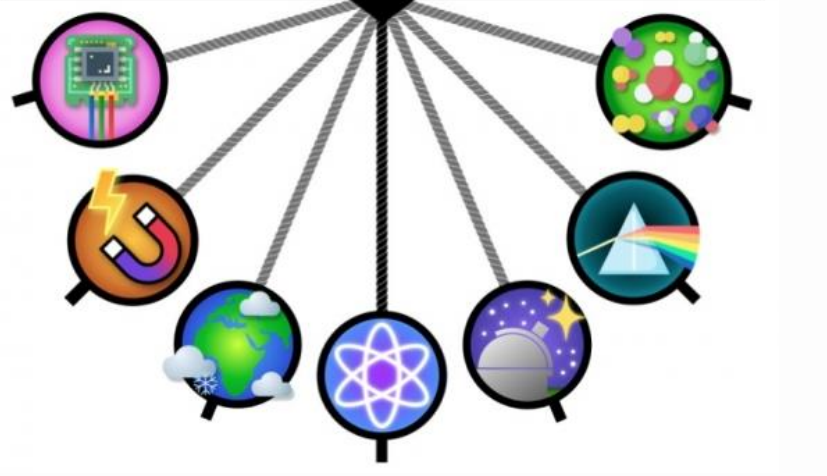


# Performance of an impact-based Earthquake Early Warning System in the Alboran Sea

2025  
PhDay Físicas

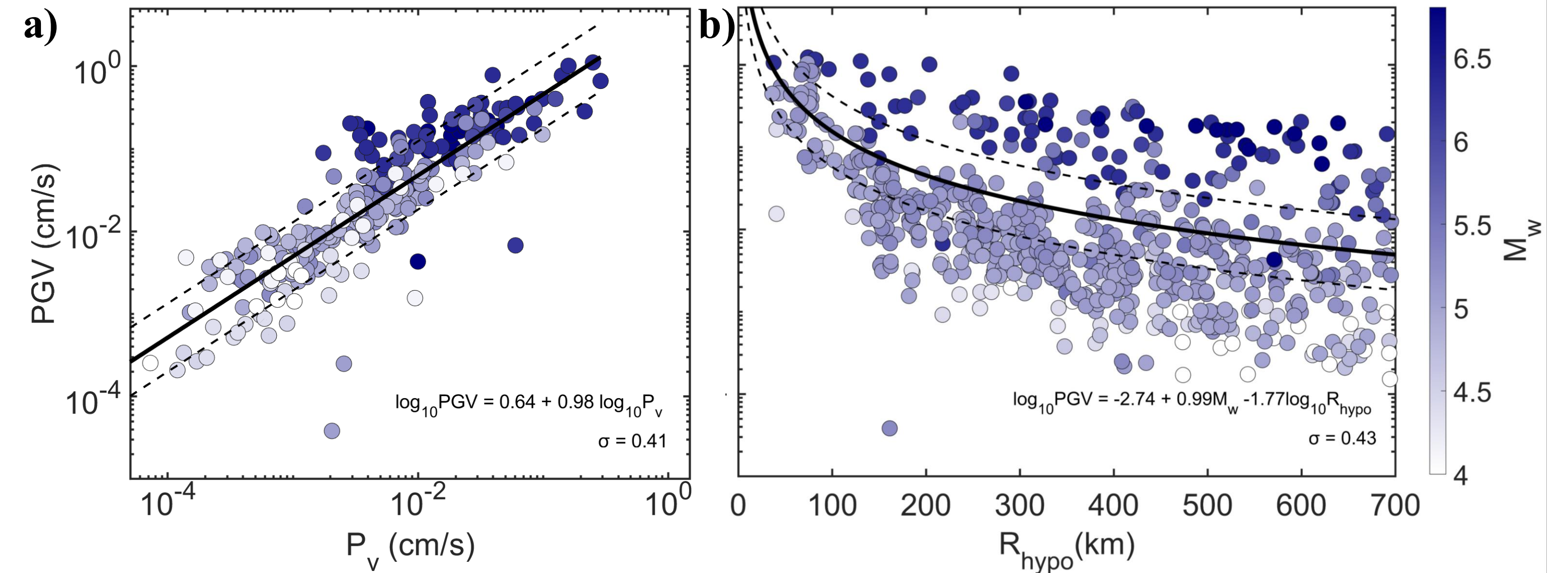
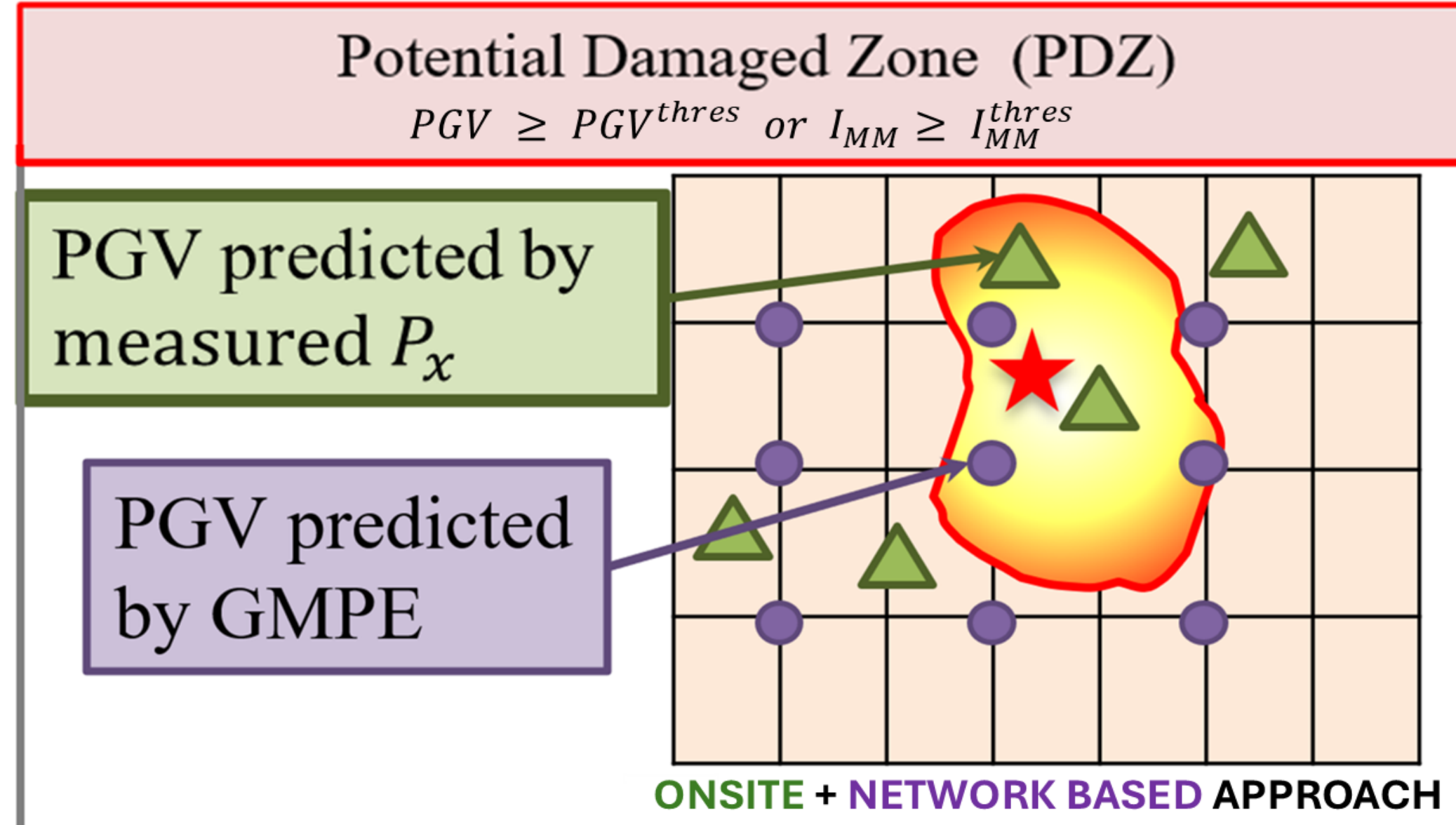


ESCUADERO, Lucía<sup>(1)</sup>; MATTESINI, Maurizio<sup>(1,3)</sup>; ZOLLO, Aldo<sup>(2)</sup>; REA, Raffaele<sup>(2)</sup>; ELIA, Luca<sup>(2,4)</sup>; COLOMBELLI, Simona<sup>(2)</sup> and BUFORN, Elisa<sup>(1,3)</sup>

<sup>1</sup>: Departamento de Física de la Tierra y Astrofísica, Facultad de Ciencias Físicas, Universidad Complutense de Madrid, Spain; <sup>2</sup>: Dipartimento di Fisica "Ettore Pancini", Università degli Studi di Napoli Federico II, Italy; <sup>3</sup>: Facultad de Ciencias Físicas, Instituto de Geociencias (UCM-CSIC), Spain; <sup>4</sup>: Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Napoli Osservatorio Vesuviano, Italy

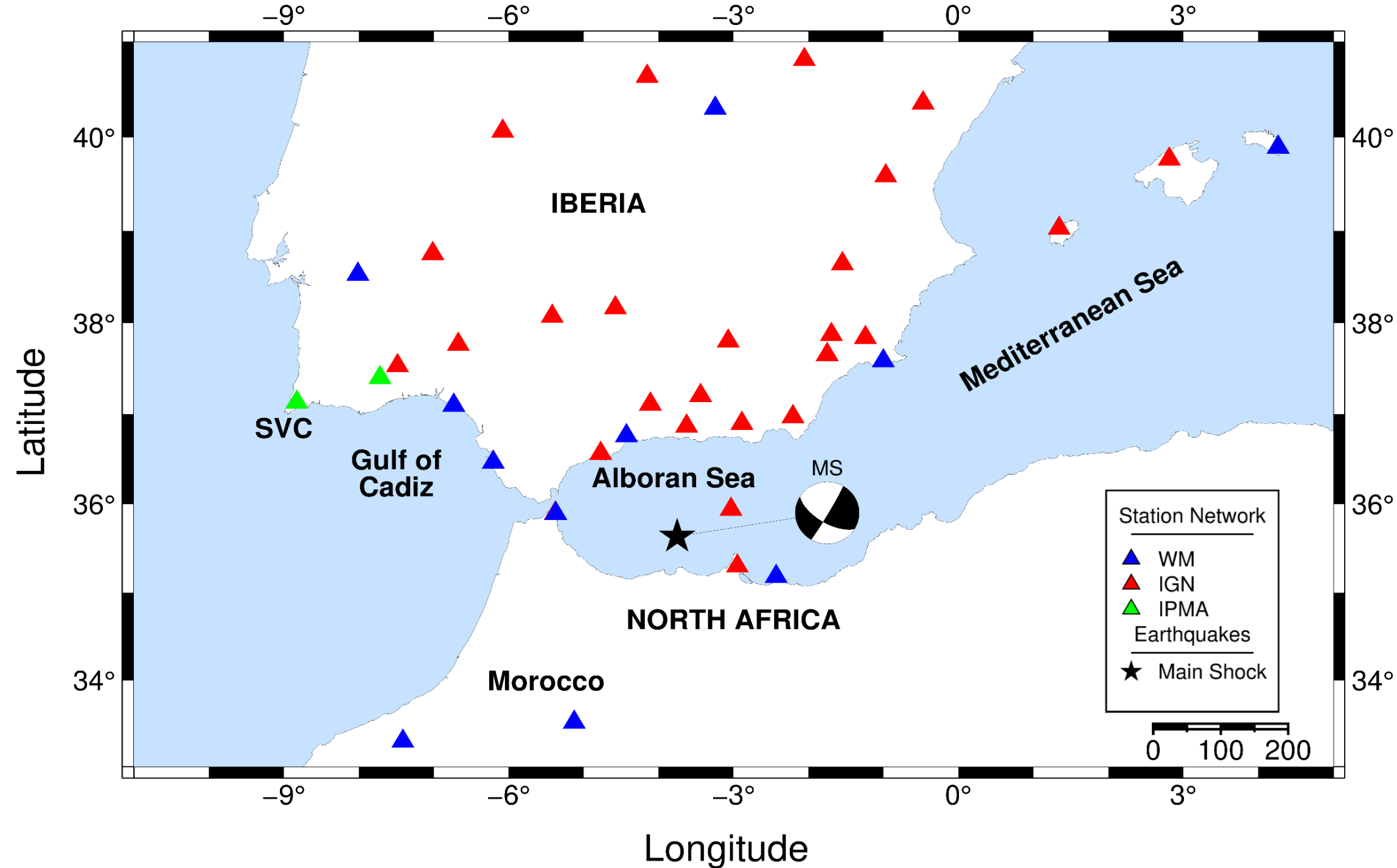
## 1. Introduction

We implemented a P-wave shaking-forecast-based Earthquake Early Warning System (EEWS) method in the Ibero-Maghrebian Region (IMR), using real-time mapping of the Potential Damage Zone (PDZ)-the epicentral area where the Peak Ground Velocity (PGV) is predicted to exceed a pre-set threshold during an earthquake (Zollo *et al.*, 2023). This method uses *QuakeUp* software, developed by the *RISSC-Lab*\*. PGV values are converted to Instrumental Intensity ( $I_{MM}$ ) using the Faenza & Michelini (2010) empirical relation (MCS scale), generating an  $I_{MM}$  shake map that updates over time to monitor the PDZ.



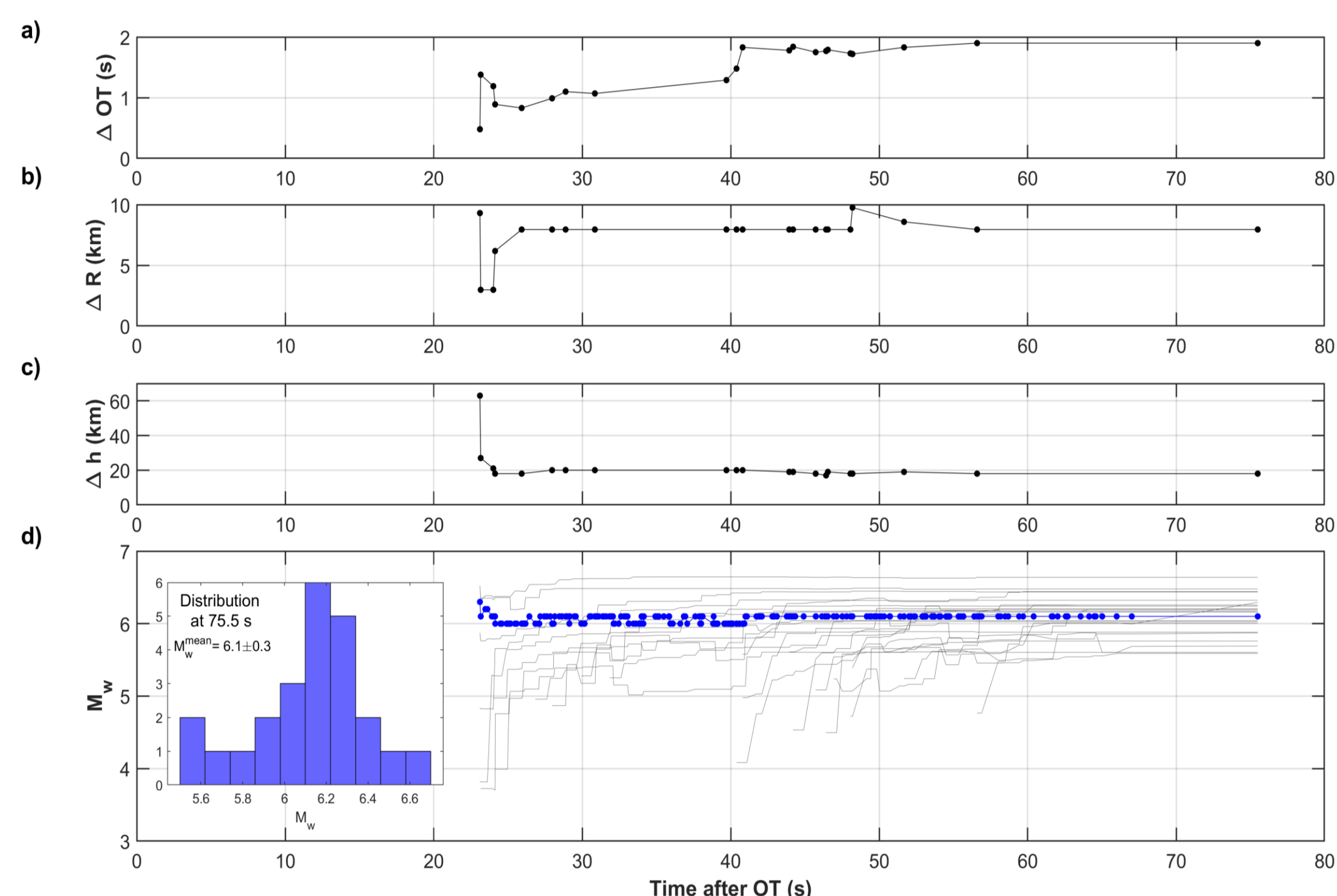
## 2. Offline testing of the EEWS performance

Here we illustrate the retrospective analysis of the method's performance for the main shock ( $M_w$  6.4) of the 2016 Alboran Sea seismic series.

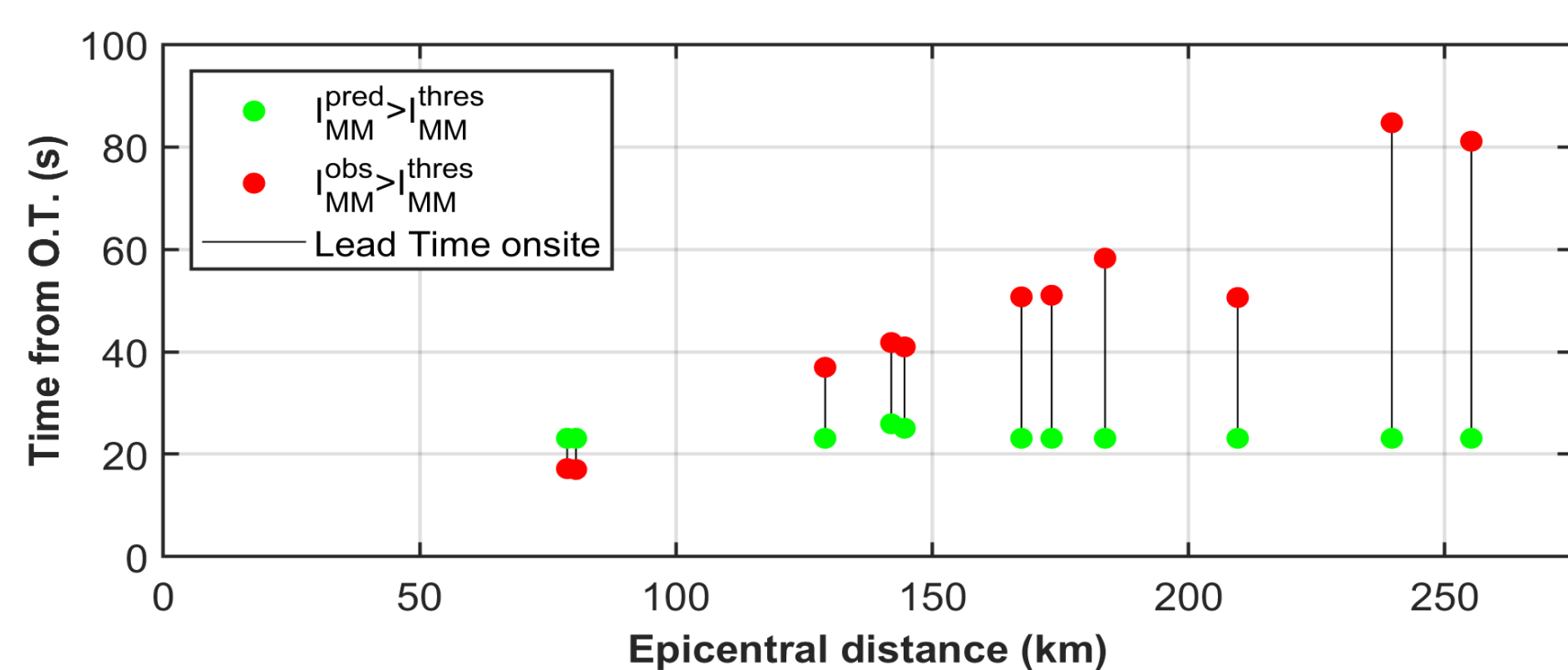


### 2.1 Time-evolutive earthquake location and $M_w$ estimation

As the P-wave is detected at 5 stations, a probabilistic and time-evolving location and magnitude estimation are performed using *RTLloc* algorithm (Satriano *et al.*, 2008) and the method of Zollo *et al.*, 2023, respectively.



### 2.2 Lead-Time ( $I_{MM}^{thres} = IV$ )



### 2.3. Quality of the impact prediction ( $I_{MM}^{thres} = IV$ )

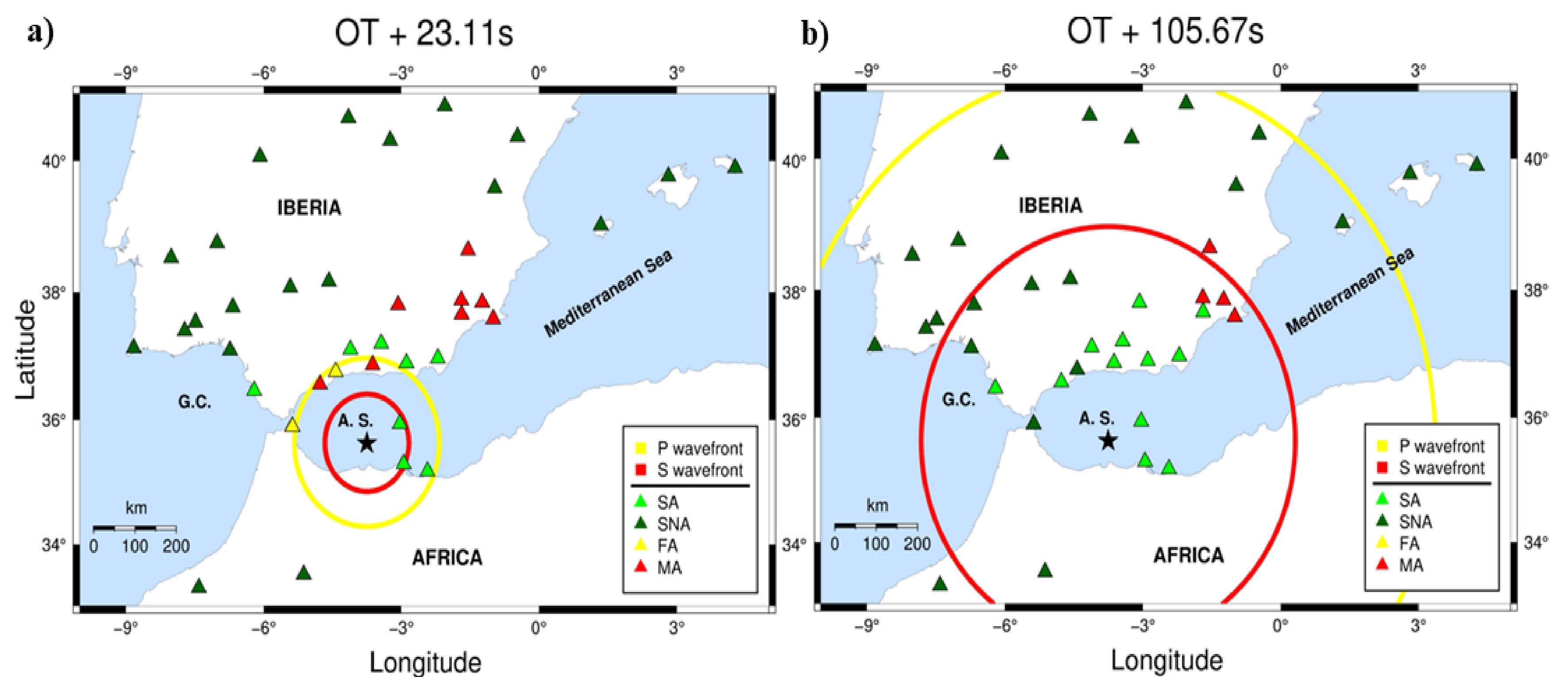
The accuracy of impact prediction is assessed by applying the decision matrix of Zollo *et al.*, (2023):

Successful Alerts (SA):  $I_{MM}^{pred} \geq I_{MM}^{thres}$  &  $I_{MM}^{obs} \geq I_{MM}^{thres}$

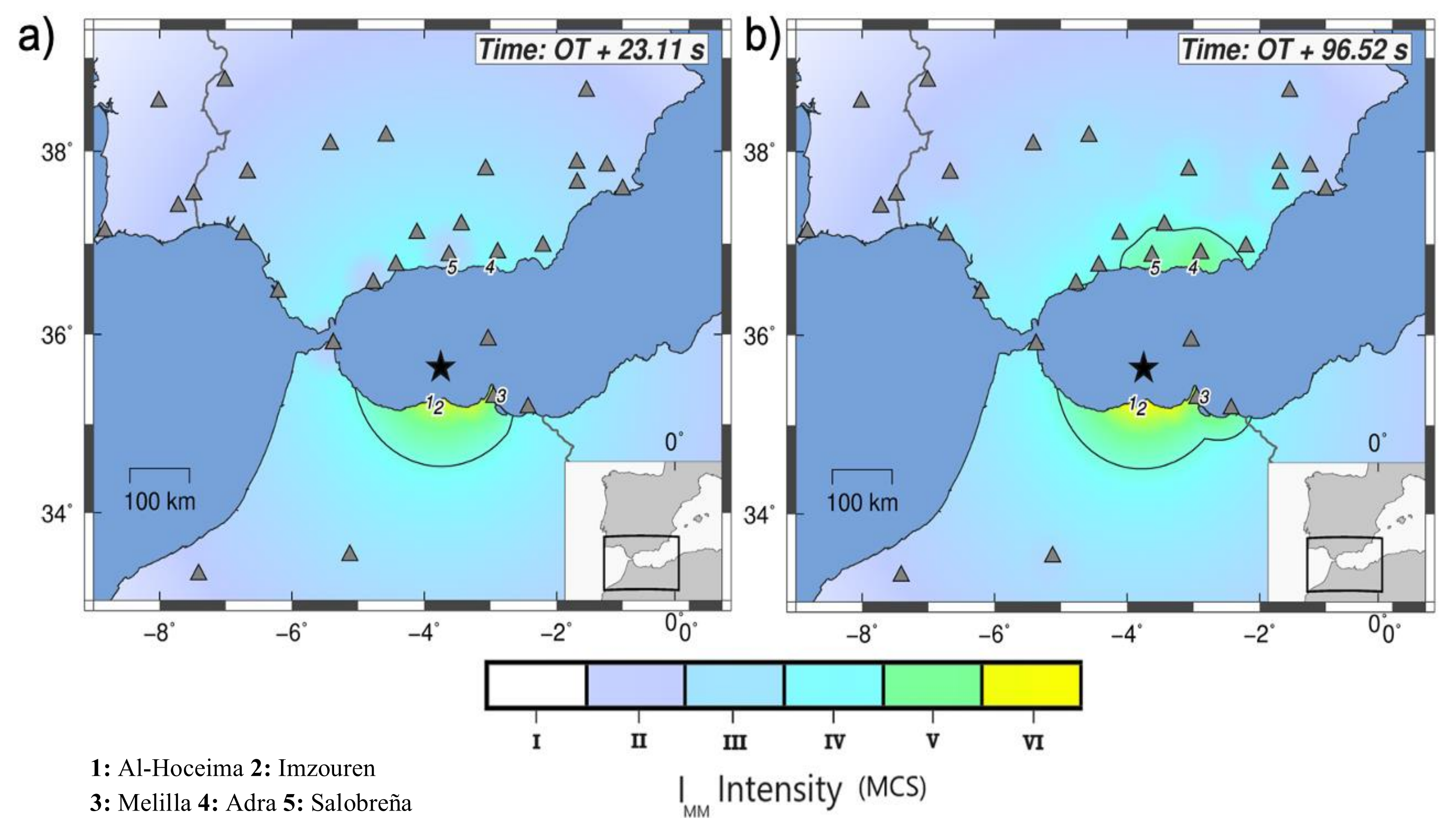
Successful No-Alerts (SNA):  $I_{MM}^{pred} < I_{MM}^{thres}$  &  $I_{MM}^{obs} < I_{MM}^{thres}$

Missed Alerts (MA):  $I_{MM}^{pred} < I_{MM}^{thres}$  &  $I_{MM}^{obs} \geq I_{MM}^{thres}$

False Alert (FA):  $I_{MM}^{pred} \geq I_{MM}^{thres}$  &  $I_{MM}^{obs} < I_{MM}^{thres}$



### 2.4. P-wave based shake maps. Potential Damage Zone ( $I_{MM}^{thres} = V$ )



## 3. Conclusions

- We implemented and tested a new P-wave shaking-forecast-based EEWS, called *QuakeUp*, at the IMR. It has proven effective for moderate-magnitude offshore earthquakes in the IMR.
- We calibrated region-specific relationships between PGV and P-wave peak amplitudes (acceleration, velocity, and displacement), as well as between magnitude and P-wave peak amplitudes. A GMPE  $M_w \geq 4$  earthquakes in the IMR was developed.
- For  $I_{MM}^{thres} = IV$ , the lead-time ranges from 14 to 62 s, which increases with the epicentral distance (up to 260 km). The accuracy of the impact prediction improves over time.

\*RISSC-Lab: Unità di Ricerca in Sismologia Sperimentale e Computazionale, Università degli Studi di Napoli Federico II (Italy)

## References

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- Faenza & Michelini (2010): <https://doi.org/10.1111/j.1365-246X.2009.04467.x>
- Satriano *et al.*, (2008): <https://doi.org/10.1785/0120060159>
- Zollo *et al.*, (2023): <https://doi.org/10.1029/2022EA002657>

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