

Recent developments in seismological networks and data management in Europe

The **ORFEUS** community

Presented by Angelo Strollo*

Prague

June 26. 2014

Outline

- **EPOS and EPOS-Seismology**
- **ORFEUS**
- **EIDA => EIDA-NG**
- **RRSM and ESM**
- **DOIs for Seismic networks**
- **ORFEUS networking and outreach**

EPOS

Implementation Phase project starting 10.2015 +4 years

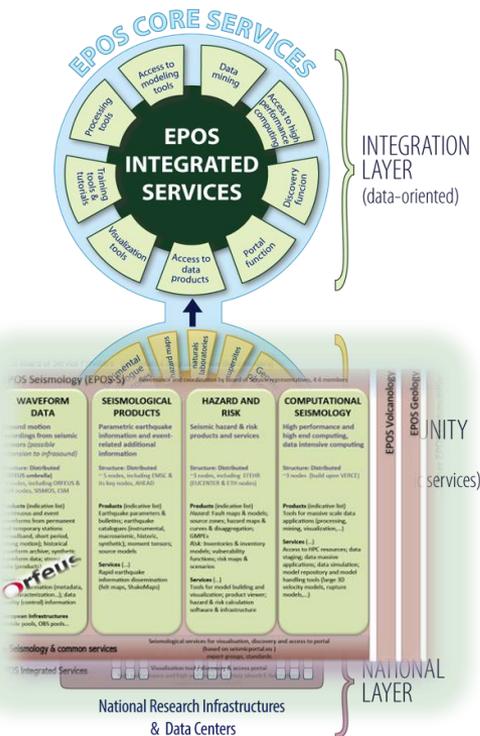


The European Plate Observing System (EPOS) is the ESFRI initiative of the Solid Earth sciences:

- long-term plan to facilitate integrated use of data, models and facilities from pre-existing and newly established research infrastructures for solid Earth science;
- represents a scientific vision and approach to enable innovative multidisciplinary research towards a better understanding of the physical processes controlling earthquakes, volcanic eruptions and unrest episodes, tsunamis, as well as those driving tectonics and Earth surface dynamics.

EPOS-Seismology

Seismology provides Thematic Core Services (TCS) to EPOS. The multidisciplinary integration and interoperability will be ensured by the Integrated Core Services (ICS).



EPOS Integrated Core Services provide simplified access to multidisciplinary data and data-derived products, combine data with modeling results (simulations), processing and visualization tools

Thematic Core Services community-driven infrastructures provide discipline-specific data services, these will build on pre-existing international collaboration/organizations (e.g. **ORFEUS**).

The various communities organize their services. Seismology (**EPOS-S**) will provide and extend waveform data offerings through **ORFEUS/EIDA**.

National Research Infrastructures and facilities provide services at national level and send data to the European thematic data infrastructures.

ORFEUS

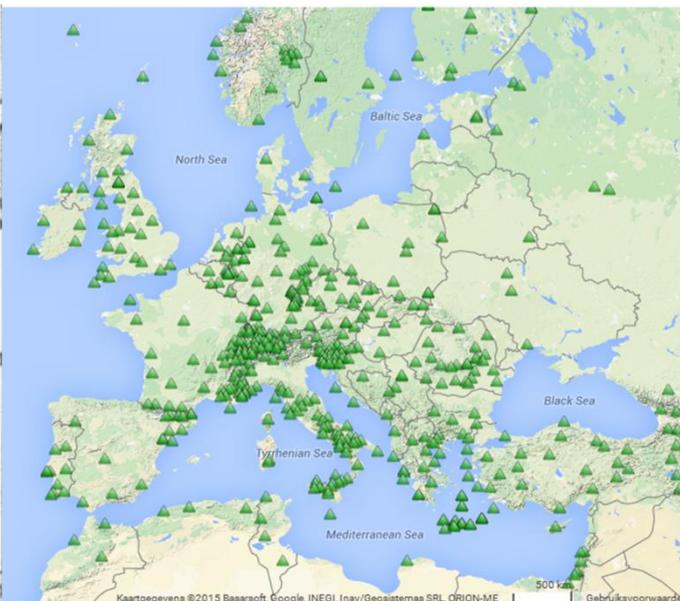
From the ORFEUS Data Center (single DC) to EIDA (distributed DC)

- 1986/87: ORFEUS plan launched/realized
- 2012/13: ORFEUS-VEBSN => ORFEUS-EIDA (EIDA = VEBSN + data holdings from 9 European DCs)
- 2015: ORFEUS-EIDA (10 nodes)

1987 - 30



2013 - 613



2015 ~2000



Year - Number of open and operational stations

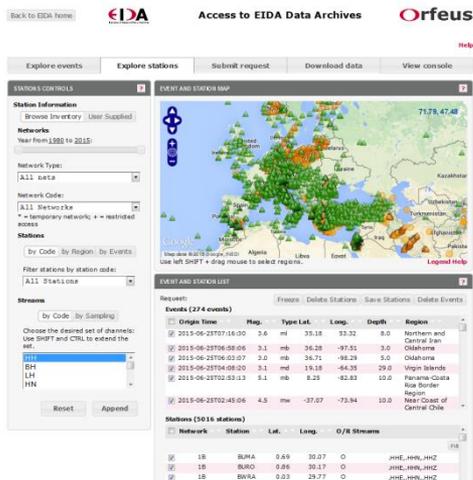
ORFEUS data infrastructure, services and products

EIDA => EIDA-Next Generation

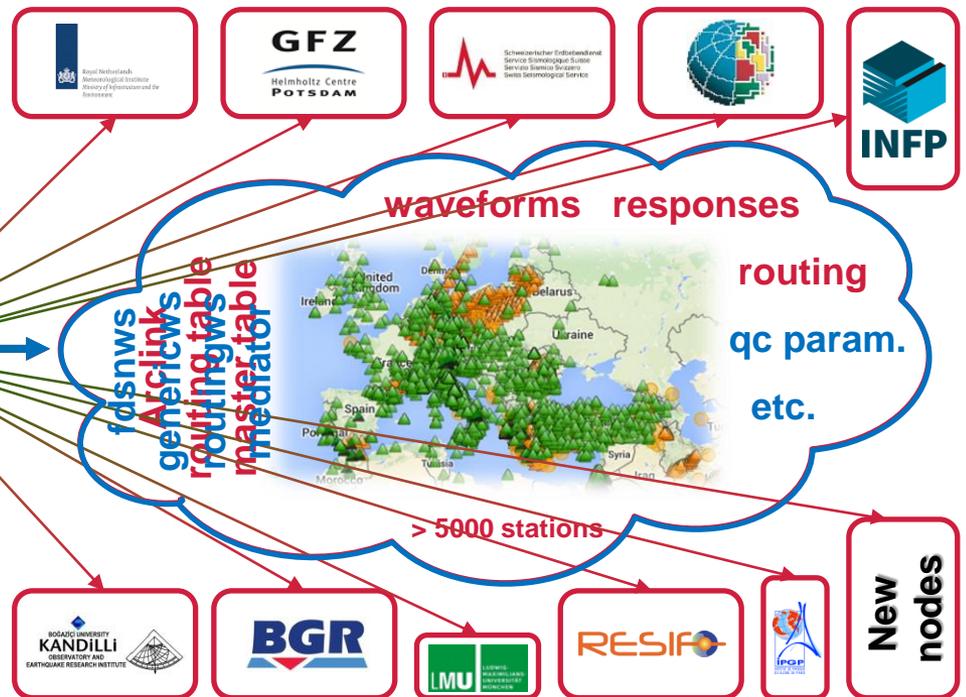
More than just data and federated archive

- Coordination of data holdings and software/strategic developments
- Provides quality control of data/metadata
- Helps define seismological center 'best practice' for ORFEUS community

<http://www.orfeus-eu.org/eida/eida.html>



**Users:
Geoscientists
Etc...**



ORFEUS data infrastructure, services and products

NERA key products: Station Inventory, RRSM and ESM

NERA

Station inventory: up-to-date station information (“Station Book”) for strong motion and broad-band stations operational in Europe (station metadata, site characterization). www.orfeus-eu.org/stationbook

Rapid Raw Strong Motion database (RRSM): a high-quality, automatically and rapidly filled database build on state-of-the-art data collection and processing software to provide near real-time (web) access to open (unrestricted) strong motion data after a significant earthquake in Europe.

<http://www.orfeus-eu.org/rrsm>

Engineering Strong Motion database (ESM): a single, high quality database with historical and present time strong motion waveforms and carefully reviewed metadata, dynamically updated with manually processed data when significant new events occur. <http://www.orfeus-eu.org/esm>

ORFEUS data infrastructure, services and products

NERA key products: Station Inventory, RRSM and ESM

NERA

RRSM Rapid Response SM

Collection of accelerometric data from EIDA immediately after an earthquake

- Magnitude threshold: 3.5
- since **2005**
- wfs are processed automatically (software **scwfparam module of SeisComp3**)
- Station and event metadata are not revised
- Input for SHAKEMAPS provided

At 2015-06-15:

- **3700** events
- **>50000** waveforms,
- only digital instruments
- raw wf, DS and PSA (5%-dam.) comp. up to 10s
- PGA and PGV, SA @ 0.1s 0.3s and 1s

ESM Engineering SM

Collection of accelerometric data from EIDA and/or offline data

- Magnitude threshold: 4
- since **1969**
- wfs are processed manually (Paolucci et al. 2011)
- Station and event metadata are periodically revised

At 2015-06-15:

- **2345** events
- **2500** stations
- **14800** waveforms including records from analog instruments
- Unpr. acc, vel, DS and PSA (5% damping) PGA, PGV, PGD

Digital Object Identifiers for seismic networks

“... to ensure that permanent seismic networks and individual experiments undertaken by small groups or individuals are reliably identified in citations by researchers or monitoring networks that make use of their data ...”



Geological Survey of Austria
Deutsches Geoforschungszentrum

ORFEUS EIDA permanent and temporary network list

Tables generated by ODC at 2015-06-25 13:15:52.

Permanent EIDA Stations (83)

ID#	Network Name	Number of Stations	Operator	Region	Active	Identifier
AB	National Seismic Network of Azerbaijan	3	RISIC-IRAD	Azerbaijan	ODC	-
AI	Andean Seismographic Array (AIS-Net)	9	ODC, IAA	Andarica	ODC	-
AW	AWI Network Antarctica (AWI-Net)	18	AWI	Antarctica	GFZ	-
BA	Università della Basilicata	1		Italy	ODC	-
BE	Belgian Seismic Network	5	RSB	Belgium	ODC	-
BN	UK-Net, Blacknet Array	5	AWI Blacknet	United Kingdom	ODC	-
BS	Bulgarian Seismic Network	18		Bulgaria	NIEP	-
BW	BayernNetz	62		Germany	LMU	-
CA	Catalan Seismic Network	7	ICOP	Catalonia	ODC	-
CH	CH - Swiss Seismological Network	198	Swiss Seismological Service	Switzerland	SED	-
OC	COE/ONL Centre Asian Cross-border Network (COE/ONL)	7	Kyrgyz Institute of Seismology	Central Asian	GFZ	-
CL	Corvish RIA Laboratory (FRANCE)	17		France	RESB	doi
CR	Canadian National Seismograph Network	3	GLSN	Canada	GFZ	-
OR	Orfeus Seismograph Network	1	Univ. Zagreb	Croatia	ODC	doi
CO	ODC Seismic Network (Emergent Plate Boundary Observatory Chile)	20	GFZ/ODP	Northern Chile	GFZ	doi
CZ	Czech Regional Seismic Network	14	IGCIS/PEHU	Czech Rep.	GFZ	-



Network Codes

The following network codes are assigned by the FDSN archive (IRIS DMC) to provide uniqueness to seismological data streams.

Request a new network code | Other available formats:

Show network types: All Permanent Temporary

Show only network codes starting with:

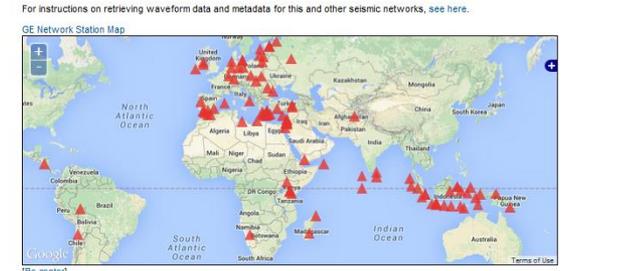
Search for network code or name:

network code	network name	network operator	operator country	deployment country/region	DOI
IAQ009-2002	Aifla	Institut des Sciences de la Terre	FR France	France	-
IAQ003-2003	Waste Isolation Pilot Plant Noise Analysis	New Mexico Tech INMET Mining & Technology (NM USA)	US United States	United States	-
IAQ004-2003	Mining-Induced seismicity network at mine Proteron-Haniel, Boitrop	Ruhr Universität Bochum (RUB Germany)	DE Germany	Germany	doi
18Q006-2008	UCANDA	University of Frankfurt	DE Germany	Germany	-
18Q00-2010	Culf of Alaska Active Source Experiment	Woods Hole Oceanographic Institution (WHOI)	US United States	United States	-
18Q003-2003	Assured Arctic Awareness	University of Washington	US United States	United States	-
18Q004-2004	Sweetwater Array	IRIS HD (DO)	US United States	United States	-
1CQ009-2000	Urban Seismology 2	Karlsruhe Institute of Technology (KIT GFZ Germany)	DE Germany	Germany	-
1CQ001-2004	Seismic Characterization of Menagall Crater, Kenya	University of Texas at El Paso (UTEP)	US United States	United States	-
1CQ000-2009	Whitlans/USCS	UC Santa Cruz	US United States	United States	-
1DQ004-2004	MSH Node Array	University of New Mexico (UNM)	US United States	United States	doi

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Basic Network Information

Network code: GE Type: Permanent Identifier: doi:10.14470/TR560404
 Restricted: No Archived at: GFZ (Citation information)
 Network KML file: [View in Google Earth](#) DataCite metadata: [HTML](#) [XML](#)
 Time Range: 1993 - Seismic metadata: [Station XML](#)
 Institution(s): GFZ/partners
 Creator(s): GEOFON Data Centre
 Description: GEOFON Program, GFZ Potsdam, Germany
 Abstract: GEOFON (GEOForchungsNetz) is the global seismological broad-band network operated by the German GeoForschungsZentrum (GFZ). The GEOFON seismic network came into being in 1993 as one of the three pillars of the GEOFON program dedicated to Ernst von Rebeur-Paschwitz, proposer of a global earthquake monitoring system, who recorded the first teleseismic seismogram in Potsdam in 1889. The program and its seismic network were created to provide high quality broad-band data for scientific use and foster common standards in the seismological community. The network has evolved towards real-time data acquisition and distribution while keeping the high quality broad-band data in focus. Today the network plays a leading role in global real-time seismology providing valuable data for almost all fundamental and applied (global/regional) seismological research projects at GFZ and the wider seismological community. The GEOFON network is operated jointly with more than 50 international partners and in 2014 consists of about 50 active stations on all continents, but concentrated in Europe and the Mediterranean region as well as in the Indian Ocean. Station operation is mostly performed by local partners with GFZ guidance and logistic support, allowing the global network to be well-advanced technically while still extremely cost-effective. All stations are equipped with broad-band sensors (generally STS-2) that allow resolution of the complete seismic spectrum from small high-frequency local earthquakes to the largest global earthquakes. Data from all stations are freely redistributed in real-time for earthquake monitoring and tsunami warning centers immediately after acquisition at the GEOFON data centre via wired or satellite links. Archived data is also available. GEOFON is part of the Modular Earth Science Infrastructure (MESI) housed at GFZ.
 * Description is taken from seismic metadata, and may not match the preferred title for citations.



Extended Network Information for network GE

Show/Hide additional network information:
 Creator(s): GEOFON Data Centre
 Title: GEOFON Seismic Network
 Publisher: Deutsches Geoforschungszentrum GFZ
 Network DOI: doi:10.14470/TR560404
 Citation example: GEOFON Data Centre (1993): GEOFON Seismic Network. Deutsches Geoforschungszentrum GFZ. Other/Seismic Network: doi:10.14470/TR560404.

Related Reference(s): 1. Hanks, W.; Kind, R.: The GEOFON Program. *Annals of Geophysics* v. 37, n. 5, Nov. 1994. *ISBN 2037-416X*. doi:10.4401/ag-4196

Network Station List (Network Code: GE)

#	Station Code	Station description	Begin	End	Loc	Channels
<<	return to network list					
1	APE	GEOFON Station Apirathos, Naxos	2000-200	2008-122	-	BH BHN BHZ HHE HHN HHZ LHE LHN LHZ SHE SHZ SHZ VHE VHN VHZ

FDSN recommendations for seismic network DOIs and related FDSN services

Adam Clark (1), Peter L. Evans (2), Angelo Strollo (2)

- Incorporated Research Institutions for Seismology (IRIS), 220 New York Avenue NW, Suite 400, Washington, DC 20001, 202-462-2200. www.iris.washington.edu
- Deutsches Geoforschungszentrum GFZ, Telegrafenberg, 14473 Potsdam, Germany. www.gfz-potsdam.de

Version 1.0
21 July 2014

6. Examples and overview

- FDSN recommendations for metadata fields, station format and landing page
- FDSN Metadata Field Recommendations
- Metadata (Citation Fields)
- Station
- Station
- Publication Year
- Recommended Fields
- Resource Type
- Description
- Station
- Optional Fields
- Coordinate
- Location
- Site
- State
- Related Identifier
- Citation Format
- Landmark Dates
- DOI services to be offered by FDSN
- DOI Network Service
- Station Value Loading
- Temporary Network Loading
- Full Data Ingestion
- Virtual Networks
- High Storage
- Station
- DOI Generation and Management Service (FDSN-related DOIs)
- DOI Network Generation

<http://www.fdsn.org/services/doi/>

Digital Object Identifiers for seismic networks

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Article

Development and Operation of a Regional Moment Tensor Analysis System in the Philippines: Contributions to the Understanding of Recent Damaging Earthquakes

Punangbaran, Hiroaki Kumagai, Nelson Pulido, Jun Bonita, Masaru Nakano, Tadahshi Yamashina

012015

ABSTRACT A network of 10 satellite-telemetered broadband stations was established under a cooperative project between Japan and the Philippines, and a source analysis system based on waveform inversion of regional seismology. [more]

Full-text [Download full-text](#)

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REFERENCES (2) **CITED IN (8)** Sorted by: Appearance in publication

Article: **Estimation of the magnitudes and epicenters of Philippine historical earthquakes**
 Maria Leonita P. Baudista, Kazuo Oike
[\[Show abstract\]](#)
 Tectonophysics 622000; 317-327-369. DOI 10.1016/S0040-1951(08)02720-3 · 2.87 Impact Factor

Performance of Broadband Seismic Network of the Philippines: A A Melosantos, K V C Soriano, P C M Alcones, J U Parang, J D Bonita, I C Narag, H Kumagai, H Inoue · *Journal of Disaster Research* 10 2015.

GEOFON Seismic Network. Geofon Data Centre - 1993. Deutsches Geoforschungszentrum GFZ, Other/Seismic Network

Article: **Waveform inversion in the frequency domain for the simultaneous determination of earthquake source mechanism and moment function**
 M. Nakano, H. Kumagai, H. Inoue
[\[Show abstract\]](#)
 Geophysical Journal International 042000; 173(3):1600 - 1611. DOI 10.1111/j.1365-246X.2008.03763.x · 2.72 Impact Factor

Article: **Real-time earthquake monitoring for tsunami warning in the Indian Ocean and beyond**
 Hanika W. Saul, J. Weber, B. Becker, J. Harjoto, P. Fauzi, GITEWS Seismology Group
[\[Show abstract\]](#)
 Natural hazards and earth system sciences 012010; 10(12). DOI 10.5194/nhess-10-2611-2010 · 1.83 Impact Factor

Article: **Discrete wave number representation of elastic wave fields in three-space dimensions**
 Michel Bouchon
[\[Show abstract\]](#)
 Journal of Geophysical Research Atmospheres 011979; 84:3698-3614. DOI 10.1029/JB084B07p3699 · 3.44 Impact Factor

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 *Description is taken from seismic metadata, and may not match the preferred title for citations.

For instructions on retrieving waveform data and metadata for this and other seismic networks, see [here](#).

GE Network Station Map

Extended Network Information for network GE

Show/hide additional network information:

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 [+]

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2015 ORFEUS Observatory Meeting

21-24 September, Bucharest, Romania

<http://orfeus.infp.ro/>

2015 ORFEUS Annual Observatory Coordination meeting
21-24 September 2015 Bucharest, Romania

Home Information Programme Accomodation Registration Contact

2015 ORFEUS Annual Observatory Coordination meeting Workshop
21 – 24 September 2015, Bucharest, Romania

Hosting Institute
National Institute for Earth Physics

Organizers

- ♦ ORFEUS - Observatory and Research Facilities for European Seismology
- ♦ NIEP - National Institute for Earth Physics

The meeting will focus on the following topics:

- (Meta)data management and EIDA
- Quality assurance
- Attribution and data policies
- Strong motion community workshop on site characterization
- Joint SeisComP3 and ObsPy communities workshop

Thanks for your attention!

Additional information at:

<http://www.orfeus-eu.org/index.html>

To join ORFEUS contact

orfeus_secretary@knmi.nl

Torild van Eck



5 Dec 1949 - 30 Nov 2014