CHARACTERIZATION OF ACCELEROMETRIC SITES LOCATED ON STIFF SOIL AND ROCK MASS BY MEANS OF GEOPHYSICAL AND GEOMECHANICAL JOINT ANALYSIS

D. Albarello[1], E. Lunedei[1], D. Pileggi[1], G. Scarascia Mugnozza[2], S. Hailemikael[2]

[1] Dipartimento di Scienze della Terra - Università di Siena, Via Laterina 8, 53100 Siena

[2] Dipartimento di Scienze della Terra - Università di Roma " La Sapienza", P.le Aldo Moro 5, 00100 Roma

UR7 ACTIVITIES MAIN GOALS

- The seismic characterization of **stiff-soil and rock-mass** sites represents a **critical aspect** for effective and proper location of seismic and accelerometric stations

- Although it is assumed that rock and stiff soil sites represent an ideal location where amplification effects can be excluded, **modification of seismic response have been observed** in stiff soil and rock-mass sites, in relation to faulting, jointing and weathering subsoil conditions

- **Main goals of UR-7** activities are:
  a) **definition of an experimental protocol** for low cost joint geomechanical/geotechnical and geophysical characterization of accelerometric sites
  b) selection of 8 to 10 accelerometric **sites representatives** of above mentioned subsoil conditions
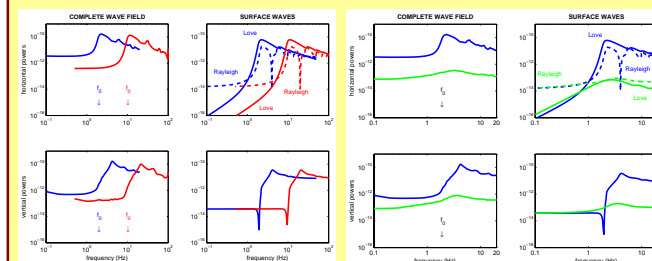 c) field **analysis of selected sites**, synthesis of results and validation of the protocol

METHODOLOGY

1. Reappraisal of **available information** and **preliminary** sites **surveys**

2. **Geologic and structural survey** on a detailed scale (1:10000 – 1:5000) to define geologic weathering and faulting conditions and to locate measuring points

3. **Geomechanical analysis** (GMA) **in rock-mass sites**, in order to:
   - identify subvertical outcroppings (min. surface 4m^2) useful to rock-mass class recognition (IRSM classification)
   - recognize principal discontinuities sets and relative orientation
   - measure rock-mass jointing condition parameters (Jv, "rock block index ", "joint compressive strength"), in order to estimate the "rock quality designation index" and "rock mass rating index"

4. **Passive seismic surveys by single station** (H/V analysis), aimed at estimating fundamental frequency value at site and lateral variations

5. **Passive seismic surveys by array** (ESAC), to evaluate the V_S profile via joint inversion of HVSR and dispersion curves

6. Possible evaluation of the level of **anisotropy and damping**

7. **Joint interpretation of geomechanic and seismic measures**

PROBLEMS IN CHARACTERIZATION OF SITES ON OUTCROPPING ROCK

I - The shallow soft layer acting as **wave-guide does not exist** or is very thin

II - This implies a **strong reduction** of the surface waves **powers** below the resonance frequency

III - **Poor array resolution** for surface waves having wavelengths longer than array dimension

Numerical simulation of a single layer over an half-space

- THIN LAYER & HIGH IMPEDENCE CONTRAST
- THICK LAYER & HIGH IMPEDENCE CONTRAST
- VERY THICK LAYER & LOW IMPEDENCE CONTRAST

SITE SELECTION

In order to select representative sites of different stiff-soil and rock-mass conditions in three selected regions (Abruzzo, Lazio and Calabria), an analysis of existing data has been carried on together with a preliminary survey of 17 pre-selected sites, aiming at:
- verifying geologic condition at the sites
- performing ambient vibrations single station measurements and H/V analysis to detect anomalous seismic response
- verifying logistic conditions for array and geomechanic measurements

After the preliminary survey, 10 sites have been selected: AQP, AQC, CPS, SCN, PSC, MTC, MRM, SPS, VBM, VBV
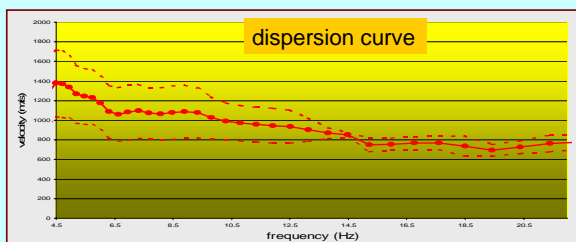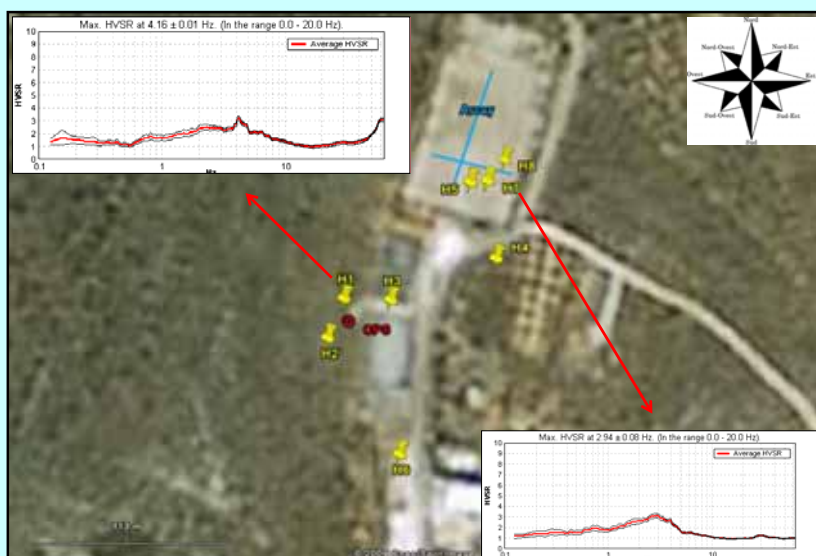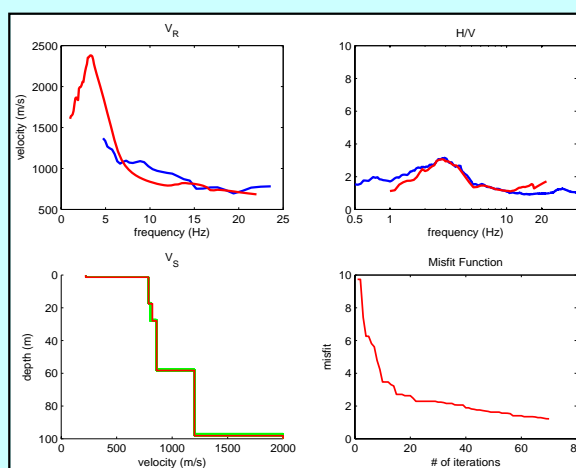
- HVSR, ARRAY & GEOLOGIC SURVEY
- HVSR, ARRAY
- HVSR
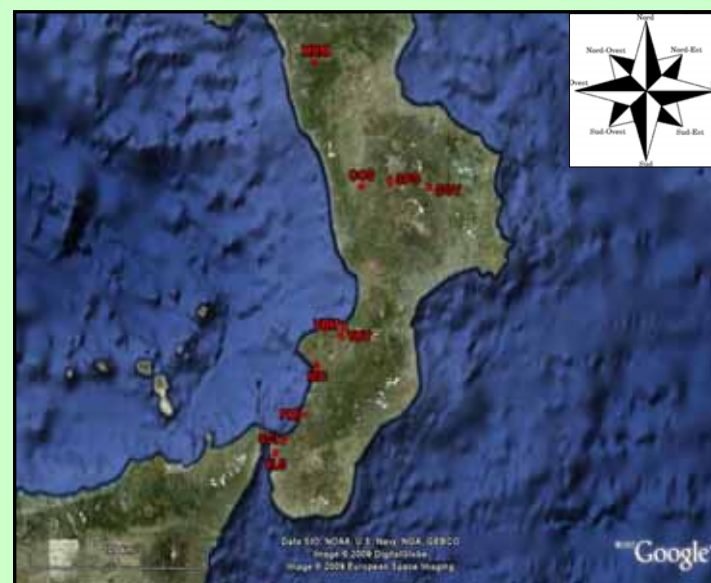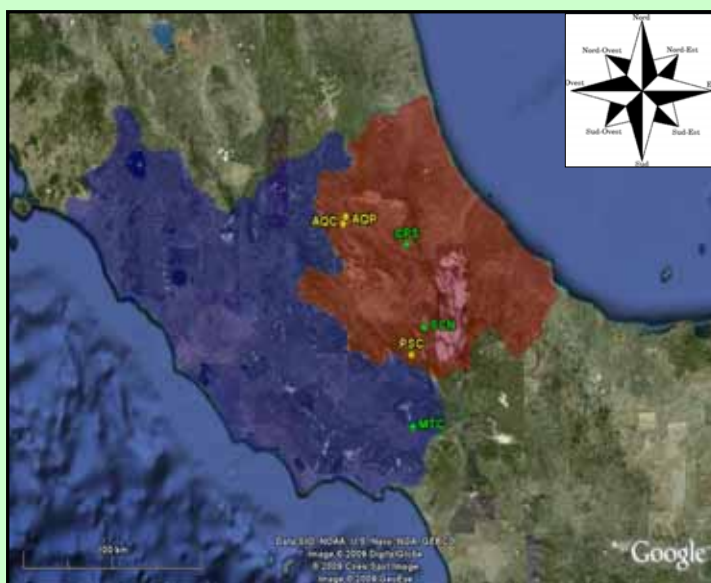
EXAMPLE ON "CPS" STATION

Preliminary results from geophysic survey

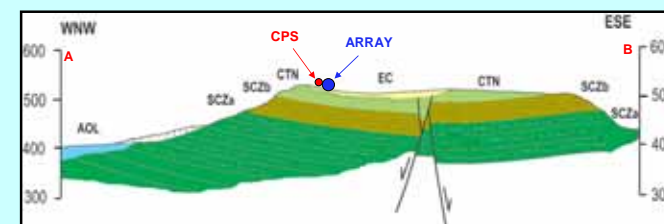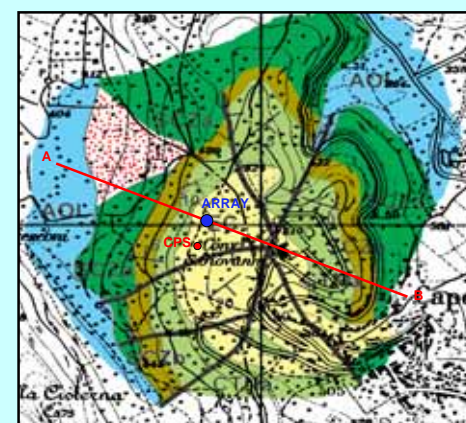**Satellite image shows locations of HVSR and Array measurements**

dispersion curve

INVERSION RESULTS

V_R H/V V_S Misfit Function

Preliminary results from geologic survey

- AOL — alluvium
- EC — colluvium
- CTN — limestone
- SCZb — "Scaglia" debris
- SCZa — "Scaglia" debris

UR-7 FUTURE ACTIVITIES

In order to reach the above mentioned main goals, UR7 programmed 3 field measurement campaigns to be realized over the period 11/2009-03/2010. The activities will include:

- **geologic survey and GMA at remaining RAN rock-mass sites** in Abruzzo (PSC-AQG) and Calabria regions (MRM-SPS)

- **geologic survey at remaining sites** (VBM-VBV)

- **array measurements at remaining sites in Calabria region** (MRM-SPS-VBM-VBV)

Analysis of the results of these campaigns, will allow to **evaluate the reliability of the experimental protocol here developed to characterize local seismic response of accelerometric stations with stiff-soil/rock-mass subsoil conditions**