

EGU General Assembly, 13th to 18th April, 2008, Vienna, Austria Generation of alert and shake maps from data provided by the Self-Organising Seismic Early Warning Information Network

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Introduction

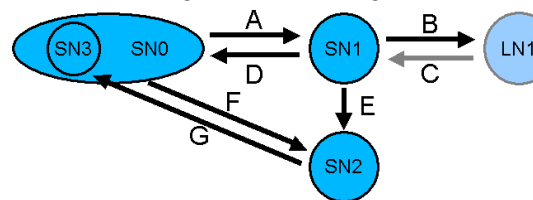
A Self-Organising Seismic Early Warning Information Network (SOSEWIN) is being developed as part of the SAFER (Seismic eARly warning For EuRope) and EDIM (Earthquake Disaster Information systems for the Marmara Sea region, Turkey) projects.

An application of the SOSEWIN is the generation of alert and shake maps. Within the context of this network,

- **Alert maps** are predictions of peak ground motion, using the earliest ground motion recorded closest to an earthquake's epicentre and region-specific empirical relationships, for as yet unaffected sites. The predictions are updated with more data and as stations are triggered. However, alert maps are ONLY for the seismological sensing units and are simply one form in which alarms will be issued.
- **Shake maps** are maps of the peak ground motion for an area following an earthquake, and as far as possible are based on recorded ground motion. These products are potentially of great value to, for example, disaster response authorities.

Alarm protocols

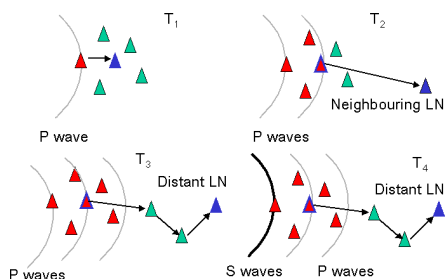
The sensors (Sensing Nodes or SN) of the SOSEWIN are arranged into clusters, where one SN within each cluster is designated as a Leading Node (LN).



- **SN0 Monitoring:** Each SN carries out its own data processing (filtering, integration of accelerometric data, P wave detection using STA/LTA), and communicates with its LN.
- **SN1 Detection:** The SN or LN is triggered by a P-wave (A) and informs its LN (B). If, after a certain time, too few SNs within a cluster trigger, the LN informs it (C) to return to monitoring (D).
- **SN2 Characterisation:** The event is confirmed (E) or its LN tells it that one has occurred (F). Characterisation tools include predominant period, CAV, Arias intensity, S-wave detection and *alert map generation* if the SN is also a LN.
- **SN3 Disaster management:** The event has ended (G) and a report describing ground motion (PGA, PGV etc.) is produced, including *shake map files*.

Alert maps

As the SOSEWIN is mainly being developed for urban areas, alert maps are only useful if the network is sufficiently extensive, continuously or as scattered groups of clusters.



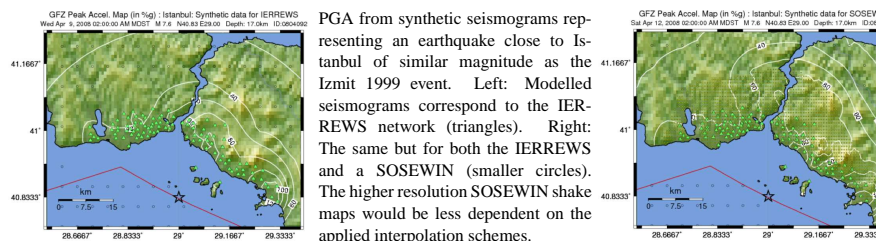
- **T₃:** The LN then predicts the peak values for different ground motion parameters and frequencies i.e. *alert maps*, for LNs expected to experience severe ground motion using empirical relations and the earliest P-wave time series. Therefore, the LN must know:
 - The other LN's locations (all units have GPS).
 - Site-amplification factors for each LN.
- **T₄:** As better estimates become available e.g. when the S-wave is detected, and more LNs confirm the event, alert maps are reissued.

- **T₁:** A SN detects an event using its P-wave trigger and informs its LN.
- **T₂:** If the LN confirms an event (after $\geq 50\%$ of the SNs in its cluster trigger), it informs the neighbouring LNs.

The empirical relations generally require information about distance, depth and magnitude, although these can only be estimated by relating the observed time series to other parameters (e.g. predominant period).

Shake maps

Each SN will produce files appropriate for the USGS tool ShakeMap containing the recorded PGA, PGV and spectral accelerations (for periods of 0.3, 1.0 3.0 seconds).



PGA from synthetic seismograms representing an earthquake close to Istanbul of similar magnitude as the Izmit 1999 event. Left: Modelled seismograms correspond to the IERREWS network (triangles). Right: The same but for both the IERREWS and a SOSEWIN (smaller circles). The higher resolution SOSEWIN shake maps would be less dependent on the applied interpolation schemes.

The SOSEWIN, with station spacings of 100's of metres, would allow shake maps to be produced at *neighbourhood* scales. Such information would be invaluable to loss-estimation tools such as *QUAKELOSS* and *SELENA*.

Such a sensor density is feasible, as an aim of this work is to develop a low-cost sensor unit purchasable by the general public. This could then lead to one (or several) units being installed in most houses or apartment blocks.