Seismic early warning system ALERT_ES: a simulation case study for southwest Iberia using different software packages

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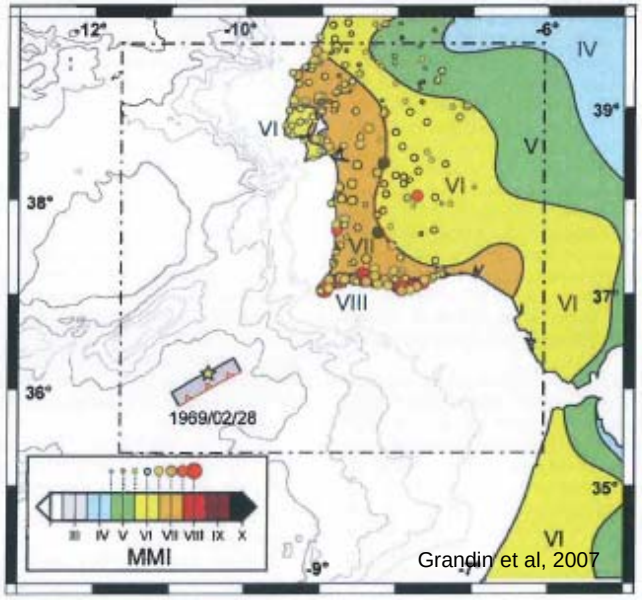
The main goal of the Spanish ALERT-ES project is to study the feasibility of an EEWS for the potentially damaging earthquakes that occur in the zone Cape S. Vicente - Gulf of Cadiz in the SW Iberian peninsula, such as the 1755 Lisbon (I_{max}=X) or 1969 S. Vicente Cape (Ms=8,1) events.



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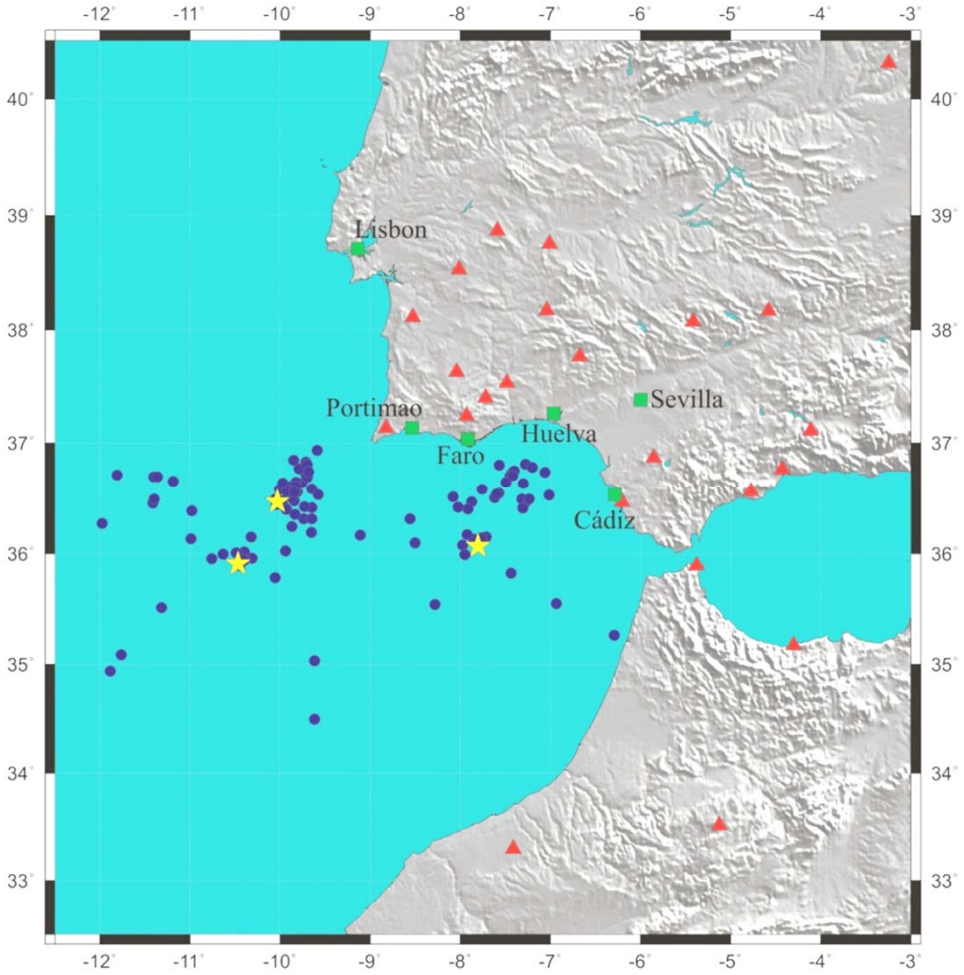


- Database earthquakes (2006-2011); M>3.8

★ The three earthquakes selected for the simulation. The hypocentre location parameters are taken from the IGN catalogue:

	Date	Origin Time	Latitude (º)	Longitude (º)	Depth (km)	Mw
SV1	12/02/2007	10:35:24	35.9100	-10.4684	30	6.1
SV2	17/12/2009	01:37:49	36.4702	-10.0318	36	5.5
GC1	18/08/2009	06:56:04	36.0689	-7.8024	50	3.9

▲ Selected BB stations:

- 9 from IGN network
- 7 from WM network
- 8 from IPMA network

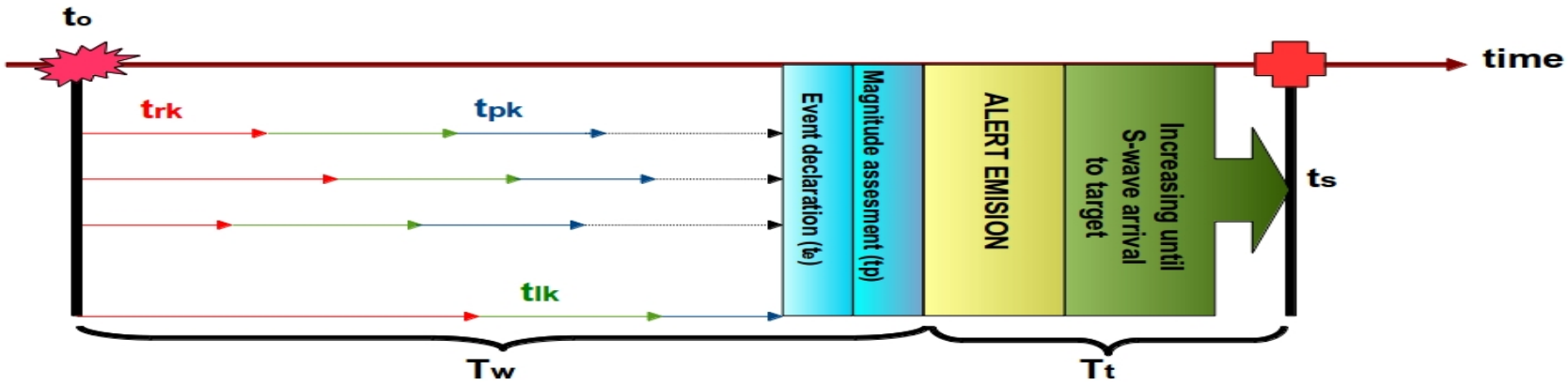
■ Targets

i) Simulations of the selected earthquakes using three different seismology software packages running in simulation mode:

- Earthworm (USGS, 2005)
- SeiscomP3 (GEOFON, 2007)
- PRESTo (RISSC Lab-Naples Federico II University, 2010)

ii) Error analysis of the onset picks, the location and the origin time taking as reference the earthquake parameters from the IGN catalogue

iii) The elapsed time, the blind zone and the lead time to targets are computed taking into account not only the simulation cases but also the IGN location



T_w: Elapsed time between the origin time and the instant in which an event is declared, addition of:

- t_{ri}: P-wave propagation time needed to reach the last station i
- t_{li}: communication system latency (a fix value of 8 seconds is assumed because it is close to the mean delays for IGN and IGC VSAT stations)
- t_{pi}: consumed time for the picking module,
- t_e: time consumed by the event declaration and location modules
- t_p : execution time for the magnitude module.

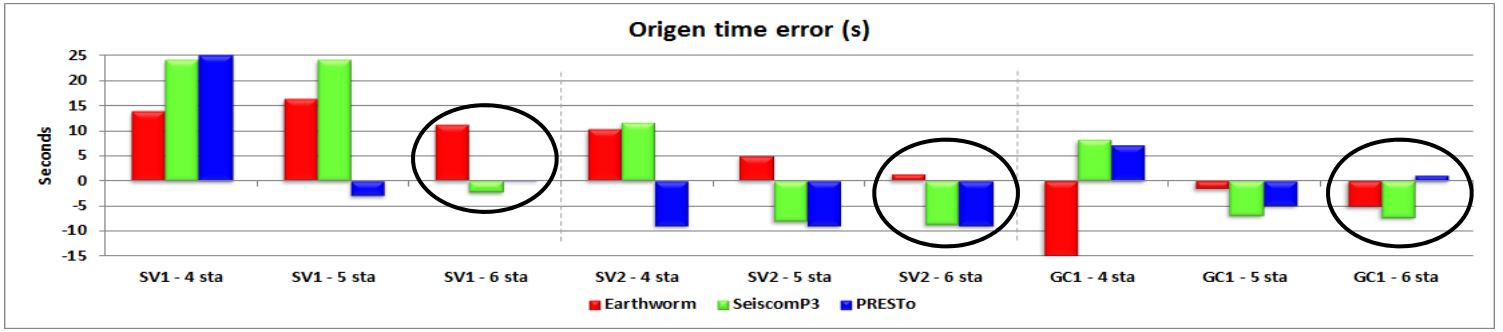
i) *Pick discussion*

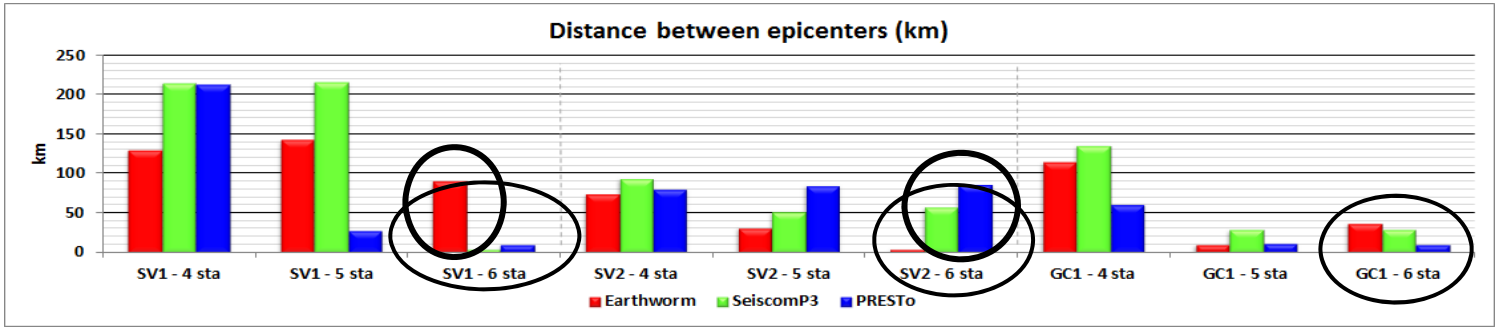
- Mean values of differences between the automatic and the manual P-arrival picks: 0.02 s to 0.11s

- Not significant differences on mean values between using only the first 4, 5 or 6 stations

- Picking errors should not have a large influence in the earthquake location and therefore location errors are due to others factors (azimuthal gap).

ii) *Location errors (simulation – true situation)*





- For all methods and for the three events, Origine Time and location are improved using 6 stations,

- The largest origin time error is about 10s for the three methods for SV1 or SV2,

- The maximum location error is: 90km for Earthworm in SV1
85km for Presto in SV2
55km for Seiscomp in SV2

iii) Elapsed time (T_w)

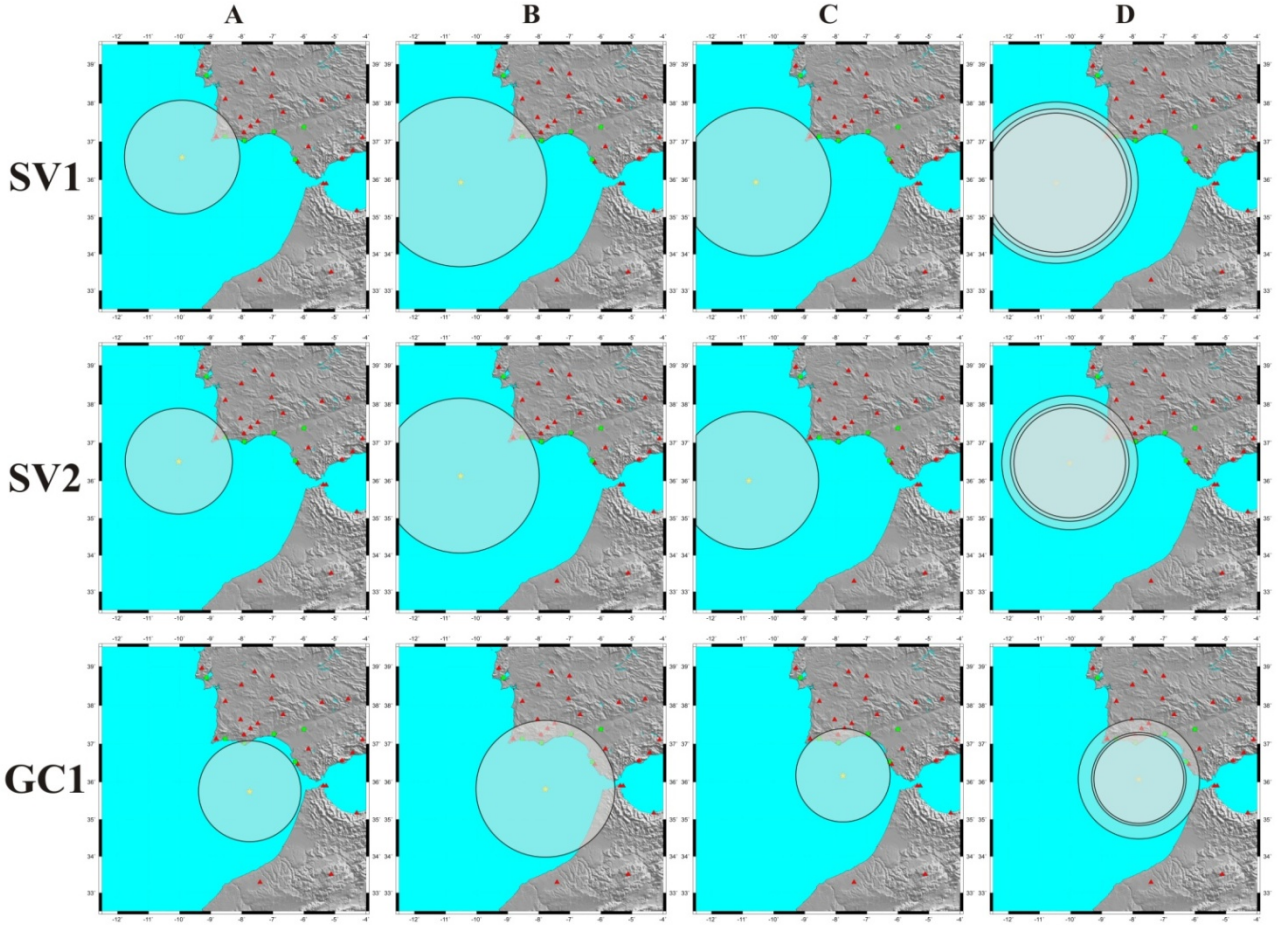
Actual elapsed times, in seconds, for the 4, 5 and 6 stations cases referred to IGN origin time, and for the selected software packages.

- Elapsed times for 6 stations are about 5 seconds greater than for 4 ststions
- Very similar values for all the methods when improvement will be introduced on Seiscomp

	Earthworm	SeiscomP3	PRESTo
	4- 6 Stations	4-6 Stations	4-6 Stations
SV1	55 - 60s	66 - 70s	59 - 63s
SV2	42 – 48s	53 - 57s	44 - 50s
GC1	34 – 39s	45 – 52s	35 – 40s

iv) Blind zone

Blind zone for the 6 station case for the three selected events. A) Earthworm, B) SeiscomP3, C) PRESTo and D) Estimated blind zone for the IGN hypocentre and for 4, 5 and 6 station cases



The resulting lead times simulated using 3 different seismological software packages are useful for all the Southwest Spain and South Portugal, apart from some parts of shoreline which depend on the earthquake epicentre area