

A photograph of a cable-stayed bridge at sunset. The sun is low on the horizon, casting a golden glow over the sky and water. The bridge's deck is covered with a grid of white lines that recede into the distance. The bridge's structure, including the towers and cables, is visible on the left and right sides.

EARLY WARNING SYSTEMS

Earthquakes and Volcanoes

amra

■ analysis and monitoring of environmental risk

AMRA ACTIVITIES

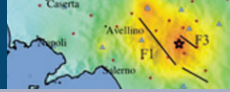
In the field of **Earthquake Early Warning (EEW)**, AMRA's activities are focused on the **Research on new technologies**. AMRA develops and implements management systems for seismic early warning, including predictive ground shaking scenarios.

AMRA designed and built **ISNet** (Irpinia Seismic Network, in the figure) a local network equipped with accelerometers and short-period/broadband seismic sensors.

It is located in the southern Apennines, Italy, and it is operated by the RISSC-Lab in Naples (Laboratory of Research on Experimental and Computational Seismology).

ISNet is a laboratory for experimenting new methodologies of real-time data analysis and management. The network is also a prototype for an earthquake early warning and rapid information system for the Campania region and the city of Naples.

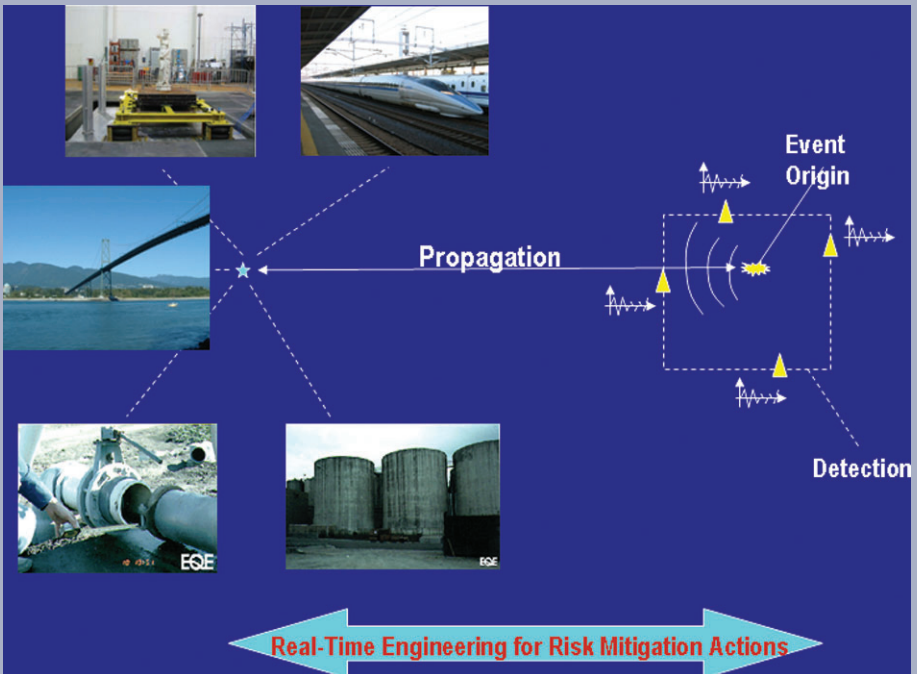




MAIN OBJECTIVES

AMRA activities for the development of EEW systems are focused to:

- developing a fully probabilities framework for application of EEW based on costs benefit analysis;
- warning the population of impending danger, in a manner appropriate for the social system;
- protecting critical structures, and allowing them to remain operational (e.g. hospitals, air traffic control);
- helping civil protection authorities to obtain timely alerts for more rapid and efficient mobilization and adaptable response;
- minimizing earthquake-induced secondary effects (e.g. fires, industrial accidents) as well as the impact of aftershocks and triggered events.





EQUIPMENT

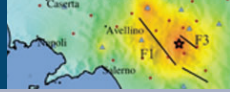
In the field of Earthquake Early Warning Systems, AMRA has developed:

- **ERGO** (EaRly warninG demO) is a visual terminal developed to test the potential of hybrid EEWs. The system was developed by staff of the RISSC-Lab and of the Department of Structural Engineering of the University of Naples Federico II under the umbrella of AMRA. ERGO processes in real-time the accelerometric data provided by a sub-net of ISNet and it is able to perform RTPSHA and eventually to issue an alarm in the case of events occurring with magnitude larger than 3 in the southern Apennines region.

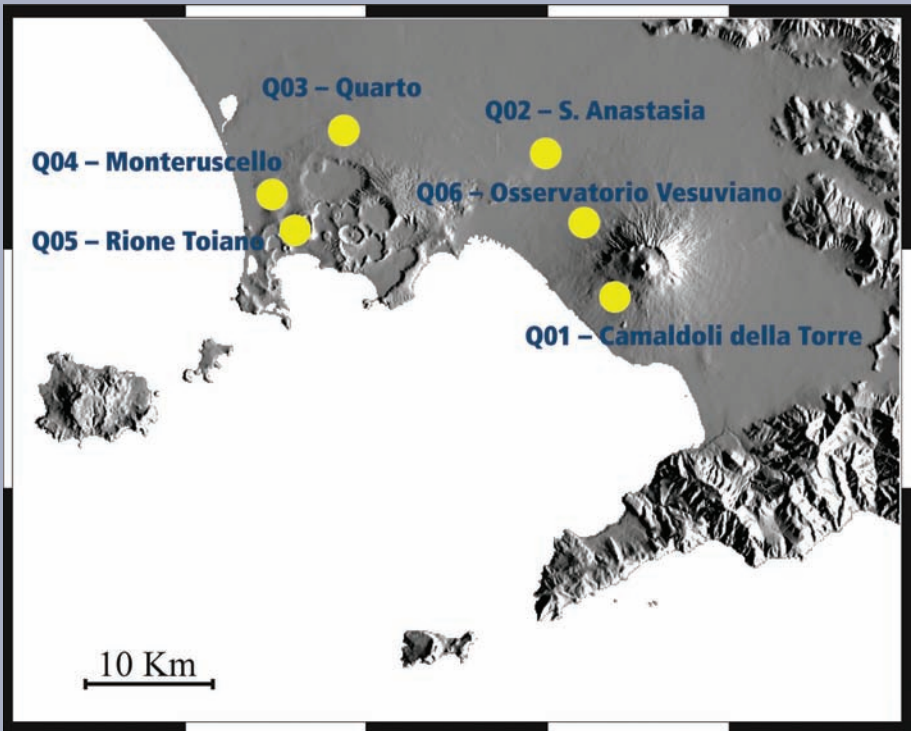
- **PRESTo** (Probabilistic and Evolutionary early warning System) is a software platform for regional earthquake early warning that integrates recently developed algorithms for real-time earthquake location and magnitude estimation into a highly configurable and easily portable package. The system is under active experimentation in

Southern Italy on the Irpinia Seismic Network (ISNet, in the figure a seismic station), which is deployed in a seismogenic area that is expected to produce a large earthquake within the next 20 years.





In the field of Early Warning of **Volcanic Eruptions**, AMRA has developed a prototype system, using high sensitivity instrumentation, in partnership with the INGV – Osservatorio Vesuviano and the University of Salerno. Three boreholes are located within the Campi Flegrei active caldera and three are located in the area of Mt. Vesuvius (in figure). Each of them is equipped with a Sacks-Everton strain meter, at a depth of 120-200 m, and will be equipped with a large band seismometer.





MAIN PROJECTS

EUROPEAN COMMISSION FP7

NERA, Network of European Research Infrastructures for Earthquake Risk Assessment and Mitigation.

The aim of NERA is to achieve a measurable improvement and a long-term impact in the assessment and reduction of the vulnerability of constructions and citizens to earthquakes.

EUROPEAN COMMISSION FP6

SAFER, Seismic Early Warning for Europe.

The project aims to fully exploit the possibilities offered by the real-time analysis of the signals coming from seismic networks for a wide range of actions, performed in a time interval of a few seconds to some tens of minutes.

REGIONAL DEPARTMENT OF CIVIL PROTECTION, REGIONE CAMPANIA

Feasibility Study of Temporary Earthquake Early Warning.

REGIONAL DEPARTMENT OF CIVIL PROTECTION, REGIONE CAMPANIA

SAMS, Seismic Alert Management System.

LABORATORIES UNIVERSITY NETWORK OF SEISMIC ENGINEERING (RELUIS) / NATIONAL DEPARTMENT OF CIVIL PROTECTION

REWS, feasibility of automatic applications of seismic early warning in Italy.

SELEX COMMUNICATIONS

SIT_MEW, Broadband Telecommunication Integrated System for land and emergency management based on early warning methodologies.

EUROPEAN UNION (INTERREG ARCHIMED)

SE-RISK, Advanced techniques for SEismic RISK reduction in Mediterranean Archipelago Regions.

ISTITUTO AUTONOMO CASE POPOLARI, ITALY

Monitoring and control of civil buildings.



MAIN SCIENTIFIC PAPERS

G. Iannaccone, A. Zollo (eds.)

Metodi e tecnologie per l'early warning sismico

DoppiaVoce, ISBN: 978-88-89972-20-5, 2010

V. Convertito, R. De Matteis, L. Cantore, A. Zollo, G. Iannaccone, M. Caccavale

Rapid estimation of ground-shaking maps for seismic emergency management in the Campania region of southern Italy

Natural Hazards, doi: 10.1007/s11069-009-9359-2, 2009

L. Elia, C. Satriano, G. Iannaccone

SeismNet Manager – A web application to manage hardware and data of a seismic network

Seismological Research Letters, Vol.80, N.3, doi: 10.1785/gssrl.80.3.420, 2009

A. Zollo, G. Iannaccone, M. Lancieri, L. Cantore, V. Convertito, A. Emolo, G. Festa, F. Gallovic, M. Vassallo, C. Martino, C. Satriano, P. Gasparini

Earthquake early warning system in southern Italy: Methodologies and performance evaluation

Geophys. Res. Lett., 36, L00B07, doi:10.1029/2008GL036689, 2009

G. Iannaccone, A. Zollo, L. Elia, V. Convertito, C. Satriano, C. Martino, G. Festa, M. Lancieri, A. Bobbio, T.A. Stabile, M. Vassallo, A. Emolo

A prototype system for earthquake early-warning and alert management in southern Italy

Bull. Earthquake Eng., doi: 10.1007/s10518-009-9131-8, 2009

I. Iervolino, M. Giorgio, C. Galasso, G. Manfredi

Uncertainty in early warning predictions of engineering ground motion parameters: what really matters?

Geophys. Res. Lett., 36, L00B06, doi:10.1029/2008GL036644, 2009

A. Zollo, M. Lancieri

Real-time estimation of earthquake magnitude for seismic early warning

in "Earthquake Early Warning Systems", P. Gasparini, G. Manfredi, J. Zschau (Eds.), Springer, ISBN 978-3-540-72240-3, 2007

I. Iervolino, M. Giorgio, G. Manfredi

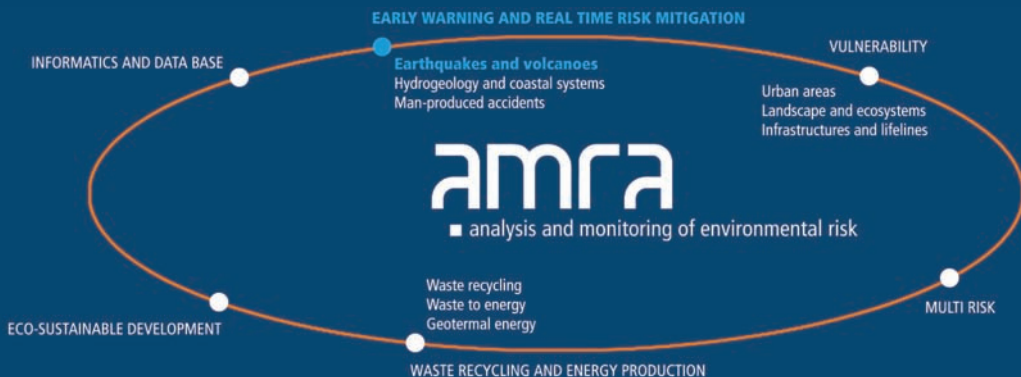
Expected loss-based alarm threshold set for earthquake early warning systems

Earthquake Engng Struct. Dyn. 36 (9), 1151-1168, 2007

R. Scarpa, A. Amoroso, L. Crescentini, P. Romano, W. De Cesare, M. Martini, G. Scarpato, A.T. Linde, S.I. Sacks

New borehole strain system detects uplift at Campi Flegrei

Eos Trans. AGU, 88 (18), doi:10.1029/2007EO180002, 2007



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