Agreement INGV-DPC 2007-2009

Project S4: ITALIAN STRONG MOTION DATA BASE

Responsibles: Francesca Pacor, INGV Milano – Pavia
and Roberto Paolucci, Politecnico Milano

http://esse4.mi.ingv.it

Deliverable # 05

Catalogue of geological/geotechnical information at accelerometric stations

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edited by:

UR2 - Giuseppe Di Capua, INGV Roma
UR6 - Giuseppe Lanzo, Sapienza University of Rome

1. Scope and Description of the Deliverable

The activities carried out within Task 2 aim to collect, organize and synthesize geological, geomorphological, geotechnical and geophysical data for the location site of the Accelerometric National Network (RAN) stations in Italy, managed by the Department of Civil Protection, to improve the knowledge of the subsoil characteristics and to allow the site classification based on the EC8 criteria.
In the first phase a new monograph template, that summarizes in 12 cognitive modules and various sub-modules the state of knowledge on the accelerometric station and on the location site, has been developed (see Deliverable D3: "Definition of the standard format to prepare descriptive monographs of ITACA stations" (see Deliverable D03 at http://esse4.mi.ingv.it/images/stories/Deliv_D3templeate_monografia.pdf).
The structure of the monograph has been described in the Deliverable D4: "*Progress report on the ongoing activity for constructing a catalogue of geological/geotechnical information at accelerometer stations*" (http://esse4.mi.ingv.it/images/stories/deliverable_d4.pdf). A handbook for describing and compiling the monograph modules is also in preparation (see Appendix B).
At the end of the previous S6 project 419 monographs prepared using the old format were compiled. These monographs incorporate data from ENEL monographs, compiled after the 1980 Irpinia-Basilicata earthquake. The table 1 shows the number of monographs prepared for each Italian region.

Table 1. Number of old ITACA monograph compiled in a previous project.

Region	**Number**
Abruzzo	56
Basilicata	23
Calabria	48
Campania	37
Emilia Romagna	35
Friuli Venezia Giulia	18
Lazio	13
Liguria	1
Lombardia	12
Marche	19
Molise	10
Piemonte	8
Puglia	14
Sardegna	0
Sicilia	46
Toscana	40
Trentino	1
Umbria	29
Valle d'Aosta	0
Veneto	9
Total	**419**

At the end of S4 project 550 monographs have been compiled using the new standard format (Deliverable D3). This deliverable describes synthetically how the compilation of monographs have been taken, the data collected and the information processed.

2. Online filling and automatic drafting

According to the request from the International Evaluation Committee, web pages were created to include relevant information in the online ITACA database for the compilation of new monographs. The access to the web database is made using account and password. Changes and/or insertion of new data are possible by two different web pages. A page called "modify Station" to access fields that contain general information, geographic information, the morphology of the site and the site classification according to EC8 subsoil classes and topographic categories. Instead, in the web page "Monography" it is possible to insert and/or edit all other data provided by the ITACA monograph. This page can also be used to upload photos, geographical maps, location maps, landslides maps from IFFI project, geological maps and geological sections, results of noise measurements. The computer system has been programmed to automatically generate an ITACA monograph, using data and image files in the database. This system is an important tool that has been widely used in this project and that will be essential in the future to update the monographs already available and/or to compile new ones.
Figure 1 shows the organization of compiling activity between the different research units involved.

Modules	Automatic	INGV-RM1	UniRM1	INGV-MI	Other RUs
General Information	■				
Geographical Information	■	■		■	
Geomorphology		■			
Geology		■		■	■
Geotechnical & Geophysical Information			■		
Microtremor H/V spectral ratio				■	■
Earthquake H/V spectral ratio		■			
Site Classification (EC8 – NTC2008)		■	■		
Synthesis of information		■	■		
References		■	■	■	■

Figure 1. Organization of compiling activities of ITACA monographs.

2. Data collected and information produced for ITACA monographs

Data comes from elaborations carried out within this project or from other activities by local authorities and/or other research projects.
All information collected during the S4 project were made available to the research unit through a web-store (http://esse4.mi.ingv.it/). The access to the store is allowed only by using account and password. The store is organized into folders. There is a folder for each Italian region. By entering each of these, it is possible to have access to the single station folders of that region. A number of tools allows to create subfolders, to upload files and to delete files containing data no longer needed.
In the following subsections some results produced by RU involved in the project are briefly described.

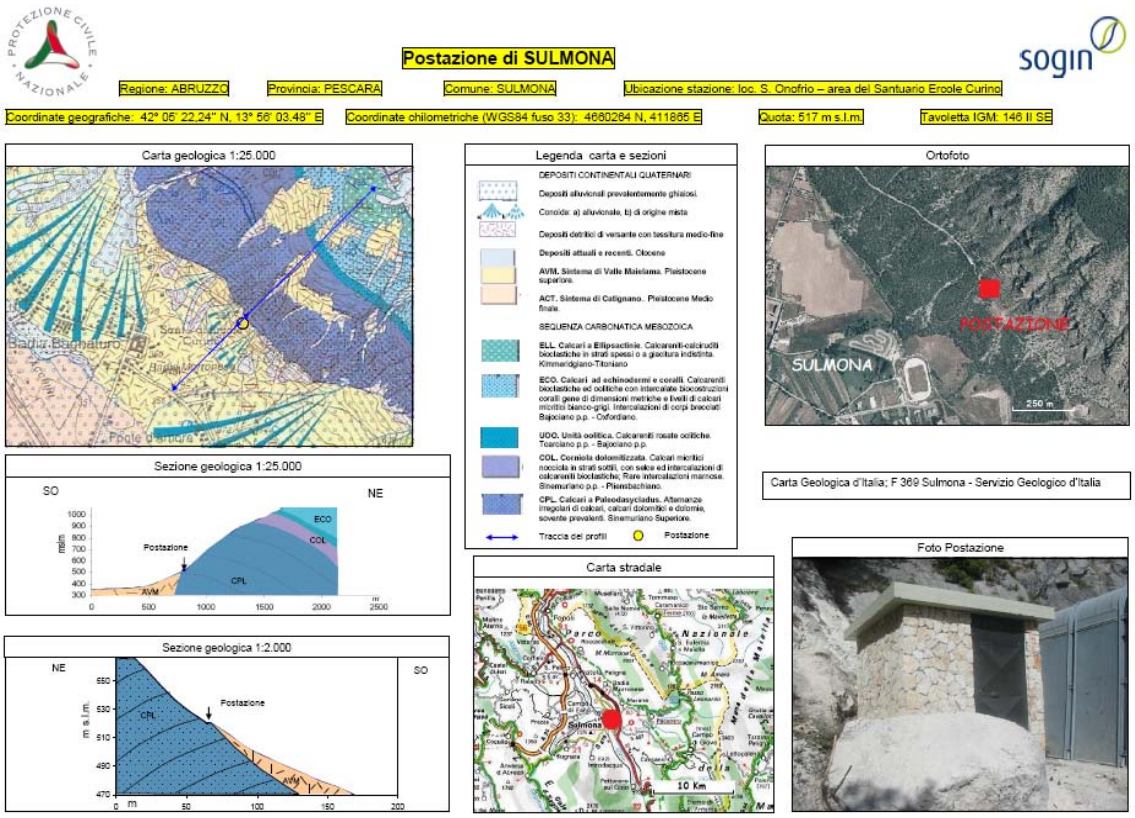

Figure 2. DPC monograph compiled by SOGIN.

2.1 DPC monographs by SOGIN

In the second phase data collection of geological, geomorphological, geotechnical and geophysical information has continued. In particular, DPC Monographs compiled by SOGIN (figure 2) for 136 stations in 15 of the 20 Italian regions has been recovered. These monographs contain the following information and maps:

- General information: Region, Province, Municipality, address, location, geographic and kilometric coordinates, elevation, number of IGMI Topographical Map at 1:25.000 scale.
- Geological map at 1:25.000 scale.
- Geological cross section at 1:25.000 scale.
- Geological cross section at 1:2.000 scale.

- Legend of the geological map and cross sections.
- Orthophoto
- Location on a road map.
- Photo of the station.

All these monographs have been uploaded into the S4 project online warehouse (http://esse4.mi.ingv.it), so that they could be available to all Research Units.

2.2 Geological maps

During the project 552 geological maps (at 1:100,000 scale primarily, but also at 1:25,000 scale - see paragraph 2.1) and 200 geological cross sections at different scales (1:2,000, 1:25,000, 1:50,000) have been prepared. The geological maps at 1:100,000 scale have been drawn from the Geological Map of Italy, at the same scale.

2.3 Landslides and morphology

The activity has provided also the examination of the presence of landslides in the sites of the 199 stations, by consulting the maps produced by the IFFI Project (Inventory of Italian Landslides: http://193.206.192.244/cartanetiffi/) (see examples in Figure 3, 4 and 5). It was found that in 63 cases the stations are located on or in the proximity of active / quiescent landslides (with sliding type of movements, slow / fast slide / flow, deep-seated gravitational slope deformation) also of considerable size (> 700,000 m^2). So these stations are located in areas that could have a loosening and mobility of the surface soil, with an increment in thickness of the weathering and mechanically poor layer.
In addition, the topographic characteristics of the sites have been analyzed using Google Earth (an example in Figure 6). So 8 morphological situations, provided in the monograph (Plain, Valley centre, Valley edge, Alluvial fan, Saddle, Slope, Edge of scarp, Ridge), have been identified for 199 stations (Figure 7).

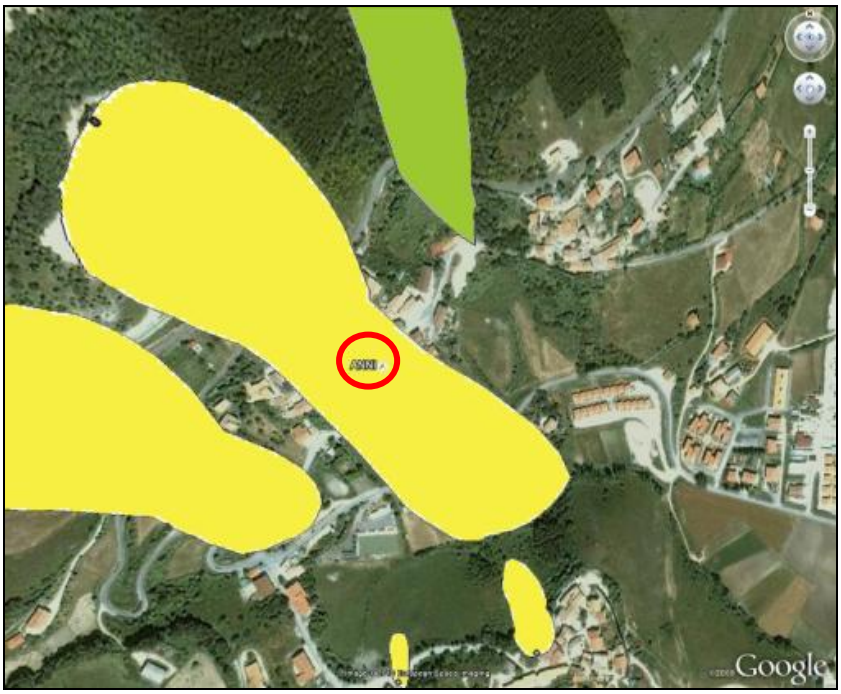

Figure 3. Annifo station (ANNI): quiescent rotational slide from IFFI Project in the ITACA site (red circle).

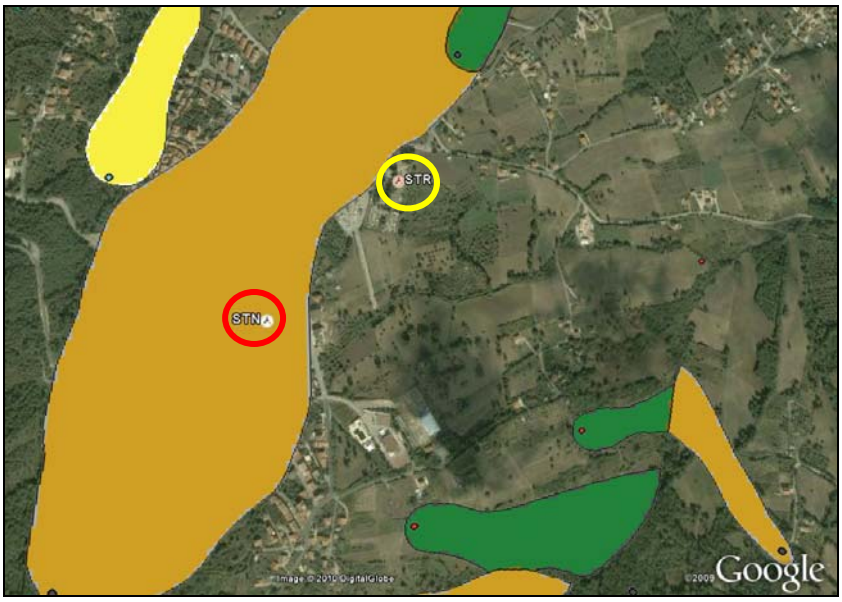

Figure 4. Sturno stations (STR and STN): quiescent complex slide from IFFI Project in the ITACA site of STN station (red circle), while STR station (yellow circle) is close to the landslide.

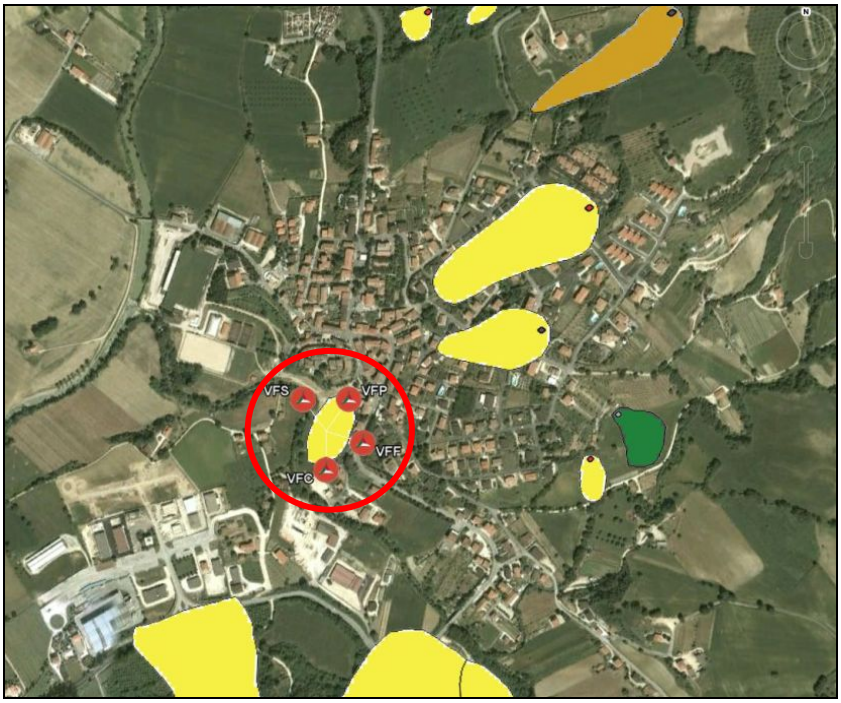

Figure 5. Valfabbrica stations (VFC, VFF, VFP and VFS): quiescent rotational slide from IFFI Project in the ITACA site (red circle).

Figure 6. Cerreto di Spoleto (Umbria region): morphology of several ITACA stations (on the ridge, slope and in the valley) evaluated with Google Earth software.

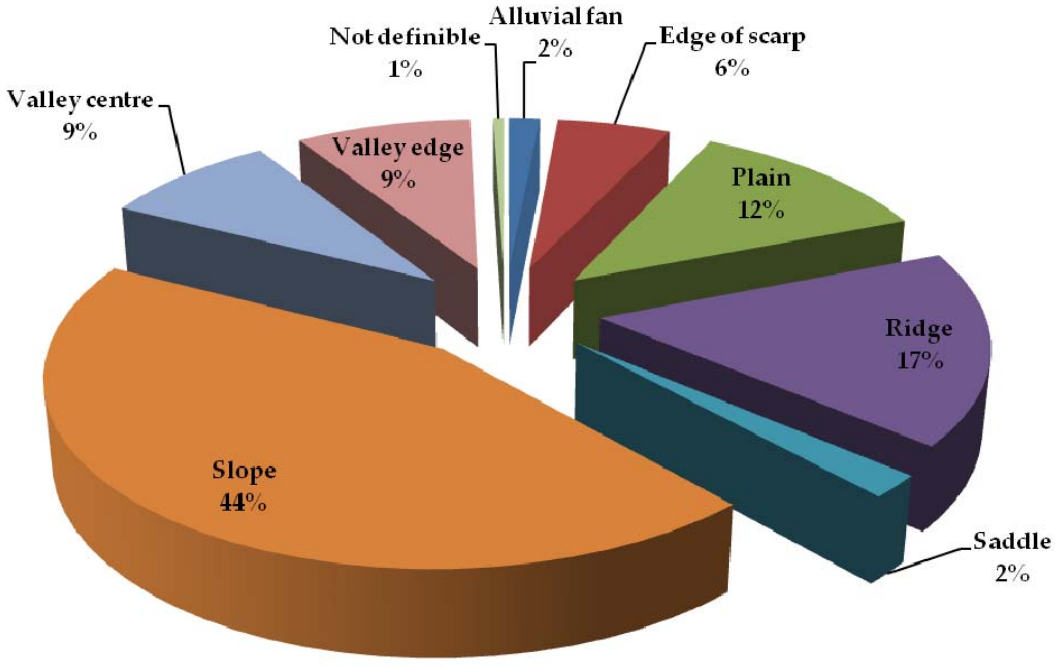

Figure 7. Distribution of the morphological situations evaluated for 199 ITACA sites.

2.4 Vs profiles and noise measurements

Overall 102 stations with shear wave velocity profile have been compiled using the new standard format. For the compilation data coming from different sources were used, that is data already available or collected in the previous S6 project (DPC-INGV 2004-2006

agreement) and data obtained in the framework of the present project, collected as well as measured front *ad hoc* in situ tests carried out by different research units. In particular for 43 stations collected data were used while for 59 stations in situ DH and surface wave tests were specially carried out.

2.5 Appendices

Appendix A – Handbook for describing and compiling the ITACA monograph
(*Di Capua and Lanzo*)

This appendix gives a brief description of the the modules in the ITACA monograph (see the Deliverable D3) and provides some instructions for compiling the existing.

Appendix B – Activities following the April 6, 2009, L'Aquila earthquake
(*Lanzo*)

Following the L'Aquila earthquake, a major effort was undertaken to improve the characterization of subsoil conditions at some recording stations located in the epicentral area. In particular down-hole tests were carried out at the stations AQA and AQK, where a borehole was drilled by the Department of Civil Protection, while a borehole and a down-hole test were carried out at the station AQG. Further, an additional borehole was drilled approximately between AQA and AQV.

2. Availability/Restrictions and contact person

All appendices of this Deliverable are available at the project web site: http://esse4.mi.ingv.it.

3. Relevance for DPC and/or for the scientific community

The activities have allowed a great improvement of knowledge of the site characteristics of the Italian accelerometric stations. This update allowed to obtain an EC8 site classification for all ITACA stations (see Deliverable D10) with important practical implications in both engineering and seismological fields. On one hand, the current framework of knowledge allows to interface the ITACA database with the REXEL software for the selection of natural accelerograms, usable in seismic design; on the other hand, studies on attenuation laws will be supported from a better characterization of sites.

4. Changes with respect to the original plans and reasons for it

No major changes occur in the plans for this Deliverable.