ECGS & ESC/EAEE Joint Workshop: Earthquake and Induced Multi-Risk Early Warning and Rapid Response

PRESTo^{Plus} and Sentinel and Earthquake Early Warning System for Schools: feasibility study in Southern Italy

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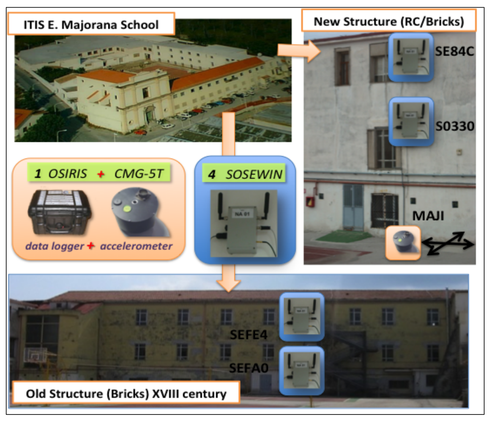
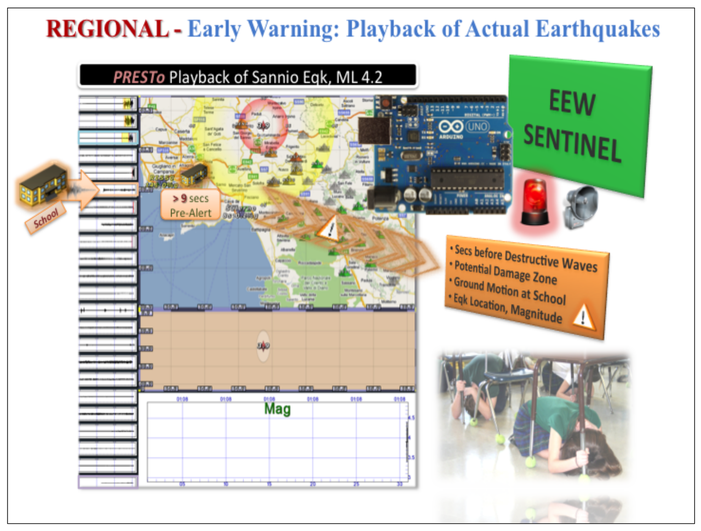
INTRODUCTION

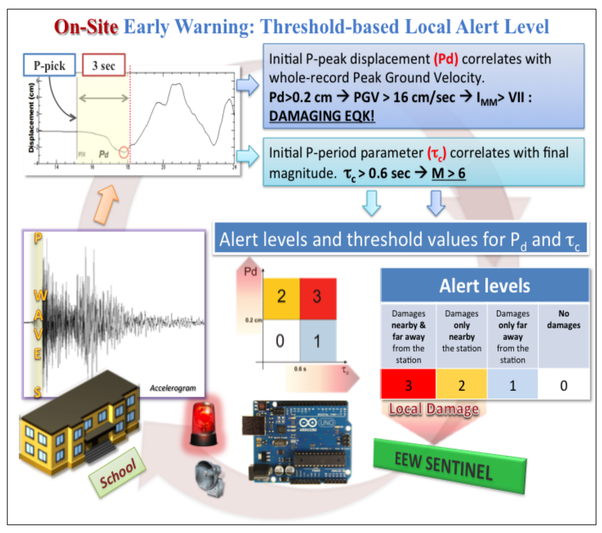
In the framework of the REAKT-Strategies and tools for Real Time Earthquake RisK ReducTion FP7 European project, we have been engaged in a feasibility study on the application of earthquake early warning procedures in the high school ITIS 'E. Majorana', Somma Vesuviana, MAJI located in the Irpinia region (Southern Italy)

THE MONITORING SYSTEM



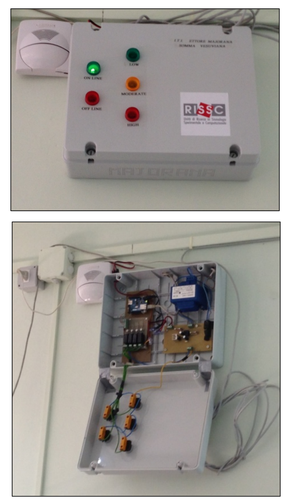
PRESTo^{Plus} SYSTEM AND THE EQ. EARLY WARNING SENTINEL





PRESTo (PRobabilistic and Evolutionary early warning SysTem) is a software platform for Earthquake Early Warning, that integrates a regional, network-based approach with an on-site, single station approach (Satriano et al., 2011).
The EEW Sentinel realized using Arduino® is a low cost programmable actuator that we set-up to keep listening and interpreting the messages and alert levels from PRESTo^{Plus}. The EEW Sentinel provides different warnings by the control of different hardware (i.e., alarm bells, emergency lights). Furthermore, it declares the end of the most threatening condition, which will assist the emergency coordinator starting the evacuation plan defined by the current legislation (Picozzi et al., 2015a).
Whenever an alert is released by PRESTo, independently from the EEWS source (i.e. On-site, Regional, or even from both of them cooperating), the message is received and taken in charge by the EEW Sentinel. Hence, in case of an event, the EEW sentinel is able to provide to the school users a real-time P-wave based prediction of the ground motion severity expected at the target site.

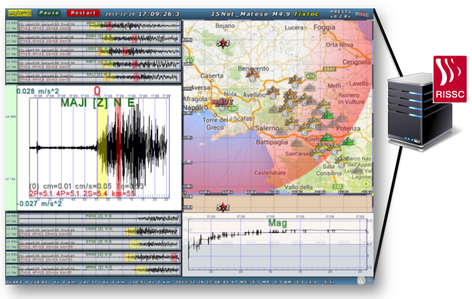
THE EEW SENTINEL



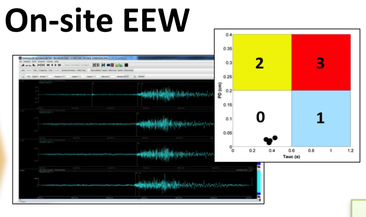
INTEGRATED EEWS ALERT: the M_L4.9, 2013 Matese earthquake

The first test of the EEW system performance on real data was possible following the M_L 4.9 Matese Earthquake (2013/12/29 17:08:43). The distance between the school and the hypocenter was about 55 km. The Regional and On-site systems provided consistent EEW estimates.

Regional



On-site EEW

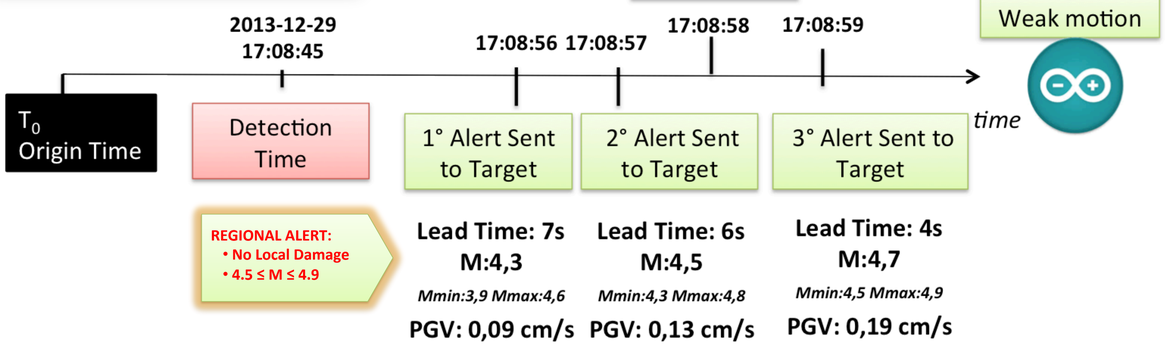


ON-SITE ALERT LEVEL ZERO:
• No Local Damage
• M < 6

Alert level confirmed on-site

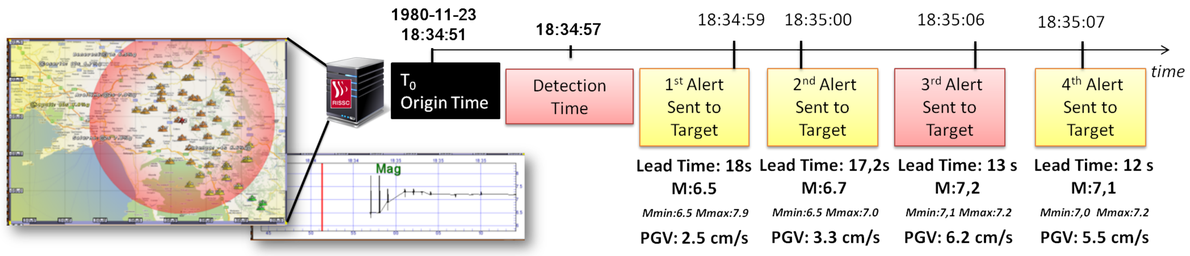
SILENT
Green Light
No Siren

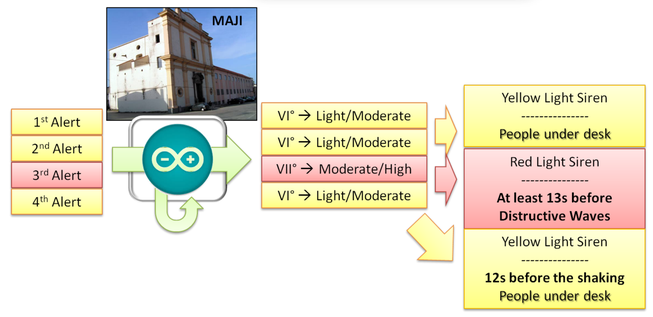
Weak motion



DRILL: playback of the simulated M_S6.9, 1980 Irpinia earthquake

After the capacity building of students and teachers on the EEW and seismic risk, a blind drill was realized doing the playback of the M_S6.9, 1980 Irpinia earthquake. With the only exception of the P-wave ground shaking, the students experimented a situation rather close to what would occur during an earthquake.





EEW drill at MAJI: some facts

Alert duration ≈ 150 s

Time needed for going under the desk ≈ 4 s

Alert level: moderate predicted PGV ≈ 5.5 cm that corresponds to IMM of VI (strong perceived shaking/light potential damage)

FEASIBILITY OF EEW FOR SCHOOLS IN SOUTHERN ITALY USING THE NATIONAL ACCELEROMETRIC NETWORK

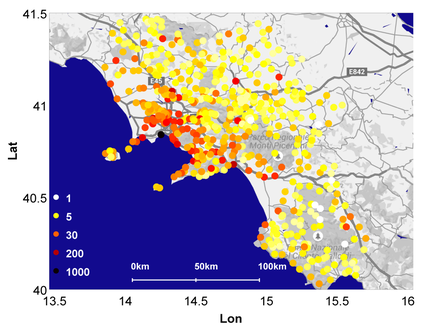
A scientific feasibility study for an EEWS in the Campania region has been done considering the national accelerometric network RAN and the software platform PRESTo following Picozzi et al. (2015b). Schools are considered the target of the EEWS.

We assessed the potential rapidity of the RAN network in issuing an alert considering the timing of the first alert, defined as the time when P-waves reaches 3 accelerometric stations.

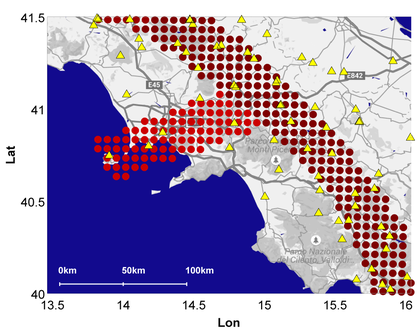
We characterized the EEWS potential performance of the RAN also by assessing the extent of the Blind Zone (BZ) associated to the virtual seismic sources.

The effectiveness of the system requires an update of the network, to cut down telemetry delays and bring them to the levels of standard networks designed for EEWS.

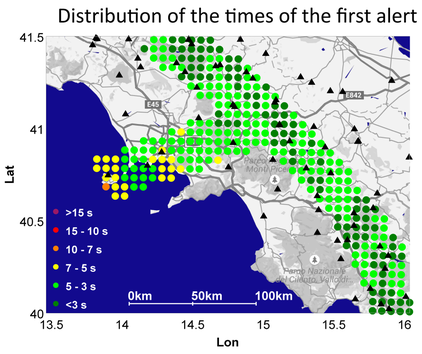
Number of schools for municipality in the Campania region



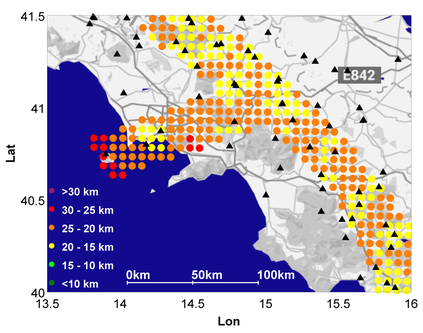
Distribution of RAN stations (yellow triangles) and grid of synthetic sources for the ZS 927 (dark red) and ZS 928 (light red)



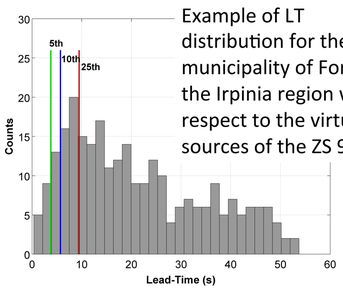
Distribution of the times of the first alert



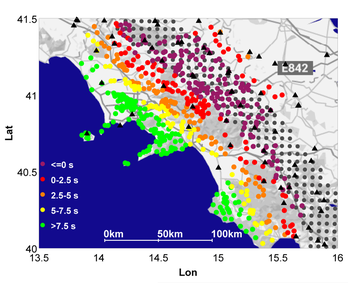
Blind zone dimension



We have also estimated the Lead-Times (LT) for each municipality relative to all the virtual sources of our grids. For each LT distribution we extracted the 5th percentile, which we believe useful to characterize the potential performance of the RAN for EEWS purposes in the Campania region in terms of lead-times (i.e. targets would benefit in the 95% of the cases of larger lead-times).

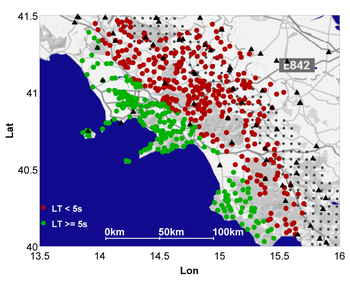


Example of LT distribution for the municipality of Forino in the Irpinia region with respect to the virtual sources of the ZS 927.



Distribution of lead-times for municipalities in the Campania region considering the 5° percentiles and the virtual sources of the ZS 927

Operative lead-times (OLT) Map



Municipalities where schools can benefit in the 95% of cases of OPL larger than 5s, and hence students can potentially reduce their exposure to seismic risk.

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Acknowledgements
The work was supported by the project REAKT, funded by the European Community's Seventh Framework Programme for Research (FP7) under the grant agreement 282862.
The authors wish to thank the staff and students of the ITIS 'E. Majorana' for their effective collaboration during all the phases of the project.