



AdriaArray – a Passive Seismic Experiment to Study Structure, Geodynamics and Geohazards of the Adriatic Plate

Petr Kolínský (Institute of Geophysics, Czech Academy of Sciences, Prague, Czech Rep.)

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&

the AdriaArray Seismology Group

IAGA/IASPEI Joint Scientific Meeting 2025, Lisbon, Portugal, 3. September, solicited talk

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Christian-Albrechts-Universität zu Kiel
Mathematisch-
Naturwissenschaftliche Fakultät

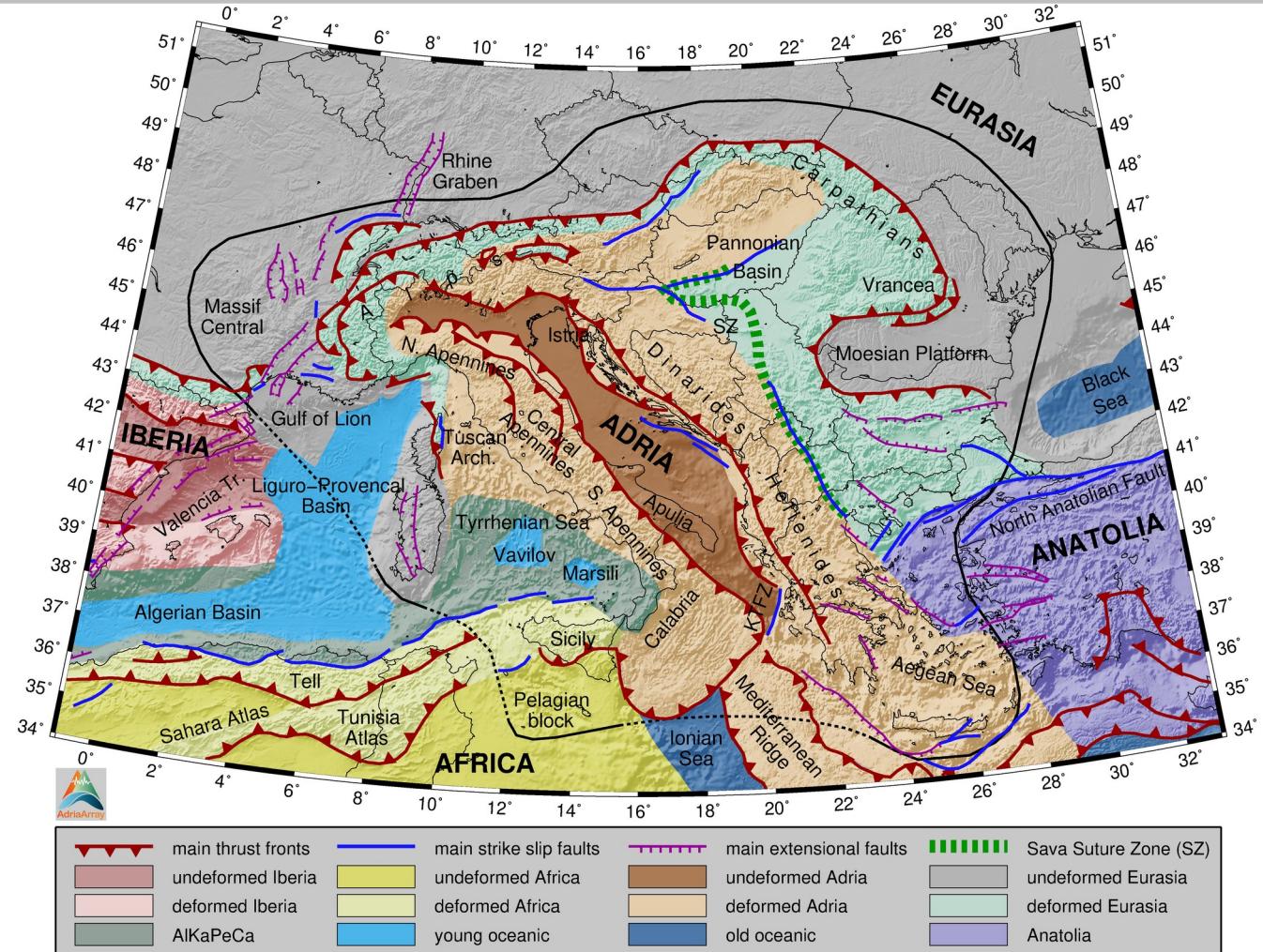


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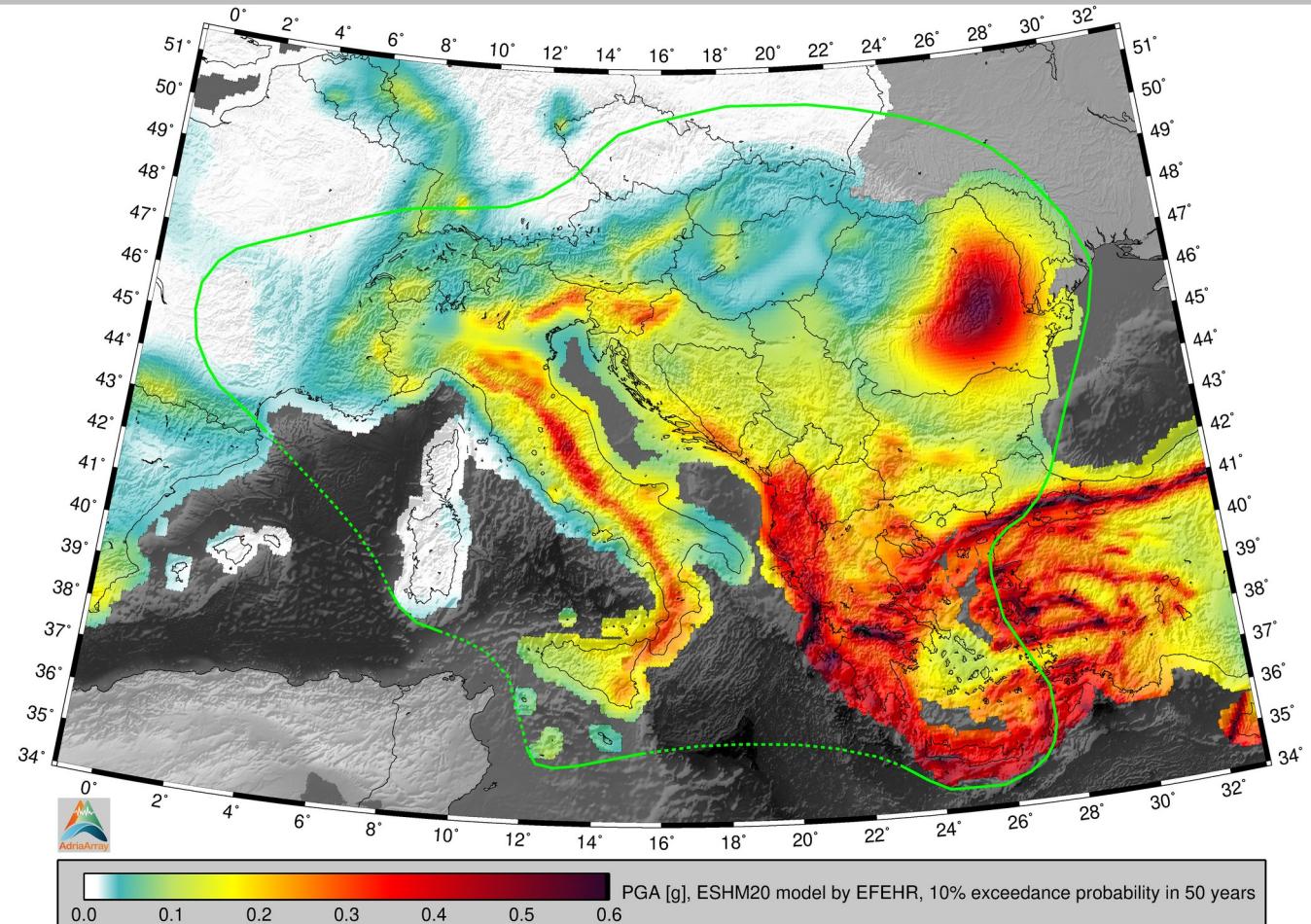


Orfeus

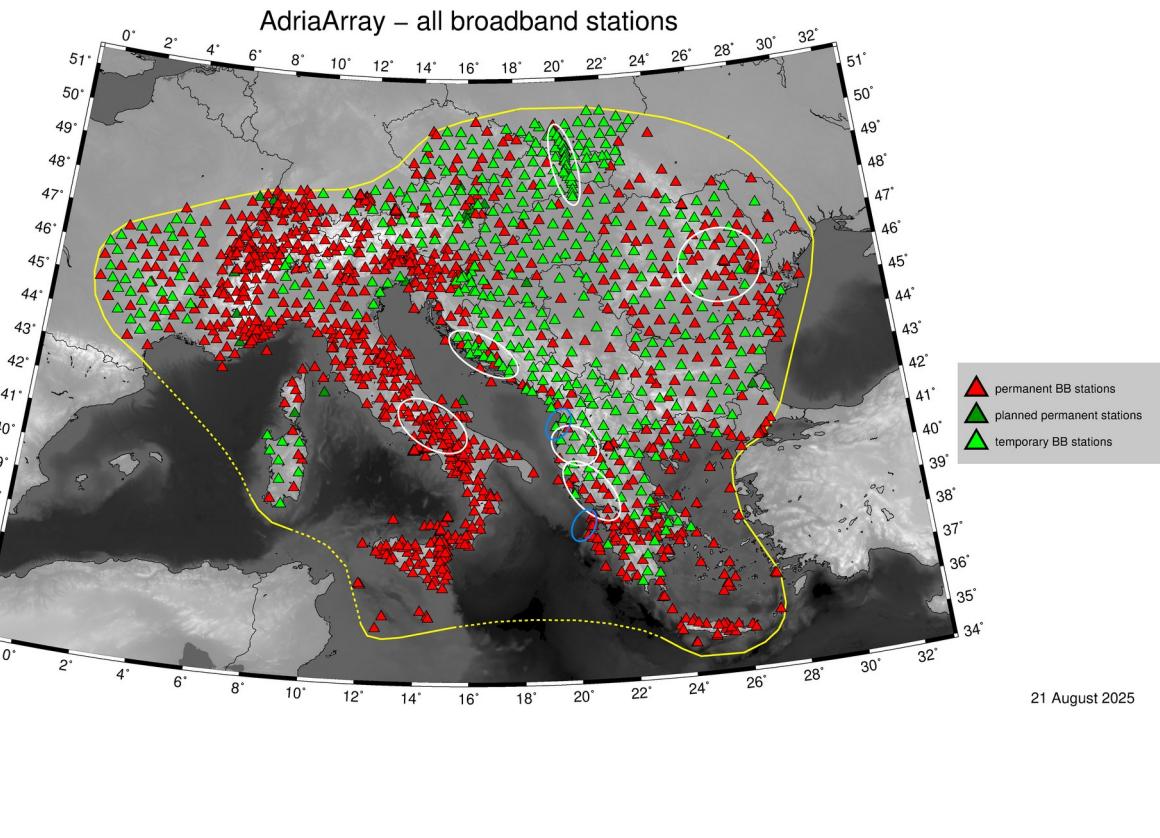
Tectonic map of the central European and Mediterranean region, from Kolínský et al., (2025), modified after Faccenna et al. (2014), Le Breton et al. (2017, 2021) and Handy et al. (2010, 2019).



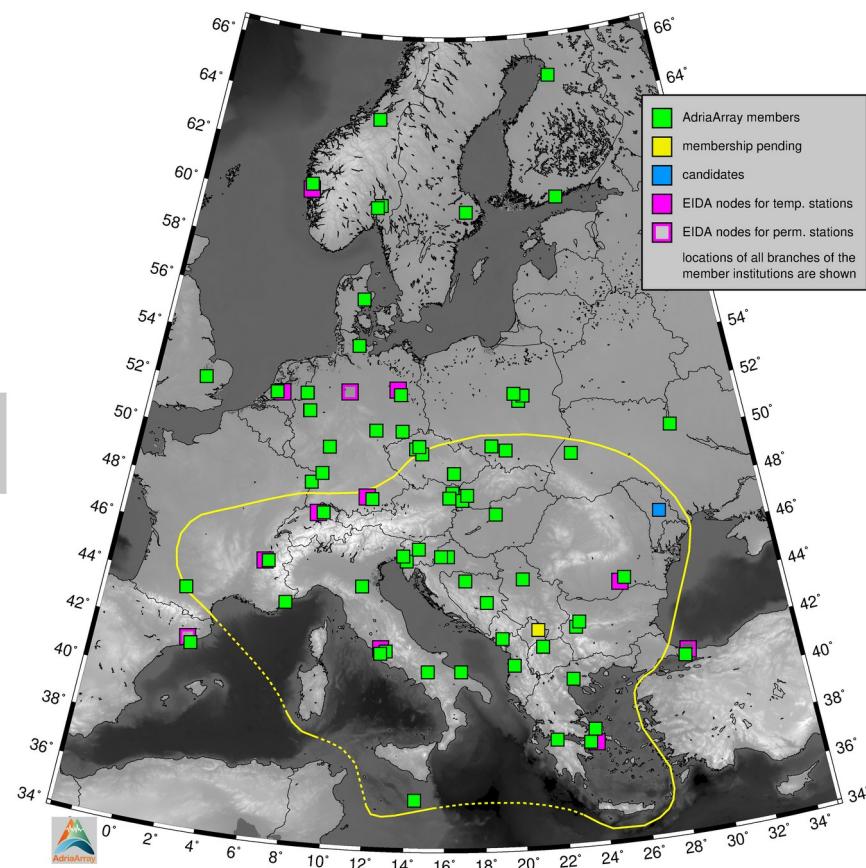
The 2020 European Seismic Hazard Model (ESHM20), by European Facilities for Earthquake Hazard and Risk (EFEHR), after Danciu et al. (2021)



seismic network



consortium of 64 institutions



- proposed in **2018** at the AlpArray Science Meeting Zürich
- preparation from 2019 – 2022
- **AdriaArray Seismology Group** founded in 2022
- deployment of stations: 2022 – 2024
- duration: 2022 – 2026 (not all stations kept till 2026)

AdriaArray Workshops:

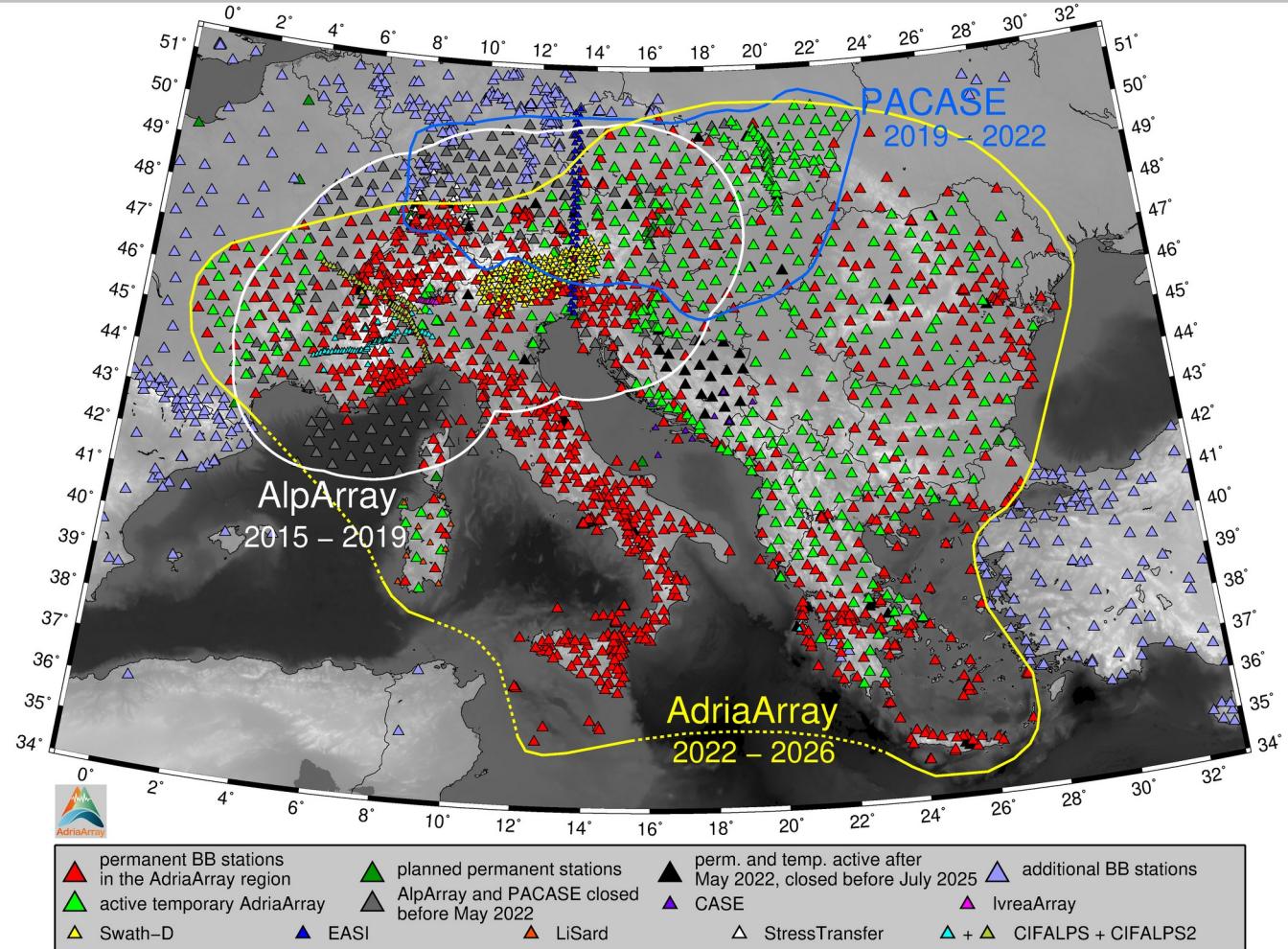
2019	kick-off meeting, Thessaloniki, Greece
2020 + 2021	online workshops (EPOS/ORFEUS)
2022	AdriaArray/EPOS/ORFEUS Workshop, Potsdam, Germany
2023	AdriaArray workshop, Dubrovnik, Croatia
2024	AdriaArray workshop, Sofia, Bulgaria
2025	AdriaArray workshop, Venice, Italy
2026	AdriaArray workshop, Sopron, Hungary
2027	AdriaArray workshop, Czech Republic ?

COST proposals: submitted in November 2020
resubmitted in October 2024

- declined
- declined



previous experiments

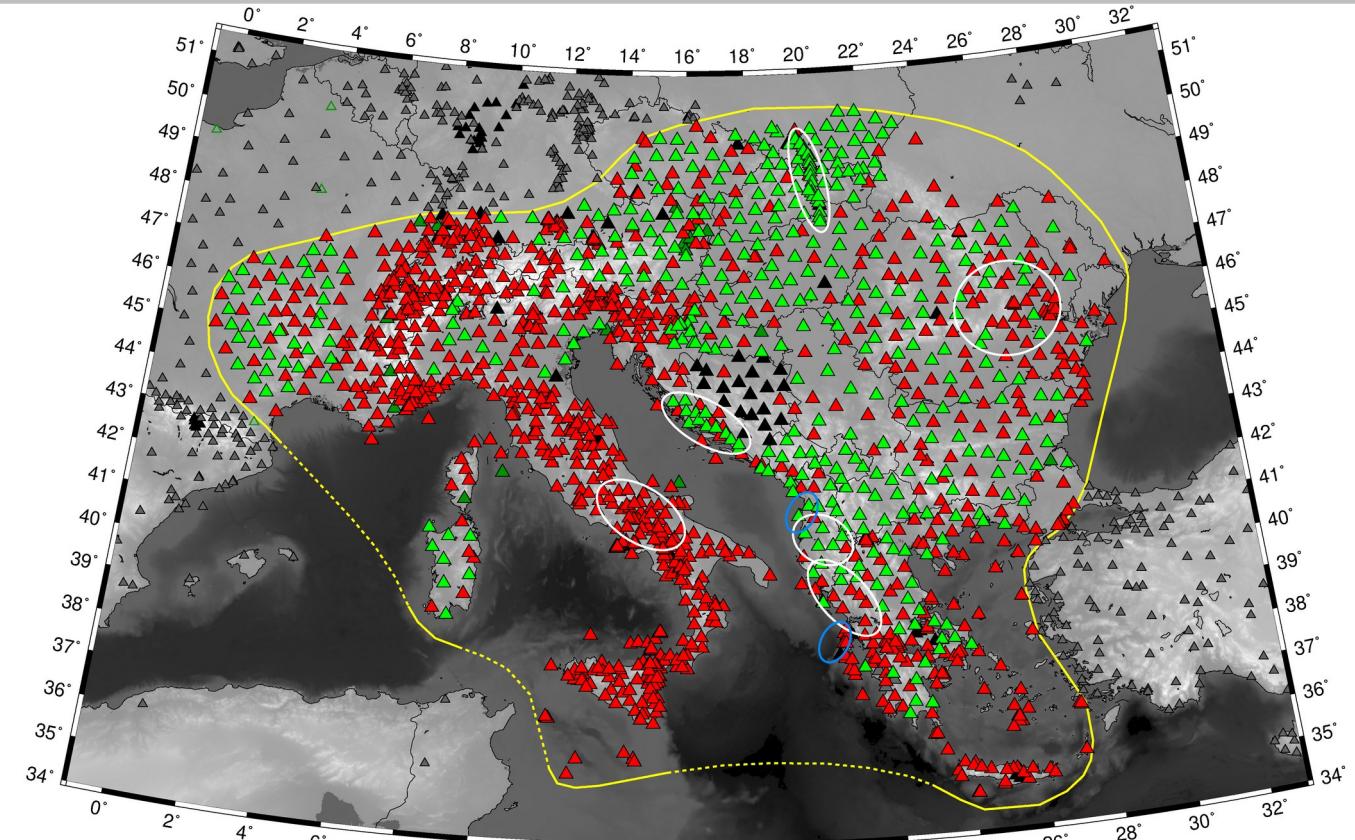


PERMANENT stations

inside the AdriaArray region:

BB ($\geq 30s$) = backbone 1092

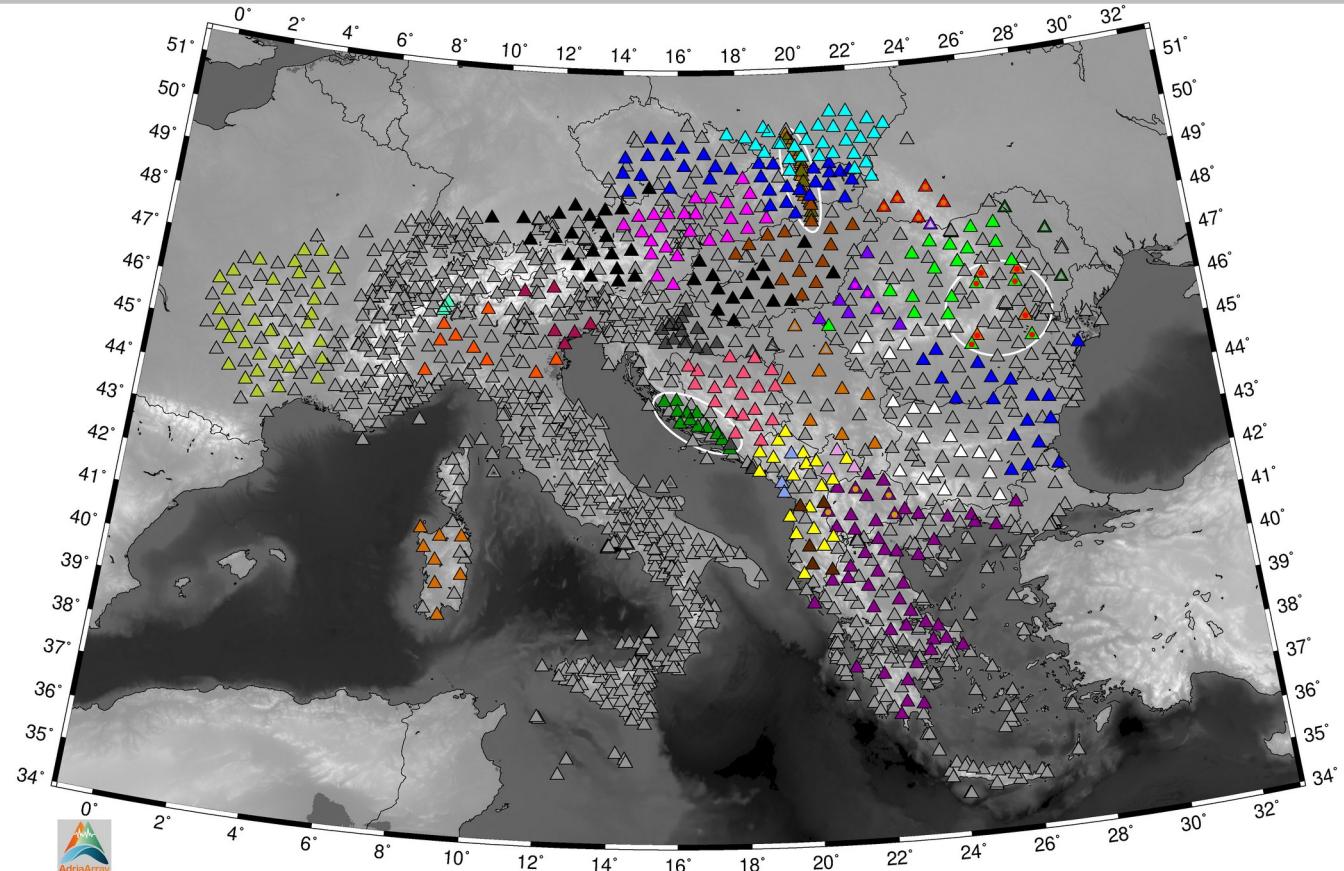
(there are ~ 3200 stations
on the map including those
outside the AdriaArray region)



- ▲ permanent BB stations
- ▲ planned permanent stations
- ▲ stations operational after May 2022 but closed now
- ▲ temporary BB stations
- ▲ additional BB stations

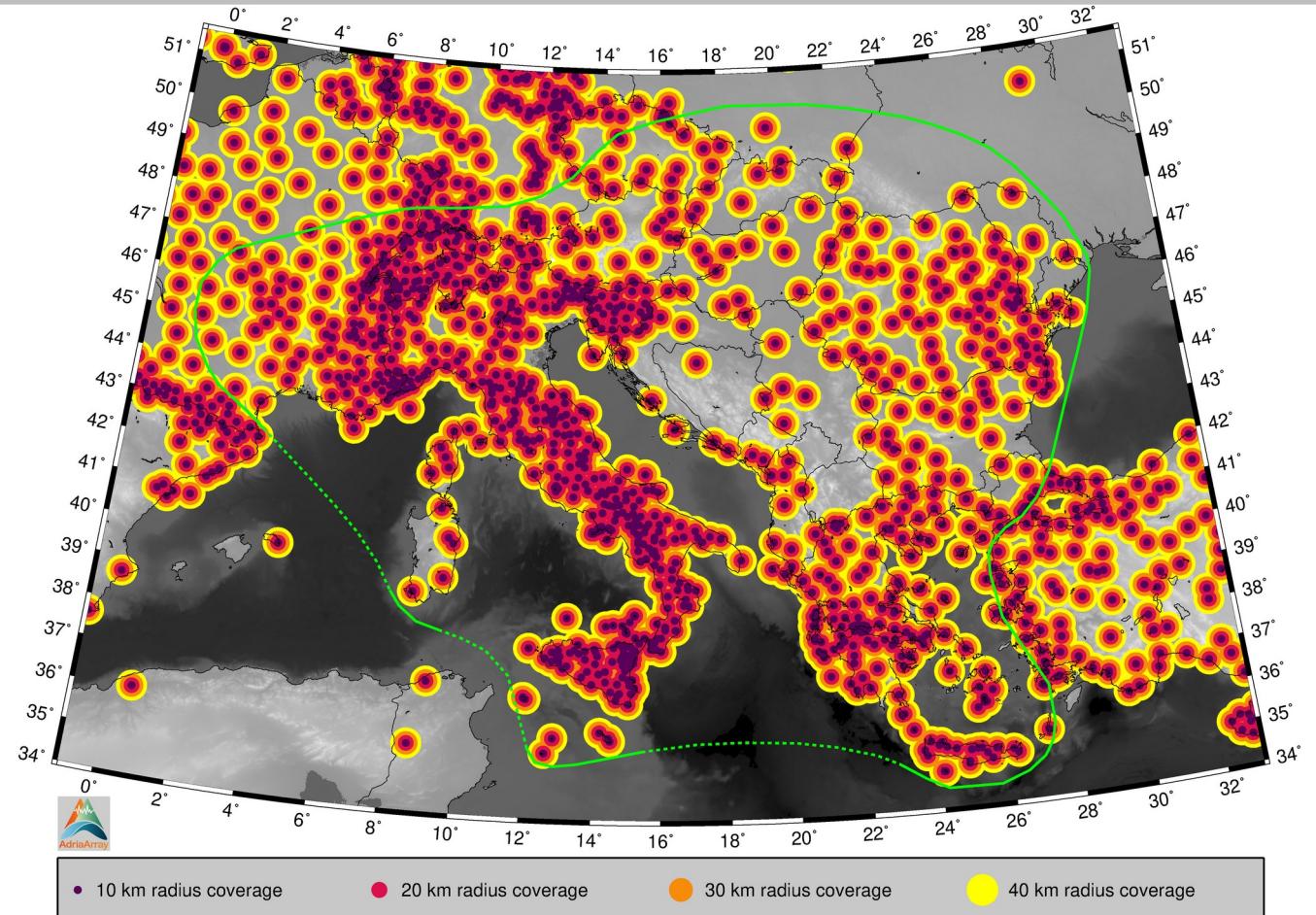
AdriaArray backbone**436 BB temporary stations****1092 BB permanent stations**

1528 BB stations in total
 (local BB experiments included)

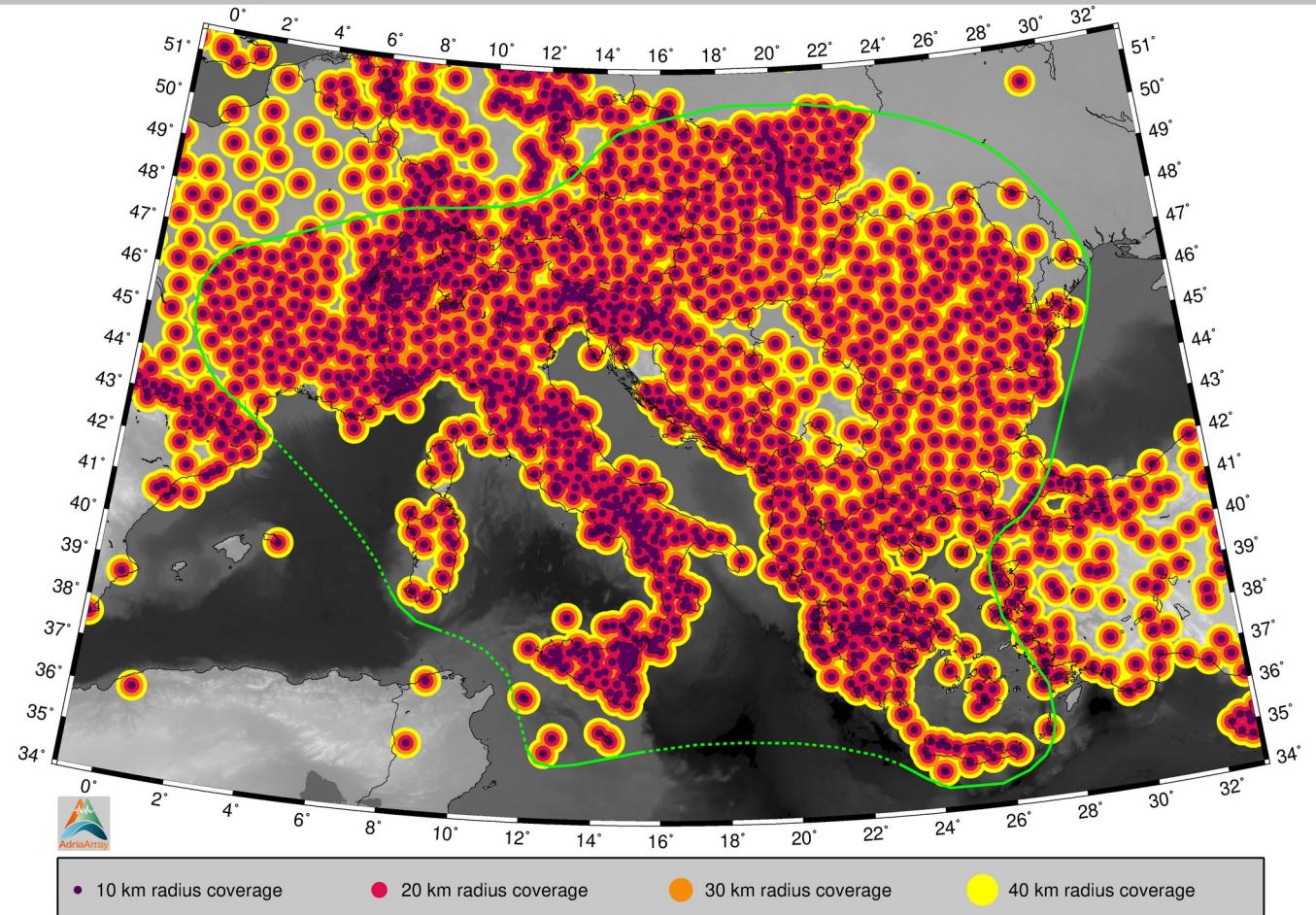


△ permanent BB stations	▲ Norwegian Pool + UniZagreb	▲ Resif-Sismob, France	▲ NIEP Pool, Romania
▲ IG CAS Prague, CZ	▲ Uni Kiel, Germany	▲ OGS, Italy	▲ Karlsruhe IT, Germany
▲ Uni Helsinki, Finland	▲ EPSS, Hungary	▲ ETH Zurich, Switzerland	▲ GIPP + IRSM
▲ Uni Helsinki + IRSM Prague	▲ Uni Twente, the Netherlands	▲ INGV Bologna, Italy	▲ GIPP + Carpathian Project
△ Uni Aarhus, Denmark	▲ Uni Bochum, Germany	▲ Croatia Seism. Survey	▲ GIPP, GFZ, Germany
▲ Unis + PAS, Poland	▲ Uni Bochum + Uni Frankfurt	▲ Montenegro Pool	▲ Uni Jena, Germany
▲ Uni Oulu, Finland	▲ Uni Munich, Germany	▲ Kosovo Pool	▲ Geoazur+GIPP UT permanent
▲ Uni Oulu + Uni Wien	▲ Uni Wien, Austria		

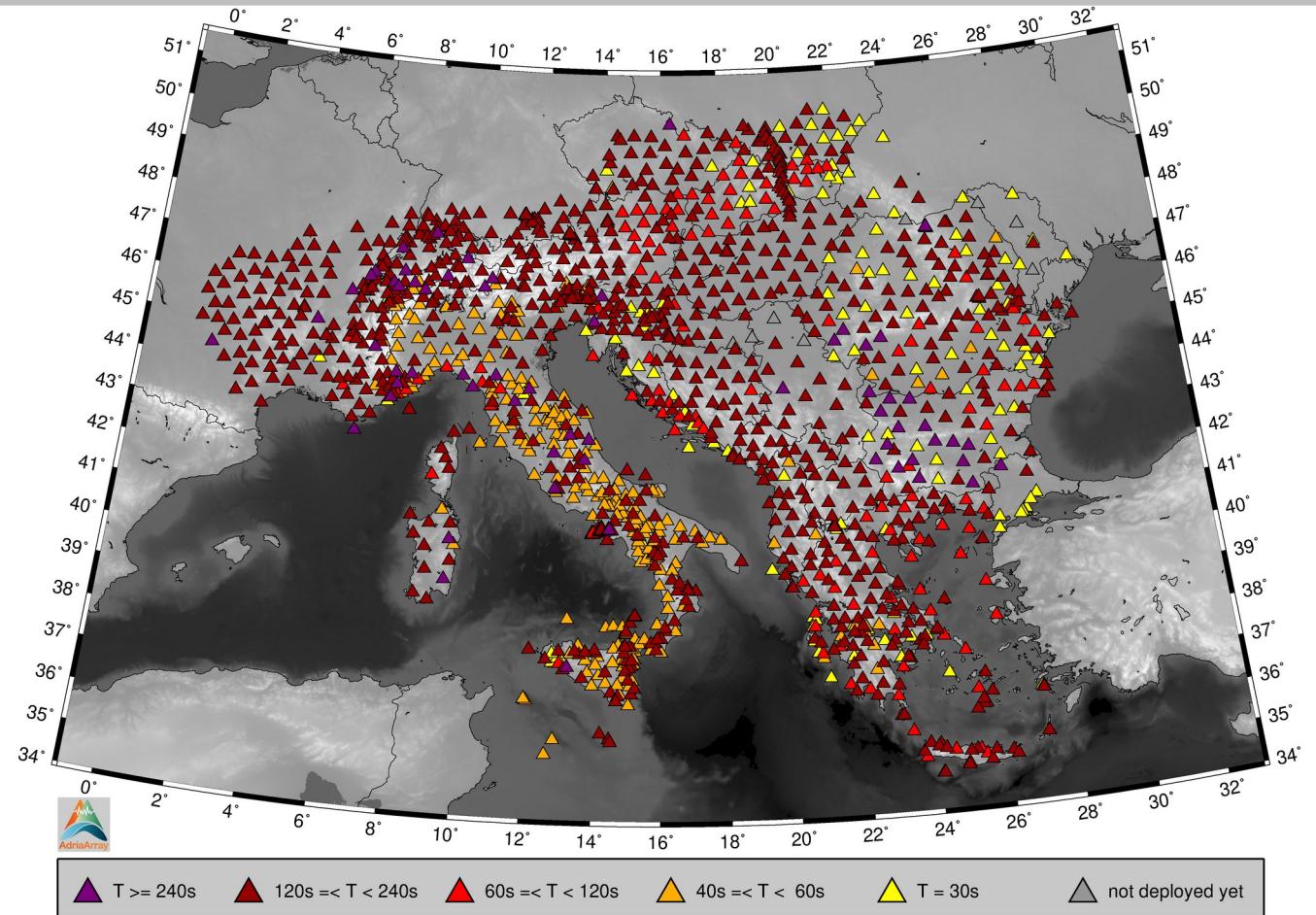
permanent



permanent
+
temporary



corner periods



Data access via EIDA:

permanent stations:

1092 stations are open

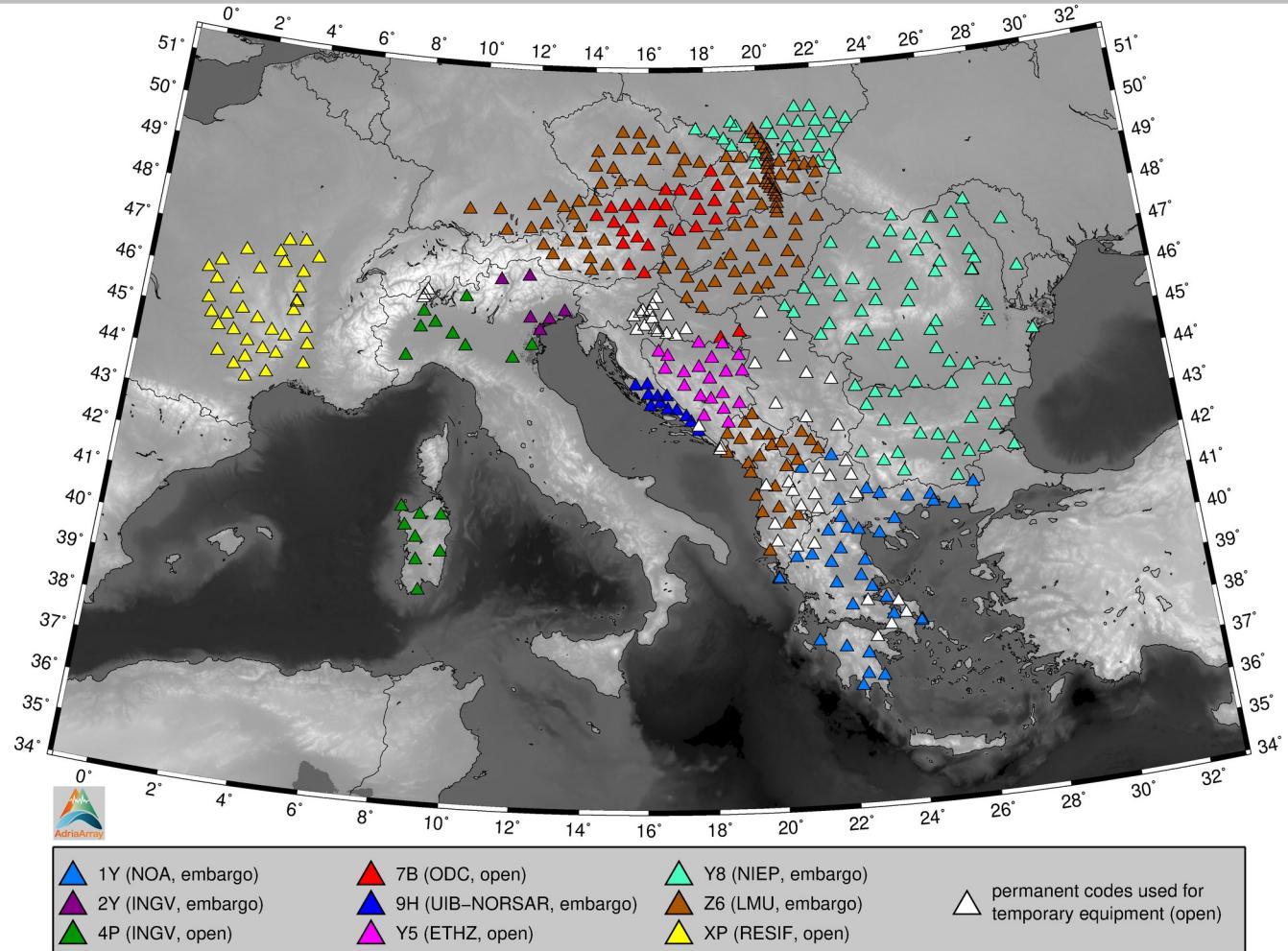
temporary stations: available immediately for the AdriaArray participants

public access to temporary stations:rolling embargo of two years is applied to **288** stations**148** stations are open

~ 1/3 = open

~ 2/3 = embargoed

real-time data exchange of AdA data: according to existing institutional agreements

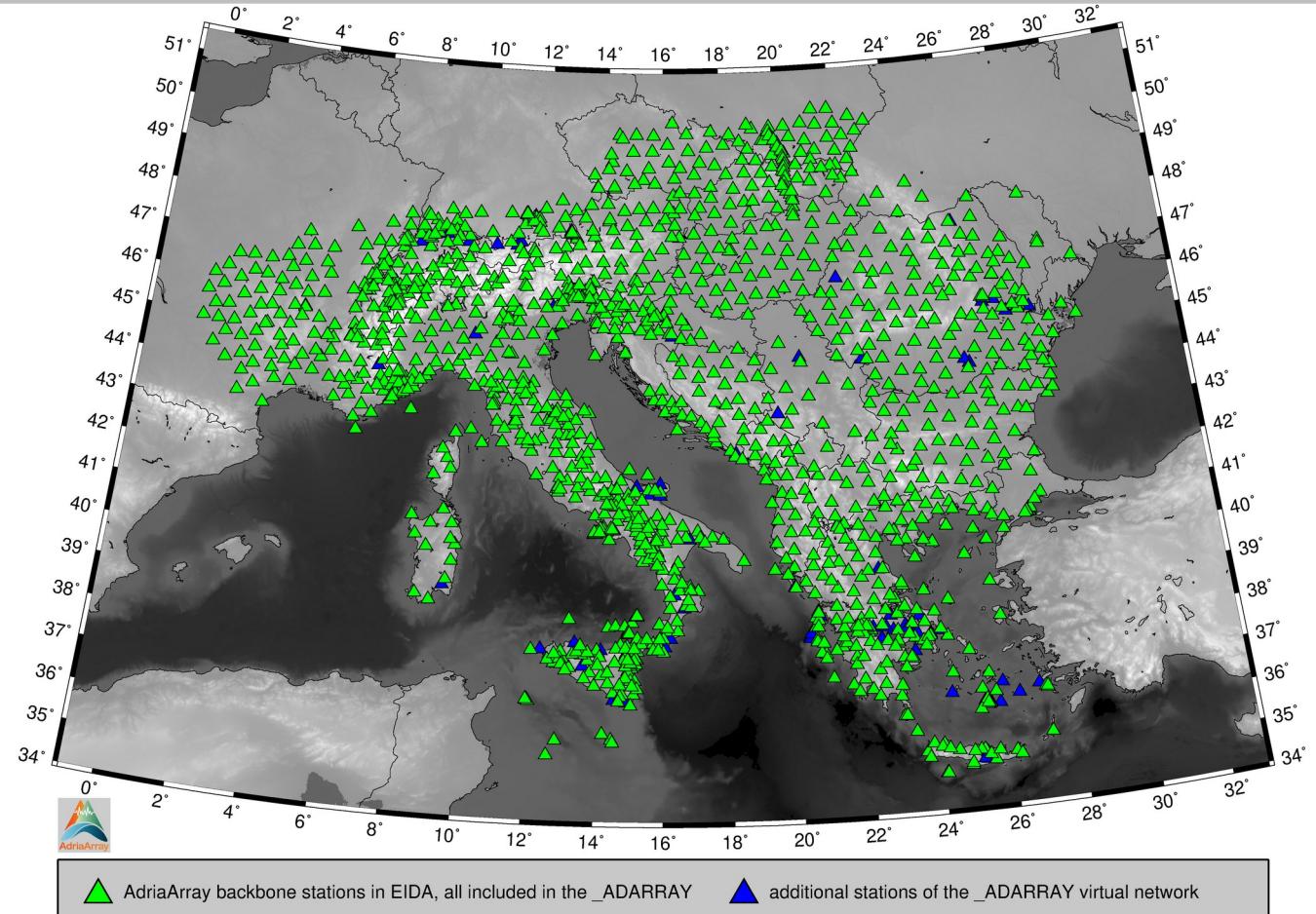


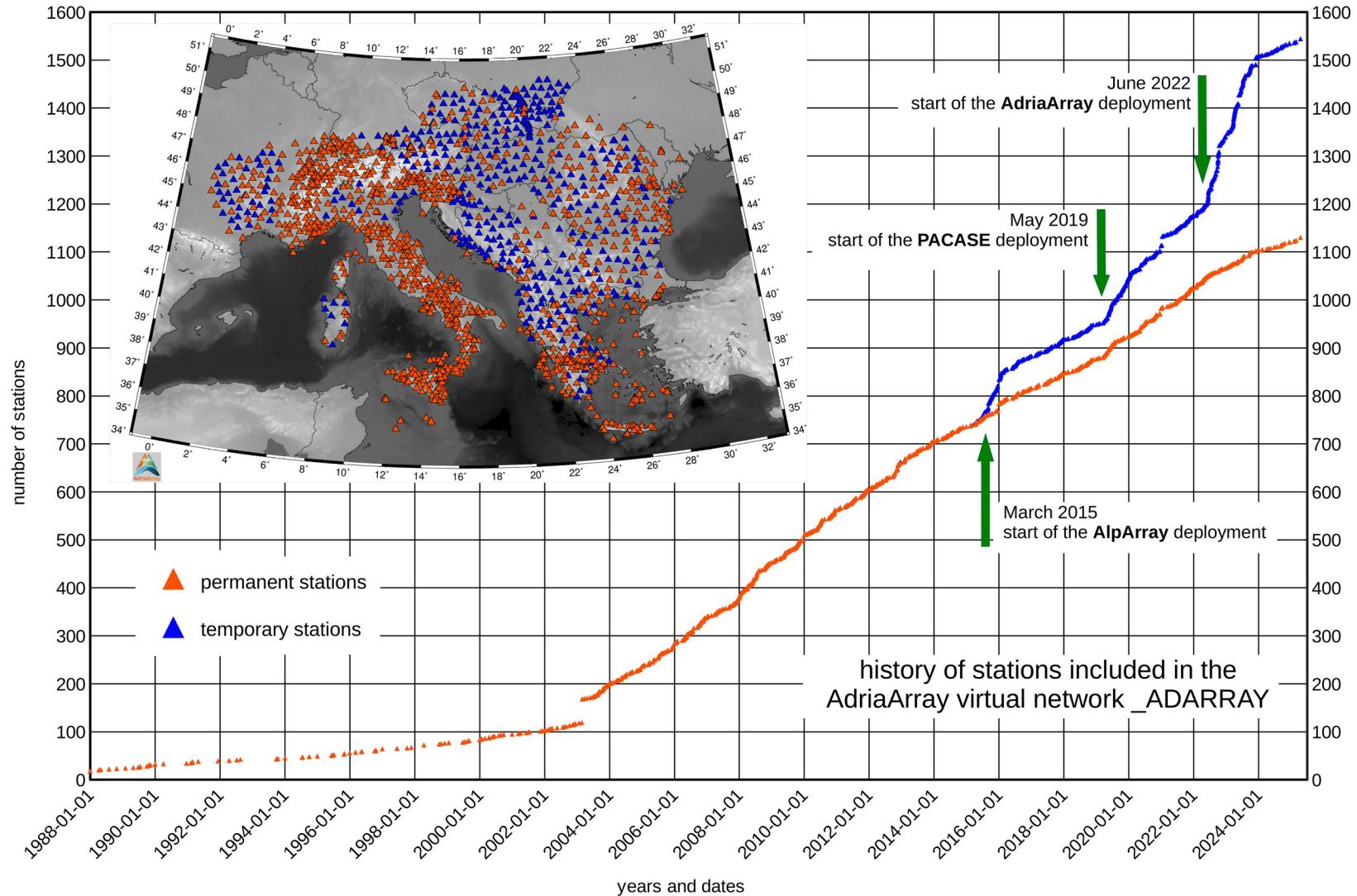
virtual network
_ADARRAY

backbone == all BB stations
with corner period ≥ 30 s

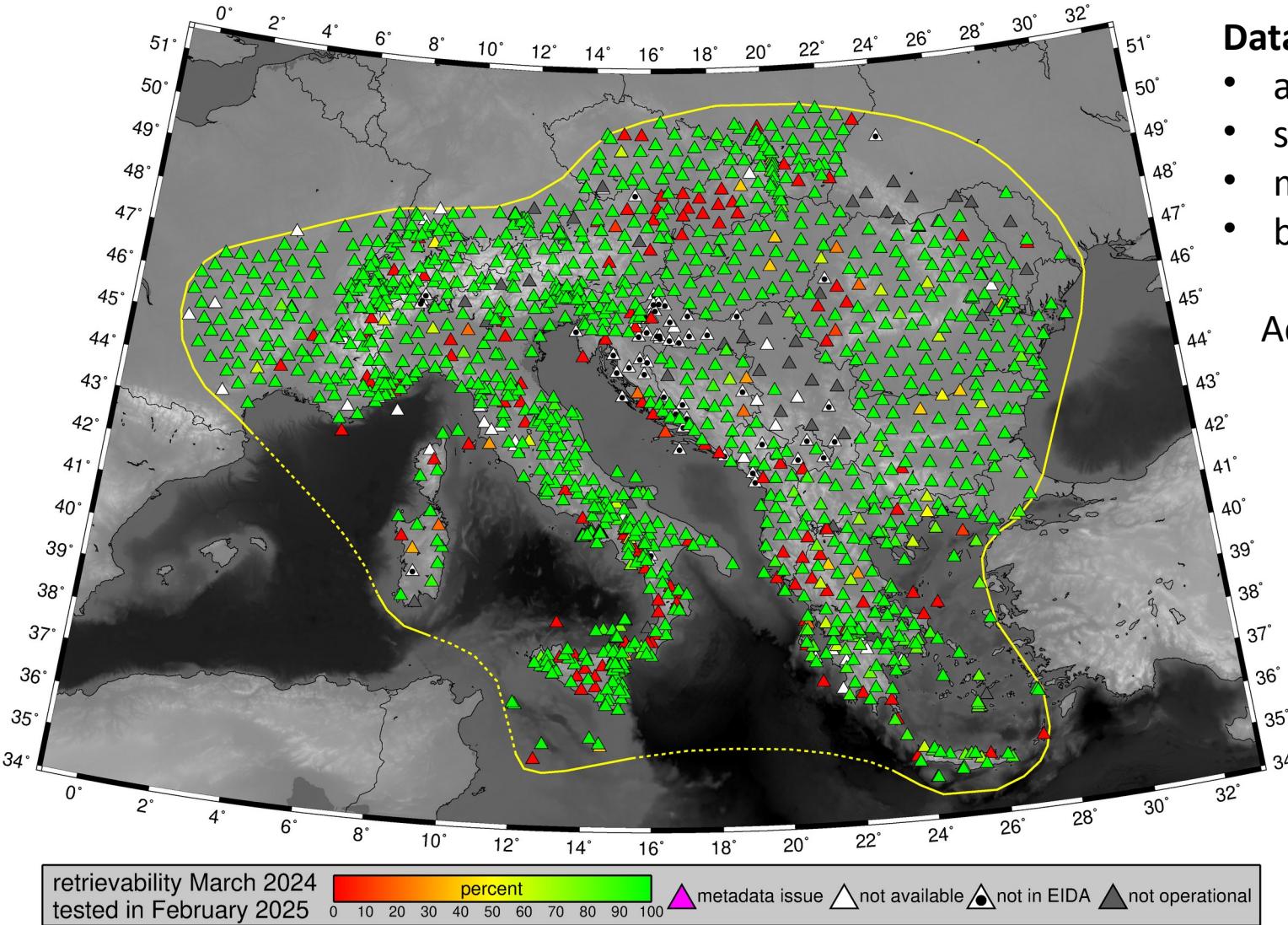
_ADARRAY == all BH* and
HH* channels, meaning all
BB stations with corner
period ≥ 10 s

backbone is a subset
of the virtual network
_ADARRAY





history of
deployment
of the stations
included in
_ADARRAY



Data quality control:

- availability / retrievability
- signal-to-noise ratio
- metadata
- backfilling of data

AdA Working Groups together
with the ORFEUS UAG



Methods for data and metadata quality tests of large dense seismic networks - focus on AdriaArray

Petr Kolínský^{1*}, Johannes Stampa^{2,3}, Luděk Vecsey¹, Felix Eckel², Tena Belinić Topić⁴, Thomas Meier² and the AdriaArray Seismology Group⁵

⁽¹⁾ Institute of Geophysics of the Czech Academy of Sciences, Prague, Czech Republic

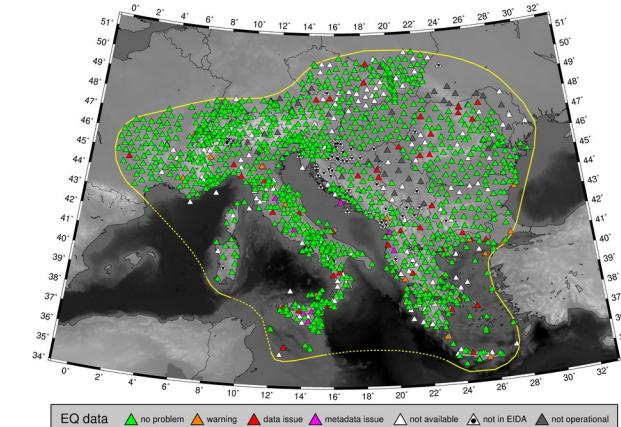
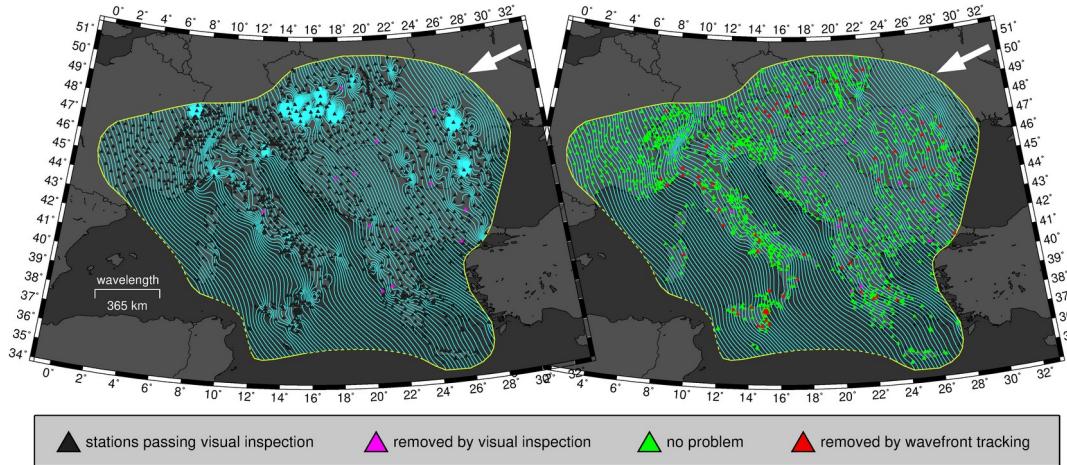
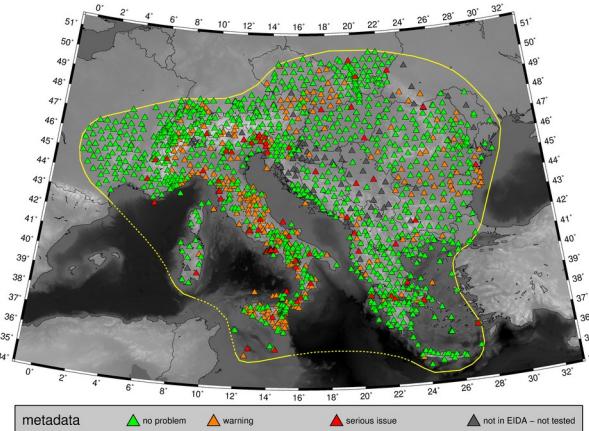
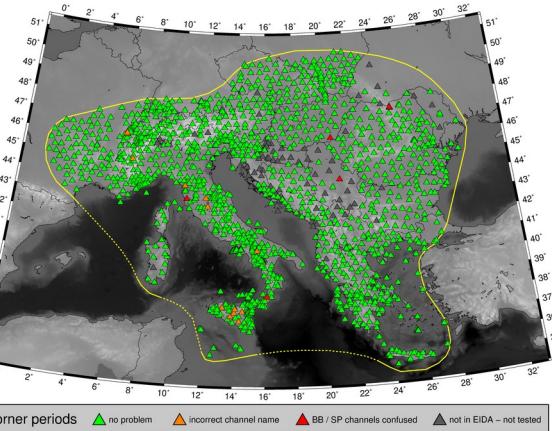
⁽²⁾ Institute for Geosciences, University of Kiel, Germany

⁽³⁾ Department of Earth Sciences, Bullard Laboratories, University of Cambridge, Cambridge, United Kingdom

⁽⁴⁾ Department of Geophysics, Faculty of Science, University of Zagreb, Croatia

⁽⁵⁾ https://orfeus.readthedocs.io/en/latest/adria_array_main.html

data and metadata tests



AdriaArray webpage

https://orfeus.readthedocs.io/en/latest/adria_array_main.html

ORFEUS Strong-Motion Support Grants

Focus Section on European Seismic Networks and Associated Services and Products

Conference Sessions

EPOS Seismology Workshop 2023

ORFEUS & Geo-INQUIRE Workshops 2024

GEO-INQUIRE PRODUCTS

Integration of UT network (Ukraine) in EIDA

Infrasound integration guidelines

EIDA Guidelines for the creation of derived products from raw DAS data

ORFEUS & Geo-INQUIRE Workshops 2024

ADRIAARRAY INITIATIVE:

AdriaArray

AdriaArray - Mission

AdriaArray - Logo

AdriaArray - Current deployment

AdriaArray - Station map

AdriaArray - Station properties

AdriaArray - Relation to EPOS

AdriaArray News

AdriaArray - Organization

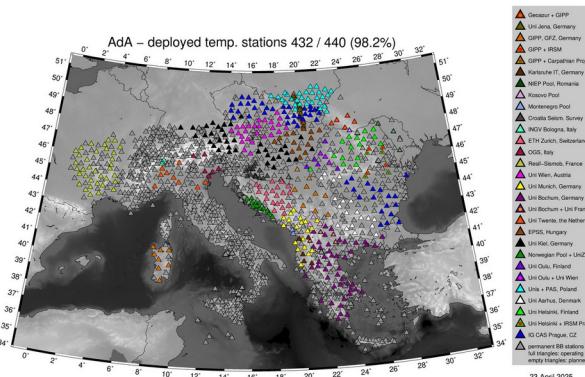
AdriaArray - Working Groups

AdriaArray - Data analysis and research

AdriaArray - Seismic networks

AdriaArray - Current deployment

Current status of the AdA seismic network. Filled triangles represent stations already in the field, while empty triangles indicate stations that are not yet deployed.

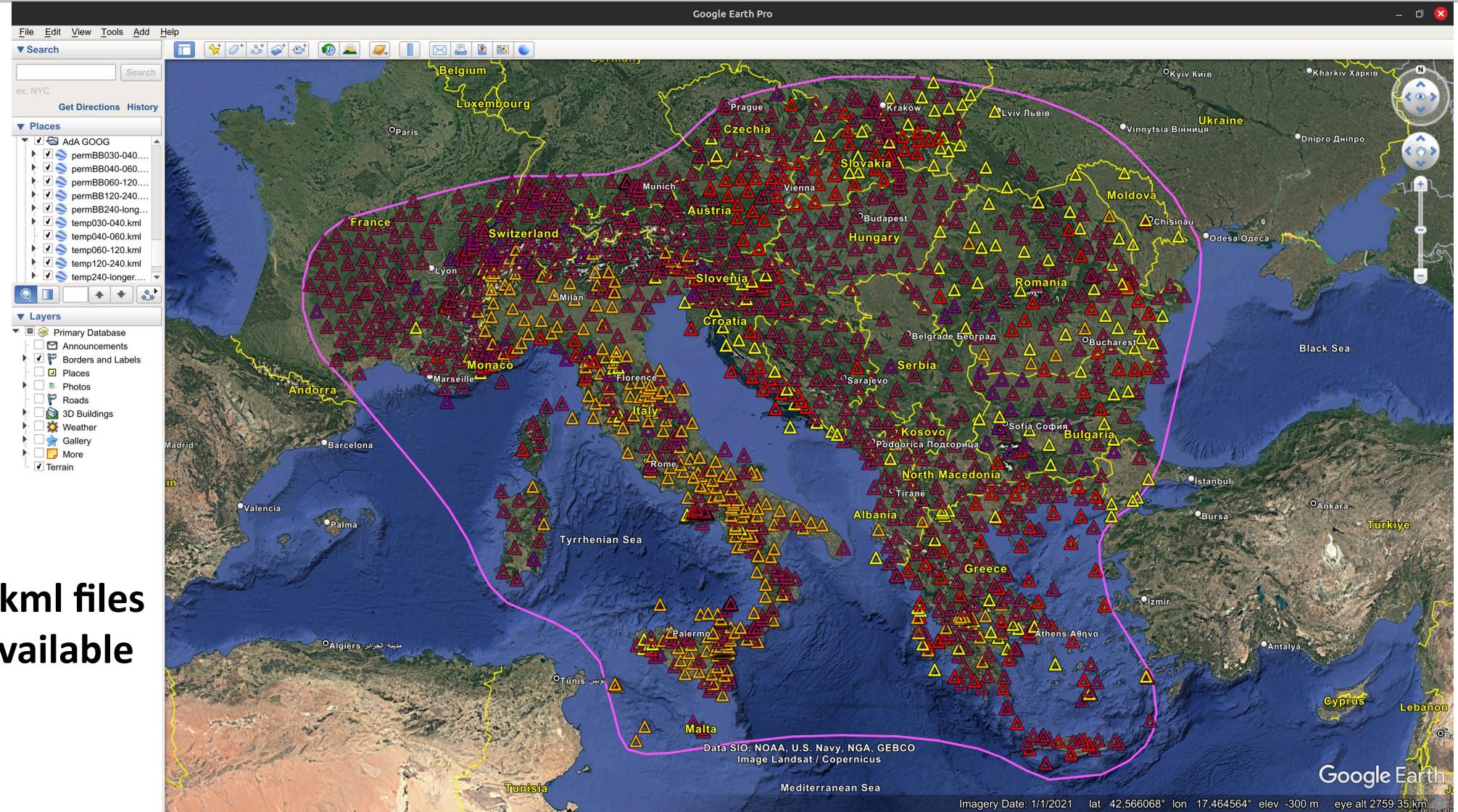


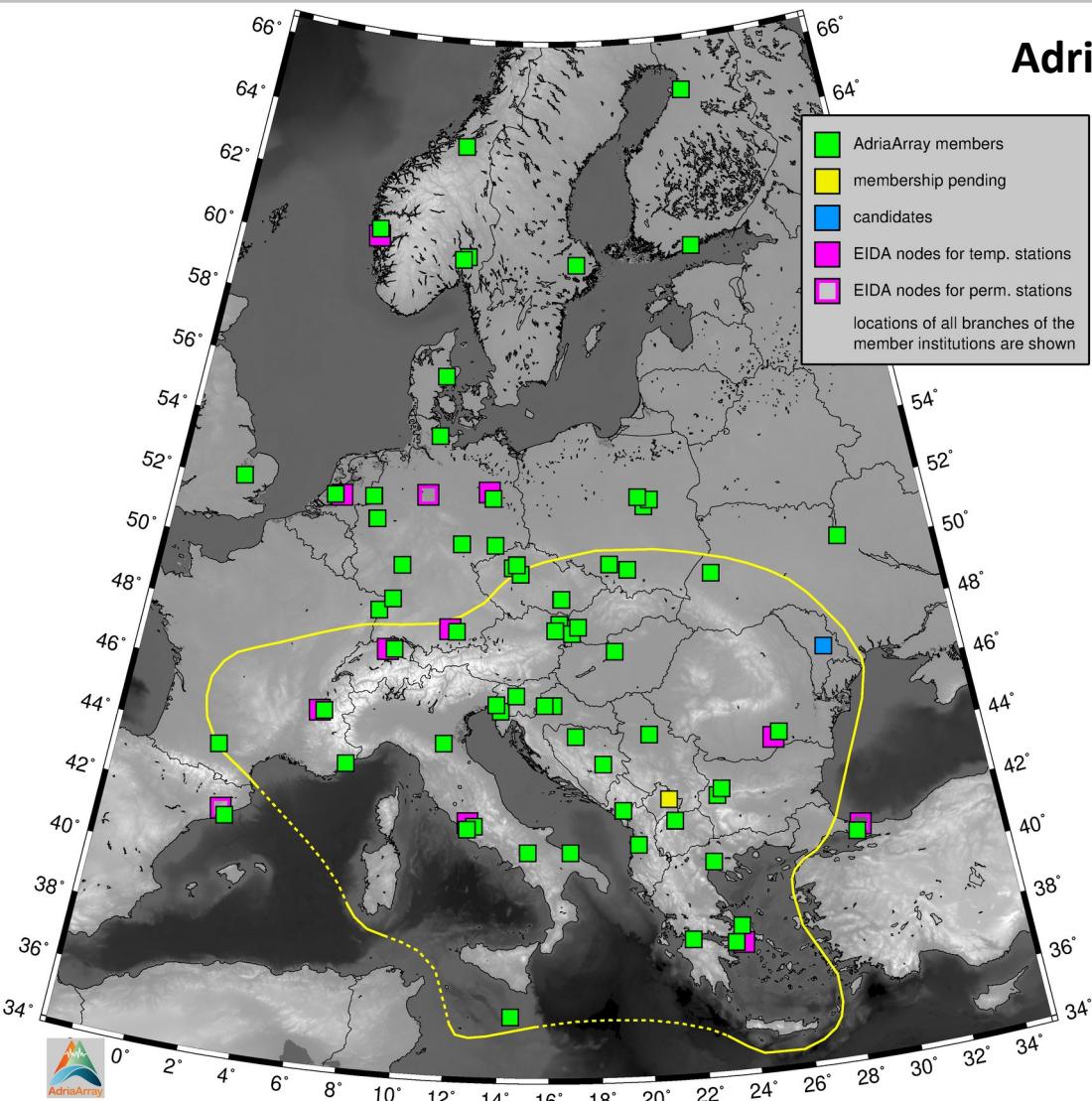
AdriaArray GitHub

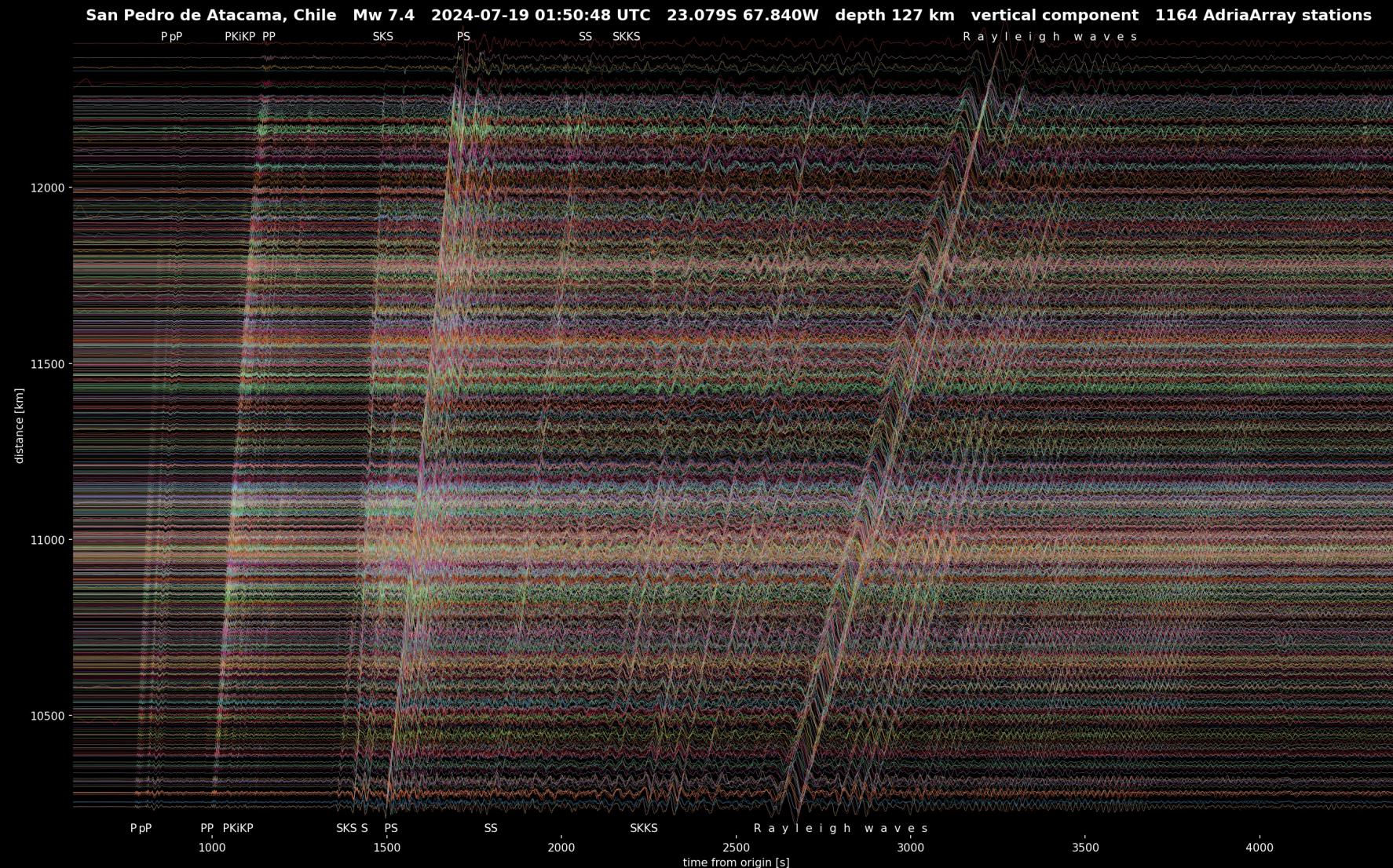
inventories, scripts, manuals, GMT files, *.kml files, maps
<https://github.com/PetrColinSky/AdriaArray>

presentations about AdriaArray:
 posters, slides from EGU, SSA, DGG,
 IUGG, AG Seismologie,
 AdA & ORFEUS/EPOS workshops,
 splinter meetings









Collaborative Research Groups:

- Data processing & research
- Suggested by participants (since 2023): topics, chairs, first activities of 8 CRGs
- To be approved by the Steering Committee
- Work independently
- Report on activities at the AdASG Workshops
- Consist of participants of at least two countries
- Coordination of individual CRGs: experienced researcher + early career scientist if possible
- Members may change
- May be established at the beginning of the experiment or later
- current CRGs are:
 - Seismicity and seismic sources
 - Body wave tomography
 - Modelling seismic wave propagation and full waveform inversion
 - Receiver functions
 - Surface wave and ambient noise tomography
 - Shear-wave splitting and anisotropy
 - Engineering Seismology
 - Linking geophysical observables and geodynamics

Special Issue Annals of Geophysics 2025:

Recent large-scale temporary passive seismic experiments in Europe: deployment and data quality

28 submissions including the “general” paper presenting AdriaArray (Kolínský et al., 2025)

guest editors:

Irene Molinari, Gergana Georgieva,
Petr Kolínský, Thomas Meier

Annales of Geophysics
is a diamond open access journal
(free of charge)

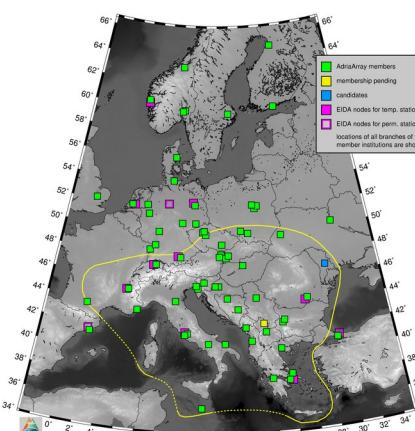
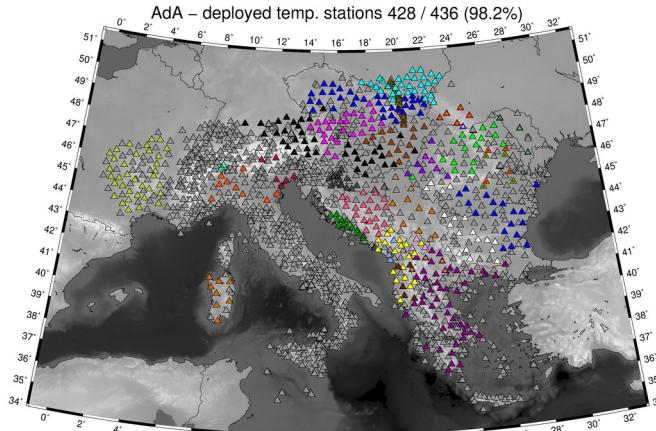


ANNALS OF GEOPHYSICS

**AdriaArray – a Passive Seismic Experiment to Study
Structure, Geodynamics and Geohazards of the
Adriatic Plate**

Petr Kolínský^{1*}, Thomas Meier², Matthew R. Agius³, Almir Bijedić⁴, Götz Bokelmann⁵, Felix Borleanu⁶, Dušica Brnović⁷, Musavver Didem Cambaz⁸, Fabio Cammarano⁹, Martina Čarman¹⁰, Carlo Cauzzi^{11, 12}, Dragana Chernih¹³, Kristian Csicsay¹⁴, Snježana Cvijić Amulić¹⁵, Wojciech Czuba¹⁶, Jordi Diaz¹⁷, Liliya Dimitrova¹⁸, Edmond Dushi¹⁹, Christos P. Evangelidis²⁰, Claudio Faccenna^{9, 21}, Liudmyla Farfuliak²², Wolfgang Friederich²³, Gergana Georgieva²⁴, Nikolaus Horn²⁵, Ines Ivanić²⁶, Yan Jia²⁵, George Kaviris²⁷, István János Kovács²⁸, Sergei Lebedev²⁹, Eline Le Breton³⁰, Renata Lukešová³¹, Stanisław Mazur³², Mark van der Meijde³³, Irene Molinari³⁴, Shemsi Mustafa³⁵, Thorsten Nagel³⁶, Søren Bom Nielsen³⁷, Anne Obermann¹², Costas Papazachos³⁸, Stefano Parolai³⁹, Anne Paul⁴⁰, Claudia Piromallo⁴¹, Vladimír Plicka⁴², Andreas Rietbrock⁴³, Stéphane Rondenay⁴⁴, Giuliana Rossi⁴⁵, Georg Rümpker⁴⁶, Christian Schiffer⁴⁷, Antje Schlömer⁴⁸, Karin Sigloch⁴⁹, Hanna Silvennoinen⁵⁰, Eftimios Sokos⁵¹, Petr Špaček⁵², Josip Stipčević⁵³, Andrea Tallarico⁵⁴, Timo Tiira⁵⁵, Frederik Tilmann^{21, 56}, Dejan Valčić⁵⁷, Joachim Wassermann⁴⁸, Viktor Wesztergom²⁸, Anila Xhahysa¹⁹, Mladen Živčić¹⁰ and the AdriaArray Seismology Group⁵⁸

- + AdriaArray: community effort of 64 institutions from 30 countries – the „hidden“ goal: join the community
- + potential for large scale experiments if deployment of mobile pools is coordinated – 23 mobile pools
- + cooperation with ORFEUS: archiving, data quality control, connection of UAG, sponsoring of workshops
- + necessity for intense communication between network operators, mobile pool owners, and ORFEUS
- many institutions, expected complexity of organization
- long preparation time, 2019 – 2022, and then long deployment period 2022 – 2024
- heterogeneous experiences of members (also diverse technical support, variable financial support)
- metadata: the same issues as with AlpArray ... around 10% stations have problems initially, mainly permanent ones



outlook:

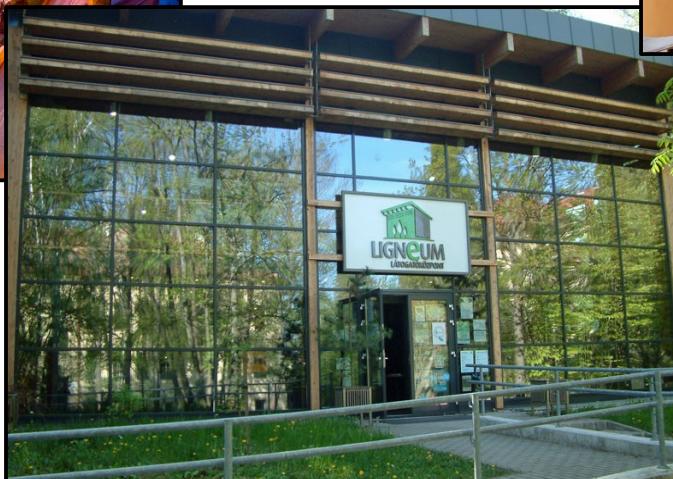
We expect that the AdriaArray data will be the basis for scientific research by the European seismological community for about a decade to identify the Earth structure and geodynamic drivers of geohazards in the region.

Local organizers:

Dániel Kalmár, István Kovács et al. (HUN-REN, Institute of Earth Physics and Space Science, Hungary)

place: **Sopron, Hungary**

Dates: 17 – 20 March 2026 (Tuesday - Friday)





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Christian-Albrechts-Universität zu Kiel
Mathematisch-
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EPOS
EUROPEAN PLATE OBSERVING SYSTEM

Orfeus



IASPEi!AGA

acknowledgements



acknowledgements

Maps plotted using GMT by Wessel, P., Smith, W. H. F., Scharroo, R., Luis, J. F. and Wobbe, F., 2013: Generic Mapping Tools: Improved version released, EOS Trans. AGU, 94, 409-410.

AdA temporary stations by the AdriaArray Seismology Group https://orfeus.readthedocs.io/en/latest/adria_array_main.html.

Permanent stations by national seismological services and ORFEUS-EIDA.

Big thanks to all the network operators for supplying the station information.

AdriaArray initiative is supported by Orfeus / EPOS.

PK is supported by the grant No. 23-06370S - Recognition of remote velocity anomalies in the upper mantle,
provided by the Czech Science Foundation (GAČR)

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