Real time seismic monitoring in South-Central Europe: data sharing, cooperation and improvements of the OGS NI Seismic Network

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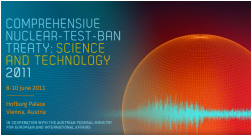(*) Istituto Nazionale di Oceanografia e di Geofisica Sperimentale - OGS, Udine, Italy

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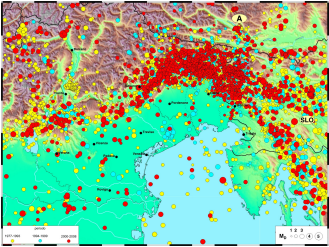
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CRS Centro di Ricerche Sismologiche

SUMMARY

Seismicity of North-East Italy during 1977-2008 (courtesy of S. Urban). The 1976 Ms=6.4 was the last severe earthquake.


The OGS Virtual Seismic Network: 33 OGS stations (blue squares) and 60 stations contributed by other institutions (yellow squares) in real time .

The Centro di Ricerche Sismologiche (CRS, Seismological Research Center) of the Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS, Italian National Institute for Oceanography and Experimental Geophysics) in Udine (Italy) after the strong earthquake of magnitude Mw=6.4 occurred in 1976 in the Italian Friuli-Venezia Giulia region, started to operate the North-eastern Italy (NI) Seismic Network: it currently consists of 13 very sensitive broad band and 21 simpler short period seismic stations, all telemetered to and acquired in real time at the OGS-CRS data centre in Udine.

Real time data exchange agreements in place with neighbouring Italian, Slovenian, Austrian and Swiss seismological institutes lead to a total number of 94 seismic stations acquired in real time, which makes the OGS the reference institute for seismic monitoring of North-eastern Italy. Since 2002 OGS-CRS is using the Antelope software suite on a SUN SPARC cluster as the main tool for collecting, analyzing, archiving and exchanging seismic data, initially in the framework of the EU Interreg IIIA project "Trans-national seismological networks in the South-Eastern Alps".

At OGS-CRS we spent a considerable amount of efforts in improving the long-period performances of the broad-band seismic stations, either by carrying out full re-installations and/or applying thermal insulations to the seismometers: the example of the new PRED broad-band seismic station installation in the cave tunnel of Cave del Predil using a Quanterra Q330HR high resolution digitizer and a Streckeisen STS-2 broad-band seismometer will be illustrated. Efforts have been also put in strengthening the reliability of data links, either from stations to data centre by exploring the use of redundant satellite/radio/GPRS links, and between different data centres by exploiting the usage of the Antelope "orbxchange" module.
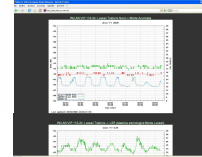
DATA MANAGEMENT
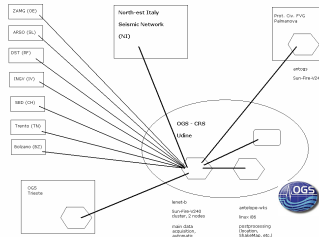
Antelope @ OGS
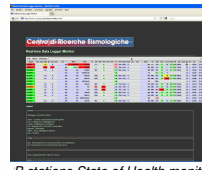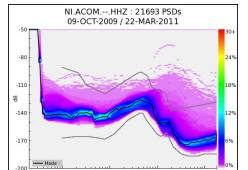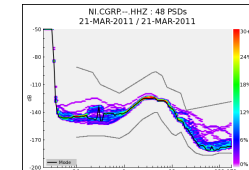

B stations State of Health monitor

Drumplots of the waveform data refreshed every 5 minutes.

Daily plot of the power supply voltage of the seismic stations and their radio link devices.

OGS-CRS waveform drumplots

The data quality check of the broadband seismic stations is performed through the PQLX software (McNamara & Boaz. 2005) that computes power spectral density (PSD) for frequencies ranging from ~0.01 to 16 Hz. A comparison of day and night PDFs and an examination of artifacts related to station operation and episodic cultural noise allow us to estimate both the overall station quality and the level of Earth noise at each site.

The Antelope software suite is used at OGS-CRS as the main data acquisition tool for the Northeastern Italy Seismic Network run by OGS. The main OGS-CRS Antelope server is running in Udine on a 2 nodes SUN Fire V240 cluster: the main module does data acquisition, automatic locations, data archiving and exchange, plus the alert system via Short Message Service (SMS), email, fax and web. Another 2 workstations, an old Linux and a new MAac PRO, running Antelope at the OGS-CRS headquarters in Udine are used for post-processing including ShakeMaps and manual relocations. Data is also forwarded for redundancy to a SUN Fire V245 Antelope machine at Protezione Civile della Regione Friuli-Venezia Giulia headquarters in Palmanova and for convenience to a Linux Antelope workstation at OGS headquarters in Trieste. Data is shared on the main Antelope cluster in Udine with a SeisComP server for data exchange.

We implemented the TDMT_INV code (e.g. Dreger, 2003) for moment tensor computation. The automatic procedures is activate for earthquakes ML>3.6 located in NE Italy and surroundings.
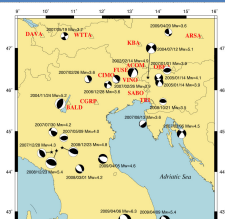
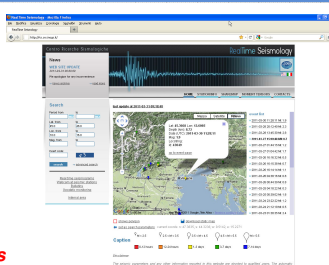*Moment tensors computed using OGS data.*

REAL TIME ANALYSIS

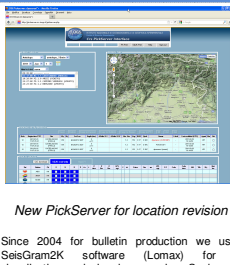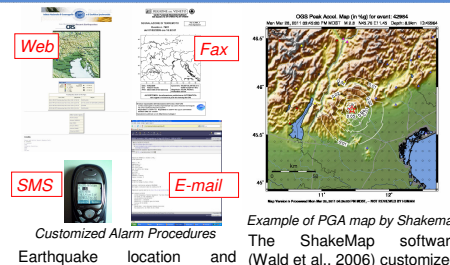### Earthquake detection and notification
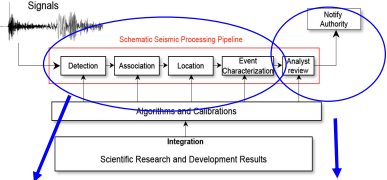
BRTT Antelope   **CRS procedures**

New "Real Time Seismology" OGS-CRS web page http://rts.crs.inogs.it/

New PickServer for location revision

Since 2004 for bulletin production we use the SeisGram2K software (Lomax) for quick visualization and signal processing. Such program reads picks and waveforms from the Antelope system through an ad-hoc Java interface created at our department (PickServer).

Web   *Fax*   *SMS*   *E-mail*

Customized Alarm Procedures

Earthquake location and magnitude are automatically notified via multiple means to governmental institutions.

Example of PGA map by Shakemap

The ShakeMap software (Wald et al., 2006) customized for Italy by INGV automatically runs at OGS as earthquakes
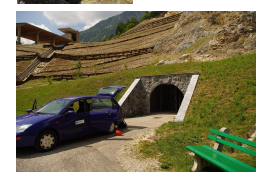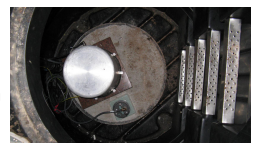
STATIONS

At OGS-CRS we also spent a considerable amount of efforts in improving the long-period performances of broadband seismic stations, either by carrying out full re-installations and/or applying thermal insulations to the seismometers. Efforts have been put also in strengthening the reliability of data links, exploring the use of redundant satellite/radio/GPRS links.
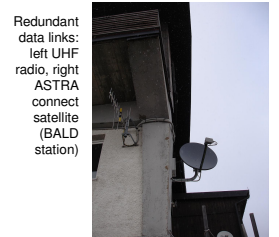

A new plastic container for installing seismic stations deep, to insulate from thermal variations affecting long period performances of seismometers (ZOU station)

Seismometers installed at the bottom on a pier, with extra thermal insulation (ZOU station)

Where possible, stations are installed in natural caves or artificial tunnels, to improve long period performances (PRED station). PRED station is acquired in real time both at OGS in Udine (Italy) and at ZAMG in Vienna (Austria) data centers

Redundant data links: left UHF radio, right ASTRA connect satellite (BALD station)

ACKNOWLEDGMENTS

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