

Historical Earthquake Data and Services for Geohazards

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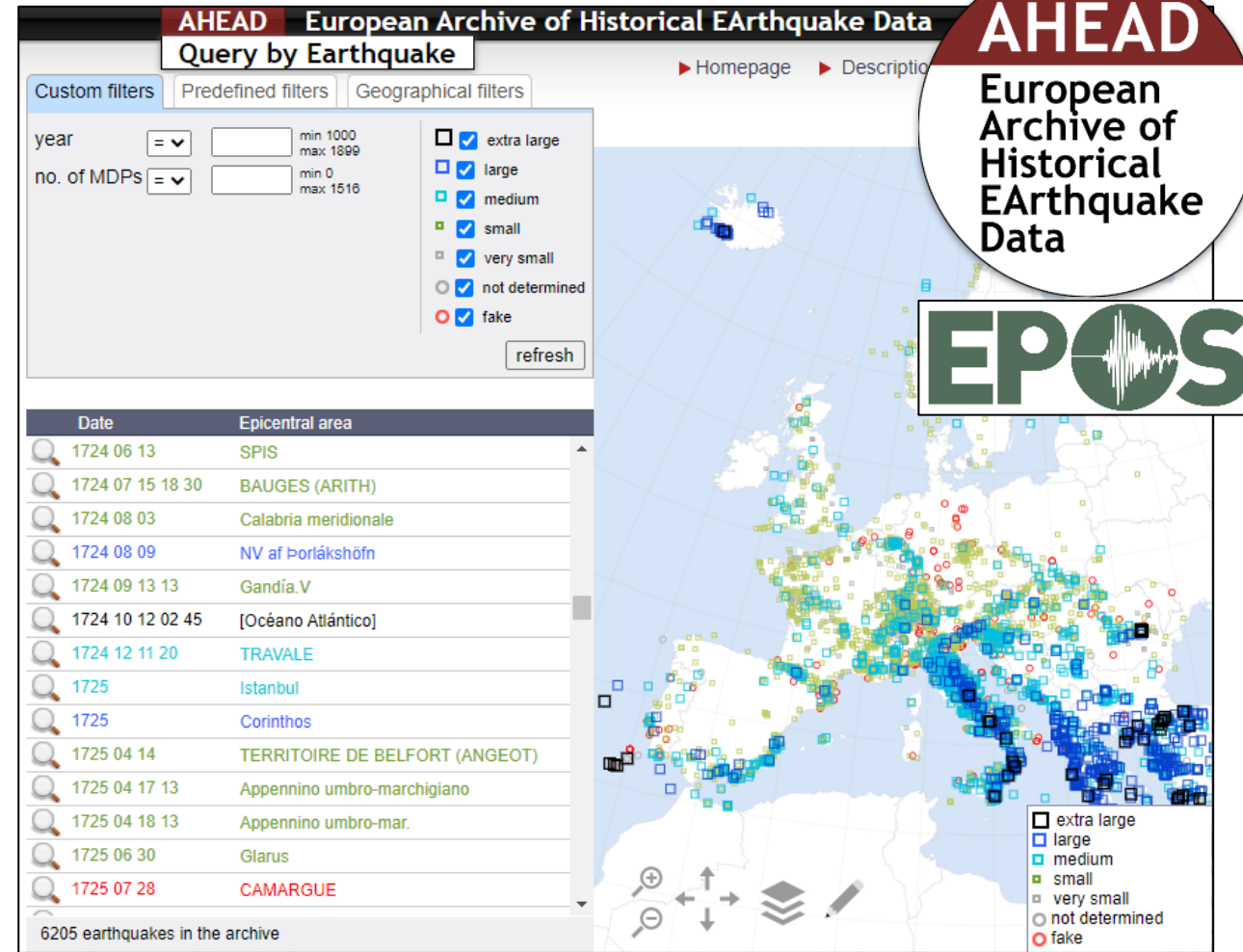


AHEAD, the European Archive of Historical Earthquake Data 1000-1899

EPOS node for historical earthquake data

Collects and distributes multiple datasets (parameters, intensity data, bibliography) for each earthquake from:

- Regional databases
 - Studies on individual earthquakes
 - Regional catalogues
- 6204 earthquakes
 - 365 sources of data
 - 8100 sets of intensity data
 - 450 fakes



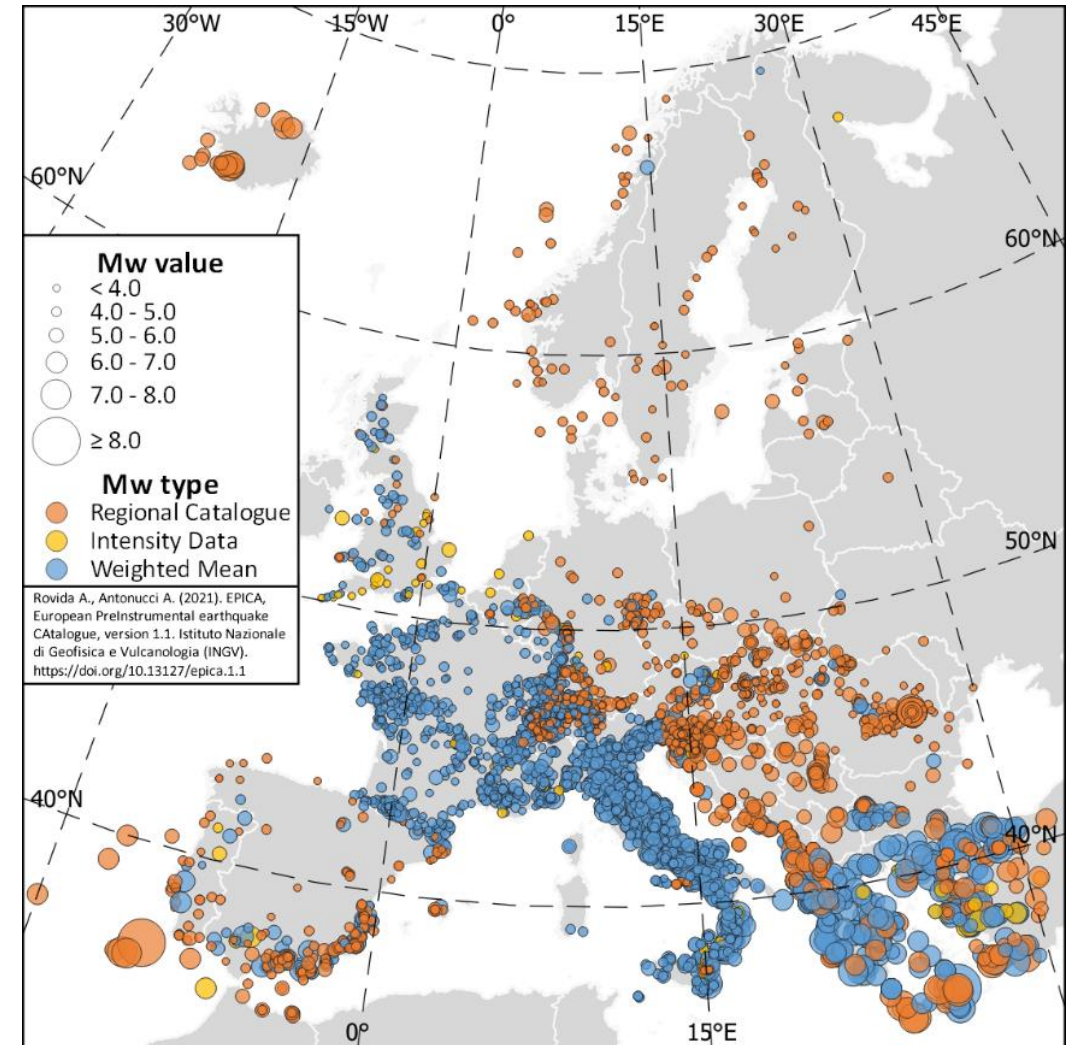
Albini et al (2013); Locati et al (2014); Rovida & Locati (2015); Rovida et al (2020)

EPICA - European PreInstrumental Earthquake Catalogue 1000-1899

The dataset in a nutshell

- Continent-wide catalogue of historical earthquakes 1000-1899
- EPICA relies on the most informative dataset from AHEAD
 - highest priority to intensity data from descriptive studies
 - independent from national constraints
- 5703 earthquakes with Intensity ≥ 5 or $M_w \geq 4.0$
- 63% of locations and magnitudes are re-assessed from intensity data from 160 studies
- 37% of the parameters are harmonized from the 39 most recent regional historical catalogues

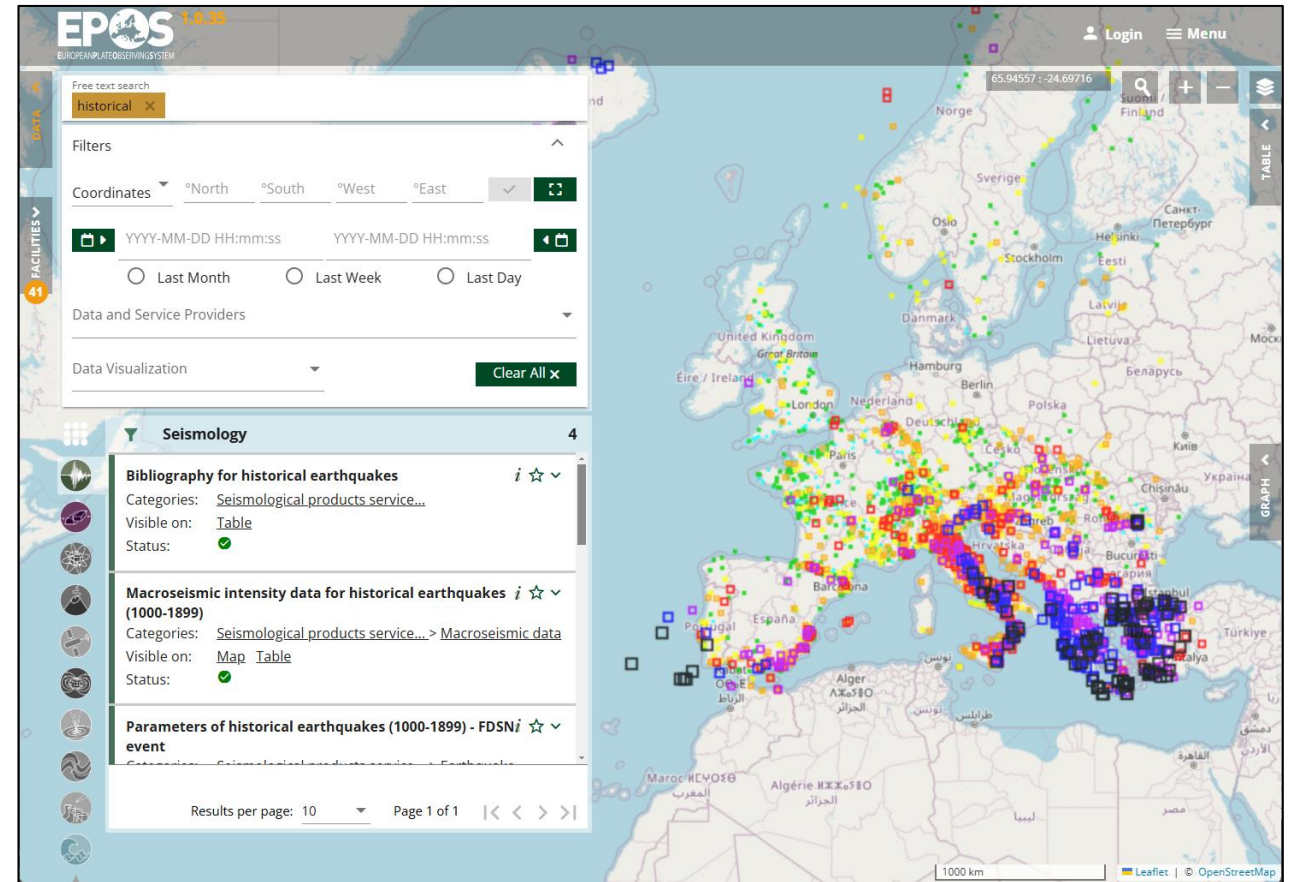
Rovida A., Antonucci A. (2021), <https://doi.org/10.13127/epica.1.1> [Dataset].
Rovida A., Antonucci A., Locati M. (2022). <https://doi.org/10.5194/essd-14-5213-2022> [ESSD data paper]



AHEAD – Access to data



- FAIR data
- Creative Commons Attribution 4.0 International (CC BY 4.0) license
- Access through:
 - AHEAD web services
 - AHEAD web portal
 - EPOS data portal



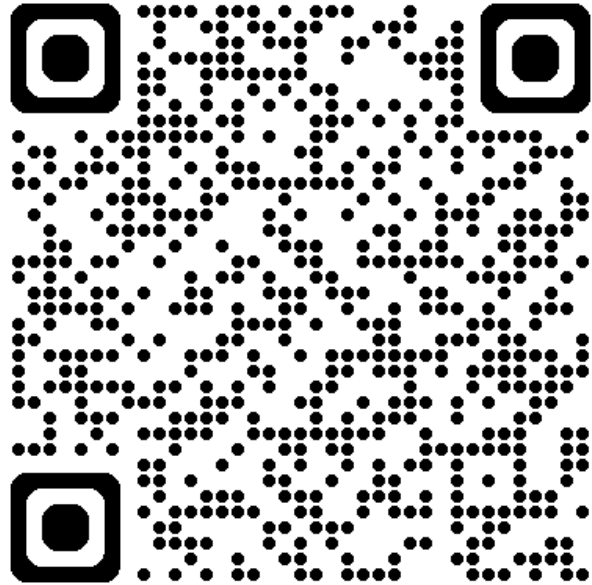
<https://www.ics-c.epos-eu.org/>

AHEAD web services

Data	WS standard	Output	Output formats
Event parameters (EPICA)	fdsnws-event	<u>EPICA origins and magnitudes</u> (and all alternatives from AHEAD)	QuakeML 1.2 (XML), CSV (text), GeoJSON
	OGC WMS	<u>Styled map</u> with EPICA origins and magnitudes	PNG, JPG, GIF, PDF, GeoTiff
	OGC WFS	<u>Geographical features</u> of EPICA origins and magnitudes	GML 3.2, GML 3.1, GML 2, KML, Shapefile, GeoJSON, CSV, MS Excel
Macroseismic data (AHEAD)	<i>fdsnws-event compatible</i>	Preferred and alternative <u>intensity data points</u> of earthquakes in AHEAD	QuakeML 2.0 (XML), CSV (text), GeoJSON
Bibliography (AHEAD)	<i>custom</i>	<u>Bibliographical metadata</u> of AHEAD data sources	Dublin Core (XML), RDF, BibTex

AHEAD web services

<https://www.emidius.eu/AHEAD/services/>



- List of available web services
- Documentation
- Examples

AHEAD European Archive of Historical Earthquake Data				
Web services				
▶ homepage ▶ query by earthquake ▶ query by data source				
The following web services are available for accessing AHEAD data.				
Feedback is welcome, please send bug reports and comments to ahead@ingv.it				
Type of data	URL	Standard	Output	More infos
event parameters	URL	fdsnws-event	QuakeML 1.2 (XML) , CSV (text) , GeoJSON	Documentation and Examples application.wadl Query builder
	URL	OGC WFS	GML 3.2 , GML 3.1 , GML 2 , KML , shapefile , GeoJSON , CSV , Ms Excel <i>Warning: these output examples are limited to 50 elements using the query parameter "maxFeatures".</i>	Documentation and Examples GetCapabilities
	URL	OGC WMS	PNG , JPG , GIF , PDF , GeoTiff	Documentation and Examples GetCapabilities
macroseismic data	URL	custom (highly compatible with fdsnws-event)	QuakeML 2.0 (XML) , CSV (text) , GeoJSON	Documentation and Examples application.wadl
bibliography	URL	custom	Dublin Core (XML) , RDF , BibTex	Documentation and Examples application.wadl

AHEAD – FDSN Web Services - fdsnws-event

Example: earthquakes with M5+ of the 16th century in Northern Italy, Switzerland, and SE France in text format:

```
https://www.emidius.eu/fdsnws/event/1/query?  
starttime=1500-01-01T00:00:00&endtime=1599-12-31T23:59:59&  
minmag=5&maxmag=9&  
minlat=43&maxlat=48&minlon=4&maxlon=11&  
orderby=time-asc&limit=500&  
format=text
```

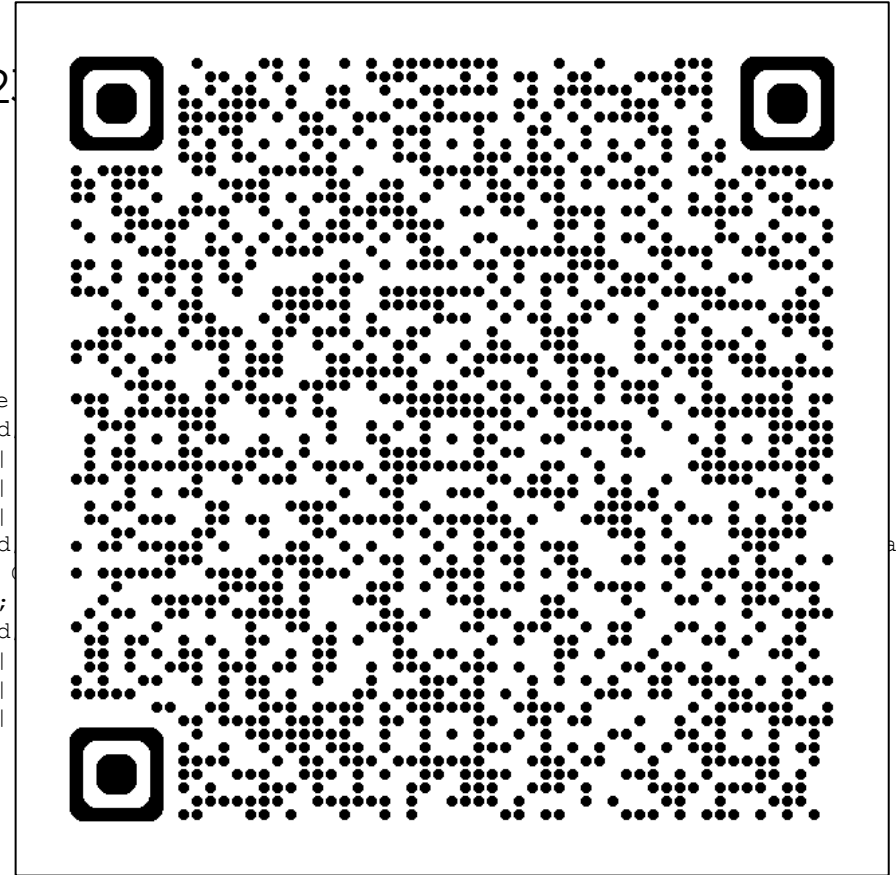
```
#EventID|Time|Latitude|Longitude|Depth/km|Author|Catalog|Contributor|ContributorID|MagType|Magnitude|MagAuthor|EventLocationName|EventType  
quakeml:eu.ahead/event/15010605_1000_000|1501-06-05T10:00:--|44.519|10.844||AHEAD|EPICAv1.1|CFTI5med; CPTI15||Mw|6.02|EPICAv1.1|Appennino modenese|earthquake  
quakeml:eu.ahead/event/15091213_1100_000|1509-12-13|43.833|5.783||AHEAD|EPICAv1.1|SISFR016; FCAT-17||Mw|5.05|EPICAv1.1|MOYENNE-DURANCE (MANOSQUE)|earthquake  
quakeml:eu.ahead/event/15240400_0000_000|1524-04-20|46.228|7.303||AHEAD|EPICAv1.1|SCHAL018; ECOS-09||Mw|5.59|EPICAv1.1|Ardon|earthquake  
quakeml:eu.ahead/event/15271004_0000_000|1527-10-04|43.933|10.915||AHEAD|EPICAv1.1|CASAL996; CPTI15||Mw|5.34|EPICAv1.1|Pistoia|earthquake  
quakeml:eu.ahead/event/15360817_0005_000|1536-08-17T00:05:--|44.365|10.934||AHEAD|EPICAv1.1|CFTI5med; CPTI15||Mw|5.16|EPICAv1.1|Appennino tosco-emiliano?|earthquake  
quakeml:eu.ahead/event/15411022_1800_000|1541-10-22T18:--:--|44.761|8.909||AHEAD|EPICAv1.1|ENEL985; CPTI15||Mw|5.26|EPICAv1.1|Valle Scrivia|earthquake  
quakeml:eu.ahead/event/15450609_1545_000|1545-06-09T15:45:--|44.473|9.825||AHEAD|EPICAv1.1|CFTI5med; CPTI15||Mw|5.35|EPICAv1.1|Valle del Taro|earthquake  
quakeml:eu.ahead/event/15470210_1320_000|1547-02-10T13:20:--|44.698|10.631||AHEAD|EPICAv1.1|CFTI5med; CPTI15||Mw|5.11|EPICAv1.1|Reggio Emilia|earthquake  
quakeml:eu.ahead/event/15640720_0000_000|1564-07-20|44.024|7.276||AHEAD|EPICAv1.1|LAMAL994; FCAT-17||Mw|5.51|EPICAv1.1|Alpi Marittime|earthquake  
quakeml:eu.ahead/event/15840311_1100_000|1584-03-11|46.391|6.942||AHEAD|EPICAv1.1|SCHAL018; ECOS-09||Mw|5.82|EPICAv1.1|Aigle|earthquake  
quakeml:eu.ahead/event/15840314_0000_000|1584-03-14|46.396|6.918||AHEAD|EPICAv1.1|SCHAL018; ECOS-09||Mw|5.22|EPICAv1.1|Aigle|earthquake
```

- The XML output include more parameters (e.g. uncertainties)
- The fdsnws-event standard does not include any macroseismic information (e.g. origin and number of intensity data, maximum intensity...)

AHEAD – FDSN Web Services - fdsnws-event

Example: earthquakes with M5+ of the 16th century in Northern Italy, Switzerland, and SE France in text format:

```
https://www.emidius.eu/fdsnws/event/1/query?  
starttime=1500-01-01T00:00:00&endtime=1599-12-31T23:59:59  
minmag=5&maxmag=9&  
minlat=43&maxlat=48&minlon=4&maxlon=11&  
orderby=time-asc&limit=500&  
format=text
```



```
#EventID|Time|Latitude|Longitude|Depth/km|Author|Catalog|Contributor|ContributorID|MagType|Magnitude  
quakeml:eu.ahead/event/15010605_1000_000|1501-06-05T10:00:--|44.519|10.844||AHEAD|EPICAv1.1|CFTI5med  
quakeml:eu.ahead/event/15091213_1100_000|1509-12-13|43.833|5.783||AHEAD|EPICAv1.1|SISFR016; FCAT-17|  
quakeml:eu.ahead/event/15240400_0000_000|1524-04-20|46.228|7.303||AHEAD|EPICAv1.1|SCHAL018; ECOS-09|  
quakeml:eu.ahead/event/15271004_0000_000|1527-10-04|43.933|10.915||AHEAD|EPICAv1.1|CASAL996; CPTI15|  
quakeml:eu.ahead/event/15360817_0005_000|1536-08-17T00:05:--|44.365|10.934||AHEAD|EPICAv1.1|CFTI5med  
quakeml:eu.ahead/event/15411022_1800_000|1541-10-22T18:--:--|44.761|8.909||AHEAD|EPICAv1.1|ENEL985; C  
quakeml:eu.ahead/event/15450609_1545_000|1545-06-09T15:45:--|44.473|9.825||AHEAD|EPICAv1.1|CFTI5med;  
quakeml:eu.ahead/event/15470210_1320_000|1547-02-10T13:20:--|44.698|10.631||AHEAD|EPICAv1.1|CFTI5med  
quakeml:eu.ahead/event/15640720_0000_000|1564-07-20|44.024|7.276||AHEAD|EPICAv1.1|LAMAL994; FCAT-17|  
quakeml:eu.ahead/event/15840311_1100_000|1584-03-11|46.391|6.942||AHEAD|EPICAv1.1|SCHAL018; ECOS-09|  
quakeml:eu.ahead/event/15840314_0000_000|1584-03-14|46.396|6.918||AHEAD|EPICAv1.1|SCHAL018; ECOS-09|
```

- The XML output include more parameters (e.g. uncertainties)
- The fdsnws-event standard does not include any macroseismic information (e.g. origin and number of intensity data, maximum intensity...)

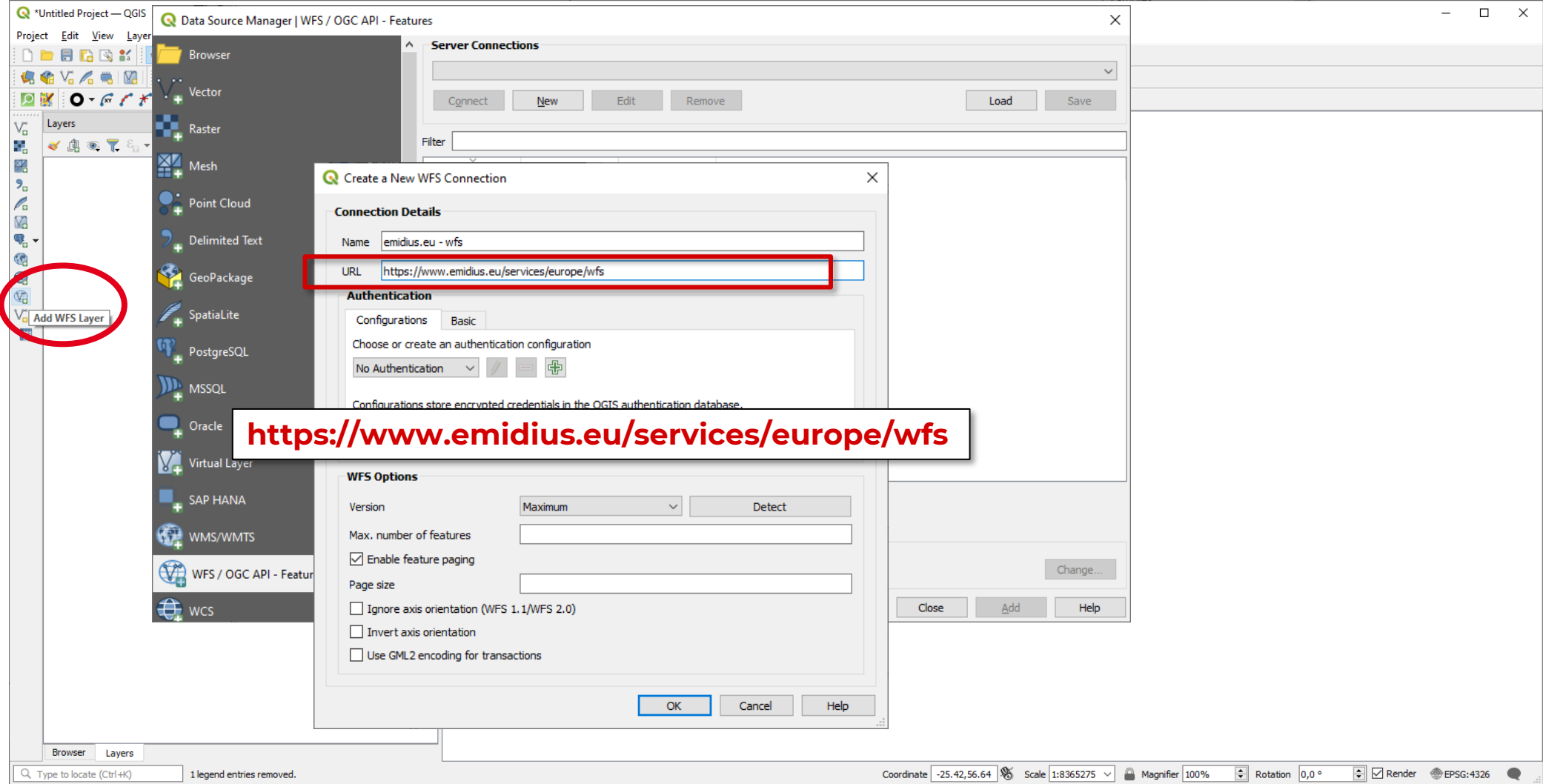
AHEAD – FDSN Web Services - fdsnws-event



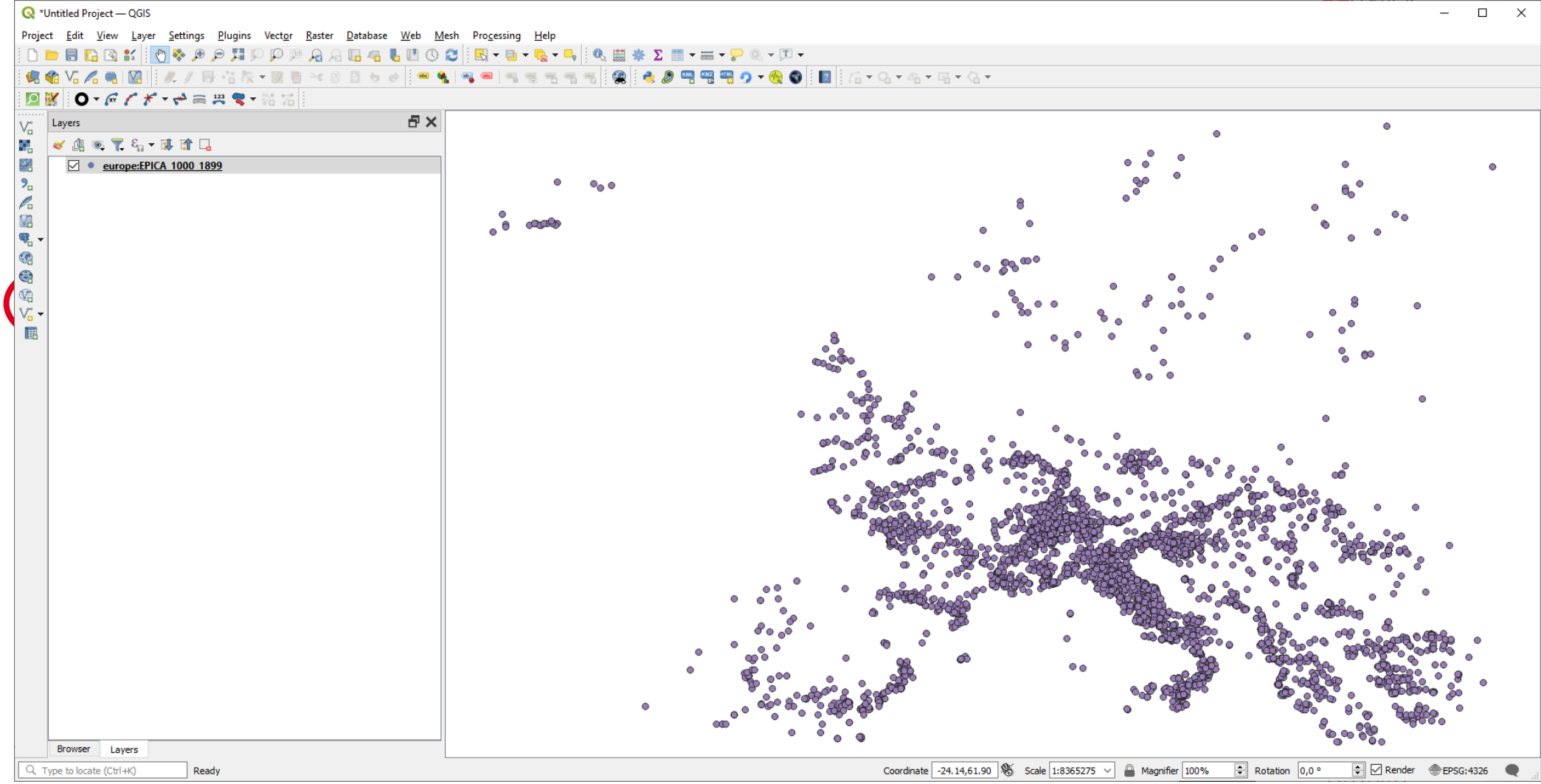
This XML file does not appear to have any style information associated with it. The document tree is shown below.

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xsi:schemaLocation="http://quakeml.org/schema/xsd http://quake.ethz.ch/schema/xsd/QuakeML-1.2.xsd">
  <eventParameters publicID="smi:eu.ahead/fdsnws/event/1/query">
    <comment>
      <creationInfo>
        <creationTime>2024-11-28T13:15:04</creationTime>
        <author>European Archive of Historical Earthquake Data (AHEAD)</author>
        <authorURI>smi:doi.org/10.6092/INGV.IT-AHEAD</authorURI>
        <agencyID>INGV</agencyID>
        <version>0.1</version>
      </creationInfo>
    </comment>
    <event publicID="quakeml:eu.ahead/event/15010605_1000_000">
      <type>earthquake</type>
      <typeCertainty>known</typeCertainty>
      <description>
        <text>
          <![CDATA[ Appennino modenese ]]>
        </text>
        <type>region name</type>
      </description>
      <description>
        <text>
          <![CDATA[ Northern Italy ]]>
        </text>
        <type>Flinn-Engdahl region</type>
      </description>
      <preferredOriginID>quakeml:eu.ahead/origin/EPICAV1.1/117062#15010605_1000_000</preferredOriginID>
      <preferredMagnitudeID>quakeml:eu.ahead/magnitude/EPICAV1.1/117062#15010605_1000_000</preferredMagnitudeID>
      <origin publicID="quakeml:eu.ahead/origin/EPICAV1.1/117062#15010605_1000_000">
        <type>macroseismic</type>
        <time>
          <value>1501-06-05T10:00:--</value>
        </time>
        <compositeTime>
          <year>
            <value>1501</value>
          </year>
          <month>
            <value>6</value>
          </month>
          <day>
            <value>5</value>
          </day>
          <hour>
            <value>10</value>
          </hour>
        </compositeTime>
      </origin>
    </event>
  </eventParameters>
</q:quakeml>
```

AHEAD – OGC WFS - shapefile



AHEAD – OGC WFS - shapefile



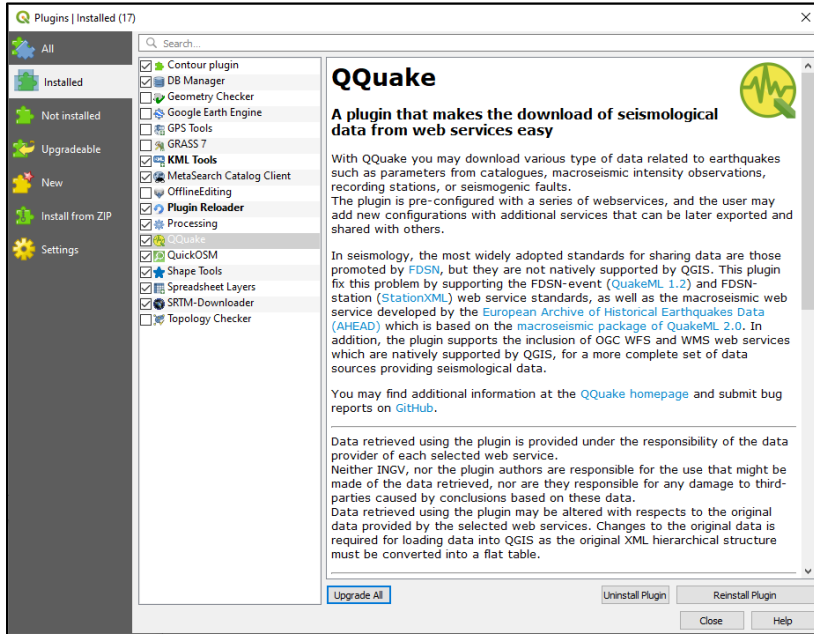
AHEAD – OGC WFS - shapefile

QGIS interface showing a table of features from a shapefile named 'europe:EPICA_1000_1899'. The table contains 18 rows of data with various columns including identifiers, dates, locations, and technical parameters.

	EqID	SheecID	Year	Mo	Da	Ho	Mi	Ax	Reg	Lat	Lon	TEpi	LatUnc	LonUnc	TEpiUnc	H	HUnc	TH	Io	Tlo	Mw	MwUnc	TMw	MDPsSource	NMDP	Mix	MMw	MMwUnc	TMMw	CatSource
1	10000329_0000_000	210	1000	3	29	NULL	NULL	HAINAUT (CHARLEROI ?)	SCR	50,183	4,237	bx	31	37,9	orig	NULL	NULL	NULL	4	bx	3,72	1,32	wm	SISFR016	4	F	3,73	1,46	bx	FCAT-17
2	10050000_0000_000	500	1005	NULL	NULL	NULL	NULL	Arezzo	APD	43,464	11,882	bx	30	30	def	NULL	NULL	NULL	6-7	bx	4,88	0,43	wm	CASAL996	4	7-8	4,93	0,34	bx	CPTI15
3	10050000_0000_001	600	1005	NULL	NULL	NULL	NULL	Cassino	APD	41,488	13,831	bx	30	30	def	NULL	NULL	NULL	7	bx	5,11	0,43	wm	FIMA002	5	7	5,14	0,34	bx	CPTI15
4	10090000_0000_000	800	1009	NULL	NULL	NULL	NULL	Offshore Portugal	TSZ	36	-10,7	cat	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	nd	NULL	NULL	NULL	NULL	NULL	NULL	MAMV001
5	10100100_0000_000	900	1010	1	NULL	NULL	NULL	Istanbul	BAS	41,008	28,98	bx	50	50	orig	NULL	NULL	NULL	5	bx	5,36	0,36	wm	GUICO005	1	5	5,07	0,25	bx	SOYAL981
6	10100309_0000_000	1000	1010	3	9	NULL	NULL	Istanbul	BAS	41,008	28,98	bw	50	50	def	NULL	NULL	NULL	NULL	NULL	5,88	0,46	wm	GUICO005	1	7	5,5	0,44	bw	PAPA003
7	10131118_0000_000	1210	1013	11	18	12	NULL	PAYS DE LIEGE (LIEGE ?)	SCR	50,65	5,583	bx	30	30	def	NULL	NULL	NULL	4	bx	3,15	0,3	MMw	SISFR016	1	F	3,15	0,25	bx	NULL
8	10140000_0000_000	1300	1014	NULL	NULL	NULL	NULL	Angouleme	SCR	45,65	0,15	bx	30	30	def	NULL	NULL	NULL	7-8	bx	5,43	0,36	wm	ALEX990	1	7-8	5,44	0,25	bx	FCAT-17
9	10190401_0000_000	1600	1019	4	1	NULL	NULL	Benevento	APD	41,131	14,778	bx	30	30	def	NULL	NULL	NULL	6	bx	4,65	0,43	wm	FIMA002	5	6	4,72	0,34	bx	CPTI15
10	10210512_0000_002	1810	1021	5	12	16	NULL	SOUABE (W. MEMMINGEN ?)	SCR	47,839	10,067	bx	59,6	86,4	orig	NULL	NULL	NULL	4	bx	3,81	1,31	MMw	SISFR016	5	F	3,81	1,31	bx	NULL
11	10240000_0000_000	1900	1024	NULL	NULL	NULL	NULL	Andalucia	SCR	37,6	-5,3	pr	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	nd	GUICO005	NULL	NULL	NULL	NULL	NULL	NULL
12	10261204_0000_000	2000	1026	12	4	NULL	NULL	Istanbul	BAS	41,008	28,98	bx	30	30	def	NULL	NULL	NULL	8	bx	6,24	0,3	MMw	GUICO005	1	8	6,24	0,25	bx	NULL
13	10320813_1745_000	2200	1032	8	13	17	45	Istanbul	BAS	41,008	28,98	bx	30	30	def	NULL	NULL	NULL	6-7	bx	5,43	0,36	wm	GUICO005	1	6-7	5,17	0,25	bx	SOYAL981
14	10330306_0715_000	2300	1033	3	6	7	15	Istanbul	BAS	41,008	28,98	bx	50	50	orig	NULL	NULL	NULL	4	bx	5,74	0,36	wm	GUICO005	1	F	5,71	0,25	bx	SOYAL981
15	10350500_0000_000	2450	1035	5	NULL	NULL	NULL	Istanbul	BAS	41	29	cat	99,9	99,9	def	NULL	NULL	NULL	7	cat	5,82	0,5	CMw	NULL	NULL	NULL	NULL	NULL	NULL	SOYAL981
16	10350523_0000_000	2410	1035	5	23	NULL	NULL	Corvey	SCR	51,778	9,409	pr	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	nd	ALEX990	1	NC	NULL	NULL	NULL	NULL
17	10361218_1930_000	NULL	1036	12	18	19	30	Istanbul TR	BAS	41,012	28,976	bx	30	30	def	NULL	NULL	NULL	5	bx	5,18	0,3	MMw	GUICO005	1	5	5,18	0,25	bx	NULL
18	10371102_0000_000	2600	1037	11	2	NULL	NULL	Istanbul	BAS	40,8	28,7	cat	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	nd	GUICO005	1	F	NULL	NULL	NULL	PAPA003

QQuake, a plugin for QGIS

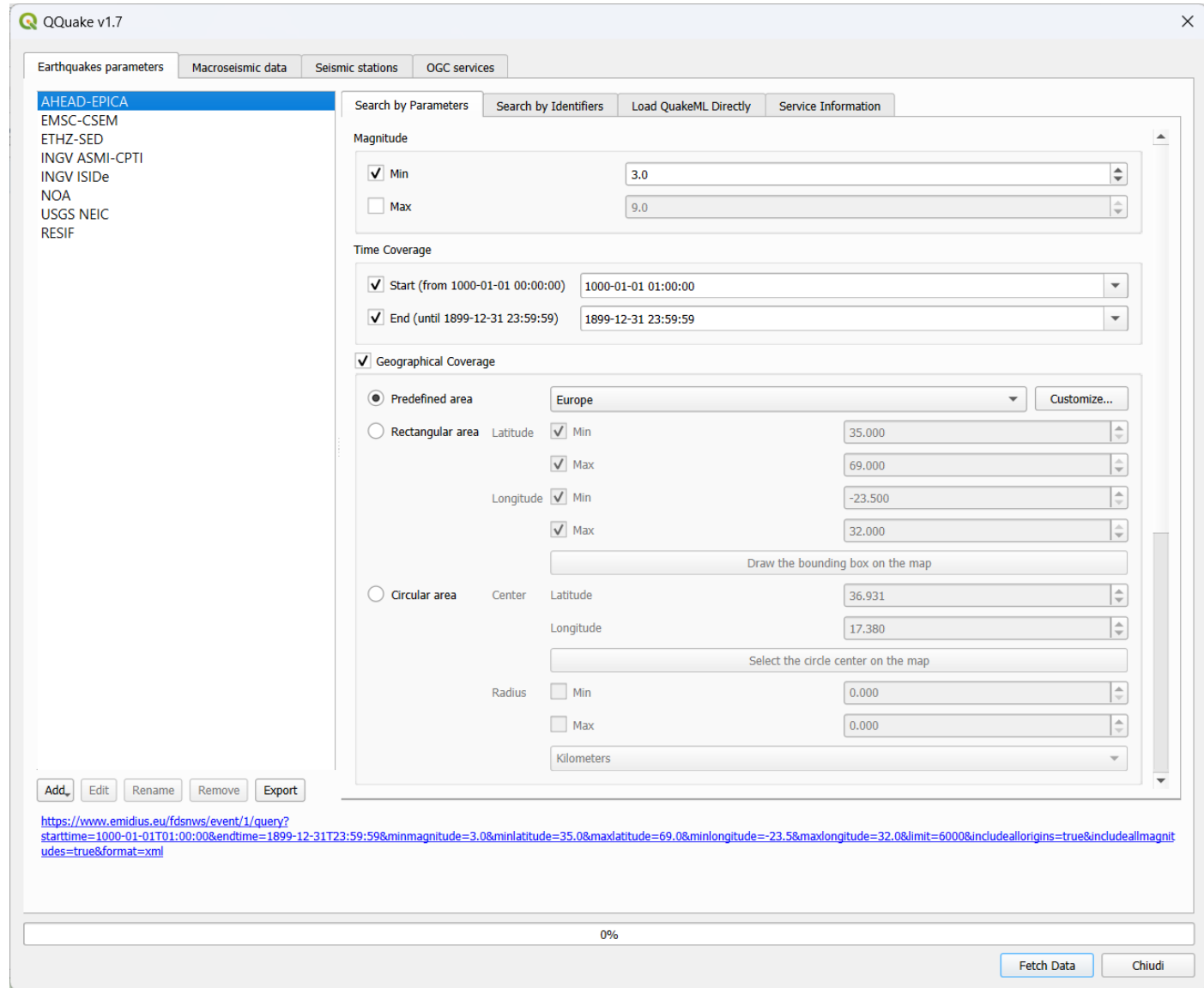
A plugin for loading seismological data from web services



<https://github.com/INGV/qquake/>

Locati et al. (2021),

<https://doi.org/10.3389/feart.2021.614663>



QQuake, a plugin for QGIS

A plugin for
data from

QGIS Plugins | Installed (17)

- All
- Installed
 - Contour plugin
 - DB Manager
 - Geometry Checker
 - Google Earth Engine
 - GPS Tools
 - GRASS 7
 - KML Tools
 - MetaSearch Catalog
 - OfflineEditing
 - Plugin Reloader
 - Processing
 - QQuake
 - QuickOSM
 - Shape Tools
 - Spreadsheet Layers
 - SRIM-Downloader
 - Topology Checker
- Not installed
- Upgradeable
- New
- Install from ZIP
- Settings

Browser

- Favorites
- C:\Mappe
- C:\Users\mario\Documents
- Spatial Bookmarks
- Home
- C:\ (OS)
- GeoPackage
- SpatialLite
- PostgreSQL
- SAP HANA
- MS SQL Server
- Oracle
- WMS/WMTS
- Vector Tiles
- XYZ Tiles
- WCS
- WFS / OGC API - Features
- ArcGIS REST Servers
- GeoNode

Layers

- AHEAD-EPICA
 - <3.75
 - 4.0±0.25
 - 4.5±0.25
 - 5.0±0.25
 - 5.5±0.25
 - 6.0±0.25
 - 6.5±0.25
 - >6.75
- OpenStreetMap

<https://github.com>

Locati et al. (2021)

<https://doi.org/>

QQuake v1.7

*Untitled Project — QGIS

Project Edit View Layer Settings Plugins Vector Raster Database Web Mesh Processing Help

Identify Results

Feature	Value
AHEAD-EPICA	
EventLocationName	(Derived)
(Actions)	
EventID	quakemleu.ahead/...
Time	1780-09-21 13:15:00...
Latitude	42.4
Longitude	18.5
DepthMeters	NULL
Author	AHEAD
Catalog	EPICAv1.1
Contributor	HERA995
ContributorID	
MagType	Mw
Magnitude	5.35
MagAuthor	EPICAv1.1
EventLocation...	
Event type	earthquake

EventID	Time	Latitude	Longitude	DepthMeters	Author	Catalog	Contributor	ContributorID	MagType	Magnitude	MagAuthor
5690	quakemleu.ah...	1899-11-13 21:00:00...	45.83	14.25	4500	AHEAD	EPICAv1.1	ZIVC009	Mw	3.87	EPICA
5691	quakemleu.ah...	1899-11-15 23:40:00...	45.404	11.44	NULL	AHEAD	EPICAv1.1	CFT15med; CPT115	Mw	4.31	EPICA
5692	quakemleu.ah...	1899-12-16 00:00:00...	50.183	12.316	NULL	AHEAD	EPICAv1.1	LEYD011	Mw	3.8	EPICA
5693	quakemleu.ah...	1899-12-16 20:00:00...	47.69	14.62	6000	AHEAD	EPICAv1.1	ZAMG010	Mw	4.3	EPICA
5694	quakemleu.ah...	1899-12-19 21:17:00...	45.5	15.25	3200	AHEAD	EPICAv1.1	ZIVC009	Mw	3.87	EPICA
5695	quakemleu.ah...	1899-12-20 17:28:00...	44.8	28.2	50000	AHEAD	EPICAv1.1	SHELE998	Mw	3.48	EPICA
5696	quakemleu.ah...	1899-12-26 10:10:00...	44.475	7.517	NULL	AHEAD	EPICAv1.1	SISFR016; FCAT-17	Mw	4.22	EPICA

Coordinate: 1516811,5498155 | Scale: 1:4977841 | Magnifier: 100% | Rotation: 0.0° | Render | EPSG:3857

Fetch Data | Chiudi

[?&includeallorigins=true&includeallmagnit](#)

AHEAD web portal

AHEAD European Archive of Historical Earthquake Data

Query by Earthquake

► Homepage ► Description ► Query by Data Source

Custom filters | Predefined filters | Geographical filters

year = [] min 1000 max 1899

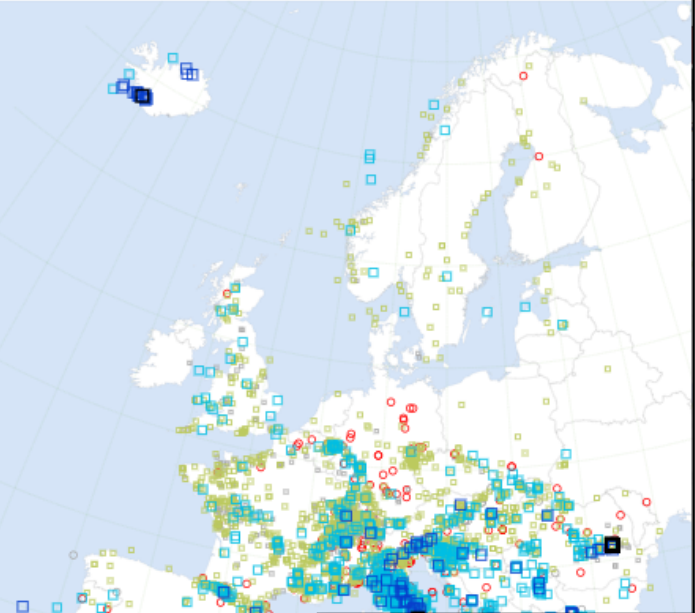
no. of MDPs = [] min 0 max 1516

- extra large
- large
- medium
- small
- very small
- not determined
- fake

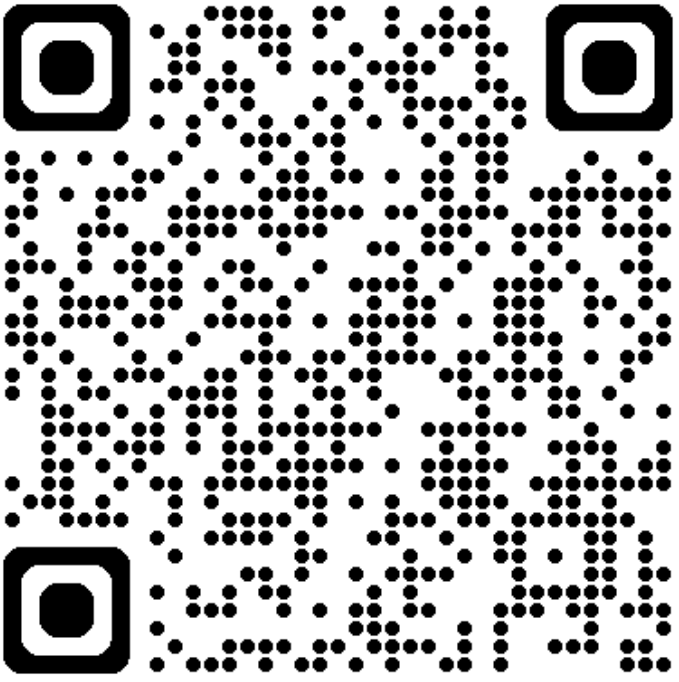
refresh

Date	Epicentral area
1724 06 13	SPIS
1724 07 15 18 30	BAUGES (ARITH)
1724 08 03	Calabria meridionale
1724 08 09	NV af Þorlákshöfn
1724 09 13 13	Gandía.V
1724 10 12 02 45	[Océano Atlántico]
1724 12 11 20	TRAVALE
1725	Istanbul
1725	Corinthos
1725 04 14	TERRITOIRE DE BELFORT (ANGEOT)
1725 04 17 13	Appennino umbro-marchigiano
1725 04 18 13	Appennino umbro-mar.
1725 06 30	Glarus
1725 07 28	CAMARGUE

6205 earthquakes in the archive



- extra large
- large
- medium
- small
- very small
- not determined
- fake



https://www.emidius.eu/AHEAD/query_event/