Present-day seismic activity in the Mugello Basin and adjoining areas (Northern Apennines, Italy)

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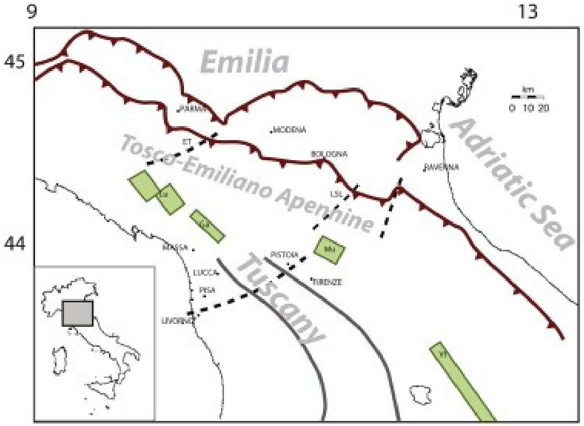
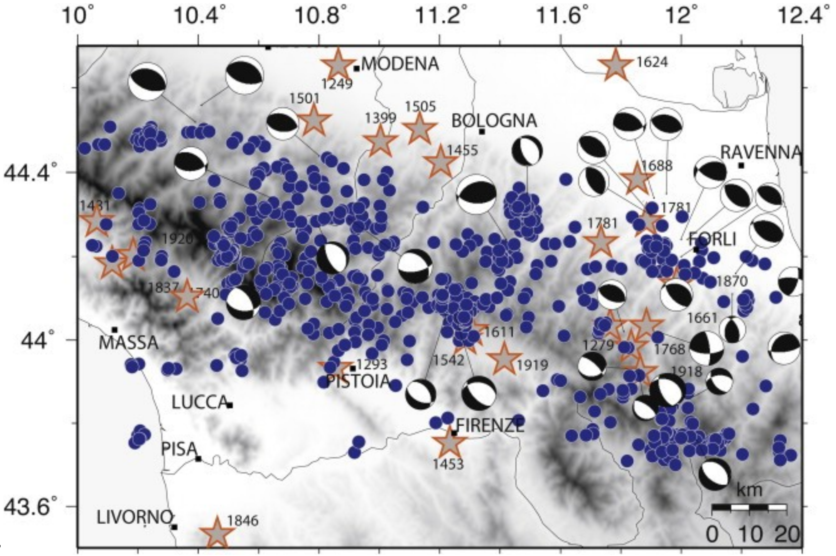
The surrounding area of the Mugello basin, in Northern Tuscany, represents one of the most important seismogenic areas of the north-central Apennines.

Large historical earthquakes have occurred in this region (Rovida et al., 2016). The proximity to Florence and the potential impact of strong earthquakes on the cultural heritage of the city makes a better knowledge of the seismicity in this area an important target.

Seismicity and geodetic data indicate that contemporaneous crustal shortening in the Adriatic part and extension in the Tyrrhenian side characterize the current tectonic activity of the Apennines (e.g., Piccinini et al., 2014; Bonini et al., 2016).



Largest historical earthquakes	M_W
29 June 1919	6.4
11 December 1864	5.1
15 April 1762	5.1
8 September 1611	5.1
3 August 1597	5.3
13 June 1542	6.0



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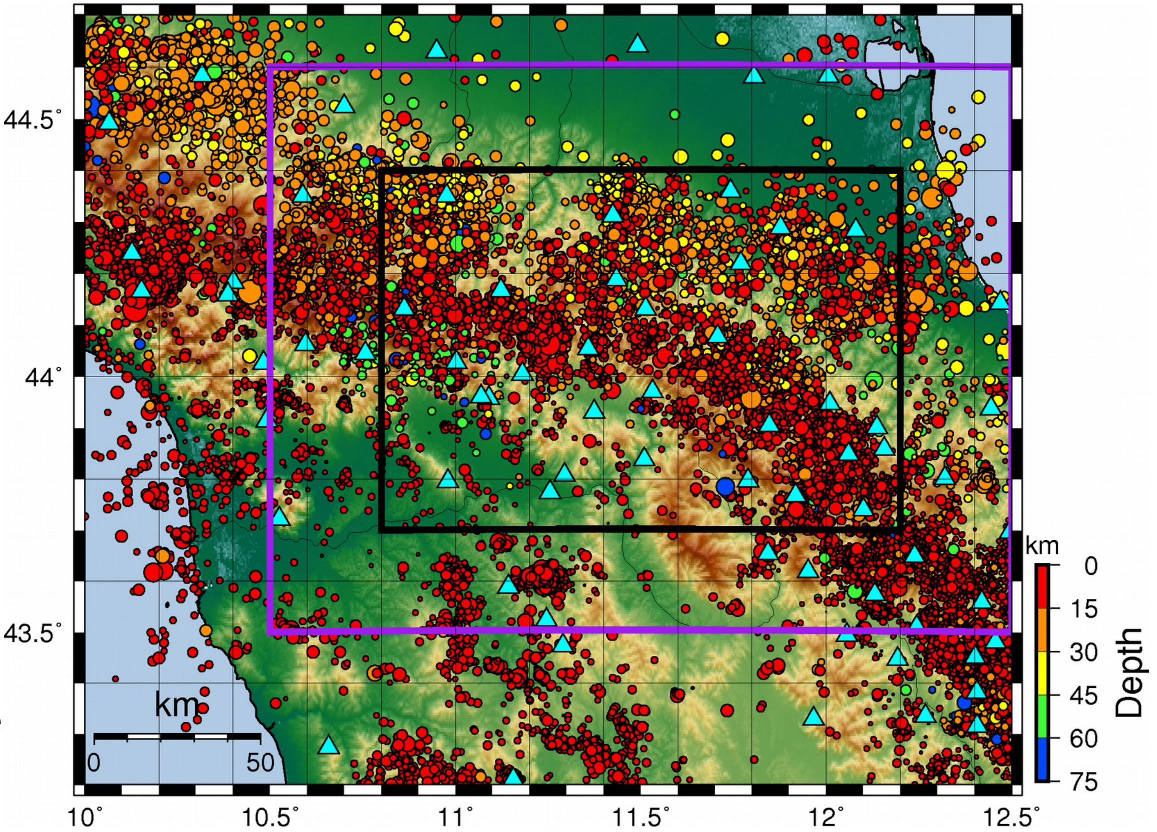
Figures from Piccinini et al., 2014

Main objectives

The main objectives of the study are to constrain the position, shape and type of slip of subsurface faults, and to constrain the seismotectonic model of the area.



black box: seismically active region around the Mugello basin selected from the earthquake distribution

purple box: stations that are being used for the location of the earthquakes in the next analysis

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Seismological database

In the area of study the seismicity is recorded by the INGV and the Fondazione PARSEC, which runs its own seismic network and delivers the respective catalog.

Objective

Creation of a single catalog by merging these two different data-sets, which will improve the accuracy of the earthquake locations.

The time period considered is 2005 – 2019, during which both catalogs exhibit the best completeness.

The first step of the merging procedure consists in the re-location of the two datasets using the velocity model of the study area of Piccinini et al. (2014).

We re-locate each of the two earthquake catalogues separately, using the NonLinLoc software package (Lomax et al., 2008).

Depth [km]	VP [km/s]	VS [km/s]
-2.00	5.03	2.78
1.00	5.62	3.11
3.00	5.73	3.17
5.00	5.76	3.18
9.00	5.82	3.22
11.00	5.88	3.25
15.00	6.11	3.38
19.00	6.41	3.54
30.00	7.77	4.29

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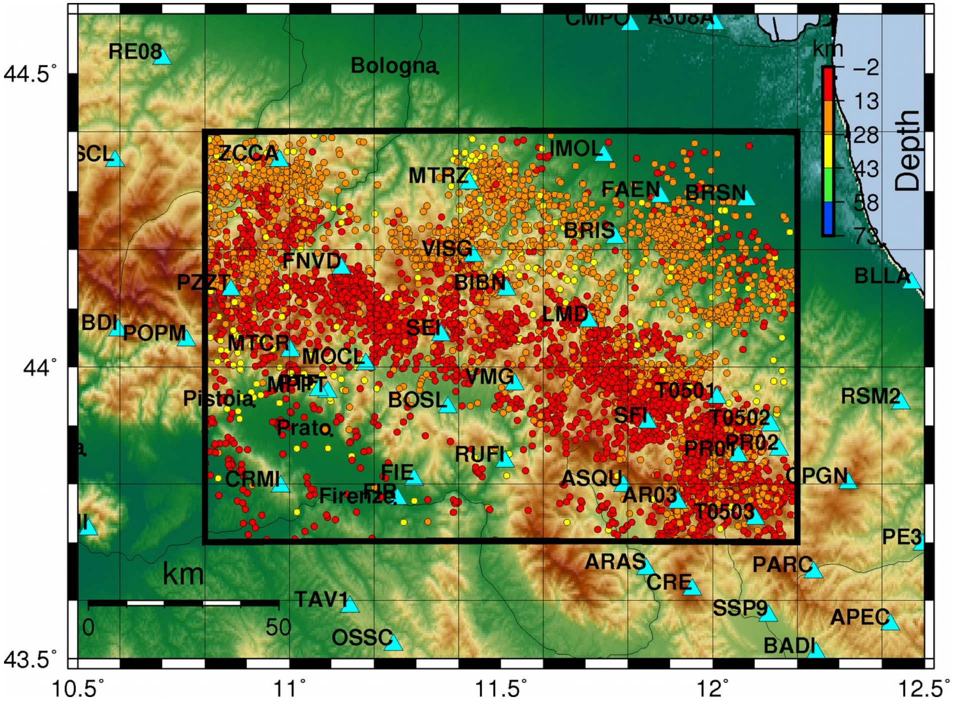
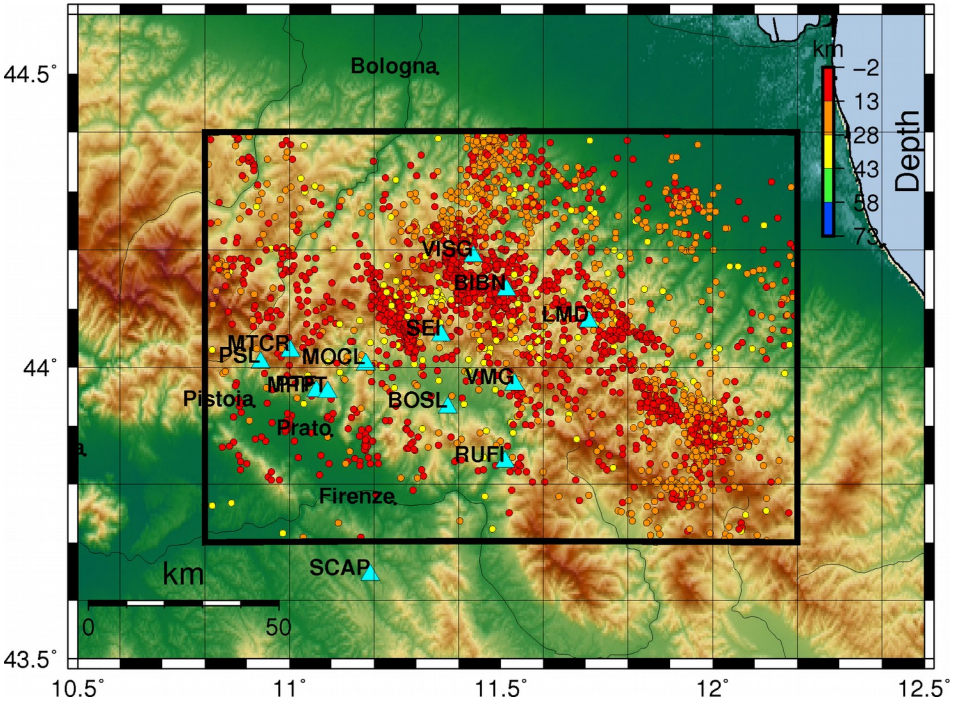
Seismological database

NonLinLoc location of INGV data, time period 2005 – 2019, 10094 earthquakes



NonLinLoc location of PARSEC data, time period 2005 – 2019, 5741 earthquakes



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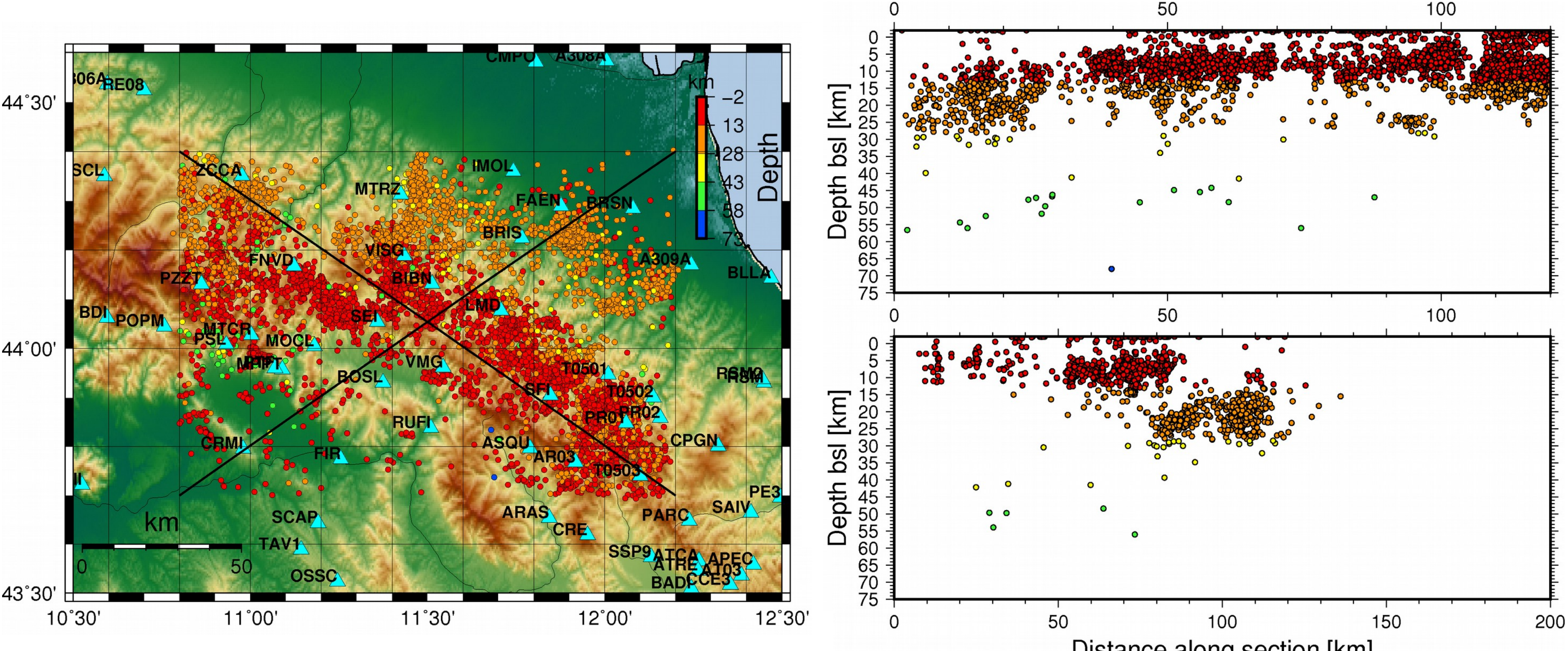
Seismological database

By merging the time pickings from the two bulletins we generate a single set of arrival times that draws on all available information.

NonLinLoc relocation of the single catalog, time period 2005 – 2019, 12593 earthquakes.



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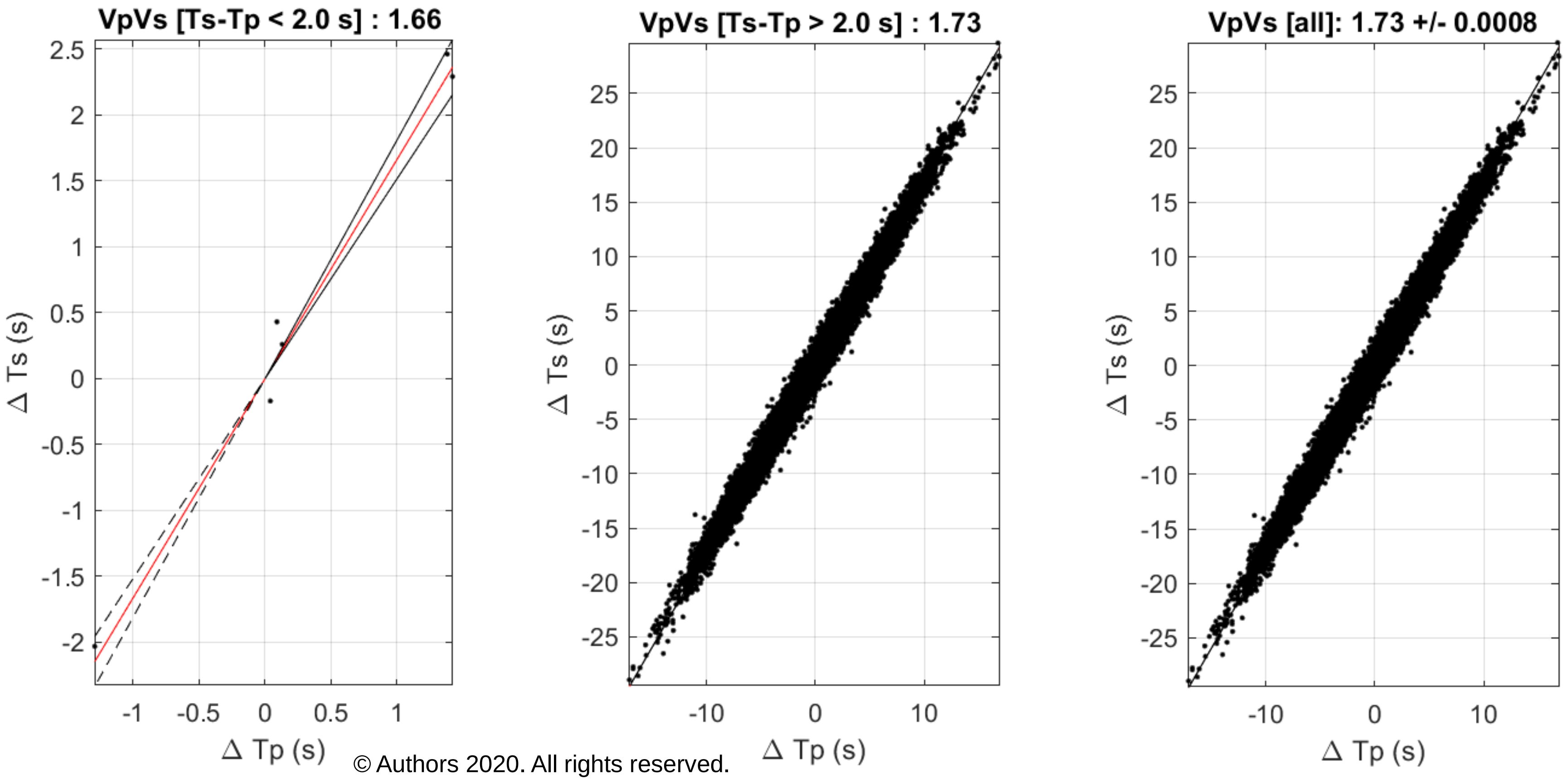
To obtain a Vp/Vs ratio representative of the selected data we compute a Wadati diagram which yields a best-fit Vp/Vs ratio of 1.73 ± 0.0008



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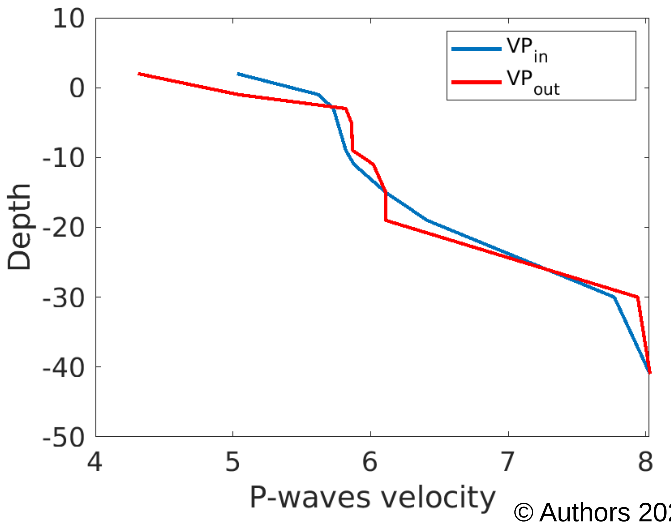
Objective

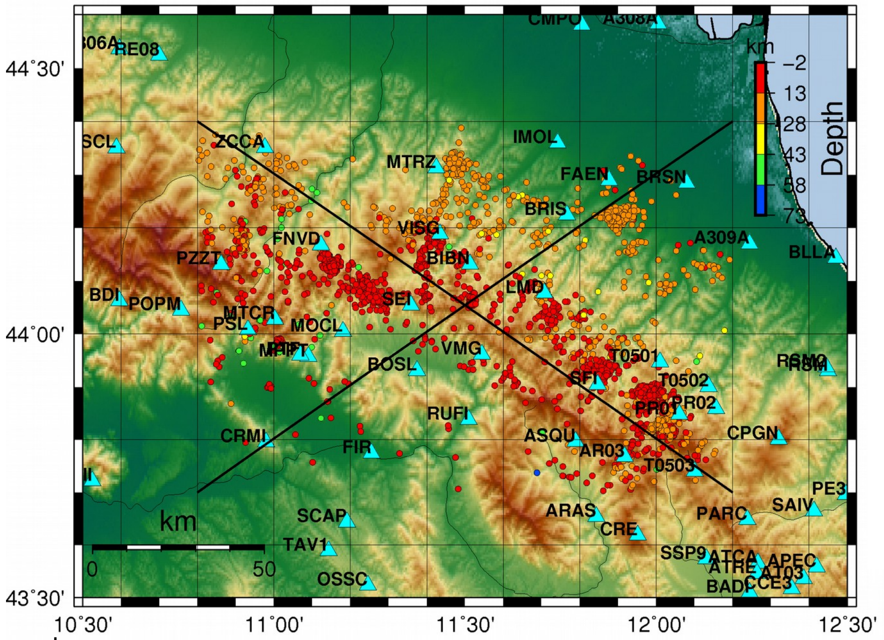
Create a 1D velocity model that will be used as starting model for the 3-D tomography.

To do this, we inverted the arrival time data to best-fit a 1D velocity model using the program Velest (Kissling et al. 1995). We selected from the catalog the earthquakes with number of phases >= 20 and RMS < 0,3. The seismic stations and earthquakes considered are plotted in the map.

The final model is similar to the input model as we can see from the RMS value of the two model:

$RMS_{input} = 0.256$; $RMS_{output} = 0.257$





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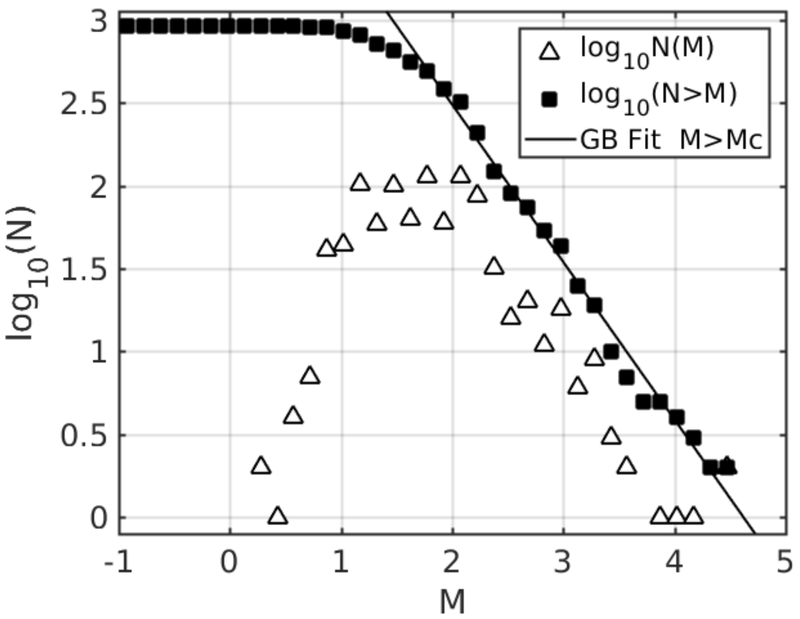
Installation of the temporary seismic network

Objective

To improve the accuracy of local earthquake locations, and to obtain a 3D tomographic model of the seismic velocity in the area

Installation of 9 additional seismic stations within and around the Mugello basin, which are expected to operate through the 2019-2021 time span.



Earthquakes within a radius of 15 km from Barberino M. (FI) [44.00 11.24]
Time period 1985 - 2019
Magnitude of completeness ~ 1.7

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Installation of the temporary seismic network

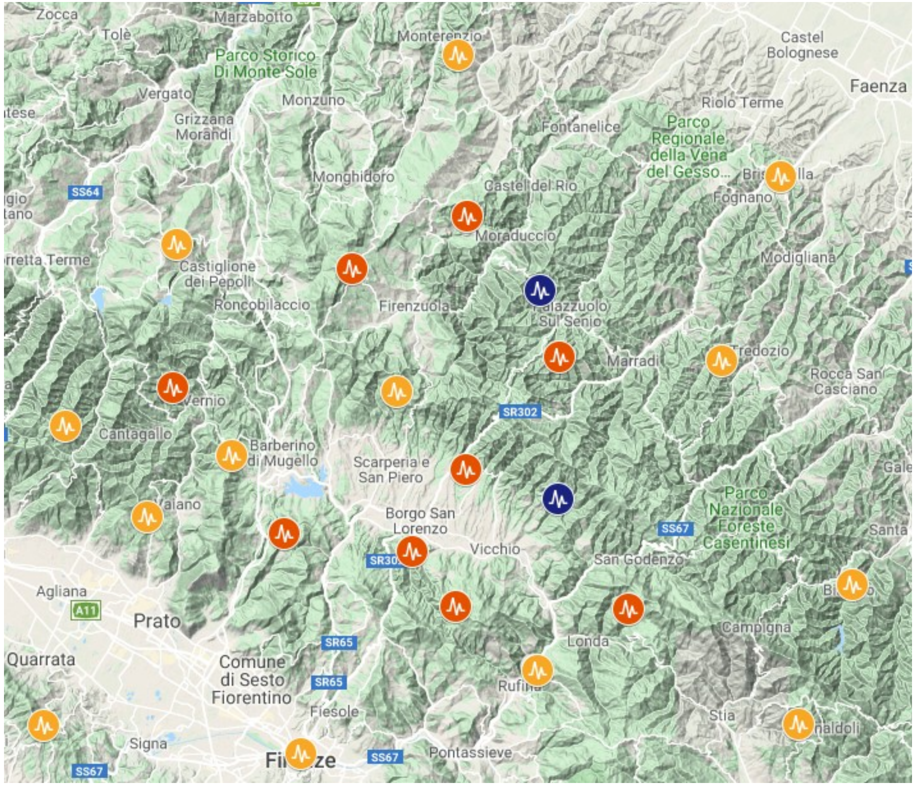
Installation of seismic network

October 2017: submission of the proposal to the SEIS-UK, for the use of instruments.

November 2017: approval of the proposal

April 2019: delivery of the instruments, site selection, beginning of the installation

July 2019: end of the installation



stations of INGV network

stations of PARSEC network

stations of the temporary seismic network

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Summary and References

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Summary

- We combined phases from the INGV and PARSEC network for the time period 2005-2019 to create a single earthquake catalog;
- Re-located the single catalog using NonLinLoc (Lomax et al., 2008);
- Computed a Wadati diagram to obtain a best-fit Vp/Vs ratio;
- Created a 1D velocity model that will be used as starting model for the 3-D tomography, using the program Velest (Kissling et al. 1995);
- Installed a temporary seismic network to improve the accuracy of local earthquake locations.

References

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