



UNIVERSITÀ DEGLI STUDI DI NAPOLI
FEDERICO II

INGEGNERIA STRUTTURALE, GEOTECNICA E RISCHIO SISMICO



The 2017, Ischia Earthquake (South Italy): Source mechanism and rupture model from the inversion of a near-source strong motion record

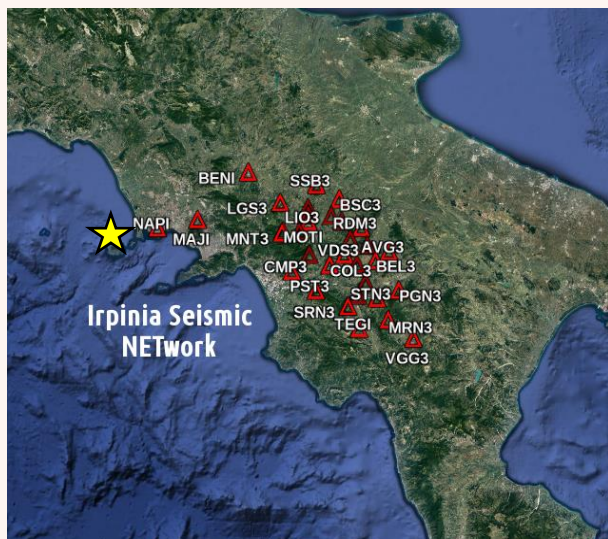
26th May 2022 Vienna - EGU

Sahar Nazeri

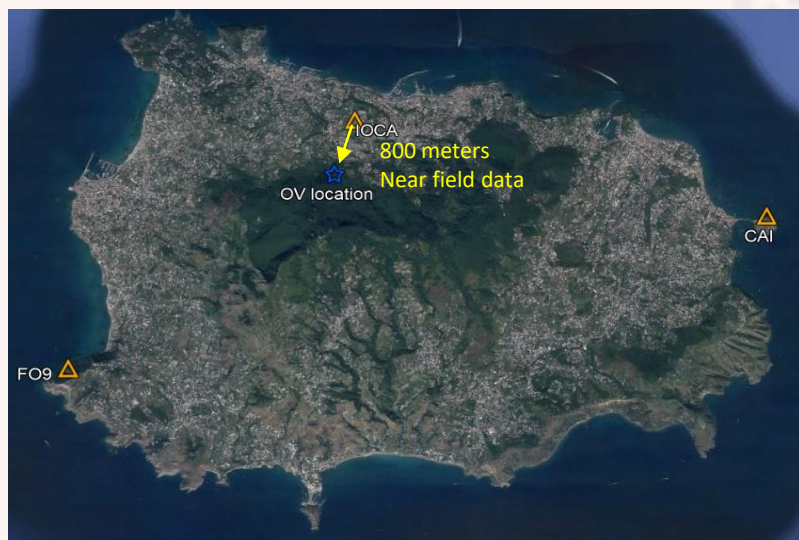
**Aldo Zollo, Guido Maria Adinolfi,
Ortensia Amoroso, Matteo Picozzi**

Dept. Physics E. Pancini, University of Naples Federico II

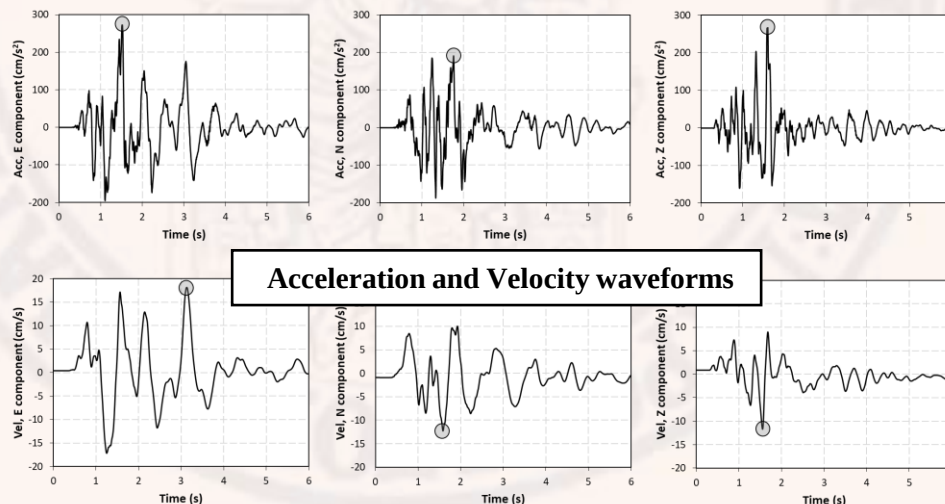
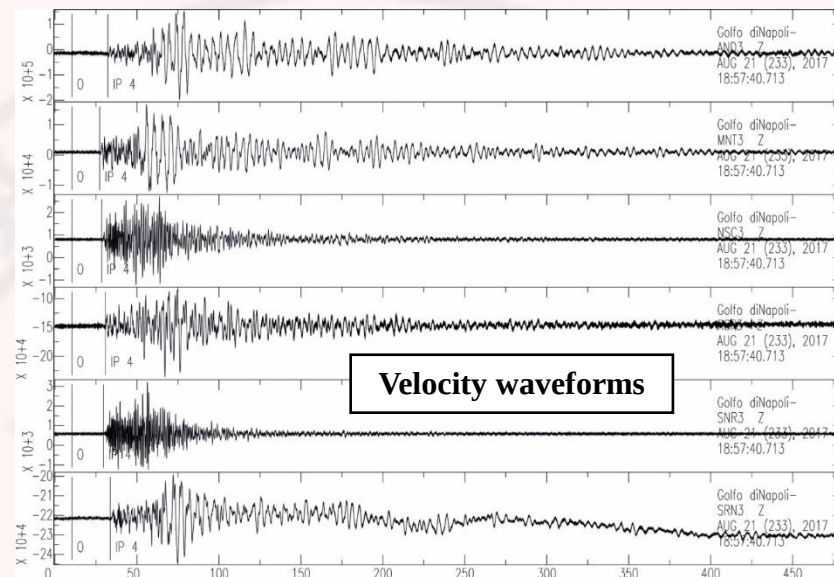
S. Nazeri, A. Zollo, G. M. Adinolfi, O. Amoroso and M. Picozzi, "The 2017 Ischia Earthquake (Southern Italy): Source Mechanism and Rupture Model From the Inversion of a Near-Source Strong Motion Record," in *IEEE Transactions on Geoscience and Remote Sensing*, vol. 60, pp. 1-10, 2022, Art no. 4505510, doi: 10.1109/TGRS.2021.3111400.



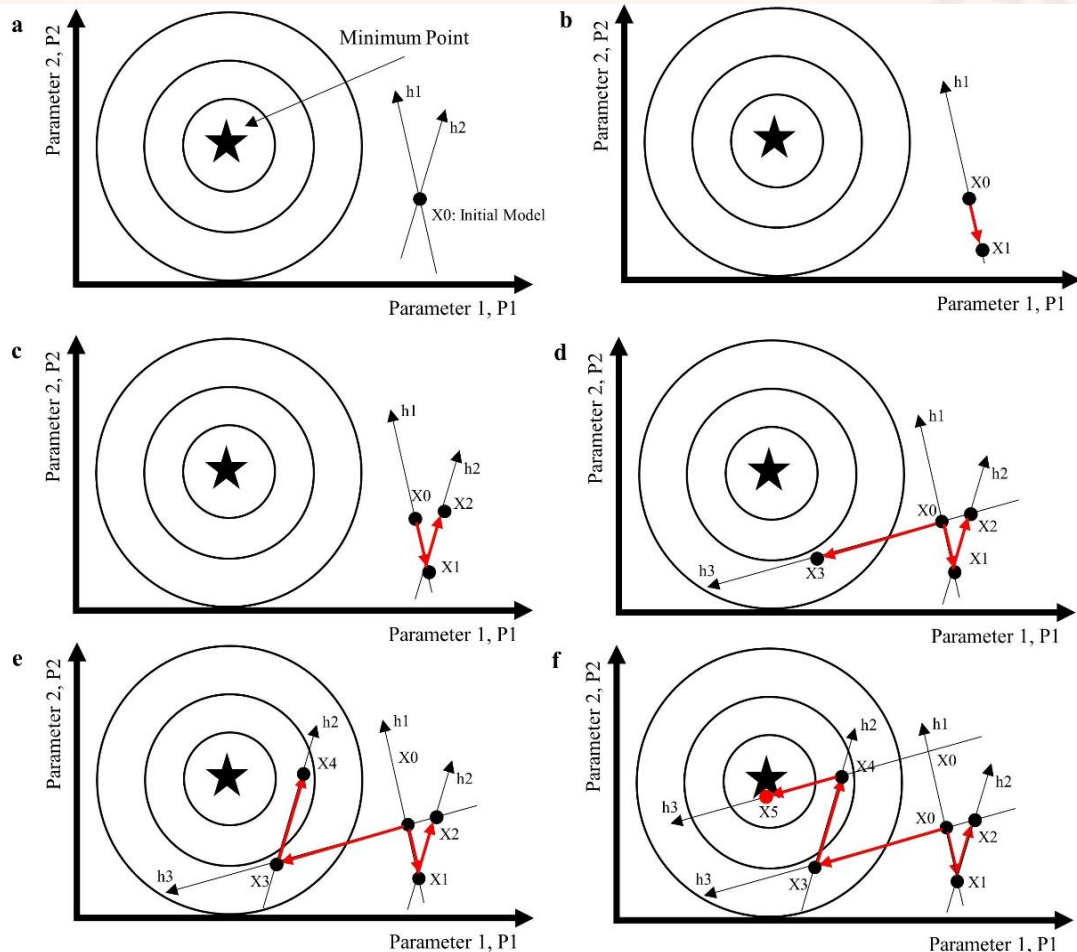
ISNet (Irpinia Seismic Network)



Data, IOCA Station



Inversion and Optimization Method



The unconstrained, nonlinear Powell's optimization algorithm
(Powell, 1983; Tonel, 2020)

Cust Functions:

$$RMSD = \sqrt{\frac{1}{N} \sum_{i=1}^N \|A_i^{obs} - A_i^{syn}\|^2}$$

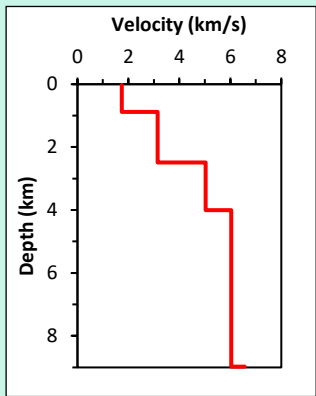
$$CC = \frac{1}{N-1} \sum_{i=1}^N \left(\frac{A_i^{obs} - \mu_{A^{obs}}}{\sigma_{A^{obs}}} \right) \left(\frac{A_i^{syn} - \mu_{A^{syn}}}{\sigma_{A^{syn}}} \right)$$

Inversion and Optimization Method

Flowchart

INPUT:

1. Acceleration waveforms recorded at IOCA station
2. Velocity Model (4 layers) (Capuano et al., 2015)



OUTPUT: 12 Variable Parameters

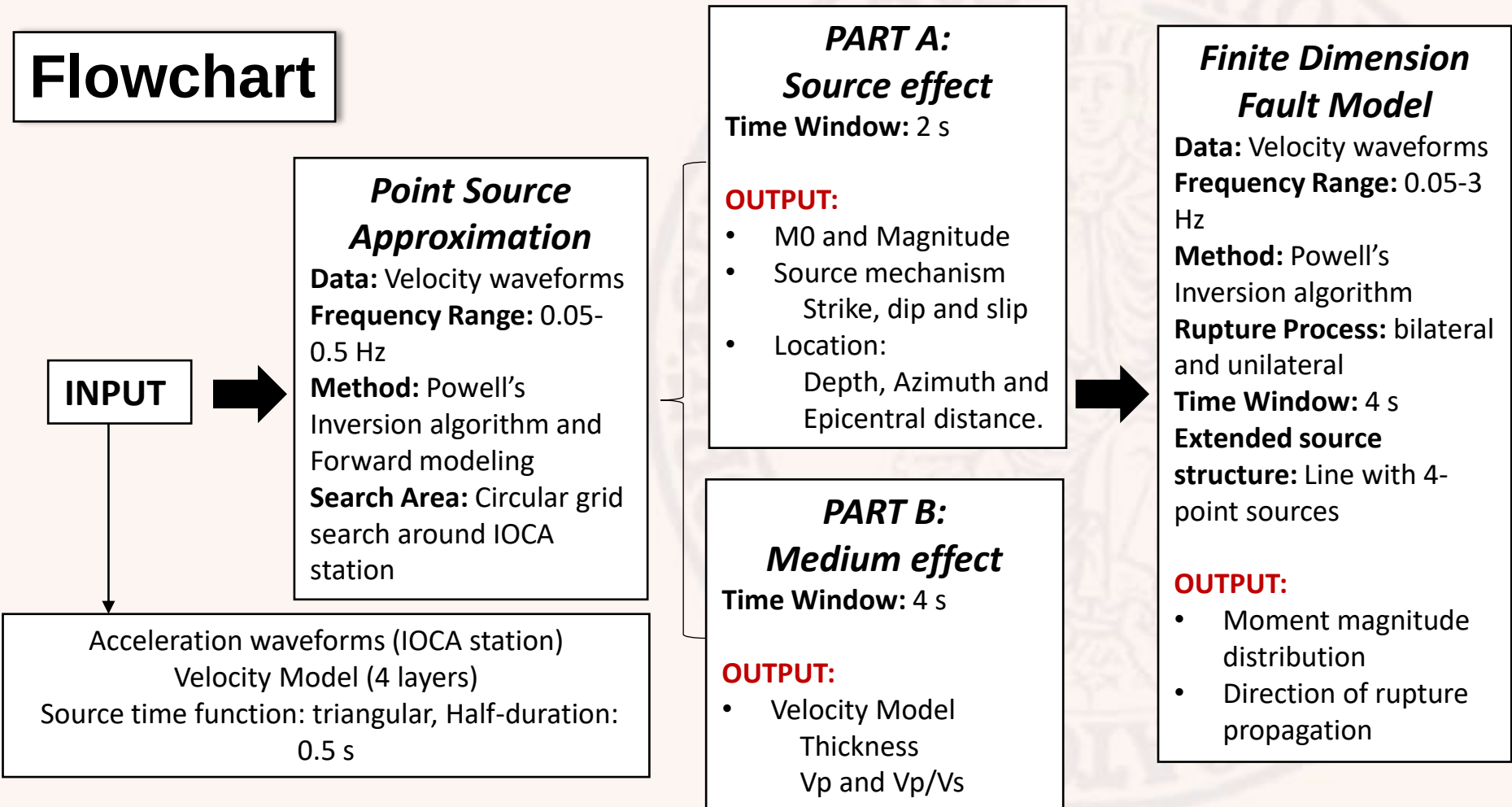
1. Magnitude $\rightarrow 1$
2. Modified Velocity Model (Thickness of the shallow layer, V_p and V_p/V_s) $\rightarrow 3$
3. Location of the event (Depth, Epicentral distance and Azimuth with respect to IOCA) $\rightarrow 3$
4. Focal Mechanism (Strike, Dip and Rake) $\rightarrow 3$
5. Moment magnitude distribution
6. Direction of rupture propagation

Assumptions:

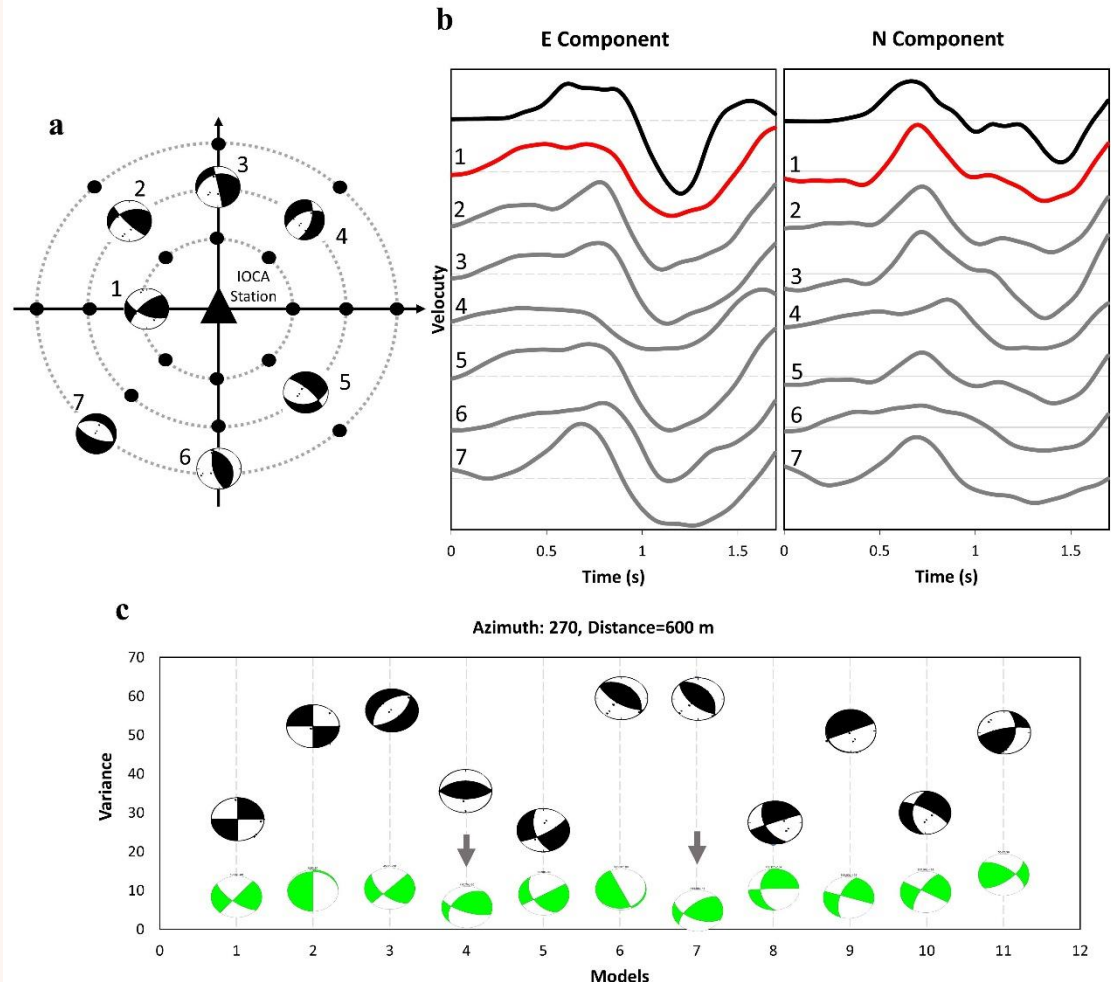
1. Point-Source and Extended-Source (Line) approaches
2. Circular grid search around IOCA station
3. Forward Modeling and Inversion (Newton and Powell)
4. Qualitative (Fitting the waveforms)
5. Quantitative (Cost Functions: RMSD and Correlation Coefficient)

Inversion and Optimization Method

Flowchart



Point-Source Approach, Location & Focal Mechanism



Black → Observed waveform, IOCA
Red → Best point at Az:270,
Distance:600 m

Gray → For the other point
sources as some examples

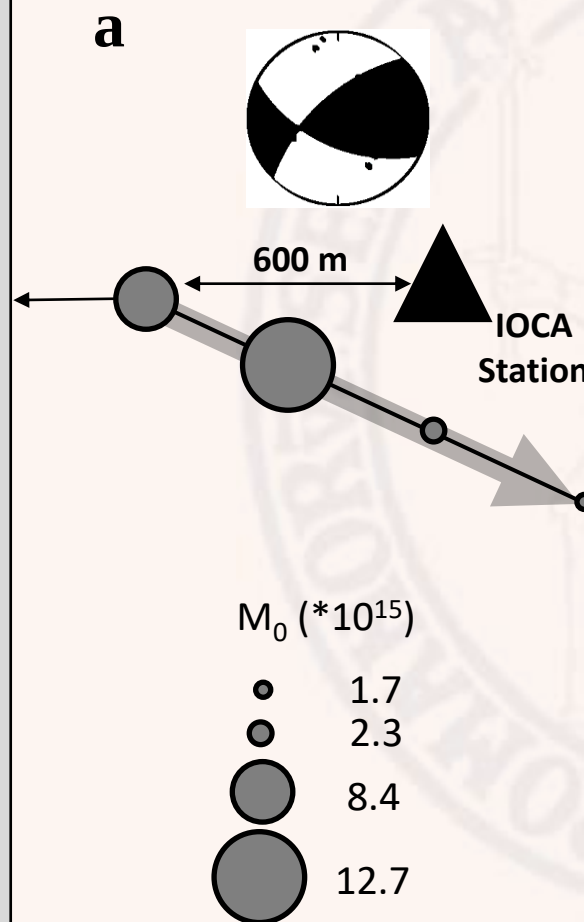
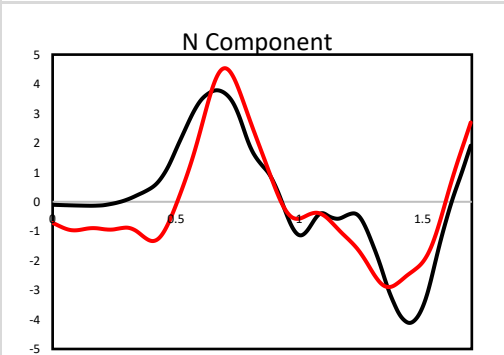
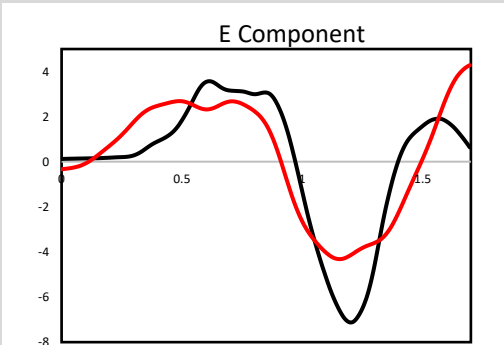
Output of the Powell's Inversion codes,
POINT source

Black beach-balls → Initial focal
mechanisms

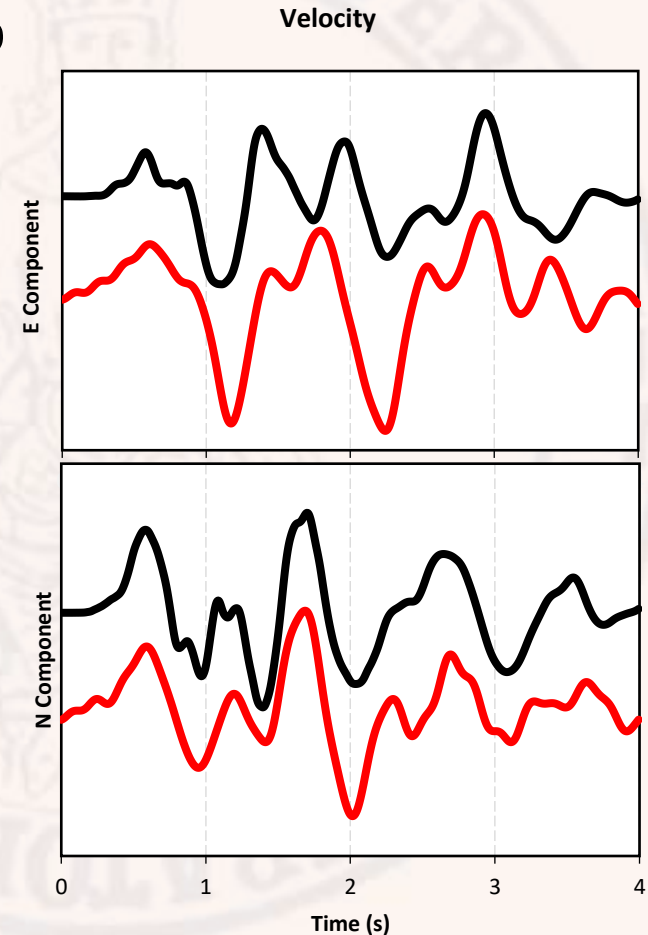
Green beach-balls → Final focal
mechanisms

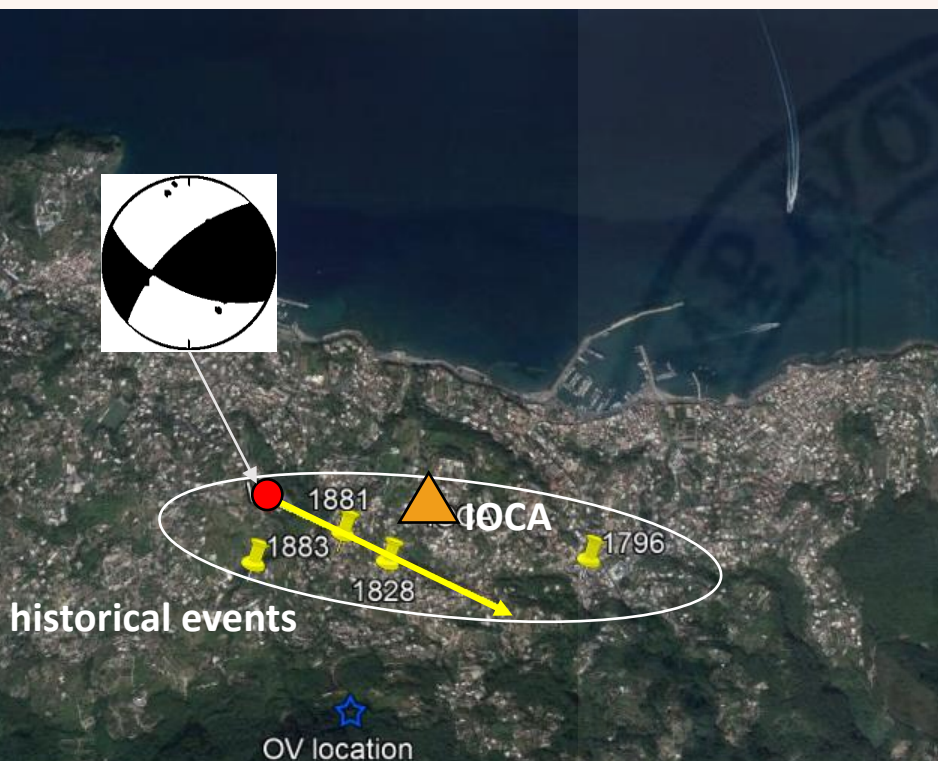
Line-Source Analysis, Rupture Propagation

Output of the previous Step: **Point Source Approach**



b





OUTPUT:

- Magnitude: **4.2**
- Velocity Model 6 layers (Thickness of the shallow layer: **75 cm**, V_p and V_p/V_s : **1.8**)
- Location of the event (Depth: **1.1 km**, Epicentral distance: **600 m** and Azimuth: **270°** with respect to IOCA)
- Focal Mechanism (Strike **115**, Dip **55** and Rake **145**)

