

European seismology in the digital era: ORFEUS and the contribution of Torild van Eck

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J. Clinton, F. Haslinger and the ORFEUS community

IASPEI

Prague, July 1, 2015

Key elements

- High-quality sensors (STS-1) and 24-bit ADC
- IRIS/GSN
- mid 80': research networks: GEOSCOPE, MEDNET, GEOFON, NARS
- mid 90': national networks
- ORFEUS
- ORFEUS-EMSC integration
- EIDA
- EU projects: MEREDIAN, NERIES, NERA
- EPOS
- FDSN
- People
- Torild van Eck

ORFEUS plan launched at 1986

ORFEUS SCIENCE PLAN

*Observatories and Research Facilities
for European Seismology*

editors

Guust Nolet (Utrecht University)
Barbara Romanovicz (IPG, Paris)
Rainer Kind (Graefenberg Observatory)
Erhard Wielandt (ETH, Zurich)

Orfeus Data Center



Observatories & Research Facilities for European Seismology

Data Center director:
Bernard Dost

Data Center host:
University of Utrecht
The Netherlands



European and global organizations and coordination



IASPEI – International Association of seismology and Physics of the Earth Interior

FDSN – International Federation of Digital Seismograph Networks

EMSC – European-Mediterranean Seismological Center

ESFRI – European Strategic Forum for Research Infrastructures

ESC – European Seismological Commission

GEO – group on Earth Observation

EPOS – European Plate Observing System

ORFEUS Infrastructure developments in Europe since 2000

MEREDIAN EC-project FP5 (2000 – 2005): Mediterranean-European Rapid Earthquake Data Info- & Archiving Network

NERIES EC I3 Project FP6 (2006 – 2010): Network of European Research Infrastructures for Earthquake Seismology

NERA EC I3 Project FP7 (2010 – 2014): Network of EU Research Infrastructures for Earthquake Risk Assessment and Mitigation

EPOS-PP (2010–2014): European Plate Observing System - Preparatory Phase

EPOS-IP (2015–2019): Implementation Phase

NERA-II (2016–2020)

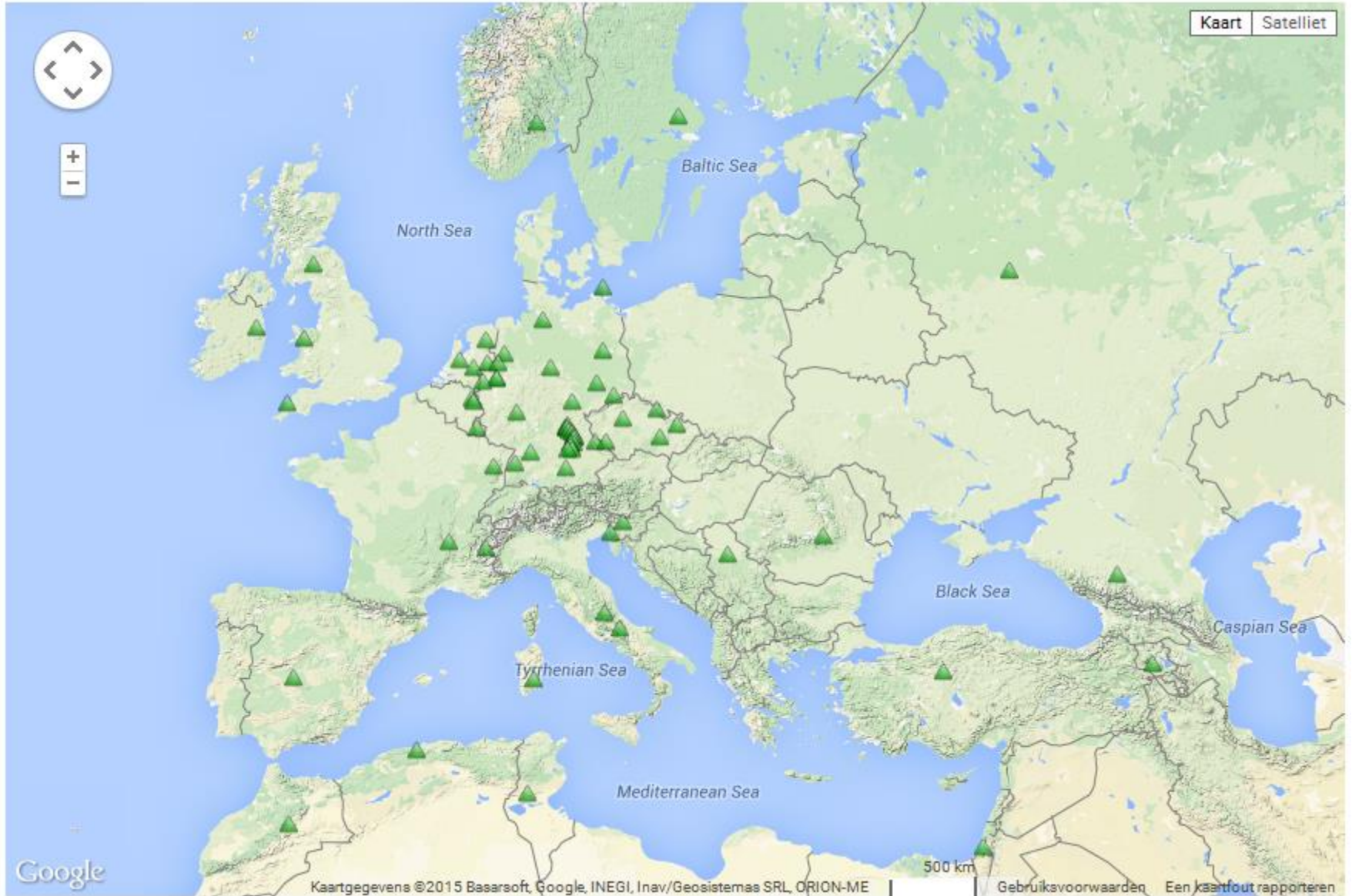


NA2 - Real-time data exchange
NA3 - Distributed European waveform data archive
NA4 - Distributed European historical data archive
NA5 - Access to European accelerometer data
NA6 - Broadband OBS networking
NA7 - Portal and data services
JRA5 - New approaches to data mining
Transnational Access to five facilities

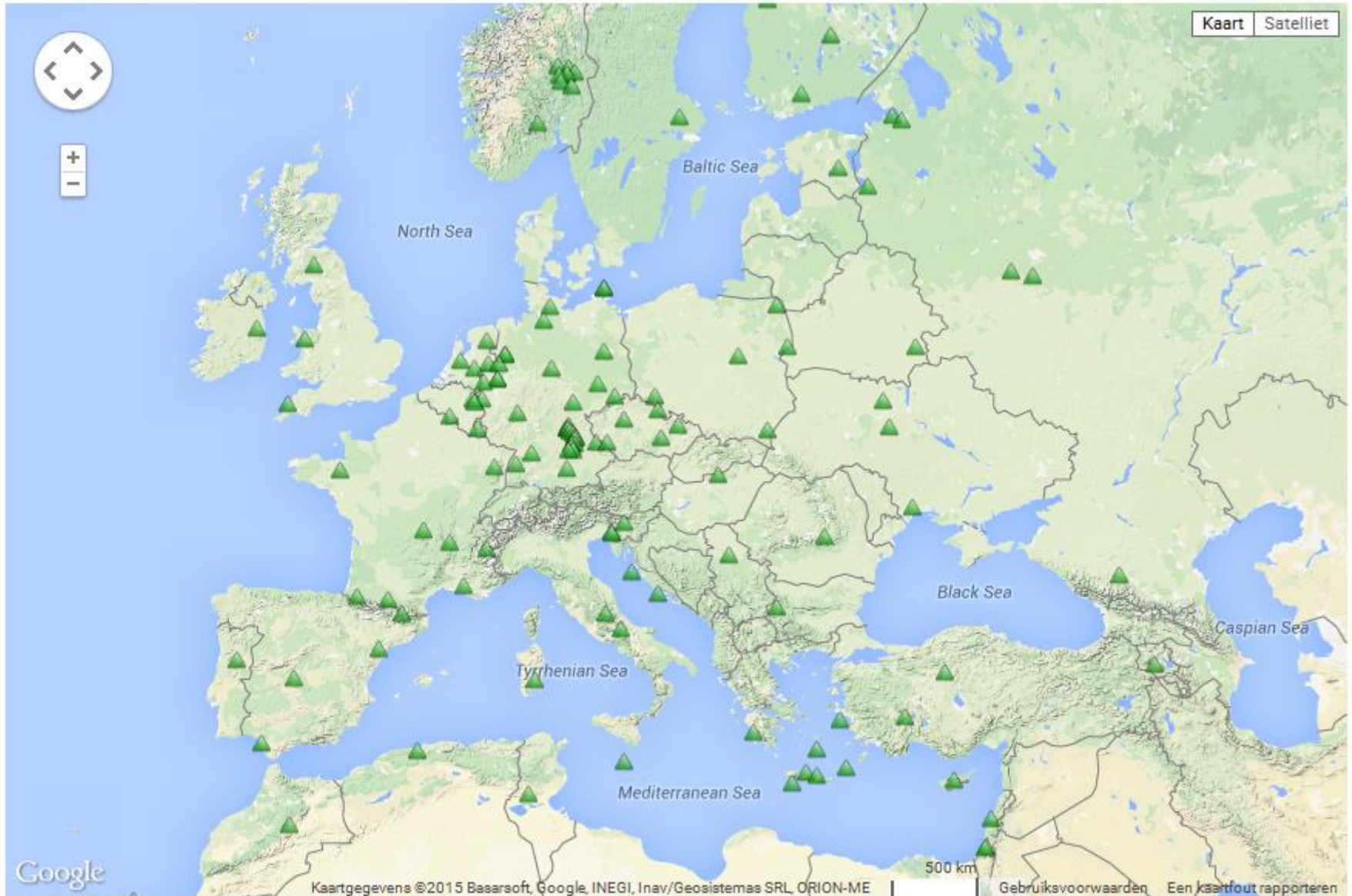


NA2 – Access to seismic waveforms in the Euro-Med region
NA3 – Networking accelerometric networks / SM data users
NA4 – Networking European rapid response networks
NA5 – Networking near fault observatories
NA9 – European Mediterranean Earthquake portal services
JRA2 – Tools for real-time seismology, acquisition and mining
Transnational Access to four facilities
Service Access to three facilities: ORFEUS, EMSC, EFEHR

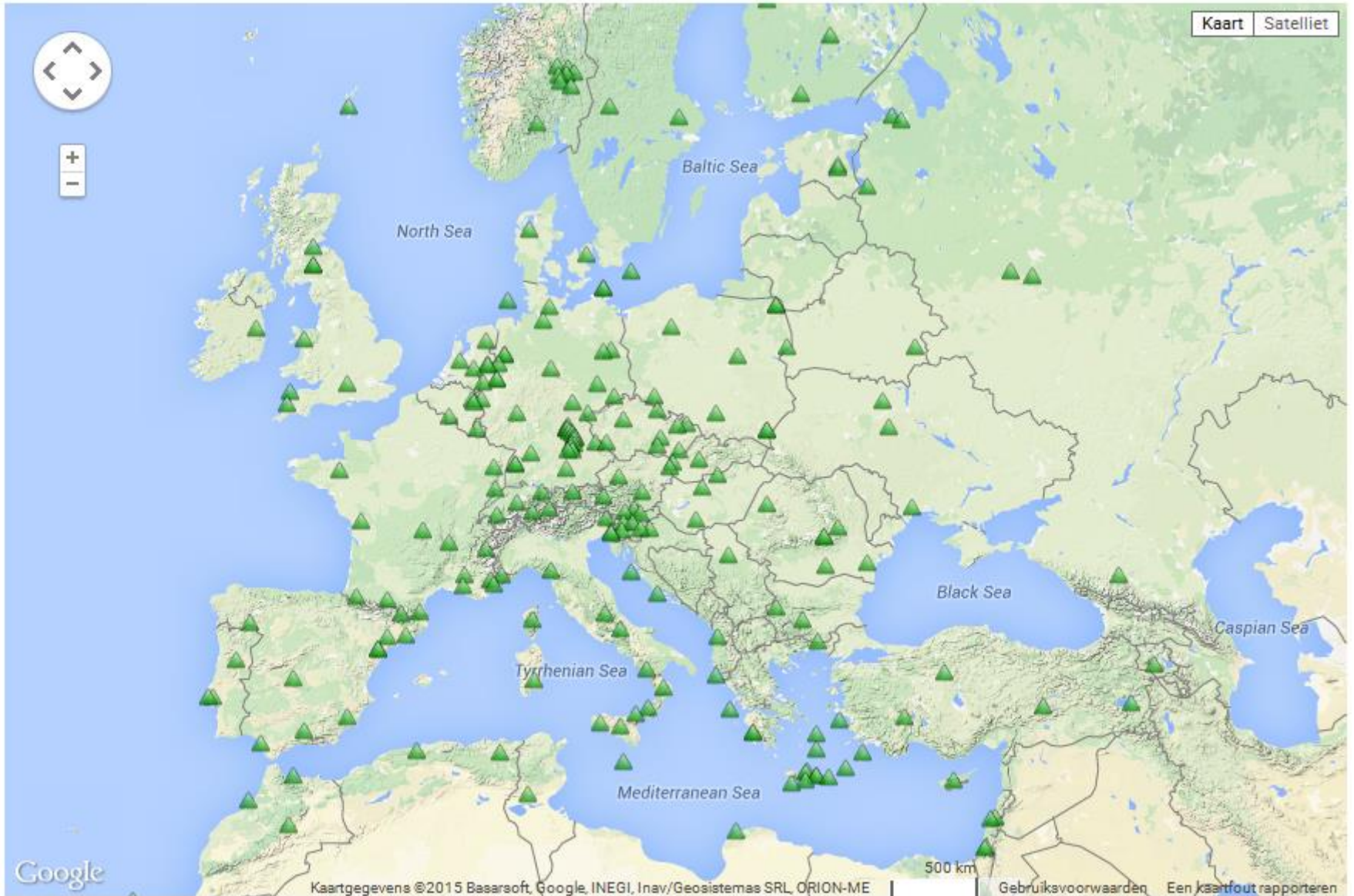
Open station ORFEUS 1900 – 1995 (82)



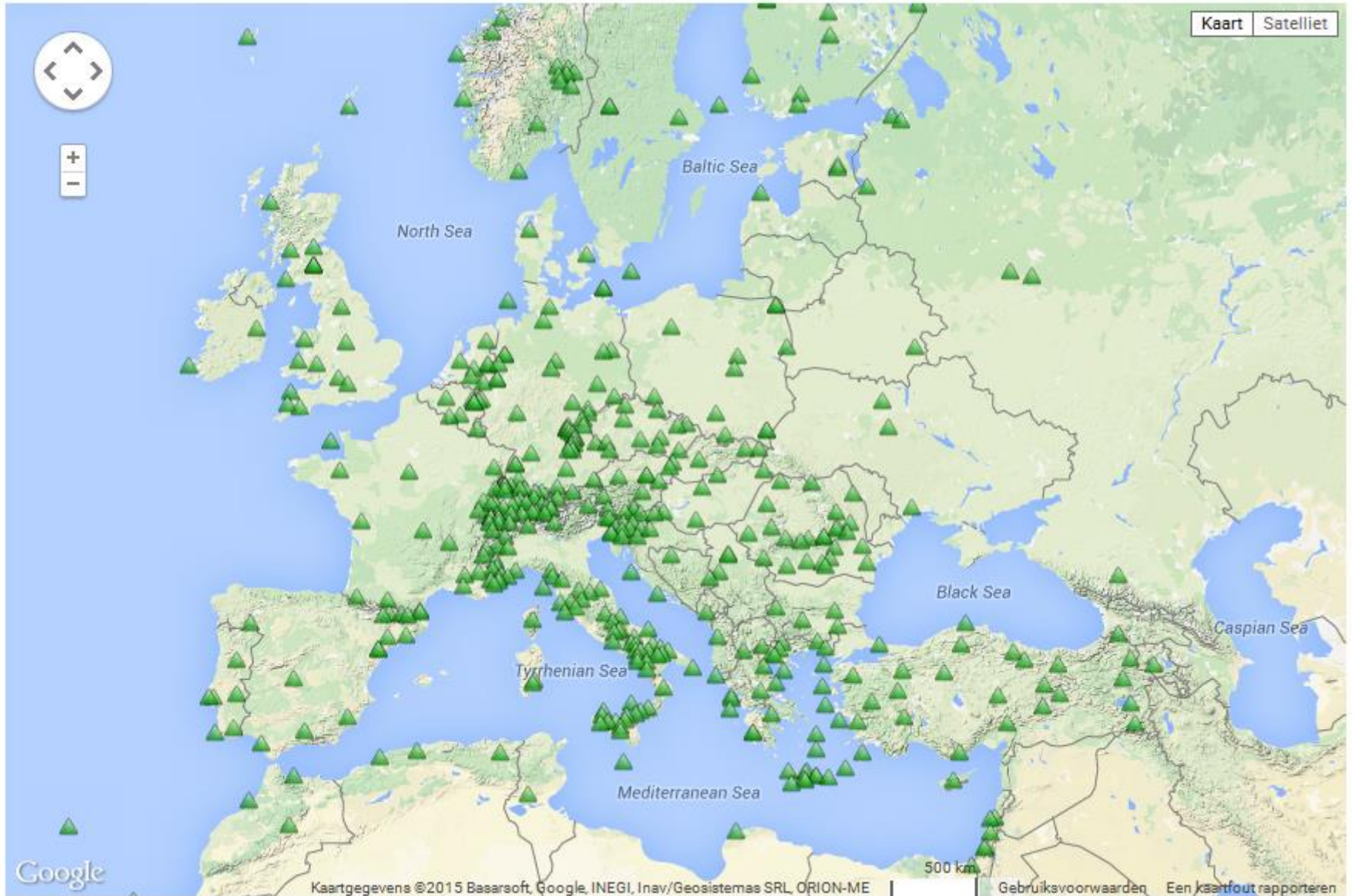
Open station ORFEUS 1900 – 2000 (146)



Open station ORFEUS 1900 – 2005 (239)



Open station ORFEUS 1900 – 2010 (513)



Open station ORFEUS 1900 – 2013 (613)



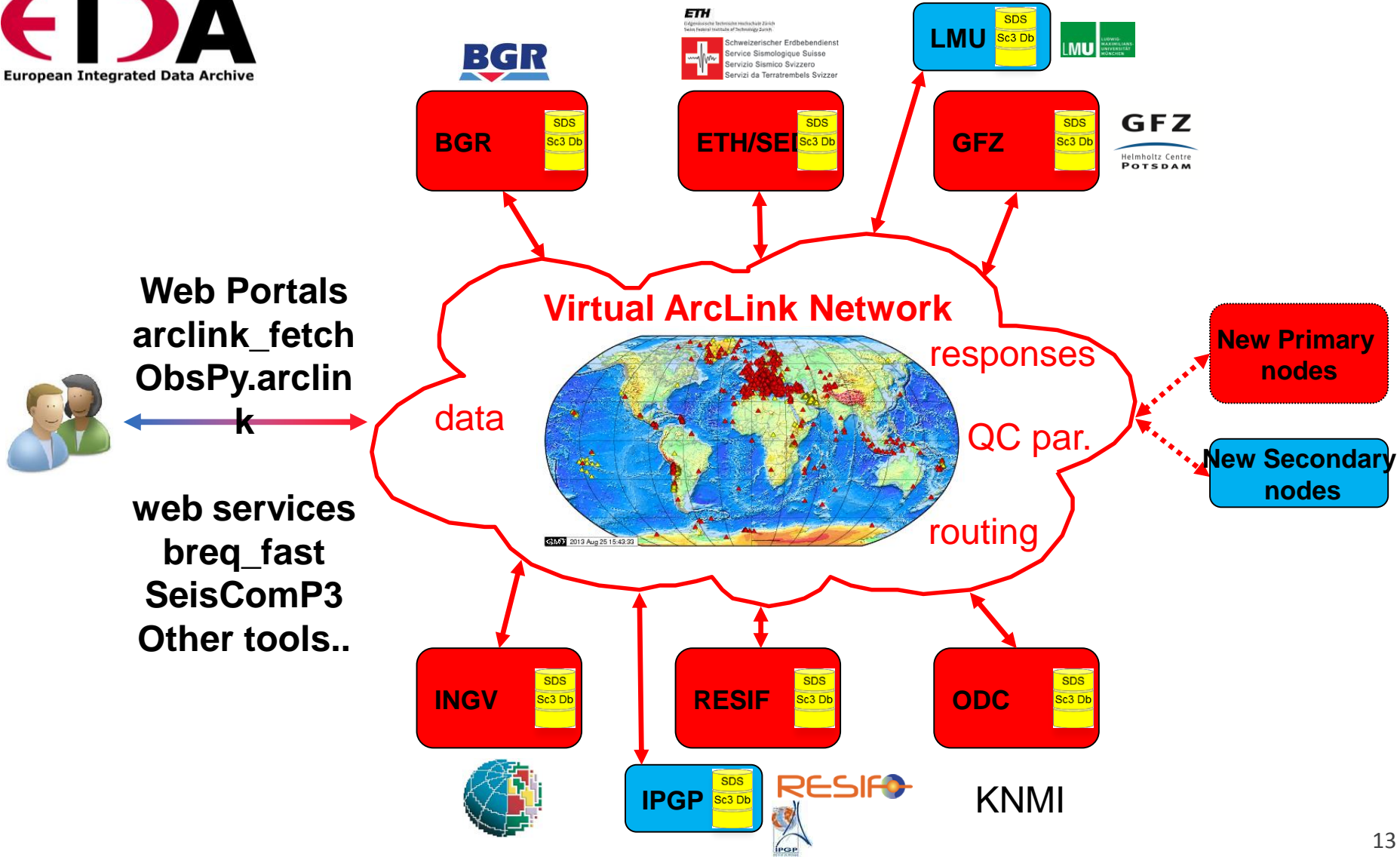
Data exchange 1988 - 2003 & Data management in 1990



Data media

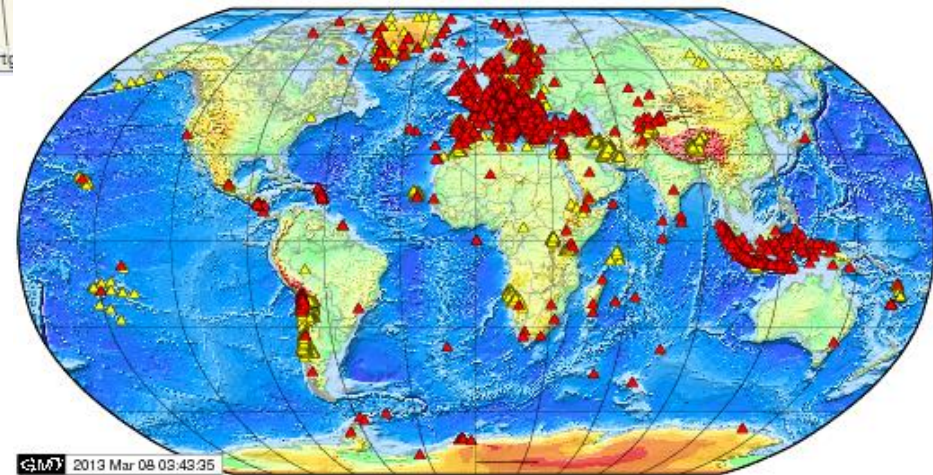


Access to the Data Center



EIDA 2015

- ✓ 6 primary nodes
- ✓ 2 secondary nodes
- ✓ >100 networks
- ✓ 1'851 open stations
- ✓ 3'217 temporary stations
- ✓ >2'000 restricted stations
- ✓ >300 TB archive



Back to EIDA home



Access to EIDA Data Archives



[Help](#)

Explore events

Explore stations

Submit request

Download data

View console

EVENTS CONTROLS



Event Information

Catalog Services

Catalog Service:

Date Interval (yyyy-mm-dd):

to

Minimum Magnitude:

Depth from to km

Coordinates: (Use -ve for S/W; +ve for N/E)

N

EVENT AND STATION MAP



Use left SHIFT + drag mouse to select regions.

[Legend Help](#)

Gateway's facilitating data and computational intensive analysis



Integrated view of community webservices
via the Forward Simulation GUI



Integrating existing
techniques from elsewhere

User's Actions

- 1 Select Solver
- 2 Select Mesh
- 3 Select Velocity Model

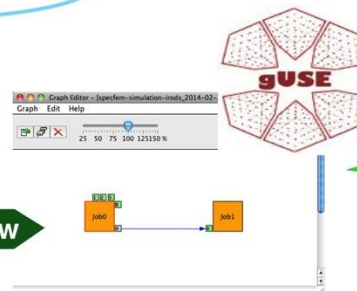
4

- Upload Input
- Retrieve Input
- Reuse Input



5 Select Workflow

6 Submit Workflow



Many Tasks
Simulation workflows
in HPC
resources

VERCE Science
Gateway

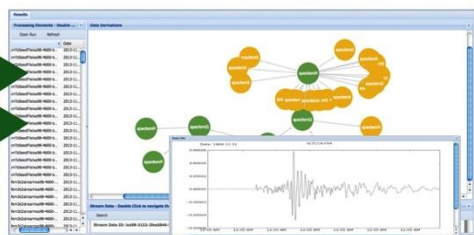


Provenance Production

MyProxy
Credential Management Service

7

- Access Provenance
- Visualise Results

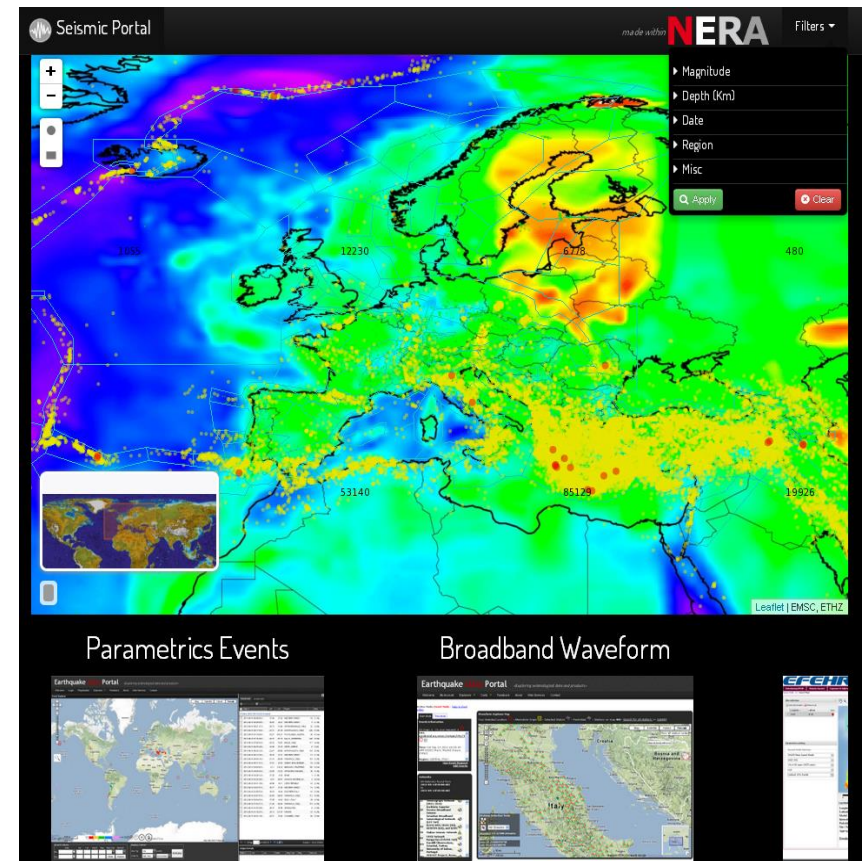
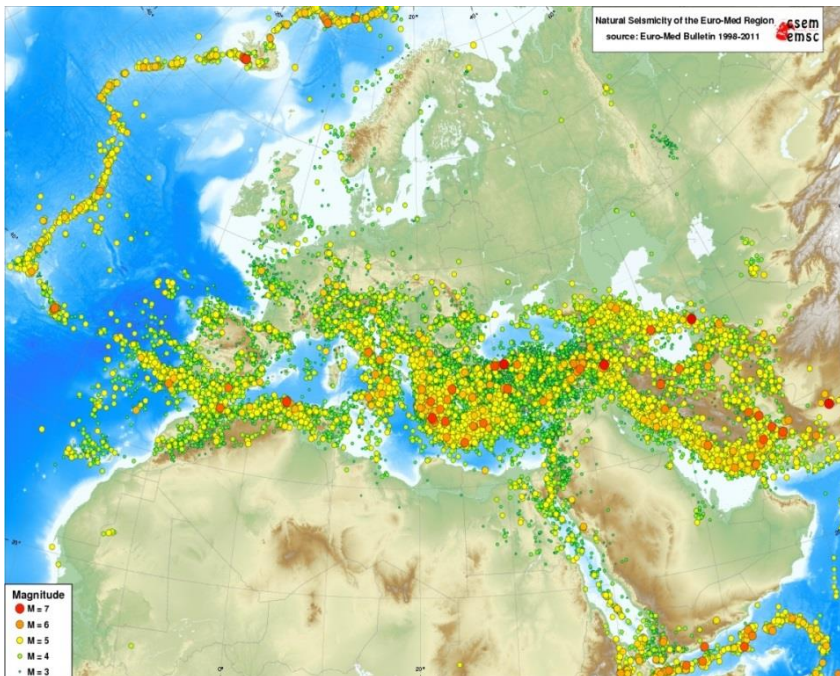


Data storage within
the VERCE Federation





- ✓ NGO established in 1975 to provide redundancy and back-up to national services
- ✓ Moved from Strasbourg to Bruyères (LDG) in 1994
- ✓ 20 member institutes in 1994, 85 from 56 countries today
- ✓ UNESCO partner for Middle East and N. Africa since 1996
- ✓ 1998: Euro-Med Bulletin starts
- ✓ 2006: Seismic portal starts
- ✓ Pioneer in citizen-based seismology



Developments towards the EPOS RI

Observatories and Research Facilities for European Seismology

www.orfeus-eu.org



European-Mediterranean Seismological Center

www.emsc-csem.org



European Facility for Earthquake Hazard & Risk (EFEHR)

www.efehr.org

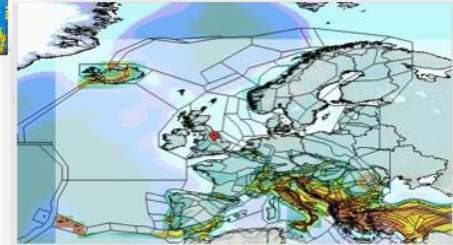
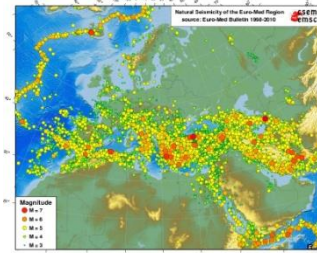


and a large number of on-going (infrastructure and research) projects



are integrated within and contributing to the

European Plate Observing System (EPOS) www.epos-eu.org



EPOS Seismology (EPOS-S)

WAVEFORM DATA

Ground motion recordings from seismic sensors

Structure: Distributed (ORFEUS umbrella)
~8 nodes, including ORFEUS & EIDA nodes

Products (indicative list)
Continuous and event waveforms from permanent and temporary stations (broadband, short period, strong motion); historical waveform archive; synthetic waveform data; strong motion data (products)

Services (...)
Station information (metadata, site characterization...); data quality (control) information



EARTHQUAKE PRODUCTS

Parametric earthquake and event-related information

Structure: Distributed
~ 5 nodes, including EMSC & its key nodes, AHEAD

Products (indicative list)
Earthquake parameters & bulletins; earthquake catalogues (instrumental, macroseismic, historic, synthetic); moment tensors; source models

Services (...)
Rapid earthquake information dissemination (felt maps, ShakeMaps)



HAZARD AND RISK

Seismic hazard & risk products and services

Structure: Distributed
~6 nodes, leader EFEHR (EUCENTER & ETH nodes)

Products (indicative list)
Hazard: Fault maps & models; source zones; hazard maps & curves & disaggregation; GMPEs
Risk: Inventories & inventory models; vulnerability functions; risk maps & scenarios

Services (...)
Tools for model building and visualization; product viewer; hazard & risk calculation software & infrastructure



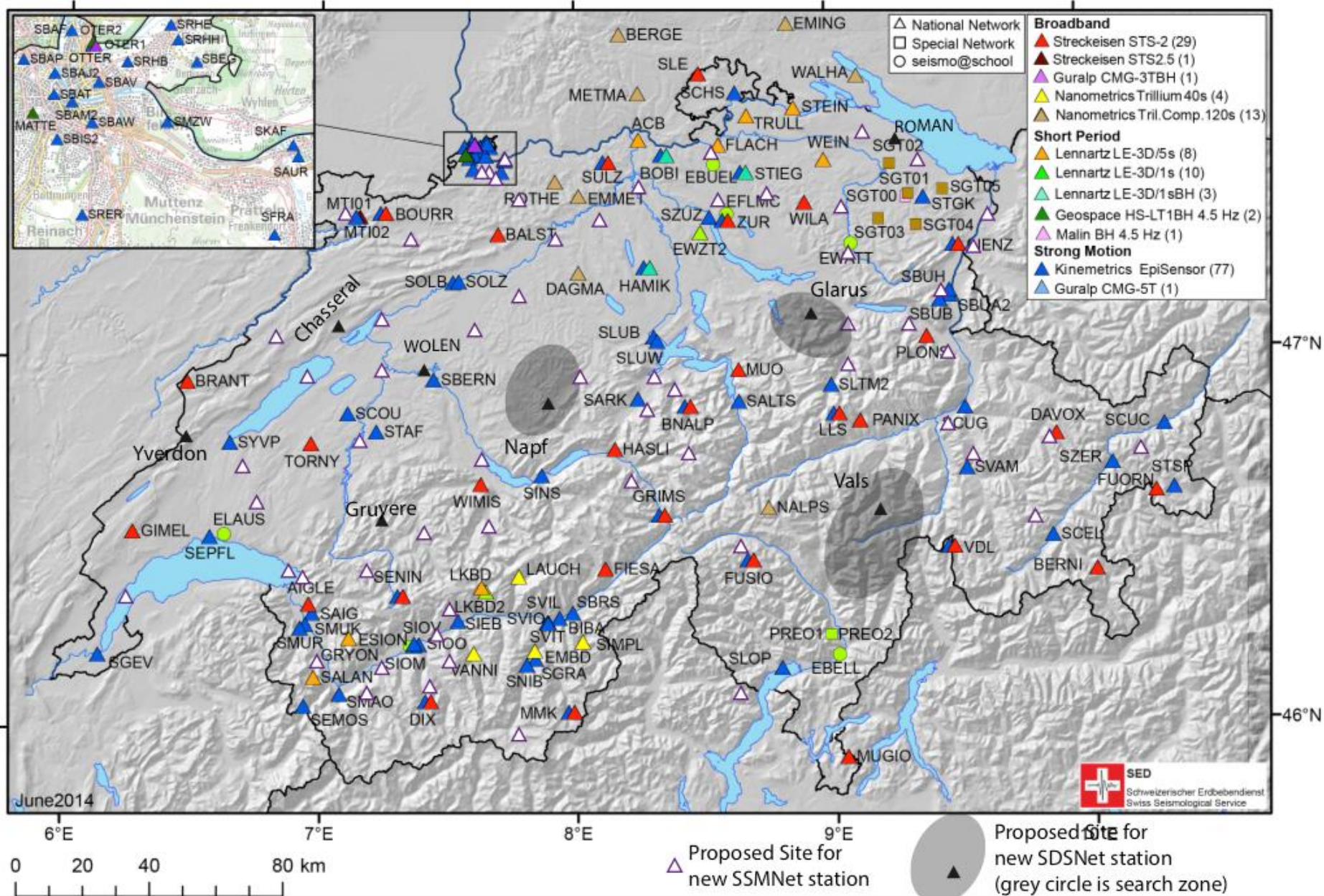
COMPUTATIONAL SEISMOLOGY

High performance and high end computing, data intensive computing

Structure: Distributed
~3 nodes (build upon VERCE)

Products (indicative list)
Tools for massive scale data applications (processing, mining, visualization,...)

Services (...)
Access to HPC resources; data staging; data massive applications; data simulation; model repository and model handling tools (large 3D velocity models, rupture models,...)



Torild van Eck, 1949-2014

- The major force behind European digital seismology in the past 20 years
 - Secretary General ORFEUS, 1997-2014
 - Coordinator, EU FP5 MEREDIAN, 2000-2005
 - Manager, EU FP6 NERIES, 2006-2010
 - Manager, EU FP7 NERA, 2010-2014
 - Leader WG1 and Program Committee, EU FP7 EPOS-PP, 2010-2014
 - WG leader in various EU projects: EERWEM, EUDAT, REAKT, ...
 - Program Committee, EU H2020 EPOS-IP, 2014
- † *The main author of this presentation*

