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An earthquake early warning system (EEWS) is a real-time, modern monitoring infrastructure that is able to provide an automatic notification of the potential damaging effects of an impending earthquake, through rapid telemetry and processing of data from dense instrument arrays deployed in the source region of the event of concern and/or surrounding the target infrastructure. Such a system allows mitigating actions to be taken before strong shaking and can significantly shorten the time necessary for emergency response and the recovery of critical facilities such as roads, hospitals and communication lines.

Most of worldwide developed EEWS are conceived as either “regional” (network-based) or “on-site” (stand-alone) systems (Kanamori,2005). A “regional” EEWS is based on a dense sensor network covering a portion or the entirety of an area that is threatened by earthquakes. The relevant source parameters (event location and magnitude) are estimated from the early portion of recorded P-signals and are used to predict, with a quantified confidence, a ground motion intensity measure at a distant site where a target structure to protect is located. An “on-site” EEWS consists of a single sensor or an array of sensors deployed in the proximity of the target structure that is to be alerted, and whose measurements of peak amplitude and/or predominant period on the initial P-wave motion are used to predict the ensuing peak ground motion (mainly related to the arrival of S and surface waves) at the same site.

Robust and effective algorithms for the real time processing of streamed seismic signals have been developed and off-line/real-time tested on several moderate to large earthquake data recorded in several seismic regions world-wide. Most of developed early-warning systems base on the measurement of ground motion quantities such as the peak displacement/acceleration amplitude, the average and dominant period, squared/absolute velocity integral in a narrow time window after the first P-arrival. The earthquake magnitude or the earthquake potential damage is generally estimated using prediction equations which are obtained through empirical regression analyses of early warning, ground motion parameter measured on strong motion and broadband earthquake records. On the other hand, the feasibility and accuracy of the real-time earthquake magnitude determination for large earthquakes, using the information carried out in the initial portion of recorded P-signals, is matter of investigation and debate.

For regional EEWS, the event detection and location is conceptually a simple problem which is solved using standard or more innovative techniques, while the prediction of ground shaking intensity at the target site, critically depends on the accuracy and variability of ground motion prediction equations and uncertainty on the earthquake magnitude estimation. The onsite approach has faster report times, since, in many cases, it can issue an alarm within 3-4 seconds from the first P-arrival at the site. It is therefore suited for targets close to the epicenter, where a regional system cannot provide an adequate lead-time. However the accuracy of the estimates is generally lower than for a regional system, and the probability of false alarms can be higher.

In this keynote we shall review the principles, methods and technological developments related to the feasibility and implementation of an early warning system with a special focus on the seismic alert management system developed and under testing in southern Italy.