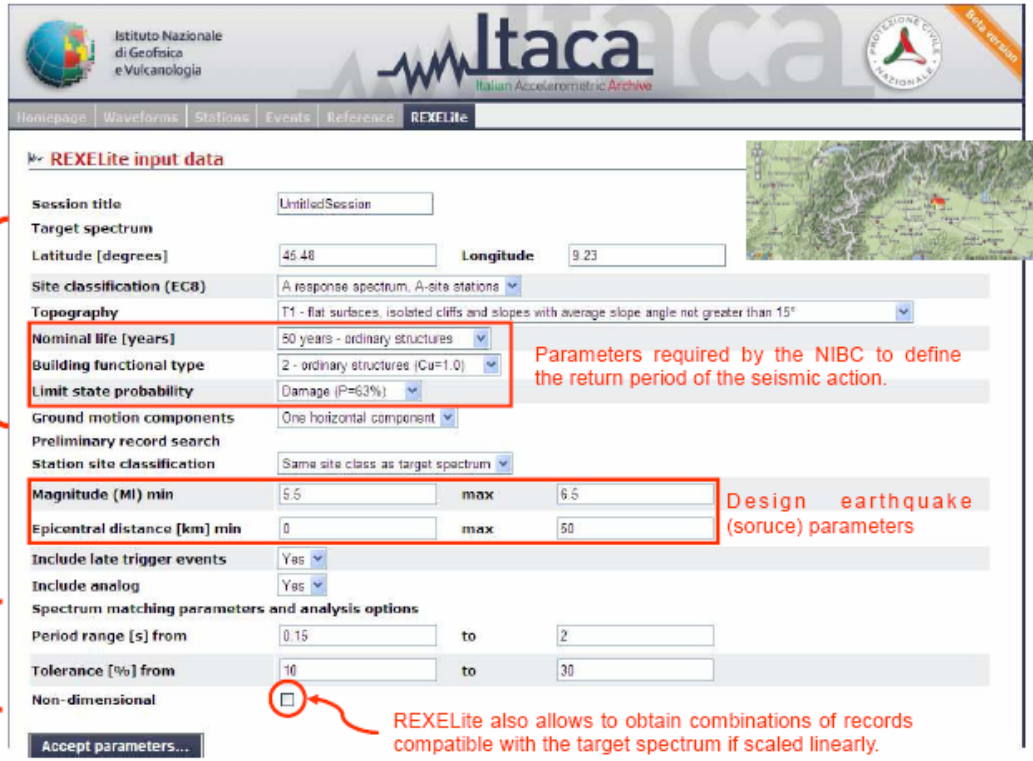
⇧ Image of the REXEL (v 2.5 beta) GUI - http://www.reluis.it/

### 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 .




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

Design earthquake (soruce) parameters

REXELite also allows to obtain combinations of records compatible with the target spectrum if scaled linearly.

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

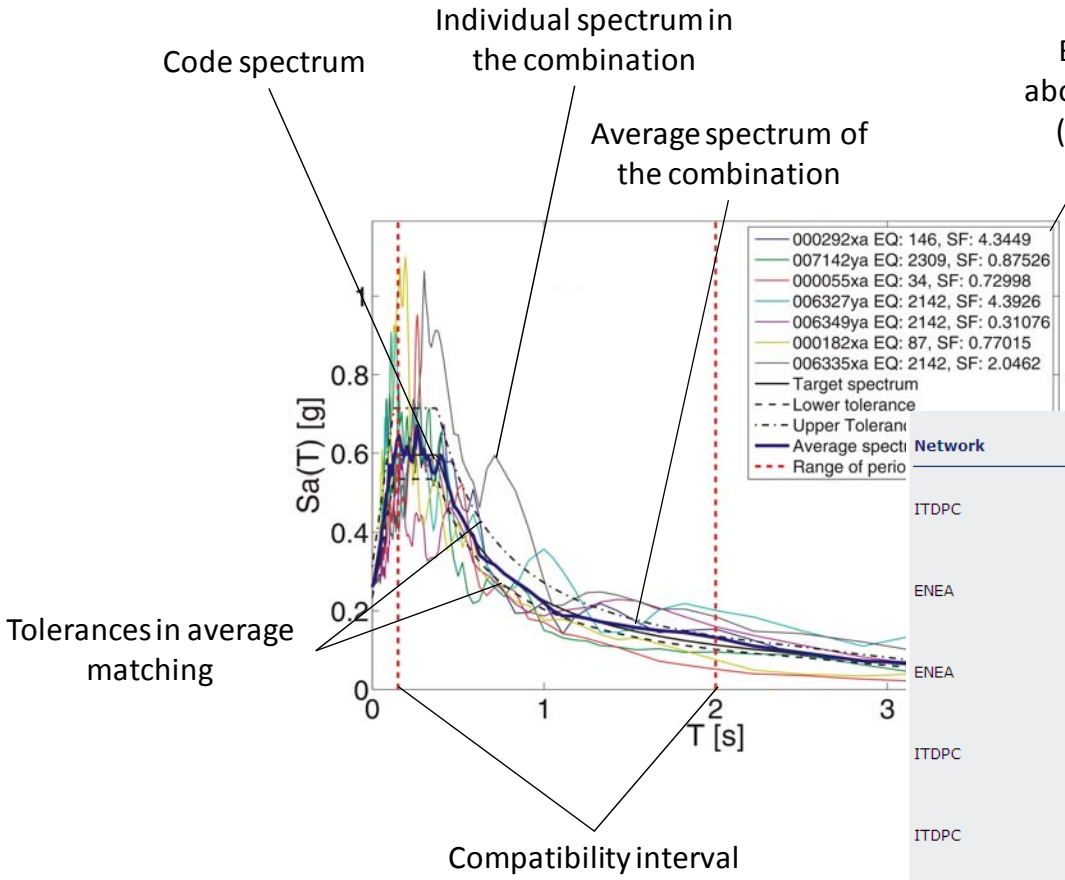
⇧ Image of the REXELite GUI - http://itaca.mi.ingv.it/

### … and ④ Run REXELite …

Individual spectrum in

# ITACA – REXELite

## REXELite – example of output

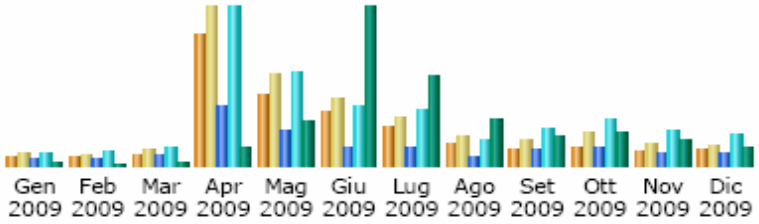



| Network | Station code | Type | Event time | m | Sparkline |
|---|---|---|---|---|---|
| ITDPC | SMT | Analog | 1976-09-11 16:35:01 | | |
| ENEA | SRC0 | Analog | 1976-09-11 16:35:01 | | |
| ENEA | SRC0 | Analog | 1976-09-15 09:21:18 | | |
| ITDPC | SPL | Analog | 1979-09-19 21:35:37 | | |
| ITDPC | ALT | Analog | 1980-11-23 18:34:53 | | |
| ENEA | ATR | Analog | 1984-05-11 10:41:48 | | |
| ITDPC | GBB | Analog | 1997-09-26 09:40:25 | | |

# Conclusions and perspectives (1)

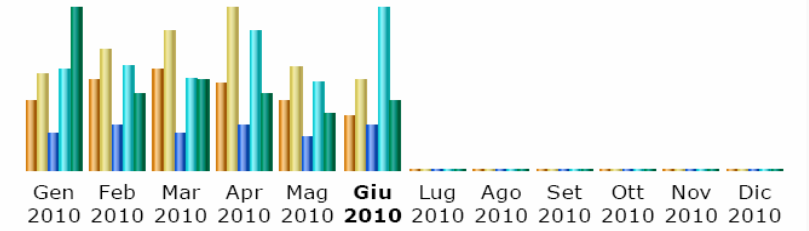
✓ ITACA has consolidated its role as the **reference Italian strong motion database,** both at a national and international scale:

**Riepilogo mensile**




| Mese | Visitatori diversi | Numero di visite | Pagine | Accessi | Banda usa |
|---|---|---|---|---|---|
| Gen 2009 | 346 | 483 | 9155 | 15282 | 432.97 M |
| Feb 2009 | 305 | 439 | 7246 | 16847 | 269.69 M |
| Mar 2009 | 409 | 607 | 13176 | 23869 | 541.38 M |
| Apr 2009 | 5420 | 6588 | 78999 | 214661 | 3.21 GE |
| Mag 2009 | 2964 | 3849 | 46316 | 128590 | 7.52 GE |
| Giu 2009 | 2233 | 2834 | 25764 | 78773 | 26.28 GI |
| Lug 2009 | 1572 | 2017 | 24411 | 74274 | 14.66 GI |
| Ago 2009 | 881 | 1182 | 11231 | 33819 | 7.70 GE |
| Set 2009 | 641 | 1092 | 19926 | 48727 | 4.91 GE |
| Ott 2009 | 762 | 1321 | 24520 | 62547 | 5.30 GE |
| Nov 2009 | 560 | 949 | 15674 | 46948 | 4.21 GE |
| Dic 2009 | 601 | 857 | 14957 | 40944 | 3.14 GE |
| Totale | 16694 | 22218 | 291375 | 785281 | 78.14 GI |

**Riepilogo mensile**




| Mese | Visitatori diversi | Numero di visite | Pagine | Accessi | Banda usata |
|---|---|---|---|---|---|
| Gen 2010 | 623 | 855 | 24694 | 68896 | 3.46 GB |
| Feb 2010 | 805 | 1083 | 31394 | 70516 | 1.64 GB |
| Mar 2010 | 904 | 1241 | 24928 | 62148 | 1.95 GB |
| Apr 2010 | 785 | 1445 | 31264 | 93388 | 1.62 GB |
| Mag 2010 | 619 | 916 | 21784 | 59604 | 1.22 GB |
| **Giu 2010** | 494 | 808 | 30959 | 108792 | 1.49 GB |
| Lug 2010 | 0 | 0 | 0 | 0 | 0 |
| Ago 2010 | 0 | 0 | 0 | 0 | 0 |
| Set 2010 | 0 | 0 | 0 | 0 | 0 |
| Ott 2010 | 0 | 0 | 0 | 0 | 0 |
| Nov 2010 | 0 | 0 | 0 | 0 | 0 |
| Dic 2010 | 0 | 0 | 0 | 0 | 0 |
| Totale | 4230 | 6348 | 165023 | 463344 | 11.39 GB |

✓ Integration of ITACA records in **NERIES** (only digital records since 1998) has been accomplished.

✓Integration of ITACA records within **COSMOS** about to be finished (only records with M > 5).

# Conclusions and perspectives (2)

✓ Aside from minor updates that will be implemented soon, **all major objectives initially planned have been attained**; involvement of other local networks in Italy should be probably made on the basis of a consortium, with a common web portal.

✓ The **"backstage" activity** was huge, more than initially expected.

✓ Important **research activities** carried out in Project S4 were strictly related to the ITACA development (see Poster and Oral sessions)

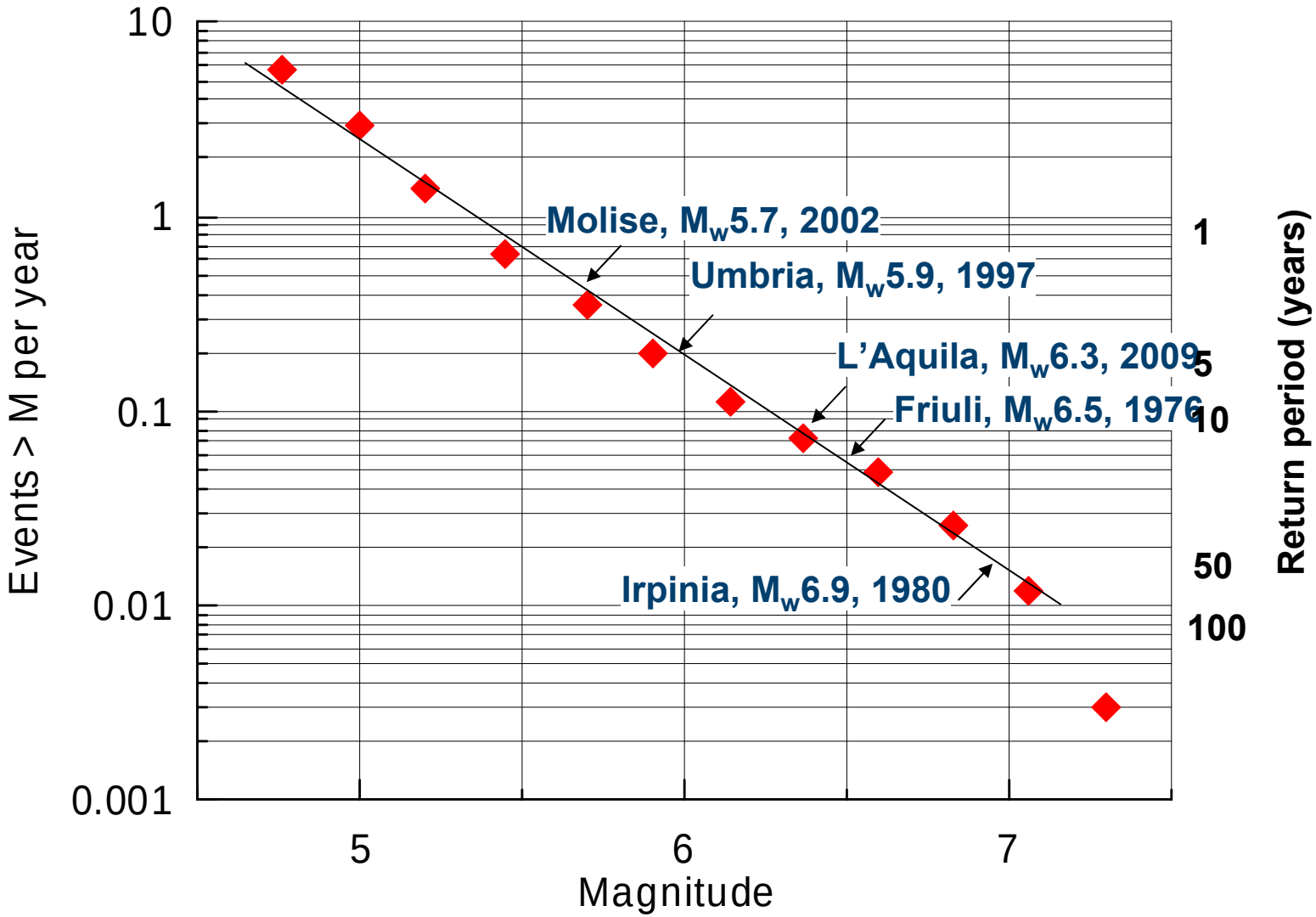
# Conclusions and perspectives (3)

✓ The successful efforts to create ITACA, jointly made by the staff of DPC with the installation and maintenance of the RAN and by the researchers of Projects S6 and S4, risk to be wasted, if a program for **continuing maintenance and improvement of the database** is not implemented soon after the end of Project S4, in parallel with the completion of RAN and the growing of other strong motion networks.

✓ Now that RAN is very densely distributed throughout Italy, **the amount of records is expected to grow very fast**. In Italy we have a M>5.5 earthquake every 2-3 year and about 2 M > 5 earthquakes per year. What to do with the next earthquake?

✓ A possible solution, recommended by the International Evaluation Committee after the Rome meeting of October 2009: "**To create a permanent operational and administration environment and most important a stable funding for ITACA** (given its international, multidisciplinary user base)"

# Numero di terremoti di magnitudo > M per anno in Italia



Thanks to DPC staff (M. Dolce, A. Gorini, S.Marcucci, A. De Sortis)

... to IMteam (A. Spinelli)

... to Reluis (I. Iervolino)

... and especially to the S4 teams!