Answers to comments of Reviewer#1

December 5, 2025

We wish to thank Dino Bindi for his helpful comments which gave us the possibility to rewrote some parts of the manuscript that weren't so clear. Hereafter, the responses to his comments.
1.
Reviewer #1:
The seismic catalog covers the years 2013-2022. What is the rationale for stopping at 2022? Why not include more recent seismic activity, such as that from 2023-2025? How can users consistently extend the catalog to include more recent data? Is the catalog for this area now consistent with the national one available from INGV?

Authors:
As illustrated in the manuscript, the OT network works since 2013 and during the 2019 changed the data transmission protocol and recordings are available real time on the web services of EIDA node managed by INGV. So, being data starting from the second half of 2019 already available, our main interest was to enrich the knowledge of the seismicity rates in the period in which data are not available online on the EIDA web service (so for the period from 2013 to the first half of 2019. We decided to extend the analysis up to the end of 2022 to allow a comparison of the detect of the software CASP (Scafidi et al., 2019) with that of the ONT. The analysis of ten years of seismograms was extremely time-consuming so when we stopped the picking phases processing we dedicated to the analysis and evaluation of the results for that decade. The comparison of our catalog with the ONT catalog is then possible only from 2019 to 2022. Being the CASP software set ad hoc for the microseismicity detection, our catalog present a greater number of events of lower magnitude than that of the ONT catalog (2640 in our catalog respect to 1463 of ONT). Among the 1463 of the ONT catalog, there are about 300 earthquakes that CASP did not detect, probably for the different settings in the STA/LTA algorithm. We added this comment in the manuscript, in the discussion section. To extend the analysis to the present, the users may download the waveforms from the INGV webservice of EIDA and should process them with the CASP software (having previously acquired the license) to continue with the same workflow or use some other open source detection codes as SeisComP3.

2.
Reviewer #1:
The authors used the CASP tool to detect, pick, and locate events, and they emphasized its advantages, particularly for detecting small events, while also noting the need for manual revision of automatic picks (especially for S-waves). In the last decade machine-learning approaches for event detection, phase picking, and event association have become also increasingly common. Have the authors considered testing such tools and comparing their performance with CASP? For example, many state-of-the-art models are available through SeisBench (https://seisbench.readthedocs.io/en/stable/index.html), including models trained on Italian datasets such as INSTANCE, prepared by INGV.

Authors:
The CASP tool is successfully implemented for the seismic monitoring of Northwestern Italy. So we explored the possibility to implement this code for the seismic monitoring of the Gargano Promontory. The CASP license was acquired thank to a collaboration between the University of Bari Aldo Moro and the INGV. The code is nowadays operative. The CASP code gave us the possibility to analyze ten years of seismic recordings in offline mode with the results illustrated in the manuscript. We conclude that the CASP software is able to detect a large number of small magnitude events, the S-wave picking suffers of some uncertainties that do not affect the reliability of the final location, manual revision is necessary to exclude from the catalog the non-earthquake events. Overall the CASP software was useful to build the released catalog. Manual review of the catalog obtained with CASP allowed us to collect a dataset of highly reliable earthquakes, as they were re-picked. This dataset, for which we have released a bulletin in the Data Availability section, will allow us to test the effectiveness of machine learning techniques in automatic picking and building automatic catalogs. In fact, the machine learning detection (PhaseNet, Zhu et a., 2019) and association techniques (GAMMA, Zhu et al., 2021) can be applied to the same dataset, leading to a greater number of detected events. The results of this study and the well located earthquakes of the released catalogs can be used to test the effectiveness of machine learning techniques in automatic picking when building automatic catalogs. We modified the discussion section to account for this comment.

3.
Reviewer #1: Building on the previous observation, machine learning tools are also effective for classification problems, such as distinguishing tectonic events from quarry blasts. Have the authors considered applying one of the tools continuously proposed in the literature to validate their simple approach and confirm the large number of quarry blasts detected in the area? Did the authors check the waveforms and their spectra to confirm the plausibility of the quarry blast records?

Authors:

We partially agree about the effectiveness of the machine learning tools to avoid human costs. Our experience, which will be subject of a subsequent dedicated work, indicates that visual revision is still necessary to build a reliable catalog of earthquakes. The machine learning based tool for binary classification (quarry blasts and earthquakes) should work on a catalog where all the false events and the regional events located as local earthquakes are already eliminated from the list. In our case, the catalog includes 4 types of events (earthquakes, quarries, false and bad located) and the binary classificator cannot be implemented, at this stage.
The recognition of a quarry explosion was carried out, as described in the manuscript, on a subset of events, located in the vicinity of known mining quarries, which occurred during working hours on working days, by observing the waveforms of the closest station, where the arrival of the S-wave is absent, and neglecting waveforms of the more distant ones, where a surface wave can be confused with the S-wave arrival. We rewrote to clarify the procedure.

4.
Reviewer #1:
The authors wrote: "In this paper, we will refer to the Gargano Seismic Network (hereafter GSN) as to a network for the seismic monitoring of the GP area that includes 11 selected stations of the OT network and 10 selected stations of the IV network (Fig. 2) resulting in a very dense network optimized for this study.". To better understand the suitability of the network geometry with respect to the considered seismicity, it would be helpful to add in Figure 2 the location of the events included in the catalog (Figure 13). This would provide an immediate view of the suitability of the network geometry for monitoring the seismicity of interest. Are the mean statistical location errors in Table 3 too large for an optimized, dense local network? The depth of the identified quarry blasts (Figure 7c) also seems to indicate large uncertainty in depth location, assuming that quarry blasts are shallow.

Authors:
We have already discussed in the manuscript (in the discussion section) the seismicity distribution across the years (Figures are in section Supplementary material) with the different three stations configuration: from April 2013 to June 2015, from July 2015 to March 2021 and from April 2021 to December 2022. This was aimed to better understand how seismicity shifts based on the variation in stations configuration. Regarding location errors, we need to do two considerations. First, the velocity model used for location (de Lorenzo et al. 2017) was developed with the OT network geometry of the early years (2013-2015) when some stations (OT13, OT14, OT16, OT17, TREM) weren't installed yet and some others were subsequently removed (OT01, OT02, OT08, OT09, OT10). We think that a revision of the velocity model is necessary, maybe it is slightly fast and this could be the reason why blasts are located deeper in the crust than they should. Second, the seismicity of the GP is very deep in the crust, at depth between 15 and 25 km, and it is of very low energy, for the

majority of the earthquakes we have $0.1 < M_L < 3$, so the takeoff angle of the most of the recording stations is small and the recordings are few for each event. This could explain why we have horizontal and vertical errors that are typical of regional events. We added these considerations in the discussion section.

5.

Reviewer:
In Table A1, the availability for OT stations MASS, CGL1 and TAR1 is missing.
The authors could explain how to use standard webservices to obtain information about the data availability from 2019.

Authors:
In table A1, we refer only to the Gargano Seismic Network (GSN), which include OT stations and IV stations installed in the Gargano area. Stations MASS, CGL1 and TAR1 are OT stations installed in Massafra (TA), Ceglie Messapica (BR) and Taranto (TA), respectively.
We have included information about INGV web services and their use, adding the following sentence in the manuscript in the data availability section: The availability of the OT stations after 2019 can be downloaded through the standard FDSN web services (https://www.fdsn.org/webservices/), using the INGV webservice. For example, the availability from 2019 to 2014 for station OT07, channel EHE, can be obtained through the following web request:
`https://webservices.ingv.it/fdsnws/availability/1/query?network=OT&station=OT07&start=2019-01-01T00:00:00&end=2024-12-31T00:00:00&mergegaps=86400&channel=EHE`
This request shows the availability of the channel, ignoring the gaps smaller than 24h (mergegaps=86400 s). To obtain information on seismic station and instrumentation, one possible query can be:
`https://webservices.ingv.it/fdsnws/station/1/query?level=channel&network=OT&format=text`
which returns the geographical coordinates and instrument details of the seismic stations belonging to the network OT. Some other information and examples could be found at the link:
`https://www.orfeus-eu.org/data/eida/nodes/INGV/`
6.

Reviewer #1:
The authors computed the local magnitude using Di Bona's (2016) model, which was calibrated for Italy. However, the dataset used to calibrate the local magnitude included very few events and stations from the Gargano area. It would be helpful if the authors shared as an additional asset, the Wood-Anderson amplitudes used to calculate the local magnitude, along with the associated station and event information. This would allow users interested in magnitude to calibrate a local magnitude scale with station corrections specific to the Gargano area, as propagation effects and source parameters (e.g., stress drop) could differ

significantly from the average in Di Bona's catalog, particularly for deep events. Furthermore, the Di Bona model was mostly calibrated for Ml>2.8, whereas most of the magnitudes considered in the manuscript are below 2.

Authors:
We used the Di Bona (2016) local magnitude scale since it is derived for the Italian region and it is based on recent seismicity. Di Bona (2016) attenuation law analyzed the local magnitude bias with the Hutton and Boore (1987), used in the routine magnitude computation in the ONT at INGV, and found that for the Italian region Hutton and Boore (1987) would lead to magnitude overestimation at short-range stations and underestimation farther than 100 km. The magnitude bias varies with distance and increases in absolute value up to ~ 0.55 from 100 to 10 km and up to ~ 0.35 from 100 to 600 km. Moreover, the effect of the attenuation function of Di Bona (2016) highlights that using HB87 leads to overestimation of the lowest magnitudes and underestimation of the highest magnitudes, with a bias within about 0.2 within a magnitude range from 2.8 to 5.5. In our seismic catalog we have earthquakes both of low magnitude and at short distance so the effect of overestimation of the HB87 attenuation law respect to DB16 could be enhanced. This effect can be observed when computing the differences between the ML_{DB16}, used in this work, and the ML_{HB87}, used by the ONT. Results in L_1 norm of $ML_{DB16} - ML_{HB87}$ are shown in the following histogram (Fig. 1 and in Fig. 2) and indicate that, as expected, the HB87 attenuation law tends to overestimate the local magnitude respect to the DB16 attenuation law. The effect of the overestimation is, as expected and predicted by DB16, increases moving toward very small magnitudes and the HB87 does not compute $M_L < 0$. The bias decreases moving toward greater value of magnitude where the two formulations agree. For $M_L > 2.8$ the bias is less than 0.2 as also observed by DB16. Results indicate that it would be useful to calibrate a magnitude scale for the microseismicity of the Gargano area. We added this discussion in the Section 5.4. Regarding amplitude data, we can share the WA amplitudes of the earthquakes in the released catalogs to anyone who requests them. We added this sentence in the Data availability section.

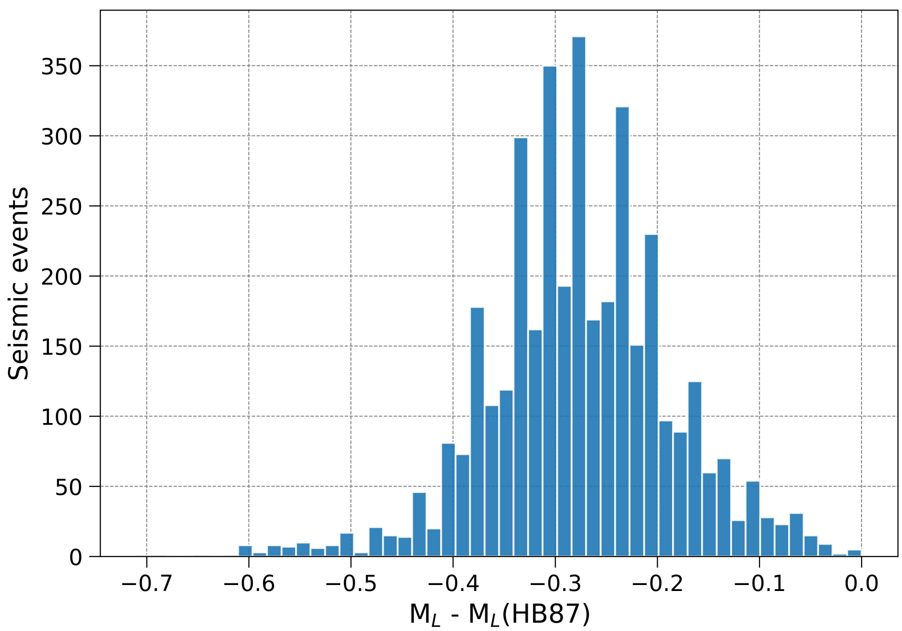

Figure 1: Histogram of magnitude differences for CASP earthquakes by comparing the magnitude estimates computed using the DB16 attenuation law with those obtained using the HB87 attenuation law.

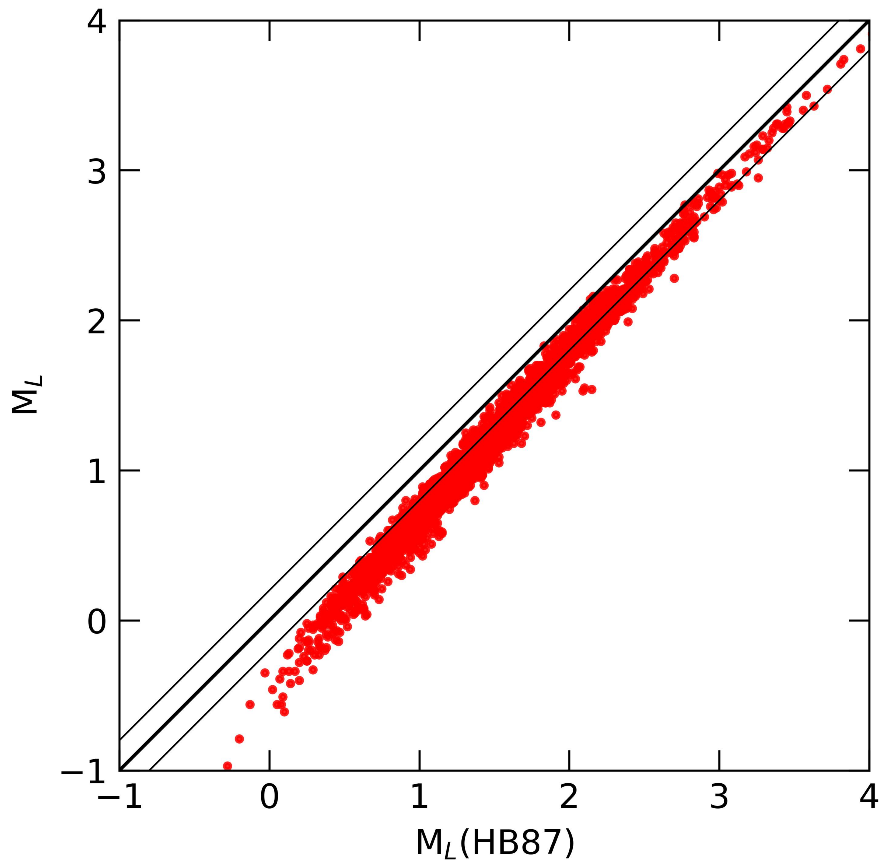

Figure 2: Correlation between CASP magnitude values computed with DB16 attenuation law (vertical axis) and HB87 attenuation law (horizontal axis).

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